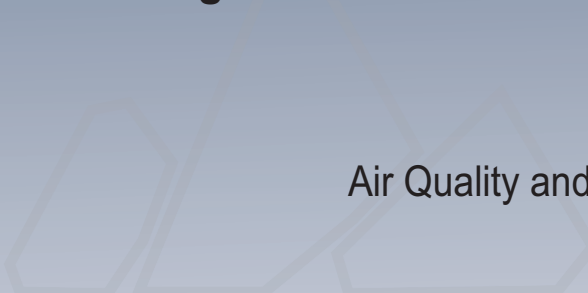




MIDDLEMOUNT COAL MINE

SOUTHERN EXTENSION PROJECT Original EPBC Referral Submission 18/03/2021 (EPBC 2021/8920)

EVA Appendix E Air Quality and Greenhouse Gas Assessment



Air Quality and Greenhouse Gas Report for the Middlemount Coal Mine Southern Extension Project

Prepared for:

Middlemount Coal Pty Ltd

November 2020

Final

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Document Control

Deliverable #: D19032-15

Title: Air Quality and Greenhouse Gas Assessment for the Middlemount Coal Mine Southern Extension

Version: 1.5 (Final)

Client: Middlemount Coal Pty Ltd

Document reference: D19032-15 Air Quality and Greenhouse Gas Assessment for the Middlemount Coal Mine Southern Extension_V1.5.docx

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15 November 2020

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Glossary

Term	Definition
$\mu\text{g}/\text{m}^3$	micrograms per cubic metre
$^{\circ}\text{C}$	degrees Celsius
g/s	grams per second
GJ/t	Gigajoule per tonne
m	metre
$\text{mg}/\text{m}^2/\text{day}$	milligram per metre square per day
MJ/kWh	Megajoule per kilowatt-hour
mm	millimetre
m/s	metres per second
km	kilometres
km/hr	kilometres per hour
Mtpa	million tonnes per annum
TJ	terajoule
Nomenclature	Definition
CO_2	Carbon dioxide
$\text{CO}_2\text{-e}$	Carbon dioxide equivalent
$\text{kg CO}_2\text{-e}/\text{GJ}$	kilogram carbon dioxide equivalent per gigajoule
$\text{kg CO}_2\text{-e}/\text{kWh}$	kilogram carbon dioxide equivalent per kilowatt-hour
kt $\text{CO}_2\text{-e}$	kilotonnes of carbon dioxide equivalent
Mt $\text{CO}_2\text{-e}$	million tonnes of carbon dioxide equivalent
N_2O	Nitrous oxide
PM_{10}	particulate matter with a diameter less than 10 micrometres
$\text{PM}_{2.5}$	particulate matter with a diameter less than 2.5 micrometres
t $\text{CO}_2\text{-e}$	tonnes of carbon dioxide equivalent
t $\text{CO}_2\text{-e}/\text{GJ}$	tonnes carbon dioxide equivalent per gigajoule
Abbreviations	Definition
Air EPP	<i>Environmental Protection (Air) Policy 2019</i>
Air NEPM	<i>National Environment Protection (Ambient Air Quality) Measure</i>
ANFO	Ammonium Nitrate fuel oil
CHPP	Coal Handling and Preparation Plant
DES	Department of Environment and Science
EA	Environmental Authority
EIS	Environmental Impact Statement
EP Act	<i>The Environmental Protection Act 1994</i>
ERF	Emissions Reduction Fund
GHG	Greenhouse Gas
GWP	Global warming potential
Katestone	Katestone Environmental Pty Ltd
MCM	Middlemount Coal Mine
MCPL	Middlemount Coal Pty Ltd
ML	Mine Lease
NGER	National Greenhouse and Energy Reporting
NGER Act	<i>National Greenhouse and Energy Reporting Act 2007</i>
NGER Determination	<i>National Greenhouse and Energy Reporting (Measurement) Determination 2008</i>
NGER Regulation	<i>National Greenhouse and Energy Reporting Regulation</i>
NPI	National Pollutant Inventory
Peabody	Peabody Australia Pty Ltd
ROM	Run-of-mine
TSP	Total suspended particulates
UNFCCC	United Nations Framework Convention on Climate Change
Yancoal	Yancoal Australia Ltd

EXECUTIVE SUMMARY

Katestone Environmental Pty Ltd (Katestone) was commissioned by Middlemount Coal Pty Ltd (MCPL) to conduct an air quality and greenhouse gas assessment of a proposed extension of the Middlemount Coal Mine (MCM), referred to as the Southern Extension Project (the Project).

The air quality and greenhouse gas assessment has included the following:

- Analysis of the existing environment at MCM.
- Preparation of dust emissions inventories for two years that were selected based on material extraction/handling rates, proximity of mining activities to the closest sensitive receivers, and other parameters relating to the potential for dust generation - Year 2037 and Year 2043 of the Project.
- A comparison of the Project dust emission inventories with the dust emission inventories previously developed for the Stage 2 Middlemount Coal Project Environmental Impact Statement (EIS) and subsequent extension projects, and inference of the potential air quality impacts.
- Calculation of greenhouse gas emissions for each operation year from 2021 up to and including 2044.

In summary, the air quality and greenhouse gas assessment for the Project indicates the following:

- The emission rates of particulate matter/dust estimated for the Project are comparable to, or lower than, the scenario assessed in the Stage 2 Middlemount Coal Project EIS, which has been approved to operate.
- Overall, ground-level concentrations of air pollutants at sensitive receptors will, therefore, be comparable to, or lower than, what was anticipated by the Stage 2 Middlemount Coal Project EIS and what is currently occurring from MCM operations.
- Particulate monitoring could be considered at Tralee 2, which is the closest receptor to mining activities related to the Southern Extension Project.
- Annual greenhouse gas emissions associated with the Project range from 46 kilotonnes carbon dioxide equivalent (kt CO₂-e) to 316 kt CO₂-e, with an average of 256 kt CO₂-e.
- The majority of greenhouse gas emissions are associated with diesel (60%) and fugitive methane (34%), with the remaining 6% attributed to electricity consumption and use of explosives.
- MCM will continue to have obligations under both the National Greenhouse and Energy Reporting scheme and the Safeguard Mechanism.

1. INTRODUCTION

Katestone Environmental Pty Ltd (Katestone) was commissioned by Middlemount Coal Pty Ltd (MCPL) to conduct an air quality and greenhouse gas assessment of the proposed Middlemount Coal Mine (MCM) Southern Extension Project, herein referred to as the Project.

MCM is an existing open cut coal mine located in central Queensland, approximately 90 kilometres (km) north-east of Emerald and approximately 3 km south-west of the township of Middlemount (Figure 1). MCM has an approved run-of-mine (ROM) capacity of 5.7 million tonnes per annum (Mtpa) under Environmental Authority (EA) EPML00716913.

In 2011, Katestone completed an air quality impact assessment as part of the Environmental Impact Statement (EIS) for the Stage 2 Middlemount Coal Project (Katestone, 2011). Subsequently, Katestone has completed assessments for the MCM North-eastern Extension Project (Katestone, 2015) and MCM Western Extension Project (Katestone, 2018).

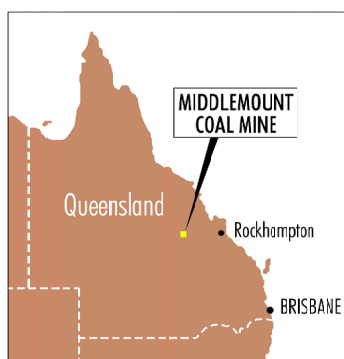
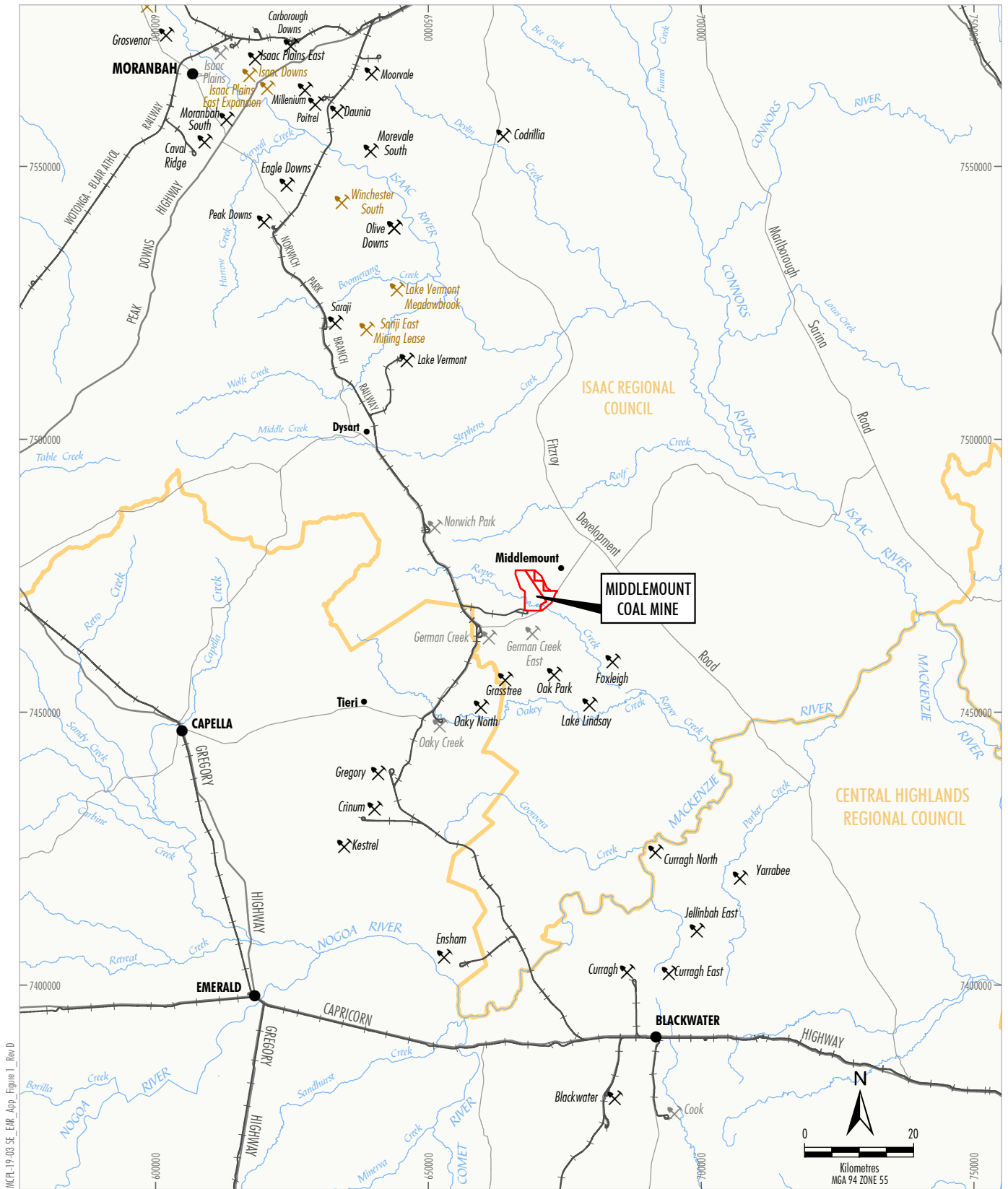
MCPL received approval for the Stage 2 Middlemount Coal Project and the subsequent North-eastern Extension Project and Western Extension Project.

1.1 Project Description

The main activities associated with the development of the Project would include:

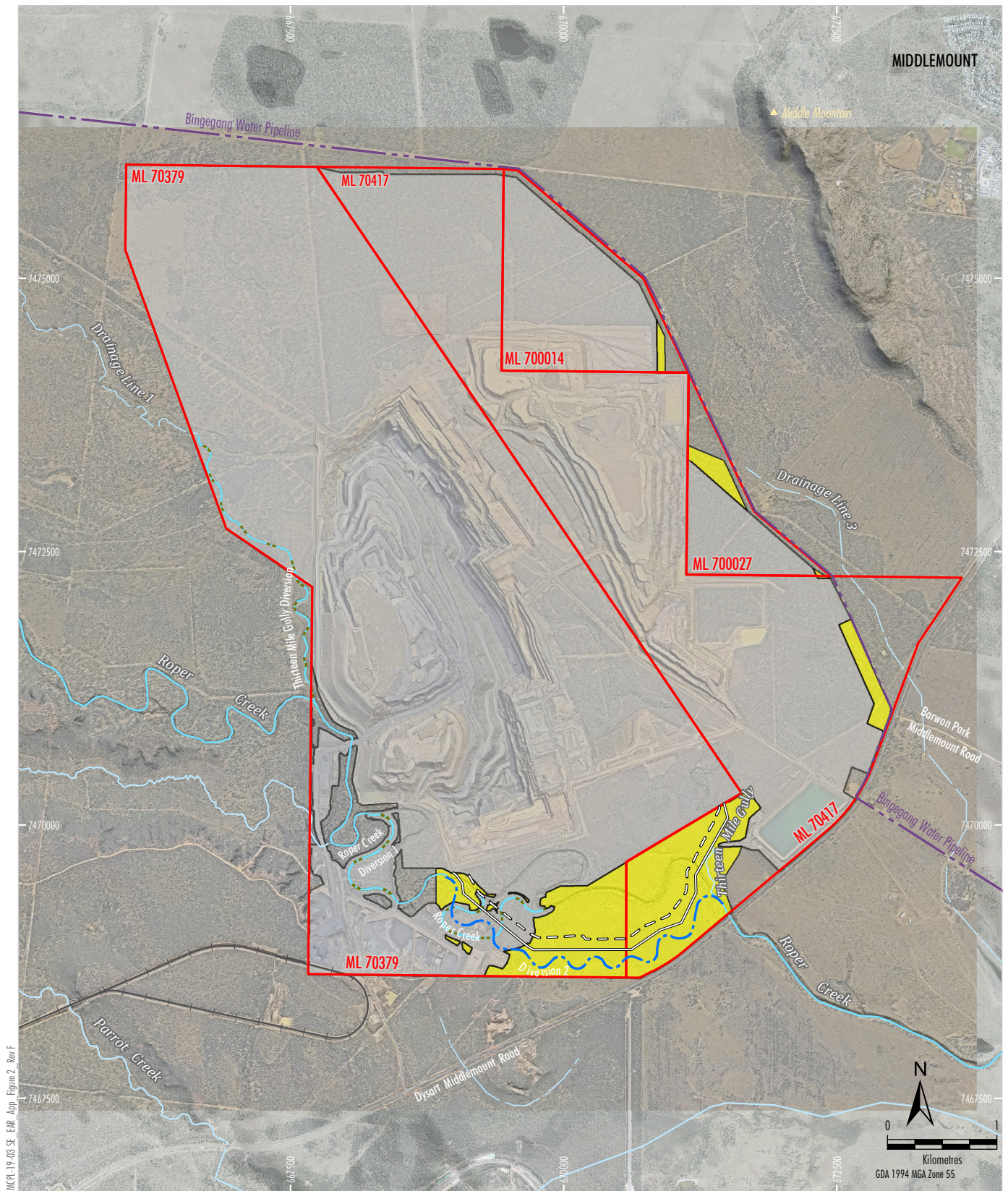
- Extension of the open cut pit to the south within Mining Leases (MLs) 70379 and 70417
- Continued extraction of ROM coal up to approximately 5.7 Mtpa using conventional open cut mining equipment
- Minor extensions to waste rock emplacement footprints
- Placement of waste rock in existing emplacements, expanded emplacements (West Dump and East Dump) and within the mined-out void
- Progressive development of sediment dams, pipelines and other water management equipment and structures
- Re-positioning of the approved southern flood levee and water management infrastructure
- Realignment of the approved (but not yet constructed) eastern diversion of Roper Creek inside the MLs
- Progressive development of new haul roads and internal roads
- Continued development of soil stockpiles, laydown areas and borrow areas
- Continued use of existing and approved supporting mine infrastructure
- Extension of the approved mine life by approximately seven years (to 2044)
- A change to the final landform for the end of the mine life

