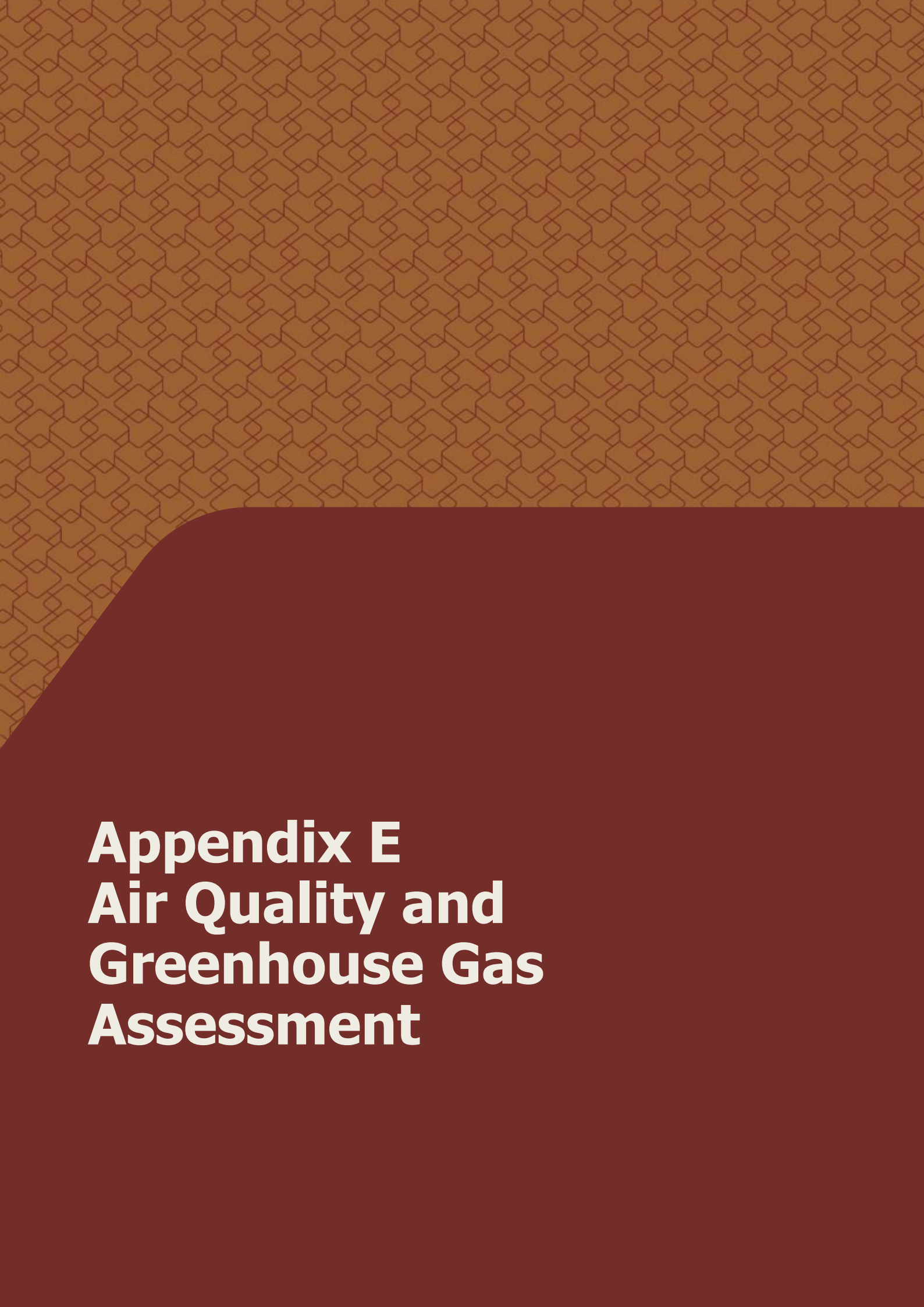


The background of the page is a solid brown color. The top half of the page features a repeating geometric pattern of interlocking squares and diamonds in a slightly darker shade of brown. A large, smooth, curved shape in a darker brown color cuts across the middle of the page, creating a space for the title text.

Appendix E

Air Quality and Greenhouse Gas Assessment



BOGGABRI COAL MINE MODIFICATION 10

Air Quality and Greenhouse Gas Assessment

Final | Revision 0

23 May 2025

Project: 23005

Boggabri Coal Mine Modification 10

Project number	23005
Title	Boggabri Coal Mine Modification 10
Subject	Air Quality and Greenhouse Gas Assessment
Version	Final
Revision	Revision 0
Date	23 May 2025
Client	Boggabri Coal Operations Pty Ltd
Project manager	Shane Lakmaker
File name	23005_BCM MOD10_Air Quality and GHG_Final_rev0.docx

Version	Date	Description	Author	Review
D1R0	27/08/24	Draft report	SL	NL
D2R0	12/09/24	Draft report	SL	NL, JBA
D3R0	28/11/24	Draft report	SL	NL, JBA, IA
D4R0	7/04/25	Draft report	SL	NL, Xenith, IA
D5R0	16/05/25	Draft report	SL	NL, Xenith, CU
D6R0	22/05/25	Draft report	SL	NL, Xenith
Final R0	23/05/25	Final report	SL	NL, Xenith

© Copyright 2025 Airen Consulting ABN 44 646 147 579

Limitation: This document has been prepared on behalf of, and for the exclusive use of Airen Consulting's client, and is subject to, and issued in accordance with, the provisions of the contract between Airen Consulting and the client. In preparing this report, Airen Consulting has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Airen Consulting has not attempted to verify the accuracy or completeness of any such information. Airen Consulting has prepared this report in accordance with the usual care and thoroughness of the consulting profession. No other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law. This report should be read in full, and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Airen Consulting for use of any part of this report in any other context.

Contents

Executive Summary	vi
1 Introduction	1
1.1 Background	1
1.2 Approved Operation	1
1.3 Modification Description	2
1.4 Report Structure	4
2 Key Issues	5
3 Policy Setting	6
3.1 Air Quality Criteria	6
3.2 Greenhouse Gas	7
3.2.1 Overview	7
3.2.2 Federal Policy	8
3.2.3 State Policy	9
4 Existing Environment	10
4.1 Local Setting	10
4.2 Meteorology	11
4.3 Air Quality	14
4.3.1 Extraordinary Events	15
4.3.2 Particulate Matter (as PM ₁₀)	16
4.3.3 Particulate Matter (as PM _{2.5})	19
4.3.4 Particulate Matter (as TSP)	20
4.3.5 Deposited Dust	21
4.3.6 Nitrogen Dioxide (NO ₂)	21
4.4 Background Levels	23
5 Assessment Methodology	25
5.1 Mining Dust	25
5.2 Diesel Exhaust	29
5.3 Post Blast Fume	29
6 Air Quality Assessment	31
6.1 Mining Dust	31
6.1.1 Particulate Matter (as PM ₁₀)	31
6.1.2 Particulate Matter (as PM _{2.5})	39
6.1.3 Particulate Matter (as TSP)	43
6.1.4 Deposited Dust	45
6.2 Diesel Exhaust	47
6.3 Post Blast Fume	49
6.4 Mitigation Measures	50
7 Greenhouse Gas Assessment	51
7.1 Overview	51
7.2 Assessment Boundary and Scenarios	51
7.3 Source Prioritisation	52
7.4 Emission Reduction Measures	52
7.5 Estimated Emissions	54
7.6 Benchmarking and Goal Setting	57
7.7 Offset Strategy	58
8 Conclusions	59

9	References.....	60
Appendix A.	Annual and seasonal wind-roses.....	63
Appendix B.	Model settings.....	64
Appendix C.	Particulate matter emission calculations.....	70
Appendix D.	Tabulated particulate matter model results.....	71
Appendix E.	Greenhouse gas emissions.....	72
Appendix F.	Independent expert review.....	75

List of figures

Figure 1	Location of the BCM and surrounds.....	3
Figure 2	Three-dimensional representation of the local terrain	10
Figure 3	Location of meteorological stations.....	11
Figure 4	Wind speed and rainfall between 2015 and 2024.....	12
Figure 5	Wind-roses from data collected at the BCM meteorological station	13
Figure 6	Location of air quality monitors	15
Figure 7	Rolling annual average PM ₁₀ concentrations at various NSW air quality monitoring sites.....	16
Figure 8	Measured 24-hour average PM ₁₀ concentrations.....	17
Figure 9	Measured 24-hour average PM _{2.5} concentrations.....	19
Figure 10	Measured NO ₂ to NO _x ratios from hourly average data collected at Gunnedah.....	22
Figure 11	Background PM ₁₀ and PM _{2.5} concentrations as inferred from the measurement data.....	24
Figure 12	Overview of model inputs and outputs	25
Figure 13	Estimated ROM coal and overburden movements from the BCM.....	26
Figure 14	Modelled maximum 24-hour average PM ₁₀ due to BCM	32
Figure 15	Modelled number of days above 50 µg/m ³ PM ₁₀ due to BCM and other sources	33
Figure 16	Time series of 24-hour average PM ₁₀ at receiver 140.....	34
Figure 17	Time series of 24-hour average PM ₁₀ at receiver 158.....	35
Figure 18	Time series of 24-hour average PM ₁₀ at receiver 165.....	36
Figure 19	Modelled annual average PM ₁₀ due to BCM.....	37
Figure 20	Modelled annual average PM ₁₀ due to BCM and other sources	38
Figure 21	Modelled maximum 24-hour average PM _{2.5} due to BCM.....	39
Figure 22	Modelled number of days above 25 µg/m ³ PM _{2.5} due to BCM and other sources	40
Figure 23	Modelled annual average PM _{2.5} due to BCM.....	41
Figure 24	Modelled annual average PM _{2.5} due to BCM and other sources.....	42
Figure 25	Modelled annual average TSP due to BCM.....	43
Figure 26	Modelled annual average TSP due to BCM and other sources	44
Figure 27	Modelled annual average deposited dust due to BCM	45
Figure 28	Modelled annual average deposited dust due to BCM and other sources.....	46
Figure 29	Modelled maximum 1-hour average NO ₂ due to BCM (diesel exhausts) and other sources	47
Figure 30	Modelled annual average NO ₂ due to BCM (diesel exhausts) and other sources.....	48
Figure 31	Modelled 1-hour average NO ₂ due to BCM (blasting) and other sources.....	49
Figure 32	Distribution of Scope 1 and 2 GHG emission sources from the BCM MOD 8.....	52
Figure 33	Estimated GHG emissions.....	57

List of tables

Table 1 Air quality criteria from SSD 09_0182	6
Table 2 EPA air quality assessment criteria.....	6
Table 3 VLAMP mitigation criteria for particulate matter	7
Table 4 VLAMP acquisition criteria for particulate matter	7
Table 5 Statistics from meteorological data collected between 2015 and 2024	14
Table 6 Summary of measured PM ₁₀ concentrations	18
Table 7 Summary of measured PM _{2.5} concentrations.....	19
Table 8 Summary of estimated TSP concentrations.....	20
Table 9 Summary of measured deposited dust.....	21
Table 10 Summary of measured NO ₂ concentrations.....	21
Table 11 Assumed background levels that apply at sensitive receptors	23
Table 12 Assumed ROM coal production from each mining operation in the model domain	26
Table 13 Estimated TSP emissions.....	27
Table 14 Estimated PM ₁₀ emissions.....	27
Table 15 Estimated PM _{2.5} emissions	27
Table 16 Estimated PM ₁₀ and PM _{2.5} emissions from diesel engines	29
Table 17 Estimated NO _x emissions from diesel engines.....	29
Table 18 Air quality management measures.....	50
Table 19 GHG source inclusions and exclusions	51
Table 20 GHG emission estimation methodologies.....	54
Table 21 Estimated GHG emissions.....	56
Table 22 Comparison of emissions in the State, National and Global context	57

Acronyms and definitions

Abbreviation	Definition
BoM	Bureau of Meteorology
BCOPL	Boggabri Coal Operations Pty Ltd
CALMET	Meteorological model for the CALPUFF air dispersion model
CALPUFF	Computer-based air dispersion model
CO	Carbon monoxide
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEC	Department of Environment and Conservation
DPHI	Department of Planning, Housing and Infrastructure
EPA	NSW Environment Protection Authority
EPL	Environment Protection Licence
HVAS	High volume air sampler
MCCPL	Maules Creek Coal Pty Ltd
MIA	Mine Infrastructure Area
Mtpa	Million tonnes per annum
NEPM	National Environment Protection Measure
NEPC	National Environment Protection Council of Australia
NO	Nitric oxide
NO ₂	Nitrogen dioxide

Abbreviation	Definition
NO _x	Oxides of nitrogen
NPI	National Pollutant Inventory
OEI	Office of Environment and Heritage, now part of the Department of Planning, Housing and Infrastructure
OEM	Original Equipment Manufacturer
PM _{2.5}	Particulate matter with equivalent aerodynamic diameters less than 2.5 microns
PM ₁₀	Particulate matter with equivalent aerodynamic diameters less than 10 microns
POEO Act	<i>Protection of the Environment Operations (POEO) Act 1997 (NSW)</i>
ROM	Run-of-mine
SMC	Safeguard Mechanism Credit
SO ₂	Sulphur dioxide
SSD	State Significant Development (Boggabri's Project approval declared SSD 09_0182 in June 2019)
TAPM	The Air Pollution Model – a meteorological and air dispersion model developed by CSIRO
TCPL	Tarrawonga Coal Pty Ltd
TEOM	Tapered Element Oscillating Microbalance
TSP	Total suspended particulate matter

Executive Summary

Boggabri Coal Operations Pty Ltd (BCOPL), a subsidiary of Idemitsu Australia Pty Ltd (IA), is seeking approval to modify its approved mining operations under State Significant Development (SSD) 09_0182 for the Boggabri Coal Mine (BCM), hereafter referred to as MOD 10. Approval is sought via an application made under Section 4.55 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act). MOD 10 seeks approval to recover additional known coal resources within the mining authorities held for the BCM, but which are located outside of the currently approved Mine Disturbance Boundary. This report provides an assessment of the potential air quality impacts of MOD 10 and compares it to the approved operation and original project approval which is MOD 7 (due to the transitional provisions that were put in place when Part 3A of the EP&A Act was revoked). Greenhouse gas (GHG) emissions have been estimated in accordance with recognised Australian Government procedures to address the environmental assessment requirements.

The assessment involved identifying the key air quality and greenhouse gas issues, characterising the existing environment, quantifying emissions to air and modelling to predict the impact of MOD 10 on local air quality. The key air quality issues for the proposed changes associated with MOD 10 were identified as mining dust, post-blast fume and diesel exhaust. These issues were the focus of the assessment.

A detailed review of the existing environment was carried out including an analysis of historically measured concentrations of key quality indicators from representative monitoring stations. This included analysis of ten years of site-specific monitoring data. The following conclusions were made in relation to the existing environment:

- Meteorological conditions in 2017 were representative of the long term, local conditions around the BCM.
- There was a deterioration in air quality conditions from 2017 to early 2020, heavily influenced by drought, dust storms and bushfires. These conditions were not unique to the Northwest Slopes and Plains.
- The BCM has complied with the air quality criteria specified in SSD 09_0182 throughout its mining operations.

The key outcomes of the modelling and subsequent assessment are:

- The potential extent of air quality impacts due to the BCM (including the changes sought by MOD 10) would be largely within the currently approved extent of air quality impacts based on comparisons to the EPA air quality impact assessment criteria. In addition, the potential extent of air quality impacts are expected to be consistent with the originally approved development (MOD 7).
- Dust concentrations and deposition levels due to mining are unlikely to exceed relevant EPA and Voluntary Land Acquisition and Mitigation Policy (VLAMP) assessment criteria at the nearest private sensitive receptors and are expected to continue to comply with the existing air quality criteria in SSD 09_0182.
- In respect of cumulative impacts, when background levels from other sources approach the EPA criteria (specifically 24-hour average PM₁₀), the BCM has the potential to influence an exceedance. However, under these conditions, modelling indicated that the contribution from BCM (including the changes sought by MOD 10) would be very small (<3 µg/m³ at one property) and this risk can be managed through the ongoing implementation of the air quality management measures currently in place at BCM. The model results indicated that the additional mining for MOD 10 would not materially contribute to cumulative air quality impacts.
- Emissions from diesel exhausts associated with off-road vehicles and equipment are not expected to result in any adverse air quality impacts, based on modelling which showed compliance with air quality assessment criteria at all sensitive receptors.
- Emissions associated with post blast fume are not expected to result in any adverse air quality impacts (as NO₂), based on modelling which showed compliance with air quality assessment criteria at all sensitive receptors.
- BCOPL monitors air quality at various locations around the BCM and for all relevant air quality indicators. The monitoring occurs near locations that may be expected to experience the highest contributions from potential BCM emissions. As the modelling results show that MOD 10 is unlikely to cause exceedances of air quality criteria at sensitive receptors, the current monitoring program will continue to be appropriate and no additional monitoring is proposed.
- The estimated highest annual incremental increase in Scope 1 emissions due to MOD 10 (over approved operations) is 0.21 Mt CO₂-e, which represents approximately 0.05% of Australia's emissions (that is 432.62 Mt CO₂-e for 2022, the latest year of estimates available¹). Emissions from the end use of the coal have been calculated as Scope 3 emissions for the purposes of the MOD 10 assessment. BCOPL's customers account for these same emissions as Scope 1 emissions and are required to comply with their respective countries' emissions targets.

¹ <https://ageis.climatechange.gov.au/>

Based on this assessment, it has been concluded that MOD 10 is unlikely to affect air quality beyond the range of historically measured fluctuations of key air quality indicators around the region. This conclusion has been informed by modelling which showed that BCM (including changes sought by MOD 10) would not result in changes to air quality that would cause exceedances of air quality criteria at the nearest private sensitive receptors.

1 Introduction

1.1 Background

Boggabri Coal Operations Pty Ltd (BCOPL), a subsidiary of Idemitsu Australia Pty Ltd (IA), is seeking approval for a modification to operations at the Boggabri Coal Mine (BCM). Specifically, BCOPL is seeking approval to recover additional known coal resources within the mining authorities held for the BCM, but which are located outside of the currently approved Mine Disturbance Boundary (MOD 10). Approval is sought via an application to be made under Section 4.55(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This report provides an assessment of the potential air quality and greenhouse gas (GHG) impacts of the BCM incorporating changes sought by MOD 10.

1.2 Approved Operation

The BCM is an open-cut coal mine located approximately 15 kilometres (km) northeast of the township of Boggabri in north-western NSW. The mine has been operating since 2006. Truck and excavator operations are used to mine coal which is crushed and screened or washed in the Coal Handling Preparation Plant (CHPP) to produce thermal, semi-soft coking and Pulverised Coal Injected (PCI) products. Product coal is loaded onto trains via an on-site train loading facility and transported by rail to the Port of Newcastle for sale to the export market. BCOPL manages the BCM operations on behalf of IA and its joint venture partners.

The BCM Project was originally granted Project Approval (PA, now State Significant Development approval (SSD)) 09_0182 on 18 July 2012. To date, there have been ten applications to modify SSD 09_0182. An initial modification to SSD 09_0182 (MOD1) was made in December 2012, but was subsequently withdrawn. Modification 7 (MOD 7) was the final modification granted to SSD 09_0182 under the provisions of the former Section 75W of the EP&A Act. Since the repeal of Part 3A, SSD 09_0182 has been the subject to the grant of three modification applications, being Modification 8 (MOD 8), Modification 9 (MOD 9) and Modification 11 (MOD 11).

SSD 09_0182 (as modified up to MOD 7) facilitated:

- Open cut mining activities using truck and shovel operations in the existing Coal Lease (CL) 368 and Mining Lease (ML) 1883 (formerly Authorisation (A) 355);
- Extraction of up to 8.6 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal until December 2033;
- Construction and operation of a CHPP, rail spur, rail loop and associated equipment;
- Processing of up to 4.2 Mtpa of ROM coal using the Boggabri CHPP;
- Rail transportation of up to 8.6 Mtpa of product coal from the BCM and 3 Mtpa from Tarrawonga Mine, with the maximum rail haulage from both sites being capped at 10 Mtpa;
- Construction and use of offices, workshops, bathhouse, access roads and water storage infrastructure; and
- Employment of up to 500 full time equivalent (FTE) personnel.

MOD 8 to SSD 09_0182 was approved under delegation by the Deputy Secretary of the Department of Planning, Housing and Infrastructure (DPHI) on 22 January 2024 and provides approval for the following key changes to the BCM:

- Increased depth of approved mining operations to recover an additional coal resource. MOD 8 approves an increase to the depth of mining operations from the Merriown Seam down to the Templemore Coal Seam and is expected to recover an additional 28.1 Mtpa of ROM coal within the approved Mine Disturbance Boundary;
- Extend life of mine for a further three years (until 2036); and
- Increase in peak workforce from 500 to 876 Full time Equivalent (FTE) employees.

MOD 9 to SSD 09_0182 was approved by the DPE (now DPHI) under Section 4.55(1A) of the EP&A Act on 3 March 2023 for the following:

- Operation of a mobile rock crushing facility and associated fleet within the approved Mine Disturbance Boundary at BCM;
- Construction of a new Pre-Shift Infrastructure (PSI) building which is within an already disturbed location closer to active mining operations and access to the new site via a section of the former Leard Forest Road (previously closed to the public); and
- Minor administrative changes to conditions of SSD 09_0182 relating to the management of rehabilitation activities to align requirements with recent amendments to the Mining Regulation 2016.

MOD 11 to SSD 09_0182 was approved by DPHI under Section 4.55(1A) of the EP&A Act on 19 July 2024 for the following:

- Construction and operation of an additional two bays on the southern side of the existing workshop and associated concrete aprons;
- Westerly extension to the stores building and construction of an associated concrete unloading pad; and
- Minor adjustments to associated hardstand areas and the subsequent realignment of the light vehicle access road to account for changes to the Mine Infrastructure Area (MIA) layout.

In summary, BCM operates pursuant to SSD 09_0182 (as modified) which allows for the extraction of up to 8.6 Mtpa of ROM coal until the end of December 2036. These operations are referred to as the Approved Development.

1.3 Modification Description

The additional mining operations sought by MOD 10 would involve the following changes beyond that approved by MOD 11 to SSD 09_0182:

- An additional 85 ha of disturbance within the existing Project Boundary and beyond the disturbance footprint currently approved for BCM. The existing Vegetation Corridor will be maintained as conditioned in SSD 09_0182;
- Mining will continue to recover coal down to the Templemore Coal Seam within the existing Mine Disturbance Boundary recovering up to 15.4 Million tonnes (Mt) (approximate) of additional ROM coal resource;
- Operations in the Modification Disturbance Footprint will allow the mining of resources down to the Templemore Coal Seam. This is an additional 14.5 Mt of ROM coal;
- An additional four years of mining activities until the end of 2040;
- Changes to the conceptual final landform design (for MOD 8 and changes proposed for MOD 10) to reflect the additional overburden materials to be mined and the increase in mining area; and
- Amendments to the Conceptual Final Landform design resulting from the additional mining proposed.

There are no proposed changes to the currently approved mining methods, annual ROM coal extraction rate of up to 8.6 Mtpa, the operational workforce, nor the coal seams approved to be mined at BCM. Further to this, MOD 10 does not seek to change the approved operational hours, mining related infrastructure, water management system, coal handling and processing, transport methods and rates or access to the mine site.

Figure 1 shows the location of the BCM, surrounding features and nearest properties. It also illustrates the key features related to MOD 10, including the Project Boundary, approved Mine Disturbance Boundary and Modification Mining Area. MOD 10 will continue to mine the ROM coal resource down to the Templemore coal seam as was approved for MOD 8.

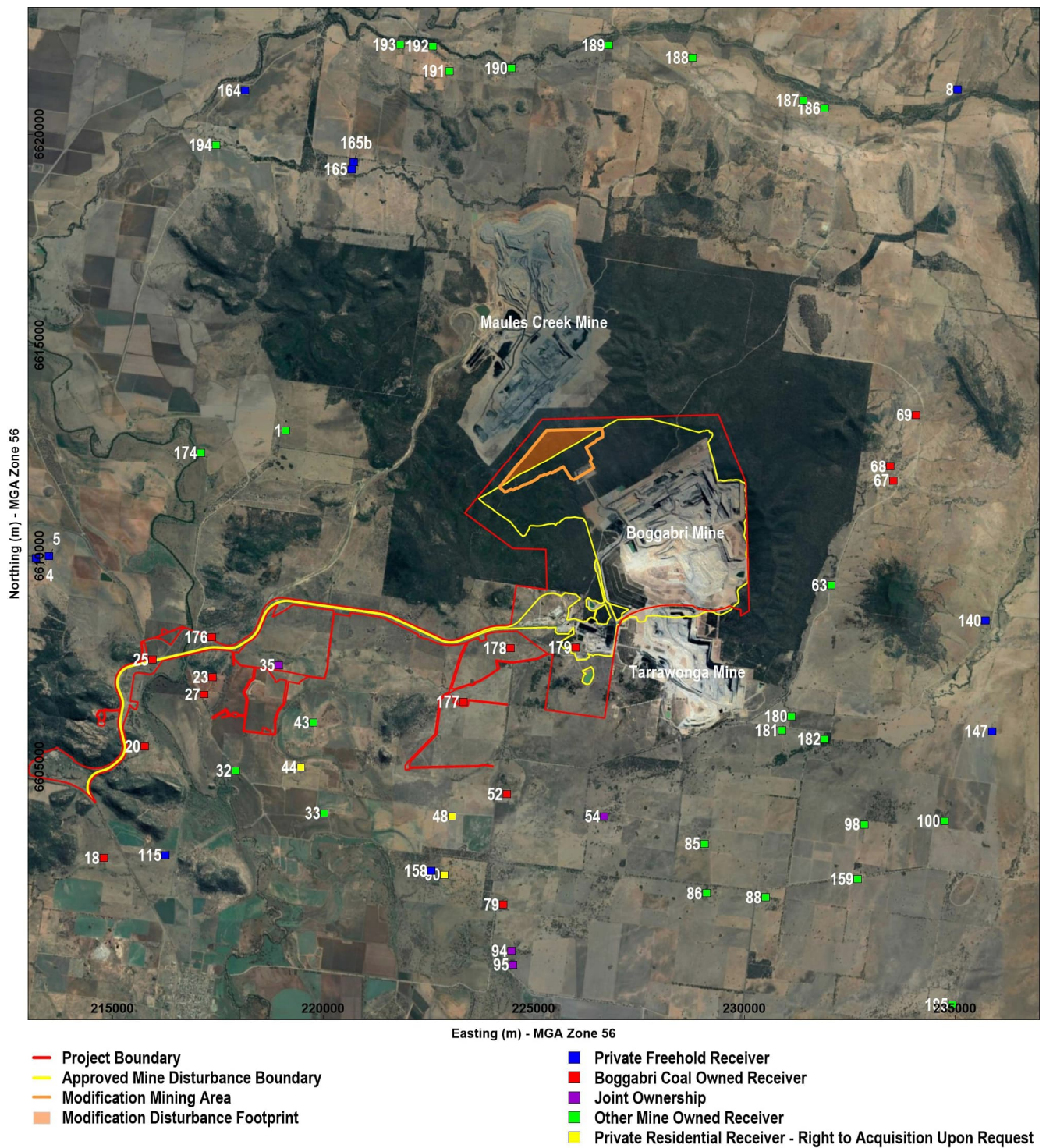


Figure 1 Location of the BCM and surrounds

1.4 Report Structure

The report is structured as follows:

- Section 1 provides the background to the BCM and MOD 10.
- Section 2 identifies the key air quality issues to be addressed.
- Section 3 outlines the key legislative and policy assessment requirements.
- Section 4 discusses key features of the existing environment including surrounding land uses, sensitive receptors, and local meteorological and air quality conditions.
- Section 5 provides an overview of the methods used to assess the potential for air quality impacts.
- Section 6 provides an assessment of the air quality impacts including measures to mitigate or otherwise effectively manage impacts.
- Section 7 provides an assessment of the greenhouse gas impacts including measures to mitigate or otherwise effectively manage impacts.
- Section 8 provides the conclusions of the assessment.

2 Key Issues

Air quality issues can arise when emissions from an industry or activity lead to a deterioration in the ambient air quality beyond a level that government nominates is typically acceptable. The potential emission sources which may impact the local air quality have been identified from a review of MOD 10 and associated activities. This identification process has considered the types of emissions to air and proximity of these emission sources to private dwellings.

Emissions to air from the BCM could occur from a variety of activities including material handling, material transport, processing, and wind erosion from exposed areas. These emissions will primarily occur during the operational phase, as limited construction works will be required for MOD 10. The main emission to air from BCM due to changes associated with MOD 10 will be dust, also referred to as particulate matter. Key classifications of particulate matter include:

- Total suspended particulates (TSP).
- Particulate matter with equivalent aerodynamic diameter of 10 microns or less (PM₁₀).
- Particulate matter with equivalent aerodynamic diameter of 2.5 microns or less (PM_{2.5}).
- Deposited dust.

Plant and equipment engine exhausts also have the potential to generate emissions that include carbon monoxide (CO), oxides of nitrogen (NO_x) and particulate matter, and to a lesser extent sulphur dioxide (SO₂). Post-blast fume has the potential to generate nitric oxide (NO) emissions which, in turn, can oxidise to the more harmful nitrogen dioxide (NO₂).

The area around the BCM contains various emission sources that contribute to local air quality and the potential cumulative impacts are an important issue to address.

The key issues for consideration in this assessment have been identified as:

- Mining dust (i.e. particulate matter in the form of TSP, PM₁₀, PM_{2.5} and deposited dust).
- Products of combustion (PM₁₀, PM_{2.5} and NO₂) from plant and equipment exhausts.
- Post-blast fume (NO₂).
- GHG emissions e.g. carbon dioxide equivalent gases (CO₂-e).

These issues were the focus of this assessment.

3 Policy Setting

3.1 Air Quality Criteria

Air quality is typically quantified by the concentrations of substances in the ambient air. Air pollution occurs when the concentration (or some other measure of intensity) of one or more substances known to cause health, nuisance and/or environmental effects, exceeds a certain level. Regarding human health and nuisance effects, the substances most relevant to BCM have been identified (from Section 2) as particulate matter and NO₂.

The existing Project Approval (SSD 09_0182 (as modified)) requires BCOPL to “ensure that particulate matter emissions generated by the project do not exceed the criteria” for PM₁₀ and PM_{2.5}. Table 1 shows the air quality assessment criteria from SSD 09_0182.

Table 1 Air quality criteria from SSD 09_0182

Air quality indicator	Averaging time	Air quality criteria from SSD 09_0182
Particulate matter (PM ₁₀)	24-hour	^b 50 µg/m ³
	Annual	^{a,d} 25 µg/m ³
Particulate matter (PM _{2.5})	24-hour	^b 25 µg/m ³
	Annual	^{a,d} 8 µg/m ³

^a Total impact (i.e. incremental increase in concentrations due to the project plus background concentrations due to all other sources);

^b Incremental impact (i.e. incremental increase in concentrations due to the project on its own);

^d Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents or any other activity agreed by the Secretary.

The Environment Protection Authority (EPA) has developed assessment criteria for a range of air quality indicators including particulate matter and NO₂. These criteria are outlined in the “Approved Methods for the Modelling and Assessment of Air Pollutants in NSW” (EPA, 2022), hereafter referred to as the Approved Methods. Most of the EPA criteria referred to in this report have been drawn from national standards for air quality set by the National Environmental Protection Council of Australia (NEPC) as part of the National Environment Protection Measures (NEPMs) (NEPC, 1998 and updates to 2021).

MOD 10 has been assessed in terms of its ability to comply with the relevant air quality criteria set by the EPA as part of the Approved Methods. These criteria are outlined in Table 2 and apply to existing and potentially sensitive receptors, where the Approved Methods defines a sensitive receptor as including “a location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area”.

Table 2 EPA air quality assessment criteria

Air quality indicator	Averaging time	Criterion	Application
Particulate matter (PM ₁₀)	24-hour	50 µg/m ³	Cumulative, at sensitive receptors
	Annual	25 µg/m ³	Cumulative, at sensitive receptors
Particulate matter (PM _{2.5})	24-hour	25 µg/m ³	Cumulative, at sensitive receptors
	Annual	8 µg/m ³	Cumulative, at sensitive receptors
Particulate matter (TSP)	Annual	90 µg/m ³	Cumulative, at sensitive receptors
Deposited dust	Annual (maximum increase)	2 g/m ² /month	Incremental, at sensitive receptors
	Annual (maximum total)	4 g/m ² /month	Cumulative, at sensitive receptors
Nitrogen dioxide (NO ₂)	1-hour	164 µg/m ³	Cumulative, at sensitive receptors
	Annual	31 µg/m ³	Cumulative, at sensitive receptors

Source: EPA, 2022.

Many of the EPA air quality assessment criteria relate to the total concentration of pollutants in the air (that is, cumulative) and not just the contribution from project-specific sources. Therefore, some consideration of background levels needs to be made when using these criteria to assess the potential impacts. In situations where background levels are elevated the proponent must “demonstrate that no additional exceedances of the impact assessment criteria will occur as a result of the proposed activity and that best management practices will be implemented to minimise emissions of air pollutants as far as is practical” (EPA, 2022). Section 4 provides further discussion on background levels.

The NSW Voluntary Land Acquisition and Mitigation Policy (VLAMP) (NSW Government, 2018) includes the NSW Government's policy for voluntary mitigation and land acquisition to address dust (particulate matter) impacts from State significant mining, petroleum and extractive industry developments. The VLAMP brings the air quality criteria in line with the NEPM standards and EPA assessment criteria.

From the VLAMP, voluntary mitigation rights may apply where, even with best practice management, the development contributes to exceedances of the criteria in Table 3 at any residence on privately owned land or workplace on privately owned land where the consequences of those exceedances in the opinion of the consent authority are unreasonably deleterious to worker health or the carrying out of business at that workplace, including consideration of the relevant factors identified on this subject in the VLAMP.

Table 3 VLAMP mitigation criteria for particulate matter

Air quality indicator	Averaging time	Criterion	Impact type
Particulate matter (PM ₁₀)	24-hour	50 µg/m ³ **	Human health
	Annual	25 µg/m ³ *	Human health
Particulate matter (PM _{2.5})	24-hour	25 µg/m ³ **	Human health
	Annual	8 µg/m ³ *	Human health
Particulate matter (TSP)	Annual	90 µg/m ³ *	Amenity
Deposited dust	Annual (maximum increase)	2 g/m ² /month **	Amenity
	Annual (maximum total)	4 g/m ² /month *	Amenity

* Cumulative impact (i.e. increase in concentrations due to the development plus background concentrations due to all other sources).

** Incremental impact (i.e. increase in concentrations due to the development alone), with zero allowable exceedances of the criteria over the life of the development.

Voluntary acquisition rights may apply where, even with best practice management, the development contributes to exceedances of the criteria in Table 4 at any residence on privately owned land or workplace on privately owned land where the consequences of those exceedances in the opinion of the consent authority are unreasonably deleterious to worker health or the carrying out of business at that workplace (including consideration of the relevant factors identified on this subject in the VLAMP), or on more than 25% of any privately owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls.

Table 4 VLAMP acquisition criteria for particulate matter

Air quality indicator	Averaging time	Criterion	Impact type
Particulate matter (PM ₁₀)	24-hour	50 µg/m ³ **	Human health
	Annual	25 µg/m ³ *	Human health
Particulate matter (PM _{2.5})	24-hour	25 µg/m ³ **	Human health
	Annual	8 µg/m ³ *	Human health
Particulate matter (TSP)	Annual	90 µg/m ³ *	Amenity
Deposited dust	Annual (maximum increase)	2 g/m ² /month **	Amenity
	Annual (maximum total)	4 g/m ² /month *	Amenity

* Cumulative impact (i.e. increase in concentrations due to the development plus background concentrations due to all other sources).

** Incremental impact (i.e. increase in concentrations due to the development alone), with five allowable exceedances of the criteria over the life of the development.

The particulate matter levels for comparison with the criteria in Table 3 and Table 4 must be calculated in accordance with the Approved Methods.

3.2 Greenhouse Gas

3.2.1 Overview

GHG is a collective term for a range of gases that are known to trap radiation in the upper atmosphere, where they have the potential to contribute to the greenhouse effect (global warming). GHGs include:

- Carbon dioxide (CO₂); by far the most abundant GHG, primarily released during fuel combustion.
- Methane (CH₄); generated from the anaerobic decomposition of carbon-based material (including enteric fermentation and waste disposal in landfills).

- Nitrous oxide (N₂O); generated from industrial activity, fertiliser use and production.
- Hydrofluorocarbons (HFCs); commonly used as refrigerant gases in cooling systems.
- Perfluorocarbons (PFCs); used in a range of applications including solvents, medical treatments and insulators.
- Sulphur hexafluoride (SF₆); used as a cover gas in magnesium smelting and as an insulator in heavy duty switch gear.

It is common practice to aggregate the emissions of these gases to the equivalent emission of carbon dioxide. This provides a simple figure for comparison of emissions against targets. Aggregation is based on the potential of each gas to contribute to global warming relative to carbon dioxide and is known as the global warming potential (GWP). The resulting number is expressed as carbon dioxide equivalents (or CO₂-e).

GHG emissions that form an inventory can be split into three categories known as 'Scopes'. Scopes 1, 2 and 3 are defined by the Greenhouse Gas Protocol² (WRI, 2004) and can be summarised as follows:

- Scope 1 – Direct emissions from sources that are owned or operated by the organisation (examples include combustion of diesel in company owned vehicles or used in on-site generators).
- Scope 2 – Indirect emissions associated with the import of energy from another source (examples include importation of electricity or heat).
- Scope 3 – Other indirect emissions (other than Scope 2 energy imports) which are a direct result of the operations of the organisation but from sources not owned or operated by them (examples include business travel, by air or rail, and product usage).

The purpose of differentiating between the scopes of emissions is to avoid the potential for double counting, where two or more organisations assume responsibility for the same emissions.

3.2.2 Federal Policy

Conference of Parties

The 21st yearly session of the Conference of Parties (COP), held in Paris in 2015, was pivotal for developing an international treaty on climate change. It resulted in "The Paris Agreement", an agreement 'to achieve a balance between anthropogenic (human induced) emissions by sources and removals by sinks of greenhouse in the second half of this century'. Subsequent COPs have sought to develop policy architecture to deliver on the commitments of COP21. In particular, following COP21, international agreements were made to:

- Keep global warming well below 2.0 degrees Celsius, with an aspirational goal of 1.5 degrees Celsius (based on temperature pre-industrial levels).
- From 2018, countries are to submit revised emission reduction targets every five years, with the first being effective from 2020, and goals set to 2050.
- Define a pathway to improve transparency and disclosure of emissions.
- Make provisions for financing the commitments beyond 2020.

The *Climate Change Act 2022* operates as 'umbrella' legislation to implement Australia's net-zero commitments. It codifies Australia's net 2030 and 2050 GHG emissions reductions targets under the Paris Agreement including targets to cut emissions by 43% by 2030 from 2005 levels and achieve net zero emissions by 2050.

National Greenhouse and Energy Reporting Act 2007

The Federal Government uses the *National Greenhouse and Energy Reporting Act 2007* (NGER Act) for the measurement, reporting and verification of GHG emissions in Australia. This legislation is used for a range of purposes, including international GHG reporting. Under the NGER Act, constitutional corporations in Australia which exceed thresholds for GHG emissions or energy production or consumption are required to measure and report data to the Clean Energy Regulator (CER) on an annual basis. The *National Greenhouse and Energy Reporting (Measurement) Determination 2008* (Measurement Determination) identifies several methodologies to account for GHGs from specific sources relevant to MOD 10. This includes emissions of GHGs from direct fuel combustion (fuels for

² The Greenhouse Gas Protocol is a collaboration between the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). The Protocol provides guidance on the calculation and reporting of carbon footprints.

transport energy purposes), emissions associated with consumption of power from direct combustion of fuel (e.g. diesel generators used during construction), and from consumption of electricity from the grid.

The Measurement Determination provides methods, criteria, and measurement standards for calculating and reporting GHG emissions and energy data under the NGER Act. It covers Scope 1 and Scope 2 emissions and energy production and consumption. The Measurement Determination is primarily used for historical reporting of activities. The calculation methodologies for BCM have been based on the National Greenhouse Accounts (NGA) Factors as the NGA Factors are used for the purposes of project assessment.

Safeguard Mechanism

The Safeguard Mechanism has been in place since 1 July 2016 and is a legislated framework that applies to all facilities that emit more than 100,000 tonnes of CO₂-e of Scope 1 emissions (emissions produced on-site) in a year. The Safeguard Mechanism places a limit on the amount of greenhouse gases Australia's largest industrial facilities can emit by assigning each facility covered by the Mechanism a 'baseline'. Each year, every large facility within the Safeguard Mechanism reports their emissions to the CER. Any facility that emits more greenhouse gases than allowed by their baseline has to take actions to reduce their emissions. For example, through purchasing Australian Carbon Credit Units.

Reforms to the Safeguard Mechanism took effect from 1 July 2023. Under these reforms, new baseline emissions numbers ('baselines') for designated large facilities are set on a declining trajectory aligned with achieving Australia's emissions reduction targets set out in the *Climate Change Act 2022* and its Nationally Determined Contribution (NDC) under the Paris Agreement. The decline rate for Safeguard baselines is currently 4.9% per year to 2030, and the Government has indicated that this will reduce to 3.285% per year from 1 July 2030 (with the decline rate to thereafter be set in 5-year blocks). The BCM is a Safeguard facility and will need to reduce its emissions in accordance with the Mechanism's emissions reduction targets.

3.2.3 State Policy

The NSW government has a Climate Change Policy Framework which sets the objective of achieving net-zero emissions by 2050. The policy does not impose any specific requirements on the public, nor on developments undertaken by private companies, but intends to achieve net-zero emissions through a combination of consultative policy development intended to avoid duplication of Commonwealth frameworks. The *Climate Change (Net Zero Future) Act 2023* legislates the NSW approach to addressing climate change and delivering net zero by 2050. The Act sets a path to 2050 with emissions reduction targets. The Act legislates:

- Guiding principles for action to address climate change that consider the impacts, opportunities and need for action in NSW.
- Net emissions reduction targets for NSW (50% reduction on 2005 levels by 2030, 70% reduction on 2005 levels by 2035, and net zero by 2050).
- An objective for NSW to be more resilient to a changing climate.
- Establishing an independent, expert Net Zero Commission to monitor, review, report on and advise on progress towards these targets.

In January 2025, the EPA finalised its GHG assessment requirements in the "NSW Guide for Large Emitters" (EPA, 2025) (Guide). The Guide outlines the assessment requirements for new projects likely to have large emissions and proposed modifications of existing facilities likely to significantly increase their emissions. There are two main tests to determine the applicability of the Guide. These consider whether the project is a large emitter, and if these emissions will be "significant" based on the development type. The potential applicability and requirements of the Guide has been discussed (see Section 7).

4 Existing Environment

This section provides a description of the environmental characteristics of the area, including outcomes from a review of recent and historical meteorological and ambient air quality conditions. One of the objectives for this review was to develop an understanding of any existing air quality issues and to identify the main factors that have influenced air quality conditions.

4.1 Local Setting

The BCM is located in a predominantly rural-residential area in the Northwest Slopes and Plains of NSW, approximately 15 km northeast of Boggabri, and within the Narrabri Shire Council (NSC) Local Government Area (LGA). The closest regional centres are Gunnedah, approximately 40 km to the south, and Narrabri, approximately 50 km to the northwest. The Willow Tree Range forms part of the Leard State Forest and borders the BCM to the north, east and west.

