



ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION

MODIFICATION REPORT

ATLAS-CAMPASPE MINERAL SANDS PROJECT
OPTIMISATION MODIFICATION

MODIFICATION REPORT



PREPARED BY
RESOURCE STRATEGIES PTY LTD

JULY 2019
Project No. CMA-18-07
Document No. 00970717

EXECUTIVE SUMMARY

ES.1 INTRODUCTION

The Atlas-Campaspe Mineral Sands Project (the Project) includes the development of a mineral sands mining operation (herein referred to as the Atlas-Campaspe Mine), together with the construction and operation of a rail loadout facility located near the township of Ivanhoe (herein referred to as the Ivanhoe Rail Facility).

The Atlas-Campaspe Mine is located approximately 80 kilometres (km) north of Balranald, New South Wales (NSW), and approximately 270 km south-east of Broken Hill, NSW. The Ivanhoe Rail Facility is located approximately 135 km north-east of the Atlas-Campaspe Mine, and is approximately 4.5 km south-west of the township of Ivanhoe.

The Project operates in accordance with Development Consent (SSD_5012) issued under Part 4 of the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act) in 2014. Construction activities at the Atlas-Campaspe Mine commenced in 2018.

The Project is being developed by Cristal Mining Australia Limited, which will be renamed Tronox Mining Australia Limited (Tronox) on 25 July 2019.

The Atlas-Campaspe Mineral Sands Project Optimisation Modification (the Modification) is sought under section 4.55(2) of the EP&A Act.

ES.2 OVERVIEW OF THE MODIFICATION

Since the preparation of the *Atlas-Campaspe Mineral Sands Project Environmental Impact Statement*, Tronox has undertaken Project optimisation planning in consideration of recent experience at its existing NSW operations.

A key outcome of the Project optimisation planning is revised mine scheduling for the Atlas deposit, which would increase the maximum mineral concentrate production rate; without increasing the approved ore mining rate. Other changes to optimise Project operations were also identified as part of the Project optimisation planning. The optimisation of the Project will increase its efficiency and economic viability.

The Modification would implement the outcomes of the optimisation planning and would include:

- increased mineral concentrate production from 546,000 tonnes per annum (tpa) to 665,000 tpa;

- increased mineral concentrate transport from 450,000 tpa to 665,000 tpa;
- increased mineral concentrate transport truck trips from 24 per day to 35 per day;
- increased mineral concentrate transport train length (from 600 metres to 920 metres) and frequency (from six to eight train movements per week [i.e. four arrivals, four departures]);
- increased mineral separation plant (MSP) process waste disposal from 50,000 tpa to 65,000 tpa;
- the option to use an overland conveyor to transfer overburden in addition to haul trucks;
- the relocation of the Atlas-Campaspe Mine accommodation camp;
- the option to develop on-site solar power generation infrastructure at the Atlas-Campaspe Mine to supplement diesel generator sets;
- development of an emergency airstrip at the Atlas-Campaspe Mine;
- construction and operation of a telecommunications tower at the Atlas-Campaspe Mine;
- extension to the Ivanhoe Rail Facility hardstand area;
- extension of the Ivanhoe Rail Facility rail siding and addition of a passing siding;
- a revised alignment of the Ivanhoe Rail Facility access road and access road intersection;
- a groundwater supply bore for the Ivanhoe Rail Facility; and
- the use of local roads other than the road haulage route by Project-related light vehicles to access site.

Table ES-1 provides a comparative summary of the approved and modified Project. Based on a review of the proposed Project changes, Tronox considers that the modified Project would be substantially the same as the originally approved Project.

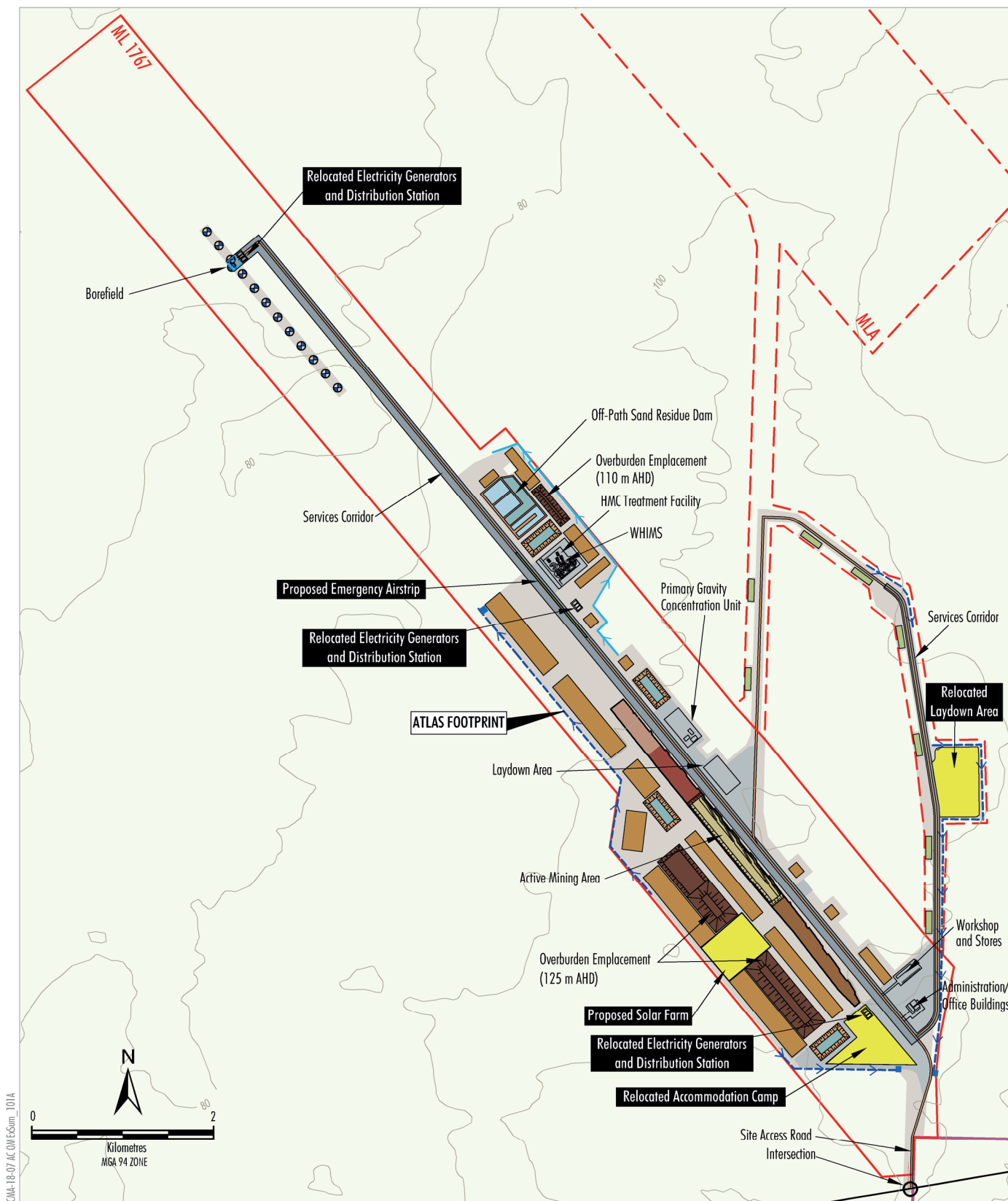
Figures ES-1 and ES-2 show the modified Atlas-Campaspe Mine and Ivanhoe Rail Facility, respectively. Figure ES-3 shows the proposed light vehicle access routes.

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

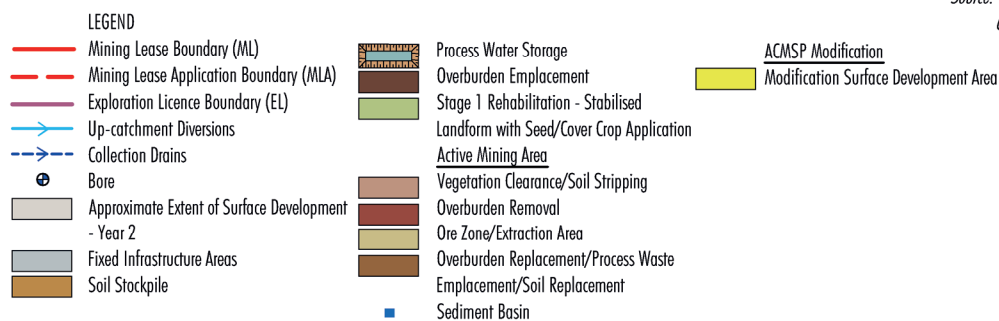
Project Component	Approved Project	Modified Project
Atlas-Campaspe Mine		
Project Life	Mining operations until 30 June 2034.	No change.
Tenement	Mining Lease 1767 and Mining Lease Application 1.	No change.
Mining	Dry mining (i.e. dozers and/or loaders and excavators) operation producing approximately 7.2 million tonnes per annum of ore.	No change.
Mineral Concentration and Mineral Concentrate Transport	- Ore concentrated in the primary gravity concentration unit (comprising a screen, surge bin and wet concentrator) to produce heavy mineral concentrate. - Heavy mineral concentrate washed in the salt washing facility prior to processing in the wet high intensity magnetic separator circuit to produce ilmenite-rich, leucoxene-rich and non-magnetic (containing rutile-rich and zircon-rich) mineral concentrates. - Mineral concentrate production up to 546,000 tpa. - Mineral concentrate transport up to 450,000 tpa. - Up to 24 Roads and Maritime Services-approved haulage vehicle trips per day.	- No change to mineral concentration methods. - Increase in mineral concentrate production and transport up to 665,000 tpa. - Increase in Roads and Maritime Services -approved haulage vehicle trips up to 35 per day.
Overburden Management	- Overburden removal ahead of ore extraction areas using conventional truck and shovel methods (e.g. excavators and haul trucks). - Overburden replacement, including progressive backfilling of mine voids behind the advancing ore extraction areas or in overburden emplacements adjacent to the mine path using haul trucks.	Option to use an overland conveyor to transfer overburden in addition to haul trucks.
Sand Residue and Coarse Reject Management	Sand residues and coarse rejects placed in either overburden emplacement cells behind the advancing ore extraction area or in off-path sand residue dams.	No change.
MSP Process Waste Management	- MSP process waste placed behind the advancing ore extraction areas at either the Ginkgo Mine, Snapper Mine or Atlas-Campaspe Mine. - MSP process waste production of up to 50,000 tpa.	- No change to MSP process waste management. - Increase in MSP process waste production up to 65,000 tpa.
Water Supply	Water requirements will be supplied by the Atlas-Campaspe Mine borefield.	No change.
Electricity Supply	Electricity supplied by diesel generator sets.	Option to develop on-site solar power generation infrastructure to supplement diesel power generation.
Supporting Infrastructure	Construction of supporting infrastructure within the approved surface development area.	- Relocation of the accommodation camp. - Development of an emergency airstrip. - Construction and operation of a telecommunications tower.
Site Access	Access to the Atlas-Campaspe Mine is via the road haulage route.	The use of other local roads other than the haulage route by Project-related light vehicles to access site.

Table ES-1 (Continued)
Comparison of the Existing/Approved and Modified Project

Project Component	Approved Project	Modified Project
<i>Atlas-Campaspe Mine (Cont.)</i>		
Employment	- Approximately 300 personnel during peak construction. - Approximately 200 personnel during operations.	No change.
Rehabilitation Works	Progressive rehabilitation undertaken as mining advances.	No change.
Biodiversity Offset Area	Approximately 16,540 hectares will be established to offset native vegetation communities cleared for the Project.	No change.
<i>Ivanhoe Rail Facility</i>		
Infrastructure	Construction of infrastructure within the approved surface development area, including access road, rail siding, hardstand area, site office, parking, fencing, lighting and water management infrastructure.	- Extension to the hardstand area. - Extension of the rail siding and addition of a passing siding. - Revised alignment of the access road and access road intersection.
Unloading and Stockpiling	Mineral concentrate emptied directly onto a mineral concentrate stockpile for reclaim by a front-end loader to load directly into train wagon containers.	No change.
Train Movements	- Up to three trains per week. - Up to one train trip in any 24-hour period.	- Increase in train frequency to four per week. - No change to number of trains in any 24-hour period.
Water Supply	Waters collected onsite and potable water trucked from the Atlas-Campaspe Mine or the Ivanhoe town water supply.	- Addition of a groundwater supply bore. - No change to the potable water supply.
Electricity Supply and Distribution	Electricity supplied via the local network.	No change.

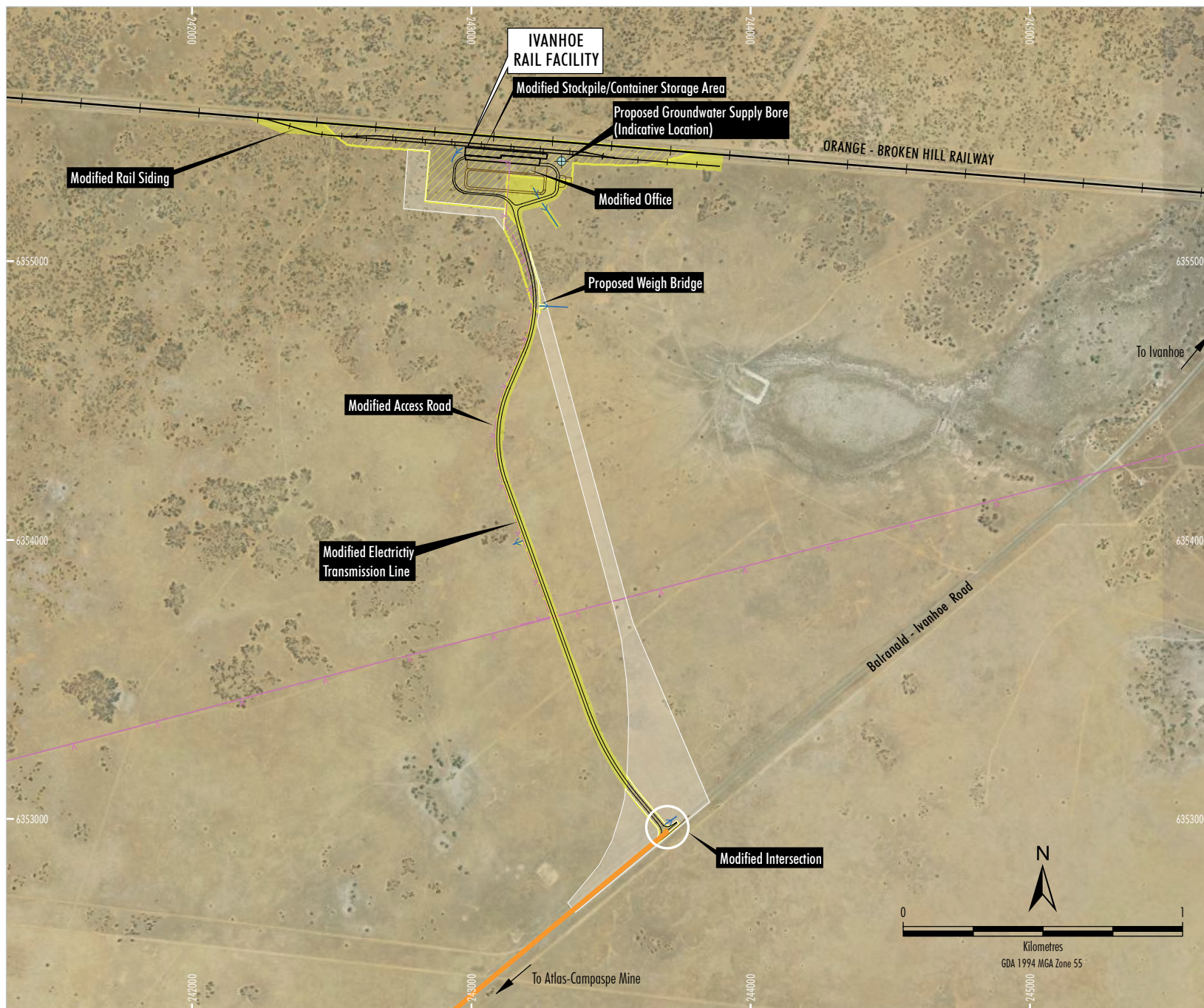


Source: © NSW Department of Finance, Services & Innovation (2018);
Cristal Mining Australia (2012) and Tronox (2019)



TRONOX
OPTIMISATION MODIFICATION
Modified Atlas-Campaspe Mine
General Arrangement - Year 2

Figure ES-1



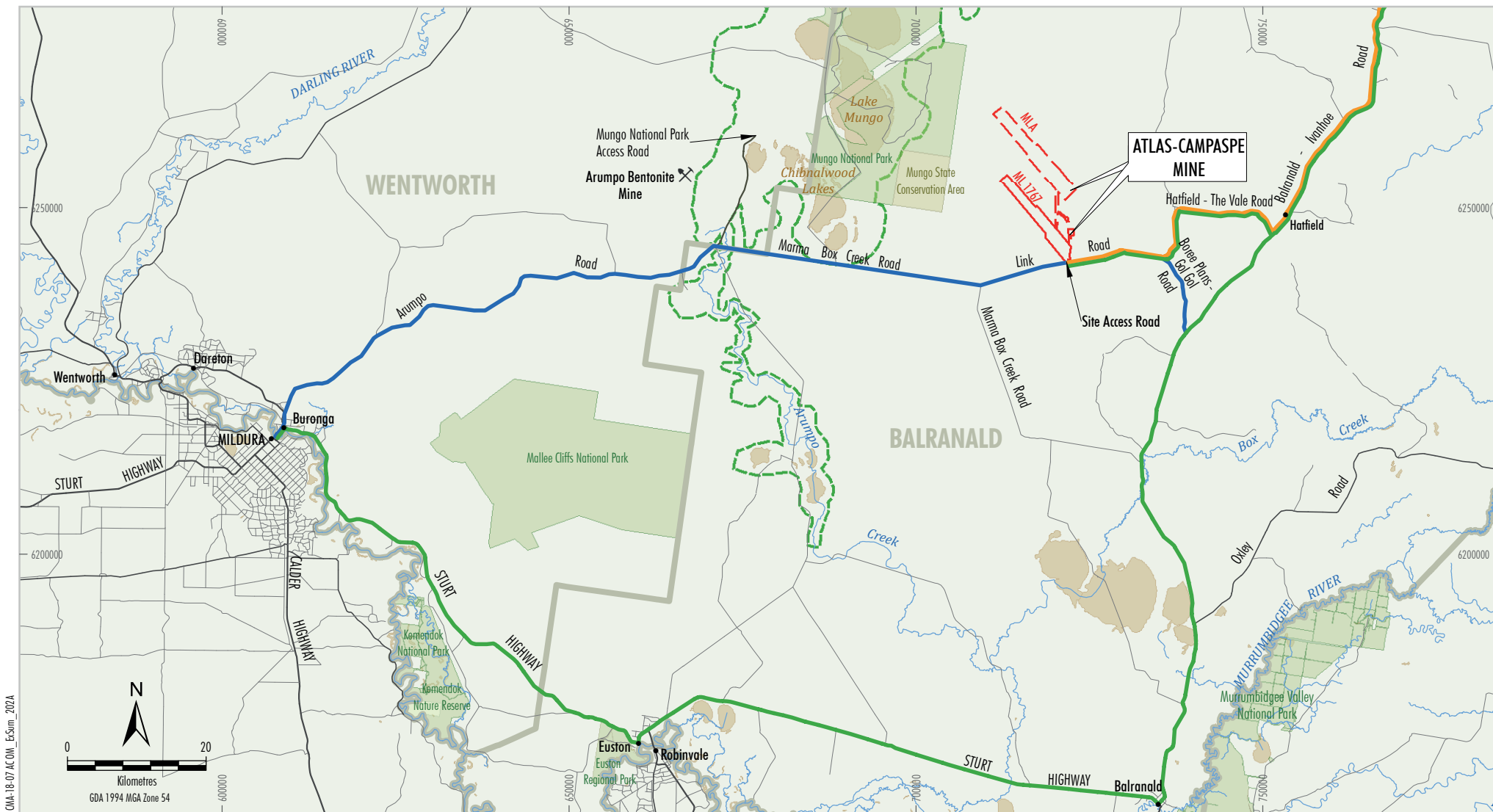
- LEGEND**
- Approved Surface Development Area Required
 - Additional Surface Development Area
 - Approved Surface Development Area not Required
 - Approved Mineral Concentrate Transport Route*
 - Existing Electricity Transmission Line

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

Source: Cristal Mining Australia (2012); Tronox (2019)
 Orthophoto: © NSW Department of Finance, Services & Innovation (2017)

TRONOX
 OPTIMISATION MODIFICATION
 Modified Ivanhoe Rail Facility
 General Arrangement

Figure ES-2



OMA-18-07 ACOM, 65km, 202A

LEGEND

- Mining Lease Boundary (ML 1767)
- Mining Lease Application Boundary (MLA)
- Willandra Lakes Region World Heritage Area
- Local Government Area Boundary
- National Park
- Nature Reserve
- Regional Park
- State Conservation Area
- Approved Light Vehicle Access Route
- Approved Mineral Concentrate Transport Route
- Proposed Light Vehicle Access Routes

Source: © NSW Department of Finance, Services & Innovation (2018);
Cristal Mining Australia (2012); Tronox (2019) and TTPP (2019)

TRONOX
OPTIMISATION MODIFICATION
Project Transport Routes

Figure ES-3

ES.3 ENVIRONMENTAL REVIEW

The key potential impacts of the Modification are related to the proposed changes to the approved Atlas-Campaspe Mine, Ivanhoe Rail Facility and Project transport activities described in Table ES-1.

In order to assess the potential environmental impacts of the Modification, an environmental review of the key potential impacts of the Modification was undertaken. The key outcomes of the environmental review are summarised in Table ES-2.

Table ES-2
Key Outcomes of Environmental Review

Environmental Aspect	Summary of Key Environmental Review Conclusions	
	Atlas-Campaspe Mine	Ivanhoe Rail Facility
Road Transport	- The increased heavy vehicle trips on the approved road haulage route would be well within the day-to-day variation in traffic volumes and would not have a perceivable impact on the level of service experienced by drivers along the route. - The proposed local roads routes would satisfactorily accommodate the Project-generated traffic, subject to the implementation of road improvements. - Portions of Link Road and Boree Plains-Gol Gol Road would be upgraded for the Modification. - The Modification would have road safety benefits for the Project workforce and other road users.	
Air Quality	- Potential air quality impacts associated with the modified Atlas-Campaspe Mine would not contribute to any exceedances of the relevant air quality criteria at the closest privately-owned sensitive receptors. - Dust emissions from the modified Atlas-Campaspe Mine would decrease if the overland conveyor is adopted to transfer overburden.	- Potential air quality impacts associated with the modified Ivanhoe Rail Facility would not contribute to any exceedances of the relevant air quality criteria at the closest privately-owned sensitive receptors. - The Modification would result in an overall reduction in emissions from the Ivanhoe Rail Facility.
Noise	- Noise emissions from the modified Atlas-Campaspe Mine would be unchanged and therefore comply with the relevant noise criteria for all modelled receivers under neutral and adverse meteorological conditions. - Noise emissions from the modified Atlas-Campaspe Mine would decrease if the overland conveyor is adopted to transfer overburden.	Noise emissions due to the modified Ivanhoe Rail Facility would not result in any material increase in noise levels, and relevant noise criteria are predicted to be achieved for all modelled receivers under neutral and adverse meteorological conditions.
Biodiversity	As the Modification would not change the extent of the approved surface development area associated with the Atlas-Campaspe Mine, no changes to the approved impacts on biodiversity are expected.	- No increase in impacts on biodiversity values would occur as a result of the Modification, as there would be a reduction in native vegetation/habitat clearance for the modified Ivanhoe Rail Facility. - A Biodiversity Development Assessment Report is not required to be prepared for the Modification as the Modification would not increase impacts on biodiversity values, with reference to the <i>Biodiversity Conservation Act, 2016</i> and the Department of Planning and Environment's <i>Biodiversity Development Assessment Report Waiver Determinations for SSD and SSI Applications</i>.

Table ES-2 (Continued)
Key Outcomes of Environmental Review

Environmental Aspect	Summary of Key Environmental Review Conclusions	
	Atlas-Campaspe Mine	Ivanhoe Rail Facility
Aboriginal Cultural Heritage	As the Modification would not change the extent of the approved surface development area associated with the Atlas-Campaspe Mine, no changes to the approved impacts on Aboriginal cultural heritage are expected.	- Five Aboriginal cultural heritage sites were identified in the modified Ivanhoe Rail Facility surface development area. - Tronox would arrange collection of the objects prior to the commencement of disturbance activities and engage a suitably qualified archaeologist and representatives of the Registered Aboriginal Parties to record and collect the artefacts.
Historic Heritage	As the Modification would not change the extent of the approved surface development area associated with the Atlas-Campaspe Mine, no changes to the approved impacts on historic heritage are expected.	No historic heritage sites were recorded during the field survey of the modified Ivanhoe Rail Facility surface development area.
Land and Agricultural Resources	As the Modification would not change the extent of the approved surface development area associated with the Atlas-Campaspe Mine, no changes to the approved impacts on land and agricultural resources are expected.	The Modification would result in a net reduction in surface development area at the Ivanhoe Rail Facility, therefore there is expected to be an overall reduction in potential land and agricultural resource impacts as a result of the Modification.
Surface Water Resources	As the Modification would not change the extent of the approved surface development area associated with the Atlas-Campaspe Mine, no changes to the approved impacts on surface water resources are expected.	The Modification would not significantly change the general arrangement and/or water management at the Ivanhoe Rail Facility, therefore no material change to potential surface water impacts are expected.
Groundwater Resources	As the Modification would not change the approved mine path, mine life or mining rate, or the water demand at the Atlas-Campaspe Mine, no changes to the approved groundwater impacts are expected.	- The maximum predicted drawdown due to the proposed Ivanhoe Rail Facility groundwater supply bore is not predicted to be significant beyond 100 metres. - Drawdown at the closest bore (approximately 2 km away) is predicted to be negligible. - The proposed Ivanhoe Rail Facility groundwater supply bore would have "minimal impact" as defined in the NSW Aquifer Interference Policy. - Tronox holds sufficient entitlements (100 share components or ML) under the <i>Water Sharing Plan for the Lower Lachlan Groundwater Source 2003</i> for the Ivanhoe Rail Facility groundwater supply bore.
Greenhouse Gases	It is expected that although annual greenhouse gas emissions may increase during certain years, the total greenhouse gas emissions due to the modified Project (over the whole Project life) would not change significantly as a result of the Modification.	

Table ES-2 (Continued)
Key Outcomes of Environmental Review

Environmental Aspect	Summary of Key Environmental Review Conclusions	
	Atlas-Campaspe Mine	Ivanhoe Rail Facility
Economic	- The estimated NSW Government royalties over the life of the Project (i.e. \$95 million) would not significantly change as a result of the Modification as the total amount of mineral concentrates produced would not significantly change. - The Modification would not change the approved Project workforce, and therefore the economic benefits associated with these employment opportunities would be unchanged.	
Hazards and Risks	The Modification would not significantly change the existing potential risks or hazard consequences identified in the Preliminary Hazard Analysis for the approved Project, as the proposed activities associated with the Modification are consistent with those for the approved Project.	
Visual	As the Modification would not significantly change the design or arrangement of the approved Project, no significant changes to the approved potential visual impacts are expected.	
Social and Community Infrastructure	As the Modification would not result in any additional demand for employees or change the expected employee residential distribution, no material alteration to the approved social and community infrastructure impacts is expected.	

ES.5 MODIFICATION JUSTIFICATION

Approval of the Modification is considered to be justified given:

It is therefore considered that the Modification is justified on environmental, economic and social grounds.