The approximate extent of the proposed additional disturbance is shown on Figure 2.



SOUTHERN EXTENSION PROJECT
Regional Location

Figure 1



MCPL-19-03 SE EIR App Figure 2 Rev F

- LEGEND**
- Mining Lease Boundary (ML)
 - Middlemount Rail Spur and Loop
 - Approved Disturbance Footprint
 - Approved Diversion Structure
 - Realigned Diversion Structure
 - Levee
 - Open Cut Pit Extension
 - Approximate Extent of Additional Disturbance

Source: MCPL (2020); The State of Queensland (2020)
Orthophoto: MCPL (September 2019)



SOUTHERN EXTENSION PROJECT
Approximate Project Footprint

Figure 2

1.2 Assessment Scope

The Project represents a relatively small change to mining activities at the MCM. If the Project does not cause an increase in dust emissions compared to the air quality assessment that accompanied the Stage 2 Middlemount Coal Project EIS, the EIS's findings will remain valid and further quantitative assessment of the Project is not necessary.

Accordingly, this assessment quantifies dust emissions from the Project and compares them to the dust emissions presented in the Stage 2 Middlemount Coal Project EIS (Katestone, 2011), the North-eastern Extension Project (Katestone, 2015) and the Western Extension Project (Katestone, 2018). This report also summarises the ongoing ambient air quality monitoring conducted at the MCM.

The low sulphur content of Australian diesel, in combination with widely dispersed mining equipment across a mine site, is such that the air quality objectives for sulphur dioxide described in the relevant guidelines would not be exceeded by the Project. Similarly, nitrogen dioxide and carbon monoxide emissions from diesel combustion by the Project would be limited and widely dispersed. Accordingly, the air quality objectives for these indicators are not considered relevant to the Project and the magnitude of potential emissions of these pollutants has not been considered in detail. That is, this assessment focuses on potential dust emissions, consistent with previous assessments and EA EPML00716913.

Annual greenhouse gas emissions for the life of the Project have been estimated and are summarised in Section 3.5 of this report.

2. AIR QUALITY ASSESSMENT

This section provides a qualitative assessment for the Project and includes:

- A summary of the existing air environment including:
 - The location of sensitive receptors
 - Ambient monitoring conducted at the MCM;
- A description of assessment scenarios
- Quantification of dust emissions from the Project
- Comparison of the Project dust emissions with the dust emissions presented in the Stage 2 Middlemount Coal Project EIS air quality assessment (Katestone, 2011), the North-eastern Extension Project air quality assessment (Katestone, 2015), and the Western Extension Project air quality assessment (Katestone, 2018).

2.1 Legislative Framework for Air Quality

2.1.1 Environmental Protection Act

The *Environmental Protection Act 1994* (EP Act) provides for the management of the air environment in Queensland. The EP Act gives the Department of Environment and Science (DES) the power to create Environmental Protection Policies that identify, and aim to protect, environmental values of the atmosphere that are conducive to the health and well-being of humans and biological integrity. The *Environmental Protection (Air) Policy 2019* (Air EPP) was made under the EP Act and gazetted in 1997; the Air EPP was revised and reissued in 2019.

The objective of the Air EPP is:

...to identify the environmental values of the air environment to be enhanced or protected and to achieve the objective of the Environmental Protection Act 1994, i.e. ecologically sustainable development.

The environmental values to be enhanced or protected under the Air EPP are the qualities of the environment that are conducive to:

- Protecting health and biodiversity of ecosystems
- Human health and wellbeing
- Protecting the aesthetics of the environment, including the appearance of building structures and other property
- Protecting agricultural use of the environment.

The administering authority must consider the requirements of the Air EPP when it decides an application for an environmental authority, amendment of a licence or approval of a draft environmental management plan. Schedule 1 of the Air EPP specifies air quality indicators and objectives for a number of contaminants that may be present in the air environment.

2.1.2 Project Approval

In 2011, Katestone completed an air quality impact assessment as part of the Stage 2 Middlemount Coal Project EIS (Katestone, 2011). The Stage 2 Middlemount Coal Project considered the MCM producing up to 5.4 Mtpa of ROM coal. The Stage 2 Project was subsequently approved, and mining operations have since commenced.

The following air quality assessments were subsequently completed by Katestone:

- Air quality assessment for the MCM North-eastern Extension Project (Katestone, 2015)
- Air quality and greenhouse gas impact assessment of MCM Western Extension Project (Katestone, 2018).

MCPL received approval for the North-eastern Extension Project and the Western Extension Project.

The MCM is currently approved to extract up to 5.7 Mtpa of ROM coal under EA EPML00716913, most recently issued on 26 February 2020. Conditions B1 – B8 are relevant to air quality and are reproduced in Table 1.

Table 1 Conditions relating to air quality from EPML00716913

Condition number	Condition
B1	Dust nuisance Subject to Conditions B2 and B3 the release of dust or particulate matter or both resulting from the mining activity must not cause an environmental nuisance at any sensitive or commercial place
B2	When requested by the administering authority, dust and particulate monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorized officer) of environmental nuisance at any sensitive or commercial place, and the results must be notified within (fourteen) 14 days to the administering authority following completion of monitoring
B3	The environmental authority holder must ensure that all reasonable and feasible avoidance and mitigation measures are employed so that the dust and particulate matter emissions generated by the mining activities do not cause an exceedance of the following levels when measured at any sensitive or commercial place: a) Dust deposition of 120 milligrams per square meter per day, averaged over one month, when monitored in accordance with the most recent version of Australian Standard AS3580.10.1 Methods for sampling and analysis of ambient air – Determination of particulates – Deposited matter – Gravimetric method. b) A concentration of particulate matter with an aerodynamic diameter of less than 10 micrometres (µm) (PM₁₀) suspended in the atmosphere of 50 micrograms per cubic metre over a (twenty four) 24 hour averaging time, for no more than five exceedances recorded each year, when monitored in accordance with the most recent version of either: a. Particulate matter – determination of suspended particulate PM₁₀ high-volume sampler with size-selected inlet – Gravimetric method, when monitored in accordance with Australian Standard AS 3580.9.6 Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – PM₁₀ high volume sampler with size-selective inlet – Gravimetric method or b. Australia Standard AS3580.9.9 Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – PM₁₀ low volume sampler – Gravimetric method.

Condition number	Condition
B4	If monitoring indicates exceedance of the relevant limits in Conditions B3, then the environmental authority holder must: a) Address the complaint including the use of appropriate dispute resolution if required; b) Immediately implement dust abatement measures so that emissions of dust from the activity do not result in further environmental nuisance; and c) Notify the administering authority within five (5) business days.
B5	Odour nuisance The release of noxious or offensive odour(s) or any other noxious or offensive airborne contaminant(s) resulting from the mining activity must not cause an environmental nuisance at any nuisance sensitive or commercial place.
B6	When requested by the administering authority odour monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer) of environmental nuisance at any sensitive or commercial place and the results must be notified within fourteen (14) days to the administering authority following completion of monitoring.
B7	If the administering authority determines the odour released to constitute an environmental nuisance the environmental authority holder must: a) Address the complaint including the use of appropriate dispute resolution if required; and b) Immediately implement odour abatement measures so that emissions of odour from the activity do not result in further environmental nuisance.
B8	Meteorological monitoring The environmental authority holder must establish a permanent, continuous, real time meteorological and dust monitoring network to measure and record wind speed, wind direction, temperature, rainfall, relative humidity and PM10. The station must comply with the following Standards (or their successors): a) "AS 2923-1987: Ambient air – Guide for measurement of horizontal wind for air quality applications" or its successor. b) "AS/NZS 3580.1.1:2016: Methods for sampling and analysis of ambient air. Guide to siting air monitoring equipment" or its successor.

2.1.3 National Environment Protection (Ambient Air Quality) Measure

The *National Environment Protection (Ambient Air Quality) Measure* (Air NEPM) was established under the *National Environment Protection Council Act 1994* to provide a nationally consistent framework for monitoring and reporting on seven common ambient air pollutants. The standards contained in the Air NEPM informed the objectives specified in the Air EPP.

2.1.4 Application Requirements for Activities with Impacts to Air

DES has published the guideline *Application requirements for activities with impacts to air* (ESR/2015/1840) that:

"seeks to assist both regulators and operators of ERAs to identify, quantify and evaluate the impact that air emissions from proposed ERAs may have on environmental values, and to manage the impacts in a way that achieves a balance between the social and economic benefits of development, and maintaining the environmental values of the receiving environment."

The guideline identifies that the first step in making an application is to “identify the environmental values of the site and surrounding areas including any nearby sensitive places” including a description of ambient air quality. Sources of data may include:

- Site-specific ambient air quality monitoring
- National Pollutant Inventory (NPI) data
- Ambient air quality monitoring undertaken by the Queensland Government.

2.1.5 Model Mining Conditions

DES regulates specific environmental activities through granting of an EA. An EA includes project specific conditions that relate to environmental management that include air quality. To streamline the EA application process, DES has released a number of “draft model conditions” for various activities. The DES Model Mining Conditions (ESR/2016/1936) include requirements relating to dust and particulate matter monitoring that are likely to be applied to future mining projects in the area.

The Model Mining Conditions state the following:

“B4 The environmental authority holder shall ensure that all reasonable and feasible avoidance and mitigation measures are employed so that the dust and particulate matter emissions generated by the mining activities do not cause exceedances of the following levels when measured at any sensitive or commercial place:

a) Dust deposition of 120 milligrams per square metre per day, averaged over one month, when monitored in accordance with the most recent version of Australian Standard AS3580.10.1 Methods for sampling and analysis of ambient air—Determination of particulate matter—Deposited matter – Gravimetric method.

b) A concentration of particulate matter with an aerodynamic diameter of less than 10 micrometres (PM₁₀) suspended in the atmosphere of 50 micrograms per cubic metre over a 24-hour averaging time, for no more than five exceedances recorded each year, when monitored in accordance with the most recent version of either: 1. Australian Standard AS3580.9.6 Methods for sampling and analysis of ambient air— Determination of suspended particulate matter—PM₁₀ high volume sampler with size selective inlet – Gravimetric method, or 2. Australian Standard AS3580.9.9 Methods for sampling and analysis of ambient air— Determination of suspended particulate matter—PM₁₀ low volume sampler—Gravimetric method.

c) A concentration of particulate matter with an aerodynamic diameter of less than 2.5 micrometres (PM_{2.5}) suspended in the atmosphere of 25 micrograms per cubic metre over a 24-hour averaging time, when monitored in accordance with the most recent version of AS/NZS3580.9.10 Methods for sampling and analysis of ambient air—Determination of suspended particulate matter—PM_{2.5} low volume sampler—Gravimetric method.

d) A concentration of particulate matter suspended in the atmosphere of 90 micrograms per cubic metre over a 1 year averaging time, when monitored in accordance with the most recent version of AS/NZS3580.9.3:2003 Methods for sampling and analysis of ambient air—Determination of suspended particulate matter—Total suspended particulate matter (TSP)—High volume sampler gravimetric method.”

2.1.6 Summary of Air Quality Criteria

The relevant air quality objectives from the Air EPP, MCM EA and Model Mining Conditions are presented in Table 2.

