

APPENDIX E

ABORIGINAL CULTURAL HERITAGE ASSESSMENT



# ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION

## APPENDIX E

### ABORIGINAL CULTURAL HERITAGE ASSESSMENT

# Atlas-Campaspe Mineral Sands Project Optimisation Modification

# Aboriginal Cultural Heritage Assessment



Report to Tronox Mining Australia Limited  
12 July 2019

***Landskape***

a division of ML Copper Pty Ltd  
ABIN 48 107 932 918

PO Box 1068 Carlton 3053

e-mail: [landskape@telstra.com](mailto:landskape@telstra.com)

tel: 0408 006 690

**Tronox Mining Australia Limited**

**Atlas-Campaspe Mineral Sands Project  
Optimisation Modification**

**Aboriginal Cultural Heritage Assessment**



**Natural and Cultural Heritage Management**

a division of M.L. Copper Pty Ltd

ABN: 48 107 932 918

**Author: Dr Matt Cupper**

**Date: 12 July 2019**

PO Box 1068  
Carlton 3053  
e-mail: [landscape@telstra.com](mailto:landscape@telstra.com)  
tel: 0408 006 690

# CONTENTS

<b>CONTENTS.....</b>	<b>ii</b>
<b>EXECUTIVE SUMMARY .....</b>	<b>v</b>
<b>1 INTRODUCTION .....</b>	<b>1</b>
1.1 Aim and Objectives of the Assessment.....	1
1.2 Structure of this Report .....	2
<b>2 INVESTIGATORS.....</b>	<b>5</b>
<b>3 DESCRIPTION OF THE MODIFICATION.....</b>	<b>6</b>
<b>4 ABORIGINAL COMMUNITY CONSULTATION .....</b>	<b>8</b>
4.1 Introduction .....	8
4.2 Aboriginal Community Participation.....	8
4.2.1 Identification of Registered Aboriginal Parties .....	8
4.2.2 Presentation of Information about the Proposed Modification .....	9
4.2.3 Aboriginal Cultural Heritage Field Survey .....	9
4.3 Aboriginal Community Information about Cultural Significance .....	10
4.4 Review of the Draft ACHA.....	10
<b>5 ENVIRONMENTAL CONTEXT .....</b>	<b>11</b>
5.1 Introduction .....	11
5.2 Geology.....	11
5.3 Landforms and vegetation.....	11
<b>6 ABORIGINAL CULTURAL HERITAGE CONTEXT .....</b>	<b>13</b>
6.1 Ethno-Historic Context .....	13
6.2 Prehistoric Context .....	13
6.3 Types of Aboriginal Cultural Heritage Sites in the Region .....	14
6.3.1 Stone Artefact Scatters.....	14
6.3.2 Hearths .....	14
6.3.3 Freshwater Shell Middens .....	15
6.3.4 Earth Mounds.....	15
6.3.5 Quarry Sites .....	15
6.3.6 Modified Trees.....	15
6.3.7 Stone Arrangements, Ceremonial Rings and Ceremony and Dreaming Sites ...	15
6.3.8 Burials .....	16
6.4 Previously Recorded Aboriginal Cultural Heritage Sites in the Modification ....	16
<b>7 CULTURAL HERITAGE FIELD INVESTIGATION .....</b>	<b>17</b>
7.1 Overview of Previous Archaeological Investigations .....	17
7.2 Cultural Heritage Site Predictive Model .....	17
7.3 Field Methodology.....	18
7.3.1 Personnel.....	19
7.3.2 Survey Methods .....	19
7.4 Survey Coverage Data .....	21
7.4.1 Conditions of Visibility.....	21
7.4.2 Coverage Analysis .....	22
7.5 Survey Results .....	23
7.6 Identified Aboriginal Cultural Values .....	27

<b>8</b>	<b>CULTURAL HERITAGE VALUES.....</b>	<b>28</b>
<b>8.1</b>	<b>Aboriginal Cultural Heritage Significance .....</b>	<b>28</b>
8.1.1	Scientific Significance.....	28
8.1.2	Aboriginal Social, Cultural, Spiritual and Historical Significance .....	30
8.1.3	Educational Significance .....	31
8.1.4	Aesthetic Significance .....	31
<b>8.2</b>	<b>Aboriginal Cultural Landscape.....</b>	<b>31</b>
8.2.1	Summary of the Archaeological Record .....	31
8.2.2	Aboriginal Settlement Patterns .....	31
8.2.3	Aboriginal Subsistence Strategies .....	32
8.2.4	Synthesis.....	33
<b>9</b>	<b>POTENTIAL IMPACTS OF THE MODIFICATION ON ABORIGINAL CULTURAL HERITAGE.....</b>	<b>34</b>
9.1	Potential Direct Impacts.....	34
9.2	Potential Indirect Impacts .....	35
9.3	Cultural Heritage Avoided by the Modification .....	35
9.4	Cultural Heritage Potentially Impacted by the Modification .....	35
9.5	Potential For Previously Unidentified Aboriginal Cultural Heritage To Occur In The Modification Area.....	36
9.6	Flexibility of the Modification Design.....	36
9.7	Potential Cumulative Impacts.....	37
<b>10</b>	<b>MANAGEMENT STRATEGIES FOR CULTURAL HERITAGE .....</b>	<b>38</b>
<b>10.1</b>	<b>General Recommendations .....</b>	<b>38</b>
10.1.1	Heritage Management Plan.....	38
10.1.2	Role of the Local Aboriginal Community.....	38
10.1.3	Site Management and Cultural Awareness Training .....	38
<b>10.2</b>	<b>Management of Cultural Heritage in Proximity to the Disturbance Areas.....</b>	<b>39</b>
<b>10.3</b>	<b>Management of Cultural Heritage Within the Disturbance Area .....</b>	<b>39</b>
<b>10.4</b>	<b>Summary of Management Recommendations .....</b>	<b>39</b>
<b>11</b>	<b>SUMMARY RECOMMENDATIONS .....</b>	<b>41</b>
<b>12</b>	<b>REFERENCES .....</b>	<b>42</b>
	<b>APPENDICES .....</b>	<b>46</b>

## Figures

Figure 1. Regional Location.....	4
Figure 2. Modified Ivanhoe Rail Facility – General Arrangement .....	7
Figure 3. Belah woodland with Bluebush understorey in the Hatfield land system of the northern part of the Modification. ....	12
Figure 4. Belah woodland with Bluebush understorey in the Hatfield land system of the southern part of the Modification. ....	12
Figure 5. Survey team members inspecting the Modification area. ....	19
Figure 6. Survey team members inspecting the Modification area. ....	19
Figure 7. Modified Ivanhoe Rail Facility Survey Units .....	20
Figure 8. Example of surface exposure at the Modification area.....	22
Figure 9. Example of surface exposure at the Modification area.....	22
Figure 10. Example of surface exposure at the Modification area.....	22
Figure 11. Example of surface exposure at the Modification area.....	22
Figure 12. RLF29.....	25
Figure 13. RLF30.....	25
Figure 14. RLF31.....	25
Figure 15. RLF32.....	25
Figure 16. Modified Ivanhoe Rail Facility – Aboriginal Heritage Sites.....	26

## Tables

Table 1. Visibility Conditions at the Modification. ....	21
Table 2. Coverage of the Modification Area. ....	23
Table 3. Landform Summary of Sampled Areas of the Modification Area. ....	23
Table 4. Newly Identified Aboriginal Cultural Heritage Sites within and near the Modification Area.....	24
Table 5. Assessment of Significance of the Aboriginal Cultural Heritage Sites. ....	30
Table 6. Summary of Potential Impacts to Aboriginal Cultural Heritage Sites. ....	36
Table 7. Proposed Specific Management Strategies for known Aboriginal Cultural Heritage Sites. ....	40

## Appendices

Appendix 1: Glossary.....	47
Appendix 2: Consultation Log.....	49
Appendix 3: Correspondence to Aboriginal Community Stakeholders .....	50
Appendix 4: Correspondence from Aboriginal Community Stakeholders.....	51
Appendix 5: AHIMS Register Search .....	52
Appendix 6: AHIMS Site Cards (to be included with the final report).....	53
Appendix 7: Cadastre Information .....	54

## EXECUTIVE SUMMARY

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Cristal Mining Australia Limited, which will be renamed Tronox Mining Australia Limited (Tronox) on 25 July 2019. Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* in 2014.

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, NSW and 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 to the south-west of the township of Ivanhoe.

This Aboriginal Cultural Heritage Assessment has been prepared to support the application to modify Development Consent (SSD 5012) for the Project.

The Modification does not change the approved Atlas-Campaspe Mine surface disturbance footprint, however a portion of the modified Ivanhoe Rail Facility surface disturbance footprint is situated outside of the approved Ivanhoe Rail Facility surface disturbance area. Hence, this ACHA has been prepared in consideration of the modified Ivanhoe Rail Facility only (herein referred to as the Modification area).

This report presents an assessment of the Aboriginal cultural heritage related issues for the Modification area in accordance with the general requirements of the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (Part 6 National Parks and Wildlife Act 1974)* (DECCW, 2010a), *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010b), *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH, 2011), *Draft Guidelines for Aboriginal Cultural Impact Assessment and Community Consultation* (DEC, 2005), The Australia International Council on Monuments and Sites (ICOMOS) Burra Charter (Australia ICOMOS 1999), NSW National Parks and Wildlife Service *Aboriginal Cultural Heritage: Standards and Guidelines Kit* (NPWS, 1997), the Australian Heritage Commission *Ask First; A Guide to Respecting Indigenous Heritage Places and Values* (AHC 2002) and NSW Minerals Council *NSW Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects* (NSW Minerals Council, 2010).

The specific objectives of the cultural heritage assessment were to:

- Consult the local Aboriginal community to identify any concerns they may have (consultation with the Aboriginal community followed *Aboriginal Cultural Heritage Community Consultation Requirements for Proponents* [DECCW, 2010a]).
- Conduct a desktop assessment to delineate areas of known and predicted cultural heritage within the Modification area.
- Undertake an archaeological survey of known and predicted cultural heritage identified in the desktop assessment with representatives of the local Aboriginal community.

- Record any cultural heritage sites within the Modification area and assess their significance.
- Identify the nature and extent of potential impacts of the Modification on cultural heritage.
- Devise options in consultation with the community to avoid or mitigate potential impacts of the development on cultural heritage places and items.