- The Modification would promote the more efficient and economic recovery of mineral sands resources at the Atlas-Campaspe Mine (i.e. through increasing the mineral concentrate production rate without having to increase the mineral sands ore extraction rate).
- The proposed use of local roads would improve the safety of the Project workforce and the road network.
- The proposed increases in the rate of mineral concentrate production and transport could be achieved with no exceedances of the relevant noise and air quality criteria.
- The proposed telecommunications tower would provide mobile coverage/reception to the Atlas-Campaspe Mine area that would also be able to be used by community members.
- The proposed emergency air strip would improve safety of the Project workforce.
- The proposed changes to the Ivanhoe Rail Facility layout would reduce potential biodiversity and land resource impacts.
- The Modification would improve the productivity of the Project, improving the security of the continued employment of the workforce and ongoing expenditure in the State and local economies.

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1 INTRODUCTION

This document is a Modification Report for a proposed modification to the Atlas-Campaspe Mineral Sands Project (the Project).

The Project includes the development of a mineral sands mining operation (herein referred to as the Atlas-Campaspe Mine), together with the construction and operation of a rail loadout facility located near the township of Ivanhoe (herein referred to as the Ivanhoe Rail Facility).

The Project operates in accordance with Development Consent (SSD_5012) (Attachment 1) issued under Part 4 of the New South Wales (NSW) *Environmental Planning and Assessment Act, 1979* (EP&A Act) in 2014. Construction activities at the Atlas-Campaspe Mine commenced in 2018.

The Project is being developed by Cristal Mining Australia Limited, which will be renamed Tronox Mining Australia Limited (Tronox) on 25 July 2019.

The Atlas-Campaspe Mineral Sands Project Optimisation Modification (the Modification) is sought under section 4.55(2) of the EP&A Act.

1.1 OVERVIEW OF THE APPROVED PROJECT

The Atlas-Campaspe Mine is located approximately 80 kilometres (km) north of Balranald, NSW, and approximately 270 km south-east of Broken Hill, NSW (Figure 1). The Ivanhoe Rail Facility is located approximately 135 km north-east of the Atlas-Campaspe Mine, and is approximately 4.5 km south-west of the township of Ivanhoe (Figure 1).

The Project will integrate with currently existing/approved Tronox operations in western NSW, including (Figure 1):

- the Broken Hill Mineral Separation Plant (MSP) – located in Broken Hill approximately 270 km north-west of the Atlas-Campaspe Mine;
- Snapper Mine – located approximately 105 km west of the Atlas-Campaspe Mine; and
- Ginkgo Mine – located approximately 100 km west of the Atlas-Campaspe Mine.

Product (mineral concentrates) generated as a result of operations at the Atlas-Campaspe Mine will be trucked to the Ivanhoe Rail Facility for transfer to train wagons, which will then be railed to the MSP for processing (Figure 1).

At the MSP, the mineral concentrates from the Atlas-Campaspe Mine will be separated and treated to produce valuable minerals. Process wastes generated as a result of processing mineral concentrates at the MSP will be backloaded to the Snapper and Ginkgo Mines until operations at these existing mines cease. At that time, the MSP process waste generated from the processing of mineral concentrates from the Atlas-Campaspe Mine will be railed to the Ivanhoe Rail Facility for subsequent road transport to the Atlas-Campaspe Mine for unloading, stockpiling and placement behind the advancing ore extraction areas.

The Project is approved to extract up to 7.2 million tonnes per annum (Mtpa) of mineral sands ore from the Atlas and Campaspe deposits, and transport a maximum of 450,000 tonnes per annum (tpa) of mineral concentrate to the MSP.

The approved Atlas-Campaspe Mine and Ivanhoe Rail Facility general arrangements are shown on Figures 2 and 3, respectively.

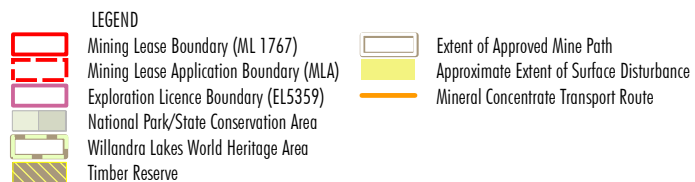
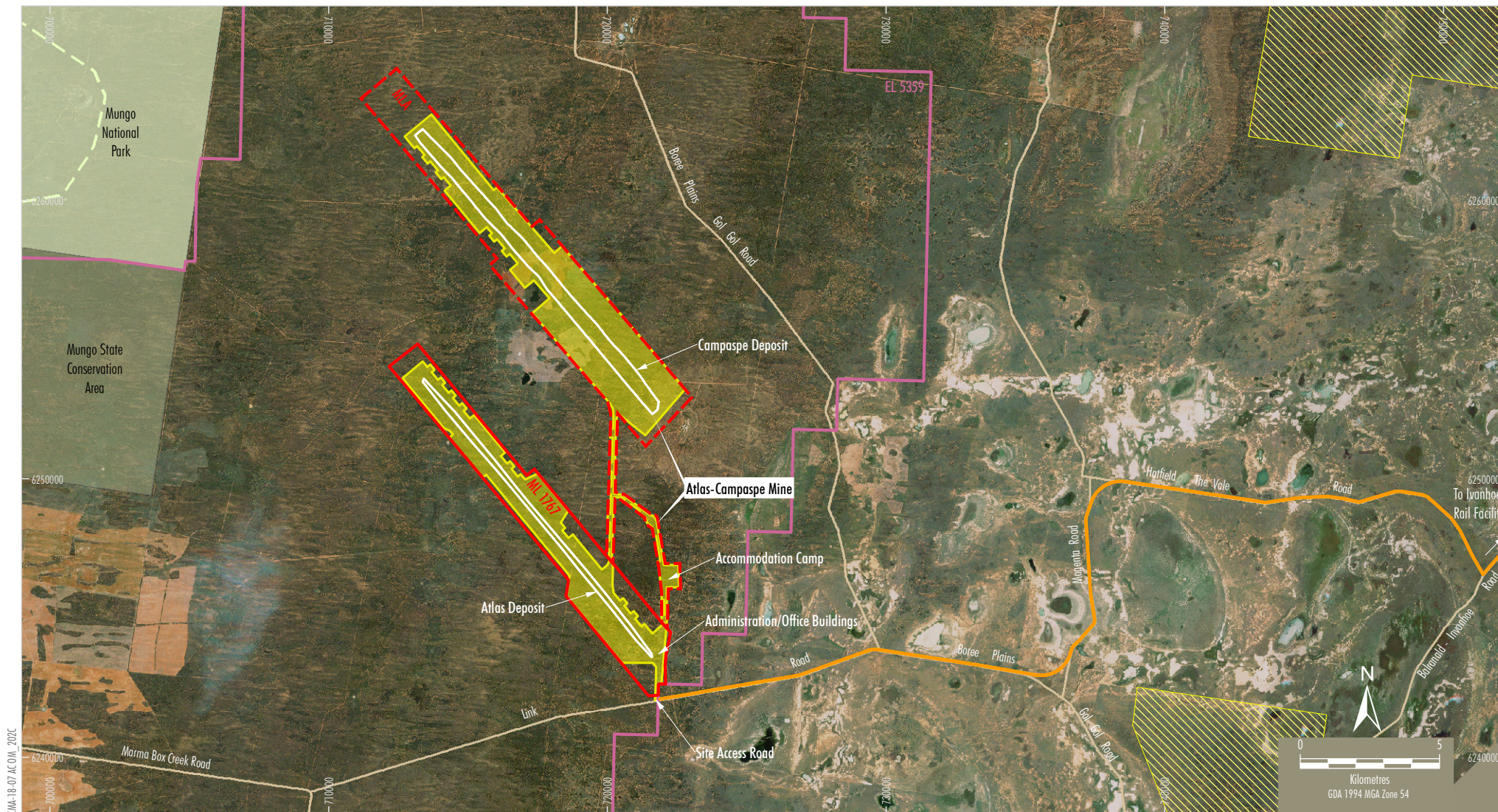
1.2 OVERVIEW OF THE MODIFICATION

Since the preparation of the *Atlas-Campaspe Mineral Sands Project Environmental Impact Statement* (the Project EIS) (Cristal Mining Australia [CMA], 2013), Tronox has undertaken Project optimisation planning in consideration of recent experience at its existing NSW operations.

A key outcome of the Project optimisation planning is revised mine scheduling for the Atlas deposit, which would increase the maximum mineral concentrate production rate; without increasing the approved ore mining rate. Other changes to optimise Project operations were also identified as part of the Project optimisation planning. The optimisation of the Project will increase its efficiency and economic viability.

The Modification would implement the outcomes of the optimisation planning and would include:

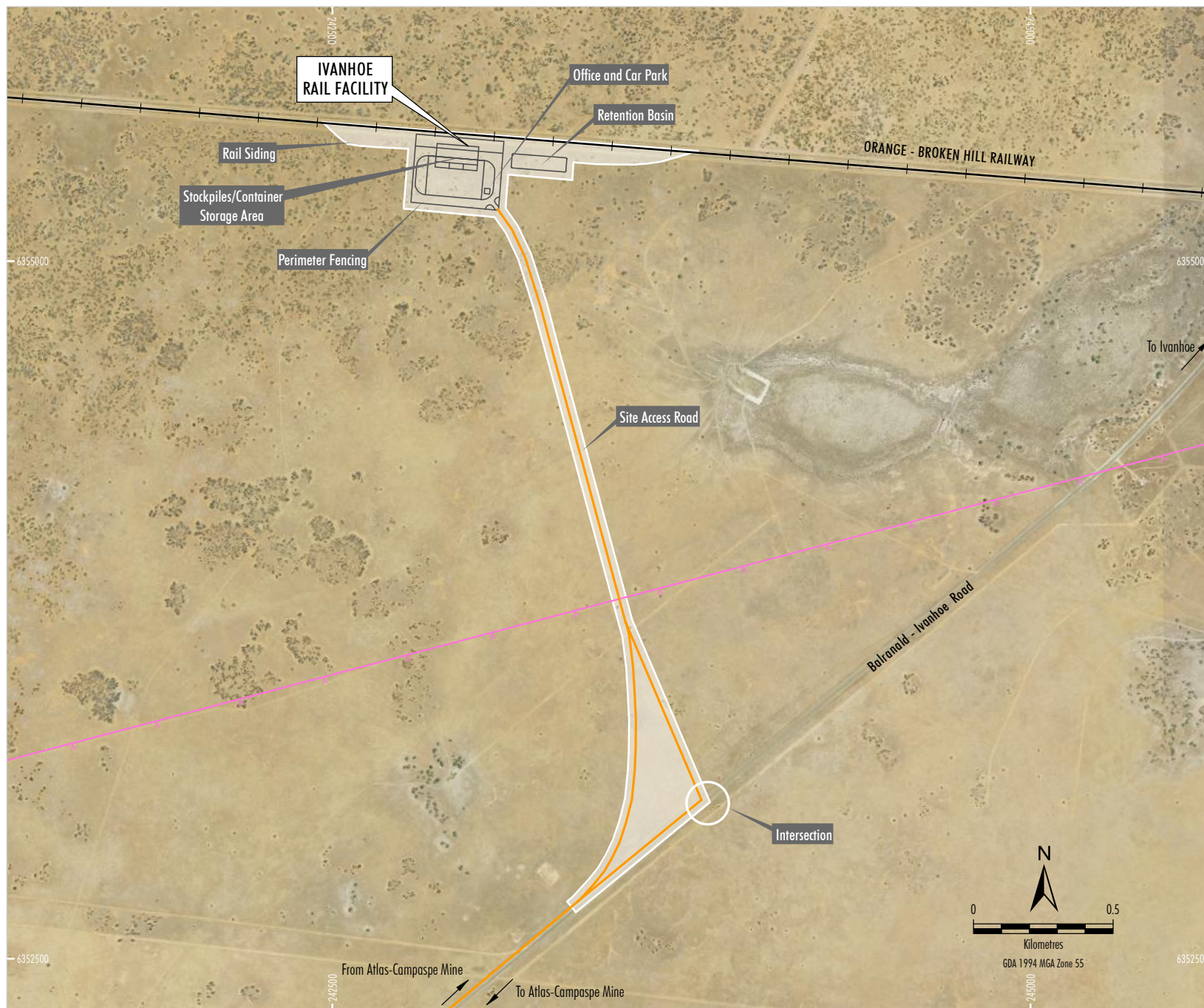
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- increased mineral concentrate transport truck trips from 24 per day to 35 per day;
- increased mineral concentrate transport train length (from 600 metres [m] to 920 m) and frequency (from six to eight train movements per week [i.e. four arrivals, four departures]);



Source: © NSW Department of Finance, Services & Innovation (2018); Cristal Mining Australia (2012)
 Orthophoto: AAM Pty Ltd (2011)

TRONOX
 OPTIMISATION MODIFICATION
 Approved Atlas-Campaspe Mine
 General Arrangement

Figure 2



CMA-18-07 AC OM_203C

TRONOX

OPTIMISATION MODIFICATION

Approved Ivanhoe Rail Facility
 General Arrangement

Figure 3

- increased MSP process waste disposal from 50,000 tpa to 65,000 tpa;
- the option to use an overland conveyor to transfer overburden in addition to haul trucks;
- the relocation of the Atlas-Campaspe Mine accommodation camp;
- the option to develop on-site solar power generation infrastructure at the Atlas-Campaspe Mine to supplement diesel generator sets;
- development of an emergency airstrip at the Atlas-Campaspe Mine;
- construction and operation of a telecommunications tower at the Atlas-Campaspe Mine;
- extension to the Ivanhoe Rail Facility hardstand area;
- extension of the Ivanhoe Rail Facility rail siding and addition of a passing siding;
- a revised alignment of the Ivanhoe Rail Facility access road and access road intersection;
- a groundwater supply bore for the Ivanhoe Rail Facility; and
- the use of local roads other than the road haulage route by Project-related light vehicles to access site.

Table 1 provides a comparative summary of the approved and modified Project. Based on a review of the proposed Project changes, Tronox considers that the modified Project would be substantially the same as the originally approved Project (Section 4.1.1).

The modified Atlas-Campaspe Mine and Ivanhoe Rail Facility general arrangements are shown on Figures 4 and 5, respectively.

1.3 CONSULTATION

Consultation has been conducted with relevant leaseholders, Aboriginal stakeholders, key NSW Government agencies, relevant local councils and relevant service providers during the preparation of this Modification Report. A summary of this consultation is provided below.

It is anticipated that consultation will continue during the public exhibition of this Modification Report and the assessment of the Modification by the NSW Government.

Relevant Leaseholders

Tronox provided the leaseholder surrounding the Ivanhoe Rail Facility a briefing that provided information on the Modification (particularly the proposed changes to the Ivanhoe Rail Facility), the environmental approval process and the scope of the Modification Report in May 2019.

Furthermore, Tronox consulted with leaseholders surrounding the Ivanhoe Rail Facility during the preparation of the Bore Census (provided as Attachment A of Appendix F). Tronox also provided the relevant leaseholders surrounding the Ivanhoe Rail Facility a copy of the finalised Ivanhoe Rail Facility Bore Census (included as Attachment A of Appendix F) in July 2019.

Aboriginal Stakeholders

Aboriginal stakeholders were consulted throughout the preparation of the Aboriginal Cultural Heritage Assessment (ACHA) for the Modification (Appendix E). Consultation was conducted in accordance with the NSW Office of Environment and Heritage (OEH) policy *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water [DECCW], 2010a).

Further detail on consultation with Aboriginal stakeholders for the Modification is provided in Section 3.6.

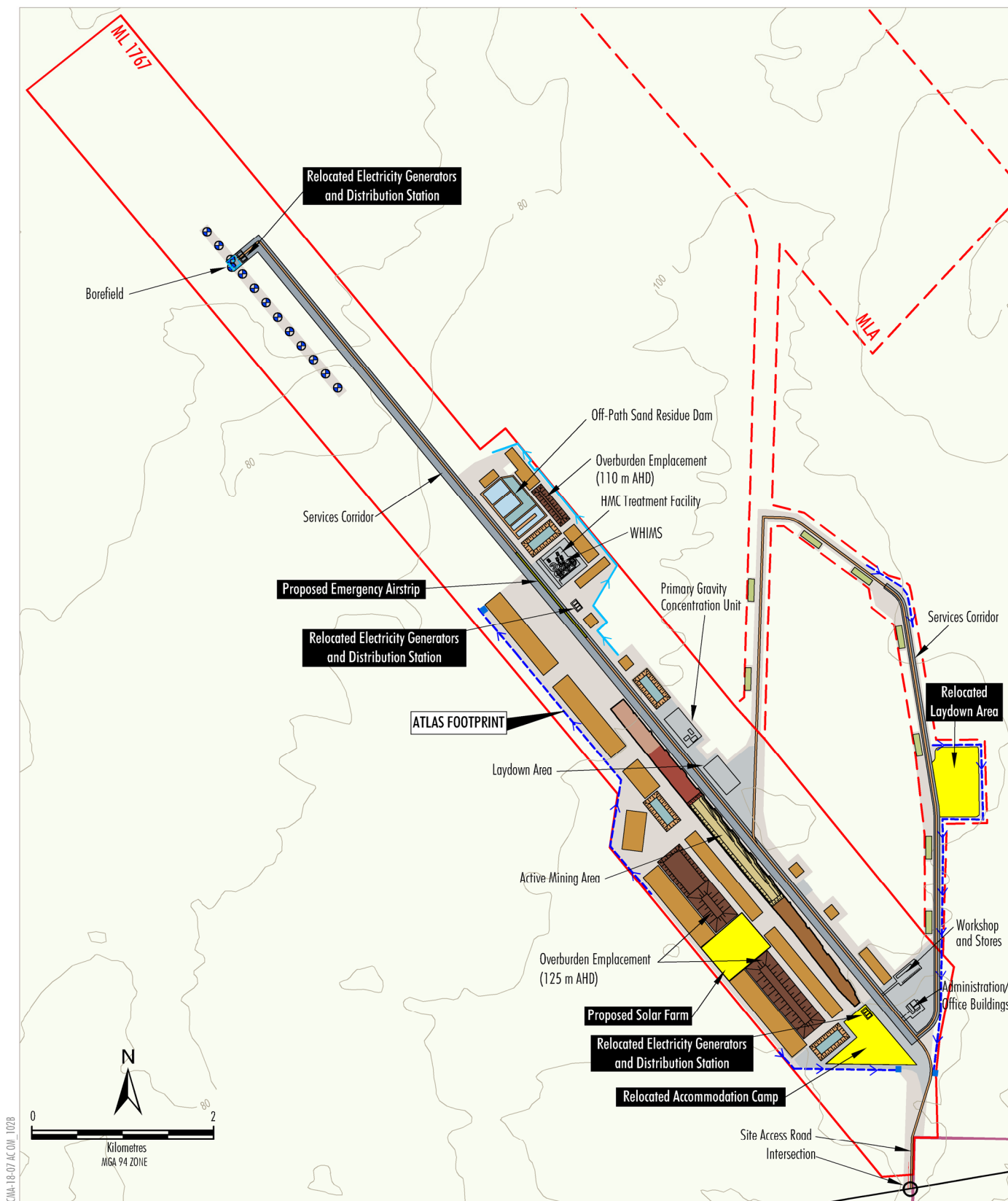
NSW Government Agencies

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

Department of Planning, Industry and Environment

Tronox met with the NSW Department of Planning and Environment (DP&E) (now the Department of Planning, Industry and Environment [DPIE]) on 29 April 2019 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 DP&E regarding the Modification, the proposed approval pathway and the proposed scope of the environmental assessment. The DP&E subsequently wrote to Tronox on 30 May 2019 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.

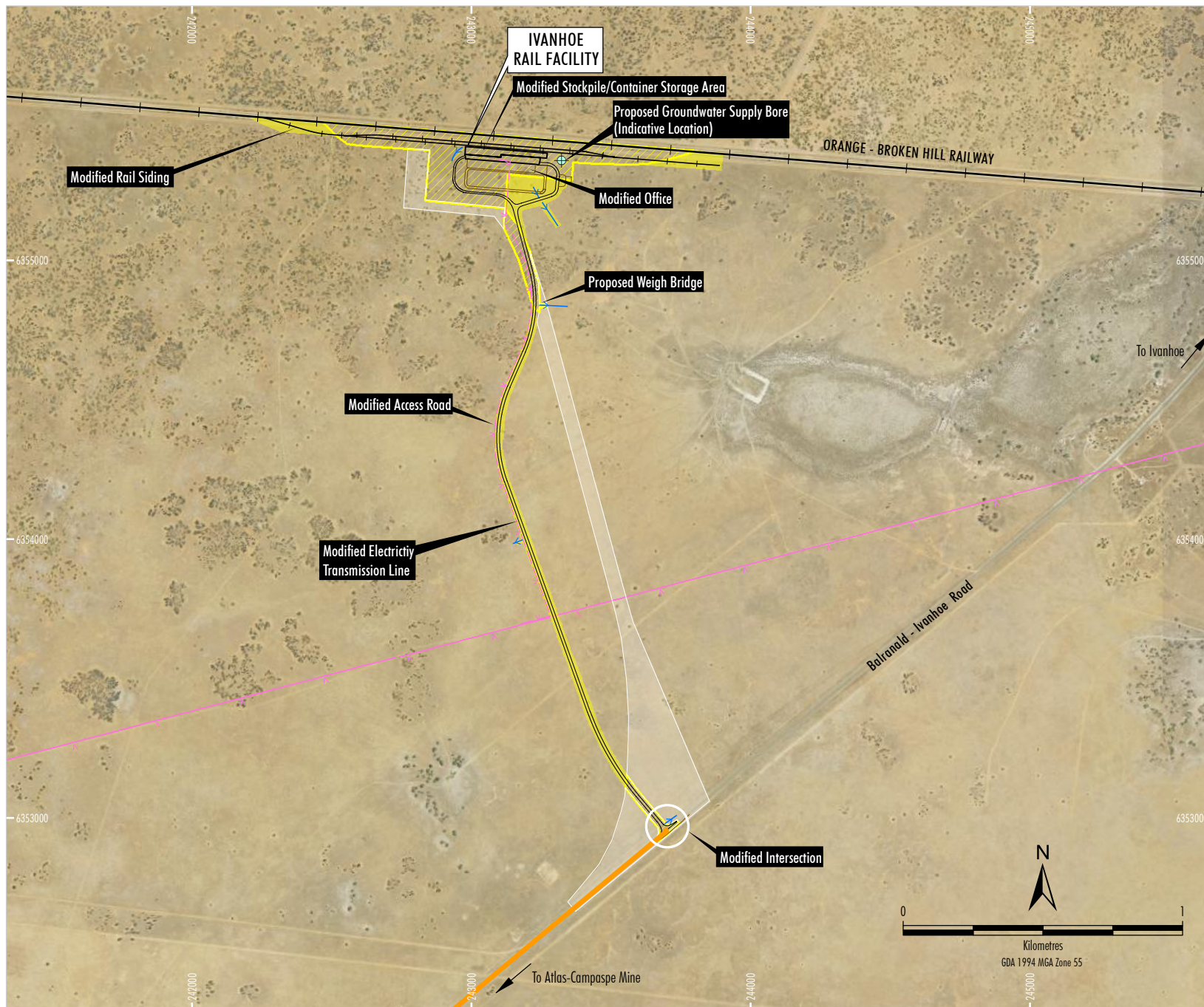


Source: © NSW Department of Finance, Services & Innovation (2018);
Cristal Mining Australia (2012) and Tronox (2019)

LEGEND			ACMSP Modification
	Mining Lease Boundary (ML)		Process Water Storage
	Mining Lease Application Boundary (MLA)		Overburden Emplacement
	Exploration Licence Boundary (EL)		Stage 1 Rehabilitation - Stabilised
	Up-catchment Diversions		Landform with Seed/Cover Crop Application
	Collection Drains		<u>Active Mining Area</u>
	Bore		Vegetation Clearance/Soil Stripping
	Approximate Extent of Surface Development - Year 2		Overburden Removal
	Fixed Infrastructure Areas		Ore Zone/Extraction Area
	Soil Stockpile		Overburden Replacement/Process Waste
			Emplacement/Soil Replacement
			Sediment Basin

TRONOX
OPTIMISATION MODIFICATION
Modified Atlas-Campaspe Mine
General Arrangement - Year 2

Figure 4



CMA-18-07 AC OM_204F

TRONOX

OPTIMISATION MODIFICATION

**Modified Ivanhoe Rail Facility
General Arrangement**

Figure 5

Table 1
Comparison of the Existing/Approved and Modified Project

Project Component	Approved Project	Modified Project
Atlas-Campaspe Mine		
Project Life	Mining operations until 30 June 2034.	No change.
Tenement	Mining Lease (ML) 1767 and Mining Lease Application (MLA) 1.	No change.
Mining	Dry mining (i.e. dozers and/or loaders and excavators) operation producing approximately 7.2 Mtpa of ore.	No change.
Mineral Concentration and Mineral Concentrate Transport	- Ore concentrated in the primary gravity concentration unit (comprising a screen, surge bin and wet concentrator) to produce heavy mineral concentrate (HMC). - HMC washed in the salt washing facility prior to processing in the wet high intensity magnetic separator (WHIMS) circuit to produce ilmenite-rich, leucoxene-rich and non-magnetic (containing rutile-rich and zircon-rich) mineral concentrates. - Mineral concentrate production up to 546,000 tpa. - Mineral concentrate transport up to 450,000 tpa. - Up to 24 Roads and Maritime Services (RMS)-approved haulage vehicle trips per day.	- No change to mineral concentration methods. - Increase in mineral concentrate production and transport up to 665,000 tpa. - Increase in RMS-approved haulage vehicle trips up to 35 per day.
Overburden Management	- Overburden removal ahead of ore extraction areas using conventional truck and shovel methods (e.g. excavators and haul trucks). - Overburden replacement, including progressive backfilling of mine voids behind the advancing ore extraction areas or in overburden emplacements adjacent to the mine path using haul trucks.	Option to use an overland conveyor to transfer overburden in addition to haul trucks.
Sand Residue and Coarse Reject Management	Sand residues and coarse rejects placed in either overburden emplacement cells behind the advancing ore extraction area or in off-path sand residue dams.	No change.
MSP Process Waste Management	- MSP process waste placed behind the advancing ore extraction areas at either the Ginkgo Mine, Snapper Mine or Atlas-Campaspe Mine. - MSP process waste production of up to 50,000 tpa.	- No change to MSP process waste management. - Increase in MSP process waste production up to 65,000 tpa.
Water Supply	Water requirements will be supplied by the Atlas-Campaspe Mine borefield.	No change.
Electricity Supply	Electricity supplied by diesel generator sets.	Option to develop on-site solar power generation infrastructure to supplement diesel power generation.
Supporting Infrastructure	Construction of supporting infrastructure within the approved surface development area.	- Relocation of the accommodation camp. - Development of an emergency airstrip. - Construction and operation of a telecommunications tower.
Site Access	Access to the Atlas-Campaspe Mine is via the road haulage route.	The use of other local roads other than the haulage route by Project-related light vehicles to access site.
Employment	- Approximately 300 personnel during peak construction. - Approximately 200 personnel during operations.	No change.

Table 1 (Continued)
Comparison of the Existing/Approved and Modified Project

Project Component	Approved Project	Modified Project
Atlas-Campaspe Mine (Cont.)		
Rehabilitation Works	Progressive rehabilitation undertaken as mining advances.	No change.
Biodiversity Offset Area	Approximately 16,540 hectares (ha) will be established to offset native vegetation communities cleared for the Project.	No change.
Ivanhoe Rail Facility		
Infrastructure	Construction of infrastructure within the approved surface development area, including access road, rail siding, hardstand area, site office, parking, fencing, lighting and water management infrastructure.	- Extension to the hardstand area. - Extension of the rail siding and addition of a passing siding. - Revised alignment of the access road and access road intersection.
Unloading and Stockpiling	Mineral concentrate emptied directly onto a mineral concentrate stockpile for reclaim by a front-end loader to load directly into train wagon containers.	No change.
Train Movements	- Up to three trains per week. - Up to one train trip in any 24-hour period.	- Increase in train frequency to four per week. - No change to number of trains in any 24-hour period.
Water Supply	Waters collected onsite and potable water trucked from the Atlas-Campaspe Mine or the Ivanhoe town water supply.	- Addition of a groundwater supply bore. - No change to the potable water supply.
Electricity Supply and Distribution	Electricity supplied via the local network.	No change.