Table 2 Air quality objectives relevant to the project

Pollutant	Environmental value	Averaging period	Air quality objective ($\mu\text{g}/\text{m}^3$)	No. of allowable exceedance days	Source
TSP	Health and wellbeing	1-year	90	-	Air EPP, Model Mining Conditions
PM ₁₀	Health and wellbeing	24-hour	50	5	MCM EA, Model Mining Conditions
		24-hour	50	-	Air EPP
		1-year	25	-	Air EPP
PM _{2.5}	Health and wellbeing	24-hour	25	-	Air EPP
		1-year	8	-	Air EPP
Dust deposition	Amenity	1-month	120 mg/m ² /day	-	MCM EA, Model Mining Conditions
Table note: $\mu\text{g}/\text{m}^3$ = micrograms per cubic metre. mg/m²/day = milligrams per square metre per day					

2.2 Existing Environment

The existing environment in the vicinity of MCM is described in the following sections and includes:

- Identification of sensitive receptors
- A summary of dust deposition monitoring
- A summary of meteorological monitoring.

2.2.1 Local Terrain and Land Use

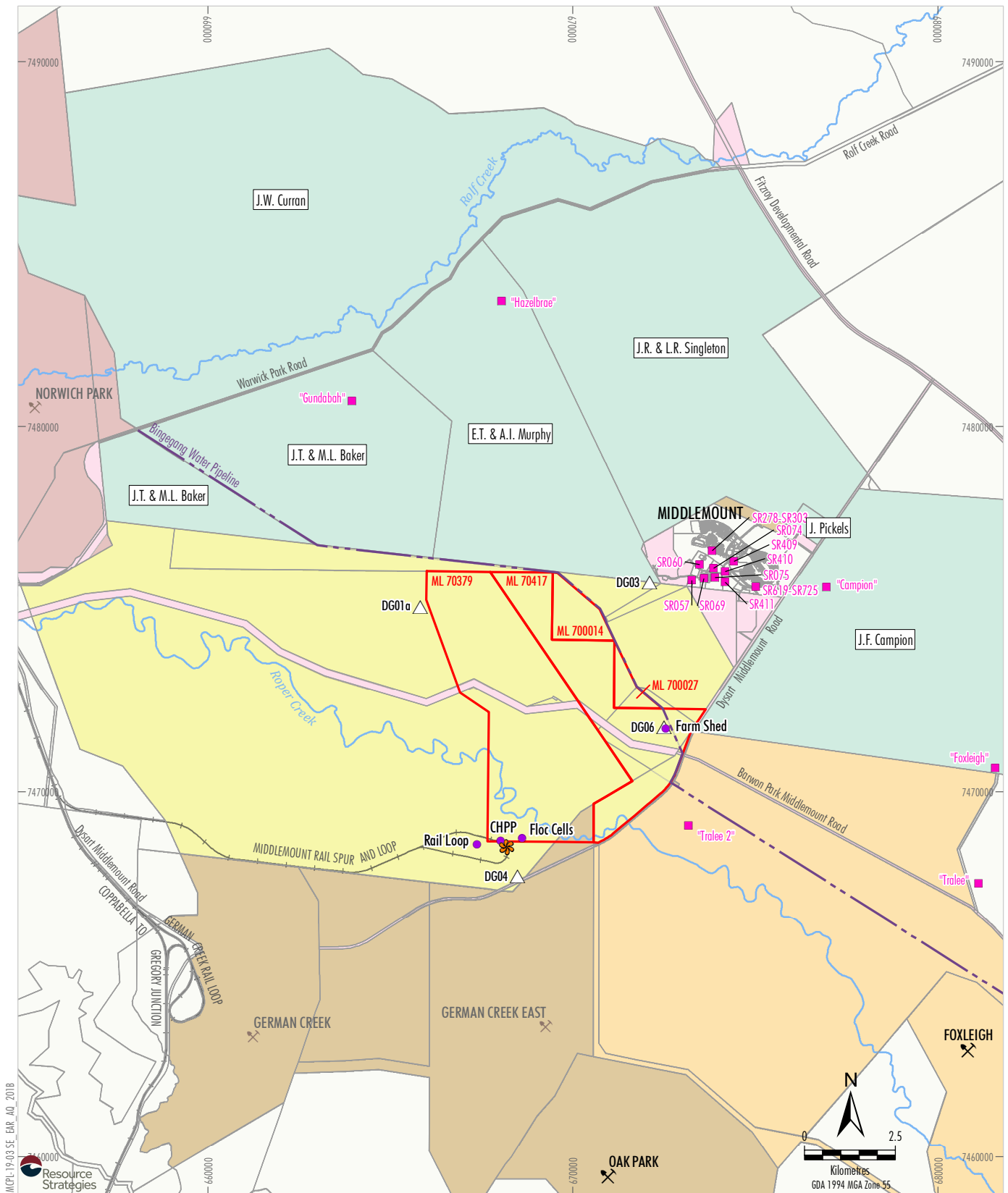
MCM is located in Central Queensland, approximately 3 km south-west of the township of Middlemount. Middlemount is situated at approximately 168 metres (m) above sea level and the terrain in the surrounding area of the Project area is fairly flat. There is a rise in topography, Middle Mount, to the east of the Project area, which separates the Middlemount township from the Project.

The Middlemount township has a population of approximately 2,000 people. Several isolated rural residences are also located within the area. Land use surrounding the area of Middlemount includes areas of agriculture, industry and state forest or national park. The main industry in the region is coal mining, with several other coal mines located in the surrounding area.

2.2.2 Sensitive Receptors

Sensitive receptors in proximity to MCM include the residential areas of Middlemount township, along with isolated rural residences and properties in the region. A map showing the location of the sensitive receptors is provided in Figure 3. The nearest receptor to the Project is the Tralee 2 homestead, located approximately 1.25 km to the south-east of the existing MCM. The Project would not decrease the distance between MCM mining activities and the nearest sensitive receiver (i.e. Tralee 2).

It is noted that the Tralee 2 dwelling is located on mine owned land (owned by Foxleigh Land Management Pty Ltd) (Figure 3) and was first identified during the preparation of the Middlemount Coal Mine Western Extension Project. Specifically, Tralee 2 was constructed subsequent to the approval of the Middlemount Coal Mine Stage 2 EIS, after the occupants were relocated due to operations at the Foxleigh Coal Mine.



Source: MCPL (2020); AGE (2018); The State of Queensland (2020)

- LEGEND**
- Middlemount Coal Mining Lease Boundary (ML)
 - Cadastral Boundary
 - Railway
 - ✂ Active Coal Mine
 - ✂ Inactive Coal Mine
 - LANDHOLDER**
 - Middlemount Coal Owned Land
 - Anglo Coal (Capcoal Management) Pty Limited
 - BHP Coal Pty Ltd; QCT Mining Pty Ltd; Mitsubishi Development Pty Ltd; QCT Investment Pty Ltd; BHP Queensland Coal Investments Pty Ltd; Umal Consolidated Pty Ltd; QCT Resources Pty Limited
 - Foxleigh Land Pty Ltd
 - Crown Land
 - Relevant Private Landholder
 - Owner not Referenced

- △ Dust Gauge
- PM₁₀ Monitor
- ✿ Meteorological Station
- Sensitive Receiver

SENSITIVE PLACES

Receiver	Location
SR075	Accommodation Village 1
SR074	Accommodation Village 2
SR410	Accommodation Village 3
SR411	Accommodation Village 4
SR278-SR303	Alfred Quinn Drive Residences
SR619-SR725	Centenary Drive South Residences
SR069	Industrial Estate
SR409	Middlemount Community School
SR060	Norm Blache Oval
SR057	Treatment Plant



SOUTHERN EXTENSION PROJECT

Location of Sensitive Receptors and Dust Monitoring Sites

Figure 3

2.2.3 Meteorology

MCPL operates a meteorological station south of the MCM ML 70379 boundary near the rail loop (Figure 3). Hourly average meteorological data from April 2016 to early December 2019 has been considered as part of this assessment. The distribution of hourly average winds measured by the monitoring station are presented in Figures 4 to 6 as annual, seasonal and diurnal wind roses. The winds are predominantly from the south-east quadrant, with an average wind speed of 2.2 metres per second (m/s).

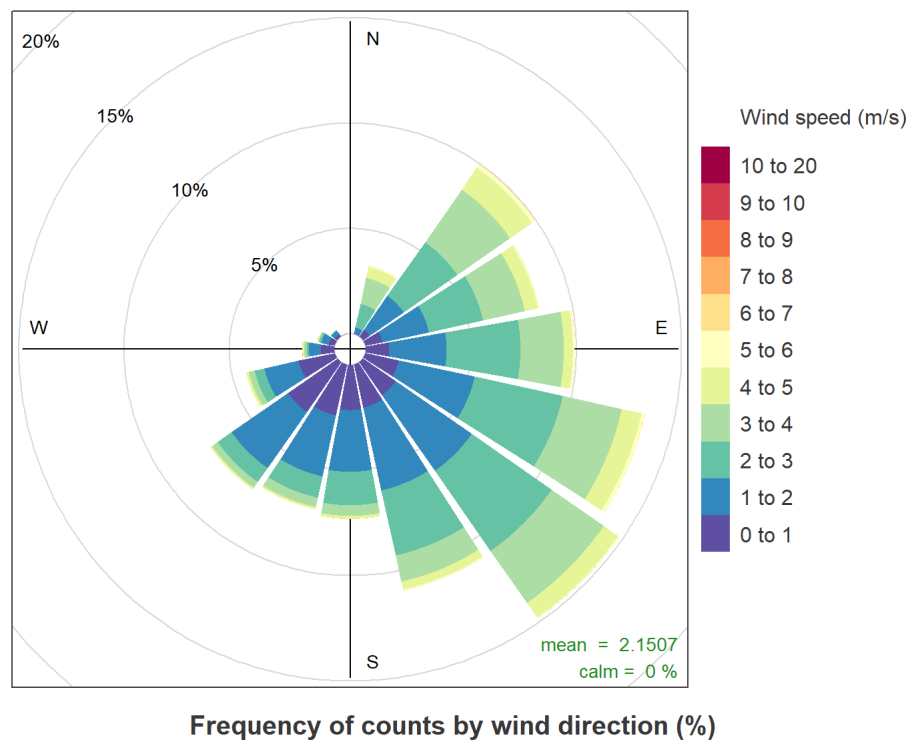


Figure 4 Annual distribution of winds measured at the MCM meteorological monitoring station

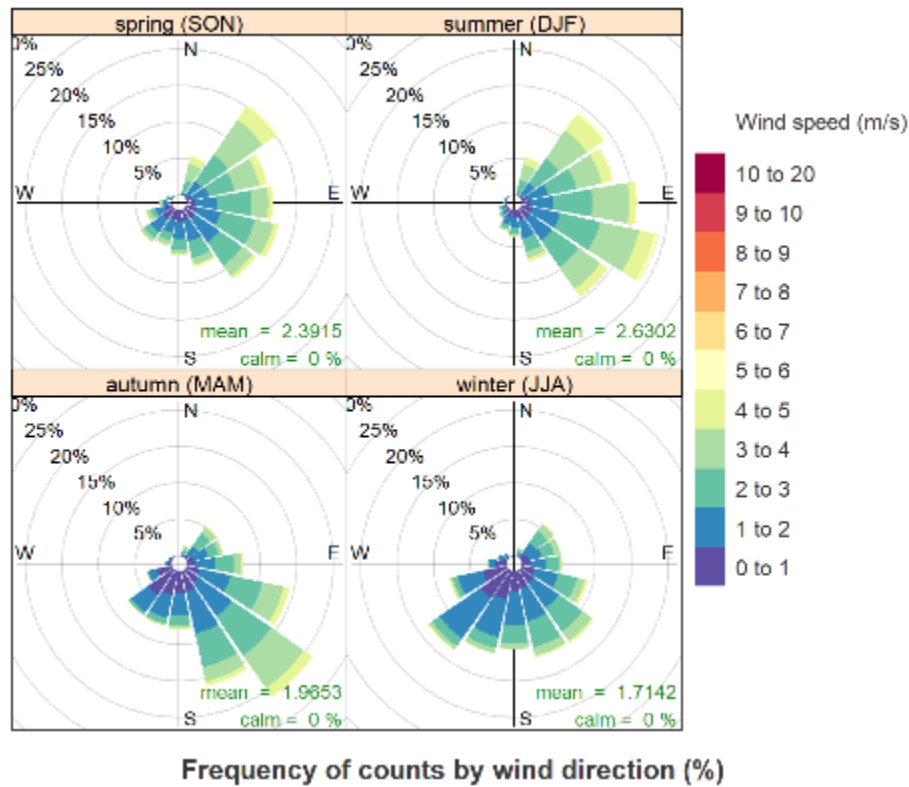


Figure 5 Seasonal distribution of winds measured at the MCM meteorological monitoring station

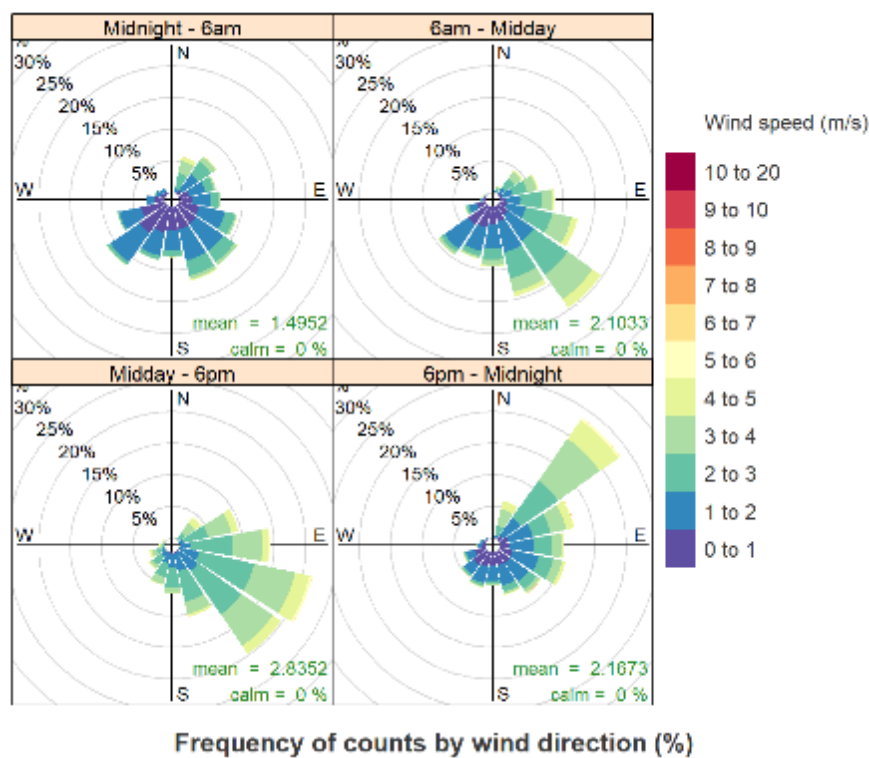


Figure 6 Diurnal distribution of winds measured at the MCM meteorological monitoring station

Time series of daily average temperature and daily rainfall measured at MCM over the previous three years are shown in Figure 7 and Figure 8. The temperature profile shows typical Central Queensland temperatures, with the average temperature ranging from 16 degrees Celsius (°C) during winter months and increasing to 28°C in the summer months. The rainfall profile at MCM is indicative of the region with larger rainfall events during summer.

