Appendix 12

Air Quality Impact Assessment

prepared by

Northstar Air Quality Pty Ltd

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Copi Mineral Sands Project

Air Quality Impact Assessment

Addressee(s):	R. W. Corkery & Co. Pty. Limited
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Quality Control

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Final Authority

This report must by regarded as draft until the above study components have been each marked as final, and the document has been signed and dated below.

Martin Doyle **23rd April 2024**

Non-Technical Summary

R.W Corkery and Co Pty Limited has engaged Northstar Air Quality Pty Ltd on behalf of RZ Resources Limited, to perform an air quality impact assessment and greenhouse gas assessment for the proposed Copi Mineral Sands Project, which is located northwest of Wentworth in the Murray Basin of southwest NSW.

This assessment forms part of the Environment Impact Statement prepared to accompany the development application for the Project under Part 4 of the *Environmental Planning and Assessment Act* 1979.

The assessment has been performed in accordance with the requirements of the NSW Approved Methods document and meets the Secretary Environmental Assessment Requirements.

Four separate scenarios were subject to assessment, reflecting activities during mining operations. Results of the assessment indicate that predicted incremental concentrations associated with the operation of the Project at non-Project related receptors are minor, and exceedances of the annual average PM_{10} and $PM_{2.5}$ criteria are dominated by the already exceeding background conditions. The contribution of the Project to those exceedances is predicted to be minimal. A small number of additional exceedances of the 24-hour PM_{10} and $PM_{2.5}$ criteria are predicted, although the background concentrations on those days are either just below, or at the criterion, and the addition of the minimal incremental contribution from the Project results in marginal exceedances. The adopted control measures adopted result in minimal incremental contributions on these days.

The greenhouse gas assessment indicates that direct emissions associated with the Project are likely to be of the order of approximately 47.3 kt CO_2-e·yr^{-1}, as a maximum. The Applicant has committed to sourcing renewable power for a minimum 30% of power requirements, from the on-site solar farm and supplemented with externally contracted and certified renewable sources where required. Nonetheless, the Applicant is committed to continue to investigate ways to minimise the emission of greenhouse gas, and to reviewing any schemes which may provide opportunity to modernise plant and increase productivity, under the NSW Government Net Zero Plan Stage 1: 2020-2030.

In conclusion, the Project can be constructed and operated in accordance with best management practice, to minimise the concentrations of air pollutants on the surrounding environment.

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1. INTRODUCTION

R. W. Corkery & Co. Pty. Limited (RWC) has engaged Northstar Air Quality Pty Ltd (Northstar) on behalf of RZ Resources Limited (the Applicant) to perform an air quality impact assessment (AQIA) for the proposed Copi Mineral Sands Project (the Project) which is located approximately 75 kilometres (km) northwest of Wentworth in the Far West Region of NSW.

This AQIA forms part of the Environmental Impact Statement (EIS) prepared to accompany the State Significant Development application for the Project under Division 4.7 of the *Environmental Planning and Assessment Act* 1979.

The AQIA presents an assessment of the impacts of activities associated with the operational phases of the Project. The AQIA has used a quantitative dispersion modelling approach, performed in accordance with the relevant NSW guidelines. The results of the assessment are presented as predicted incremental change, and as a cumulative impact accounting for the prevailing background air quality conditions.

A greenhouse gas assessment (GHGA) has also been performed which quantifies emissions of GHG associated with the construction and operational phases of the Project and compares these to national and State total emissions. Opportunities for GHG reduction are identified and discussed.

1.1. Assessment Requirements

Planning Secretary's Environmental Assessment Requirements (SEARs) for SSD 41294067 have been provided for the Project by the NSW Department of Planning & Environment (DPE) on 19 May 2022. The SEARs included input from NSW Environment Protection Authority (EPA). Table 1 provides a summary of the SEARs relevant to this AQIA.

Table 1 Coverage of SEARs and other Government Agency Requirements relevant to air quality and greenhouse gas emissions

Authority	Requirement	Relevant section
SEARs (December 2023)	An assessment of the likely air quality impacts of the development, including cumulative impacts from nearby developments, in accordance with the *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW* and having regard to the NSW Government's *Voluntary Land Acquisition and Mitigation Policy.*	Section 6
	Ability to comply with the relevant regulatory framework, specifically the *Protection of the Environment Operations Act 1997* and the *Protection of the Environment Operations (Clean Air) Regulation 2010.*	Section 3, Section 6

Authority	Requirement	Relevant section
	An assessment of the likely greenhouse gas impacts of the development including measures to minimise emissions having regard to the targets set in *Climate Change (Net Zero Future) Act* 2023 and the EPA's *Climate Change Policy* and *Climate Action Plan*, and Commonwealth Safeguard Mechanism reforms.	Section 7
	A description of the air pollution control techniques from any air emission sources of the development that would be implemented to manage and monitor efficiency and performance (including fugitive dust, particulates, emissions from vehicle movements and greenhouse gases).	Section 8
NSW EPA (4 May 2022)[(A)]	Details would need to be provided on the proposed measures to manage dust and particulates from all sources.	Section 5.1.4
	Measures to prevent or control the emission of dust from vehicle movements and particulates from mining activities must be detailed based on the outcome of an assessment for undertaken in accordance with our guidelines the 'Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales' (EPA, 2016).	Section 6
	The assessment must identify all sensitive receptors in proximity to the proposed development and present the potential impacts on those receptors including worst case scenarios.	Section 6

Note: (A) NSW EPA advice received for previous SEARs, not available for the most recent (December 2023) SEARs.

Further to the above, the policies, guidelines and plans which have been referenced during the performance of the AQIA include:

- *Protection of the Environment Operations Act* 1997.
- *Protection of the Environment Operations (Clean Air) Regulation* 2022.
- Approved Methods for the Modelling and Assessment of Air Quality in NSW (NSW EPA, 2022a)
- Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (NSW EPA, 2022b).

2. PROJECT DESCRIPTION

2.1. Overview

The Applicant is proposing to develop and operate an open cut mineral sands mine operation approximately 75 km northwest of Wentworth in the Murray Basin of southwest NSW to extract and process heavy mineral ore and produce a heavy mineral concentrate (refer to Figure 1).

The Copi Mineral Sands deposit occupies land within the following Exploration Licenses (EL) held by the Applicant (refer to Figure 1):

- EL8385;
- EL8865;
- EL8312;
- EL9496; and
- EL8769.

The Project would comprise progressive development of an extraction area with capacity to extract up to approximately 27.7 million tonnes per year ($Mt{\cdot}yr^{-1}$) of ore, and an infrastructure area including:

- Mine Camp and associated infrastructure for up to 220 personnel;
- Offices and Administration Area;
- Workshops, Stores and Laydown Areas;
- A Water Storage Dam and Off Path Storage Facility;
- Stockpile areas; and
- A Site Access Road (approximately 27 km) would be constructed from Anabranch Mail Road to the Infrastructure Area.

Power for the Project would be provided by a combination of diesel generated power during construction operations, solar power from an approximately 35 MW solar farm (if required), and mains power sourced via a 66kV powerline. A minimum 30% of the Project's power would be sourced from renewable sources, including the onsite solar farm and/or externally contracted and certified renewable sources.

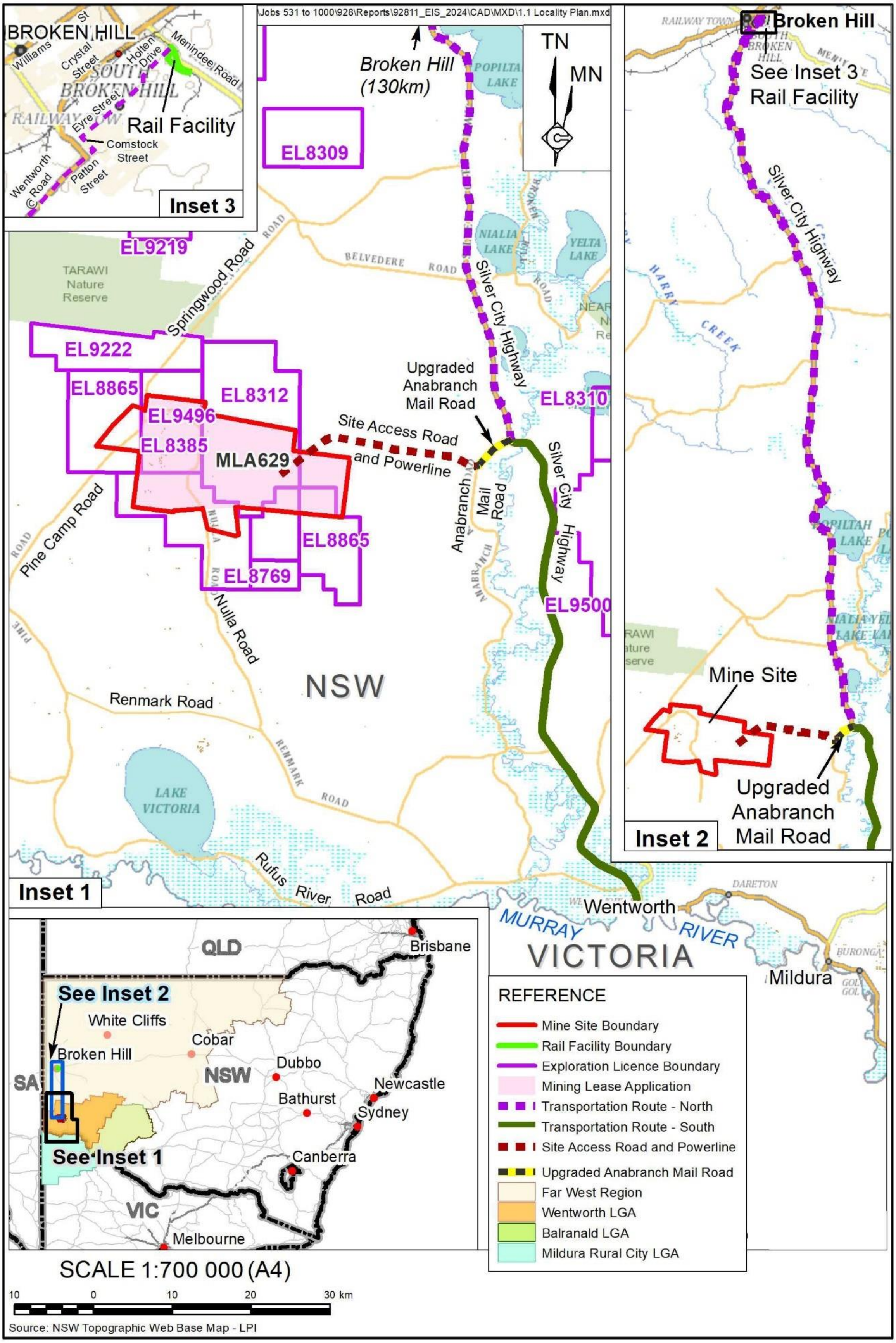
An indicative layout of the Mine Site is illustrated in Figure 2. Mining operations associated with the Project are anticipated to comprise the following:

- Dredge mining from an Extraction Area approximately 17 km long and up to approximately 3.3 km wide.
- Mining would commence with a starter pond at the at the southwestern extent of the deposit. The starter pond would be extracted using conventional free dig, load and haul mining techniques. Extracted overburden, namely material located above the water table with no heavy mineral, would

be used to construct infrastructure within the Mine Site or stockpiled for later use during rehabilitation operations.

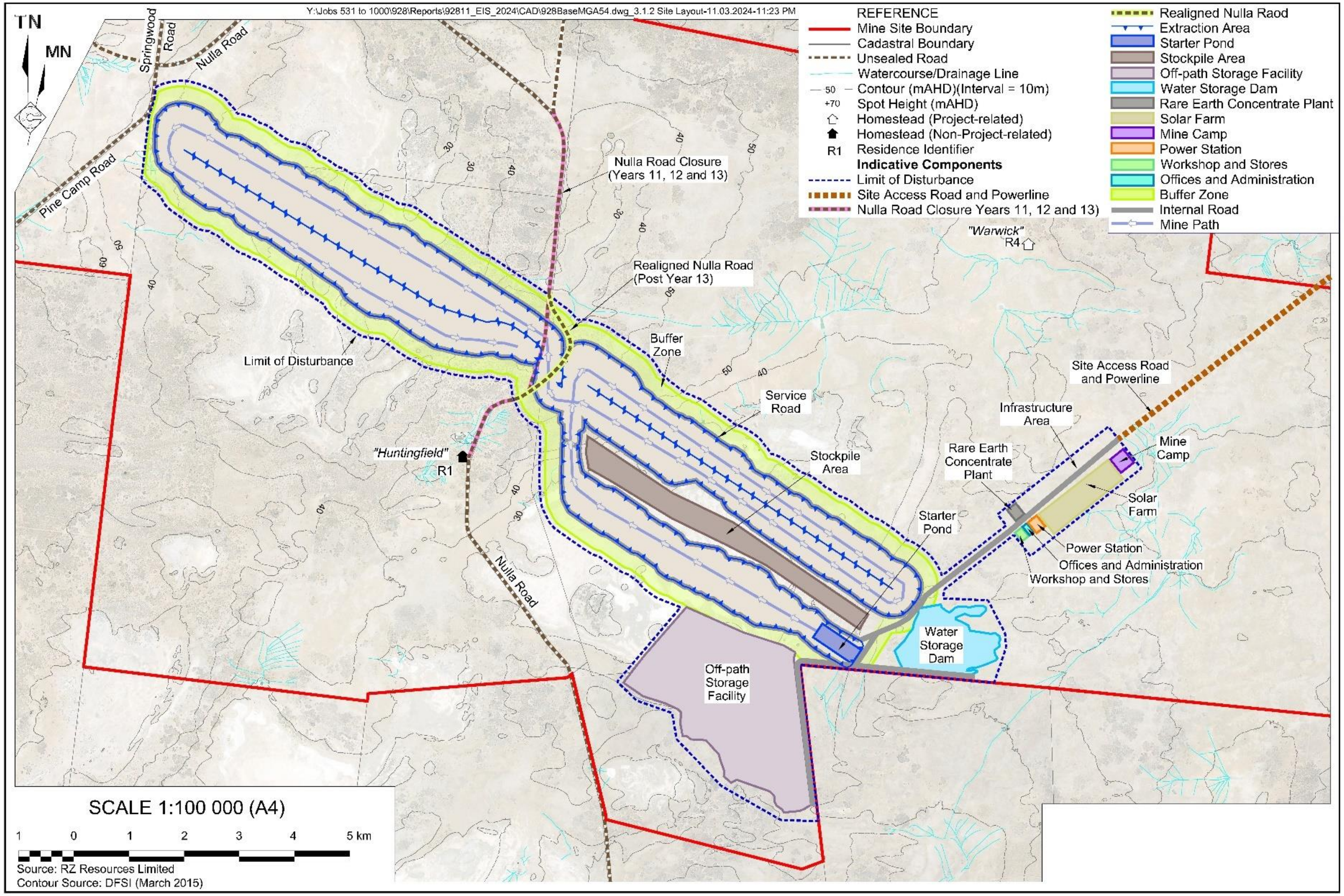
- Following establishment of the starter pond, the dredges would be installed, followed by the floating Wet Concentration Plant.
- Interburden, namely material located below the water table with uneconomic heavy mineral, would be extracted using floating dredges. Interburden would initially be transferred to the Off Path Storage Facility. Once the dredge pond has achieved its full operational size, extracted interburden would be used to backfill completed sections of the Extraction Area.
- Ore, namely material with sufficient heavy mineral to justify processing, would be extracted using a floating dredge. The ore would be transferred to the floating Wet Concentration Plant for processing.
- Reject from the Wet Concentration Plant would initially be transferred to the Off Path Storage Facility. Once the dredge pond has achieved its full operational size, reject would be combined with the extracted interburden to backfill completed sections of the Extraction Area.
- The placed reject and interburden would be covered by overburden and soil before being rehabilitated.

Figure 1 Locality plan



Source: RWC

Figure 2 Indicative mine layout



Source: RWC

The Project is expected to operate for approximately 26 years including:

- Construction period of approximately 2 years;
- Mining operations of up to approximately 17 years; and
- A post-mining rehabilitation period of approximately 7 years following cessation of mining activities.

2.1.1. Proposed Mining Operations

Dry Mining Operations

Mining operations would commence with removal of vegetation and soil. This would be followed by extraction of overburden using conventional free dig, load and haul open cut mining methods. The thickness of overburden to be removed using this method would vary depending on the depth from surface to the water table. Where required, multiple benches would be established to ensure safe operation of the mining plant. Extracted overburden would be used to cap the Off-path Storage Facility and construct the final landform.

Overburden placed in-pit would typically be placed close to the advancing face of the landform under construction before being pushed over the face using a bulldozer. Placed material would be compacted through the action of laden and unladen haul trucks passing and repassing over the placed material, as well as dozing. The overburden backfilling process may be carried out in benches to ensure geotechnical stability.

No drilling or blasting is required to facilitate mining.

Dredge Mining Operations

Once the overburden has been extracted, dredge mining operations would extract interburden and ore. The Applicant anticipates commissioning and operating two jet suction dredges and one cutter suction dredge. These dredges would use high pressure water jets and a rotating cutter head to extract material which would then be removed using a suction pipe.

The Applicant would initially excavate a starter pond and would install a small, temporary dredge to deepen and enlarge the pond sufficiently to allow the first dredge to be launched.

During construction of the dredges and Wet Concentration Plant, water would be pumped from the starter pond to the Water Storage Dam. Once the first dredge has been assembled, stored water within the Water Storage Dam would be returned to the construction pond, flooding the construction pad and allowing the first dredge to be floated off. Once complete, the process would be repeated for the second and third dredges and the Wet Concentration Plant.

Typically, two dredges would extract interburden while one dredge would extract ore once the floating Wet Concentration Plant has been installed. Each dredge would extract material to be pumped to the Wet Concentration Plant, with material from the interburden dredges passing directly to the reject circuit.

A full description of the material movement schedule is presented in Section 3.4 of the main EIS.

Processing and Rejects Management

The Wet Concentration Plant would be established on a floating platform located within the dredge pond. The Plant would include the following circuits:

- A feed preparation circuit.
  - Feed from the ore dredge would be pumped to a rotating trommel. The trommel would progressively separate sand from oversize material greater that 2mm in size, with the oversize material placed directly back into the dredge pond.
  - Undersize material would then pass through a series of cyclones that would separate the sand from the very fine material, or slimes, less than 53µm in size. The coarser material, or cyclone underflow, would be pumped to the spiral circuit, while the finer material or cyclone overflow would be treated with flocculant and settled within a thickener. Thickened fines would be transferred to the reject circuit, with recovered water reporting into the dredge pond.
- A spiral circuit.
  - Following removal of oversize and slimes, the ore would be passed to the spiral circuit where it would be processed through a series of spiral separators and fine screens to separate the denser heavy mineral, namely ilmenite, zircon, rutile, leucoxene, monazite and xenotime, from the less dense gangue or quartz and aluminium silicate minerals. The material would be processed in stages, with a series of recycle loops consisting of roughing, middlings, fine screening, cleaning, scavenging and recleaning stages to maximise the heavy mineral concentration within the concentrate while minimising loss of heavy mineral to rejects.
- Heavy Mineral Concentrate Washing and Stockpiling Circuit.
  - Heavy mineral concentrate from the spiral circuit would be transferred to a land-based dewatering cyclone which would dewater the concentrate. The concentrate would then be transferred as a damp concentrate to the Rare Earth Concentrate Plant and the water would be returned to the dredge pond.
- A reject circuit:

- Reject (including thickened slimes) from the feed preparation and spiral circuits and interburden from the interburden dredges would be pumped to a rejects circuit. Flocculant will be added to the rejects and thickened slimes, before being co-disposed sub-aquas. Interburden will be disposed sub-aquas without any treatment. Land based stackers or cyclones could also be used if and when required to dispose of the interburden.
- The reject and interburden would comprise primarily coarse to fine sand. This material would settle relatively quickly, with the water component returning to the dredge pond. The reject and interburden would naturally consolidate to form a beach, with an underwater face that would slope back into the dredge pond. Once sufficiently consolidated and stabilised, overburden would be placed over the reject and interburden to further promote consolidation and compaction of the material prior to shaping the final landform and rehabilitation.
- Following the commencement of dredge mining, there would be a period during which the dredge pond would not have sufficient capacity to accept rejects and interburden. Until sufficient capacity has been established, rejects and interburden would be placed into the Off Path Storage Facility.
- The final design of the Off Path Storage Facility would be prepared by a suitably qualified and experienced engineering consultancy.
- Following commencement of material placement into the dredge pond, placement of interburden and reject material into the Off Path Storage Facility would cease and the Applicant would complete the landform with overburden material, capping the wet placed material. The resultant landform would then be contoured to design, topsoil placed and rehabilitated.

2.1.2. Mine Site Road Network

The internal road network, namely those roads inside the security gate that would not be publicly accessible, would provide access for light and heavy vehicles to the operational areas of the Mine Site. These roads may be classified as:

- heavy vehicle roads, suitable for use by the mine haulage fleet and other heavy vehicles: and
- light vehicle roads, suitable for use by the light vehicle fleet.

Internal roads would be constructed adjacent to the proposed Extraction Area and would be relocated and reconstructed as necessary. Heavy vehicle roads would generally have the following design criteria.

- A width sufficient to allow two laden haul trucks to pass.
- An unsealed pavement suitable for all weather heavy vehicle use.
- Culverts and under road and roadside drainage as required.

Light vehicle roads would typically be narrower than the proposed heavy vehicle roads and their use would be restricted to particular classes of vehicles.

Where practicable, the pavement of internal roads would be constructed of low-silt materials to minimise dust lift off and the volume of water required for dust suppression. Polymer-based dust suppressants may be used to minimise dust lift-off. Water for mixing the dust suppressants would typically be sourced from sediment basins and clean water storage facilities. When water from those sources is not available, low salinity treated groundwater would be used for dust suppression. Untreated groundwater with elevated salt levels would only be used in exceptional circumstances. This would minimise the potential for salt accumulation in soils underlying or adjacent to the internal roads.

Finally, all roads would be delineated using guideposts at suitable intervals and all vehicles would be required to remain on the marked roads or within defined work areas. This would limit the formation of unplanned and unnecessary tracks.

Where roads are no longer required for an operational purpose, they would be barricaded to prevent vehicular access and rehabilitated during progressive rehabilitation.

2.1.3. Offsite Transportation

Heavy mineral concentrate would be transported off-site by heavy vehicles (AB-quad [Type 2] road train,) north to a rail facility at Broken Hill via the Silver City Highway and Anabranch Mail Road, or south to Wentworth, also via Anabranch Mail Road and Silver City Highway. All material would be sealed in containers prior to leaving the Mine Site, and emissions to air associated with the Broken Hill or Wentworth facilities would be limited to those associated with vehicle movements.

2.1.4. Power Generation

The Project may include an on-site solar farm with generation capacity of 35 MW. The solar power farm would be constructed progressively during the construction phase of the Project. During construction, diesel generators will be required.

2.1.5. Hours of Operation

Presented in Table 2 is a summary of the proposed hours of operation of the Project.

Table 2 Proposed hours of operation

Activity	Proposed days of operation	Proposed hours of operation
Land preparation	7 days per week	7:00 am to 6:00 pm
Construction operation: - Road construction within Broken Hill LGA - All other construction	 7 days per week[1] 7 days per week	 7:00 am to 10:00 pm[1] 24 hours per day
Mining operations	7 days per week	24 hours per day
Processing operations	7 days per week	24 hours per day
Transportation operations: - Heavy mineral concentrate transportation within Broken Hill LGA - All other transportation	 7 days per week 7 days per week	 7:00 am to 10:00 pm 24 hours per day
Maintenance operations	7 days per week	24 hours per day
Rehabilitation operations	7 days per week	7:00 am to 6:00 pm

Notes: [1] Or as instructed by the relevant road authority

2.1.6. Equipment

Presented in Table 3 is a summary of the indicative mining fleet proposed for the Project.

Table 3 Indicative mining fleet

Equipment	Indicative make and model	Number
Concentrate management		
Excavator	Komatsu PC300 or equivalent	2
Bulldozer	CAT D9	1
Haul truck	CAT 745 or equivalent	3
Wheel Loader	CAT 966 or equivalent	1
Overburden Management		
Excavator	EX2600	1 to 3
Haul Truck	CAT 785	3 to 8
Bulldozer	CAT D10	1 to 3
Grader	CAT 16K	1 to 2
Water Cart	CAT777 WC	1
Bulldozer	CAT D9	1 to 2
Scraper	CAT Scraper	2
Excavator	CAT390	1
Excavator	CAT349	1
Excavator	CAT336	1
Wheel Loader	CAT992G	1
Wheel Loader	CAT980K	1
Articulated Haul Truck	Volvo A60H	2 to 3
Articulated Haul Truck	Bell Moxy B50D	2 to 3
Grader	CAT14M Grader	1 to 2
Water Truck	CAT773 Water truck	1
Water Cart	Moxi Watercart	1
Water Cart	CAT777 WC	1

In addition to the mining fleet outlined in Table 3, road trucks (AB-quad road train) would be used, and diesel fired generators are also proposed to be used during construction.

2.2. Identified Potential for Emissions to Air

The processes which may result in the emission of pollutants to air during mine establishment and mining operations may include:

- Vegetation and topsoil removal;
- Overburden and interburden removal;
- Ore extraction;
- Ore processing;
- Loading, movement, and unloading of haul trucks on-site;
- On and off-site movement of trucks carrying heavy mineral concentrate;

- Wind erosion of disturbed areas; and
- Emissions from vehicle and equipment exhaust.

The specific pollutants of interest associated with those activities are:

- Total suspended particulate (TSP) assessed as TSP and deposited dust;
- Particulate matter with an aerodynamic diameter of 10 microns (PM_{10}) or less;
- Particulate matter with an aerodynamic diameter of 2.5 microns ($PM_{2.5}$) or less; and
- Silica (Si).

The removal of interburden and ore by wet dredging, the processing of ore in the Wet Concentration Plant, and pumping of rejects and slimes are all wet processes and will correspondingly not generate emissions of particulate matter.

Emissions of NO_X, carbon monoxide (CO) and sulphur dioxide (SO_2) related to diesel combustion in plant and machinery, power generation during construction, and LPG use during operations in dryers, would also be experienced (in addition to particulates considered above). Given the distances between the Project (Infrastructure Area) and nearest non-Project related sensitive receptors (approximately 9.5 km), and the quantity of equipment operating on site, it is not anticipated that emissions associated with diesel combustion would be a significant contributor to total site emissions and have not been addressed further.

3. LEGISLATION, REGULATION AND GUIDANCE

3.1. NSW EPA Approved Methods

State air quality guidelines adopted by the NSW EPA are published in the *'Approved Methods for the Modelling and Assessment of Air Quality in NSW'* (NSW EPA, 2022a) (the Approved Methods) which has been consulted during the preparation of this assessment report.

The Approved Methods lists the statutory methods that are to be used to model and assess emissions of criteria air pollutants from stationary sources in NSW. Section 7.1 of the Approved Methods clearly outlines the impact assessment criteria to be applied.

The criteria listed in the Approved Methods are derived from a range of sources (including National Health and Medical Research Council [NHMRC], National Environment Protection Council [NEPC], Department of Environment [DoE], and World Health Organisation [WHO]).

The criteria specified in the Approved Methods are the defining ambient air quality criteria for NSW. The standards adopted to protect members of the community from health impacts in NSW are presented in Table 4.

Table 4 NSW EPA impact assessment criteria

Pollutant	Averaging period	Units	Criterion	Notes
Particulates (as PM_{10})	24 hours	$\mu g \cdot m^{-3}$ (a)	50	Numerically equivalent to the Ambient Air Quality National Environment Protection Measure (AAQ NEPM)(b) standards and goals.
	1 year	$\mu g \cdot m^{-3}$	25	
Particulates (as $PM_{2.5}$)	24 hours	$\mu g \cdot m^{-3}$	25	
	1 year	$\mu g \cdot m^{-3}$	8	
Particulates (as total suspended particulate [TSP])	1 year	$\mu g \cdot m^{-3}$	90	
Deposited dust	1 year	$g \cdot m^{-2} \cdot month^{-1}$ (c)	2	Assessed as insoluble solids as defined by AS 3580.10.1
		$g \cdot m^{-2} \cdot month^{-1}$ (d)	4	

Notes: (a): micrograms per cubic metre of air
(b): National Environment Protection (Ambient Air Quality) Measure
(c): Maximum increase in deposited dust level
(d): Maximum total deposited dust level

Given the nature of the material to be extracted at the Mine, silica (Si) may be generated during extraction activities. NSW EPA do not provide air quality criteria for this pollutant, although VIC EPA in their State Environmental Planning Policy (SEPP) Protocol for Environmental Management: Mining and Extractive Industries (PEM) (VIC EPA, 2007) do include an annual average criterion for respirable crystalline silica (RCS, assessed as $PM_{2.5}$) as 3 µg·m^{-3}, which has been adopted from the California EPA Office for Environmental Health Hazard Assessment Reference Exposure Levels.

This criterion is referenced in this assessment and calculates RCS by adjusting annual average $PM_{2.5}$ modelling results on a *pro-rata* basis to account for the determined maximum free silica content of the extracted material (conservatively assumed to be 100 %, although the mass fraction is likely to be significantly lower than this assumed value). RCS is generally an occupational health and safety issue (i.e. on-site) rather than an environmental issue (i.e. off-site) when considering mining activities but has been presented within this AQIA for completeness.

3.2. Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations* (POEO) *Act* (1997) sets the statutory framework for managing air quality in NSW, including establishing the licensing scheme for major industrial premises (scheduled activities) and a range of air pollution offences and penalties.

Should the Project gain approval the operations would be defined as a scheduled activity under the POEO Act. As such, an Environment Protection Licence (EPL) would be required to be obtained from NSW EPA and once issued would contain a range of conditions related to minimisation of emissions from the site.

3.3. Protection of the Environment (Clean Air) Regulation 2022

The Protection of the Environment Operations (POEO) (Clean Air) Regulation (2022) sets standards of concentration for emissions to air from both scheduled and non-scheduled activities. For the activities performed at the Mine Site, the POEO (Clean Air) Regulation provides general standards of concentration for scheduled premises which are presented in Table 5 for the pollutants of relevance to this assessment.

Further to the requirements in Table 5, Part 4 Clause 15 of the POEO (Clean Air) Regulation requires that motor vehicles do not emit excessive air impurities which may be visible for a period of more than 10-seconds when determined in accordance with the relevant standard.