Roads and Maritime Services

Tronox provided a briefing package to the RMS in April 2019 that provided an overview of the proposed Modification and the approach to assessing the potential road transport impacts associated with the Modification.

Tronox held a teleconference with RMS on 28 June 2019, where the RMS environmental assessment requirements were discussed. These environmental assessment aspects have been considered in this Modification Report.

Office of Environment and Heritage

Tronox provided a briefing package and held a teleconference with the OEH on 25 March 2019 to provide an overview of the Modification and discuss the approach to assessing potential biodiversity and Aboriginal cultural heritage impacts associated with the Modification.

Tronox further consulted with the OEH regarding the approach to assessing potential biodiversity impacts in April and May 2019; the OEH confirmed the approach adopted in this Modification Report was appropriate.

Natural Resources Access Regulator

Tronox provided a briefing package and held a teleconference with the NSW Natural Resources Access Regulator (NRAR) on 26 March 2019 to provide an overview of the Modification and discuss the approach to assessing potential water resource impacts associated with the Modification.

The NRAR indicated that the *NSW Aquifer Interference Policy* (AIP) (NSW Department of Primary Industries [DPI], 2012) did not apply to the proposed Ivanhoe Rail Facility groundwater supply bore, and confirmed the proposed analytical methods would be appropriate to predict groundwater drawdown associated with the groundwater supply bore at the Ivanhoe Rail Facility.

Notwithstanding the NRAR advice, the minimal impact considerations in the AIP (DPI, 2012) have been addressed in Sections 3.9 and 4.4, and Appendix F.

Environment Protection Authority

Tronox provided a briefing package and held a teleconference with the NSW Environment Protection Authority (EPA) in May 2019 to provide an overview of the Modification and discuss the approach to assessing potential noise, air quality and water resources impacts associated with the Modification.

Tronox held a teleconference with the EPA on 27 May 2019, where the EPA confirmed it was satisfied with the proposed approach to assessing potential noise, air quality and water resources impacts associated with the Modification.

Other NSW Government Agencies

In May 2019, Tronox provided a briefing package that included information on the Modification and offered further information if requested to the following NSW Government agencies:

- NSW Division of Resources and Geosciences (DRG);
- NSW Resources Regulator; and
- NSW Department of Industry – Crown Lands.

No request for further information was received from these NSW Government agencies.

Local Councils

The Project is located within the Balranald Shire Council (BSC) and Central Darling Shire Council (CDSC) local government areas (LGAs) (Figure 1).

In addition, a portion of the light vehicle access routes proposed as part of the Modification would be located within the Wentworth Shire Council (WSC) LGA.

Tronox consulted with the BSC, CDSC and WSC throughout May to July 2019 regarding potential road transport impacts associated with the Modification.

A copy of the draft Road Transport Assessment was provided to the BSC, CDSC and WSC in June 2019.

The BSC confirmed on 24 June 2019 that Tronox's existing road maintenance contributions made to the BSC (as outlined in Appendix 7 of Development Consent [SSD_5012]) (Section 2.2.3) would address the road maintenance requirements associated with the proposed increase in mineral concentrate transport truck trips.

Tronox is continuing to consult with the BSC regarding contributions toward local road upgrades, improvements and maintenance.

On 3 July 2019, the CDSC confirmed that Tronox's existing road maintenance contributions made to the CDSC (as outlined in Appendix 8 of Development Consent [SSD_5012]) (Section 2.2.3) would address the road maintenance requirements associated with the proposed increase in mineral concentrate transport truck trips.

The WSC confirmed on 13 June 2019 that it was satisfied with Tronox's proposed use of local roads in the WSC LGA for the modified Project.

Further details on the road upgrades and maintenance required are provided in Sections 2.1.7 and 2.2.3.

Service Providers

Australian Rail Track Corporation

Product (mineral concentrates) generated as a result of operations at the Atlas-Campaspe Mine will be railed from the Ivanhoe Rail Facility to the MSP on the Orange – Broken Hill Railway (Figure 1). The Orange – Broken Hill Railway is owned by the Australian Rail Track Corporation (ARTC).

Tronox has consulted with the ARTC regarding the design of the proposed rail siding extension and passing siding. The outcomes of this consultation have been incorporated into the design of the proposed rail siding extension and passing siding.

Tronox has also consulted the ARTC regarding the proposed increase in train length (from 600 m to 920 m) and frequency (from six to eight train movements per week).

Tronox will continue to consult with the ARTC regarding the construction and operation of the Ivanhoe Rail Facility.

Royal Flying Doctor Service

Tronox has consulted with the Royal Flying Doctor Service regarding the design requirements for the proposed emergency airstrip at the Atlas-Campaspe Mine.

Telstra

Tronox has consulted with Telstra regarding the proposed telecommunications tower at the Atlas-Campaspe Mine (Section 2.1.8).

Tronox would continue to consult with Telstra regarding the construction and operation of the telecommunications tower.

1.4 STRUCTURE OF THE DOCUMENT

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

Section 1	Provides an overview of the approved Project, the Modification and the consultation undertaken in relation to the Modification.
Section 2	Provides a description of the Modification.
Section 3	Provides an environmental assessment of the Modification, and describes the existing environmental management systems and measures available to manage and monitor any potential impacts.
Section 4	Describes the general statutory context of the Modification and describes how the Modification meets relevant statutory requirements.
Section 5	Provides a conclusion and justification for the Modification.
Section 6	Lists the references cited in this report.

Attachment 1 and Appendices A to F provide supporting information as follows:

Attachment 1	Development Consent (SSD_5012)
Appendix A	Road Transport Assessment
Appendix B	Air Quality Review
Appendix C	Noise Review
Appendix D	Vegetation Condition Assessment
Appendix E	Aboriginal Cultural Heritage Assessment
Appendix F	Groundwater Review

2 MODIFICATION OVERVIEW

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

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

2.1 ATLAS-CAMPASPE MINE

2.1.1 Mining Operations

Mining operations using dry mining methods (i.e. dozers and/or loaders and excavators) are approved to be undertaken up to 24 hours per day, seven days per week at the Atlas-Campaspe Mine.

Mining will commence at the south-eastern end of the Atlas deposit and then progress in a north-westerly direction.

Mining of the Campaspe deposit will commence once mining within the Atlas footprint is complete. Initial development will commence at the south-eastern end of the Campaspe deposit and mining would progress in a north-westerly direction.

The general sequence of the approved mining operations is as follows (Figure 6):

1. Vegetation clearance and soil stripping.
2. Overburden removal ahead of ore extraction areas using conventional truck and shovel methods (e.g. excavators and haul trucks).
3. Mineral sands ore extraction and placement in a dry mining unit (DMU) using conventional dry mining equipment (e.g. dozers and loaders) at up to 7.2 Mtpa.
4. Overburden replacement using haul trucks, including progressive backfilling of mine voids behind the advancing ore extraction areas or in overburden emplacements adjacent to the mine path.
5. Placement of process wastes (i.e. sand residues, coarse rejects and MSP process waste) following mineral processing to either the active mining area (behind the advancing ore extraction area) or in sand residue dams.
6. Overburden and soil replacement, including profiling of the final landform in preparation for rehabilitation activities.
7. Progressive rehabilitation behind the advancing mining operation.

The Modification would involve revised mine scheduling for the Atlas deposit, which would increase the maximum mineral concentrate production rate.

The Modification would also include the option to use an overland conveyor to transfer overburden in addition to haul trucks.

If the overland conveyor is adopted, overburden would be placed directly into a hopper, which would feed onto the overland conveyor. The overburden would then be transported behind the advancing ore extraction areas to backfill mine voids consistent with the approved Project (Figure 6). The overland conveyor system would comprise approximately 1 to 3 km of overland conveyor and a mobile stacker conveyor. The conveyor feed hopper would be periodically relocated to follow the stripping operation.

Changes to the operational mobile and fixed equipment after Year 1 would also be included in the Modification. Further details of the modified operational mobile and fixed equipment are provided in Appendix C.

The Modification would not change the approved mine path, mining method, operational hours, maximum mining rate or rehabilitation strategy.

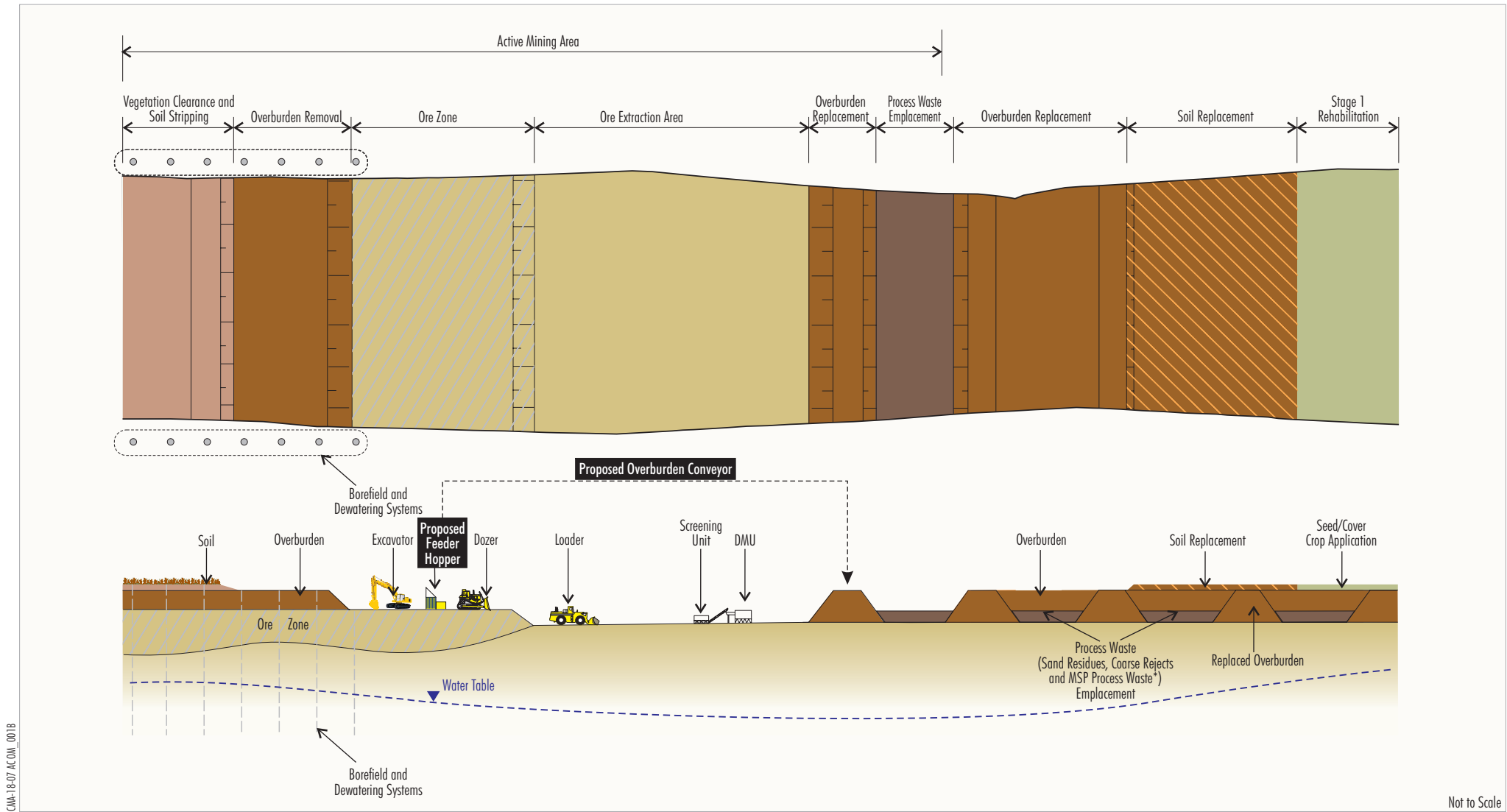
2.1.2 Mineral Processing

Processing of mineral sands ore is approved to occur at the Atlas-Campaspe Mine up to 24 hours per day, seven days per week.

Primary separation of HMC from ore will occur in the primary gravity concentration unit. The HMC recovered by the primary gravity concentration unit will be processed further at the HMC treatment facility. The HMC treatment facility includes a salt washing facility and the WHIMS circuit. The HMC will be washed with desalinated water in the salt washing facility prior to processing in the WHIMS circuit.

The WHIMS circuit is a preliminary treatment stage that separates the HMC into ilmenite-rich, leucoxene-rich and non-magnetic (containing rutile-rich and zircon-rich) mineral concentrates. Up to 546,000 tpa of mineral concentrates are approved to be produced.

The mineral concentrates from the WHIMS circuit will be stockpiled in the mineral concentrate stockpile areas by product stackers before they are loaded onto trucks for transport to the Ivanhoe Rail Facility.



Not to Scale

* Following cessation of operations at the Ginkgo and Snapper Mines

Source: Cristal Mining Australia (2012) and Tronox (2019)

TRONOX
OPTIMISATION MODIFICATION
Modified Mining Operations
Conceptual Plan and Section

Figure 6

In consideration of the MSP processing schedule (including Ginkgo and Snapper Mines), the total mineral concentrate transported from the Atlas-Campaspe Mine to the MSP was expected to be 450,000 tpa. Given the approved maximum mineral concentrate production rate is greater than 450,000 tpa, mineral concentrate will need to be stockpiled at the Atlas-Campaspe Mine during years where the mineral concentrate production rate exceeds 450,000 tpa.

The Modification would include an increase in the maximum mineral concentrate production rate to 665,000 tpa.

In addition, a review of the MSP processing schedule conducted as part of the optimisation planning identified that 665,000 tpa of mineral concentrate could be transported from the Atlas-Campaspe Mine to the MSP. All mineral concentrates produced would therefore be transported to the MSP shortly after processing for the modified Project, rather than be stockpiled at the Atlas-Campaspe Mine.

No other changes to the approved mineral processing operations are proposed as part of the Modification.

2.1.3 Process Waste Management

Approved process wastes comprise sand residues (including a small proportion of clays) and coarse reject materials from on-site processing and MSP process waste.

Sand residues (and coarse materials) will be pumped from the primary gravity concentration unit to either the overburden emplacement cells behind the advancing ore extraction area or in off-path sand residue dams.

Up to approximately 50,000 tpa of MSP process waste is approved to be produced by the Project. The MSP process wastes produced by the Project will be combined with the existing/approved MSP process wastes produced from the Ginkgo and Snapper Mines and continue to be transported to the Ginkgo and Snapper Mines in accordance with existing/approved operations up until cessation of those operations.

Following the cessation of the Ginkgo and Snapper Mines, MSP process waste in sealed containers (transported via the Orange – Broken Hill railway) will be unloaded from trains at the Ivanhoe Rail Facility, and temporarily held in a designated area prior to loading onto haulage vehicles for transportation to the Atlas-Campaspe Mine.

MSP process waste will be transported via road in sealed storage containers from the Ivanhoe Rail Facility to the Atlas-Campaspe Mine for unloading, stockpiling and placement behind the advancing ore extraction areas. No MSP process waste will be placed in off-path sand residue dams at the Atlas-Campaspe Mine.

The Modification would increase the rate of MSP process waste production to up to 65,000 tpa. This increase is due to the proposed increase in mineral concentrate production (i.e. increased mineral concentrate production results in an increase in MSP process waste production at the MSP).

No changes to the approved process waste management are proposed as part of the Modification.

2.1.4 Accommodation Camp

The accommodation camp is approved to accommodate the peak construction workforce (up to approximately 300 people) before being reduced in size to accommodate approximately 200 people for operations.

The approved accommodation camp is located to the east of the Atlas deposit and immediately north of the site access road (Figure 2).

Facilities at the accommodation will include:

- up to 300 single quarters/rooms;
- mess area (including stores, kitchen and wet mess);
- office building;
- laundry facilities;
- ablution facilities;
- garden/recreation area; and
- sewage treatment plant.

The Modification includes the relocation of the accommodation camp to the south-eastern end of the Atlas deposit inside the existing surface development area (Figure 4). The relocation is proposed based on the outcomes of optimisation planning undertaken for the Project.

The modified accommodation camp would be located in the footprint of an approved laydown area. The approved accommodation camp footprint may be used as a laydown area if required (Figure 4).

The Modification would not change the approved accommodation camp capacity or facilities.

2.1.5 Electricity Supply

Electricity for the Atlas-Campaspe Mine is approved to be supplied by diesel generator sets.

The Modification would include the option to develop on site solar power generation infrastructure to supplement the diesel generator sets. If developed, the on-site solar power generation infrastructure would have an installed capacity of up to 1 megawatt and would provide approximately 2,000 megawatt hours of power to the Atlas-Campaspe Mine each year.

The on-site solar power generation infrastructure would include the following:

- photovoltaic (PV) solar modules;
- inverters and transformers;
- electrical conduits and cabling connecting PV solar modules with inverters;
- internal access tracks; and
- perimeter fencing.

The on-site solar power generation infrastructure would be located on the southern side of the Atlas deposit inside the approved surface development area (Figure 4).

Tronox is separately considering importing electricity to the Atlas-Campaspe Mine via an electricity transmission line. The electricity transmission line would be subject to separate environmental assessment and approval.

2.1.6 Emergency Airstrip

The Modification includes the development of an emergency airstrip at the Atlas-Campaspe Mine to allow for the evacuation of Project personnel in the event of an emergency.

The emergency airstrip would be approximately 1,200 m long and located on an approved haul road inside the approved surface development area (Figure 4).

The emergency airstrip would be designed and constructed in accordance with the requirements of the Royal Flying Doctor Service.

The emergency airstrip would not be used to transport Project workforce to and from the Atlas-Campaspe Mine.

2.1.7 Site Access

Condition 6, Schedule 3 of Development Consent (SSD_5012) states:

The Applicant shall ensure that no project-related traffic (including employees and contractors) uses local roads to access the site, other than those local roads that form part of the haulage route shown in Appendix 3, except in an emergency to avoid the loss of life, property and/or to prevent environmental harm.

Note: This condition does not apply to any employees that may reside on a local road that does not form part of the haulage route (in the vicinity of the development), or the infrequent use of the roads for consultation, environmental monitoring and inspection and maintenance of nearby infrastructure.

The Modification would include the use of local roads other than the road haulage route by Project-related light vehicles to access the site, including (Figures 7a and 7b):

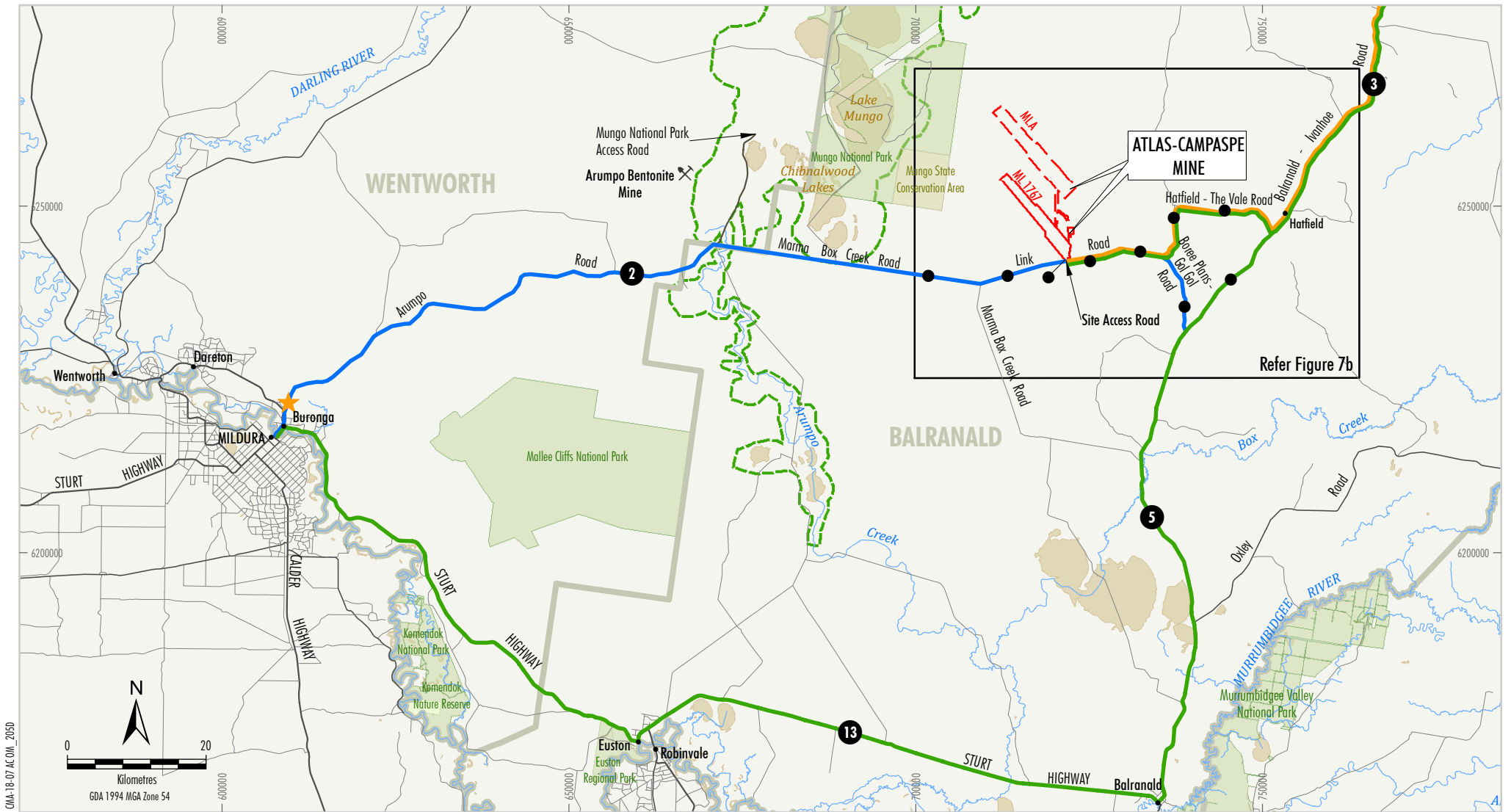
- to/from Mildura/Buronga via Arumpo Road, Marma Box Creek Road and Link Road; and
- to/from Balranald via Balranald-Ivanhoe Road, Boree Plains-Gol Gol Road and Link Road.

The proposed local road routes would reduce the travel distances to Mildura/Buronga and Balranald from the Atlas-Campaspe Mine relative to the approved routes by approximately 150 km and 32 km, respectively (Appendix A).

Tronox is currently reviewing the feasibility of operating shuttle buses between the Atlas-Campaspe Mine and Buronga/Mildura or Balranald for Project workers. If a Project worker shuttle bus was to operate, it would also travel along these local roads.

Tronox has consulted with the BSC, WSC and RMS regarding the proposed light vehicle use of these local roads and the following road upgrades are proposed (Appendix A):

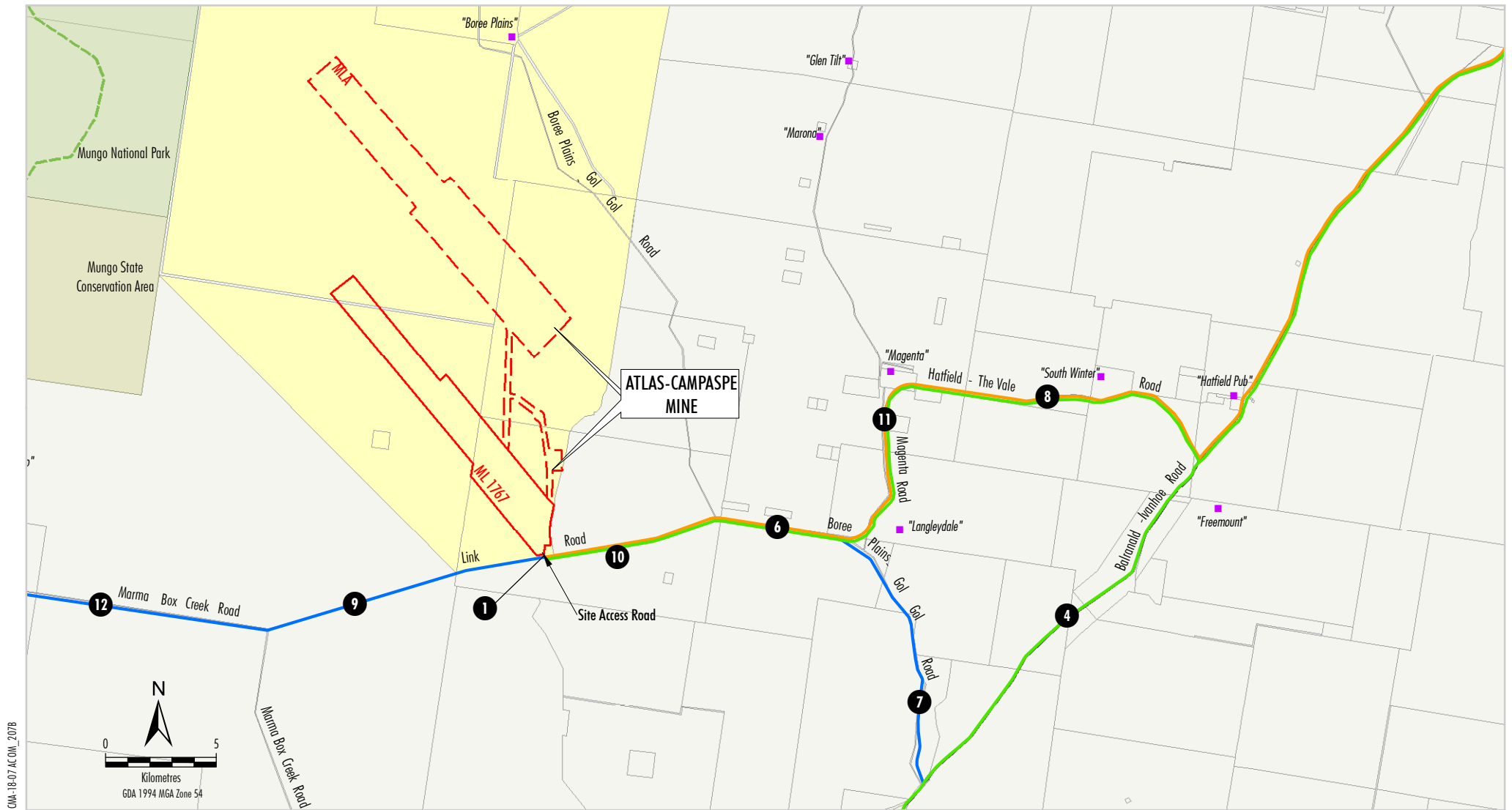
- Link Road (between Marma Box Creek Road and the Atlas-Campaspe Mine) would be upgraded to meet the minimum carriageway and formation width requirements for a Class 4B unsealed road (Australian Road Research Board [RRB], 2009); and
- the surface of Boree Plains-Gol Gol Road would be sealed on its approach to its intersection with Balranald-Ivanhoe Road.



TRONOX
 OPTIMISATION MODIFICATION
 Project Light Vehicle Access Routes

Source: © NSW Department of Finance, Services & Innovation (2018);
 Cristal Mining Australia (2012); Tronox (2019) and TTPP (2019)

Figure 7a



CMA-18-07 ACOM_2078

LEGEND

- Mining Lease Boundary (ML 1767)
- - - Mining Lease Application Boundary (MLA)
- - - Willandra Lakes Region World Heritage Area
- National Park
- State Conservation Area
- Tronox Owned Land
- Private Landholder
- Dwelling
- Approved Mineral Concentrate Transport Route
- Proposed Light Vehicle Access Routes
- Approved Light Vehicle Access Route
- 1 Traffic Forecast Location

Source: © NSW Department of Finance, Services & Innovation (2018);
Cristal Mining Australia (2012); Tronox (2019) and TIPP (2019)

TRONOX
OPTIMISATION MODIFICATION
Project Light Vehicle Access Routes - Inset

Figure 7b

In addition, the following road improvements would progressively be made as part of ongoing maintenance activities (Appendix A):

- the road surface of relevant sections of the local road routes would be improved to establish a good riding surface with reduced dust emissions; and
- appropriate traffic control signs would be installed along the local road routes.

