Broken Hill Mineral Separation Plant Modification

Modification Report

TRONOX

EXECUTIVE SUMMARY

ES.1 INTRODUCTION

The Broken Hill Mineral Separation Plant (MSP) is located on the south-western outskirts of Broken Hill, New South Wales (NSW) (Figure ES-1). Tronox Mining Australia Limited (Tronox) is the proponent of the MSP.

Development Consent (DA 345-11-01) for the MSP was issued under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2002.

The MSP interacts with Tronox's mineral sand mining operations in western NSW:

- Ginkgo Mineral Sands Mine (Ginkgo Mine) – approved under Part 4 of the EP&A Act in 2002 (Development Consent [DA 251-09-01]).
- Snapper Mineral Sands Mine (Snapper Mine) – approved under Part 3A of the EP&A Act in 2007 (Project Approval [06_0168]).
- Atlas-Campaspe Mineral Sands Project (Atlas-Campaspe Mine) – approved under Part 4 of the EP&A Act in 2014 (Development Consent [SSD _5012]).

This Modification Report is a Statement of Environmental Effects that has been prepared by Tronox to support a request to modify Development Consent (DA 345-11-01) under Section 4.55(1A) of the EP&A Act.

ES.2 OVERVIEW OF THE MODIFICATION

In preparation for the commencement of processing of Atlas-Campaspe Mine mineral concentrates/heavy mineral concentrate (HMC) in 2022, Tronox has conducted a review of the existing/approved MSP operations to identify opportunities to optimise the MSP operations to improve overall mineral recovery.

This review identified that mineral recovery could be improved by bypassing the wet high intensity magnetic separator and reconfiguring the existing ilmenite and leucoxene circuits. The Modification includes the implementation of these changes to the MSP processing circuits.

The Broken Hill Mineral Separation Plant Modification (the Modification) would also include changes to reflect road and rail transport changes previously assessed and approved as part of separate modification applications to the Ginkgo and Snapper Mines and Atlas-Campaspe Mine, respectively.

Table ES-1 provides a comparative summary of the existing/approved and modified MSP.

In accordance with Clause 3BA(6) of Schedule 2 of the *Environmental Planning and Assessment (Savings, Transitional and Other Provisions) Regulation 2017*, the consent authority is required to satisfy itself that any consent as modified would result in the MSP remaining substantially the same development as was last modified under Section 75W of the EP&A Act (i.e. Modification 5, October 2017 which is the existing/approved MSP), inclusive of consideration of the changes arising from previously approved modifications.

Based on a review of the proposed changes, Tronox considers that the modified MSP would be substantially the same as the existing/approved MSP.

ES.3 ENGAGEMENT

Tronox has consulted with a number of stakeholders during the development of the Modification Report, including:

- Department of Planning, Industry and Environment;
- Environment Protection Authority;
- Broken Hill City Council (BHCC); and
- relevant landholders.

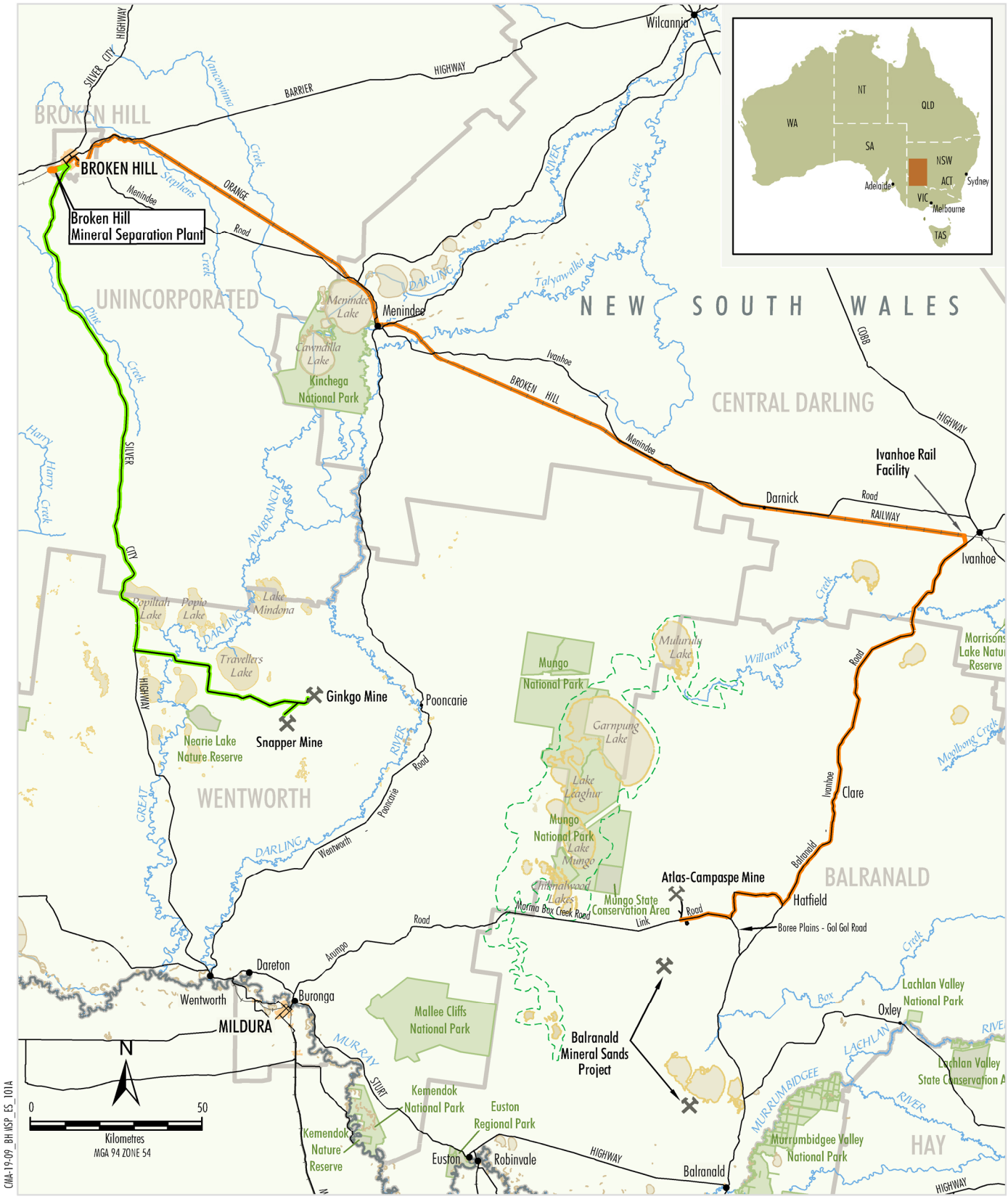
No significant issues regarding the Modification were raised by stakeholders during the development of the Modification Report.

The outcomes of engagement with these stakeholders has informed the development of the scope of the Modification and Tronox's preparation of the Modification Report.

ES.4 ASSESSMENT OF IMPACTS

Tronox has undertaken a review of the potential environmental impacts of the Modification to identify key potential environmental issues requiring assessment. The key environmental issues identified are summarised in Table ES-2 below.

The assessments conclude that the Modification is of "minimal environmental impact". In particular, the Modification would not result in any additional surface disturbance, and amenity impacts at nearby privately-owned dwellings are not expected to be significant.



LEGEND

- National Park, Regional Park or State Conservation Area
- Willandra Lakes Region World Heritage Area
- Local Government Area Boundary
- Mine Site
- Mineral Concentrate Transport Route and MSP Process Waste Transport Route
- Atlas-Campaspe Mine Mineral Concentrate Transport Route*

Source: © NSW Department of Finance, Services & Innovation (2018); Cristal Mining Australia (2012)

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BROKEN HILL MSP

Regional Location

* MSP Process Waste Transport Route following cessation of operations at the Ginkgo and Snapper Mines.

Figure ES- 1

Table ES-1
Comparison of the Existing/Approved and Modified MSP

Project Component	Existing/Approved	Modified
Project Life	• 31 December 2032.	• No change.
Mineral Concentrate/HMC Processing Rate	• Processing of up to approximately 1,200,000 tpa of mineral concentrates/HMC.	• No change.
Mineral Separation	• Mineral separation is conducted using gravity, electrostatic and magnetic separation methods.	• No change to separation methods. • Bypassing of the WHIMS. • Reconfiguration of the existing ilmenite and leucoxene circuits. • Components of the existing leucoxene circuit to be placed in care and maintenance.
Processing Fuel Types	• Gas (LNG or LPG) for the leucoxene, ilmenite, rutile and zircon dryers. • Brown Coal Briquettes for the ilmenite kiln/roaster.	• No change.
Stacks	• Eight stacks associated with the leucoxene, ilmenite, rutile and zircon circuits.	• Two additional ilmenite reheaters (and associated stacks).
Mineral Products	• Leucoxene, sulphate ilmenite, roasted ilmenite, non-magnetic concentrate, rutile, and zircon mineral products are approved to be produced at the MSP.	• No change.
Mineral Product Storage	• Mineral products are stored in mineral product stockpiles or storage sheds.	• No change.
MSP Process Waste Management	• MSP process waste is managed in accordance with the MSP Waste Management Plan.	• No change.
Mobile Equipment	• Mobile equipment includes front end loaders, integrated tool carrier, water truck and light vehicles.	• No change.
Mineral Concentrate/HMC Transport to the MSP	• Transport of up to approximately 735,000 tpa of mineral concentrates/HMC from the Ginkgo and Snapper Mines to the MSP. • Transport of up to approximately 450,000 tpa of mineral concentrates from the Ivanhoe Rail Facility to the MSP (up to three trains per week).	• Transport of up to approximately 975,000 tpa of mineral concentrates from the Ginkgo and Snapper Mines to the MSP[1]. • Transport of up to approximately 665,000 tpa of mineral concentrates from the Ivanhoe Rail Facility to the MSP (up to four trains per week)[2].
Mineral Product Transport	• Mineral products transported by rail to South Australia for shipping (up to three trains per week).	• No change.
MSP Process Waste Transport	• MSP process waste material transported in accordance with the *Code for the Safe Transport of Radioactive Material* (Australian Radiation Protection and Nuclear Safety Agency, 2019). • Transport of up to approximately 300,000 tpa of MSP process waste via road to the Ginkgo and Snapper Mines for disposal. • Transport of up to approximately 50,000 tpa MSP process waste via rail to the Ivanhoe Rail Facility and onto the Atlas-Campaspe Mine via road.	• No change to MSP process waste transport management. • No change to MSP process waste transport to the Ginkgo and Snapper Mines. • Transport of up to approximately 65,000 tpa MSP process waste via rail to the Ivanhoe Rail Facility and onto the Atlas-Campaspe Mine via road [2].

Table ES-1 (continued)
Comparison of the Existing/Approved and Modified MSP

Project Component	Existing/Approved	Modified
Water Supply and Demand	• Water is supplied from the Wills Street Waste Water Treatment Plant or Broken Hill City Council mains water supply at up to approximately 175 million litres per annum.	• No change.
Hours of Operation	• Operations – 24 hours per day, seven days per week. • Construction – 7.00 am to 6.00 pm Monday to Friday, 8.00 am to 1.00 pm Saturday.	• No change to operational hours. • Modification construction works to be undertaken 24 hours per day, seven days per week.
Workforce	• Operational workforce of up to approximately 85 personnel plus an additional 40 personnel associated with the haulage vehicle contractor.	• No change.

[1] Assessed and approved as part of Ginkgo Mine Modification 9 and Snapper Mine Modification 5 in 2015.

[2] Assessed and approved as part of Atlas-Campaspe Mine Modification 1 in 2019.

Table ES-2
Key Outcomes of Environmental Review for the Modified MSP

Environmental Aspect	Summary of Key Environmental Review Conclusions
Air Quality	It is expected that the modified MSP would continue to comply with the relevant air quality criteria at all sensitive receptors surrounding the MSP.
Noise	The modified MSP operations are expected to continue to comply with the Development Consent (DA 345-11-01) noise criterion.
Visual	The level of visual modification associated with the Modification in the context of the existing/approved MSP would not be significant. Given this insignificant level of visual modification and the visual character of the MSP area, a low level of visual impact would be expected.
Greenhouse Gas	Additional greenhouse gases directly generated as a result of the Modification (Scope 1 emissions) would be approximately 1.52 kilotonnes of carbon dioxide equivalent. Indirect emissions associated with the on-site use of electricity (i.e. Scope 2 emissions) are not expected to change.
Hazards and Risks	The Modification would not materially change the operational activities at the MSP and would not significantly alter the consequences or likelihood of a hazardous event occurring at the MSP.
Road and Rail Transport	Potential road and rail transport impacts associated with increased road and rail transport were previously assessed and approved as part of separate modification applications to the Ginkgo and Snapper Mines and Atlas-Campaspe Mine, respectively.
Aboriginal Cultural Heritage	As the Modification would not change the existing/approved surface development area at the MSP, no material changes to the approved impacts on Aboriginal cultural heritage, historic heritage, land and agricultural resources and biodiversity are expected.
Historic Heritage	
Land and Agricultural Resources	
Biodiversity	
Water Resources	As the Modification would not result in any change to the existing/approved site water management system and water supply and demand, no material changes to the existing/approved water resource impacts are expected.
Socio-Economic	As no change to the approved MSP workforce or project life is proposed for the Modification, there would be no material alteration to the approved socio-economic impacts.

ES.5 EVALUATION OF MERITS

Approval of the Modification is considered to be justified given:

- The Modification would improve mineral recovery at the MSP while maximising the use of Tronox's established facilities and associated returns on existing financial investment.
- The recovery of this additional mineral product would be conducted in a manner that minimises environmental impacts through the implementation of the Environmental Management Strategy and other measures.
- No significant issues regarding the Modification were raised by stakeholders during the development of the Modification Report.

In weighing up the main environmental impacts (costs and benefits) associated with the proposal as assessed and described in this Modification Report, the Modification is on balance, considered to be in the public interest of the State of NSW.

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1 INTRODUCTION

The Broken Hill Mineral Separation Plant (MSP) is located on the south-western outskirts of Broken Hill, New South Wales (NSW) (Figure 1). Tronox Mining Australia Limited (Tronox) is the proponent of the MSP.

Development Consent (DA 345-11-01) for the MSP was issued under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2002. Subsequently, five modifications to Development Consent (DA 345-11-01) have since been granted under the EP&A Act.

The MSP interacts with Tronox's mineral sand mining operations in western NSW (Figure 1):

- Ginkgo Mineral Sands Mine (Ginkgo Mine) – approved under Part 4 of the EP&A Act in 2002 (Development Consent [DA 251-09-01]).
- Snapper Mineral Sands Mine (Snapper Mine) – approved under Part 3A of the EP&A Act in 2007 (Project Approval [06_0168]).
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This Modification Report is a Statement of Environmental Effects that has been prepared by Tronox to support a request to modify Development Consent (DA 345-11-01) under Section 4.55(1A) of the EP&A Act.

The Broken Hill Mineral Separation Plant Modification (the Modification) includes the implementation of changes to MSP operations to improve overall mineral recovery at the MSP.

1.1 DESCRIPTION OF THE EXISTING/APPROVED MSP

The MSP is approved to process up to approximately 1,200,000 tonnes per annum (tpa) of mineral concentrate/heavy mineral concentrate (HMC) from the Ginkgo, Snapper and Atlas-Campaspe Mines, including:

- up to 735,000 tpa from the Ginkgo and Snapper Mines (transported to the MSP by road); and
- up to 450,000 tpa from the Atlas-Campaspe Mine (transported to the MSP by rail).

Only mineral concentrates from the Gingko and Snapper Mines have been processed at the MSP to date as mining operations at the Atlas-Campaspe Mine are yet to commence. Processing of Atlas-Campaspe Mine mineral concentrates/HMC at the MSP is expected to commence in 2022.

The existing/approved MSP uses gravity, electrostatic and magnetic separation methods and consists of the following processing circuits:

- wet high intensity magnetic separator (WHIMS) (not constructed);
- feed preparation circuit;
- leucoxene circuit;
- ilmenite circuit;
- ilmenite kiln/roaster circuit (not constructed);
- rutile circuit (not constructed); and
- zircon circuit (not constructed).

Mineral products are railed from the MSP to South Australia.

The MSP is approved to operate until 31 December 2032.

1.2 MODIFICATION OVERVIEW

In preparation for the commencement of processing of Atlas-Campaspe Mine mineral concentrates/HMC in 2022, Tronox has conducted a review of the existing/approved MSP operations to identify opportunities to optimise the MSP operations to improve overall mineral recovery.

This review identified that mineral recovery could be improved by bypassing the WHIMS and reconfiguring the existing ilmenite and leucoxene circuits. The Modification includes the implementation of these changes to the MSP processing circuits.

The Modification would also include changes to reflect road and rail transport changes previously assessed and approved as part of separate modification applications to the Ginkgo and Snapper Mines and Atlas-Campaspe Mine, respectively.

LEGEND

- National Park, Regional Park or State Conservation Area
- Willandra Lakes Region World Heritage Area
- Local Government Area Boundary
- Mine Site
- Mineral Concentrate Transport Route and MSP Process Waste Transport Route
- Atlas-Campaspe Mine Mineral Concentrate Transport Route*

Source: © NSW Department of Finance, Services & Innovation (2018); Cristal Mining Australia (2012)

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BROKEN HILL MSP

Regional Location

* MSP Process Waste Transport Route following cessation of operations at the Ginkgo and Snapper Mines.

Figure 1

1.3 STRUCTURE OF THE DOCUMENT

This Modification Report, prepared in consideration of the draft *Preparing a Modification Report State Significant Development Guide Exhibition Draft* (Department of Planning, Industry and Environment [DPIE], 2020), and is structured as follows:

Section 1	Provides an overview of the existing/approved MSP and an overview to the Modification.
Section 2	Provides an overview of the strategic context for the Modification.
Section 3	Provides a description of the Modification.
Section 4	Describes the statutory context of the Modification.
Section 5	Provides a summary of the engagement undertaken for the Modification and key issues raised.
Section 6	Provides a review of the existing environmental management at the MSP and an environmental assessment of the Modification.
Section 7	Evaluates the merits of the Modification, and provides justification for approval of the Modification.
Section 8	Lists the references cited in Sections 1 to 7.

Appendix A provides a supporting air quality assessment for the Modification.

2 STRATEGIC CONTEXT

2.1 REGIONAL CONTEXT

The MSP is located in the Far West region of NSW, which comprises the local government areas (LGAs) of Balranald, Brewarrina, Bourke, Broken Hill, Central Darling, Cobar, Walgett, Wentworth and the Unincorporated Area (NSW Government, 2017a).

The Far West regional economy is centred around mining and agriculture which contribute approximately 40 percent (%) of the region's gross regional product (NSW Government, 2017a).

Broken Hill is a "strategic centre" that services other parts of the Far West region (NSW Government, 2017a).

The MSP is located on the south-western outskirts of Broken Hill in an industrial area. Surrounding land uses include industrial facilities (generally mining support-related), mining, solar power generation and rail infrastructure.

Nearby sensitive receivers include predominantly industrial-related receivers and residential receivers (Section 6.2.1).

The MSP integrates with Tronox's other mineral sands mining and processing operations located in the Far West region (Section 1.1). Tronox is a significant employer and engages a range of local contractors at its operations in the Far West region.

2.2 POTENTIAL CUMULATIVE INTERACTIONS WITH OTHER PROJECTS

Key proposed or approved projects that may potentially interact with, or have potential cumulative impacts with, the MSP include:

- Broken Hill Solar Plant – existing solar farm located approximately 800 metres (m) to the west of the MSP;
- Perilya South Operations – existing lead-zinc underground mine which has a tailings storage facility located approximately 1.5 kilometres (km) to the south-east of the MSP;
- Rasp Mine – existing lead-zinc-silver underground mine located approximately 4 km to the north-east of the MSP; and
- Broken Hill Battery Energy Storage System Project – proposed battery facility located approximately 400 m to the north-east of the MSP.

Relevant cumulative impacts with the modified MSP and these existing and approved projects (where relevant) have been considered in this Modification Report (Section 6).

2.3 RELEVANT STRATEGIC PLANNING DOCUMENTS

The *Far West Regional Plan 2036* (NSW Government, 2017a) (the Regional Plan) applies to the Broken Hill LGA and is, therefore, relevant to the Modification.

The Regional Plan recognises the significance of mineral resource development and includes the sustainable management of mineral resource development in the overall vision for the region.

The modified MSP would be consistent with the overall vision in the Regional Plan to provide for the continuation of mineral resource development that incorporates a range of strategies to manage and minimise potential impacts on the surrounding environment (Section 6).

2.4 STRATEGIC NEED AND POTENTIAL BENEFITS OF THE MODIFICATION

The Modification would promote the efficient and economic recovery of additional mineral product at the MSP.

Overall mineral recovery is expected to increase from 88.3% to 90.1% while maximising the use of established MSP infrastructure and associated returns on existing financial investment.

The recovery of this additional mineral product would be conducted in a manner that minimises environmental impacts through the implementation of management measures (Section 6).

3 DESCRIPTION OF THE MODIFICATION

A description of the Modification is provided in this section, including a comparison of the modified MSP with the approved MSP.

As only minor changes are proposed to the approved MSP as part of the Modification (Table 1), this section focuses on the components of the MSP that would change as a result of the Modification.

3.1 OVERVIEW

The Modification would include the following:

- Bypassing of the WHIMS as HMC would no longer be pre-processed in the WHIMS prior to processing in the other MSP circuits.
- The existing ilmenite circuit would be reconfigured to allow it to process HMC without pre-processing in the WHIMS, including:
  - addition of two gas-fired mineral reheaters and associated stacks;
  - addition of magnetic separators;
  - addition of a trash screen;
  - duplication of the existing ilmenite circuit feed conveyor;
  - a minor extension to the ilmenite circuit building (including connecting conveyor); and
  - other minor reconfigurations to processing infrastructure inside the existing ilmenite circuit building.
- The existing leucoxene circuit building and associated equipment (e.g. magnetic separators) would be reconfigured to support the reconfigured ilmenite circuit.
- The following key components of the existing leucoxene circuit would be placed in care and maintenance:
  - gas-fired mineral dryer and associated stack;
  - trash screens; and
  - leucoxene circuit feed conveyor.
- Construction activities associated with the Modification would be undertaken 24 hours per day, seven days per week to minimise the duration of the suspension of MSP operational activities required during the construction phase.

The Modification would not change the following components of the existing/approved MSP:

- operational life and hours;
- processing rate;
- mineral separation methods;
- mineral products;
- mineral product storage, loading and transport;
- MSP process waste management;
- supporting infrastructure (administration/workshop/laboratory buildings, access road, rail spur, water management infrastructure);
- fuel storage and management;
- water supply and demand; and
- workforce.

The Modification would also include changes to reflect road and rail transport changes previously assessed and approved as part of separate modification applications to the Ginkgo and Snapper Mines and Atlas-Campaspe Mine, respectively.

Table 1 provides a comparative summary of the existing/approved and modified MSP. Based on a review of the proposed changes, Tronox considers that the modified MSP would be substantially the same as the existing/approved MSP.

The sub-sections below provide a detailed description of the MSP components relevant to the Modification.

3.2 GENERAL ARRANGEMENT

The existing/approved MSP includes the following major site components:

- WHIMS (not constructed);
- feed preparation circuit;
- leucoxene circuit;
- ilmenite circuit;
- ilmenite kiln/roaster circuit (not constructed);
- rutile circuit (not constructed);
- zircon circuit (not constructed);
- dryer and baghouse stacks;
- mineral concentrate/HMC stockpiles;

Table 1
Comparison of the Existing/Approved and Modified MSP

Project Component	Existing/Approved	Modified
Project Life	• 31 December 2032.	• No change.
Mineral Concentrate/HMC Processing Rate	• Processing of up to approximately 1,200,000 tpa of mineral concentrates/HMC.	• No change.
Mineral Separation	• Mineral separation is conducted using gravity, electrostatic and magnetic separation methods.	• No change to separation methods. • Bypassing of the WHIMS. • Reconfiguration of the existing ilmenite and leucoxene circuits. • Components of the existing leucoxene circuit to be placed in care and maintenance.
Processing Fuel Types	• Gas (liquified natural gas [LNG] or liquified petroleum gas [LPG]) for the leucoxene, ilmenite, rutile and zircon dryers. • Brown Coal Briquettes for the ilmenite kiln/roaster.	• No change.
Stacks	• Eight stacks associated with the leucoxene, ilmenite, rutile and zircon circuits.	• Two additional ilmenite reheaters (and associated stacks).
Mineral Products	• Leucoxene, sulphate ilmenite, roasted ilmenite, non-magnetic concentrate, rutile and zircon mineral products are approved to be produced at the MSP.	• No change.
Mineral Product Storage	• Mineral products are stored in mineral product stockpiles or storage sheds.	• No change.
MSP Process Waste Management	• MSP process waste is managed in accordance with the MSP Waste Management Plan.	• No change.
Mobile Equipment	• Mobile equipment includes front end loaders, integrated tool carrier, water truck and light vehicles.	• No change.
Mineral Concentrate/HMC Transport to the MSP	• Transport of up to approximately 735,000 tpa of mineral concentrates/HMC from the Ginkgo and Snapper Mines to the MSP. • Transport of up to approximately 450,000 tpa of mineral concentrates from the Ivanhoe Rail Facility to the MSP (up to three trains per week).	• Transport of up to approximately 975,000 tpa of mineral concentrates from the Ginkgo and Snapper Mines to the MSP[1]. • Transport of up to approximately 665,000 tpa of mineral concentrates from the Ivanhoe Rail Facility to the MSP (up to four trains per week)[2].
Mineral Product Transport	• Mineral products transported by rail to South Australia for shipping (up to three trains per week).	• No change.
MSP Process Waste Transport	• MSP process waste material transported in accordance with the *Code for the Safe Transport of Radioactive Material* (Australian Radiation Protection and Nuclear Safety Agency, 2019). • Transport of up to approximately 300,000 tpa of MSP process waste via road to the Ginkgo and Snapper Mines for disposal. • Transport of up to approximately 50,000 tpa MSP process waste via rail to the Ivanhoe Rail Facility and onto the Atlas-Campaspe Mine via road.	• No change to MSP process waste transport management. • No change to MSP process waste transport to the Ginkgo and Snapper Mines. • Transport of up to approximately 65,000 tpa MSP process waste via rail to the Ivanhoe Rail Facility and onto the Atlas-Campaspe Mine via road [2].

Table 1 (continued)
Comparison of the Existing/Approved and Modified MSP

Project Component	Existing/Approved	Modified
Water Supply and Demand	• Water is supplied from the Wills Street Waste Water Treatment Plant or Broken Hill City Council (BHCC) mains water supply at up to approximately 175 million litres per annum.	• No change.
Hours of Operation	• Operations – 24 hours per day, seven days per week. • Construction – 7.00 am to 6.00 pm Monday to Friday, 8.00 am to 1.00 pm Saturday.	• No change to operational hours. • Modification construction works to be undertaken 24 hours per day, seven days per week.
Workforce	• Operational workforce of up to approximately 85 personnel plus an additional 40 personnel associated with the haulage vehicle contractor.	• No change.

[1] Assessed and approved as part of Ginkgo Mine Modification 9 and Snapper Mine Modification 5 in 2015.

[2] Assessed and approved as part of Atlas-Campaspe Mine Modification 1 in 2019.

- mineral product stockpiles;
- mineral product storage sheds;
- gas storage;
- coal container storage (not constructed);
- MSP process waste storage area;
- rail spur;
- access road;
- secondary access road;
- electricity transmission line;
- water supply pipeline;
- water management infrastructure;
- processing water treatment plant;
- sewage treatment plant;
- effluent utilisation areas;
- process water dam;
- laydown area; and
- administration, laboratory and workshop buildings.

The existing/approved and modified MSP general arrangements are shown on Figures 2 and 3.

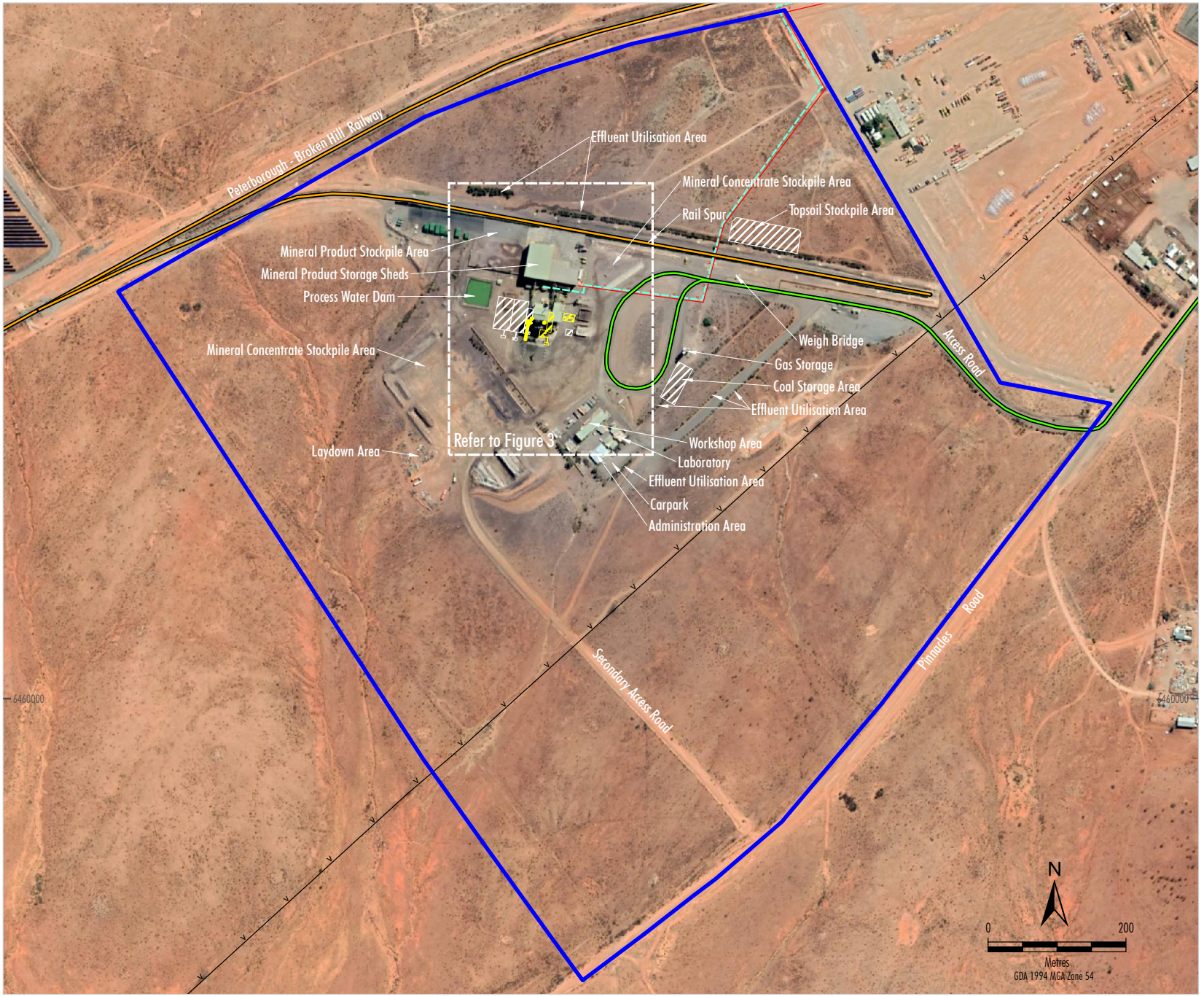
The Modification would include the following changes to the approved MSP general arrangement (Figures 2 and 3):

- addition of two stacks associated with the gas-fired mineral reheaters;
- duplication of the existing ilmenite circuit feed conveyor;
- a minor extension to the ilmenite circuit building;
- the following key components of the existing leucoxene circuit would be placed in care and maintenance:
  - stack associated with the gas-fired mineral dryer;
  - trash screens; and
  - leucoxene circuit feed conveyor.