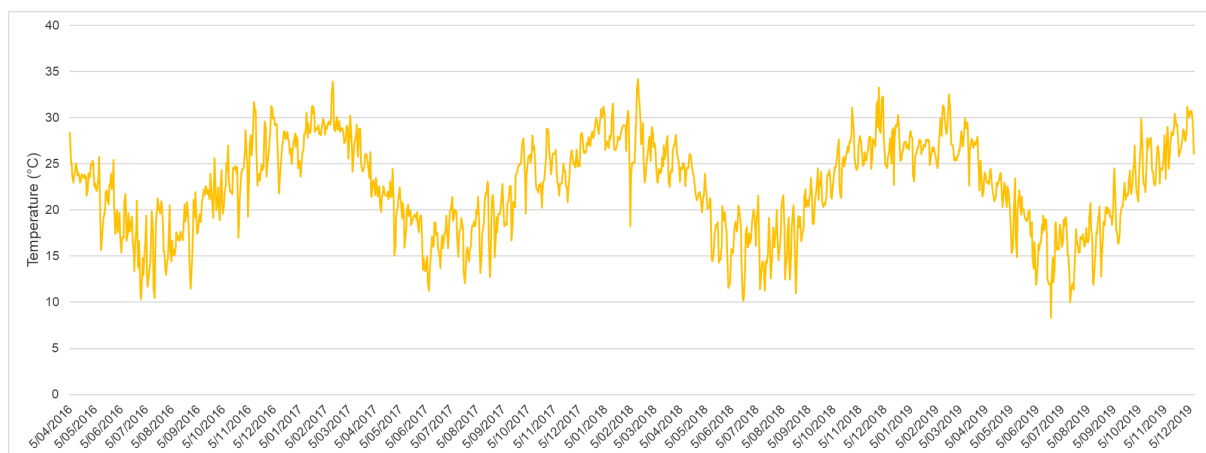


Figure 7 Time series of daily average air temperature (°C) from April 2016 – December 2019

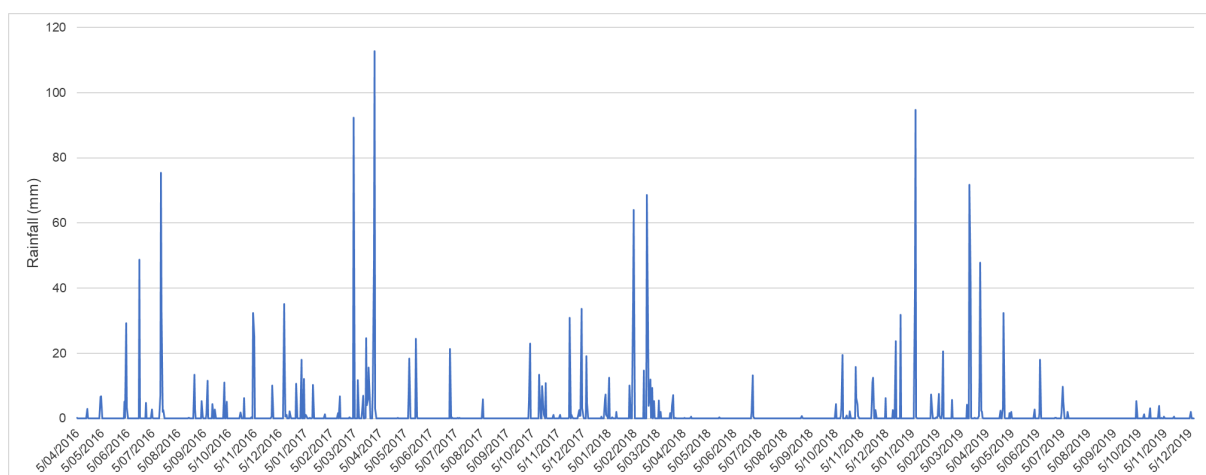


Figure 8 Time series of daily rainfall (millimetres [mm]) from April 2016 – December 2019

2.2.4 Ambient Air Quality

2.2.4.1 Dust Deposition

Historical dust deposition data between December 2013 and April 2016, obtained from a total of six dust deposition gauges located at the MCM (this includes the four existing sites and two which have been decommissioned), have previously been analysed (Katestone, 2018) and were generally below the criterion.

Dust deposition gauges are currently operated on a monthly basis at four sites surrounding MCM (Figure 3).

A summary of the most contemporary monthly dust deposition rates available at the time of assessment, between July 2019 and December 2019, is provided in Table 3 and Figure 9. The monitoring results are all below the criterion of 120 milligrams per square metre per day (mg/m²/day), except for October 2019 at DG03 and December 2019 at DG04.

Note, however, DG04 is located relatively close to the MCM processing plant and is therefore not considered representative of dust deposition levels at sensitive receptors in the region, which are located further from mining activities. Dust deposition recorded during October 2019 at DG03 was significantly higher than measurements at the other three sites, suggesting a source local to that dust gauge contributed to the elevated levels, rather than regional events. DG03 is located downwind of the MCM during south-westerly winds.

Overall, the measured dust deposition rates were indicative of inland regional areas of Queensland and did not suggest a significant contribution from MCM mining activities.

Table 3 A summary of dust deposition rates measured at MCM

Month	Total insoluble matter (mg/m ² /day)			
	DG01a	DG03	DG04	DG06
July 2019	33.3	33.3	56.7	30.0
August 2019	23.3	10.0	30.0	16.7
September 2019	40.0	33.3	33.3	30.0
October 2019	63.3	153.3	43.3	76.7
November 2019	26.7	13.3	110.0	33.3
December 2019	No data	53.3	180.0	83.3
Criterion	120 mg/m ² /day			

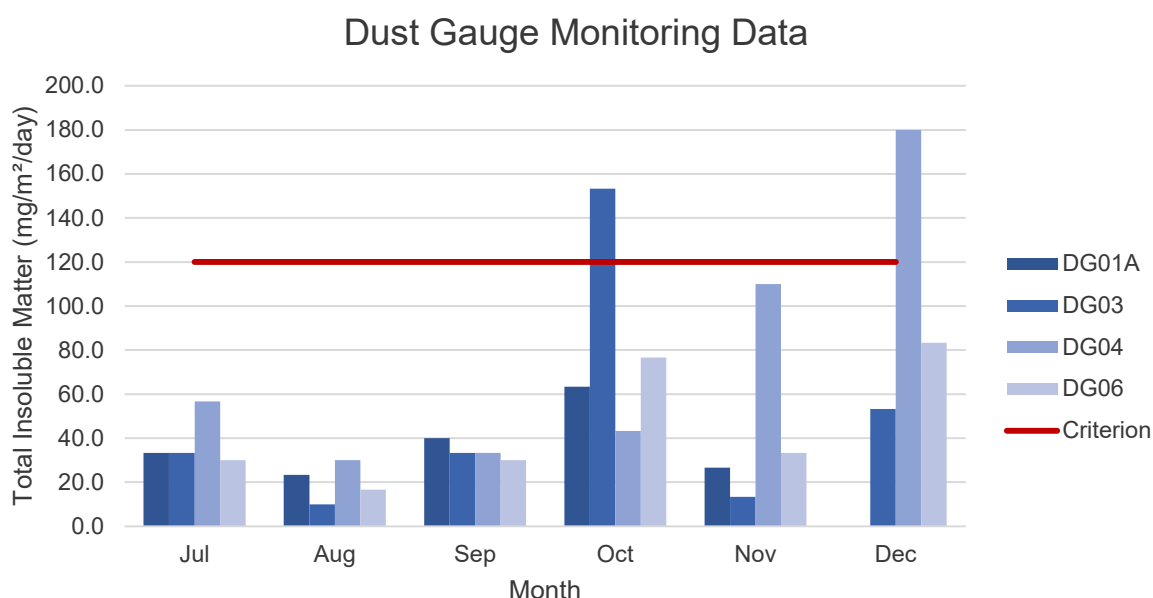


Figure 9 Dust deposition rates for July to December 2019 at dust gauge monitoring locations

2.2.4.2 Particulate Monitoring

2.2.4.2.1 DES Monitoring

There are no publicly available measurements of recent ambient levels of particulates in the area around the MCM. DES operates a number of monitoring stations across Central Queensland, with the nearest monitoring stations to the MCM located in Blackwater and Moranbah. The Moranbah monitoring station is approximately 110 km north of the MCM and has measured PM₁₀ concentrations since 2011. DES commenced monitoring of PM₁₀ and PM_{2.5} at the Blackwater monitoring station, located approximately 80 km south of the MCM, in 2019. The DES Moranbah and Blackwater monitoring stations have been commissioned to assess the impact of coal mining operations in the community and surrounds. MCPL also commenced PM₁₀ monitoring in 2019 at two locations within the vicinity of the MCM. Land uses in the vicinity of these monitoring stations are primarily mining activities and agricultural land uses, which is consistent with the region around the MCM. A review of NPI data for the 2018/19 reporting year provides some context on the representativeness of this data. Facilities within 50km of the MCM reported total PM₁₀ emissions of 36 kilotonnes (kt), compared to 42 kt reported by facilities within 50km of Blackwater, and 66 kt reported by facilities within 50km of Moranbah. This suggests that ambient levels of particulates recorded at Blackwater may provide a more representative, though potential still conservative, estimate of ambient levels in the vicinity of the MCM.

Measurements of PM₁₀ from the Moranbah monitoring station over the most recent five calendar years are summarised in Table 4, along with the available data from the Blackwater monitoring station for 2019. Measurements of PM_{2.5} from Blackwater during 2019 are summarised in Table 5. DES does not conduct monitoring of TSP at the Moranbah or Blackwater monitoring stations.

Data recorded at the Blackwater monitoring site illustrates similar levels to those measured at the Moranbah monitoring site. A total of 19 exceedances of the 24-hour average PM₁₀ Air EPP objective were recorded, and the average measurement was equal to the Air EPP objective of 25 µg/m³.

Table 4 Summary of PM₁₀ concentrations measured at Moranbah and Blackwater by DES

Year	24-hour Average (µg/m³)				Annual Average (µg/m³)
	Maximum	No. of days >50 µg/m³	90 th percentile	70 th percentile	
Moranbah					
2014	49.9	0	30.5	24.0	20.4
2015	91.9	4	34.3	25.3	21.3
2016	49.5	0	30.7	25.3	22.4
2017	68.8	7	38.2	29.6	26.4
2018	113.6	19	45.9	34.6	30.3
Blackwater					
2019 *	193.4	19	40.6	26.1	25.4
Table note:					
* Data recorded between 12 February 2019 and 31 December 2019.					

Table 5 **Summary of PM_{2.5} concentrations measured at Blackwater by DES**

Year	24-hour Average (µg/m ³)				Annual Average (µg/m ³)
	Maximum	No. of days >25 µg/m ³	90 th percentile	70 th percentile	
2019 *	34.4	2	13.6	7.9	7.3
Table note: * Data recorded between 12 February 2019 and 31 December 2019.					

2.2.4.2.2 Middlemount Coal PM₁₀ Monitoring

MCPL has recently commenced monitoring of PM₁₀ levels at four temporary sites using DustTrak monitors (the locations of these sites are shown in Figure 3) as part of calibration of the monitoring equipment. As such, a limited amount of data was available for analysis. Given the short time frame covered by the dataset, it is not considered suitable for determining ambient background levels of PM₁₀, however the available data is presented in Figure 10 to Figure 13 as 24-hour rolling averages for completeness. All available measurements from these monitors are below the 24-hour average criterion of 50 µg/m³.

Three of these sites are located close to coal processing and transport infrastructure (CHPP, flocc cells, and rail loop sites) (Figure 3). They are also located on the south-western side of the open cut pit areas, whilst the nearest sensitive receptors are located to the north-east (Middlemount), and to the south-east (Tralee 2). These PM₁₀ monitoring locations may be suitable for evaluating exposure of the workforce to particulate levels, but they are not expected to be representative of ambient levels in the wider area.

Of the temporary monitoring sites, the Farm Shed monitoring site is located furthest from mining infrastructure (Figure 3). It is located approximately 2 km north of the Tralee 2 receptor. A longer-term dataset from this monitor may provide an assessment of existing particulate levels at Tralee 2. All other receptors in the area are located further from the MCM than this monitoring site. However, this site is unlikely to be representative of ambient dust levels in the Middlemount township, as dust would disperse towards the township during south-westerly winds, and this may not be detected by the monitoring station due to its location to the east of the MCM open cut mining areas.

MCPL is currently reviewing prospective monitoring locations and will site the monitoring equipment at appropriate locations in the near future.