No Aboriginal cultural heritage places or items have previously been recorded in the Modification area. The present survey encountered five Aboriginal cultural heritage sites, however two of these were located outside of the Modification area. These are two small stone artefact scatters and three isolated finds of stone artefacts. This assessment concludes these sites are not of high scientific or cultural significance. No non-Aboriginal heritage sites were recorded in the Modification area. Based on the results of this cultural heritage investigation and consultation with representatives of the Registered Aboriginal Parties the following is recommended:

- The Modification be allowed to proceed because the Modification area would be located in an area where harm to highly significant cultural heritage would be avoided.
- A suitably qualified archaeologist and representatives of the local Aboriginal community should be engaged to record and collect the Aboriginal objects in the Modification area. These items should be properly curated and stored at the approved "Keeping Place". The artefacts should be replaced within rehabilitated areas in consultation with local Aboriginal groups and the NSW Office of Environment and Heritage (OEH).
- In the unlikely event that human skeletal remains are encountered during the course of activities associated with the Modification, all work in that area must cease. Remains must not be handled or otherwise disturbed except to prevent further disturbance. If the remains are thought to be less than 100 years old, the Police or the State Coroner's Office (tel: 02 9552 4066) must be notified. If there is reason to suspect that the skeletal remains are more than 100 years old and Aboriginal, Tronox should contact the NSW Office of Environment and Heritage's Environmental Line (tel: 131 555) for advice. In the unlikely event that an Aboriginal burial is encountered, strategies for its management would need to be developed with the involvement of the local Aboriginal community.
- Tronox should revise the Heritage Management Plan (HMP) for the Atlas-Campaspe Mine to reflect the results and recommendations of this assessment. The HMP should continue to remain active for the life of the Modified Project and define the tasks, scope and conduct of all Aboriginal cultural heritage management activities. The HMP should be revised in consultation with the local Aboriginal community.
- Tronox should continue to provide training to all on-site personnel regarding the HMP strategies relevant to their employment tasks.
- Tronox should continue to involve the registered Aboriginal parties and any other relevant Aboriginal community groups or members in matters pertaining to the Modification.

# 1 INTRODUCTION

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Cristal Mining Australia Limited, which will be renamed Tronox Mining Australia Limited (Tronox) on 25 July 2019. Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* in 2014.

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, NSW and 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 to the south-west of the township of Ivanhoe (**Figure 1**).

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 existing Broken Hill Mineral Separation Plant (the MSP) (**Figure 1**).

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

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

Tronox proposes to modify Development Consent (SSD 5012) for the Project to allow for changes to optimise the Project (herein referred to the Optimisation Modification or Modification). To this end, Tronox commissioned Landsape Natural and Cultural Heritage Management (Landsape) to undertake an Aboriginal Cultural Heritage Assessment (ACHA) of the Modification. This Aboriginal Cultural Heritage Assessment (ACHA) has been prepared to support the application to modify Development Consent (SSD\_5012) for the Project.

The Modification (detailed in Section 3) does not change the approved Atlas-Campaspe Mine surface disturbance footprint, however a portion of the modified Ivanhoe Rail Facility surface disturbance footprint is situated outside of the approved Ivanhoe Rail Facility surface disturbance area. Hence, this ACHA has been prepared in consideration of the modified Ivanhoe Rail Facility only (herein referred to as the Modification area).

## 1.1 AIM AND OBJECTIVES OF THE ASSESSMENT

The objective of this assessment is to provide Tronox with an ACHA to support an approval for the Modification under the EP&A Act and the NSW *Environmental Planning and Assessment Regulation, 2000*.

This investigation provides a description of the context of the Modification and surrounds, identification of heritage places and cultural values within the Modification area, an assessment of the potential impacts to Aboriginal heritage as a result of the Modification, and development of recommendations to minimise, manage and mitigate these potential impacts.

This assessment has been undertaken in accordance with the relevant requirements of the various advisory documents and guidelines. These guidelines and documents include:

- *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (Part 6 National Parks and Wildlife Act 1974)* (NSW Department of Environment, Climate Change and Water [DECCW] 2010a).
- *Due Diligence Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010b).
- *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (NSW Office of Environment and Heritage [OEH], 2011)
- *Draft Guidelines for Aboriginal Cultural Impact Assessment and Community Consultation* (NSW Department of Environment and Conservation [DEC], 2005).
- The Australia International Council on Monuments and Sites (ICOMOS) Burra Charter (Australia ICOMOS, 1999).
- *Aboriginal Cultural Heritage: Standards and Guidelines Kit* (NSW National Parks and Wildlife Service [NPWS] 1997).
- *Ask First; A Guide to Respecting Indigenous Heritage Places and Values* (Australian Heritage Commission, 2002).
- *NSW Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects* (NSW Minerals Council, 2010).

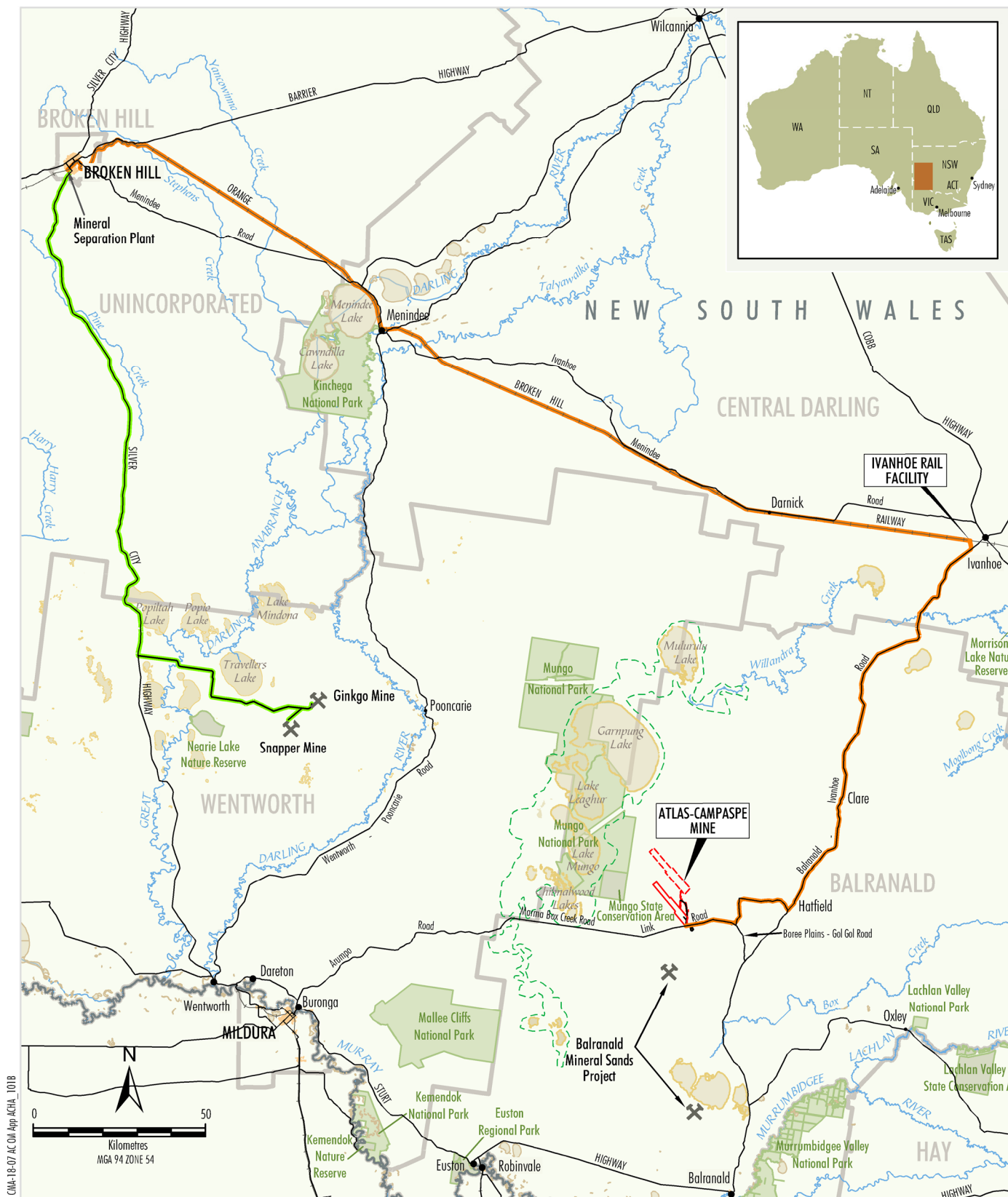
## 1.2 STRUCTURE OF THIS REPORT

This report has been prepared in consideration of the requirements of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010b) and as such includes the following specific information:

- Section 1: Outlines the Modification and the objectives and structure of this report.
- Section 2: Lists the investigators and contributors involved with this report.
- Section 3: Provides a summary description of the development proposal.
- Section 4: Details the consultation and partnership with indigenous communities.
- Section 5: Outlines the landscape context and includes descriptions of land use history, geology and vegetation within the locality of the Modification area.
- Section 6: Provides background information relevant to previous archaeological works including relevant ethno-history, the regional archaeological context and previous predictive models for the locality.

- Section 7: Describes predictions for the Modification and documents the archaeological survey and data collection, and includes information regarding the method of the survey and a description of the areas surveyed. Lists the results of the survey and provides a discussion and analysis of these results.
- Section 8: Assesses the cultural heritage significance of the Modification.
- Section 9: Assesses the impact of the Modification on Aboriginal heritage.
- Section 10: Lists the management, mitigation measures and recommendations.
- Section 11: Lists the references cited in this report.

A glossary of commonly used terms in the report is provided in **Appendix 1**.



**TRONOX**  
 OPTIMISATION MODIFICATION  
 Regional Location

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

**Figure 1**

## 2 INVESTIGATORS

Landskape was commissioned by Tronox in April 2019 to complete the ACHA for the Modification and to prepare this report.

Dr Matt Cupper, a qualified archaeologist and geoscientist with 20 years' experience as a cultural heritage advisor, was Landskape's project archaeologist.

The field investigation for the Modification was completed on 1 May 2019, and was attended by members of the Ivanhoe Community Working Party (Brian Etrich, Shana Kennedy and Joan Slade).

Community consultation pursuant to the OEH policy *Aboriginal cultural heritage consultation requirements for proponents 2010* (Consultation Guidelines) (DECCW, 2010a) was managed by Tronox.