The Modification would not require additional surface development areas as the changes would occur within the existing surface development area at the MSP (Figures 2 and 3).

3.3 CONSTRUCTION AND OPERATIONAL HOURS OF OPERATION

MSP operations are approved to occur up to 24 hours per day, seven days per week.



LEGEND

- MSP Property Boundary
- Approved MSP Component (Not Constructed)
- Existing/Approved MSP Component to be Placed in Care and Maintenance
- Modified MSP Component
- Water Supply Pipeline
- Electricity Transmission Line
- High Voltage Powerline
- Mineral Concentrate Transport Route and MSP Process Waste Transport Route
- Atlas-Campaspe Mine Mineral Concentrate Transport Route*

** MSP Process Waste Transport Route following cessation of operations at the Ginkgo and Snapper Mines.*

Source: NSW Spatial Services (2020)
Orthophoto: Google Earth (2020)

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BROKEN HILL MSP

Existing/Approved and Modified General Arrangement

Figure 2

CMA-19-09 BH MSPMod MT_202A

CMA-19-09 BH MSPMod MT_203A

LEGEND

- Approved MSP Component (Not Constructed)
- Existing/Approved MSP Component to be Placed in Care and Maintenance
- Modified MSP Component
- Water Supply Pipeline
- Electricity Transmission Line
- Mineral Concentrate Transport Route and MSP Process Waste Transport Route
- Atlas-Campaspe Mine Mineral Concentrate Transport Route*

** MSP Process Waste Transport Route following cessation of operations at the Ginkgo and Snapper Mines.*

Stacks

1. Leucoxene Dryer Stack
2. Leucoxene Hygiene Baghouse Stack
3. Ilmenite Dryer Stack
4. Ilmenite Hygiene Baghouse Stack
5. Rutile Dryer Stack (Not Constructed)
6. Ilmenite Kiln Stack (Not Constructed)
7. Zircon Dryer Stack (Not Constructed)
8. Rutile/Zircon Hygiene Baghouse Stack (Not Constructed)
9. Ilmenite Reheater Stack 1
10. Ilmenite Reheater Stack 2

Source: NSW Spatial Services (2020)
Orthophoto: Google Earth (2020)

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BROKEN HILL MSP

Existing/Approved and Modified General Arrangement Inset

Figure 3

The Modification would include a construction phase associated with the reconfiguration of the existing ilmenite and leucoxene circuits (including the additional gas-fired mineral reheaters [and associated stacks]).

The construction phase would occur over an approximate three month period and would require limited additional fleet items (Section 6.3.2).

During the construction phase, operational activities at the MSP would need to cease (i.e. construction activities would not occur concurrently with operational activities).

Schedule 2, Condition 3.6D of Development Consent (DA 345-11-01), construction work at the MSP would be undertaken during the following hours:

- 7:00 am to 6:00 pm Monday to Friday; and
- 8:00 am to 1:00 pm Saturdays.

To minimise the duration of the suspension of MSP operational activities, Tronox proposes to undertake the construction activities for the Modification components 24 hours per day, seven days per week (i.e. consistent with the approved hours of operation).

3.4 MINERAL CONCENTRATES/HMC PROCESSING

The existing/approved MSP uses gravity, electrostatic and magnetic separation methods and consists of the following processing circuits:

- WHIMS (not constructed);
- feed preparation circuit;
- leucoxene circuit;
- ilmenite circuit;
- ilmenite kiln/roaster circuit (not constructed);
- rutile circuit (not constructed); and
- zircon circuit (not constructed).

The Modification would not change the approved feed preparation circuit, ilmenite kiln/roaster circuit, rutile or zircon circuit.

The Modification would include the bypassing of the WHIMS and the reconfiguration of the existing ilmenite and leucoxene circuits to improve overall mineral recovery at the MSP. A description of these changes to the processing circuits is provided below.

The process flow sheet schematic for the approved and modified MSP is shown on Figure 4.

WHIMS

The WHIMS is a preliminary treatment stage which separates HMC into ilmenite-rich, leucoxene-rich and non-magnetic (containing rutile and zircon) mineral concentrates for subsequent processing in the MSP (Figure 4).

HMC is currently approved to be processed in the WHIMS at either the MSP or at the Ginkgo, Snapper and Atlas-Campaspe Mines. The WHIMS is currently located at the Gingko Mine and has therefore not been constructed at the MSP (Figure 4).

The Modification would allow for HMC to be processed at the MSP without pre-processing in the WHIMS. HMC would bypass the WHIMS and be fed directly to the modified ilmenite circuit (Figure 4).

Notwithstanding the above, the approved WHIMS may be constructed at the MSP if ongoing operational reviews determine that the WHIMS is required.

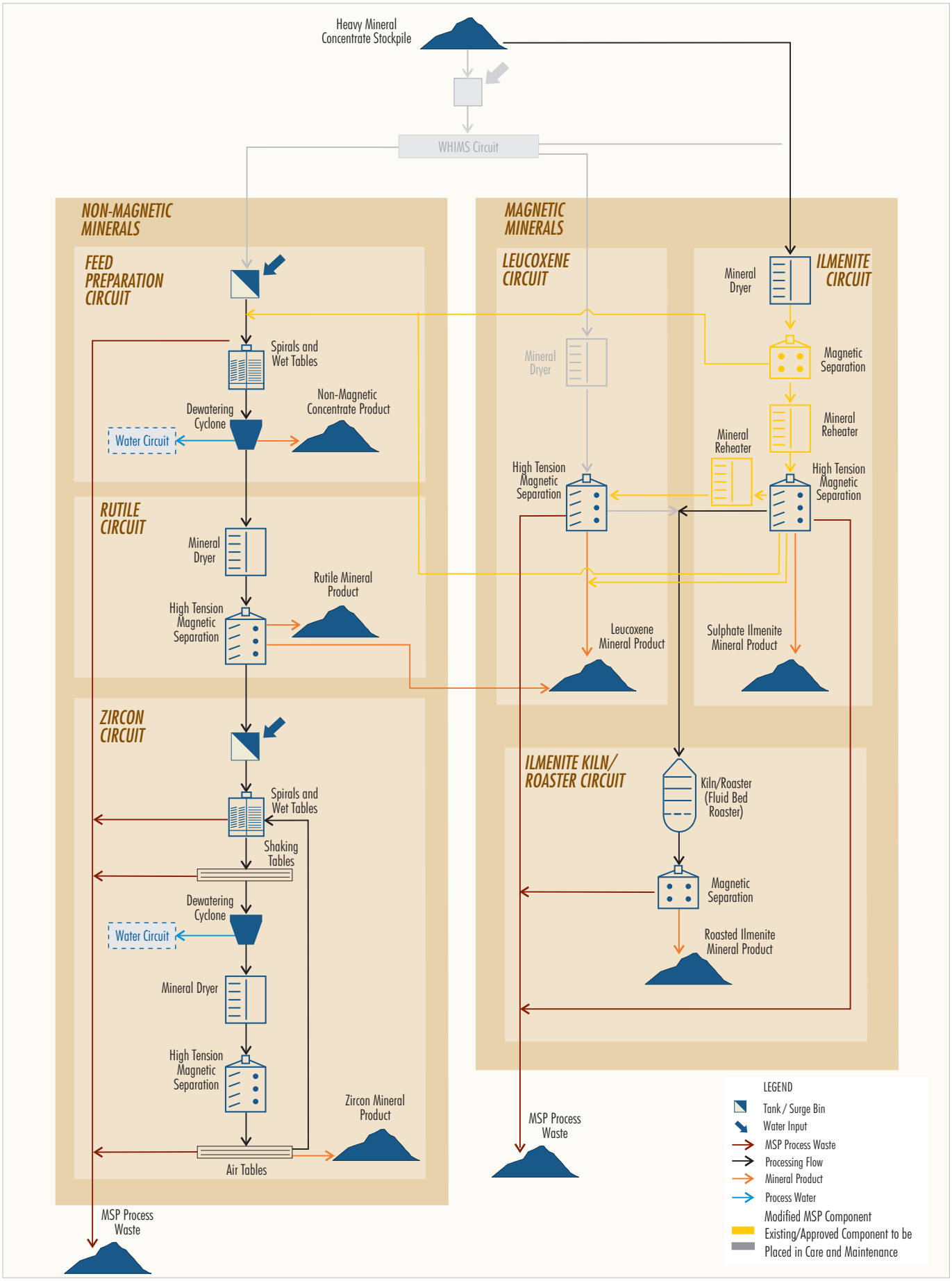
Ilmenite Circuit

The approved ilmenite circuit processes the ilmenite mineral concentrate to produce sulphate ilmenite mineral product and a minor process waste component (Figure 4).

The ilmenite circuit uses magnetic separation and requires no chemical reagents. The ilmenite mineral concentrate is initially washed and then dried in a gas-fired dryer before being transferred to a magnetic separator (Figure 4).

The Modification would include the reconfiguration of the existing ilmenite circuit to allow it to process HMC without pre-processing in the WHIMS, including:

- addition of two gas-fired mineral reheaters and associated stacks;
- addition of magnetic separators;
- addition of a trash screen;
- duplication of the existing ilmenite circuit feed conveyor;
- a minor extension to the ilmenite circuit building (including connecting conveyor); and
- other minor reconfigurations to processing infrastructure inside the existing ilmenite circuit building.



TRONOX

BROKEN HILL MSP

Modified MSP
Process Flow Sheet Schematic

Figure 4

The modified ilmenite circuit would produce a leucoxene mineral product stream and a non-magnetic mineral concentrate stream that would be further processed in the feed preparation circuit (Figure 4).

Leucoxene Circuit

The approved leucoxene circuit processes the leucoxene mineral concentrate to produce leucoxene mineral product, sulphate ilmenite mineral product and a minor process waste component (Figure 4).

The leucoxene circuit uses magnetic separation and requires no chemical reagents. The leucoxene mineral concentrate is initially washed and then dried in a gas-fired dryer before being transferred to a magnetic separator.

The Modification would include the reconfiguration of the existing leucoxene circuit building and associated equipment (e.g. magnetic separators) to support the reconfigured ilmenite circuit (Figure 4).

In addition, the following key components of the existing leucoxene circuit would be placed in care and maintenance as part of the Modification:

- gas-fired mineral dryer and associated stack;
- trash screens; and
- leucoxene circuit feed conveyor.

Notwithstanding the above, these approved leucoxene circuit components may be recommissioned if ongoing operational reviews determine that they are required.

3.5 STACK DESIGN PARAMETERS

The approved stack design parameters (minimum height, diameter and discharge velocity) are provided in Table 2.

The Modification would include (Table 2):

- the placement of the existing stack associated with the leucoxene circuit gas-fired mineral dryer into care and maintenance; and
- the addition of two stacks associated with the gas-fired mineral reheaters.

Although the design parameters for the mineral reheater stacks would be confirmed during detailed design, the final design would comply with the design parameters (minimum height, diameter and discharge velocity) outlined in Table 2.

The mineral reheater stacks would be designed to comply with the in-stack concentration criteria in the *Protection of the Environment Operations (Clean Air) Regulation 2010*.

Table 2
Existing/Approved and Modified Stack Design Parameters

Stack	Minimum Stack Height (m)	Minimum Stack Diameter (m)	Minimum Discharge Velocity (m/s)
Approved Stacks			
Leucoxene Hygiene Baghouse	40.0	0.49	15
Leucoxene Dryer[1]	40.2	0.50	-
Ilmenite Hygiene Baghouse	40.4	0.75	17.3
Ilmenite Dryer	40.4	0.90	18.5
Rutile Dryer	40.2	0.55	15
Ilmenite Kiln	41.2	0.55	15
Rutile/ Zircon Hygiene Baghouse	40.5	1.00	15
Zircon Dryer	40.2	0.35	15
Modified Stacks			
Ilmenite Reheater 1[2]	40.4	0.31	15.6
Ilmenite Reheater 2[2]	40.4	0.22	16.1

m/s = metres per second.

[1] To be placed in care and maintenance under the Modification.

[2] Stack design parameters to be confirmed during detailed design.

In addition, consistent with Condition 3.2(b) of Development Consent (DA 345-11-01), the mineral reheater stacks would be designed in accordance with good engineering practice in order to minimise the effects of stack tip downwash and building wake effects on ground – level air pollutant concentrations.

3.6 MINERAL CONCENTRATES/HMC TRANSPORT

Mineral concentrate/HMC is transported to the MSP as follows:

- Road Transport – up to 735,000 tpa from the Ginkgo and Snapper Mines; and
- Rail Transport – up to 450,000 tpa from the Atlas-Campaspe Mine (via the Ivanhoe Rail Facility).

In August 2014, an application to modify the Snapper Mine Project Approval (06_0168) under section 75W of the EP&A Act was lodged to allow for changes to the approved mineral concentrate/HMC road transport operations (amongst other things). The Snapper Mine modification application was subsequently approved in March 2015.

The Ginkgo Mine Development Consent (DA 251-09-01) was also modified in March 2015 to incorporate the mineral concentrate/HMC road transport operations proposed in the Snapper Mine modification application.

The Modification would include an increase in the approved mineral concentrate/HMC road transport rate from 735,000 tpa to 975,000 tpa to reflect road transport changes previously assessed and approved as part of the Snapper Mine and Gingko Mine modification applications.

The increased road transport rate did not require an increase in heavy vehicle movements as larger capacity vehicles would be used (Cristal Mining [Cristal], 2014).

In July 2019, Tronox lodged an application to modify the Atlas-Campaspe Mine Development Consent (SSD_5012) under section 4.55(2) of the EP&A Act to allow for changes to the approved mineral concentrate/HMC rail transport operations (amongst other things). The Atlas-Campaspe Mine modification application was subsequently approved in December 2019.

The Modification would include the following changes to the approved mineral concentrate/HMC rail transport operations to reflect rail transport changes previously assessed and approved as part of the Atlas-Campaspe Mine modification application (Tronox, 2019a):

- increased mineral concentrate/HMC transport from the Ivanhoe Rail Facility from 450,000 tpa to 665,000 tpa;
- increased mineral concentrate/HMC transport train length (from 600 m to 920 m) and frequency (from three to four trains per week); and
- increased MSP process waste transport to the Ivanhoe Rail Facility from 50,000 tpa to 65,000 tpa.

There would be no change to the maximum number of trains in any 24-hour period (i.e. one train per day) (Tronox, 2019a).

3.7 MSP PROCESS WASTE MANAGEMENT

Characterisation and Classification

Process waste generated at the MSP comprises the following:

- silica and quartz from the feed preparation circuit;
- silicate minerals and monazite from the leucoxene and ilmenite circuits;
- silicate minerals and monazite from the rutile and zircon circuits; and
- ash waste by-product and sulphur-based effluent from the combustion of coal.

All heavy mineral sands (including those from the Ginkgo, Snapper and Atlas-Campaspe Mines) contain traces of naturally occurring radioactive elements (e.g. thorium). Monazite contains cerium, lanthanum and neodymium and is a source of the radioactive element thorium.

Monazite concentrates in the waste streams along with other minerals that have similar specific gravities, magnetic and conductivity properties.

Given the presence of monazite in the MSP process waste, its specific activity can be greater than 100 becquerels per gram. The MSP process waste is likely to be classified as:

- "Hazardous" in accordance with the *Waste classification guidelines Part 3: Waste containing radioactive material* (NSW Environment Protection Authority [EPA], 2014); and
- a "radioactive substance" under the NSW *Radiation Control Act 1990*.

Quantities and Management Strategy

The MSP is currently approved to produce up to approximately 300,000 tpa of MSP process waste.

Although the Modification would not increase the rate of MSP process waste production at the MSP (i.e. 300,000 tpa), the Modification would increase the rate of MSP process waste transported to the Ivanhoe Rail Facility and then on to the Atlas-Campaspe Mine from 50,000 tpa to 65,000 tpa to reflect rail transport changes previously assessed and approved as part of the Atlas-Campaspe Mine modification application (Section 3.6).

The management of MSP process waste at the MSP is conducted in accordance with the MSP Waste Management Plan.

The MSP Waste Management Plan outlines the following management measures:

- separate dust collection for sections of the MSP that involve streams containing elevated monazite contents;
- use of an industrial vacuum system to minimise potential dust sources;
- separately enclose equipment items that involve streams containing elevated monazite contents; and
- wetting (or "pugging") of any dust collected to eliminate the dust hazard at its source.

MSP waste streams containing monazite are directed to a process sump where it is wetted and blended with the other MSP waste streams.

Front end loaders are used to load the "pugged" MSP process waste on to haulage vehicles or rail containers for transport via the mineral concentrate and MSP process waste transport route to the Gingko, Snapper and Atlas-Campaspe Mines for disposal.

The MSP process waste is transported in accordance with the Traffic Management Plan and Code of Conduct (Tronox, 2020a) and the *Code for the Safe Transport of Radioactive Material* (Australian Radiation Protection and Nuclear Safety Agency, 2019).

The Modification would not change the MSP process waste management strategy.

4 STATUTORY CONTEXT

4.1 ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

The EP&A Act and *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) set the framework for planning and environmental assessment in NSW.

4.1.1 Applicability of S4.55(1A) of the Environmental Planning and Assessment Act 1979

The MSP was approved under Part 4 of the EP&A Act in 2002 (Development Consent [DA 345-11-01]).

Section 4.55(1A) of the EP&A Act relevantly provides:

> **4.55 Modifications of consents-generally**
>
> …
>
> ***(1A) Modifications involving minimal environmental impact*** *A consent authority may, on application being made by the applicant or any other person entitled to act on a consent granted by the consent authority and subject to and in accordance with the regulations, modify the consent if:*
>
> *(a) it is satisfied that the proposed modification is of minimal environmental impact, and*
>
> *(b) it is satisfied that the development to which the consent as modified relates is substantially the same development as the development for which the consent was originally granted and before that consent as originally granted was modified (if at all), and*
>
> *(c) it has notified the application in accordance with:*
>
> *(i) the regulations, if the regulations so require, or*
>
> *(ii) a development control plan, if the consent authority is a council that has made a development control plan that requires the notification or advertising of applications for modification of a development consent, and*
>
> *(d) it has considered any submissions made concerning the proposed modification within any period prescribed by the regulations or provided by the development control plan, as the case may be.*
>
> *Subsections (1), (2) and (5) do not apply to such a modification.*

Consideration of the key comparatives detailed in the draft guideline *Modifying an Approved Project* (NSW Government, 2017b) when considering whether the Modification could be considered to be "substantially the same" is provided in Table 3.

The MSP has demonstrably remained a large mineral separation plant that incorporates the following key elements approved under Development Consent (DA 345-11-01) (Table 3):

- mineral processing facilities;
- mineral handling and storage facilities;
- mineral concentrate road and rail transport activities; and
- supporting infrastructure and facilities.

Table 3
Existing/Approved and Modified Mineral Separation Plant

Key Comparatives	Broken Hill MSP	Modified MSP
Development size, scale and footprint	MSP operation and associated facilities.	No change.
Intensity including rates of production	1,200,000 tpa.	No change.
Primary, secondary and ancillary use	Operation of MSP to process mineral sands from Ginkgo, Snapper and Atlas-Campaspe Mines.	Modification to existing MSP configuration to bypass the WHIMS.
Project life and hours of operation	Project Approval to 31 December 2032. Operating hours are 24 hours per day, seven days per week.	No change.
Extent, duration and severity of impacts	As described in previous environmental assessments and as authorised by DA 345-11-01.	No material change.

This would also clearly continue to be the case if the Modification was approved (Table 3) and therefore the consent authority can be satisfied that the MSP incorporating the Modification would remain "substantially the same".

Furthermore, this Modification Report includes a Statement of Environmental Effects in accordance with clause 115(1)(e) of the EP&A Regulation. The assessments contained herein conclude that the Modification is of "minimal environmental impact". In particular, the Modification would not result in any additional surface disturbance, and amenity impacts at nearby privately-owned dwellings are not expected to be significant.

4.1.2 EP&A Act Objects

Section 1.3 of the EP&A Act describes the objects of the EP&A Act as follows:

(a) to promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources,

(b) to facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment,

(c) to promote the orderly and economic use and development of land,

(d) to promote the delivery and maintenance of affordable housing,

(e) to protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats,

(f) to promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage),

(g) to promote good design and amenity of the built environment,

(h) to promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants,

(i) to promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State,

(j) to provide increased opportunity for community participation in environmental planning and assessment.

The Modification is considered to be generally consistent with the objects of the EP&A Act, because it is a Modification that:

- incorporates:
  - continued operation of the MSP in a manner that minimises environmental impacts through the implementation of environmental management measures (Section 6);
  - measures to minimise potential amenity impacts associated with air quality and noise impacts on surrounding land uses (Sections 6.2 and 6.3); and
  - continued employment and other socio-economic benefits to the community (Section 6);
- involves the orderly and economic use of land as the Modification would not require additional surface development;
- would support the ongoing provision of community services and facilities through contributions to NSW Government taxes, Commonwealth tax revenue and voluntary contributions to community initiatives;
- is an application under Section 4.55(1A) of the EP&A Act that would be determined by the NSW Government however, consultation with the EPA, BHCC and a range of stakeholders has been undertaken (Section 5); and
- involves public involvement and participation through Tronox's consultation activities (Section 5), which would be ongoing through DPIE's assessment of the Modification in accordance with the requirements of the EP&A Act.

4.1.3 Evaluation under Section 4.15(1) of the Environmental Planning and Assessment Act 1979

In evaluating the Modification, under section 4.15(1) of the EP&A Act, the consent authority is required to take into consideration a range of matters as they are of relevance to the subject of the application, including:

(a) the provisions of:

(i) any environmental planning instrument, and

(ii) any proposed instrument that is or has been the subject of public consultation under this Act and that has been notified to the consent authority (unless the Planning Secretary has notified the consent authority that the making of the proposed instrument has been deferred indefinitely or has not been approved), and

(iii) any development control plan, and

(iiia) any planning agreement that has been entered into under section 7.4, or any draft planning agreement that a developer has offered to enter into under section 7.4, and

(iv) the regulations (to the extent that they prescribe matters for the purposes of this paragraph),

…

that apply to the land to which the development application relates,

(b) the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality,

(c) the suitability of the site for the development,

…

(e) the public interest.

While this is a requirement of the consent authority, this Modification Report has been prepared to generally address the requirements of section 4.15(1) of the EP&A Act to assist the consent authority, as follows:

- Consideration of the requirements of relevant environmental planning instruments and development control plans is provided in Sections 4.3 and 4.4.
- While no planning agreement or draft planning agreement has been developed for the MSP to date, Tronox currently makes contributions to the BHCC generally in accordance with Condition 3.11, Schedule 2 of Development Consent (DA 345-11-01).
- This Modification Report has been prepared in consideration of the prescribed matters in the EP&A Regulation.
- The predicted impacts of the Modification, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality are provided in Section 6.
- The suitability of the proposed site for the Modification is considered in Section 7.
- Consideration of whether, on evaluation, the Project is considered to be in the public interest is provided in Section 7.

4.2 OTHER NSW LEGISLATION

In addition to the EP&A Act, the following NSW Acts may be applicable to the MSP, incorporating the Modification:

- *Biosecurity Act 2015;*
- *Biodiversity Conservation Act 2016* (BC Act);
- *Contaminated Land Management Act 1997*;
- *Dangerous Goods (Road and Rail Transport) Act 2008*;
- *Fisheries Management Act 1994*;
- *Heritage Act 1977*;
- *Local Land Services Act 2013*;
- *National Parks and Wildlife Act 1974* (NPW Act);
- *Protection of the Environment Operations Act 1997* (PoEO Act);
- *Radiation Control Act 1990*;
- *Roads Act 1993*;
- *Water Management Act 2000*; and
- *Work Health and Safety Act 2011*.

Relevant licences or approvals required under these Acts would continue to be obtained for the modified MSP.

Additional detail on the likely requirements under some of the key Acts is provided in the sub-sections below.

Protection of the Environment Operations Act 1997

The PoEO Act is the primary NSW legislation that regulates pollution control and licensing. One key feature of the PoEO Act is the statutory requirement to apply for and obtain an Environment Protection Licence (EPL) in circumstances where a scheduled activity or activities are being carried out (those activities being defined in Schedule 1 of the PoEO Act).

The approved MSP is currently licensed under EPL 12314 to conduct “mineral waste generation” and “mineral processing” as defined in Schedule 1 of the PoEO Act.

EPL 12314 also licences discharges from the stacks at the MSP.

Tronox would apply to vary EPL 12314 under the PoEO Act to incorporate the Modification in consultation with the EPA.

National Parks and Wildlife Act 1974

The NPW Act contains provisions for the protection and management of national parks, historic sites, nature reserves and Aboriginal heritage in NSW.

Tronox holds a section 87 Permit and a section 90 Consent issued under the NPW Act. The section 87 Permit and the section 90 Consent together permit the destruction and collection of relevant Aboriginal cultural heritage sites at the MSP.

As the Modification would not require additional surface development areas, no additional approvals under the NPW Act would be required for the Modification.

Biodiversity Conservation Act 2016

The BC Act provides the legislative framework for biodiversity conservation in NSW.

Section 6.1 considers the potential biodiversity impacts associated with the Modification.

As described in Section 6.1, with reference to Clause 30A, Sections 1(a) and 2(c) of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017*, the Modification would not increase impacts on biodiversity values and therefore, it is considered that a Biodiversity Development Assessment Report is not required.

4.3 NSW ENVIRONMENTAL PLANNING INSTRUMENTS

Local environmental plans and NSW environmental planning policies that may be relevant to the Modification are discussed below.

4.3.1 Broken Hill Local Environmental Plan 2013

The MSP is located wholly within the Broken Hill LGA (Figure 1) and, therefore, the *Broken Hill Local Environmental Plan 2013* (Broken Hill LEP) is relevant.

Permissibility

The MSP is located within Zone IN1 (General Industrial) within the Broken Hill LGA.

Under the Broken Hill LEP, the MSP is permissible activity within consent of lands zoned IN1 (General Industrial).

Zone Objectives

Part 2.3, clause 2 of the Broken Hill LEP provides:

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

The MSP is located within Zone IN1 (General Industrial) within the Broken Hill LGA. The objectives of the zone include:

- To provide a wide range of industrial and warehouse land uses.
- To encourage employment opportunities.
- To minimise any adverse effect of industry on other land uses.
- To support and protect industrial land for industrial uses.

The modified MSP is not inconsistent with the objectives of Zone IN1 (General Industrial), as:

- The MSP site would continue to be used for industrial use.
- The modified MSP would continue to provide employment opportunities for up to approximately 85 personnel.
- The MSP site is considered suitable, and incorporates measures to allow for compatibility with existing, approved and likely preferred land uses (Section 7).

4.3.2 State Environmental Planning Policies

State Environmental Planning Policy No. 33 – Hazardous and Offensive Development

Clause 13 of *State Environmental Planning Policy No 33 – Hazardous and Offensive Development* requires that in determining an application to carry out development for the purposes of a potentially hazardous industry, the consent authority must take into account:

> *…*
>
> *(c) in the case of development for the purpose of a potentially hazardous industry—a preliminary hazard analysis prepared by or on behalf of the applicant, and*
>
> *(d) any feasible alternatives to the carrying out of the development and the reasons for choosing the development the subject of the application (including any feasible alternatives for the location of the development and the reasons for choosing the location the subject of the application), and*

Although the Modification would include a reconfiguration of the existing ilmenite and leucoxene circuits at the MSP, the Modification would not materially change the operational activities at the MSP and would not significantly alter the consequences or likelihood of a hazardous event occurring at the MSP (Section 6.6).

Notwithstanding, relevant environmental management plans would be reviewed and, if necessary, revised by Tronox to include the Modification and manage any associated environmental risk (subject to any modified Development Consent [DA 345-11-01] conditions).

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

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

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

(a) it has considered whether the land is contaminated, and

(b) if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out, and

(c) if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose.

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

Because the Modification is within the Development Application Area in Development Consent (DA 345-11-01), no change of use is proposed and no preliminary land contamination investigation is required.