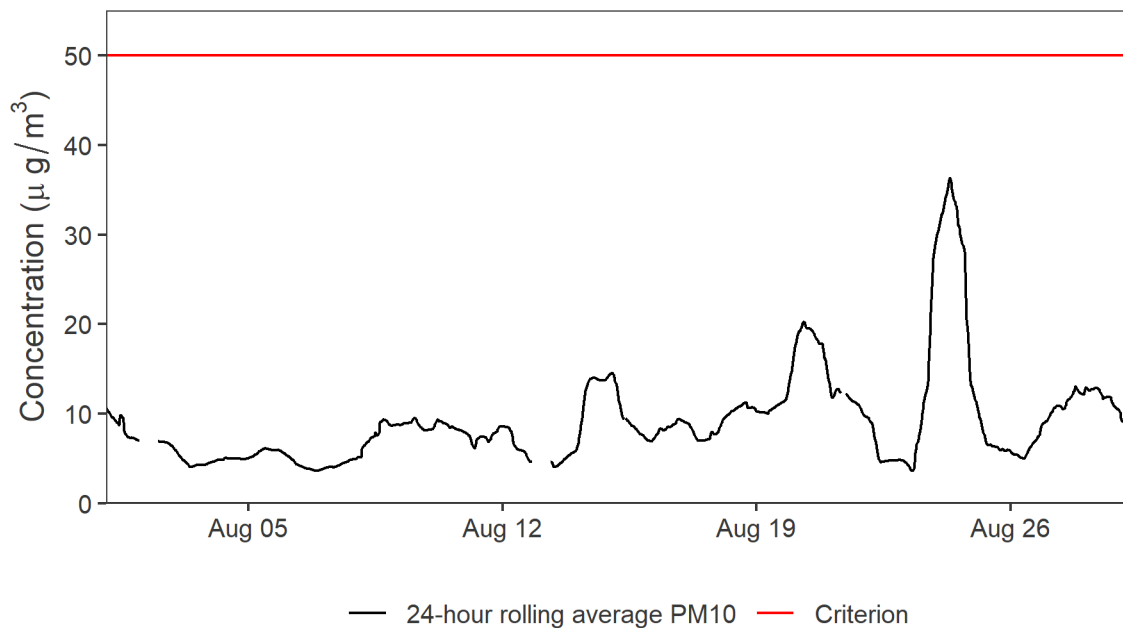


Figure 10 CHPP PM₁₀ (µg/m³) monitoring data for 2019

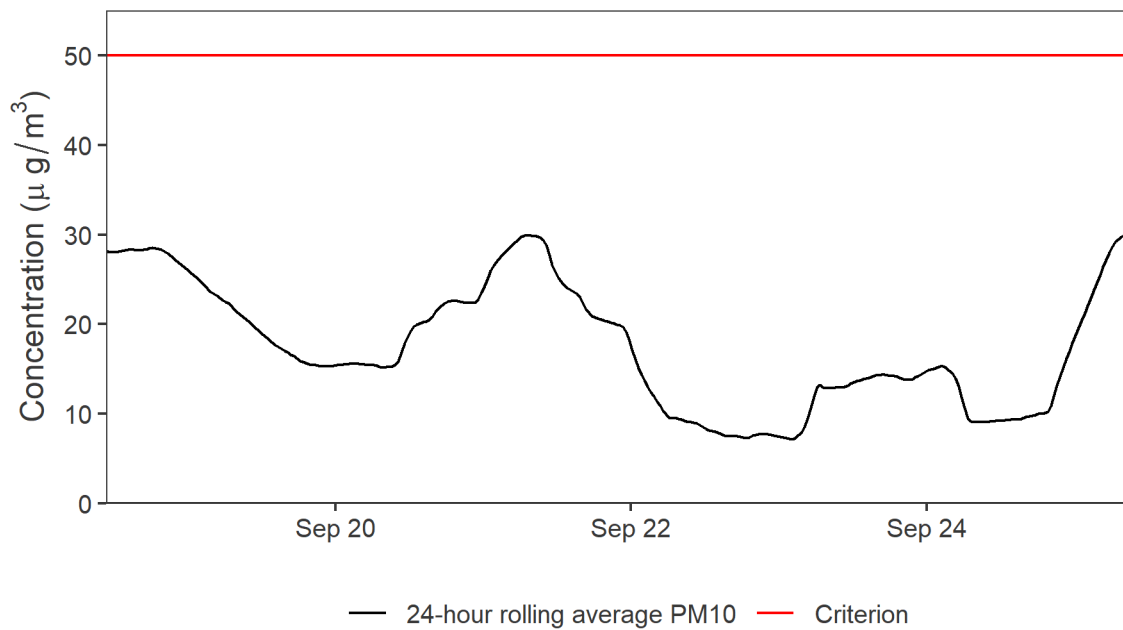


Figure 11 Farm Shed PM₁₀ ($\mu\text{g}/\text{m}^3$) monitoring data for 2019

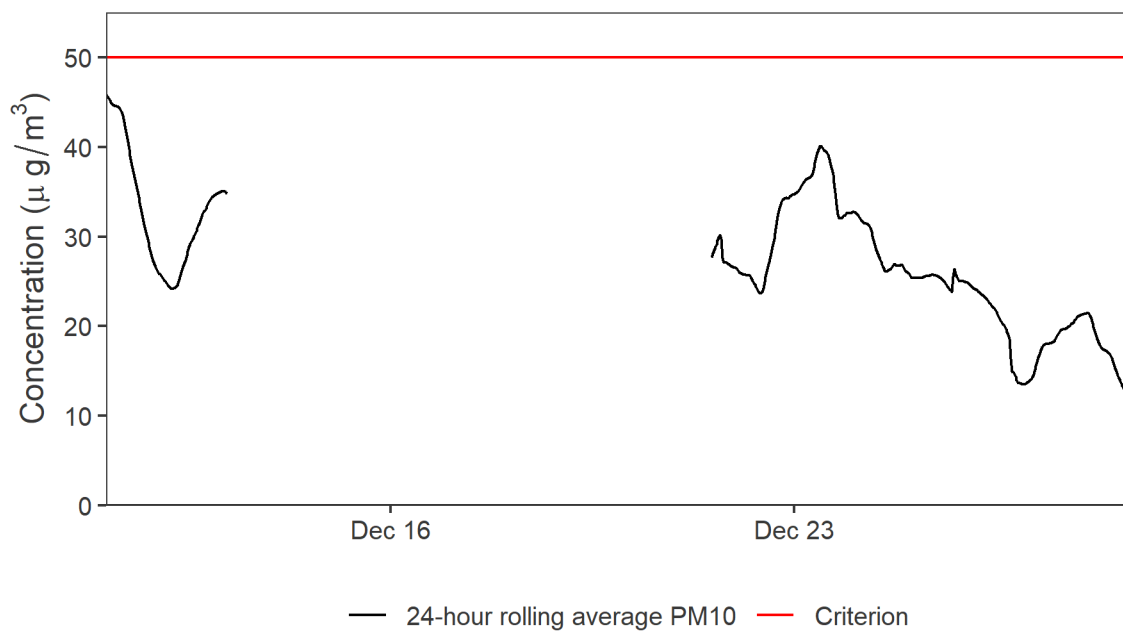


Figure 12 Rail Loop PM₁₀ ($\mu\text{g}/\text{m}^3$) monitoring data for 2019

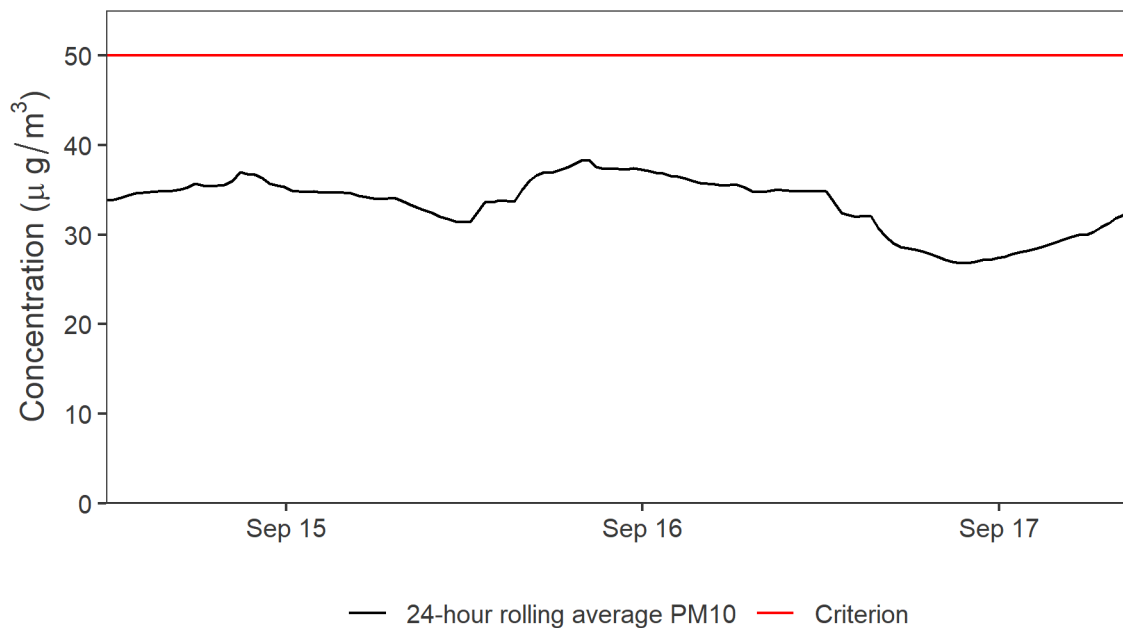


Figure 13 Floc Cells PM₁₀ (µg/m³) monitoring data for 2019

2.2.4.2.3 Summary

The particulate monitoring data collected in the vicinity of the MCM is limited. The nearest DES operated monitoring sites are at Moranbah and Blackwater, over 80 km from the MCM. The Moranbah station has recorded the most comprehensive ambient air quality dataset, with measurements available from 2011. DES commenced particulate monitoring at the Blackwater monitoring station in 2019, which is expected to be more representative than data collected in Moranbah. However, the Blackwater monitoring station has not yet been operating for a full year. Data from the Moranbah monitoring station indicates that levels of particulates in these locations have been above the air quality objectives in recent years, and data from the Blackwater monitoring station shows exceedances of the short-term criteria for PM₁₀.

Particulate monitoring at the MCM commenced in late 2019 at four temporary sites as part of calibration of the monitoring equipment. MCPL is currently reviewing prospective monitoring locations and will site the monitoring equipment at appropriate locations in the near future.

2.2.5 Complaints

To date, MCM has received one complaint regarding air quality, recorded during October 2017. This complaint related to dust from blasting, which had been noted as reaching a residence. The complaints register record identified that peak wind speeds during that time were over 20 kilometres per hour (km/hr), and that blasting should only occur when winds are less than 10 km/hr if they are from the south-west.

2.3 Scenario Selection

Following review of the Project mine plan, two years were selected for assessment purposes, 2037 and 2043. These two years were selected based on material extraction/handling rates, proximity of mining activities to the closest sensitive receivers, and other parameters relating to the potential for dust generation. The selection of these years is described further below.

The production schedule for the life of the mine indicates that 2036 is expected to have the highest overburden extraction rate, which is typically an indicator for the magnitude of dust emissions from mining operations. However, Year 2037 mining operations would be located closer to the nearest sensitive receiver (i.e. Tralee 2) than Year 2036 mining operations, with continued activities in the northern section of the MCM. Given this, a conservative assessment has been made based on the Year 2037 mine layout, using extraction rates from 2036.

Year 2043 has also been selected as this represents a year when the entire mine fleet would be located within the Project's southern open cut pit extension. The production schedule indicates that of the years in which mining is entirely within this area, 2043 is expected to have the highest ROM coal and overburden extraction rates.

The location of proposed Project mining activities for Years 2037 and 2043 are shown in Figure 14 and Figure 15, respectively.

It is noted that the Project includes a realignment of the previously approved Roper Creek Diversion and associated landform levee. The associated construction activities are anticipated to occur upon approval of the EA Amendment (currently anticipated to occur in Q1/Q2 2021) and are therefore not included in the emissions inventories considered in this assessment. Construction activities are expected to take approximately six months. Whilst these construction activities would occur simultaneously with mining operations, air quality impacts during this time are still expected to be lower than during years 2037 and 2043. This is due to:

- Overall waste volumes associated with mining during 2021 are expected to be approximately 28% less than those in Year 2036, and ROM quantities are comparable
- Whilst construction activities may occur marginally closer to Tralee 2 than active mining in the extension area for Year 2043 the scale of construction activities is less than ongoing mining activities.

Notwithstanding this, appropriate mitigation measures (such as watering of trafficked and exposed surfaces where appropriate and reasonable) will be employed to minimise the dust emissions associated with the construction of the diversion and levee.