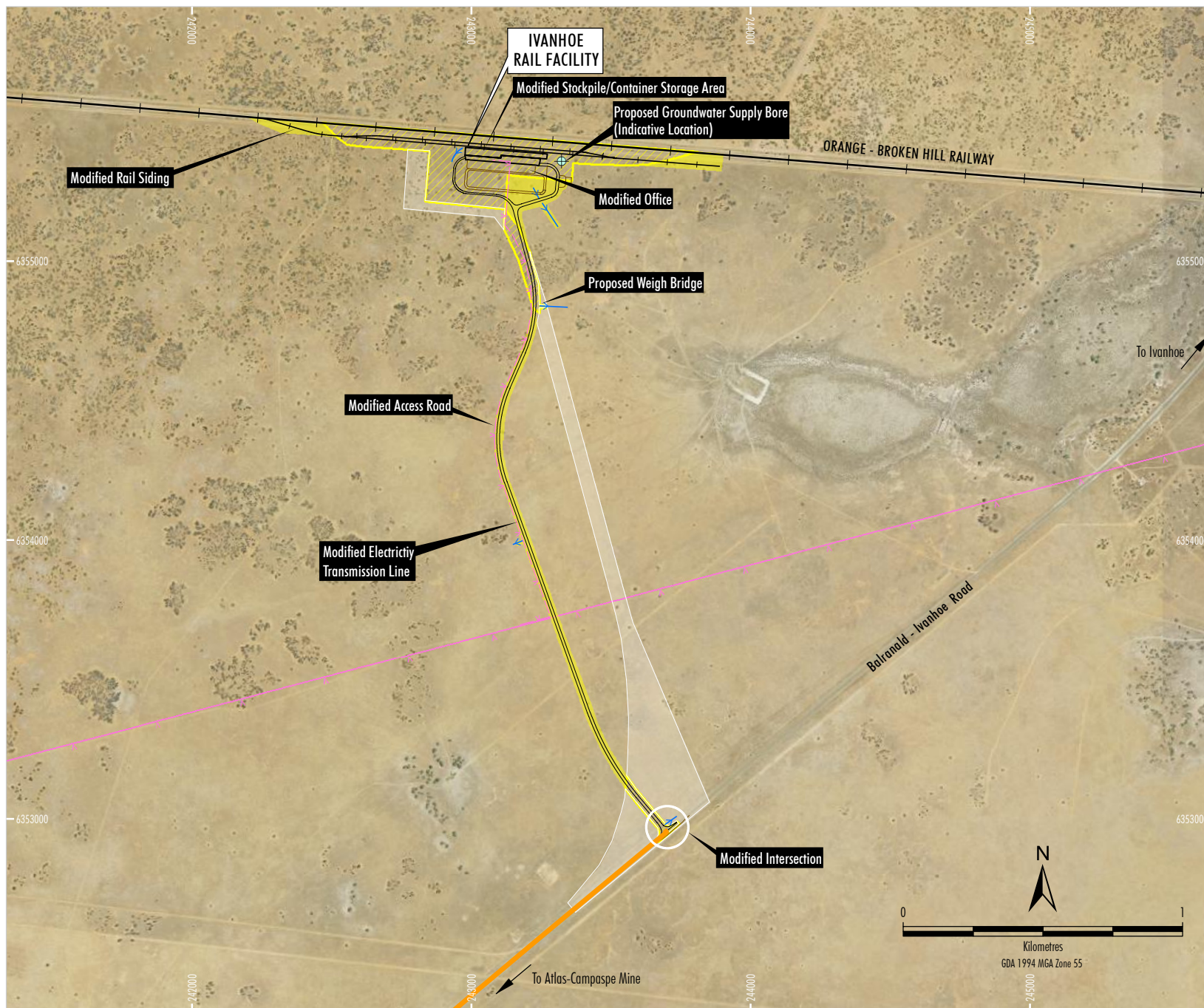
### 3 DESCRIPTION OF THE MODIFICATION

As described in Section 1, Tronox proposes to modify Development Consent (SSD 5012) for the Project to allow for changes to optimise the Project. The Modification 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 [m] to 920 m) and frequency (from six to eight train movements per week [i.e. four arrivals, four departures]) (**Figure 2**);
- 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 (**Figure 2**);
- extension of the Ivanhoe Rail Facility rail siding and addition of a passing siding (**Figure 2**);
- a revised alignment of the Ivanhoe Rail Facility access road and access road intersection (**Figure 2**);
- a groundwater supply bore for the Ivanhoe Rail Facility (**Figure 2**); and
- the use of local roads other than the road haulage route by Project-related light vehicles to access site.

The Modification would not change the following components of the Project:

- mine path, mine life or 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.



- 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 2**

## 4 ABORIGINAL COMMUNITY CONSULTATION

### 4.1 INTRODUCTION

In accordance with the Consultation Guidelines (DECCW, 2010a), this assessment has been prepared in consultation with the Aboriginal community (via the Registered Aboriginal Parties [RAPs]).

The following sections describe involvement by the RAPs and demonstrate that the input of the Aboriginal community has been considered when determining and assessing impacts, developing management measures, and making final recommendations relevant to Aboriginal cultural heritage within the Modification area.

### 4.2 ABORIGINAL COMMUNITY PARTICIPATION

The RAPs were consulted throughout the preparation of this assessment, including:

- review and comment on the Proposed Methodology;
- during the field survey with the representatives of the RAPs;
- during the review period for the draft ACHA; and,
- encouraged to provide feedback and input throughout the assessment process.

The following sections outline the process and outcomes of the community consultation undertaken during preparation of the assessment, and to ascertain the Aboriginal cultural heritage values, and associated management strategies, of the Modification area.

#### 4.2.1 Identification of Registered Aboriginal Parties

In accordance with Sections 4.1 and 4.2 of the Consultation Guidelines (DECCW, 2010a), the following individuals and organisations have been previously identified as Aboriginal stakeholders for the Project:

- Kullila Site Consultants;
- Michael (Mick) Kelly on behalf of Ngiyampaa people;
- Balranald Local Aboriginal Land Council;
- Barkindji Elders Council;
- Badger Bates;
- Ivanhoe Community Working Party;
- Muthi Muthi Nations Aboriginal Corporation;
- National Koorie Site Management;
- Wakool Indigenous Corporation;

- Maria Maher; and,
- Willandra Lakes 2 Traditional Tribal Groups Elders Council.

These Aboriginal stakeholders groups with an interest in Aboriginal heritage at the Project have been previously identified and Tronox has maintained ongoing consultation and engagement with these groups since their individual expressions of interest. These Aboriginal stakeholder groups include those parties who registered for Atlas-Campaspe Mineral Sands Project Aboriginal and Non-Aboriginal Heritage Assessment in 2012 (Niche Environment and Heritage, 2012), and who were consulted during the preparation of the Heritage Management Plan (HMP) (Cristal Mining Australia, 2017) in accordance with Condition 28, Schedule 3 of the Project Development Consent (SSD\_5012).

A consultation log with RAPs is included as **Appendix 2**.

#### **4.2.2 Presentation of Information about the Proposed Modification**

Information regarding the Modification was provided in writing to all RAPs on 29 March 2019. The correspondence included an invitation to attend an information session and field survey for the Modification and a copy of the Proposed Methodology was provided for review and comment (**Appendix 3**).

A minimum of 28 days were allowed for RAPs to provide input in regards to the following aspects of the Proposed Methodology:

- The nature of the Proposed Methodology.
- Any Aboriginal objects or places of cultural value within the Modification area, or issues of cultural significance.
- Any restrictions or protocols considered necessary in relation to any information of sensitivity that may be provided.
- Any other factors considered to be relevant to the heritage assessment.

The period for commenting on the Proposed Methodology was open between 29 March 2019 and 3 May 2019.

The information session regarding the modification was held on 30 April 2019 in Ivanhoe to explain the Modification and Proposed Methodology and address any RAP queries. The information session was attended by representatives of RAP Ivanhoe Community Working Party (represented by Faye Johnson and Brian Etrich).

#### **4.2.3 Aboriginal Cultural Heritage Field Survey**

All RAPs were invited to provide a representative for involvement in the field survey for the Modification. The following RAP participated in the survey:

- Ivanhoe Community Working Party (represented by Brian Etrich, Shana Kennedy and Joan Slade).

The Aboriginal cultural heritage field survey was completed on 1 May 2019. Further details regarding the survey and survey coverage are provided in Section 7.

The field survey was undertaken during the period for review and comment on the Proposed Methodology. It was described in the material provided to all RAPs with the Proposed Methodology and survey invitation, that if any RAP had comments on the Proposed (assessment) Methodology which (subject to agreement by Tronox) would have altered the field survey design/implementation (i.e. pedestrian survey across the Modification area), Tronox would commit to considering those submissions and take reasonable steps to address them, having regard to the survey requirements and the objectives of the Consultation Guidelines (DECCW, 2010a).

As no comments of this nature were received, no additional survey work was undertaken.

#### **4.3 ABORIGINAL COMMUNITY INFORMATION ABOUT CULTURAL SIGNIFICANCE**

As part of the review of the Proposed Methodology and during the field survey, the RAPs were asked to contribute their knowledge on the Modification area and surrounds. This information contributed to the assessment of the cultural heritage significance of the Modification area and is discussed further in Section 8.

#### **4.4 REVIEW OF THE DRAFT ACHA**

In accordance with the Consultation Guidelines (DECCW, 2010a), an initial draft of this ACHA was provided to all RAPs listed in Section 4.2 for review and comment on 17 May 2019, with feedback requested by 21 June 2019. No comments were received from the RAPs on the draft ACHA.

## 5 ENVIRONMENTAL CONTEXT

### 5.1 INTRODUCTION

The *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW, 2010b) requires a review of the environmental context to assist in the determination or prediction of the potential of a landscape to have accumulated or preserved objects, the ways Aboriginal people may have used the landscape in the past, with regard to identifiable resources or focal points for activities, and the likely distribution of the material traces of Aboriginal land use based on these factors.

Detailing the landscape context is an integral procedure in modelling potential past Aboriginal land use practices and/or predicting site distribution patterns. The natural environment of an area influences the availability of local resources such as food and raw materials for artefacts, rock platforms for engravings and axe sharpening, and rock outcrops that may provide shelter. The landscape also provides the sediments that may bury objects and archaeological features, as well as the erosive processes that might expose or disperse them.

Geomorphic (land formative) processes may impact upon the type and frequency of archaeological remains. Past climate may also influence the location and types of resources available, which in turn shapes settlement and mobility patterns of past Aboriginal groups in the area. The location of different site-types (such as middens, stone artefact scatters, etc.) are strongly influenced by factors such as these along with a range of other associated features, which are specific to different land systems.

### 5.2 GEOLOGY

The Modification area is located in the Central Darling region of the Murray Basin. The surface geology of the region is mostly aeolian (wind-blown) sediments, while underlying sequences within the basin were deposited by shallow seas and lakes over the past 60 million years (Brown and Stephenson, 1991).

### 5.3 LANDFORMS AND VEGETATION

The Modification area is located in sandplains, aeolian features comprising low, undulating regions of irregular sandy hummocks. The sandplains are vegetated by mosaics of Belah—Rosewood/Acacia Woodland and Native Grassland/Sparse Acacia/Chenopod Shrubs.