All vehicles, plant and equipment to be used either at the Mine Site or to transport personnel and materials to and from the Mine Site will be maintained regularly and in accordance with manufacturers' requirements, where these vehicles are under the operational control of the Applicant.

Table 5 POEO (Clean Air) Regulation – General standards of concentration

Air Impurity	Activity	Standard of concentration (group 6)[1]
Solid particles (total)	Any activity or plant (except as listed below)	50 mg·m^{-3}
	Any crushing, grinding, separating or materials handling activity	20 mg·m^{-3}
Nitrogen dioxide (NO_2) or nitric oxide (NO) or both, as NO_2 equivalent	Any activity or plant (except boilers, gas turbines and stationary reciprocating internal combustion engines listed below)	350 mg·m^{-3}
	Any turbine operating on gas, being a turbine used in connection with an electricity generation system with a capacity of 30 MW or more	70 mg·m^{-3}

Note: (1) Group 6 – pursuant to application made on or after 1 September 2005

3.4. NSW Voluntary Land Acquisition and Mitigation Policy

The NSW Government published the "*Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments*" (hereafter, the policy) in September 2018 (NSW Government, 2018). The policy is to be applied by consent authorities when assessing and determining applications for mining, petroleum and extractive industry developments that are subject to State Significant Development provisions of the *Environmental Planning and Assessment Act* 1979.

A number of policies and guidelines include Air Quality Assessment criteria to protect the amenity, health and safety of people, including those outlined in Section 3.1. They typically require applicants to implement all reasonable and feasible avoidance and/or mitigation measures to minimise the impacts of a development. In some circumstances however, it may not be possible to comply with these assessment criteria even with the implementation of all reasonable and feasible avoidance and/or mitigation measures. This can occur with large resource projects where the resources are fixed, and there is limited scope for avoiding and/or mitigating impacts. However, as outlined within the policy it is important to recognise that:

- Not all exceedances of the relevant assessment criteria equate to unacceptable impacts.
- Consent authorities may decide that it is in the public interest to allow the development to proceed, even though there would be exceedances of the relevant assessment criteria, because of the broader social and economic benefits of the development.
- Some landowners may be prepared to accept higher impacts on their land, subject to entering into suitable negotiated agreements with applicants, which may include the payment of compensation.

Consequently, the assessment process can lead to a range of possible outcomes.

In the application of the policy, the applicant must demonstrate that all viable alternatives have been considered, and all reasonable and feasible avoidance and mitigation measures have been incorporated into the project design. Should acquisition or mitigation criteria (see Table 6 and Table 7) be exceeded as a result of the project operation then the applicant should consider a negotiated agreement with the affected landowner or acquisition of the affected land. Full details of the negotiated agreement and acquisition process is provided in the policy (NSW Government, 2018).

In relation to air quality, the policy applies specifically to particulate matter (TSP, PM_{10}, $PM_{2.5}$ and dust deposition). Applicants are required to assess the impacts of the development in accordance with the Approved Methods guidance (NSW EPA, 2022a). Should exceedances of the relevant particulate matter criteria (refer Section 3.1) be predicted, then comparison with the mitigation and acquisition criteria is performed.

3.4.1. Voluntary Mitigation

As outlined in the policy, a consent authority should only apply voluntary mitigation rights where, even with the implementation of best practice management, the development contributes to exceedances of the mitigation criteria outlined in Table 6:

- At any residence on privately owned land; or
- At any 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 following factors:
  - The nature of the workplace;
  - The potential for exposure of workers to elevated levels of particulate matter;
  - The likely period of exposure; and,
  - The health and safety measures already employed in that workplace.

Table 6 Particulate matter mitigation criteria

Pollutant	Averaging period	Units	Criterion	Impact type
$PM_{2.5}$	Annual	$\mu g \cdot m^{-3}$ (a)	8	Human health
	24 hour	$\mu g \cdot m^{-3}$ (b)	25	Human health
PM_{10}	Annual	$\mu g \cdot m^{-3}$ (a)	25	Human health
	24 hour	$\mu g \cdot m^{-3}$ (b)	50	Human health
Total suspended particulate (TSP)	Annual	$\mu g \cdot m^{-3}$ (a)	90	Amenity
Deposited dust	Annual	$g \cdot m^{-2} \cdot month^{-1}$ (b)	2	Amenity
		$g \cdot m^{-2} \cdot month^{-1}$ (a)	4	Amenity

Notes: (a): Cumulative impact (i.e. increase in concentrations due to the development plus background concentrations due to all other sources)
(b): 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)

Mitigation measures should be directed towards reducing the potential human health and amenity impacts of the development and must be directly relevant to the mitigation of those impacts.

3.4.2. Voluntary Acquisition

A consent authority should only apply voluntary acquisition rights where, even with the implementation of best practice management, the development is predicted to contribute to exceedances of the acquisition criteria in Table 7:

- At any residence on privately owned land; or
- At any 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 following factors:
  - The nature of the workplace;
  - The potential for exposure of workers to elevated levels of particulate matter;
  - The likely period of exposure; and
  - The health and safety measures already employed in that workplace.
- 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[1].

Table 7 Particulate matter acquisition criteria

Pollutant	Averaging period	Units	Criterion	Impact type
$PM_{2.5}$	Annual	$\mu g{\cdot}m^{-3}$ (a)	8	Human health
	24 hour	$\mu g{\cdot}m^{-3}$ (b)	25	Human health
PM_{10}	Annual	$\mu g{\cdot}m^{-3}$ (a)	25	Human health
	24 hour	$\mu g{\cdot}m^{-3}$ (b)	50	Human health
Total suspended particulate (TSP)	Annual	$\mu g{\cdot}m^{-3}$ (a)	90	Amenity
Deposited dust	Annual	$g{\cdot}m^{-2}{\cdot}month^{-1}$ (b)	2	Amenity
		$g{\cdot}m^{-2}{\cdot}month^{-1}$ (a)	4	Amenity

Notes: (a): Cumulative impact (i.e. increase in concentrations due to the development plus background concentrations due to all other sources)
(b): Incremental impact (i.e. increase in concentrations due to the development alone), with up to five allowable exceedances of the criteria over the life of the development.

[1] Voluntary land acquisition rights should not be applied to address particulate matter levels on vacant land other than to vacant land specifically meeting these criteria.

3.5. Greenhouse Gas Legislation and Guidance

The Australian Government Clean Energy Regulator administers schemes legislated by the Australian Government for measuring, managing, reducing or offsetting Australia's carbon emissions.

Schemes administered by the Clean Energy Regulator include:

- National Greenhouse and Energy Reporting Scheme, under the *National Greenhouse and Energy Reporting Act* (2007).
- Emissions Reduction Fund, under the *Carbon Credits (Carbon Farming Initiative) Act* (2011).
- Renewable Energy Target, under the *Renewable Energy (Electricity) Act* (2000).
- Australian National Registry of Emissions Units, under the *Australian National Registry of Emissions Units Act* (2011).

3.5.1. National Greenhouse and Energy Reporting Scheme

The National Greenhouse and Energy Reporting (NGER) scheme, established by the *National Greenhouse and Energy Reporting Act* (2007) (NGER Act), is a national framework for reporting and disseminating company information about greenhouse gas emissions, energy production, energy consumption and other information specified under NGER legislation.

The objectives of the NGER scheme are to:

- Inform government policy;
- Inform the Australian public;
- Help meet Australia's international reporting obligations;
- Assist Commonwealth, state and territory government programmes and activities; and
- Avoid duplication of similar reporting requirements in the states and territories.

Further information on the NGER scheme, specifically the definitions of various scopes and types of greenhouse gas (GHG) emissions which have also been adopted for the purposes of this assessment, is provided in Section 5.2.

3.5.2. Relevant NSW Legislation

There is no specific GHG legislation administered within NSW. The NGER scheme (and other identified Commonwealth schemes in Section 3.5) forms the applicable legislation within NSW.

3.5.3. Guidance

The GHG accounting and reporting principles adopted within this GHG assessment are based on the following financial accounting and reporting standards:

- Australian Government Department of the Environment, Australian National Greenhouse Accounts, National Greenhouse Accounts Factors, August 2023 (DoE, 2023);
- The World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) GHG Protocol: A Corporate Accounting and Report Standard (WRI, 2004);
- ISO 14064-1:2018 (Greenhouse Gases – Part 1: Specification with guidance at the organisation level for quantification and reporting of GHG emissions and removal);
- ISO 14064-2:2019 (Greenhouse Gases – Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of GHG emission reductions or removal enhancements); and
- ISO 14064-3:2019 (Greenhouse Gases – Part 3: Specification with guidance for the validation and verification of GHG assertions) guidelines (internationally accepted best practice).

4. EXISTING CONDITIONS

4.1. Surrounding Land Sensitivity

4.1.1. Discrete Receptor Locations

Air quality assessments typically use a desk-top mapping study to identify 'discrete receptor locations', which are intended to represent a selection of locations that may be susceptible to changes in air quality. In broad terms, the identification of sensitive receptors refers to places at which humans may be present for a period representative of the averaging period for the pollutant being assessed. Typically, these locations are identified as residential properties although other sensitive land uses may include schools, medical centres, places of employment, recreational areas or ecologically sensitive locations.

It is noted that in addition to the identified 'discrete' receptor locations, the entire modelling area is gridded with 'uniform' receptor locations (see Section 4.1.2) that are used to plot out the predicted impacts, and as such the accidental non-inclusion of a location sensitive to changes in air quality does not render the AQIA invalid, or otherwise incapable of assessing those potential risks.

To ensure that the selection of discrete receptors for the AQIA are reflective of the locations in which the population of the area surrounding the Mine Site reside, population density data has been examined. Population density data based on the 2016 census have been obtained from the Australian Bureau of Statistics (ABS) for a 1 square kilometre (km^2) grid, covering mainland Australia (ABS, 2017). Using a Geographical Information System (GIS), the locations of sensitive receptor locations have been confirmed with reference to their population densities.

Using ABS data in a GIS, the population density of the area surrounding the Mine Site has been reviewed. The Mine Site and surrounds is located in an area of very low population density (between 0 and <500 persons·km^{-2}).

It is noted that the Mine Site is situated on land occupied by a number of pastoral stations either owned by Wentworth Pastoral Company, a wholly owned subsidiary of RZ Resources Limited, or the subject of commercial agreements with the owners of the stations rendering them Project related. The current lease / landholders for Project related stations are as follows:

- Belmore (R2);
- Warwick (R4); and
- Sunshine (R5).

For transparency, these receptors have been included in this study and labelled as 'Project related' receptors. Furthermore, receptor R5 has been identified as an unoccupiable residence, although impacts have been assessed at this location.

In addition, the proposed Mine Camp has also been assessed as Project related residence.

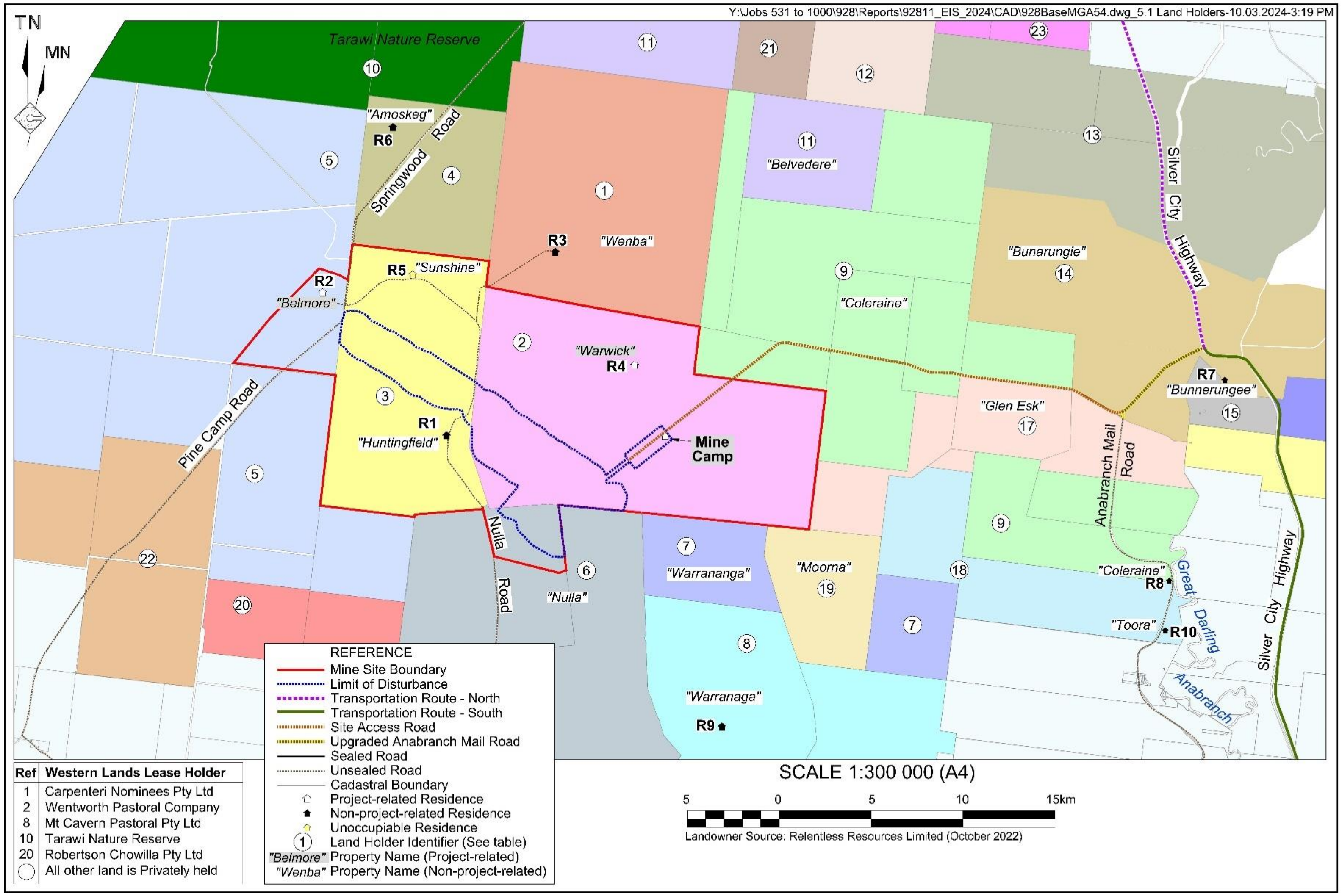
The receptors surrounding the Mine Site adopted for use within this AQIA as presented in Figure 3 and Table 8. It is noted that the nomenclature has been adopted to be consistent with that adopted for the noise assessment for the Project.

Table 8 Discrete sensitive receptor locations used in the study

ID	Type	Name	Location (m, UTM 54)	
			Eastings	Northings
R1	Non-Project related	Huntingfield	527 465	6 279 757
R2	Project related	Belmore	520 744	6 287 533
R3	Non-Project related	Wenba	533 397	6 289 733
R4	Project related	Warwick	537 702	6 283 600
R5	Unoccupiable	Sunshine	525 628	6 288 406
R6	Non-Project related	Amoskeg	524 562	6 296 514
R7	Non-Project related	Bunnerungee	569 790	6 282 698
R8	Non-Project related	Coleraine	566 775	6 271 855
R9	Non-Project related	Warranaga	542 446	6 263 925
R10	Non-Project related	Toora	566 554	6 269 159
R11	Non-Project related	Springwood	555 583	6 318 366
R12	Non-Project related	Cooinda	548 476	6 311 672
R13	Non-Project related	Belvedere	542 090	6 309 887
Mine Camp	Project related	Mine Camp	539 381	6 279 743

In addition to the assessment of potential air quality impacts at discrete locations, an assessment of impacts in accordance with the NSW Government's Voluntary Land Acquisition and Mitigation Policy (NSW Government, 2018) has been performed, as required by the SEARs.

Figure 3 Sensitive receptors surrounding the Mine Site



Source: RWC

4.1.2. Uniform Receptor Locations

Additional to the sensitive receptors identified in Section 4.1.1, a grid of uniform receptor locations has been used in the AQIA to allow presentation of contour plots of predicted impacts.

4.2. Meteorology

The meteorology experienced within an area can govern the generation (in the case of wind-dependent emission sources), dispersion, transport and eventual fate of pollutants in the atmosphere. The meteorological conditions surrounding the Mine Site have been characterised using data collected by the Australian Government Bureau of Meteorology (BoM) at a number of surrounding Automatic Weather Stations (AWS), and specifically at Mildura Airport AWS, which is approximately 90 km southeast of the Mine Site. Given the lack of meteorological monitoring in the immediate area surrounding the Mine Site, this AWS is considered the most representative station for the area surrounding the Mine Site as it is significantly closer than others in the area (refer to Appendix A). The meteorological conditions measured at Mildura Airport AWS are presented in Appendix A.

The wind roses presented in Appendix A indicate that from 2017 to 2021, winds at Mildura Airport AWS show similar wind distribution patterns across the years assessed, with predominant winds from southern vectors.

The majority of wind speeds experienced at the Mildura Airport AWS between 2017 and 2021 are generally in the range 0.5 meters per second ($m \cdot s^{-1}$) to 8 $m \cdot s^{-1}$ with the highest wind speeds (greater than 8 $m \cdot s^{-1}$) occurring from mostly north and north-easterly directions. Winds of this speed are rare and occur during 1.3 % of the observed hours during the years while calm winds (< 0.5 $m \cdot s^{-1}$) occur during 4.2 % of hours on average across the years 2017-2021.

To provide a characterisation of the meteorology which would be expected at the Mine Site, a meteorological modelling exercise has been performed.

Data from the year 2019 have been selected for use in the AQIA to provide an approximation of 'representative' conditions surrounding the Mine Site. This year has been selected through examination of meteorology for the five-year period 2017 to 2021. The year 2019 was selected as being most representative as wind speed and direction measured at Mildura AWS in 2019 were considered to be most representative of the five-year period examined.

4.3. Air Quality

The air quality experienced at any location will be a result of emissions generated by natural and anthropogenic sources on a variety of scales (local, regional and global). The relative contributions of sources at each of these scales to the air quality at a location will vary based on a wide number of factors including the type, location, proximity and strength of the emission source(s), prevailing meteorology, land uses and other factors affecting the emission, dispersion and fate of those pollutants.

When assessing the impact of any particular source of emissions on the potential air quality at a location, the impact of all other sources of an individual pollutant should also be assessed. This 'background' (sometimes called 'baseline') air quality will vary depending on the pollutants to be assessed and can often be characterised by using representative air quality monitoring data.

The Mine Site is located at significant distance from any of the air quality monitoring stations (AQMS) operated by NSW Department of Planning and Environment (DPE). The locations of the nearest AQMS are briefly summarised in Table 9 and presented in Appendix B.

It is noted that none of the NSW DPE AQMS presented in Table 9 monitor concentrations of NO_2. Given the location of the Mine Site, AQMS located in South Australia (SA) as operated by SA EPA have also been considered for use in this assessment.

he year 2019 is indicated in Table 9 as this is the year selected for assessment. Further information is provided below.

Table 9 Closest DPE AQMS to the Mine Site

AQMS Location	Source	Approximate distance to Project (km)	2019 Data	Measurements		
				PM_{10}	$PM_{2.5}$	TSP
Wagga Wagga North	NSW DPE	581	✓	✓	✓	×
Albury	NSW DPE	589	✓	✓	✓	×
Elizabeth Downs	SA EPA	259	✓	✓	✓	×

The closest representative NSW DPE AQMS with data available for the year 2019 (consistent with the meteorological modelling) is noted to be located at Wagga Wagga North and correspondingly, PM data collected at Wagga Wagga North AQMS has been adopted for use in this assessment. It is noted that the use of data from these AQMS is considered to represent a conservative approach to this assessment as there are a greater number of sources of PM surrounding the AQMS locations as they are generally more suburban in nature.

The adoption of air quality monitoring data, often collected at significant distances from proposed projects, to represent conditions at those locations is a routinely adopted approach in NSW. NSW DPE operates an extensive air quality monitoring network, generally reflective of the most populated areas of the State. Site specific air quality monitoring funded by applicants can sometimes be used, although for the purposes of use within an AQIA, at least a full year of continuous measurement is required.

Appendix B provides a detailed assessment of the background air quality monitoring data collected at the Wagga Wagga North and Elizabeth Downs AQMS.

It is noted that none of the AQMS identified in Table 9 measured concentrations of TSP. This pollutant is of relevance to the expected emissions from the Project. Other sources of data have been adopted to allow representation of the TSP environment in the area surrounding the Project, and a full discussion is provided in Appendix B.

No dust deposition data is available for the area surrounding the Mine Site. The incremental impact criterion of 2 $g·m^{-2}·month^{-1}$ as outlined within the Approved Methods has been adopted which effectively provides a background deposition level of 2 $g·m^{-2}·month^{-1}$ (see Table 10) (the total allowable deposition being 4 $g·m^{-2}·month^{-1}$).

No data is available to allow the background silica (Si) concentrations experienced in areas surrounding the Mine Site. In the absence of any information, the background concentration has been assumed to be negligible. This assumption is considered to be reasonable, given the general absence of other sources in close proximity to the Mine Site.

A summary of the air quality monitoring data for the year 2019 is presented in Table 10.

Table 10 Summary of background air quality used in the AQIA

Pollutant	Ave Period	Units	Measured Value	Notes
Particles (as TSP)	Annual	$µg·m^{-3}$	82.7	Estimated on a TSP:PM_{10} ratio of 2.3404 : 1
Particles (as PM_{10})	24-hour	$µg·m^{-3}$	Daily Varying	The 24-hour maximum PM_{10} in 2019 at Wagga Wagga North was measured to be 251.7 $µg.m^{-3}$
	Annual	$µg·m^{-3}$	35.3	
Particles (as $PM_{2.5}$)	24-hour	$µg.m^{-3}$	Daily Varying	The 24-hour maximum $PM_{2.5}$ in 2019 at Wagga Wagga North was measured to be 239.6 $µg.m^{-3}$
	Annual	$µg.m^{-3}$	11.3	
Dust deposition	Annual	g·m-2·month-1	2	Difference in NSW EPA maximum allowable and incremental impact criterion
Silica	Annual	$µg·m^{-3}$	N/A	Assumed to be negligible

Note: Reference should be made to Appendix B

It is noted that the maximum 24-hour PM_{10} and the maximum 24-hour $PM_{2.5}$ concentrations measured at Wagga Wagga North exceed the relevant criteria. Discussion is provided in Appendix B is to the sources of those elevated background concentration measurement.

4.4. Topography

The elevation of the Mine Site is between approximately 40 m and 55 m Australian Height Datum (AHD). Surface geology within the Mine Site is dominated by aeolian sediments, comprising a series of discontinuous, east-west orientated sand dunes separated by broad swales and sand plains. The topography of the Mine Site and surrounds is presented in Figure 4. The topography of the area, and the locations of surrounding receptors in relation to the Project and surrounding topography has informed the approach to meteorological modelling (refer Section 5.1).

4.5. Potential for Cumulative Impacts

The area surrounding the Mine Site is generally rural in nature, with no significant anthropogenic sources of particulate matter that may impact cumulatively with the Project on nearby sensitive receptors. The inclusion of the background air quality data as described in Section 4.3 would appropriately account for any potential cumulative impacts associated with surrounding land uses.

4.6. Greenhouse Gas

Emissions of GHG are tracked by the Commonwealth of Australia via the Australian National Greenhouse Accounts program. This program, and the reports and data submitted as part of the program, fulfils Australia's international and domestic reporting requirements. Carbon emission totals by State and Territory by year and by sector are reported in the 'State and Territory Greenhouse Gas Inventories' report each year.

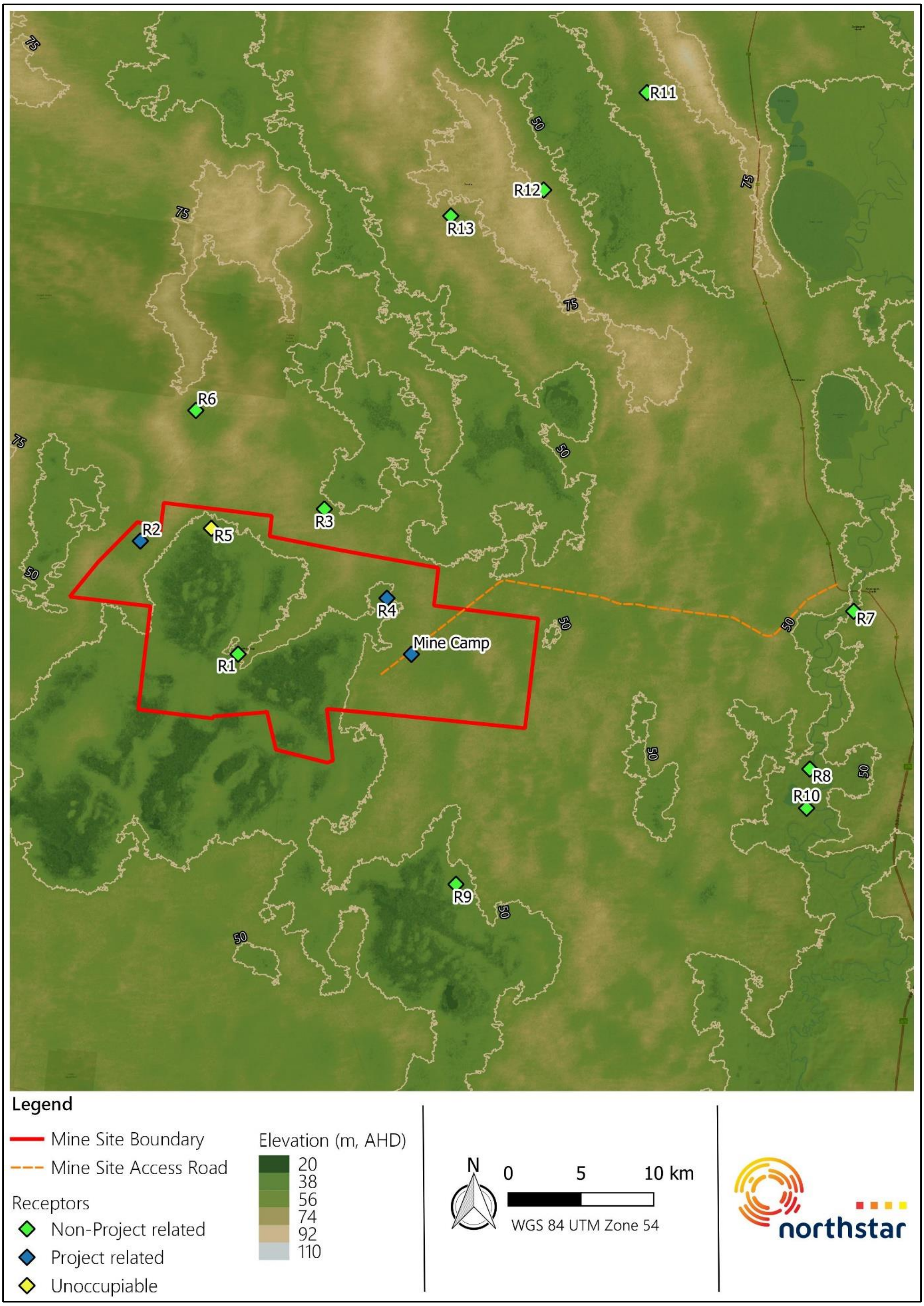
These data are used to:

- Meet Australia's reporting commitments under the United Nations Framework Convention on Climate Change (UNFCCC);
- Track progress against Australia's emission reduction commitments; and
- Inform policy makers and the public.

Data from the 2020 report for Australia (DISER, 2020) and NSW have been obtained for the purposes of this GHG assessment. These reports are the most recent available at the time of reporting.

Emissions of GHG from Australia across all economic sectors were 484.6 Mt carbon dioxide equivalent (CO_2-e). GHG emissions in NSW in 2020 were 132.4 Mt CO_2-e.

Figure 4 Topography surrounding the Mine Site



Source: Northstar

5. APPROACH TO ASSESSMENT

5.1. Air Quality Impact Assessment

5.1.1. Dispersion Modelling

A dispersion modelling assessment has been performed using the NSW EPA approved CALPUFF atmospheric dispersion model. The modelling has been performed in CALPUFF 2-dimensional (2-D) mode. Given the distance between the Mine Site and receptors, and the generally uncomplicated terrain (in air quality impact assessment terms) in the area, the performance of a full 3-D modelling assessment is not considered to be warranted.

An assessment of the impacts of the operation of activities at the Project has been performed which characterises the likely day-to-day operations, approximating average operational characteristics which are appropriate to assess against longer term (annual average) criteria for particulate matter. The likely peak activities at the Mine Site have also been characterised to allow comparison of potential impacts against shorter term (24-hour) criteria for particulate matter.

The modelling scenarios provide an indication of the air quality impacts of the operation of activities at the Mine Site. Added to these impacts are regional background air quality concentrations (as discussed in Section 4.3 and Appendix B) which represent the air quality which may be expected within the area surrounding the Mine Site, without the impacts of the Project itself.

5.1.2. Modelling Scenarios

Four modelling scenarios have been developed to provide an indication of the air quality impacts of the operation of activities at the Mine Site at the nearest sensitive receptors:

- Scenario 1 - Year 5 operations;
- Scenario 2 – Year 11 operations;
- Scenario 3 – Year 15 operations; and
- Scenario 4 – Year 17 operations.

These scenarios would all include the following activities:

- Vegetation and topsoil stripping;
- Removal of overburden and interburden;
- Extraction and processing of ore; and
- Transport of heavy mineral concentrate from the Mine Site and along Anabranch Mail Road.

Construction activities would occur at the commencement of the Project which would include:

- Vegetation and topsoil stripping;
- Removal of overburden and interburden;
- Transport of construction materials to the Mine Site; and
- Operation of diesel powered generators.

The activity rates and emissions are anticipated to be greater during all operational scenarios than during construction, and impacts are therefore likely to be correspondingly greater. Impacts associated with construction activities have therefore not been quantitatively assessed.

The relevant activity rates associated with the four operational scenarios are presented in Table 11.