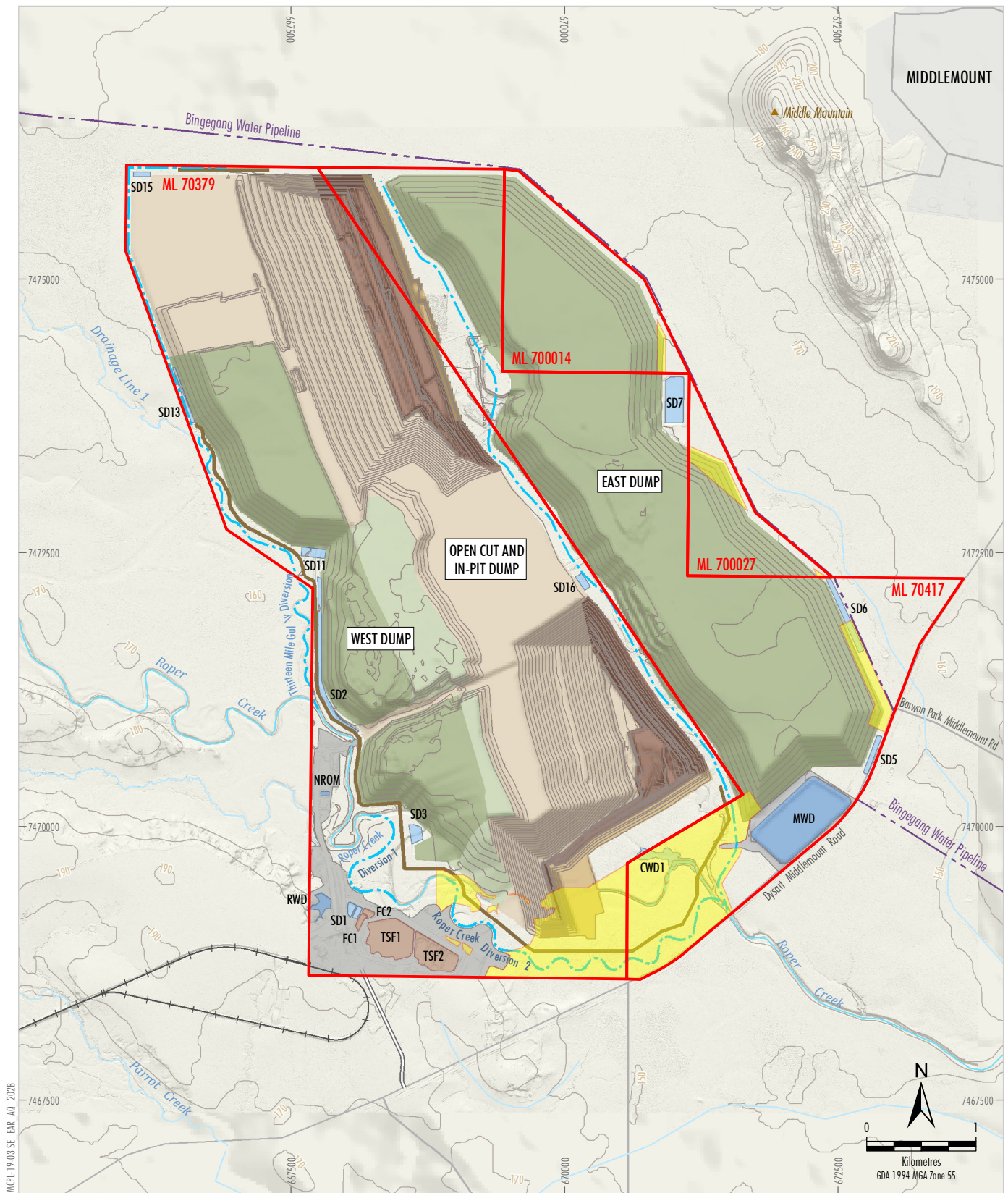
The production schedule for the lifetime of the Project has been provided by MCPL and details for Year 2037 and Year 2043 are provided in Table 6.

As described in Section 1.2, this assessment quantifies dust emissions from the Project and compares them to the dust emissions presented in the Stage 2 Middlemount Coal Project EIS (Katestone, 2011), the North-eastern Extension Project (Katestone, 2015) and the Western Extension Project (Katestone, 2018). For comparative purposes Table 6 therefore, also includes the amounts of material extracted/handled for Year 14 of the Stage 2 Middlemount Coal Project EIS (the worst-case scenario presented in the EIS), and worst-case assessment years from the North-eastern Extension Project and Western Extension Project.

The production schedule shows that the overburden, ROM coal and product coal volumes for Year 2037 are comparable to Year 14 of the Stage 2 Middlemount Coal Project EIS, whilst in Year 2043 these are significantly lower. Extraction rates and product coal volumes during Year 2043 are expected to be approximately 50-65% of those assessed in the Year 14 scenario for the Stage 2 Middlemount Coal Project EIS.

Table 6 **Comparison of previous MCM assessment scenarios with the Project assessment scenarios**

Material Handled	Amount of Material (tonnes)					
	Southern Extension Project		Western Extension Project (Katestone, 2018)		North-eastern Extension Project - Year 2029 (Katestone, 2015)	Stage 2 Middlemount Coal Project EIS Year 14 (Katestone, 2011)
	Year 2037 *	Year 2043	Year 2028	Year 2032		
Overburden	81,857,038	47,418,533	63,116,012	72,673,956	82,303,393	93,876,667
ROM coal	5,414,500	3,196,243	5,414,500	5,414,500	4,132,315	5,400,000
Product coal	4,366,902	2,650,076	3,945,000	3,730,500	3,181,355	4,000,000
Table note: * Expected production rates from 2036 have been used for a conservative assessment of Year 2037 operations.						



LEGEND

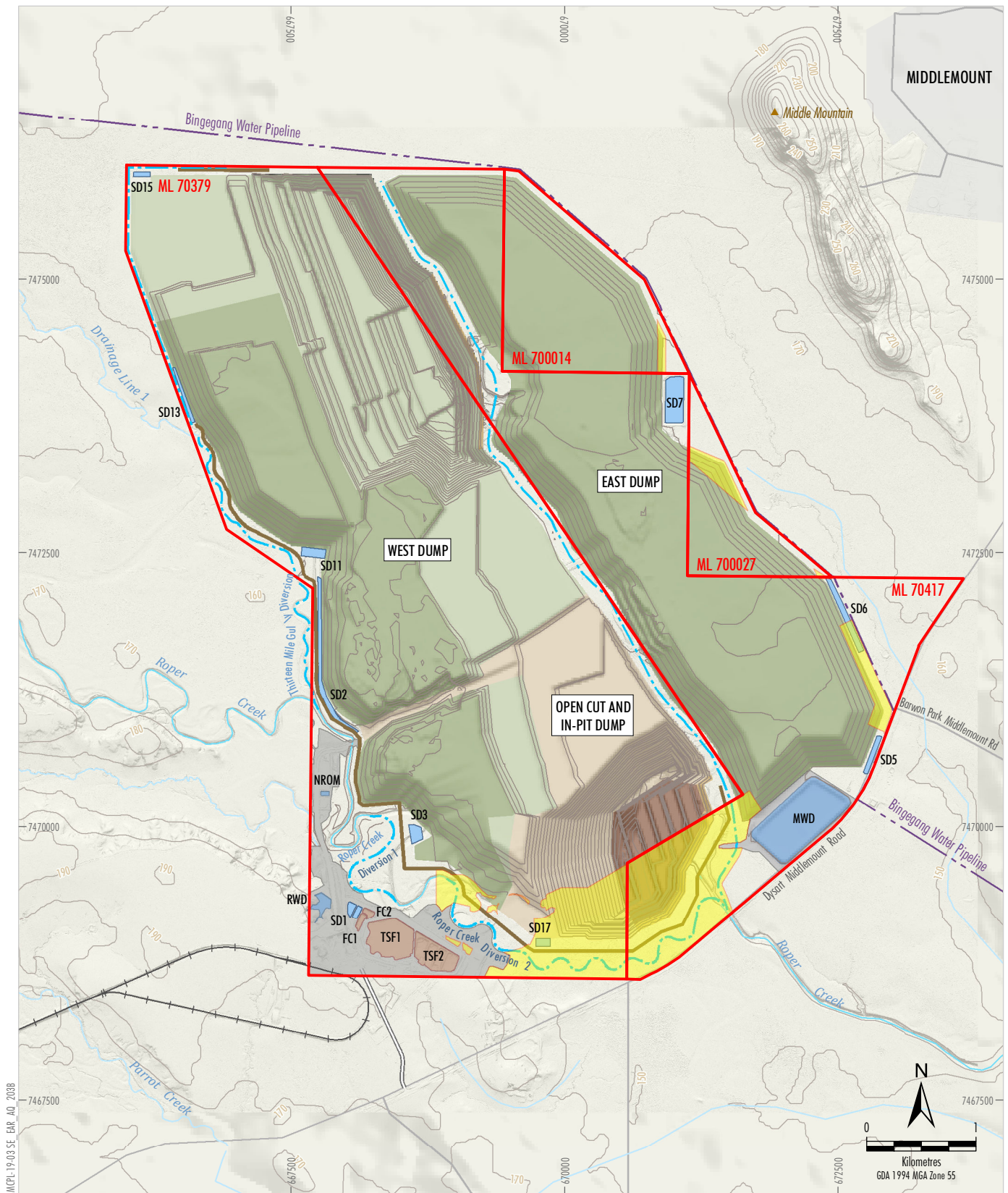
- Mining Lease Boundary (ML)
- Topsoil Stripped
- Active Open Cut Mining Area
- Active Waste Rock Emplacement
- Initial Rehabilitation
- Established Rehabilitation
- Mine Infrastructure Area
- Tailings Storage Facility
- Sediment Dam
- Water Storage
- Diversion Structure
- Levee
- Mine Access Road
- + + Middlemount Rail Spur and Loop
- Approximate Extent of Proposed Additional Disturbance

Source: MCPL (2020); The State of Queensland (2020)



SOUTHERN EXTENSION PROJECT
Conceptual General Arrangement
Year 17 (2037)

Figure 14



MCPL 19-03 SE EAB AO 2038

Source: MCPL (2020); The State of Queensland (2020)

- LEGEND**
- Mining Lease Boundary (ML)
 - Topsoil Stripped
 - Active Open Cut Mining Area
 - Active Waste Rock Emplacement
 - Initial Rehabilitation
 - Established Rehabilitation
 - Mine Infrastructure Area
 - Tailings Storage Facility
 - Sediment Dam
 - Water Storage
 - Diversion Structure
 - Levee
 - Mine Access Road
 - + + Middlemount Rail Spur and Loop
 - Approximate Extent of Proposed Additional Disturbance


SOUTHERN EXTENSION PROJECT
Conceptual General Arrangement
Year 23 (2043)

Figure 15

2.4 Dust Emissions Inventory

The major source of dust emissions from MCM is the truck and shovel operations to remove coal and overburden from the open-cut pits. Other sources of dust at MCM include: the coal processing plant, rail loadout facility, wind-blown dust from stockpiles, pit dumps, bare-ground and areas undergoing rehabilitation.

A dust emissions inventory for the Project has been prepared using the same methodology as previous air quality assessments of the MCM, including the Western Extension Project (Katestone, 2018), North-eastern Extension Project (Katestone, 2015) and the Stage 2 Middlemount Coal Project EIS (Katestone, 2011). The emissions inventory has been developed using emission factors published by the US EPA in its Compilation of Air Pollution Emission Factors Volume 1 (AP-42) (US EPA, 1998, 2004, 2006a, 2006b) and by the Commonwealth Department of the Environment in its National Pollutant Inventory Handbooks (NPI, 2012), and information on mining equipment, activity rates and mining locations for the Project provided by MCPL.

The dust emission inventories for Year 2037 and Year 2043 of the Project have been prepared for the following mining activities:

- Topsoil and overburden removal, handling, transport and dumping
- Drilling
- Blasting
- ROM coal handling in the open-cut pits
- Hauling ROM coal to processing area
- Handling of overburden and waste rock in the open-cut pits
- Hauling of overburden to emplacement areas
- Dumping and shaping of the waste rock emplacement areas
- Wind erosion from areas disturbed by mining activities
- Wind erosion of overburden emplacement areas
- Wind erosion, loading and unloading coal from ROM coal stockpiles
- ROM coal processing
- Wind erosion, loading and unloading coal from product coal stockpiles
- Loading rail wagons.

Dust control measures employed at the MCM (and that will be continued for Project) have been accounted for in the dust emissions inventory. The same dust control measures and level of control that were assumed in the dust inventory for the Stage 2 Middlemount Coal Project EIS, North-eastern Extension Project and Western Extension Project have been applied to the Project. These dust control measures are shown in Table 7. In addition to these, various other control measures are implemented at the MCM but are not specifically accounted for in the dust inventory for the Project. These include minor operational modifications in response to real time meteorological and air quality monitoring, and blast management measures.

Table 7 Dust Control Measures

Source	Control measure	Level of control	Reference
Haul roads	Watering	75%	NPI for Mining Version 3.1 (2012) – Level 2 watering assumed
Stockpiles (ROM and product coals)	Watering	50%	NPI for Mining Version 3.1 (2012)
Drilling	Dust collectors	70%	NSW Mineral Council (2000)
Material transfers in processing area	Watering	50%	NPI for Mining Version 3.1 (2012)
Exposed areas	Initial rehabilitation	30%	NPI for Mining Version 3.1 (2012)
Exposed areas	Established rehabilitation	60%	NPI for Mining Version 3.1 (2012)

A summary of total estimated annual dust emissions for Year 2037 and Year 2043 of the Project are shown in Table 8. For comparison, Table 8 also shows the total annual dust emissions that were estimated in the Stage 2 Middlemount Coal Project EIS for Year 14, and subsequent extension projects, for the years assessed.

Table 8 shows that the estimated dust emission rates for Year 2037 are approximately 2% to 14% lower than those estimated for Year 14 of the Stage 2 Middlemount Coal Project EIS.

Table 8 shows that the estimated dust emission rates for Year 2043 of the Project are approximately between 56-65% of the estimated dust emission rates for Year 14 of the Stage 2 Middlemount Coal Project EIS, and lower than the estimated dust emission rates estimated for the North-eastern Extension Project and Western Extension Project.

Table 8 Estimated total annual dust emission rates (tonnes/annum)

Operation Scenario		Total dust emission rate (tonnes/annum)		
		TSP	PM ₁₀	PM _{2.5}
Southern Extension Project	Year 2037	9,171	3,354	489
	Year 2043	5,981	2,251	324
Western Extension Project	Year 2028	7,099	2,709	396
	Year 2032	7,442	2,834	420
North-eastern Extension Project	Year 2029	8,085	3,004	432
Stage 2 Middlemount Coal Project EIS	Year 14	10,664	3,730	497

A detailed breakdown of the estimated dust emissions inventories for Year 2037 and Year 2043 of the Project are shown in Table 9, and Table 10 details the breakdown of estimated dust emissions for Stage 2 Middlemount Coal Project EIS for Year 14 and emissions from the subsequent extension projects for comparison.