The Modification area falls within the Hatfield sandplain land system (Soil Conservation Service, 1985, 1991) (**Figures 3 and 4**). The features of the Hatfield sandplain land system are provided below:

- *Hatfield land system*: plains of solonized brown soils, red and brown texture-contrast soils and red earths with scattered clumps of Rosewood and Belah; moderately dense Bluebushes and Bladder Saltbush (*Atriplex vesicaria*); dunes of deep brownish sands with clumped White Cypress Pine (*Callitris glaucophylla*), Prickly Wattle (*Acacia victoriae*) and Bluebushes; depressions of grey clays with Dillon Bush and Canegrass (*Eragrostis australasica*).



**Figure 3.** Belah woodland with Bluebush understorey in the Hatfield land system of the northern part of the Modification.



**Figure 4.** Belah woodland with Bluebush understorey in the Hatfield land system of the southern part of the Modification.

## 6 ABORIGINAL CULTURAL HERITAGE CONTEXT

Some of the earliest evidence of human occupation of Australia comes from south-western NSW (Bowler *et al.*, 1970, 2003; Thorne *et al.*, 1999; Cupper and Duncan, 2006; Olley *et al.*, 2006). Stone artefacts found at Lake Mungo, about 100 km to the west of the Modification, have been dated to between 46,000 to 50,000 years ago (Bowler *et al.*, 2003). The burials of a male and female at Lake Mungo are 42,000 years old (Olley *et al.*, 2006, cf. Thorne *et al.*, 1999). People were also at nearby Lake Menindee from 45,000 years ago (Cupper and Duncan, 2006) and at Lake Victoria on the Murray River by around 21,000 years ago (Gill, 1973).

### 6.1 ETHNO-HISTORIC CONTEXT

Aboriginal people of the Ngiyampaa language group occupied the Central Darling region at the time of first contact with Europeans (Sturt, 1982 [1833]; 1984 [1844-6]; Mitchell, 1839; Eyre, 1985 [1842]; Krefft, 1865, Allen, 1974; Tindale, 1974; Hardy, 1976; Hercus, 1982, 1993). These tribes shared similar language and kinship systems, notably the division of members into matrilineal moieties (two-part social classification) known as Mukwara (Wedge-tailed Eagle) and Kilpara (Raven) (Tindale, 1974; Hercus, 1982, 1993; Blows, 1995).

At the time of European contact the Barkandji were hunter-fisher-gatherers and appear to have had a semi-sedentary lifestyle. Early accounts by European observers suggest that they lived near more permanent water sources such as along the stream courses and lakes of the Murrumbidgee and Lachlan Rivers during the warmest months of the year, with people moving into the sandplains to collect food after winter rains (Allen 1974).

Aspects of the initial interaction between Europeans and Ngiyampaa led to violent conflict. Aborigines were shot, poisoned and displaced from their land by pastoral settlers and, in retaliation, sheep and shepherds were speared. Within a decade of the first contact many of the Ngiyampaa were living adjacent to pastoral homesteads, often working as shepherds or engaged in other labouring activities.

### 6.2 PREHISTORIC CONTEXT

Accounts of Aboriginal land use of the Central Darling during the late nineteenth and early twentieth centuries provide an insight into possible settlement patterns in the prehistoric period. Allen (1974), using these historical ethnographies and the archaeological record, invoked a subsistence model for the region based on the relationship between occupation of the riverine corridors and sandplains. Large populations of people congregated at the rivers during spring and summer and whenever the systems were high. Following seasonal rains smaller, mobile bands dispersed over the plains exploiting ephemeral resources (Allen, 1974).

The material record of this occupation is preserved in the archaeological sites of the Central Darling region, most of which date to the period since the last Ice Age (after around 18,000 years ago) (Hope, 1981; Balme and Hope, 1990; Balme, 1995). All that remains at many of these sites are flakes of stone debris from the making and resharpening of stone tools. These were made both at Aboriginal open habitation areas (campsites) or special activity areas such as stone knapping sites. As well as being the sites of manufacture and maintenance of stone implements, open habitation areas usually contain evidence of domestic and other activities such as cooking and food preparation. Campfires or oven hearths are common, marked by calcrete, baked clay, ferricrete, sandstone and silcrete heat retaining stones or hearthstones and charcoal. Organic remains consist of burnt animal bones, Emu and aquatic bird eggshell and freshwater mussel shell.

### **6.3 TYPES OF ABORIGINAL CULTURAL HERITAGE SITES IN THE REGION**

Based on the results and analytical conclusions of previous archaeological surveys in similar landscape contexts in the Central Darling it is possible to predict the types and topographic contexts of Aboriginal cultural heritage sites in the Modification area. The occurrence and survival of archaeological sites is, however, dependent on many factors including micro-topography and the degree of land surface disturbance.

The types of Aboriginal cultural heritage site previously recorded in the Central Darling are described in Sections 6.3.1-6.3.8.

#### **6.3.1 Stone Artefact Scatters**

Scatters of stone artefacts exposed at the ground surface are one of the most commonly occurring types of archaeological site in the region (Hope, 1982). The remains of fire hearths may also be associated with the artefacts. In rare instances, sites that were used over a long period of time may accumulate sediments and become stratified. That is, there may be several layers of occupation buried one on top of another.

Stone artefact scatters are almost invariably located near permanent or semi-permanent water sources. Local topography is also important in that open campsites tend to occur on level, well-drained ground elevated above the local water source. In the Central Darling region they are commonly located on river terraces and along creek-lines and also around the margins of lakes, swamps and claypans.

#### **6.3.2 Hearths**

Hearths consist of lumps of burnt clay or stone cobble hearthstones. Sometimes ash and charcoal are preserved. Other materials found in hearths include animal bone, freshwater mussel shell, emu eggshell and stone artefacts. Hearths probably represent the remains of cooking ovens, similar to those described in ethnographic accounts by Major Thomas Mitchell (1839) and Peter Beveridge (1889) (see also Coutts *et al.*, 1979). These were lined with baked clay nodules and stone cobbles, possibly to retain heat. Hearths may be isolated or occur in clusters and may be associated with open campsites or middens. They are often located in dune swales, particularly on claypans, near soaks and on floodplain terraces.

### 6.3.3 Freshwater Shell Middens

Shell middens are deposits of shell and other food remains accumulated by Aboriginal people as food refuse. In inland New South Wales these middens typically comprise shells of the freshwater lacustrine mussel *Velesunio ambiguus* or the freshwater riverine mussel *Alathyria jacksoni*. Freshwater middens are most frequently found as thin layers or small patches of shell and often contain stone or bone artefacts and evidence of cooking. Such sites are relatively common along the Murrumbidgee and Lachlan Rivers and their associated lakes and tributaries.

### 6.3.4 Earth Mounds

Earth mounds may have been used by Aboriginal people as cooking ovens or as campsites. They are common on the plains of southwestern NSW. Originally they appear to have ranged from 3 to 35 metres in diameter and from 0.5 to 2 metres in height. Today, however, they may be difficult to recognize because of the effects of ploughing, grazing and burrowing rabbits. Earth oven material, stone artefacts, food refuse and the remains of hut foundations have been exposed in excavated earth mounds.

### 6.3.5 Quarry Sites

Quarries are locations where Aboriginal people obtained raw material for their stone tools or ochre for their art and decoration. Materials commonly used for making flaked stone tools include chert, silcrete, quartz and quartzite. In the Central Darling region stone sources are particularly scarce. Silcrete outcrops occur at a number of locations in south-western New South Wales). Chert is found exposed in cliffs incised by the Murray River in South Australia. Most other stone in the Central Darling region was probably sourced via long-distance trade links with the Barrier Ranges and the southeastern Australian Highlands.

### 6.3.6 Modified Trees

Slabs of bark were cut from trees by Aboriginal people and used for a variety of purposes including roofing shelters and constructing canoes, shields and containers. Scars also resulted from the cutting of toeholds for climbing trees to obtain honey or to capture animals such as possums. In the Central Darling region River Red Gums and Black Box are the most commonly scarred species. The classification of scarred trees as natural, European or Aboriginal is often problematic. However, if the scar is Aboriginal the tree must now be more than ~150 years old.

### 6.3.7 Stone Arrangements, Ceremonial Rings and Ceremony and Dreaming Sites

Stone arrangements range from cairns or piles of rock to more elaborate arrangements such as stone circles or standing slabs of rock held upright by stones around the base. Some stone arrangements were used in ceremonial activities whilst others may represent sacred or totemic sites. Other features associated with the spiritual aspects of Aboriginal life are those now called 'ceremony and dreaming' sites. These can be either stone arrangements or natural features such as rock outcrops, which may be associated with initiation ceremonies or the activities of ancestral creators.

### 6.3.8 Burials

Aboriginal burial grounds may consist of a single interment or a suite of burials. Burials tend to be in areas of sandy soil that were easy to dig and above floodwaters. Burials are frequently located in source-bordering sand dunes, sand ridges, lunettes and levees along watercourses (Bonhomme, 1993; Hope, 1993). Knowledge of Aboriginal burial grounds is best sought from local Aboriginal communities.

## 6.4 PREVIOUSLY RECORDED ABORIGINAL CULTURAL HERITAGE SITES IN THE MODIFICATION AREA

There are no previously recorded Aboriginal cultural heritage sites recorded within the Modification area on the NSW OEH Aboriginal Heritage Information Management System (AHIMS) database (AHIMS search 419820 10 May 2019; **Appendix 5**).

The closest previously recorded sites to the Modification area are twenty-two Aboriginal cultural heritage sites comprising fifteen stone artefact scatters, five with hearths, and seven isolated finds of stone artefacts. These were recorded by Niche Environment and Heritage (2012) in the vicinity of the approved Ivanhoe Rail Facility surface disturbance area, and are located immediately adjacent to the Modification area.

## 7 CULTURAL HERITAGE FIELD INVESTIGATION

In accordance with the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH, 2011) and *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECC, 2010b), an archaeological design and survey methodology was prepared as a key component of the cultural heritage field assessment. Details of the archaeological design and survey methodology are presented in the following sections.

### 7.1 OVERVIEW OF PREVIOUS ARCHAEOLOGICAL INVESTIGATIONS

The Aboriginal archaeology of the Central Darling region is known generally from a number of studies, but very little systematic archaeological research has been undertaken in the sandplains of the Central Darling. Archaeological surveys of developments in these areas are limited to those conducted by Niche Environment and Heritage (2012) and Cupper (2018).