Tronox is continuing to consult with the BSC regarding contributions toward local road upgrades, improvements and maintenance.

The WSC has stated that no ongoing financial contributions to the maintenance of Arumpo Road is required at this stage.

2.1.8 Telecommunications Tower

The Modification includes the construction of a telecommunications tower at the Atlas-Campaspe Mine to provide mobile reception to the Project area and surrounds.

The telecommunications tower would be constructed adjacent to approved infrastructure, within the approved surface development area of the Atlas-Campaspe Mine. The exact location of the tower would be determined in consultation with Telstra.

The tower would be constructed in accordance with relevant Telstra requirements.

2.1.9 Other Atlas-Campaspe Mine Components

There would be no change to the following key components of the approved Atlas-Campaspe Mine due to the Modification:

- mine life and hours of operation;
- mining tenement;
- water demand and supply;
- water management;
- dangerous goods management;
- workforce; and
- rehabilitation strategy.

2.2 MINERAL CONCENTRATE AND MSP PROCESS WASTE ROAD TRANSPORT

2.2.1 Road Haulage Route and Vehicles

Mineral concentrates generated at the Atlas-Campaspe Mine (Section 2.1.2) are approved to be trucked to the Ivanhoe Rail Facility for unloading, stockpiling and subsequent loading to trains for rail transportation to the MSP.

RMS-approved vehicles will be used to transport the mineral concentrates and MSP process waste.

The approved road haulage route consists of (Figures 1 and 3):

- the Atlas-Campaspe Mine access road;
- Link Road;
- Boree Plains-Gol Gol Road;
- Magenta Road;
- Hatfield-The Vale Road;
- Balranald-Ivanhoe Road; and
- Ivanhoe Rail Facility access road.

The Modification would not change the approved road haulage route or vehicles.

2.2.2 Road Haulage Frequency

Up to 450,000 tpa of mineral concentrate is approved to be transported from the Atlas-Campaspe Mine to the Ivanhoe Rail Facility.

In addition, up to 50,000 tpa of MSP process waste is approved to be transported from the Ivanhoe Rail Facility to the Atlas-Campaspe Mine via the road haulage route in sealed storage containers.

Up to 24 heavy vehicle trips in any 24-hour period are approved.

The Modification would increase heavy vehicle trips from 24 per day to 35 per day to allow for the transport of increased mineral concentrate production and MSP process waste proposed as part of the Modification (Sections 2.1.2 and 2.1.3).

2.2.3 Road Upgrades

Condition 1, Schedule 3 of Development Consent (SSD_5012) requires Tronox to implement road haulage route upgrades to an acceptable standard for Type 1 road trains and to the satisfaction of the RMS, BSC and CDSC prior to the haulage of mineral concentrate.

In addition, Tronox will make financial contributions to the BSC and CDSC to rectify the “high risk” road safety deficiencies along Balranald-Ivanhoe Road in accordance with Condition 5, Schedule 3 of Development Consent (SSD_5012).

The BSC and CDSC have confirmed that the above road upgrades along the road haulage route are appropriate for the Modification.

The Modification would not change the approved road haulage route upgrades (Appendix A).

2.2.4 Road Maintenance Contributions

Tronox will make financial contributions to the BSC and CDSC for the maintenance of Balranald-Ivanhoe Road and other local roads along the road haulage route in accordance with Conditions 4 and 5, Schedule 3 of Development Consent (SSD_5012).

The Modification would not change the approved methodology for determining road haulage route maintenance contributions (Section 1.3).

2.3 IVANHOE RAIL FACILITY

2.3.1 General Arrangement

The approved Ivanhoe Rail Facility comprises:

- a rail siding;
- hardstand areas, including stockpiles/sealed container storage areas;
- access road and internal haul roads/pavements;
- a retention basin, drains, pumps, pipelines and other water management equipment and structures;
- site office, ablutions and car parking facilities;
- perimeter fencing;
- extension to existing powerline;
- night-lighting; and
- vegetation management area.

The approved Ivanhoe Rail Facility general arrangement is shown on Figure 3.

The Modification includes the following changes to the approved general arrangement to allow for longer trains proposed as part of the Modification (Section 2.3.2) (Figure 5):

- extension to the hardstand area; and
- extension of the rail siding and addition of a passing siding.

The design and construction of the modified rail siding would be undertaken in accordance with the requirements of the ARTC.

In addition, the approved access road and intersection would be realigned (Figure 5). The realignment of the access road and intersection is proposed to address the outcomes of consultation with the underlying leaseholder.

The realigned intersection would be designed and constructed in accordance with Austroads requirements in consultation with the RMS and CDSC (Appendix A).

Other components of the approved Ivanhoe Rail Facility general arrangement would not be significantly changed.

The modified Ivanhoe Rail Facility components would require an additional 10 ha of surface development area (herein referred to as the additional surface development area). The modified Ivanhoe Rail Facility general arrangement would however not require the use of approximately 24 ha of currently approved surface development area. The Modification would therefore result in a net reduction in surface development area of approximately 14 ha.

2.3.2 Operations

Operations at the Ivanhoe Rail Facility are approved to be undertaken up to 24 hours per day, seven days per week.

A turn-around loop at Ivanhoe Rail Facility will enable the haulage vehicles to turn-around, unload and exit using the access road. Mineral concentrate emptied from the haulage vehicles will be stockpiled within the hardstand area.

A front-end loader will be used to reclaim mineral concentrate from the stockpile and load containers on the hardstand area. A forklift will be used to remove and replace container covers and to load the containers onto the train wagons.

Once operations at the Ginkgo and Snapper Mines cease, MSP process waste in sealed containers will be unloaded from trains at the Ivanhoe Rail Facility prior to returning to the Atlas-Campaspe Mine.

The Modification would include changes to the operational mobile equipment at the Ivanhoe Rail Facility. Further details of the modified operational mobile equipment are provided in Appendix C.

Based on train lengths of up to 600 m, the approved Project will require a maximum of three trains per week with no more than one train in any 24-hour period.

The Modification would include an increase in the train length to 920 m and frequency to four trains per week. The increased train length and frequency would be required to allow for the transport of the increased mineral concentrate production proposed as part of the Modification (Section 2.1.2).

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

Tronox has also consulted the ARTC regarding the proposed increase in train length and frequency.

2.3.3 Water Supply

The approved water supply at the Ivanhoe Rail Facility includes:

- waters collected in the retention basin will be utilised for dust suppression; and
- potable water will be provided from the Atlas-Campaspe Mine or Ivanhoe town water supply and delivered by truck for use at the site office buildings.

The Modification includes the addition of a groundwater supply bore at the Ivanhoe Rail Facility (Figure 5). Up to 60 million litres per year (ML/year) would be extracted from the groundwater supply bore to be utilised for wash-down purposes and dust suppression on the access road and mineral concentrate stockpiles.

The groundwater supply bore would be located inside the approved surface development area (Figure 5).

3 ENVIRONMENTAL ASSESSMENT

3.1 IDENTIFICATION OF KEY ISSUES

The key potential impacts of the Modification are related to the proposed changes to the approved Atlas-Campaspe Mine, Ivanhoe Rail Facility and Project transport activities described in Table 1 and Section 2.

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 2 and addressed in Sections 3.2 to 3.13 and the relevant appendices.

Table 2
Summary of Key Potential Environmental Issues/Impacts

Environmental Aspect	Key Potential Environmental Issues/Impacts		Report Section/Appendix
	Atlas-Campaspe Mine	Ivanhoe Rail Facility	
Road Transport	Potential road transport impacts associated with increased mineral concentrate transport and the use of local roads by Project-related light vehicles.	Potential road transport impacts associated with increased mineral concentrate transport and the modified Ivanhoe Rail Facility access road intersection.	Section 3.2 and Appendix A
Air Quality	Potential air quality impacts due to increased mineral concentrate production and the potential use of conveyors to transfer overburden.	Potential air quality impacts due to increased mineral concentrate transport rate and handling (e.g. additional mobile fleet).	Section 3.3 and Appendix B
Noise	Potential noise impacts due to operational mobile and fixed equipment changes, and potential road noise impacts associated with increased mineral concentrate transport.	Potential noise impacts due to increased mineral concentrate transport rate and handling (e.g. additional mobile fleet, trains), and operational mobile equipment changes.	Section 3.4 and Appendix C
Biodiversity	As the Modification would not change the extent of the approved surface development area associated with the Atlas-Campaspe Mine, no changes to the approved impacts on biodiversity, Aboriginal and historic heritage, land and agricultural resources or surface water resources are expected.	Potential impacts on biodiversity, Aboriginal and historic heritage, land and agricultural resources and surface water resources associated with the modified Ivanhoe Rail Facility surface development area.	Section 3.5 and Appendix D
Aboriginal Cultural Heritage			Section 3.6 and Appendix E
Historic Heritage			Section 3.7 and Appendix E
Land and Agricultural Resources			Section 3.8
Surface Water Resources			Section 3.10
Groundwater Resources	As the Modification would not change the approved mine path, mine life or mining rate, or the water demand at the Atlas-Campaspe Mine, no changes to the approved groundwater impacts are expected.	Potential groundwater impacts associated with the addition of a groundwater supply bore.	Section 3.9 and Appendix F
Greenhouse Gas	Potential greenhouse gas emission changes due to increased mineral concentrate production, the potential use of conveyors to transfer overburden and potential addition of on-site solar power generation infrastructure.	Potential greenhouse gas emission changes due to increased mineral concentrate transport rate (e.g. additional fleet, trains etc.).	Section 3.11
Economic	Potential economic impacts associated with the increased maximum mineral concentrate production rate as part of the Modification.		Section 3.12

Table 2 (Continued)
Summary of Key Potential Environmental Issues/Impacts

Environmental Aspect	Key Potential Environmental Issue/Impact		Report Section/Appendix
	Atlas-Campaspe Mine	Ivanhoe Rail Facility	
Hazards and Risks	As the Modification would not change the existing potential risks or hazard consequences identified in the Preliminary Hazard Analysis for the approved Project, no significant changes to the approved potential hazards and/or risks are expected.		Section 3.13
Visual	As the Modification would not significantly change the design or arrangement of the approved Project, no significant changes to the approved potential visual impacts are expected.		N/A
Social and Community Infrastructure	As the Modification would not result in any additional demand for employees or change the expected employee residential distribution, no material alteration to the approved social and community infrastructure impacts is expected.		N/A

3.2 ROAD TRANSPORT

A Road Transport Assessment was undertaken for the Modification by The Transport Planning Partnership Pty Ltd (TTPP) (2019) and is presented in Appendix A.

3.2.1 Background

Previous Assessment

GTA Consultants (2012) prepared a Road Transport Assessment for the approved Project in accordance with the *Guide to Traffic Generating Developments* (Roads and Traffic Authority, 2002). GTA Consultants (2012) concluded:

The proposal ... to develop the Project in the south-west of NSW would have acceptable impacts on the operation of the surrounding road system.

No significant impacts on the performance, capacity, efficiency and safety of the road network are expected to arise as a result of the Project.

Road Hierarchy and Conditions

Road Haulage Route

The approved road haulage route consists of (Figures 1 and 3):

- the Atlas-Campaspe Mine access road;
- Link Road;
- Boree Plains-Gol Gol Road;
- Magenta Road;
- Hatfield-The Vale Road;
- Balranald-Ivanhoe Road; and
- Ivanhoe Rail Facility access road.

Link Road is an unsealed local road that provides a link from Marma Box Creek Road to Boree Plains-Gol Gol Road. The Atlas-Campaspe Mine access road is located off Link Road (Appendix A).

Boree Plains-Gol Gol Road is an unsealed local road that extends from Balranald-Ivanhoe Road to Gol Gol Road on the eastern side of Garmpung Lake. Between Link Road and Magenta Road, Boree Plains-Gol Gol Road forms part of the road haulage route. The intersection of Boree Plains-Gol Gol Road and Link Road is aligned such that Boree Plains-Gol Gol Road has priority. At its intersection with Balranald-Ivanhoe Road, Boree Plains-Gol Gol Road is the minor road (Appendix A).

Magenta Road is an unsealed local road that provides a north-south link between Boree Plains-Gol Gol Road and Hatfield-The Vale Road. The intersections of Magenta Road with Hatfield-The Vale Road and Boree Plains-Gol Gol Road are T-intersections, with Magenta Road as the minor road (Appendix A).

Hatfield-The Vale Road is an unsealed local road that provides an east-west link between Balranald-Ivanhoe Road and Magenta Road, then turns northwards west of Magenta Road. Hatfield-The Vale Road is the minor road at the T-intersection formed with Balranald-Ivanhoe Road, and is the major road at the T-intersection formed with Magenta Road (Appendix A).

Balranald-Ivanhoe Road is a Regional Road that links the Sturt Highway at Balranald, generally north-south to the Cobb Highway at Ivanhoe. North of Hatfield-The Vale Road, it forms part of the road haulage route. Balranald-Ivanhoe Road is a two-lane road, and has a sealed surface between Balranald and a point 71 km north of its intersection with Hatfield-The Vale Road. North of this point, the road is generally unsealed, with short sections of sealed road (Appendix A).

As described in Section 2.2.3, Tronox will upgrade the road haulage route to an acceptable standard for Type 1 road trains to the satisfaction of the RMS, BSC and CDSC in accordance with Condition 1, Schedule 3 of Development Consent (SSD_5012).

In addition, Tronox will make financial contributions to the BSC and CDSC to rectify the “high risk” road safety deficiencies along Balranald-Ivanhoe Road in accordance with Condition 5, Schedule 3 of Development Consent (SSD_5012).

Other Local Roads

Marma Box Creek Road is an unsealed local road that provides an east-west link between Link Road and Arumpo Road (Figure 7a). The intersection of Marma Box Creek Road with Link Road is a T-intersection, with Link Road being the minor road and Marma Box Creek Road the major road, which bends through 90 degrees at the intersection (Appendix A).

Arumpo Road is a Regional Road that links the Silver City Highway north of Buronga to the western side of Lake Mungo at the Mungo National Park (Figure 7a). Access to the Mungo National Park is available via Arumpo Road. Its intersection with Marma Box Creek Road is a T-intersection and is aligned such that Arumpo Road has priority. Arumpo Road is a two-lane road, and has a sealed surface between the Silver City Highway and a point approximately 18 km north-east of its intersection with the Silver City Highway. North-east of this point, it has a good quality unsealed road surface (Appendix A).

Traffic Volumes

Background Traffic Volumes

Traffic volumes on Balranald-Ivanhoe Road are an average of 35 vehicles per day in the vicinity of the Ivanhoe Rail Facility, and an average of 32 vehicles per day north of Hatfield-The Vale Road (Appendix A).

Traffic volumes on Boree Plains-Gol Gol Road, Marma Box Creek Road and Link Road are expected to be lower than those recorded on Balranald-Ivanhoe Road (Appendix A).

The south-western end of Arumpo Road in the vicinity of Buronga (Figure 7a) carries approximately 400 vehicles per day. Traffic volumes at the north-eastern end of Arumpo Road (further away from Buronga) however are expected to be lower (Appendix A).

Project Traffic Generation

Table 3 summarises the approved Project peak daily vehicle movements (traffic in both directions) for the construction and operations phases.

Table 3
Approved Project Peak Traffic Volumes
(Vehicles/Day)

Vehicle Type	Construction	Operations
Light Vehicles	244	162
Heavy Vehicles	10	10
Mineral Concentrate Transport	0	48
Total Vehicles	254	220

Source: After GTA Consultants (2012).

As the workforce will reside at the Atlas-Campaspe Mine accommodation camp during their roster, the Project workforce will travel to and from the accommodation camp at the start and end of their roster periods (which vary for different types of employees). The predicted peak light vehicle movements presented in Table 3 are maximum case and will only occur when rosters start and/or finish on the same day which would only occur occasionally (i.e. estimated to be 10 to 11 days per year) (GTA Consultants, 2012).

Road Safety

The Road Transport Assessment did not identify any inherent safety concerns on the Project routes (Appendix A).

School Bus Operations

No commercial school buses currently operate on the road haulage route. There are, however, informal carpooling arrangements along the road haulage route (Appendix A).

Road Maintenance

Tronox will make financial contributions to the BSC and CDSC for the maintenance of Balranald-Ivanhoe Road and other local roads along the road haulage route in accordance Conditions 4 and 5, Schedule 3 of Development Consent (SSD_5012).

Management Regime

In accordance with Condition 9, Schedule 3 of Development Consent SSD_5012, a Transport Management Plan (CMA, 2018a) has been prepared for the construction phase of the Project. Prior to the commencement of operations, the Transport Management Plan will be updated to include:

- a program to monitor and report on the amount of mineral concentrate and MSP process waste transported;
- the measures to be implemented to address the relevant requirements in the *Code of Practice for the Safe Transport of Radioactive Materials* (Australian Radiation Protection and Nuclear Safety Agency, 2008, or its latest version);
- a Road Transport Protocol for all drivers transporting materials to and from the site with measures to ensure:
 - heavy vehicles adhere to the designated road haulage route;
 - all vehicles transporting mineral concentrate are completely covered whilst in transit;
 - the staggering of heavy vehicle departures to minimise impacts on the road network, where practicable;
 - no disruption to school bus timetables;
 - the management of worker fatigue during trips to and from the site (including a fatigue management plan);
 - appropriate driver behaviour (i.e. a Driver Code of Conduct);
 - adherence to drug and alcohol policies;
 - appropriate vehicle maintenance;
 - contingency plans when the road haulage route is disrupted due to low visibility or closed due to wet weather;
 - emergency response plans;

- the safe transportation of MSP process wastes; and
- compliance with, and enforcement of, the protocol.

During the 2018 Annual Review reporting period, Tronox received no road transport-related complaints (Appendix A).

3.2.2 Potential Impacts

Modified Project Traffic Generation

A summary of the predicted distribution of the approved and modified Project maximum case traffic during the construction and operations phases is provided in Table 4.

Mineral Concentrate Transport

The Modification would increase heavy vehicle trips from 24 per day to 35 per day (or 48 to 70 movements per day) on the approved road haulage route to allow for the transport of the increased mineral concentrate production proposed as part of the Modification (Table 4).

The approved road haulage route or vehicle types would not change as a result of the Modification (Section 2.2.1).

The increased heavy vehicle trips on the approved road haulage route are well within the day-to-day variation in traffic volumes and would not have a perceivable impact on the level of service experienced by drivers along the route (Appendix A).

Light Vehicles

The number of light vehicle trips during the construction and operations phases would not change as a result of the Modification.

Project-related light vehicles would however use local roads in addition to the road haulage route to access the site, including (Figures 7a and 7b):

- to/from Mildura/Buronga via Arumpo Road, Marma Box Creek Road and Link Road; and
- to/from Balranald via Balranald-Ivanhoe Road, Boree Plains-Gol Gol Road and Link Road.

Table 4
Predicted Peak Approved and Modified Project Traffic Volumes (Vehicles/Day)
on the Road Network

	Location ¹	Construction Phase		Operations Phase	
		Approved Project (LV/HV) ²	Modified Project (LV/HV) ²	Approved Project (LV/HV) ²	Modified Project (LV/HV) ²
1	Atlas-Campaspe Mine Access Road	228/10	228/10	156/58	156/80
2	Arumpo Road between Marma Box Creek Road and Silver City Highway	0/0	110/0	0/0	58/0
3	Balranald-Ivanhoe Road between Ivanhoe Rail Facility and Hatfield-The Vale Road	68/2	68/2	42/50	42/72
4	Balranald-Ivanhoe Road between Hatfield-The Vale Road and Boree Plains-Gol Gol Road	160/8	0/8	114/8	0/8
5	Balranald-Ivanhoe Road between Boree Plains-Gol Gol Road and Sturt Highway	160/8	50/8	114/8	56/8
6	Boree Plains-Gol Gol Road between Link Road and Magenta Road	228/10	118/10	156/58	98/80
7	Boree Plains-Gol Gol Road between Magenta Road and Balranald-Ivanhoe Road	0/0	50/0	0/0	56/0
8	Hatfield-The Vale Road between Magenta Road and Balranald-Ivanhoe Road	228/10	68/10	156/58	42/80
9	Link Road between Atlas-Campaspe Mine access and Marma Box Creek Road	0/0	110/0	0/0	58/0
10	Link Road between Atlas-Campaspe Mine access and Boree Plains-Gol Gol Road	228/10	118/10	156/58	98/80
11	Magenta Road between Boree Plains-Gol Gol Road and Hatfield-The Vale Road	228/10	68/10	156/58	42/80
12	Marma Box Creek Road between Link Road and Arumpo Road	0/0	110/0	0/0	58/0
13	Sturt Highway between Balranald and Mildura	110/2	0/2	58/2	0/2

¹ Refer to Figures 7a and 7b.

² Light Vehicles/Heavy Vehicles

Source: Appendix A.

As the workforce would reside at the Atlas-Campaspe Mine accommodation camp during their roster, modified Project light vehicle movements would vary each day depending on when rosters start and/or finish.

During peak construction, the modified Project would generate up to 56 to 110 light vehicles movements per day on Arumpo Road, Marma Creek Box Creek Road and Link Road on three days of the week (Table 4). On the remaining four days of the week, the modified Project would generate negligible traffic on these local roads.

Once operational, the modified Project would generate up to 58 light vehicle movements per day on Arumpo Road, Marma Creek Box Creek Road and Link Road on the busiest 10 to 11 days of the year (Table 4). On an average day, this would fall to fewer than 20 light vehicle movements per day.

The modified Project would generate up to 54 and 56 light vehicle movements per day on Boree Plains-Gol Gol Road during the operation and construction phases, respectively (Table 4).

It is noted that these light vehicle movements would decrease if Tronox implements a shuttle bus service between the Atlas-Campaspe Mine and Mildura/Buronga or Balranald (Section 2.1.7).

The local roads proposed to be used by Project-related light vehicles would satisfactorily accommodate the Project-generated traffic (subject to the implementation of road upgrades and improvements).

Other Heavy Vehicles

The Modification would not change the number or routes of other heavy vehicles during the construction and operations phases of the Project.

Road Upgrades and Improvements

In addition to the approved road upgrade requirements (Section 2.2.3), Tronox has consulted with the BSC, WSC and RMS regarding the proposed light vehicle use of local roads, and the following additional road upgrades are proposed (Appendix A):

- Link Road (between Marma Box Creek Road and the Atlas-Campaspe Mine) would be upgraded to meet the minimum carriageway and formation width requirements for a Class 4B unsealed road (ARRB, 2009); and
- the surface of Boree Plains-Gol Gol Road would be sealed on its approach to its intersection with Balranald-Ivanhoe Road.

In addition, the following road improvements would progressively be made as part of ongoing maintenance activities (Appendix A):

- the road surface of relevant sections of the local road routes would be improved to establish a good riding surface with reduced dust emissions; and
- appropriate traffic control signs would be installed along the local road routes.

Tronox is continuing to consult with the BSC regarding contributions toward local road upgrades, improvements and maintenance (Section 1.3).

The WSC confirmed on 13 June 2019 that it was satisfied with Tronox's proposed use of local roads in the WSC LGA for the modified Project (Section 1.3).

Modified Ivanhoe Rail Facility Access Road Intersection

The approved Ivanhoe Rail Facility access road and intersection would be realigned (Figure 5).

The realigned intersection would be designed and constructed in accordance with Austroads requirements in consultation with the RMS and CDSC (Appendix A).

Road Safety

The Modification (including road upgrades and improvements) is expected to have positive impacts on the safety of the Project workforce and the road network (Appendix A).

The Modification would result in improved road conditions along Link Road, Marma Box Creek Road and Arumpo Road with the implementation of the proposed road upgrades and improvements (e.g. road surface improvements). This would improve the safety of all road users (Appendix A).

The use of local roads other than the road haulage route by Project-related light vehicles would reduce the travel distance for trips from the Atlas-Campaspe Mine to Mildura/Buronga and Balranald by approximately 150 km and 32 km, respectively. Over one year of Project operations, this represents a saving of over 2.1 million vehicle kilometres travelled. The reduction in Project vehicle kilometres travelled would reduce exposure to road accidents (Appendix A).

In addition, the use of local roads other than the road haulage route by Project-related light vehicles would reduce travel times for Project workers travelling from the Atlas-Campaspe Mine to Mildura/Buronga and Balranald, which would reduce the risk of drivers driving or working while fatigued (Appendix A).

School Bus Operations

No school buses currently operate on the road haulage route. There are, however, informal carpooling arrangements along the road haulage route (Appendix A).

In the event school bus operations commence on the road haulage route, Tronox would consult with school bus operators to develop measures to minimise potential disruption to school bus operations. These measures would be incorporated in the Transport Management Plan (CMA, 2018a) (Section 3.2.3).

Mungo National Park Traffic

Access to the Mungo National Park is available via Arumpo Road. As described above, the Modification is expected to have positive impacts on the safety of other road users on the road network (including Arumpo Road) as it would include proposed road improvements (e.g. road surface improvements) (Appendix A).

In addition, it is noted that the increased use of these roads would improve safety in the event of an accident, as the time before a vehicle would pass (and be able to render assistance) would be reduced.

Level Crossings

GTA Consultants (2012) considered the incremental risk of road and rail traffic interaction due to the increase in Project road movements (i.e. employees and other traffic) at the Orange – Broken Hill railway crossing south of Ivanhoe and concluded the risk would be low.

As the Modification would not change Project-generated road or rail movements at this road level crossing, there would be no change to the risk of road and rail traffic interaction associated with the modified Project at this road level crossing and no upgrades to the road level crossing are therefore required (Appendix A).

Cumulative Impacts

EMM (2015) examined the likely routes used by traffic generated during the construction and operational stages of Iluka Resources Limited's Balranald Mineral Sands Project (Figure 1). The Balranald Mineral Sands Project is approved but has not commenced.

No Balranald Mineral Sands Project traffic is expected to use the road haulage route or the local roads proposed to be used by modified Project traffic. Given the above, no cumulative road transport impacts are expected on these routes as a result of the Modification (Appendix A).

3.2.3 Mitigation Measures, Management and Monitoring

The existing road system, with the implementation of the proposed road upgrades and improvements, would satisfactorily accommodate the expected future traffic generated by the modified Project (Appendix A). Tronox would implement the following management measures:

- Implement road haulage route upgrades to an acceptable standard for Type 1 road trains and to the satisfaction of the RMS, BSC and CDSC prior to the haulage of mineral concentrate in accordance with Condition 1, Schedule 3 of Development Consent (SSD_5012).
- Make financial contributions to the BSC and CDSC to rectify the “high risk” road safety deficiencies along Balranald-Ivanhoe Road in accordance with Condition 5, Schedule 3 of Development Consent (SSD_5012).
- Make financial contributions to the BSC and CDSC for the maintenance of Balranald-Ivanhoe Road and other local roads along the road haulage route in accordance with Conditions 4 and 5, Schedule 3 of Development Consent (SSD_5012).
- Implement the proposed road upgrades and improvements to the local roads proposed to be used by Project light vehicles (Section 2.1.7).
- Complete a review into the feasibility of operating shuttle buses between the Atlas-Campaspe Mine and Buronga/Mildura or Balranald for Project workers.

The Transport Management Plan (CMA, 2018a), and its relevant mitigation and management measures, would be reviewed and, if necessary, revised by Tronox to include the Modification (subject to any modified Development Consent conditions).

The revised Transport Management Plan (CMA, 2018a) would include a revised Fatigue Management Plan prepared in consideration of the Fatigue Management Guide (NSW Resources Regulator, 2018) and incorporates specific measures for the Project workforce. It is expected that the Fatigue Management Plan would include:

- consultation with the workforce;
- identification of factors that contribute to fatigue (e.g. roster and shift arrangements, unplanned work requirements, non-work-related factors);

- fatigue risk assessment that considers:
 - how likely is it that workers could become fatigued; and
 - the severity of the consequences that may be expected because of fatigue impairment;
- control measures (identified through a risk assessment) that will be implemented so that hazards that pose risk to workers or to others are properly controlled.

3.3 AIR QUALITY

An Air Quality Review was undertaken for the Modification by Katestone Environmental Pty Ltd (Katestone) (2019) and is presented in Appendix B.