The land surrounding the BCM is predominantly used for agriculture including cattle grazing, cotton, and wheat farming. The area also includes two other existing open-cut coal mines. Maules Creek Coal Mine (MCCM) is located approximately 5 km to the northwest and Tarrawonga Coal Mine (TCM) borders the BCM to the south. There are also several isolated rural residences associated with the surrounding farms (Figure 1).

The local terrain is gently undulating with steeper slopes emerging near ridgelines, encompassing the BCM Project Boundary. Figure 2 shows a three-dimensional representation of the local terrain. This topographical environment has the potential to influence local wind conditions, discussed in Section 4.2.

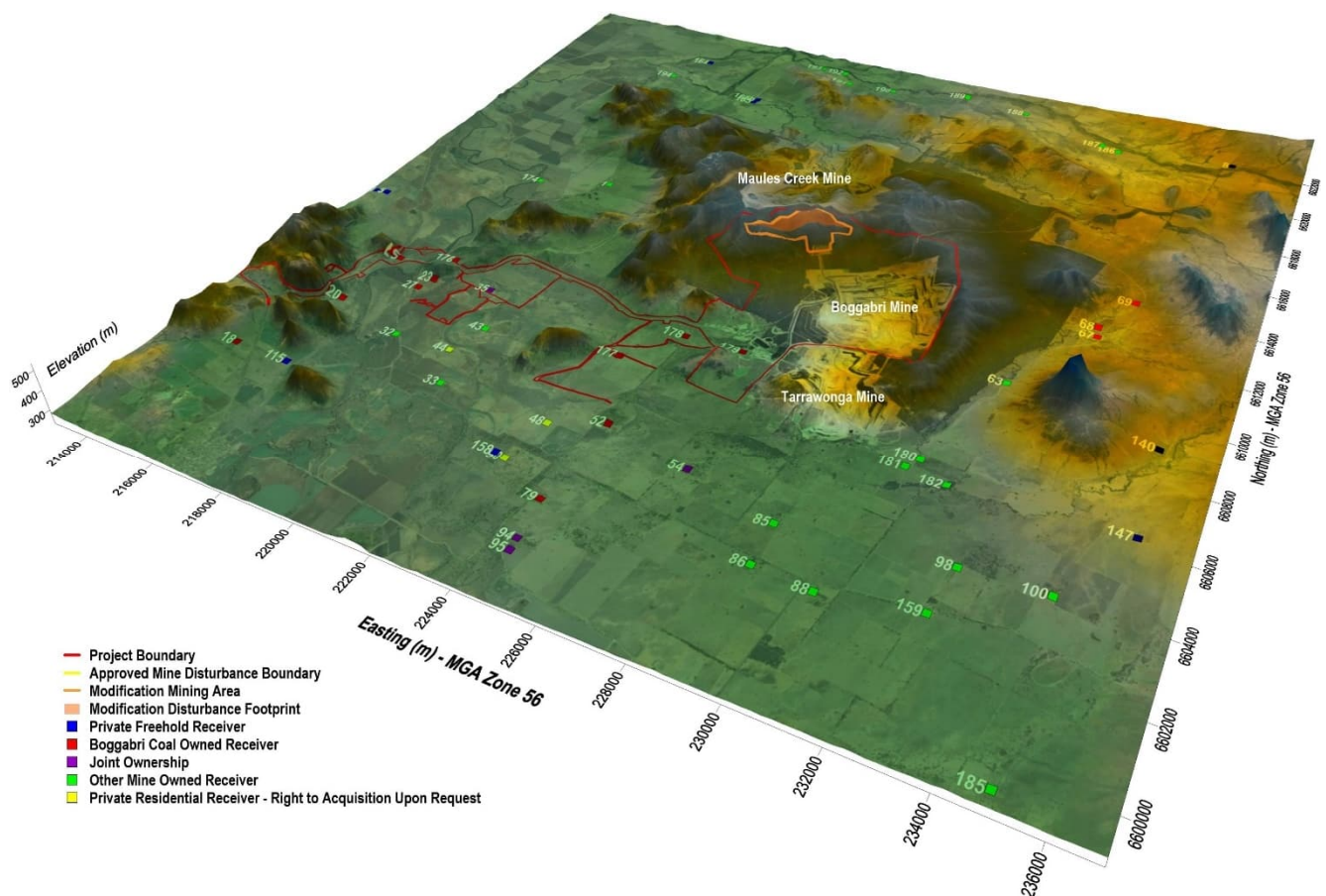


Figure 2 Three-dimensional representation of the local terrain

4.2 Meteorology

Meteorological conditions are important for determining the transport of emissions, and the potential influences on air quality. In addition, meteorological data are often used with concurrent air quality data to determine potential contributions from sources of interest. This section provides an analysis of the meteorological conditions around the BCM and identifies the datasets that are representative of the long term, local conditions.

BCOPL operates four meteorological stations around the BCM with one station, referred to as "W1", specifically operated to meet the monitoring requirements of SSD 09_0182. Meteorological monitoring is also carried out by the operators of the MCCM and TCM. Figure 3 shows the location of all identified meteorological stations near the BCM.

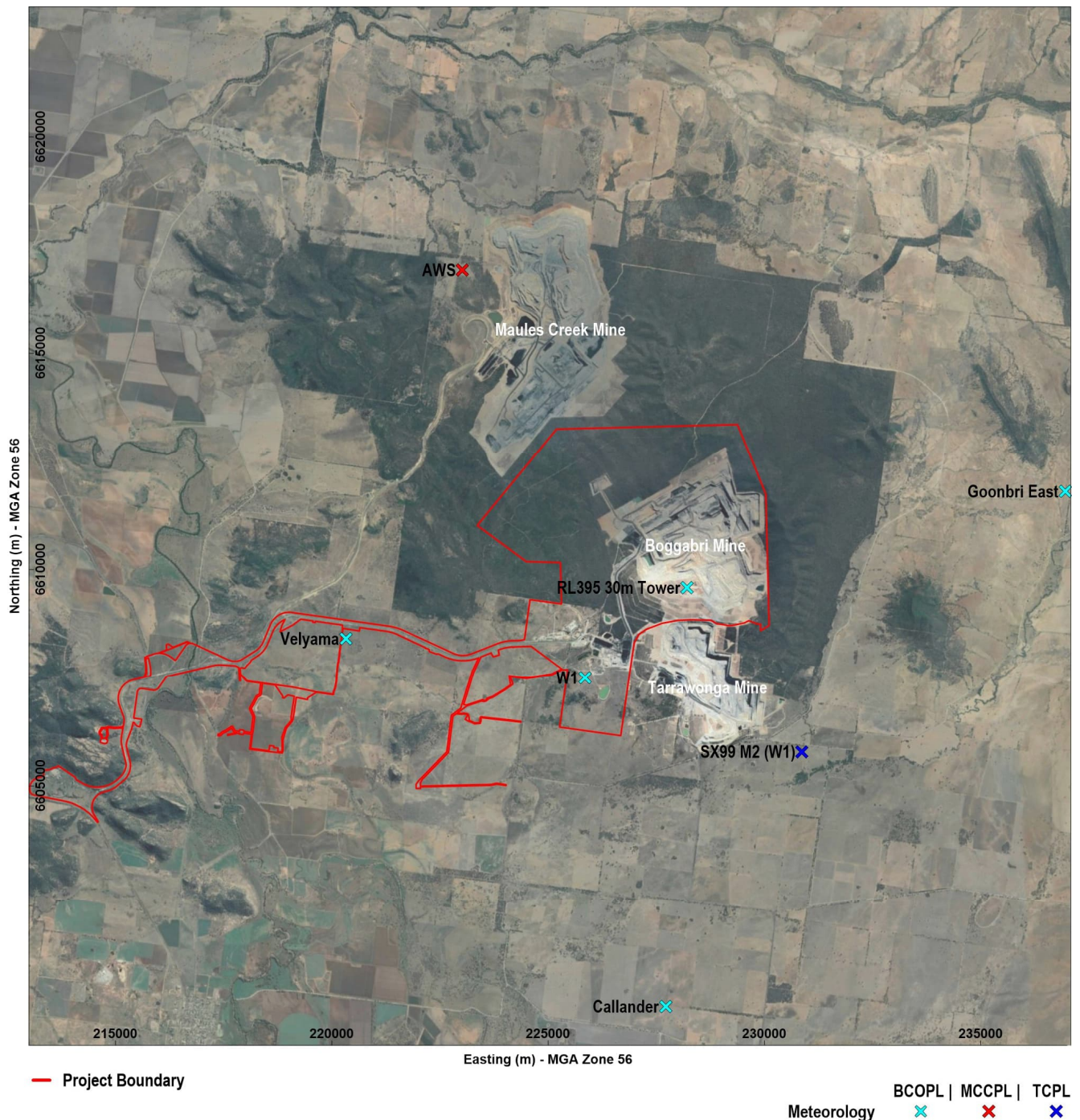


Figure 3 Location of meteorological stations

The EPA prescribes the minimum requirements for meteorological data that are to be used for air quality assessments. These requirements are outlined in the Approved Methods and include minimum data capture rates, siting and operation, and data preparation. Meteorological stations that are used for the purposes of air quality assessments can be classified (EPA, 2022) as either “site specific” or “site representative”. Data from site-specific meteorological stations are preferred however site representative data are also acceptable where site-specific meteorological data are not available provided that the data adequately describe the expected meteorological conditions at the site of interest. Air quality assessments that involve modelling are usually carried out using at least one year of site-specific or site-representative meteorological data that is over 90% complete. From the EPA descriptions (EPA, 2022), the W1 meteorological station can be considered as “site-specific” for the purposes of air quality assessment and will have collected data that can be classified as specific to conditions at and around the BCM.

Ten years of data from the primary BCOPL meteorological station, W1, have been analysed to characterise the local conditions and to identify representative datasets. The analysis involved comparing statistics from the data collected at W1 for each calendar year to determine a year-long dataset that most closely reflects the longer term, local conditions. Wind data have primarily been used for this purpose although rainfall data have also been considered.

Figure 4 shows wind speed data from W1 and rainfall data from Boggabri Post Office between 2015 and 2024. These data show that wind speeds are generally lower in winter and higher in summer with maximum wind speeds reaching approximately 10 metres per second. Rainfall data from the Bureau of Meteorology’s station at Boggabri Post Office (SN 55007) have also been included. The rainfall data shows the effect of the drought from 2017 to early 2020, with annual rainfall at least 20 per cent lower than the long-term average of 595 mm, based on 140 years of data collected between 1884 to 2024.

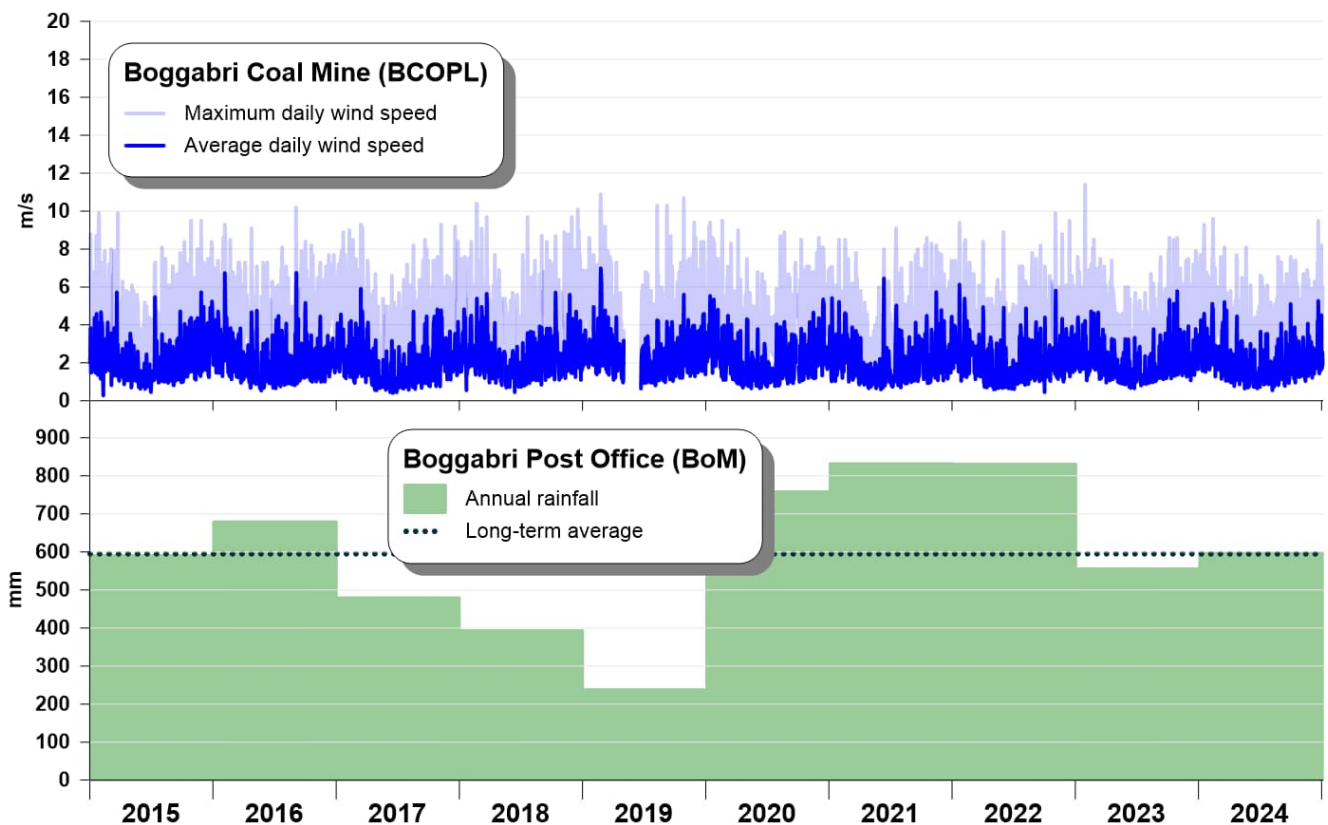


Figure 4 Wind speed and rainfall between 2015 and 2024

Wind-roses have been prepared from the data collected at W1 between 2015 and 2024. The wind-roses (Figure 5) show the frequency of wind speeds and wind directions based on hourly records. The most common winds in the area are from the north-northwest and south-southeast. This pattern of winds is evident in all years of data, to various degrees. There are seasonal variations in the wind patterns (see Appendix A). The figures in Appendix A show that autumn is generally when the north-northwest winds become less common. Figure 5 shows some fluctuations in the prevailing winds, from north to northwest and from south to southeast, but the data generally indicate that wind patterns do not vary significantly from year to year, and potentially the data from any of the years presented could be considered as representative of the longer-term conditions.



Figure 5 Wind-roses from data collected at the BCM meteorological station

Table 5 provides annual wind statistics for the 2015 to 2024 calendar years. With the exception of rainfall, these statistics support the earlier observation that conditions do not vary significantly from year to year.

Table 5 Statistics from meteorological data collected between 2015 and 2024

Location	Statistic	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
BCM (W1)	Percentage complete (%)	93	95	98	93	85	96	96	98	100	100
BCM (W1)	Mean wind speed (m/s)	2.1	2.0	2.0	2.2	2.4	2.1	2.0	2.0	2.0	2.0
BCM (W1)	Percentage of calms (≤ 0.5 m/s)	13.2	13.0	17.0	12.5	9.8	15.0	16.4	14.9	12.6	16.1
BCM (W1)	Percentage wind speeds >6 m/s	2.5	2.4	2.4	3.2	3.7	2.6	2.3	2.2	1.9	1.9
Boggabri Post Office	Rainfall (mm)	522	575	506	385	239	759	833	832	556	599

Data from the 2017 calendar year have been identified as being representative of the long term, local conditions around the BCM and suitable for informing the air quality impacts of the MOD 10. This determination was based on:

- High data capture rate, meeting the EPA's requirement for a minimum 90% complete dataset.
- Similar wind patterns to other years.
- Rainfall slightly below the long-term average and the preference was for a drier than average year resulting in a potentially more conservative approach in terms of air quality (dust) conditions.

The selection of 2017 data also provided consistency with the most recent modelling for BCM (MOD 8). This allowed for more accurate determination of the potential change in impacts. Section 4.3 also shows that air quality conditions in 2017 were not adversely influenced by bushfire activity or extreme conditions. Methods used for incorporating the 2017 data into modelling for MOD 10 are discussed in detail in Section 5. Annual and seasonal wind-roses are provided in Appendix A.

4.3 Air Quality

There is an extensive air quality monitoring network surrounding the BCM and neighbouring mines. Each mining company is required to operate an air quality monitoring network as part of their planning approval conditions. The DPHI also monitors air quality at various locations across NSW including at Gunnedah and Narrabri. The DPHI network includes over 90 air quality monitoring stations. Over 50 stations use compliance methods to monitor air quality in areas of the State's highest populations, near industrial activities, and at locations with special interest or research purposes. Over 35 stations, supported by rural communities, use indicative instrumentation methods to monitor particles across the NSW rural air quality monitoring network. This section examines the historical air quality conditions around the BCM and establishes the appropriate background levels to be considered for the assessment of MOD 10.

BCOPL monitors air quality at various locations and by various technologies. Figure 6 shows the monitoring locations. These include the measurement of PM₁₀ and PM_{2.5} by Tapered Element Oscillating Microbalance (TEOM), PM₁₀ by high volume air sampler (HVAS) and deposited dust by deposition gauges.

It should be noted that air quality monitoring data represent the contributions from all sources that have at some stage been upwind of each monitor. In the case of particulate matter (as PM₁₀) for example, a measurement may contain contributions from many sources including (but not limited to) mining activities, construction works, bushfires and 'burning off', agricultural activities, industry, vehicles, roads, wind-blown dust from nearby and remote areas, fragments of pollens and moulds.

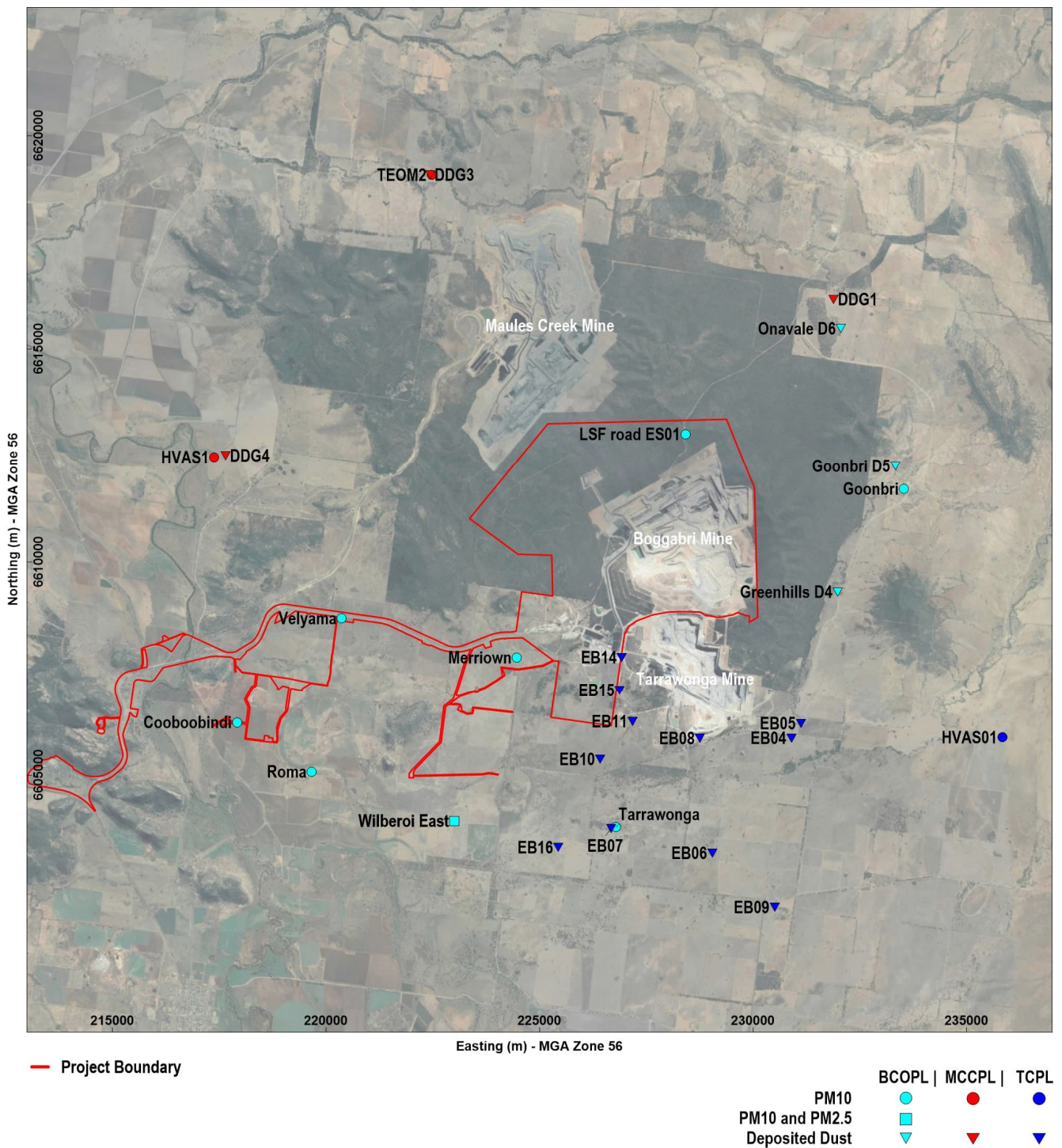


Figure 6 Location of air quality monitors

4.3.1 Extraordinary Events

Air quality in many parts of NSW, including the Northwest Slopes and Plains, was adversely influenced by drought conditions between 2017 to early 2020. A deterioration in air quality conditions over these years was not unique to the Northwest Slopes and Plains and extraordinary events, beyond normal conditions, have been identified as part of annual reviews of monitoring data.

In its "Annual Air Quality Statement 2018", DPHI concluded that particle levels increased across NSW due to dust from the widespread, intense drought and smoke from bushfires and hazard reduction burning (OEH, 2019). The DPHI subsequently concluded, from their "Annual Air Quality Statement 2019", that air quality in NSW was greatly affected by the continuing intense drought conditions and unprecedented extensive bushfires during 2019. In addition, the continued "intense drought has led to an increase in widespread dust

events throughout the year” (DPE, 2020). Subsequent annual air quality statements (2021 to 2024) have not reported these extraordinary conditions.

The influence of drought conditions on air quality is evident in the DPHI’s monitoring data. Figure 7 shows the rolling annual average PM₁₀ concentrations from data collected at various rural and urban air quality monitoring sites since 2011. These data clearly show an increase in PM₁₀ concentrations at all rural and urban locations from 2017 onwards, reflecting the onset of drought conditions, and increased bushfire activity in 2019. The rolling annual average PM₁₀ concentrations decreased rapidly from 2020 to 2022 as rainfall increased.

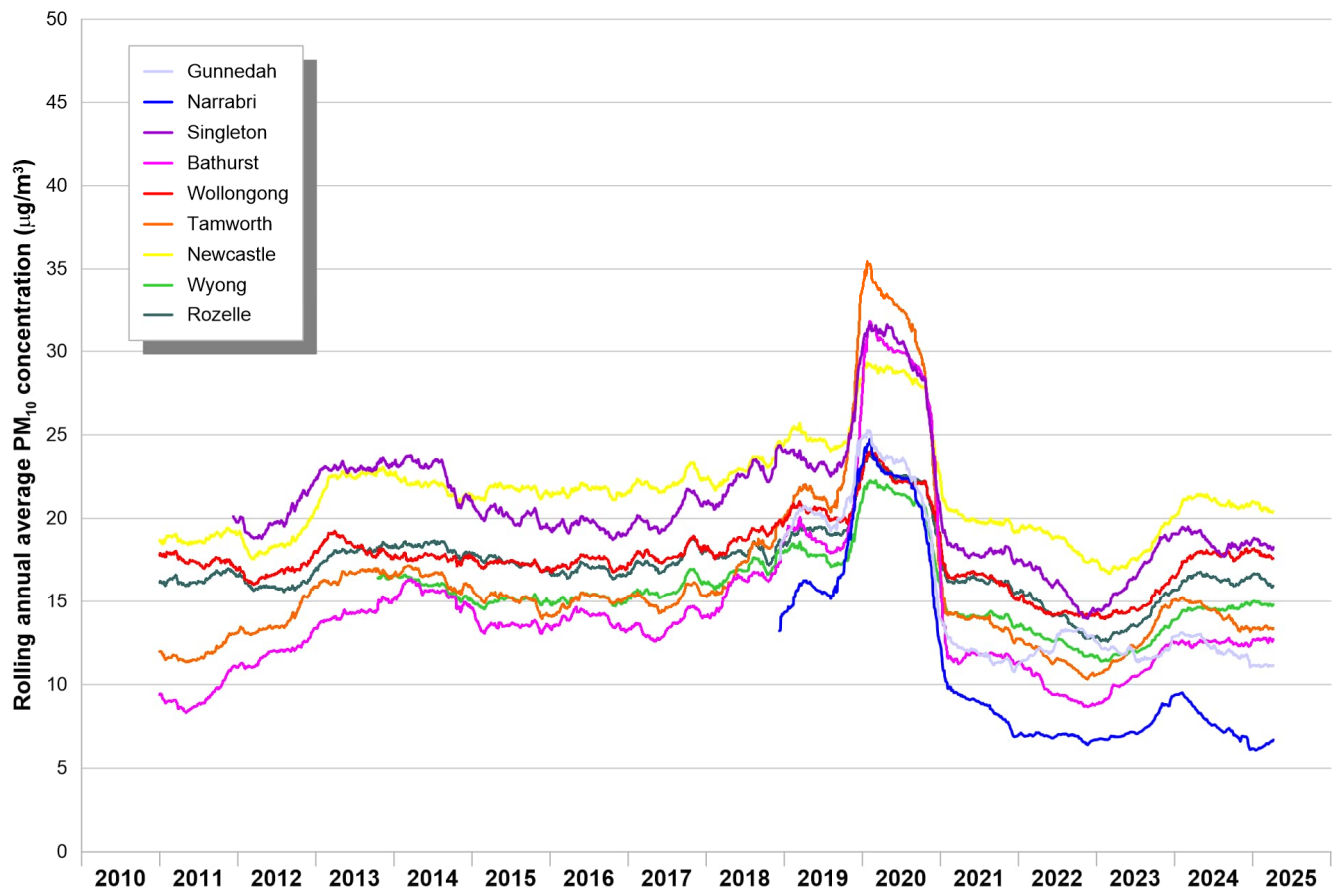


Figure 7 Rolling annual average PM₁₀ concentrations at various NSW air quality monitoring sites

The use of years with elevated air quality levels, largely driven by extraordinary events or extreme climatic conditions (or both) are avoided in modelling studies primarily because they do not address the definition of representative (EPA, 2022). In addition, extraordinary events cannot be reliably simulated in air dispersion models as it is not possible to identify all possible factors that led to these events, for example, the factors that influence the time, location, and intensity of bushfires. This context has been considered in the analysis below.

4.3.2 Particulate Matter (as PM₁₀)

Figure 8 shows the measured 24-hour average PM₁₀ concentrations from each BCM monitoring site for data collected between 2015 and 2024. The data shows that PM₁₀ concentrations increased from 2017 to early 2020 coinciding with drought conditions and lower than average rainfall. These conditions led to increases in the number of days when the 24-hour average PM₁₀ concentration exceeded 50 µg/m³ and increases in the annual average PM₁₀ concentrations. The increases in PM₁₀ concentrations were observed across many locations in NSW and were not unique to the Northwest Slopes and Plains. Concentrations decreased from mid-2020, coinciding with increased rainfall. There are also seasonal variations with higher PM₁₀ concentrations generally occurring in the warmer months.

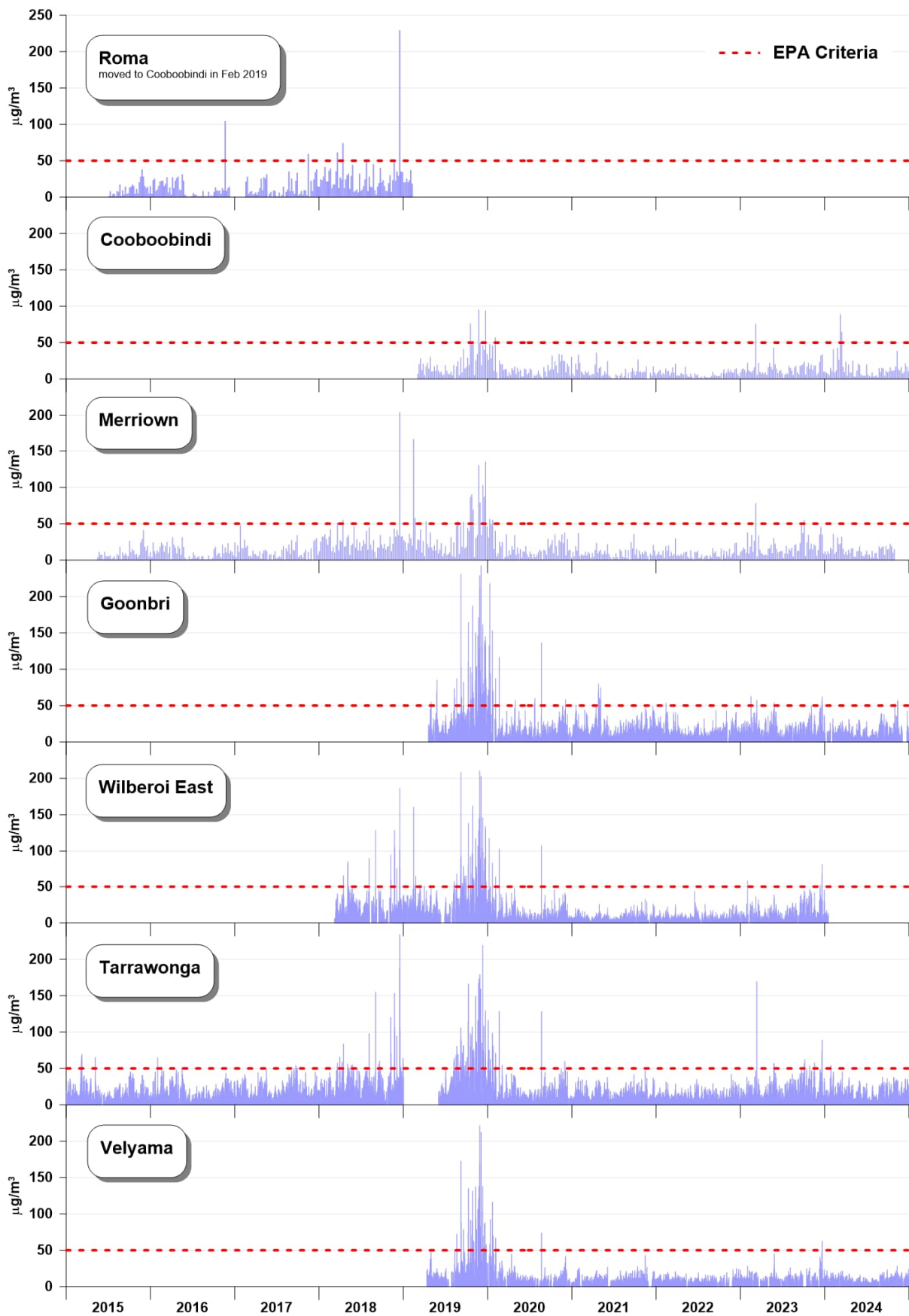
Figure 8 Measured 24-hour average PM₁₀ concentrations

Table 6 provides a summary of all data. These data highlight the increased PM₁₀ concentrations between 2017 and early 2020, due to the drought conditions. The PM₁₀ monitoring data are reviewed by BCOPL as part of annual reporting and with consideration of extraordinary events, as outlined in Section 4.3.1. These reviews have shown that BCOPL has complied with the PM₁₀ criteria specified in SSD 09_0182 in all years between 2015 and 2024.

Table 6 Summary of measured PM₁₀ concentrations

Statistic	Roma / Coobooindi (HVAS) ¹	Merriown (HVAS) ²	Goonbri (TEOM) ²	Wilberoi East (TEOM) ¹	Tarrawonga (TEOM) ²	Velyama (TEOM) ²	EPA criterion
Maximum 24-hour average (µg/m ³)							
2015	38*	41*	*	*	69	*	50
2016	104	31	*	*	65	*	50
2017	59	48	*	*	54	*	50
2018	229	204	*	187	234	*	50
2019	95	167	242	210	707*	222*	50
2020	57*	56	218	118	129	117	50
2021	36	37	80	33	47	43	50
2022	21	30	54	44	42	25	50
2023	76	78	63	82	170	63	50
2024	89	36	57	18	54	28	50
Number of days above 50 µg/m ³ (days)							
2015	0*	0*	*	*	5	*	-
2016	1	0	*	*	3	*	-
2017	1	0	*	*	3	*	-
2018	4	3	*	15	30	*	-
2019	5	13	62	64	67*	42*	-
2020	1	2	17	6	13	7	-
2021	0	0	7	0	0	0	-
2022	0	0	1	0	0	0	-
2023	1	3	7	4	10	1	-
2024	2	0	3	0	1	0	-
Annual average (µg/m ³)							
2015	11*	10*	*	*	17	*	30
2016	12	11	*	*	18	*	30
2017	12	12	*	*	19	*	25
2018	27	28	*	26	29	*	25
2019	23	36	43	37	56*	32*	25
2020	15*	17	21	15	20	15	25
2021	10	10	20	9	15	11	25
2022	7	9	16	9	13	10	25
2023	15	19	19	16	21	13	25
2024	15	13	15	12	17	11	25

Notes: Grey shading illustrates a measurement above the EPA criterion. SSD 09_0182 criteria are 50 µg/m³ (24-hour incremental) and 25 µg/m³ (annual cumulative).

* Less than 75% data capture

¹ Used for compliance monitoring

² Used for proactive management

4.3.3 Particulate Matter (as PM_{2.5})

BCOPL has been monitoring PM_{2.5} at Wilberoi East by TEOM since at least 2019. The DPHI also monitors PM_{2.5} at Gunnedah (40 km to the south) and Narrabri (50 km to the northwest). Figure 9 shows the measured 24-hour average PM_{2.5} concentrations from each monitoring site for data collected between 2015 and 2024. The EPA's current air quality assessment criterion for PM_{2.5} (25 µg/m³) has also been shown, but it should be noted that this assessment criterion came into effect from 20 January 2017 onwards. PM_{2.5} concentrations did not exceed the EPA criterion until mid-2018 coinciding with the increasing effects of the drought.



Figure 9 Measured 24-hour average PM_{2.5} concentrations

Table 7 summarises the measured PM_{2.5} concentrations for data collected between 2015 and 2024. All locations have recorded multiple days above the 25 µg/m³ criterion since the monitoring commenced. Annual average concentrations at Wilberoi East and Narrabri were generally lower than at Gunnedah. This may be partially due to the lower population of Narrabri, meaning less anthropogenic emission sources such as wood smoke.

Table 7 Summary of measured PM_{2.5} concentrations

Statistic	Wilberoi East	Gunnedah	Narrabri	EPA criterion
Maximum 24-hour average (µg/m ³)				
2015	-	-	-	-
2016	-	-	-	-
2017	-	11	9	25
2018	-	51	26	25
2019	119	94	88	25
2020	54	35	42	25
2021	9	24	12	25
2022	17	28	9	25
2023	55	50	47	25
2024	16	26	17	25

Statistic	Wilberoi East	Gunnedah	Narrabri	EPA criterion
Number of days above 25 µg/m ³ (days)				
2015	-	-	-	-
2016	-	-	-	-
2017	-	0	0	-
2018	-	5	1	-
2019	33	24	20	-
2020	3	6	1	-
2021	0	0	0	-
2022	0	4	0	-
2023	1	1	0	-
2024	0	0	0	-
Annual average (µg/m ³)				
2015	-	-	-	-
2016	-	-	-	-
2017	-	6.4	5.4	8
2018	-	9.0	4.9	8
2019	12.0	11.2	7.8	8
2020	5.9	7.7	5.5	8
2021	3.9	6.6	3.1	8
2022	3.8	6.4	3.6	8
2023	5.8	7.6	4.8	8
2024	4.5	6.4	4.0	9

Notes: Grey shading illustrates a measurement above the EPA criterion. SSD 09_0182 criteria are 25 µg/m³ (24-hour incremental) and 8 µg/m³ (annual cumulative).

4.3.4 Particulate Matter (as TSP)

TSP is not monitored in the vicinity of the BCM. The NSW Minerals Council (2000) estimated that, for rural environments in NSW, the average PM₁₀ concentrations are typically 40% of the TSP concentrations, a value that is consistently reported across many locations of NSW. For this assessment it has therefore been assumed that PM₁₀ concentrations would be 40% of the TSP concentrations, an assumption that yields an estimated annual average TSP concentration of 47 µg/m³ based on the highest measured annual average PM₁₀ concentration of 19 µg/m³ in 2017. Table 8 shows the estimated annual average TSP concentrations for data collected between 2015 and 2024.

Table 8 Summary of estimated TSP concentrations

Statistic	Roma / Coobooobindi (HVAS) ¹	Merriown (HVAS) ²	Goonbri (TEOM) ²	Wilberoi East (TEOM) ¹	Tarrawonga (TEOM) ²	Velyama (TEOM) ²	EPA criterion
Annual average (µg/m ³)							
2015	28*	25*	-	-	42	-	90
2016	30	27	-	-	44	-	90
2017	31	30	-	-	47	-	90
2018	68	69	-	64	73	-	90
2019	58	91	109	92	140*	81*	90
2020	38*	43	53	39	50	37	90
2021	24	26	49	22	38	26	90
2022	18	22	39	23	33	25	90
2023	37	48	47	40	53	32	90

Statistic	Roma / Coobooobindi (HVAS) ¹	Merriown (HVAS) ²	Goonbri (TEOM) ²	Wilberoi East (TEOM) ¹	Tarrawonga (TEOM) ²	Velyama (TEOM) ²	EPA criterion
2024	36	33	39	29	42	27	90

Notes: Grey shading illustrates a measurement above the EPA criterion. SSD 09_0182 criteria are 50 µg/m³ (24-hour incremental) and 25 µg/m³ (annual cumulative).

* Less than 75% data capture

¹ Used for compliance monitoring

² Used for proactive management

4.3.5 Deposited Dust

Monitoring of deposited dust relates to the collection of particles that settle from the ambient air. Insoluble and soluble matter are separated by filtration and the mass of dried insoluble solids is determined gravimetrically. The exposure period is 30 ±2 days and one result (of insoluble solids) is obtained every month. Monitoring of deposition dust is carried out by BCOPL at three locations (Figure 6) and the measurements are used to determine ongoing compliance with SSD 09_0182. Table 9 shows the annual average deposited dust levels from each BCM monitoring site for data collected between 2015 and 2024. Deposited dust levels have not exceeded the 4 g/m²/month criterion in this recent ten-year period.

Table 9 Summary of measured deposited dust

Statistic	Greenhills D4	Goonbri D5	Onavale D6	EPA criterion
Annual average (g/m ² /month)				
2015	0.8	0.7	1.4	4
2016	1.5	2.0	1.9	4
2017	2.6	1.6	1.5	4
2018	3.0	1.8	2.2	4
2019	2.3	1.7	2.9	4
2020	2.1	1.2	1.3	4
2021	1.2	0.8	0.8	4
2022	0.9	1.0	0.8	4
2023	1.1	1.2	1.2	4
2024	1.2	1.4	0.7	4

4.3.6 Nitrogen Dioxide (NO₂)

Table 10 provides a summary of the measured NO₂ concentrations from Gunnedah, the closest known air quality monitoring site which records this air quality indicator. As expected for this rural location, these data show that the maximum NO₂ concentrations have not exceeded the EPA's (current) 1-hour average criterion of 164 µg/m³. Annual averages have not exceeded the EPA's annual average criterion of 31 µg/m³.

Table 10 Summary of measured NO₂ concentrations

Statistic	Gunnedah	EPA criterion
Maximum 1-hour average (µg/m ³)		
2015	-	246
2016	-	246
2017	-	246
2018	70	246
2019	74	246
2020	57	246
2021	105	246
2022	53	164

Statistic	Gunnedah	EPA criterion
2023	53	164
2024	49	164
Annual average ($\mu\text{g}/\text{m}^3$)		
2015	-	62
2016	-	62
2017	-	62
2018	10	62
2019	10	62
2020	6	62
2021	6	62
2022	4	31
2023	6	31
2024	4	31

Concentrations of NO_2 can be associated with diesel exhaust emissions. These emissions comprise of NO_x including nitric oxide (NO) and NO_2 . In general, at the point of emission, NO will comprise the greatest proportion of the total NO_x emission. Typically, this is 90% by volume of the NO_x . The remaining 10% will comprise mostly NO_2 . Ultimately however, much of the NO emitted into the atmosphere is oxidised to NO_2 . The rate at which this oxidation takes place depends on prevailing atmospheric conditions including temperature, humidity, and the presence of other substances in the atmosphere such as ozone. It can vary from a few minutes to many hours. The rate of conversion is important because from the point of emission to the point of maximum ground-level concentration there will be an interval of time during which some oxidation will take place. If the dispersion is sufficient to have diluted the plume to the point where the concentration is very low, then the level of oxidation is unimportant. However, if the oxidation is rapid and the dispersion is slow then high concentrations of NO_2 can occur.

The NO_x monitoring data from Gunnedah (DPHI data from 2018 to 2024) show that the percentage of NO_2 in the NO_x is inversely proportional to the total NO_x concentration, and when NO_x concentrations increase, the percentage of NO_2 in the NO_x generally decreases to 20% or less. This is demonstrated by Figure 10 which shows that, for higher NO_x concentrations, the NO_2 to NO_x ratio reduces to less than 20%.

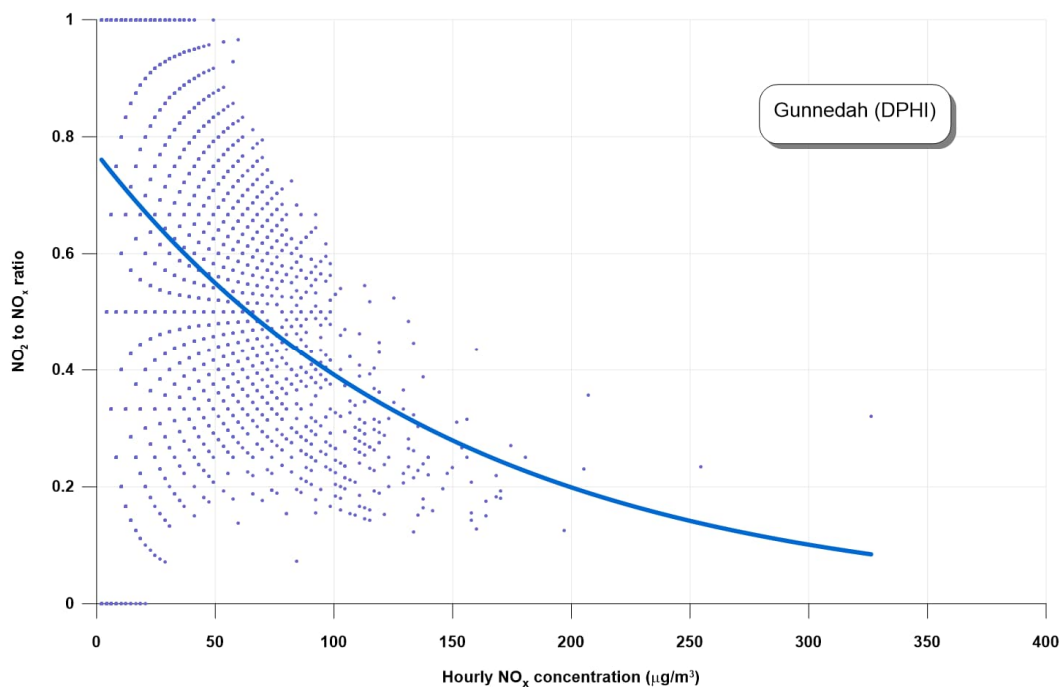


Figure 10 Measured NO_2 to NO_x ratios from hourly average data collected at Gunnedah

4.4 Background Levels

One of the objectives for reviewing the air quality monitoring data was to determine appropriate background levels to be added to the BCM contributions for the assessment of potential cumulative impacts. For this objective, it was important to identify the monitoring stations that are sufficiently close to the area of interest but not adversely influenced by those sources which are proposed for modification, such as mining operations. Table 11 shows the assumed background levels that would apply to sensitive receptors near the BCM. These levels have been added to the BCM contributions to determine the potential cumulative impacts.