4.4 DEVELOPMENT CONTROL PLAN

The *Broken Hill Development Control Plan* (BHCC, 2016) provides detailed planning and design guidelines to support the planning controls in the Broken Hill LEP.

Clause 11 of the *State Environmental Planning Policy (State and Regional Development) 2011* provides that development control plans (whether made before or after the commencement of the *State Environmental Planning Policy [State and Regional Development] 2011*) do not apply to State Significant Developments (e.g. the MSP), and hence to do not apply to the Modification.

4.5 RELEVANT NSW ASSESSMENT POLICIES

Where relevant to the Modification, the requirements of these policies and the assessed outcomes relative to these policies are presented in Section 6 and/or the associated specialist assessment (Appendix A).

4.6 DEVELOPMENT APPLICATION AREA

The Modification would not necessitate an extension to the Development Application Area for Development Consent (DA 345-11-01).

4.7 ENVIRONMENT PROTECTION AND BIODIVERSITY ACT 1999

The objective of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is to provide for the protection of those aspects of the environment that are of national environmental significance.

Proposals that are likely to have a significant impact on a matter of environmental significance are defined as a controlled action under the EPBC Act. A proposal that is, or may be, a controlled action is required to be referred to the Commonwealth Department of Agriculture, Water and Environment to determine whether or not the action is a controlled action.

It is concluded that the Modification would not have a significant impact on Matters of National Environmental Significance for the following reasons:

- The Modification would not have a significant impact on listed threatened species and ecological communities and/or migratory species as these have not been identified in the vicinity of the Modification area.
- The Modification would not have a significant impact on wetlands of international importance.
- The Modification would not have a significant impact on world heritage properties or national heritage places (i.e. Willandra Lakes Regional World Heritage Area) as the Ginkgo Mine is located approximately 60 km from the Willandra Lakes Regional World Heritage Area.
- The Modification would not impact the Great Barrier Reef Marine Park and/or Commonwealth marine areas.
- The Modification is not a nuclear action.
- The Modification is not a coal mining or coal seam gas project that could have an impact on a water resource.

It is considered that there is no need to refer the Modification to the Commonwealth Minister for the Environment.

4.8 MANAGEMENT/MONITORING PLANS

The MSP has an Environmental Management Strategy in place that has been developed to minimise environmental impacts by providing the strategic context for environmental management of the site.

Tronox would continue to implement the existing Environmental Management Strategy at the modified MSP, and would review and revise it where necessary (subject to any modified Development Consent conditions) for the Modification.

A more detailed description of the monitoring programs and control strategies relevant to the Modification is provided in Section 6.

5 ENGAGEMENT

Tronox has consulted with government agencies and stakeholders during the preparation of this Modification Report. A summary of this consultation is provided below.

It is anticipated that consultation with key state government agencies, BHCC and surrounding landholders will continue during the assessment of the proposal by the NSW Government.

5.1 NSW GOVERNMENT AGENCIES

Tronox continues to consult with relevant NSW Government agencies on a regular basis in relation to the current activities at the MSP.

NSW Department of Planning, Industry and Environment

Tronox provided a briefing package and held a videoconference with the DPIE on 3 February 2021 to provide an overview of the Modification, proposed approval pathway and the proposed scope of the environmental assessment.

Following the meeting, Tronox wrote to the DPIE regarding the Modification, the proposed approval pathway and the proposed scope of the environmental assessment.

The DPIE subsequently wrote to Tronox on 24 February 2021, confirming it agreed with the proposed approval pathway and outlining additional environmental assessment aspects to be considered as part of the Modification application. These environmental assessment aspects have been considered in this Modification Report.

NSW Environment Protection Authority

Tronox provided a briefing package to the EPA on 10 March 2021 to provide an overview of the Modification, and the proposed noise and air quality assessment approach and results.

The EPA requested that an Air Quality Assessment in accordance with the *NSW Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (the Approved Methods) (EPA, 2017a) be prepared to assess the potential air quality impacts. No significant issues regarding the Modification were raised by the EPA.

5.2 BROKEN HILL CITY COUNCIL

The MSP is located within the Broken Hill LGA (Figure 1).

Tronox provided a briefing package to the BHCC on 9 March 2021 to provide an overview of the Modification, outline the approach to assessing potential environment and community infrastructure impacts associated with the Modification.

The BHCC did not raise any significant issues regarding the Modification.

5.3 RELEVANT LANDHOLDERS

Tronox provided nearby landholders a briefing on the Modification, the environmental approval process and the scope of the Modification Report in March 2021.

The landholders did not raise any significant issues regarding the Modification.

Tronox will continue to consult with these landholders regarding the Modification (as required).

6 ASSESSMENT OF IMPACTS

6.1 IDENTIFICATION OF KEY ISSUES

Tronox has undertaken a review of the potential environmental impacts of the Modification to identify key potential environmental issues requiring assessment.

The key environmental issues identified are summarised in Table 4 and addressed in Sections 6.2 to 6.7 and in Appendix A.

Table 4
Summary of Key Potential Environmental Issues/Impacts

Environmental Aspect	Key Potential Environmental Issues/Impacts	Report Section/Appendix
Air Quality	Potential air quality impacts related to the emissions from the two additional stacks associated with the gas-fired mineral reheaters.	Section 6.2 and Appendix A
Noise	Potential noise impacts associated with the reconfiguration of the ilmenite and leucoxene circuits (e.g. addition of a mineral reheater fan and additional conveyors).	Section 6.3
Visual	Potential visual impacts of the two additional stacks associated with the reconfiguration of the ilmenite and leucoxene circuits.	Section 6.4
Greenhouse Gas	Potential increase in greenhouse gas emissions associated with the addition of the two gas-fired mineral reheaters.	Section 6.5
Hazards and Risks	Consideration of potential changes associated with the Modification.	Section 6.6
Road and Rail Transport	Potential road and rail transport impacts associated with increased road and rail transport approved as part of separate modification applications to the Ginkgo and Snapper Mines and Atlas-Campaspe Mine, respectively.	Section 6.7[1]
Aboriginal Cultural Heritage	As the Modification would not change the existing/approved surface development area at the MSP, no material changes to the approved impacts on Aboriginal cultural heritage, historic heritage and land and agricultural resources are expected.	N/A
Historic Heritage		N/A
Land and Agricultural Resources		N/A
Biodiversity	Tronox has undertaken an assessment of the impacts of the Modification on biodiversity values, in consideration of the BC Act and Clause 30A, Sections 1(a) and 2(c) of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017*. In summary, as the Modification would require additional surface development areas, the Modification would not increase impacts on vegetation abundance, vegetation integrity, habitat suitability, threatened species abundance, habitat connectivity, threatened species movement, flight path integrity or hydrological processes that are known to sustain a threatened species or ecological community.	N/A
Water Resources	As the Modification would not result in any change to the existing/approved site water management system and water supply and demand, no material changes to the existing/approved water resource impacts are expected.	N/A
Socio-Economic	As no change to the approved MSP workforce or project life is proposed for the Modification, there would be no material alteration to the approved socio-economic impacts.	N/A

[1] These potential impacts were previously assessed and approved as part of separate modification applications to the Ginkgo and Snapper Mines and Atlas-Campaspe Mine, respectively.

6.2 AIR QUALITY

6.2.1 Background

Sensitive Receivers

Nearby sensitive receivers include predominantly industrial-related receivers and residential receivers (Figure 5).

The closest residential receiver to the MSP (Finlayson) is located approximately 1 km south-east of the MSP (Figure 5).

An industrial receiver is located approximately 50 m from the north-east boundary of the MSP (Figure 5). This receiver (Consolidated Mining and Civil) has been conservatively assumed to be a residential receiver in the Air Quality Assessment (Appendix A).

This receiver (Consolidated Mining and Civil) is also considered representative of the industrial receivers located further east in the Kanadah Industrial Area (Figure 5).

Previous Assessments

Pacific Environment Limited (PEL) (2013) assessed the potential air quality impacts of the existing/approved MSP.

The assessment concluded that no potentially affected receivers were predicted to exceed the applicable assessment criteria, except for very small potential for cumulative 24-hour particulate matter with an equivalent aerodynamic diameter of 10 micrometres or less (PM_{10}) exceedances at the closest sensitive receiver (PEL, 2013).

Air Quality Monitoring

The Air Quality Management Plan (Tronox, 2018) details relevant air quality criteria, air quality emission sources, the monitoring program, mitigation procedures, complaints protocol and a contingency plan.

Dust deposition is measured at three locations (Figure 5). The annual average dust deposition results at all of these locations have been within the EPA criterion (i.e. 4 grams per square metre per month [g/m^2/month]) since 2014 (Appendix A).

Air quality monitoring of PM_{10} was undertaken at the MSP from 2006 to 2017. PM_{10} monitoring ceased in 2017 after a modification application (Modification 5) to remove the PM_{10} monitor from the MSP monitoring network was approved by the Department of Planning and Environment (now DPIE) in October 2017 (Appendix A).

The EPA 24-hour PM_{10} criterion (i.e. 50 micrograms per cubic metre [$\mu g/m^3$]) has been complied with since 2014, except on one occasion in 2014 and one occasion in 2015. These exceedances were identified as being caused by unusual high wind speed conditions, with either ‘near gale force’, or ‘gale force’ winds present (Appendix A).

In-stack total suspended particulates (TSP) and nitrogen dioxide (NO_2) concentrations are also monitored at the existing MSP stacks (Figure 3).

The monitored TSP and NO_2 concentrations in the leucoxene dryer stack have complied with the EPL 12314 criteria (i.e. 100 milligrams per cubic metre [mg/m^3] and 350 grams per cubic metre [g/m^3], respectively) on all occasions since 2006. The monitored TSP concentrations in the leucoxene baghouse hygiene stack have complied with the EPL 12314 criterion (100 mg/m^3) on all occasions since 2006 (Appendix A).

Complaints

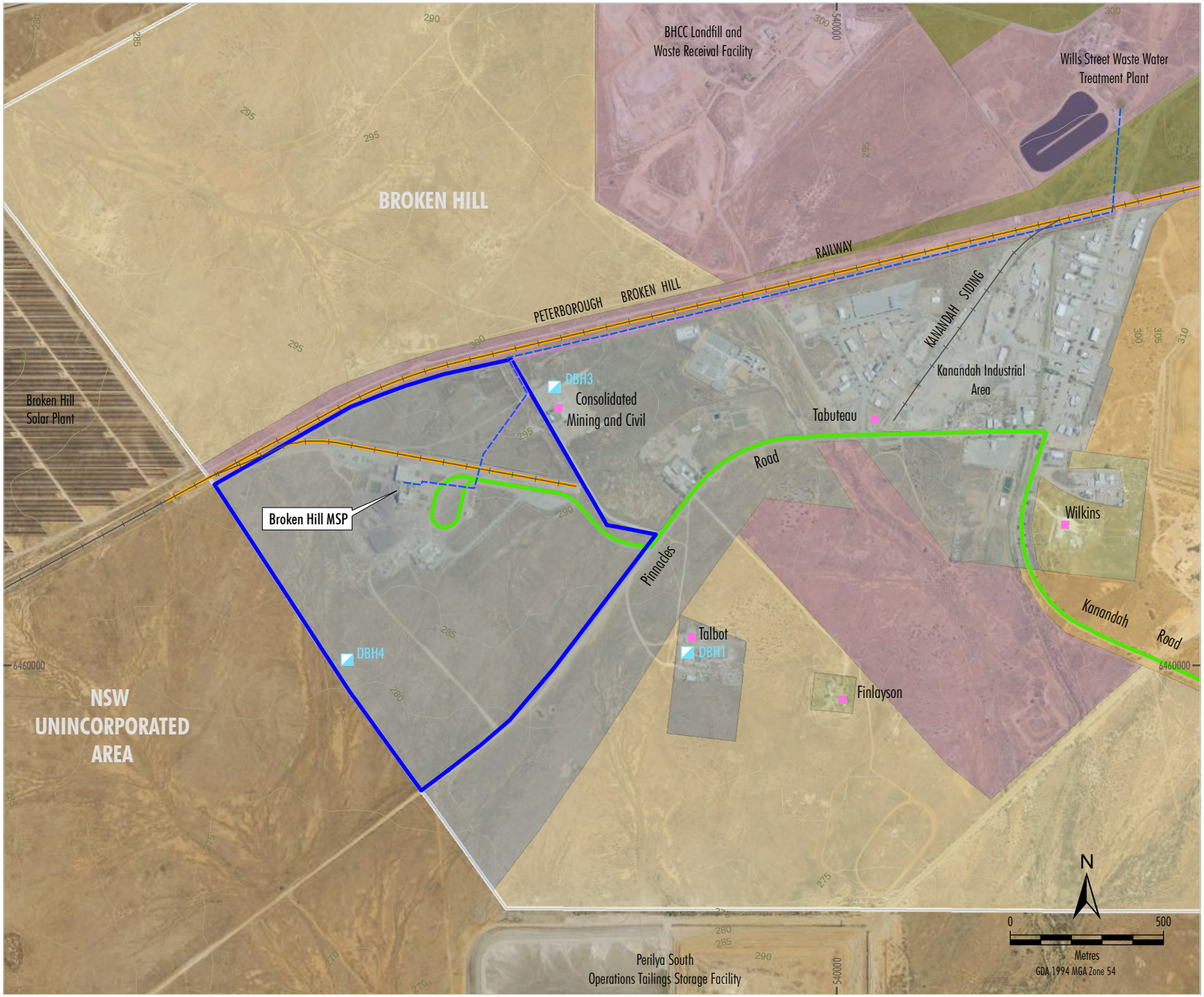
No air quality related complaints have been received since 2013.

Air Quality Management Measures

Tronox operates in accordance with the Air Quality Management Plan (Tronox, 2018).

Existing/approved air quality management measures implemented at the MSP include (Tronox, 2018; 2019b):

- mineral concentrate and product are stored in storage sheds where possible;
- mineral concentrate/product conveyors are enclosed;
- containers are filled up on the ground, lids placed on and loaded onto the train with reach stackers;
- water trucks are used to reduce wind borne dust;



LEGEND

- Local Government Area Boundary
- MSP Property Boundary
- Mineral Concentrate Transport Route and MSP Process Waste Transport Route
- Atlas-Campaspe Mineral Sands Project Mineral Concentrate Transport Route and MSP Process Waste Transport Route*
- Water Supply Pipeline
- Electricity Transmission Line
- Railway
- Receiver
- Dust Deposition Gauge

Land Zoning (Broken Hill LEP)

- E2 - Environmental Conservation
- E4 - Environmental Living
- IN1 - General Industrial
- RU2 - Rural Landscape
- SP1 - Special Activities
- SP2 - Infrastructure

** MSP Process Waste Transport Route following cessation of operations at the Ginkgo and Snapper Mines.*

Source: NSW Spatial Services (2020)

TRONOX

BROKEN HILL MSP

MSP Site and Surrounds

Figure 5

CMA-19-09 BH MSPMod MT_201B

- on-site water storage tanks are fitted with high flow pumps to reduce water truck fill times;
- the heights of stockpiles are limited to reduce the surface area exposed to the wind;
- stockpiles are turned into the predominant wind direction to minimise the frontal area to reduce dust lift-off;
- wind breaks have been established around the MSP;
- internal roads are sealed;
- a vacuum truck is used to collect mineral concentrates that have migrated from designated storage areas;
- a ducted vacuum system is used to remove mineral fines;
- activities are carried out in a manner that will minimise the generation of wind-blown or traffic generated dust and the MSP;
- the air quality monitoring program is implemented to assess air quality against acceptable levels as defined by the air quality standards and to review the air quality management measures;
- obsolete access tracks used during construction are ripped and re-vegetated;
- fixed irrigation and/or chemical dust suppressants are used on mineral product stockpiles and the waste material stockpile to minimise the generation of dust;
- baghouses are installed on the dryer stacks;
- a wet scrubber will be installed on the ilmenite kiln stack;
- devices (i.e. alarms) are fitted to the dryer and ilmenite kiln stacks to warn operators of any malfunctions have occurred in the emission controls; and
- process equipment is maintained to manufacturer's specifications to minimise the potential for leaks and fugitive emissions.

6.2.2 Potential Impacts

An Air Quality Assessment was undertaken by Todoroski Air Sciences (TAS) (2021) and is presented in Appendix A. The assessment was conducted in accordance with the Approved Methods (EPA, 2017a).

Relevant Pollutants

TAS (2021) identified the following potential pollutants of concern of relevance to the MSP:

- suspended particulates, including TSP, PM_{10}, particulate matter with an equivalent aerodynamic diameter of 2.5 micrometres or less ($PM_{2.5}$) and dust deposition;
- oxides of nitrogen, including nitrous oxides (NO_x) which is produced when fossil fuels are combusted; and
- sulfur dioxide (SO_2) and hexavalent chromium (Cr [VI]) emissions from the ilmenite kiln stack.

Potential impacts of these pollutants are considered below.

Assessment Methodology

Potential air quality impacts at the MSP were modelled for the MSP at full development (i.e. all MSP circuits operational) and maximum processing rate to assess the potential maximum case air quality impacts at the nearest receivers (Figure 5).

An emission inventory was prepared for the modified MSP including mineral concentrate/HMC haulage, unloading and loading mineral concentrates/HMC, managing mineral concentrate/HMC stockpiles, stack emissions and wind-blown emissions (e.g. from mineral concentrate stockpiles).

The Air Quality Assessment (TAS, 2021) conservatively considers the potential air quality impacts of all of the existing/approved MSP (including the existing stack to be placed in care and maintenance [Section 3.4]) and two additional ilmenite reheaters (and associated stacks) in full operation.

Cumulative impacts associated with the existing Broken Hill Solar Plant, Perilya South Operations and Rasp Mine have been considered in the assessment (Appendix A).

A hybrid modelling approach using CALPUFF and TAPM was used by TAS (2021) to assess potential air quality impacts associated with the Modification.

A full description of the dispersion model methodology, predicted in-stack concentration calculation methodology and the emissions inventory is provided in Appendix A.

Predicted In-Stack Concentrations

The predicted in-stack particulate matter and NO_x concentrations and relevant criteria are summarised in Appendix A. All predicted particulate matter and NO_x concentrations comply with the relevant criteria (Appendix A).

Ground Level Concentrations

Table 5 presents the relevant air quality criteria and predicted air quality levels from the modified MSP in full operation.

No exceedances of the EPA's impact assessment criterion are predicted at any privately-owned receiver for project-only and cumulative 24-hour average PM_{10} or $PM_{2.5}$ concentrations, annual average PM_{10}, $PM_{2.5}$, TSP concentrations or dust deposition levels (Table 5).

Table 5 also presents the predicted cumulative levels of NO_2, which conservatively assumes a maximum conversion rate of 100% NO_x to NO_2.

No exceedances of the NO_2 assessment criteria is predicted for the modified MSP (Table 5).

Ilmenite Kiln Stack Emissions

Chromium (IV) Emissions

Pacific Air and Environment (2001) assessed the potential impacts associated with Cr [VI] emissions and concluded that the maximum Cr (VI) concentrations would be well below the relevant criteria. As there is no change proposed to the ilmenite kiln stack as part of the Modification, these findings are still considered relevant (Appendix A).

Sulphur Dioxide Emissions

As described in Section 3.4, the Modification would not change the approved ilmenite kiln/roaster circuit.

Notwithstanding, the ilmenite kiln stack would be designed and/or an appropriate fuel type chosen to achieve compliance with the relevant SO_2 criteria.

6.2.3 Mitigation Measures, Management and Monitoring

Management Measures

The Air Quality Management Plan (Tronox, 2018) would continue to be implemented for the MSP incorporating the Modification. This would include the continued implementation of the air quality management measures described in Section 6.2.1.

The Air Quality Management Plan (Tronox, 2018) would be reviewed and, if necessary, revised for the Modification.

Ilmenite Kiln/Roaster Emissions

In accordance with Condition E2 of EPL 12314, prior to constructing the ilmenite kiln/roaster circuit, Tronox will apply for a licence variation that includes an air quality assessment that demonstrates the ilmenite kiln/roaster circuit will meet the relevant in-stack and ground level concentration air quality criteria.

Table 5
Predicted Cumulative Air Quality Levels from the Modification

Receptor	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	Dust Deposition (g/m²/ month)	NO_2 (µg/m³)	
	24-hour	Annual	24-hour	Annual	Annual	Annual	1-hour	Annual
Criteria	25	8	50	25	90	2	246	62
Consolidated Mining and Civil	21.1	3.6	39.4	10.5	36.2	1.4	157.7	11.2
Talbot	16.5	3.2	31.7	9.6	33.9	1.3	112.6	10.4
Finlayson	15.2	3.1	29.3	9.3	33.2	1.3	99.6	10.1
Tabuteau	14.4	3.0	28.0	9.2	32.7	1.3	100.1	9.9
Wilkins	14.8	3.0	28.6	9.3	33.0	1.3	97.7	9.9

Source: After Appendix A.

6.3 NOISE

6.3.1 Background

Sensitive Receivers

A description of relevant sensitive receivers can be found in Section 6.2.1.

Previous Assessments

A Noise Assessment for the MSP was undertaken by Renzo Tonin & Associates (Renzo Tonin) (2013). The assessment was conducted in accordance with the *NSW Industrial Noise Policy* (INP) (EPA, 2000).

Renzo Tonin (2013) concluded:

- There would be no exceedance of the 35 A-weighted decibels (dBA) equivalent continuous noise level ($L_{Aeq,15minute}$) criteria at any residential receiver during the day or evening, or during the night under calm meteorological conditions.
- There would be a moderate (i.e. 4 dBA) exceedance of the 35 dBA $L_{Aeq,15minute}$ criteria at the Finlayson receiver during the most adverse weather conditions (i.e. G Class temperature inversions).
- There would be no exceedances of the relevant amenity criteria at any receiver location.

In addition, Renzo Tonin (2013) predicted a moderate (i.e. 3 dBA) exceedance of the sleep disturbance noise criteria at the Finlayson receiver during adverse weather conditions.

Noise Limits

Operations at the MSP are currently required to comply with the noise limits in Development Consent (DA 345-11-01) and EPL 12314.

Condition 3.6A, Schedule 2 of Development Consent (DA 345-11-01) and Condition L5.1 of EPL 12314 both specify that noise from the MSP premises must not exceed 35 dBA $L_{Aeq\ [15minute]}$ during the day, evening or night, with compliance with these noise limits determined by noise monitoring at the Finlayson residence (Figure 5).

Management Measures

Noise management at the MSP is conducted in accordance with the existing Noise Management Plan (Cristal, 2016).

In accordance with Schedule 2, Condition 3.6C of the Development Consent (DA 345-11-01), the following noise mitigation measures would be implemented at the MSP:

- External auxiliary equipment to the processing circuit (i.e. external fans, pumps and screening) – acoustically treated with cladding or are enclosed.
- The zircon, rutile and ilmenite kiln/roaster circuits – constructed to be enclosed within a building.
- Once mineral concentrates are received from the Atlas-Campaspe Mine, any front end loader operating in the night-time period – fitted with noise suppression kit.

Tronox also currently implements the following noise mitigation measures at the MSP in accordance with the Noise Management Plan (Cristal, 2016):

- External conveyors and conveyor drives are enclosed.
- Scheduling of operations to avoid potential maximum noise generating activities occurring during the night (i.e. loading of product trains, which requires two front end loaders and an integrated tool carrier does not occur during the night-time period).
- Road trains transporting mineral concentrate do not idle when not in use.
- All equipment is regularly maintained and serviced.

In accordance with Schedule 2, Condition 3.6B of Development Consent (DA 345-11-01), upon receiving a written request for noise mitigation measures from the owner of the Finlayson residence, Tronox would arrange the commencement of noise mitigation measures at the property.

Monitoring

Noise monitoring at the MSP ceased in 2015 in consultation with the relevant landholder and the DPIE.

In accordance with the Noise Management Plan, Tronox would recommence noise monitoring if a noise related complaint is received.

No noise related complaints have been received since the MSP operations commenced in 2005.

6.3.2 Potential Impacts

Construction Noise

The Modification would include a construction phase associated with the reconfiguration of the existing ilmenite and leucoxene circuits (including the additional gas-fired mineral reheaters [and associated stacks]) (Section 3.3).

The construction phase would occur over an approximate three month period (Section 3.3).

During the construction phase, operational activities at the MSP would need to cease (i.e. construction activities would not occur concurrently with operational activities).

Tronox would undertake construction activities 24 hours per day, seven days per week over the short construction period.

An indicative fleet list and corresponding sound power level for construction phase of the modified MSP is presented in Table 6.

Table 6 presents a total sound power level summary of the construction scenario of the modified MSP. The construction phase total sound power level (Table 6) is lower than the approved total operational sound power level (Table 7).

Given the above, it is expected that the Modification construction noise levels would be less than the operational noise levels predicted in Renzo Tonin (2013).

In addition, the construction phase total sound power level conservatively assumes all construction plant items are running concurrently. Typically, a correction factor of -3 to -5 dB is applied to the total sound power level to account for time correction, as the entire construction fleet would not always operate concurrently (i.e. not all plant items are expected to be operating all the time and, therefore, the total sound power level estimate is considered conservative).

Modified construction hours to 24 hours, seven days per week for the Modification is considered justified given that:

- Total noise levels are expected to be less than the levels of the operational MSP.
- MSP operations occur 24 hours per day, seven days per week.
- Tronox would cease MSP operations during the construction phase (i.e. noise from MSP operations would not occur concurrently with the construction activities).
- Minimises the duration of the MSP operations suspension.

Table 6
Total Sound Power Level of the Modification Construction Phase

Item	Sound Power Level (dBA)	No. of Items
Franna Crane (25 t)	99[1]	1
Rough Terrain Crane (40 t)	100[2]	1
Mobile Slew Crane (200 t)	103[3]	1
Elevated Work Platform	98[4]	4
Telehandler (3.7 t)	98[3]	1
Welder (400A Diesel)	99[3]	2
Lighting Tower	101[1]	8
Excavator (Small)	103[1]	1
	Total Sound Power Level	**113.13 dBA**

1 Wilkinson Murray Pty Ltd (2019).
2 Sydney Intermodal Terminal Alliance (2019).
3 Renzo Tonin (2019).
4 Renzo Tonin (2017).

Operational Noise

The Modification would result in the addition of the following noise-generating sources at the MSP:

- fan associated with one of the additional mineral reheaters in the ilmenite circuit;
- trash screen associated with the ilmenite circuit reconfiguration;
- conveyor associated with the duplication of the existing ilmenite circuit feed conveyor; and
- conveyor associated with the minor extension to the ilmenite circuit building.

The Modification would not change other existing/approved noise-generating sources at the MSP (e.g. mobile fleet).

Table 7 presents a total sound power level comparison of the existing/approved MSP and the modified MSP. All of the existing noise-generating sources at the MSP (including sources that would be placed in care and maintenance as part of the Modification) are included in Table 7.

Consistent with Schedule 2, Condition 3.6C of the Development Consent (DA 345-11-01) and the Noise Management Plan (Cristal, 2016), the reconfigured ilmenite circuit, fan and conveyors would be enclosed.

The proposed modifications to the MSP are not expected to materially change noise emissions from the MSP given that the increase in total sound power level is minimal (less than 0.1 dBA increase) (Table 7).

Given the above, no significant change to the noise levels predicted at nearby sensitive receivers in Renzo Tonin (2013) (Section 6.3.1) is expected.

Consideration of the Noise Policy for Industry

As described in Section 6.3.1, a Noise Assessment for the MSP was undertaken by Renzo Tonin (2013). The assessment was conducted in accordance with the INP (EPA, 2000), which has since been superseded by the *Noise Policy for Industry* (NPfI) (EPA, 2017b).

The INP defines a minimum noise criterion of 35 dBA for the day, evening and night-time. The NPfI increased the minimum daytime noise criterion to 40 dBA, while the evening and night-time criteria remained at 35 dBA.

The Renzo Tonin (2013) assessment assumed temperature inversions of 8 degrees Celsius per 100 m (°C/100 m) for the night-time period in accordance with the INP.

Table 7
Total Sound Power Level Comparison of the Existing/Approved and Modified Mineral Separation Plant

Item	Sound Power Level (dBA)[1]	Number of Items	
		Existing/Approved MSP	Modified MSP
Top Floor Vent Openings	77	4	4
Screen	89	2	3
Pump	93	1	1
Fans 1 to 6	97	1	1
Additional Fan (Fan 7)[2]	87	-	1
Wet Plant Opening	79	1	1
Conveyors 1 to 4	83/m	92.4	92.4
Additional Conveyor (Conveyor 5)	83/m	-	28.7
Additional Conveyer (Conveyor 6)	83/m	-	8.7
Road Train	105	1	1
Front End Loader	107	1	1
Light Vehicle	88	2	2
Integrated Tool Carrier	105	1	1
Reach Stacker	106	1	1
Tip Truck	105	2	2
Total Sound Power Level		**113.88**	**113.97**

[1] Sourced from Renzo Tonin (2013).

[2] Only one of the additional gas-fired mineral reheaters would require a fan.

The NPfI (EPA, 2017b), however, prescribes the use of the less conservative temperature inversions of 4°C/100 m, where relevant:

> *…the upper bounds of F class should be selected, that is, 4 degrees Celsius per 100 metres.*

In addition to the minimal increase in total sound power level, the previous Noise Assessment is also considered conservative based on the adopted meteorological data (i.e. it is expected that the noise generated from the modified MSP would not be materially different to those presented in Renzo Tonin [2013]).

Cumulative Noise

Consistent with Renzo Tonin (2013), no cumulative exceedances of the relevant amenity criteria are expected at any receiver location as a result of the modified MSP given that no material change to noise levels is expected (Table 7).

Sleep Disturbance

Renzo Tonin (2013) predicted there would be a moderate (i.e. 3 dBA) exceedance of the sleep disturbance noise criteria of 45 dBA $L_{Aeq,1minute}$ at one receiver location (Finlayson) during adverse weather conditions.