Table 11 Mining schedule associated with modelled scenarios

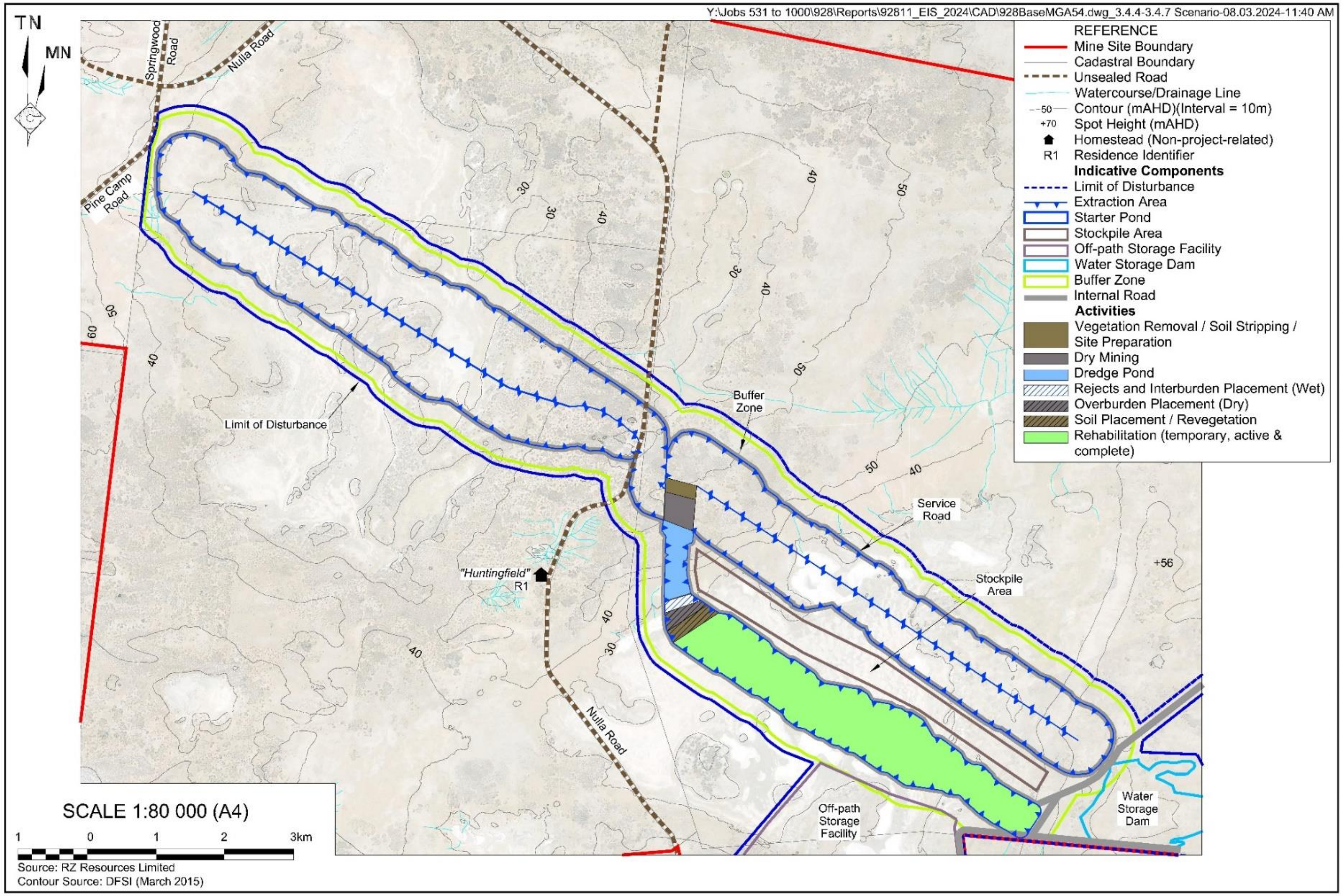
Parameter	Scenario 1 Year 5	Scenario 2 Year 11	Scenario 3 Year 15	Scenario 4 Year 17
Vegetation clearing	83.2 ha	255.2 ha	198.6 ha	14.2 ha
Soil stripped	0.4 $Mt{\cdot}yr^{-1}$	1 33 $Mt{\cdot}yr^{-1}$	1 03 $Mt{\cdot}yr^{-1}$	0.7 $Mt{\cdot}yr^{-1}$
Overburden removed	27.1 $Mt{\cdot}yr^{-1}$	25.2 $Mt{\cdot}yr^{-1}$	16.1 $Mt{\cdot}yr^{-1}$	11.0 $Mt{\cdot}yr^{-1}$
Interburden removed (wet process)	36.3 $Mt{\cdot}yr^{-1}$	34.2 $Mt{\cdot}yr^{-1}$	32.1 $Mt{\cdot}yr^{-1}$	27.7 $Mt{\cdot}yr^{-1}$
Ore extracted	23.4 $Mt{\cdot}yr^{-1}$	23.4 $Mt{\cdot}yr^{-1}$	27.6 $Mt{\cdot}yr^{-1}$	20.9 $Mt{\cdot}yr^{-1}$
Slimes produced	1.0 $Mt{\cdot}yr^{-1}$	1.0 $Mt{\cdot}yr^{-1}$	1.4 $Mt{\cdot}yr^{-1}$	1.2 $Mt{\cdot}yr^{-1}$
Rejects produced	1.4 $Mt{\cdot}yr^{-1}$	1.0 $Mt{\cdot}yr^{-1}$	1.7 $Mt{\cdot}yr^{-1}$	1.0 $Mt{\cdot}yr^{-1}$
HMC transported	450 000 $t{\cdot}yr^{-1}$	465 000 $t{\cdot}yr^{-1}$	385 000 $t{\cdot}yr^{-1}$	340 000 $t{\cdot}yr^{-1}$
Average daily heavy vehicle movements[(a)]				
Type 1 and Type 2 Road Train	20	20	20	20
B-Double / Semi Trailer Truck / other heavy vehicle	8	8	8	8
22 seater bus	2	2	2	2
Peak daily heavy vehicle movements				
Type 1 and Type 2 Road Train[(b)]	24	24	24	24
B-Double / Semi Trailer Truck / other heavy vehicle	14	14	14	14
22 seater bus	4	4	4	4

Notes: (a): one return trip = two movements
(b): Particulate matter emissions associated with the use of Type 1 (up to 32 movements per day) and Type 2 (up to 24 movements per day) road trains have been assessed and it has been determined that there would be no material difference in predicted impacts at sensitive receptors between the vehicle types. As a result, Type 2 road trains have been assessed.

Layouts of all four scenarios are presented in Figure 5, Figure 6, Figure 7, and Figure 8.

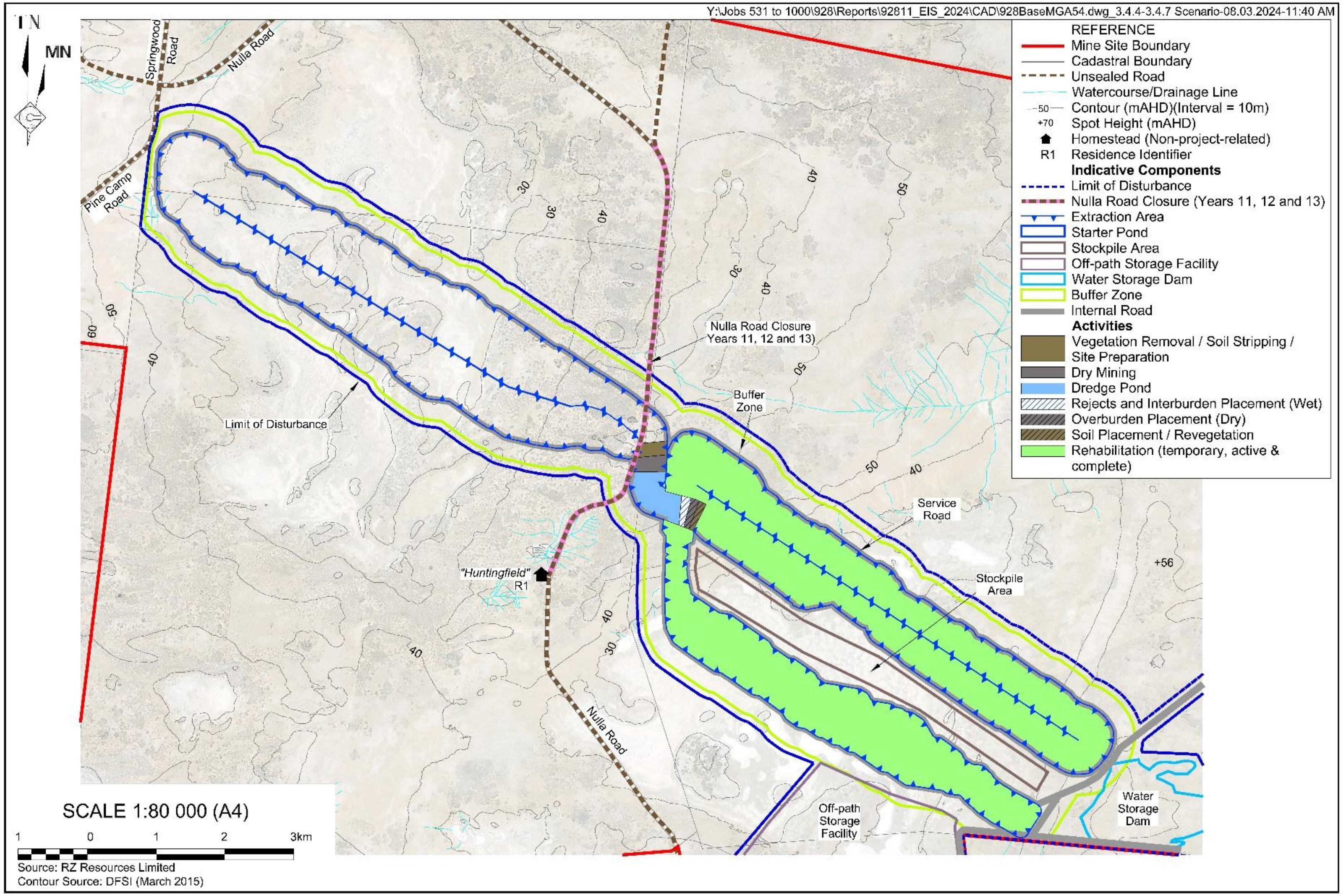
In relation to peak daily material extraction and on-site haulage rates, these are taken to be equal to the annual average, divided by 365 days of operation. Given the limitation of available equipment, on certain days those rates may increase, although it is anticipated that when the rate of certain activities increases, rates of others may decrease. The average daily extraction rate is therefore anticipated to be the maximum daily extraction rate in any year of operation.

Figure 5 Scenario 1 layout – year 5 operations



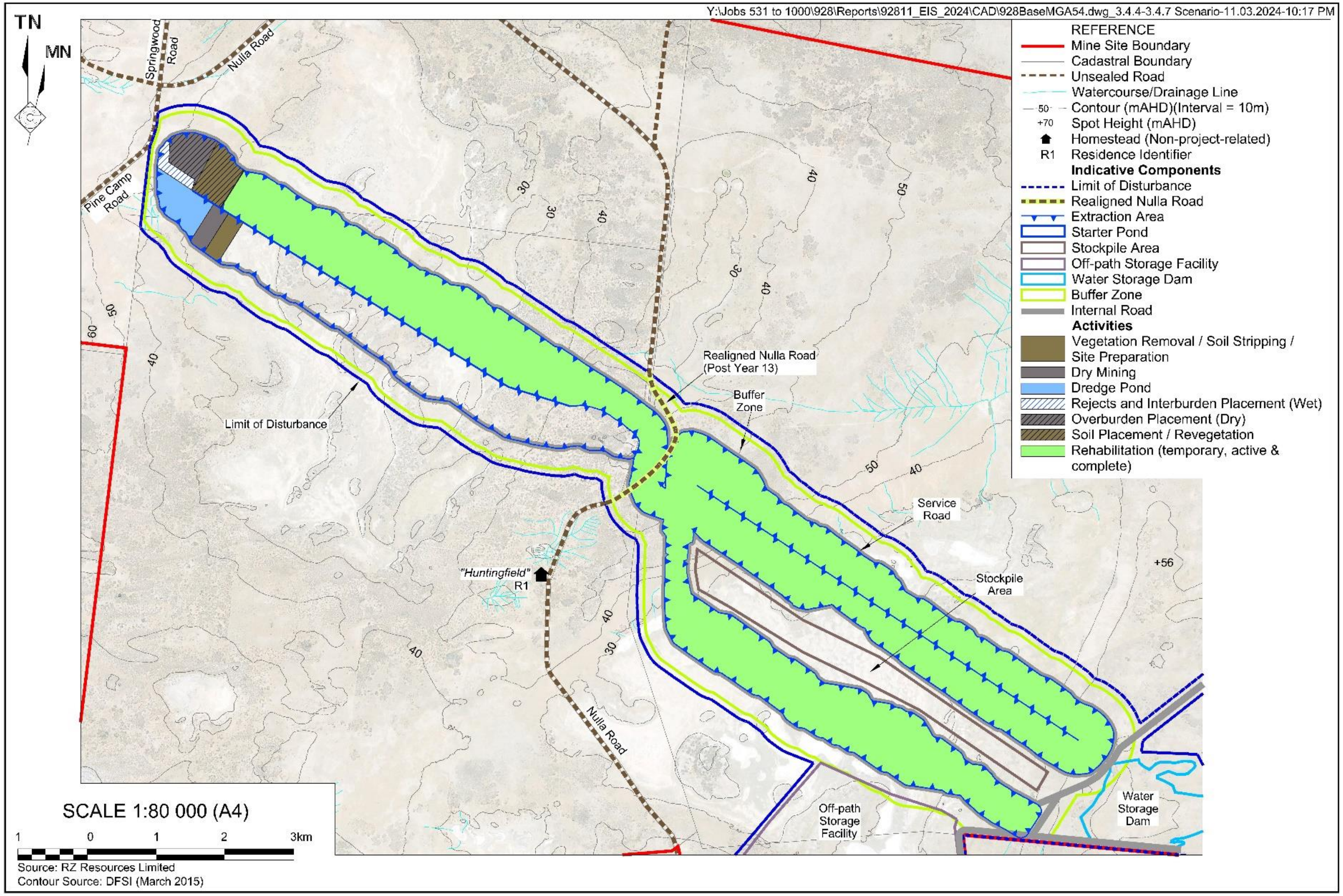
Source: RWC

Figure 6 Scenario 2 layout – year 11 operations



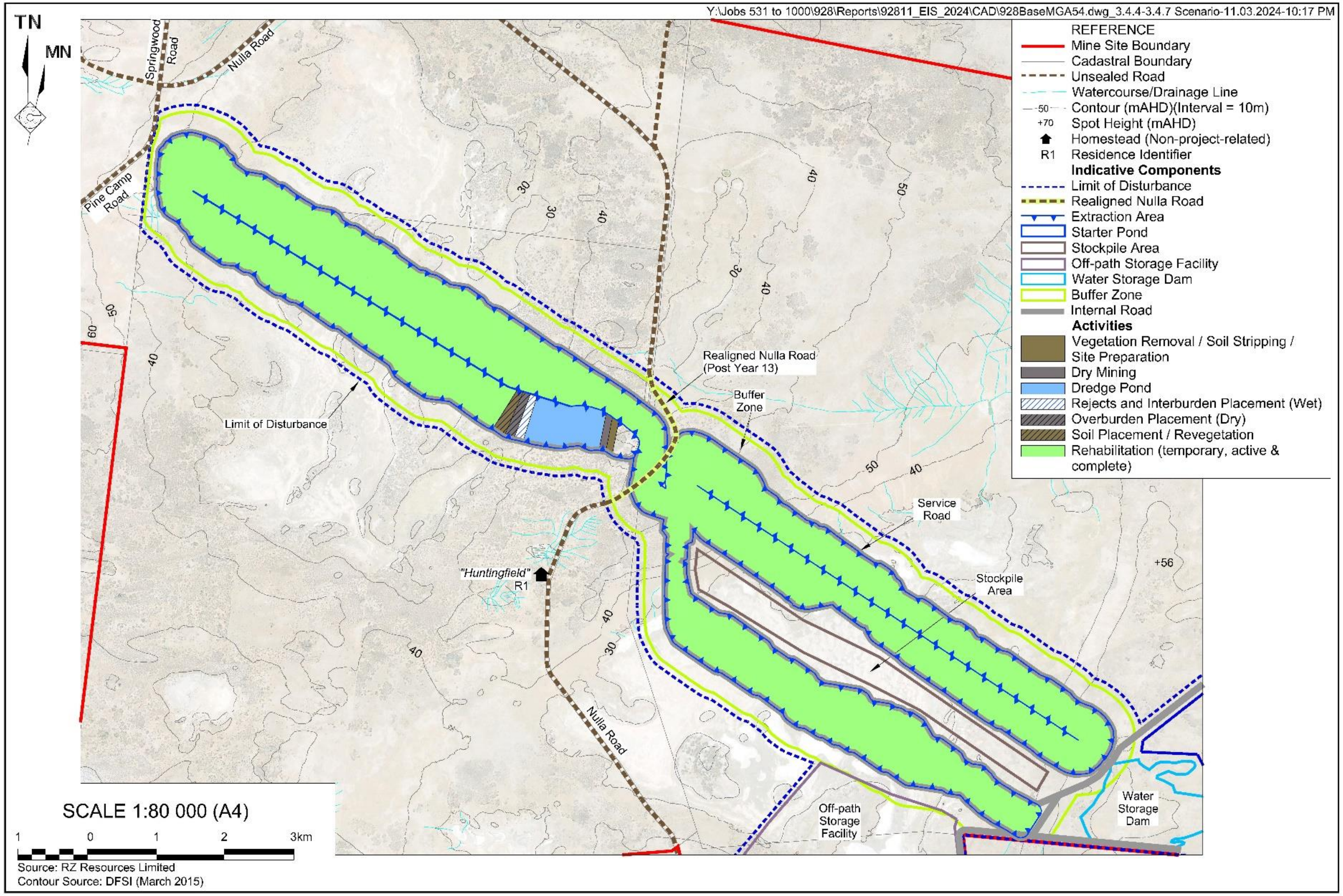
Source: RWC

Figure 7 Scenario 3 layout – year 15 operations



Source: RWC

Figure 8 Scenario 4 layout – year 17 operations



Source: RWC

5.1.3. Emissions Estimation

The estimation of emissions from a process is typically performed using direct measurement or through the application of factors which appropriately represent the processes under assessment. This assessment has adopted emission factors for materials handling processes, movement of trucks on unpaved site roads, screening, and wind erosion contained within the US EPA AP-42 emission factor compendium (US EPA, 1995 and updates) to represent the emission of particulate matter resulting from the operations occurring at the Mine Site as described in Section 2. These factors are appropriate for adoption in Australia and are routinely adopted in the assessment of operations of this nature.

Potential emissions of particulate matter during operations have been quantified, with an emissions inventory associated with the average operational characteristics, and peak characteristics during each stage calculated.

A full description of the emission sources included in the assessment, and the emission factors and assumptions adopted are presented in Appendix C.

In relation to potential impacts associated with materials transport along Anabranch Mail Road, an assessment of the potential for discrete impacts at distances away from the road has been performed. A nominal 5 km stretch of Anabranch Mail Road has been subject to dispersion modelling, and the inputs to that assessment are presented in Appendix C.

5.1.4. Emissions Controls

Emissions controls will be employed at the Mine Site. The application of these controls results in quantifiable reductions in the quantity of particulate matter being emitted as part of the Project operation.

A summary of the emissions reductions measures that would be adopted as part of the Project operation is presented in Table 12. These emission reductions are outlined in the NPI EETM for Mining (NPI, 2012) and relevant AP-42 documentation (US EPA, 1995).

Table 12 Summary of emission reduction methods adopted as part of Project operation

Emission control method	Control efficiency (%)
Application of water and/or chemical suppressants on unpaved haulage routes	90
Limiting of on-site vehicle speeds to less than or equal to 50 $km \cdot hr^{-1}$	75
Ore extraction, dredge mining, wet concentrator plant – wet processes	100
Retention of particulate matter in sub-ground level areas (pit retention)	95 (TSP) 5 (PM_{10} and $PM_{2.5}$)
Storage of heavy mineral concentrate in 3-sided bins prior to load-out	75
Movement of heavy mineral concentrate in sealed containers	Not quantified

An emission control factor of 90 % has been adopted for the implementation of controls on unpaved haulage routes. As outlined in the literature (summarised in (Katestone, 2011)), the effectiveness of emissions controls can vary widely (30 % to 95 %) and is dependent upon the measures implemented. Recent studies performed at coal mines in NSW as part of the 'Dust Stop' program (under an EPA Pollution Reduction Program) provided data relating to the levels of dust control achieved through the implementation of controls (water, chemical suppressant). The average level of control achieved across 16 sites was 92 %, with the minimum being 80 % and the maximum 99 %.

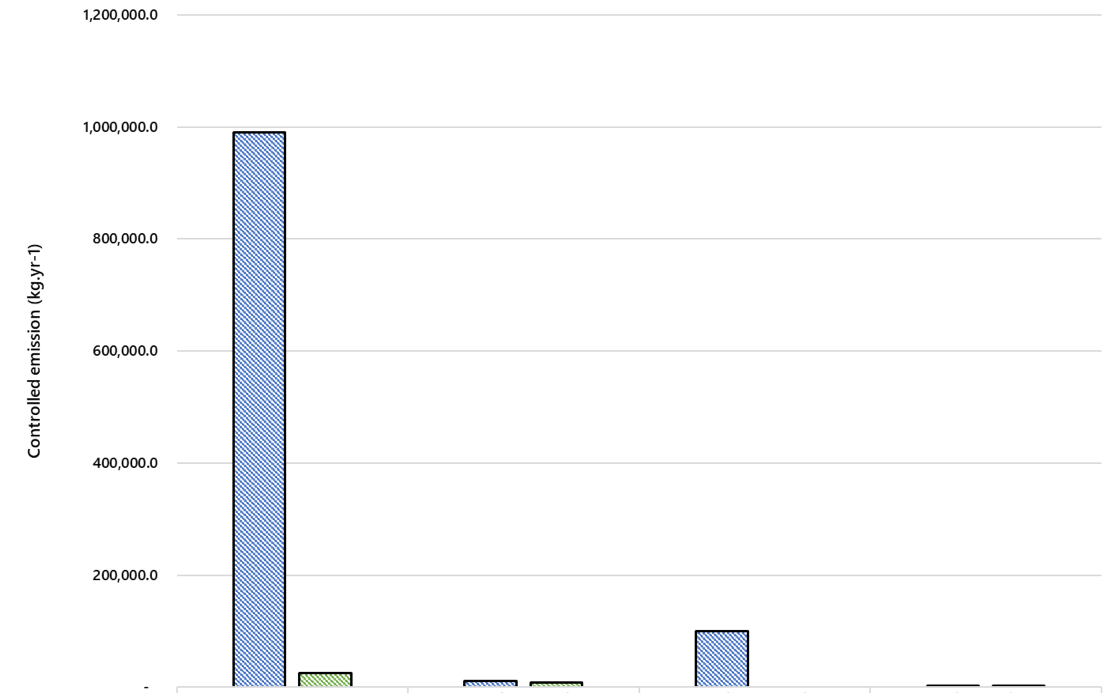
The Applicant commits to achieving a particulate control efficiency of 90 % at the Mine Site and based on the findings of other mine sites across NSW, this is achievable.

Further discussion of these control measures is presented in Section 8.1.

Material moisture contents have been measured to be high (SSM, 2020) (10 % for topsoil, and 17.5 % for overburden and ore). Silt contents as measured (SSM, 2020) of 6.2 % for topsoil, and 10 % for overburden and ore have been adopted in the calculation of emissions as outlined in Appendix C

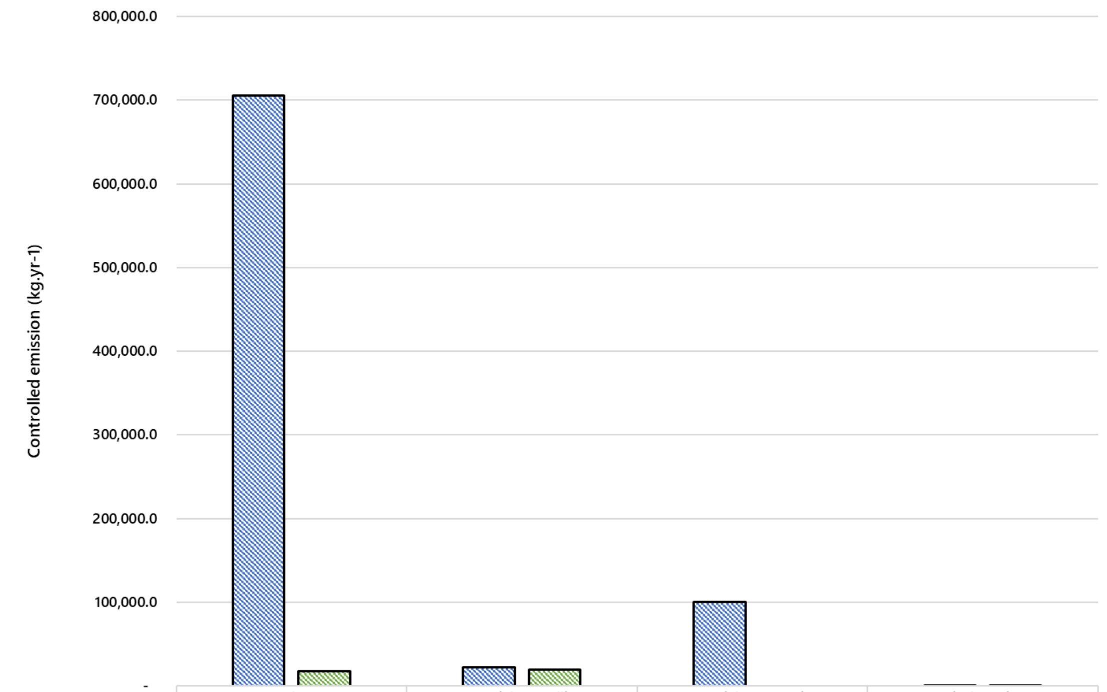
Based on the foregoing, and the information provided in Appendix C, the distribution of uncontrolled and controlled particulate emissions in each year subject to assessment is presented in Figure 9, Figure 10, Figure 11 and Figure 12.

Figure 9 Calculated uncontrolled & controlled annual PM_{10} emissions – Scenario 1



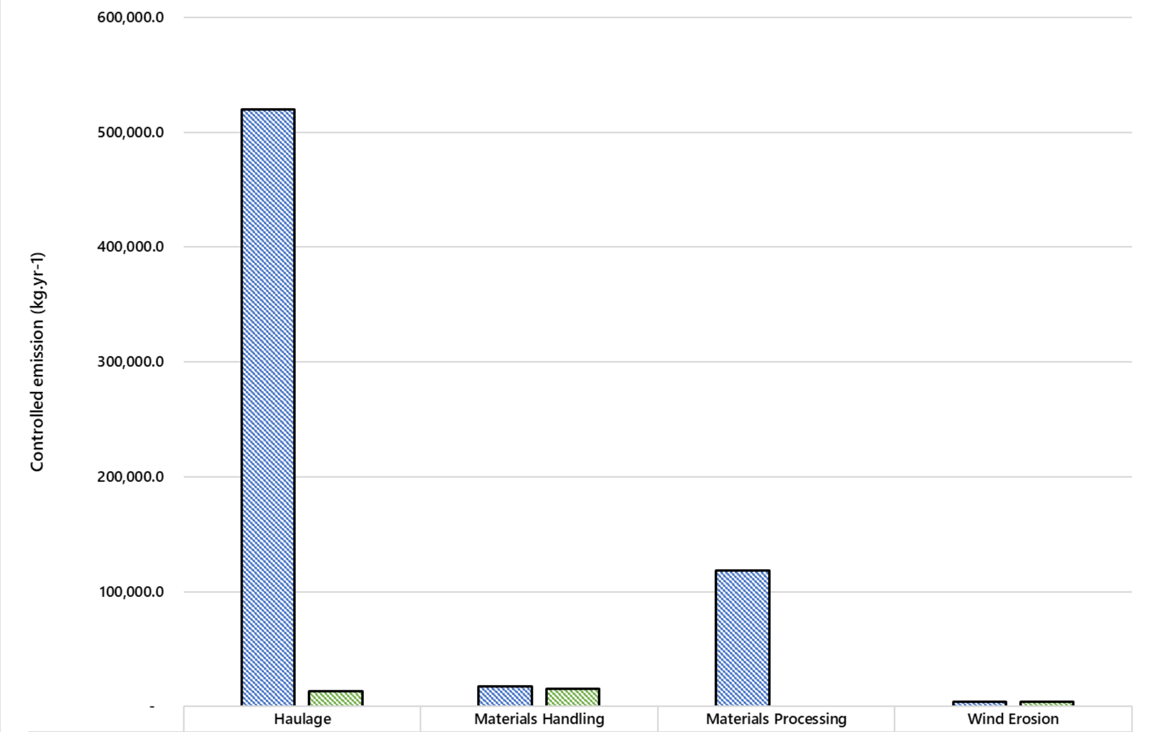
	Haulage	Materials Handling	Materials Processing	Wind Erosion
Uncontrolled PM10	990,834.2	11,370.1	100,524.5	2,281.0
Controlled PM10	24,817.4	8,774.8	-	2,255.5

Figure 10 Calculated uncontrolled & controlled annual PM_{10} emissions – Scenario 2



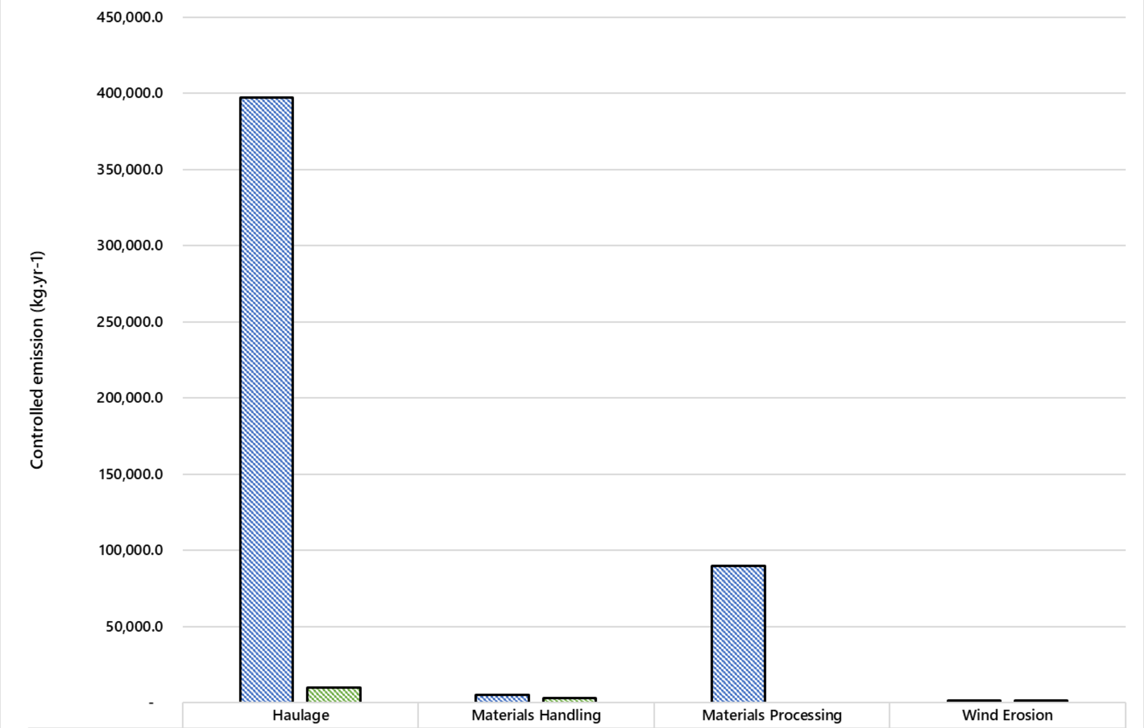
	Haulage	Materials Handling	Materials Processing	Wind Erosion
Uncontrolled PM10	705,819.4	22,094.8	100,481.6	1,213.2
Controlled PM10	17,692.1	19,596.3	-	1,187.7

Figure 11 Calculated uncontrolled & controlled annual PM_{10} emissions – Scenario 3



	Haulage	Materials Handling	Materials Processing	Wind Erosion
Uncontrolled PM10	519,817.0	17,796.4	118,465.9	4,379.5
Controlled PM10	13,042.0	15,249.2	-	4,354.0

Figure 12 Calculated uncontrolled & controlled annual PM_{10} emissions – Scenario 4



	Haulage	Materials Handling	Materials Processing	Wind Erosion
Uncontrolled PM10	397,380.8	5,159.7	89,813.0	1,276.7
Controlled PM10	9,981.1	3,086.3	-	1,251.2

5.2. Greenhouse Gas Assessment

The purpose of the GHG assessment is to examine the potential impacts of the construction and operation of the Project relating to emissions of GHG. A quantitative assessment of emissions is performed with direct emissions compared with total national and NSW GHG emissions for context (refer Section 4.6).