Table 11 Assumed background levels that apply at sensitive receptors

Air quality indicator	Averaging time	Assumed background level	Notes
Particulate matter (PM ₁₀)	24-hour	Variable by day (Figure 11)	Measured 24-hour average PM ₁₀ concentrations in the representative year (2017) from the Tarrawonga monitoring site, less the modelled contributions from BCM, MCCM and TCM. The resultant data been inferred as 'background' levels and added to the model predictions for MOD 10 for the assessment of potential cumulative impacts, as per the Approved Methods (EPA, 2022). The Tarrawonga monitoring site had the most comprehensive records.
	Annual	14 µg/m ³	Measured annual average PM ₁₀ concentrations in the representative year (2017) from Tarrawonga monitoring site, less the modelled contributions from BCM, MCCM and TCM. The Tarrawonga monitoring site had the most comprehensive records.
Particulate matter (PM _{2.5})	24-hour	Variable by day (Figure 11)	Estimated 24-hour average PM _{2.5} concentrations in the representative year (2017) and derived from the background PM ₁₀ concentrations on the assumption that 40% of the PM ₁₀ is PM _{2.5} . The Wilberoi East data from 2019 to 2024 showed that PM _{2.5} was on average 40% of the PM ₁₀ . The data have been added to the project contributions for the assessment of potential cumulative impacts, as per the Approved Methods (EPA, 2022).
	Annual	5.8 µg/m ³	Estimated annual average PM _{2.5} concentrations in the representative year (2017) and derived from the PM ₁₀ concentrations on the assumption that 40% of the PM ₁₀ is PM _{2.5} .
Particulate matter (TSP)	Annual	47 µg/m ³	Annual average TSP concentration in the representative year (2017) from Tarrawonga, calculated by assuming PM ₁₀ is 40% of the TSP.
Deposited dust	Annual	2.6 g/m ² /month	Annual average deposited dust level (total) in the representative year (2017) from Greenhills.
Nitrogen dioxide (NO ₂)	1-hour	105 µg/m ³	Highest 1-hour average NO ₂ concentration from data collected between 2018 and 2024 from Gunnedah.
	Annual	10 µg/m ³	Highest annual average NO ₂ concentration from data collected between 2018 and 2024 from Gunnedah.

Figure 11 shows a graphical representation of the assumed background PM₁₀ and PM_{2.5} concentrations that were used in this assessment and added to the model results. As shown in Figure 11, these background concentrations have been inferred from the measurement data. This approach recognises that the monitored levels may contain some contribution from existing activities at the BCM and other mines.

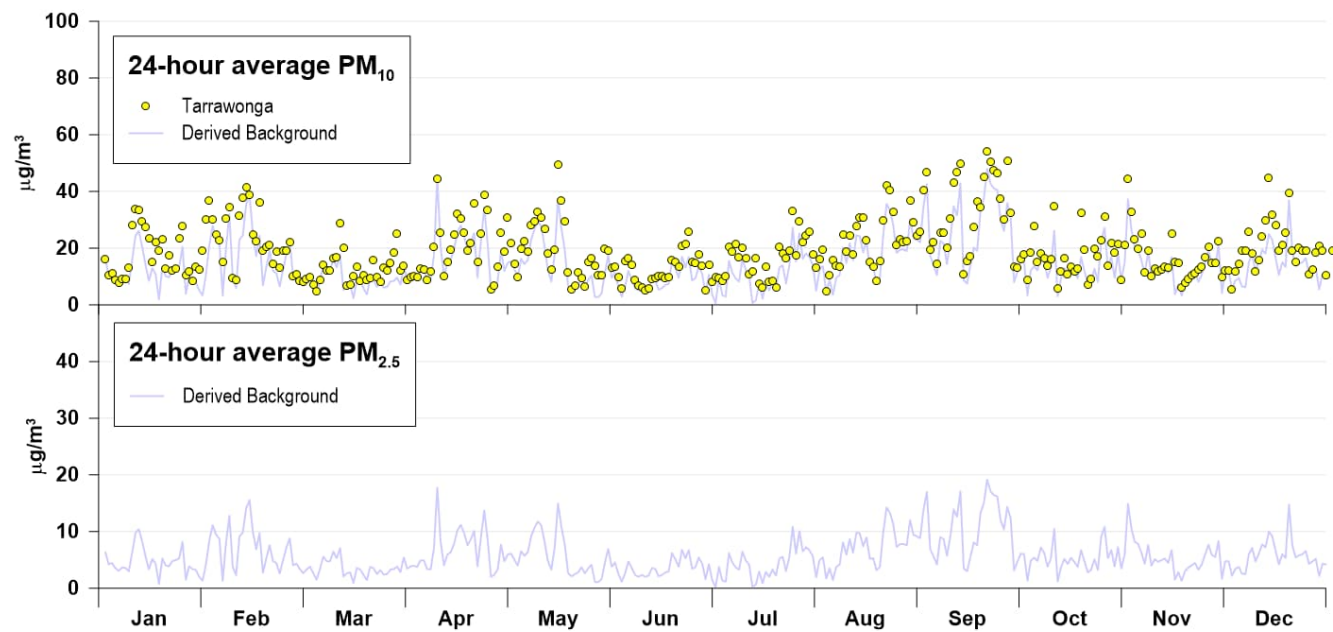


Figure 11 Background PM_{10} and $\text{PM}_{2.5}$ concentrations as inferred from the measurement data

5 Assessment Methodology

The air quality assessment has followed the procedures outlined in the Approved Methods (EPA, 2022). The Approved Methods include guidelines for the preparation of meteorological data, reporting requirements and air quality assessment criteria to assess the significance of expected impacts. Specific methodologies for each of the identified key issues (from Section 2) are described below.

5.1 Mining Dust

Operational dust has been quantified by modelling. The choice of model has considered the expected transport distances for the emissions, as well as the potential for temporally and spatially varying flow fields due to influences of the locally complex terrain, non-uniform land use, and potential for stagnation conditions characterised by calm or very low wind speeds with variable wind directions. The CALPUFF model was selected for this purpose. This model is listed in the Approved Methods and has been used to predict ground-level particulate matter concentrations and deposition levels due to the BCM and other sources. Concentrations and deposition levels have been simulated for every hour of the representative year and results at the surrounding private sensitive receptors have then been compared to the relevant air quality assessment criteria.

Figure 12 shows an overview of the model inputs and outputs. Appendix B provides details of all model settings.

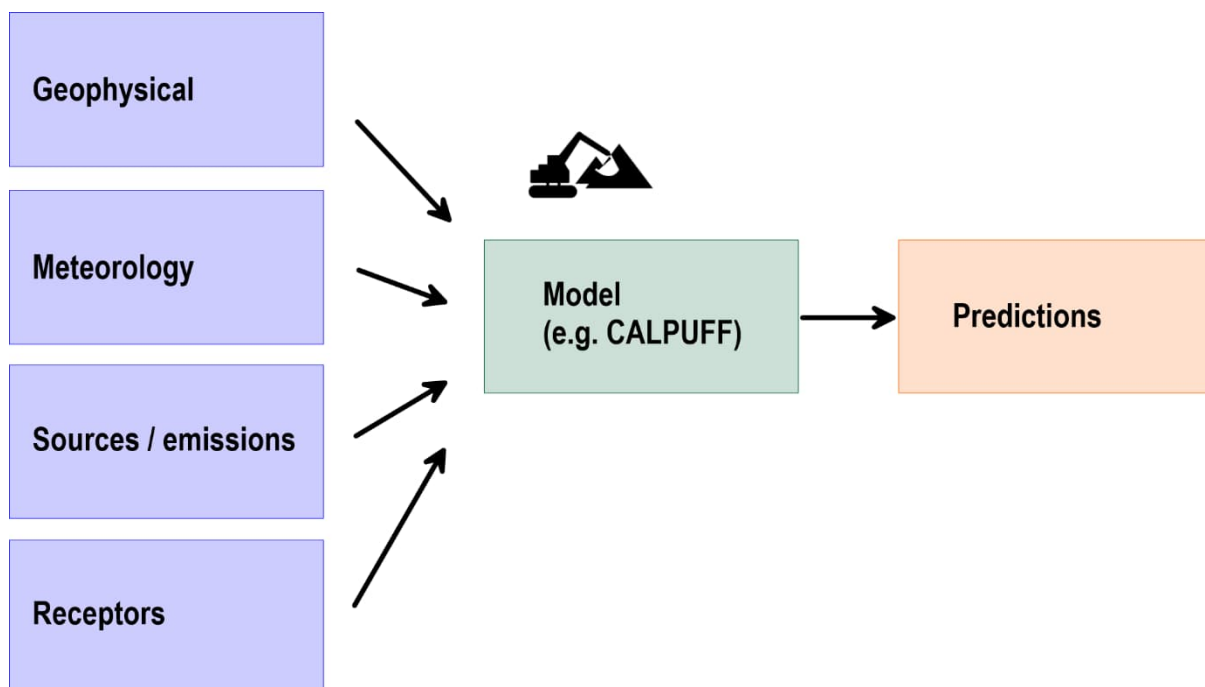


Figure 12 Overview of model inputs and outputs

Dust (particulate matter) is the most significant emission to air from the BCM and estimates of dust emissions are required by the dispersion model. Total dust emissions have been estimated for the proposed activities using the material handling schedule, equipment listing, and site layout plans combined with emission factors from:

- “Emission Estimation Technique Manual for Mining” (NPI, 2012); and
- AP 42 (US EPA 1985 and updates).

The BCM production schedule and equipment usage forecasts have been used to identify a range of future operational years to be assessed. Figure 13 shows the estimated ROM coal and overburden movements from the BCM over the life of MOD 10. There are no specific guidelines or procedures which define an adequate level of information to demonstrate that selected scenarios are representative of worst-case impacts. The worst-case for one location may be different to the worst-case for another location so it is important to consider scenarios of mining at various locations and intensities as well as potential for cumulative effects with other existing or approved operations.

Three future operational scenarios have been selected; 2025, 2028 and 2036. These three scenarios address the periods of anticipated maximum material handling quantities, maximum haul distances, varying proximities to local communities, and combined interactions

with other approved mining operations. A scenario for a historical, representative year (2017) was also developed to quantify recent contributions of the three mining operations to air quality and to establish background levels.

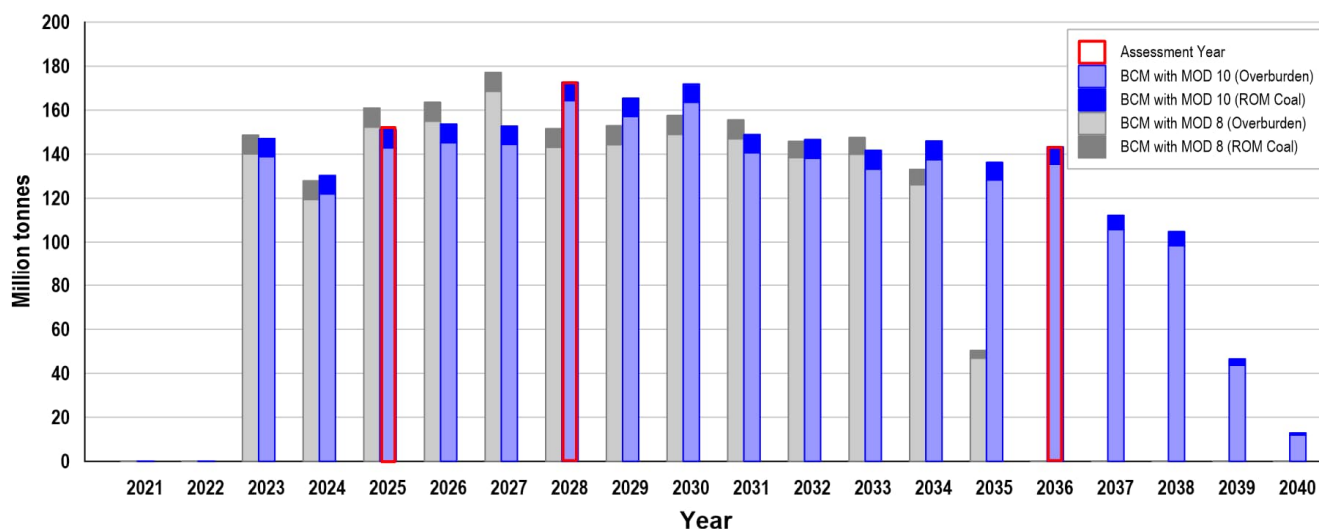


Figure 13 Estimated ROM coal and overburden movements from the BCM

The modelling has considered contributions from the BCM as well as from the surrounding mining operations. Table 12 shows the assumed ROM coal production data from each operation in the model domain. The data for 2017 were derived from the Annual Reviews produced by each mining operation and available on their respective websites. The Annual Reviews also included overburden handling quantities and plans showing the active mining locations which are important for determining site dust emissions.

The data for future mining scenarios were sourced from publicly available materials including relevant assessment documents (i.e. Environmental Assessments [EAs], Environmental Impact Statement [EIS] etc.) for the existing and approved operations. These data have been included in the model for future mining scenarios to reflect the current approved life and maximum approved production limit in accordance with the planning approvals in place at the time of completing this assessment. Estimated production quantities for the BCM were provided by BCOPL.

Table 12 Assumed ROM coal production from each mining operation in the model domain

Operation	ROM coal production (Mtpa)			
	2017	2025	2028	2036
Boggabri Coal Mine (SSD 09_0182) as approved	8.0	8.6	8.6	8.6
Boggabri Coal Mine with MOD 10	-	8.2	8.6	7.9
Maules Creek Mine (PA 10_0138) approved to end 2035*	10.5	13.0	13.0	-
Tarrawonga Mine (PA 11_0047) approved to end 2030*	1.9	3.5	3.5	-

* It is noted that an application for the Maules Creek Mine Continuation Project has recently been submitted to the DPHI. The modelling has considered operations (Maules Creek and Tarrawonga) as currently approved.

Table 13, Table 14 and Table 15 summarise the estimated annual TSP, PM₁₀ and PM_{2.5} emissions, respectively, due to the BCM as well as all other operating, or assumed to be operating, mines in the model domain. The 2028 scenario has been calculated to produce the highest dust emissions. This is largely due to the anticipated production, longer haul distances and more exposed areas of land (not fully rehabilitated) in 2028. It should be noted that the main intent of the inventories was to capture the most significant emission sources that may affect off-site air quality. Not every source will be captured. However, the contribution of emissions from sources not identified will be captured in the air quality monitoring data and these data have been added to the predicted mining contributions. Full details on the emission calculations, including assumptions, emission controls and allocation of emissions to modelled locations are provided in Appendix C.

Table 13 Estimated TSP emissions

Operation	Annual TSP emissions (kg/y)			
	2017	2025	2028	2036
Boggabri Coal Mine (SSD 09_0182) as approved	4,749,815	-	-	-
Boggabri Coal Mine with MOD 10	-	6,354,628	6,492,094	5,572,136
Maules Creek Mine (PA 10_0138) approved to end 2035	4,934,897	5,688,863	5,688,863	-
Tarrawonga Mine (PA 11_0047) approved to end 2030	1,497,140	2,134,462	2,134,462	-

Table 14 Estimated PM₁₀ emissions

Operation	Annual PM ₁₀ emissions (kg/y)			
	2017	2025	2028	2036
Boggabri Coal Mine (SSD 09_0182) as approved	1,588,516	-	-	-
Boggabri Coal Mine with MOD 10	-	2,106,275	2,186,049	1,893,683
Maules Creek Mine (PA 10_0138) approved to end 2035	1,661,388	1,887,563	1,887,563	-
Tarrawonga Mine (PA 11_0047) approved to end 2030	515,381	719,323	719,323	-

Table 15 Estimated PM_{2.5} emissions

Operation	Annual PM _{2.5} emissions (kg/y)			
	2017	2025	2028	2036
Boggabri Coal Mine (SSD 09_0182) as approved	225,482	-	-	-
Boggabri Coal Mine with MOD 10	-	326,642	337,261	294,550
Maules Creek Mine (PA 10_0138) approved to end 2035	228,406	253,214	253,214	-
Tarrawonga Mine (PA 11_0047) approved to end 2030	83,344	107,021	107,021	-

As noted above, emission estimates for 2017 were based on the production and material handling quantities contained in the respective Annual Reviews. Estimates for future years were based on the maximum approved production rates as per the relevant planning approvals. The model predictions will likely over-state actual impacts as, based on historical data, the mines are not likely to operate at their maximum approved production rate in each year.

Emissions from other mining operations (MCCM and TCM) were important for quantifying the potential cumulative impacts. Two approaches were considered for estimating emissions from other mining operations. These approaches included:

- Deriving emission estimates from previously published EIS data; or
- Recalculating emissions from other mines in the model domain specifically for this assessment.

The approach of recalculating emissions from other mining operations in the model domain has been chosen for this assessment. This approach has been favoured because it maintains consistency in the emission calculation methods for all mining operations. It also has the following advantages over recent EIS data:

- TSP, PM₁₀ and PM_{2.5} can be separated for each activity for each mining operations. To date, many EIS air quality assessments have only calculated TSP emissions, with PM₁₀ and PM_{2.5} emissions derived from regional ratios such as those published by the SPCC (1986).
- The proportions of wind sensitive, wind insensitive and wind erosion activities can be more accurately defined. Historical assessments have often applied fixed ratios of these three activity types, usually based on information from the Mt Arthur Mine EIS (URS, 2000). The ratios can be made more specific to the operation than these historical data.
- Pit retention can be modelled, and the adjusted emissions can be made specific to each activity and the hourly wind speed.
- Triggered control factors can be modelled. For example, the effect of rainfall for suppressing dust from exposed areas can be simulated for relevant hours in the year.

There are also disadvantages to the approach of recalculating emissions from other mines. The main disadvantages are potential inconsistencies between the emission estimates and other published EIS emissions data, and the inability to precisely match source locations to future mine plans. However, Section 6 outlines that the emission estimation approach combined with model setup assumptions has produced results which do not underestimate average concentrations at key sensitive receptor locations.

There will be operational controls in place at the BCM which will also have a direct effect on emissions to air. Specifically, BCOPL is committed to the continued implementation of operational controls during adverse weather conditions to minimise air quality impacts, as per Section 5.4 of the approved Air Quality and Greenhouse Gas Management Plan (AQGGMP) (BCOPL, 2018) and Schedule 3 Condition 30 (d) of SSD 09_0182. The operational controls will result in reduced levels of activity at the BCM relative to the capacity considered as part of the current air quality modelling. In practice these operational controls, which will vary daily, will lead to lower emissions to air than for unconstrained activities. Consequently, the estimated emissions in Table 13, Table 14 and Table 15 should represent conservative estimates, as these further detailed operational controls are not included, and it follows that the predicted impacts of MOD 10 will also be conservative. That is, the predicted impacts are likely to over-state actual impacts to some extent.

Mining operations were represented by a series of volume sources according to the location of the activities. Emissions from the dust generating activities were assigned to one or more source locations (refer to Appendix C for details of the allocations).

Dust emissions for all modelled operational and construction-related sources have been considered to fit in one of the following three categories:

- Wind insensitive sources, where emissions are relatively insensitive to wind speed (for example, dozers).
- Wind sensitive sources, where emissions vary with the hourly wind speed, raised to the power of 1.3, a generic relationship published by the US EPA (1987). This relationship has been applied to sources such as loading and unloading of material to/from trucks and results in increased emissions with increased wind speed.
- Wind sensitive sources, where emissions also vary with the hourly wind speed, but raised to the power of 3, a generic relationship published by Skidmore (1998). This relationship has been applied to sources including wind erosion from stockpiles or emplacement areas, and results in increased emissions with increased wind speed.

Emissions from each volume source were developed on an hourly time step, considering the level of activity at that location and, in some cases, the hourly wind speed. This approach ensured that light winds corresponded with lower dust generation and higher winds, with higher dust generation.

Blasting activities and associated emissions were assumed to take place only during daylight hours (9 am to 5 pm for the purposes of the modelling) while all other activities have been modelled for 24 hours per day.

Pit retention (that is, retention of dust particles within the open pits) has been included in the model simulations. The pit retention calculation determines the fraction of dust emitted in the pit that may escape the pit. The “escaped fraction” is a function of the gravitational settling velocity of the particles and the wind speed and is shown by the following relationship (US EPA, 1995).

Equation 1:

$$\varepsilon = \frac{1}{\left(1 + \frac{v_g}{(\alpha U_r)}\right)}$$

where:

ε = escaped fraction for the particle size category

V_g = gravitational settling velocity (m/s)

U_r = approach wind speed at 10 m (m/s)

α = proportionality constant in the relationship between flux from the pit and the product of U_r and concentration in the pit (0.029)

To model the effect of pit retention, the emissions from mining sources within the open pits have been reduced by the calculation above. This approach means that much of the coarser dust would remain trapped in the pits. Typically, five per cent of the PM₁₀ emissions are trapped in the pit using this calculation but application of Equation 1 means that emissions can be more dependent on the changing wind speeds.

Finally, the model predictions at identified sensitive receptors were then compared with the EPA air quality criteria, previously discussed in Section 3. Contour plots have also been created to show the spatial distribution of model predictions. Section 6.1 provides the assessment of dust.

5.2 Diesel Exhaust

The main emissions from diesel exhausts are products of combustion including CO, NO_x, PM₁₀ and PM_{2.5}. It is the NO_x, or more specifically NO₂, and PM₁₀ (including PM_{2.5}) which have been assessed. DPHI monitoring data have shown that CO concentrations have not exceeded relevant air quality criteria at rural or urban monitoring stations in NSW, including near busy roads, so CO will not be an issue for vehicle movements associated with the BCM.

The modelling for operational dust (Section 5.1) has considered emission factors that represent the contribution from both wheel-generated particulates and the exhaust particulates. These emission factors, including relevant control factors, are based on measured emissions which included diesel particulates in the form of both PM₁₀ and PM_{2.5}.

Table 16 provides estimates of PM₁₀ and PM_{2.5} emissions due only to diesel plant and equipment exhausts at the BCM, which are based on fuel consumption data provided by BCOPL. Emission factors for "Industrial off-road vehicles and equipment" from the EPA's 2008 Air Emissions Inventory (EPA, 2012) were used for the calculations. These factors relate to diesel exhaust and evaporative emissions.

Table 16 Estimated PM₁₀ and PM_{2.5} emissions from diesel engines

Parameter	Value
Estimated maximum annual fuel usage from BCM with MOD 10 between 2025 and 2040 (kL/y)	85,676
PM ₁₀ calculations	
Diesel exhaust emission factor (kg/kL)	2.84
Diesel exhaust emission (all equipment) (kg/y)	243,320
PM _{2.5} calculations	
Diesel exhaust emission factor (kg/kL)	2.75
Diesel exhaust emission (all equipment) (kg/y)	235,609

Emissions of NO_x from diesel exhausts have been estimated using fuel consumption data, provided by BCOPL, and an emission factor from the EPA's Air Emissions Inventory for 2008 (EPA, 2012). Table 17 shows the calculations.

Table 17 Estimated NO_x emissions from diesel engines

Parameter	Value
Estimated maximum annual fuel usage from BCM with MOD 10 between 2025 and 2040 (kL/y)	85,676
NO _x calculations	
Diesel exhaust emission factor (kg/kL)	40.77
Diesel exhaust emission (all equipment) (kg/y)	3,493,011

The NO_x emission estimates from Table 17 have been modelled to provide an indication of the off-site NO₂ concentrations due to diesel exhaust emissions. Section 6.2 provides the assessment of diesel exhaust.

5.3 Post Blast Fume

Blasting activities have the potential to result in fume and particulate matter emissions. Particulate matter emissions from blasting are produced from the modelling discussed in Section 5.1. Post-blast fume has also been quantified by modelling.

The methodology for the operation post-blast fume modelling is outlined below:

- Blasts modelled as a single volume source in a location indicative of the centre of BCM.
- Release heights of 20 m, effective plume heights of 40 m, initial horizontal spread (sigma y) of 25 m and initial vertical spread (sigma z) of 10 m. These are conservative estimates based on the data presented by Attalla et al. (2008). No plume rise due to buoyancy was modelled, which is again a conservative assumption.
- Emissions assumed to occur every hour between 9 am and 5 pm.
- Blasting could be on any day of the week, a conservative assumption as, in accordance with SSD 09_0182, blasting cannot occur on Sundays or public holidays unless written approval is obtained from the Secretary.

- NO_x emissions based on data presented in the Queensland Guidance Note for the management of oxides in open cut blasting (DEEDI, 2011). It was conservatively assumed that the initial NO₂ concentration in the plume would be 7 ppm (14.4 mg/m³) based on the Rating 2 Fume Category in the Queensland Guidance Note. Of the 123 blasts that occurred in 2024, 85% were rated as category 0, 11% were rated as category 1, 4% were rated as category 2, and 0% were rated as category 3. The assumption of a blast fume rating of 2 for every hour is therefore very conservative.
- The initial NO₂ concentration in the plume was converted to a total NO_x emission rate based on a detailed measurement program of NO_x in blast plumes in the Hunter Valley made by Attalla et al. (2008) which found that the NO:NO₂ ratio was typically 27:1, giving a NO_x:NO₂ ratio of approximately 18.6 g NO_x/g NO₂.
- Calculated emission of 356 g/s of NO_x per blast and an emission release time of 5 minutes.
- 20% of the NO_x is NO₂ at the points of maximum 1-hour average concentrations and at sensitive receptors.

Model results for post-blast fume have been compared to the applicable EPA air quality criterion for NO₂; that is 164 µg/m³ as a 1-hour average and taking background levels into account. Section 6.2 provides the assessment of operational post blast fume.

6 Air Quality Assessment

6.1 Mining Dust

This section provides an assessment of MOD 10 in terms of mining dust, based on the methodology described in Section 5.1. Model results have been assessed for each of the key particulate matter classifications.

6.1.1 Particulate Matter (as PM₁₀)

Figure 14 shows the modelled maximum 24-hour average PM₁₀ concentrations due to BCM (including the changes sought by MOD 10) for each assessment scenario. The EPA does not prescribe a project only criteria for 24-hour average PM₁₀, but the VLAMP refers to 50 µg/m³ for the purposes of determining land acquisition and mitigation rights. The modelling shows that the 50 µg/m³ criterion would not be exceeded at any private sensitive receptor. In addition, the extent of the 50 µg/m³ contour is largely within the approved maximum extent, based on historical modelling for the operation, with the exception of a potential increase on Crown Land to the north-northeast. The air quality impacts of the BCM (including the changes sought by MOD 10) are also expected to be consistent with the originally approved development (MOD 7).

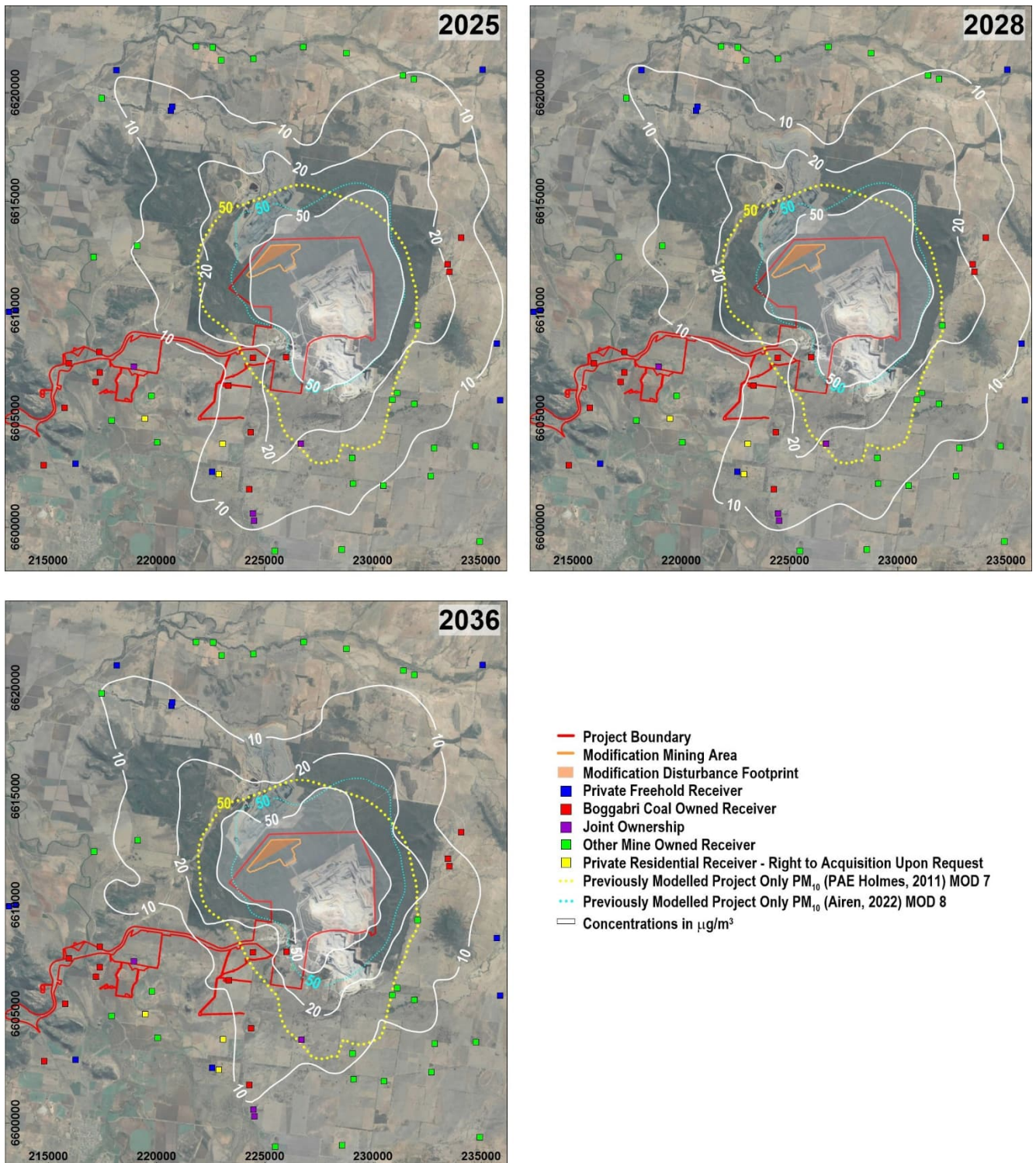
Figure 14 Modelled maximum 24-hour average PM₁₀ due to BCM

Figure 15 shows the modelled number of days above $50 \mu\text{g}/\text{m}^3$ due to BCM (with MOD 10), other mining operations and other sources of PM_{10} . These results show that, for a representative year, three private sensitive receptors (140, 147 and 165) are expected to experience in the order of one day when PM_{10} concentrations may exceed $50 \mu\text{g}/\text{m}^3$. While further investigation of the factors influencing this outcome has been carried out, the results are within the range of historically measured days when PM_{10} concentrations have exceeded $50 \mu\text{g}/\text{m}^3$, except for extraordinary years e.g. due to dust storms and bushfires. As noted in Section 4.3, most locations around Boggabri, and NSW, have historically recorded one or more days each year when the 24-hour average PM_{10} concentration exceeded $50 \mu\text{g}/\text{m}^3$.

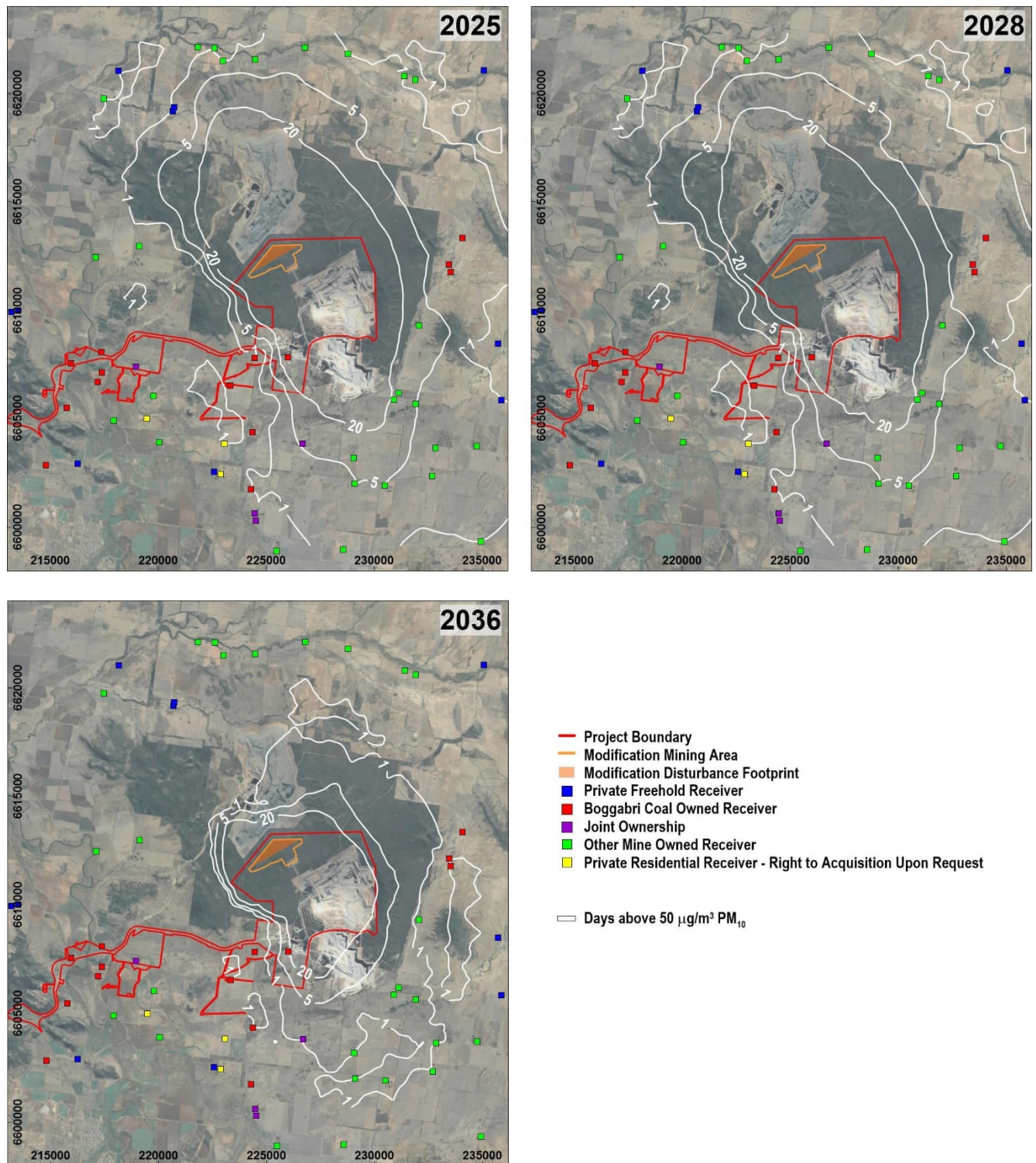


Figure 15 Modelled number of days above $50 \mu\text{g}/\text{m}^3 \text{PM}_{10}$ due to BCM and other sources

Further investigation of the potential for MOD 10 to cause an exceedance has been carried out. This involved examining contemporaneous background and mining contributions for each day in the modelling year; a “Level 2” assessment by the Approved Methods.

Figure 16 to Figure 18 show time series of 24-hour average PM_{10} concentrations for properties 140, 158 and 165 respectively. These are the three closest private sensitive receptors to BCM. The results show that concentrations would be well below $50 \mu g/m^3$ for most days of the year at each location. The modelling shows that it is only when background levels are approaching $50 \mu g/m^3$, due to other sources, that the BCM (with MOD 10) may influence an exceedance of $50 \mu g/m^3$, at property 140. In this scenario, the modelling indicates a very small ($<3 \mu g/m^3$) contribution from BCM. This risk can be managed through existing BCM air quality management measures, as described in Section 6.4.

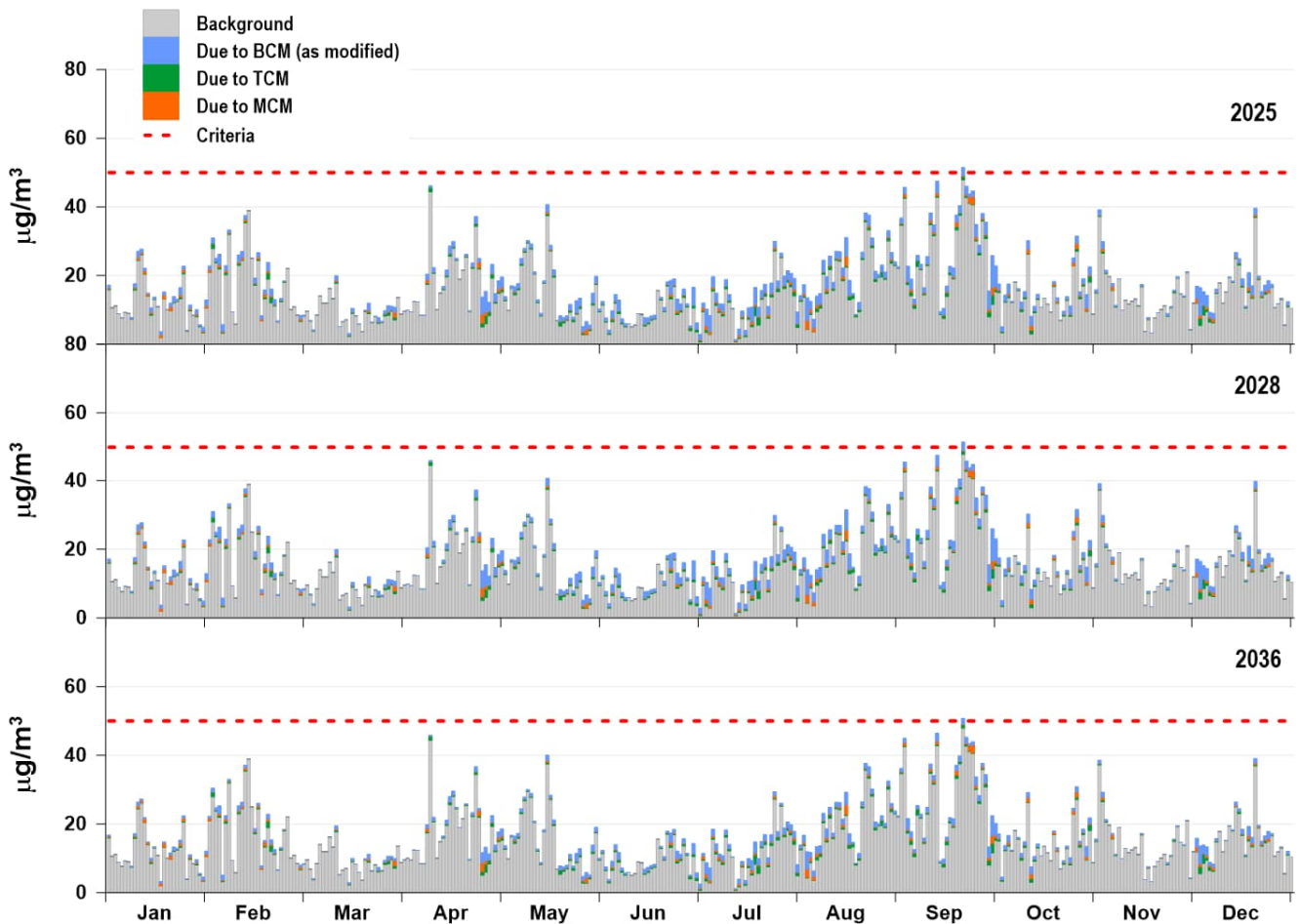


Figure 16 Time series of 24-hour average PM_{10} at receiver 140

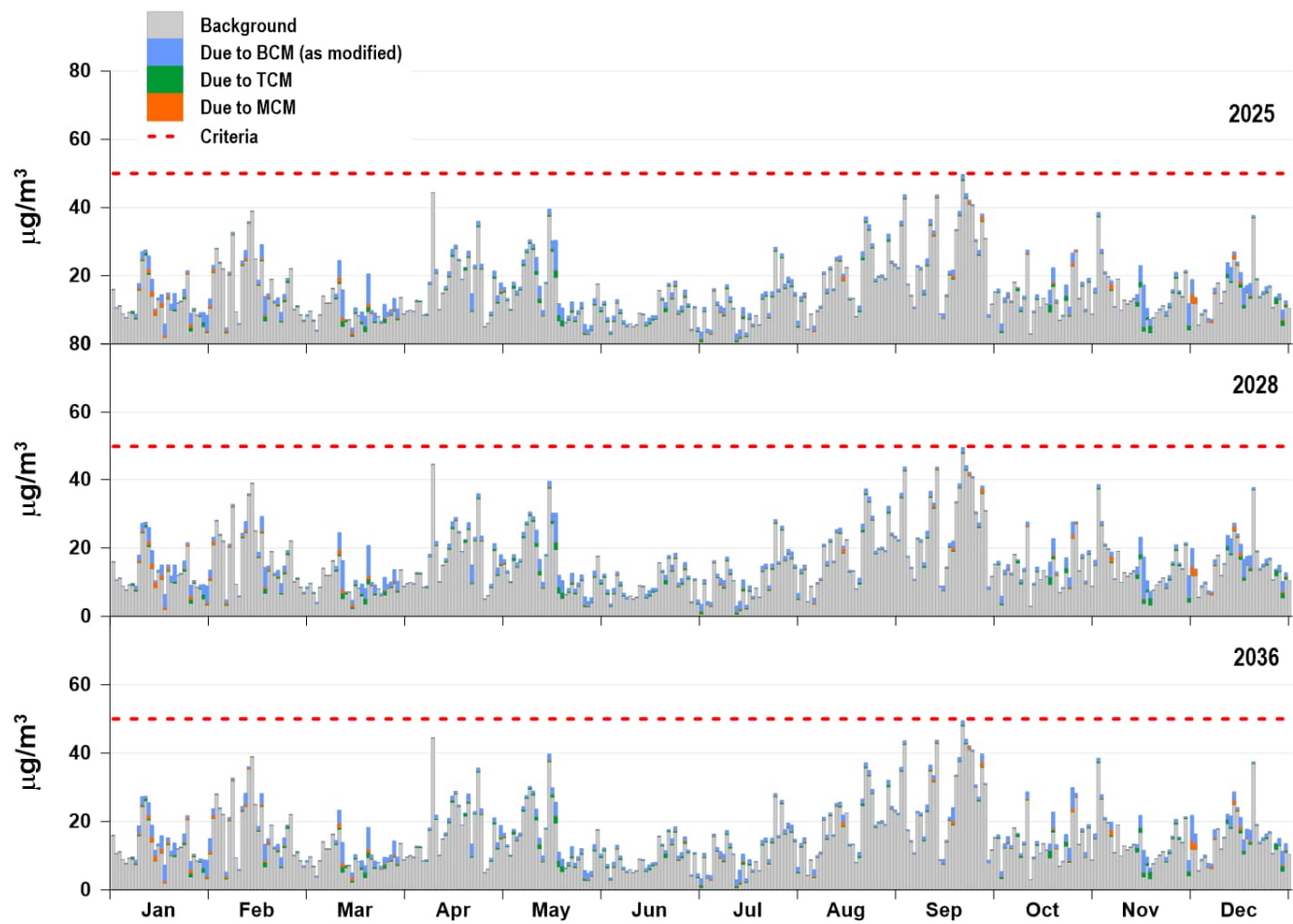


Figure 17 Time series of 24-hour average PM₁₀ at receiver 158

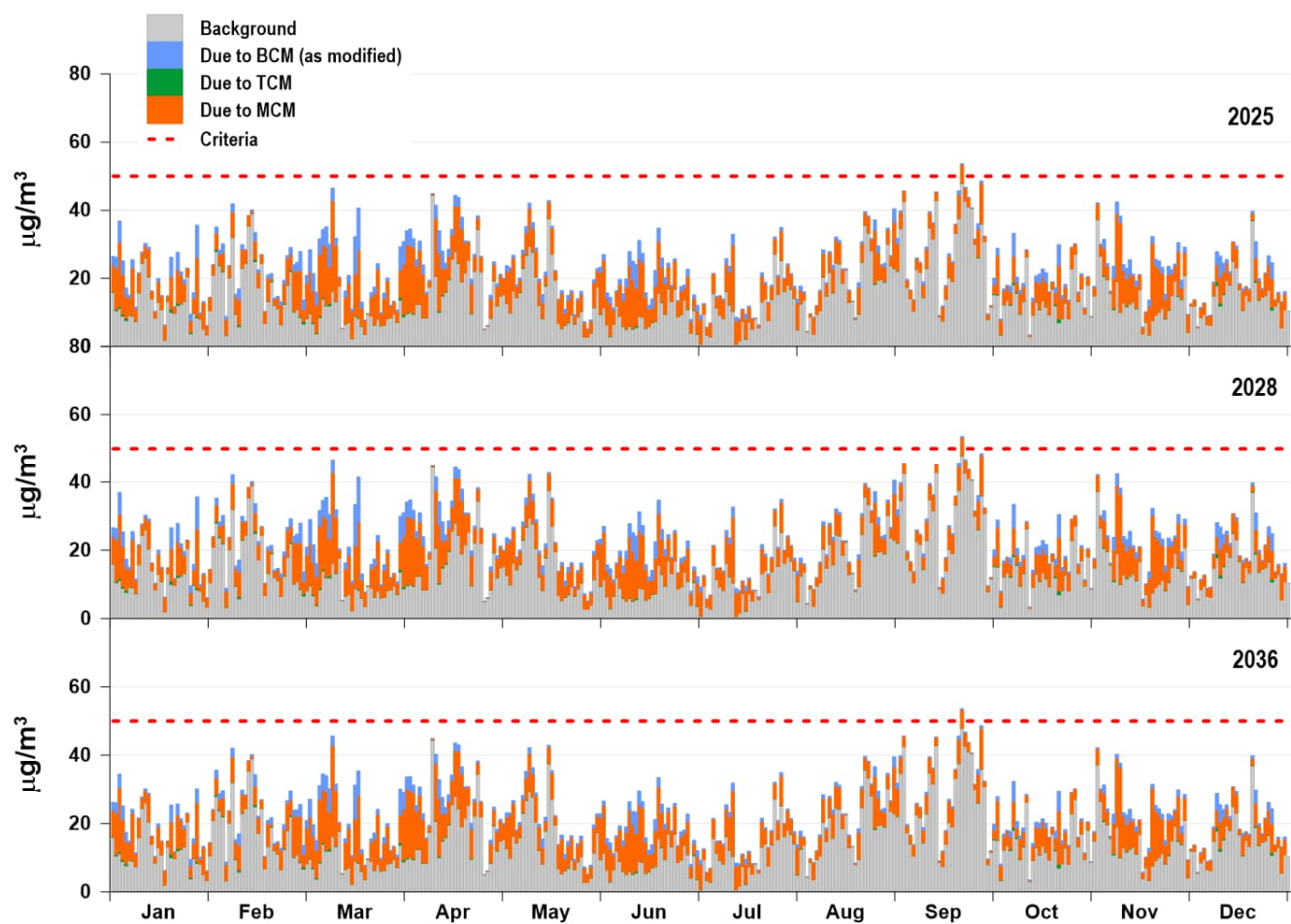


Figure 18 Time series of 24-hour average PM₁₀ at receiver 165

Figure 19 shows the modelled annual average PM₁₀ concentrations due to BCM (with MOD 10) for each assessment scenario. The EPA does not prescribe a project only criteria for annual average PM₁₀.