No material changes to the sleep disturbance levels presented in Renzo Tonin (2013) are expected given that no material changes to the noise levels of the modified MSP are expected.

6.3.3 Mitigation Measures, Management and Monitoring

The Noise Management Plan (Cristal, 2016) (Section 6.3.1) would continue to be implemented for the MSP incorporating the Modification.

The Noise Management Plan (Cristal, 2016) would be reviewed and, if necessary, revised for the Modification.

Consistent with the existing/approved MSP, upon receiving a written request for noise mitigation measures from the owner of the Finlayson residence, Tronox will arrange the commencement of noise mitigation measures at the property.

6.4 VISUAL

6.4.1 Background

The MSP site is located within a flat to gently sloping area with limited topographical relief and limited vegetation cover (Bemax Resources, 2001).

The visual character in the vicinity of the MSP is varied due to the range of land uses surrounding the MSP site. Surrounding land uses include industrial facilities (generally mining support-related), mining, solar power generation and rail infrastructure (Figure 5).

Public viewpoints providing opportunity to view the MSP are available along public roads. Although views of the MSP are available along Pinnacles Road, the number of potential viewers is limited due to the low public use of Pinnacles Road in the vicinity of the MSP. Views from Kanandah Road and the Silver City Highway of the MSP are limited due to intervening distance (at least approximately 2 km) and vegetation.

Views of the MSP would also be available from nearby industrial-related receivers and residential receivers. The closest residential receiver to the MSP is located approximately 1 km south-east of the MSP (Figure 5).

The night-time character of the MSP site includes a variety of local light sources associated with the industrial, mining and rail operations and the significant glow generated by Broken Hill.

6.4.2 Potential Impacts

Potential visual impacts associated with the Modification would primarily be related to the addition of two stacks associated with the gas-fired mineral reheaters.

The additional stacks would be approximately 40 m high which is consistent with the eight existing/approved stack heights (Table 2). The additional stacks would be visible from public viewpoints and nearby industrial-related receivers and residential receivers.

The reconfiguration of the ilmenite circuit would not significantly change the approved footprint of the MSP (Figures 2 and 3).

The level of visual modification associated with the Modification in the context of the existing/approved MSP would therefore not be significant. Given this insignificant level of visual modification and the visual character of the MSP area, a low level of visual impact would be expected.

The scale and intensity of night-lighting for the modified MSP would be of a similar intensity when compared to the existing night-lighting at the MSP.

6.4.3 Mitigation Measures, Management and Monitoring

Consistent with the existing/approved MSP, the minor extension to the ilmenite circuit building and the two additional stacks would be coloured to minimise visual impacts.

No additional specific visual impact management measures are proposed.

6.5 GREENHOUSE GAS EMISSIONS

6.5.1 Background

Greenhouse Gas Protocol

The Greenhouse Gas Protocol (GHG Protocol) contains methodologies for assessing and calculating greenhouse gas emissions (World Business Council for Sustainable Development [WBCSD] and World Resources Institute [WRI], 2015). The GHG Protocol provides standards and guidance for companies and other types of organisations preparing a greenhouse gas emissions inventory. It covers the accounting and reporting of the six greenhouse gases covered by the Kyoto Protocol.

Under the GHG Protocol the establishment of operational boundaries involves identifying emissions associated with an entity's operations, categorising them as direct or indirect emissions, and identifying the scope of accounting and reporting for indirect emissions.

Three “Scopes” of emissions (Scope 1, Scope 2 and Scope 3) are defined for greenhouse gas accounting and reporting purposes. Scopes 1 and 2 have been carefully defined to ensure that two or more entities would not account for emissions in the same Scope.

Scope 1 greenhouse gas emissions are defined as those emissions that occur from sources that are owned or controlled by the entity (WBCSD and WRI, 2015).

Scope 2 emissions are a category of indirect emissions that accounts for greenhouse gas emissions from the generation of purchased electricity consumed by an entity. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organisational boundary of the entity (WBCSD and WRI, 2015).

Scope 3 emissions are defined as those emissions that are a consequence of the activities of an entity, but which arise from sources not owned or controlled by that entity (WBCSD and WRI, 2015).

Previous Assessments

The total Scope 1 and 2 greenhouse gas emissions from the approved MSP are 5,390 kilotonnes of carbon dioxide equivalent (kt CO_2-e) (Cristal, 2013).

Existing MSP Greenhouse Gas Emissions

Tronox participates in the Commonwealth Government’s National Greenhouse and Energy Reporting (NGER) scheme under the *National Greenhouse and Energy Reporting Act 2007*. The NGER scheme is a single national framework for reporting and disseminating company information about greenhouse gas emissions, energy production, energy consumption and other information specified under the *National Greenhouse and Energy Reporting Act 2007*.

The major sources of greenhouse gas emissions generated by the MSP would include:

- combustion of gas (LNG or LPG) during MSP operations (Scope 1);
- combustion of diesel during MSP operations (Scope 1); and
- off-site generation of electricity consumed at MSP (Scope 2).

During the 2019-2020 NGERs reporting period, the following greenhouse gas emissions were generated by the MSP (Tronox, 2020b):

- Scope 1 emissions – 2.1 kt CO_2-e.
- Scope 2 emissions – 2.2 kt CO_2-e.

6.5.2 Potential Impacts

The Modification would not change the processing rates at the MSP (Section 3.1). As diesel and electricity consumption at the MSP are predominantly related to production, it is expected that the total diesel and electricity consumption at the MSP on an annual basis would not change significantly as a result of the Modification.

The Modification would, however, increase the consumption of gas (LNG or LPG) due to the addition of two gas-fired mineral reheaters to the ilmenite circuit.

The direct and indirect greenhouse gas emissions associated with the two gas-fired mineral reheaters have been estimated by TAS (Appendix A) using emission factors from the *National Greenhouse Accounts Factors Australian National Greenhouse Accounts* (Department of Industry, Science, Energy and Resources, 2020).

The Modification would result in the following incremental annual greenhouse gas emissions (Appendix A):

- Scope 1 emissions – 1.52 kt CO_2-e.
- Scope 2 emissions – 0 kt CO_2-e.
- Scope 3 emissions – 0.41 kt CO_2-e.

6.5.3 Mitigation Measures, Management and Monitoring

Minimising fuel and electricity usage is an inherent objective of MSP planning and cost control systems and measures to mitigate greenhouse gas emissions at the MSP include:

- consideration of energy efficiency in plant and equipment selection/purchase; and
- regular maintenance of plant and equipment to minimise fuel consumption and associated emissions.

Tronox conducts assessments of energy use to identify cost effective energy savings and energy-efficiency opportunities in accordance with the Energy Savings Management Plan (GHD, 2016).

The effectiveness of these measures in reducing the greenhouse gas emissions (and energy consumption) would be monitored, as Tronox would annually estimate greenhouse gas emissions and energy consumption in accordance with NGER scheme requirements.

The Energy Savings Management Plan (GHD, 2016) would continue to be implemented and no specific additional management measures are proposed as part of the Modification.

6.6 HAZARDS AND RISKS

6.6.1 Background

A Preliminary Hazard Analysis (PHA) (Resource Strategies Pty Ltd [Resource Strategies], 2001) for the MSP was prepared in accordance with the general principles of risk evaluation and assessment provided in the *Multi Level Risk Assessment Guidelines* (NSW Department of Urban Affairs and Planning, 1999).

Potential hazards associated with the public, property and environment were identified and the consequences and likelihood of hazardous events were assessed qualitatively.

The main potential risk areas identified in the PHA included:

- transportation and storage of gas (e.g. explosion, fires);
- transportation and storage of diesel (e.g. leaks/spills, fires); and
- mineral concentrate/HMC and MSP process waste transport (e.g. vehicle accidents, leaks/spills).

Following the implementation of the proposed hazard mitigation measures, no risks posing significant off-site impacts were identified (Resource Strategies Pty Ltd, 2001).

A Hazard and Operability Study (Pinnacle Risk Management, 2012) was prepared for the MSP in accordance with *Hazardous Industry Planning Advisory Paper Nº 8 – HAZOP Guidelines* (NSW Department of Planning, 2008) prior to the construction of the ilmenite circuit.

A Fire Safety Study (Norman Disney & Young, 2012) was prepared for the MSP in accordance with *Hazardous Industry Planning Advisory Paper No. 2 – Fire Safety Guidelines* (Department of Planning, 2011) prior to the construction of the ilmenite circuit. The Fire Safety Study concluded that with the implementation of the proposed management measures, associated risks would be at an acceptable level (Norman Disney & Young, 2012).

6.6.2 Potential Impacts

Although the Modification would include a reconfiguration of the existing ilmenite and leucoxene circuits at the MSP, the Modification would not materially change the operational activities at the MSP and would not significantly alter the consequences or likelihood of a hazardous event occurring at the MSP.

6.6.3 Mitigation Measures, Management and Monitoring

The following hazard mitigation and/or preventative measures would be applied to the MSP to reduce the likelihood of potentially hazardous incidents:

- Structures – Civil engineering structures would be constructed in accordance with applicable codes, guidelines and Australian Standards. Where applicable, the necessary licences and permitting for engineering structures would be obtained.
- Fuel Storage – The storages for diesel and gas at the MSP site would be designed, constructed and operated in accordance with the requirements of applicable Australian Standards (e.g. AS 1940:2017 *The Storage and Handling of Flammable and Combustible Liquids* and AS 3961:2017 *The Storage and Handling of Liquefied Natural Gas*). In addition, the bunded gas storage facility would be fitted with both manual and remote shut-off valves and would be bunded.
- Water Management – Structures such as stormwater diversion drains and sediment dams would be constructed to separate upslope and operational areas and to collect MSP site runoff. These structures would also enable the containment of potential spills or fire suppression water runoff within operational areas.
- Maintenance – Ongoing and timely maintenance of all mobile and fixed plant and equipment would be undertaken in accordance with a maintenance schedule.
- Staff Training – Operators and drivers would be trained and (where applicable) licensed for their positions.
- Emergency Response Plan – This plan would provide emergency response objectives, site roles and responsibilities and a series of detailed response procedures for a range of potential emergencies.
- Safety Management System – Specifies all safety-related procedures, responsibilities, policies and adherence mechanisms.
- Site Emergency Response Team – Selected Tronox employees and/or contractors would be trained to respond to emergencies and spills within the MSP site. The emergency response team would be supported by Broken Hill emergency service authorities, as required.

The Emergency Response Plan and the Safety Management System would be reviewed and, if necessary, revised for the Modification.

6.7 TRANSPORT

6.7.1 Background

Road transport at the MSP and the Ginkgo and Snapper Mines is currently managed in accordance with the Traffic Management Plan and Code of Conduct (Tronox, 2020a).

6.7.2 Potential Impacts

Road Transport

The Modification would include an increase in the approved mineral concentrate/HMC road transport rate from 735,000 tpa to 975,000 tpa to reflect road transport changes previously assessed and approved as part of the Snapper Mine and Gingko Mine modification applications.

The increased road transport rate did not require an increase in heavy vehicle movements as larger capacity vehicles would be used (Cristal, 2014).

The potential road transport impacts associated with these road transport changes were assessed in the Snapper Mine modification application (Cristal, 2014) which concluded that there would be no significant change to the existing road transport impacts.

Rail Transport

The Modification would include the following changes to the approved mineral concentrate/HMC rail transport operations to reflect rail transport changes previously assessed and approved as part of the Atlas-Campaspe Mine modification application (Tronox, 2019a):

- increased mineral concentrate/HMC transport from the Ivanhoe Rail Facility from 450,000 tpa to 665,000 tpa;
- increased mineral concentrate/HMC transport train length (from 600 m to 920 m) and frequency (from three to four trains per week); and
- increased MSP process waste transport to the Ivanhoe Rail Facility from 50,000 tpa to 65,000 tpa.

There would however be no change to the maximum number of trains in any 24-hour period (i.e. one train per day) (Tronox, 2019a).

Given the above, the Modification is not expected to have a significant impact on the rail network (Tronox, 2019a).

6.7.3 Mitigation Measures, Management and Monitoring

The management measures in the Traffic Management Plan and Code of Conduct (Tronox, 2020a) would continue to be implemented for the MSP incorporating the Modification.

In addition, the Traffic Management Plan and Code of Conduct (Tronox, 2020a) would be reviewed and, if necessary, revised for the Modification.

7 EVALUATION OF MERITS

The MSP operates in accordance with Development Consent (DA 345-11-01) issued under Part 4 of the EP&A Act in 2002.

Tronox proposes to modify Development Consent (DA 345-11-01) to optimise the MSP operations to improve overall mineral recovery prior to the commencement of processing of Atlas-Campaspe Mine mineral concentrates/HMC in 2022.

The Modification would also include changes to reflect road and rail transport changes previously assessed and approved as part of separate modification applications to the Ginkgo and Snapper Mines and Atlas-Campaspe Mine, respectively.

7.1 STAKEHOLDER ENGAGEMENT OVERVIEW

Tronox has consulted with a number of stakeholders during the development of the Modification, including:

- DPIE;
- EPA;
- BHCC; and
- relevant landholders.

The outcomes of engagement with these stakeholders has informed the development of the scope of the Modification and Tronox's preparation of the Modification Report.

7.2 SUITABILITY OF THE SITE

Mineral products are produced at the MSP site using gravity, electrostatic and magnetic separation methods.

The Modification would allow for improved overall mineral recovery at the existing MSP site.

Key existing infrastructure at the MSP (e.g. mineral processing facilities, mineral handling and storage facilities, and supporting infrastructure and facilities) would continue to be used for the modified MSP.

The use of existing/approved MSP infrastructure for the modified MSP maximises the potential benefits of previous Tronox investment and avoids the need for new surface development areas.

Existing/approved land uses in the vicinity of the MSP is characterised by a combination of general industrial, mining and power generation land uses.

Tronox would implement a range of measures to avoid or minimise incompatibility of the modified MSP with existing and future land uses in the area. This would be achieved through the implementation of the existing Environmental Management Strategy, with updates to the relevant environmental management plans outlined in Section 6.

7.3 CONSOLIDATED SUMMARY OF IMPACTS

Tronox operates in accordance with its existing environmental management plans and environmental monitoring programs.

Tronox has undertaken a review of the potential environmental impacts of the Modification to identify key potential environmental issues requiring assessment. The key environmental issues identified are summarised in Table 8.

The assessments contained herein conclude that the Modification is of "minimal environmental impact". In particular, the Modification would not result in any additional surface disturbance, and amenity impacts at nearby privately-owned dwellings are not expected to be significant.

7.4 JUSTIFICATION OF IMPACTS

Approval of the Modification is considered to be justified given:

- The Modification would improve mineral recovery at the MSP while maximising the use of Tronox's established facilities and associated returns on existing financial investment.
- The recovery of this additional mineral product would be conducted in a manner that minimises environmental impacts through the implementation of the Environmental Management Strategy and other measures (Section 6).
- No significant issues regarding the Modification were raised by stakeholders during the preparation of the Modification Report.

Table 8
Key Outcomes of Environmental Review for the Modified Mineral Separation Plant

Environmental Aspect	Summary of Key Environmental Review Conclusions
Air Quality	It is expected that the modified MSP would continue to comply with the relevant air quality criteria at all sensitive receptors surrounding the MSP.
Noise	The modified MSP operations are expected to continue to comply with the Development Consent (DA 345-11-01) noise criterion.
Visual	The level of visual modification associated with the Modification in the context of the existing/approved MSP would not be significant. Given this insignificant level of visual modification and the visual character of the MSP area, a low level of visual impact would be expected.
Greenhouse Gas	Additional greenhouse gases directly generated as a result of the Modification (Scope 1 emissions) would be approximately 1.52 kt CO_2-e. Indirect emissions associated with the on-site use of electricity (i.e. Scope 2 emissions) are not expected to change.
Hazards and Risks	The Modification would not materially change the operational activities at the MSP and would not significantly alter the consequences or likelihood of a hazardous event occurring at the MSP.
Road and Rail Transport	Potential road and rail transport impacts associated with increased road and rail transport were previously assessed and approved as part of separate modification applications to the Ginkgo and Snapper Mines and Atlas-Campaspe Mine, respectively.
Aboriginal Cultural Heritage	As the Modification would not change the existing/approved surface development area at the MSP, no material changes to the approved impacts on Aboriginal cultural heritage, historic heritage, land and agricultural resources and biodiversity are expected.
Historic Heritage	
Land and Agricultural Resources	
Biodiversity	
Water Resources	As the Modification would not result in any change to the existing/approved site water management system and water supply and demand, no material changes to the existing/approved water resource impacts are expected.
Socio-Economic	As no change to the approved MSP workforce or project life is proposed for the Modification, there would be no material alteration to the approved socio-economic impacts.

7.5 CONCLUSION

The modified MSP would be substantially the same as the existing/approved MSP. The Modification Report concludes that the Modification is of “minimal environmental impact” (Section 4.1).

In weighing up the main environmental impacts (costs and benefits) associated with the proposal as assessed and described in this Modification Report, the Modification is on balance, considered to be in the public interest of the State of NSW.

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Broken Hill Mineral Separation Plant Modification

Appendix A

Air Quality Assessment

AIR QUALITY ASSESSMENT
BROKEN HILL MINERAL SEPARATION PLANT MODIFICATION

Tronox Mining Australia Limited

1 April 2021

Job Number 21011229

Prepared by
Todoroski Air Sciences Pty Ltd
Suite 2B, 14 Glen Street
Eastwood, NSW 2122
Phone: (02) 9874 2123
Fax: (02) 9874 2125
Email: info@airsciences.com.au

Air Quality Assessment
Broken Hill Mineral Separation Plant Modification

DOCUMENT CONTROL

Report Version	Date	Prepared by	Reviewed by
DRAFT - 001	08/03/2021	P Henschke	D Kjellberg
DRAFT - 002	26/03/2021	P Henschke	
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1 INTRODUCTION

The Broken Hill Mineral Separation Plant (MSP) is an existing mineral separation plant located on the south-western outskirts of Broken Hill, New South Wales (NSW) (**Figure 1-1**). Tronox Mining Australia Limited's (Tronox) is the proponent of the MSP.

Todoroski Air Sciences has assessed the potential for air quality impacts associated with the proposed modifications to the MSP (hereafter referred to as the Modification).

The key aspects of the Modification involve optimising operations to improve overall mineral recovery by bypassing the wet high intensity magnetic separator and reconfiguring the existing ilmenite and leucoxene circuits at the MSP.

This air quality assessment has been prepared in general accordance with the NSW Environment Protection Authority (EPA) document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (Approved Methods) (**NSW EPA, 2017**).

To assess the potential air quality impacts associated with the Modification, this report comprises:

- a description of the existing/ approved MSP and the background to the Modification;
- a review of the existing meteorological and air quality environment surrounding the MSP site;
- a description of the dispersion modelling approach and emission estimation used to assess potential air quality impacts; and
- presentation of the predicted results and discussion of the potential air quality impacts and associated mitigation and management measures.

Figure 1-1: Regional location

2 DESCRIPTION OF THE EXISTING/APPROVED OPERATIONS

2.1 Overview

The MSP is approved under Development Consent No. DA 345-11-01 to process up to 1.2 million tonnes per annum (Mtpa) of mineral concentrate/ heavy mineral concentrate. The mineral concentrate/ heavy mineral concentrate is sourced from mining operations including:

- up to 735,000 tonnes per annum (tpa) from the Ginkgo and Snapper Mines (transported by road); and,
- up to 450,000tpa from the Atlas-Campaspe Mine (transported by rail).

Only mineral concentrates from the Gingko and Snapper Mines have been processed at the MSP to date as mining operations at the Atlas-Campaspe Mine are yet to commence. Gravity, electrostatic and magnetic separation methods are used to process the mineral concentrate/ heavy mineral concentrate via the following processing circuits:

- wet high intensity magnetic separator (not constructed);
- feed preparation circuit;
- leucoxene circuit;
- ilmenite circuit;
- ilmenite kiln/roaster circuit (not constructed);
- rutile circuit (not constructed); and,
- zircon circuit (not constructed).

Product material is railed from the MSP to South Australia.

2.2 Existing/approved stack parameters

Environment Protection Licence (EPL) No. 12314 for the MSP identifies several air discharge points associated with the process which have air concentration limits and require annual air pollution monitoring. DA 345-11-01 includes plant and equipment design parameters for the discharge points at the MSP as outlined in **Table 2-1**.

Table 2-1: Design parameters for discharge points

Development Consent Number	Description	Minimum Stack Height	Minimum Discharge Velocity (m/s)	Minimum Stack Diameter (m)
6	Leucoxene Hygiene Bag House	40.0	15	0.49
7	Ilmenite Hygiene Bag House	40.2	15	0.75
8	Rutile/ Zircon Hygiene Baghouse	40.2	15	1.00
9	Zircon Dryer	40.2	15	0.35
10	Leucoxene Dryer	40.2	15	0.50
11	Rutile Dryer	40.2	15	0.55
12	Ilmenite Dryer	40.2	15	0.60
13	Ilmenite Kiln	41.2	15	0.55

2.3 Previous air quality assessment

The potential air quality impacts for the existing/approved MSP (Modification 4) were assessed in *Murray-Darling Basin Operations Modification – Broken Hill Mineral Separation Plant Air Quality Assessment* (**Pacific Environment Limited, 2013**).

The focus of the assessment was the proposed modifications to allow for the integration of the Atlas-Campaspe Mineral Sands Project. To assess the potential for air quality impacts, the CAPLUFF dispersion model was used with meteorological data for the 2011 calendar period. Air emissions associated with the fugitive dust sources at the site and exhaust stack emissions were modelled. The assessment concluded that the dust deposition and ground level concentrations of TSP, PM_{10} (inferred $PM_{2.5}$) and NO_2 would not exceed the relevant ambient air quality criteria. **Pacific Environment Limited (2013)** also concluded that there is a very small risk of additional exceedance days from the operation of the MSP and background concentrations.

The estimated in-stack concentrations for all stacks would comply with the relevant limits in the EPL and *Protection of the Environment Operations (Clean Air) Regulation 2010* (**Pacific Environment Limited, 2013**).

3 DESCRIPTION OF THE MODIFICATION

The main elements proposed for the Modification include the following (**Figure 3-1** and **Figure 3-2**):

- Bypassing of the wet high intensity magnetic separator prior to processing in the other MSP circuits.
- The existing ilmenite circuit would be reconfigured to include:
  - addition of two gas-fired mineral reheaters and associated stacks;
  - addition of magnetic separators;
  - addition of a trash screen;
  - duplication of the existing ilmenite circuit feed conveyor;
  - a minor extension to the ilmenite circuit building (including connecting conveyor); and
  - other minor reconfigurations to processing infrastructure inside the existing ilmenite circuit building.
- The existing leucoxene circuit building and associated equipment (e.g. magnetic separators) would be reconfigured to support the reconfigured ilmenite circuit.
- The following key components of the existing leucoxene circuit would be placed in care and maintenance:
  - gas-fired mineral dryer and associated stack;
  - trash screens; and
  - leucoxene circuit feed conveyor.

The Modification would include the following changes to the approved mineral concentrate/ HMC rail transport operations to reflect rail transport changes previously assessed and approved as part of the Atlas-Campaspe Mine modification application (**Tronox, 2019**):

- increased mineral concentrate/ HMC transport from the Ivanhoe Rail Facility from 450,000tpa to 665,000tpa;
- increased mineral concentrate/HMC transport train length (from 600 metres [m] to 920m) ad frequency (from three to four trains per week); and,
- increased MSP process waste transport to the Ivanhoe Rail Facility from 50,000tpa to 65,000tpa.

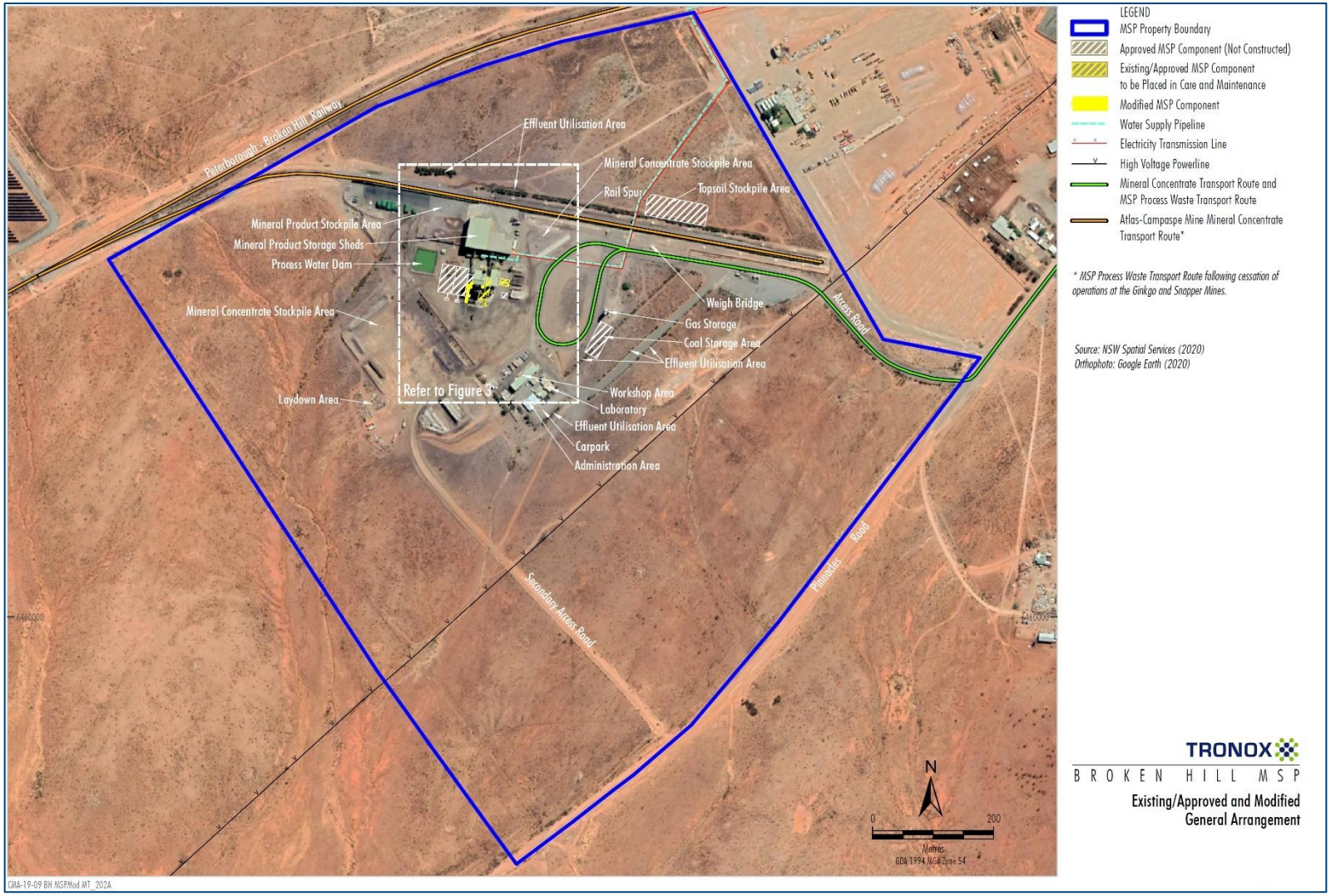

Figure 3-1: Existing/approved and modified general arrangement

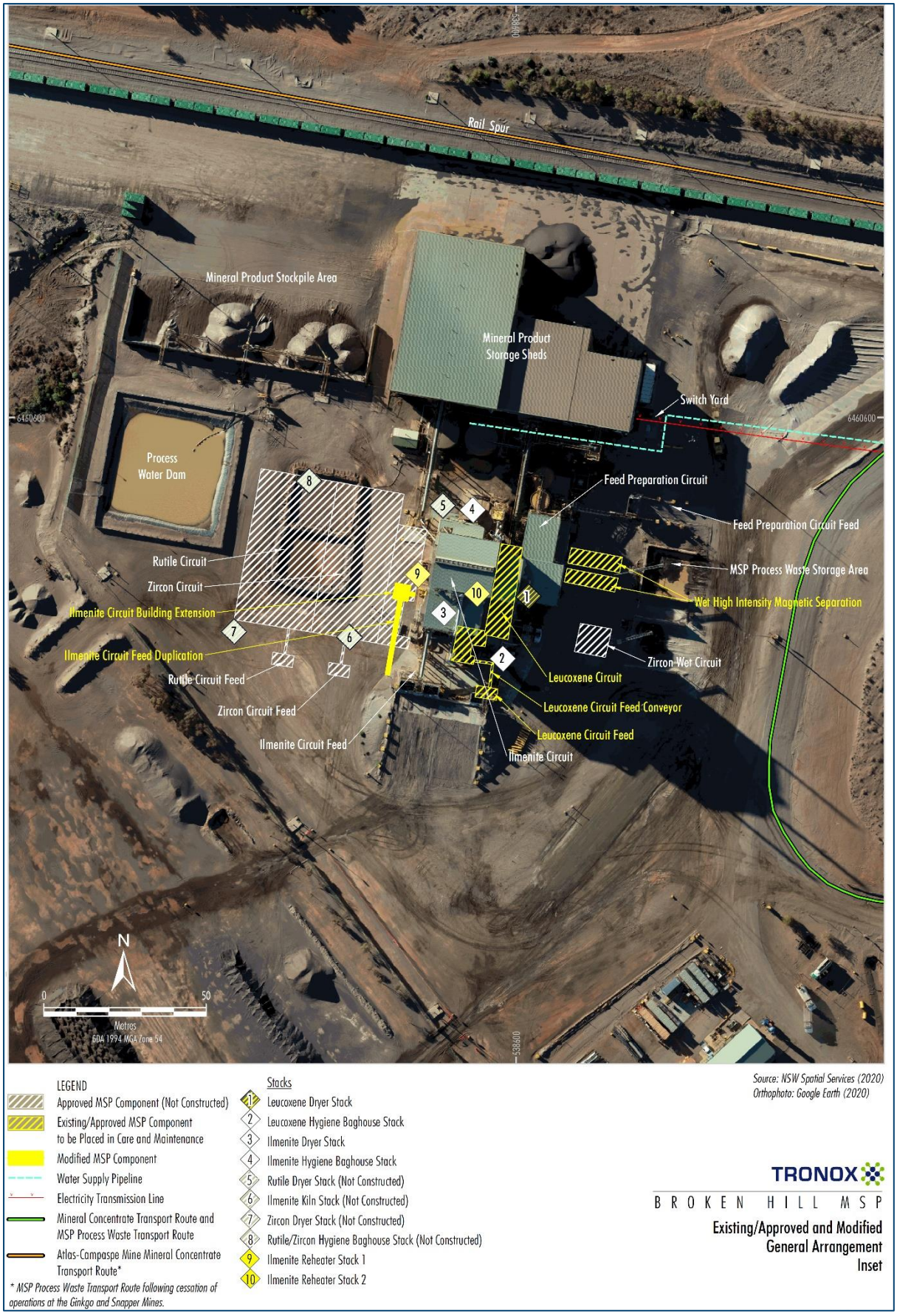

Figure 3-2: Existing/approved and modified general arrangement - inset

4 LOCAL SETTING

The MSP is in the Far West region of NSW, approximately 6.5 kilometres (km) to the southwest of Broken Hill. Nearby privately-owned receptors include predominately industrial-related receptors and residential receptors. The Kanadah Industrial Area is located to the east of the MSP (**Figure 4-1**).