3.3.1 Background

Sensitive Receptors

The Project components are located at significant distances from sensitive receptors. The closest privately-owned sensitive receptors to the Project components are:

- Atlas-Campaspe Mine – Marona is located approximately 14 km to the north-east (Figure 8).
- Road haulage route – Magenta is located approximately 800 m to the north (Figure 8).
- Ivanhoe Rail Facility – the Ivanhoe Township is located approximately 4.5 km to the north-east (Figure 9).

Previous Assessment

Katestone (2013) prepared an Air Quality and Greenhouse Gas (AQGHG) Assessment for the approved Project. The AQGHG Assessment was prepared in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (Approved Methods) (NSW Department of Environment and Conservation [DEC], 2005).

The results of the AQGHG Assessment for the approved Project are outlined below.

Atlas-Campaspe Mine and Ivanhoe Rail Facility

Potential air quality impacts at the Atlas-Campaspe Mine and the Ivanhoe Rail Facility were modelled and the assessment indicated (Katestone, 2013):

- compliance with annual average impact assessment criteria for total suspended particles (TSP), particulate matter 10 micrometres or less in diameter (PM₁₀) and dust deposition at all sensitive receptors for the Project in isolation;
- compliance with 24-hour average impact assessment criteria for TSP, PM₁₀ and dust deposition at all sensitive receptors for the Project in isolation;
- compliance with annual average impact assessment criteria for TSP, PM₁₀ and dust deposition for the Project with the inclusion of conservative background levels;
- compliance with the relevant annual average National Environment Protection (Ambient Air Quality) Measure (Air-NEPM) advisory standard for PM_{2.5} for the Project in isolation and with the inclusion of conservative background levels; and
- compliance with the relevant 24-hour average Air-NEPM advisory standard for PM_{2.5} for the Project in isolation and with the inclusion of conservative background levels.

No cumulative air quality impacts were predicted from the coincident construction and operation of the approved Project and the Balranald Mineral Sands Project (Katestone, 2013).

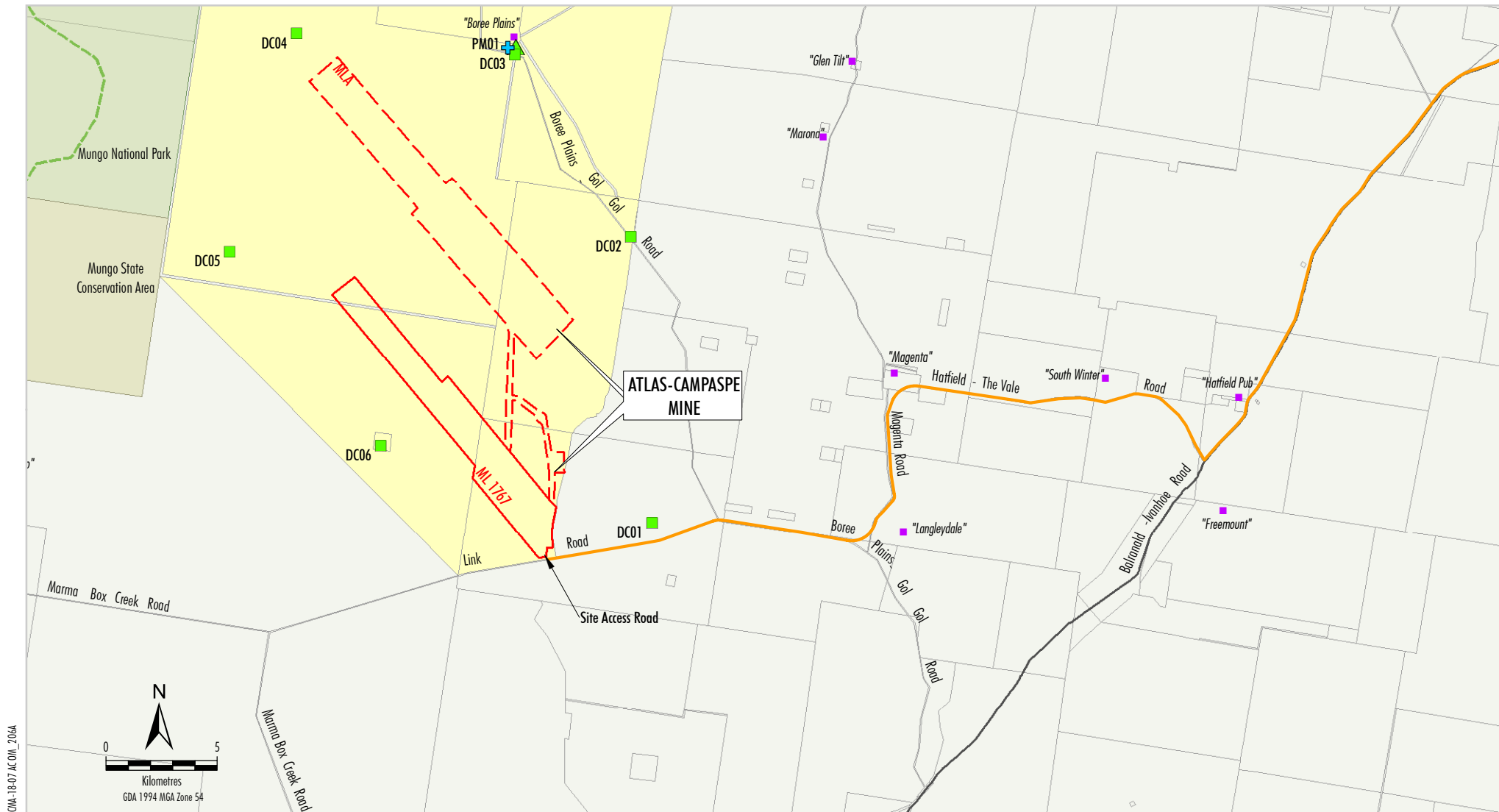
Road Haulage Route

Dust emissions generated by the transport of mineral concentrates on unsealed sections of the road haulage route were not expected to result in any exceedance of the relevant air quality criteria at any residence along the road haulage route (Figure 8) (Katestone, 2013).

Management and Monitoring Regime

In accordance with Condition 21, Schedule 3 of Development Consent (SSD_5012), an Air Quality Management Plan (CMA, 2018b) has been prepared for the Project. The Air Quality Management Plan includes:

- emission control and management measures;
- an air quality monitoring program; and
- air quality management protocols.



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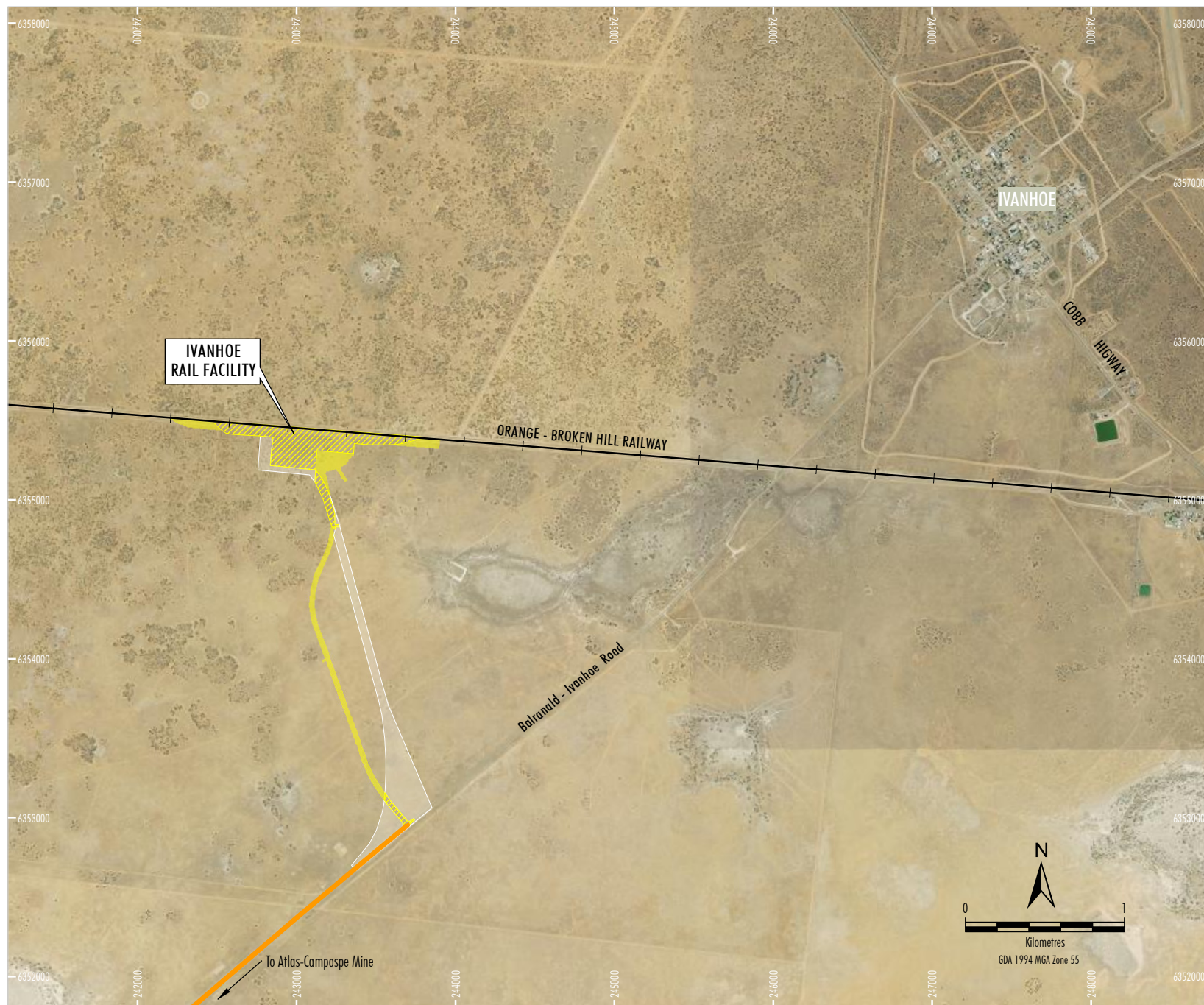
LEGEND

- Mining Lease Boundary (ML 1767)
- - - Mining Lease Application Boundary (MLA)
- - - Willandra Lakes Region World Heritage Area
- National Park
- State Conservation Area
- Tronox Owned Land
- Private Landholder
- Dwelling
- Approved Mineral Concentrate Transport Route
- ▲ Automatic Weather Station
- Dust Gauge Location
- + PM₁₀/TSP Monitoring Site

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

TRONOX
OPTIMISATION MODIFICATION
Atlas-Campaspe Mine
- Air Quality Monitoring Sites

Figure 8



- LEGEND**
- Approved Surface Development Area Required
 - Additional Surface Development Area
 - Approved Surface Development Area not Required
 - Approved Mineral Concentrate Transport Route*

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

Source: Cristal Mining Australia (2012); Tronox (2019)
Orthophoto: © NSW Department of Finance, Services & Innovation (2018)

TRONOX

OPTIMISATION MODIFICATION

Modified Ivanhoe Rail Facility
and Surrounds

Figure 9

In accordance with Condition 20(d), Schedule 3 of Development Consent (SSD_5012), dust deposition monitoring is conducted at six locations (DC01 to DC06), and particulate matter (PM₁₀ and TSP) monitoring is conducted at one location in the vicinity of the Atlas-Campaspe Mine (PM01) (Figure 8).

The results of the air quality monitoring program are assessed against the air quality criteria described in Condition 19, Schedule 3 of Development Consent (SSD_5012).

Dust deposition monitoring to date shows that the average annual dust deposition rate is below the relevant Development Consent (SSD_5012) criterion of 4 grams per square metre per month [g/m²/month] (Appendix B).

24-hour average PM₁₀ measurements recorded at PM01 exceeded the Development Consent (SSD_5012) 24-hour PM₁₀ criterion of 50 micrograms per cubic metre (µg/m³) on a total of nine days during the period 4 September 2018 to 8 February 2019 (Appendix B).

PM01 is located approximately 18 km north of current Project activities at the Atlas deposit. It is expected that other, more localised sources of particulate matter are contributing to elevated PM₁₀ levels at PM01, such as increased wind-blown dust due to the dry and warm conditions present throughout 2018 and 2019, and the proximity of nearby ephemeral lakes (Appendix B).

The average TSP concentration calculated to date complies with the Development Consent (SSD_5012) criterion of 90 µg/m³ (Appendix B).

During the 2018 Annual Review reporting period, Tronox received no complaints in regard to air quality (Appendix B).

Air Quality Criteria

Subsequent to the grant of Development Consent (SSD_5012), the Approved Methods (DEC, 2005) were updated to include criteria for PM_{2.5} (consistent with the Air-NEPM advisory standard assessed by Katestone [2013] in the AQGHG Assessment).

The updated Approved Methods (EPA, 2016) also includes a reduced annual average PM₁₀ criterion of 25 µg/m³.

Katestone (2019) has assessed the potential air quality impacts of the Modification against the updated Approved Methods (EPA, 2016).

It is noted, however, that baseline air quality levels (i.e. before Project activities commenced) were in excess of the reduced annual average PM₁₀ criterion.

3.3.2 Potential Impacts

The Air Quality Review (Appendix B) has evaluated the potential air quality impacts of the Modification and a summary is provided below.

Atlas-Campaspe Mine

The following components of the Modification would have the potential to alter particulate matter (e.g. dust) emissions at the Atlas-Campaspe Mine (Appendix B):

- increased mineral concentrate production (i.e. increased product stacking, road train loading and on-site haulage of mineral concentrate); and
- option to use conveyors to transfer overburden (i.e. reduction in wheel-generated dust by overburden haul trucks).

The increased mineral concentrate production is expected to increase total emissions from the modified Atlas-Campaspe Mine by approximately 4 percent (%) compared to emissions from the approved Atlas-Campaspe Mine (if conveyors are not adopted for overburden transport) (Appendix B).

Overburden haulage (by haul trucks) will account for an estimated 30% of total PM₁₀ emissions at the approved Atlas-Campaspe Mine. As the use of conveyors instead of haul trucks for overburden transport would reduce dust emissions due to overburden haulage by approximately 95%, the use of conveyors (if adopted) would result in an overall reduction in PM₁₀ emissions (and other dust metrics) from the approved Atlas-Campaspe Mine (Appendix B).

Given the Modification would result in either a decrease or a relatively small increase in emissions (depending on whether conveyors are adopted), and the significant distances to the nearest sensitive receptors, it is likely the conclusions of the AQGHG Assessment (Katestone, 2013) for the approved Project would remain valid (i.e. the potential air quality impacts of the modified Atlas-Campaspe Mine on privately-owned sensitive receptors would be very low) (Appendix B).

However, as described in Section 3.3.1, due to the arid/semi-arid location of the Atlas-Campaspe Mine, there is the potential for exceedances of relevant air quality criteria with or without a contribution from the Project (i.e. due to elevated background levels).

Notwithstanding, with the continued implementation of reasonable and feasible mitigation measures (Section 3.3.3), the modified Atlas-Campaspe Mine is not predicted to materially contribute to any exceedances of the relevant air quality criteria.

Ivanhoe Rail Facility

The following components of the Modification would have the potential to alter particulate matter (e.g. dust) at the Ivanhoe Rail Facility (Appendix B):

- increased mineral concentrate transport truck movements along the Ivanhoe Rail Facility access road;
- increased mineral concentrate handling;
- revised alignment of the Ivanhoe Rail Facility access road and access road intersection (i.e. increased distance from the nearest privately-owned sensitive receptors);
- extension to the Ivanhoe Rail Facility hardstand area and rail siding (i.e. increased size of stockpile areas); and
- addition of a groundwater supply bore (i.e. water would be available for dust suppression resulting in less wheel-generated dust).

The proposed increase in mineral concentrate handling and associated increase in the mineral concentrate transport rate would increase emissions at the Ivanhoe Rail Facility. However, the watering of the Ivanhoe Rail Facility access road (from the proposed groundwater supply bore) would reduce wheel-generated dust emissions from the access road. The Modification would therefore result in an overall 15% reduction in emissions from the Ivanhoe Rail Facility (Appendix B).

It is therefore likely that the conclusions of the AQGHG Assessment (Katestone, 2013) for the approved Project would remain valid (i.e. the potential air quality impacts of the modified Ivanhoe Rail Facility on privately-owned sensitive receptors would be very low) (Appendix B).

However, as described in Section 3.3.1, due to the arid/semi-arid location of the Ivanhoe Rail Facility, there is the potential for exceedances of relevant air quality criteria with or without a contribution from the Ivanhoe Rail Facility (i.e. due to elevated background levels).

Notwithstanding, with the continued implementation of the mitigation measures described in the Air Quality Management Plan (CMA, 2018b) (Section 3.3.1), the modified Ivanhoe Rail Facility is not predicted to materially contribute to any exceedances of the relevant air quality criteria (Appendix B).

Road Haulage Route

The proposed increase in truck trips from 24 to 35 per day along unsealed sections of the road haulage route is unlikely to result in additional exceedances of the relevant air quality criteria, given the relatively small contribution of the road haulage route emissions to ground-level concentrations and the distance between the road haulage route and sensitive receptors (Appendix B).

3.3.3 Management Measures

The Air Quality Management Plan (CMA, 2018b) would continue to be implemented for the Modification.

Given the Modification is not expected to contribute to any additional exceedances of the relevant air quality criteria at any sensitive receptors in the vicinity of the Project, Tronox does not propose any additional air quality management measures.

Notwithstanding, the Air Quality Management Plan (CMA, 2018b) would be reviewed and, if necessary, revised by Tronox to include the Modification (subject to any modified Development Consent conditions).

3.4 NOISE

A Noise Review was undertaken for the Modification by Wilkinson Murray (2019) and is presented in Appendix C.

3.4.1 Background

Sensitive Receptors

The Project components are located at significant distances from sensitive receptors (Section 3.3.1).

Previous Assessment

The Noise Assessment for the approved Project (Wilkinson Murray, 2012) was prepared in accordance with the *Industrial Noise Policy* (INP) (EPA, 2000) and considered the noise impacts associated with the Atlas-Campaspe Mine, Ivanhoe Rail Facility and mineral concentrate transport between the Atlas-Campaspe Mine and the MSP.

The results of the Noise Assessment for the approved Project (Wilkinson Murray, 2012) are outlined below.

Atlas-Campaspe Mine

Wilkinson Murray (2012) concluded that the approved Atlas-Campaspe Mine will comply with the project-specific noise criteria and the applicable sleep disturbance criteria at all privately-owned sensitive receptors during construction and operation.

It was predicted that the approved Atlas-Campaspe Mine will comply with the relevant amenity criteria at the Mungo National Park, Mungo State Conservation Area and the Willandra Lakes Region World Heritage Area (Wilkinson Murray, 2012).

It was concluded that no cumulative impacts between the approved Project and the Balranald Mineral Sands Project will occur (Wilkinson Murray, 2012).

Ivanhoe Rail Facility

Wilkinson Murray (2012) determined that the approved Ivanhoe Rail Facility will comply with the Project-specific noise criteria and the applicable sleep disturbance criteria at all modelled privately-owned sensitive receptors during construction and operation.

Road Transport

Wilkinson Murray (2012) determined that the additional Project-related traffic movements on the road haulage route are expected to result in measurable increases in traffic noise levels along Magenta Road, Hatfield-The Vale Road and Balranald-Ivanhoe Road (north of the intersection with Hatfield-The Vale Road); however, compliance at the nearest private receptors was predicted.

Rail Movements

Wilkinson Murray (2012) determined that the approved Project would result in two additional exceedances of the ARTC Environment Protection Licence (EPL) night-time rail noise criteria along the Orange-Broken Hill Railway. Notwithstanding, given that the peak approved Project-related noise increase was anticipated to be less than 2 A-weighted decibels (dBA), an assessment of 'reasonable and feasible' noise mitigation measures was not considered warranted (Wilkinson Murray, 2012).

Management and Monitoring Regime

In accordance with Condition 18, Schedule 3 of Development Consent (SSD_5012), a Noise Management Plan (CMA, 2018c) has been prepared for the Project. The Noise Management Plan:

- identifies relevant noise criteria;
- identifies potential sources of noise during the construction and operational phases;
- identifies noise mitigation and management measures;
- details the noise monitoring program;
- establishes proactive and responsive noise emission management protocols; including a standard protocol, a complaint response protocol and an amenity protocol; and
- establishes community consultation protocols.

In accordance with Condition 18(c), Schedule 3 of Development Consent (SSD_5012), noise monitoring is conducted at three sites at the Atlas-Campaspe Mine and three sites at the Ivanhoe Rail Facility (Figures 10 and 11). The results of the noise monitoring program are assessed against criteria in Condition 16, Schedule 3 of Development Consent (SSD_5012).

No exceedances of the relevant noise monitoring criteria have been recorded to date (CMA, 2019d).

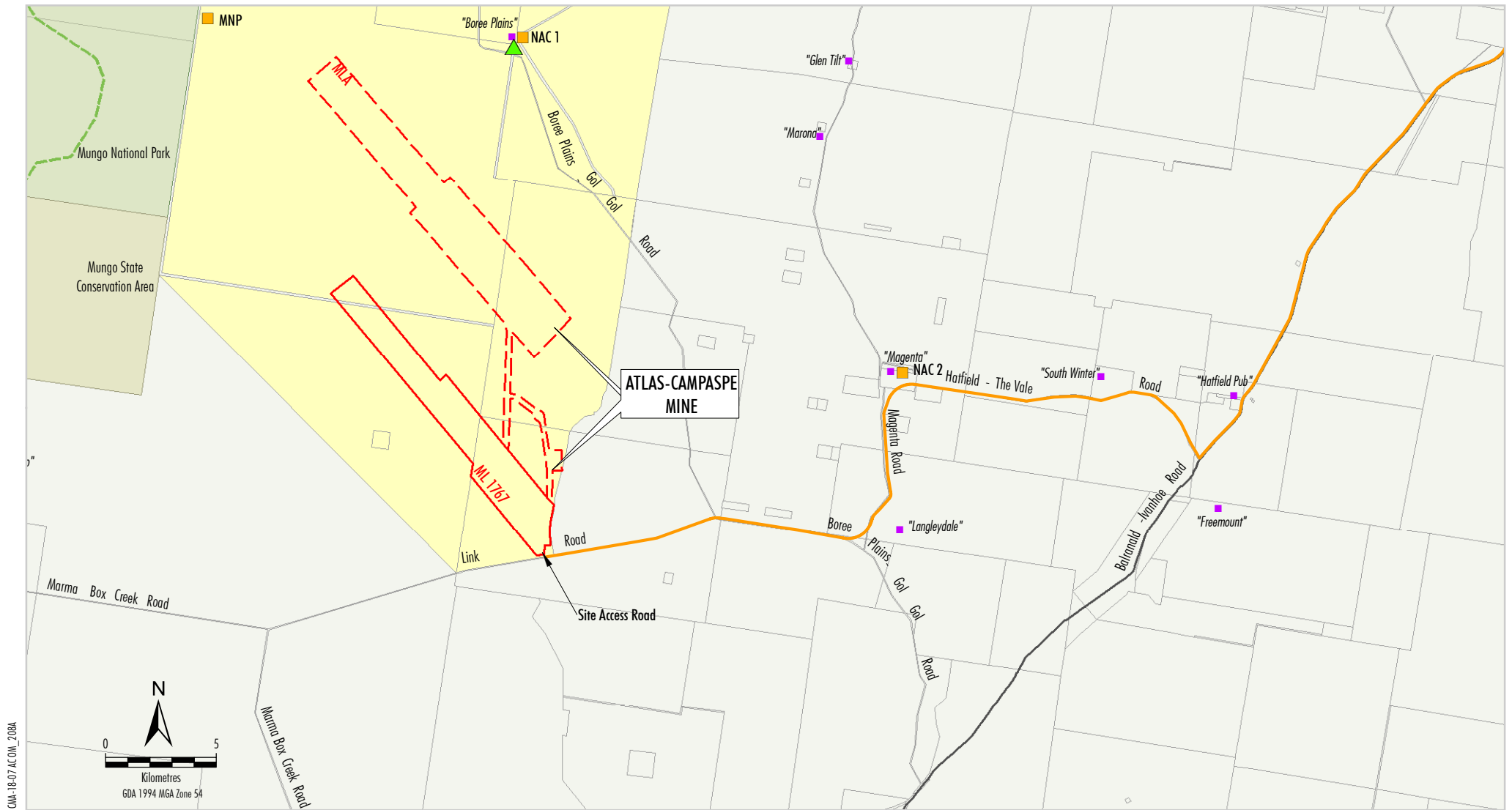
During the 2018 Annual Review reporting period, Tronox received no complaints in regard to noise (Wilkinson Murray, 2019).

Noise Criteria

The Noise Assessment for the approved Project (Wilkinson Murray, 2012) was prepared in accordance with the INP (EPA, 2000), which has since been superseded by the *Noise Policy for Industry* (NPfI) (EPA, 2017).

The INP defines a minimum noise criterion of 35 dBA for the day, evening and night-time. Based on background monitoring conducted for the approved Project, the project-specific noise criteria determined for the Project were the minimum applicable criteria (i.e. 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. Wilkinson Murray (2019) therefore considered the potential noise impacts of the Modification against the NPfI criteria (Section 3.4.2).



CMA-18-07 ACOM_208A

LEGEND

- Mining Lease Boundary (ML 1767)
- - - Mining Lease Application Boundary (MLA)
- - - Willandra Lakes Region World Heritage Area
- National Park
- State Conservation Area
- Tronox Owned Land
- Private Landholder
- Dwelling
- Approved Mineral Concentrate Transport Route
- ▲ Automatic Weather Station
- Noise Monitoring Location

Source: © NSW Department of Finance, Services & Innovation (2017);
Cristal Mining Australia (2012)

TRONOX
OPTIMISATION MODIFICATION
Atlas-Campaspe Mine
- Noise Monitoring Sites

Figure 10

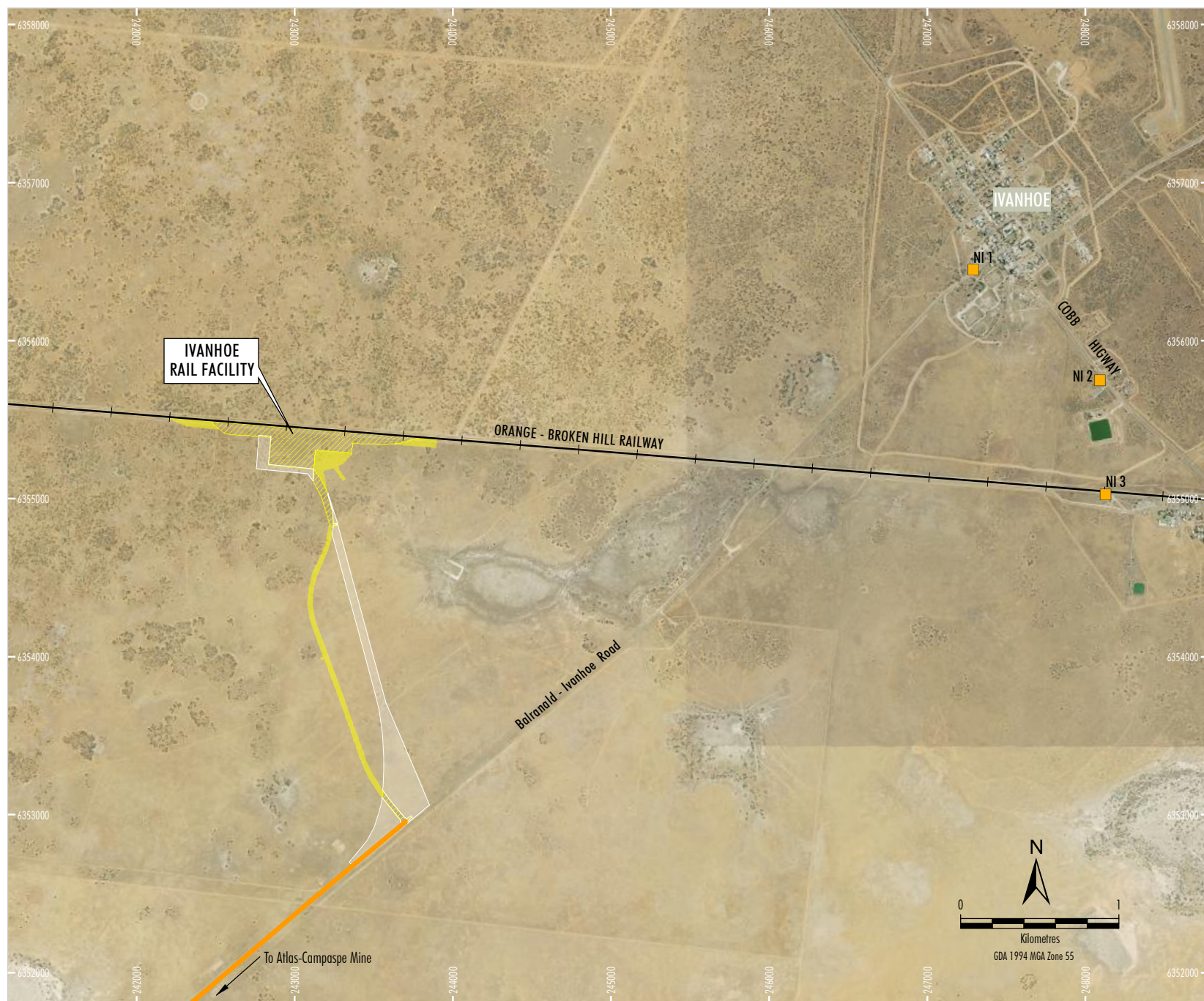


Figure 11

3.4.2 Potential Impacts

The Noise Review (Appendix C) has evaluated the potential noise impacts of the Modification and a summary is provided below.