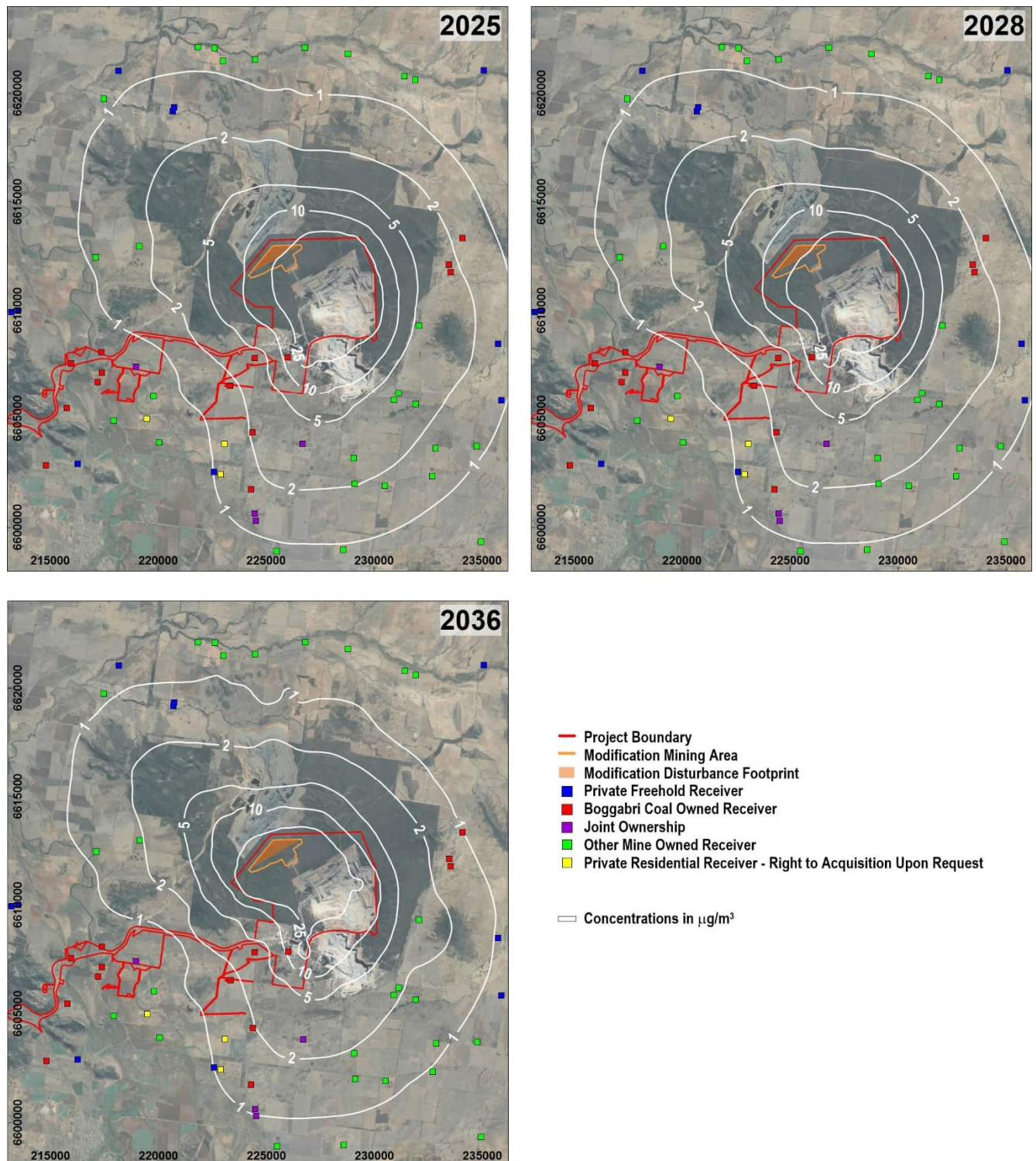


Figure 19 Modelled annual average PM₁₀ due to BCM

Figure 20 shows the modelled annual average PM₁₀ concentrations due to BCM (with MOD 10) and other sources of PM₁₀. These results indicate compliance with the EPA's assessment criterion for annual average PM₁₀ (25 µg/m³) at all private sensitive receptors. In addition, the extent of the 25 µg/m³ contour is within the approved maximum extent, based on historical modelling for the operation. The air quality impacts of the BCM (including the changes sought by MOD 10) are also expected to be consistent with the originally approved development (MOD 7).

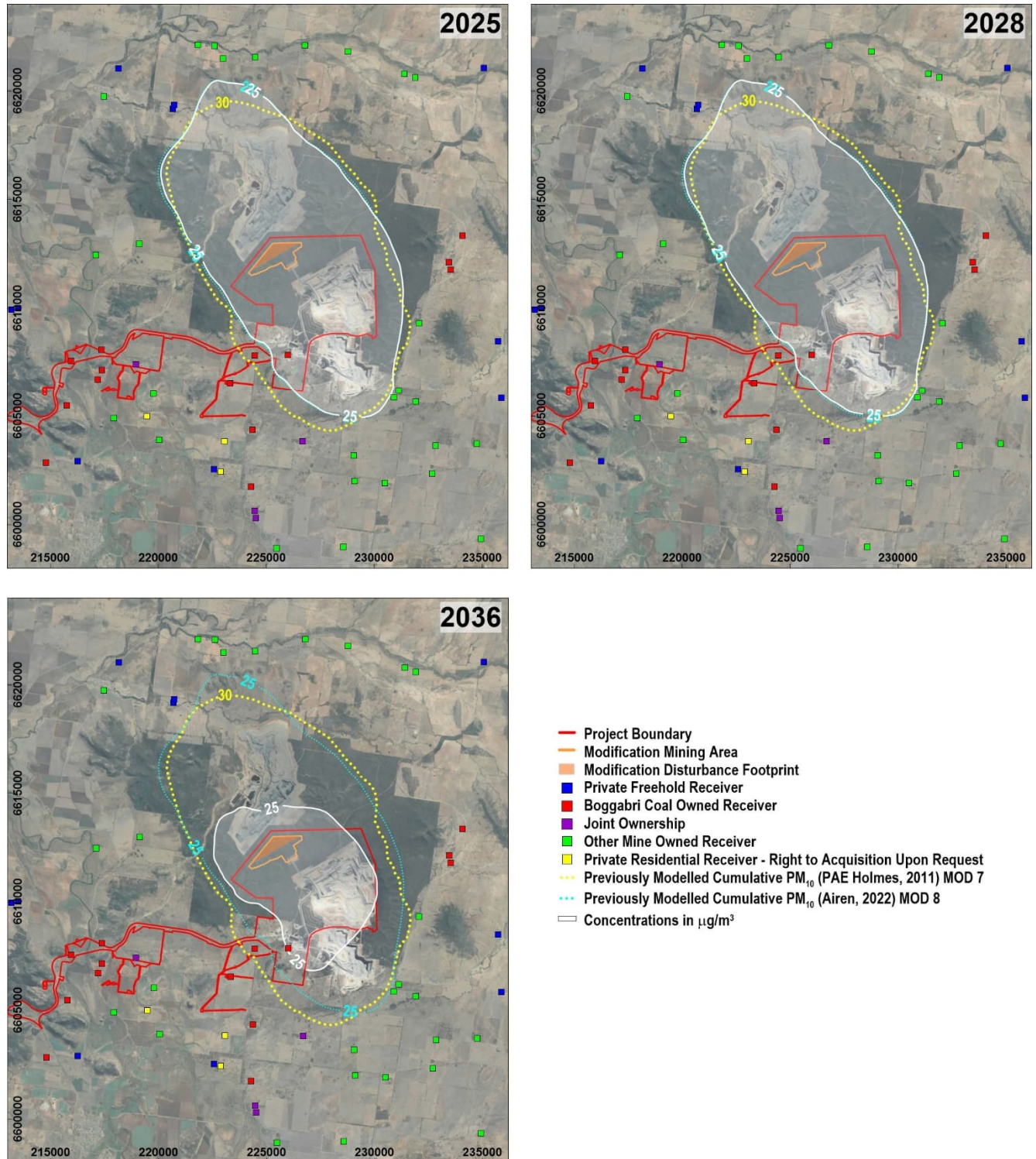


Figure 20 Modelled annual average PM₁₀ due to BCM and other sources

6.1.2 Particulate Matter (as PM_{2.5})

Figure 21 shows the modelled maximum 24-hour average PM_{2.5} concentrations due to BCM (with MOD 10) for each assessment scenario. The EPA does not prescribe a project only criteria for 24-hour average PM_{2.5}, but the VLAMP refers to 25 µg/m³ for the purposes of determining land acquisition and mitigation. The modelling shows that the 25 µg/m³ criterion would not be exceeded at any private sensitive receptor.

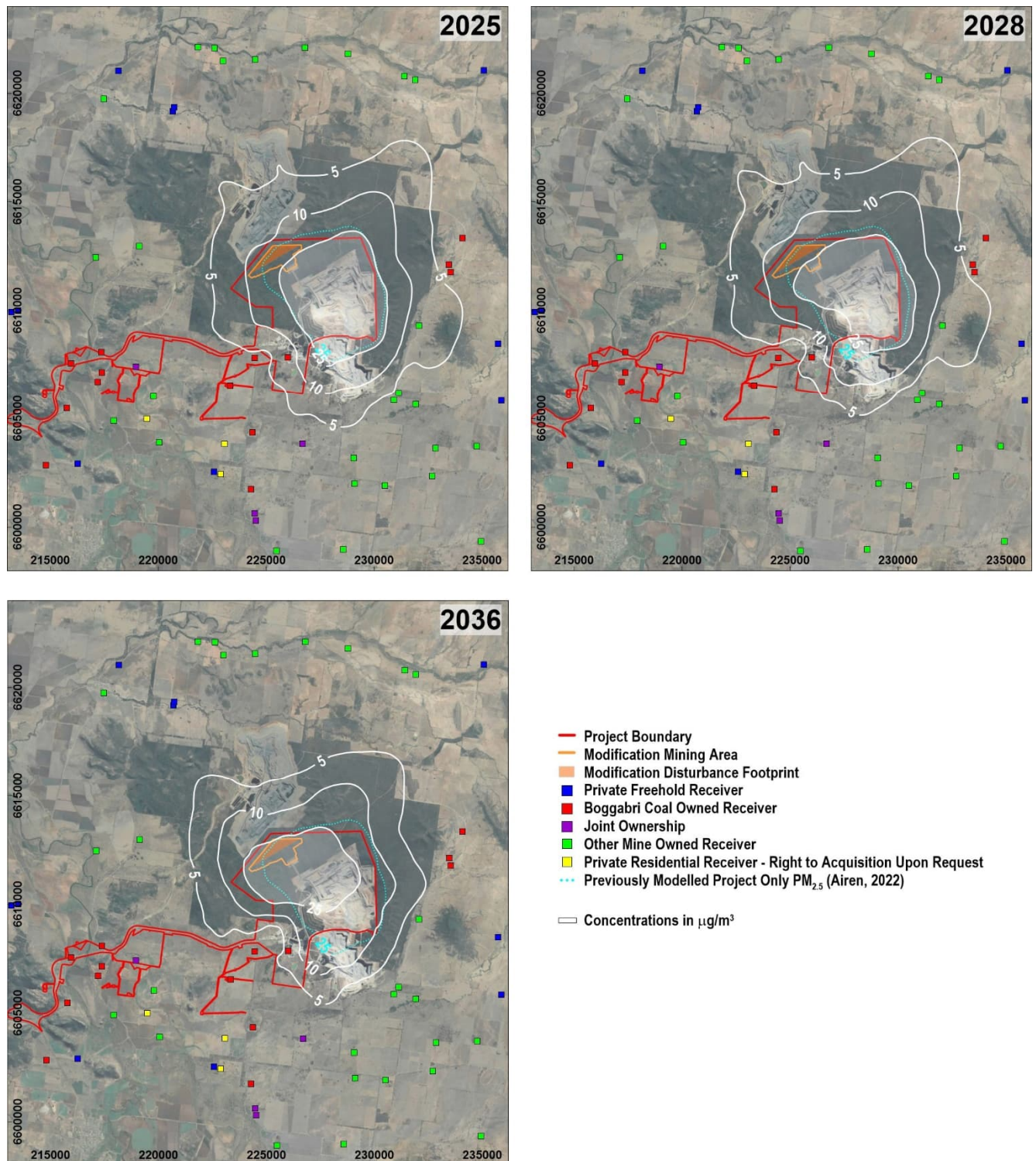


Figure 21 Modelled maximum 24-hour average PM_{2.5} due to BCM

Figure 22 shows the modelled number of days above $25 \mu\text{g}/\text{m}^3$ due to BCM (with MOD 10), other mining operations and other sources of $\text{PM}_{2.5}$. These results show that, for a representative year, the nearest private sensitive receptors are not expected to experience $\text{PM}_{2.5}$ concentrations above $25 \mu\text{g}/\text{m}^3$. However, based on historical monitoring data (Section 4.3) it is possible that $\text{PM}_{2.5}$ concentrations will exceed $25 \mu\text{g}/\text{m}^3$ at times due to other factors such as dust storms, bushfires and influences of drought.

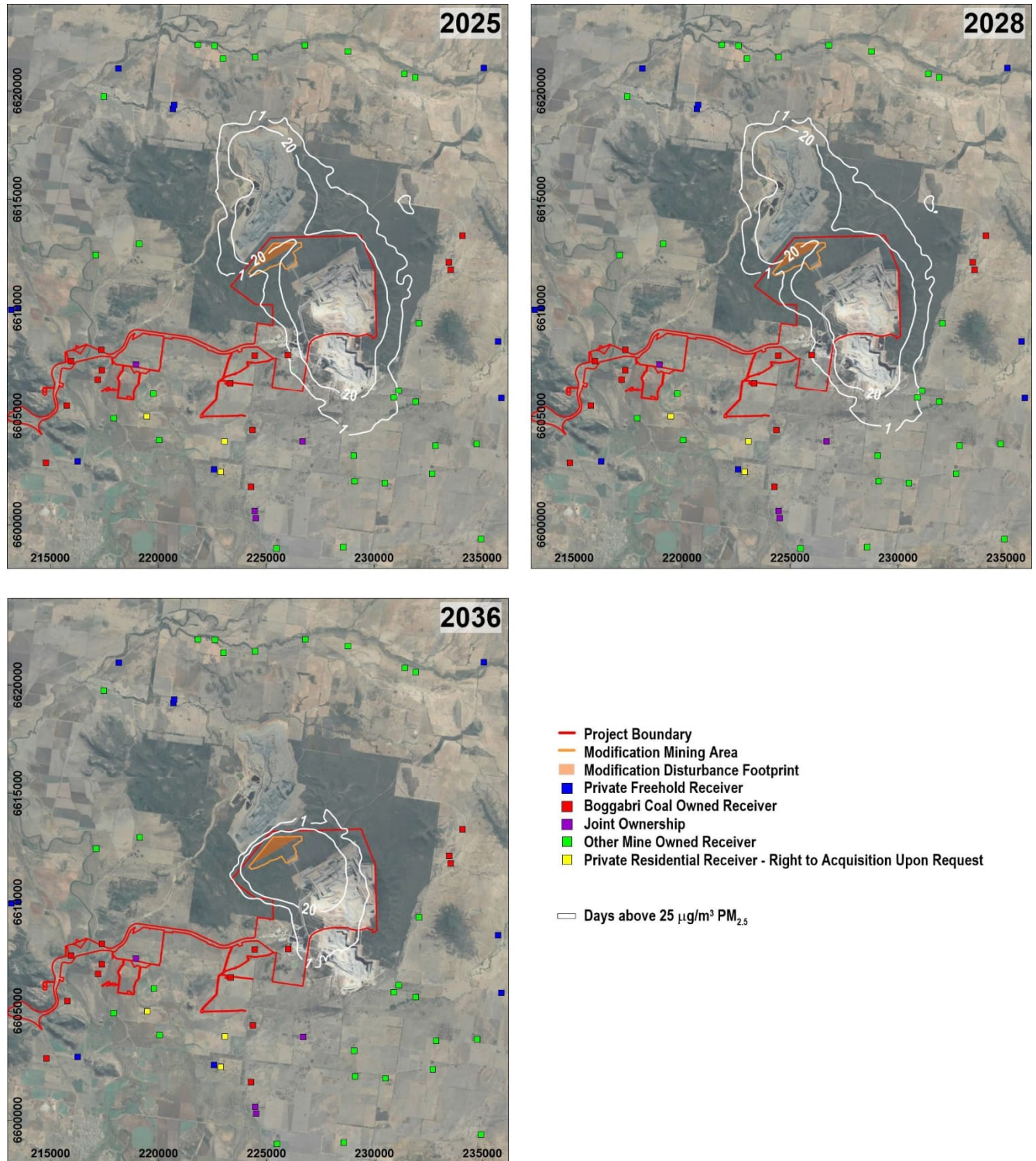


Figure 22 Modelled number of days above $25 \mu\text{g}/\text{m}^3$ $\text{PM}_{2.5}$ due to BCM and other sources

Figure 23 shows the modelled annual average PM_{2.5} concentrations due to BCM (with MOD 10). There are no applicable “project only” criteria but it is useful to note that the BCM is predicted to contribute no more than 1 µg/m³ at the nearest private sensitive receptors including properties 140, 147, 158 and 165 (including 165b).

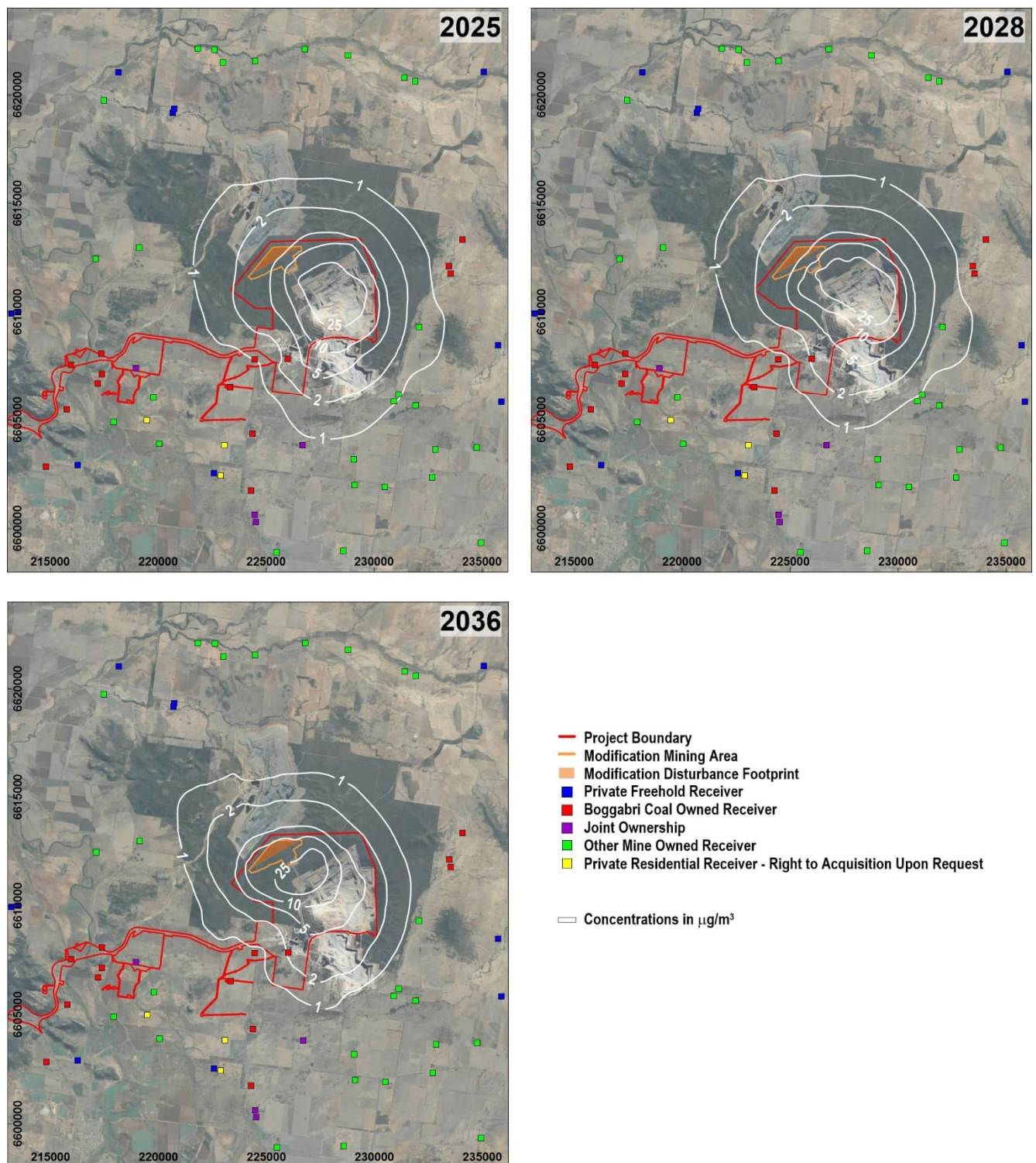


Figure 23 Modelled annual average PM_{2.5} due to BCM

Figure 24 shows the modelled annual average $PM_{2.5}$ concentrations due to BCM (with MOD 10), other mining operations and other sources of $PM_{2.5}$. These results show that the EPA's assessment criterion for annual average $PM_{2.5}$ ($8 \mu g/m^3$) will not be exceeded at private sensitive receptors including properties 140, 147, 158 and 165.

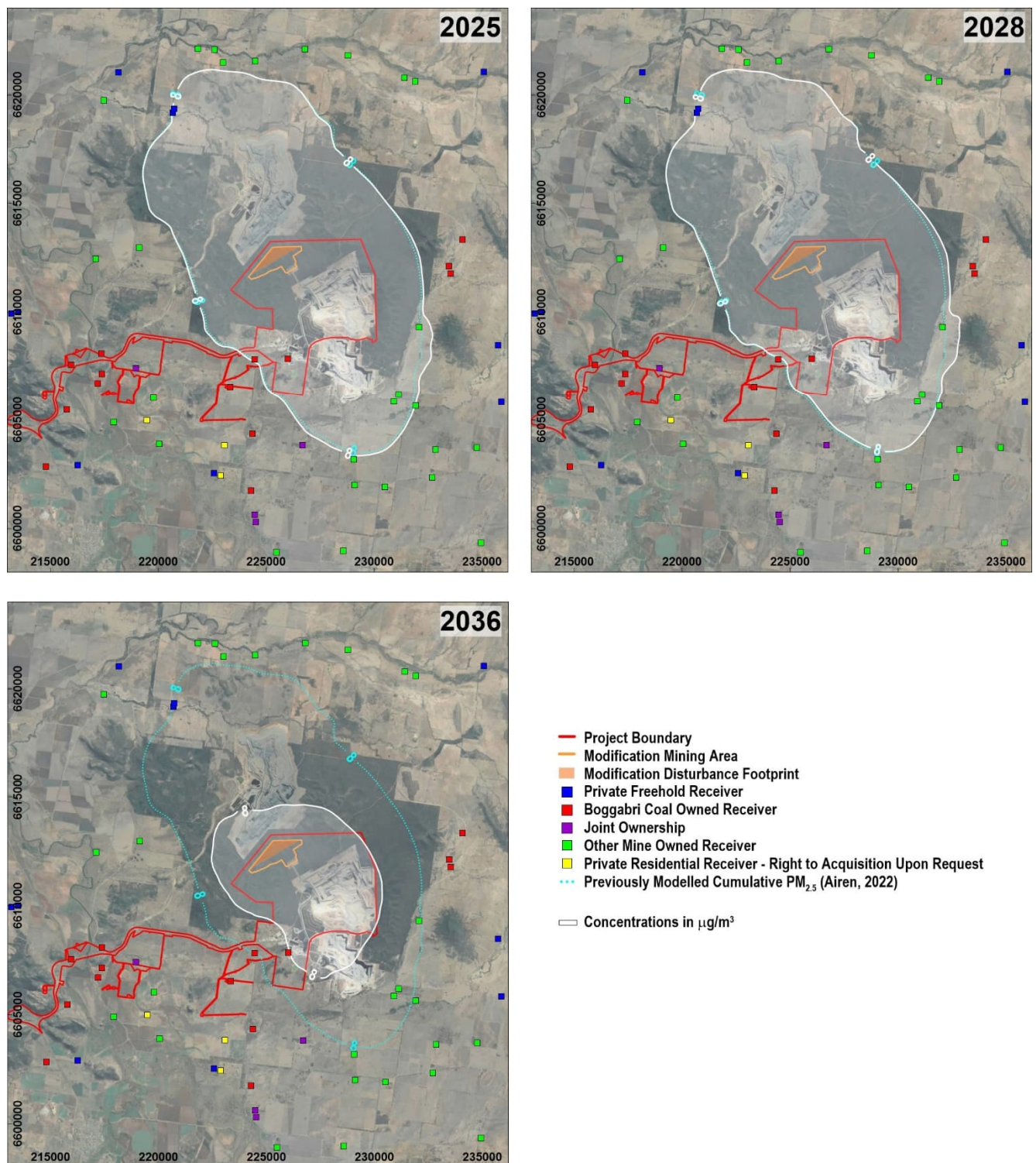


Figure 24 Modelled annual average $PM_{2.5}$ due to BCM and other sources

6.1.3 Particulate Matter (as TSP)

Figure 25 shows the modelled annual average TSP concentrations due to BCM (with MOD 10). There are no applicable “project only” criteria but it is useful to note that the BCM is predicted to contribute no more than $1 \mu\text{g}/\text{m}^3$ at the nearest private sensitive receptors.

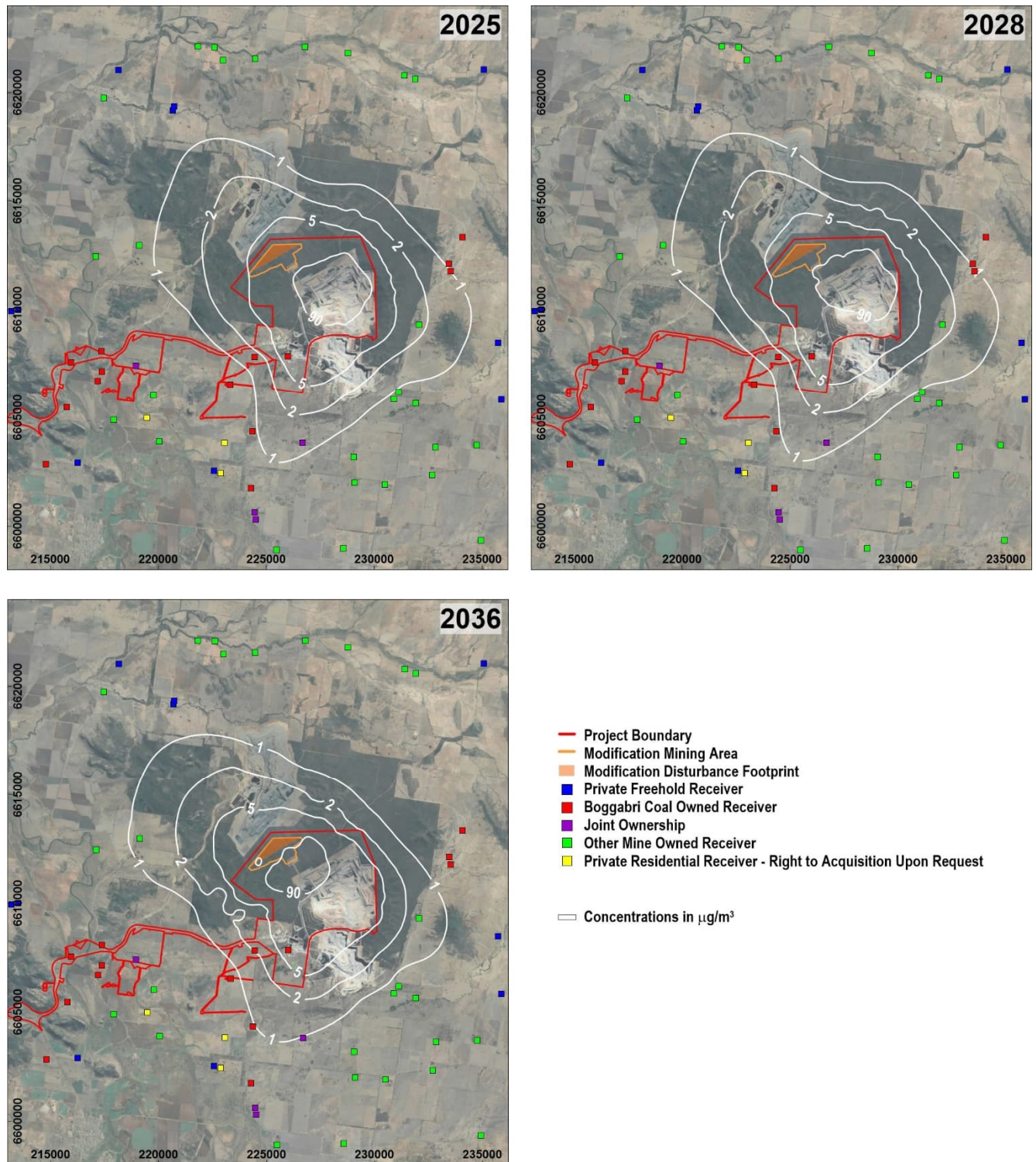


Figure 25 Modelled annual average TSP due to BCM

Figure 26 shows the modelled annual average TSP concentrations due to BCM (with MOD 10), other mining operations and other sources of TSP. These results show that the EPA's assessment criterion for annual average TSP ($90 \mu\text{g}/\text{m}^3$) will not be exceeded at private sensitive receptors. The air quality impacts of the BCM (including the changes sought by MOD 10) are also expected to be consistent with the originally approved development (MOD 7).

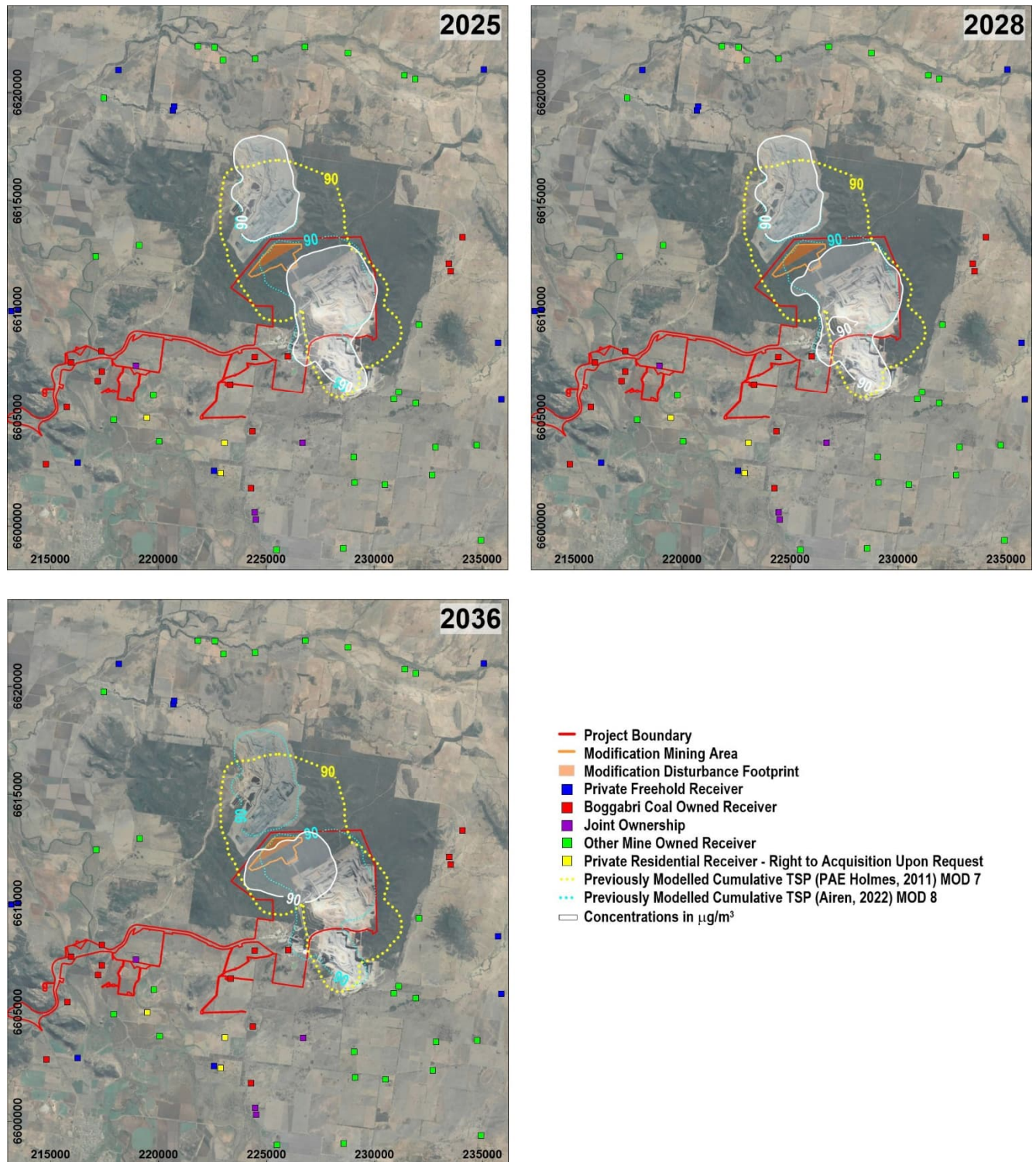


Figure 26 Modelled annual average TSP due to BCM and other sources

6.1.4 Deposited Dust

Figure 27 shows the modelled annual average deposited dust levels due to BCM (with MOD 10). These results have been assessed against the EPA's criteria of 2 g/m²/month (incremental). These results indicate compliance with the EPA's assessment criteria at all private sensitive receptors. The air quality impacts of the BCM (including the changes sought by MOD 10) are also expected to be consistent with the originally approved development (MOD 7).

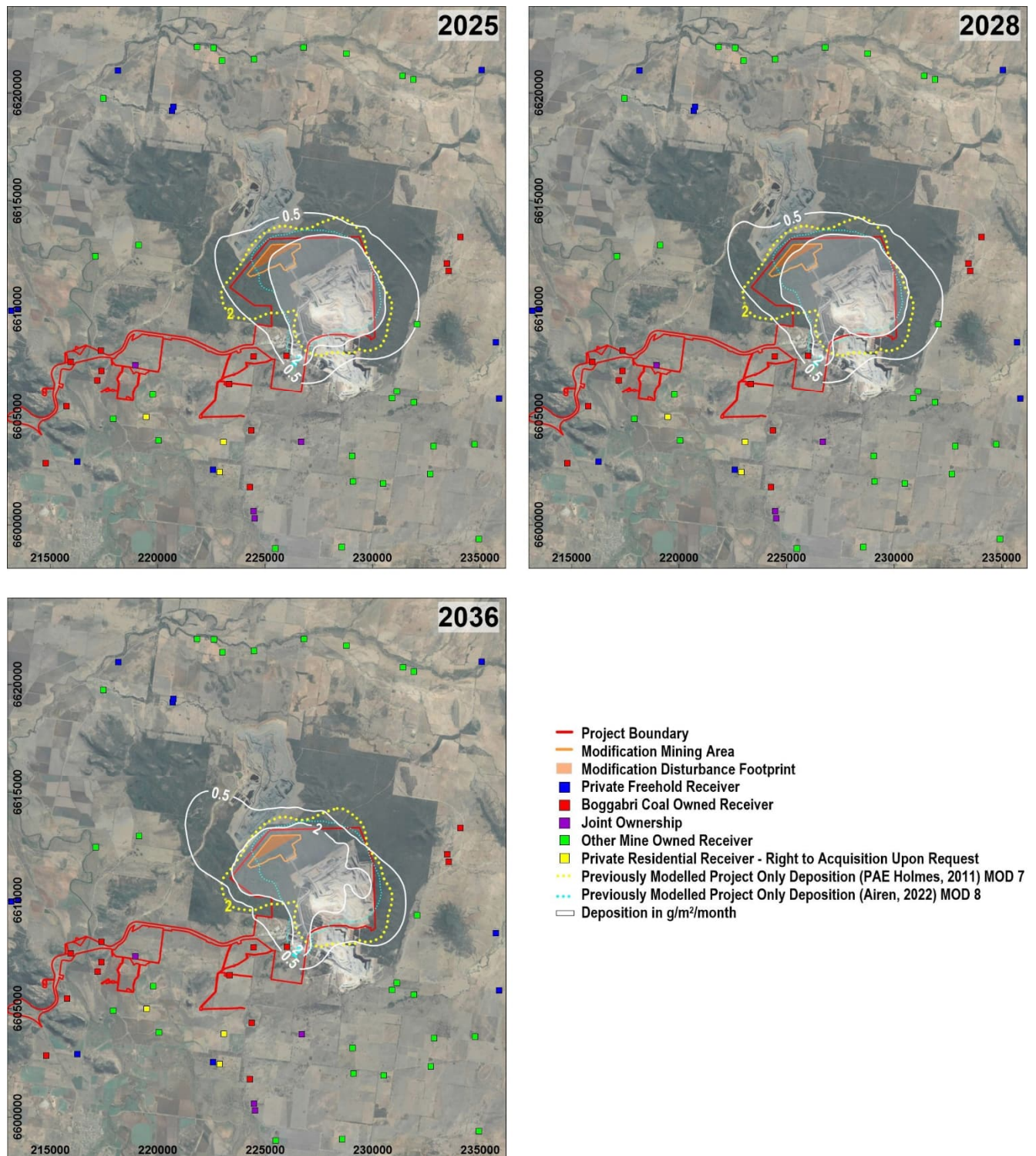


Figure 27 Modelled annual average deposited dust due to BCM

Figure 28 shows the modelled annual average deposited dust levels due to BCM (with MOD 10) and other sources. These results have been assessed against the EPA's criteria of 4 g/m²/month (cumulative). These results indicate compliance with the EPA's assessment criteria at all private sensitive receptors. The air quality impacts of the BCM (including the changes sought by MOD 10) are also expected to be consistent with the originally approved development (MOD 7).