The detailed breakdown of the estimated Project dust emissions shows the following:

- Total estimated dust emissions for the Project are significantly lower during Year 2043, due to lower extraction rates and shorter haul routes for ROM coal, as no ROM coal is extracted from the northern area.
- The area exposed to wind erosion is greater by Year 2043 than in Year 2037, however as a larger portion is rehabilitated, this does not result in higher estimated emissions due to wind erosion.

- Total estimated dust emissions for the Project during Year 2037 are higher than those estimated for the North-eastern Extension Project and Western Extension Project, due to the higher extraction and production rates. The estimated Project emissions for Year 2037 are based on the extraction rates for 2036, which are the highest over the Project lifetime.
- Total estimated dust emissions for the Project during Year 2043 are significantly lower than those estimated for the North-eastern Extension Project and Western Extension Project, due to the lower extraction rates in these later years.

Table 9 Project estimated dust emission rates for each mining activity (g/s)

Activity	Southern Extension Project					
	Year 2037			Year 2043		
	TSP	PM ₁₀	PM _{2.5}	TSP	PM ₁₀	PM _{2.5}
Active Pits (Blasting, Drilling, Dozing)	81.3	34.3	4.8	51.6	22.2	2.9
In-Pit (Haul, Dump, Dozing, Wind Erosion)	145.1	49.6	7.7	78.2	25.7	4.0
Out-of-Pit Dump (Dump, Dozing, Wind Erosion)	22.8	10.3	1.8	33.3	15.8	2.6
Coal Haul - Pit to Plant	34.4	9.4	0.9	21.3	5.8	0.6
Coal Processing and Loadout	7.1	2.7	0.2	5.2	1.9	0.2
TOTAL (g/s)	291	106	16	190	71	10
TOTAL (tonnes/annum)	9,171	3,354	489	5,981	2,251	324

Table 10 Western Extension Project, North-eastern Extension Project and Stage 2 Middlemount Coal Project EIS estimated dust emission rates for each mining activity (g/s)

Activity	Western Extension Project Year 2032			North-eastern Extension Project Year 2029			Stage 2 Middlemount Coal Project EIS Year 14		
	TSP	PM ₁₀	PM _{2.5}	TSP	PM ₁₀	PM _{2.5}	TSP	PM ₁₀	PM _{2.5}
Active Pits (Blasting, Drilling, Dozing)	79.7	33.9	4.7	89.5	38.7	5.4	101.4	43.3	6.1
In-Pit (Haul, Dump, Dozing, Wind Erosion)	93.6	33.8	6.0	90.3	30.0	4.5	125.5	39.1	5.2
Out-of-Pit Haul (Overburden to East Dump)	0.0	0.0	0.0	27.3	7.5	0.9	52.3	14.3	1.4
Out-of-Pit Dump (Dump, Dozing, Wind Erosion)	19.0	9.4	1.4	33.1	14.2	2.5	29.4	12.8	2.2
Coal Haul - Pit to Plant	36.6	10.0	1.0	11.1	3.0	0.3	23.5	6.5	0.6
Coal Processing and Loadout	7.1	2.7	0.2	5.1	1.9	0.2	6.0	2.3	0.2
TOTAL (g/s)	236	90	13	256	95	14	338	118	16
TOTAL (tonnes/annum)	7,442	2,834	420	8,085	3,004	432	10,664	3,730	497

2.5 Summary of the Potential Air Quality Impacts from the Project

Table 8 shows that the estimated dust emission rates for Year 2037 are approximately 2% to 14% lower than those estimated for Year 14 of the Stage 2 Middlemount Coal Project EIS. The overburden extraction rate is expected to be slightly lower in Year 2037 compared to Year 14 of the Stage 2 Middlemount Coal Project EIS, whilst similar quantities of ROM coal and product coal are anticipated.

In Year 2037, the majority of mining activities would be contained within the current approved mine lease areas. Within the Project open cut pit extension, topsoil stripping will occur. It is not anticipated that this change would significantly impact dust levels at the Tralee 2 receptor, particularly given how infrequent winds that would place this receptor downwind occur. Air quality impacts at other receptors in the region, and at the Middlemount township, are not anticipated to differ from those predicted for Year 14 of the Stage 2 Middlemount Coal Project EIS given the comparable dust emission rates, and comparable spatial spread of activities.

The estimated dust emissions for the Project show that dust emissions during later years such as Year 2043 are significantly lower than dust emissions expected during Year 14 of the Stage 2 Middlemount Coal Project EIS, and are also lower than emissions estimated for each of the Western Extension Project and North-eastern Extension Project.

As described in Section 2.2.2, later years of the Project do not involve mining in closer proximity to the nearest receptor (Tralee 2) than currently approved components of the MCM. Further, when all mining activity will be located within the southern part of the MCM (e.g. in Year 43), the overall material extraction and handling rates are reduced as the Project approaches completion. In addition, prevailing winds are likely to continue to be away from "Tralee 2". Air quality impacts at other receptors in the region are expected to be significantly lower than those predicted for Year 14 of the Middlemount Coal Stage 2 EIS given the overall lower dust emission rates in these later years.

Dust emissions from the Project are expected to be comparable to, or lower than, those modelled in the Stage 2 Middlemount Coal Project EIS air quality assessment.

Cumulative impacts due to the Project and other surrounding mining activities may be lower than considered in the Stage 2 Middlemount Coal Project EIS air quality assessment. This is due to the German Creek open-cut mine and Norwich Park mines now being under care and maintenance. Whilst the Oak Park open cut mine opened in 2004, this is located further south of MCM than the German Creek East open cut pit, and any cumulative impacts are likely to be lower than those experienced during operation of the German Creek East open cut operation. Cumulative impacts that may have occurred at receptors to the northeast of the MCM (i.e. the Middlemount township) and to the southeast (i.e. Tralee 2), are anticipated to be lower due to a reduction in emissions from these surrounding activities as well as a possible reduction in emissions from the Project.

As such, quantification of air quality impacts from the Project through dispersion modelling has not been explicitly conducted for this air quality assessment. Dispersion modelling was undertaken for the Stage 2 Middlemount Coal Project EIS air quality assessment (Katestone, 2011) and approved in 2011.

3. GREENHOUSE GAS ASSESSMENT

3.1 Climate Change and the Greenhouse Effect

The term greenhouse gases (GHG) comes from the 'greenhouse effect', which refers to the natural process that warms the Earth's surface. GHG in the atmosphere absorb the solar radiation released by the Earth's surface and then radiate some heat back towards the ground, increasing the surface temperature. Human activity, especially burning fossil fuels and deforestation, is increasing the concentration of GHG in the atmosphere and hence increasing the absorption of outgoing heat energy. Even a small increase in long-term average surface temperatures has numerous direct and indirect consequences for climate.

Australia is a signatory to United Nations Framework Convention on Climate Change (UNFCCC), the associated Kyoto Protocol signalling its commitment to reducing GHG emissions at a national level. Under the Paris Agreement, the most recent progression of the UNFCCC, Australia has set an ambitious target to reduce emissions by 26-28 per cent below 2005 levels by 2030, building on the 2020 target of reducing emissions by five per cent below 2000 levels.

The main GHG associated with the Project are carbon dioxide (CO₂) and methane (CH₄) with a smaller contribution from nitrous oxide (N₂O). These gases vary in effect and longevity in the atmosphere, however a system named Global Warming Potential (GWP) allows them to be described in terms of CO₂ (the most prevalent greenhouse gas) called carbon dioxide equivalents (CO₂-e). A unit of one tonne of CO₂-e is the basic unit used in carbon accounting. In simple terms the greenhouse gas emissions associated with the Project can be expressed as the sum of the emission rate of each greenhouse gas multiplied by its associated GWP (denoted in squares). For example:

$$\text{tonnes CO}_2\text{-e} = \text{tonnes CO}_2 \times \boxed{1} + \text{tonnes CH}_4 \times \boxed{25} + \text{tonnes N}_2\text{O} \times \boxed{298}$$

While few, if any, individual projects would make a noticeable change to the Earth's climate, the summation of human activities increasing the concentrations of GHG in the upper atmosphere does. Climate change is an environmental concern at a global level. Governments and the global scientific community have established conventions for accounting for GHG emissions to enable the transparent and verifiable assessment of GHG emissions among all global jurisdictions. This assessment employs these established conventions so that the relative impact of the Project can be assessed and understood.

3.2 Regulatory Framework for Greenhouse Gas Emissions

3.2.1 Australian International Commitments

Australia will meet its targets through the Government's Direct Action Plan. The Emissions Reduction Fund (ERF) is a central component of the Direct Action policies that is made up of an element to credit emissions reductions, a fund to purchase emissions reductions, and a Safeguard Mechanism.

The Safeguard Mechanism has been put in place to ensure that emissions reductions purchased by the Government through the ERF are not offset by significant increases in emissions by large emitters elsewhere in the economy. The Safeguard Mechanism commenced on 1 July 2016 and requires Australia's largest emitters to keep emissions within baseline levels. It applies to around 140 large businesses that have facilities with direct emissions (Scope 1 Emissions) of more than 100,000 tonnes of carbon dioxide equivalent (t CO₂-e) a year and is expected to cover approximately half of Australia's emissions.

Direct emissions associated with the Project are anticipated to exceed 100,000 t CO₂-e for all years with the exception of the final year of operation (2044). As a result, the Project will be subject to the requirements of the Safeguard Mechanism.

3.2.2 National Greenhouse and Energy Reporting (NGER)

The *National Greenhouse and Energy Reporting Act 2007* (NGER Act) established a national framework for corporations to report GHG emissions and energy consumption.

The *National Greenhouse and Energy Reporting Regulations 2008* (NGER Regulations) recognises Scope 1 and Scope 2 emissions as follows:

- Scope 1 emissions – in relation to a facility, means the release of GHG into the atmosphere as a direct result of an activity or series of activities (including ancillary activities) that constitute the facility.
- Scope 2 emissions – in relation to a facility, means the release of GHG into the atmosphere as a direct result of one or more activities that generate electricity, heating, cooling or steam that is consumed by the facility but that do not form part of the facility.

A third category of GHG emissions, namely Scope 3 emissions, are defined as indirect greenhouse gas emissions other than scope 2 emissions that are generated in the wider economy. They occur as a consequence of the activities of a facility, but from sources not owned or controlled by that facility's business. Some examples are extraction and production of purchased materials, transportation of purchased fuels, use of sold products and services, and flying on a commercial airline by a person from another business. Due to the potential for double-counting of GHG emissions, Scope 3 emissions are not included in NGER reporting.

Registration and reporting are mandatory for corporations that have energy production, energy use or GHG emissions that exceed specified thresholds. GHG emission thresholds include Scope 1 and Scope 2 emissions. NGER reporting thresholds are summarised in Table 11.

Table 11 NGER annual reporting thresholds – greenhouse gas emissions and energy use

Threshold level	Threshold type	
	GHG (kt CO ₂ -e)	Energy consumption (TJ)
Facility	25	100
Corporate	50	200
Note: kt CO ₂ -e = kilotonnes of carbon dioxide equivalent. TJ = terajoules.		

With annual combined Scope 1 and Scope 2 emissions ranging from 46 kt CO₂-e to 316 kt CO₂-e, MCPL will have reporting obligations associated with the Project under the NGER Scheme, including estimating and reporting of GHG emissions and energy use on an annual basis.

MCPL is an incorporated joint venture between Peabody Energy Australia Pty Ltd (Peabody) and Yancoal Australia Ltd (Yancoal). Peabody and Yancoal both having existing reporting obligations in relation to the NGER Scheme. MCPL will have ongoing reporting obligations under the NGER Scheme for GHG emissions and energy use associated with the Project.

3.3 Existing Environment

GHG emissions associated with the Project contribute to State and National GHG inventories. A summary of Queensland's and Australia's most recently published GHG emissions inventories are provided in Table 12 (Commonwealth of Australia, 2019c).

Table 12 Annual GHG emissions for Australia and Queensland – 2017

Category	Australia	Queensland	
	Emissions (Mt CO ₂ -e)	Emissions (Mt CO ₂ -e)	Contribution to national emissions
Inventory total*	554.1	142.1	25.6%
Notes: * National and State GHG emissions excluding Land Use and Land Use Change. Mt CO ₂ -e = million tonnes of carbon dioxide equivalent.			

GHG emissions associated with existing MCM mining operations together with GHG emissions estimates for the recently approved Western Extension Project are summarised in Table 13.

Table 13 Summary of annual GHG emissions for the MCM incorporating the Western Extension Project

Annual emissions	GHG (t CO ₂ -e)
Average	288,960
Maximum	315,455
Minimum	227,581
TOTAL	5,915,236
Source: Middlemount Coal Mine Western Extension Project – Air Quality and Greenhouse Gas Assessment. (Katestone, 2018).	

3.4 Greenhouse Gas Emission Estimation Methodology

The main sources of GHG emissions associated with the Project, organised according to the scope of emissions, are:

- Scope 1 emissions:
 - Fugitive methane emissions that result from the open-cut mining of coal
 - Diesel usage for mining operations including earthmoving equipment, heavy machinery, haulage trucks and site vehicles
 - Explosive usage for blasting operations.
- Scope 2 emissions:
 - Electricity usage for mining operations including CHPP, mining equipment, lighting and amenities.

Pollutants of importance to climate change, associated with the Project, are CO₂, CH₄ and N₂O. The GWPs associated with these pollutants are summarised in Table 14. This study will assess the emissions of GHG from the Project during operation based on activity data representative of the proposed activities and the methods described in the following resources:

- The National Greenhouse Accounts, August 2019 (Commonwealth Department of the Environment and Energy, 2019)
- NGER Regulations
- *National Greenhouse and Energy Reporting (Measurement) Determination 2008* (NGER Determination)
- The Greenhouse Gas Protocol (World Resources Institute/World Business Council for Sustainable Development, 2004).