Other areas in southwestern NSW that have been archaeologically surveyed include the Darling River and its associated lakes (Hope, 1981; Balme and Hope, 1990; Craib, 1992; Martin *et al.*, 1994; Balme, 1995; Marshall and Smith, 1998; Pardoe and Martin, 2002; Pardoe, 2003), Murray River and Lake Victoria (Bonhomme, 1993; Hope, 1998) and the Willandra Lakes (see Johnston and Clark, 1998). Regional studies and syntheses of the archaeological record of south-western NSW include those of Allen (1974), Hope (1982) and Bonhomme Craib and Associates (1999, 2001).

Niche Environment and Heritage (2012) previously surveyed the areas associated with the approved Project (i.e. the Atlas-Campaspe Mine, mineral concentrate transport route and Ivanhoe Rail Facility). Cupper (2018) further recorded Aboriginal stone artefacts in the areas associated with the approved Project.

Niche Environment and Heritage (2012) recorded twenty-two Aboriginal cultural heritage sites in the vicinity of the approved Ivanhoe Rail Facility surface disturbance footprint. These comprised fifteen stone artefact scatters, five with hearths, and seven isolated finds of stone artefacts.

### 7.2 CULTURAL HERITAGE SITE PREDICTIVE MODEL

Previous archaeological studies indicate that sandplains of the Central Darling have a low density of cultural heritage places. Occupation sites are almost invariably located at small ephemeral water sources such as swamps and claypans (McIntyre, 1981; Clark, 1983; Witter, 2001; Cupper, 2003a, 2018; Niche Environment and Heritage, 2012). The most frequently recorded Aboriginal sites in the sandplains are stone artefact scatters and hearths (OEH AHIMS site database). Isolated finds of stone artefacts and hearthstones are also represented in the archaeological record. Other Aboriginal cultural heritage site types previously identified in the Central Darling region are shell middens, stone quarries, ceremonial and dreaming sites, trees scarred by Aboriginal people, burials, earth mounds and stone arrangements (OEH AHIMS site database).

Based on these observations of archaeological site types and their distribution and landscape setting, the following predictive model of site types and locations within the Modification area was developed prior to the survey:

- **Stone artefact scatters, hearth sites and isolated finds of stone artefacts or hearthstones** have the potential to occur within the Modification area. The density of these types of sites was predicted to be low, given the absence of nearby permanent sources of water. Open occupation sites are typically found within 500 m of water sources, so such sites are most likely to be encountered on level ground adjacent to ephemeral swamps and claypans that intermittently retain surface water following rain.
- **Stone quarry** sites have the potential to occur in the Modification area. Silcrete outcrops noted elsewhere in the Central Darling region often occur at topographic low points in the landscape such as abandoned lake beds and playa floors (e.g. Hope, 1998; Cupper, 2003a, 2003b).
- **Scars made by Aboriginal people** are unlikely to occur on any of the trees in the Modification area, because River Red Gum and Black Box trees, the taxa typically scarred by Aboriginal people in the region, are absent in the study area.
- The chance of encountering **shell middens** was predicted to be negligible, as they are usually found near permanent water sources, absent from the area, as are **burial** sites. Source-bordering dunes adjacent to rivers and lakes are the landforms most likely to contain human skeletal remains.
- Although **stone arrangements** have been recorded in the Central Darling region, they are not common and were considered unlikely to be encountered in the area. Stone arrangements tend to occur on level ground, often on elevated landforms such as floodplain terraces.

While predictive studies such as this can be expected to identify areas in which sites associated with economic or subsistence activities may be present, notably open habitation areas, other sites may fall outside such a predictive framework. For example, places associated with spiritual aspects of traditional Aboriginal society such as ceremony and dreaming sites are often located at topographically distinct or unique features, which cannot be identified from an examination of maps or other records. For this reason, it was essential that local Aboriginal communities be consulted so that sites of significance to them can be identified.

### 7.3 FIELD METHODOLOGY

The archaeological field survey was conducted based on the sampling strategy developed in accordance with the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011) and Requirement 5a of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010b) and outlined in Section 7.1.

The objective of the field survey was to identify places of Aboriginal cultural significance within the Modification area.

### 7.3.1 Personnel

The survey was conducted over a period of one day on 1 May 2019. The participants of the field survey were project archaeologist Dr Matt Cupper of Landsape, together with the representatives from the RAP listed in Section 4.2.3 (**Figures 5 and 6**).



**Figure 5.** Survey team members inspecting the Modification area.



**Figure 6.** Survey team members inspecting the Modification area.

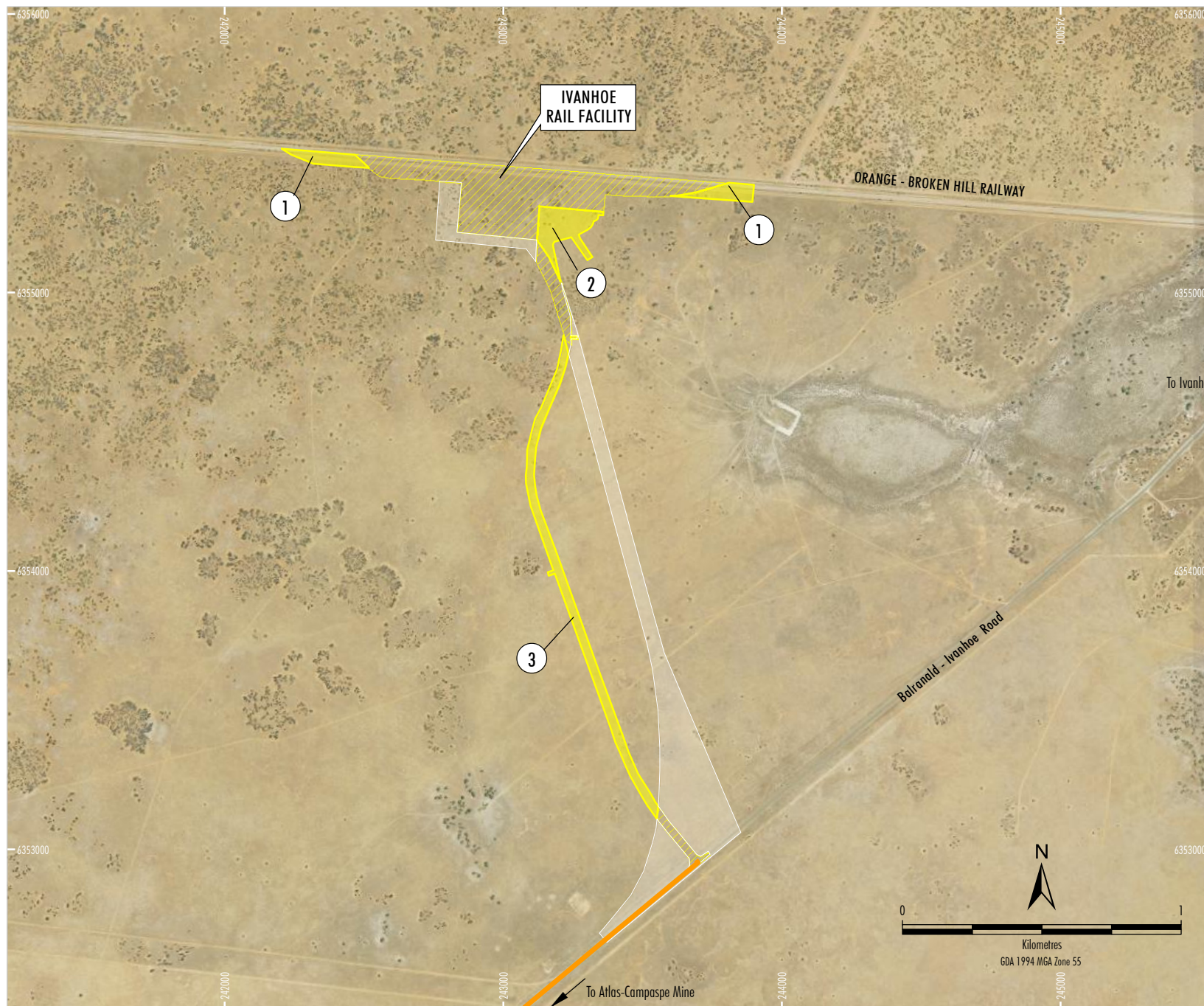
### 7.3.2 Survey Methods

The Modification area was inspected on foot by the project archaeologist and Aboriginal community representatives. The field team examined the ground surface for any archaeological traces such as stone artefacts, hearths, hearthstones, shells, bones and mounds. All mature trees in the areas of proposed disturbance were inspected for scarring or carving by Aboriginal people.

Particular attention was paid to areas with high ground surface visibility such as along stock and vehicle tracks and in scalds, gullies and other eroded areas.

The team members walked abreast across the surveyed areas in a series of closely spaced transects. These were evenly distributed over the areas of proposed disturbance and approximately 4 m apart. Due to the general openness of the landscape it was usually possible to identify likely site locations from at least 4 m and deviate from the transects to make closer inspections.

Survey units and descriptions of the visibility conditions for each survey unit are provided in **Table 1** and **Figure 7**.



- 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) and Landscape (2019)

Orthophoto: © NSW Department of Finance, Services & Innovation (2017)

**TRONOX** 

OPTIMISATION MODIFICATION

**Modified Ivanhoe Rail Facility**

- Survey Units

**Figure 7**

**Table 1.** Visibility Conditions at the Modification.

Survey Unit	Landforms	Vegetation	Exposures	Visibility	Survey Method
1	Sandplain	Belah-Rosewood woodland, Bluebush low shrubland	Animal tracks, Vehicle tracks, Scalds	80 %	Pedestrian
2	Sandplain	Belah-Rosewood woodland, Bluebush low shrubland	Animal tracks, Vehicle tracks, Scalds	80 %	Pedestrian
3	Sandplain	Belah-Rosewood woodland, Bluebush low shrubland	Animal tracks, Vehicle tracks, Scalds	80 %	Pedestrian

## 7.4 SURVEY COVERAGE DATA

### 7.4.1 Conditions of Visibility

Conditions of ground surface visibility affect how many sites are located. Visibility may also skew the results of a survey. If, for example, conditions of ground surface visibility vary dramatically between different environments, then this would be reflected in the numbers of sites reported for each area. The area with the best visibility may be reported as having the most sites (because they are visible on the ground) while another area with less visibility but perhaps more sites would be reported as having very little occupation. It is important therefore to consider the nature of ground surface visibility as part of any archaeological investigation.

Conditions of ground surface visibility were typically around 80 % (**Table 1**). Grass and herbaceous plant growth was very low and the ground surface was exposed by erosion by scalding and stock and vehicular traffic (**Figures 8-11**).

Survey units and descriptions of the visibility conditions for each survey unit are provided in **Table 1** and **Figure 7**.