Atlas-Campaspe Mine

Given no changes to the major construction and operational mobile and fixed equipment are proposed during Year 1, the Year 1 noise levels from the modified Atlas-Campaspe Mine would be unchanged and therefore comply with the relevant noise criteria for all modelled receivers under neutral and adverse meteorological conditions (Appendix C).

The Modification would include changes to the operational mobile and fixed equipment after Year 1 of the Project (Section 2.1.1), which could alter noise levels associated with the Atlas-Campaspe Mine (Appendix C).

Wilkinson Murray (2019) conducted a review of the approved and modified mobile and fixed equipment sound power levels (SWLs), and concluded that the Modification would not result in an increase in the overall SWL at the Atlas-Campaspe Mine (Appendix C). Given the above, the Modification would not result in an increase in operational noise at the modified Atlas-Campaspe Mine, and compliance with the NPfI noise criteria for all modelled receivers under neutral and adverse meteorological conditions is predicted (Appendix C).

Additionally, the Modification would include the option to use conveyors to transfer some or all of the overburden at the Atlas-Campaspe Mine (rather than haul trucks). The SWL of a typical conveyor system is significantly lower than that generated by haul or product trucks; therefore, if they were adopted, the overall noise emissions generated by the modified Atlas-Campaspe Mine would be lower than those of the approved Atlas-Campaspe Mine (Appendix C).

Ivanhoe Rail Facility

As described in Section 2.3.2, the Modification would change the operational mobile equipment at the Ivanhoe Rail Facility. The additional equipment would increase the overall SWL associated with the Ivanhoe Rail Facility by 3 dBA, assuming concurrent operation of all sources (Appendix C).

Notwithstanding, Wilkinson Murray (2019) determined that the increased noise emissions at the modified Ivanhoe Rail Facility would not result in any material increase in noise levels at surrounding receivers, and all NPfI noise criteria are predicted to be achieved.

Road Transport

The Modification would increase mineral concentrate transport truck trips from 24 per day to 35 per day, which would increase noise levels over the daytime and night-time periods by approximately 1.6 dBA. Notwithstanding, noise generated by increased traffic associated with the Modification is predicted to comply with the relevant assessment criteria at all receiver locations given predicted compliance at the closest receiver (Magenta) (Appendix C).

Rail Movements

The Modification would increase the mineral concentrate transport train length from 600 m to 920 m and train frequency from six to eight train movements per week. As the increased train frequency is not expected to result in any change to the maximum number of train movements per day, the approved rail noise impacts as previously assessed by Wilkinson Murray (2012) for the approved Project would remain unchanged (Appendix C).

3.4.3 Management Measures

The Noise Management Plan (CMA, 2018c) would continue to be implemented for the Modification.

Given the Modification is not expected to contribute to any additional exceedances of the relevant noise criteria at any sensitive receptors in the vicinity of the Project, Tronox does not propose any additional noise management measures.

Notwithstanding, the Noise Management Plan (CMA, 2018c) would be reviewed and, if necessary, revised by Tronox to include the Modification (subject to any modified Development Consent conditions).

3.5 BIODIVERSITY

As the Modification would not change the extent of the approved Atlas-Campaspe Mine surface development area (Table 2), this section considers potential biodiversity impacts associated with the modified Ivanhoe Rail Facility surface development area.

3.5.1 Background

Biodiversity Values

Australian Museum Business Services (AMBS) (2013a; 2013b) assessed the biodiversity values within a study area surrounding the Ivanhoe Rail Facility.

The Ivanhoe Rail Facility is largely located within a paddock subject to grazing by goats, introduced non-native vegetation and past clearing. The native vegetation which remains comprises of Native Grassland/Sparse Acacia/Chenopod Shrubs (Plant Community Type [PCT] 166) (Plate 1) and smaller areas of Belah-Rosewood/Acacia (PCT 57) (Plate 2) (AMBS, 2013a) (Figure 12).

No threatened flora species or ecological communities listed under the *Biodiversity Conservation Act, 2016* (BC Act) or *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) are present within the approved or modified Ivanhoe Rail Facility surface development areas (AMBS, 2013a).

No threatened fauna species listed under the BC Act or EPBC Act have been recorded within the approved or modified Ivanhoe Rail Facility surface development areas. Three wide-ranging threatened birds species, namely Major Mitchell's Cockatoo (*Lophochroa leadbeateri*), Little Eagle (*Hieraaetus morphnoides*) and White-fronted Chat (*Epthianura albifrons*) were recorded outside the approved Ivanhoe Rail Facility area.

A vegetation condition assessment of the approved and modified Ivanhoe Rail Facility surface development area was carried out in June 2019 (Appendix D). The assessment consisted of the collection of vegetation condition (vegetation integrity) data from nine vegetation plots in accordance with the *Biodiversity Assessment Method* (BAM) (OEH, 2017) (Appendix D).

Vegetation Management Area

In accordance with Condition 13, Schedule 3 of Development Consent (SSD_5012), the approved Ivanhoe Rail Facility will include retention and management of 15 ha of existing vegetation in a Vegetation Management Area (VMA) (Figure 13).

Management and Monitoring Regime

In accordance with Condition 14, Schedule 3 of Development Consent (SSD_5012), a Biodiversity Management Plan (CMA, 2018d) has been prepared for the Project.

Of relevance to the Ivanhoe Rail Facility, the Biodiversity Management Plan contains measures for the short, medium, and long-term management of the VMA at the Ivanhoe Rail Facility (Figure 13).

3.5.2 Potential Impacts

No additional potential impacts on biodiversity are likely to occur as a result of the Modification. Instead, approximately 12 ha less native vegetation/habitat clearance¹ would be required for the modified Ivanhoe Rail Facility, resulting in retention of 0.1 ha of Belah-Rosewood/ Acacia (PCT 57) and 11.9 ha of Native Grassland/ Sparse Acacia/Chenopod Shrubs (PCT 166) that would otherwise be cleared (Table 5 and Figure 12).

Table 5
Vegetation Communities at the Ivanhoe Rail Facility

PCT	Approved Surface Development Area (ha)	Modified Surface Development Area (ha)	Difference (ha)
Belah-Rosewood/ Acacia (PCT 57)	10	9.9	-0.1
Native Grassland/ Sparse Acacia/Chenopod Shrubs (PCT 166)	30	18.1	-11.9
Total	40	28	-12

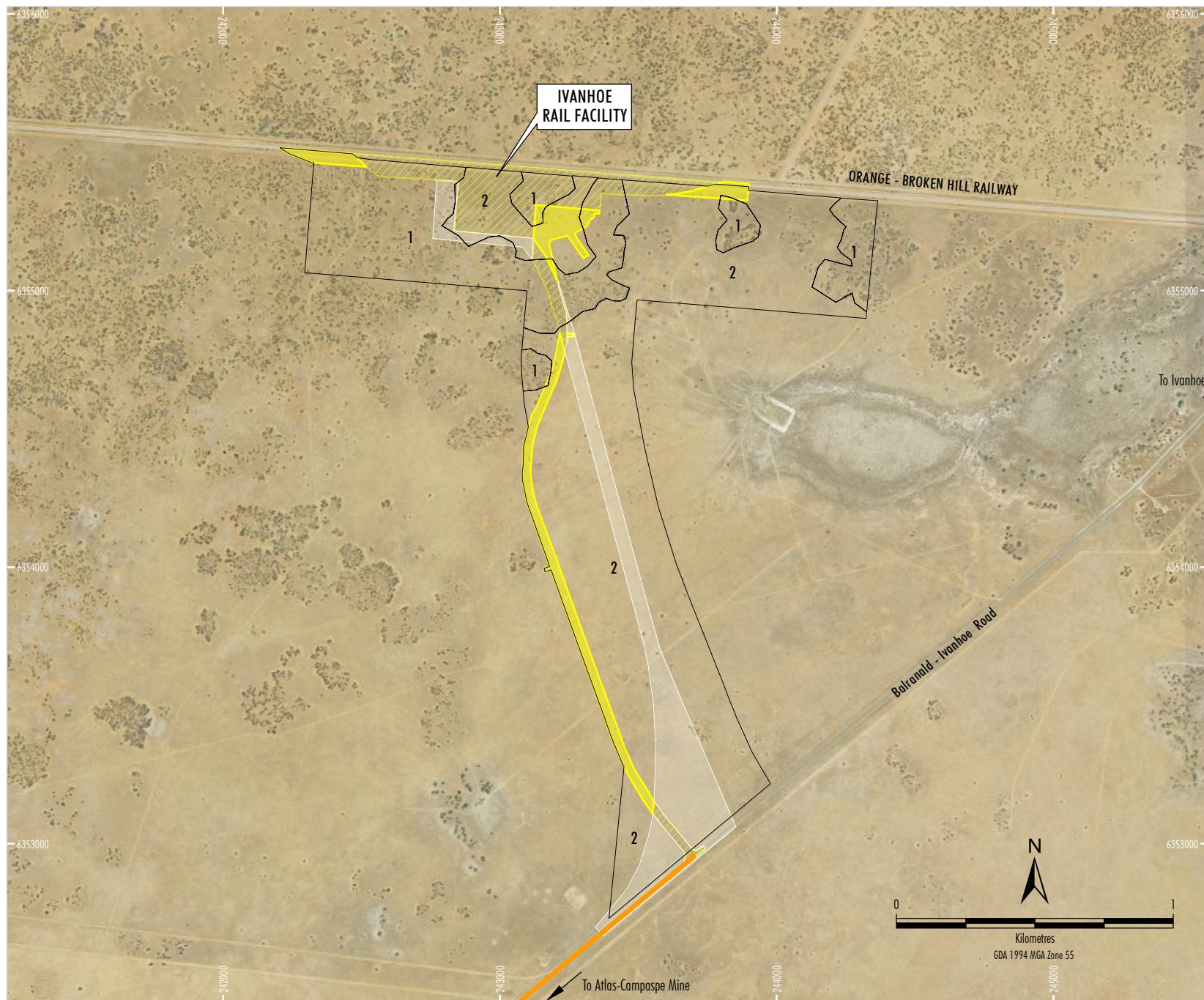
¹¹ The Modification would result in an approximate 14 ha reduction in the size of the Ivanhoe Rail Facility surface development area (Section 2.3.1), comprising approximately 12 ha of native vegetation, and approximately 2 ha of existing road and rail infrastructure.



**Plate 1 Native Grassland/ Sparse Acacia/ Chenopod Shrubs (PCT 166)
in the Additional Surface Development Area**



Plate 2 Belah-Rosewood/ Acacia (PCT 57) in the Additional Surface Development Area



- LEGEND**
- Approved Surface Development Area Required
 - Additional Surface Development Area
 - Approved Surface Development Area not Required
 - Approved Mineral Concentrate Transport Route*
- Vegetation Communities**
- 1 Belah-Rosewood/Acacia Woodland
 - 2 Native Grassland/Sparse Acacia/Chenopod Shrubs

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

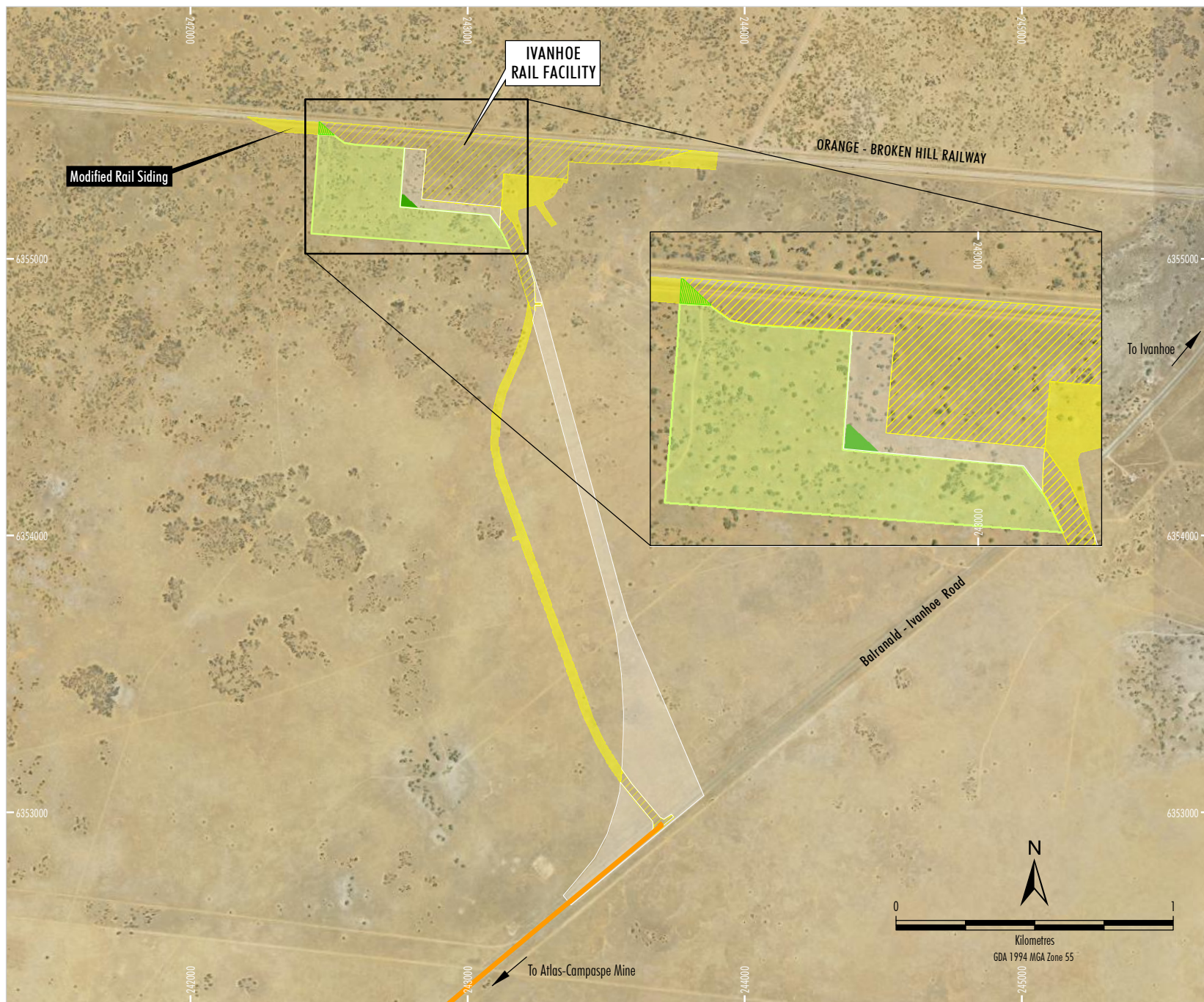
Source: Cristal Mining Australia (2012); AMBS (2012); Tronox (2019) and GHD (2019)
 Orthophoto: © NSW Department of Finance, Services & Innovation (2017)

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OPTIMISATION MODIFICATION

**Modified Ivanhoe Rail Facility
 - Vegetation Communities**

Figure 12



- LEGEND**
- Approved Surface Development Area Required
 - Additional Surface Development Area
 - Approved Surface Development Area not Required
 - Approved Mineral Concentrate Transport Route*
 - Approved Vegetation Management Area
 - Approved Vegetation Management Area to be Replaced
 - Replacement Vegetation Management Area

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

Source: Cristal Mining Australia (2015); Tronox (2019)
Orthophoto: © NSW Department of Finance, Services & Innovation (2017)

TRONOX

OPTIMISATION MODIFICATION

**Modified Ivanhoe Rail Facility -
Vegetation Management Area**

Figure 13

A separate Biodiversity Development Assessment Report (BDAR) is not required for the Modification, as the Modification would not increase impacts on biodiversity values, with reference to section 7.17(2)(c) of the BC Act and the *Biodiversity Development Assessment Report Waiver Determinations for SSD and SSI Applications* (DP&E, 2018).

The potential impact of the modified Ivanhoe Rail Facility on biodiversity values is further described in Table 6.

Vegetation Management Area

The Modification would impact approximately 0.17 ha of the approved VMA at the Ivanhoe Rail Facility (Figure 13). To maintain the overall size of the VMA, a portion (i.e. 0.17 ha) of the approved surface development area no longer required would be incorporated in the VMA at the Ivanhoe Rail Facility (Figure 13).

3.5.3 Management Measures

Given the Modification would not result in any additional biodiversity impacts, no additional management measures are proposed as part of the Modification.

The Biodiversity Management Plan (CMA, 2018d) would be reviewed and, if necessary, revised by Tronox to include the Modification, such as the revised VMA (subject to any modified Development Consent conditions).

Table 6
Biodiversity Values Consideration

Biodiversity Value	Meaning	Relevant (✓ or NA)*	Explanation
<i>Vegetation abundance</i> 1.4(b) BC Regulation	<i>Occurrence and abundance of vegetation at a particular site</i>	✓	The Modification would result in a net reduction (approximately 12 ha) in the amount of native vegetation clearance associated with the modified Ivanhoe Rail Facility.
<i>Vegetation integrity</i> 1.5(2)(a) BC Act	<i>Degree to which the composition, structure and function of vegetation at a particular site and the surrounding landscape has been altered from a near natural state</i>	✓	The Vegetation Integrity Score (VIS) calculated using the BAM Calculator indicates that there is a slight difference in the condition of the vegetation between the additional surface development area and approved surface development area no longer required; however, the apparent difference in the calculated VIS is likely natural variation and not a material measure that the vegetation is in better condition in the additional Ivanhoe Rail Facility surface development area (Appendix D). Notwithstanding, even if the apparent differences in the calculated VIS between the additional surface development area and approved surface development area no longer required are real, the approximate 12 ha reduction in native vegetation clearance required for the modified Ivanhoe Rail Facility would lead to an overall net reduction of impacts on native vegetation (Appendix D).
<i>Habitat suitability</i> 1.5(2)(b) BC Act	<i>Degree to which the habitat needs of threatened species are present at a particular site</i>	✓	The Modification would result in a net reduction (approximately 12 ha) in the amount of native vegetation/habitat clearance associated with the modified Ivanhoe Rail Facility. No other habitat features (e.g. karst, caves, crevices, cliffs and other geological features of significance, rocks, human made structures or non-native vegetation) are present within the approved or modified Ivanhoe Rail Facility surface development areas. No threatened flora species or ecological communities listed under the BC Act or EPBC Act are present within the approved or modified Ivanhoe Rail Facility surface development areas.

Table 6 (Continued)
Biodiversity Values Consideration

Biodiversity Value	Meaning	Relevant (✓ or NA)*	Explanation
<i>Habitat suitability</i> 1.5(2)(b) BC Act (Cont.)	<i>Degree to which the habitat needs of threatened species are present at a particular site</i> (Cont.)	✓	No threatened fauna species listed under the BC Act or EPBC Act have been recorded within the approved or modified Ivanhoe Rail Facility surface development areas. Three wide-ranging threatened bird species, namely Major Mitchell's Cockatoo (<i>Lophochroa leadbeateri</i>), Little Eagle (<i>Hieraaetus morphnoides</i>) and White-fronted Chat (<i>Epthianura albifrons</i>) were recorded outside the approved Ivanhoe Rail Facility area.
<i>Threatened species abundance</i> 1.4(a) BC Regulation	<i>Occurrence and abundance of threatened species or threatened ecological communities, or their habitat, at a particular site</i>	✓	The Modification would result in a net reduction (approximately 12 ha) in the amount of native vegetation/habitat clearance associated with the modified Ivanhoe Rail Facility.
<i>Habitat connectivity</i> 1.4(c) BC Regulation	<i>Degree to which a particular site connects different areas of habitat of threatened species to facilitate the movement of those species across their range</i>	N/A	The native vegetation/habitat in the associated with the modified Ivanhoe Rail Facility does not connect different areas of habitat of threatened species to facilitate the movement of those species across their range.
<i>Threatened species movement</i> 1.4(d) BC Regulation	<i>Degree to which a particular site contributes to the movement of threatened species to maintain their lifecycle</i>	N/A	The native vegetation/habitat in the associated with the modified Ivanhoe Rail Facility would not contribute to the movement of threatened species to maintain their lifecycle.
<i>Flight path integrity</i> 1.4(e) BC Regulation	<i>Degree to which the flight paths of protected animals over a particular site are free from interference</i>	N/A	The Modification would not interfere with any flight paths of protected animals.
<i>Water sustainability</i> 1.4(f) BC Regulation	<i>Degree to which water quality, water bodies and hydrological processes sustain threatened species and threatened ecological communities at a particular site</i>	N/A	The Modification would not impact water quality, water bodies and hydrological processes that sustain threatened species. The Groundwater Review (Appendix F) demonstrates that the Ivanhoe Rail Facility groundwater supply bore would not result in impacts on groundwater dependent ecosystems as none are present.

* A biodiversity value is not relevant to a proposed development if the value is not present on the development site and there is no potential for direct or indirect impacts on the biodiversity value if it occurs off-site (DP&E, 2018).

3.6 ABORIGINAL CULTURAL HERITAGE

An ACHA has been prepared for the Modification by Landscape Natural and Cultural Heritage Management (Landscape) (2019) and is presented in Appendix E.

As the Modification would not change the extent of the approved Atlas-Campaspe Mine surface development area (Table 2), this section considers potential Aboriginal heritage impacts associated with the modified Ivanhoe Rail Facility surface development area.

3.6.1 Background

The ACHA for the Modification has been undertaken in consideration of relevant requirements of various advisory documents and guidelines, including but not limited to (Appendix E):

- *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW, 2010a);
- *Due Diligence Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010b); and
- *Guide to investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW* (OEH, 2011).

Previous Archaeological Investigations

An Aboriginal and Non-Aboriginal Cultural Heritage Assessment was previously prepared for the approved Project by Niche Environment and Heritage (Niche) (2012). The assessment recorded 22 Aboriginal cultural heritage sites in the vicinity of, but not within, the approved Ivanhoe Rail Facility surface development area (Niche, 2012) (Figure 14). Of the 22 sites, 15 consisted of stone artefact scatters (five with hearths), and seven consisted of isolated finds of stone artefacts (Niche, 2012).

A detailed description of previous archaeological investigations and assessments undertaken in the region surrounding the Project is provided in Appendix E.

Management and Monitoring Regime

In accordance with Condition 28, Schedule 3 of Development Consent (SSD_5012), a Heritage Management Plan (CMA, 2017a) has been prepared for the approved Project. The Heritage Management Plan:

- identifies Aboriginal heritage sites and values;
- details the management of Aboriginal heritage sites, including:
 - protocol for the ongoing involvement of the Aboriginal community; and
 - monitoring, management and avoidance measures for known and unknown Aboriginal objects;
- establishes a contingency plan; and
- establishes the roles and responsibilities of Tronox staff with regard to the Heritage Management Plan.

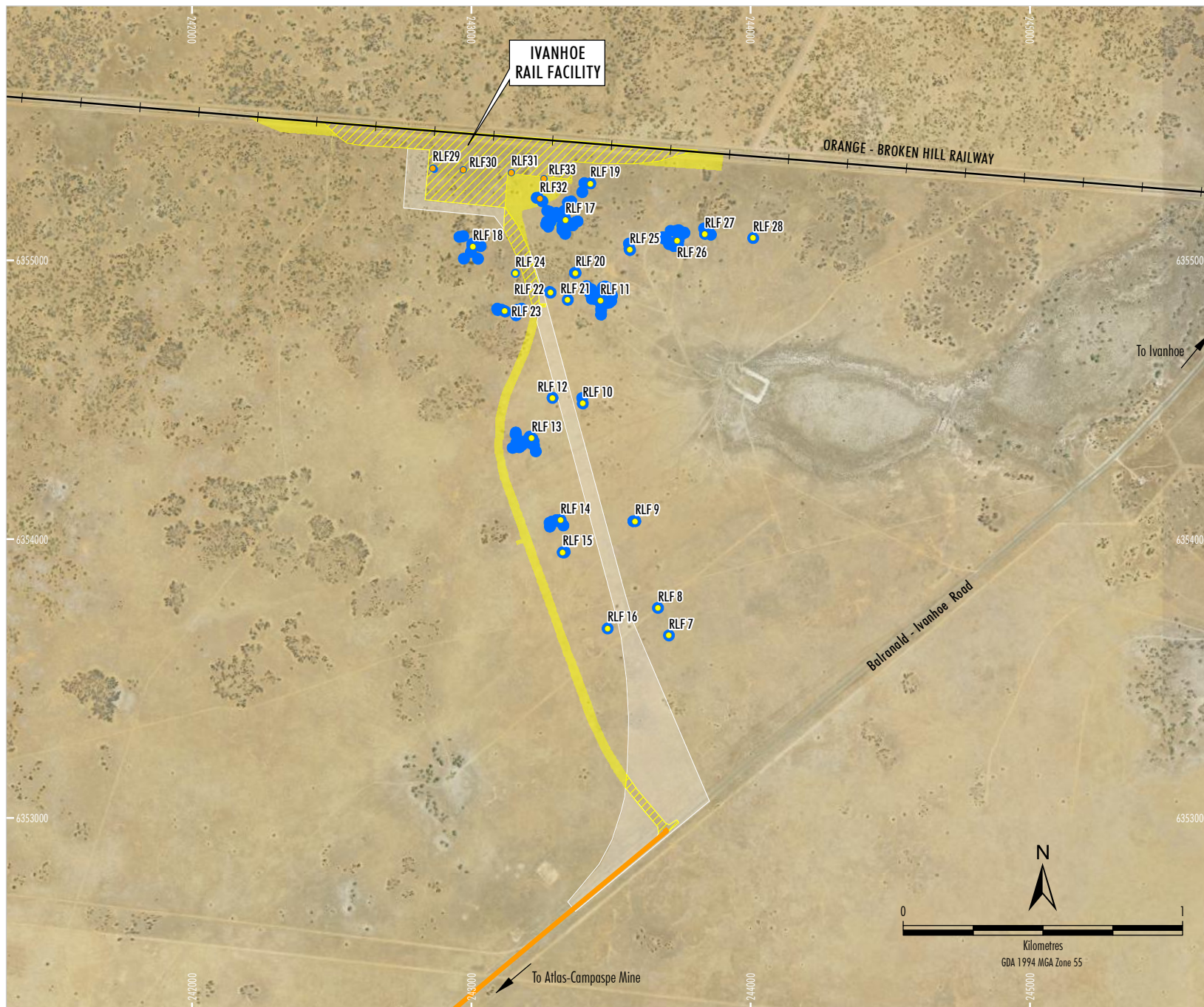
The Heritage Management Plan (CMA, 2017a) provides for the fencing and demarcation of six of the 22 Aboriginal heritage sites identified in the vicinity of the approved Ivanhoe Rail Facility sites (namely RLF 11, RLF 13, RLF 17, RLF 18, RLF 22 and RLF 26), which will be undertaken prior to any surface disturbance activities occurring in the vicinity of the sites.