The scope of the GHG assessment is to provide a quantitative assessment of GHG emissions arising from the operation of the Project. This report does not provide a definitive quantification of GHG emissions arising from the Project operation but provides the general context of the likely quantum of emissions.

Opportunities for reduction of GHG emissions are discussed.

5.2.1. Emission Types

The Australian Government Department of the Environment (DoE) document, "National Greenhouse Accounts Factors" Workbook (NGA Factors) (Department of Climate Change, 2023), defines two types of GHG emissions (see Table 13), namely 'direct' and 'indirect' emissions. This assessment considers both direct emissions and indirect emissions resulting from the operation of the Project.

Table 13 Greenhouse gas emission types

Emission Type	Definition
Direct	Produced from sources within the boundary of an organisation and as a result of that organisation's activities (e.g. consumption of fuel in on-site vehicles)
Indirect	Generated in the wider economy as a consequence of an organisation's activities (particularly from its demand for goods and services), but which are physically produced by the activities of another organisation (e.g. consumption of purchased electricity).

Note: Adapted from NGA Factors Workbook (Department of Climate Change, 2023)

5.2.2. Emission Scopes

The NGA Factors (Department of Climate Change, 2023) identifies two 'scopes' of emissions for GHG accounting and reporting purposes as shown in Table 14.

Table 14 Greenhouse gas emission scopes

Emission Scope	Definition
Scope 1	Direct (or point-source) emission factors give the kilograms of carbon dioxide equivalent (CO_2-e) emitted per unit of activity at the point of emission release (i.e. fuel use, energy use, manufacturing process activity, mining activity, on-site waste disposal, etc.). These factors are used to calculate Scope 1 emissions.
Scope 2	Indirect emission factors are used to calculate Scope 2 emissions from the generation of the electricity purchased and consumed by an organisation as kilograms of CO_2-e per unit of electricity consumed. Scope 2 emissions are physically produced by the burning of fuels (coal, natural gas, etc.) at the power station.

Note: Adapted from NGA Factors Workbook (Department of Climate Change, 2023)

A third scope of emissions, Scope 3 Emissions, are also recognised in some GHG assessments. The Greenhouse Gas Protocol (GHG Protocol) (WRI, 2004) defines Scope 3 emissions as "other indirect GHG emissions":

> *"Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the company, but occur from sources not owned or controlled by the company. Some examples of Scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services."*

Scope 3 emissions related to the extraction and transport of fuels, and the use of fuels in employee transport have been considered.

5.2.3. Emission Source Identification

The geographical boundary set for this GHG assessment covers the Mine Site and also includes the transport of product from the Mine Site to Broken Hill. Material may also be transported to Wentworth, although for the purposes of this assessment, 100 % of product is assumed to be transported to Broken Hill. From Broken Hill and/or Wentworth, materials would be further transported by a combination of road, rail, and sea. The boundaries of this assessment encompass product transport to Broken Hill only.

All Scope 1, Scope 2, and Scope 3 emissions within the defined boundary have been identified and reported as far as possible.

The GHG emission sources associated with the operation of the Project have been identified through the review of the proposed broad activities as described in Section 2.1. The activities/operations being performed as part of the Project, which have the potential to result in emissions of GHG, are presented in Table 15 below.

Table 15 Greenhouse gas emission sources

Scope	Project Component	Emission Source Description
1	Consumption of diesel fuel in fixed plant and mobile equipment - construction	Emissions from combustion of fuel
	Consumption of diesel fuel in fixed plant and mobile equipment - operations	Emissions from combustion of fuel
	Consumption of diesel fuel for power generation – construction	Emissions from combustion of fuel
	Consumption of diesel fuel in transport vehicles - operations	Emissions from combustion of fuel
	Consumption of liquified petroleum gas (LPG) for dryers – operations	Emissions from combustion of LPG
2	Consumption of electricity – construction and operations	Consumption of purchased electricity.
3	Consumption of diesel fuel in transport vehicles - operations	Emissions associated with the extraction and processing of fuel
	Consumption of diesel fuel in fixed plant and mobile equipment – construction and operations	Emissions associated with the extraction and processing of fuel
	Consumption of diesel fuel for power generation – construction	Emissions associated with the extraction and processing of fuel
	Consumption of liquified petroleum gas (LPG) for dryers – operations	Emissions associated with the manufacture and processing of LPG
	Consumption of electricity – construction and operations	Emissions associated with distribution and processing of electricity

5.2.4. Emissions Estimation

Emissions of GHG from the sources identified in Table 15 have been calculated using activity data for the source per annum (e.g. per kilolitre (kL) of diesel) and the relevant emission factor for each source.

The assumptions used in the calculation of activity data for the emission source and emission factors, are presented below.

Activity Data

The assumptions relating to activity (i.e. consumption) data during both construction and operations are outlined in Table 16.

Table 16 Calculated activity data

Component	Assumptions	Consumption	Units
Construction			
Consumption of diesel fuel in fixed plant and mobile equipment	Annual maximum as provided by the Applicant	12 700	$kL{\cdot}yr^{-1}$
Consumption of purchased electricity	Information provided by Applicant	172 296[a]	$kWh{\cdot}yr^{-1}$
Consumption of diesel fuel for power generation	Calculation based on information provided by Applicant	68.92[c]	$kL{\cdot}yr^{-1}$
Operations			
Consumption of liquified petroleum gas (LPG) for dryers	Information provided by Applicant	200 000	$GJ\ yr^{-1}$
Consumption of purchased electricity	Information provided by Applicant	120 607[b]	$kWh{\cdot}yr^{-1}$
Consumption of diesel fuel in fixed plant and mobile equipment	Annual maximum consumption as provided by the Applicant	10 500	$kL{\cdot}yr^{-1}$
Consumption of diesel fuel in transport vehicles	Calculation based on information provided by Applicant	2 481[d]	$kL{\cdot}yr^{-1}$

Notes: [a] Electricity usage is during construction is estimated based on the maximum annual usage from approximately year 2 of construction works once the grid has been connected.

[b] Electricity usage during operations is estimated based on the maximum annual usage assuming full production, noting a minimum 30% of this usage will be sourced from either the on-site solar farm or from externally contracted and certified renewable sources.

[c] The Applicant has determined that 172 296 kWh of electricity will be required during the construction phase, which will be generated by diesel powered generators. Review of a number of resources indicates that to produce 1 kWh of electricity from diesel power generation requires 0.4 L of diesel, which equates to 68.92 kL of diesel required for power generation during construction. This agrees well with calculations of energy content, where 38.6 GJ of energy are available in 1 kL of diesel, with 277.8 kWh of energy are available in 1 GJ of diesel. This equates to 620 GJ, or 16 kL of diesel required to produce 172 296 kWh at 100 % efficiency. Given that diesel generators run at approximately 25 % efficiency, this would result in 64.3 kL of diesel required during construction. For the purposes of this assessment, the higher value of 68.92 kL has been adopted.

[d] Diesel fuel for transport use has been calculated based on haulage of maximum total tonnes of concentrate provided by Applicant of 510 000 $t{\cdot}yr^{-1}$, and distance travelled of 458 km return trip. Based on assumption of articulated B-Double capacity of 50 tonnes per trip and fuel usage of 53.1 L/km, this equates to total diesel consumption of 2 481 $kL\ y^{-1}$

Note that emissions from land clearing and vegetation removal and resultant reduction in carbon biomass has not been included in the calculation of Scope 1 emissions, as the Mine Site will be progressively rehabilitated and revegetated. Through revegetation with similar or natural species, this will enhance biodiversity and potentially sequester any greenhouse gases.

Emission Factors

Emissions factors used for the assessment of GHG emissions associated with the operation of the Project have been sourced from the NGA Factors (Department of Climate Change, 2023) (refer to Table 17).

Table 17 Greenhouse gas emission factors

Emission Scope	Emission Source	Emission Factor	Energy Content Factor
Scope 1	Consumption of diesel fuel in fixed plant and equipment – construction and operations	70.2 kg CO_2-e·GJ^{-1}	38.6 GJ·kL^{-1}
	Consumption of diesel fuel in transport vehicles - operations	70.4 kg CO_2-e·GJ^{-1}	38.6 GJ·kL^{-1}
	Consumption of liquified petroleum gas (LPG) for dryers – operations	60.6 kg CO_2-e·GJ^{-1}	25.7 GJ·kL^{-1}
Scope 2	Consumption of purchased electricity – construction and operations (NSW)	0.68 kg CO_2-e kWh^{-1}	-
Scope 3	Consumption of diesel fuel in fixed plant and equipment – construction and operations	17.3 kg CO_2-e·GJ^{-1}	38.6 GJ·kL^{-1}
	Consumption of diesel fuel in transport vehicles - operations	17.3 kg CO_2-e·GJ^{-1}	38.6 GJ·kL^{-1}
	Consumption of liquified petroleum gas (LPG) for dryers – operations	20.2 kg CO_2-e·GJ^{-1}	25.7 GJ·kL^{-1} (A)
	Consumption of purchased electricity – construction and operations (NSW)	0.05 kg CO_2-e kWh^{-1}	-

Note: (A) Energy content factor not used as activity data provided in GJ not kL. Provided for information only

6. AIR QUALITY IMPACT ASSESSMENT

This section presents the results of the dispersion modelling assessment and uses the following terminology:

- Incremental impact – relates to the concentrations predicted as a result of the construction and operation of the Project in isolation.
- Cumulative impact – relates to the incremental concentrations predicted as a result of the construction and operation of the Project PLUS the background air quality concentrations discussed in Section 4.3.

The results are presented in this manner to allow examination of the likely impact of the Project in isolation and the contribution to air quality impacts in a broader sense.

In the presentation of results, the tables included shaded cells which represent the following:

Model prediction	Pollutant concentration / deposition rate less than the relevant criterion	Pollutant concentration / deposition rate equal to, or greater than the relevant criterion

Predicted impacts are presented at all receptors, with those Project related receptors (R2, R4, and the Mine Camp), or unoccupiable (R5) being greyed out. The statistics related to the contribution of the Project to incremental and cumulative impacts (% of criterion) are shown only for non-Project related receptors.

6.1. Scenario 1

The following presents the results of the modelling assessment under the assumptions of Scenario 1 (refer Section 5.1.2).

6.1.1. Particulate Matter – Annual Average PM_{10} and $PM_{2.5}$

The predicted annual average particulate matter concentrations (as TSP, PM_{10} and $PM_{2.5}$) resulting from the operation of the Project under Scenario 1 are presented in Table 18.

The results indicate that incremental concentrations of TSP, PM_{10} and $PM_{2.5}$ at surrounding receptor locations are all below the relevant criteria. It is noted that cumulative concentrations for PM_{10} and $PM_{2.5}$ are shown to be above the relevant criteria at all receptor locations, driven by elevated background concentrations that are already in exceedance of the criteria (refer Appendix B).

Table 18 Predicted annual average TSP, PM_{10} and $PM_{2.5}$ concentrations – Scenario 1

Receptor	Annual Average Concentration ($\mu g \cdot m^{-3}$)								
	TSP			PM_{10}			$PM_{2.5}$		
	Incr.	Bg.	Cumul.	Incr.	Bg.	Cumul.	Incr.	Bg.	Cumul.
Criterion	90			25			8		
Max. % of criterion	1.1	91.9	93.0	2.8	141.2	144.0	1.2	141.3	142.5
R1	1.0	82.7	83.7	0.7	35.3	36.0	0.1	11.3	11.4
R3	0.2	82.7	82.9	0.2	35.3	35.5	<0.1	11.3	11.4
R6	0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R7	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R8	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R9	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R10	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R11	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R12	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R13	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R2	0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R4	0.2	82.7	82.9	0.2	35.3	35.5	<0.1	11.3	11.4
R5	0.3	82.7	83.0	0.2	35.3	35.5	<0.1	11.3	11.4
Mine Camp	0.4	82.7	83.1	0.2	35.3	35.5	<0.1	11.3	11.4

Note: Incr = Incremental impact, Bg = Background, Cumul = Cumulative Impact

6.1.2. Particulate Matter – Annual Average Dust Deposition Rates

Table 19 presents the annual average dust deposition predicted as a result of the operation of the Project under Scenario 1.

The results indicate minor incremental impacts at all surrounding receptor locations, and compliance with the relevant criterion.

Table 19 Predicted annual average dust deposition – Scenario 1

Receptor	Annual Average Dust Deposition ($g \cdot m^{-2} \cdot month^{-1}$)		
	Incr.	Bg.	Cumul.
Criterion	2	-	4
Max. % of criterion	<5.0	-	51.3
R1	<0.1	2.0	2.1
R3	<0.1	2.0	2.1
R6	<0.1	2.0	2.1
R7	<0.1	2.0	2.1
R8	<0.1	2.0	2.1
R9	<0.1	2.0	2.1
R10	<0.1	2.0	2.1
R11	<0.1	2.0	2.1
R12	<0.1	2.0	2.1
R13	<0.1	2.0	2.1
R2	<0.1	2.0	2.1
R4	<0.1	2.0	2.1
R5	<0.1	2.0	2.1
Mine Camp	<0.1	2.0	2.1

Note: Incr = Incremental impact, Bg = Background, Cumul = Cumulative Impact

6.1.3. Particulate Matter – Maximum 24-hour Average

Presented in Table 20 are the maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations predicted to occur at the nearest sensitive receptors as a result of the operation of the Project under Scenario 1. No background concentrations are included within this table. The highest incremental impacts are predicted at non-project related receptor R1 for PM_{10} and $PM_{2.5}$.

Table 20 Predicted maximum incremental 24-hour PM_{10} and $PM_{2.5}$ concentrations – Scenario 1

Receptor	Maximum 24-hour average concentration ($\mu g \cdot m^{-3}$)	
	PM_{10}	$PM_{2.5}$
Criterion	50	25
Max. % of criterion	16.0	4.8
R1	8.0	1.2
R3	1.5	0.2
R6	0.6	0.1
R7	0.2	<0.1
R8	0.2	<0.1
R9	0.4	<0.1
R10	0.2	<0.1
R11	0.1	<0.1
R12	0.2	<0.1
R13	0.2	<0.1
R2	1.5	0.2
R4	1.3	0.2
R5	1.8	0.3
Mine Camp	1.7	0.2

Table 21 and Table 22 present the predicted maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations resulting from the operation of the Project under Scenario 1, with background included.

Results are presented for the non-project related receptor at which the highest incremental PM_{10} and $PM_{2.5}$ impacts have been predicted, and also for the non-project related receptors at which the highest cumulative impacts (increment plus background) have been predicted. These may be different receptors than those at which the highest incremental impacts are predicted.

The left side of the tables show the predicted concentration on days with the highest cumulative impact (principally driven by the highest background concentrations), and the right side shows the total predicted concentration on days with the highest predicted incremental concentrations with the contemporaneous background values to derive the respective cumulative predictions.

It is noted that there is a high number of background concentrations already in exceedance of the relevant criteria. Correspondingly, Table 21 and Table 22 present the top ten highest ranking cumulative concentrations, followed by non-exceeding background concentrations to highlight any additional exceedances resulting from the Proposal. Their associated ranks are also shown in those tables. This approach has also been adopted for Scenario 2, Scenario 3, and Scenario 4.

Contour plots of the incremental contribution of the proposed operation of the Project under Scenario 1 to the 24-hour average PM_{10} concentrations are presented in Figure 13.

It is noted that an additional exceedance of the 24-hour criteria for PM_{10} was experienced at receptor R6 when applying the background concentration on 21 February 2019. However, it is also noted that the background concentration for that day represents 99.8 % of the criterion while the predicted incremental concentration only represents 0.4 % of the criterion. Wagga Wagga North AQMS experienced many days above the relevant criterion in 2019 due to prolonged drought conditions in addition to increased windblown dust and bushfire events (NSW DPE, 2021).

As shown in Table 22, 24-hour $PM_{2.5}$ concentrations with background included indicate that the cumulative impacts are also all driven by background conditions. The addition of the predicted increments does result in one minor additional exceedance of the criterion at receptor R1, although this represents 0.4 % of the criterion, with the increment already being less than 0.1 $\mu g \cdot m^{-3}$ (i.e. cannot realistically be controlled further).

Table 21 Summary of contemporaneous impact and background – PM_{10} – Scenario 1

Cumul. Impact Rank	Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$) Receptor R6			Inc. Impact Rank	Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$) Receptor R1		
		Incremental Impact	Background	Cumulative Impact			Incremental Impact	Background	Cumulative Impact
	Criterion	50				Criterion	50		
1	20/12/2019	<0.1	251.7	251.8	1	25/06/2019	8.0	21.1	29.1
2	12/02/2019	<0.1	221.9	222.0	2	22/05/2019	7.3	30.7	38.0
3	18/02/2019	<0.1	209.7	209.8	3	26/06/2019	7.1	19.4	26.5
4	22/12/2019	0.1	205.5	205.6	4	24/06/2019	7.0	23.3	30.3
5	21/09/2019	<0.1	196.8	196.9	5	18/05/2019	5.5	34.2	39.7
6	24/12/2019	0.4	148.3	148.7	6	7/06/2019	5.3	23.0	28.3
7	23/12/2019	0.4	145.8	146.2	7	26/02/2019	5.1	55.6	60.7
8	26/11/2019	<0.1	133.0	133.1	8	19/04/2019	4.9	61.0	65.9
9	17/12/2019	<0.1	131.5	131.6	9	17/05/2019	4.8	40.5	45.3
10	21/11/2019	<0.1	130.5	130.6	10	12/05/2019	4.7	12.3	17.0
71	21/02/2019	0.2	49.9	50.1	11	2/04/2019	4.3	52.3	56.6
72	17/02/2019	0.5	48.0	48.5	12	13/05/2019	4.3	23.0	27.3
These data represent the highest Cumulative Impact 24-hour PM_{10} predictions (outlined in red) as a result of the operation of the project.					These data represent the highest Incremental Impact 24-hour PM_{10} predictions (outlined in blue) as a result of the operation of the project.				

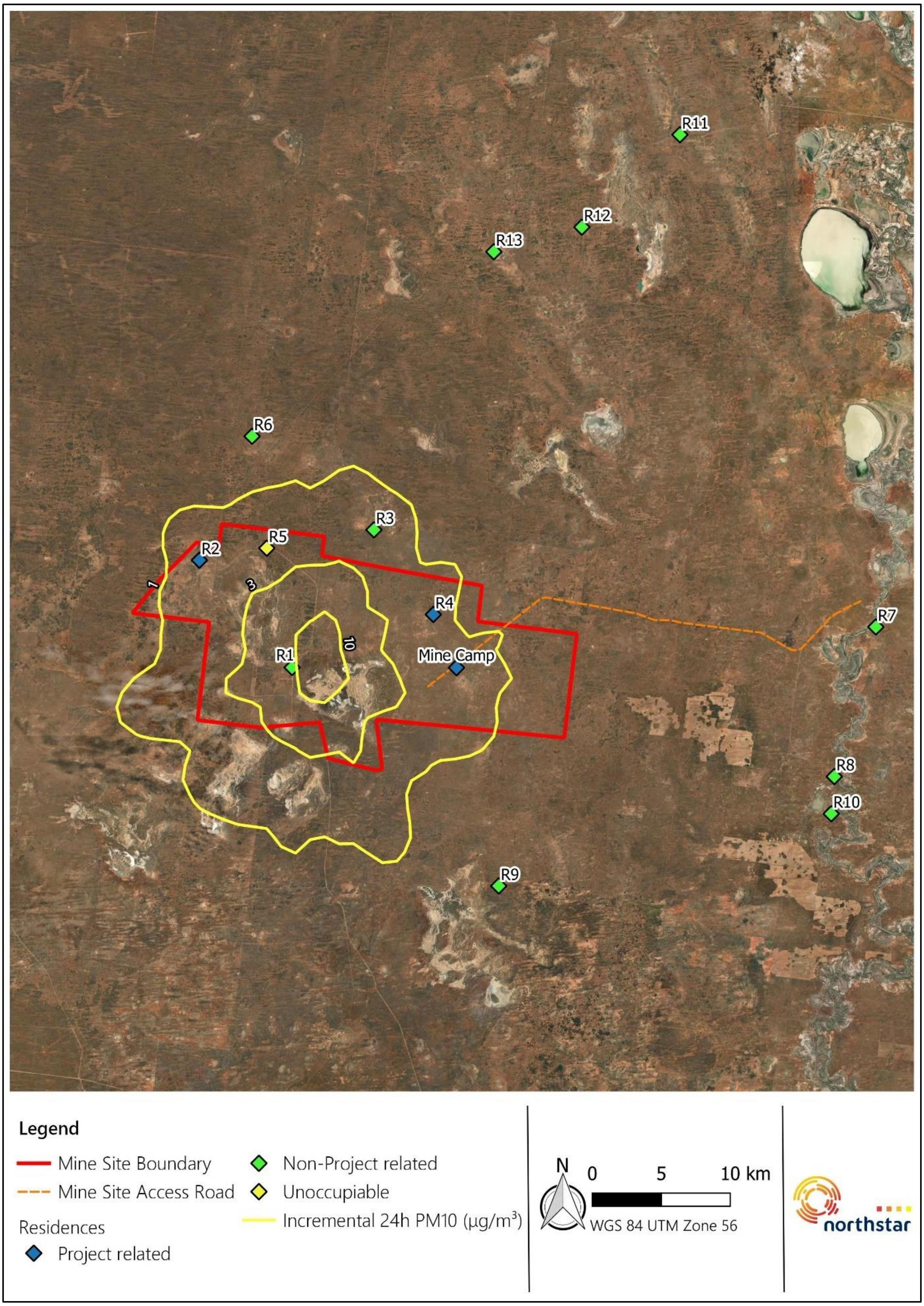
Note: Cumul. = Cumulative, Inc. = Incremental

Table 22 Summary of contemporaneous impact and background – $PM_{2.5}$ – Scenario 1

Cumul. Impact Rank	Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) Receptor R1			Inc. Impact Rank	Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) Receptor R1		
		Incremental Impact	Background	Cumulative Impact			Incremental Impact	Background	Cumulative Impact
	Criterion	25				Criterion	25		
1	20/12/2019	0.3	239.6	239.9	1	25/06/2019	1.2	15.0	16.2
2	22/12/2019	<0.1	129.4	129.5	2	22/05/2019	1.1	11.4	12.5
3	23/12/2019	<0.1	103.6	103.7	3	24/06/2019	1.0	16.3	17.3
4	24/12/2019	<0.1	87.5	87.6	4	26/06/2019	0.9	13.5	14.4
5	17/12/2019	0.5	83.2	83.7	5	7/06/2019	0.9	19.3	20.2
6	18/12/2019	0.5	71.6	72.1	6	18/05/2019	0.8	22.3	23.1
7	9/12/2019	<0.1	58.8	58.9	7	12/05/2019	0.7	7.4	8.1
8	28/12/2019	0.3	53.2	53.5	8	26/02/2019	0.7	11.5	12.2
9	21/12/2019	<0.1	50.5	50.6	9	2/04/2019	0.7	5.2	5.9
10	21/11/2019	<0.1	45.5	45.6	10	17/05/2019	0.7	26.6	27.3
18	10/12/2019	<0.1	25.0	25.1	11	16/05/2019	0.7	30.8	31.5
19	18/05/2019	0.8	22.3	23.1	12	19/04/2019	0.7	14.1	14.8
These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) as a result of the operation of the project.					These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) as a result of the operation of the project.				

Note: Cumul. = Cumulative, Inc. = Incremental

Figure 13 Incremental 24-hour PM_{10} concentrations – Scenario 1



Source: Northstar

6.2. Scenario 2

The following presents the results of the modelling assessment under the assumptions of Scenario 2 (refer Section 5.1.2).

6.2.1. Particulate Matter – Annual Average PM_{10} and $PM_{2.5}$

The predicted annual average particulate matter concentrations (as TSP, PM_{10} and $PM_{2.5}$) resulting from the Project under Scenario 2 operations are presented in Table 23. Table 23 shows that predicted incremental concentrations of TSP, PM_{10} and $PM_{2.5}$ at all receptor locations are significantly below the annual average TSP, PM_{10} and $PM_{2.5}$ criteria.

The annual average TSP criterion is predicted to be achieved, although the annual average PM_{10} and $PM_{2.5}$ criteria are shown to be exceeded, given the already exceeding background conditions. It is noted that the Project operation under Scenario 2 does not result in any significant increases in those concentrations.

Table 23 Predicted annual average TSP, PM_{10} and $PM_{2.5}$ concentrations – Scenario 2

Receptor	Annual Average Concentration ($\mu g \cdot m^{-3}$)								
	TSP			PM_{10}			$PM_{2.5}$		
	Incr.	Bg.	Cumul.	Incr.	Bg.	Cumul.	Incr.	Bg.	Cumul.
Criterion	90			25			8		
Max. % of criterion	0.9	91.9	92.8	2.0	141.2	143.2	<1.3	141.3	142.5
R1	0.8	82.7	83.5	0.5	35.3	35.8	<0.1	11.3	11.4
R3	0.2	82.7	82.9	0.1	35.3	35.4	<0.1	11.3	11.4
R6	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R7	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R8	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R9	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R10	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R11	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R12	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R13	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R2	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R4	0.1	82.7	82.8	0.1	35.3	35.4	<0.1	11.3	11.4
R5	0.2	82.7	82.9	0.2	35.3	35.5	<0.1	11.3	11.4
Mine Camp	0.4	82.7	83.1	0.2	35.3	35.5	<0.1	11.3	11.4

Note: Incr = Incremental impact, Bg = Background, Cumul = Cumulative Impact

6.2.2. Particulate Matter – Annual Average Dust Deposition Rates

Table 24 presents the annual average dust deposition predicted as a result of the assumptions under Scenario 2.

Annual average dust deposition is predicted to meet the criterion at all identified receptors where the predicted impacts are less than 5 % of the incremental criterion.

Table 24 Predicted annual average dust deposition – Scenario 2

Receptor	Annual Average Dust Deposition ($g \cdot m^{-2} \cdot month^{-1}$)		
	Incr.	Bg.	Cumul.
Criterion	2	-	4
Max. % of criterion	<5.0	-	51.3
R1	<0.1	2.0	2.1
R3	<0.1	2.0	2.1
R6	<0.1	2.0	2.1
R7	<0.1	2.0	2.1
R8	<0.1	2.0	2.1
R9	<0.1	2.0	2.1
R10	<0.1	2.0	2.1
R11	<0.1	2.0	2.1
R12	<0.1	2.0	2.1
R13	<0.1	2.0	2.1
R2	<0.1	2.0	2.1
R4	<0.1	2.0	2.1
R5	<0.1	2.0	2.1
Mine Camp	<0.1	2.0	2.1

Note: Incr = Incremental impact, Bg = Background, Cumul = Cumulative Impact

6.2.3. Particulate Matter – Maximum 24-hour Average

Table 25 presents the maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations predicted to occur at the nearest receptors, as a result of the Project operations under Scenario 2. No background concentrations are included within this table.

Table 25 Predicted maximum incremental 24-hour PM_{10} and $PM_{2.5}$ concentrations – Scenario 2

Receptor	Maximum 24-hour average concentration ($\mu g \cdot m^{-3}$)	
	PM_{10}	$PM_{2.5}$
Criterion	50	25
Max. % of criterion	16.6	5.6
R1	8.3	1.4
R3	1.3	0.2
R6	0.6	0.1
R7	0.1	<0.1
R8	0.1	<0.1
R9	0.2	<0.1
R10	0.1	<0.1
R11	<0.1	<0.1
R12	0.1	<0.1
R13	0.2	<0.1
R2	1.1	0.2
R4	0.9	0.2
R5	1.7	0.3
Mine Camp	1.2	0.2

The predicted incremental concentrations of PM_{10} and $PM_{2.5}$ are demonstrated to represent <17 % of the relevant criteria for PM_{10} and <6 % for $PM_{2.5}$ at all non-project related receptor locations.

As shown in Table 26 and Table 27, 24-hour PM_{10} and $PM_{2.5}$ concentrations with background included at indicate that the concentrations are all driven by background conditions. No additional exceedances of the PM_{10} criterion are predicted under Scenario 2 operations.