**Figure 8.** Example of surface exposure at the Modification area.



**Figure 9.** Example of surface exposure at the Modification area.



**Figure 10.** Example of surface exposure at the Modification area.



**Figure 11.** Example of surface exposure at the Modification area.

#### 7.4.2 Coverage Analysis

Coverage analysis is a useful measurement to allow cultural resource managers to assess surveys from adjacent areas and it also allows some meaningful calculation of the actual sample size surveyed. The *actual* or *effective* area surveyed by a study depends on the conditions of ground surface visibility. Conditions of surface visibility are affected by vegetation cover, geomorphic processes such as sedimentation and erosion rates and the abundance of natural rock that may obscure the remains of cultural activities.

All of the Modification area was inspected on foot. The areas covered during the survey are outlined in **Table 2** and summarised by landform in **Table 3**. Survey coverage was high, given the intensive nature of the survey.

**Table 2.** Coverage of the Modification Area.

Survey Unit	Landform	Area (m <sup>2</sup> )	Coverage (m <sup>2</sup> )	Visibility (%)	Effective Cover (m <sup>2</sup> )	Effective Cover (%)	No. Sites
1	Sandplain	20,000	20,000	80	16,000	80	-
2	Sandplain	40,000	40,000	80	32,000	80	5
3	Sandplain	44,000	44,000	80	35,200	80	-
<b>Total</b>		<b>104,000</b>	<b>104,000</b>	<b>80</b>	<b>83,200</b>	<b>80</b>	<b>5</b>

**Table 3.** Landform Summary of Sampled Areas of the Modification Area.

Landform	Landform Area (m <sup>2</sup> )	Area Effectively Covered (m <sup>2</sup> )	Landform Effectively Surveyed (%)	No. Sites
Sandplain	104,000	83,200	80	5
<b>Total</b>	<b>104,000</b>	<b>83,200</b>	<b>80</b>	<b>5</b>

## 7.5 SURVEY RESULTS

Five Aboriginal cultural heritage sites were newly identified during the survey in the Modification area. These sites consisted of two stone artefact scatter sites (with three artefacts at each) (RLF29, RLF 32) and three isolated finds of stone artefacts (RLF30, RLF31, RLF33). Summary descriptions of the newly identified Aboriginal cultural heritage sites are below, and in **Table 4**:

- RLF29 - two silcrete angular fragments and one silcrete flake on the scalded sandplain in the northern part of the Modification area;
- RLF30 - one silcrete flake on the scalded sandplain in the northern part of the Modification area;
- RLF31 - one silcrete angular fragment on the scalded sandplain in the northern part of the Modification area;
- RLF32 - three silcrete angular fragments on the scalded sandplain in the northern part of the Modification area; and,
- RLF33 - one silcrete angular fragment on the scalded sandplain in the northern part of the Modification area.

Three of the Aboriginal cultural heritage sites (RLF29, RLF30 and RLF31) are located in the approved Ivanhoe Rail Facility surface disturbance area. The remaining two Aboriginal cultural heritage sites (RLF32 and RLF33) are located in the Modification area.

No non-Aboriginal sites were recorded in the Modification area.

**Table 4.** Newly Identified Aboriginal Cultural Heritage Sites within and near the Modification Area.

Site Name	Location GDA94 mE (Zone 55)	Location GDA94 mN (Zone 55)	Landform	Size (m)	Contents
RLF29	242862	6355330	Sandplain	5 x 5	2 silcrete angular fragment, 1 silcrete flake
RLF30	242971	6355324	Sandplain	na	1 silcrete flake
RLF31	243143	6355314	Sandplain	na	1 silcrete angular fragment
RLF32	243246	6355220	Sandplain	10 x 10	3 silcrete angular fragments
RLF33	243260	6355292	Sandplain	Na	1 silcrete angular fragment

Images of Aboriginal cultural heritage sites at the Modification area are depicted in **Figures 12 to 15**. The locations of the sites are shown on **Figure 16**.



**Figure 12.** RLF29



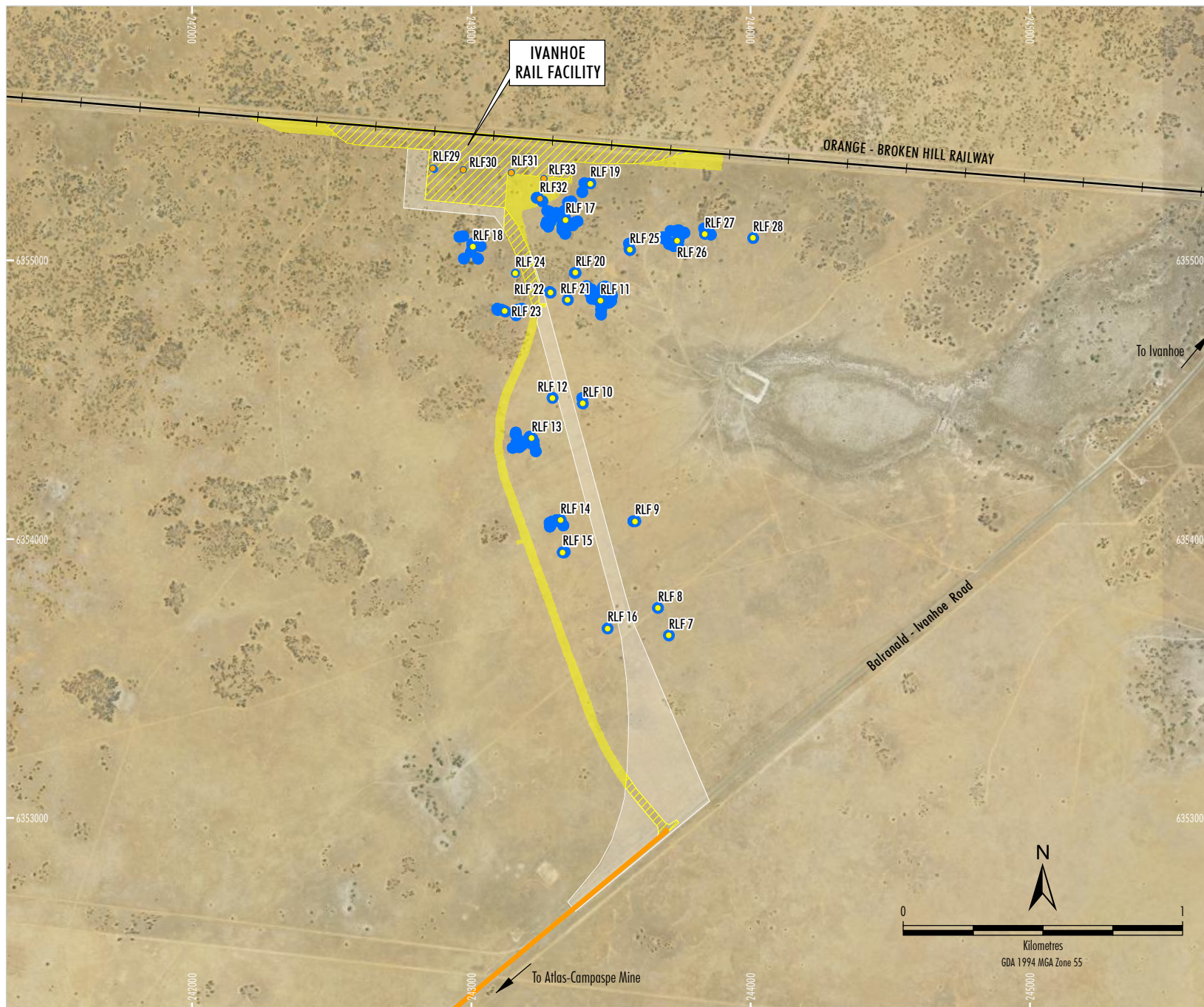
**Figure 13.** RLF30



**Figure 14.** RLF31



**Figure 15.** RLF32.



**Figure 16**

## 7.6 IDENTIFIED ABORIGINAL CULTURAL VALUES

As described in earlier sections, this assessment has been prepared in accordance with the Consultation Guidelines (DECCW, 2010a) and the NSW *National Parks and Wildlife Regulation 2009*.

The cultural values assessment undertaken to date has been based on the following:

- Review of background resources including previous archaeological investigations for the surrounding region and the approved Project (Niche Environment and Heritage, 2012; Cupper, 2018);
- Historical research;
- Discussions with RAPs during field survey;
- Discussions with RAPs during community information sessions;
- Requests for comments during the review period for the Proposed Methodology; and
- Specific meetings with RAPs upon request.

These points of consultation provided the opportunity for the Aboriginal community to have direct input into the management of Aboriginal cultural heritage values (both tangible and intangible) in the Modification area.

During the archaeological survey the attending RAPs did not identify any specific locations within the Modification area or wider surrounds as being of high or specific cultural significance.

RAPs identified the Modification area as a place that Aboriginal people had occupied in the past. Generally, the Aboriginal representatives viewed all the Aboriginal cultural heritage sites as significant because they preserve a record of how and where people lived in the past.

## 8 CULTURAL HERITAGE VALUES

### 8.1 ABORIGINAL CULTURAL HERITAGE SIGNIFICANCE

The significance of Aboriginal cultural heritage sites such as that found during this study are usually assessed in terms of their importance to archaeologists (i.e. their scientific or research significance), their importance to contemporary Aboriginal people and their importance to the general public. Once the significance of a site has been assessed it can be ranked against others and specific recommendations formulated. Criteria for assessing scientific significance are set out below. The values used in this assessment have been the subject of some discussion in the archaeological literature and the information provided is drawn from a number of sources (e.g. Bowdler, 1983).

#### 8.1.1 Scientific Significance

A number of criteria are used to assess the scientific significance of a site. These include the integrity of a site, its structure and contents. All of these criteria combine to give a site its value as a research tool for archaeologists. In addition to the above criteria a site may also be of scientific significance because of its representativeness or rarity. It is a basic tenet of archaeology that any site which is not represented elsewhere is of great value because archaeologists are concerned with preserving a representative sample of all site types for future generations.

##### Site Integrity

Site integrity refers to its state of preservation or condition. A site can be disturbed through a number of factors including natural erosional processes, destructive land use practices or repeated use of a site in the past by both humans and animals.

low	highly disturbed or poorly preserved with little research potential.
moderate	some disturbance but remaining cultural material allows for some research potential.
high	little or no disturbance to site, good preservation and considerable research potential.

In terms of site integrity the sites located during this survey would rate low. This assessment is based on the degree of disturbance noted during the investigation. The stone artefact scatters were typically identified in modified contexts such as along gullied drainage lines or graded fence lines. They have been disturbed by repeated traffic of hooved animals and vehicles, coupled with erosion by wind and water.