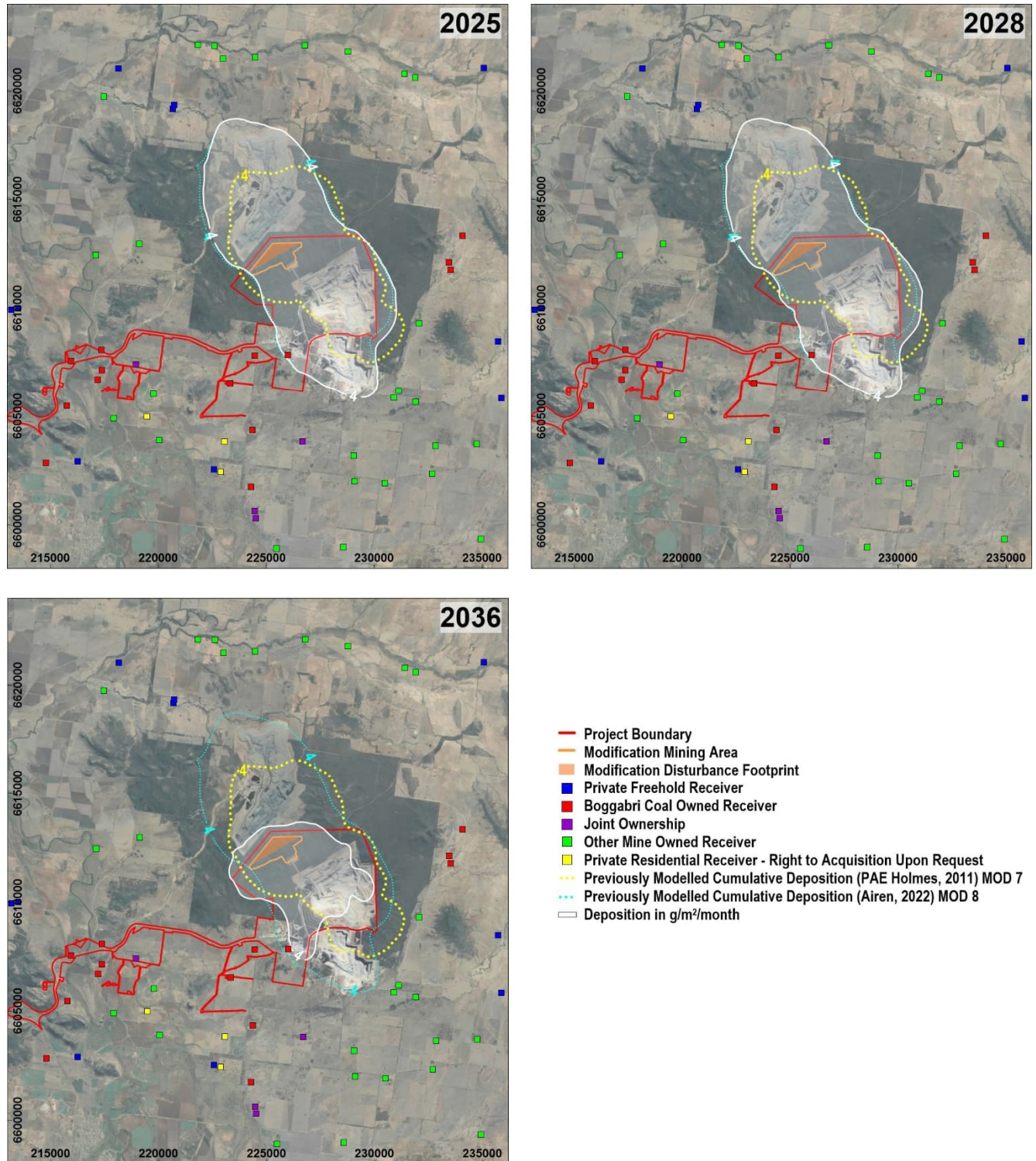


Figure 28 Modelled annual average deposited dust due to BCM and other sources

6.2 Diesel Exhaust

Figure 29 shows the modelled maximum 1-hour average NO₂ concentrations due to diesel exhaust emissions at BCM as well as from other sources, based on the conservative methodology outlined in Section 5.2. Compliance with the EPA's 164 µg/m³ criterion is expected at all private sensitive receptors.

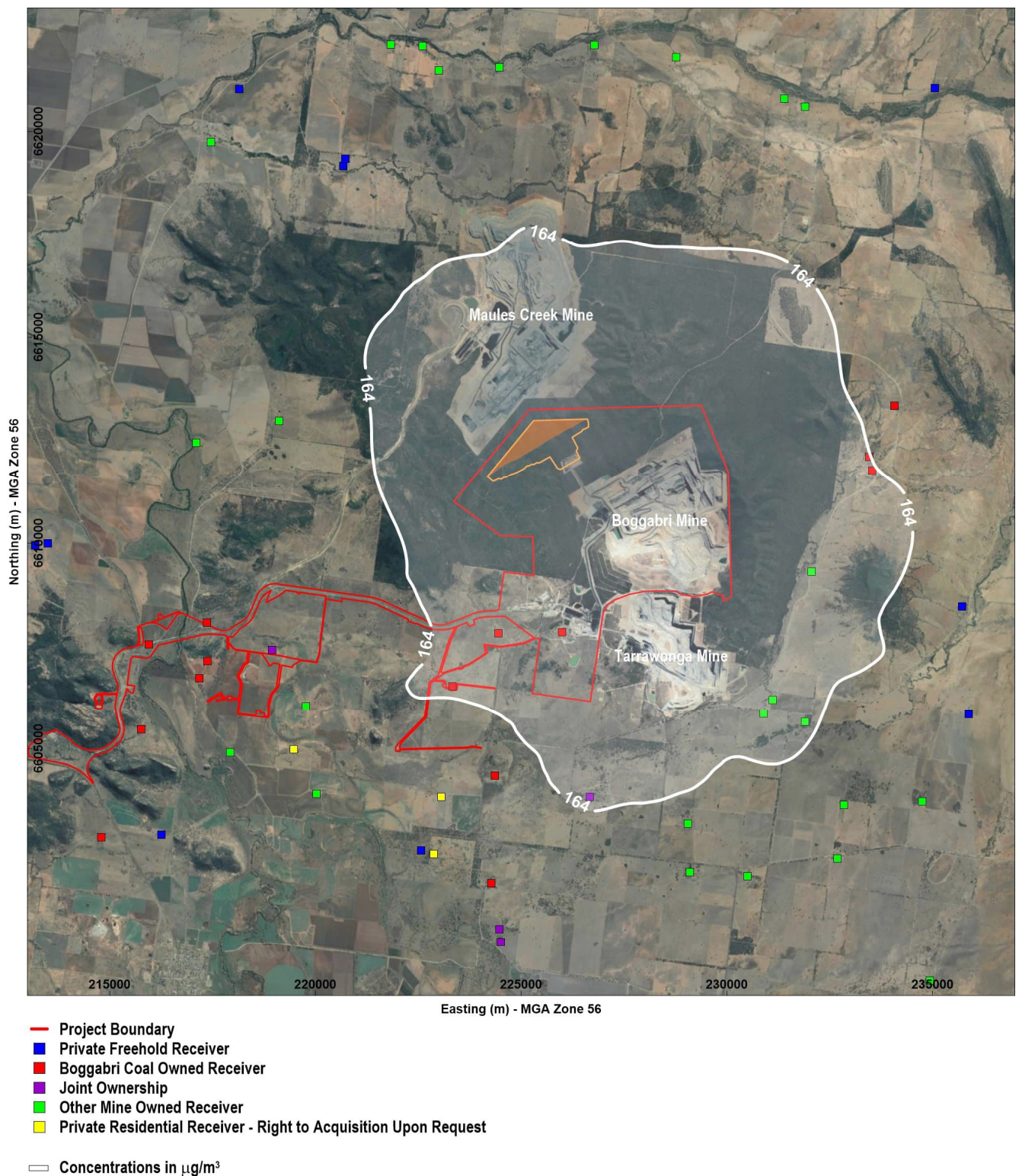


Figure 29 Modelled maximum 1-hour average NO₂ due to BCM (diesel exhausts) and other sources

Figure 30 shows the modelled annual average NO₂ concentrations due to diesel exhaust emissions at BCM as well as from other sources. These results assume that 70% of the NO_x is NO₂ (based on the monitoring data). Compliance with the EPA's 31 µg/m³ criterion is expected at all private sensitive receptors.

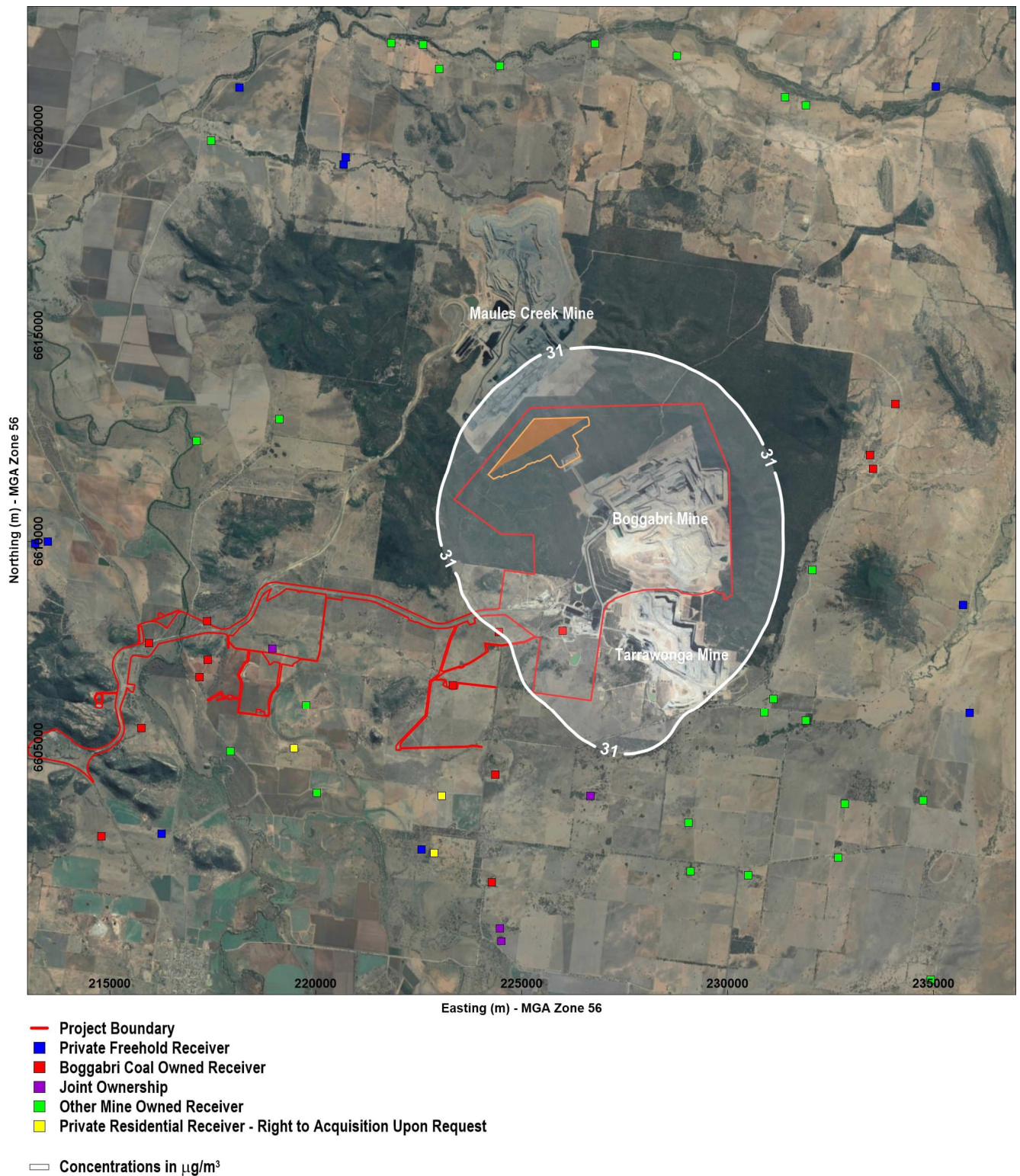


Figure 30 Modelled annual average NO₂ due to BCM (diesel exhausts) and other sources

6.3 Post Blast Fume

Figure 31 shows the modelled maximum 1-hour average NO_2 concentrations due to post-blast fume at BCM, based on the methodology outlined in Section 5.3. These results include maximum background levels. The results show that, under worst-case meteorological conditions with a rated 2 fume, blasting every day between 9 am and 5 pm and maximum background concentrations, the maximum 1-hour average NO_2 concentrations will not exceed the EPA's criterion at any off-site sensitive receptor.

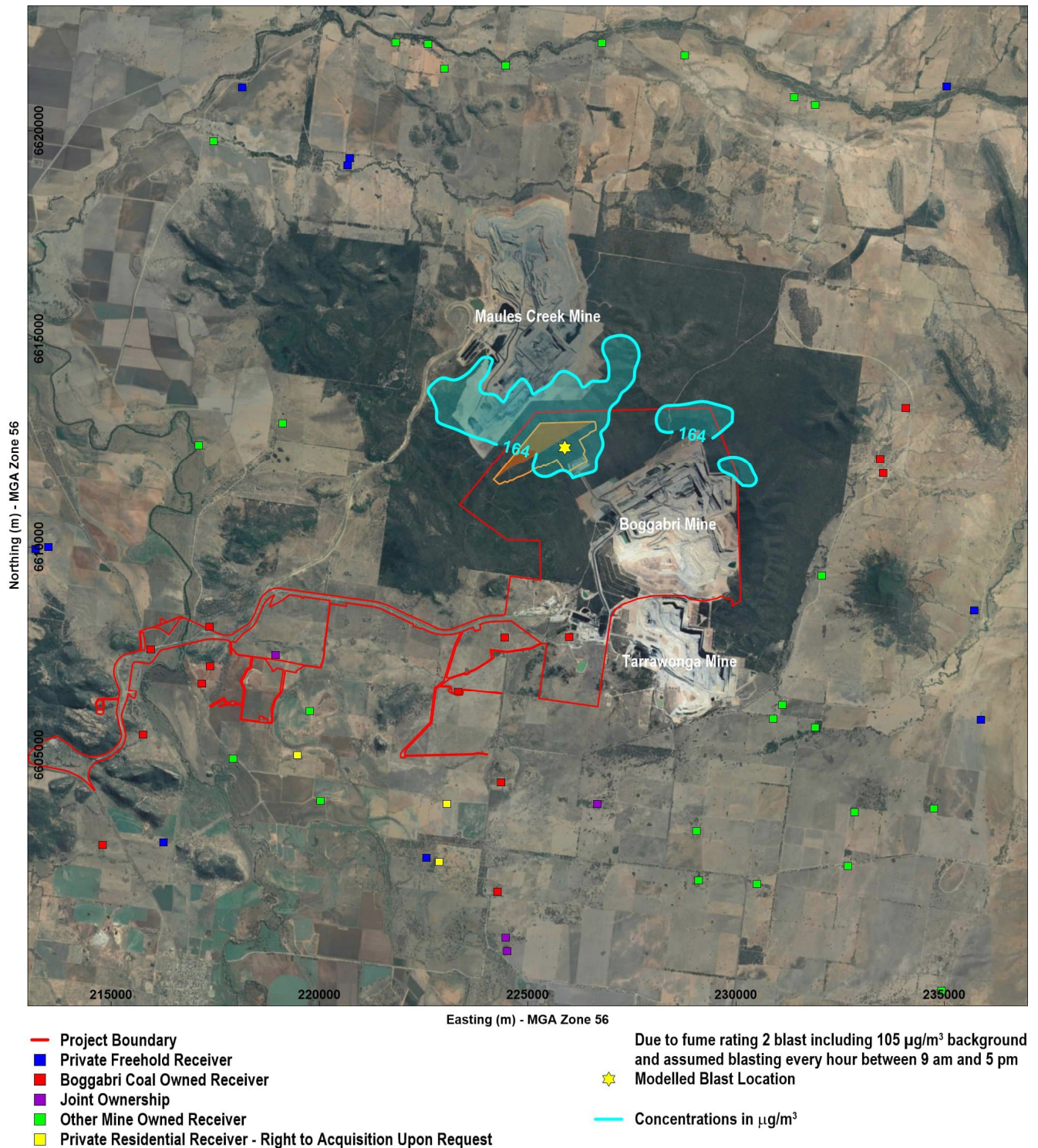


Figure 31 Modelled 1-hour average NO_2 due to BCM (blasting) and other sources

6.4 Mitigation Measures

BCOPL operates the BCM in accordance with the approved AQGGMP (IA, 2024) and the Boggabri-Maules Creek-Tarrawonga (BTM) Air Quality Management Strategy (BTM, 2017). Table 18 outlines the existing dust management measures that are in place at the existing approved BCM, based on the operational details provided by BCOPL, and the assumed emission control factors that were applied for the modelling. These measures would continue to be adopted as part of MOD 10. In addition, BCOPL currently implements, and would continue to implement, a Trigger Action Response Plan (TARP). This TARP identifies specific meteorological conditions that, upon measurement, require action for managing dust.

Table 18 Air quality management measures

Activity	Emission management measures	Assumed emission control (%) (NPI, 2012, Katestone, 2011)
Topsoil stripping	Watering	50
Hauling topsoil	Watering of unsealed haul routes / roads	75
Drilling	Water injection and / or curtains	70
Hauling overburden / coal	Watering of unsealed haul routes / roads	85
Handling coal at ROM pad / CHPP	Water sprays / enclosure	70
Dozers of coal stockpiles	Watering	50
Conveyors	Covered	70
Wind erosion from ROM stockpiles	Water sprays	50
Wind erosion from product stockpiles	Water sprays	50

The modelling showed that the potential extent of impacts due to the BCM (with MOD 10) would be largely within the approved extent of impacts and that dust concentrations and deposition levels would not exceed relevant EPA assessment criteria at the nearest private sensitive receptors. Some potential minor increases in the BCMs contribution to air quality have been predicted by modelling on Crown Land to the north of the Project Boundary. Therefore, no additional dust emission mitigation beyond that already undertaken by the BCM pursuant to their existing management plan, the TARP and BTM Complex Strategy would be warranted.

As noted in Section 4, the current BCM air quality monitoring network consists of three dust deposition gauges, three HVASs, four TEOMs and five meteorological stations. As the modelling showed that MOD 10 would not lead to exceedances of criteria at private sensitive receptors, the current monitoring regime is appropriate and no changes to the network are proposed.

7 Greenhouse Gas Assessment

7.1 Overview

The level of assessment for MOD 10 has been informed by the “NSW Guide for Large Emitters” (EPA, 2025). The assessment requirements of the Guide are applicable to a project if it meets the following three criteria:

- The project proposal requires development assessment and approval, or a change to an approval, under the EP&A Act.
- The project involves one or more scheduled activities under Schedule 1 of the *Protection of the Environment Operations Act* (POEO Act) and / or will be carried out at an existing licensed premises
- The project is likely to emit 25,000 tonnes or more of scope 1 and 2 emissions CO₂-e in any financial year during the operational life of the project (based on planned operational throughput and as designed).

For a modification, the threshold refers to an additional 25,000 tonnes or more of scope 1 and 2 emissions (CO₂-e) in any financial year when the modification project becomes operational, over and above emissions from the existing licensed premises. MOD 10 is likely to result in more than 25,000 tonnes of scope 1 and 2 emissions (CO₂-e) and criteria above, so the “NSW Guide for Large Emitters” is applicable. Section 3 of the “NSW EPA Guide for Large Emitters” outlines the assessment requirements including for projects involving modification of existing facilities. An independent expert review has also been completed as per the Guide (see Appendix F).

The DPHI advised (2024) that the GHG assessment for MOD 10 should consider the “draft of the NSW EPA Guide for Large Emitters (as amended)”. The “NSW Guide for Large Emitters” was finalised in January 2025, after the DPHI advice, and this assessment therefore considers the finalised version of the “NSW Guide for Large Emitters” (EPA, 2025).

7.2 Assessment Boundary and Scenarios

The GHG assessment boundary was developed to include all significant Scope 1, 2 and 3 emissions. The completeness principle states that all relevant emission sources within the chosen inventory boundary need to be accounted for so that a comprehensive and meaningful inventory is compiled (WRI, 2004). There are no new sources of emissions associated with proposed activities for MOD 10.

Emission sources include the dominant sources at coal mining operations that are often targeted by mitigation measures and of interest to stakeholders. Table 19 lists the sources that have been included and excluded from the assessment. The source exclusions represent activity data that are not readily available and where activity data for these sources is unlikely to generate sufficient emissions to materially change impacts or influence the decision-making outcomes of stakeholders. Emissions for the excluded sources are also not included in the NGER.

Table 19 GHG source inclusions and exclusions

Activity	Description	Scope
Included sources		
Diesel usage (on-site equipment)	Combustion of diesel fuel from on-site mobile and stationary plant and equipment	1
Fugitive	Fugitive emissions from the extraction of coal	1
Blasting	Detonation of explosives used for blasting	1
Electricity	Electricity usage	2
Transport (rail)	Transport of product coal by rail to port	3
Transport (shipping)	Transport of product coal by ship to market	3
Energy production	Combustion of thermal coal in power generators by end users	3
Coking coal use	Combustion of semi-soft coking coal by end users for steel production	3
Excluded sources		
Combustion of fuel for energy	Combustion of diesel fuel from on-site mobile and stationary plant and equipment for power generation	1
Construction diesel use	Combustion of diesel fuel from on-site equipment during the construction phase	1
Industrial processes	Sulphur hexafluoride (high voltage switch gear) Hydrofluorocarbon (commercial and industrial refrigeration)	1
Wastewater handling (industrial)	Methane emissions from wastewater management	1

Activity	Description	Scope
Solid waste	Solid waste to landfill	3
Business travel	Employees travelling for business purposes	3
Employee travel	Employees travelling between their place of residence and BCM	3

The emission scenarios were as follows:

- “Business as usual” (that is, the BCM as currently approved without MOD 10). Reference has also been made to the original project approval which is up to and including MOD 7.
- “Modified business” (that is, the BCM with MOD 10).

Emissions have been considered for the operational life of MOD 10.

7.3 Source Prioritisation

This section identifies the most significant sources of GHG emissions and prioritises those sources for mitigation. Comprehensive GHG emission inventories were developed for BCM MOD 8 (Airen, 2022). Figure 32 shows the distribution of the total life-of-mine Scope 1 and 2 emissions (as CO₂-e) by source type, based on the BCM with MOD 8. This inventory clearly identified diesel usage and electricity related emissions as the most significant sources.

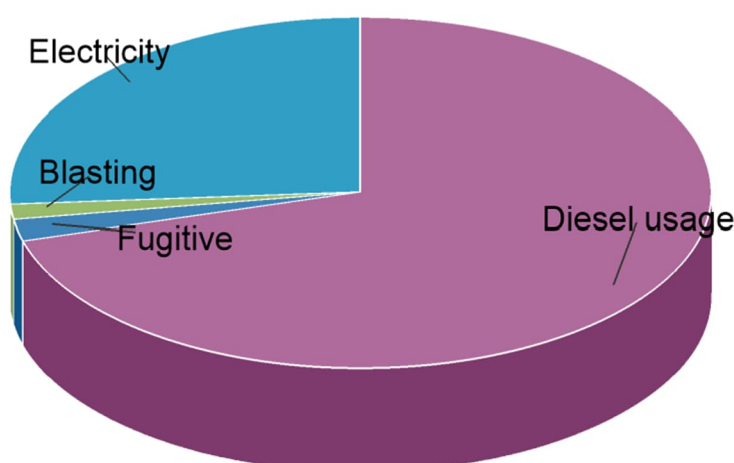


Figure 32 Distribution of Scope 1 and 2 GHG emission sources from the BCM MOD 8

Based on the distribution above, BCOPL has targeted diesel usage and electricity sources when assessing and developing emission reduction measures for MOD 10.

7.4 Emission Reduction Measures

Consideration of mitigation measures and offset strategies are embedded in the business planning processes of the BCM. Annual business planning processes forecast GHG emissions, assess the feasibility of mitigation measures, and develop offset strategies where emissions are not feasible to abate.

For example, reducing fuel and electricity usage by mobile plant and fixed equipment is an objective of mine planning and / or good operational practice. The mitigation measures to reduce the level of future GHG emissions from BCM are documented in the Air Quality and Greenhouse Gas Management Plan (which would continue for MOD 10) (BCOPL, 2024).

As per Section 7.3, GHG emissions from the BCM are principally associated with diesel combustion and the consumption of purchased electricity. The following management practices will continue to be implemented at BCM to minimise emissions from the combustion of diesel and electricity consumption during the life of the mine:

- Procurement and use of equipment incorporating best-practice emissions reduction technologies (e.g. high efficiency motors).
- Pre-start inspections at each shift on mobile plant and vehicles.

- Maintaining equipment in good operating order (e.g. routine servicing).
- Minimise engine idle time.
- Optimise the design of roads to minimise the distance travelled by construction equipment. Tracking electricity bills and fuel usage.
- Install energy-efficient electrical equipment where possible (e.g. lighting).

BCOPL's extensive revegetation works has also been carried out in the biodiversity offset and mine rehabilitation areas. In accordance with SSD 09_0182, BCOPL has finalised registration of over 7,500 ha of Conservation Agreements with the NSW Biodiversity Conservation Trust division. In addition, and in line with Condition 7 of SSD 09_0182, this has excluded mine activities within the native Vegetation Corridor that runs adjacent to the north of the Modification Disturbance Footprint.

BCOPL has continued focus on improvements and innovation with respect to minimising GHG emissions. Short and mid-term strategies to further minimise GHG emissions have been developed since 2022 and reviewed quarterly for progression and relevance to BCM operations and legislative obligations.

The following short-term (2025-2027) initiatives have been identified:

- Site-wide fuel consumption tracking has been implemented to measure and monitor:
 - The review of fuel efficiencies in production, including Hierarchy road rules and engine Control Card upgrades;
 - Fuel burn per base cubic metre of material moved;
 - Fuel burn of 930E truck fleet;
 - Total fuel consumption.
- Boggabri Solar Farm. Construction has commenced and project development is on schedule. The Boggabri Solar Farm aims to provide enough energy to support all BCM's daytime operations. This initiative will result in a significant decrease in BCM's electricity consumption from the grid. BCOPL is investigating the inclusion of solar farm battery storage. The reduction in GHG emissions due to the solar farm has been quantified in the Scope 2 emissions increment of Mod 10 (Table 21 of Section 7.5).
- Hydrogen injection trial on haul trucks to decrease diesel usage.
- Commitment to fleet optimisation and improvement: For example, installation of engine control card upgrades for the Komatsu 930 fleet is complete. Review of trial to be completed Q3 2025. Following this, investment in additional fleet (e.g. Cummins engine fleet) will be reviewed.
- Regenerative Agriculture and Reforestation: field studies have been finalised and BCOPL are progressing with the registration of the Project. This is anticipated to commence implementation in Horizon 2 2025.
- Continual review and improvement of:
 - Available technologies to reduce electricity consumption;
 - Available technologies to reduce/replace diesel motors;
 - Encouraging staff to car-pool to and from work;
 - Light vehicle replacement strategy;
 - A business carbon management policy and roadmap that will form part of the IA decarbonisation strategy.

For longer term strategy, the following initiatives (2027+) have been identified:

- Further investigation into alternative renewable energy supplies;
- Assessing opportunities for variable speed drive units;
- Further assessment of opportunities for diesel fuel alternatives; and
- Further assessment of opportunities for diesel motor alternatives.

BCOPL has been working on initiatives to reduce GHG emissions throughout the coal chain. Such initiatives include regular reviews of emerging technologies and abatement measures to reduce GHG emissions. Through BCOPL and IA quarterly reporting, the following is tracked to ensure proposed emission reduction strategies align with realistic outcomes:

- Watching briefs for technology readiness to be assessed for future implementation.

- Fugitive emissions: BCOPL fugitive emissions are currently recorded as immaterial (CER Materiality criteria 5%) and accounted for 3.1% of its total scope 1 emissions (2023/24 Financial Year). There is currently no developed technology that is viable for the capture and treatment of fugitive emissions for surface mines.
- Biodiesel: Biodiesel is currently 2-4 times the cost of regular diesel. The majority of Original Equipment Manufacturers (OEMs) engines are compatible for the use of Biodiesel at 5%, some approving up to 30% and trialling up to 50%. Based on availability and current cost it is not currently viable to use biodiesel. As more becomes available and purchase costs are reduced, BCOPL will investigate its use as a transition fuel.
- Renewable diesel: Renewable diesel is an emerging alternative to regular diesel. One OEMs engine is compatible with the use of renewable diesel at 25%. Renewable diesel is not currently produced commercially in Australia and currently not viable to import from overseas. As renewable diesel becomes commercially produced and available in Australia, BCOPL will investigate its use as a transition fuel.
- Electrification: Trolley assist systems are not practical for coal mines due to the spatial distribution and frequent changes in operations e.g. haul roads. There are currently a number of OEMs partnering with Tier 1 Mining companies to develop and trial non diesel haul trucks (e.g. battery electric vehicles [BEV's], diesel-electric hybrid vehicles [HV's]). Currently it is forecast that this equipment will not be technologically feasible until post 2030, with the Tier 1 OEM partnering companies getting their global fleets replaced prior to an offering being made to the broader mining industry. Challenges currently remain around the battery size, capacity (how long it will last) and charging time. Additional charging infrastructure will also need to be implemented for electric equipment. Operations may also require additional spare batteries based on the battery life and charging times which will require additional infrastructure/storage in addition to cost. Major engine OEM's believe that internal combustion engines will remain the dominant engine for the next 10-15 years. BCOPL will continue to watch the development of electric equipment and investigate BEV engine replacement or new BEV's at current equipment engine replacement/truck end of life.

BCOPL has applied the mitigation hierarchy in the "Guide for Large Emitters" (EPA, 2025) for developing MOD 10. In order of priority, the preference is to avoid, reduce, substitute, and offset emissions. As detailed above, the measures that accompany MOD 10 have primarily targeted the reduction of diesel and electricity related emissions.

7.5 Estimated Emissions

The GHG inventory in this document has been calculated in accordance with the principles of the GHG Protocol and the "Technical Guidelines for the Estimation of Greenhouse Gas Emissions by Facilities in Australia" (DEE, 2017). The initial actions for a GHG inventory are to determine the sources of GHG emissions, assess their likely significance and set a boundary for the assessment. Creating an inventory of the likely GHG emissions has the benefit of determining the scale of the emissions and providing a baseline from which to assess options that may be reasonable and feasible for GHG reduction. The results of this assessment are presented in terms of the previously mentioned 'Scopes' to help understand the direct and indirect impacts of the project.

The GHG Protocol (and similar reporting schemes) dictates that reporting Scope 1 and 2 sources is mandatory, whilst reporting Scope 3 sources is optional. Reporting significant Scope 3 sources is recommended. Scope 3 emissions are a consequence of the activities of the company, although occur from sources not owned or controlled by the company. Some examples of Scope 3 activities include the extraction and production of purchased materials, transportation of purchased fuels, and use of sold products (i.e. burning of coal) and services. The inventory for this assessment includes all significant sources of GHGs (Scopes 1, 2 and 3) from the BCM as per Table 19.

GHG emissions associated with operation of the BCM are well understood, given that the mine is currently operating. Future projections of production, fuel usage and electricity usage (from BCOPL) were used to determine the GHG emissions from the BCM with and without MOD 10. Estimated emissions will be conservative as the calculations do not consider the likelihood of increased renewable energy usage or potential improvements to vehicle efficiency in the future (for example, through electrification or alternative fuel sources).

Table 20 shows the emission estimation methodologies for the key emission sources.

Table 20 GHG emission estimation methodologies

Activity	Description	Scope(s)	Emission estimation methodology
Diesel usage	Combustion of diesel fuel from on-site mobile and stationary plant and equipment	1, 3	Input data from BCOPL. Emission factors from NGA Factors (DCCEEW, 2024a).
Fugitive	Fugitive emissions from the extraction of coal	1	Measurement Determination Chapter 3, Part 3.2. Division 3.2.3, Subdivision 3.2.3.2, Method 2.

Activity	Description	Scope(s)	Emission estimation methodology
Blasting	Detonation of explosives used for blasting	1	Input data from BCOPL. Emission factors from NGA Factors (DCC, 2008). Blasting emissions are not reported in the more recent NGA Factors publications.
Electricity	Electricity usage	2, 3	Input data from BCOPL. Emission factor projections from DCCEEW (2024b).
Transport (rail)	Transport of product coal by rail to port	3	Emission factors from the Department for Environment, Food and Rural Affairs (DEFRA) (2024) for "Freighting goods / freight train".
Transport (shipping)	Transport of product coal by ship to market	3	Emission factors from DEFRA (2024), based on "Freighting goods / cargo ship, bulk carrier".
Energy production	Combustion of thermal coal in power generators by end users	3	Input data (product coal) from BCOPL. Emission factors from NGA Factors (DCCEEW, 2024a).
Coking coal use	Combustion of semi-soft coking coal by end users for steel production	3	Input data (product coal) from BCOPL. Emission factors from NGA Factors (DCCEEW, 2024a).

The calculation methodologies for BCM have been based, primarily, on the NGA Factors and it is important to identify differences between the NGA Factors and Measurement Determination. For example, three methods for calculating fugitive emissions from the extraction of coal are prescribed in the Measurement Determination. This assessment adopted data for open cut coal mine fugitive emissions compiled and reported in accordance with Method 2 of the Measurement Determination. Method 2 involves estimating fugitive emissions using site-based data that has been sampled and tested according to industry standard methodologies.

The calculated fugitive emissions from the past five years of reporting under the NGER Act have been, on average, 0.00077 t CO₂-e/t ROM coal. This value was adopted for the purposes of estimating fugitive emissions from the BCM. The coal seams at the BCM have been subject to ongoing testing and analysis to quantify gas contents. For example, the historical sampling has included:

- 28 gas content samples collected in 2009 and reported using greenhouse gas modified test protocol in 2010.
- 56 gas content samples collected in 2012 and reported using greenhouse gas modified test protocol in 2013.
- 30 gas content samples collected in 2013 and reported using greenhouse gas modified test protocol in 2013.
- 90 gas content samples collected in 2014 and reported using greenhouse gas modified test protocol in 2014.
- 42 gas content samples collected in 2017 and reported using greenhouse gas modified test protocol in 2018.
- Extensive coverage of the relevant BCM seams including the Onavale, Teston, Thornfield, Braymont, Bollol Creek, Jeralong, Merriown, Velyama, Nagero, Northam & Therribri, Flixton, Tarrawonga and Templemore units.

The completion of the above boreholes facilitates fugitive emission assessments for FY2024 onwards. The existing boreholes (BC2318, BC2316 and BC2210) support the initial extraction activities associated with MOD 10. All boreholes at the BCM have been managed to facilitate fugitive emission assessment in accordance with Method 2 of the Measurement Determination. Analysis of the gas content of working coal seams at BCM has been carried out from at least 233 samples and the key outcomes can be summarised as follows.

- Gas content exhibits a range of between 0.1 and 1.0 m³/t with the majority of samples (178 of 233, or 76%) falling into a "low gas zone" with gas contents equal or less than 0.5 m³/t.
- The highest gas contents do not necessarily occur within the deepest of the sampled boreholes, and there is no clear trend of increasing gas content with depth. Rather, the sampling suggests a general decreasing trend in gas content with depth.
- The overwhelmingly dominant seam gas is carbon dioxide. That is, the CH₄ to seam gas ratios for 215 of the 233 valid samples were lower than 20% CH₄, and the remaining 18 samples were close to 100% CO₂.

The testing and analysis conducted since 2009 has shown that gas contents in the existing and future coal seams at the BCM have been consistent and relatively low. These investigations have led to a calculated fugitive emissions factor (from the last five years of NGERs reporting) of 0.00077 t CO₂-e/t ROM coal. The analysis has also not identified any clear evidence that gas contents will increase significantly from the coal seams proposed to be mined under MOD 10. Sampling, analysis, quantification and reporting of fugitive emissions will continue with MOD 10, and additional gas content sampling and testing will be conducted as mining progresses towards the north to certify and re-validate extension of the BCM gas domain as part of NGER compliant fugitive emission assessments.

Table 21 shows the estimated GHG emissions due to all identified GHG generating activities associated with BCM. The direct annual GHG emissions from MOD 10 are estimated to be 0.05 Mt CO₂-e/y, on average. Total additional Scope 1 emissions for MOD 10 (that is, “modified development” relative to “business as usual”) are estimated to be 0.77 Mt CO₂-e.

Table 21 Estimated GHG emissions

Year	Annual emission (Mt CO ₂ -e)											
	BCM (with MOD 7) Original development			BCM (with MOD 8) Business as usual			BCM (with MOD 10) Modified development			Increment of MOD 10 (Project only)		
	Scope 1	Scope 2	Scope 3	Scope 1	Scope 2	Scope 3	Scope 1	Scope 2	Scope 3	Scope 1	Scope 2	Scope 3
2025	0.23	0.07	20.8	0.23	0.01	20.3	0.23	0.01	18.2	0.01	0.00	-2.1
2026	0.24	0.07	20.8	0.24	0.01	21.1	0.22	0.01	20.3	-0.01	0.00	-0.7
2027	0.27	0.07	20.8	0.26	0.01	20.4	0.21	0.01	19.9	-0.05	0.00	-0.5
2028	0.21	0.07	18.8	0.23	0.01	19.5	0.24	0.01	19.5	0.01	0.00	-0.1
2029	0.15	0.05	13.8	0.23	0.01	20.6	0.24	0.01	19.6	0.00	0.00	-1.0
2030	0.11	0.04	10.5	0.23	0.00	20.2	0.24	0.00	19.4	0.02	0.00	-0.8
2031	0.14	0.04	12.8	0.23	0.00	20.3	0.22	0.00	19.1	-0.01	0.00	-1.2
2032	0.11	0.04	9.6	0.22	0.00	17.1	0.23	0.00	19.7	0.01	0.00	2.6
2033	0.08	0.03	8.7	0.21	0.00	16.7	0.22	0.00	19.5	0.01	0.00	2.8
2034	-	-	-	0.19	0.00	15.0	0.22	0.00	19.6	0.04	0.00	4.5
2035	-	-	-	0.07	0.00	8.6	0.21	0.00	18.4	0.13	0.00	9.7
2036	-	-	-	-	-	-	0.21	0.00	17.7	0.21	0.00	17.7
2037	-	-	-	-	-	-	0.16	0.00	13.9	0.16	0.00	13.9
2038	-	-	-	-	-	-	0.15	0.00	13.8	0.15	0.00	13.8
2039	-	-	-	-	-	-	0.08	0.00	5.9	0.08	0.00	5.9
2040	-	-	-	-	-	-	0.02	0.00	3.6	0.02	0.00	3.6
Maximum	0.27	0.07	20.80	0.26	0.01	21.09	0.24	0.01	20.35	0.21	0.00	17.75
Average	0.17	0.05	15.18	0.21	0.00	18.18	0.19	0.00	16.75	0.05	0.00	4.25
Total	1.54	0.48	136.60	2.33	0.05	200.00	3.10	0.06	268.05	0.77	0.00	68.05

Figure 33 shows the estimated Scope 1 and 2 GHG emissions from BCM by year, based on the data presented in Table 21. Also shown is an estimate of the calculated Safeguard Mechanism Baseline emission (by the hybrid approach) and the calculated emissions intensity over time. Full details of the calculations, by source and year, are provided in Appendix E.

A 6.5MWp/4.95MVA solar farm is proposed for installation behind the meter near the BCM. This project will reduce the total electricity required to be sourced from the national grid from approximately 26,000 MWh (peak year) to approximately 14,000 MWh. This will reduce the total Scope 2 emissions (2025 to 2040) from 59,058 t CO₂-e to 31,305 t CO₂-e. That is, a reduction of approximately 47%.

The NGER Act defines facility and corporate group emission thresholds. The facility thresholds are:

- 25,000 t or more CO₂-e (scope 1 and scope 2 emissions);
- production of 100 terajoules (TJ) or more of energy; or
- consumption of 100 TJ or more of energy.

The projected annual emissions of the BCM (including with MOD 10) are likely to exceed the facility emission threshold so BCOPL will continue to have an obligation to report emissions from this facility under the NGER Act.

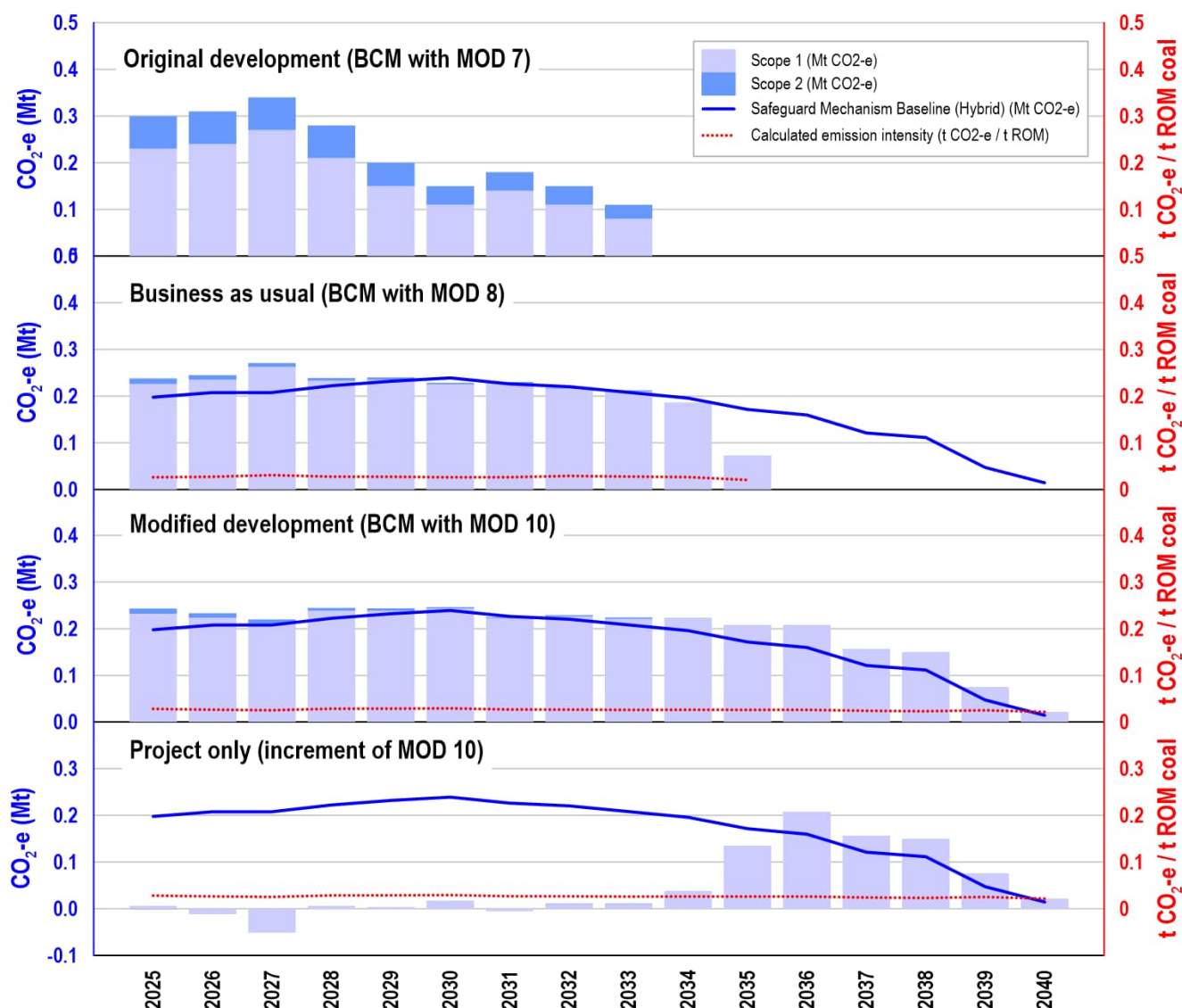


Figure 33 Estimated GHG emissions

7.6 Benchmarking and Goal Setting

The GHG emissions associated with MOD 10 have been quantified by source (see Table 21 and Figure 33). Table 22 shows the calculated GHG emissions in the State, National and Global context. Direct annual GHG emissions from MOD 10 are estimated to be 0.05 Mt CO₂-e/y, on average, representing approximately 0.011% of Australia's estimated emissions (that is 432.62 Mt CO₂-e for 2022, the latest year of estimates available). The Scope 1 and 2 incremental emissions of MOD 10 would be small in the context of global GHG emissions, but it is acknowledged that all sources of GHG emissions will contribute in some way towards the potential global, national, state and regional effects of climate change.