Figure 4-1 presents the location of the MSP with reference to the identified privately-owned receptors of relevance to this study. **Table 4-1** identifies each of these receptors. It is worth noting the R1 is considered representative of the industrial receivers located further east within the Kanadah Industrial Area.

Table 4-1: List of privately-owned receptors assessed in this study

Receptor ID	Name
R1	Consolidated Mining and Civil
R2	Talbot
R3	Finlayson
R4	Tabuteau
R5	Wilkins

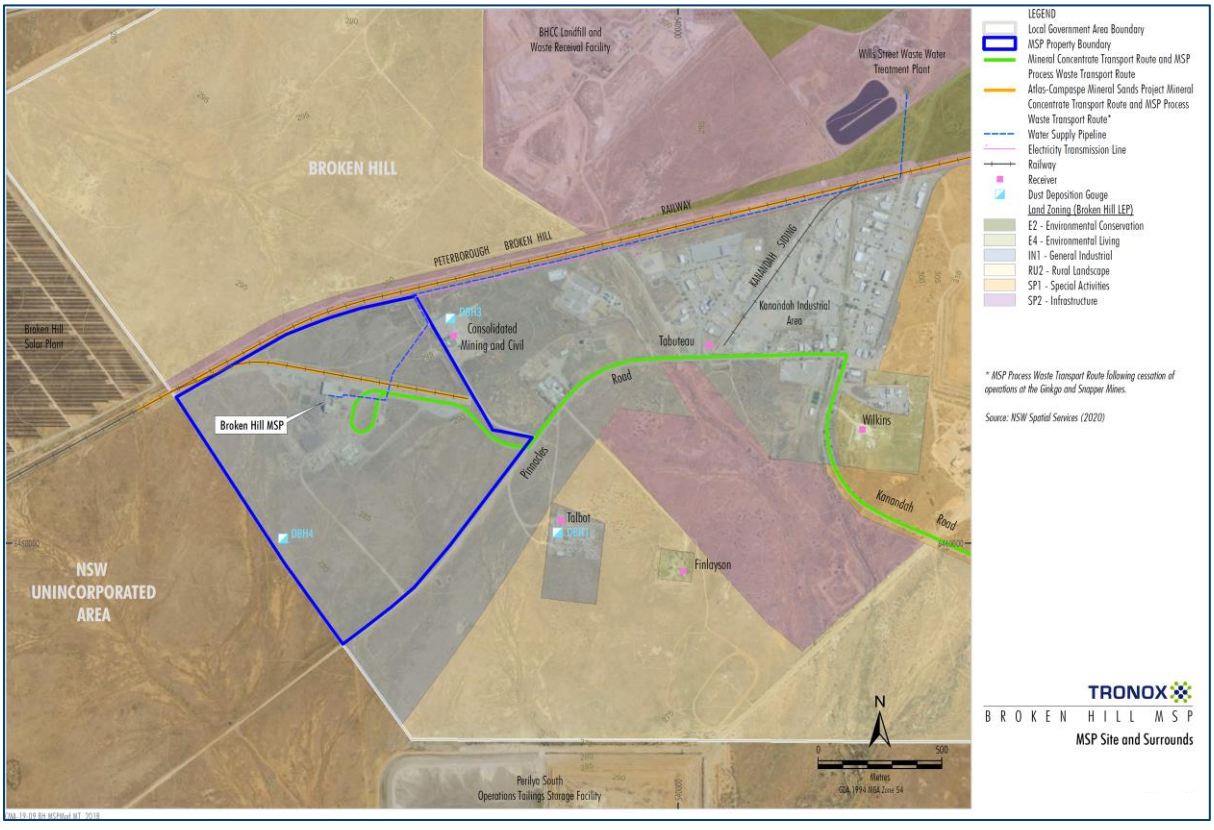

Figure 4-1: MSP setting

Figure 4-2 presents a pseudo three-dimensional visualisation of the topography in the general vicinity of the MSP. The local topography is generally flat and shows a slight rise to the northeast.

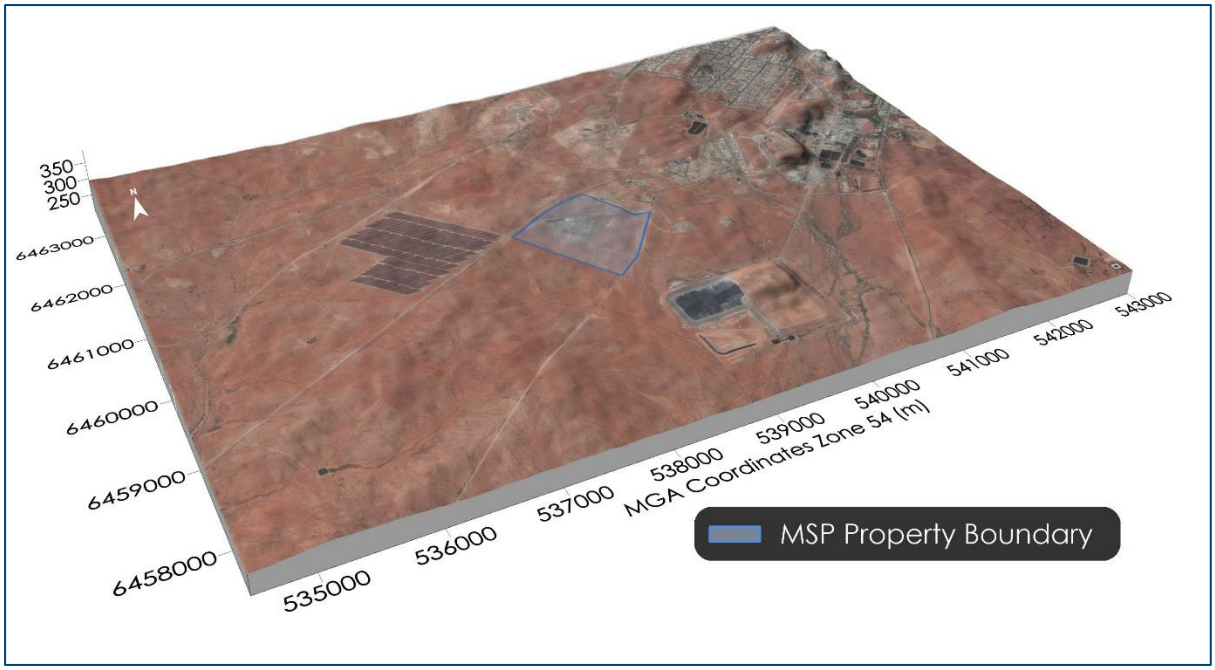

Figure 4-2: Representative visualisation of topography in the area surrounding the MSP

5 AIR QUALITY CRITERIA

Air quality criteria are benchmarks set to protect the general health and amenity of the community in relation to air quality. The sections below identify the potential air emissions generated by the modified MSP and the applicable air quality criteria.

5.1 Particulate matter

Particulate matter consists of dust particles of varying size and composition. Air quality goals refer to measures of the total mass of all particles suspended in air defined as the Total Suspended Particulate matter (TSP). The upper size range for TSP is nominally taken to be 30 micrometres (µm) as in practice particles larger than 30 to 50µm will settle out of the atmosphere too quickly to be regarded as air pollutants.

Two sub-classes of TSP are also included in the air quality goals, namely PM_{10}, particulate matter with equivalent aerodynamic diameters of 10µm or less, and $PM_{2.5}$, particulate matter with equivalent aerodynamic diameters of 2.5µm or less.

Particulate matter, typically in the upper size range, that settles from the atmosphere and deposits on surfaces is characterised as deposited dust. The deposition of dust on surfaces may be considered a nuisance and can adversely affect the amenity of an area by soiling property in the vicinity.

Table 5-1 summarises the air quality goals for particulate matter that are relevant to this assessment as outlined in the NSW EPA's Approved Methods (**NSW EPA, 2017**).

The air quality goals for total impact relate to the total pollutant burden in the air and not just the contribution from the modified MSP. Consideration of background pollutant levels needs to be made when using these goals to assess potential impacts.

Table 5-1: NSW EPA air quality assessment criteria for particulate matter

Pollutant	Averaging Period	Impact	Criterion
TSP	Annual	Total	90 µg/m³
PM_{10}	Annual	Total	25 µg/m³
	24-hour	Total	50 µg/m³
$PM_{2.5}$	Annual	Total	8 µg/m³
	24-hour	Total	25 µg/m³
Deposited dust	Annual	Incremental	2 g/m²/month
		Total	4 g/m²/month

Source: **NSW EPA (2017)**

5.2 Combustion emissions

Combustion emissions associated with the operation of the dryers at the MSP would include nitrogen dioxide (NO_2), carbon monoxide (CO) and sulfur dioxide (SO_2).

NO_2 is reddish-brown in colour (at high concentrations) with a characteristic odour and can irritate the lungs and lower resistance to respiratory infections such as influenza. NO_2 belongs to a family of reactive gases called nitrogen oxides (NO_X). These gases form when fuel is burnt at high temperatures, mainly from motor vehicles, power generators and industrial boilers (**US EPA, 2011**).

Emissions of CO and SO_2 from the dryers and ilmenite kiln would be minimal considering the nature of the fuel used (i.e. LNG, LPG and brown coal) and would not cause any tangible levels in the surrounding environment, relative to the respective impact assessment criteria, hence have not been considered further in this assessment.

Table 5-2 presents the assessment criteria for NO_2 as outlined in the NSW EPA's Approved Methods (**NSW EPA, 2017**).

Similar to the air quality goals for particulate matter, total impact relates to the total pollutant burden in the air and not just the contribution from the Modification. Consideration of background pollutant levels needs to be made when using these goals to assess potential impacts.

Table 5-2: Impact assessment criteria for NO_2

Pollutant	Averaging Period	Impact	Criterion
NO_2	Annual	Total	62 µg/m³
	1-hour	Total	246 µg/m³

Source: **NSW EPA, 2017**

5.3 Other potential air pollutants

Magnesium and iron chromite spinals can occur in the mineral concentrate feed at the MSP.

A previous study determined that in the likely temperature range of roasting applied at the MSP (600-800 degrees Celsius), the maximum level of hexavalent chromium emission was no greater than 0.1 parts per billion (ppb) and significantly lower under predominant conditions for roasting (**Pacific Environment Limited, 2013**).

A modelled assessment found that maximum ground level concentrations of hexavalent chromium associated with the Ilmenite kiln stack would be well below the safe cancer risk limit (**Pacific Environment Limited, 2013**). As there is no change to the proposed Ilmenite kiln stack, there would be no change to the predicted impact associated with hexavalent chromium.

5.4 EPL conditions

Air quality related conditions stipulated in Condition L2.2 of EPL 12314 for the MSP include limits for air concentrations within discharge points as outlined in **Table 5-3**.

Table 5-3: Air concentration limits for MSP

Discharge point	Description	Pollutant	100 percentile concentration limit	Units of measures
6	Leucoxene Hygiene Bag house	Total solid particles	100	mg/m³
7	Ilmenite Hygiene Bag house	Total solid particles	100	mg/m³
		Nitrogen oxides	0.35	g/m³
10	Leucoxene Dryer	Total solid particles	100	mg/m³
11	Ilmenite Dryer	Total solid particles	100	mg/m³
		Nitrogen oxides	0.35	g/m³

Condition O3 of EPL 12314 outlies general operating conditions for the MSP related to air quality which includes:

O3 Dust

O3.1 All operations and activities occurring at the premises must be carried out in a manner that will minimise the emission of dust from the premises.

O3.2 The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.

6 EXISTING ENVIRONMENT

This section describes the existing environment including the climate and ambient air quality in the area surrounding the MSP.

6.1 Local climatic conditions

Long-term climatic data from the Bureau of Meteorology (BoM) weather station at Broken Hill Airport Automatic Weather Station (AWS) (Site No. 047048) were analysed to characterise the local climate in the proximity of the MSP. The Broken Hill Airport AWS weather station is located approximately 5.9km east-southeast of the MSP.

Table 6-1 and **Figure 6-1** present a summary of data from the Broken Hill Airport AWS collected over an approximate 25-to-59-year period for the various meteorological parameters.

The data indicate that on average January is the hottest month with a mean maximum temperature of 33.8 degrees Celsius (°C) and July the coldest month with a mean minimum temperature of 4.8°C.

Rainfall levels are relatively constant over the year with an annual average rainfall of 246.4 millimetres (mm) over 27.9 days. The data show January is the wettest month with an average rainfall of 27.6mm over 2.3 days and June is the driest month with an average rainfall of 14.8mm over 2.3 days.

Relative humidity levels exhibit variability over the day and seasonal fluctuations. Mean 9am relative humidity levels range from 41 percent (%) in January to 73% in June. Mean 3pm relative humidity levels vary from 25% in January and December to 49% in June.

The mean 9am wind speeds range from 13.4 kilometres per hour (km/h) in June to 21.6 km/h in October. The mean 3pm wind speeds vary from 16.8 km/h in May to 21.0 km/h in October.

Table 6-1: Monthly climate statistics summary – Broken Hill AWS

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Temperature													
Mean max. temp. (°C)	33.8	32.4	29.1	24.4	19.2	15.9	15.7	17.8	21.8	25.6	28.9	31.6	24.7
Mean min. temp. (°C)	19.4	18.6	15.4	11.5	7.9	5.5	4.8	5.6	8.5	11.7	14.9	17.4	11.8
Rainfall													
Rainfall (mm)	27.6	18.5	20.0	20.1	19.7	14.8	17.0	18.3	21.3	24.3	20.7	21.3	246.4
No. of rain days (≥1mm)	2.3	1.8	1.8	1.7	2.5	2.3	2.8	2.8	2.5	2.7	2.6	2.1	27.9
9am conditions													
Mean temp. (°C)	24.0	22.9	20.2	17.5	13.3	10.1	9.5	11.6	14.8	17.9	20.7	22.7	17.1
Mean R.H. (%)	41	46	49	51	65	73	72	61	53	45	44	42	54
Mean W.S. (km/h)	21.0	20.3	18.3	16.7	13.5	13.4	14.1	17.0	20.2	21.6	21.3	20.9	18.2
3pm conditions													
Mean temp. (°C)	31.4	30.1	27.4	23.3	18.4	15.2	14.6	16.8	20.2	23.5	27.0	29.3	23.1
Mean R.H. (%)	25	28	28	32	43	49	48	38	34	28	26	25	34
Mean W.S. (km/h)	18.7	19.4	17.9	17.2	16.8	18.1	18.4	19.7	20.9	21.0	20.2	19.6	19.0

Source: **Bureau of Meteorology, 2021 (Jan 2021)**

R.H. – Relative Humidity, W.S. – wind speed

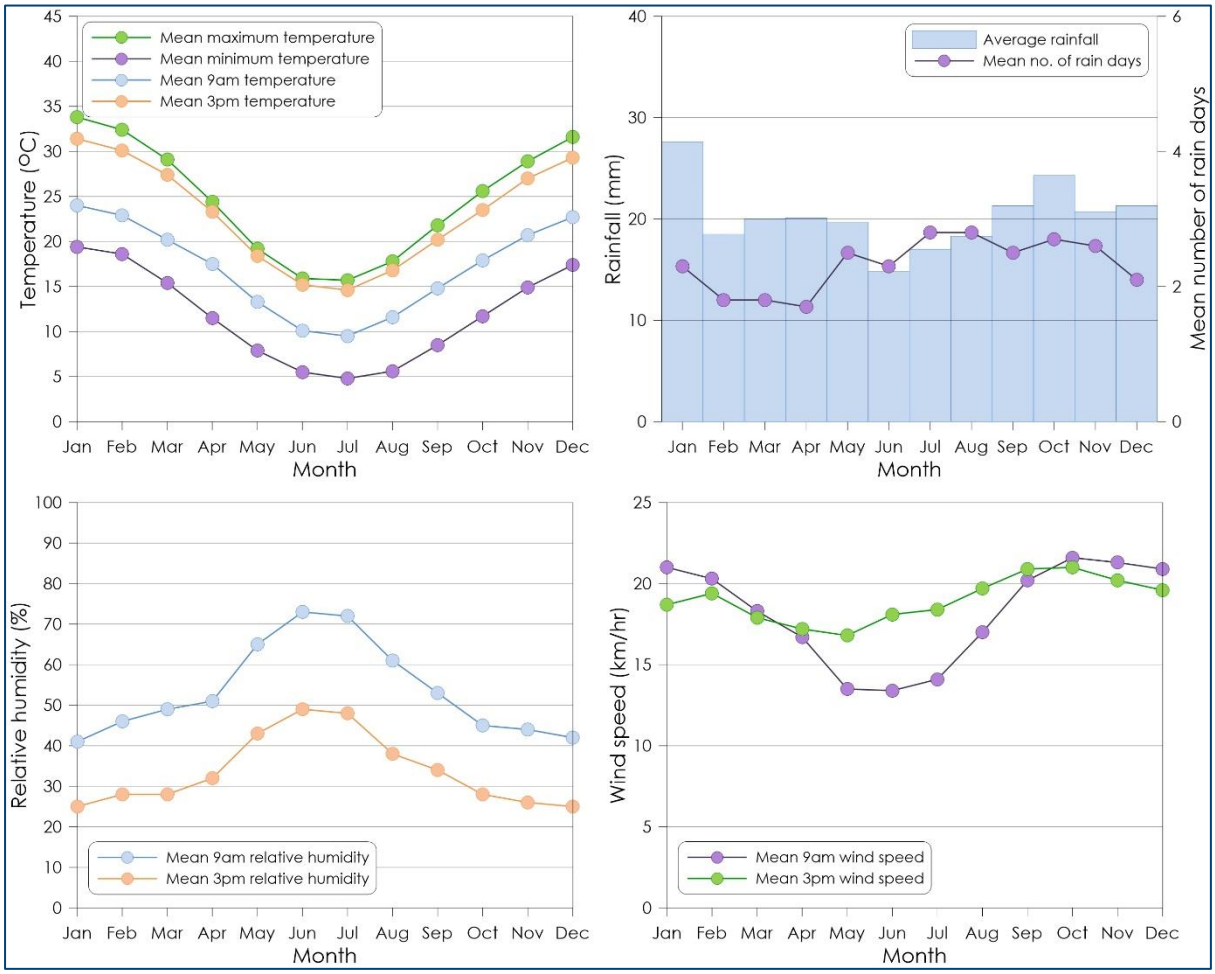

Figure 6-1: Monthly climate statistics summary – Broken Hill Airport AWS

6.2 Local meteorological conditions

Annual and seasonal windroses for the Broken Hill Airport AWS during the 2016 calendar period are presented in **Figure 6-2**. The 2016 calendar year was selected as the meteorological year for the dispersion modelling based on an analysis of data trends in meteorological data recorded and appropriate monitoring data for the area as outlined in **Appendix A**.

Analysis of the annual windrose indicates winds predominately flow on a south to north-northeast axis. The summer windrose shows winds from the south are most frequent. In autumn, a similar distribution pattern as the annual windrose is seen with the greatest winds from the south and north-northeast. During winter, winds from the west-northwest and north-northeast are most frequent with a high portion of winds from the northwest quadrant. The spring windrose shows winds are most frequent from the south-southwest and south with lesser winds from the southwest and northwest quadrants.

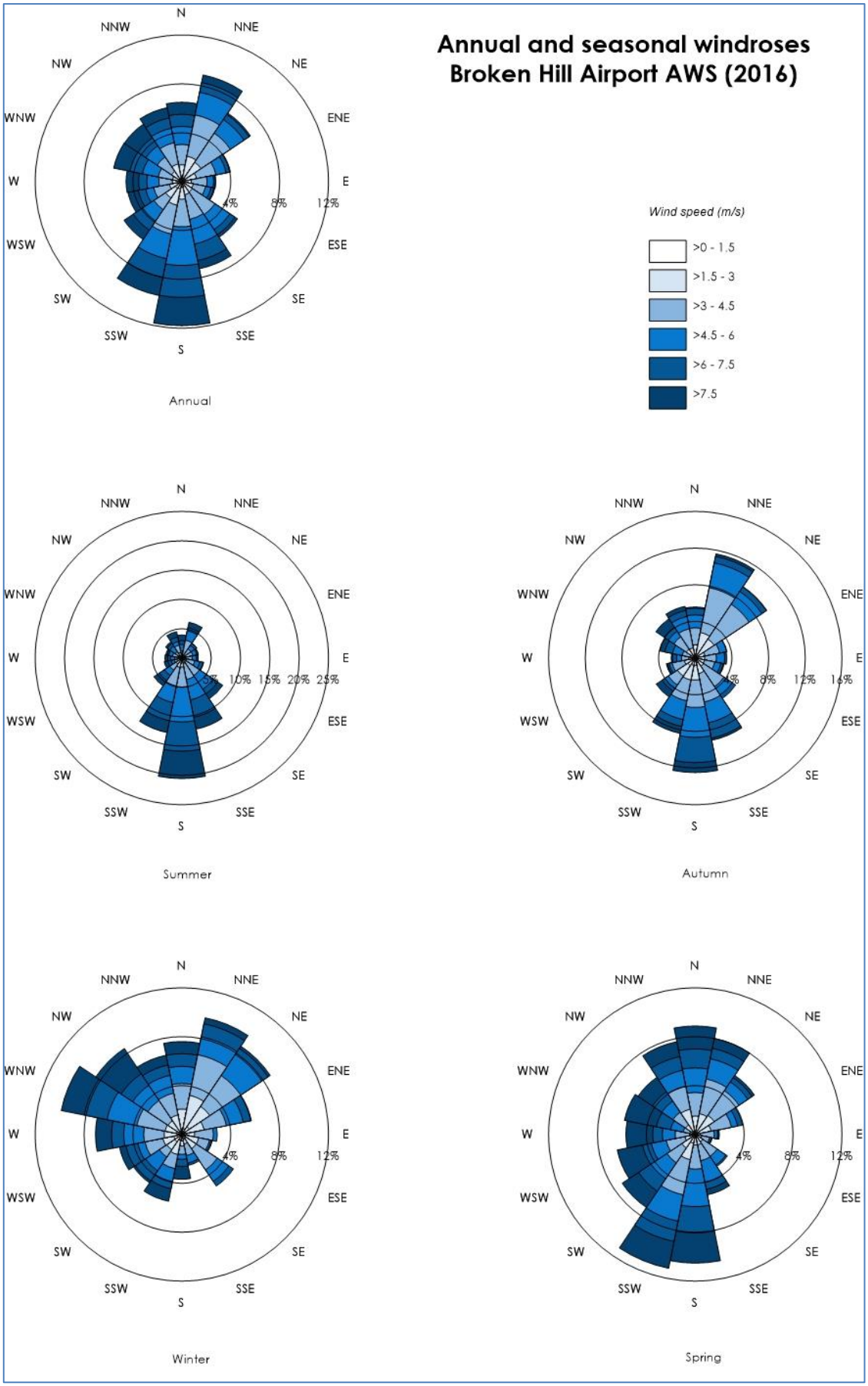

Figure 6-2 : Annual and seasonal windroses – Broken Hill Airport AWS

6.3 Local air quality monitoring

The main sources of particulate matter in the wider area surrounding MSP include industrial and commercial operations, exposed areas, and emissions from local anthropogenic activities such as motor vehicle exhaust.

This section reviews the available ambient air quality monitoring data sourced from the MSP air quality monitoring network. **Figure 6-3** shows the approximate location of each of the monitoring stations with reference to the MSP.

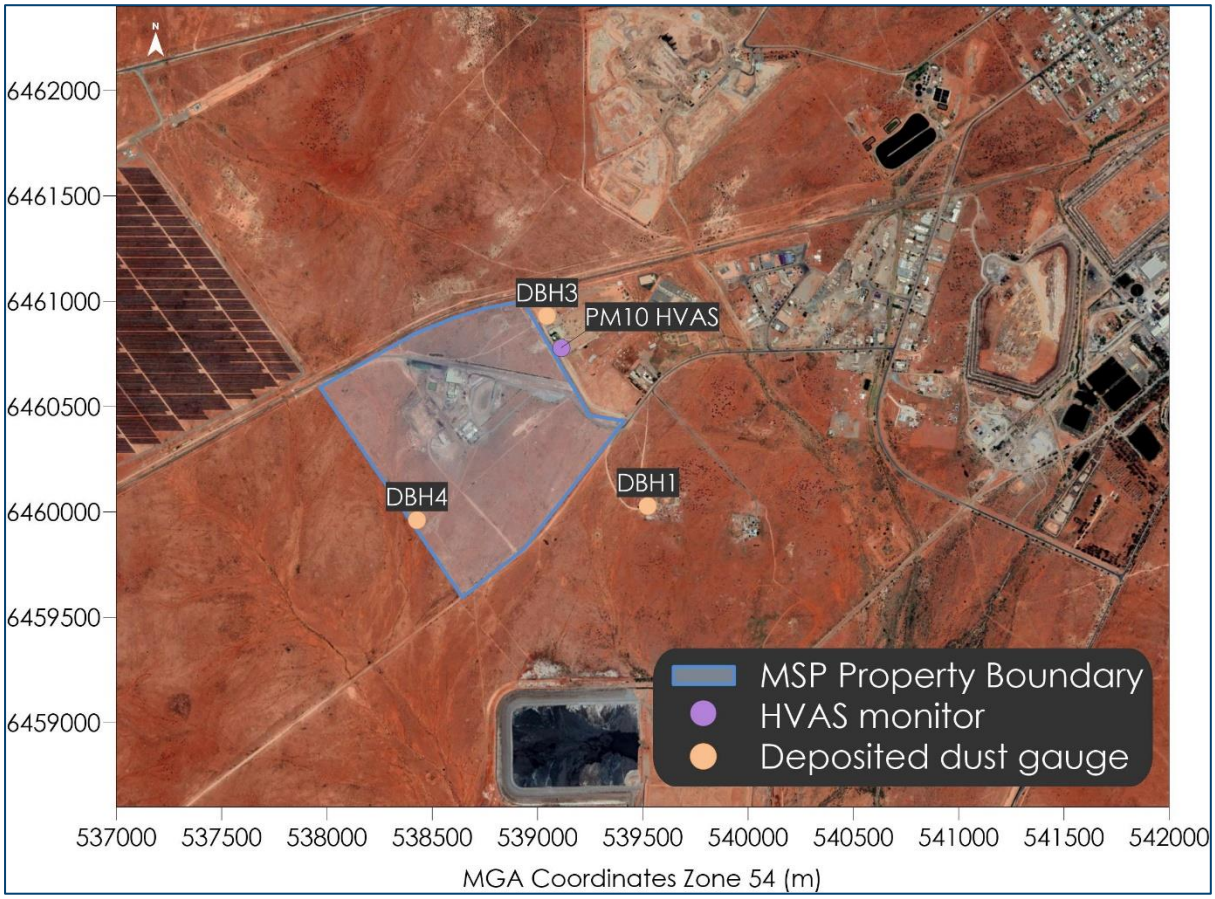

Figure 6-3: Monitoring locations

6.3.1 PM_{10} monitoring

A summary of the available PM_{10} monitoring data from the MSP air quality monitoring network is presented in **Table 6-2**. Recorded 24-hour average PM_{10} concentrations are presented in **Figure 6-4**.

A review of **Table 6-2** indicates that the annual average PM_{10} concentrations were below the NSW EPA impact assessment criterion of 25µg/m³ for all years reviewed. The maximum 24-hour average PM_{10} concentrations were found to exceed the relevant criterion of 50µg/m³ on one occasion in 2014 and 2015.