As shown in Table 27, 24-hour $PM_{2.5}$ concentrations with background included indicate that the cumulative impacts are also all driven by background conditions. The addition of the predicted increments does result in one minor additional exceedance of the criterion at receptor R1 although again, this represents 0.4 % of the criterion, with the increment already being less than 0.1 $\mu g \cdot m^{-3}$ (i.e. cannot realistically be controlled further).

Contour plots of the predicted incremental 24-hour PM_{10} concentrations associated with the Project under Scenario 2 are presented in Figure 14 to allow examination of the distribution of particulate matter in the area surrounding the Mine Site.

Table 26 Summary of contemporaneous impact and background – PM_{10} – Scenario 2

Cumul. Impact Rank	Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$) Receptor R1			Inc. Impact Rank	Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$) Receptor R3		
		Incremental Impact	Background	Cumulative Impact			Incremental Impact	Background	Cumulative Impact
	Criterion	50				Criterion	50		
1	20/12/2019	0.6	251.7	252.3	1	25/07/2019	3.5	14.3	17.8
2	12/02/2019	<0.1	221.9	222.0	2	16/06/2019	2.7	15.4	18.1
3	18/02/2019	0.7	209.7	210.4	3	1/07/2019	2.7	17.9	20.6
4	22/12/2019	<0.1	205.5	205.6	4	17/06/2019	2.7	12.3	15.0
5	21/09/2019	<0.1	196.8	196.9	5	5/08/2019	2.4	10.7	13.1
6	24/12/2019	<0.1	148.3	148.4	6	2/05/2019	2.2	25.6	27.8
7	23/12/2019	<0.1	145.8	145.9	7	8/06/2019	1.9	18.3	20.2
8	26/11/2019	<0.1	133.0	133.1	8	1/05/2019	1.9	29.3	31.2
9	17/12/2019	<0.1	131.5	131.6	9	28/03/2019	1.8	52.3	54.1
10	21/11/2019	<0.1	130.5	130.6	10	19/07/2019	1.7	17.3	19.0
67	9/04/2019	<0.1	50.2	50.3	11	9/05/2019	1.7	18.8	20.5
68	21/02/2019	<0.1	49.9	50.0	12	7/08/2019	1.7	18.8	20.5
These data represent the highest Cumulative Impact 24-hour PM_{10} predictions (outlined in red) as a result of the operation of the project.					These data represent the highest Incremental Impact 24-hour PM_{10} predictions (outlined in blue) as a result of the operation of the project.				

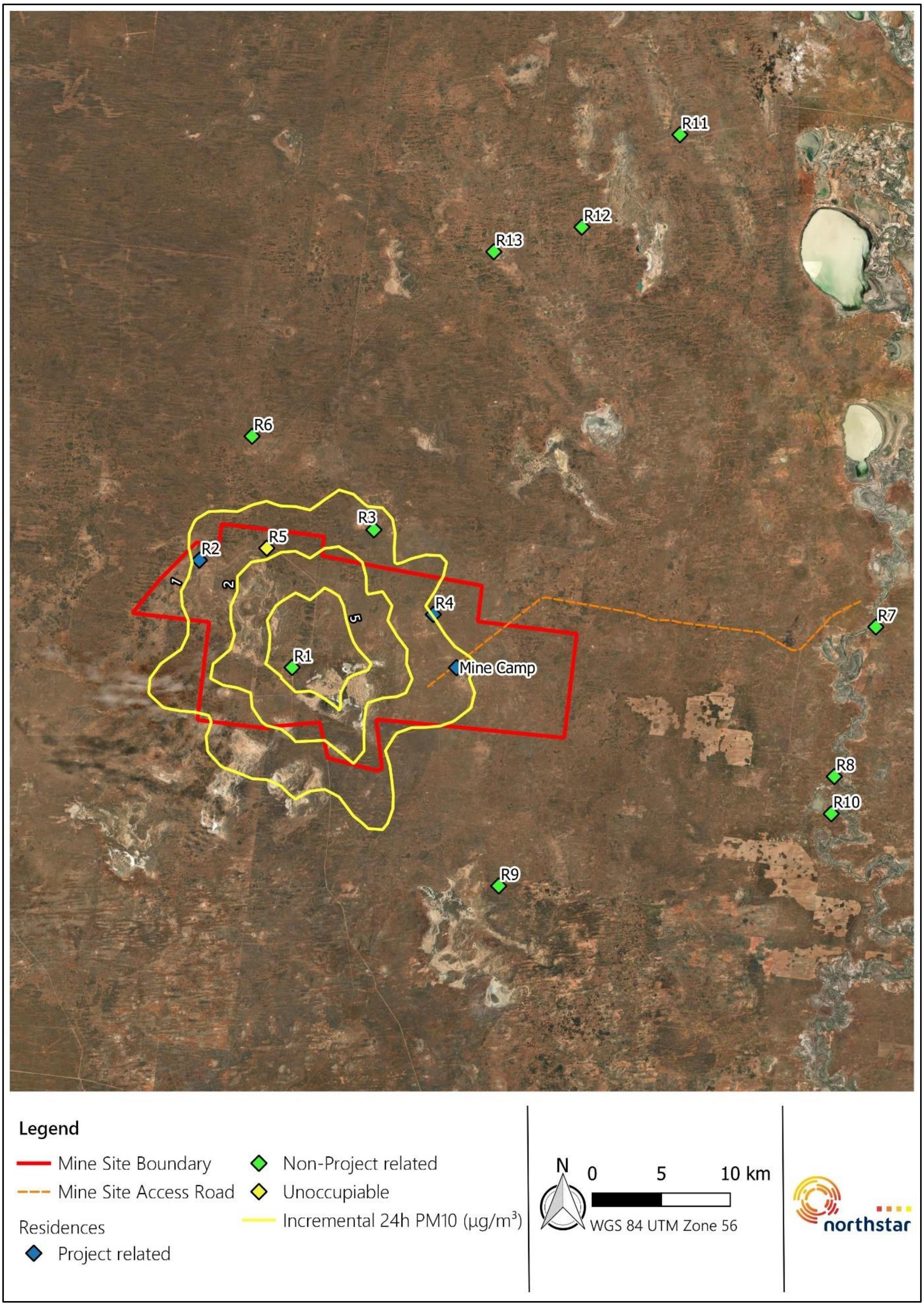
Note: Cumul. = Cumulative, Inc. = Incremental

Table 27 Summary of contemporaneous impact and background – $PM_{2.5}$ – Scenario 2

Cumul. Impact Rank	Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) Receptor R1			Inc. Impact Rank	Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) Receptor R1		
		Incremental Impact	Background	Cumulative Impact			Incremental Impact	Background	Cumulative Impact
	Criterion	25				Criterion	25		
1	20/12/2019	<0.1	239.6	239.7	1	16/06/2019	1.4	17.2	18.6
2	22/12/2019	<0.1	129.4	129.5	2	13/05/2019	0.9	14.9	15.8
3	23/12/2019	<0.1	103.6	103.7	3	8/06/2019	0.9	15.0	15.9
4	24/12/2019	<0.1	87.5	87.6	4	27/06/2019	0.6	10.8	11.4
5	17/12/2019	<0.1	83.2	83.3	5	11/06/2019	0.6	4.6	5.2
6	18/12/2019	0.5	71.6	72.1	6	2/03/2019	0.6	7.7	8.3
7	9/12/2019	0.2	58.8	59.0	7	28/07/2019	0.6	13.1	13.7
8	28/12/2019	<0.1	53.2	53.3	8	26/06/2019	0.6	13.5	14.1
9	21/12/2019	<0.1	50.5	50.6	9	24/06/2019	0.5	16.3	16.8
10	21/11/2019	<0.1	45.5	45.6	10	15/06/2019	0.5	17.0	17.5
18	10/12/2019	<0.1	25.0	25.1	11	7/03/2019	0.5	13.4	13.9
19	19/05/2019	0.3	22.6	22.9	12	15/04/2019	0.5	9.9	10.4
These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) as a result of the operation of the project.					These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) as a result of the operation of the project.				

Note: Cumul. = Cumulative, Inc. = Incremental

Figure 14 Incremental 24-hour PM_{10} concentrations – Scenario 2



Source: Northstar

6.3. Scenario 3

The following presents the results of the modelling assessment under the assumptions of Scenario 3 (refer Section 5.1.2).

6.3.1. Particulate Matter – Annual Average PM_{10} and $PM_{2.5}$

The predicted annual average particulate matter concentrations (as TSP, PM_{10} and $PM_{2.5}$) resulting from Scenario 3 operations are presented in Table 28. Table 28 shows that predicted incremental concentrations of TSP, PM_{10} and $PM_{2.5}$ at all receptor locations are minor.

The annual average TSP criterion is predicted to be achieved, although the annual average PM_{10} and $PM_{2.5}$ criteria are shown to be exceeded, given the already exceeding background conditions.

Table 28 Predicted annual average TSP, PM_{10} and $PM_{2.5}$ concentrations – Scenario 3

Receptor	Annual Average Concentration ($\mu g \cdot m^{-3}$)								
	TSP			PM_{10}			$PM_{2.5}$		
	Incr.	Bg.	Cumul.	Incr.	Bg.	Cumul.	Incr.	Bg.	Cumul.
Criterion	90			25			8		
Max. % of criterion	0.2	91.9	92.1	0.9	141.2	142.1	<1.3	141.3	142.5
R1	0.1	82.7	82.8	0.1	35.3	35.4	<0.1	11.3	11.4
R3	0.1	82.7	82.8	0.1	35.3	35.4	<0.1	11.3	11.4
R6	0.2	82.7	82.9	0.2	35.3	35.5	<0.1	11.3	11.4
R7	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R8	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R9	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R10	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R11	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R12	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R13	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R2	1.1	82.7	83.8	0.9	35.3	36.2	0.1	11.3	11.4
R4	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R5	0.5	82.7	83.2	0.5	35.3	35.8	<0.1	11.3	11.4
Mine Camp	0.4	82.7	83.1	0.1	35.3	35.4	<0.1	11.3	11.4

Note: Incr = Incremental impact, Bg = Background, Cumul = Cumulative Impact

6.3.2. Particulate Matter – Annual Average Dust Deposition Rates

Table 29 presents the annual average dust deposition predicted as a result of the assumptions under Scenario 3.

Annual average dust deposition is predicted to meet the criterion at all identified receptors where the predicted impacts are less than <5 % of the incremental criterion.

Table 29 Predicted annual average dust deposition – Scenario 3

Receptor	Annual Average Dust Deposition ($g \cdot m^{-2} \cdot month^{-1}$)		
	Incr.	Bg.	Cumul.
Criterion	2	-	4
Max. % of criterion	<5.0	-	51.3
R1	<0.1	2.0	2.1
R3	<0.1	2.0	2.1
R6	<0.1	2.0	2.1
R7	<0.1	2.0	2.1
R8	<0.1	2.0	2.1
R9	<0.1	2.0	2.1
R10	<0.1	2.0	2.1
R11	<0.1	2.0	2.1
R12	<0.1	2.0	2.1
R13	<0.1	2.0	2.1
R2	<0.1	2.0	2.1
R4	<0.1	2.0	2.1
R5	<0.1	2.0	2.1
Mine Camp	<0.1	2.0	2.1

Note: Incr = Incremental impact, Bg = Background, Cumul = Cumulative Impact

6.3.3. Particulate Matter – Maximum 24-hour Average

Table 30 presents the maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations predicted to occur at the nearest receptors, as a result of the Project operations under Scenario 3. No background concentrations are included within this table.

Table 30 Predicted maximum incremental 24-hour PM_{10} and $PM_{2.5}$ concentrations – Scenario 3

Receptor	Maximum 24-hour average concentration (µg·m^{-3})	
	PM_{10}	$PM_{2.5}$
Criterion	50	25
Max. % of criterion	4.0	1.6
R1	2.0	0.4
R3	1.0	0.2
R6	1.8	0.3
R7	0.2	<0.1
R8	0.2	<0.1
R9	0.3	<0.1
R10	0.2	<0.1
R11	0.1	<0.1
R12	0.2	<0.1
R13	0.2	<0.1
R2	12.6	2.1
R4	1.0	0.2
R5	3.9	0.7
Mine Camp	1.0	0.2

The predicted incremental concentrations of PM_{10} and $PM_{2.5}$ under Scenario 3 are shown to represent ≤4 % of the criteria for PM_{10} and <1.6 % for $PM_{2.5}$ at all non-project related receptor locations.

As shown in Table 31, 24-hour PM_{10} concentrations with background included indicate that the cumulative impacts are all driven by background conditions. The addition of the predicted increments does not result in any additional exceedances of the criterion.

As shown in Table 32, 24-hour $PM_{2.5}$ concentrations with background included indicate that the cumulative impacts are also all driven by background conditions. The addition of the predicted increments does result in one minor additional exceedance of the criterion at receptor R1, although this represents 0.4 % of the criterion, with the increment already being less than 0.1 µg·m^{-3} (i.e. cannot realistically be controlled further).

Contour plots of the predicted incremental 24-hour PM_{10} concentrations associated with the Project under Scenario 3 are presented in Figure 15 to allow examination of the distribution of particulate matter in the area surrounding the Mine Site.

Table 31 Summary of contemporaneous impact and background – PM_{10} – Scenario 3

Cumul. Impact Rank	Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$) Receptor R1			Inc. Impact Rank	Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$) Receptor R1		
		Incremental Impact	Background	Cumulative Impact			Incremental Impact	Background	Cumulative Impact
	Criterion	50				Criterion	50		
1	20/12/2019	<0.1	251.7	251.8	1	19/07/2019	2.0	17.3	19.3
2	12/02/2019	0.4	221.9	222.3	2	23/07/2019	1.8	16.8	18.6
3	18/02/2019	<0.1	209.7	209.8	3	26/07/2019	1.3	17.0	18.3
4	22/12/2019	<0.1	205.5	205.6	4	30/06/2019	1.1	13.4	14.5
5	21/09/2019	<0.1	196.8	196.9	5	2/07/2019	1.1	18.0	19.1
6	24/12/2019	<0.1	148.3	148.4	6	14/06/2019	1.0	18.5	19.5
7	23/12/2019	<0.1	145.8	145.9	7	12/06/2019	0.9	12.3	13.2
8	26/11/2019	<0.1	133.0	133.1	8	18/07/2019	0.8	10.0	10.8
9	17/12/2019	<0.1	131.5	131.6	9	17/06/2019	0.8	12.3	13.1
10	21/11/2019	<0.1	130.5	130.6	10	6/11/2019	0.8	40.6	41.4
69	9/04/2019	<0.1	50.2	50.3	11	13/06/2019	0.8	10.6	11.4
70	21/02/2019	<0.1	49.9	50.0	12	8/04/2019	0.7	19.9	20.6
These data represent the highest Cumulative Impact 24-hour PM_{10} predictions (outlined in red) as a result of the operation of the project.					These data represent the highest Incremental Impact 24-hour PM_{10} predictions (outlined in blue) as a result of the operation of the project.				

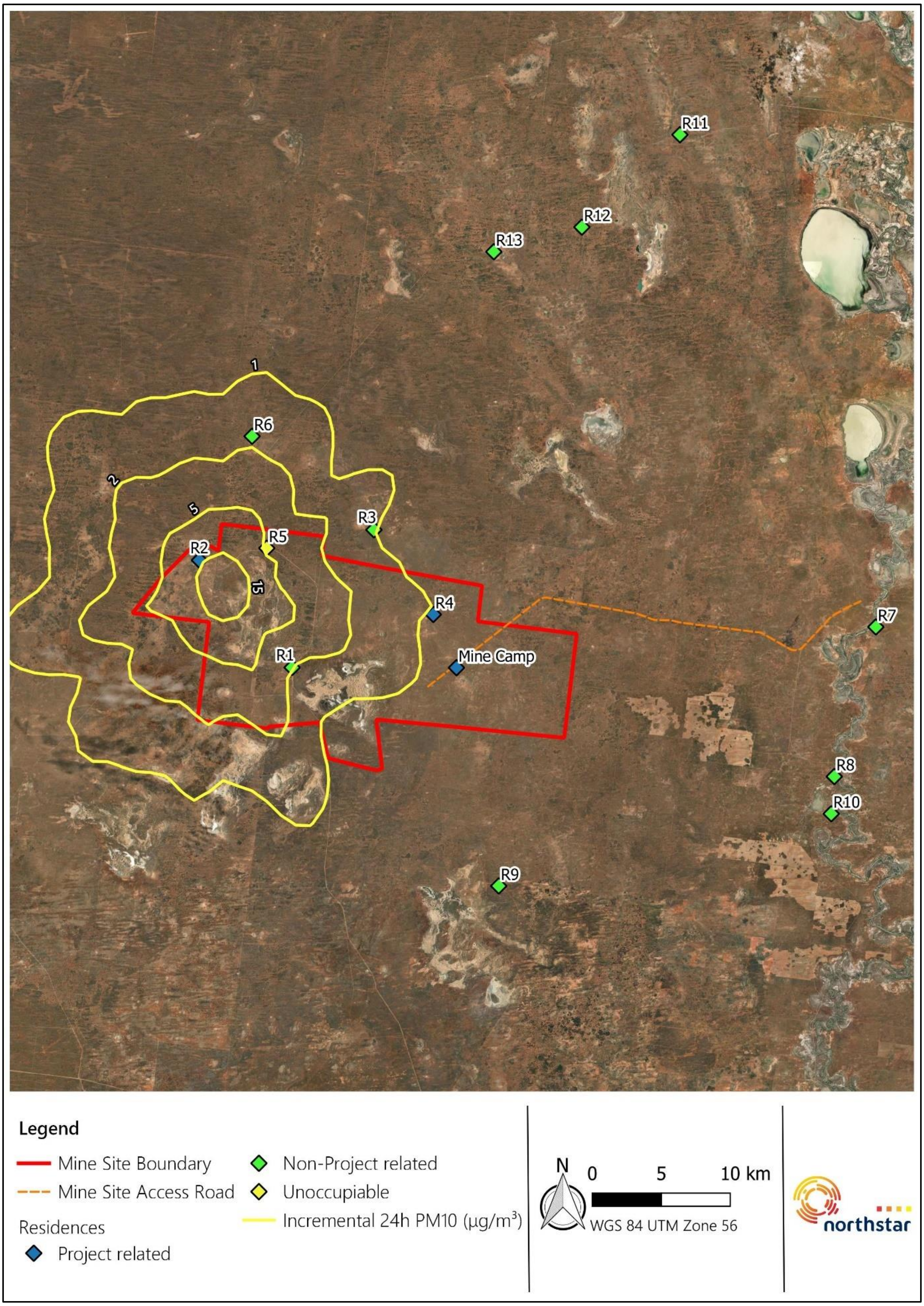
Note: Cumul. = Cumulative, Inc. = Incremental

Table 32 Summary of contemporaneous impact and background – $PM_{2.5}$ – Scenario 3

Cumul. Impact Rank	Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) Receptor R1			Inc. Impact Rank	Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) Receptor R1		
		Incremental Impact	Background	Cumulative Impact			Incremental Impact	Background	Cumulative Impact
	Criterion	25				Criterion	25		
1	20/12/2019	<0.1	239.6	239.7	1	19/07/2019	0.4	9.4	9.8
2	22/12/2019	<0.1	129.4	129.5	2	23/07/2019	0.3	9.8	10.1
3	23/12/2019	<0.1	103.6	103.7	3	26/07/2019	0.2	9.0	9.2
4	24/12/2019	<0.1	87.5	87.6	4	30/06/2019	0.2	9.5	9.7
5	17/12/2019	<0.1	83.2	83.3	5	2/07/2019	0.2	12.7	12.9
6	18/12/2019	<0.1	71.6	71.7	6	14/06/2019	0.2	12.0	12.2
7	9/12/2019	<0.1	58.8	58.9	7	18/07/2019	0.2	4.1	4.3
8	28/12/2019	<0.1	53.2	53.3	8	20/06/2019	0.1	8.6	8.7
9	21/12/2019	<0.1	50.5	50.6	9	12/06/2019	0.1	6.6	6.7
10	21/11/2019	<0.1	45.5	45.6	10	13/06/2019	0.1	5.3	5.4
18	10/12/2019	<0.1	25.0	25.1	11	17/06/2019	0.1	11.1	11.2
19	18/02/2019	<0.1	22.8	22.9	12	6/11/2019	0.1	5.4	5.5
These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) as a result of the operation of the project.					These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) as a result of the operation of the project.				

Note: Cumul. = Cumulative, Inc. = Incremental

Figure 15 Incremental 24-hour PM_{10} concentrations – Scenario 3



Source: Northstar

6.4. Scenario 4

The following presents the results of the modelling assessment under the assumptions of Scenario 4 (refer Section 5.1.2).

6.4.1. Particulate Matter – Annual Average PM_{10} and $PM_{2.5}$

The predicted annual average particulate matter concentrations (as TSP, PM_{10} and $PM_{2.5}$) resulting from Scenario 3 operations are presented in Table 33 which shows that predicted incremental concentrations of TSP, PM_{10} and $PM_{2.5}$ at all receptor locations are minor.

The annual average TSP criterion is predicted to be achieved, although the annual average PM_{10} and $PM_{2.5}$ criteria are shown to be exceeded, given the already exceeding background conditions.

Table 33 Predicted annual average TSP, PM_{10} and $PM_{2.5}$ concentrations – Scenario 4

Receptor	Annual Average Concentration (µg·m^{-3})								
	TSP			PM_{10}			$PM_{2.5}$		
	Incr.	Bg.	Cumul.	Incr.	Bg.	Cumul.	Incr.	Bg.	Cumul.
Criterion	90			25			8		
Max. % of criterion	0.4	91.9	93.1	1.2	141.2	142.4	<1.3	141.3	142.5
R1	0.4	82.7	83.1	0.3	35.3	35.6	<0.1	11.3	11.4
R3	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R6	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R7	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R8	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R9	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R10	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R11	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R12	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R13	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R2	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R4	<0.1	82.7	82.8	<0.1	35.3	35.4	<0.1	11.3	11.4
R5	0.2	82.7	82.9	0.2	35.3	35.5	<0.1	11.3	11.4
Mine Camp	0.3	82.7	83.0	0.1	35.3	35.4	<0.1	11.3	11.4

Note: Incr = Incremental impact, Bg = Background, Cumul = Cumulative Impact

6.4.2. Particulate Matter – Annual Average Dust Deposition Rates

Table 34 presents the annual average dust deposition predicted as a result of the assumptions under Scenario 4.

Annual average dust deposition is predicted to meet the criterion at all identified receptors where the predicted impacts are less than 5 % of the incremental criterion.

Table 34 Predicted annual average dust deposition – Scenario 4

Receptor	Annual Average Dust Deposition (g·m^{-2}·month^{-1})		
	Incr.	Bg.	Cumul.
Criterion	2	-	4
Max. % of criterion	<5.0	-	51.3
R1	<0.1	2.0	2.1
R3	<0.1	2.0	2.1
R6	<0.1	2.0	2.1
R7	<0.1	2.0	2.1
R8	<0.1	2.0	2.1
R9	<0.1	2.0	2.1
R10	<0.1	2.0	2.1
R11	<0.1	2.0	2.1
R12	<0.1	2.0	2.1
R13	<0.1	2.0	2.1
R2	<0.1	2.0	2.1
R4	<0.1	2.0	2.1
R5	<0.1	2.0	2.1
Mine Camp	<0.1	2.0	2.1

Note: Incr = Incremental impact, Bg = Background, Cumul = Cumulative Impact

6.4.3. Particulate Matter – Maximum 24-hour Average

Table 35 presents the maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations predicted to occur at the nearest receptors, as a result of the Project operations under Scenario 4. No background concentrations are included within this table.

Table 35 Predicted maximum incremental 24-hour PM_{10} and $PM_{2.5}$ concentrations – Scenario 4

Receptor	Maximum 24-hour average concentration ($\mu g \cdot m^{-3}$)	
	PM_{10}	$PM_{2.5}$
Criterion	50	25
Max. % of criterion	7.0	2.4
R1	3.5	0.6
R3	0.6	0.1
R6	0.4	<0.1
R7	<0.1	<0.1
R8	<0.1	<0.1
R9	0.2	<0.1
R10	<0.1	<0.1
R11	<0.1	<0.1
R12	<0.1	<0.1
R13	0.1	<0.1
R2	1.0	0.2
R4	0.6	<0.1
R5	1.5	0.2
Mine Camp	0.8	0.1

The predicted incremental concentrations of PM_{10} and $PM_{2.5}$ under Scenario 4 are shown to represent ≤7 % of the criteria for PM_{10} and <2.5 % for $PM_{2.5}$ at all non-project related receptor locations.

It is noted that an additional marginal exceedance of the 24-hour criteria for PM_{10} was experienced at receptor R6 when applying the background concentration on 21 February 2019 (refer Table 36). However, it is also noted that the background concentration for that day represents 99.8 % of the criterion while the predicted incremental concentration only represents 0.4 % of the criterion. Wagga Wagga North AQMS experienced many days above the relevant criterion in 2019 due to prolonged drought conditions in addition to increased windblown dust and bushfire events (NSW DPE, 2021).

As shown in Table 37, 24-hour $PM_{2.5}$ concentrations with background included indicate that the cumulative impacts are also all driven by background conditions. The addition of the predicted increments does result in one minor additional exceedance of the criterion at receptor R1, although this represents 0.4 % of the criterion, with the increment already being less than 0.1 $\mu g \cdot m^{-3}$ (i.e. cannot be controlled further).

Contour plots of the predicted incremental 24-hour PM_{10} concentrations associated with the Project under Scenario 4 are presented in Figure 16 to allow examination of the distribution of particulate matter in the area surrounding the Mine Site.

Table 36 Summary of contemporaneous impact and background – PM_{10} – Scenario 4

Cumul. Impact Rank	Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$) Receptor R6			Inc. Impact Rank	Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$) Receptor R3		
		Incremental Impact	Background	Cumulative Impact			Incremental Impact	Background	Cumulative Impact
	Criterion	50				Criterion	50		
1	20/12/2019	<0.1	251.7	251.8	1	25/07/2019	3.5	14.3	17.8
2	12/02/2019	<0.1	221.9	222.0	2	16/06/2019	2.7	15.4	18.1
3	18/02/2019	<0.1	209.7	209.8	3	1/07/2019	2.7	17.9	20.6
4	22/12/2019	<0.1	205.5	205.6	4	17/06/2019	2.7	12.3	15.0
5	21/09/2019	<0.1	196.8	196.9	5	5/08/2019	2.4	10.7	13.1
6	24/12/2019	0.2	148.3	148.5	6	2/05/2019	2.2	25.6	27.8
7	23/12/2019	0.2	145.8	146.0	7	8/06/2019	1.9	18.3	20.2
8	26/11/2019	<0.1	133.0	133.1	8	1/05/2019	1.9	29.3	31.2
9	17/12/2019	<0.1	131.5	131.6	9	28/03/2019	1.8	52.3	54.1
10	21/11/2019	<0.1	130.5	130.6	10	19/07/2019	1.7	17.3	19.0
70	9/04/2019	<0.1	50.2	50.3	11	9/05/2019	1.7	18.8	20.5
71	21/02/2019	0.2	49.9	50.1	12	7/08/2019	1.7	18.8	20.5
These data represent the highest Cumulative Impact 24-hour PM_{10} predictions (outlined in red) as a result of the operation of the project.					These data represent the highest Incremental Impact 24-hour PM_{10} predictions (outlined in blue) as a result of the operation of the project.				

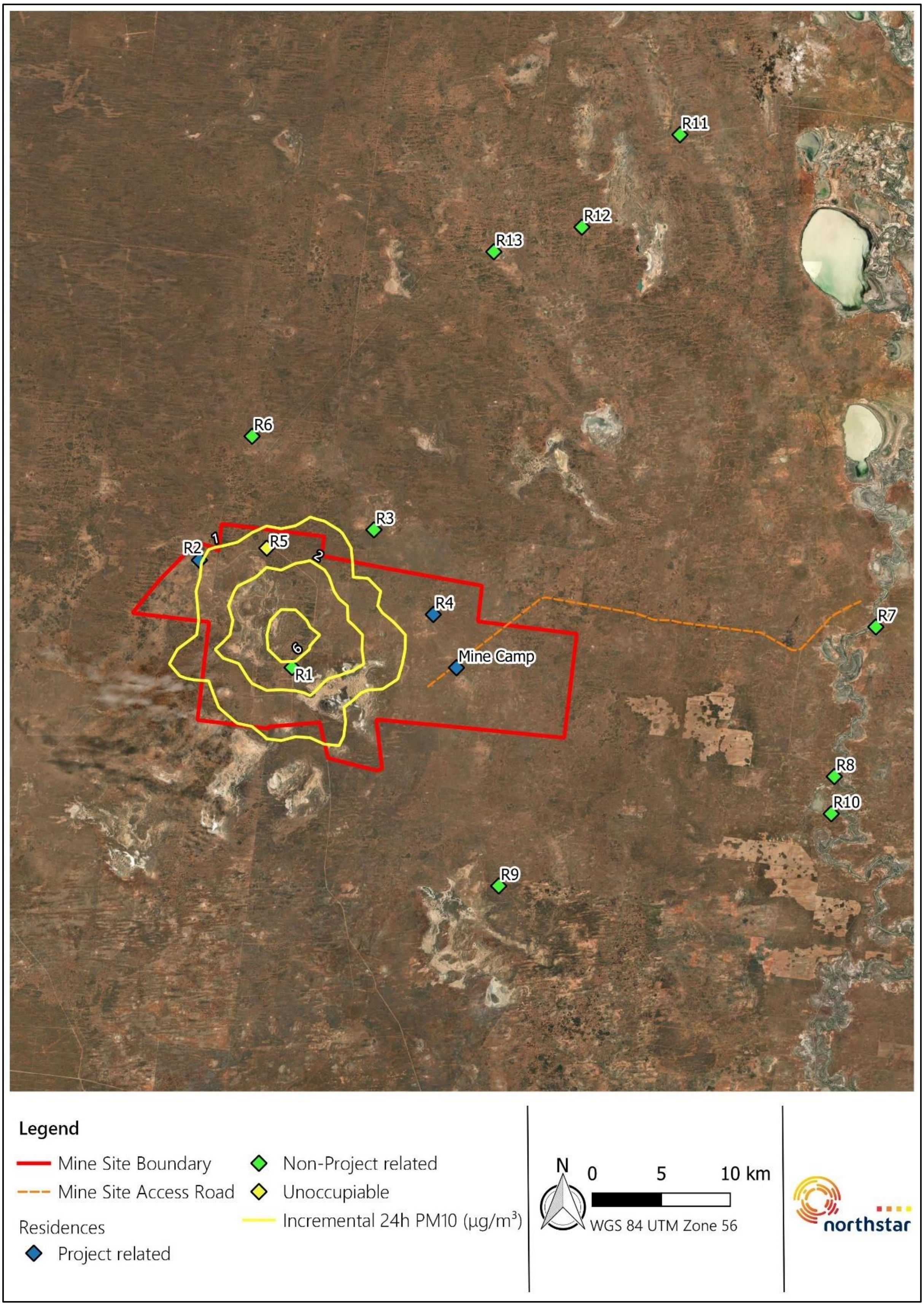
Note: Cumul. = Cumulative, Inc. = Incremental

Table 37 Summary of contemporaneous impact and background – $PM_{2.5}$ – Scenario 4

Cumul. Impact Rank	Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) Receptor R3			Inc. Impact Rank	Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) Receptor R3		
		Incremental Impact	Background	Cumulative Impact			Incremental Impact	Background	Cumulative Impact
	Criterion	25				Criterion	25		
1	20/12/2019	0.1	239.6	239.7	1	25/07/2019	0.6	8.2	8.8
2	22/12/2019	<0.1	129.4	129.5	2	1/07/2019	0.5	12.6	13.1
3	23/12/2019	<0.1	103.6	103.7	3	17/06/2019	0.5	11.1	11.6
4	24/12/2019	<0.1	87.5	87.6	4	16/06/2019	0.5	17.2	17.7
5	17/12/2019	<0.1	83.2	83.3	5	2/05/2019	0.4	8.2	8.6
6	18/12/2019	<0.1	71.6	71.7	6	5/08/2019	0.3	8.4	8.7
7	9/12/2019	<0.1	58.8	58.9	7	1/05/2019	0.3	7.9	8.2
8	28/12/2019	0.2	53.2	53.4	8	7/08/2019	0.3	9.8	10.1
9	21/12/2019	<0.1	50.5	50.6	9	9/05/2019	0.3	5.9	6.2
10	21/11/2019	<0.1	45.5	45.6	10	26/07/2019	0.3	9.0	9.3
18	10/12/2019	25.1	<0.1	25.0	11	8/06/2019	0.3	15.0	15.3
19	18/02/2019	22.9	<0.1	22.8	12	22/07/2019	0.3	10.9	11.2
These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) as a result of the operation of the project.					These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) as a result of the operation of the project.				