Table 22 Comparison of emissions in the State, National and Global context

Statistic	Value
Emissions in the State context	
Total reported NSW GHG emissions in 2022 (https://ageis.climatechange.gov.au/)	110.997 Mt CO ₂ -e
MOD 10 total average annual Scope 1 and 2 (within Australia)	0.048 Mt CO ₂ -e
MOD 10 as a proportion of NSW's annual emissions	0.043 %
Emissions in the Australian context	
Total reported Australia GHG emissions in 2022 (https://ageis.climatechange.gov.au/)	432.621 Mt CO ₂ -e

Statistic	Value
MOD 10 total average annual Scope 1 and 2 (within Australia)	0.048 Mt CO ₂ -e
MOD 10 as a proportion of Australia's annual emissions	0.011 %
Emissions in the Global context	
Total average annual Scope 1, 2, and 3 (within and outside Australia) (www.climatewatchdata.org/ghg-emissions?end_year=2021&start_year=1990)	49,600 Mt CO ₂ -e
MOD 10 total average annual Scope 1, 2, and 3 (within and outside Australia)	4.301 Mt CO ₂ -e
MOD 10 as a proportion of annual global emissions	0.009 %

The 'Safeguard Mechanism document' (DCCEEW, 2024c) includes default emissions intensities of production for various industries. The default emissions intensity for coal mining is an average of 0.0653 tonnes of CO₂-e per tonne of ROM coal. The estimated emissions intensity of MOD 10 will not exceed the default emissions intensity and is expected to decrease over the project life (Figure 33).

The BCM is a Safeguard facility and is subject to the declining emissions trajectory required by the Safeguard Mechanism, in support of Australia's NDCs, which are designed to deliver a 43% reduction in emissions (on a 2005 base year) by 2030, and net zero by 2050. As such BCOPL intends to continue to consider and assess the feasibility of mitigation measures to meet its compliance position under Safeguard or to generate Safeguard Mechanism Credits (SMCs).

The emission goals for MOD 10 will be to:

- Operate within the prescribed baseline emission decline rate for Safeguard baselines (that is, 4.9% per year to 2030, followed by 3.285% per year thereafter).
- Operate with an emission intensity below the industry default emissions intensity.

The expected declining trends in emissions intensity (Figure 33) of MOD 10 is consistent with the NSW net zero emissions trajectory and therefore supports NSW efforts to decarbonise. In addition to the goals above, BCOPL is investigating further measures to reduce emissions from its operations (Section 7.4). Should these investigations demonstrate viability of some or all of these measures (or other measures), then further reductions to GHG emissions will be realised and contribute to the reducing trend in NSW emissions. BCOPL will continue to investigate and monitor emerging measures and assess these for potential future implementation to achieve further reductions to GHG emissions.

7.7 Offset Strategy

BCOPL has applied the mitigation hierarchy described in the "Guide for Large Emitters" (EPA, 2025) with MOD 10 primarily targeting "reduction" in order to reduce electricity and diesel related emissions. An offset strategy is not a key part of MOD 10 however BCOPL will consider and assess the feasibility of various mitigation measures to meet its compliance position including carbon offsets (such as SMCs) if there are residual emissions that cannot be avoided or reduced.

8 Conclusions

This report has provided an assessment of the potential air quality and GHG impacts of MOD 10. In summary, the assessment has involved identifying the key air quality issues, characterising the existing environment, quantifying emissions to air and modelling to determine the potential impact of MOD 10 on local air quality. The key air quality issues were identified as mining dust, post-blast fume and diesel exhaust. These issues were the focus of the assessment. GHG emissions were estimated in accordance with recognised Australian Government procedures.

A detailed review of the existing environment was carried out, including an analysis of historically measured concentrations of key quality indicators from representative monitoring stations. This included analysis of ten years of site-specific monitoring data. The following conclusions were made in relation to the existing environment:

- Meteorological conditions in 2017 were representative of the long term, local conditions around the BCM.
- There was a deterioration in air quality conditions from 2017 to early 2020, heavily influenced by drought, dust storms and bushfires. These conditions were not unique to the Northwest Slopes and Plains.
- The BCM has complied with the air quality criteria specified in SSD 09_0182.

The key outcomes of the modelling and subsequent assessment are:

- The potential extent of air quality impacts due to the BCM (with MOD 10) would be largely within the currently approved extent of impacts. In addition, the potential extent of air quality impacts are expected to be consistent with the originally approved development (MOD 7).
- When background levels from other sources approach the EPA criteria (specifically 24-hour average PM₁₀), the BCM has the potential to influence an exceedance. However, under these conditions, modelling indicated that the contribution from BCM (including the changes sought by MOD 10) would be very small (<3 µg/m³ at one property) and this risk can be managed through the ongoing implementation of the air quality management measures currently in place at BCM.
- Emissions from diesel exhausts associated with off-road vehicles and equipment are not expected to result in any adverse air quality impacts, based on modelling which showed compliance with air quality assessment criteria at all sensitive receptors.
- Emissions associated with post blast fume are not expected to result in any adverse air quality impacts (as NO₂), based on modelling which showed compliance with air quality assessment criteria at all sensitive receptors.
- BCOPL monitors air quality at various locations around the BCM and for all relevant air quality indicators. The monitoring occurs near locations that may be expected to experience the highest contributions from potential BCM emissions. As the modelling showed that MOD 10 is unlikely to cause exceedances of air quality criteria at sensitive receptors, the current monitoring program would continue to be appropriate and no additional monitoring is proposed.
- The estimated highest annual incremental increase in Scope 1 emissions due to MOD 10, over approved operations, is 0.21 Mt CO₂-e, which represents approximately 0.05% of Australia's emissions (that is 432.62 Mt CO₂-e for 2022, the latest year of estimates available³). Coal produced by the BCM is predominantly exported to countries which are either signatories to the Paris Agreement and / or have announced or adopted domestic laws or policies to achieve their emissions targets. Whilst emissions from the end use of the coal have been calculated as Scope 3 emissions for the purposes of the MOD 10 assessment, BCOPL's customers account for these same emissions as Scope 1 emissions and are required to comply with their respective countries' emissions targets.

Based on this assessment, it has been concluded that MOD 10 is unlikely to affect air quality beyond the range of historically measured fluctuations of key air quality indicators around the region. This conclusion has been informed by modelling which showed that BCM (with MOD 10) would not result in changes to air quality that would cause exceedances of air quality criteria at the nearest private sensitive receptors.

³ <https://ageis.climatechange.gov.au/>

9 References

- Attalla M I, Day S J, Lange T, Lilley W and Morgan S (2008) "NO_x emissions from blasting operations in open-cut coal mining" published in *Atmospheric Environment*, 42, (2008), 7874-7883. CSIRO Energy Technology, PO Box 330, Newcastle, NSW 2300.
- Boggabri Coal (2016) "Boggabri Coal Mine 2015 Annual Review".
- Boggabri Coal (2017) "Boggabri Coal Mine 2016 Annual Review".
- Boggabri Coal (2018) "Boggabri Coal Mine 2017 Annual Review".
- Boggabri Coal (2019) "Boggabri Coal Mine 2018 Annual Review".
- Boggabri Coal (2020) "Boggabri Coal Mine 2019 Annual Review".
- Boggabri Coal (2021) "Boggabri Coal Mine 2020 Annual Review".
- Boggabri Coal (2022) "Boggabri Coal Mine 2021 Annual Review".
- Boggabri Coal (2023) "Boggabri Coal Mine 2022 Annual Review".
- Boggabri Coal (2024) "Boggabri Coal Mine 2023 Annual Review".
- BCOPL (2024) "ENV-AIR-PLN-001 Air Quality and Greenhouse Gas Management Plan". March 2024 Revision No.8.
- BTM (2017) "Air Quality Management Strategy for Boggabri – Tarrawonga - Maules Creek Complex. May 2017.
- DEEDI (2011) "Management of oxides of nitrogen in open cut blasting". Queensland Guidance Note QGN 20 v3. Department of Employment, Economic Development and Innovation.
- DEFRA (2024) "UK Government GHG Conversion Factors for Company Reporting".
- DCCEEW (2024a) "National Greenhouse Accounts Factors 2024". Department of Climate Change, Energy, the Environment and Water.
- DCCEEW (2024b) "Australia's emissions projections 2024". Department of Climate Change, Energy, the Environment and Water. November 2024.
- DCCEEW (2024c) Safeguard Mechanism document July 2021, republished October 2023, April 2024 and September 2024. Last updated 24 September 2024. Department of Climate Change, Energy, the Environment and Water.
- Donnelly S-J, Balch A, Wiebe A, Shaw N, Welchman S, Schloss A, Castillo E, Henville K, Vernon A and Planner J (2011) "NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and / or Minimise Emissions of Particulate Matter from Coal Mining". Prepared by Katestone Environmental Pty Ltd for NSW Office of Environment and Heritage, December 2010.
- DPE (2020) "Annual Air Quality Statement 2019". Available from <https://www.environment.nsw.gov.au/>
- EPA (2012) "Air Emissions Inventory for the Greater Metropolitan Region in New South Wales, 2008 Calendar Year, Off-Road Mobile Emissions". Technical Report No. 6. Prepared by the Environment Protection Authority. EPA 2012/0050. August 2012.
- EPA (2022) "Approved Methods for the Modelling and Assessment of Air Pollutants in NSW". August 2022. Published by the Environment Protection Authority.
- EPA (2025) "NSW Guide for Large Emitters – guidance on how to prepare a greenhouse gas assessment as part of NSW environmental planning processes". January 2025. Environment Protection Authority.
- NEPC (1998) "Ambient Air – National Environment Protection Measure for Ambient Air Quality", National Environment Protection Council, Canberra.
- NPI (2012) "Emission Estimation Technique Manual for Mining". Version 3.1, January 2012. National Pollutant Inventory.

NSW Government (2018) "Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments". September 2018.

NSW Minerals Council (2000) "Particulate matter and mining".

OEH (2019) "Annual Air Quality Statement 2018". Available from <https://www.dpie.nsw.gov.au/air-quality>.

Skidmore, E.L. (1998) "Wind Erosion Processes". USDA-ARS Wind Erosion Research Unit, Kansas State University. Wind Erosion in Africa and West Asia: Problems and Control Strategies. Proceedings of the expert group meeting 22-25 April 1997, Cairo, Egypt.

SPCC (1986) "Particle size distributions in dust from open cut coal mines in the Hunter Valley". Report number 10636-002-71. Prepared for the State Pollution Control Commission of NSW (now EPA) by Dames and Moore.

Tarrawonga Coal (2016) "Tarrawonga Coal Mine 2015 Annual Review".

Tarrawonga Coal (2017) "Tarrawonga Coal Mine 2016 Annual Review".

Tarrawonga Coal (2018) "Tarrawonga Coal Mine 2017 Annual Review".

Tarrawonga Coal (2019) "Tarrawonga Coal Mine 2018 Annual Review".

Tarrawonga Coal (2020) "Tarrawonga Coal Mine 2019 Annual Review".

Tarrawonga Coal (2021) "Tarrawonga Coal Mine 2020 Annual Review".

Tarrawonga Coal (2022) "Tarrawonga Coal Mine 2021 Annual Review".

Tarrawonga Coal (2023) "Tarrawonga Coal Mine 2022 Annual Review".

TRC (2007) CALPUFF model web-site (<http://www.src.com/calpuff/regstat.htm>).

TRC (2011) "Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW'". Prepared for the Office of Environment and Heritage by TRC, March 2011.

URS (2000) "Mount Arthur North Coal Project". EIS produced for Coal Australia Pty Ltd by URS Australia Pty Ltd.

US EPA (1985 and updates) "Compilation of Air Pollutant Emission Factors", AP-42, Fourth Edition United States Environmental Protection Agency, Office of Air and Radiation Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina 27711. Now a web-based document.

US EPA (1987) Update of fugitive dust emission factors in AP-42 Section 11.2, EPA Contract No. 68-02-3891, Midwest Research Institute, Kansas City, MO, July 1987.

US EPA (1995) "User's Guide for the Industrial Source Complex (ISC3) Dispersion Models – Volume 1 User's Instructions" and "Volume 2 Description of Model Algorithms" US Environmental Protection Agency, Office of Air Quality Planning and Standards Emissions, Monitoring and Analysis Division, Research Triangle Park, North Carolina 27711.

US EPA (2005) "Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions; Final Rule". Environmental Protection Agency.

Whitehaven Coal (2016) "Maules Creek Coal Mine 2015 Annual Review".

Whitehaven Coal (2017) "Maules Creek Coal Mine 2016 Annual Review".

Whitehaven Coal (2018) "Maules Creek Coal Mine 2017 Annual Review".

Whitehaven Coal (2019) "Maules Creek Coal Mine 2018 Annual Review".

Whitehaven Coal (2020) "Maules Creek Coal Mine 2019 Annual Review".

Whitehaven Coal (2021) "Maules Creek Coal Mine 2020 Annual Review".

Whitehaven Coal (2022) "Maules Creek Coal Mine 2021 Annual Review".

Whitehaven Coal (2023) "Maules Creek Coal Mine 2022 Annual Review".

WRI (2004). "Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard - REVISED EDITION". The Greenhouse Gas Protocol is a collaboration between the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). The Protocol provides guidance on the calculation and reporting of carbon footprints.

Appendix A. Annual and seasonal wind-roses

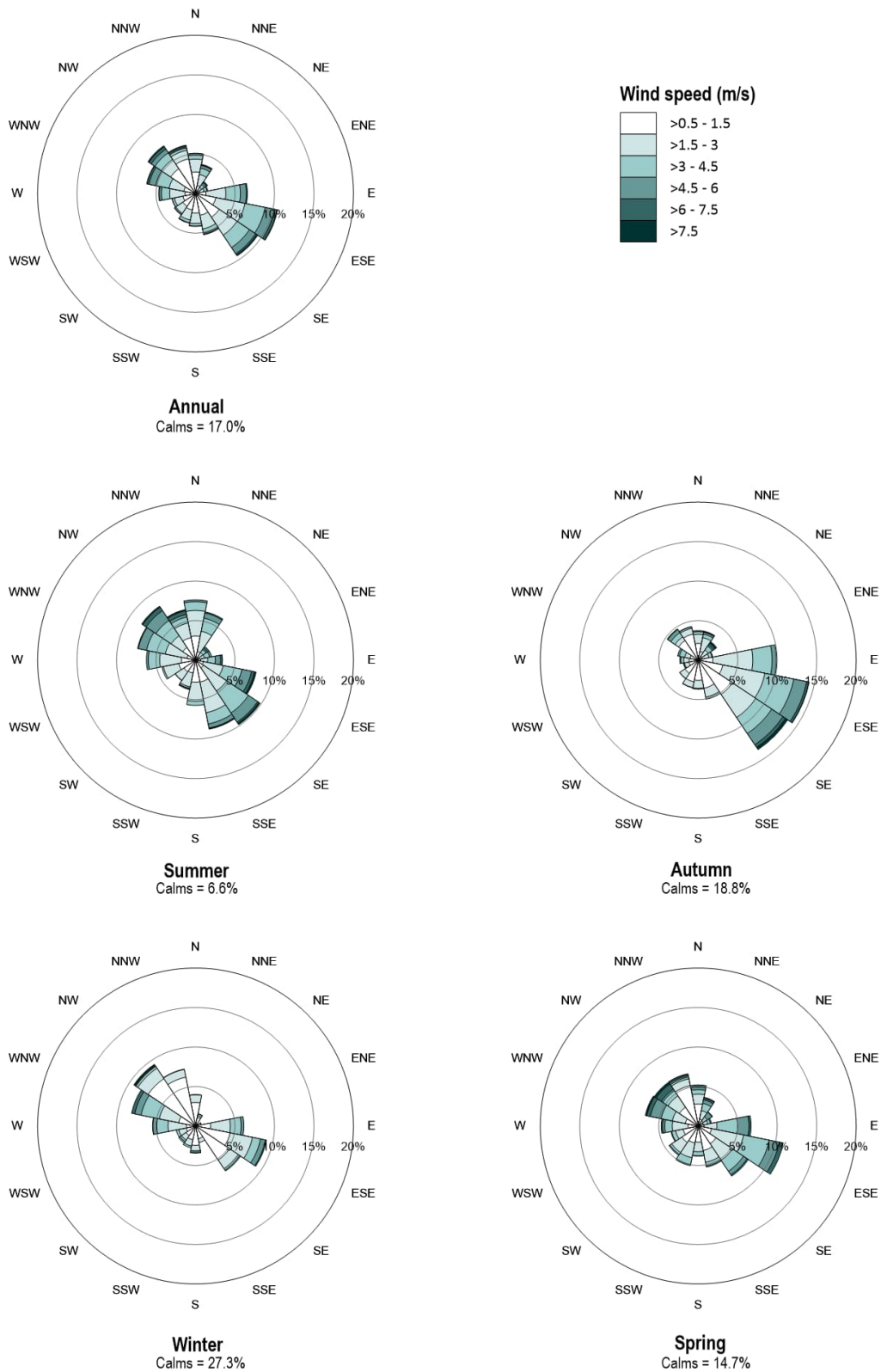


Figure A1 Annual and seasonal wind-roses from data collected at the BCM meteorological station in 2017

Appendix B. Model settings

Geophysical

Figure B1 shows the model grid, land-use and terrain information, as used by CALMET.

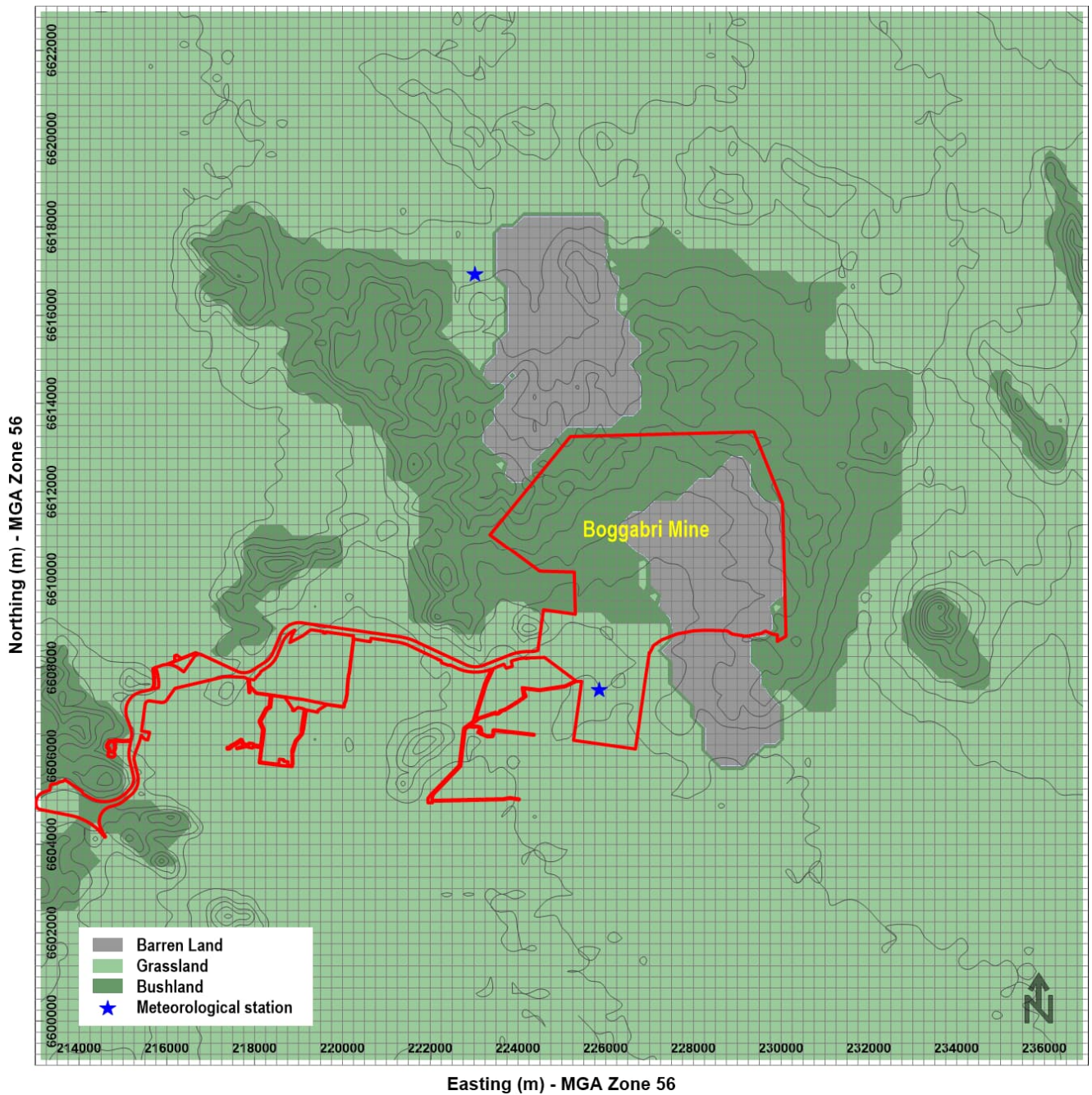


Figure B1 Model domain, grid, land use and terrain information

Meteorology

The CALPUFF model, through the CALMET meteorological pre-processor, simulates complex meteorological patterns that exist in a particular region. The necessary upper air data for CALMET were generated by the CSIRO's prognostic model, TAPM, and the required surface observation data were sourced from local weather stations. CALMET was used to produce a year-long, three-dimensional output of meteorological conditions for input to the CALPUFF air dispersion model. The meteorological modelling followed the guidance of TRC (2011) and adopted the "observations" mode.

Table B1 Model settings and inputs for TAPM

Parameter	Value(s)
Model version	4.0.5
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Number of grids point	35 x 35 x 25
Year(s) of analysis	2017
Centre of analysis	30°36' S, 150°10' E
Terrain data source	30 m Shuttle Research Topography Mission (SRTM)
Land use data source	Default
Meteorological data assimilation	BCM meteorological station. Radius of influence = 15 km. Number of vertical levels for assimilation = 4

Table B2 Model settings and inputs for CALMET

Parameter	Value(s)
Model version	6.334
Terrain data source(s)	30 m SRTM and Project DEM. Higher resolution topographical data were not necessary in order to develop wind fields that reflect the influence of terrain and effects that are important for dispersion of emissions from the project to the sensitive receptor areas.
Land use data source(s)	Digitised from aerial imagery
Meteorological grid domain	24 km x 24 km
Meteorological grid resolution	0.25 km
Meteorological grid dimensions	96 x 96 x 9 grid points
Meteorological grid origin	213000 mE, 6599000 mN. MGA Zone 56
Surface meteorological stations	W1: wind speed, wind direction. Maules Creek mine: wind speed, wind direction. TAPM (at location of W1): temperature, humidity, ceiling height, cloud cover and air pressure
Upper air meteorological stations	Upper air data file for the location of the W1 meteorological station, derived by TAPM. Biased towards surface observations (-1, -0.8, -0.6, -0.4, -0.2, 0, 0, 0, 0)
Simulation length	8760 hours (1 Jan 2017 to 31 Dec 2017)
R1, R2	0.5, 1
RMAX1, RMAX2	5, 20
TERRAD	5

Figure B2 shows a snapshot of winds at 10 metres above ground-level as simulated by the CALMET model under stable conditions. This plot shows the effect of the topography on local winds, for this particular hour, and highlights the non-uniform wind patterns in the area, further supporting the use of a non-steady-state model such as CALPUFF.

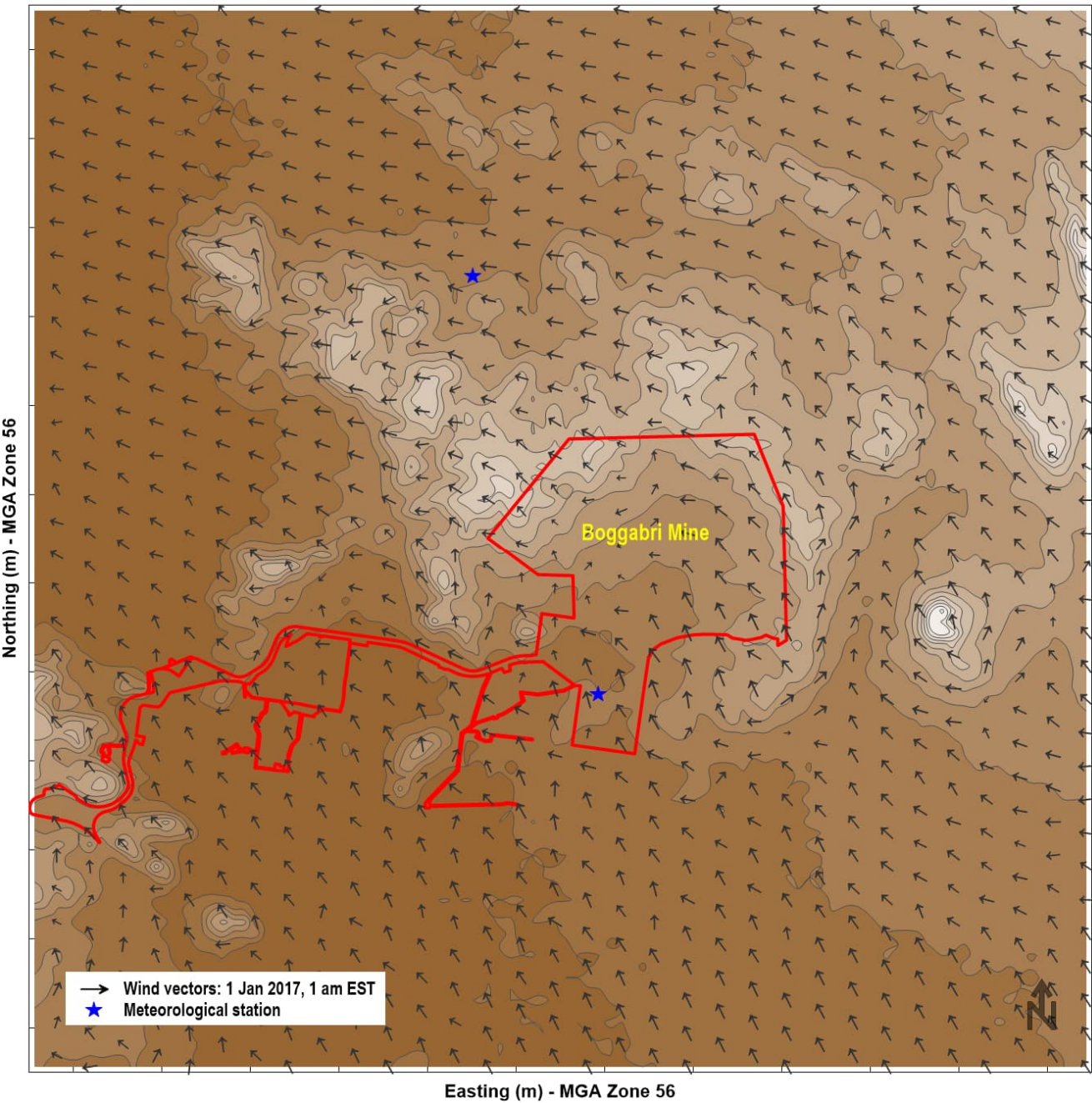


Figure A2 Example of CALMET simulated ground-level wind flows

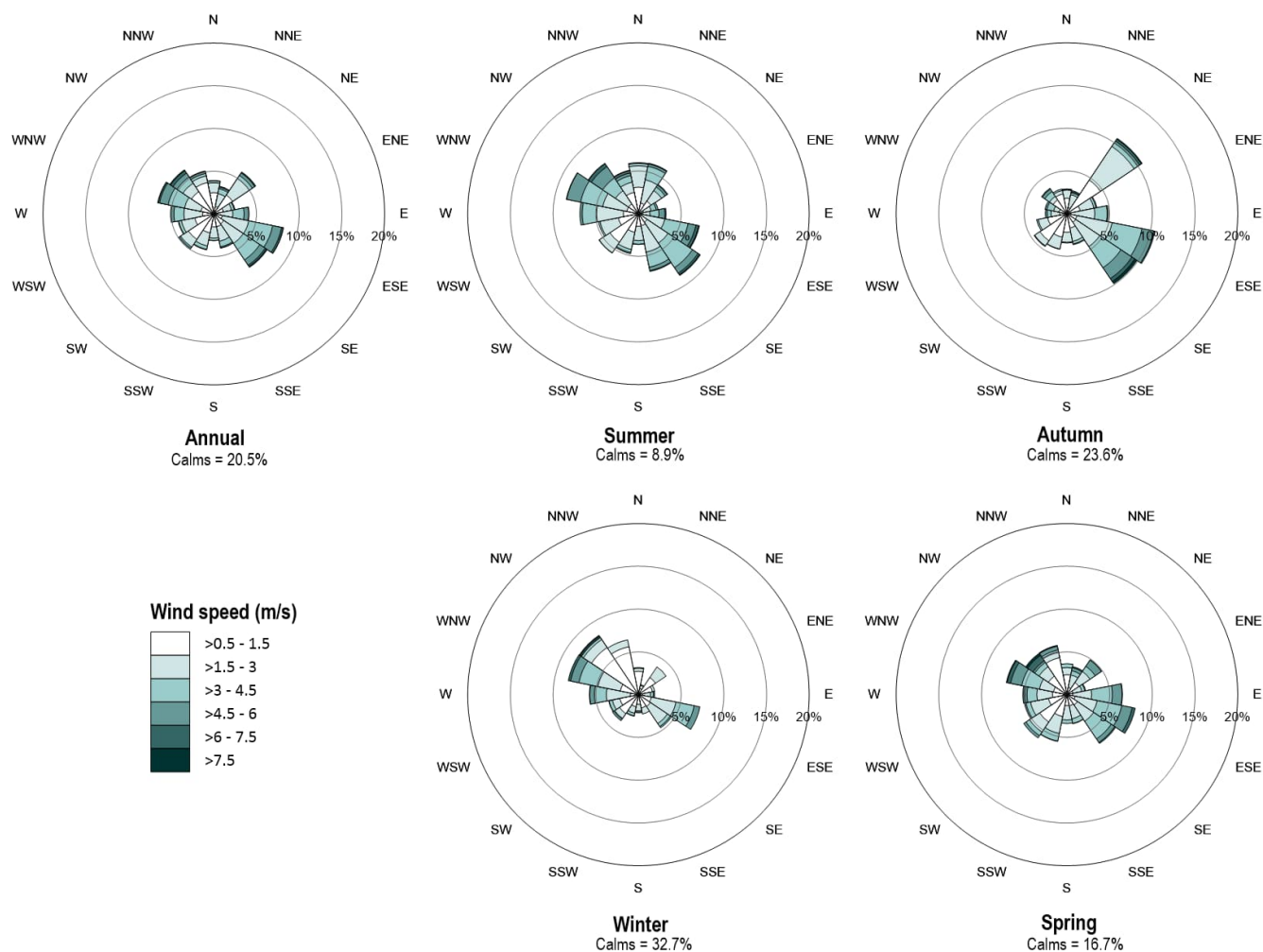


Figure B3 Annual and seasonal wind-roses from modelled data for the Project site in 2017

Table B3 shows the model settings and input for the dispersion model, CALPUFF.

Table B3 Model settings and inputs for CALPUFF

Parameter	Value(s)
Model version	6.42
Computational grid domain	96 x 96
Chemical transformation	None
Dry deposition	Yes
Wind speed profile	ISC rural
Puff element	Puff
Dispersion option	Turbulence from micrometeorology
Time step	3600 seconds (1 hour)
Terrain adjustment	Partial plume path
Number of volume sources	See below. Height = 5 m, SY = 20 m, SZ = 10 m.
Number of discrete receptors	676. See below.

Sources

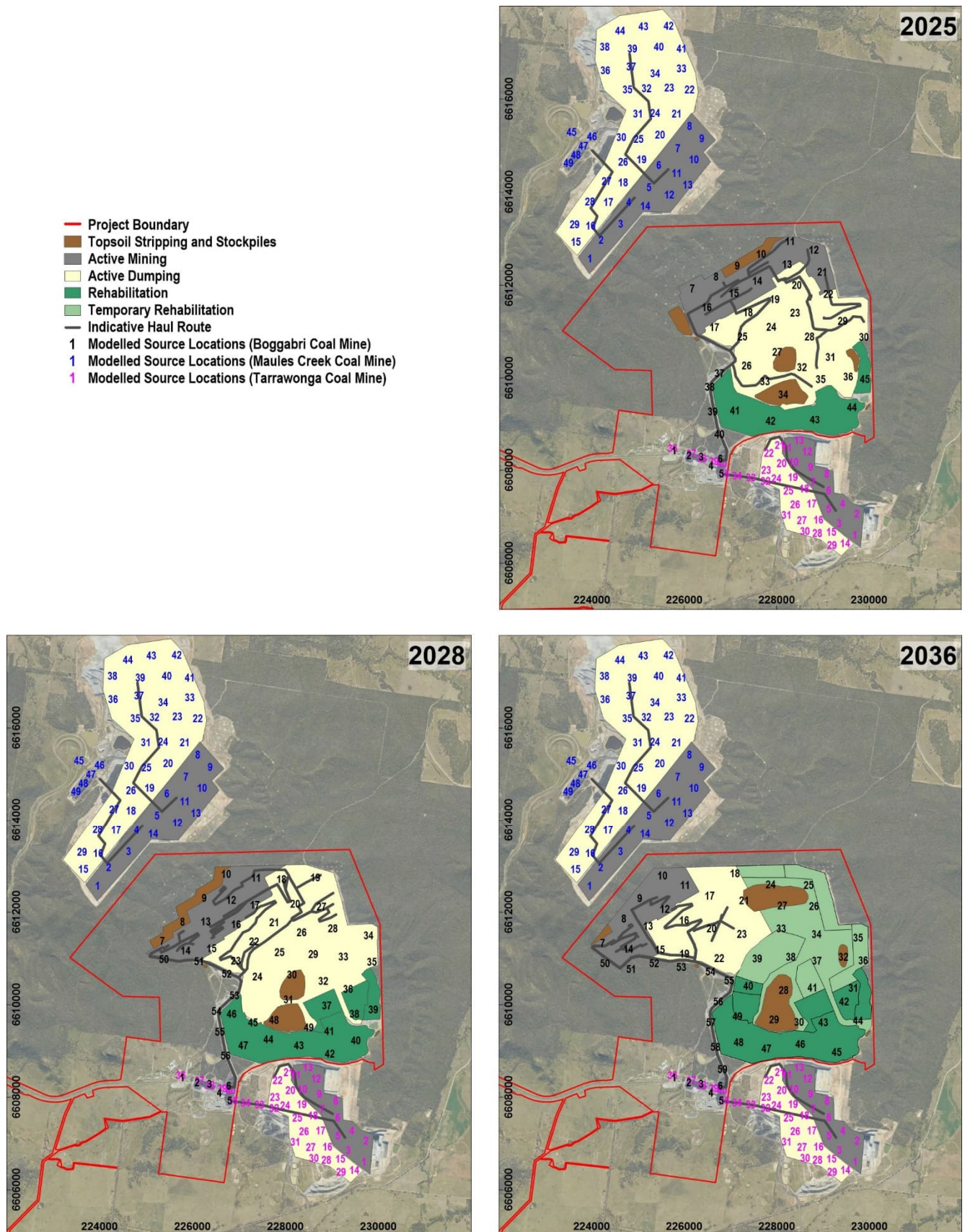


Figure B4 Modelled source locations

Receptors

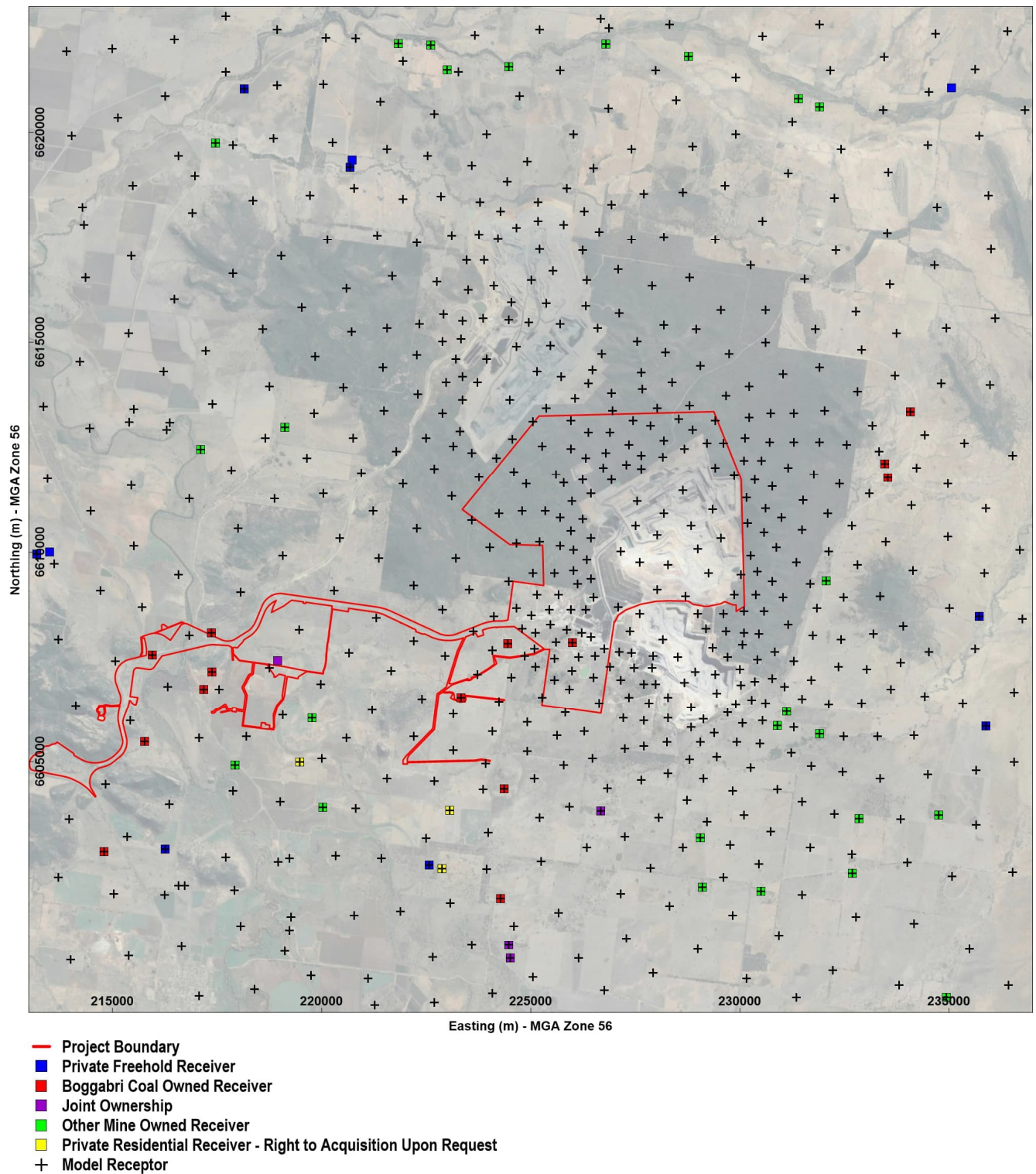


Figure B5 Model receptor locations

Appendix C. Particulate matter emission calculations

Emission factors

Activity	Emission factor			Units	Source
	TSP	PM ₁₀	PM _{2.5}		
Stripping topsoil	$E_{TSP} = 0.029$	$E_{PM10} = 0.0073 \times E_{TSP}$	$E_{PM2.5} = 0.05 \times E_{TSP}$	kg/t	US EPA / NPI
Drilling	$E_{TSP} = 0.59$	$E_{PM10} = 0.52 \times E_{TSP}$	$E_{PM2.5} = 0.03 \times E_{TSP}$	kg/hole	US EPA / NPI
Blasting	$E_{TSP} = 0.00022 \times A^{1.5}$	$E_{PM10} = 0.52 \times E_{TSP}$	$E_{PM2.5} = 0.03 \times E_{TSP}$	kg/blast	US EPA / NPI
Loading material / dumping overburden	$E_{TSP} = 0.74 \times 0.0016 \times ((U/2.2)^{1.3}/(M/2)^{1.4})$	$E_{PM10} = 0.35 \times 0.0016 \times ((U/2.2)^{1.3}/(M/2)^{1.4})$	$E_{PM2.5} = 0.053 \times 0.0016 \times ((U/2.2)^{1.3}/(M/2)^{1.4})$	kg/t	US EPA / NPI
Hauling on unsealed roads	$E_{TSP} = 4$	$E_{PM10} = 0.3 \times E_{TSP}$	$E_{PM2.5} = 0.03 \times E_{TSP}$	kg/VKT	SPCC
Dozers shaping overburden	$E_{TSP} = 2.6 \times (S^{1.2}/M^{1.3})$	$E_{PM10} = 0.3375 \times (S^{1.5}/M^{1.4})$	$E_{PM2.5} = 0.105 \times E_{TSP}$	kg/hour	US EPA / NPI
Dozers working on coal	$E_{TSP} = 35.6 \times (S^{1.2}/M^{1.3})$	$E_{PM10} = 6.33 \times (S^{1.5}/M^{1.4})$	$E_{PM2.5} = 0.022 \times E_{TSP}$	kg/hour	US EPA / NPI
Loading coal	$E_{TSP} = 0.58 / M^{1.2}$	$E_{PM10} = 0.0447 / M^{0.9}$	$E_{PM2.5} = 0.019 \times E_{TSP}$	kg/t	US EPA / NPI
Unloading coal	$E_{TSP} = 0.01$	$E_{PM10} = 0.0042$	$E_{PM2.5} = 0.019 \times E_{TSP}$	kg/t	NPI
Miscellaneous transfer	$E_{TSP} = 0.74 \times 0.0016 \times ((U/2.2)^{1.3}/(M/2)^{1.4})$	$E_{PM10} = 0.35 \times 0.0016 \times ((U/2.2)^{1.3}/(M/2)^{1.4})$	$E_{PM2.5} = 0.053 \times 0.0016 \times ((U/2.2)^{1.3}/(M/2)^{1.4})$	kg/t	US EPA / NPI
Loading product coal to trains	$E_{TSP} = 0.0004$	$E_{PM10} = 0.00017$	$E_{PM2.5} = 0.05 \times E_{TSP}$	kg/t	NPI
Wind erosion from exposed areas	$E_{TSP} = 0.1$	$E_{PM10} = 0.5 \times E_{TSP}$	$E_{PM2.5} = 0.075 \times E_{TSP}$	kg/ha/h	US EPA
Grading roads	$E_{TSP} = 0.0034 \times s^{2.5}$	$E_{PM10} = 0.00336 \times s^2$	$E_{PM2.5} = 0.0001054 \times s^{2.5}$	kg/VKT	US EPA / NPI

A = blast area (m²)
 U = wind speed (m/s)
 M = moisture content (%)
 S = silt content (%)
 s = speed (km/h)