Consultation

The ACHA included consultation with 11 Registered Aboriginal Parties (RAPs), which were identified during the registration process undertaken for the approved Project, consistent with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW, 2010a) (Appendix E).

Consultation with the Aboriginal community regarding the approved Project has been extensive and involved various methods of communication including public notices, meetings, written and verbal correspondence and archaeological survey attendance, review of the draft Heritage Management Plan (CMA, 2017a) and archaeological salvage at the Atlas-Campaspe Mine.

A detailed description of the consultation undertaken with the RAPs for the Modification is provided in Appendix E, and a summary is provided below.



Information Session

Information regarding the Modification was provided in writing to all RAPs on 29 March 2019, which included an invitation to attend an information session about the Modification, which was held on 30 April 2019 in Ivanhoe. The information session was attended by representatives of one RAP, the Ivanhoe Community Working Party (Appendix E).

Aboriginal Cultural Heritage Field Survey

All RAPs were invited to attend a field survey of the modified Ivanhoe Rail Facility, which was held on 1 May 2019. The field survey was attended by representatives of one RAP, the Ivanhoe Community Working Party (Appendix E).

Review of the Draft ACHA

A copy of the draft ACHA was provided to all RAPs on 17 May 2019, and comments were requested by 21 June 2019. No comments were received on the draft ACHA (Appendix E).

Desktop Review

An Aboriginal Heritage Information Management System (AHIMS) search was undertaken in May 2019 for the modified Ivanhoe Rail Facility and surrounds. The search identified no Aboriginal heritage sites located within the modified Ivanhoe Rail Facility surface development area (Appendix E).

Archaeological Survey and Results

The field survey of the modified Ivanhoe Rail Facility surface development area was undertaken by suitably qualified archaeologist Dr Matt Cupper (Landskape, 2019) in consultation with the Registered Aboriginal Parties on 1 May 2019.

Five Aboriginal cultural heritage sites were identified during the survey, namely RLF 29, RLF 30, RLF 31, RLF 32 and RLF 33 (Figure 14) (AHIMS site numbers 33-4-0031, 33-4-0030, 33-4-0029, 33-4-0028 and 33-4-0027, respectively). These sites consist of two stone artefact scatters and three isolated finds of stone artefacts. Three of these sites are located in the approved surface development area, while two are located within the additional surface development area (Figure 14).

The five sites identified during the survey are not of high scientific or cultural significance (Appendix E).

3.6.2 Potential Impacts

Direct and Indirect Impacts

Construction of the modified Ivanhoe Rail Facility would disturb the current land surface and would likely directly impact the five Aboriginal cultural heritage sites identified in the modified Ivanhoe Rail Facility surface development area (i.e. sites RLF 29, RLF 30, RLF 31, RLF 32 and RLF 33) if not relocated prior to disturbance (Appendix E).

Notwithstanding, harm can be avoided to the 22 Aboriginal cultural heritage sites identified by Niche (2012) located adjacent to the modified Ivanhoe Rail Facility surface development area, the management measures for which are described in Appendix E.

Although the modified Ivanhoe Rail Facility surface development area was sufficiently surveyed, there remains the potential for additional Aboriginal cultural heritage sites to be located within this area. Such previously unidentified features, should they occur, would probably be isolated finds or low-density concentrations of stone artefacts (Appendix E). The Heritage Management Plan (CMA, 2017a) contains management measures for any newly identified Aboriginal cultural heritage sites.

3.6.3 Management Measures

Management options for the five Aboriginal cultural heritage sites identified by Landskape (2019) at the Ivanhoe Rail Facility were discussed with the RAPs on the day of the survey.

Tronox would arrange collection of the objects prior to the commencement of disturbance activities and engage a suitably qualified archaeologist and representatives of the RAPs to record and collect the artefacts. These items would be properly curated and stored at the approved "Keeping Place". Artefacts would be replaced within rehabilitated areas in consultation with local Aboriginal groups and the OEH (Appendix E).

The Heritage Management Plan (CMA, 2017a) would be reviewed and, if necessary, revised by Tronox to include the Modification (subject to any modified Development Consent conditions).

3.7 HISTORIC HERITAGE

As the Modification would not change the extent of the approved Atlas-Campaspe Mine surface development area (Table 2), this section considers potential historic heritage impacts associated with the modified Ivanhoe Rail Facility surface development area.

3.7.1 Background

Previous Assessments

An Aboriginal and Non-Aboriginal Heritage Assessment was prepared for the approved Project by Niche (2012).

The assessment was prepared in consideration of the relevant principles and articles contained in the *Burra Charter* (Australia International Council on Monuments and Sites, 1999) and the *NSW Heritage Manual* (NSW Heritage Office and NSW Department of Urban Affairs and Planning, 1996).

No items of state or regional historic heritage significance were identified in the approved Ivanhoe Rail Facility surface development area (Niche, 2012).

Management and Monitoring Regime

In accordance with Condition 28, Schedule 3 of Development Consent (SSD_5012), a Heritage Management Plan (CMA, 2017a) has been prepared for the Project.

The Heritage Management Plan contains measures for historic heritage sites, including avoidance of known sites and management measures for previously unrecorded sites (should they be encountered).

3.7.2 Potential Impacts

No historic heritage sites were recorded during the field survey of the modified Ivanhoe Rail Facility surface development area conducted by Landskape (2019) (Section 3.6.1) (Appendix E).

Although the modified surface development area was sufficiently surveyed, there remains the potential for historic heritage sites to be located within this area. The Heritage Management Plan (CMA, 2017a) contains management measures for any newly identified historic heritage sites.

3.7.3 Management Measures

Given that the Modification would not result in any additional historic heritage impacts, no additional management measures are proposed as part of the Modification. Notwithstanding, the Heritage Management Plan (CMA, 2017a) would be reviewed and, if necessary, revised by Tronox to include the Modification (subject to any modified Development Consent conditions).

3.8 LAND AND AGRICULTURAL RESOURCES

As the Modification would not change the extent of the approved Atlas-Campaspe Mine surface development area (Table 2), this section considers potential land and agricultural resource impacts associated with the modified Ivanhoe Rail Facility surface development area.

3.8.1 Background

An Agricultural Impact Statement was prepared for the approved Project by CMA (2012a), which described the potential impacts of the approved Project on land resources and agricultural production. The Agricultural Impact Statement was prepared in consideration of the NSW Government's *Guideline for Agricultural Impact Statements* (NSW Government, 2012).

Topography

The landform at the Ivanhoe Rail Facility is flat at approximately 100 m Australian Height Datum (AHD) (CMA, 2012b).

Land Use and Agricultural Production

Contemporary land use in the vicinity of the Ivanhoe Rail Facility is dominated by agricultural activities (low-intensity grazing) and the Orange – Broken Hill railway. Opportunistic harvesting of feral goats is known to be undertaken in the Ivanhoe Rail Facility area (CMA, 2012a).

Land and Soil Capability

Land and Soil Capability mapping undertaken by Ogyris Ecological Research (2012) mapped the Ivanhoe Rail Facility area as Class 6, which is defined as *land capable for a limited set of land uses* (OEH, 2012). Calcic Calcarosols are the only mapped soil type at the approved Ivanhoe Rail Facility (CMA, 2012a).

Land Contamination

The Stage 1 Land Contamination Assessment prepared for the approved Project (CMA, 2012b) concluded that no potentially contaminating activities or contaminated areas were identified at the Ivanhoe Rail Facility site, no further investigation was required, and that the Ivanhoe Rail Facility site is suitable for Project use.

No potentially contaminating activities or contaminated areas have been identified in the modified surface development area.

Land Resources Management

Management of land resources for the approved Project is conducted in accordance with the Biodiversity Management Plan (CMA, 2018d), which has been prepared for the Project in accordance with Condition 14, Schedule 3 of Development Consent (SSD_5012).

The Biodiversity Management Plan (CMA, 2018d), in regard to land resources management, includes:

- vegetation clearance protocol; and
- a management program for the vegetation management areas, including bushfire management.

The Biodiversity Management Plan was prepared in consultation with the OEH, NSW National Parks and Wildlife Service, NSW Rural Fire Service and the Commonwealth Department of the Environment and Energy (DoEE).

Management of land resources for the approved Project is also conducted in accordance with the Surface Water Management Plan (CMA, 2018e), prepared for the approved Project in accordance with Condition 26(e), Schedule 3 of Development Consent (SSD_5012). In regard to land resources management, the Surface Water Management Plan includes:

- erosion and sediment control management measures;
- soil-stripping management measures;
- monitoring and reporting requirements; and
- contingency measures.

3.8.2 Potential Impacts

The modified Ivanhoe Rail Facility components would require an additional 10 ha of surface development area (Section 2.3.1).

The following land and agricultural resource aspects could potentially be impacted by the modified Ivanhoe Rail Facility:

- topographic features;
- soils and erosion potential; and
- land use and capability.

It is noted that the Modification would however result in a net reduction in surface development area of approximately 14 ha at the Ivanhoe Rail Facility, therefore there is expected to be an overall reduction in potential land and agricultural resource impacts as a result of the Modification.

Notwithstanding, these potential impacts and how they relate to the Ivanhoe Rail Facility are described in the following sub-sections. Measures to mitigate these potential impacts are also provided in this sub-section.

Topographic Features

The main modifications to the existing topography that would result from the modified Ivanhoe Rail Facility when compared to the approved Ivanhoe Rail Facility comprises:

- a small extension to the Ivanhoe Rail Facility hardstand area;
- extension of the Ivanhoe Rail Facility rail siding; and
- a revised alignment of the Ivanhoe Rail Facility access road and access road intersection.

In the context of the approved Ivanhoe Rail Facility, the landform changes associated with the modified Ivanhoe Rail Facility outlined above represent a very minor modification to the existing topography.

Soils and Erosion

The low rainfall and lack of defined drainage channels in the region generally limit the potential for fluvial erosion and sedimentation.

The potential soil and erosion-related impacts relevant to the Modification include:

- loss of *in situ* soil resources from beneath Project infrastructure;
- alteration of physical and chemical soil properties during stripping and stockpiling operations;

- reduced soil quality (structure, fertility and microbial activity) of long-term stockpiles; and
- erosion and sediment movement due to exposure of soils during clearance and construction activities.

Potential soil and erosion impacts would be managed by the implementation of the measures outlined in the Surface Water Management Plan (CMA, 2018e).

Land Use and Capability

The Modification would result in a net reduction of approximately 12 ha in the amount of potential agricultural land that would be disturbed by the Ivanhoe Rail Facility.

Rehabilitation of the modified Ivanhoe Rail Facility would aim to restore self-sustaining ecosystems, including native species characteristic of vegetation communities cleared and/or surrounding the development through direct seeding or hand-planting tube-stock.

The nature of grazing in the region primarily involves light intensity grazing by livestock on native vegetation. Therefore, by targeting the restoration of self-sustaining ecosystems, including endemic native species in the first instance, Tronox would not preclude either final land use option.

Land Contamination

Potential land contamination risks were identified as part of the Preliminary Hazard Analysis (CMA, 2012c), and included:

- leaks/spills;
- fire;
- explosion;
- theft;
- accident; and
- unplanned movement off-site.

The Modification would not change the potential impacts identified in the Preliminary Hazard Analysis (CMA, 2012c) relevant to the potential land contamination risks described above.

3.8.3 Management Measures

The Biodiversity Management Plan (CMA, 2018d) and Surface Water Management Plan (CMA, 2018e) would continue to be implemented for the modified Ivanhoe Rail Facility.

In addition, the land and agricultural resource aspects of the Biodiversity Management Plan and Surface Water Management Plan would be reviewed and, if necessary, revised for the Modification (subject to any modified Development Consent conditions).

3.9 GROUNDWATER RESOURCES

The Groundwater Review prepared for the Modification (Appendix F) has assessed the potential impacts of the proposed groundwater supply bore at the Ivanhoe Rail Facility. The Groundwater Review is presented in Appendix F.

As the Modification would not change the approved groundwater impacts at the Atlas-Campaspe Mine (Table 2), this section considers potential groundwater impacts associated with the modified Ivanhoe Rail Facility.

3.9.1 Background

Hydrogeological Setting

The Ivanhoe Rail Facility is located within the Willandra Creek catchment in the Lachlan River basin. Willandra Creek is an effluent creek of the lower Lachlan River, which terminates in a series of lignum swamps and intermittent lakes in the Benanee basin south-west of Ivanhoe (Appendix F).

The Ivanhoe Rail Facility is located within the Lower Lachlan Alluvium Groundwater Source as defined in the *Water Sharing Plan for the Lower Lachlan Groundwater Source 2003* and the draft *Water Sharing Plan for the Lachlan Alluvial Groundwater Sources 2019* under the NSW *Water Management Act, 2000* (Appendix F).

The stratigraphy of the Ivanhoe area consists of (Appendix F):

- Surficial Quaternary sediments (alluvial, evaporite, calcrete, aeolian).
- Tertiary-Quaternary Shepparton Formation is a thin fluvio lacustrine deposit comprising clay, silty clay and sand with lenses of coarse sand and gravel, and minor aeolian reworked material.
- Pliocene Calivil Formation is primarily a fluvio-lacustrine sand deposit and is expected to be the water table aquifer at the site.
- Tertiary Renmark Group comprises sands and clays and is a significant aquifer in the region.

- Cretaceous Monash Formation includes sands, sandstone, siltstone and shale, with minor coal.
- Devonian basement rock includes sandstones and metasediments.

The Renmark Group Aquifer is the target aquifer for the proposed Ivanhoe Rail Facility groundwater supply bore, and is approximately 40 to 85 m below ground level (Appendix F).

Groundwater Quality

Groundwater salinity mapping of the region (Murray Darling Basin Authority, 2008) indicates salinity of about 10,000 milligrams per litre (mg/L) (Appendix F).

Groundwater Users

A bore census for the Ivanhoe Rail Facility area was conducted by Tronox in April 2019 and is presented in Appendix F.

The bore census confirmed the existence of 10 groundwater bores within 10 km of the Ivanhoe Rail Facility, the closest of which is located approximately 2 km south-east of the Ivanhoe Rail Facility groundwater supply bore (Figure 15) (Appendix F). Of these 10 bores, 7 were confirmed to be in use for stock watering (six bores) and monitoring (one bore) (Appendix F).

The limited groundwater use in the region is expected given the poor groundwater quality (Appendix F).

Groundwater Dependent Ecosystems

No Groundwater Dependent Ecosystems (GDEs) are considered to be present within the locality of the Ivanhoe Rail Facility groundwater supply bore (Appendix F).

Groundwater Licensing

The Ivanhoe Rail Facility is located within the Lower Lachlan Alluvium Groundwater Source as defined in the *Water Sharing Plan for the Lower Lachlan Groundwater Source 2003* and the draft *Water Sharing Plan for the Lachlan Alluvial Groundwater Sources 2019* under the *NSW Water Management Act, 2000* (Appendix F).

Tronox has a total of 100 share components (units or ML) in the Lower Lachlan Alluvium Groundwater Source.

Management and Monitoring Regime

In accordance with Condition 26(f), Schedule 3 of Development Consent (SSD_5012), a Groundwater Management Plan (CMA, 2018f) has been prepared for the Project. The Groundwater Management Plan:

- details relevant groundwater criteria;
- describes a program for groundwater management and monitoring;
- details a contingency plan; and
- describes the groundwater reporting, audit and reviewing requirements of the approved Project.

During the 2018 Annual Review reporting period, no incidents relating to groundwater occurred and no complaints were received by Tronox.

3.9.2 Potential Impacts

The Ivanhoe Rail Facility groundwater supply bore would provide up to approximately 60 ML/year of water over the life of the Project.

The Groundwater Review has evaluated the potential impacts of the proposed Ivanhoe Rail Facility groundwater supply bore and concluded (Appendix F):

- the maximum predicted drawdown is low and is not significant beyond 100 m (i.e. predicted maximum drawdown 100 m from the bore is 2 cm);
- there is expected to be no significant change in groundwater quality due to the proposed groundwater supply bore;
- drawdown at the closest bore (approximately 2 km) is predicted to be negligible;
- as there are no GDEs present within the locality of the proposed Ivanhoe Rail Facility groundwater supply bore, no impacts on GDEs are expected;
- there are no significant groundwater users in the vicinity of the proposed Ivanhoe Rail Facility groundwater supply bore, and therefore no cumulative impacts are expected;



Source: © NSW Department of Finance, Services & Innovation (2019), WaterNSW (2019); Cristal Mining Australia (2012); Tronox (2019).
Orthophoto: © NSW Department of Finance, Services & Innovation (2019)

TRONOX
OPTIMISATION MODIFICATION
Ivanhoe Rail Facility Bore Census Results

Figure 15

- the proposed Ivanhoe Rail Facility groundwater supply bore would meet relevant management of local impact considerations in Division 3 of Part 10 of the *Water Sharing Plan for the Lower Lachlan Groundwater Source 2003*; and
- the proposed Ivanhoe Rail Facility groundwater supply bore would meet the relevant rules for granting water supply work approvals in Part 9 of the draft *Water Sharing Plan for the Lachlan Alluvial Groundwater Sources 2019*; and
- the proposed Ivanhoe Rail Facility groundwater supply bore would have “minimal impact” as defined in the *NSW Aquifer Interference Policy*.

3.9.3 Management Measures

The Groundwater Management Plan (CMA, 2018f) would be revised to include quarterly water level and quality (electrical conductivity, pH, standard anions and cations, and metals) at the Ivanhoe Rail Facility groundwater supply bore.

Tronox holds sufficient entitlements under the *Water Sharing Plan for the Lower Lachlan Groundwater Source 2003* for the Ivanhoe Rail Facility groundwater supply bore (Section 3.9.1).

Additionally, the Groundwater Management Plan (CMA, 2018f) would be reviewed and, if necessary, revised by Tronox to generally include the Modification (subject to any modified Development Consent conditions).

3.10 SURFACE WATER RESOURCES

As the Modification would not change the approved surface water impacts at the Atlas-Campaspe Mine (Table 2), this section considers potential surface water impacts associated with the modified Ivanhoe Rail Facility surface development area.

3.10.1 Background

Regional Hydrology

The Ivanhoe Rail Facility is located within the Willandra Creek catchment in the Lachlan River basin. Willandra Creek is an effluent creek of the lower Lachlan River which terminates in a series of lignum swamps and intermittent lakes in the Benanee basin south-west of Ivanhoe (Appendix F).

Previous Assessments

A Surface Water Assessment for the approved Project was undertaken by Evans & Peck (2012). The main potential surface water impacts associated with the approved Ivanhoe Rail facility were:

- mobilisation of sediment during construction; and
- surface runoff containing sediments from the stockpile area during operations.

Evans & Peck (2012) concluded that these potential surface water impacts could be addressed through the implementation of standard sediment controls along the access road and hardstand areas during construction.

Surface Water Licensing

The Ivanhoe Rail Facility is located within the Unregulated Effluent Creeks Water Source as defined in the *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012* under the *Water Management Act 2000*.

Management and Monitoring Regime

As described in Section 3.8.1, a Surface Water Management Plan (CMA, 2018e) has been prepared for the approved Project, and includes a range of erosion and sediment control management measures.

3.10.2 Potential Impacts

Given the Modification would not significantly change the general arrangement and/or water management at the Ivanhoe Rail Facility, no material change to potential surface water impacts are expected as a result of the Modification.

The Ivanhoe Rail Facility is located within the Unregulated Effluent Creeks Water Source as defined in the *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012* under the *Water Management Act 2000*.

Evans & Peck (2012) concluded that no access water licences would be required for the capture and use of water from the retention basin at the Ivanhoe Rail Facility. This conclusion was made on the basis that runoff water contained would be within harvestable rights (i.e. all rain water runoff on landholdings) under the *Water Management Act 2000* and/or would be relevant excluded works under schedule 1 of the *Water Management (General) Regulation 2011*.

The capture and use of water from the retention basin at the Ivanhoe Rail Facility would not significantly change as a result of the Modification and therefore the Evans & Peck (2012) conclusion would still be relevant to the modified Ivanhoe Rail Facility in consideration of schedule 1 of the *Water Management (General) Regulation 2018*.

3.10.3 Management and Monitoring

Given the Modification would not result in any material surface water impacts, no additional management measures are proposed as part of the Modification.

Notwithstanding, the Surface Water Management Plan (CMA, 2018e) would be reviewed and, if necessary, revised by Tronox to include the Modification (subject to any modified Development Consent conditions).

3.11 GREENHOUSE GASES

3.11.1 Background

Previous Assessments

The AQGHG Assessment for the approved Project (Katestone, 2013) assessed the potential impacts of the approved Project on the state and national greenhouse gas inventories, through consideration of the predicted Scope 1, 2 and 3 emissions of the approved Project.

Project direct and indirect greenhouse gas emissions were estimated using published emission factors from the *National Greenhouse Accounts Factors* workbooks (NGA Factors) (Commonwealth Department of Climate Change and Energy Efficiency [DCCEE], 2010; 2011; 2012) (Katestone, 2013).

Katestone (2013) found that the primary Scope 1, 2 and 3 greenhouse gas emissions due to the approved Project will be associated with:

- consumption of diesel fuel in heavy vehicles and on-site diesel generators (Scope 1);
- consumption of electricity at the Ivanhoe Rail Facility (Scope 2); and
- extraction, production and transport of diesel fuel consumed at the Atlas-Campaspe Mine and Ivanhoe Rail Facility, MSP operation, and the consumption of diesel fuel for mineral concentrate transport between the Ivanhoe Rail Facility, the MSP, and Port Pirie (Scope 3).

Katestone (2013) determined that the total Scope 1 emissions from the approved Project would be approximately 0.58 Mt CO₂-e.

Emissions from diesel consumption would be the most significant Scope 1 greenhouse gas source for the Project (Katestone, 2013).

The predicted total indirect greenhouse gas emissions (i.e. Scopes 2 and 3) over the life of the approved Project would be approximately 0.42 Mt CO₂-e (Katestone, 2013).

Management and Monitoring Regime

The Air Quality Management Plan (CMA, 2018b) prepared for the Project contains a number of measures to minimise greenhouse gas emissions, including:

- maximising energy efficiency as a key consideration in the development of the mine plan (e.g. significant savings of greenhouse gas emissions are achieved by mine planning decisions which minimise haul distances for topsoil and overburden, and therefore fuel use);
- regular maintenance of plant and equipment to minimise fuel consumption;
- consideration of energy efficiency in the plan and equipment selection phase; and
- implementation of 'greenhouse awareness' training as part of induction programs.

The effectiveness of these measures to reduce the Project's greenhouse gas emissions (and energy consumption) will be monitored, as Tronox will annually estimate greenhouse gas emissions and energy consumption in accordance with National Greenhouse and Energy Reporting (NGER) scheme requirements (CMA, 2018b).

3.11.2 Potential Impacts

Scope 1 Emissions

Scope 1 greenhouse gas emissions generated by the following Atlas-Campaspe Mine activities would increase proportionally (in some years) with the proposed increase in maximum mineral concentrate production rate:

- increased electricity consumption at the HMC treatment facility (resulting in increased diesel consumption for the on-site diesel generator sets); and
- increased heavy vehicle transport at the Atlas-Campaspe Mine and Ivanhoe Rail Facility.

In other years, Scope 1 emissions at the Atlas-Campaspe Mine would however decrease proportionally with the mineral concentrate production rate.

The Modification would not result in an increase in the following greenhouse gas intensive components of the Atlas-Campaspe Mine:

- mining method; or
- mining rate.

Given the above, it is expected that although annual Scope 1 emissions may increase during certain years, the total Scope 1 emissions due to the modified Project (over the whole mine life) would not change significantly as a result of the Modification as the total amount of mineral concentrates produced during the life of the mine would not significantly change.

In addition, the Modification includes the option to develop on-site solar power generation infrastructure at the Atlas-Campaspe Mine (Section 2.1.5). If developed, it would reduce the diesel consumption of the on-site diesel generator sets, and would therefore reduce potential Scope 1 emissions at the Atlas-Campaspe Mine.

Scope 2 Emissions

Scope 2 emissions associated with the generation of purchased electricity used at the Ivanhoe Rail Facility would not significantly increase as a result of the Modification as electricity consumption at the Ivanhoe Rail Facility would not change significantly.

Scope 3 Emissions

Scope 3 greenhouse gas emissions generated by the following MSP activities would increase proportionally (in some years) with the proposed increase in maximum mineral concentrate production rate:

- consumption of diesel, electricity and Liquefied Petroleum Gas at the MSP; and
- consumption of diesel during transport between the Ivanhoe Rail Facility and MSP, and between the MSP and Port Pirie.

In other years, Scope 3 emissions at the Atlas-Campaspe Mine would however decrease proportionally with the mineral concentrate production rate.

Given the above, it is expected that although annual Scope 3 emissions may increase during certain years, the total Scope 3 emissions due to the modified Project (over the whole mine life) would not change significantly as a result of the Modification as the total amount of mineral concentrates produced during the life of the mine would not significantly change.

3.11.3 Management Measures

The Air Quality Management Plan (CMA, 2018b), which includes a number of measures to minimise greenhouse gas emissions (Section 3.11.1), would continue to be implemented for the Modification, and if necessary, revised by Tronox to include the Modification (subject to any modified Development Consent conditions).

3.12 ECONOMIC

Previous Assessment

Gillespie Economics (2012) prepared a Socio-Economic Assessment for the approved Project.

The operation of the approved Project was estimated to make up to the following contribution to the regional economy (Gillespie Economics, 2012):

- \$279 million (M) in annual direct and indirect regional output or business turnover;
- \$152M in annual direct and indirect regional value added;
- \$20M in annual direct and indirect household income; and
- 229 direct and indirect jobs.

For the NSW economy, the operation of the approved Project was estimated to make up to the following contributions (Gillespie Economics, 2012):

- \$388M in annual direct and indirect regional output or business turnover;
- \$202M in annual direct and indirect regional value added;
- \$54M in annual direct and indirect household income; and
- 643 direct and indirect jobs.

Total NSW Government royalties over the life of the approved Project were estimated to be \$95M (Gillespie Economics, 2012).

3.12.1 Potential Impacts

The Modification would include an increase in the peak mineral concentrate production rate from 546,000 tpa to 665,000 tpa (Section 2.1.2). The estimated NSW Government royalties over the life of the Project (i.e. \$95M) would not however significantly change as a result of the Modification as the total amount of mineral concentrates produced during the life of the mine would not significantly change.

The Modification would not change the approved Project workforce (Table 1), and therefore the economic benefits associated with these employment opportunities would be unchanged.

Given the above, the modified Project is expected to result in similar economic benefits to those expected for the approved Project.

3.12.2 Management Measures

Given the Modification would not result in any significant economic impacts, no additional management measures are proposed as part of the Modification.

3.13 HAZARD AND RISK

3.13.1 Background

Previous Assessment

A Preliminary Hazard Analysis was undertaken for the approved Project (CMA, 2012c), in accordance with the general principles of risk evaluation and assessment outlined in the Department of Planning and Infrastructure (DP&I) *Multi-Level Risk Assessment* (DP&I, 2011).

The Preliminary Hazard Analysis for the approved Project also addressed the requirements of *State Environmental Planning Policy No. 33 (Hazardous and Offensive Development)* (SEPP 33) and has been assessed in general accordance with *Hazardous Industry Planning Advisory Paper No. 6: Hazard Analysis* (NSW Department of Planning [DoP], 2011).

The major potentially hazardous materials associated with the Project include MSP process waste, hydrocarbons and chemicals (CMA, 2012c).

The following generic classes of incident associated with on-site storage were identified (CMA, 2012c):

- leaks/spills;
- fire;
- explosion;
- theft;
- accident; and
- unplanned movement off-site.