### Site Structure

Site structure refers to the physical dimensions of a site (i.e. its area and depth or stratification). A large site, or a site with stratified deposits, usually has more research potential than a small site or surface scatter. In some instances, however, specific research questions may be aimed at smaller sites in which case they would be rated at a higher significance than normal.

low	small surface scatters with no stratified deposit.
moderate	medium to large surface scatters with or without stratification.
high	large <i>in situ</i> surface scatters, any site with stratified deposit.

All of the stone artefact sites are very small in size, with one or two artefacts, and have a low site structure. Artefacts form a lag deposit on scalded or exposed surfaces. The surfaces of all these sites are degrading.

### Site Contents

Site contents refers to the range and type of occupation debris found in a site. Generally, sites that contain a large and varied amount of organic and non-organic material are considered to have greater research potential than those sites with small, uniform artefacts.

low	small amount and low diversity of cultural material.
moderate	medium amount and diversity of cultural material.
high	large and diverse amount of cultural material.

The original cultural materials of the sites recorded during the survey have been exposed to weathering. Only stone artefacts remain all of the open sites.

Stone artefacts are of silcrete. The flaked lithics are unmodified flakes and angular fragments. Artefact density at these sites is very low.

The stone artefact sites rate low by the site contents criterion.

### Site Representativeness and Rarity

Representativeness or rarity refers to how often a particular site type occurs in an area and requires some knowledge of the background archaeology of the area in which the study is being undertaken. Sites that are representative of the local and regional archaeological record may have value for that reason and if a site is rare or unique in some way then it is *ipso facto* significant (Bowdler, 1983).

low	many of the same site type occurring in a single area or region.
moderate	site type occurs elsewhere but not in great quantity or with good preservation.
high	site type is rare or unique.

On the basis of the results of previous archaeological investigations (e.g. Niche Environment and Heritage, 2012; Cupper, 2018) and information held on the OEH AHIMS site register it is clear that stone artefacts are widespread in the region. These types of archaeological sites located during this study are therefore not unique and are well represented outside the Modification area.

A summary of the archaeological significance assessment of the sites is presented in **Table 5**.

**Table 5.** Assessment of Significance of the Aboriginal Cultural Heritage Sites.

Site Name	Scientific Significance				Cultural Significance	Educational Significance	Aesthetic Significance
	Integrity	Structure	Contents	Rarity			
RLF29	Low	Low	Low	Low	Moderate	Low	Low
RLF30	Low	Low	Low	Low	Moderate	Low	Low
RLF31	Low	Low	Low	Low	Moderate	Low	Low
RLF32	Low	Low	Low	Low	Moderate	Low	Low
RLF33	Low	Low	Low	Low	Moderate	Low	Low

### 8.1.2 Aboriginal Social, Cultural, Spiritual and Historical Significance

The significance of a site is not restricted to its scientific or research value. The views of Aboriginal people on the significance of archaeological sites are also important. Their perceptions usually stem from traditional, cultural and educational beliefs although most local Aboriginal communities also value the scientific information that archaeological sites may be able to provide.

Archaeological sites provide connections to the past for the present Aboriginal community and for future generations. Aboriginal cultural heritage sites such as those identified during this survey can also provide information about past lifestyles and strengthen the links between Aboriginal people and the land.

The level of significance attributed to individual sites may vary according to a number of factors including the nature and integrity of the heritage items and the landscape in which the site is located. The views of the Aboriginal representatives involved in the field survey and community field inspections and discussion forums are considered to be indicative of Aboriginal community attitudes.

The Aboriginal significance of the sites listed in **Table 5** was established through consultation with the Aboriginal stakeholders involved with the field survey.

Generally, the Aboriginal community view all archaeological sites as significant because they preserve a record of how and where people lived in the past. Such cultural heritage sites also stand as testimony to the continuation of Aboriginal culture and association with the land. However, the Aboriginal community representatives involved in this assessment did not have particularly high spiritual, traditional, historical or contemporary associations with the archaeological sites identified in the Modification area.

### **8.1.3 Educational Significance**

The value of archaeological sites to the general public is generally assessed by their potential to educate the public about the Aboriginal past. The sites rank low by this criterion. They are small, isolated and unlikely to attract particular interest in Aboriginal heritage.

### **8.1.4 Aesthetic Significance**

Aesthetic significance relates to the scale, form, materials, texture, colour, space and relationship of the components of the place. The relationship of the place with its setting is equally important. The sites are subdued features in the landscape and lack high aesthetic value.

## **8.2 ABORIGINAL CULTURAL LANDSCAPE**

Scientific information collected from the Aboriginal archaeological sites identified during this assessment, combined with social and cultural information provided by the Aboriginal community stakeholders and ethno-historical sources, allows interpretation of the Aboriginal cultural landscape of the Modification area, provided in the following sections.

### **8.2.1 Summary of the Archaeological Record**

The material culture of past Aboriginal occupants of the Modification area comprises five stone artefact sites.

### **8.2.2 Aboriginal Settlement Patterns**

The locations of freshwater sources are likely to have been the main controlling factor of past Aboriginal occupation of the Modification area. Humans carry out most of their activities close to fresh water, rarely straying far from reliable water sources (see Gould, 1969, 1980; Allen, 1974; Jochim, 1976; Mitchell, 1990; McNiven, 1998). They also prefer larger or more persistent water sources to smaller, ephemeral water bodies. As well as the obvious abundance of aquatic molluscs, fish and birds at large, permanent water sources, mammals (such as macropods) that were hunted for protein and skins are also limited by water availability.

The fact that all of the Aboriginal cultural heritage sites identified during the survey were on the margins of ephemeral drainage lines confirms predictive models that occupation will favour well drained land adjacent to waterways (e.g. see Allen, 1974).

There are no permanent streams or wetlands in the Modification area. There are a number of unnamed, ephemeral watercourses that episodically flow for brief periods after heavy rain, but any pools of water rapidly seep away and evaporate. Peak occupation of the Modification area is likely to have corresponded to when these transient supplies were available.

### 8.2.3 Aboriginal Subsistence Strategies

Hunter-fisher-gatherers obtain the resources necessary for life by foraging and collecting subsistence strategies. Foragers gather food as it is encountered, regularly moving between resource zones and rarely storing food (Binford, 1989). Collectors, alternatively, adopt a logistical strategy for procuring resources. They often rely on stores of food and may maintain base camps, with smaller groups dispersing to collect resources. Foraging and collecting are two end-members of a subsistence continuum, with most hunter-fisher-gatherer societies engaging in a combination of both strategies (Yellen, 1977; Binford, 1989; Renfrew and Bahn, 1991).

Sites occupied by hunter-fisher-gatherer people may reflect these strategies (Binford, 1989). For example, base camps were generally occupied for long periods of the year and were used for a range of domestic and industrial activities. Alternatively, base camps may have been intensively used for part of the year, acting as congregative focal points. Temporary field camps were dispersive sites, created when groups charged with carrying out a specific task journeyed beyond the daily foraging radius.

The frequency of site occupation can sometimes be determined from their contents and structure. Residential base campsites, occupied over relatively long periods of time, tend to have a more complex structure than short-term campsites. Base camps may contain evidence of a wide variety of activities associated with daily habitation. Short-term sites were probably only occupied for a specific reason, such as to collect a particular resource. These usually display evidence of being occupied only once or twice, and are often smaller, with fewer and less diverse archaeological remains.

It is probable that the Aboriginal people who occupied the Modification area were hunter-fisher-gatherers employing both foraging and collecting subsistence strategies. These people would have primarily occupied the riparian zones of the Lachlan River and its more permanent anabranches including Willandra Creek, dispersing from the riverine corridors to exploit ephemeral resources of the more poorly watered hinterland during favourable climatic conditions, as invoked in the subsistence model of Allen (1974).

Only relatively small areas were investigated in a heterogeneous landscape, but it is probable that the archaeological record of the Modification area reflects the occupation of the backcountry by small, mobile bands. Cultural heritage sites in the Modification area probably derive both from temporary habitation sites used by small groups during periods of seasonal dispersal and temporary field camps used by small groups engaging in specific tasks such as procuring lithic resources. This is because the drier bedrock hills and slopes seasonally supported food plants and animals and also contained mineral outcrops exploited for utilitarian purposes.

Plant resources in the Modification area that could have been harvested by winter foragers include seeds from grasses (e.g. Gott, 1983; Porteners, 1993; Latz, 1995). When holding surface water, the nearby claypans could have become havens for birds such as wading species, which may have been hunted. Ephemeral water sources would have also attracted macropods.

#### 8.2.4 Synthesis

Aboriginal people probably occupied the Modification area following the end of the last Ice Age some 18,000 years ago. The Aboriginal archaeological record of the Modification area is probably late Holocene (less than a few thousand years) in age. The lack of reliable, permanent sources of water in the hinterland of the riverine plains would have made the Modification area unattractive for permanent habitation.

The non-stratified stone artefact sites at the Modification area probably represent temporary occupation sites. People from the small, mobile groups that probably periodically journeyed into the backcountry from the rivers and streams of the riverine plains to forage for food and other resources may have occupied such an area for brief durations. Past Aboriginal people probably also transited through the region to access areas for resource exploitation and cultural purposes.

Foraging and collecting subsistence strategies are clearly artificial divisions, and these tactics undoubtedly overlapped.

## 9 POTENTIAL IMPACTS OF THE MODIFICATION ON ABORIGINAL CULTURAL HERITAGE

The Modification could potentially directly and indirectly impact upon Aboriginal cultural heritage sites. Potential negative direct and indirect impacts may result from the modified Ivanhoe Rail Facility and could include the destruction of the sites via earthmoving, indirect physical affects (e.g. dust deposition) or aesthetic affects.

In accordance with the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH, 2011), the principles of ecologically sustainable development were considered in assessing the likely harm of the Modification to Aboriginal cultural heritage sites.

### 9.1 POTENTIAL DIRECT IMPACTS

Construction of the modified Ivanhoe Rail Facility would disturb the current land surface and would likely directly impact the Aboriginal cultural heritage sites associated with the modified Ivanhoe Rail Facility surface disturbance area if not relocated prior to disturbance.

Such impacts on cultural heritage values typically fall into three categories:

- the loss of information which could otherwise be gained by conducting research today;
- the loss of the cultural heritage resource for future research using methods and addressing questions not available today; and
- the permanent loss of the physical record.

These impacts can usually be mitigated to various degrees, depending on the nature and significance of the cultural heritage. Where sites are of low scientific significance, their destruction may have little scientific consequence. This could be due to the lack of useful information that could be gained from research, or the availability of many equivalent and alternative sites for study.