Note: Cumul. = Cumulative, Inc. = Incremental

Figure 16 Incremental 24-hour PM_{10} concentrations – Scenario 4



Source: Northstar

6.5. Silica

Annual average $PM_{2.5}$ concentrations at all non-Project related receptors are predicted to be ≤ 0.1 µg·m^{-3} during all scenarios assessed. In relation to silica, even assuming that 100 % of annual average $PM_{2.5}$ incremental impacts are RCS, impacts at non-Project related receptors during all Scenarios assessed are predicted to be significantly below the relevant annual average criterion of 3 µg·m^{-3}, which has been adopted from the California EPA Office for Environmental Health Hazard Assessment Reference Exposure Levels (refer Section 3).

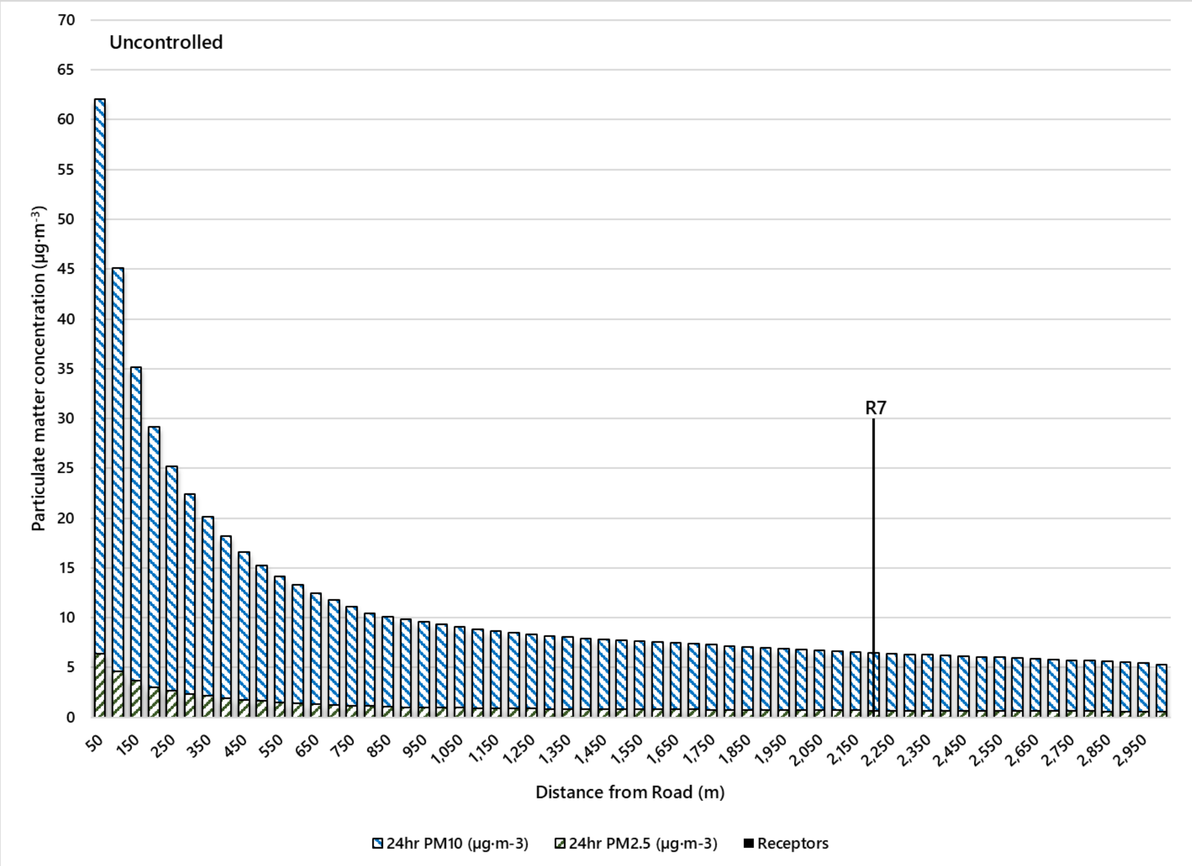
6.6. Off-site Transportation

The assessment of off-site transportation along Anabranch Mail Road during operation of the Project has been performed as described in Section 5.1.3.

Results are presented in Figure 17 for predicted maximum uncontrolled 24-hour PM_{10} and $PM_{2.5}$ impacts at distance from the centre of Anabranch Mail Road, under the worst-case conditions associated with the operational phase of the Project.

The results indicate that particulate matter concentrations reduce rapidly away from the road as would be expected, and without any emissions control, maximum 24-hour PM_{10} and $PM_{2.5}$ concentrations are predicted to be up to 6.5 µg·m^{-3} and 0.7 µg·m^{-3} respectively, at receptor R7 located approximately 2.2 km from Anabranch Road. It is noted that this is the closest receptor to the proposed transport route along Anabranch Road.

Figure 17 Uncontrolled maximum 24-hour particulate matter impacts at distance from road

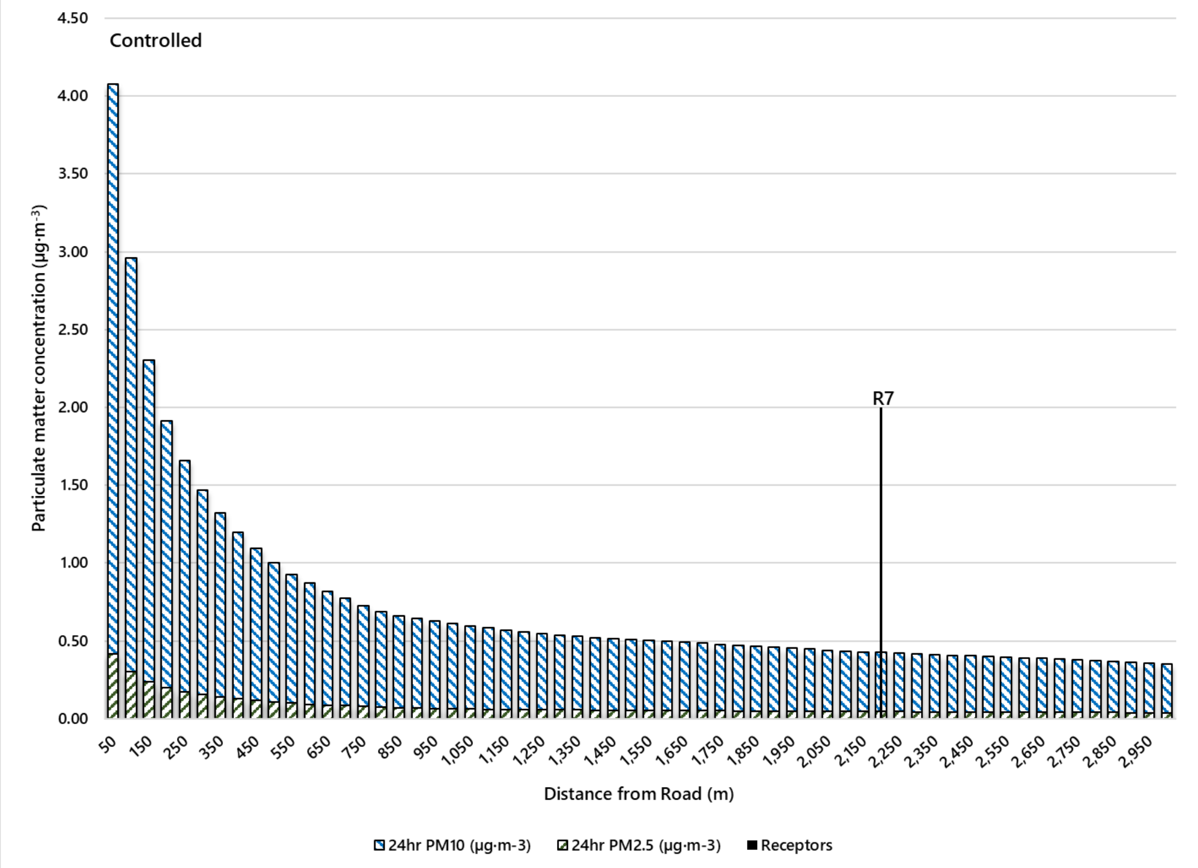


Further assessment has been performed to determine the potential particulate matter impacts at distance from Anabranch Mail Road, should emissions controls be applied. For the purposes of this assessment, those controls included the application of water and/or equivalent chemical dust suppressants to achieve a 75 % control efficiency. A 75 % control efficiency is associated with the use of water application at a rate of 2 $L \cdot m^{-2} \cdot hr^{-1}$, although as previously discussed, the use of chemical suppressants is likely to result in 90 % control. The results presented below therefore assume the lower of those control efficiencies and can be viewed as conservative.

Figure 18 presents the results of that assessment, which indicates that impacts can be significantly reduced through the adoption of those control measures, which are likely to result in predicted 24-hour PM_{10} and $PM_{2.5}$ impacts at receptor R7 of 0.4 $\mu g \cdot m^{-3}$ and <0.1 $\mu g \cdot m^{-3}$, when controlled.

Should emission controls be employed along Anabranch Mail Road during construction and operational phase activities, cumulative impacts at all receptor locations should be minor.

Figure 18 Controlled maximum 24-hour particulate matter impacts at distance from road



Further discussion regarding emission control measures along Anabranch Mail Road is provided in Section 8.1.

6.7. Voluntary Land Acquisition and Mitigation Policy

The previous sections confirm that the relevant criteria associated with the NSW Voluntary Land Acquisition and Mitigation Policy are generally not exceeded at any surrounding privately-owned residence, under any of the scenarios assessed.

Background annual average PM_{10} and $PM_{2.5}$ concentrations adopted in modelling are already in exceedance of the relevant criteria, and the incremental impacts associated with the construction and operation of the Project are demonstrated to be low. In years with a lower number of exceptional events (i.e. dust storms and bushfires), it is anticipated that these low incremental impacts would not result in exceedance of the annual average PM_{10} and $PM_{2.5}$ criteria.

One minor exceedance of the 24-hour PM_{10} criterion is predicted under Scenario 1 and Scenario 4, although the background PM_{10} concentration driving that exceedance is 49.9 µg·m^{-3} (99.8 % of the criterion). The mitigation measures adopted as part of the Project will act to minimise particulate emissions.

Similarly, voluntary acquisition criteria are all achieved, with the exception of cumulative annual average PM_{10} and $PM_{2.5}$ concentrations, which are due to the already exceeding background conditions.

Voluntary acquisition criteria are also to be applied across privately owned land (rather than just residences). Specifically, voluntary acquisition rights may be applied by the consent authority "where the development is predicted to result in exceedances of the relevant criteria 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."

The relevant air quality criteria related to voluntary acquisition or mitigation are not predicted to be exceeded on private landholdings under any of the scenarios assessed.

7. GREENHOUSE GAS ASSESSMENT

7.1. Calculations of Emissions

Based on the activity data and emission factors outlined in Section 5.2, Table 38 presents the calculated annual Scope 1 and 3 GHG emissions associated with construction of the Project and Table 39 presents the calculated annual GHG emissions associated with Project operations.

Table 38 Greenhouse gas emissions – construction

Emission Scope	Emission Source	Emission Factor	Energy Content Factor	Activity Rate	Emissions ($t\ CO_2$-e.yr^{-1}) Construction
Scope 1	Consumption of diesel fuel in fixed plant and mobile equipment	70.2 kg CO_2-e GJ^{-1}	38.6 GJ·kL^{-1}	12 700 kL·yr^{-1}	34 413.4
	Consumption of diesel fuel for power generation	70.2 kg CO_2-e GJ^{-1}	38.6 GJ·kL^{-1}	68.92 kL·yr^{-1}	186.8
				Total Scope 1	**34 600.2**
Scope 2	Consumption of purchased electricity	0.68 kg CO_2-e kWh^{-1}	-	172 296 kWh^{-1}	117.2
				Total Scope 2	**117.2**
Scope 3	Consumption of diesel fuel in fixed plant and mobile equipment	17.3 kg CO_2-e GJ^{-1}	38.6 GJ·kL^{-1}	12 700 kL·yr^{-1}	8 480.8
	Consumption of diesel fuel for power generation	17.3 kg CO_2-e GJ^{-1}	38.6 GJ·kL^{-1}	68.92 kL·yr^{-1}	46.0
	Consumption of purchased electricity	0.05 kg CO_2-e kWh^{-1}	-	172 296 kWh^{-1}	8.6
				Total Scope 3	**8 535.4**

It is noted electricity requirements for the Project site during construction will be provided through the use of diesel power until the mains electricity is connected. It is anticipated this would be available from month 24 of construction works. The greenhouse gas calculations for construction works have included emissions from both sources of mains electricity, and diesel powered generation and is therefore considered to represent a conservative scenario during construction works.

Table 39 Greenhouse gas emissions- operations

Emission Scope	Emission Source	Emission Factor	Energy Content Factor	Activity Rate	Emissions (t CO_2-e.yr^{-1}) Operations
Scope 1	Consumption of diesel fuel in fixed plant and equipment	70.2 kg CO_2-e GJ^{-1}	38.6 GJ·kL^{-1}	10 500 kL·yr^{-1}	28 452.1
	Consumption of diesel fuel in transport vehicles	70.4 kg CO_2-e GJ^{-1}	38.6 GJ·kL^{-1}	2 481 kL·yr^{-1}	6 740.9
	LPG consumption for operation of dryers	60.6 kg CO_2-e GJ^{-1}	25.7 GJ·kL^{-1}	200 000 GJ·yr^{-1}	12 120.0
				Total Scope 1	**47 313.0**
Scope 2	Consumption of purchased electricity	0.68 kg CO_2-e kWh^{-1}	-	120 607 kWh^{-1}	82.0
				Total Scope 2	**82.0**
Scope 3	Consumption of diesel fuel in fixed plant and equipment	17.3 kg CO_2-e GJ^{-1}	38.6 GJ·kL^{-1}	10 500 kL·yr^{-1}	7 011.7
	Consumption of diesel fuel in transport vehicles	17.3 kg CO_2-e GJ^{-1}	38.6 GJ·kL^{-1}	2 481 kL·yr^{-1}	1 656.5
	Consumption of purchased electricity	0.05 kg CO_2-e kWh^{-1}	-	120 607 kWh^{-1}	6.0
	LPG consumption for operation of dryers	20.2 kg CO_2-e GJ^{-1}	25.7 GJ·kL^{-1} (A)	200 000 GJ·yr^{-1}	4 040.0
				Total Scope 3	**12 714.2**

Note: (A) Energy content factor not used as activity data provided in GJ not kL. Provided for information only

It is understood the Proponent has committed to sourcing a minimum of 30% of electricity needs for the Project from a combination of renewable sources. The proposed on-site solar farm will provide electricity needs up to 35 MW, with any remaining electricity requirements sourced from externally contracted and certified renewable sources.

While vegetation removal has not been included in the Scope 1 emissions due to progressive rehabilitation and revegetation of the Mine Site, the removal of approximately 88 hectares of vegetation during construction has the potential to generate 24 449 t CO_2-e·yr^{-1}, while clearing of an annual average of approximately 123 hectares of vegetation during operations has the potential to result in emissions of 34 068 t·CO_2-e·yr^{-1}. However, through revegetation with similar or natural species, there is opportunity to enhance biodiversity and potentially sequester any greenhouse gases.

A summary of calculated emissions is presented in Table 40.

Table 40 Summary of GHG emissions

Emission Scope	Annual GHG Emissions (t CO_2-e·yr^{-1}) Construction	Annual GHG Emissions (t CO_2-e·yr^{-1}) Operations
Scope 1	34 600.2	47 313.0
Scope 2	117.2	82.0
Scope 3	8 535.4	12 714.2
Total	**43 252.8**	**60 109.2**

Based on an estimated Project life of 17 years (operations), the total estimated greenhouse emissions resulting from operation of the Project is calculated to be 1 021 857 t CO_2-e, based on an assumed constant production and throughput rate throughout the Project duration.

7.2. Comparison with National Totals

A comparison of the calculated Scope 1 GHG emissions associated with operation of the Project and NSW and Australia (2020) total emissions is presented in Table 41.

Table 41 Greenhouse gas emissions in context

Emission Scope	Project Total (t CO_2-e.yr^{-1})	Emissions (Mt CO_2-e·yr^{-1})	
		Australia (excluding LULUCF) 484.9 Mt	NSW 132.4 Mt
Scope 1	47 313.0	0.01 %	0.036 %

Note: LULUCF – Land Use Land Use Change and Forestry

These data indicate that the operation of the Project would contribute up to 0.036 % of NSW total GHG emissions and up to 0.01 % of Australian total GHG emissions.

8. MITIGATION AND MONITORING

8.1. Air Quality Mitigation

Based on the findings of the air quality impact assessment, it is considered that the particulate control measures proposed to be implemented will be more than sufficient to ensure that air quality impacts at surrounding non-Project related receptor locations are minimised.

A number of mitigation measures are proposed to be implemented as part of the Project operation. Where defensible quantification of the control efficiencies afforded by these measures can be determined, these have been applied within the assessment.

The mitigation measures which will be used as part of the Project activities are summarised in Table 42.

Table 42 Summary of emission reduction methods adopted

Emission control method	Control efficiency (%)
Application of water and/or chemical suppressants on unpaved haulage routes	90
Limiting of on-site vehicle speeds to less than or equal to 50 $km \cdot hr^{-1}$	75
Ore extraction, dredge mining, wet concentrator plant – wet processes	100
Retention of particulate matter in sub-ground level areas (pit retention)	95 (TSP) 5 (PM_{10} and $PM_{2.5}$)
Storage of heavy mineral concentrate in 3-sided bins prior to load-out	75
Movement of heavy mineral concentrate in sealed containers	Not quantified

An emission control factor of 90 % has been adopted for the implementation of controls on unpaved haulage routes. As outlined in the literature (summarised in (Katestone, 2011)), the effectiveness of emissions controls can vary widely (30 % to 95 %) and is dependent upon the measures implemented. Recent studies performed at coal mines in NSW as part of the 'Dust Stop' program (under an EPA Pollution Reduction Program) provided data relating to the levels of dust control achieved through the implementation of controls (water, chemical suppressant). The average level of control achieved across 16 sites was 92 %, with the minimum being 80 % and the maximum 99 %.

The Applicant commits to achieving a particulate control efficiency of 90 % at the Mine Site and based on the findings of other mine sites across NSW, this is achievable.

The Air Quality and Greenhouse Gas Management Plan for the Project will include the measures identified above. The site manager will be responsible for ensuring that no operations are performed without the inclusion of the relevant controls.

In relation to emissions controls applied along Anabranch Mail Road during materials transportation, the assessment in Section 6.5 has assumed that watering/application of chemical controls resulting in an equivalent of 75 % control efficiency, would result in minimal 24-hour particulate matter impacts at all receptors. Given that Anabranch Mail Road is approximately 28 km in length from the Mine Site boundary to the Silver City Highway, and that the closest receptor is located over 2 km from that route, towards the Silver City Highway, these measures would be adopted along selected sections of Anabranch Mail Road only, in consultation with the owners/occupiers of adjacent residences.

It is recommended that Air Quality and Greenhouse Gas Management Plan identifies relevant controls and sections of Anabranch Mail Road where those controls are to be applied. The Plan would also identify the requirements to consult with owners/occupiers of residences along Anabranch Mail Road and a procedure to respond to and manage complaints.

It is considered that particulate matter generation during offsite transportation of product can be adequately managed through the above controls.

8.2. Greenhouse Gas Mitigation

The Applicant is committed to sourcing a minimum 30 % of the Project's power requirement from renewable sources, including the onsite solar farm and/or externally contracted and certified renewable sources. Nonetheless, emissions of GHG resulting from the Project operation would be minimised to the maximum extent practical by consideration of the following measures:

- The most efficient vehicle and size should be used to minimise the number of trips required and minimise greenhouse gas (and particulate) emissions per tonne of material transported. This may include Type 2 road trains for transportation of concentrate from the Mine Site to Broken Hill, or Wentworth;
- All vehicles/plant and machinery should be turned off when not in use and regularly serviced to ensure efficient operation, including the optimisation of tyre pressures;
- Truck routes and loading capacity should be designed to reduce the distance and effort required by the vehicles;
- Maintenance of roads in good condition to avoid meandering of vehicles;
- Reducing gradients around site where feasible;
- Where possible, B5 fuel should be used in plant and equipment;
- Where possible, power consuming activities should be undertaken during the daytime when solar generation capacity would be at its maximum. This may include operation of the reverse osmosis plants and selected sections of the processing plant such as the concentrate washing circuits; and
- The Applicant should investigate further opportunities to maximise the use of renewable energy sources, including installation of wind generation, as well as additional solar generation capacity coupled with energy storage.

8.3. Monitoring

The predictions presented in this AQIA indicate that there would be no significant predicted exceedances of the adopted air quality criteria as a result of the Project operation. Additionally, given the distances between the Project and the receptor locations, the incremental impacts associated with the Project operation are predicted to be relatively small in comparison to background concentrations. Therefore, it is not anticipated that any air quality monitoring would be required to be performed, although it is recommended that regular audits are performed to ensure that the Project is implementing the air quality control measures appropriately, as outlined within this report.

9. CONCLUSION

RWC has engaged Northstar on behalf of the Applicant to perform an AQIA and GHGA for the proposed Project.

The AQIA forms part of the EIS prepared to accompany the development application for the Project under Part 4 of the *Environmental Planning and Assessment Act* 1979.

The AQIA has been performed in accordance with the requirements of the NSW Approved Methods document and meets the requirements of the SEARs. The AQIA provides a detailed description of:

- the proposed activities which form the Project, under four separate scenarios which reflect activities during site operation.
- the legislative requirements which are required to met, including NSW EPA air quality criteria, POEO Act, and POEO (Clean Air) Regulations, and any policies and guidelines as they relate to air quality and greenhouse gas impacts of the Project.
- the existing conditions surrounding the Mine Site, including the definition of sensitive receptor locations, prevailing meteorology and air quality, topography, and emissions of GHG in Australia and NSW in the year 2020.
- the approach to assessment, including justification for the approach adopted.
- emissions controls proposed to be employed as part of the Project operation.
- predicted air quality impacts during each of the four scenarios modelled.
- additional air quality management and mitigation measures which may need to be employed to ensure that the environmental objectives associated with the Project are achieved.
- predicted emissions of GHG during a year of operations representative of high activity.
- air quality mitigation measures which would be employed as part of the Project operation.
- greenhouse gas mitigation and monitoring measures which would be employed as part of Project construction and operation, with the aim of minimising those emissions.

The results of the AQIA indicate that predicted incremental concentrations associated with the operation of the Project at non-Project related receptors are minor, and exceedances of the annual average PM_{10} and $PM_{2.5}$ criteria are dominated by the already exceeding background conditions. The contribution of the Project to those exceedances is minimal.

Additional exceedances of the 24-hour PM_{10} and $PM_{2.5}$ criteria are predicted at non-Project related receptors over the four Scenarios modelled. Again, all of these exceedances are dominated by high background concentrations, representing 99.8 % of the PM_{10} criterion and 100 % of the $PM_{2.5}$ criterion. The emission controls measures adopted result in the incremental concentrations contributing to the exceedances on those day being insignificant, and at concentrations which could not practically be controlled further.

In relation to greenhouse gas, the assessment indicates that direct emissions associated with the Project are likely to be of the order of approximately 47.3 kt CO_2-e·yr^{-1}, as a maximum during operations. The Applicant has committed to sourcing a minimum 30% of power requirements during operations from either the on-site solar farm and supplemented with externally contracted and certified renewable sources where required. Nonetheless, the Applicant is committed to continue to investigate ways to minimise the emission of GHG, and to reviewing any schemes which may provide opportunity to modernise plant and increase productivity, under the NSW Government Net Zero Plan Stage 1: 2020-2030.

In conclusion, the Project can be constructed and operated in accordance with best management practice, to minimise the concentrations of air pollutants on the surrounding environment.

10. REFERENCES

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APPENDIX A

Meteorology

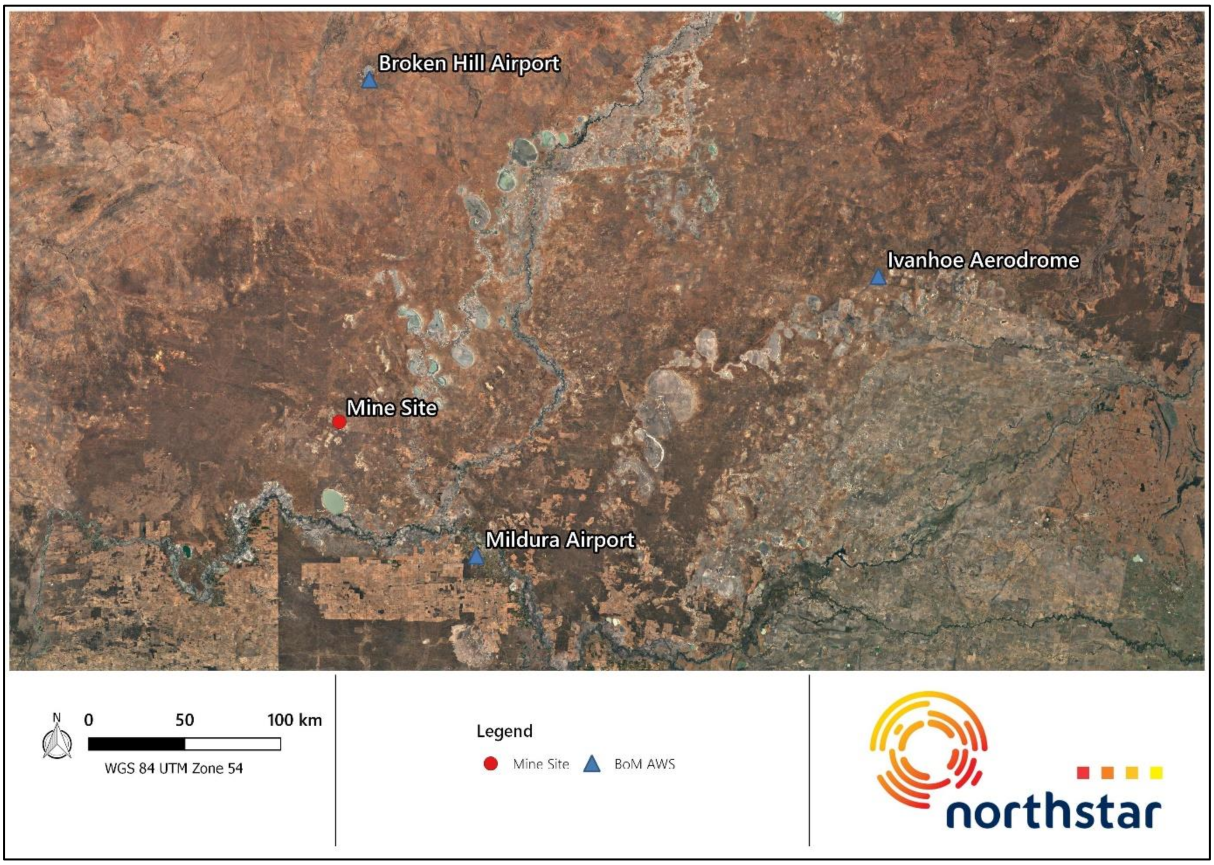
As discussed in Section 4.2 a meteorological modelling exercise has been performed to characterise the meteorology of the Mine Site in the absence of site-specific measurements covering the year 2019. The meteorological modelling has been based on measurements taken at a number of surrounding automatic weather stations (AWS).

A summary of the relevant AWS is provided in Table A1 and also displayed in Figure A1.