Emission inventory 2025

Boggabri 2025																						
	Annual emissions (kg/y)						TSP		PM10		PM2.5				Variables							
Activity	TSP	PM10	PM2.5	Control (%)	Intensity	Units	Factor	Units	Factor	Units	Factor	Units	Blast area (m2)	(ws/2.2) ^{1.3}	Moisture (%)	kg/VKT	t/truck	km/trip	Silt (%)	Speed (km/h)		
Topsoil - stripping	3350	843	167	50	231000 t/y		0.029 kg/t		0.0073 kg/t		0.001 kg/t		-	-	-	-	-	-	-	-		
Topsoil - loading to trucks	267	126	19	0	231000 t/y		0.00116 kg/t		0.00055 kg/t		0.0001 kg/t		-	0.98	2	-	-	-	-	-		
Topsoil - hauling to stockpiles	9603	2838	288	85	231000 t/y		0.27714 kg/t		0.0819 kg/t		0.008 kg/t		-	-	-	4	140	10	-	-		
Topsoil - unloading	267	126	19	0	231000 t/y		0.00116 kg/t		0.00055 kg/t		0.0001 kg/t		-	0.98	2	-	-	-	-	-		
Drilling overburden	9133	4749	274	70	51598 holes/y		0.59 kg/hole		0.31 kg/hole		0.018 kg/hole		-	-	-	-	-	-	-	-		
Blasting overburden	57800	30056	1734	0	104 blasts/y		555.8 kg/blast		289.0 kg/blast		16.7 kg/blast	18549	-	-	-	-	-	-	-	-		
Excavators loading overburden to trucks	165411	78235	11847	0	142925082 t/y		0.00116 kg/t		0.00055 kg/t		0.0001 kg/t		-	0.98	2	-	-	-	-	-		
Hauling overburden from pit to dump	2772747	819370	83182	85	142925082 t/y		0.12933 kg/t		0.0382 kg/t		0.004 kg/t		-	-	-	4	300	10	-	-		
Unloading overburden to dump	166855	78918	11950	0	144173269 t/y		0.00116 kg/t		0.00055 kg/t		0.0001 kg/t		-	0.98	2	-	-	-	-	-		
Dozers shaping overburden	861818	209806	90491	0	51497 h/y		16.7 kg/h		4.0741 kg/h		1.757 kg/h		-	-	2	-	-	-	10	-		
Dozers working on overburden for rehabilitation	163501	39804	17168	0	9770 h/y		16.7 kg/h		4.0741 kg/h		1.757 kg/h		-	-	2	-	-	-	10	-		
Drilling coal	0	0	0	70	0 holes/y		0.59 kg/hole		0.31 kg/hole		0.018 kg/hole		-	-	-	-	-	-	-	-		
Blasting coal	0	0	0	0	0 blasts/y		555.8 kg/blast		289.0 kg/blast		16.7 kg/blast	18549	-	-	-	-	-	-	-	-		
Dozers working on coal	286078	91194	6294	0	19540 h/y		14.6 kg/h		4.7 kg/h		0.322 kg/h		-	-	10	-	-	-	7	-		
Loading ROM coal to trucks	300861	46264	5716	0	8221260 t/y		0.03660 kg/t		0.0056 kg/t		0.001 kg/t		-	-	10	-	-	-	-	-		
Hauling ROM coal from pit to hopper / ROM pad	305191	90186	9156	85	8221260 t/y		0.24748 kg/t		0.0731 kg/t		0.007 kg/t		-	-	-	4	185	11.8	-	-		
Unloading ROM coal to ROM hopper / pad	24664	10359	469	70	8221260 t/y		0.01 kg/t		0.0042 kg/t		0.000 kg/t		-	-	-	-	-	-	-	-		
ROM coal rehandle to hopper	24664	10359	469	0	2466378 t/y		0.01 kg/t		0.0042 kg/t		0.000 kg/t		-	-	-	-	-	-	-	-		
Transferring ROM coal by conveyor to CHPP	300	142	21	70	8221260 t/y		0.00012 kg/t		0.00006 kg/t		0.0000 kg/t		-	0.98	10	-	-	-	-	-		
Handling coal at CHPP	1499	709	21	70	8221260 t/y		0.00061 kg/t		0.00029 kg/t		0.0000 kg/t		-	0.98	10	-	-	-	-	-		
Dozers on ROM coal stockpiles	17880	5700	393	50	2442 h/y		14.6 kg/h		4.7 kg/h		0.322 kg/h		-	-	10	-	-	-	7	-		
Dozers on product coal stockpiles	9250	2666	204	50	2442 h/y		7.6 kg/h		2.2 kg/h		0.167 kg/h		-	-	12	-	-	-	5	-		
Conveyer to product stockpiles	198	94	14	70	7000000 t/y		0.00009 kg/t		0.00004 kg/t		0.0000 kg/t		-	0.98	12	-	-	-	-	-		
Loading product coal to trains	2800	1190	140	0	7000000 t/y		0.00040 kg/t		0.00017 kg/t		0.0000 kg/t		-	-	-	-	-	-	-	-		
Wind erosion from active pits	291708	145854	21878	0	333 ha		876.0 kg/ha/y		438.0 kg/ha/y		65.7 kg/ha/y		-	-	-	-	-	-	-	-		
Wind erosion from active dumps	685908	342954	51443	0	783 ha		876.0 kg/ha/y		438.0 kg/ha/y		65.7 kg/ha/y		-	-	-	-	-	-	-	-		
Wind erosion from inactive or partially rehabed dumps	170470	85235	12785	30	278 ha		876.0 kg/ha/y		438.0 kg/ha/y		65.7 kg/ha/y		-	-	-	-	-	-	-	-		
Wind erosion from ROM coal stockpiles	2190	1095	164	50	5 ha		876.0 kg/ha/y		438.0 kg/ha/y		65.7 kg/ha/y		-	-	-	-	-	-	-	-		
Wind erosion from product coal stockpile	1752	876	131	50	4 ha		876.0 kg/ha/y		438.0 kg/ha/y		65.7 kg/ha/y		-	-	-	-	-	-	-	-		
Grading roads	18464	6528	202	50	60000 km/y		0.61547 kg/VKT		0.2176 kg/VKT		0.007 kg/VKT		-	-	-	-	-	-	-	8		
	6354628	2106275	326642																			

Notes: production data supplied by BCOPL

Emission inventory 2028

Boggabri 2028																					
	Annual emissions (kg/y)						TSP		PM10		PM2.5				Variables						
Activity	TSP	PM10	PM2.5	Control (%)	Intensity	Units	Factor	Units	Factor	Units	Factor	Units	Blast area (m2)	(ws/2.2)^1.3	Moisture (%)	kg/VKT	t/truck	km/trip	Silt (%)	Speed (km/h)	
Topsoil - stripping	3661	922	183	50	252477 t/y		0.029 kg/t		0.0073 kg/t		0.001 kg/t		-	-	-	-	-	-	-	-	
Topsoil - loading to trucks	292	138	21	0	252477 t/y		0.00116 kg/t		0.00055 kg/t		0.0001 kg/t		-	0.98	2	-	-	-	-	-	
Topsoil - hauling to stockpiles	10496	3102	315	85	252477 t/y		0.27714 kg/t		0.0819 kg/t		0.008 kg/t		-	-	-	4	140	10	-	-	
Topsoil - unloading	292	138	21	0	252477 t/y		0.00116 kg/t		0.00055 kg/t		0.0001 kg/t		-	0.98	2	-	-	-	-	-	
Drilling overburden	8639	4493	259	70	48811 holes/y		0.59 kg/hole		0.31 kg/hole		0.018 kg/hole		-	-	-	-	-	-	-	-	
Blasting overburden	63000	32760	1890	0	104 blasts/y		605.8 kg/blast		315.0 kg/blast		18.2 kg/blast	19645	-	-	-	-	-	-	-	-	
Excavators loading overburden to trucks	190185	89952	13621	0	164331498 t/y		0.00116 kg/t		0.00055 kg/t		0.0001 kg/t		-	0.98	2	-	-	-	-	-	
Hauling overburden from pit to dump	2677946	791355	80338	85	164331498 t/y		0.10864 kg/t		0.0321 kg/t		0.003 kg/t		-	-	-	4	300	8.4	-	-	
Unloading overburden to dump	191110	90390	13688	0	165130633 t/y		0.00116 kg/t		0.00055 kg/t		0.0001 kg/t		-	0.98	2	-	-	-	-	-	
Dozers shaping overburden	1001262	243753	105133	0	59829 h/y		16.7 kg/h		4.0741 kg/h		1.757 kg/h		-	-	2	-	-	-	10	-	
Dozers working on overburden for rehabilitation	0	0	0	0	0 h/y		16.7 kg/h		4.0741 kg/h		1.757 kg/h		-	-	2	-	-	-	10	-	
Drilling coal	0	0	0	70	0 holes/y		0.59 kg/hole		0.31 kg/hole		0.018 kg/hole		-	-	-	-	-	-	-	-	
Blasting coal	0	0	0	0	0 blasts/y		605.8 kg/blast		315.0 kg/blast		18.2 kg/blast	19645	-	-	-	-	-	-	-	-	
Dozers working on coal	295261	94122	6496	0	20167 h/y		14.6 kg/h		4.7 kg/h		0.322 kg/h		-	-	10	-	-	-	7	-	
Loading ROM coal to trucks	314722	48396	5980	0	8600000 t/y		0.03660 kg/t		0.0056 kg/t		0.001 kg/t		-	-	10	-	-	-	-	-	
Hauling ROM coal from pit to hopper / ROM pad	335484	99138	10065	85	8600000 t/y		0.26006 kg/t		0.0769 kg/t		0.008 kg/t		-	-	-	4	185	12.4	-	-	
Unloading ROM coal to ROM hopper / pad	25800	10836	490	70	8600000 t/y		0.01 kg/t		0.0042 kg/t		0.000 kg/t		-	-	-	-	-	-	-	-	
ROM coal rehandle to hopper	25800	10836	490	0	2580000 t/y		0.01 kg/t		0.0042 kg/t		0.000 kg/t		-	-	-	-	-	-	-	-	
Transferring ROM coal by conveyor to CHPP	314	148	22	70	8600000 t/y		0.00012 kg/t		0.00006 kg/t		0.0000 kg/t		-	0.98	10	-	-	-	-	-	
Handling coal at CHPP	1569	742	22	70	8600000 t/y		0.00061 kg/t		0.00029 kg/t		0.0000 kg/t		-	0.98	10	-	-	-	-	-	
Dozers on ROM coal stockpiles	18454	5883	406	50	2521 h/y		14.6 kg/h		4.7 kg/h		0.322 kg/h		-	-	10	-	-	-	7	-	
Dozers on product coal stockpiles	9547	2751	210	50	2521 h/y		7.6 kg/h		2.2 kg/h		0.167 kg/h		-	-	12	-	-	-	5	-	
Conveyer to product stockpiles	213	101	15	70	7541535 t/y		0.00009 kg/t		0.00004 kg/t		0.0000 kg/t		-	0.98	12	-	-	-	-	-	
Loading product coal to trains	3017	1282	151	0	7541535 t/y		0.00040 kg/t		0.00017 kg/t		0.0000 kg/t		-	-	-	-	-	-	-	-	
Wind erosion from active pits	302220	151110	22667	0	345 ha		876.0 kg/ha/y		438.0 kg/ha/y		65.7 kg/ha/y		-	-	-	-	-	-	-	-	
Wind erosion from active dumps	777012	388506	58276	0	887 ha		876.0 kg/ha/y		438.0 kg/ha/y		65.7 kg/ha/y		-	-	-	-	-	-	-	-	
Wind erosion from inactive or partially rehabed dumps	213394	106697	16005	30	348 ha		876.0 kg/ha/y		438.0 kg/ha/y		65.7 kg/ha/y		-	-	-	-	-	-	-	-	
Wind erosion from ROM coal stockpiles	2190	1095	164	50	5 ha		876.0 kg/ha/y		438.0 kg/ha/y		65.7 kg/ha/y		-	-	-	-	-	-	-	-	
Wind erosion from product coal stockpile	1752	876	131	50	4 ha		876.0 kg/ha/y		438.0 kg/ha/y		65.7 kg/ha/y		-	-	-	-	-	-	-	-	
Grading roads	18464	6528	202	50	60000 km/y		0.61547 kg/VKT		0.2176 kg/VKT		0.007 kg/VKT		-	-	-	-	-	-	-	8	
	6492094	2186049	337261																		

Notes: production data supplied by BCOPL

Emission inventory

2036

Boggabri 2036

Boggabri 2036																				
	Annual emissions (kg/y)						TSP		PM10		PM2.5		Variables							
Activity	TSP	PM10	PM2.5	Control (%)	Intensity	Units	Factor	Units	Factor	Units	Factor	Units	Blast area (m ²)	(ws/2.2) ^{*1.3}	Moisture (%)	kg/VKT	t/truck	km/trip	Silt (%)	Speed (km/h)
Topsoil - stripping	3616	910	181	50	249385 t/y		0.029 kg/t		0.0073 kg/t		0.001 kg/t		-	-	-	-	-	-	-	-
Topsoil - loading to trucks	289	137	21	0	249385 t/y		0.00116 kg/t		0.00055 kg/t		0.0001 kg/t		-	0.98	2	-	-	-	-	-
Topsoil - hauling to stockpiles	10367	3064	311	85	249385 t/y		0.27714 kg/t		0.0819 kg/t		0.008 kg/t		-	-	-	4	140	10	-	-
Topsoil - unloading	289	137	21	0	249385 t/y		0.00116 kg/t		0.00055 kg/t		0.0001 kg/t		-	0.98	2	-	-	-	-	-
Drilling overburden	8639	4493	259	70	48811 holes/y		0.59 kg/hole		0.31 kg/hole		0.018 kg/hole		-	-	-	-	-	-	-	-
Blasting overburden	63000	32760	1890	0	104 blasts/y		605.8 kg/blast		315.0 kg/blast		18.2 kg/blast	19645	-	-	-	-	-	-	-	-
Excavators loading overburden to trucks	156696	74113	11223	0	135395357 t/y		0.00116 kg/t		0.00055 kg/t		0.0001 kg/t		-	0.98	2	-	-	-	-	-
Hauling overburden from pit to dump	2101336	620962	63040	85	135395357 t/y		0.10347 kg/t		0.0306 kg/t		0.003 kg/t		-	-	-	4	300	8	-	-
Unloading overburden to dump	157915	74689	11310	0	136448161 t/y		0.00116 kg/t		0.00055 kg/t		0.0001 kg/t		-	0.98	2	-	-	-	-	-
Dozers shaping overburden	877983	213741	92188	0	52463 h/y		16.7 kg/h		4.0741 kg/h		1.757 kg/h		-	-	2	-	-	-	10	-
Dozers working on overburden for rehabilitation	0	0	0	0	0 h/y		16.7 kg/h		4.0741 kg/h		1.757 kg/h		-	-	2	-	-	-	10	-
Drilling coal	0	0	0	70	0 holes/y		0.59 kg/hole		0.31 kg/hole		0.018 kg/hole		-	-	-	-	-	-	-	-
Blasting coal	0	0	0	0	0 blasts/y		605.8 kg/blast		315.0 kg/blast		18.2 kg/blast	19645	-	-	-	-	-	-	-	-
Dozers working on coal	255115	81324	5613	0	17425 h/y		14.6 kg/h		4.7 kg/h		0.322 kg/h		-	-	10	-	-	-	7	-
Loading ROM coal to trucks	289920	44582	5508	0	7922286 t/y		0.03660 kg/t		0.0056 kg/t		0.001 kg/t		-	-	10	-	-	-	-	-
Hauling ROM coal from pit to hopper / ROM pad	338954	100164	10169	85	7922286 t/y		0.28523 kg/t		0.0843 kg/t		0.009 kg/t		-	-	-	4	185	13.6	-	-
Unloading ROM coal to ROM hopper / pad	23767	9982	452	70	7922286 t/y		0.01 kg/t		0.0042 kg/t		0.000 kg/t		-	-	-	-	-	-	-	-
ROM coal rehandle to hopper	23767	9982	452	0	2376686 t/y		0.01 kg/t		0.0042 kg/t		0.000 kg/t		-	-	-	-	-	-	-	-
Transferring ROM coal by conveyor to CHPP	289	137	21	70	7922286 t/y		0.00012 kg/t		0.00006 kg/t		0.0000 kg/t		-	0.98	10	-	-	-	-	-
Handling coal at CHPP	1445	683	21	70	7922286 t/y		0.00061 kg/t		0.00029 kg/t		0.0000 kg/t		-	0.98	10	-	-	-	-	-
Dozers on ROM coal stockpiles	15945	5083	351	50	2178 h/y		14.6 kg/h		4.7 kg/h		0.322 kg/h		-	-	10	-	-	-	7	-
Dozers on product coal stockpiles	8249	2377	181	50	2178 h/y		7.6 kg/h		2.2 kg/h		0.167 kg/h		-	-	12	-	-	-	5	-
Conveyer to product stockpiles	193	91	14	70	6815483 t/y		0.00009 kg/t		0.00004 kg/t		0.0000 kg/t		-	0.98	12	-	-	-	-	-
Loading product coal to trains	2726	1159	136	0	6815483 t/y		0.00040 kg/t		0.00017 kg/t		0.0000 kg/t		-	-	-	-	-	-	-	-
Wind erosion from active pits	340764	170382	25557	0	389 ha		876.0 kg/ha/y		438.0 kg/ha/y		65.7 kg/ha/y		-	-	-	-	-	-	-	-
Wind erosion from active dumps	462528	231264	34690	0	528 ha		876.0 kg/ha/y		438.0 kg/ha/y		65.7 kg/ha/y		-	-	-	-	-	-	-	-
Wind erosion from inactive or partially rehabed dumps	405938	202969	30445	30	662 ha		876.0 kg/ha/y		438.0 kg/ha/y		65.7 kg/ha/y		-	-	-	-	-	-	-	-
Wind erosion from ROM coal stockpiles	2190	1095	164	50	5 ha		876.0 kg/ha/y		438.0 kg/ha/y		65.7 kg/ha/y		-	-	-	-	-	-	-	-
Wind erosion from product coal stockpile	1752	876	131	50	4 ha		876.0 kg/ha/y		438.0 kg/ha/y		65.7 kg/ha/y		-	-	-	-	-	-	-	-
Grading roads	18464	6528	202	50	60000 km/y		0.61547 kg/VKT		0.2176 kg/VKT		0.007 kg/VKT		-	-	-	-	-	-	-	8
	5572136	1893683	294550																	

Notes: production data supplied by BCOPL

2025

[illegible]

```

HOURS OF DAY :
0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0
ACTIVITY NAME : Dozers working on coal
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 286078 kg/y TSP 91194 kg/y PM10 6294 kg/y PM2.5
FROM SOURCES : 10
7 8 9 10 11 12 13 14 15 16
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ACTIVITY NAME : Loading ROM coal to trucks
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 300861 kg/y TSP 46264 kg/y PM10 5716 kg/y PM2.5
FROM SOURCES : 10
7 8 9 10 11 12 13 14 15 16
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ACTIVITY NAME : Hauling ROM coal from pit to hopper / ROM pad
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 305191 kg/y TSP 90186 kg/y PM10 9156 kg/y PM2.5
FROM SOURCES : 19
5 6 7 8 9 10 11 12 13 14 15 16 17 18 25 37 38 39 40
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ACTIVITY NAME : Unloading ROM coal to ROM hopper / pad
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 24664 kg/y TSP 10359 kg/y PM10 469 kg/y PM2.5
FROM SOURCES : 2
5 6
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ACTIVITY NAME : ROM coal rehandle to hopper
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 24664 kg/y TSP 10359 kg/y PM10 469 kg/y PM2.5
FROM SOURCES : 2
5 6
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ACTIVITY NAME : Transferring ROM coal by conveyor to CHPP
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 300 kg/y TSP 142 kg/y PM10 21 kg/y PM2.5
FROM SOURCES : 3
4 5 6
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ACTIVITY NAME : Handling coal at CHPP
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 1499 kg/y TSP 709 kg/y PM10 21 kg/y PM2.5
FROM SOURCES : 1
4
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ACTIVITY NAME : Dozers on ROM coal stockpiles
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 17880 kg/y TSP 5700 kg/y PM10 393 kg/y PM2.5
FROM SOURCES : 2
5 6
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ACTIVITY NAME : Dozers on product coal stockpiles
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 9250 kg/y TSP 2666 kg/y PM10 204 kg/y PM2.5
FROM SOURCES : 2
2 3
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ACTIVITY NAME : Conveyor to product stockpiles
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 198 kg/y TSP 94 kg/y PM10 14 kg/y PM2.5
FROM SOURCES : 2
2 3
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ACTIVITY NAME : Loading product coal to trains
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 2800 kg/y TSP 1190 kg/y PM10 140 kg/y PM2.5
FROM SOURCES : 1
1
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ACTIVITY NAME : Wind erosion from active pits
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 291708 kg/y TSP 145854 kg/y PM10 21878 kg/y PM2.5
FROM SOURCES : 11
7 8 9 10 11 12 13 14 15 16 21
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
ACTIVITY NAME : Wind erosion from active dumps
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 685908 kg/y TSP 342954 kg/y PM10 51443 kg/y PM2.5
FROM SOURCES : 19
17 18 19 20 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

```


ACTIVITY NAME : Dozers on product coal stockpiles
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 9547 kg/y TSP 2751 kg/y PM10 210 kg/y PM2.5

Source allocations
2036

Appendix D. Tabulated particulate matter model results

Boggabri Modification 10

Predicted maximum 24-hour average PM10 concentrations (ug/m3)

ID	Status	Due to BCM only			Cumulative			Criteria
		2025	2028	2036	2025	2028	2036	
1	Whitehaven Coal Mining	24.0	23.8	14.5	58	58	52	50
4	Private	19.1	19.1	13.0	55	55	51	50
18	Boggabri Coal	19.3	18.8	12.5	55	55	51	50
20	Boggabri Coal	12.2	11.6	7.5	54	54	50	50
23	Boggabri Coal	14.9	14.9	11.3	50	50	49	50
25	Boggabri Coal	15.0	14.8	10.9	68	69	52	50
27	Boggabri Coal	12.2	12.7	9.1	64	64	51	50
32	Whitehaven Coal Mining	9.7	9.5	6.9	56	56	51	50
33	Whitehaven Coal Mining	12.2	12.3	8.1	50	50	49	50
35	Mining Joint Ownership	13.6	13.6	9.5	50	50	49	50
43	Whitehaven Coal Mining	11.9	12.0	8.4	50	50	49	50
44	Private	8.7	9.4	9.1	59	60	51	50
48	Private	8.0	8.8	7.4	54	54	50	50
52	Boggabri Coal	3.3	3.5	2.6	49	49	48	50
54	Mining Joint Ownership	9.3	9.5	6.3	52	52	50	50
63	Whitehaven Coal Mining	6.8	7.5	7.0	51	51	49	50
67	Boggabri Coal	12.0	12.0	7.8	50	50	49	50
68	Boggabri Coal	6.8	6.7	6.8	56	57	50	50
69	Boggabri Coal	12.5	13.7	12.1	62	63	52	50
79	Boggabri Coal	14.7	15.2	14.6	75	76	53	50
85	Whitehaven Coal Mining	14.5	15.7	14.4	67	68	53	50
86	Whitehaven Coal Mining	31.6	30.3	27.3	77	77	66	50
88	Whitehaven Coal Mining	14.9	15.2	13.5	55	55	52	50
90	Private	10.6	10.8	10.5	52	52	50	50
94	Mining Joint Ownership	6.1	6.4	5.4	49	49	48	50
95	Mining Joint Ownership	2.9	3.2	3.2	50	50	49	50
98	Whitehaven Coal Mining	10.9	11.2	8.0	54	54	48	50
100	Whitehaven Coal Mining	10.2	10.5	8.0	55	55	48	50
115	Private	4.2	4.3	3.4	52	52	48	50
140	Private	5.1	5.0	3.8	53	53	48	50
147	Private	12.3	13.1	11.9	54	54	48	50
158	Private	5.0	5.1	4.0	52	52	48	50
159	Whitehaven Coal Mining	5.7	6.0	3.9	52	52	48	50
182	Whitehaven Coal Mining	9.8	10.5	9.1	50	50	48	50
181	Whitehaven Coal Mining	8.7	9.5	10.1	50	50	48	50
180	Whitehaven Coal Mining	6.0	6.2	5.0	56	56	48	50
179	Boggabri Coal	2.9	3.2	4.2	59	60	48	50
178	Boggabri Coal	7.5	8.3	8.6	50	50	48	50
177	Boggabri Coal	2.6	2.7	3.3	49	49	48	50
176	Boggabri Coal	2.8	2.8	3.8	49	49	48	50
185	Whitehaven Coal Mining	3.3	3.8	5.0	49	49	48	50
186	Whitehaven Coal Mining	5.7	6.0	6.0	49	49	48	50
187	Whitehaven Coal Mining	5.4	5.7	5.6	49	49	48	50
192	Whitehaven Coal Mining	5.6	5.7	3.9	49	49	49	50
190	Whitehaven Coal Mining	2.6	2.9	3.6	57	58	48	50
165	Private	6.2	6.7	5.0	51	51	48	50
191	Whitehaven Coal Mining	6.3	7.1	8.7	50	50	48	50
193	Whitehaven Coal Mining	3.9	4.3	4.6	49	49	48	50
164	Private	5.9	6.6	7.3	49	49	48	50
194	Whitehaven Coal Mining	6.8	7.6	8.2	49	49	48	50
188	Whitehaven Coal Mining	4.1	4.6	5.5	49	49	49	50
189	Whitehaven Coal Mining	14.3	15.5	9.9	181	181	49	50
174	Whitehaven Coal Mining	12.7	12.9	9.3	184	184	49	50

Boggabri Modification 10

Number of days above 50 ug/m3 PM10 concentrations

ID	Status	Due to BCM only			Cumulative			Criteria
		2025	2028	2036	2025	2028	2036	
1	Whitehaven Coal Mining	0	0	0	1	1	0	-
4	Private	0	0	0	0	0	0	-
18	Boggabri Coal	0	0	0	0	0	0	-
20	Boggabri Coal	0	0	0	0	0	0	-
23	Boggabri Coal	0	0	0	0	0	0	-
25	Boggabri Coal	0	0	0	0	0	0	-
27	Boggabri Coal	0	0	0	0	0	0	-
32	Whitehaven Coal Mining	0	0	0	0	0	0	-
33	Whitehaven Coal Mining	0	0	0	0	0	0	-
35	Mining Joint Ownership	0	0	0	0	0	0	-
43	Whitehaven Coal Mining	0	0	0	0	0	0	-
44	Private	0	0	0	0	0	0	-
48	Private	0	0	0	1	1	0	-
52	Boggabri Coal	0	0	0	1	1	1	-
54	Mining Joint Ownership	0	0	0	6	5	1	-
63	Whitehaven Coal Mining	0	0	0	7	7	1	-
67	Boggabri Coal	0	0	0	2	2	1	-
68	Boggabri Coal	0	0	0	2	2	1	-
69	Boggabri Coal	0	0	0	2	2	0	-
79	Boggabri Coal	0	0	0	1	1	0	-
85	Whitehaven Coal Mining	0	0	0	9	8	1	-
86	Whitehaven Coal Mining	0	0	0	5	5	1	-
88	Whitehaven Coal Mining	0	0	0	5	5	1	-
90	Private	0	0	0	0	0	0	-
94	Mining Joint Ownership	0	0	0	1	1	0	-
95	Mining Joint Ownership	0	0	0	0	0	0	-
98	Whitehaven Coal Mining	0	0	0	2	2	1	-
100	Whitehaven Coal Mining	0	0	0	2	2	0	-
115	Private	0	0	0	0	0	0	-
140	Private	0	0	0	1	1	0	-
147	Private	0	0	0	1	1	0	-
158	Private	0	0	0	0	0	0	-
159	Whitehaven Coal Mining	0	0	0	2	2	1	-
182	Whitehaven Coal Mining	0	0	0	5	5	2	-
181	Whitehaven Coal Mining	0	0	0	19	20	2	-
180	Whitehaven Coal Mining	0	0	0	16	16	2	-
179	Boggabri Coal	0	0	0	47	48	13	-
178	Boggabri Coal	0	0	0	1	1	1	-
177	Boggabri Coal	0	0	0	1	1	1	-
176	Boggabri Coal	0	0	0	0	0	0	-
185	Whitehaven Coal Mining	0	0	0	1	1	0	-
186	Whitehaven Coal Mining	0	0	0	1	1	0	-
187	Whitehaven Coal Mining	0	0	0	1	1	0	-
192	Whitehaven Coal Mining	0	0	0	1	1	0	-
190	Whitehaven Coal Mining	0	0	0	2	2	0	-
165	Private	0	0	0	1	1	0	-
191	Whitehaven Coal Mining	0	0	0	1	1	0	-
193	Whitehaven Coal Mining	0	0	0	1	1	0	-
164	Private	0	0	0	1	1	0	-
194	Whitehaven Coal Mining	0	0	0	1	1	0	-
188	Whitehaven Coal Mining	0	0	0	1	1	0	-
189	Whitehaven Coal Mining	0	0	0	2	2	0	-
174	Whitehaven Coal Mining	0	0	0	0	0	0	-

Boggabri Modification 10

Predicted annual average PM10 concentrations (ug/m3)

ID	Status	Due to BCM only			Cumulative			Criteria
		2025	2028	2036	2025	2028	2036	
1	Whitehaven Coal Mining	1.7	1.8	1.9	18.1	18.2	16.2	25
4	Private	0.3	0.3	0.3	15.2	15.2	14.7	25
18	Boggabri Coal	0.2	0.2	0.2	14.9	14.9	14.6	25
20	Boggabri Coal	0.3	0.3	0.3	15.2	15.2	14.7	25
23	Boggabri Coal	0.5	0.5	0.5	15.7	15.7	14.9	25
25	Boggabri Coal	0.4	0.4	0.4	15.5	15.5	14.8	25
27	Boggabri Coal	0.5	0.5	0.4	15.5	15.5	14.8	25
32	Whitehaven Coal Mining	0.4	0.4	0.4	15.3	15.3	14.8	25
33	Whitehaven Coal Mining	0.6	0.6	0.6	15.5	15.5	15.0	25
35	Mining Joint Ownership	0.7	0.7	0.6	15.9	15.9	15.0	25
43	Whitehaven Coal Mining	0.7	0.7	0.6	15.8	15.8	15.0	25
44	Private	0.6	0.6	0.5	15.5	15.5	14.9	25
48	Private	1.2	1.3	1.2	16.3	16.4	15.6	25
52	Boggabri Coal	2.1	2.2	1.9	17.6	17.6	16.3	25
54	Mining Joint Ownership	3.5	3.4	2.5	19.9	19.8	16.8	25
63	Whitehaven Coal Mining	4.5	4.5	2.6	20.8	20.8	16.8	25
67	Boggabri Coal	2.3	2.3	1.4	17.9	18.0	15.8	25
68	Boggabri Coal	2.3	2.4	1.4	18.0	18.0	15.8	25
69	Boggabri Coal	1.6	1.6	1.0	17.2	17.2	15.4	25
79	Boggabri Coal	1.6	1.6	1.3	16.7	16.7	15.6	25
85	Whitehaven Coal Mining	2.7	2.6	1.9	20.3	20.2	16.3	25
86	Whitehaven Coal Mining	2.1	2.0	1.5	18.5	18.5	15.8	25
88	Whitehaven Coal Mining	1.8	1.7	1.2	18.2	18.1	15.6	25
90	Private	1.1	1.1	1.1	16.1	16.1	15.4	25
94	Mining Joint Ownership	1.4	1.4	1.1	16.5	16.5	15.5	25
95	Mining Joint Ownership	1.2	1.2	1.0	16.3	16.3	15.3	25
98	Whitehaven Coal Mining	1.6	1.6	1.1	17.8	17.8	15.5	25
100	Whitehaven Coal Mining	1.1	1.1	0.8	16.7	16.7	15.2	25
115	Private	0.3	0.3	0.3	15.0	15.0	14.7	25
140	Private	1.3	1.4	0.9	16.5	16.6	15.3	25
147	Private	1.1	1.1	0.8	16.4	16.4	15.2	25
158	Private	1.0	1.0	1.0	16.0	16.0	15.4	25
159	Whitehaven Coal Mining	1.3	1.3	1.0	17.3	17.3	15.3	25
182	Whitehaven Coal Mining	2.6	2.6	1.7	20.5	20.4	16.1	25
181	Whitehaven Coal Mining	3.5	3.3	2.2	24.2	24.1	16.5	25
180	Whitehaven Coal Mining	3.5	3.4	2.2	23.7	23.6	16.5	25
179	Boggabri Coal	12.7	12.8	11.1	35.6	35.8	25.3	25
178	Boggabri Coal	3.9	3.9	3.7	21.6	21.6	18.0	25
177	Boggabri Coal	1.8	1.8	1.8	17.6	17.6	16.1	25
176	Boggabri Coal	0.6	0.6	0.5	15.9	15.9	14.9	25
185	Whitehaven Coal Mining	0.5	0.5	0.4	15.4	15.4	14.8	25
186	Whitehaven Coal Mining	0.6	0.7	0.5	16.1	16.1	14.9	25
187	Whitehaven Coal Mining	0.7	0.7	0.5	16.2	16.2	14.9	25
192	Whitehaven Coal Mining	0.6	0.6	0.5	18.4	18.4	14.9	25
190	Whitehaven Coal Mining	0.6	0.7	0.6	18.6	18.7	15.0	25
165	Private	1.4	1.4	1.2	22.3	22.4	15.6	25
191	Whitehaven Coal Mining	0.7	0.8	0.6	19.2	19.2	15.0	25
193	Whitehaven Coal Mining	0.7	0.7	0.6	18.5	18.5	15.0	25
164	Private	0.9	0.9	0.8	18.5	18.5	15.2	25
194	Whitehaven Coal Mining	0.9	1.0	0.9	18.0	18.0	15.3	25
188	Whitehaven Coal Mining	0.6	0.6	0.5	16.5	16.5	14.9	25
189	Whitehaven Coal Mining	0.5	0.5	0.5	17.2	17.2	14.9	25
174	Whitehaven Coal Mining	1.1	1.2	1.2	16.8	16.8	15.5	25

Boggabri Modification 10

Predicted maximum 24-hour average PM2.5 concentrations (ug/m3)

ID	Status	Due to BCM only			Cumulative			Criteria
		2025	2028	2036	2025	2028	2036	
1	Whitehaven Coal Mining	2.1	2.4	2.8	22.0	21.9	19.4	25
4	Private	0.5	0.5	0.6	21.3	21.3	19.3	25
18	Boggabri Coal	0.7	0.7	0.6	21.3	21.3	19.3	25
20	Boggabri Coal	0.8	0.8	0.8	21.4	21.4	19.3	25
23	Boggabri Coal	1.3	1.2	1.0	21.5	21.5	19.4	25
25	Boggabri Coal	1.1	1.1	1.0	21.4	21.4	19.3	25
27	Boggabri Coal	1.1	1.0	0.9	21.5	21.4	19.4	25
32	Whitehaven Coal Mining	0.9	1.0	0.7	21.5	21.4	19.4	25
33	Whitehaven Coal Mining	1.0	1.1	1.5	21.6	21.5	19.4	25
35	Mining Joint Ownership	1.3	1.2	1.0	21.6	21.5	19.4	25
43	Whitehaven Coal Mining	1.1	1.1	1.0	21.6	21.6	19.5	25
44	Private	1.0	1.0	1.2	21.6	21.5	19.4	25
48	Private	2.5	2.4	1.8	21.9	21.9	19.6	25
52	Boggabri Coal	3.1	3.0	2.6	22.4	22.3	19.9	25
54	Mining Joint Ownership	3.7	3.3	2.5	23.3	23.1	20.4	25
63	Whitehaven Coal Mining	6.8	6.5	3.8	24.2	24.3	20.5	25
67	Boggabri Coal	4.1	4.4	3.0	22.7	22.9	20.1	25
68	Boggabri Coal	4.1	4.4	2.9	22.7	22.8	20.1	25
69	Boggabri Coal	3.0	3.1	2.0	22.3	22.3	19.7	25
79	Boggabri Coal	2.8	2.6	2.2	21.9	21.8	19.6	25
85	Whitehaven Coal Mining	3.6	3.0	2.5	24.4	24.1	20.5	25
86	Whitehaven Coal Mining	2.9	2.5	1.9	23.4	23.2	20.2	25
88	Whitehaven Coal Mining	2.4	2.2	1.6	23.6	23.4	20.1	25
90	Private	2.5	2.5	1.7	21.8	21.7	19.5	25
94	Mining Joint Ownership	2.6	2.5	1.9	21.8	21.8	19.6	25
95	Mining Joint Ownership	2.3	2.3	1.6	21.8	21.7	19.5	25
98	Whitehaven Coal Mining	2.4	2.2	2.2	23.3	23.3	20.0	25
100	Whitehaven Coal Mining	2.0	2.1	1.8	22.4	22.4	19.7	25
115	Private	0.8	0.8	0.6	21.3	21.3	19.3	25
140	Private	2.7	2.7	1.7	22.2	22.2	19.7	25
147	Private	1.8	1.7	1.7	22.1	22.1	19.6	25
158	Private	2.4	2.4	1.7	21.7	21.7	19.5	25
159	Whitehaven Coal Mining	1.9	1.7	1.6	23.1	23.0	19.9	25
182	Whitehaven Coal Mining	3.7	3.3	2.8	24.4	24.3	20.4	25
181	Whitehaven Coal Mining	4.7	3.9	3.3	25.9	25.6	20.8	25
180	Whitehaven Coal Mining	4.8	4.1	3.3	25.6	25.5	20.7	25
179	Boggabri Coal	6.8	5.8	5.7	27.2	26.3	22.9	25
178	Boggabri Coal	4.3	3.3	3.0	23.4	23.1	20.6	25
177	Boggabri Coal	2.4	2.2	2.4	22.4	22.2	19.9	25
176	Boggabri Coal	1.3	1.3	1.2	21.5	21.5	19.4	25
185	Whitehaven Coal Mining	0.7	0.8	0.8	21.8	21.8	19.5	25
186	Whitehaven Coal Mining	2.6	2.7	2.2	21.8	21.8	19.3	25
187	Whitehaven Coal Mining	2.4	2.4	2.2	22.0	22.1	19.3	25
192	Whitehaven Coal Mining	0.8	0.9	0.8	22.3	22.3	19.3	25
190	Whitehaven Coal Mining	1.1	1.1	0.8	22.2	22.2	19.3	25
165	Private	2.4	2.7	2.7	22.9	22.9	19.3	25
191	Whitehaven Coal Mining	1.0	1.0	0.9	22.5	22.5	19.3	25
193	Whitehaven Coal Mining	1.1	1.2	0.8	22.3	22.3	19.2	25
164	Private	2.1	2.2	2.1	21.8	21.8	19.2	25
194	Whitehaven Coal Mining	1.9	2.1	2.3	21.8	21.8	19.2	25
188	Whitehaven Coal Mining	1.3	1.3	1.3	22.2	22.2	19.3	25
189	Whitehaven Coal Mining	0.8	0.8	1.0	22.6	22.6	19.3	25
174	Whitehaven Coal Mining	1.7	1.8	1.9	21.6	21.6	19.3	25

Boggabri Modification 10

Predicted annual average PM2.5 concentrations (ug/m3)

ID	Status	Due to BCM only			Cumulative			Criteria
		2025	2028	2036	2025	2028	2036	
1	Whitehaven Coal Mining	0.4	0.4	0.5	7.2	7.2	6.2	8
4	Private	0.1	0.1	0.1	6.5	6.5	5.8	8
18	Boggabri Coal	0.1	0.1	0.1	6.5	6.5	5.8	8
20	Boggabri Coal	0.1	0.1	0.1	6.6	6.5	5.9	8
23	Boggabri Coal	0.2	0.1	0.1	6.7	6.7	5.9	8
25	Boggabri Coal	0.1	0.1	0.1	6.6	6.6	5.9	8
27	Boggabri Coal	0.1	0.1	0.1	6.6	6.6	5.9	8
32	Whitehaven Coal Mining	0.1	0.1	0.1	6.6	6.6	5.9	8
33	Whitehaven Coal Mining	0.2	0.2	0.2	6.6	6.6	5.9	8
35	Mining Joint Ownership	0.2	0.2	0.2	6.7	6.7	5.9	8
43	Whitehaven Coal Mining	0.2	0.2	0.2	6.7	6.7	5.9	8
44	Private	0.2	0.2	0.2	6.7	6.6	5.9	8
48	Private	0.3	0.3	0.3	6.9	6.8	6.1	8
52	Boggabri Coal	0.6	0.5	0.5	7.2	7.1	6.2	8
54	Mining Joint Ownership	0.9	0.8	0.6	7.7	7.6	6.4	8
63	Whitehaven Coal Mining	1.3	1.4	0.7	8.2	8.2	6.5	8
67	Boggabri Coal	0.7	0.7	0.4	7.3	7.4	6.2	8
68	Boggabri Coal	0.7	0.7	0.4	7.3	7.4	6.2	8
69	Boggabri Coal	0.5	0.5	0.3	7.1	7.1	6.1	8
79	Boggabri Coal	0.4	0.4	0.3	6.9	6.9	6.1	8
85	Whitehaven Coal Mining	0.8	0.7	0.5	7.9	7.8	6.2	8
86	Whitehaven Coal Mining	0.6	0.5	0.4	7.5	7.4	6.1	8
88	Whitehaven Coal Mining	0.5	0.5	0.3	7.4	7.3	6.1	8
90	Private	0.3	0.3	0.3	6.8	6.8	6.0	8
94	Mining Joint Ownership	0.3	0.3	0.3	6.9	6.8	6.0	8
95	Mining Joint Ownership	0.3	0.3	0.2	6.8	6.8	6.0	8
98	Whitehaven Coal Mining	0.5	0.5	0.3	7.3	7.3	6.1	8
100	Whitehaven Coal Mining	0.3	0.3	0.2	7.0	7.0	6.0	8
115	Private	0.1	0.1	0.1	6.5	6.5	5.8	8
140	Private	0.4	0.4	0.3	7.0	7.0	6.0	8
147	Private	0.3	0.3	0.2	6.9	6.9	6.0	8
158	Private	0.3	0.3	0.3	6.8	6.7	6.0	8
159	Whitehaven Coal Mining	0.4	0.4	0.3	7.1	7.1	6.0	8
182	Whitehaven Coal Mining	0.8	0.8	0.5	8.0	7.9	6.2	8
181	Whitehaven Coal Mining	1.0	1.0	0.6	8.9	8.8	6.4	8
180	Whitehaven Coal Mining	1.1	1.0	0.6	8.8	8.7	6.4	8
179	Boggabri Coal	2.5	2.1	2.0	10.3	9.9	7.8	8
178	Boggabri Coal	1.0	0.9	0.9	8.1	7.9	6.6	8
177	Boggabri Coal	0.5	0.5	0.4	7.2	7.1	6.2	8
176	Boggabri Coal	0.2	0.2	0.1	6.7	6.7	5.9	8
185	Whitehaven Coal Mining	0.2	0.1	0.1	6.6	6.6	5.9	8
186	Whitehaven Coal Mining	0.2	0.2	0.1	6.8	6.8	5.9	8
187	Whitehaven Coal Mining	0.2	0.2	0.1	6.8	6.8	5.9	8
192	Whitehaven Coal Mining	0.2	0.2	0.1	7.3	7.3	5.9	8
190	Whitehaven Coal Mining	0.2	0.2	0.2	7.4	7.4	5.9	8
165	Private	0.3	0.3	0.3	8.0	8.0	6.1	8
191	Whitehaven Coal Mining	0.2	0.2	0.2	7.5	7.5	5.9	8
193	Whitehaven Coal Mining	0.2	0.2	0.2	7.3	7.3	5.9	8
164	Private	0.2	0.2	0.2	7.2	7.2	6.0	8
194	Whitehaven Coal Mining	0.2	0.2	0.2	7.1	7.1	6.0	8
188	Whitehaven Coal Mining	0.2	0.2	0.1	6.9	6.9	5.9	8
189	Whitehaven Coal Mining	0.1	0.2	0.1	7.1	7.1	5.9	8
174	Whitehaven Coal Mining	0.3	0.3	0.3	6.9	6.9	6.0	8

Boggabri Modification 10

Predicted annual average TSP concentrations (ug/m3)