Following identification of the potential hazards associated with the approved Project, a qualitative assessment of the risks to the public, property and the environment associated with the Project was undertaken (CMA, 2012c).

An assessment of the combination of the consequence and probability rankings concluded that the residual risk levels are tolerable with respect to surrounding land uses, did not preclude approval of the Project, and societal risk is negligible (CMA, 2012c).

3.13.2 Potential Impacts

It is considered that the Modification would not significantly change the existing potential risks or hazard consequences identified in the Preliminary Hazard Analysis for the approved Project, as the proposed activities associated with the Modification are consistent with those for the approved Project.

3.13.3 Management Measures

The environmental management plans relevant to risks and hazards, and their relevant mitigation measures, would be reviewed and, if necessary, revised by Tronox to include the Modification (subject to any modified Development Consent conditions).

4 STATUTORY CONTEXT

This section outlines the statutory requirements relevant to the assessment of the Modification.

4.1 ENVIRONMENTAL PLANNING AND ASSESSMENT ACT, 1979

4.1.1 Applicability of S4.55(2) of the Environmental Planning and Assessment Act, 1979

The Project was approved under Part 4 of the EP&A Act in 2014 (Development Consent [SSD_5012]). Attachment 1 contains a copy of the current Development Consent (SSD_5012) for the Project.

Tronox is seeking to modify Development Consent (SSD_5012) under section 4.55(2) of the EP&A Act. To date, no modifications have been made to the original Development Consent (SSD_5012) for the Project.

Section 4.55(2) of the EP&A Act relevantly provides:

Modifications of consents-generally

(2) Other modifications

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 development to which the consent as modified relates is substantially the same development as the development for which consent was originally granted and before that consent as originally granted was modified (if at all), and*
- (b) *it has consulted with the relevant Minister, public authority or approval body (within the meaning of Division 4.8) in respect of a condition imposed as a requirement of a concurrence to the consent or in accordance with the general terms of an approval proposed to be granted by the approval body and that Minister, authority or body has not, within 21 days after being consulted, objected to the modification of that consent, 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 the period prescribed by the regulations or provided by the development control plan, as the case may be.*

Subsections (1) and (1A) do not apply to such a modification.

Consideration of the key comparatives detailed in the draft guideline *Modifying an Approved Project* (NSW Government, 2017) when considering whether the Modification could be considered to be “substantially the same” is provided in Table 7.

The Project has demonstrably remained a large mineral sands mining project that incorporates the following key elements approved under Development Consent (SSD_5012) (Table 1):

- mining of two mineral sands deposits;
- overburden emplacements and sand residue emplacement;
- mineral handling and processing facilities;
- mineral concentrate transport activities;
- rail loadout facility;
- water supply and water management systems; and
- supporting infrastructure and facilities.

This would also clearly continue to be the case if the Modification was approved (Table 1), and therefore the consent authority can be satisfied that the Project incorporating the Modification would remain ‘substantially the same’.

Table 7
Summary Evaluation for 'Substantially the Same' Test

Key Comparatives	Approved Project	Modified Project
Development size, scale and footprint	Large mineral sands mine incorporating a separate rail loadout facility.	No material change.
Intensity including rates of production	7.2 Mtpa (ore). 546,000 tpa (mineral concentrate).	No change. Increase to 665,000 tpa.
Primary, secondary and ancillary use	Secondary use of the area behind the advancing ore extraction area for sand residue and process waste emplacement. Rehabilitation for light intensity grazing or for nature conservation purposes.	No change.
Project life and hours of operation	Development Consent to 2034. Operating hours are 24 hours per day, seven days per week.	No change.
Extent, duration and severity of impacts	Project life to 2034. Mining within ML 1767 and MLA 1.	No substantial change.

4.1.2 Objectives of the EP&A Act

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 which:

- incorporates:
 - development of the State's mineral resources approved to be extracted from the Atlas-Campaspe Mine in a manner that minimises environmental impacts through the implementation of the Environmental Management Strategy (CMA, 2017b) and other measures (Section 3);
 - measures to minimise potential amenity impacts associated with air quality and noise impacts on surrounding land uses (Sections 3.3 and 3.4, respectively);
 - continued employment and other socio-economic benefits to the community;
- involves the orderly economic use and development of land as the Atlas-Campaspe Mine surface development area remains unchanged and wholly within ML 1767 and MLA 1;
- would be conducted in accordance with relevant lease/licence/reserve conditions over Crown land within ML 1767 and at the Ivanhoe Rail Facility;
- would support the ongoing provision of community services and facilities through contributions to NSW Government royalties, NSW Government taxes, Commonwealth tax revenue and voluntary contributions to community initiatives;

- is an application under section 4.55(2) of the EP&A Act that would be determined by the Minister for Planning and Public Spaces, however consultation with the BSC, CDSC and WSC and a range of stakeholders has been undertaken (Section 1.3); and
- involves public involvement and participation through Tronox's consultation activities (Section 1.3), which would be ongoing following the public exhibition of this Modification Report and DPIE assessment of the Modification in accordance with the requirements of the EP&A Act.

4.2 OTHER NSW LEGISLATION

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

- *Biosecurity Act, 2015*;
- *BC Act*;
- *Contaminated Land Management Act, 1997*;
- *Crown Land Management Act, 2016*;
- *Dams Safety Act, 1978*;
- *Dangerous Goods (Road and Rail Transport) Act, 2008*;
- *Fisheries Management Act, 1994*;
- *Heritage Act, 1977*;
- *Local Land Services Act, 2013*;
- *Mining Act, 1992*;
- *National Parks and Wildlife Act, 1974*;
- *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 Project. Key plans that would require revision to incorporate the Modification are outlined in Section 4.6.

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

Mining Act, 1992

The modified Atlas-Campaspe Mine would remain wholly within the boundary of ML 1767. Therefore, there is no need for the amendment or variation of existing authorities or the issue of new authorities under the *Mining Act, 1992*.

Under the *Mining Act, 1992*, environmental protection and rehabilitation are regulated by conditions of mining leases, including requirements for the submission of a Mining Operations Plan prior to the commencement of operations, and subsequent Annual Environmental Management Reports (or Annual Reviews).

The current Mining Operations Plan (CMA, 2018g) would require revision to reflect the modified mining operations as a result of the Modification (Section 4.6.1).

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 Act is the statutory requirement to apply for and obtain an 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 Project is currently licensed under EPL 21007 to conduct "crushing, grinding or separating", "extractive activities" and "metallurgical activities" as defined in schedule 1 of the PoEO Act. EPL 21007 would be varied as required following approval of the Modification.

Water Management Act, 2000

The *Water Management Act, 2000* contains provisions for the licensing, allocation, capture and use of water resources. Under the *Water Management Act, 2000*, water sharing plans are being introduced (and many have commenced) for water sources. Water sharing plans establish rules for sharing water between different users and between the various environmental sources (namely rivers or aquifers).

The Ivanhoe Rail Facility is located within the Lower Lachlan Alluvium Groundwater Source as defined in the *Water Sharing Plan for the Lower Lachlan Groundwater Source 2003* and the draft *Water Sharing Plan for the Lachlan Alluvial Groundwater Sources 2019* under the NSW *Water Management Act, 2000* (Appendix F).

Tronox has obtained a total of 100 share components (units or ML) in the Lower Lachlan Alluvium Groundwater Source of the *Water Sharing Plan for the Lower Lachlan Groundwater Source 2003* for the Ivanhoe Rail Facility, which is sufficient for the modified Ivanhoe Rail Facility.

The proposed Ivanhoe Rail Facility groundwater supply bore would meet relevant management of local impact considerations in Division 3 of Part 10 of the *Water Sharing Plan for the Lower Lachlan Groundwater Source 2003*, and the relevant rules for granting water supply work approvals in Part 9 of the draft *Water Sharing Plan for the Lachlan Alluvial Groundwater Sources 2019/* (Section 3.9.2).

Biodiversity Conservation Act, 2016

The BC Act came into effect in NSW in August 2017 and replaces the TSC Act.

Section 3.5 considers the potential biodiversity impacts associated with the modified Ivanhoe Rail Facility.

As described in Section 3.5, with reference to Section 7.17(2)(c) of the BC Act and the *Biodiversity Development Assessment Report Waiver Determinations for SSD and SSI Applications* (DP&E, 2018), no BDAR is required for the Modification as the Modification would not increase impacts on biodiversity values (Table 6).

Roads Act, 1993

As described in Section 2.2.3, the Project will include various public road-related construction activities, which would not change for the Modification.

Additional road upgrades for the proposed light vehicle access routes would be required for the Modification (Section 2.1.7).

Tronox will apply for the necessary consents under section 138 of the *Roads Act, 1993* for these works. In accordance with section 89K(1)(f) of the EP&A Act, if the Modification is approved, consent under section 138 of the *Roads Act, 1993* cannot be refused and is to be substantially consistent with the Development Consent (SSD_5012).

Crown Land Management Act, 2016

Under section 5.21(1) of the NSW *Crown Land Management Act, 2016*, a Crown Lands Licence is required to authorise the use or occupation of Crown land.

Tronox has obtained a Crown Lands Licence (LI 567639) for the Ivanhoe Rail Facility. Crown Lands Licence (LI 567639) includes the modified Ivanhoe Rail Facility surface development area.

4.3 ENVIRONMENTAL PLANNING INSTRUMENTS

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

4.3.1 Local Environment Plans

Balranald Local Environmental Plan 2010

The Atlas-Campaspe Mine is located wholly within the BSC LGA (Figure 1). The following subsection identifies the provisions in the *Balranald Local Environmental Plan 2010* (Balranald LEP) that are relevant to the Modification.

Permissibility

The Atlas-Campaspe Mine and related road upgrades are located within Zone RU1 (Primary Production) within the BSC LGA.

Open cut mining is permissible with consent within Zone RU1 (Primary Production) under the Balranald LEP. Roads are permissible without consent in the RU1 zoning.

Zone Objectives

Clause 2.3(2) of the Balranald 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 objectives of Zone RU1 (Primary Production) include:

- To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.
- To encourage diversity in primary industry enterprises and systems appropriate for the area.
- To minimise the fragmentation and alienation of resource lands.
- To minimise conflict between land uses within this zone and land uses within adjoining zones.
- To encourage development that is in accordance with sound management and land capability practices, and that takes into account the environmental sensitivity and biodiversity of the locality.

- To support rural communities.
- To ensure the provision of accommodation for itinerant workers.

The modified Project is considered to be consistent with the Zone RU1 (Primary Production) objectives of the Balranald LEP, in that:

- Mining constitutes a primary industry.
- The Modification would not result in the fragmentation and alienation of resource lands.
- The land surrounding the Atlas-Campaspe Mine is also zoned RU1 (Primary Production).
- Environmental assessments have been conducted for the Modification, and the management and mitigation measures to be employed to minimise the potential impacts of the Modification are discussed in Section 3.
- The Project is an employment generating development that is expected to provide economic stimulus in the regional and NSW economies (Section 3.12).

Central Darling Local Environment Plan 2012

The modified Ivanhoe Rail Facility is located within the CDSC LGA. The following subsection identifies the provisions in the *Central Darling Local Environment Plan 2012* (Central Darling LEP) that are relevant to the Modification.

Permissibility

Part 2 of the Central Darling LEP sets out the zone objectives and the land use table that is relevant in determining whether the modified Project, or any other part of the modified Project, is prohibited by the Central Darling LEP.

Under the Central Darling LEP, the modified Ivanhoe Rail Facility is located in the following zones:

- RU1 (Primary Production); and
- SP2 (Infrastructure) (the Orange – Broken Hill railway corridor).

The Ivanhoe Rail Facility is considered to be a “freight transport facility” under the Central Darling LEP:

freight transport facility means a facility used principally for the bulk handling of goods for transport by road, rail, air or sea, including any facility for the loading and unloading of vehicles, aircraft, vessels or containers used to transport those goods and for the parking, holding, servicing or repair of those vehicles, aircraft or vessels or for the engines or carriages involved.

Under the Central Darling LEP construction and operation of freight transport facilities are permitted with Development Consent on lands zoned as RU1 (Primary Production).

Rail-related facilities (including any development that is ordinarily incidental or ancillary to development for that purpose) are also permitted with Development Consent on land zoned as SP2 (Infrastructure) (the Orange – Broken Hill railway corridor).

Zone Objectives

Clause 2.3(2) of the Central Darling LEP provides that 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 objectives for Zone RU1 (Primary Production) under the Central Darling LEP are as follows:

- To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.
- To encourage diversity in primary industry enterprises and systems appropriate for the area.
- To minimise the fragmentation and alienation of resource lands.
- To minimise conflict between land uses within this zone and land uses within adjoining zones.

The modified Ivanhoe Rail Facility is considered to be consistent with the objectives for Zone RU1 (Primary Production), in that:

- It facilitates development of a primary industry (mining) and provides diversification of land use (i.e. alternative use to agriculture).
- It would not result in the fragmentation or alienation of resource lands.
- It would be developed in a manner to minimise potential incompatibilities with surrounding land uses.

The zone objectives for Zone SP2 (Infrastructure) under the Central Darling LEP area as follows:

- To provide for infrastructure and related uses.
- To prevent development that is not compatible with or that may detract from the provision of infrastructure.

The Modification is consistent with the objectives for Zone SP2 (Infrastructure) as the Modification comprises development for the purposes of rail infrastructure and related uses and is compatible with the existing Orange – Broken Hill railway.

4.3.2 State Environmental Planning Policies

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

The *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries)* (Mining SEPP) regularises the various environmental planning instruments that previously controlled mining activities and aims to provide for the proper management of and development of mineral resources.

Clause 5(3) of the Mining SEPP gives it primacy where there is an inconsistency between the provisions of the Mining SEPP and the provisions of any other environmental planning instrument (except the *State Environmental Planning Policy [State Significant Precincts] 2005* and *State Environmental Planning Policy [Coastal Management] 2018*).

Clause 7

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

- (b) *mining carried out:*
 - (i) *on land where development for the purposes of agriculture or industry may be carried out (with or without development consent), or*
 - (ii) *on land that is, immediately before the commencement of this clause, the subject of a mining lease under the Mining Act 1992 or a mining licence under the Offshore Minerals Act 1999,*

...

The modified Project is on land where agriculture is permissible. Therefore, the Modification activities are permissible with development consent.

Part 3 of the Mining SEPP outlines the matters to be considered when determining development applications. Relevant clauses are discussed further below.

Clause 12

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

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

Existing/approved land use in the vicinity of the Project is characterised by various agricultural land uses.

The Modification would not change the existing/approved land uses or surface development area associated with the Atlas-Campaspe Mine. The modified Ivanhoe Rail Facility is considered to be compatible with existing and future land uses in the vicinity of the Ivanhoe Rail Facility.

The potential impacts of the Modification on land resources are described in Section 3.8.

The Modification would allow for the economic extraction of mineral concentrate from the approved Atlas-Campaspe Mine.

Tronox would implement a range of measures to avoid or minimise incompatibility of the modified Project with existing and future land uses in the area. This would be achieved through the implementation of the existing Environmental Management Strategy for the Project (CMA, 2017b), with updates to the relevant environmental management plans listed in Section 4.6.

Clause 14

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

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

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

The potential impacts of the Modification on groundwater and surface water resources are discussed in Sections 3.9 and 3.10 respectively, including measures to minimise potential impacts.

The potential biodiversity impacts as a result of the Modification are described in Section 3.5.

An assessment of the potential greenhouse gas emissions due to the Modification is provided in Section 3.11.

Clause 15

Clause 15 of the Mining SEPP requires that:

- (1) *Before granting consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider the efficiency or otherwise of the development in terms of resource recovery.*
- (2) *Before granting consent for the development, the consent authority must consider whether or not the consent should be issued subject to conditions aimed at optimising the efficiency of resource recovery and the reuse or recycling of material.*

- (3) *The consent authority may refuse to grant consent to development if it is not satisfied that the development will be carried out in such a way as to optimise the efficiency of recovery of minerals, petroleum or extractive materials and to minimise the creation of waste in association with the extraction, recovery or processing of minerals, petroleum or extractive materials.*

The Modification would promote the more efficient and economic recovery of mineral sands resources at the Atlas-Campaspe Mine (i.e. through increasing the mineral concentrate production rate without having to increase the mineral sands ore extraction rate). As such, the Modification aims to achieve efficient resource recovery.

Clause 16

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

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

Mineral concentrates generated at the Atlas-Campaspe Mine will be transported by road to the Ivanhoe Rail Facility for transport to the MSP via the Orange-Broken Hill Railway for further processing and transport by rail to port.

The Modification would include an increase in the maximum mineral concentrate production rate from approximately 546,000 tpa to approximately 665,000 tpa (with an associated increase in the mineral concentrate transport rate from 450,000 tpa to 665,000 tpa) (Section 2.1.2).

The primary public road network transport routes to and from the Atlas-Campaspe Mine are generally adjacent to rural areas.

The potential impacts of the Modification on the road transport networks are discussed in Section 3.2, including measures to minimise potential impacts.

In summary, the road upgrade works required by Development Consent (SSD_5012) to be conducted along the approved road haulage route for the Modification would be suitable for traffic generated by the modified Project. Additionally, the increased heavy vehicle trips on the approved road haulage route would be well within the day-to-day variation in traffic volumes and would not have a perceivable impact on the level of service experienced by drivers along the route (Appendix A).

Road transport at the Atlas-Campaspe Mine is currently managed in accordance with the Transport Management Plan (CMA, 2018a).

Given the above, it is considered that the Modification would not result in any significant changes to the potential road transport impacts.

Clause 17

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

- (a) *require the preparation of a plan that identifies the proposed end use and landform of the land once rehabilitated, or*
- (b) *require waste generated by the development or the rehabilitation to be dealt with appropriately, or*
- (c) *require any soil contaminated as a result of the development to be remediated in accordance with relevant guidelines (including guidelines under clause 3 of Schedule 6 to the Act and the Contaminated Land Management Act 1997), or*
- (d) *require steps to be taken to ensure that the state of the land, while being rehabilitated and at the completion of the rehabilitation, does not jeopardize public safety.*

The rehabilitation of the Atlas-Campaspe Mine would generally be conducted in accordance with the existing/approved rehabilitation strategy for the Project.

No changes to the existing/approved rehabilitation strategy are proposed as part of the Modification (Section 2.1.9).

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

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

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

The environmental management plans relevant to risks and hazards, and their relevant mitigation measures, would be reviewed and, if necessary, revised by Tronox to include the Modification (subject to any modified Development Consent conditions) (Section 3.13).

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

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

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

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

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

The Modification does not include a 'change of use' because the Modification would involve the continuation of the Project activities on the approved Project site.

The Land Contamination Assessment undertaken for the Project EIS concluded that no further investigation was required and that the Atlas-Campaspe Mine and Ivanhoe Rail Facility areas are suitable for the Project use (CMA, 2012b) (Section 3.8).

No potentially contaminating activities or contaminated areas have been identified in the modified surface development area at the Ivanhoe Rail Facility.

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

The *State Environmental Planning Policy No. 44 (Koala Habitat Protection)* (SEPP 44) applies to certain LGAs (including the Central Darling where the Ivanhoe Rail Facility is located), and requires the consideration of whether land that is the subject of the Development Application is considered to be "potential Koala habitat" or "core Koala habitat".

Clause 3 of SEPP 44 outlines the aim of the SEPP, which is to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline:

- (a) *by requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat, and*
- (b) *by encouraging the identification of areas of core koala habitat, and*
- (c) *by encouraging the inclusion of areas of core koala habitat in environment protection zones.*

Clause 9 of SEPP 44 requires:

- (1) *Before a council may grant consent to a development application for consent to carry out development on land to which this Part applies that it is satisfied is a core koala habitat, there must be a plan of management prepared in accordance with Part 3 that applies to the land.*
- (2) *The council's determination of the development application must not be inconsistent with the plan of management.*

An assessment of Koala habitat for the purposes of SEPP 44 was undertaken for the approved Project. The assessment concluded that the Ivanhoe Rail Facility area does not comprise potential Koala habitat (AMBS, 2013a).

4.4 NSW GOVERNMENT POLICY

Strategic Regional Land Use Plan

The NSW Mining and Petroleum Gateway Panel was established by the NSW Government in October 2013 as part of the Strategic Regional Land Use Policy.

The Strategic Regional Land Use Policy and the 'Gateway Process' only applies to new State Significant Development applications or modifications for mining projects that are located outside of existing mining lease areas (NSW Government, 2012). As the Modification does not require any change to ML 1621, the 'Gateway Process' does not apply.

Aquifer Interference Policy

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

The stated purpose of the Aquifer Interference Policy is to ensure equitable water sharing between various water users and proper licensing of water taken by aquifer interference activities such that the take is accounted for in the water budget and water sharing arrangements.

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

- *the penetration of an aquifer;*
- *the interference with water in an aquifer;*
- *the obstruction of the flow of water in an aquifer;*

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

Notwithstanding the NRAR advice (Section 1.3), the minimal impact considerations in the AIP (DPI, 2012) have been addressed in Sections 3.9 and 4.4, and Appendix F.

A Groundwater Review (Appendix F) has been prepared in consideration of the AIP for the proposed groundwater supply bore at the Ivanhoe Rail Facility and the key conclusions are summarised below.

Water Source

The AIP requires all water taken by aquifer interference activities to be accounted for within the extraction limits set by the relevant Water Sharing Plan. The Water Sharing Plan relevant to the Ivanhoe Rail Facility is the *Water Sharing Plan for the Lower Lachlan Groundwater Source 2003*. Therefore, licensing under the *Water Sharing Plan for the Lower Lachlan Groundwater Source 2003* is required to account for the Modification.

Modelling of Potential Impacts

The potential hydrogeological impacts of the proposed groundwater supply bore at the Ivanhoe Rail Facility have been modelled (GEO-ENG, 2019).

Licensing Requirements

As described above, the Ivanhoe Rail Facility is located within the Lower Lachlan Groundwater Source as defined in the *Water Sharing Plan for the Lower Lachlan Groundwater Source 2003* and the draft *Water Sharing Plan for the Lachlan Alluvial Groundwater Sources 2019* under the *Water Management Act, 2000*.

As described in Section 3.9.1, Tronox holds an appropriate volumetric licence (100 share components [units of ML]) in accordance with the requirements of the *Water Sharing Plan for the Lower Lachlan Groundwater Source 2003* for the proposed groundwater supply bore at the Ivanhoe Rail Facility.

Minimal Impact Considerations

The AIP establishes minimal impact considerations for highly productive and less productive groundwater.

NSW Office of Water mapping indicates that there is no highly productive groundwater in the vicinity of the Ivanhoe Rail Facility. The target aquifer for the proposed Ivanhoe Rail Facility groundwater supply bore (i.e. the Renmark Group Aquifer) is considered to be a 'less productive' alluvial aquifer, due to its high salinity, in accordance with the AIP (Appendix F).

An assessment of the proposed groundwater supply bore against the minimal impact considerations in the AIP was conducted as part of the Groundwater Review and is presented in Appendix F.

The Groundwater Review concluded that the Modification is within the 'Level 1' minimal impact considerations outlined in the AIP (Appendix F).

Other Groundwater Users

The closest groundwater bore to the proposed Ivanhoe Rail Facility groundwater supply bore is located approximately 2 km to the south-east and the drawdown at this bore due to the proposed Ivanhoe Rail Facility groundwater supply bore is predicted to be negligible (i.e. the maximum predicted drawdown would be low and is not significant beyond 100 m) (Appendix F).

4.5 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT, 1999

The objective of the 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. Proposals that are, or may be, a controlled action are required to be referred to the DoEE to determine whether or not the action is a controlled action.

It is concluded that the Modification is unlikely to have a significant impact on Matters of National Environmental Significance (MNES) for the following reasons:

- The modified Project would not have a significant impact on listed threatened species and ecological communities and/or migratory species as the none of these MNES have been identified in the vicinity of the additional surface development areas at the Ivanhoe Rail Facility, and the additional surface development areas at the Ivanhoe Rail Facility comprise a paddock subject to grazing by goats, introduction of non-native vegetation and past clearing.

- The modified Project would not have a significant impact on wetlands of international importance.
- The modified Project would not have a significant impact on world heritage properties or national heritage places (i.e. Willandra Lakes Regional World Heritage Area) as the proposed changes at the Atlas-Campaspe Mine are minor and the Ivanhoe Rail Facility is located approximately 80 km from the Willandra Lakes Regional World Heritage Area.
- The modified Project would not impact the Great Barrier Reef Marine Park and / or Commonwealth marine areas.
- The modified Project is not a nuclear action.
- The modified Project 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.

4.6 MANAGEMENT/MONITORING PLANS

Some management plans may require revision to reflect updated environmental management measures or changes to Development Consent (SSD_5012) conditions resulting from the Modification, including the:

- Transport Management Plan (CMA, 2018a);
- Air Quality Management Plan (CMA, 2018b);
- Noise Management Plan (CMA, 2018c);
- Biodiversity Management Plan (CMA, 2018d);
- Groundwater Management Plan (CMA, 2018f); and
- Surface Water Management Plan (CMA, 2018e).

4.6.1 Mining Operations Plan

The current Mining Operations Plan (CMA, 2018g) would require revision to reflect the Modification.

5 CONCLUSION AND MODIFICATION JUSTIFICATION

Tronox has undertaken Project optimisation planning in consideration of recent experience at its existing NSW operations.

A key outcome of the Project optimisation planning is revised mine scheduling for the Atlas deposit, which would increase the maximum mineral concentrate production rate; without increasing the approved ore mining rate. Other changes to optimise Project operations were also identified as part of the Project optimisation planning. The optimisation of the Project will increase its efficiency and economic viability (Section 2).

The Modification would implement the outcomes of the optimisation planning and would include:

- increased mineral concentrate production from 546,000 tpa to 665,000 tpa;
- increased mineral concentrate transport from 450,000 tpa to 665,000 tpa;
- increased mineral concentrate transport truck trips from 24 per day to 35 per day;
- increased mineral concentrate transport train length (from 600 m to 920 m) and frequency (from six to eight train movements per week [i.e. four arrivals, four departures]);
- increased MSP process waste disposal from 50,000 tpa to 65,000 tpa;
- the option to use an overland conveyor to transfer overburden in addition to haul trucks;
- the relocation of the Atlas-Campaspe Mine accommodation camp;
- the option to develop on-site solar power generation infrastructure at the Atlas-Campaspe Mine to supplement diesel generator sets;
- development of an emergency airstrip at the Atlas-Campaspe Mine;
- extension to the Ivanhoe Rail Facility hardstand area;
- extension of the Ivanhoe Rail Facility rail siding and addition of a passing siding;
- a revised alignment of the Ivanhoe Rail Facility access road and access road intersection;
- a groundwater supply bore for the Ivanhoe Rail Facility; and
- the use of local roads other than the road haulage route by Project-related light vehicles to access site.

Key elements of the approved Project would remain unchanged for the Modification, including the:

- Mine path or mine life;
- Mining method;
- Mineral concentration methods;
- Overburden and ore extraction rate;
- Sand residue, coarse reject and process waste placement management;
- Annual maximum water supply/demand;
- Rehabilitation works;
- Biodiversity offset area; or
- Workforce.

5.1 JUSTIFICATION FOR MODIFICATION APPROVAL

Approval of the Modification is considered to be justified given:

- The Modification would promote the more efficient and economic recovery of mineral sands resources at the Atlas-Campaspe Mine (i.e. through increasing the mineral concentrate production rate without having to increase the mineral sands ore extraction rate).
- The proposed use of local roads would improve the safety of the Project workforce and the road network.
- The proposed increases in the rate of mineral concentrate production and transport could be achieved with no exceedances of the relevant noise and air quality criteria.
- The proposed telecommunications tower would provide mobile coverage/reception to the Atlas-Campaspe Mine area that would also be able to be used by community members.
- The proposed emergency air strip would improve safety of the Project workforce.
- The proposed changes to the Ivanhoe Rail Facility layout would reduce potential biodiversity and land resource impacts.
- The Modification would improve the productivity of the Project, improving the security of the continued employment of the workforce and ongoing expenditure in the State and local economies.

It is therefore considered that the Modification is justified on environmental, economic and social grounds.

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