Table 6-2: Summary of PM_{10} levels from HVAS monitoring station (µg/m³)

Year	Annual average	Criteria
2014	13.6	**25**
2015	12.2	**25**
2016	9.0	**25**
2017	10.6	**25**
	Maximum 24-hour average	
2014	58.9	**50**
2015	88.0	**50**
2016	25.6	**50**
2017	43.2	**50**

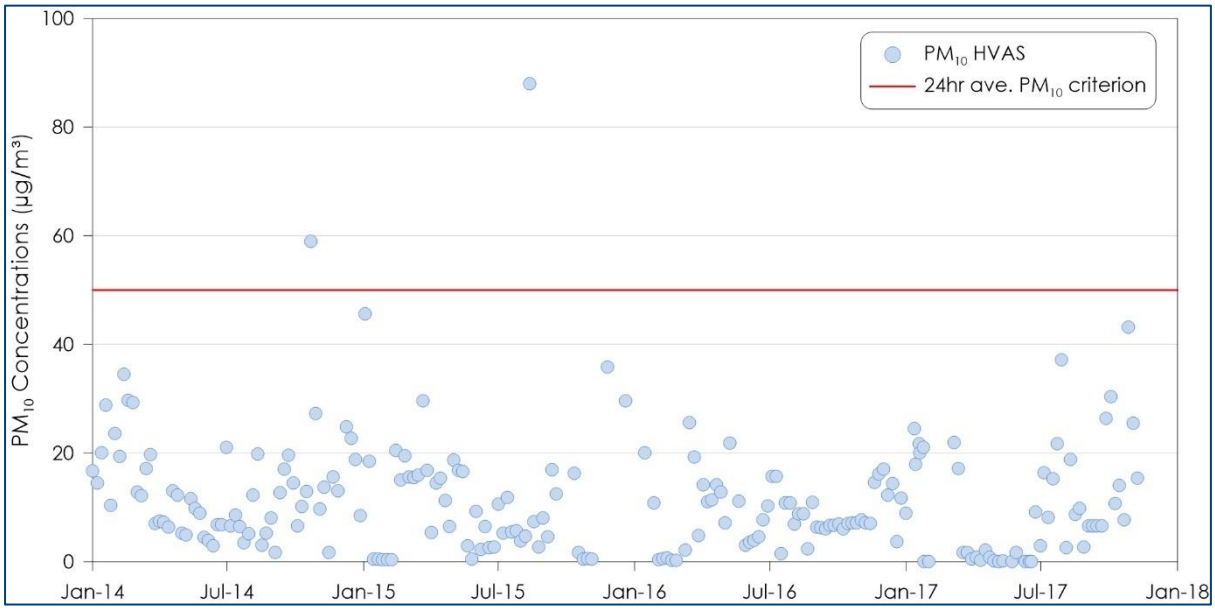

Figure 6-4: 24-hour average PM_{10} concentrations from HVAS monitoring station

The elevated 24-hour average PM_{10} concentration during 2014 occurred on the 22nd October and was identified to be caused by high wind speed conditions of 61km/h ("near gale force"- Beaufort wind scale) and low rainfall occurring during October (**Cristal Mining, 2014**). The elevated 24-hour average PM_{10} concentration during 2015 occurred on the 12th August and was also identified to be caused by high wind speed conditions on the day with average wind speeds of 33km/h and gusts of 74km/h (classed as gale forced wind - Beaufort wind scale) (**Cristal Mining, 2015**).

Figure 6-4 shows that the measured PM_{10} concentrations are nominally highest in the summer period with warmer weather raising the potential for drier ground, elevating the occurrence of windblown dust, bushfires and increased pollen levels.

The PM_{10} HVAS monitoring was suspended in November 2017 after a review of the historical monitoring results indicated that PM_{10} levels have been acceptable over the past 10 years. A modification to the Development Consent (DA 345-11-01) to remove the PM_{10} monitoring requirement was approved by the Department of Planning and Environment in September 2017.

6.3.2 Deposited dust monitoring

Dust deposition monitoring conducted in the area surrounding the MSP has been reviewed.

Table 6-3 presents the annual average dust deposition levels from 2014 to 2020. The results indicate that the dust deposition levels are below the criterion of 4g/m^2/month for all years except for 2020. During 2020 DBH1 recorded an annual average dust deposition level of 5.1g/m^2/month and DBH3 recorded an annual average dust deposition level of 5.4g/m^2/month. A review of the monthly data indicates that during February 2020, these monitors recorded a dust deposition level of 28g/m^2/month and 26g/m^2/month which appear erroneously high compared to the levels typically measured at these monitors.

Table 6-3: Summary of annual dust deposition levels (g/m²/month)

Year	DBH1	DBH3	DBH4	Criterion
2014	0.8	1.4	1.4	**4**
2015	0.8	1.2	0.6	**4**
2016	1.0	1.2	1.2	**4**
2017	1.3	2.5	-	**4**
2018	1.9	2.1	1.9	**4**
2019	2.8	3.2	2.2	**4**
2020	**5.1**	**5.4**	3.3	**4**

6.3.3 Accounting for background dust levels

To account for the contribution from other sources of particulate matter in the wider area an allowance has been added to the modelling predictions to fully address the total potential cumulative impact. The background dust levels from the MSP monitoring network for the 2016 calendar period were applied and is the same period of meteorological modelling used in this assessment.

In the absence of available measurement data for $PM_{2.5}$ and TSP, the background concentrations have been determined from a relationship with the PM_{10} level. The relationship assumes that an annual average PM_{10} concentration of 25µg/m^3 corresponds to an annual average $PM_{2.5}$ concentration of 8µg/m^3 and TSP concentration of 90µg/m^3 based on the NSW EPA air quality impact criteria. A similar relationship is applied with a 24-hour average PM_{10} concentration of 50µg/m^3 corresponding to a 24-hour average $PM_{2.5}$ concentration of 25µg/m^3.

The estimated contribution from the other dust sources applied in the assessment is presented in **Table 6-4**.

Table 6-4: Estimated background dust levels

Dust metric	Averaging period	Background dust level	Unit
TSP	Annual	32.4	µg/m^3
PM_{10}	Annual	9.0	µg/m^3
	24-hour	25.6	µg/m^3
$PM_{2.5}$	Annual	2.9	µg/m^3
	24-hour	12.8	µg/m^3
Dust deposition	Annual	1.2	g/m²/month

This approach is considered to be conservative as the background dust levels include emissions associated with the existing MSP and therefore this approach will include an element of 'double counting'.

6.3.4 NO_2 background levels

Ambient NO_2 air quality monitoring data for the MSP are not available. The nearest available data are identified from the NSW Department of Planning, Industry and Environment (DPIE) air quality monitor at Gunnedah. The Gunnedah monitoring station is located in a similar setting to the MSP and has been used to characterise the ambient levels for the site.

A summary of the available NO_2 monitoring data from March 2018 to December 2020 from the Gunnedah monitoring station is presented in **Table 6-5**. The monitoring data are well below the relevant annual average and 1-hour average criteria of 62µg/m³ and 246µg/m³, respectively.

Of the available data, the measured levels during 2019 have been applied to represent the background NO_2 levels for the Modification.

Table 6-5: Summary of NO_2 levels from NSW DPIE monitoring station (µg/m³)

Year	Annual average	Criteria
2018	-	**62**
2019	9.6	**62**
2020	7.1	**62**
	Maximum 1-hour average	
2018	69.7	**246**
2019	73.8	**246**
2020	57.4	**246**

7 DISPERSION MODELLING APPROACH

The following sections are included to provide the reader with an understanding of the model and modelling approach applied for the assessment.

Modelling was undertaken using a combination of the CALPUFF Modelling System and The Air Pollution Model (TAPM). The CALPUFF Modelling System includes three main components: CALMET, CALPUFF and CALPOST and a large set of pre-processing programs designed to interface the model to standard, routinely available meteorological and geophysical datasets. TAPM is a prognostic air model used to simulate meteorological data for input into CALMET.

The model was set up in general accordance with the NSW EPA's *Generic Guidance and Optimum Model Settings for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia'* (**TRC Environmental Corporation**, **2011**).

7.1 Meteorological modelling

The meteorological modelling methodology applied a 'hybrid' approach which includes a combination of prognostic model data from TAPM with surface observations.

The TAPM model was applied to the available data to generate a three-dimensional upper air data file for use in CALMET. The centre of analysis for the TAPM modelling used is 31deg 59.5min south and 141deg 24.5min east. The simulation involved an outer grid of 30km, with three nested grids of 10km, 3km and 1km with 35 vertical grid levels.

The CALMET domain was run on a 10 x 10km grid with a 0.1km resolution for the 2016 modelled year. The available meteorological data for January 2016 to December 2016 from the Broken Hill Airport AWS was included in the simulation. The 2016 calendar year was selected as the period for modelling based on an analysis of five consecutive years as outlined in **Appendix A**.

The seven critical parameters used in the CALMET modelling are presented in **Table 7-1**.

Table 7-1: Seven critical parameters used in CALMET

Parameter	Value
TERRAD	10
IEXTRP	-4
BIAS (NZ)	-1, -0.5, -0.25, 0, 0, 0, 0, 0
R1 and R2	10, 10
RMAX1 and RMAX2	13, 13

7.2 Meteorological modelling evaluation

The outputs of the CALMET modelling are evaluated using visual analysis of the wind fields and extract data. **Figure 7-1** presents a visualisation of the wind field generated by CALMET for a single hour of the modelling period (i.e. example only). The wind fields follow the terrain well and indicate the simulation produces realistic fine scale flow fields (such as terrain forced flows) in surrounding areas.

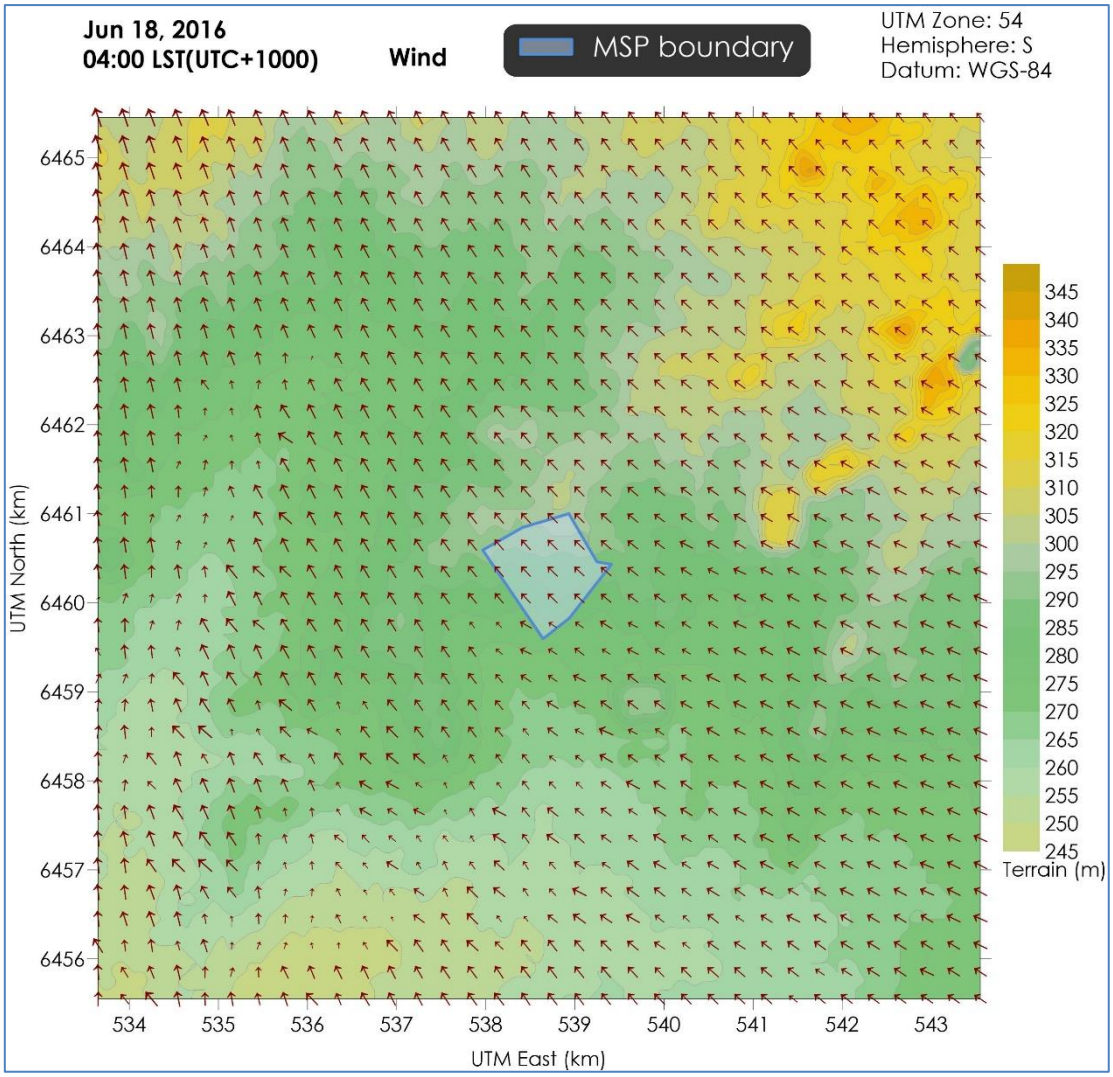

Figure 7-1: Representative 1-hour snapshot of wind field for the Modification

CALMET generated meteorological data were extracted from a point within the CALMET domain and are graphically represented in **Figure 7-2** and **Figure 7-3**.

Figure 7-2 presents the annual and seasonal windroses from the CALMET data. Overall, the windroses generated in the CALMET modelling reflect the expected wind distribution patterns of the area as determined based on the available measured data and the expected terrain effects on the prevailing winds.

Figure 7-3 includes graphs of the temperature, wind speed, mixing height and stability classification over the modelling period for the modelled year and shows sensible trends considered to be representative of the area.

In conclusion, the CALMET generated meteorological data are considered suitable for use in the air dispersion modelling for the Modification.

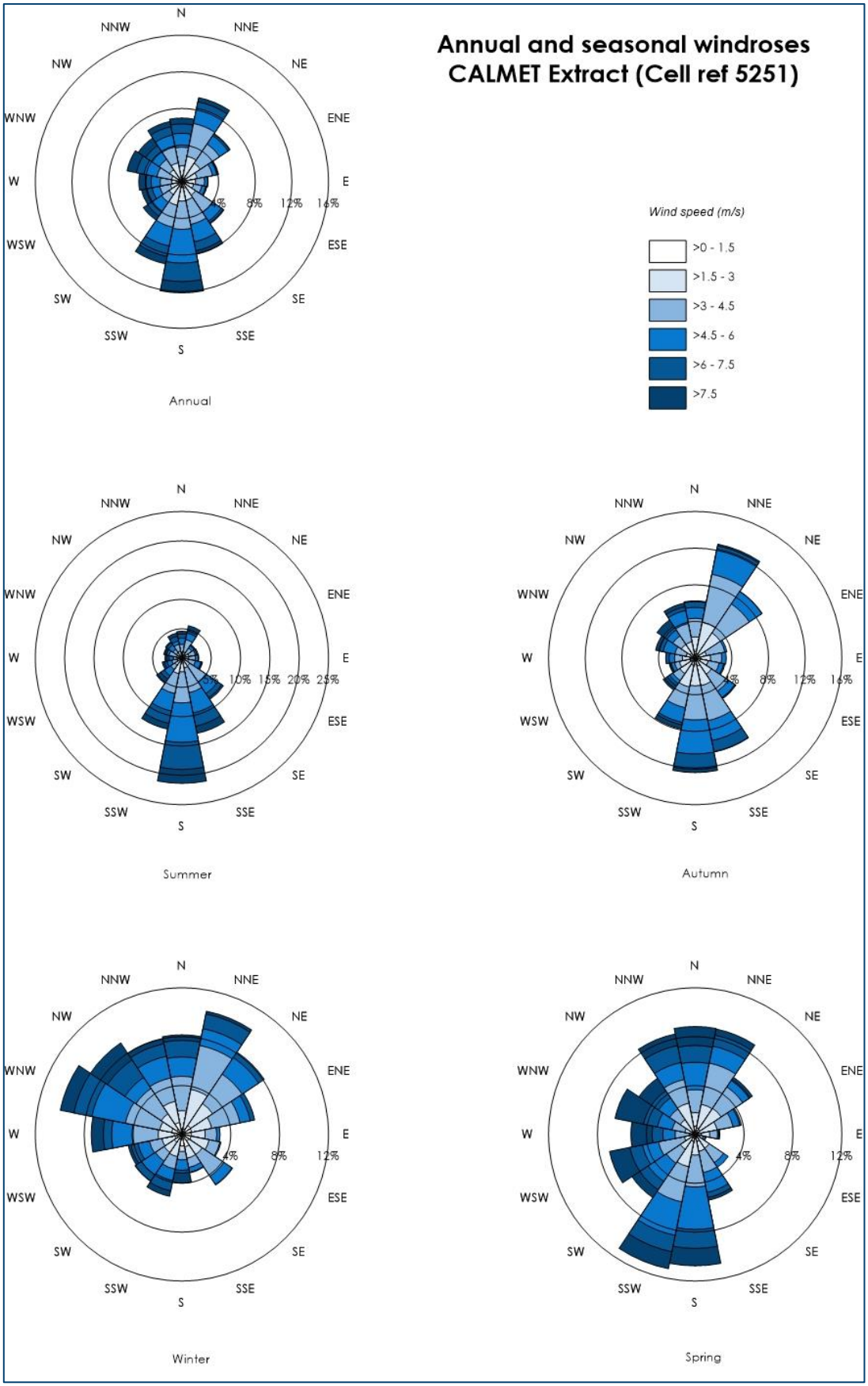

Figure 7-2: Annual and seasonal windroses from CALMET

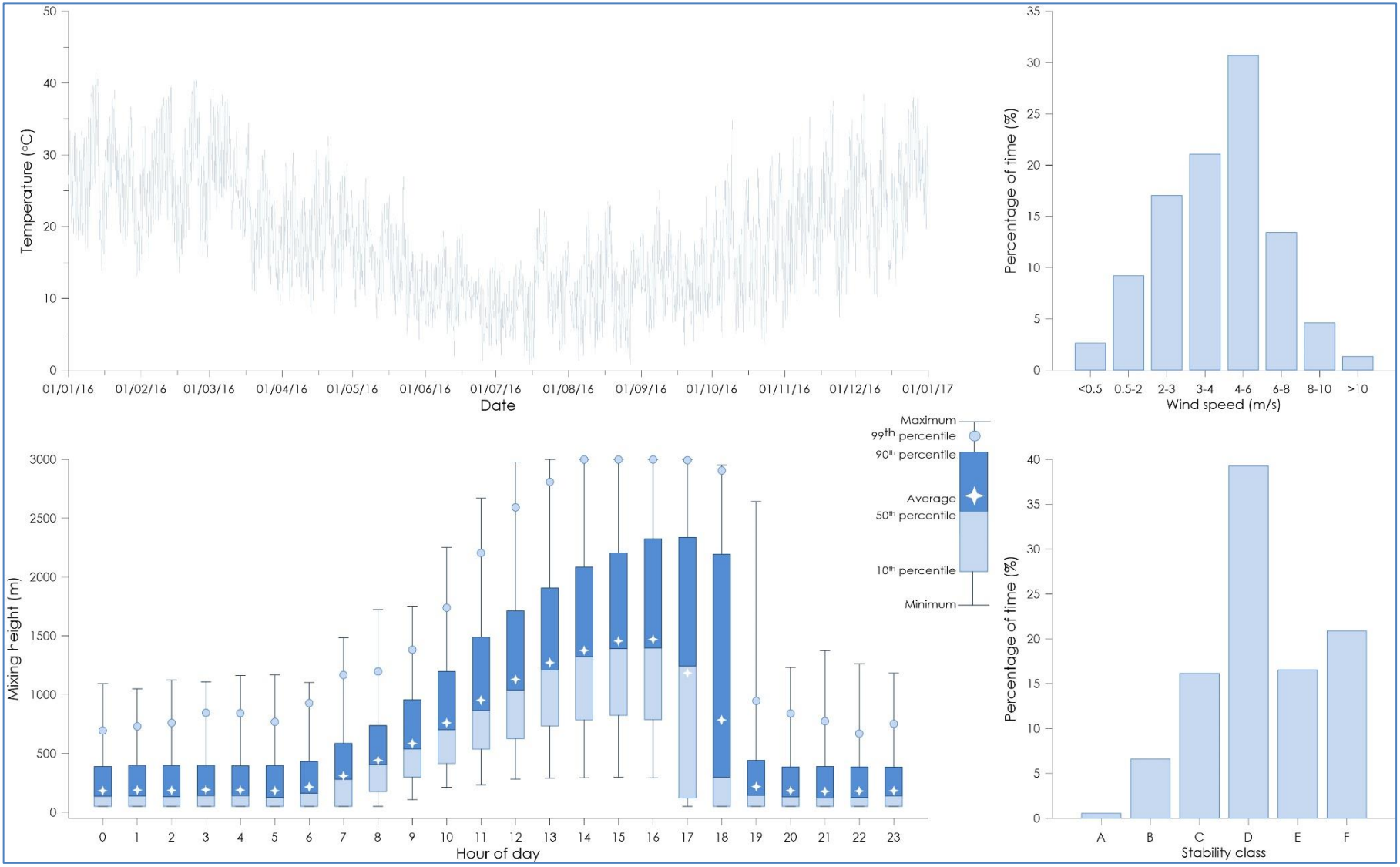

Figure 7-3: Meteorological analysis of CALMET

7.3 Dispersion modelling

The assessment considered a single maximum case scenario to represent the proposed modified MSP.

Fugitive dust emissions from each operational activity of the modified MSP were represented by a series of volume sources and were included in the CALPUFF model via an hourly varying emission file. Meteorological conditions associated with dust generation (such as wind speed) and levels of dust generating activity were considered in calculating the hourly varying emission rate for each source.

The stack parameters for the modelled point sources for the modified MSP are outlined in **Table 7-2**.

Table 7-2: Modelled stack parameters

Stack	Parameter						
	Name	Stack height (m)	Stack diameter (m)	Temperature (K)	Exit velocity (m/sec)	Flow rate (Am^3/s)	Flow rate (Nm^3/s)
Existing/approved stacks							
Stack 1	Leucoxene Dryer	40.2	0.50	340	16	3.1	2.5
Stack 2	Leucoxene Hygiene Baghouse Stack	40.0	0.49	317	15	2.8	2.4
Stack 3	Ilmenite Dryer Stack	40.4	0.90	363	18.5	11.8	7.6
Stack 4	Ilmenite Hygiene Baghouse Stack	40.4	0.75	317	17.3	7.6	6.4
Stack 5	Rutile Dryer Stack	40.2	0.55	340	15	3.6	2.9
Stack 6	Ilmenite Kiln Stack	41.2	0.55	400	15	3.6	2.4
Stack 7	Zircon Dryer Stack	40.2	0.35	340	15	1.4	1.2
Stack 8	Rutile/ Zircon Hygiene Baghouse Stack	40.5	1.00	317	15	11.8	10.1
Modification stacks							
Stack 9	Ilmenite Reheater Stack 1	40.4	0.31	378	15.6	1.2	0.8
Stack 10	Ilmenite Reheater Stack 2	40.4	0.22	378	16.1	0.6	0.4

The modelled source locations for the Modification are shown in **Figure 7-4**. The model included consideration of potential 'building' wake effects on air dispersion that arise due to the effect of winds passing over the buildings at the site.

Figure 7-4: Modelled point source locations

7.3.1 Emission estimation

7.3.1.1 Fugitive emissions

Fugitive dust emissions have been estimated by analysing the dust generating activities and utilising suitable emission factors. The emission factors were sourced from both locally developed and United States Environmental Protection Agency (US EPA) developed documentation. A summary of the estimated TSP, PM_{10} and $PM_{2.5}$ emissions from all significant activities for the modified MSP operating at the maximum production rate (i.e. 1.2 Mtpa) is presented in **Table 7-3**. Full emission inventories and associated calculations are presented in **Appendix B**.

The estimated emissions are commensurate with utilising reasonable best practice dust mitigation applied where feasible. Further details on the dust control measures applied for the Modification are outlined in **Section 7.3.2**.

Table 7-3: Summary of estimated dust emissions for the Modification (kg/annum)

Activity	TSP	PM_{10}	$PM_{2.5}$
Hauling - Access Road	8,318	2,137	214
Hauling - Internal tip truck	6,888	1,770	177
Unloading at Mineral Concentrate Stockpiles	760	359	54
Loading - Ilmenite Feed	760	359	54
Loading - Rutile/zircon feed	146	69	10
Loading - Trucks/Containers with Rejects	190	90	14
Front-end loader - Loading Trains	18,823	3,812	1,976
Front-end loader - at Mineral Concentrate Storage Pile	18,823	3,812	1,976
Front-end loader - at Mineral Concentrate Storage Pile	18,823	3,812	1,976
Unloading - Coal storage	119	56	9
Stockpiles - Mineral Concentrate Stockpile 1	931	465	70
Stockpiles - Mineral Concentrate Stockpile 2	196	98	15
Stockpiles - Product stockpile	224	112	17
Stockpiles - Reject stockpile	27	14	2
Total emissions	**75,028**	**16,965**	**6,565**

7.3.1.2 Stack emissions

The stack pollutant emissions are estimated using a similar methodology outlined in *Murray-Darling Basin Operations Modification – Broken Hill Mineral Separation Plant Air Quality Assessment* (**Pacific Environment Limited, 2013**). The additional gas-fired mineral heaters associated with the Modification are identified as Stack 9 and Stack 10.

Particulate emissions for each process are based on the throughput of materials and the estimated product loss at approximately 1% for the baghouses and 2% for the dryers. The baghouses are assumed to have a control efficiency of 99.92% and the dryers a control efficiency of 99.99%. Combustion emissions of NO_X and particulates for the dryers are estimated based on the annual fuel usage and emission factors for LPG use in *National Pollutant Inventory Emission Estimation Techniques Manual for Combustion in Boilers* (**NPI, 2010**). For the Ilmenite kiln, stack concentrations of 500mg/m^3 for NO_X and 14mg/m^3 for PM_{10} have been applied (**Pacific Environment Limited, 2013**).

Stack emissions for the modelled point sources for the Modification are outlined in **Table 7-2**.

Table 7-4: Modelled stack emissions

Stack	Parameter						
	Name	Process emissions		Combustion emissions			
		Throughput (tph)	PM_{10} (g/s)	Fuel consumption (tpa)	NO_X (g/s)	PM_{10} (g/s)	Total PM_{10} (g/s)
Stack 1	Leucoxene Dryer	36	0.017	1,512	0.214	0.012	0.03
Stack 2	Leucoxene Hygiene Baghouse Stack	36	0.079	-	-	-	0.079
Stack 3	Ilmenite Dryer Stack	90	0.043	3,530	0.499	0.029	0.072
Stack 4	Ilmenite Hygiene Baghouse Stack	90	0.197	-	-	-	0.197
Stack 5	Rutile Dryer Stack	12	0.006	302	0.043	0.002	0.008
Stack 6	Ilmenite Kiln Stack	33	0.016	-	1.8	0.18	0.196
Stack 7	Zircon Dryer Stack	13	0.006	328	0.046	0.003	0.009
Stack 8	Rutile/Zircon Hygiene Baghouse Stack	27	0.059	-	-	-	0.059
Stack 9	Ilmenite Reheater Stack 1	60	0.028	376	0.053	0.003	0.032
Stack 10	Ilmenite Reheater Stack 2	15	0.007	118	0.017	0.001	0.008

7.3.1.3 In-stack concentration limits

As described in **Section 2.3**, the estimated in-stack concentrations for the existing/approved MSP stacks would comply with the relevant limits in the EPL (**Pacific Environment Limited, 2013**). As the Modification is not changing the existing/approved stacks, continued compliance with these limits is expected.

Table 7-5 presents a comparison between the estimated in-stack concentrations for the Modification stacks and the applicable standards of concentration for scheduled activity Group 6 set out in the *Protection of the Environment Operations (Clean Air) Regulation 2010*. The comparison indicates that the Modification stacks would comply with the relevant standards of concentration.

Table 7-5: Comparison of applicable POEO emission standards – Modification stacks

Stack	Estimated emission concentration (mg/Nm^3)			POEO Standard of Concentration (Group 6) (mg/Nm^3)
	Combustion emissions	Product emissions	Total	
NO_x				
Ilmenite Reheater Stack 1	64.9	-	64.9	350
Ilmenite Reheater Stack 2	39.0	-	39.0	350
Particulate matter				
Ilmenite Reheater Stack 1	3.8	34.7	38.5	50
Ilmenite Reheater Stack 2	2.3	16.7	19.0	50

7.3.2 Dust mitigation and management

A summary of the dust mitigation measures applied at the MSP is shown in **Table 7-6**. These include environmental mitigation measures as outlined in the *MSP Air Quality Management Plan* (**Tronox, 2018**) and other appropriate mitigation measures. Where applicable, these controls have been applied in the dust emission estimates shown in **Table 7-3**. Further specific detail on the level of control applied is set out in **Appendix B**.

Table 7-6: Operational dust mitigation measures

Source	Mitigation Measure
General	Activities to be assessed during adverse weather conditions and modified as required (e.g. cease activity where reasonable levels of dust cannot be maintained using the available means).
	Weather forecast to be checked prior to undertaking material handling or processing.
	Engines of on-site vehicles and plant to be switched off when not in use.
	Vehicles and plant are to be fitted with pollution reduction devices where practicable.
	Vehicles are to be maintained and serviced according to manufacturers' specifications.
	Baghouses and wet scrubber on Ilmenite kiln maintained to manage emissions from stack sources
	Alarms fitted to warn of potential malfunctions with stack source operations
Material handling	Reduce drop heights from loading and handling equipment where practical.
	Modify activities in windy conditions.
Stockpiles	Fixed irrigation and/or chemical dust suppressants used on mineral product stockpiles and waste material stockpiles
Hauling activities	Haul roads should be watered using water carts such that the road surface has sufficient moisture to minimise on-road dust generation.
	Regularly inspect haul roads and maintain surfaces to remove potholes or depressions.
	Driveways and hardstand areas to be swept/cleaned regularly as required, etc.
	Vehicle traffic is to be restricted to designated routes.
	Speed limits are to be enforced.
	Vehicle loads are to be covered when travelling off-site.

8 DISPERSION MODELLING RESULTS

This section presents the predicted impacts on air quality which may arise from air emissions generated by the Modification.

8.1 Dust concentrations

The dispersion model predictions presented in this section include those for the operation of the modified MSP in isolation and the operation of the modified MSP with consideration of other sources (total cumulative impact). The results show the predicted:

- maximum 24-hour average $PM_{2.5}$ and PM_{10} concentrations;
- annual average $PM_{2.5,}$ PM_{10} and TSP concentrations; and,
- annual average dust (insoluble solids) deposition rates.

It is important to note that when assessing impacts per the maximum 24-hour average levels, these predictions are based on the highest predicted 24-hour average concentrations which were modelled at each point within the modelling domain for the worst day (i.e. a 24-hour period) in the one-year-long modelling period.