ID	Status	Due to BCM only			Cumulative			Criteria
		2025	2028	2036	2025	2028	2036	
1	Whitehaven Coal Mining	0.9	0.9	1.1	48.7	48.7	48.1	90
4	Private	0.1	0.1	0.1	47.3	47.3	47.1	90
18	Boggabri Coal	0.1	0.1	0.1	47.2	47.2	47.1	90
20	Boggabri Coal	0.1	0.1	0.1	47.3	47.3	47.1	90
23	Boggabri Coal	0.2	0.2	0.2	47.5	47.5	47.2	90
25	Boggabri Coal	0.2	0.2	0.2	47.4	47.4	47.1	90
27	Boggabri Coal	0.2	0.2	0.2	47.4	47.4	47.1	90
32	Whitehaven Coal Mining	0.1	0.1	0.1	47.3	47.3	47.1	90
33	Whitehaven Coal Mining	0.2	0.2	0.2	47.3	47.4	47.2	90
35	Mining Joint Ownership	0.2	0.2	0.2	47.6	47.6	47.2	90
43	Whitehaven Coal Mining	0.2	0.2	0.2	47.5	47.5	47.2	90
44	Private	0.2	0.2	0.2	47.4	47.4	47.2	90
48	Private	0.5	0.5	0.6	47.7	47.7	47.6	90
52	Boggabri Coal	0.9	0.9	1.0	48.3	48.3	47.9	90
54	Mining Joint Ownership	1.2	1.2	1.0	49.1	49.1	47.9	90
63	Whitehaven Coal Mining	2.3	2.4	1.5	50.0	50.0	48.3	90
67	Boggabri Coal	1.0	1.0	0.6	48.5	48.5	47.6	90
68	Boggabri Coal	0.9	1.0	0.6	48.4	48.5	47.5	90
69	Boggabri Coal	0.5	0.6	0.3	48.0	48.0	47.3	90
79	Boggabri Coal	0.7	0.7	0.6	47.9	47.9	47.5	90
85	Whitehaven Coal Mining	0.6	0.6	0.6	48.9	48.9	47.5	90
86	Whitehaven Coal Mining	0.5	0.4	0.4	48.2	48.2	47.4	90
88	Whitehaven Coal Mining	0.4	0.4	0.3	47.9	47.9	47.3	90
90	Private	0.5	0.5	0.5	47.6	47.7	47.5	90
94	Mining Joint Ownership	0.5	0.5	0.5	47.8	47.8	47.4	90
95	Mining Joint Ownership	0.5	0.5	0.4	47.7	47.7	47.4	90
98	Whitehaven Coal Mining	0.4	0.4	0.4	48.0	48.1	47.4	90
100	Whitehaven Coal Mining	0.4	0.4	0.3	47.8	47.8	47.3	90
115	Private	0.1	0.1	0.1	47.2	47.2	47.1	90
140	Private	0.6	0.7	0.5	47.9	48.0	47.4	90
147	Private	0.5	0.5	0.4	47.8	47.8	47.3	90
158	Private	0.4	0.4	0.5	47.6	47.6	47.5	90
159	Whitehaven Coal Mining	0.3	0.3	0.3	47.8	47.8	47.3	90
182	Whitehaven Coal Mining	0.7	0.7	0.7	49.4	49.4	47.6	90
181	Whitehaven Coal Mining	0.9	0.9	0.8	51.5	51.5	47.8	90
180	Whitehaven Coal Mining	1.0	1.0	0.9	51.2	51.2	47.8	90
179	Boggabri Coal	10.2	10.6	10.0	66.0	66.4	56.8	90
178	Boggabri Coal	1.6	1.7	2.1	50.7	50.8	49.0	90
177	Boggabri Coal	0.6	0.7	0.8	48.2	48.3	47.8	90
176	Boggabri Coal	0.2	0.2	0.2	47.6	47.6	47.2	90
185	Whitehaven Coal Mining	0.1	0.1	0.1	47.2	47.2	47.1	90
186	Whitehaven Coal Mining	0.2	0.2	0.1	47.5	47.5	47.1	90
187	Whitehaven Coal Mining	0.2	0.2	0.1	47.5	47.5	47.1	90
192	Whitehaven Coal Mining	0.2	0.2	0.2	48.6	48.6	47.2	90
190	Whitehaven Coal Mining	0.2	0.2	0.2	48.4	48.4	47.2	90
165	Private	0.7	0.7	0.7	51.8	51.8	47.6	90
191	Whitehaven Coal Mining	0.3	0.3	0.2	49.0	49.0	47.2	90
193	Whitehaven Coal Mining	0.3	0.3	0.2	48.8	48.8	47.2	90
164	Private	0.4	0.4	0.4	49.2	49.3	47.4	90
194	Whitehaven Coal Mining	0.4	0.5	0.5	48.8	48.8	47.4	90
188	Whitehaven Coal Mining	0.1	0.2	0.1	47.6	47.6	47.1	90
189	Whitehaven Coal Mining	0.1	0.1	0.1	47.9	47.9	47.1	90
174	Whitehaven Coal Mining	0.5	0.6	0.7	48.1	48.1	47.6	90

Boggabri Modification 10

Predicted annual average dust deposition (g/m2/month)

ID	Status	Due to BCM only			Cumulative			Criteria
		2025	2028	2036	2025	2028	2036	
1	Whitehaven Coal Mining	0.1	0.1	0.2	2.8	2.8	2.7	4
4	Private	0.0	0.0	0.0	2.6	2.6	2.6	4
18	Boggabri Coal	0.0	0.0	0.0	2.6	2.6	2.6	4
20	Boggabri Coal	0.0	0.0	0.0	2.6	2.6	2.6	4
23	Boggabri Coal	0.0	0.0	0.0	2.7	2.7	2.6	4
25	Boggabri Coal	0.0	0.0	0.0	2.7	2.7	2.6	4
27	Boggabri Coal	0.0	0.0	0.0	2.7	2.7	2.6	4
32	Whitehaven Coal Mining	0.0	0.0	0.0	2.6	2.6	2.6	4
33	Whitehaven Coal Mining	0.0	0.0	0.0	2.6	2.6	2.6	4
35	Mining Joint Ownership	0.0	0.0	0.0	2.7	2.7	2.6	4
43	Whitehaven Coal Mining	0.0	0.0	0.0	2.7	2.7	2.6	4
44	Private	0.0	0.0	0.0	2.6	2.6	2.6	4
48	Private	0.1	0.1	0.1	2.7	2.7	2.7	4
52	Boggabri Coal	0.1	0.1	0.1	2.7	2.8	2.7	4
54	Mining Joint Ownership	0.1	0.1	0.1	2.8	2.8	2.7	4
63	Whitehaven Coal Mining	0.5	0.5	0.3	3.2	3.2	2.9	4
67	Boggabri Coal	0.2	0.2	0.1	2.8	2.8	2.7	4
68	Boggabri Coal	0.1	0.1	0.1	2.8	2.8	2.7	4
69	Boggabri Coal	0.1	0.1	0.0	2.8	2.8	2.6	4
79	Boggabri Coal	0.1	0.1	0.1	2.7	2.7	2.7	4
85	Whitehaven Coal Mining	0.1	0.1	0.1	2.8	2.8	2.6	4
86	Whitehaven Coal Mining	0.0	0.0	0.0	2.7	2.7	2.6	4
88	Whitehaven Coal Mining	0.0	0.0	0.0	2.7	2.7	2.6	4
90	Private	0.1	0.1	0.1	2.7	2.7	2.7	4
94	Mining Joint Ownership	0.1	0.1	0.0	2.7	2.7	2.6	4
95	Mining Joint Ownership	0.0	0.0	0.0	2.7	2.7	2.6	4
98	Whitehaven Coal Mining	0.0	0.1	0.1	2.7	2.7	2.6	4
100	Whitehaven Coal Mining	0.1	0.1	0.1	2.7	2.7	2.6	4
115	Private	0.0	0.0	0.0	2.6	2.6	2.6	4
140	Private	0.1	0.1	0.1	2.8	2.8	2.7	4
147	Private	0.1	0.1	0.1	2.7	2.7	2.7	4
158	Private	0.1	0.1	0.1	2.7	2.7	2.6	4
159	Whitehaven Coal Mining	0.0	0.0	0.0	2.7	2.7	2.6	4
182	Whitehaven Coal Mining	0.1	0.1	0.1	2.9	2.9	2.7	4
181	Whitehaven Coal Mining	0.1	0.1	0.1	3.2	3.2	2.7	4
180	Whitehaven Coal Mining	0.1	0.1	0.1	3.1	3.2	2.7	4
179	Boggabri Coal	0.9	0.9	0.8	4.3	4.3	3.4	4
178	Boggabri Coal	0.2	0.2	0.2	3.0	3.0	2.8	4
177	Boggabri Coal	0.1	0.1	0.1	2.7	2.7	2.7	4
176	Boggabri Coal	0.0	0.0	0.0	2.7	2.7	2.6	4
185	Whitehaven Coal Mining	0.0	0.0	0.0	2.6	2.6	2.6	4
186	Whitehaven Coal Mining	0.0	0.0	0.0	2.7	2.7	2.6	4
187	Whitehaven Coal Mining	0.0	0.0	0.0	2.7	2.7	2.6	4
192	Whitehaven Coal Mining	0.0	0.0	0.0	2.8	2.8	2.6	4
190	Whitehaven Coal Mining	0.0	0.0	0.0	2.7	2.7	2.6	4
165	Private	0.1	0.1	0.1	3.1	3.1	2.7	4
191	Whitehaven Coal Mining	0.0	0.0	0.0	2.8	2.8	2.6	4
193	Whitehaven Coal Mining	0.0	0.0	0.0	2.8	2.8	2.6	4
164	Private	0.0	0.1	0.1	2.8	2.9	2.6	4
194	Whitehaven Coal Mining	0.1	0.1	0.1	2.8	2.8	2.7	4
188	Whitehaven Coal Mining	0.0	0.0	0.0	2.7	2.7	2.6	4
189	Whitehaven Coal Mining	0.0	0.0	0.0	2.7	2.7	2.6	4
174	Whitehaven Coal Mining	0.1	0.1	0.1	2.7	2.7	2.7	4

Appendix E. Greenhouse gas emissions

BCM with Modification 10

Diesel usage										

Blasting emissions										
Year	ROM coal (t)	Explosives (t)	Emission factor (t CO ₂ -e/t Explosives)			Emissions (t CO ₂ -e/year)			Total	
			Scope 1	Scope 2	Scope 3	Scope 1	Scope 2	Scope 3		
2025	8,221,260	26,308	0.17	0	0	4,472	-	-	4,472	
2026	8,449,918	27,040	0.17	0	0	4,597	-	-	4,597	
2027	8,349,901	26,720	0.17	0	0	4,542	-	-	4,542	
2028	8,349,897	26,720	0.17	0	0	4,542	-	-	4,542	
2029	8,308,968	26,589	0.17	0	0	4,520	-	-	4,520	
2030	8,299,942	26,560	0.17	0	0	4,515	-	-	4,515	
2031	8,269,517	26,462	0.17	0	0	4,499	-	-	4,499	
2032	8,499,907	27,200	0.17	0	0	4,624	-	-	4,624	
2033	8,499,889	27,200	0.17	0	0	4,624	-	-	4,624	
2034	8,499,924	27,200	0.17	0	0	4,624	-	-	4,624	
2035	7,939,705	25,407	0.17	0	0	4,319	-	-	4,319	
2036	7,922,286	25,351	0.17	0	0	4,310	-	-	4,310	
2037	6,473,890	20,716	0.17	0	0	3,522	-	-	3,522	
2038	6,450,600	20,642	0.17	0	0	3,509	-	-	3,509	
2039	2,983,184	9,546	0.17	0	0	1,623	-	-	1,623	
2040	1,001,331	3,204	0.17	0	0	545	-	-	545	
Average									3,962	
Total									63,387	

Electricity usage										
Year	ROM coal (t)	Usage (kWh)	Emission factor (kg CO ₂ -e/kWh)			Emissions (t CO ₂ -e/year)			Total	
			Scope 1	Scope 2	Scope 3	Scope 1	Scope 2	Scope 3		
2025	8,221,260	23,377,657	0	0.49	0.04	-	11,455	935	12,390	
2026	8,449,918	25,509,354	0	0.39	0.03	-	9,949	765	10,714	
2027	8,349,901	25,620,198	0	0.34	0.02	-	8,711	512	9,223	
2028	8,349,897	25,185,618	0	0.24	0.01	-	6,045	252	6,296	
2029	8,308,968	25,140,927	0	0.2	0.02	-	5,028	503	5,531	
2030	8,299,942	24,948,694	0	0.12	0.01	-	2,994	249	3,243	
2031	8,269,517	24,591,373	0	0.11	0.01	-	2,705	246	2,951	
2032	8,499,907	25,321,329	0	0.11	0.01	-	2,785	253	3,039	
2033	8,499,889	25,252,504	0	0.12	0.01	-	3,030	253	3,283	
2034	8,499,924	25,172,018	0	0.02	0	-	503	-	503	
2035	7,939,705	23,986,185	0	0.02	0	-	480	-	480	
2036	7,922,286	22,953,225	0	0.02	0	-	459	-	459	
2037	6,473,890	18,176,610	0	0.02	0	-	364	-	364	
2038	6,450,600	17,840,005	0	0.02	0	-	357	-	357	
2039	2,983,184	7,535,202	0	0.02	0	-	151	-	151	
2040	1,001,331	3,734,728	0	0.02	0	-	75	-	75	
Average									3,691	
Total									59,058	

Transport (Rail)										
Factor	kg CO2-e/t.km	0.03333	DEFRA 2019 - Freightng goods - Freight train							
Distance	km	720	Assumed distance to port (return)							

Transport (Shipping)										
Factor	kg CO ₂ -e/t.km	0.00354	DEFRA 2019 - Freightage goods - Cargo ship, bulk carrier, average							
Distance	km	8000	Assumed distance to market							
Year	Product coal (t)		Emission factor (kg CO ₂ -e/t)			Emissions (t CO ₂ -e/year)			Total	
			Scope 1	Scope 2	Scope 3	Scope 1	Scope 2	Scope 3		
2025	7,000,000	-	0	0	28.31	-	-	198,184	198,184	
2026	7,801,952	-	0	0	28.31	-	-	220,889	220,889	
2027	7,654,373	-	0	0	28.31	-	-	216,711	216,711	
2028	7,541,535	-	0	0	28.31	-	-	213,516	213,516	
2029	7,537,673	-	0	0	28.31	-	-	213,407	213,407	
2030	7,465,895	-	0	0	28.31	-	-	211,374	211,374	
2031	7,369,071	-	0	0	28.31	-	-	208,633	208,633	
2032	7,588,177	-	0	0	28.31	-	-	214,836	214,836	
2033	7,561,277	-	0	0	28.31	-	-	214,075	214,075	
2034	7,528,850	-	0	0	28.31	-	-	213,157	213,157	
2035	7,189,048	-	0	0	28.31	-	-	203,536	203,536	
2036	6,815,483	-	0	0	28.31	-	-	192,960	192,960	
2037	5,370,890	-	0	0	28.31	-	-	152,061	152,061	
2038	5,366,005	-	0	0	28.31	-	-	151,922	151,922	
2039	2,313,873	-	0	0	28.31	-	-	65,510	65,510	
2040	1,347,290	-	0	0	28.31	-	-	38,144	38,144	
Average									183,057	
Total									2,928,916	

Energy Production										
Year	Product coal (t)	Thermal coal (t)	Emission factor (kg CO ₂ -e/t)			Emissions (t CO ₂ -e/year)			Total	Thermal %
			Scope 1	Scope 2	Scope 3	Scope 1	Scope 2	Scope 3		
2025	7,000,000	4,865,000	0	0	2436.48	-	-	11,853,475	11,853,475	70%
2026	7,801,952	5,104,601	0	0	2436.48	-	-	12,437,258	12,437,258	65%
2027	7,654,373	5,241,684	0	0	2436.48	-	-	12,771,258	12,771,258	68%
2028	7,541,535	5,509,945	0	0	2436.48	-	-	13,424,870	13,424,870	73%
2029	7,537,673	5,092,878	0	0	2436.48	-	-	12,408,696	12,408,696	68%
2030	7,465,895	5,018,184	0	0	2436.48	-	-	12,226,705	12,226,705	67%
2031	7,369,071	5,047,602	0	0	2436.48	-	-	12,298,380	12,298,380	68%
2032	7,588,177	5,258,279	0	0	2436.48	-	-	12,811,693	12,811,693	69%
2033	7,561,277	5,721,776	0	0	2436.48	-	-	13,940,994	13,940,994	76%
2034	7,528,850	5,172,817	0	0	2436.48	-	-	12,603,465	12,603,465	69%
2035	7,189,048	5,909,319	0	0	2436.48	-	-	14,397,938	14,397,938	82%
2036	6,815,483	4,543,971	0	0	2436.48	-	-	11,071,295	11,071,295	67%
2037	5,370,890	3,920,554	0	0	2436.48	-	-	9,552,352	9,552,352	73%
2038	5,366,005	4,137,024	0	0	2436.48	-	-	10,079,775	10,079,775	77%
2039	2,313,873	2,002,702	0	0	2436.48	-	-	4,879,542	4,879,542	87%
2040	1,347,290	543,045	0	0	2436.48	-	-	1,323,118	1,323,118	40%
Average									11,130,051	
Total									178,080,813	

Coking coal use										
Year	Product coal (t)	Coking coal (t)	Emission factor (kg CO ₂ -e/t)			Emissions (t CO ₂ -e/year)			Total	Coking coal %
			Scope 1	Scope 2	Scope 3	Scope 1	Scope 2	Scope 3		
2025	7,000,000	2,135,000	0	0	2760.9	-	-	5,894,522	5,894,522	31%
2026	7,801,952	2,697,351	0	0	2760.9	-	-	7,447,117	7,447,117	35%
2027	7,654,373	2,412,689	0	0	2760.9	-	-	6,661,192	6,661,192	32%
2028	7,541,535	2,031,590	0	0	2760.9	-	-	5,609,018	5,609,018	27%
2029	7,537,673	2,444,794	0	0	2760.9	-	-	6,749,833	6,749,833	32%
2030	7,465,895	2,447,711	0	0	2760.9	-	-	6,757,886	6,757,886	33%
2031	7,369,071	2,321,470	0	0	2760.9	-	-	6,409,346	6,409,346	32%
2032	7,588,177	2,329,898	0	0	2760.9	-	-	6,432,615	6,432,615	31%
2033	7,561,277	1,839,500	0	0	2760.9	-	-	5,078,676	5,078,676	24%
2034	7,528,850	2,356,033	0	0	2760.9	-	-	6,504,772	6,504,772	31%
2035	7,189,048	1,279,729	0	0	2760.9	-	-	3,533,203	3,533,203	18%
2036	6,815,483	2,271,512	0	0	2760.9	-	-	6,271,417	6,271,417	33%
2037	5,370,890	1,450,336	0	0	2760.9	-	-	4,004,232	4,004,232	27%
2038	5,366,005	1,228,982	0	0	2760.9	-	-	3,393,095	3,393,095	23%
2039	2,313,873	311,172	0	0	2760.9	-	-	859,114	859,114	13%
2040	1,347,290	804,245	0	0	2760.9	-	-	2,220,441	2,220,441	60%
Average									5,239,155	
Total									83,826,479	

Appendix F. Independent expert review

Nathan Cooper
Xenith Consulting
Shops 4-6, Mezzanine Level, The Singleton Centre, 157-159 John Street, Singleton NSW 2330

By email:
Nathan.cooper@xenith.com.au

27 May 2025

Dear Nathan,

Re: Peer Review of Boggabri Coal Mine Modification 10 Air Quality and Greenhouse Gas Assessment

Xenith Consulting Pty Ltd (Xenith) has undertaken a peer review of the Air Quality and Greenhouse Gas Assessment prepared by Airen Consulting Pty Ltd in April 2025 (Draft 4, Rev 0) and associated mitigation documentation for the Boggabri Coal Mine (BCM) Modification 10 (MOD 10) application. The peer review focused on the Greenhouse Gas Assessment (GHG Assessment) component and was reviewed in accordance with the NSW Government's guidance for State Significant Projects and applicable climate change and emissions regulations. The GHG Peer Review report is provided in Appendix A.

The review evaluated the methodology, assumptions, emission estimates, and mitigation planning documented in the GHG Assessment in the context of relevant state and Federal policies, regulations and national climate policy frameworks.

The review has been conducted by a suitably qualified professional from Xenith, an independent consultancy with recognised expertise in mining environmental assessments, GHG accounting, and regulatory compliance.

The GHG Assessment was found to be methodologically sound, policy-aligned, and appropriate for inclusion in the Modification Application under SSD 09_0182. No critical deficiencies were identified. A series of minor enhancements were recommended to improve transparency, support replicability, and demonstrate forward compliance with evolving GHG regulatory guidance. These have been addressed and/or acknowledged in the final revision.

Xenith considers the GHG Assessment to be fit for purpose, consistent with all key guidance and legislative requirements, and suitable for submission with the Modification Application for MOD 10. The assessment appropriately characterises emissions impacts and provides a credible basis for the project's climate risk profile.

Please do not hesitate to contact me with any questions you may have.

Kind Regards

Zack Colgrave
Senior Environmental Scientist
Xenith Consulting



Appendix A Greenhouse Gas Peer Review Report



xenith

Peer Review of Boggabri Coal Mine Modification 10 Air Quality and Greenhouse Gas Assessment

**Boggabri Coal Mine Modification 10
Boggabri Coal Operations Pty Ltd
May 2025**

Contents

Executive Summary	4
1. Introduction	5
1.1 Purpose of Review	5
1.2 Modification Description	5
1.3 Scope of Work	5
1.4 Reviewer Qualifications and Independence	6
2. Methodology	7
2.1 Documents Reviewed	7
2.2 Criteria Guidance	7
2.3 Review Focus Areas	7
3. Findings of the Peer Review	9
3.1 Categorisation and Calculation of Scope 1, 2, and 3 Emissions	9
3.1.1 Scope 1: Direct Emissions	9
3.1.2 Scope 2: Indirect Emissions from Purchased Electricity	9
3.1.3 Scope 3: Other Indirect Emissions	10
3.2 Compliance with State and Federal Government Requirements	11
3.2.1 Federal Requirements	11
3.2.2 NSW Requirements	11
3.3 Mitigation Measures and Offset Strategies	12
3.3.1 Review Findings	13
3.4 Monitoring and Governance	13
3.4.1 Recommendations for Alignment	13
4. Conclusion	14
5. References	15

Appendices

Appendix A	Peer Review CV
------------	----------------



Figures

No table of contents entries found.

Tables

Table 1: Summary of Key Findings

Table 2: Frameworks and Regulatory References

Table 3: Summary of Key Findings

Table 4: Summary of Key Findings



Document issue approval				
Title	Peer Review of Boggabri Coal Mine Modification 10 Air Quality and Greenhouse Gas Assessment			
Client	Boggabri Coal Operations Pty Ltd			
Status	Final	Project/document no.	1	
Date	May 2025	Revision no.	3	

Approvals				
	Name	Position	Signature	Date
Prepared by	Romana Thefs	ESG Decarbonisation Lead	RT	12/04/2025
Reviewed by	Zack Colgrave	Senior Environmental Scientist	ZC	14/04/2025
Approved by	Zack Colgrave	Senior Environmental Scientist	ZC	27/05/2025

Distributions				
Organisation	Attention	Hard copies	Electric copies	Actioned
Xenith Consulting	Nathan Cooper	0	1	RT

To be initialled and dated by the person who actions the issue of the documents.

DISCLAIMER

Xenith Consulting Pty Ltd makes no representation, undertakes no duty, and accepts no responsibility to any third party who may use or rely upon this document, or the drawings, information and data recorded in this document.

We do not accept responsibility or liability for losses arising from the assessment and determination of the Project, or if approved, the reliance on this document for any other purpose.

Any operating or capital cost estimation (as relevant) is current as at the date of estimation only. The estimation assessed herein may change significantly and unexpectedly over a relatively short period (including as a result of general market movements and factors specific to the particular mine, project or deposit). We do not accept responsibility or liability for losses arising from such subsequent changes in cost.

Executive Summary

Xenith Consulting Pty Ltd has undertaken a peer review of the Greenhouse Gas Assessment included within the Air Quality and Greenhouse Gas Assessment prepared by Airen Consulting Pty Ltd in April 2025 (Draft 4, Rev 0) for the Boggabri Coal Mine Modification 10 application. The peer review focused on the Greenhouse Gas Assessment component of the Air Quality and Greenhouse Gas Assessment and was reviewed in accordance with the New South Wales Government's guidance for State Significant Projects and applicable climate change and emissions regulations.

The peer review found that the Greenhouse Gas Assessment is methodologically robust and complies with key Commonwealth and NSW requirements, including:

- *National Greenhouse and Energy Reporting (Measurement) Determination 2008*;
- National Greenhouse Accounts (NGA) Factors (2023); and
- NSW EPA Guide for Large Emitters (2025).

The Greenhouse Gas Assessment applies standard estimation methodologies, accurately categorises emissions across Scopes 1, 2, and 3 for the proposed life of mine (out to 2040). Mitigation strategies and offset measures are summarised within the report (Section 7.3).

The peer review concludes that the Greenhouse Gas Assessment is fit for purpose, suitable for inclusion in the Modification 10 application, and is likely to meet regulator and stakeholder expectations. Minor enhancements are recommended to improve transparency, replicability, and alignment with industry leading practice.

Table 1: Summary of Key Findings

Assessment Area	Finding
Methodology & Assumptions	Appropriate and consistent with NGA and Measurement Determination.
Scope Categorisation	Scope 1, 2, and 3 emissions are correctly categorised, and all exclusions justified.
Regulatory Compliance	Complies with typical SSD Guidelines, Safeguard Mechanism, EPA Guide.
Greenhouse Gas Emissions Forecasting	Greenhouse gas emissions due to all identified GHG generating activities associated with BCM have been estimated for the proposed life of mine (out to 2040) using correct factors and activity data.
Mitigation Measures	Summary included in GHG Assessment. Consideration of mitigation measures and offset strategies are embedded in the business planning processes of the BCM.

1. Introduction

1.1 Purpose of Review

Xenith Consulting Pty Ltd (Xenith) has been engaged by Boggabri Coal Operations Pty Ltd (BCOPL) to complete a Peer Review of a Greenhouse Gas Assessment (GHG Assessment). The GHG Assessment is included within the Air Quality and Greenhouse Gas Assessment prepared by Airen Consulting Pty Ltd in respect of a proposed extension to operations at the Boggabri Coal Mine (BCM) for which approval is being sought by way of a modification to State Significant Development (SSD) 09_0182 (MOD 10).

The purpose of this Peer Review was to assess whether the GHG Assessment for MOD 10 has been prepared in accordance with relevant policies and technical guidance, and is robust, transparent, and suitable for inclusion within the MOD 10 Modification Report.

1.2 Modification Description

BCM is an operational open-cut coal mine located approximately 15 kilometres (km) northeast of Boggabri in the Gunnedah Basin of New South Wales (NSW) and is located wholly within the Narrabri Local Government Area (LGA). BCM is part of the Boggabri, Tarrawonga, Maules Creek Coal Mining Complex (BTM Complex) and is immediately adjacent to the Tarrawonga Coal Mine to the south and Maules Creek Coal Mine to the north.

MOD 10 to SSD 09_0182 seeks approval for the continuation of mining operations at the BCM towards the north-west beyond the approved Mine Disturbance Boundary but entirely within the existing Project Boundary. Key parameters of MOD 10 includes the extraction of an additional 30 million tonnes (Mt) of Run of Mine (ROM) coal down to the Templemore Coal Seam, disturbance to an additional 85 hectares (ha) of land within the Project Boundary, an extension to the life of mining by an additional four years (i.e. out to 2040), and amendments to the Conceptual Final Landform design to account for the proposed additional mining.

As part of the environmental assessment process, an Air Quality and Greenhouse Gas Impact Assessment has been prepared to assess the expected emissions profile and mitigation performance of MOD 10. The GHG Assessment estimates Scope 1 (direct), Scope 2 (indirect energy), and Scope 3 (downstream product combustion) emissions for MOD 10 for the proposed life of mine (out to 2040). These projections support the environmental impact narrative and are used to determine whether MOD 10 would materially increase BCM's emissions footprint or compliance risk under regulatory schemes such as the Safeguard Mechanism.

1.3 Scope of Work

The scope of the peer review included a technical assessment of the GHG Assessment with reference to the following key areas:

- Evaluation of the estimation approach, emission factor selection and embedded assumptions.
- Review of alignment with the following regulatory and policy instruments:
 - *National Greenhouse and Energy Reporting (Measurement) Determination 2008*;
 - National Greenhouse Accounts (NGA) Factors (2023);
 - State Significant Development Guidelines (SSD Guideline) (DPHI, 2024); and
 - NSW Guide for Large Emitters (EPA Guide) (2025).
- Scope 1, 2, and 3 emissions categorisation and quantification.

- Review of mitigation strategies and offsets.

1.4 Reviewer Qualifications and Independence

The peer review has been conducted by a suitably qualified professional from Xenith's Environment Social and Governance (ESG) team. Xenith is an independent consultancy with recognised expertise in mining environmental assessments, GHG accounting, and regulatory compliance.

Qualifications and declarations of independence for the reviewer are provided in **Appendix A** of this report. Xenith has no financial or operational interest in MOD 10 and has undertaken this review in accordance with the principles of objectivity, confidentiality, and technical accuracy.

It is important to acknowledge as part of the declaration of independence, Xenith's Environment and Planning Australia South team (which formerly were known as James Bailey and Associates Pty Ltd) has also been engaged by BCOPL to prepare the application to modify SSD 09_0182 and the supporting Modification Report.

2. Methodology

2.1 Documents Reviewed

As part of the peer review process, the following key documents were reviewed:

- Boggabri Coal Mine Modification 10 Air Quality and Greenhouse Gas Assessment (Draft 4, Rev 0), including:
 - Appendix C - Emissions Calculations; and
 - Appendix D - Tabulated Model Results.
- Mitigation Measures and Offset Strategies_MOD10 Report.

2.2 Criteria Guidance

The review was conducted against the technical frameworks, guidelines, and regulatory references outlined in **Table 2**.

Table 2: Frameworks and Regulatory References

Reference	Purpose
Measurement Determination	Provides methods, criteria and measurement standards for calculating and reporting greenhouse gas emissions and energy data under the NGER Act.
NGA Factors	Provides standardised emission factors used in Scope 1, 2 and 3 estimations.
Safeguard Mechanism	Limits and reduces greenhouse gas emissions from Australia's largest industrial facilities in line with national climate targets through the establishment of an emissions baseline.
SSD Guideline	Outlines requirements for environmental assessments including GHG and climate impact assessments.
EPA Guide	Outlines the assessment requirements for projects involving modification of existing facilities.

2.3 Review Focus Areas

The review focused on six key dimensions of the GHG Assessment:

- **Policy and legislative compliance:** Assessment of alignment with relevant State and Federal climate and emissions reporting obligations.
- **Emissions scope and accuracy:** Review of the categorisation of Scope 1, Scope 2, and Scope 3 emissions. Evaluation of emissions estimation approach, activity data and emission factors.
- **Mitigation measures and offset strategy:** Analysis of the embedded mitigation measures, forward abatement planning, offset strategies, and monitoring mechanisms.

- **Transparency and replicability:** Evaluation of how clearly methods, assumptions, and data sources are communicated to allow independent verification.

3. Findings of the Peer Review

3.1 Categorisation and Calculation of Scope 1, 2, and 3 Emissions

The GHG Assessment for MOD 10 estimates emissions over the proposed full operational life of the BCM (i.e. out to 2040), incorporating all material sources across Scope 1, Scope 2, and Scope 3. The assessment applies an activity-based bottom-up approach consistent with the NGA Factors and the NGER Measurement Determination. All emission sources are clearly identified, with any exclusions transparently justified.

3.1.1 Scope 1: Direct Emissions

Sources Assessed:

- Diesel combustion (mobile and stationary equipment);
- Blasting (explosives); and
- Fugitive emissions from open cut coal extraction.

Calculation Approach:

- Emissions are calculated by applying NGA default factors to forecasted activity data (e.g. diesel volume, explosive use, ROM production); and
- Fugitive emissions are calculated using Method 2, which uses site-specific data and emission factors from the Measurement Determination. This method is aligned with the Clean Energy Regulator's updated guidance and is considered best practice for open cut coal mines.

Review Finding:

- The scope and method for Scope 1 are compliant and robust;
- Assumptions and emission factors are appropriate; and
- Emission trends (e.g. peak year in 2028) are clearly identified.

3.1.2 Scope 2: Indirect Emissions from Purchased Electricity

Sources Assessed:

- Electricity purchased from the NSW grid.

Calculation Approach:

- Total electricity demand is forecasted and multiplied by the NGA 2023 grid emission factor for NSW.

Additional Context:

- A 6.5 MWp / 4.95 MVA solar farm is planned for behind-the-meter installation but has not been factored into Scope 2 emissions. This represents a conservative estimate and aligns with the precautionary principle.

Review Finding:

- Scope 2 categorisation and calculation are compliant; and
- The solar farm exclusion is justified, but a sensitivity scenario or commentary on future Scope 2 reduction would strengthen alignment with decarbonisation planning expectations.

3.1.3 Scope 3: Other Indirect Emissions

Sources Assessed:

- Downstream combustion of exported coal by end users (customers).

Calculation Approach:

- Estimated total ROM/product coal export volumes are multiplied by default coal combustion factors from the NGA Factors (2023).

Scope and Limitations:

- No other Scope 3 categories (e.g. upstream fuel production, capital goods, transport and distribution, or employee commuting) were quantified. These categories are not required for environmental impact assessment purposes but are recommended under the GHG Protocol for full corporate inventories.

Review Finding:

- The inclusion of downstream combustion as the sole Scope 3 category is standard practice for NSW SSD assessments.
- The report acknowledges the overlap between Scope 3 emissions for BCM and Scope 1 for international customers under the Paris Agreement.
- A roadmap for future Scope 3 category inclusion, aligned with the GHG Protocol, would improve completeness and forward alignment.

Table 3: Summary of Key Findings

Review Dimension	Evaluation	Recommendations
Categorisation	Accurate and in accordance with GHG Protocol and NGA Factor definitions.	None
Emission Factors	Correctly sourced from NGA Factors and up to date.	None
Assumption Transparency	Partial	Appendix C – Emission Calculations provides a clear and detailed breakdown of emission factors, sources, and calculation methods for Scope 1 and 2 emissions. The approach is consistent with the NGA Factors and NGER Measurement Determination. To enhance transparency, a summary table of key input assumptions (e.g. diesel volume, grid electricity, coal volume) could be included in the main body of the GHG Assessment. Scope 3 assumptions are not documented in Appendix C and should be summarised and disclosed in future iterations.
Scope 3 Breadth	Limited to coal combustion and transport of product	Recommend a staged plan to assess other Scope 3 categories where material, especially for corporate GHG disclosures.

3.2 Compliance with State and Federal Government Requirements

3.2.1 Federal Requirements

Measurement Determination:

- Emissions sources and methods appear consistent with required default factors for Scope 1 and 2. Method 2 for fugitive emissions is consistent with the latest Clean Energy Regulator guidance on the transition to Method 2 under the Measurement Determination.

NGA Factors:

- Used correctly throughout for MOD 10 emissions estimation for Scope 1 and 2.

Safeguard Mechanism:

- The BCM is a safeguard facility and will continue to have an obligation to report emissions from this facility under the NGER Act. MOD 10 emissions are contextualised against the Safeguard baseline using the hybrid approach. Any exceedance of the Safeguard baseline will be managed through the purchase of Safeguard Mechanism Credits or Australian Carbon Credit Unit's. The hybrid baseline approach under the Safeguard Mechanism applies to large industrial facilities and combines site-specific production variables with industry average emissions intensity values. It ensures baselines:
 - Reflect actual production levels (flexible baseline); and
 - Align with Australia's decarbonisation goals by using declining industry average intensities over time.

3.2.2 NSW Requirements

SSD Guidelines:

- Meets all core SSD requirements, is methodologically robust, and is appropriate for inclusion in the MOD 10 application.

EPA Guide:

- The GHG Assessment for MOD 10 has been informed by the EPA Guide. The EPA Guide requirements for projects involving modification of existing facilities, such as MOD 10, are outlined in the GHG Assessment and includes:
 - Inventoried emissions by source;
 - Mitigation measures and offset strategies being implemented;
 - Any obligations under the Safeguard Mechanism; and
 - Current and planned emissions goals.

Table 4: Summary of Key Findings

Policy / Guidance	Compliance Status	Comments
NGA Factors	Compliant	Correct and consistent application of NGA Factors across all emission scopes.

Measurement Determination	Compliant	Applied correctly. Method 2 for fugitive emissions is consistent with the latest Clean Energy Regulator guidance on the transition to Method 2 under the Measurement Determination.
SSD Guidelines	Compliant	Meets all core SSD requirements, is methodologically robust, and is appropriate for inclusion in the MOD 10 application.
Safeguard Mechanism	Compliant	Facility identified as covered and modelled against the Safeguard hybrid baseline for the proposed life of mine. The GHG Assessment states that BCOPL intends to continue to consider and assess the feasibility of mitigation measures to meet its compliance position under Safeguard or to generate Safeguard Mechanism Credits (SMCs).
EPA Guide	Substantially Compliant (with scope for enhancement)	The GHG Assessment demonstrates substantial alignment with the NSW EPA Guide for Large Emitters (2025). It includes: • A complete inventory of Scope 1, 2, and 3 emissions by source (Table 19), with justified exclusions. • Mitigation measures aligned with the abatement hierarchy, including efficiency measures, solar integration, and governance processes (Section 7.3). • Obligations under the Safeguard Mechanism clearly acknowledged and contextualised against the hybrid baseline. • Current and planned emissions goals are noted, but lack quantified abatement benchmarks or trajectories.

3.3 Mitigation Measures and Offset Strategies

Section 7.3 of the GHG Assessment outlines a suite of mitigation measures and offset strategies that broadly align with the emissions hierarchy and planning best practice expectations under the NSW EPA Guide for Large Emitters and SSD Guideline. The measures address both current and planned abatement initiatives and reflect a conservative approach to quantifying future reductions.

The GHG Assessment includes the following types of mitigation measures:

- **Operational efficiency:** BCM implements scheduled equipment maintenance, idling reduction, fuel use tracking, and low-emissions lighting systems.
- **Energy transition:** The Merriown Solar Farm is identified as a key mitigation asset, offsetting daytime electricity use. Battery storage is under ongoing review and consideration.
- **Monitoring and governance:** Fuel and electricity use are monitored internally, and mitigation performance is intended to be reviewed periodically.

These measures demonstrate baseline compliance with SSD Modification expectations.

The current summary is fit for purpose but would benefit from integrating additional detail or cross-referencing to BCM's broader emissions reduction roadmap. Including forward-looking abatement benchmarks or Scope 1 and 2 intensity trajectories would better align with the intent of the EPA Guide.

3.3.1 Review Findings

The mitigation measures described in the GHG Assessment demonstrate baseline compliance with expectations for SSD Modifications and satisfy the core EPA Guide requirement to describe emissions reduction efforts.

The current summary remains largely qualitative and would benefit from:

- Integration of quantitative abatement benchmarks, including projected emission reductions from solar and efficiency measures (once committed).
- Inclusion of emissions intensity forecasts (e.g. t CO₂-e / tonne coal produced) for Scope 1 and Scope 2 to allow performance tracking over time.
- Cross-referencing BCM's broader decarbonisation strategy or net zero roadmap to demonstrate forward alignment with evolving Safeguard Mechanism obligations.
- Clarification of governance mechanisms, such as roles, review intervals, or internal targets, to support credibility of proposed actions.

3.4 Monitoring and Governance

The GHG Assessment notes that emissions tracking and internal quarterly strategy reviews are in place, with a business-level carbon policy under development. While this satisfies baseline expectations for operational governance, the EPA Guide and associated frameworks increasingly favour transparent, well-documented governance arrangements that demonstrate strategic alignment, accountability, and emissions performance integration into management systems.

3.4.1 Recommendations for Alignment

- **Formalise governance documentation:** Include review frequency, accountable roles, and escalation pathways for emissions or energy performance deviations.
- **Link mitigation to internal targets:** Define whether performance is tied to KPIs or investment decisions.
- **Enable public-facing summary reporting** (e.g. in sustainability statements or MOD compliance reports) to demonstrate credibility of mitigation implementation, especially for future net zero alignment or ACCU use.
- **Reference carbon policy intent:** Clarify if the carbon policy in development will govern Scope 1,2 and 3 treatments, offset usage, and compliance responses under Safeguard.

4. Conclusion

The GHG Assessment that is included within the Air Quality and Greenhouse Gas Assessment prepared by Airen Consulting for MOD 10 is methodologically sound, compliant with relevant regulatory guidance, and fit for purpose as an attachment to the Modification Application under SSD 09_0182. This Peer Review has determined:

- Emissions from Scope 1, 2, and 3 sources are appropriately defined and calculated using the NGA Factors and consistent with the Measurement Determination.
- The assessment adequately addresses State and Federal reporting requirements and climate change policies.
- A structured mitigation framework is summarised in Section 7.3, with coverage of operational improvements, energy efficiency, renewable energy integration (e.g., solar), and transition planning for lower-emissions technologies.

While no material deficiencies were identified, enhancements are recommended to improve clarity, traceability, and future-alignment with evolving climate assessment standards. These include:

- Improved visibility of key emissions assumptions (e.g., diesel use, emission factors) within the report body.
- Integration or summary of BCOPL's broader abatement benchmarking and long-term mitigation strategy.
- Inclusion of a table or appendix aligning content with the EPA Guide.

These updates would strengthen the assessment's transparency and increase confidence for regulators and stakeholders during review.

5. References

Airen Consulting Pty Ltd (2025). Boggabri Coal Mine Modification 10 Air Quality and Greenhouse Gas Assessment.

Department of Climate Change, Energy, the Environment and Water (2008). National Greenhouse and Energy Reporting (Measurement) Determination.

Department of Climate Change, Energy, the Environment and Water (2023). National Greenhouse Accounts Factors.

Department of Planning and Environment (2018). Voluntary Land Acquisition and Mitigation Policy.

Department of Planning, Housing and Infrastructure (2025). State Significant Development Guidelines.

Environment Protection Authority (2025). NSW EPA Guide for Large Emitters.

Appendix A - Peer Review CV

Consultant profile



Romana Thefs

ESG Decarbonisation Lead

Qualifications

- › BSc (Geology)
- › Master of Environmental Management

Expertise

GHG Emissions Measurement

- › Alignment with climate-regulations
- › Quantitative analysis

Decarbonisation

- › Project identification
- › Roadmap and strategy development

Regulatory Compliance

- › Navigating diverse reporting frameworks
- › GHG Protocol, TCFD, SBTi

Skills

- › Stakeholder engagement
- › Policy & strategy development
- › Project & resource management
- › Microsoft suite, Miro, Confluence
- › Technology integration
- › Corporate reporting
- › Complex research
- › Data analysis



xenith

know the way

Romana has extensive professional expertise in the areas of climate change, sustainability, and environmental compliance, encompassing roles held within both corporate and governmental settings. In recent years, Romana has developed and implemented strategic sustainability plans and decarbonisation programs for clients, emphasising the alignment of business objectives with rapidly evolving climate change regulations and stakeholder expectations. Romana's experience also includes conducting comprehensive GHG measurement and assessments, identifying emerging trends to enhance sustainability strategies, and fostering crucial stakeholder relationships.

Career highlights

Pathzero

Developed and implemented performance measurement frameworks to measure, track and report GHG emissions as well as wider sustainability targets. Identified emerging trends, best practices, and industry benchmarks to enhance sustainability strategies for organisation's to be compliant with regulation changes.

Aurizon

Development and implementation of nationwide Climate Action and Strategy Plan in conjunction with industry and government stakeholders.

Glencore

Planned, implemented and managed environmental management projects. Undertook analysis and reporting of operational and environmental monitoring data to ensure compliance with legal and internal policy obligations.

Professional experience

2023 – current

Xenith

ESG Decarbonisation Lead

2022 – 2023

Pathzero

Manager of Sustainability Consulting

2020 – 2022

Aurizon

Sustainability and Environmental Advisor

2017 – 2020

Glencore

Environmental Advisor

2014 – 2017

Geological Survey of Qld

Geologist