Table 14 Greenhouse gases and their Global Warming Potential

Greenhouse Gas	Chemical formula	GWP
Carbon Dioxide	CO ₂	1
Methane	CH ₄	25
Nitrous oxide	N ₂ O	298

Source: NGER Regulations (Commonwealth of Australia, 2019b).

Emissions factors and energy content factors used for this assessment are summarised in Table 15.

Table 15 Emission factor summary (Schedule 1, NGER Determination)

Emission source	Scope	Energy content	Units	Emission factor	Units
Diesel	1	38.6	GJ/kL	70.5	kg CO ₂ -e/GJ
Fugitive methane (Queensland - open cut)	1	-	-	0.02	t CO ₂ -e/t ROM
Explosives (ANFO)	1	2.4	GJ/t	0.17	t CO ₂ -e/t ANFO
Electricity (Queensland)	2	3.6	MJ/kWh	0.81	kg CO ₂ -e/kWh

Sources: NGER Determination (Commonwealth of Australia, 2020), NGA Workbook (Department of Climate Change, 2008)

Notes: ANFO = Ammonium nitrate fuel oil. GJ/kL = Gigajoules per kilolitre. GJ/t = Gigajoules per tonne. MJ/kWh = Megajoules per kilowatt-hour. kg CO₂-e/GJ = kilograms carbon dioxide equivalent per gigajoule. kg CO₂-e/kWh = kilograms carbon dioxide equivalent per kilowatt-hour.

3.5 Greenhouse Gas Emission Estimation

It is anticipated that with the Project, the MCM would continue to operate until 2044, with an average annual ROM coal production of approximately 5 Mtpa. A summary of annual emission sources, together with activity data, is provided in Table 16.

Table 16 **Summary of emission sources and activity indicators for the Project**

Year	ROM	Product coal	Diesel usage	Explosives*	Electricity usage
	tonnes	tonnes	L	tonnes	kWh
2021	5,399,625	4,177,135	52,558,984	17,613	18,518,988
2022	5,399,625	4,072,720	53,156,748	17,613	18,518,988
2023	5,399,625	4,095,432	52,787,696	17,613	18,518,988
2024	5,414,500	3,970,400	52,119,934	17,661	18,570,004
2025	5,399,625	3,968,280	51,707,471	17,613	18,518,988
2026	5,399,625	4,037,786	62,889,960	17,613	18,518,988
2027	5,399,625	4,054,460	63,160,572	17,613	18,518,988
2028	5,414,500	3,958,830	61,315,915	17,661	18,570,004
2029	5,399,625	4,005,911	61,519,163	17,613	18,518,988
2030	5,399,625	3,944,992	61,146,162	17,613	18,518,988
2031	5,399,625	4,101,713	60,373,580	17,613	18,518,988
2032	5,383,813	4,014,276	60,399,387	17,561	18,464,757
2033	5,399,625	4,116,666	66,931,840	17,613	18,518,988
2034	5,059,873	3,856,725	69,350,392	16,505	17,353,749
2035	5,399,625	4,254,193	69,459,415	17,613	18,518,988
2036	5,414,500	4,366,902	69,678,633	17,661	18,570,004
2037	4,805,353	3,684,910	59,879,857	15,674	16,480,824
2038	4,660,423	3,438,481	59,648,507	15,202	15,983,762
2039	3,479,454	2,594,548	38,756,646	11,349	11,933,415
2040	3,790,142	2,925,337	40,581,795	12,363	12,998,975
2041	3,466,509	2,555,599	39,589,667	11,307	11,889,016
2042	1,932,891	1,559,959	35,475,956	6,305	6,629,199
2043	3,196,243	2,650,076	40,531,478	10,426	10,962,091
2044	1,307,774	1,139,924	5,790,765	4,266	4,485,248
Notes: *Explosives used have been assumed to be ANFO					

Annual energy use and GHG emissions associated with the Project are summarised in Table 17. Maximum GHG emissions and energy use, 316 ktCO₂-e and 2,799 TJ respectively, are expected to occur in 2036.

Table 17 Annual energy use (GJ) and GHG emissions (tCO₂-e)

Year	Energy use (GJ)				GHG Emissions (t CO ₂ -e)						
	Diesel usage	Explosives	Electricity usage	TOTAL	Fugitive methane	Diesel usage	Explosives	Electricity usage	Scope 1	Scope 2	TOTAL
2021	2,028,777	42,471	66,668	2,137,916	107,992	143,029	2,994	15,000	254,015	15,000	269,016
2022	2,051,850	42,471	66,668	2,160,989	107,992	144,655	2,994	15,000	255,642	15,000	270,643
2023	2,037,605	42,471	66,668	2,146,744	107,992	143,651	2,994	15,000	254,638	15,000	269,638
2024	2,011,829	42,588	66,852	2,121,269	108,290	141,834	3,002	15,042	253,126	15,042	268,168
2025	1,995,908	42,471	66,668	2,105,047	107,993	140,712	2,994	15,000	251,698	15,000	266,699
2026	2,427,552	42,471	66,668	2,536,691	107,992	171,142	2,994	15,000	282,129	15,000	297,130
2027	2,437,998	42,471	66,668	2,547,137	107,992	171,879	2,994	15,000	282,866	15,000	297,866
2028	2,366,794	42,588	66,852	2,476,234	108,290	166,859	3,002	15,042	278,151	15,042	293,193
2029	2,374,640	42,471	66,668	2,483,779	107,992	167,412	2,994	15,000	278,399	15,000	293,399
2030	2,360,242	42,471	66,668	2,469,381	107,992	166,397	2,994	15,000	277,384	15,000	292,384
2031	2,330,420	42,471	66,668	2,439,559	107,992	164,295	2,994	15,000	275,281	15,000	290,282
2032	2,331,416	42,346	66,473	2,440,236	107,676	164,365	2,985	14,956	275,027	14,956	289,983
2033	2,583,569	42,471	66,668	2,692,708	107,993	182,142	2,994	15,000	293,128	15,000	308,129
2034	2,676,925	39,798	62,473	2,779,197	101,197	188,723	2,806	14,057	292,726	14,057	306,783
2035	2,681,133	42,471	66,668	2,790,272	107,993	189,020	2,994	15,000	300,007	15,000	315,007
2036	2,689,595	42,588	66,852	2,799,035	108,290	189,616	3,002	15,042	300,909	15,042	315,951
2037	2,311,362	37,796	59,331	2,408,490	96,107	162,951	2,665	13,349	261,723	13,349	275,072
2038	2,302,432	36,656	57,542	2,396,630	93,208	162,321	2,584	12,947	258,114	12,947	271,061
2039	1,496,007	27,367	42,960	1,566,334	69,589	105,468	1,929	9,666	176,987	9,666	186,653
2040	1,566,457	29,811	46,796	1,643,065	75,803	110,435	2,102	10,529	188,340	10,529	198,869
2041	1,528,161	27,266	42,800	1,598,227	69,330	107,735	1,922	9,630	178,988	9,630	188,618
2042	1,369,372	15,203	23,865	1,408,440	38,658	96,541	1,072	5,370	136,270	5,370	141,640
2043	1,564,515	25,140	39,464	1,629,118	63,925	110,298	1,772	8,879	175,996	8,879	184,875
2044	223,524	10,286	16,147	249,957	26,155	15,758	725	3,633	42,639	3,633	46,272

GHG emissions associated with the Project are predominantly related to diesel combustion and the release of fugitive methane emissions. The relative proportions of GHG emissions according to emissions scope and emissions source are illustrated in Figure 16.

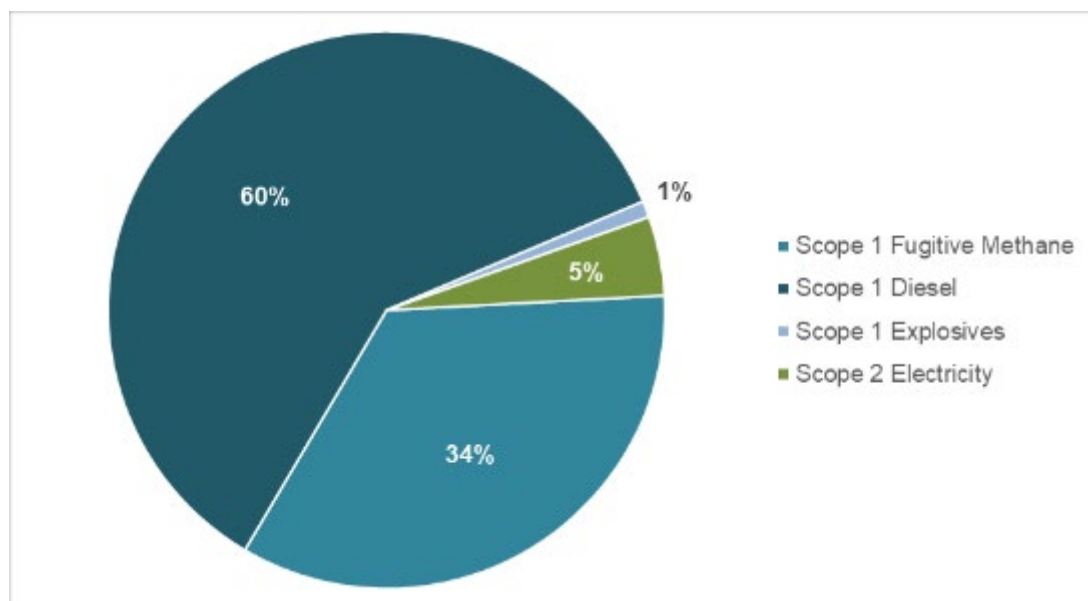


Figure 16 Project GHG emissions by scope and source

GHG emissions from the Project will contribute to Australia's and Queensland's annual GHG emissions inventories. A summary of the impact of the maximum annual GHG emissions from the Project at a state and national scale is provided in Table 18.

Table 18 Project contribution to annual GHG emissions for Australia and Queensland

Category	Project	Australia		Queensland	
	Maximum Annual Emissions (ktCO ₂ -e)	Emissions (Mt CO ₂ -e)	Project %	Emissions (Mt CO ₂ -e)	Project %
Inventory total	316	554.1	0.06%	142.1	0.22%

Notes: State and Territory Greenhouse Gas Inventories 2017 (Commonwealth of Australia, 2019c), GHG emissions excluding Land Use and Land Use Change.

GHG emissions associated with the Project compared to the Western Extension Project, which has recently been approved, are summarised in Table 19. This comparison shows that while the Project would not significantly increase the total GHG emissions of the MCM (i.e. over the life of mining operations, total GHG emissions would increase by an estimated 4% compared to the Western Extension Project), annual GHG emissions at MCM would decrease by 2% on average due to the increased mine life.

Table 19 Comparison of GHG emissions for the Southern Extension Project compared to the Western Extension Project

Annual emissions	GHG Emissions (t CO ₂ -e)	
	Western Extension Project	Southern Extension Project
Average	288,960	283,003
Maximum	315,455	315,951
Minimum	227,581	186,653
TOTAL	5,915,236	6,137,329

3.6 Regulatory Obligations – NGER and the Safeguard Mechanism

MCPL currently has NGER reporting obligations associated with the existing activities (Section 3.2.2). GHG emissions and energy use/production associated with the Project will need to be accounted for in ongoing annual NGER reporting associated with the existing mine in accordance with the NGER Act and supporting legislation.

In all years, except for the final year of operations, GHG emissions associated with the Project would exceed 100 kt CO₂-e. As a result, MCM will be subject to the requirements of the Safeguard Mechanism (Section 3.2.1). Its responsibilities would include establishing annual baseline emissions and keeping net emissions at or below baseline emissions levels. The legislative framework for the Safeguard Mechanism is set out in the NGER Act, through amendments included in the *Carbon Farming Initiative Amendment Act 2014*.

3.7 Greenhouse Gas Mitigation Strategies

The following initiatives, used to help mitigate, reduce, control or manage GHG emissions through energy efficiency at the existing MCM, would continue to be implemented for the Project:

- Regular assessment, review and evaluation of GHG reduction opportunities
- Procurement policies that require the selection of energy efficient equipment and vehicles
- Monitoring and maintenance of equipment in accordance with manufacturer recommendations
- Optimisation of diesel consumption through logistics analysis and planning (e.g. review of the mine plan to optimise haul lengths, dump locations, and road gradients).

4. CONCLUSIONS

The air quality and greenhouse gas assessment has included the following:

- Analysis of the existing environment at MCM
- Preparation of dust emissions inventories for Year 2037 and Year 2043 of the Project
- A comparison of the Project dust emission inventories with the dust emission inventories previously developed for the EIS and subsequent extension projects, and inference of the potential air quality impacts
- Calculation of greenhouse gas emissions for each operation year from 2021 up to and including 2044.

In summary, the air quality and greenhouse gas assessment for the Project indicates the following:

- The dust emission rates estimated for the Project are comparable to, or lower, than the scenario assessed in the Stage 2 Middlemount Coal Project EIS, which has been approved to operate.
- Ground-level concentrations of air pollutants at sensitive receptors will, therefore, be comparable to, or lower, than was anticipated by the Stage 2 Middlemount Coal Project EIS and what is currently occurring from MCM operations.
- Annual greenhouse emissions associated with the Project range from 46 kt CO₂-e to 316 kt CO₂-e, with an average of 256 kt CO₂-e.
- The Project would not significantly increase the total GHG emissions of the MCM – i.e. over the life of mining operations, total GHG emissions would increase by an estimated 4% compared to the Western Extension Project.
- The majority of GHG emissions are associated with diesel (60%) and fugitive methane (34%).
- MCM will continue to have obligations under both the NGER scheme and the Safeguard Mechanism.

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