Associated isopleth diagrams of the dispersion modelling results are presented in **Appendix C**.

Table 8-1 presents the predicted particulate dispersion modelling results for the modified MSP in isolation at each of the assessed receptor locations. The results show that the modified MSP in isolation would not exceed the relevant criteria for deposited dust at the receptor locations.

Table 8-1: Particulate dispersion modelling results for assessed receptors – Modified MSP in isolation

Receptor ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD^ (g/m²/month)
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average
	Air quality impact criteria					
	-	-	-	-	-	2
R1	8.3	0.7	13.8	1.5	3.8	0.1
R2	3.7	0.3	6.1	0.6	1.5	0.1
R3	2.4	0.2	3.7	0.3	0.8	<0.1
R4	2.0	0.1	3.0	0.3	0.6	<0.1
R5	1.6	0.1	2.4	0.2	0.3	<0.1

^Deposited dust

The cumulative (total) impact is defined as the modelling impact associated with the operation of the modified MSP combined with the estimated ambient background levels in **Section 6.3**.

The predicted cumulative annual average $PM_{2.5}$, PM_{10}, TSP and dust deposition levels due to the modified MSP with the estimated background levels are presented in **Table 8-2**. The results in **Table 8-2** indicate that all of the assessed receptors are predicted to experience levels below the relevant criteria for each of the assessed dust metrics.

Table 8-2: Particulate dispersion modelling results for assessed receptors – Cumulative impact

Receptor ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average
	Air quality impact criteria					
	25	8	50	25	90	4
R1	21.1	3.6	39.4	10.5	36.2	1.4
R2	16.5	3.2	31.7	9.6	33.9	1.3
R3	15.2	3.1	29.3	9.3	33.2	1.3
R4	14.4	3.0	28.0	9.2	32.7	1.3
R5	14.8	3.0	28.6	9.3	33.0	1.3

Time series plots of the predicted cumulative 24-hour average PM_{10} concentrations for Receptor R1 are presented in **Figure 8-1**.

The orange bars in the figures show the predicted levels due to the Modification above background levels (i.e. the orange sections of the bars indicate the amount of increased dust from the modified MSP). The blue bars show the existing background levels. For missing data in the background levels, the 70th percentile of the HVAS data from 2014 to 2017 has been applied. The top of the orange bar indicates the predicted future cumulative level associated with the modified MSP and background combined.

The results indicate that the PM_{10} levels would only see a relatively small increase compared to existing dust levels. It should be noted that the background levels include the contribution from the existing MSP. Nevertheless, the graph indicates the operation of the modified MSP would not result in any additional days of exceedance of the cumulative 24-hour average PM_{10} criteria.

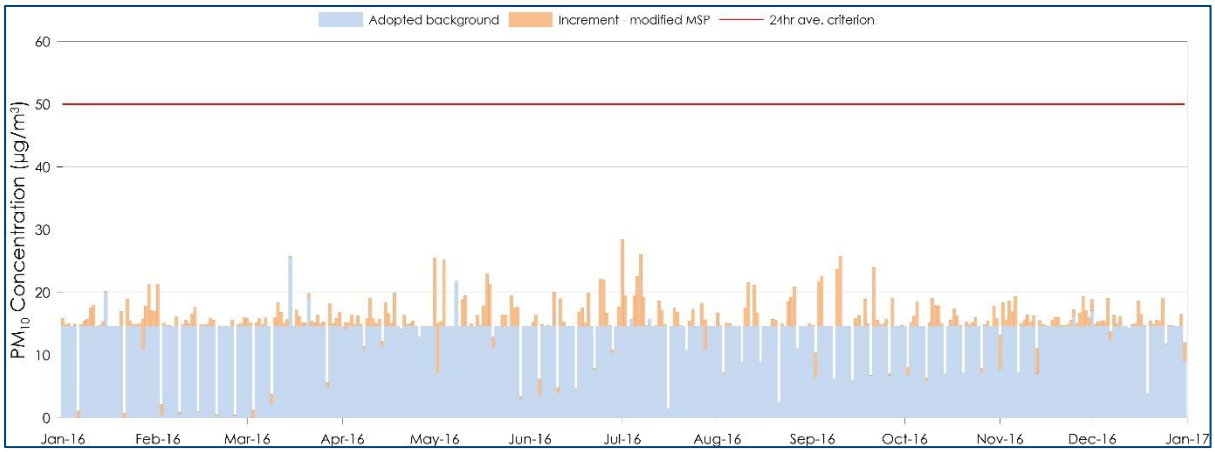

Figure 8-1: Time series plots of predicted cumulative 24-hour average PM_{10} concentrations for Receptor R1

8.2 Consideration of other local sources

Other existing/approved developments identified which have potential to generate dust emissions include:

- The Perilya South Operation which is an existing lead-zinc underground mine that mines ore at a rate of up to 5Mtpa and is located approximately 1.5km to the southeast of the MSP. As this is an underground mining operation there would be modest dust emissions generated and any contribution near the MSP would be captured in the background air quality measurements.

- The Rasp Mine, which is an existing lead-zinc-silver underground mine that mines ore at a rate of up to 750,000tpa and is located approximately 4km to the northeast of the MSP. As this is an underground mining operation and is located a considerable distance from the MSP it is not expected to have any tangible contribution in the immediate area surrounding the MSP. Nevertheless, any potential contribution from the Rasp Mine would be captured in the background air quality measurements.

- The Broken Hill Solar Plant is an existing solar energy facility located approximately 0.8km to the west of the MSP. The facility would not generate any significant air emissions which would warrant consideration in the cumulative assessment.

8.3 NO_2 concentrations

Table 8-3 presents the predicted NO_2 dispersion modelling results at each of the assessed receptor locations. The NO_X emissions from the Modification are assumed to have a maximum conversion rate of 100% to NO_2.

The results show that minimal incremental effects would arise at the receptor locations due to the Modification and that all the assessed receptors are predicted to experience levels below the relevant NO_2 criteria.

Table 8-3: NO_2 dispersion modelling results for assessed receptors (µg/m³)

Receptor ID	Incremental impact – modified MSP		Cumulative impact	
	1-hour average	Annual average	1-hour average	Annual average
	Air quality impact criteria			
	-	-	246	62
R1	83.9	1.6	157.7	11.2
R2	38.8	0.8	112.6	10.4
R3	25.8	0.5	99.6	10.1
R4	26.3	0.3	100.1	9.9
R5	23.9	0.3	97.7	9.9

8.4 Comparison with predicted air quality levels for Modification 4

The predicted air quality levels for Modification 4 of the MSP in *Murray-Darling Basin Operations Modification – Broken Hill Mineral Separation Plant Air Quality Assessment* (**Pacific Environment Limited, 2013**) have been compared with levels predicted for the Modification.

Table 8-4 presents a comparison of the predicted cumulative annual average PM_{10} and NO_2 levels due to the MSP at the assessed receptor locations. The comparison indicates that relative to the approved MSP (per Modification 4), the modified MSP in isolation would result in an increase in the contribution at the receptor locations as expected considering the proposed modifications.

The increase in predicted levels is small relative to the impact assessment criteria, approximately 0.8% for PM_{10} and 1.0% for NO_2 and is unlikely to be discernible beyond the existing background levels.

Table 8-4: Comparison of change in predicted air quality levels

Pollutant	Receptor ID	Predicted level – Approved MSP in isolation *	Predicted level - modified MSP in isolation
PM_{10}	R1	1.5	1.5
	R2	0.4	0.6
	R3	0.2	0.3
	R5	0.1	0.2
NO_2	R1	1.0	1.6
	R2	0.3	0.8
	R3	0.2	0.5
	R5	0.1	0.3

* **Pacific Environment Limited (2013)**

9 GREENHOUSE GAS ASSESSMENT

The Modification would not change the processing rates at the MSP. As diesel and electricity consumption at the MSP are predominately related to production, it is expected that the total diesel and electricity consumption at the MSP on an annual basis would not change significantly as a result of the Modification.

The Modification would, however, increase the consumption of gas (LNG or LPG) due to the addition of two gas-fired mineral reheaters to the ilmenite circuit.

The direct and indirect greenhouse gas emissions associated with the two gas-fired mineral reheaters have been considered using emission factors from the *National Greenhouse Accounts Factors Australian National Greenhouse Accounts October 2020* (**Department of Industry, Science, Energy and Resources, 2020**).

The Modification would result in the following incremental annual greenhouse gas emissions:

- Scope 1 emissions – 1.52 kt CO_2-e.
- Scope 2 emissions – 0 kt CO_2-e.
- Scope 3 emissions – 0.41 kt CO_2-e.

The estimated change due to the Modification relative to the incremental greenhouse gas emissions for Modification 4 (**Resource Strategies, 2013**) is a 0.06% increase in Scope 1 emissions and a 0.09% increase in Scope 3 emissions.

10 SUMMARY AND CONCLUSIONS

This study has examined the air quality impacts which may arise from the Modification.

The air dispersion modelling methodology uses recent and comprehensive weather and dust monitoring data, incorporates conservative emissions estimations and considers existing background levels.

The results indicate that for all assessed dust metrics, the Modification would produce very minimal additional dust emissions with the predicted levels being below the relevant criterion at the assessed receptor locations. The predicted NO_2 concentrations from the Modification are also predicted to be below the relevant criteria at the receptor locations.

Compared to the approved MSP (per Modification 4), the modified MSP in isolation would result in an increase in the contribution at the receptor locations, however this increase is small relative to the impact assessment criteria, approximately 0.8% for PM_{10} and 1.0% for NO_2 and is unlikely to be discernible beyond the existing background levels.

The estimated change in greenhouse gas emissions due to the Modification is 1.52 kt of CO_2-e for Scope 1 emissions and 0.41 kt CO_2-e for Scope 3 emissions and relative to the approved operations is a 0.06% increase in Scope 1 emissions and a 0.09% increase in Scope 3 emissions.

Overall, the assessment shows that no adverse air quality impacts would arise due to the operation of the modified MSP.

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Appendix A

Selection of Meteorological Year

Selection of meteorological year

A statistical analysis of the latest five contiguous years of meteorological data from the nearest BoM weather station with suitable available long-term data, Broken Hill Airport AWS weather station, is presented in **Table A-1**.

The standard deviation of the latest five years of meteorological data spanning 2016 to 2020 was analysed against the available long-term measured wind speed, temperature and relative humidity. The analysis indicates that the 2016 and 2017 dataset is closest to the mean for wind speed, the 2016 and 2020 datasets are closest for temperature and the 2020 dataset is closest for relative humidity. The 2016 dataset appears to best align with long-term data and therefore is considered most representative.

Table A-1: Statistical analysis results for Broken Hill Airport AWS

Year	Wind speed	Temperature	Relative humidity
2016	0.4	0.9	4.2
2017	0.4	1.2	4.8
2018	0.6	1.3	6.1
2019	0.5	1.3	6.5
2020	0.5	0.9	3.5

Figure A-1 shows the frequency distributions for wind speed, temperature, wind direction and relative humidity for the 2017 year compared with the mean of the 2016 to 2020 data set. The 2016 year data appear to be well aligned with the mean data for wind speed and temperature.

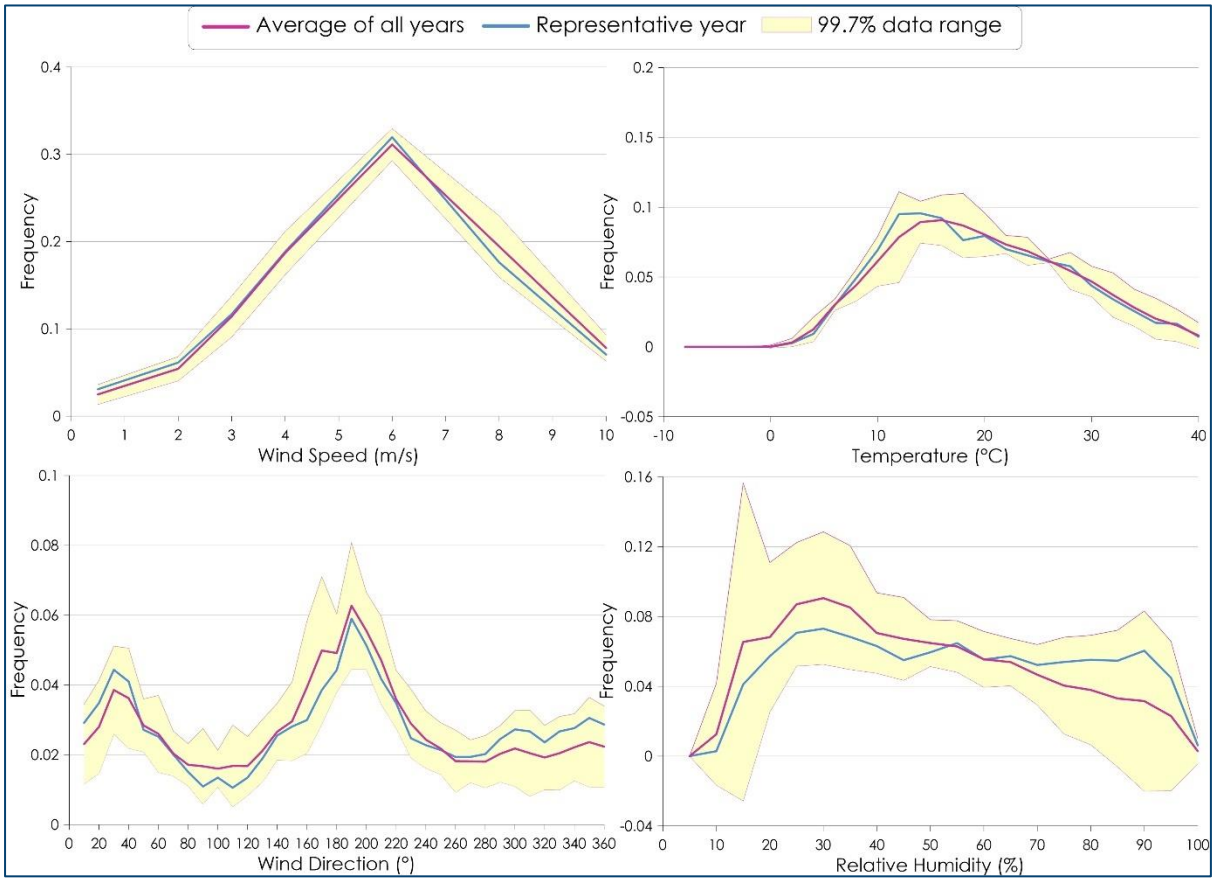

Figure A-1: Frequency distributions for wind speed, wind direction, temperature and relative humidity

Appendix B

Emission Calculations

Emission Calculation

The proposed production schedule provided by the Proponent have been combined with emissions factor equations that relate to the quantity of dust emitted from particular activities based on intensity, the prevailing meteorological conditions, and composition of the material being handled.

Emission factors and associated controls have been sourced from:

- United States (US) EPA AP42 Emission Factors (**US EPA, 1985 and Updates**); and,
- NSW EPA document, *NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining*, prepared by Katestone Environmental (**Katestone Environmental, 2011**).

The emission factor equations used for each dust generating activity are outlined in **Table B-1** below. A detailed dust emission inventory for fugitive modelled sources is presented in **Table B-2**.

Control factors include the following:

- Hauling on unpaved surfaces – 75% control for watering of trafficked areas.

Table B-1: Emission factor equations

Activity	Emission factor equation		
	TSP	PM_{10}	$PM_{2.5}$
Loading / emplacing material	$EF = 0.74 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right)$ $kg/tonne$	$EF = 0.35 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right)$ $kg/tonne$	$EF = 0.053 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right)$ $kg/tonne$
Hauling on unsealed surfaces	$EF = \left(\frac{0.4536}{1.6093}\right) \times 4.9 \times (s/12)^{0.7} \times (1.1023 \times M/3)^{0.45}$ kg/VKT	$EF = \left(\frac{0.4536}{1.6093}\right) \times 1.5 \times (s/12)^{0.9} \times (1.1023 \times M/3)^{0.45}$ kg/VKT	$EF = \left(\frac{0.4536}{1.6093}\right) \times 0.15 \times (s/12)^{0.9} \times (1.1023 \times M/3)^{0.45}$ kg/VKT
Front-end loader (FEL) working	$EF = 2.6 \times s^{1.2} / M^{1.3}$ kg/hr	$EF = (0.45 \times s^{1.5} / M^{1.4}) \times 0.75$ kg/hr	$EF = (2.6 \times s^{1.2} / M^{1.3}) \times 0.105$ kg/hr
Wind erosion on stockpiles	$EF = 850\, kg/ha/year$	$0.5 \times TSP$	$0.075 \times TSP$

EF = emission factor, U = wind speed (m/s), M = moisture content (%), s = silt content (%), W = average weight of vehicle (tonne), VKT = vehicle kilometres travelled (km).

Table B-2: Dust Emissions Inventory

Activity	TSP emission (kg/y)	PM10 emission (kg/y)	PM25 emission (kg/y)	Intensity	Units	EF - TSP	EF - PM10	EF - PM25	Units	Var. 1	Units	Var. 2	Units	Var. 3 - TSP / PM10 / PM2.5	Units	Var. 4	Units	Var. 5	Units	Var. 6	Units
Hauling - Access Road	8,318	2,137	214	535,000	t/y	0.062	0.016	0.002	kg/t	67	t/load	1.1	km/return	3.8 / 0.97 / 0.10	kg/VKT	5.0	% S.C.	100	Ave. weight (t)	75	% Control
Hauling - Internal tip truck	6,888	1,770	177	665,000	t/y	0.041	0.011	0.001	kg/t	64	t/load	0.7	km/return	3.8 / 0.97 / 0.10	kg/VKT	5.0	% S.C.	100	Ave. weight (t)	75	% Control
Unloading at Mineral Concentrate Stockpiles	760	359	54	1,200,000	t/y	0.00063	0.00030	0.00005	kg/t	2.490	ave. $(WS/2.2)^{1.3}$	6	% M.C.								
Loading - Ilmenite Feed	760	359	54	1,200,000	t/y	0.00063	0.00030	0.00005	kg/t	2.490	ave. $(WS/2.2)^{1.3}$	6	% M.C.								
Loading - rutile/zircon feed	146	69	10	230,000	t/y	0.00063	0.00030	0.00005	kg/t	2.490	ave. $(WS/2.2)^{1.3}$	6	% M.C.								
Loading - Trucks/Containers with Rejects	190	90	14	300,000	t/y	0.00063	0.00030	0.00005	kg/t	2.490	ave. $(WS/2.2)^{1.3}$	6	% M.C.								
FEL - Loading Trains	18,823	3,812	1,976	6,132	hr/y	3.1	0.6	0.3	kg/h	8	% S.C.	6	% M.C.								
FEL - at Mineral Concentrate Storage Pile	18,823	3,812	1,976	6,132	hr/y	3.1	0.6	0.3	kg/h	8	% S.C.	6	% M.C.								
FEL - at Mineral Concentrate Storage Pile	18,823	3,812	1,976	6,132	hr/y	3.1	0.6	0.3	kg/h	8	% S.C.	6	% M.C.								
Unloading - Coal storage	119	56	9	187,767	t/y	0.00063	0.00030	0.00005	kg/t	2.490	ave. $(WS/2.2)^{1.3}$	6	% M.C.								
Stockpiles - Mineral Concentrate Stockpile 1	931	465	70	1.10	ha	850	425	64	kg/ha/yr							WS	wind speed				
Stockpiles - Mineral Concentrate Stockpile 2	196	98	15	0.23	ha	850	426	64	kg/ha/yr							S.C.	silt content				
Stockpiles - Product stockpile	224	112	17	0.26	ha	850	425	64	kg/ha/yr							M.C.	moisture content				
Stockpiles - Reject stockpile	27	14	2	0.03	ha	850	425	64	kg/ha/yr												
Total emissions	**75,028**	**16,965**	**6,565**																		

Appendix C

Isopleth Diagrams

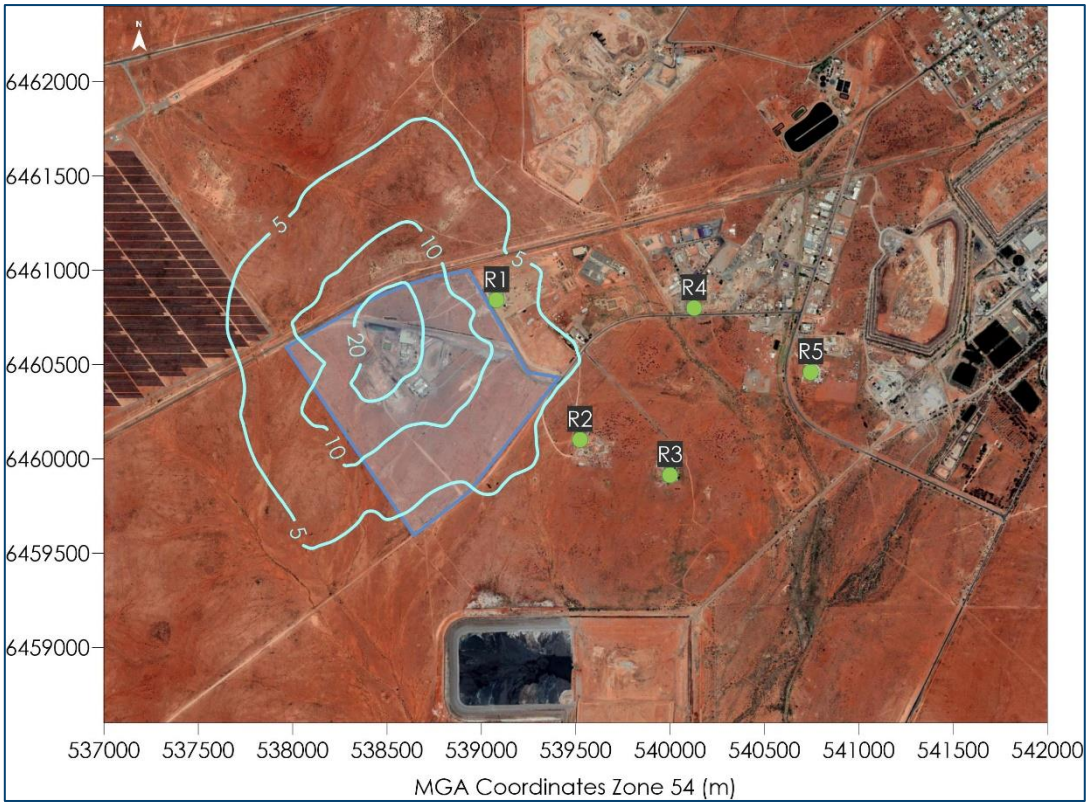

Figure C-1: Predicted maximum 24-hour average $PM_{2.5}$ concentrations due to emissions from the Modification (µg/m³)

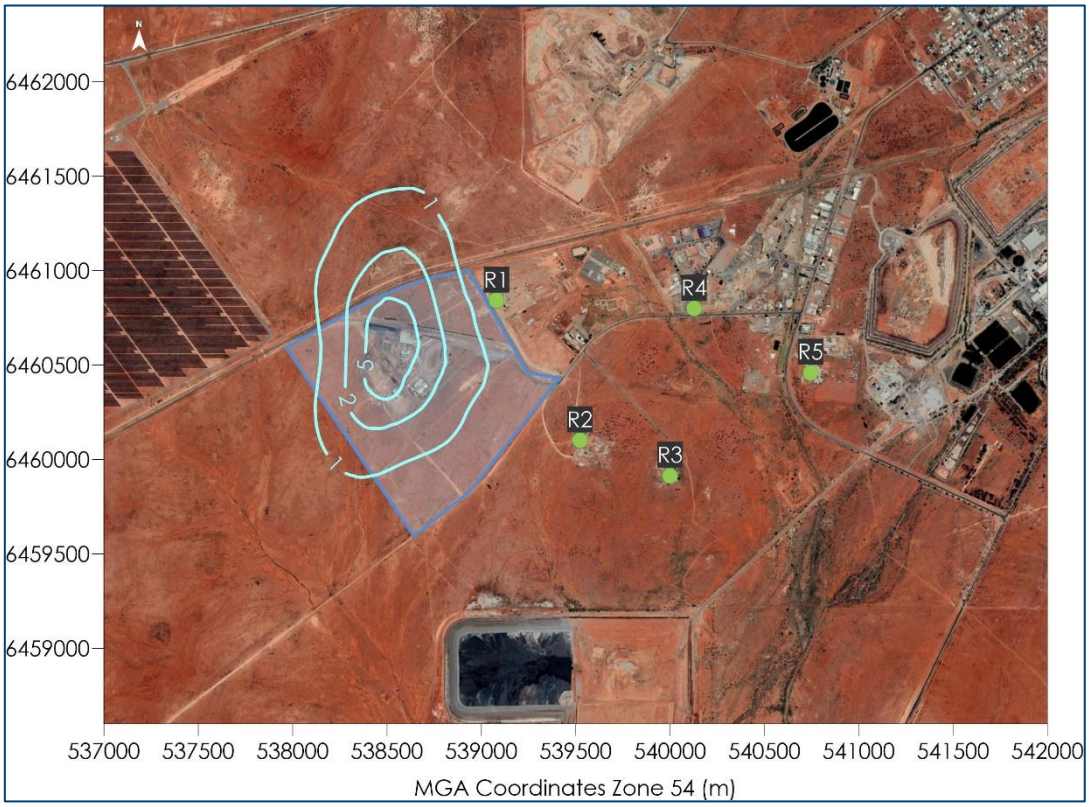

Figure C-2: Predicted annual average $PM_{2.5}$ concentrations due to emissions from the Modification (µg/m³)

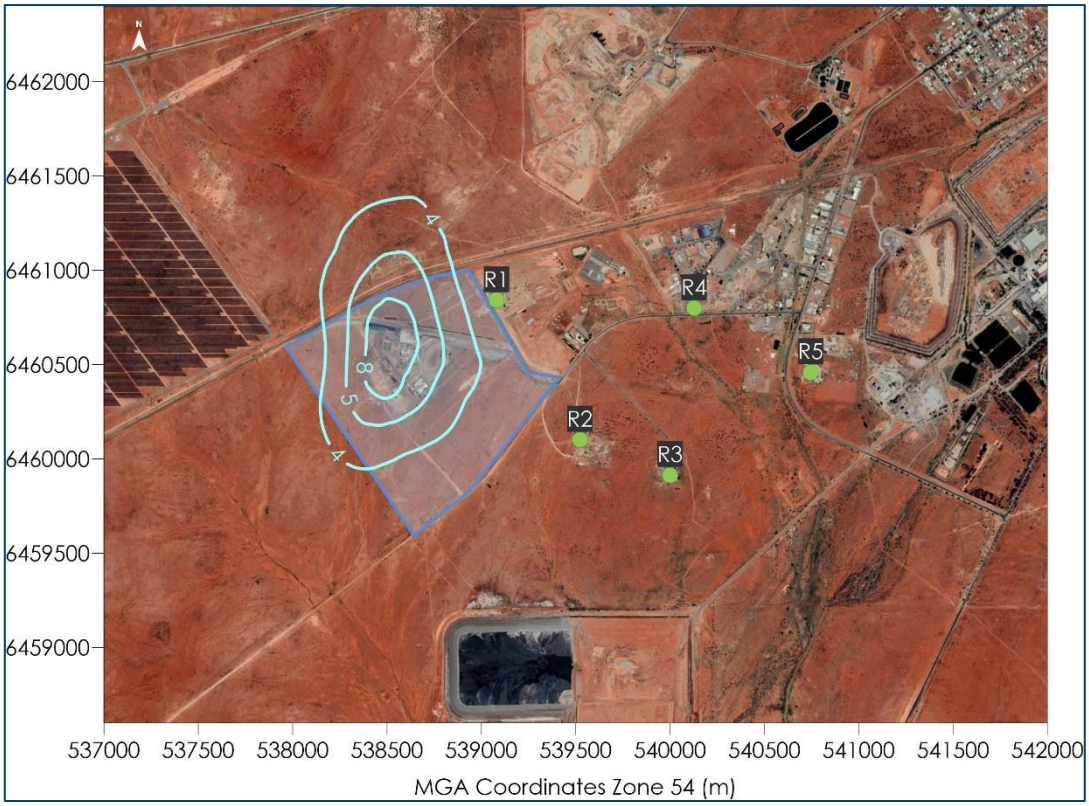

Figure C-3: Predicted annual average $PM_{2.5}$ concentrations due to emissions from the Modification and other sources (µg/m³)

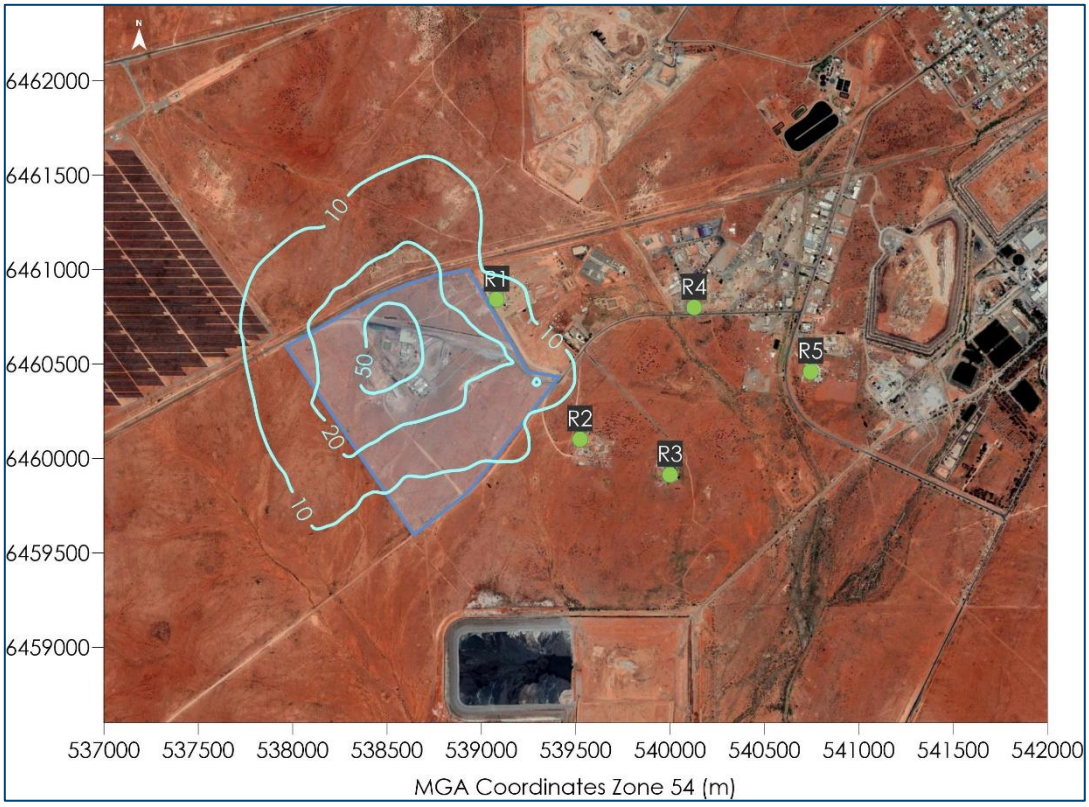

Figure C-4: Predicted maximum 24-hour average PM_{10} concentrations due to emissions from the Modification (µg/m³)