Table A1 Details of the meteorological monitoring surrounding the Mine Site

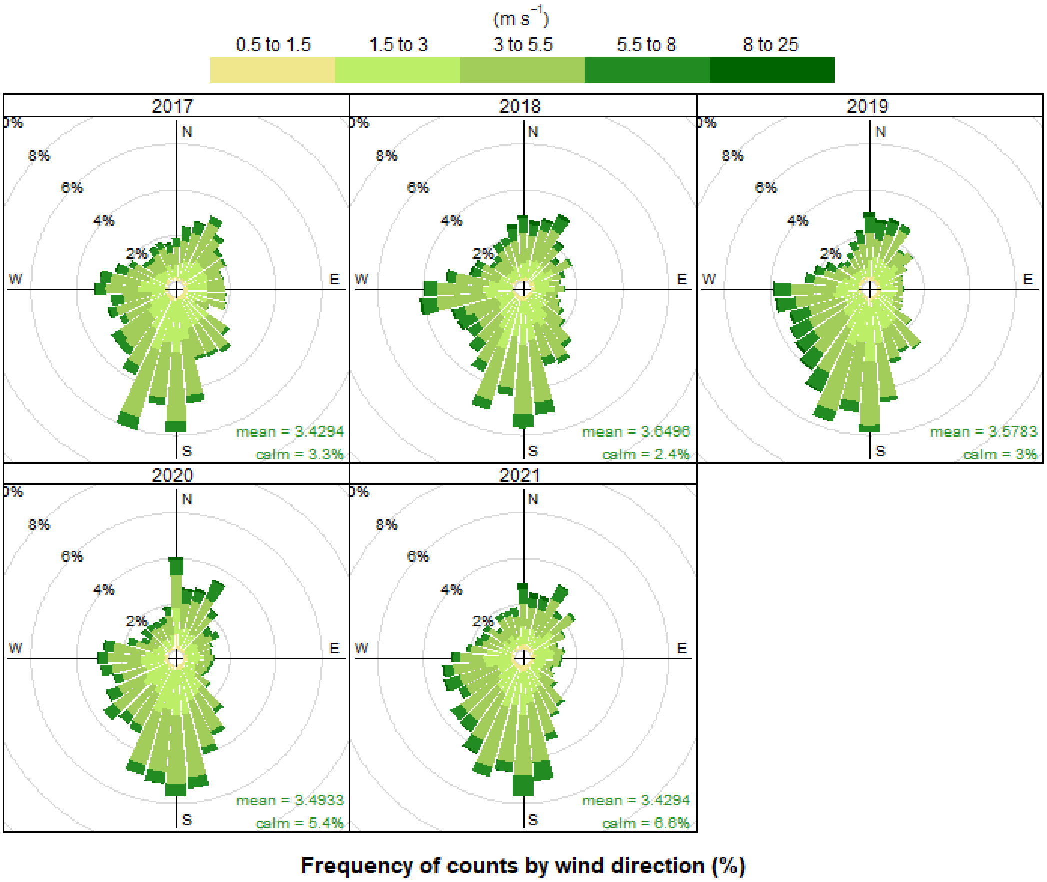
Site Name	Source	Approximate Location (UTM)		Approximate Distance	Availability
		mE	mS	km	
Mildura Airport AWS #076031	BoM	600 074	6 211 157	90	From 2010
Broken Hill Airport AWS #047048	BoM	544 337	6 459 335	186	From 2009
Ivanhoe Aerodrome AWS #049000	BoM	248 268	6 358 440	280	From 2012
On-Site AWS	-	550 020	6 285 480	2	9 Mar – 31 Dec 2017 1 Jan – 3 Dec 2018 26 Feb – 31 Dec 2019

Figure A1 Meteorological and air quality monitoring surrounding the Mine Site



Given the proximity of the AWS in relation to the Mine Site, meteorological data measured at Mildura Airport AWS are considered to be most representative of the meteorological conditions surrounding the Mine Site. Correspondingly, meteorological data from Mildura Airport AWS have been examined to determine a ‘typical’ or representative dataset for use in dispersion modelling. Annual wind roses for the years 2017-2021 are presented in Figure A2.

Figure A2 Annual wind roses 2017 to 2021, Mildura Airport AWS



The wind roses indicate that from 2017 to 2021, winds at Mildura Airport AWS shows predominant southerly and south-westerly wind directions with a westerly component evident.

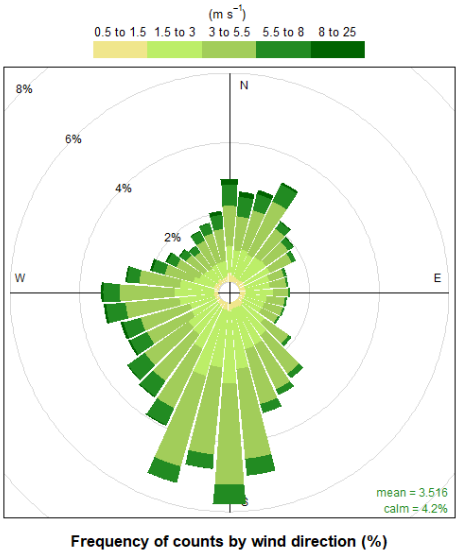
The majority of wind speeds experienced at the Mildura Airport AWS between 2017 and 2021 are generally in the range 0.5 meters per second (m·s^{-1}) to 8 m·s^{-1} with the highest wind speeds (greater than 8 m·s^{-1}) occurring from mostly north and north-easterly directions. Winds of this speed are rare and occur during 1.3 % of the observed hours during the years while calm winds (< 0.5 m·s^{-1}) occur during 4.2 % of hours on average across the years 2017-2021.

Given the wind distributions across the years examined, data for the year 2019 has been selected as being appropriate for further assessment, as it best represents the general trend across the 5-year period studied.

Presented in Figure A3 are the annual wind rose for the 2017 to 2021 period and the year 2019 and in Figure A4 the annual wind speed distribution for Mildura Airport AWS. These figures indicate that the distribution of wind speed and direction in 2019 is very similar to that experienced across the longer-term period.

Figure A3 Annual wind roses 2017 to 2021, and 2019 Mildura Airport AWS

2017-2021	2019



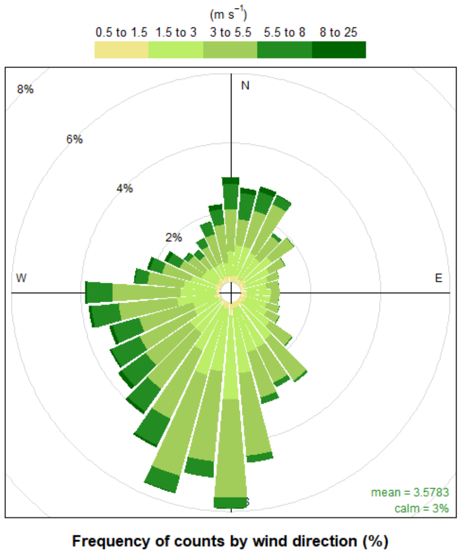
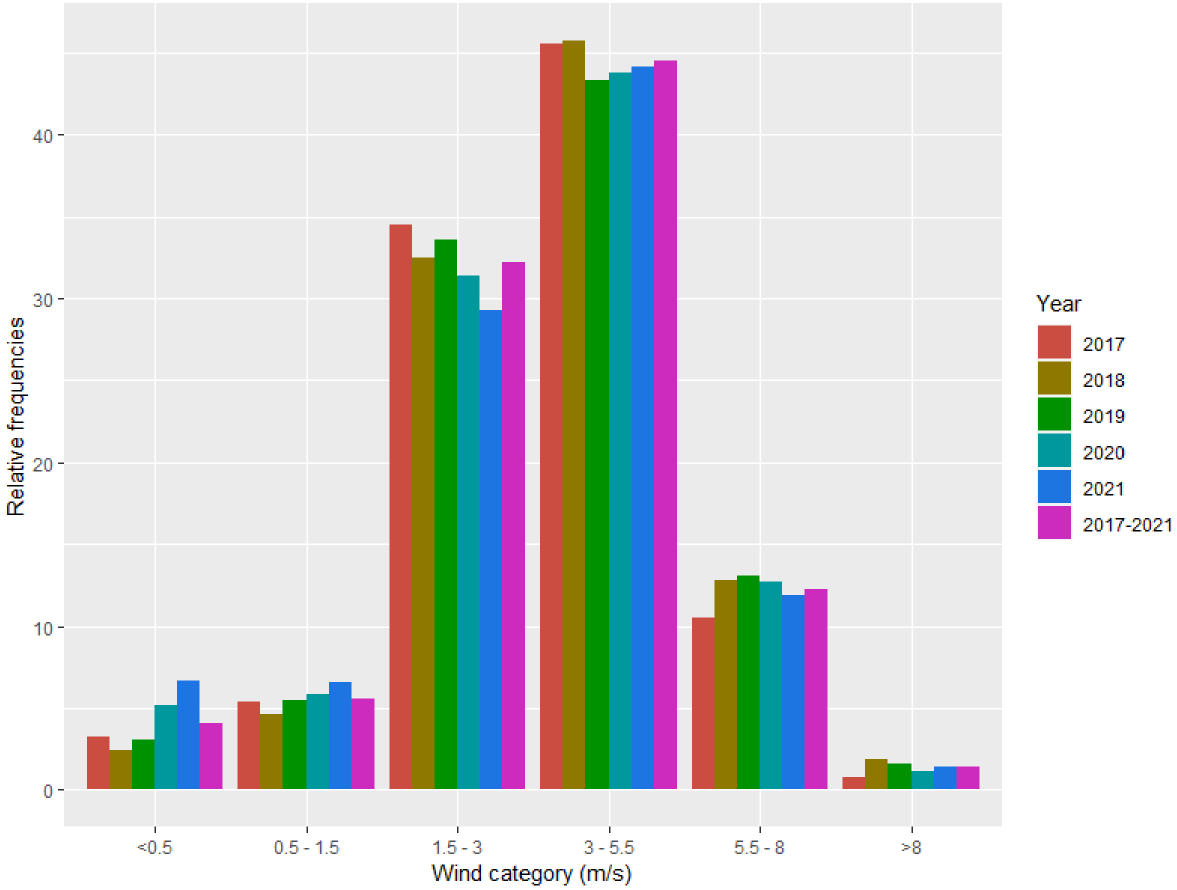


Figure A4 Annual wind speed distribution – Mildura Airport AWS



APPENDIX B

Background Air Quality Data

Air quality is not monitored at the Mine Site and therefore air quality monitoring data measured at a representative location has been adopted for the purposes of this assessment. Determination of data to be used as a location representative of the Mine Site and during a representative year can be complicated by factors which include:

- The sources of air pollutant emissions around the Mine Site and representative air quality monitoring station(s); and,
- The variability of particulate matter concentrations (often impacted by natural climate variability).

Air quality monitoring is performed by the NSW Department of Planning and Environment (DPE) at two air quality monitoring station (AQMS) within a 590 km radius of the Mine Site. Details of the monitoring performed at these AQMS is presented in Table B1 and Figure A1. As discussed in Section 4.2 and Section 4.3, the year 2019 was selected for assessment based upon an analysis of meteorological and background air quality data.

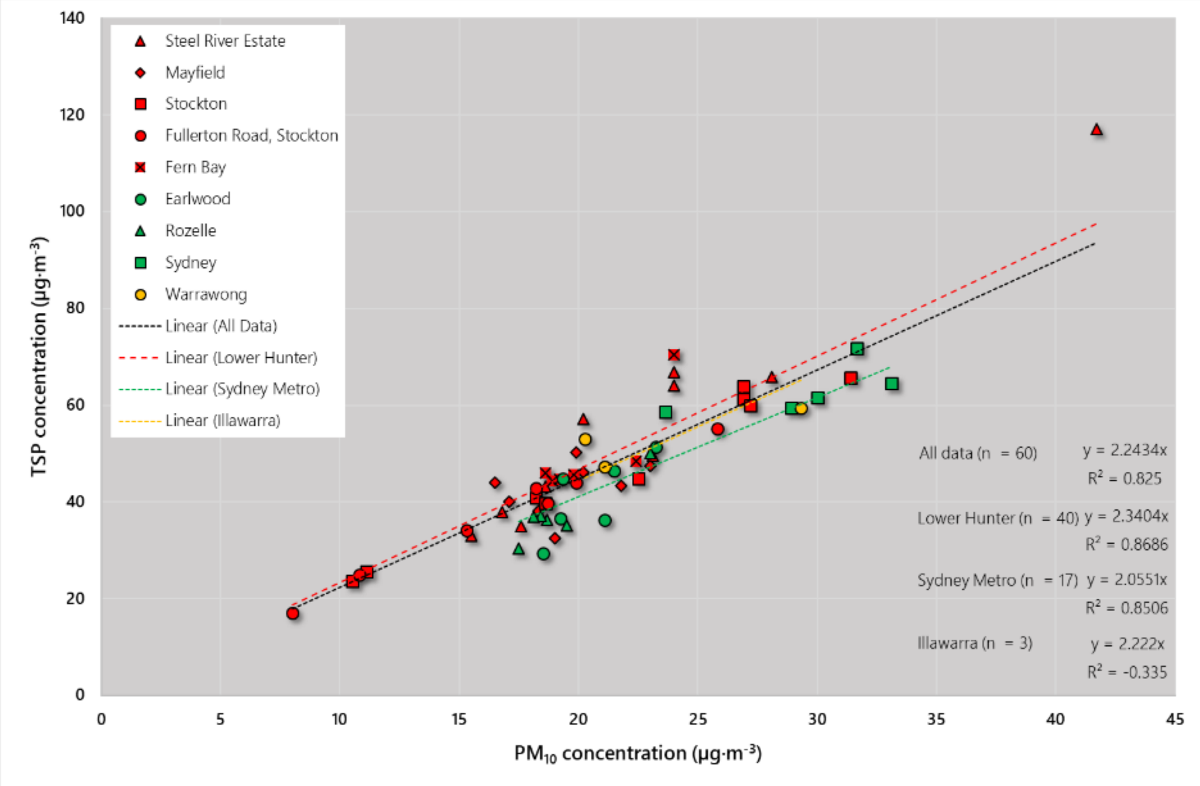
Table B1 Details of closest AQMS surrounding the Mine Site

AQMS Location	Source	Approximate distance to Project (km)	2019 Data	Measurements		
				PM_{10}	$PM_{2.5}$	TSP
Wagga Wagga North	NSW DPE	581	✓	✓	✓	×
Albury	NSW DPE	589	✓	✓	✓	×
Elizabeth Downs	SA EPA	259	✓	✓	✓	×

The closest representative NSW DPE AQMS with data available for the year 2019 (consistent with the meteorological modelling) is noted to be located at Wagga Wagga North and correspondingly, PM data collected at Wagga Wagga North AQMS has been adopted for use in this assessment.

Concentrations of TSP are not available from any AQMS identified in Table B1. An analysis of co-located measurements of TSP and PM_{10} in the Lower Hunter (1999 to 2011), Illawarra (2002 to 2004), and Sydney Metropolitan (1999 to 2004) regions is presented in Figure B1. The analysis concludes that, on the basis of the measurements collected in all regions between 1999 to 2011, the derivation of a broad TSP:PM_{10} ratio of 2.3404 : 1 (i.e. PM_{10} represents ~43 % of TSP) from the Lower Hunter is appropriate, and the most conservative of all the relationships assessed. In the absence of any more specific information, this ratio has been adopted within this AQIA, resulting in a background annual average TSP concentration of 82.7 $\mu g \cdot m^{-3}$ being adopted.

Figure B1 Co-located TSP and PM_{10} measurements, Lower Hunter, Sydney Metro and Illawarra



Similarly, no dust deposition data is available for the area surrounding the Mine Site. The incremental impact criterion of 2 $g \cdot m^{-2} \cdot month^{-1}$ as outlined within the Approved Methods has been adopted which effectively provides a background deposition level of 2 $g \cdot m^{-2} \cdot month^{-1}$ (the total allowable deposition being 4 $g \cdot m^{-2} \cdot month^{-1}$).

Summary statistics for the pollutants assessed are presented in Table B2.

Table B2 Background air quality statistics

Pollutant	TSP ($\mu g \cdot m^{-3}$)	PM_{10} ($\mu g \cdot m^{-3}$)	$PM_{2.5}$ ($\mu g \cdot m^{-3}$)	O_3 ($\mu g \cdot m^{-3}$)
Averaging Period	Annual	24-Hour	24-Hour	1-Hour
Data Points (number)	346	346	346	3384
Mean	82.7	35.3	11.3	40.5
Standard Deviation	-	34.4	17.8	15.9
Skew[1]	-	3.0	8.2	0.6
Kurtosis[2]	-	11.6	88.0	1.7
Minimum	-	4.3	1.5	0.0
25	-	14.8	5.3	29.4
50	-	24.4	7.6	41.2
75	-	42.9	11.4	49.0
90	-	68.5	15.9	58.8
95	-	100.0	24.5	66.6

Pollutant	TSP (µg·m^{-3})	PM_{10} (µg·m^{-3})	$PM_{2.5}$ (µg·m^{-3})	O_3 (µg·m^{-3})
97	-	129.1	41.9	72.5
98	-	134.3	53.8	78.4
99	-	201.6	85.6	88.2
Maximum	82.7	251.7	239.6	129.4
Data Capture (%)	94.8	94.8	94.8	38.6

Graphs presenting the daily varying PM_{10} and $PM_{2.5}$ data recorded at Wagga Wagga North are presented in Figure B2 and Figure B3, respectively.

Figure B2 PM_{10} measurements, Wagga Wagga North 2019

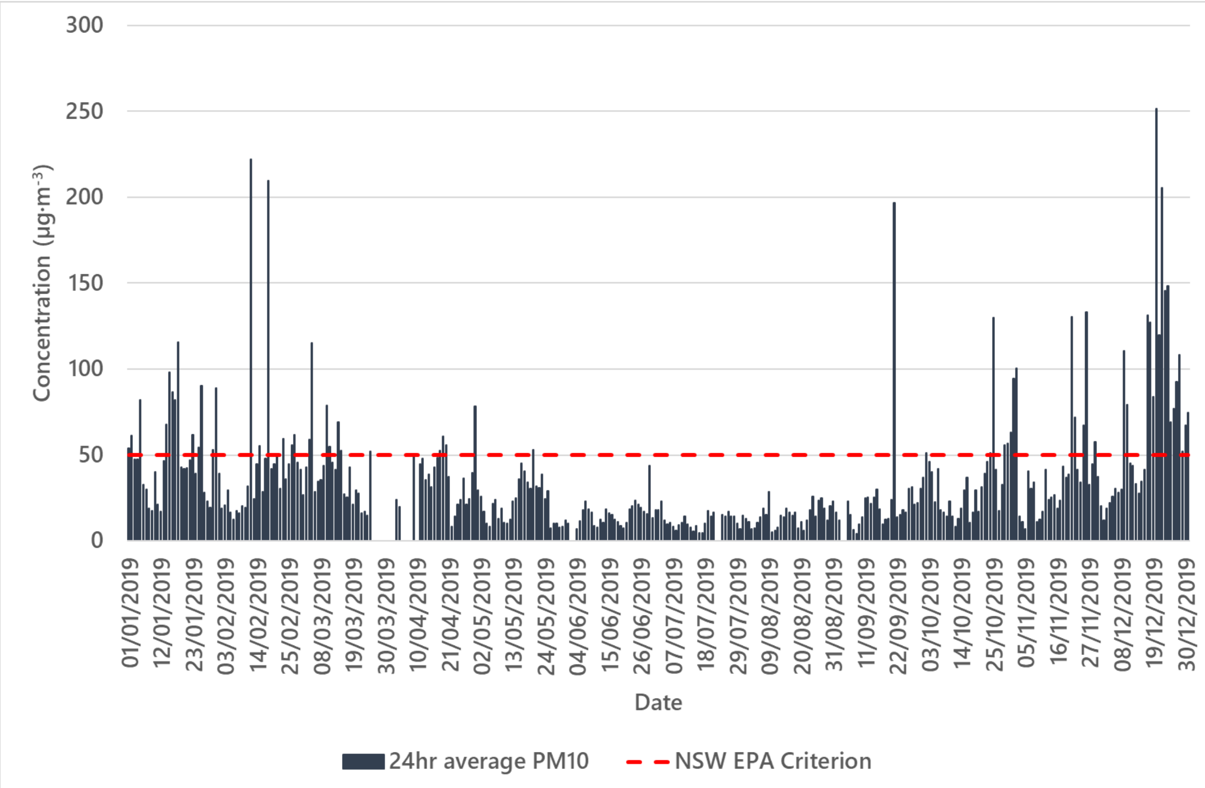
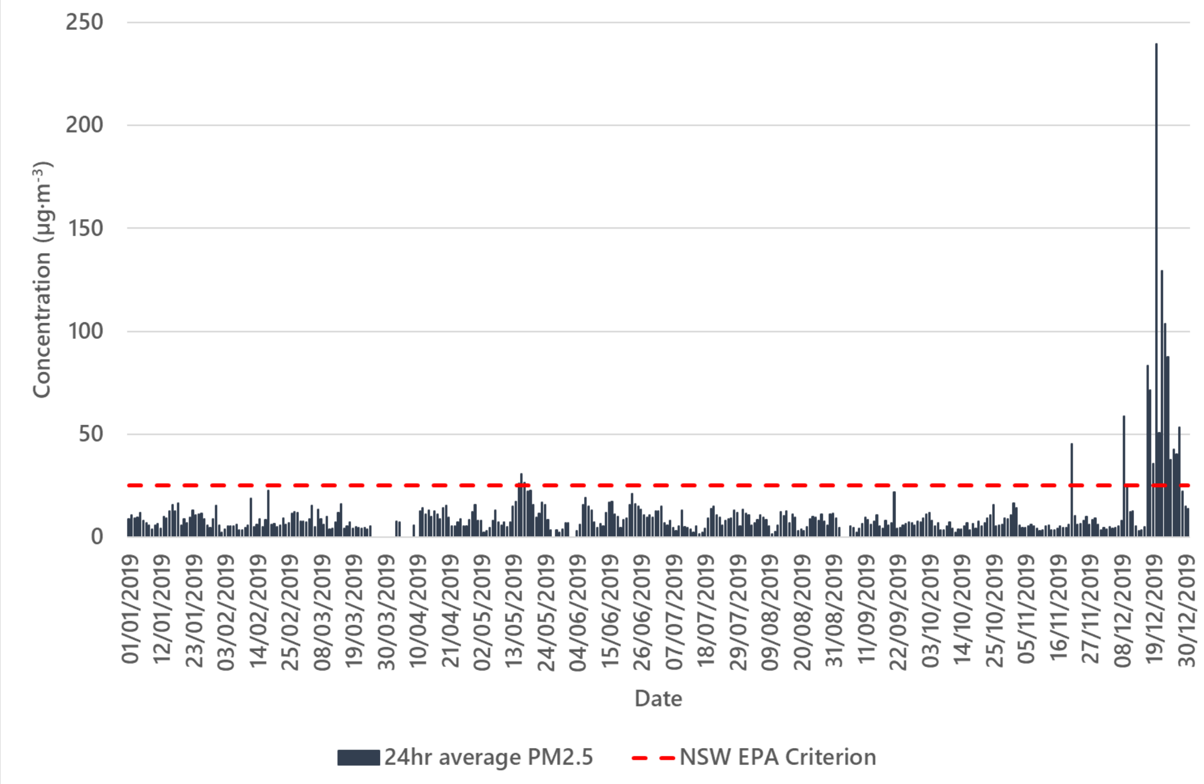


Figure B3 $PM_{2.5}$ measurements, Wagga Wagga North 2019



Many exceedances of the NSW EPA maximum 24-hour average PM_{10} and $PM_{2.5}$ criteria were measured at the Wagga Wagga North AQMS in late 2019. The NSW Annual Compliance Report for the National Environment Protection (Ambient Air Quality) Measure for 2019 (NSW DPE, 2021) provides commentary on the likely source of PM exceedances summarising that extensive drought conditions and bushfires were the primary source.

Given the likely source of particulates which influence measurements of particulate matter at the Wagga Wagga North AQMS, it is likely that measurements of particulate matter experienced in the area surrounding the Mine Site may be lower. The use of air quality data from Wagga Wagga North to characterise the air quality in the area surrounding Wentworth and the Mine Site is considered to be appropriate, if not conservative.

The AQIA considers all measured particulate concentrations within the background dataset (including exceedances) and provides discussion as to the potential impact of the Project on air quality. Impacts are discussed in terms of 'incremental' and 'cumulative' impact, and in relation to the number of 'additional exceedances' which may eventuate with the operation of the Project.

APPENDIX C

Emissions Estimation

As outlined in Section 2.2, several operations to be performed as part of the Project have the potential to result in emissions of particulate matter. A detailed outline of the emission estimation techniques adopted to derive total emissions from the sources identified are presented in this appendix.

Bulldozing (Overburden)

The emissions of particulate matter from the bulldozing (overburden [or material other than coal in the NPI]) process have been estimated using emission factors presented in Section 11.9-2 of AP-42 (Western Surface Coal Mining) (USEPA, 1998). The emission factor is:

$$EF_{TSP}\ (kg.hr^{-1}) = \frac{2.6 \times (s)^{1.2}}{(M)^{1.3}}$$

$$EF_{PM_{15}}\ (kg.hr^{-1}) = \frac{0.45 \times (s)^{1.5}}{(M)^{1.4}}$$

$$EF_{PM_{10}}(kg.hr^{-1}) = 0.75\ \times EF_{PM_{15}}$$

$$EF_{PM_{2.5}}\ (kg.hr^{-1}) = 0.105 \times EF_{TSP}$$

where:

$EF_{(kg \cdot hr^{-1})}$ = emission factor for particulate matter

$s_{(\%)}$ = silt content in %, by weight

$M_{(\%)}$ = moisture content of overburden in %, by weight

The quality rating for this emission factor is rated B for TSP, C for PM_{15}, D for PM_{10}, D for $PM_{2.5}$.

Excavators/Frontend Loaders

Emissions associated with all loading and unloading operations have been characterised using the factor outlined in AP-42 for Batch Drop processes (Section 13.2.4.3) (USEPA, 2006a). This equation is consistent with that associated with the use of excavators, shovels and front end loaders outlined in the NPI EETM for Mining (NPI, 2012):

$$EF\ (kg \cdot tonne^{-1}) = k(0.0016)\ \frac{\left(\frac{U\ (m \cdot s^{-1})}{2.2}\right)^{1.3}}{\left(\frac{M\ (\%)}{2}\right)^{1.4}}$$

where:

$EF_{TSP\ (kg \cdot tonne^{-1})}$ = emission factor for total suspended particles

$EF_{PM_{10}\,(kg \cdot tonne^{-1})}$ = emission factor for total suspended particles

k_{TSP} = 0.74 for particles less than 30 micrometres aerodynamic diameter

$k_{PM_{10}}$ = 0.35 for particles less than 10 micrometres aerodynamic diameter

$k_{PM_{2.5}}$ = 0.053 for particles less than 2.5 micrometres aerodynamic diameter

U = mean wind speed ($m \cdot s^{-1}$)

M = material moisture content (% by weight)

The quality rating for this application is rated U (no rating).

Grading

The emissions of particulate matter from grading operations have been estimated using emission factors presented in Section 11.9-2 of AP-42 (Western Surface Coal Mine) (USEPA, 1998). The emission factor is:

$$EF_{TSP}\ (kg.VKT^{-1}) = 0.0034 \times (S)^{2.5}$$

$$EF_{PM_{10}}\ (kg.VKT^{-1}) = 0.60 \times (EF_{PM_{15}})$$

$$EF_{PM_{2.5}}\ (kg.VKT^{-1}) = 0.031 \times (EF_{TSP})$$

where:

$EF_{\ (kg \cdot VKT^{-1})}$ = emission factor for particulate matter

S = mean vehicle speed ($km \cdot hr^{-1}$), taken to be 2.5 $km \cdot hr^{-1}$.

The quality rating for this emission factor is rated C for TSP, D for PM_{10}, D for $PM_{2.5}$.

Scraper

The emissions of particulate matter from the topsoil removal by scraper process have been estimated using emission factors presented in Section 11.9-4 of AP-42 (Western Surface Coal Mining) (US EPA, 1998). The emission factor is:

$$EF_{TSP}\ (kg.tonne^{-1}) = 0.029$$

where:

$EF_{(kg \cdot tonne^{-1})}$ = emission factor for particulate matter

PM_{10} & $PM_{2.5}$ emission factors are not available in NPI although have been taken to be 25% of TSP for PM_{10} and 15% of PM_{10} for $PM_{2.5}$ as per MRI WRAPAIR ratio for Aggregate Handling & Storage Piles, consistent with AP-42 for Batch Drop (Section 13.2.4.3).

The quality rating for this emission factor is rated E.

Unpaved Roads

Emissions of particulate matter resulting from the movement of materials on unpaved roads have been estimated using the emission factors presented in Section 13.2.2 (Unpaved Roads) of AP-42 (USEPA, 2006c).

The emission factor in section 13.2.2 of (USEPA, 2006c) has been adopted for the operations of vehicles on unpaved roads:

$$EF_{(kg.VKT^{-1})} = 0.2819 \times k \times (\frac{s}{12})^{a} \times (\frac{W \times 0.907185}{3})^{b}$$

where:

$EF_{(kg.VKT^{-1})}$ = emission factor (kg per vehicle kilometre travelled) multiplied by 0.2819 to convert from lb per vehicle mile travelled

k = particle size multiplier (dimensionless)

s = surface material silt content (%)

W = mean vehicle weight (tons) multiplied by 0.907185 to convert from metric tonnes

The particle size multipliers for TSP, PM_{10} and $PM_{2.5}$ (k) are provided in (US EPA, 2006a) as 4.9, 1.5 and 0.15, respectively.

The quality rating for this application is rated B for TSP, B for PM_{10} and B for $PM_{2.5}$.

The silt content of unpaved haul roads at the Mine Site has been taken to be 4.8 %.

Wind Erosion (Exposed Areas)

Emissions of particulate matter resulting from the wind erosion of exposed areas have been estimated using the emission factors presented in Section 11.9-4 of AP-42 (Western Surface Coal Mining) (US EPA, 1998).

The emission factors within table 11.9-4 have been adopted for the operations outlined above. The emission factor applies to the materials: seeded land, stripped overburden and graded overburden. The emission factor is:

$$EF_{TSP}\ (tonne.(hectare.year)^{-1}) = 0.85$$

where:

$EF_{TSP}\ (tonne.(hectare.year)^{-1})$= emission factor for total suspended particulate matter

PM_{10} and $PM_{2.5}$ emission factors are not available in AP-42 although have been taken to be 50% of TSP for PM_{10} and, 7.5% of TSP for $PM_{2.5}$ as per AP-42 section (13.2.5) for industrial wind erosion.

The quality rating for this emission factors is C.

The active area of exposed areas, with the exception of the HMC storage area, is taken to be 10 % of the total area.

The material and road moisture and silt contents assumed in the calculation of emissions is presented below.