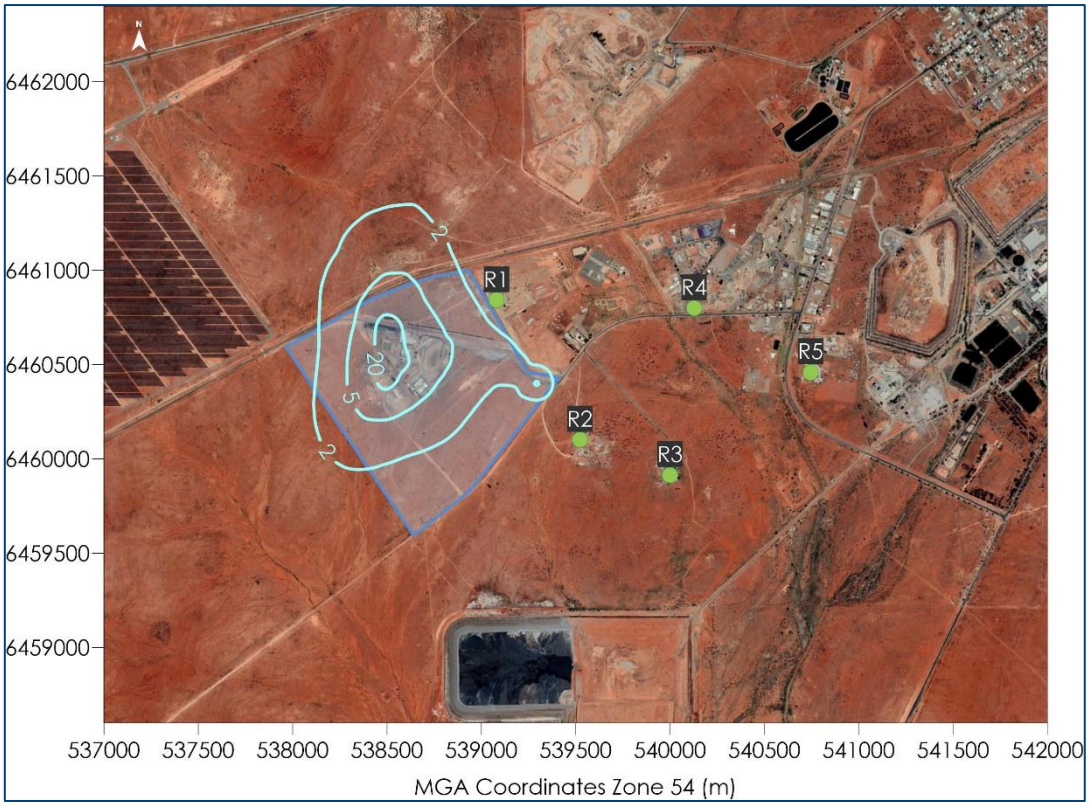

Figure C-5: Predicted annual average PM_{10} concentrations due to emissions from the Modification (µg/m³)

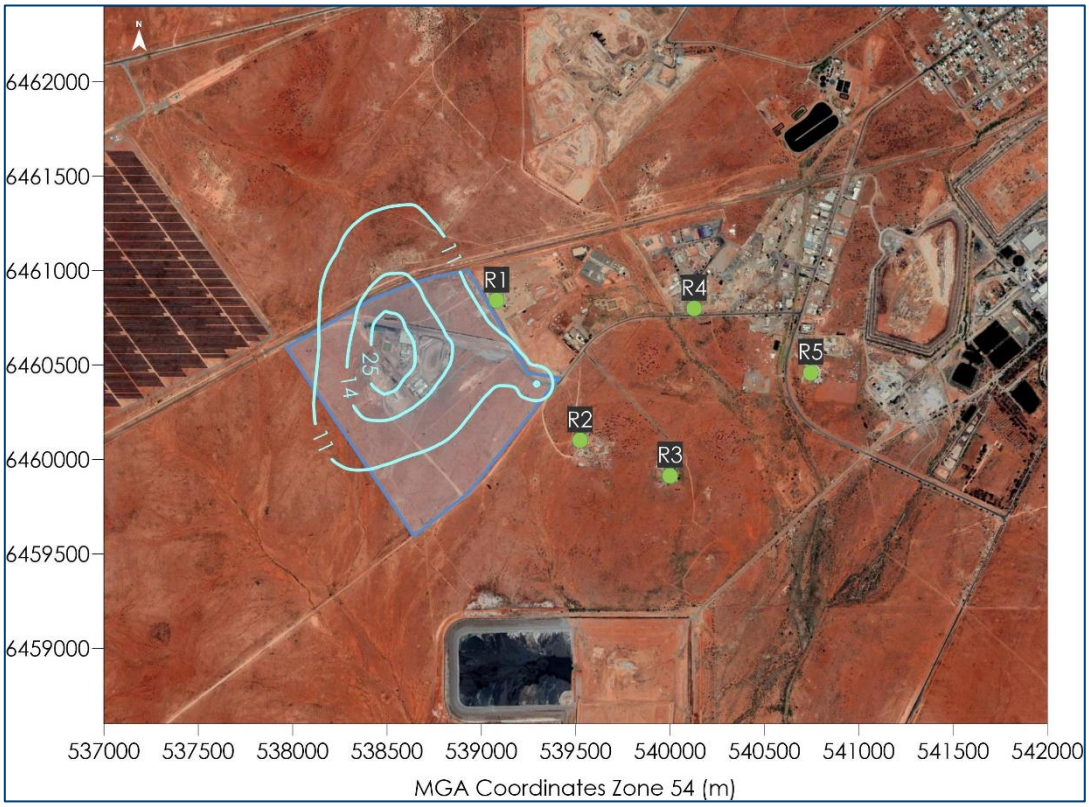

Figure C-6: Predicted annual average PM_{10} concentrations due to emissions from the Modification and other sources (µg/m³)

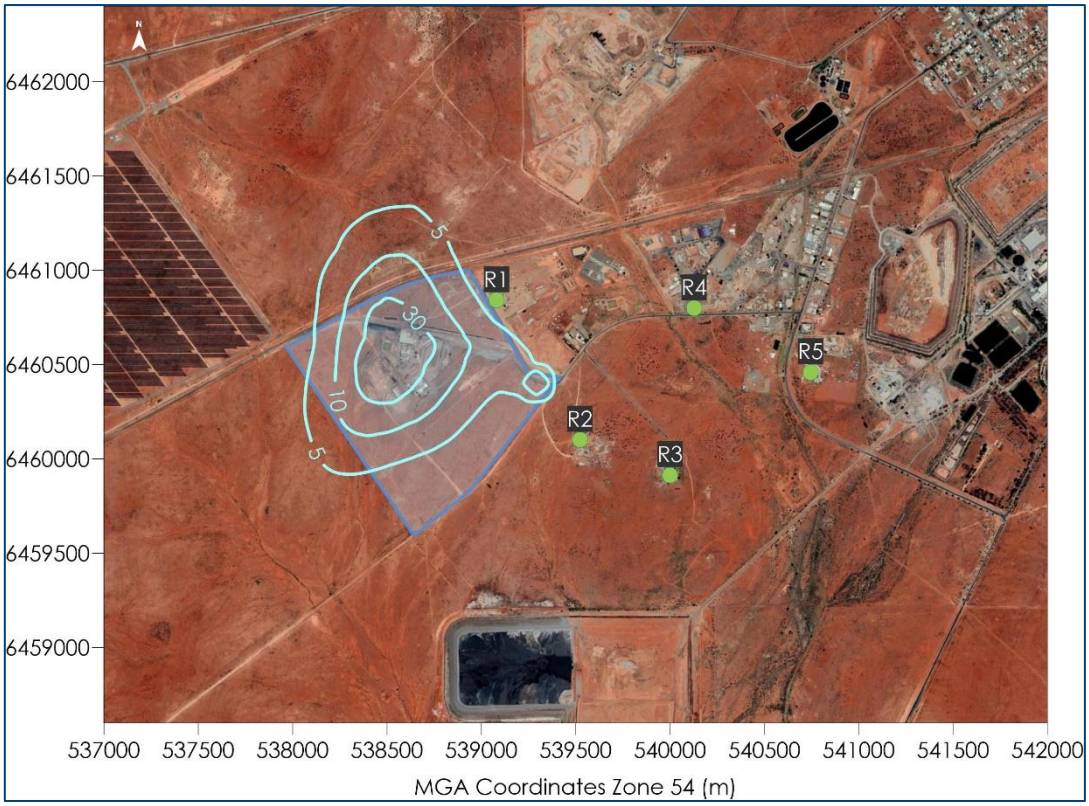

Figure C-7: Predicted annual average TSP concentrations due to emissions from the Modification (µg/m³)

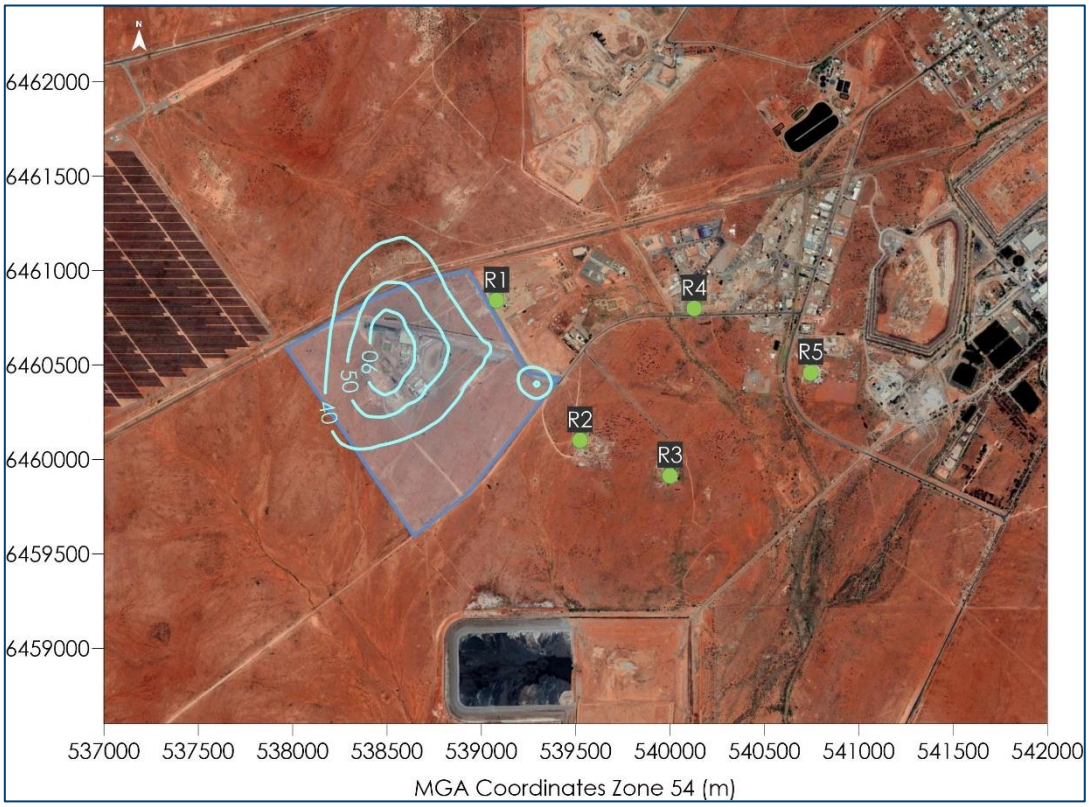

Figure C-8: Predicted annual average TSP concentrations due to emissions from the Modification and other sources (µg/m³)

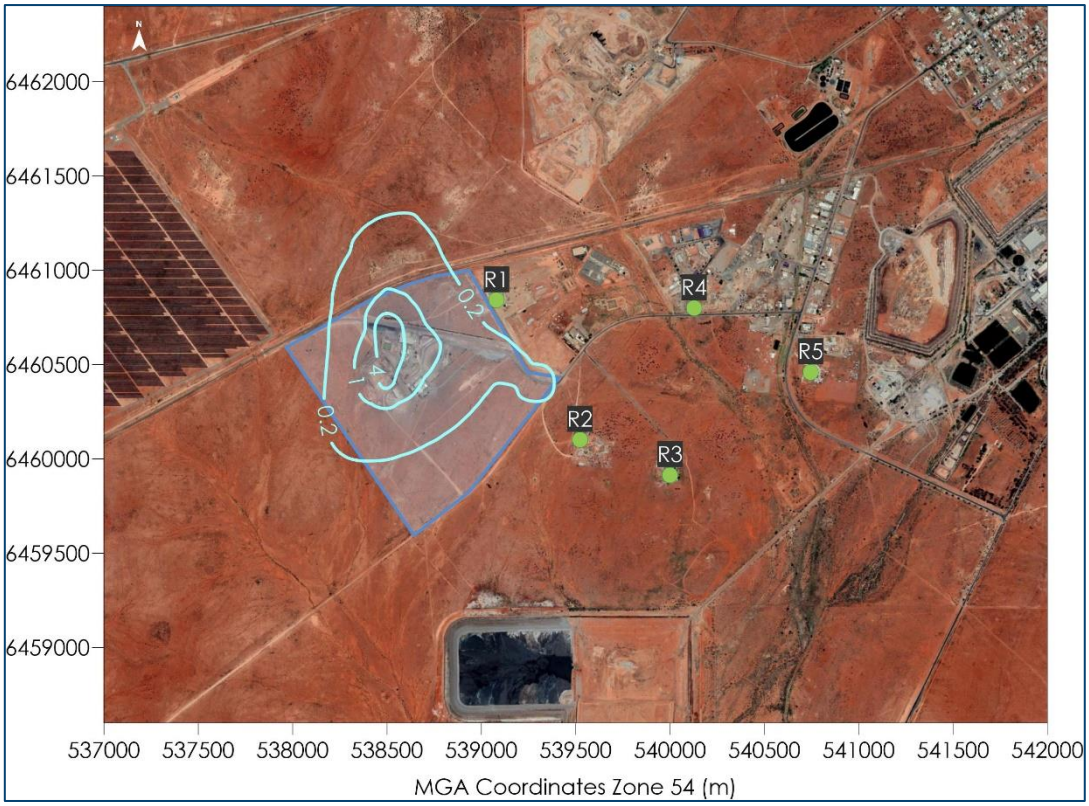

Figure C-9: Predicted annual average dust deposition levels due to emissions from the Modification (g/m²/month)

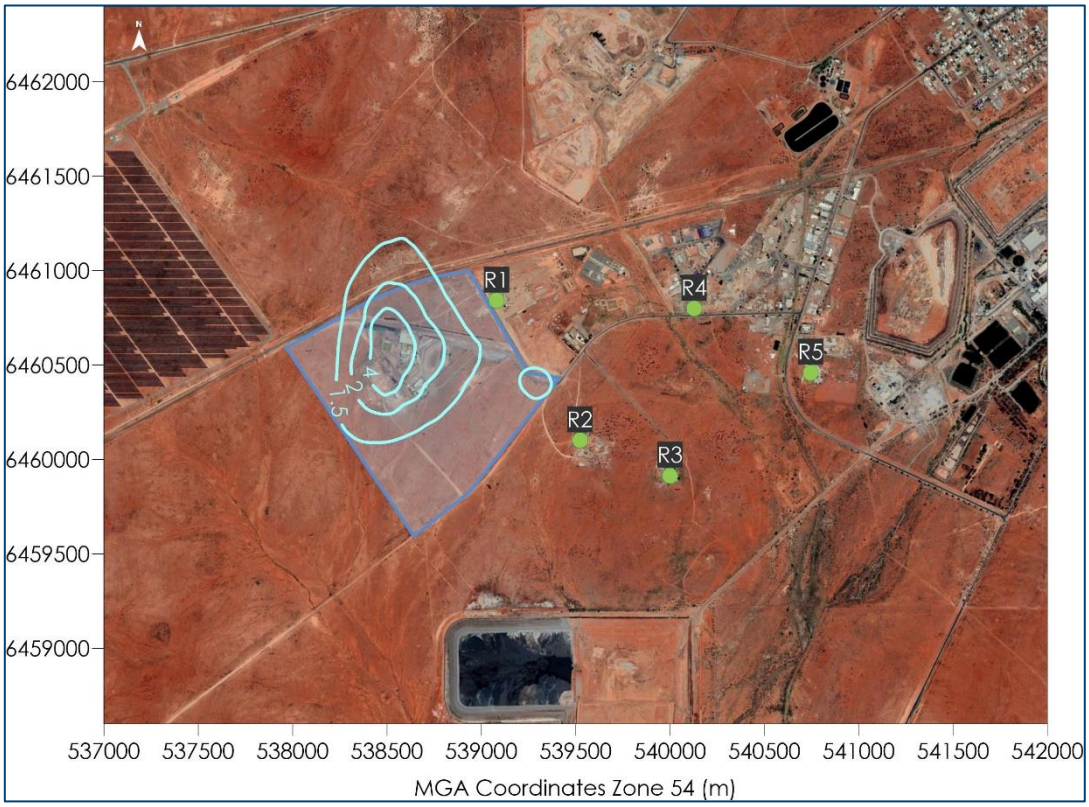

Figure C-10: Predicted annual average dust deposition levels due to emissions from the Modification and other sources (g/m²/month)

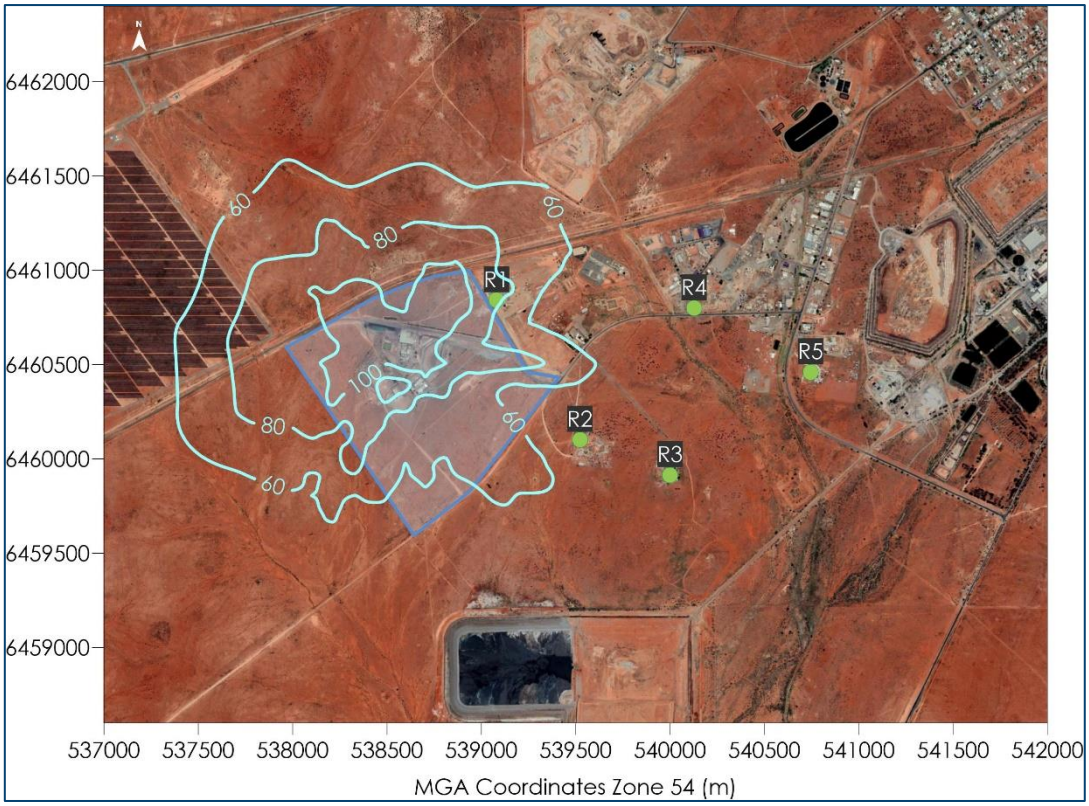

Figure C-11: Predicted maximum 1-hour average NO_2 concentrations due to emissions from the Modification (µg/m³)

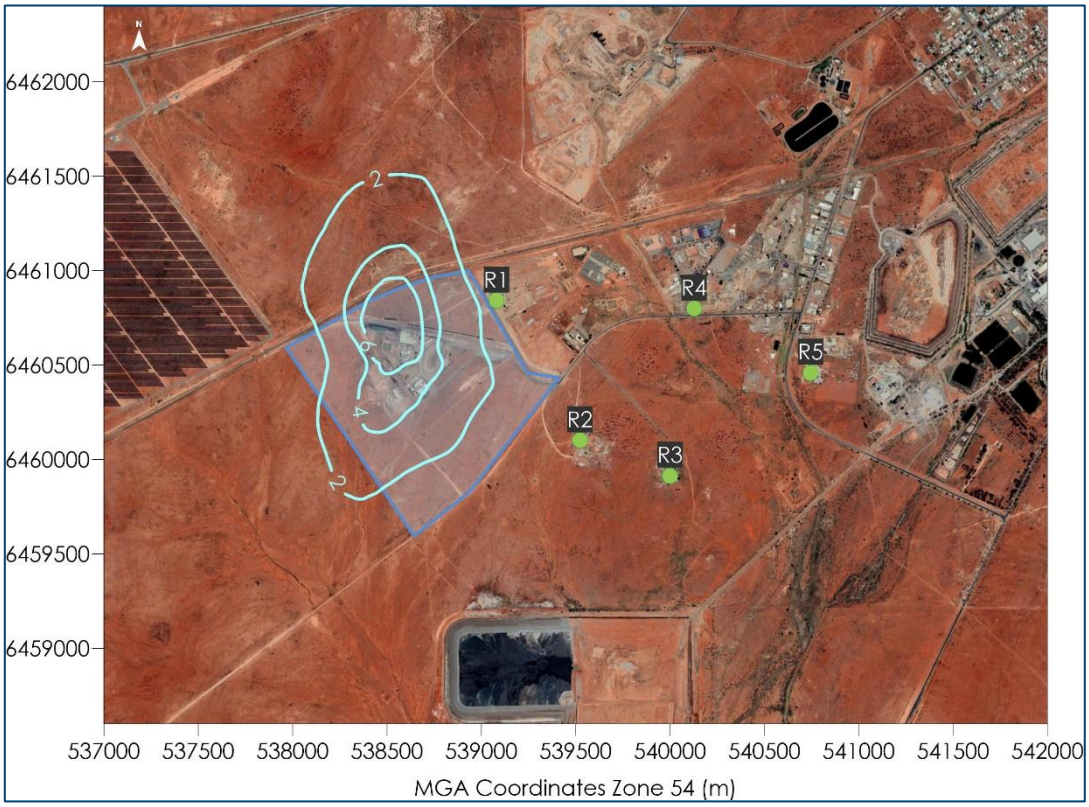

Figure C-12: Predicted annual average NO_2 concentrations due to emissions from the Modification (µg/m³)

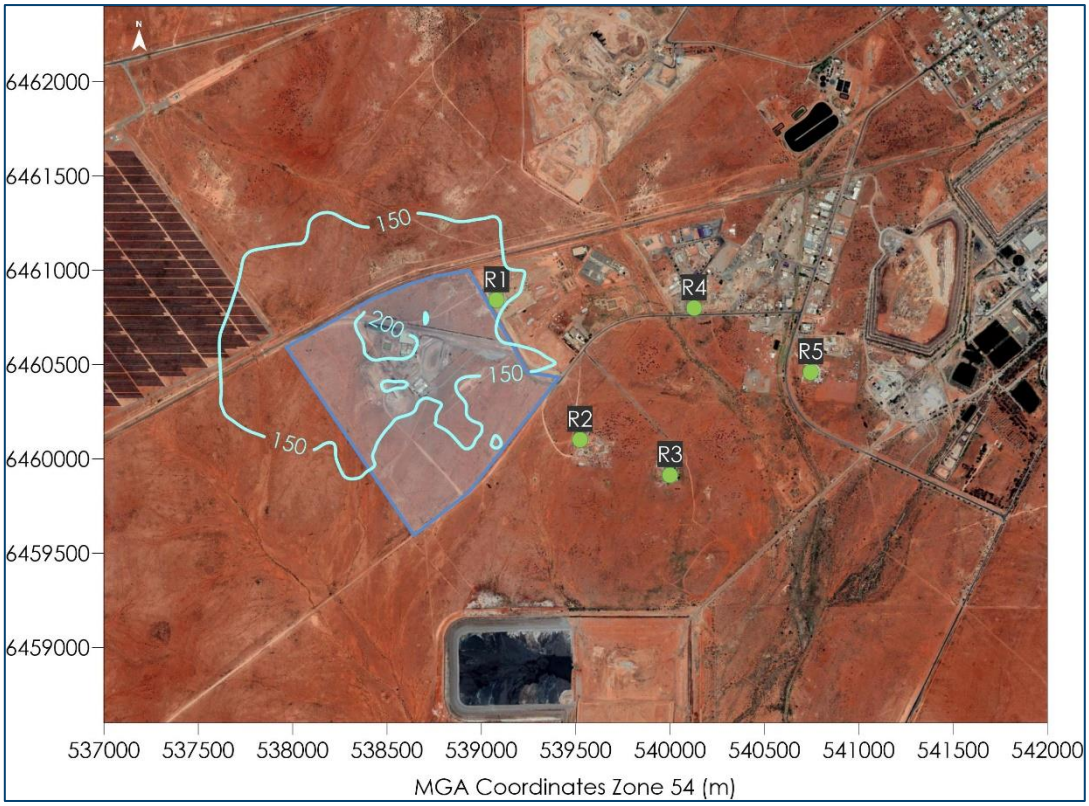

Figure C-13: Predicted 1-hour average NO_2 concentrations due to emissions from the Modification and other sources (µg/m³)

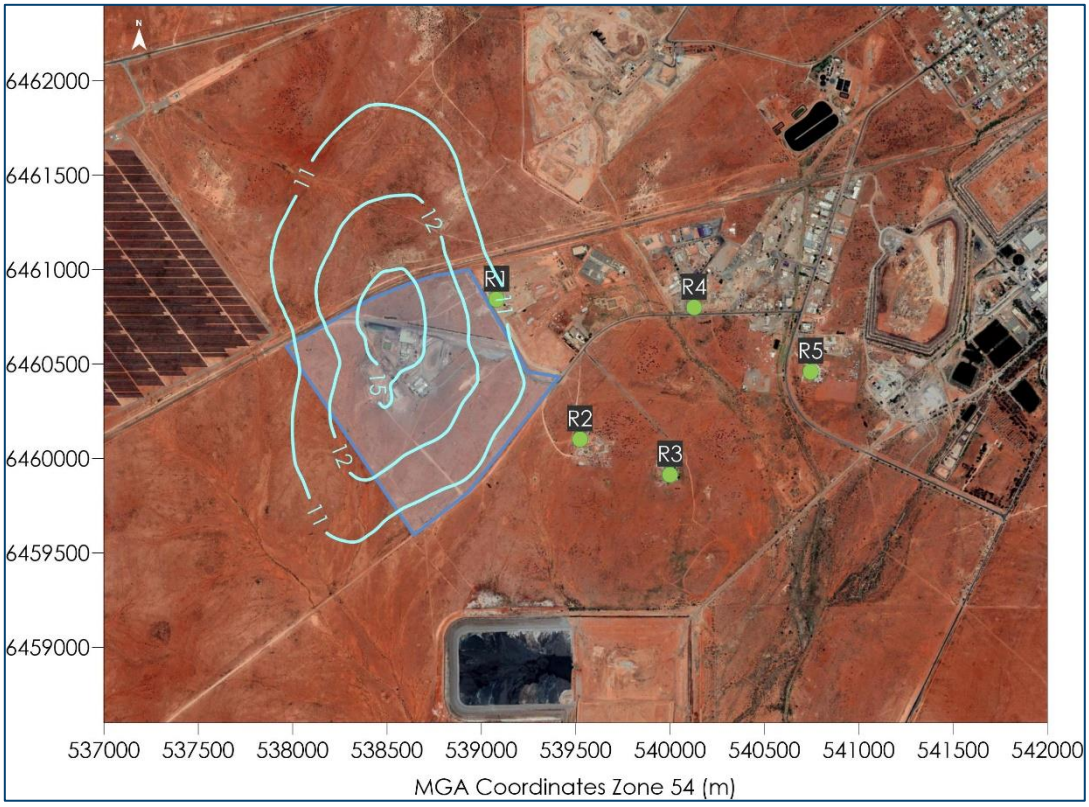

Figure C-14: Predicted annual average NO_2 concentrations due to emissions from the Modification and other sources (µg/m³)

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