Description	Silt content (%)	Moisture content (%)
Topsoil and subsoil	6.2	10
Overburden and Interburden	10	17.5
Ore	10	17.5
Product	10	5.5

Emissions inventories for each of Scenario 1, Scenario 2, Scenario 3, and Scenario 4 are presented overleaf. Inventories are presented in a consistent manner, to allow easy identification of the sources which are active or inactive in each modelled scenario.

Scenario 1 – annual emissions

Description	Emission Factor	Emission rate						Emission Controls	Controlled emission (kg.yr-1)		
		TSP	PM10	PM2.5	Units	Activity Rate	Units		TSP	PM10	PM2.5
AVC - bulldozer clearing vegetation	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.2E+00	2.1E-01	1.2E-01	kg·hr-1	913	hr	0	1,061.9	189.3	111.5
ASS - scraper on topsoil	AP-42 - Topsoil removal by scraper - Table 11.9-4	2.9E-02	7.3E-03	1.1E-03	kg·t-1	432,701	t	0	12,548.3	3,137.1	470.6
DM - excavator loading overburden to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	27,053,114	t	Pit retention	1,169.5	1,051.0	159.1
OBF - unloading of haul trucks at OBF area	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	27,053,114	t	Pit retention	1,169.5	1,051.0	159.1
OBF - bulldozer push overburden	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.0E+00	1.9E-01	1.0E-01	kg·hr-1	4,380	hr	Pit retention	2,185.1	807.6	435.9
SSR - unloading of soil in reveg area	AP-42 - Scraper unloading (batch drop) - Table 11.9-4	2.0E-02	5.0E-03	7.5E-04	kg·t-1	432,701	t	0	8,654.0	2,163.5	324.5
SSR - bulldozer spreading soil in reveg area	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.2E+00	2.1E-01	1.2E-01	kg·hr-1	913	hr	0	1,061.9	189.3	111.5
DrM - Interburden removal, dredge mining	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	36,343,499	t	Wet - 100% controlled	-	-	-
DrM - Ore extraction, dredge mining	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	23,377,797	t	Wet - 100% controlled	-	-	-
Pr - wet concentration plant	AP-42 - Screening - Table 11.19.2.1	1.3E-02	4.3E-03	3.0E-04	kg·t-1	23,377,797	t	Wet - 100% controlled	-	-	-
Pr - HMC loaded to stockpiles for drying	AP-42 - Batch drop - Section 13.2.4.3	4.4E-04	2.1E-04	3.1E-05	kg·t-1	450,000	t	0	196.7	93.0	14.1
Pr - HMC loaded to shipping containers	AP-42 - Batch drop - Section 13.2.4.3	4.4E-04	2.1E-04	3.1E-05	kg·t-1	450,000	t	0	196.7	93.0	14.1
Stripped topsoil and subsoil to reveg area	AP-42 Unpaved roads - Section 13.2.2	2.8E+00	7.2E-01	7.2E-02	kg·VKT-1	49,519	VKT	Polymer application (90%), speed reduction (75%)	3,485.7	888.4	88.8
Stripped overburden to placement area	AP-42 Unpaved roads - Section 13.2.2	4.7E+00	1.2E+00	1.2E-01	kg·VKT-1	742,635	VKT	Polymer application (90%), speed reduction (75%)	87,454.1	22,288.8	2,228.9
Offsite transportation of product in containers, B-	AP-42 Unpaved roads - Section 13.2.2	3.2E+00	8.1E-01	8.1E-02	kg·VKT-1	77,745	VKT	Polymer application (90%), speed reduction (75%)	6,192.0	1,578.1	157.8
Grader on all roads	AP-42 - Grading - Table 11.9-2	1.5E-01	6.8E-02	4.5E-03	kg·VKT-1	9,125	VKT	Polymer application (90%)	133.3	62.1	4.1
Vegetation cleared	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.9	ha	0	768.0	384.0	57.6
Overburden removal area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	1.9	ha	0	1,634.3	817.2	122.6
Overburden backfill area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	1.1	ha	0	934.6	467.3	70.1
Soil spreading and reveg area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	1.4	ha	0	1,157.0	578.5	86.8
Product drying stockpiles	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.1	ha	3 sided bins	17.0	8.5	1.3
								TOTAL	**130,019.6**	**35,847.6**	**4,618.5**

Scenario 1 – peak daily emissions

Description	Emission Factor	Emission rate						Emission Controls	Controlled emissions (kg.day-1)		
		TSP	PM10	PM2.5	Units	Activity Rate	Units		TSP	PM10	PM2.5
AVC - bulldozer clearing vegetation	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.2E+00	2.1E-01	1.2E-01	kg·hr-1	3	hr	0	2.9	0.5	0.3
ASS - scraper on topsoil	AP-42 - Topsoil removal by scraper - Table 11.9-4	2.9E-02	7.3E-03	1.1E-03	kg·t-1	1,185	t	0	34.4	8.6	1.3
DM - excavator loading overburden to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	74,118	t	Pit retention	3.2	2.9	0.4
OBF - unloading of haul trucks at OBF area	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	74,118	t	Pit retention	3.2	2.9	0.4
OBF - bulldozer push overburden	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.0E+00	1.9E-01	1.0E-01	kg·hr-1	12	hr	Pit retention	6.0	2.2	1.2
SSR - unloading of soil in reveg area	AP-42 - Scraper unloading (batch drop) - Table 11.9-4	2.0E-02	5.0E-03	7.5E-04	kg·t-1	1,185	t	0	23.7	5.9	0.9
SSR - bulldozer spreading soil in reveg area	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.2E+00	2.1E-01	1.2E-01	kg·hr-1	3	hr	0	2.9	0.5	0.3
DrM - Interburden removal, dredge mining	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	99,571	t	Wet - 100% controlled	-	-	-
DrM - Ore extraction, dredge mining	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	64,049	t	Wet - 100% controlled	-	-	-
Pr - wet concentration plant	AP-42 - Screening - Table 11.19.2.1	1.3E-02	4.3E-03	3.0E-04	kg·t-1	64,049	t	Wet - 100% controlled	-	-	-
Pr - HMC loaded to stockpiles for drying	AP-42 - Batch drop - Section 13.2.4.3	4.4E-04	2.1E-04	3.1E-05	kg·t-1	1,233	t	0	0.5	0.3	0.0
Pr - HMC loaded to shipping containers	AP-42 - Batch drop - Section 13.2.4.3	4.4E-04	2.1E-04	3.1E-05	kg·t-1	1,233	t	0	0.5	0.3	0.0
Stripped topsoil and subsoil to reveg area	AP-42 Unpaved roads - Section 13.2.2	2.8E+00	7.2E-01	7.2E-02	kg·VKT-1	136	VKT	Polymer application (90%), speed reduction (75%)	9.5	2.4	0.2
Stripped overburden to placement area	AP-42 Unpaved roads - Section 13.2.2	4.7E+00	1.2E+00	1.2E-01	kg·VKT-1	2,035	VKT	Polymer application (90%), speed reduction (75%)	239.6	61.1	6.1
Offsite transportation of product in containers, B-	AP-42 Unpaved roads - Section 13.2.2	3.2E+00	8.1E-01	8.1E-02	kg·VKT-1	298	VKT	Polymer application (90%), speed reduction (75%)	23.8	6.1	0.6
Grader on all roads	AP-42 - Grading - Table 11.9-2	1.5E-01	6.8E-02	4.5E-03	kg·VKT-1	25	VKT	Polymer application (90%)	0.4	0.2	0.0
Vegetation cleared	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.9	ha	0	2.1	1.1	0.2
Overburden removal area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	1.9	ha	0	4.5	2.2	0.3
Overburden backfill area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	1.1	ha	0	2.6	1.3	0.2
Soil spreading and reveg area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	1.4	ha	0	3.2	1.6	0.2
Product drying stockpiles	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.1	ha	3 sided bins	0.0	0.0	0.0
								TOTAL	**363.0**	**99.9**	**12.8**

Scenario 2 – annual emissions

Description	Emission Factor	Emission rate				Activity Rate	Units	Emission Controls	Controlled emission (kg.yr-1)		
		TSP	PM10	PM2.5	Units				TSP	PM10	PM2.5
AVC - bulldozer clearing vegetation	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.2E+00	2.1E-01	1.2E-01	kg·hr-1	913	hr	0	1,061.9	189.3	111.5
ASS - scraper on topsoil	AP-42 - Topsoil removal by scraper - Table 11.9-4	2.9E-02	7.3E-03	1.1E-03	kg·t-1	1,327,287	t	0	38,491.3	9,622.8	1,443.4
DM - excavator loading overburden to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	25,208,119	t	Pit retention	1,089.7	979.3	148.3
OBF - unloading of haul trucks at OBF area	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	25,208,119	t	Pit retention	1,089.7	979.3	148.3
OBF - bulldozer push overburden	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.0E+00	1.9E-01	1.0E-01	kg·hr-1	4,380	hr	Pit retention	2,185.1	807.6	435.9
SSR - unloading of soil in reveg area	AP-42 - Scraper unloading (batch drop) - Table 11.9-4	2.0E-02	5.0E-03	7.5E-04	kg·t-1	1,327,287	t	0	26,545.7	6,636.4	995.5
SSR - bulldozer spreading soil in reveg area	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.2E+00	2.1E-01	1.2E-01	kg·hr-1	913	hr	0	1,061.9	189.3	111.5
DrM - Interburden removal, dredge mining	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	34,170,273	t	Wet - 100% controlled	-	-	-
DrM - Ore extraction, dredge mining	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	23,367,821	t	Wet - 100% controlled	-	-	-
Pr - wet concentration plant	AP-42 - Screening - Table 11.19.2.1	1.3E-02	4.3E-03	3.0E-04	kg·t-1	23,367,821	t	Wet - 100% controlled	-	-	-
Pr - HMC loaded to stockpiles for drying	AP-42 - Batch drop - Section 13.2.4.3	4.4E-04	2.1E-04	3.1E-05	kg·t-1	465,000	t	0	203.2	96.1	14.6
Pr - HMC loaded to shipping containers	AP-42 - Batch drop - Section 13.2.4.3	4.4E-04	2.1E-04	3.1E-05	kg·t-1	465,000	t	0	203.2	96.1	14.6
Stripped topsoil and subsoil to reveg area	AP-42 Unpaved roads - Section 13.2.2	2.8E+00	7.2E-01	7.2E-02	kg·VKT-1	122,964	VKT	Polymer application (90%), speed reduction (75%)	8,655.7	2,206.0	220.6
Stripped overburden to placement area	AP-42 Unpaved roads - Section 13.2.2	4.7E+00	1.2E+00	1.2E-01	kg·VKT-1	461,325	VKT	Polymer application (90%), speed reduction (75%)	54,326.6	13,845.8	1,384.6
Offsite transportation of product in containers, B-	AP-42 Unpaved roads - Section 13.2.2	3.2E+00	8.1E-01	8.1E-02	kg·VKT-1	77,745	VKT	Polymer application (90%), speed reduction (75%)	6,192.0	1,578.1	157.8
Grader on all roads	AP-42 - Grading - Table 11.9-2	1.5E-01	6.8E-02	4.5E-03	kg·VKT-1	9,125	VKT	Polymer application (90%)	133.3	62.1	4.1
Vegetation cleared	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.9	ha	0	739.0	369.5	55.4
Overburden removal area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	1.1	ha	0	932.2	466.1	69.9
Overburden backfill area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.4	ha	0	367.3	183.6	27.5
Soil spreading and reveg area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.4	ha	0	319.9	159.9	24.0
Product drying stockpiles	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.1	ha	3 sided bins	17.0	8.5	1.3
								TOTAL	**143,614.7**	**38,476.0**	**5,368.8**

Scenario 2 – peak daily emissions

		Emission rate							Controlled emissions (kg.day-1)		
Description	Emission Factor	TSP	PM10	PM2.5	Units	Activity Rate	Units	Emission Controls	TSP	PM10	PM2.5
AVC - bulldozer clearing vegetation	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.2E+00	2.1E-01	1.2E-01	kg·hr-1	3	hr	0	2.9	0.5	0.3
ASS - scraper on topsoil	AP-42 - Topsoil removal by scraper - Table 11.9-4	2.9E-02	7.3E-03	1.1E-03	kg·t-1	3,636	t	0	105.5	26.4	4.0
DM - excavator loading overburden to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	69,063	t	Pit retention	3.0	2.7	0.4
OBF - unloading of haul trucks at OBF area	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	69,063	t	Pit retention	3.0	2.7	0.4
OBF - bulldozer push overburden	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.0E+00	1.9E-01	1.0E-01	kg·hr-1	12	hr	Pit retention	6.0	2.2	1.2
SSR - unloading of soil in reveg area	AP-42 - Scraper unloading (batch drop) - Table 11.9-4	2.0E-02	5.0E-03	7.5E-04	kg·t-1	3,636	t	0	72.7	18.2	2.7
SSR - bulldozer spreading soil in reveg area	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.2E+00	2.1E-01	1.2E-01	kg·hr-1	3	hr	0	2.9	0.5	0.3
DrM - Interburden removal, dredge mining	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	93,617	t	Wet - 100% controlled	-	-	-
DrM - Ore extraction, dredge mining	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	64,021	t	Wet - 100% controlled	-	-	-
Pr - wet concentration plant	AP-42 - Screening - Table 11.19.2.1	1.3E-02	4.3E-03	3.0E-04	kg·t-1	64,021	t	Wet - 100% controlled	-	-	-
Pr - HMC loaded to stockpiles for drying	AP-42 - Batch drop - Section 13.2.4.3	4.4E-04	2.1E-04	3.1E-05	kg·t-1	1,274	t	0	0.6	0.3	0.0
Pr - HMC loaded to shipping containers	AP-42 - Batch drop - Section 13.2.4.3	4.4E-04	2.1E-04	3.1E-05	kg·t-1	1,274	t	0	0.6	0.3	0.0
Stripped topsoil and subsoil to reveg area	AP-42 Unpaved roads - Section 13.2.2	2.8E+00	7.2E-01	7.2E-02	kg·VKT-1	337	VKT	Polymer application (90%), speed reduction (75%)	23.7	6.0	0.6
Stripped overburden to placement area	AP-42 Unpaved roads - Section 13.2.2	4.7E+00	1.2E+00	1.2E-01	kg·VKT-1	1,264	VKT	Polymer application (90%), speed reduction (75%)	148.8	37.9	3.8
Offsite transportation of product in containers, B-	AP-42 Unpaved roads - Section 13.2.2	3.2E+00	8.1E-01	8.1E-02	kg·VKT-1	298	VKT	Polymer application (90%), speed reduction (75%)	23.8	6.1	0.6
Grader on all roads	AP-42 - Grading - Table 11.9-2	1.5E-01	6.8E-02	4.5E-03	kg·VKT-1	25	VKT	Polymer application (90%)	0.4	0.2	0.0
Vegetation cleared	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.9	ha	0	2.0	1.0	0.2
Overburden removal area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	1.1	ha	0	2.6	1.3	0.2
Overburden backfill area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.4	ha	0	1.0	0.5	0.1
Soil spreading and reveg area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.4	ha	0	0.9	0.4	0.1
Product drying stockpiles	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.1	ha	3 sided bins	0.0	0.0	0.0
								TOTAL	**400.3**	**107.1**	**14.9**

Scenario 3 – annual emissions

Description	Emission Factor	Emission rate						Emission Controls	Controlled emission (kg.yr-1)		
		TSP	PM10	PM2.5	Units	Activity Rate	Units		TSP	PM10	PM2.5
AVC - bulldozer clearing vegetation	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.2E+00	2.1E-01	1.2E-01	kg·hr-1	913	hr	0	1,061.9	189.3	111.5
ASS - scraper on topsoil	AP-42 - Topsoil removal by scraper - Table 11.9-4	2.9E-02	7.3E-03	1.1E-03	kg·t-1	1,032,964	t	0	29,956.0	7,489.0	1,123.3
DM - excavator loading overburden to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	16,088,234	t	Pit retention	695.5	625.0	94.6
OBF - unloading of haul trucks at OBF area	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	16,088,234	t	Pit retention	695.5	625.0	94.6
OBF - bulldozer push overburden	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.0E+00	1.9E-01	1.0E-01	kg·hr-1	4,380	hr	Pit retention	2,185.1	807.6	435.9
SSR - unloading of soil in reveg area	AP-42 - Scraper unloading (batch drop) - Table 11.9-4	2.0E-02	5.0E-03	7.5E-04	kg·t-1	1,032,964	t	0	20,659.3	5,164.8	774.7
SSR - bulldozer spreading soil in reveg area	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.2E+00	2.1E-01	1.2E-01	kg·hr-1	913	hr	0	1,061.9	189.3	111.5
DrM - Interburden removal, dredge mining	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	32,091,664	t	Wet - 100% controlled	-	-	-
DrM - Ore extraction, dredge mining	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	27,550,203	t	Wet - 100% controlled	-	-	-
Pr - wet concentration plant	AP-42 - Screening - Table 11.19.2.1	1.3E-02	4.3E-03	3.0E-04	kg·t-1	27,550,203	t	Wet - 100% controlled	-	-	-
Pr - HMC loaded to stockpiles for drying	AP-42 - Batch drop - Section 13.2.4.3	4.4E-04	2.1E-04	3.1E-05	kg·t-1	385,000	t	0	168.3	79.6	12.1
Pr - HMC loaded to shipping containers	AP-42 - Batch drop - Section 13.2.4.3	4.4E-04	2.1E-04	3.1E-05	kg·t-1	385,000	t	0	168.3	79.6	12.1
Stripped topsoil and subsoil to reveg area	AP-42 Unpaved roads - Section 13.2.2	2.8E+00	7.2E-01	7.2E-02	kg·VKT-1	72,617	VKT	Polymer application (90%), speed reduction (75%)	5,111.7	1,302.8	130.3
Stripped overburden to placement area	AP-42 Unpaved roads - Section 13.2.2	4.7E+00	1.2E+00	1.2E-01	kg·VKT-1	336,486	VKT	Polymer application (90%), speed reduction (75%)	39,625.3	10,099.0	1,009.9
Offsite transportation of product in containers, B-	AP-42 Unpaved roads - Section 13.2.2	3.2E+00	8.1E-01	8.1E-02	kg·VKT-1	77,745	VKT	Polymer application (90%), speed reduction (75%)	6,192.0	1,578.1	157.8
Grader on all roads	AP-42 - Grading - Table 11.9-2	1.5E-01	6.8E-02	4.5E-03	kg·VKT-1	9,125	VKT	Polymer application (90%)	133.3	62.1	4.1
Vegetation cleared	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	1.6	ha	0	1,390.4	695.2	104.3
Overburden removal area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	1.6	ha	0	1,393.3	696.7	104.5
Overburden backfill area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	3.2	ha	0	2,759.4	1,379.7	207.0
Soil spreading and reveg area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	3.7	ha	0	3,148.0	1,574.0	236.1
Product drying stockpiles	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.1	ha	3 sided bins	17.0	8.5	1.3
								TOTAL	**116,421.9**	**32,645.2**	**4,725.6**

Scenario 3 – peak daily emissions

		Emission rate							Controlled emissions (kg.day-1)		
Description	Emission Factor	TSP	PM10	PM2.5	Units	Activity Rate	Units	Emission Controls	TSP	PM10	PM2.5
AVC - bulldozer clearing vegetation	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.2E+00	2.1E-01	1.2E-01	kg·hr-1	3	hr	0	2.9	0.5	0.3
ASS - scraper on topsoil	AP-42 - Topsoil removal by scraper - Table 11.9-4	2.9E-02	7.3E-03	1.1E-03	kg·t-1	2,830	t	0	82.1	20.5	3.1
DM - excavator loading overburden to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	44,077	t	Pit retention	1.9	1.7	0.3
OBF - unloading of haul trucks at OBF area	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	44,077	t	Pit retention	1.9	1.7	0.3
OBF - bulldozer push overburden	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.0E+00	1.9E-01	1.0E-01	kg·hr-1	12	hr	Pit retention	6.0	2.2	1.2
SSR - unloading of soil in reveg area	AP-42 - Scraper unloading (batch drop) - Table 11.9-4	2.0E-02	5.0E-03	7.5E-04	kg·t-1	2,830	t	0	56.6	14.2	2.1
SSR - bulldozer spreading soil in reveg area	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.2E+00	2.1E-01	1.2E-01	kg·hr-1	3	hr	0	2.9	0.5	0.3
DrM - Interburden removal, dredge mining	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	87,922	t	Wet - 100% controlled	-	-	-
DrM - Ore extraction, dredge mining	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	75,480	t	Wet - 100% controlled	-	-	-
Pr - wet concentration plant	AP-42 - Screening - Table 11.19.2.1	1.3E-02	4.3E-03	3.0E-04	kg·t-1	75,480	t	Wet - 100% controlled	-	-	-
Pr - HMC loaded to stockpiles for drying	AP-42 - Batch drop - Section 13.2.4.3	4.4E-04	2.1E-04	3.1E-05	kg·t-1	1,055	t	0	0.5	0.2	0.0
Pr - HMC loaded to shipping containers	AP-42 - Batch drop - Section 13.2.4.3	4.4E-04	2.1E-04	3.1E-05	kg·t-1	1,055	t	0	0.5	0.2	0.0
Stripped topsoil and subsoil to reveg area	AP-42 Unpaved roads - Section 13.2.2	2.8E+00	7.2E-01	7.2E-02	kg·VKT-1	199	VKT	Polymer application (90%), speed reduction (75%)	14.0	3.6	0.4
Stripped overburden to placement area	AP-42 Unpaved roads - Section 13.2.2	4.7E+00	1.2E+00	1.2E-01	kg·VKT-1	922	VKT	Polymer application (90%), speed reduction (75%)	108.6	27.7	2.8
Offsite transportation of product in containers, B-	AP-42 Unpaved roads - Section 13.2.2	3.2E+00	8.1E-01	8.1E-02	kg·VKT-1	298	VKT	Polymer application (90%), speed reduction (75%)	23.8	6.1	0.6
Grader on all roads	AP-42 - Grading - Table 11.9-2	1.5E-01	6.8E-02	4.5E-03	kg·VKT-1	25	VKT	Polymer application (90%)	0.4	0.2	0.0
Vegetation cleared	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	1.6	ha	0	3.8	1.9	0.3
Overburden removal area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	1.6	ha	0	3.8	1.9	0.3
Overburden backfill area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	3.2	ha	0	7.6	3.8	0.6
Soil spreading and reveg area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	3.7	ha	0	8.6	4.3	0.6
Product drying stockpiles	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.1	ha	3 sided bins	0.0	0.0	0.0
								TOTAL	**325.7**	**91.2**	**13.1**

Scenario 4- annual emissions

		Emission rate							Controlled emission (kg.yr-1)		
Description	Emission Factor	TSP	PM10	PM2.5	Units	Activity Rate	Units	Emission Controls	TSP	PM10	PM2.5
AVC - bulldozer clearing vegetation	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.2E+00	2.1E-01	1.2E-01	kg·hr-1	913	hr	0	1,061.9	189.3	111.5
ASS - scraper on topsoil	AP-42 - Topsoil removal by scraper - Table 11.9-4	2.9E-02	7.3E-03	1.1E-03	kg·t-1	73,985	t	0	2,145.6	536.4	80.5
DM - excavator loading overburden to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	10,981,770	t	Pit retention	474.7	426.6	64.6
OBF - unloading of haul trucks at OBF area	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	10,981,770	t	Pit retention	474.7	426.6	64.6
OBF - bulldozer push overburden	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.0E+00	1.9E-01	1.0E-01	kg·hr-1	4,380	hr	Pit retention	2,185.1	807.6	435.9
SSR - unloading of soil in reveg area	AP-42 - Scraper unloading (batch drop) - Table 11.9-4	2.0E-02	5.0E-03	7.5E-04	kg·t-1	73,985	t	0	1,479.7	369.9	55.5
SSR - bulldozer spreading soil in reveg area	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.2E+00	2.1E-01	1.2E-01	kg·hr-1	913	hr	0	1,061.9	189.3	111.5
DrM - Interburden removal, dredge mining	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	27,679,289	t	Wet - 100% controlled	-	-	-
DrM - Ore extraction, dredge mining	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	20,886,750	t	Wet - 100% controlled	-	-	-
Pr - wet concentration plant	AP-42 - Screening - Table 11.19.2.1	1.3E-02	4.3E-03	3.0E-04	kg·t-1	20,886,750	t	Wet - 100% controlled	-	-	-
Pr - HMC loaded to stockpiles for drying	AP-42 - Batch drop - Section 13.2.4.3	4.4E-04	2.1E-04	3.1E-05	kg·t-1	340,000	t	0	148.6	70.3	10.6
Pr - HMC loaded to shipping containers	AP-42 - Batch drop - Section 13.2.4.3	4.4E-04	2.1E-04	3.1E-05	kg·t-1	340,000	t	0	148.6	70.3	10.6
Stripped topsoil and subsoil to reveg area	AP-42 Unpaved roads - Section 13.2.2	2.8E+00	7.2E-01	7.2E-02	kg·VKT-1	8,628	VKT	Polymer application (90%), speed reduction (75%)	607.4	154.8	15.5
Stripped overburden to placement area	AP-42 Unpaved roads - Section 13.2.2	4.7E+00	1.2E+00	1.2E-01	kg·VKT-1	272,750	VKT	Polymer application (90%), speed reduction (75%)	32,119.6	8,186.1	818.6
Offsite transportation of product in containers, B-	AP-42 Unpaved roads - Section 13.2.2	3.2E+00	8.1E-01	8.1E-02	kg·VKT-1	77,745	VKT	Polymer application (90%), speed reduction (75%)	6,192.0	1,578.1	157.8
Grader on all roads	AP-42 - Grading - Table 11.9-2	1.5E-01	6.8E-02	4.5E-03	kg·VKT-1	9,125	VKT	Polymer application (90%)	133.3	62.1	4.1
Vegetation cleared	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.5	ha	0	420.5	210.2	31.5
Overburden removal area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.5	ha	0	459.5	229.7	34.5
Overburden backfill area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.9	ha	0	781.0	390.5	58.6
Soil spreading and reveg area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	1.0	ha	0	824.5	412.3	61.8
Product drying stockpiles	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.1	ha	3 sided bins	17.0	8.5	1.3
								TOTAL	**50,735.4**	**14,318.6**	**2,129.1**

Scenario 4 - peak daily emissions

		Emission rate							Controlled emissions (kg.day-1)		
Description	Emission Factor	TSP	PM10	PM2.5	Units	Activity Rate	Units	Emission Controls	TSP	PM10	PM2.5
AVC - bulldozer clearing vegetation	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.2E+00	2.1E-01	1.2E-01	kg·hr-1	3	hr	0	2.9	0.5	0.3
ASS - scraper on topsoil	AP-42 - Topsoil removal by scraper - Table 11.9-4	2.9E-02	7.3E-03	1.1E-03	kg·t-1	203	t	0	5.9	1.5	0.2
DM - excavator loading overburden to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	30,087	t	Pit retention	1.3	1.2	0.2
OBF - unloading of haul trucks at OBF area	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	30,087	t	Pit retention	1.3	1.2	0.2
OBF - bulldozer push overburden	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.0E+00	1.9E-01	1.0E-01	kg·hr-1	12	hr	Pit retention	6.0	2.2	1.2
SSR - unloading of soil in reveg area	AP-42 - Scraper unloading (batch drop) - Table 11.9-4	2.0E-02	5.0E-03	7.5E-04	kg·t-1	203	t	0	4.1	1.0	0.2
SSR - bulldozer spreading soil in reveg area	AP-42 - Bulldozing (Overburden) - Table 11.9-2	1.2E+00	2.1E-01	1.2E-01	kg·hr-1	3	hr	0	2.9	0.5	0.3
DrM - Interburden removal, dredge mining	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	75,834	t	Wet - 100% controlled	-	-	-
DrM - Ore extraction, dredge mining	AP-42 - Batch drop - Section 13.2.4.3	8.6E-05	4.1E-05	6.2E-06	kg·t-1	57,224	t	Wet - 100% controlled	-	-	-
Pr - wet concentration plant	AP-42 - Screening - Table 11.19.2.1	1.3E-02	4.3E-03	3.0E-04	kg·t-1	57,224	t	Wet - 100% controlled	-	-	-
Pr - HMC loaded to stockpiles for drying	AP-42 - Batch drop - Section 13.2.4.3	4.4E-04	2.1E-04	3.1E-05	kg·t-1	932	t	0	0.4	0.2	0.0
Pr - HMC loaded to shipping containers	AP-42 - Batch drop - Section 13.2.4.3	4.4E-04	2.1E-04	3.1E-05	kg·t-1	932	t	0	0.4	0.2	0.0
Stripped topsoil and subsoil to reveg area	AP-42 Unpaved roads - Section 13.2.2	2.8E+00	7.2E-01	7.2E-02	kg·VKT-1	24	VKT	Polymer application (90%), speed reduction (75%)	1.7	0.4	0.0
Stripped overburden to placement area	AP-42 Unpaved roads - Section 13.2.2	4.7E+00	1.2E+00	1.2E-01	kg·VKT-1	747	VKT	Polymer application (90%), speed reduction (75%)	88.0	22.4	2.2
Offsite transportation of product in containers, B-	AP-42 Unpaved roads - Section 13.2.2	3.2E+00	8.1E-01	8.1E-02	kg·VKT-1	298	VKT	Polymer application (90%), speed reduction (75%)	23.8	6.1	0.6
Grader on all roads	AP-42 - Grading - Table 11.9-2	1.5E-01	6.8E-02	4.5E-03	kg·VKT-1	25	VKT	Polymer application (90%)	0.4	0.2	0.0
Vegetation cleared	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.5	ha	0	1.2	0.6	0.1
Overburden removal area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.5	ha	0	1.3	0.6	0.1
Overburden backfill area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.9	ha	0	2.1	1.1	0.2
Soil spreading and reveg area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	1.0	ha	0	2.3	1.1	0.2
Product drying stockpiles	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg·ha-1·yr-1	0.1	ha	3 sided bins	0.0	0.0	0.0
								TOTAL	**145.8**	**41.0**	**6.0**

Offsite transport – peak daily emissions

Description	Emission Factor	Emission rate						Emission Controls	Controlled emissions (kg.day-1)		
		TSP	PM10	PM2.5	Units	Activity Rate	Units		TSP	PM10	PM2.5
Offsite transportation of product in containers, B-doubles plus buses	AP-42 Unpaved roads - Section 13.2.2	3.2E+00	8.1E-01	8.1E-02	kg·VKT-1	210	VKT	L2 watering (75%), speed reduction (85%)	25.1	6.4	0.6
								TOTAL	**25.1**	**6.4**	**0.6**