Aboriginal cultural heritage sites with greater scientific significance may be the subject of investigation prior to their disturbance. This allows for the salvage of information, and the recovery of a sample of artefactual materials according to current methods and research priorities. Sites and site groupings that are common elsewhere may not require the same degree of salvage attention as those which are rare, of high significance, and subject to active deterioration.

Salvage investigations can provide for the discovery of new knowledge about the past human occupation and land use of an area. Despite the loss of physical evidence involved, the information gained can in turn aid the interpretation and better management of the remaining cultural heritage resource.

## 9.2 POTENTIAL INDIRECT IMPACTS

The surface disturbance area for the modified Ivanhoe Rail Facility, which would disturb the Aboriginal cultural heritage sites, is relatively inflexible. Engineering constraints mean that facility components cannot be relocated away from the Aboriginal cultural heritage sites to avoid disturbance. Additionally, any such relocation would not remove threats to the sites from indirect disturbance.

## 9.3 CULTURAL HERITAGE AVOIDED BY THE MODIFICATION

Harm can be avoided to twenty-two Aboriginal cultural heritage sites near the proposed disturbance areas for the Modification. These comprise fifteen stone artefact scatters, five with hearths, and seven isolated finds of stone artefacts. These were recorded by Niche Environment and Heritage (2012) in the vicinity of the approved Ivanhoe Rail Facility surface disturbance area and are adjacent to proposed disturbance areas for the Modification area.

## 9.4 CULTURAL HERITAGE POTENTIALLY IMPACTED BY THE MODIFICATION

Five Aboriginal cultural heritage sites are located within the proposed disturbance area for the modified Ivanhoe Rail Facility. The Aboriginal cultural heritage sites are five stone artefact sites (RLF29 through to RLF33). This assessment has concluded that these sites are not of high scientific significance. The impact of the Modification on Aboriginal cultural heritage sites is determined by the nature and the degree of harm that the construction works for the Ivanhoe Rail Facility will cause. The type of harm is either direct or indirect and therefore the consequence of harm is a total or a partial loss in value (DECCW, 2010b). A total loss in value would occur when the entire site is impacted by the Modification. A partial loss of value would occur when only part of the site (such as in the case of an artefact scatter) is impacted by the Modification.

The potential impacts of the Modification on each of the Aboriginal cultural heritage sites in the Modification area are summarised in **Table 6**.

For the purposes of this assessment, it is conservatively assumed that the construction of the Ivanhoe Rail Facility would be of a nature that would cause direct harm to any Aboriginal objects or areas of cultural value (should they occur).

**Table 6.** Summary of Potential Impacts to Aboriginal Cultural Heritage Sites.

Site Name	Site Type	Type of Harm	Degree of Harm	Consequence of Harm
RLF29	Artefact (n=3)	Direct	Total	Total loss of value
RLF30	Artefacts (n=1)	Direct	Total	Total loss of value
RLF31	Artefacts (n=1)	Direct	Total	Total loss of value
RLF32	Artefacts (n=3)	Direct	Total	Total loss of value
RLF33	Artefacts (n=1)	Direct	Total	Total loss of value

## 9.5 POTENTIAL FOR PREVIOUSLY UNIDENTIFIED ABORIGINAL CULTURAL HERITAGE TO OCCUR IN THE MODIFICATION AREA

Although the Modification area was sufficiently surveyed, there remains the potential for Aboriginal cultural heritage sites to be located within this area (e.g. sites that may have been obscured by grass or soil at the time of survey). Such previously unidentified features, should they occur, would probably be isolated finds or low-density concentrations of stone artefacts (based on the predictive model outlined in Section 7.1 and informed by the results of the current survey, summarised in Section 7.5).

The shallow soils of the Modification area, coupled with past disturbance from pastoralism and track and fence construction, means that significant *in situ* subsurface cultural deposits are highly improbable.

The Modification area does not contain culturally sensitive landforms such as lunettes or source-bordering sand dunes where subsurface Aboriginal cultural deposits (e.g. burials) have been recorded previously.

A strategy for managing any newly identified Aboriginal objects during the life of the Modification is outlined in Section 10.

## 9.6 FLEXIBILITY OF THE MODIFICATION DESIGN

The potential area of disturbance associated with the modified Ivanhoe Rail Facility is relatively inflexible. Engineering constraints mean that the components cannot be relocated away from Aboriginal heritage sites to avoid disturbance.

## 9.7 POTENTIAL CUMULATIVE IMPACTS

The Modification is located within the south-western region of NSW, which contains a number of currently approved or operational mine sites and/or other large-scale infrastructure projects. These existing operations have caused adverse heritage impacts to a range of Aboriginal cultural heritage sites, principally archaeological ones. For the most part, these adverse impacts have been associated with the disturbance or destruction of Aboriginal cultural heritage sites subsequent to archaeological investigation and assessment.

The survey undertaken for this assessment indicate that the types of Aboriginal cultural heritage sites within the Modification area that may be impacted by the Modification generally comprise part of a region-wide distribution of very small open occupation sites including disturbed artefacts and hearths of low scientific significance. Given the low scientific significance of these Aboriginal cultural heritage sites, the cumulative effect that may result from the development of the Modification is considered to be low, and would be mitigated by the ongoing program of archaeological recording/salvage recommended by this assessment.

In terms of cultural values, the Modification is located within an area that has already been heavily modified by past clearing and pastoral activities. The Modification is considered likely to cause few impacts additional to those that have already occurred. On this basis, it is considered that the Modification would not appreciably increase cumulative impacts to Aboriginal heritage in the region.

## **10 MANAGEMENT STRATEGIES FOR CULTURAL HERITAGE**

This section presents proposed strategies for the management of Aboriginal cultural heritage values within the Modification area that may be subject to direct impacts by the construction of the modified Ivanhoe Rail Facility. These recommendations have been developed in consideration of the management approved in the EIS.

### **10.1 GENERAL RECOMMENDATIONS**

#### **10.1.1 Heritage Management Plan**

In accordance with Condition 28, Schedule 3 of the Project Development Consent (SSD\_5012), a HMP, which outlines the management and mitigation measures for Aboriginal cultural heritage, has been previously prepared for the Project in consultation with the Aboriginal community and the OEH. Tronox should revise the HMP to reflect the results and recommendations of this assessment. The HMP should continue to remain active for the life of the Modified Project and define the tasks, scope and conduct of all Aboriginal cultural heritage management activities. The HMP should be revised in consultation with the local Aboriginal community.

The measures presented below are considered best practice in the mining industry. Their effectiveness and reliability is demonstrated by their continued use and inclusion in management plans and strategies developed in consultation with the RAPs and to the satisfaction of OEH.

#### **10.1.2 Role of the Local Aboriginal Community**

Tronox is committed to involving the local Aboriginal community as an integral participant in the management of Aboriginal cultural heritage values in the Modification area. The strategies outlined in this report have incorporated the views of community representatives and the HMP would be prepared in consultation with the local Aboriginal community.

The recording, collection, curation, storage and replacement of moved Aboriginal objects would occur with the invited participation of local Aboriginal community representatives.

#### **10.1.3 Site Management and Cultural Awareness Training**

The effective application of the HMP and its strategies will be dependent on an appreciation of its content and function by on-site staff and employees.

It is proposed to provide training to all on-site personnel regarding the HMP strategies relevant to their employment tasks.

## 10.2 MANAGEMENT OF CULTURAL HERITAGE IN PROXIMITY TO THE DISTURBANCE AREAS

Harm to the twenty-two Aboriginal cultural heritage sites near the proposed disturbance areas for the Modification should be avoided. Temporary barrier/fences should be erected around the sites (a minimum 10 m radius buffer) when works are occurring in their vicinity. At a minimum, these should include star pickets and flagging. These barriers would remain in place throughout the life of the Modified Project.

## 10.3 MANAGEMENT OF CULTURAL HERITAGE WITHIN THE DISTURBANCE AREA

The Aboriginal cultural heritage sites are five stone artefact sites (with one or three artefacts at each) (RLF29 through to RLF33). This assessment has concluded that these sites are not of high scientific significance.

The area of disturbance for the modified Ivanhoe Rail Facility, which would disturb the Aboriginal cultural heritage sites, is relatively inflexible. Engineering constraints mean that facility components cannot be relocated away from the Aboriginal cultural heritage sites to avoid disturbance. Additionally, any such relocation would not remove threats to the sites from indirect disturbance.

Representatives of the RAPs visited the Aboriginal cultural heritage sites, where options for their management were discussed. Based on the results of these discussions, it is recommended that Tronox arrange collection of the Aboriginal objects prior to the commencement of disturbance activities. Tronox should engage a suitably qualified archaeologist and representatives of the RAPs to record and collect the artefacts. These items should be properly curated and stored at the approved "Keeping Place". Artefacts should be replaced within rehabilitated areas in consultation with local Aboriginal groups and OEH.

This strategy of recording and collection should also apply to the management of any newly identified Aboriginal cultural heritage items that may be encountered during construction activities.

Examination of the artefacts and their contexts should form an integral part of the recording programme in order to better understand and interpret local and regional patterns of past Aboriginal settlement and resource use. In particular, this could involve investigating lithic technologies and reduction strategies adopted at the Aboriginal cultural heritage sites. These strategies of information collection would complement the salvage programme.

## 10.4 SUMMARY OF MANAGEMENT RECOMMENDATIONS

Proposed site management strategies for the Aboriginal cultural heritage sites identified during the field survey are summarised in **Table 7**.

**Table 7.** Proposed Specific Management Strategies for known Aboriginal Cultural Heritage Sites.

<b>Site Name</b>	<b>Type</b>	<b>Summary Scientific Significance</b>	<b>Potential Impacts</b>	<b>Proposed Management Measures</b>
RLF29	Artefact (n=3)	Direct	Total	Collect Aboriginal objects
RLF30	Artefacts (n=1)	Direct	Total	Collect Aboriginal object
RLF31	Artefacts (n=1)	Direct	Total	Collect Aboriginal object
RLF32	Artefacts (n=3)	Direct	Total	Collect Aboriginal objects
RLF33	Artefacts (n=1)	Direct	Total	Collect Aboriginal object

## 11 SUMMARY RECOMMENDATIONS

Based on the results of this cultural heritage investigation and consultation with representatives of the RAPs the following is recommended:

- The Modification be allowed to proceed because the Modification area would be located in an area where harm to highly significant cultural heritage would be avoided.
- A suitably qualified archaeologist and representatives of the local Aboriginal community should be engaged to record and collect the Aboriginal objects in the Modification area. These items should be properly curated and stored at the approved “Keeping Place”. The artefacts should be replaced within rehabilitated areas in consultation with local Aboriginal groups and the NSW Office of Environment and Heritage (OEH).
- In the unlikely event that human skeletal remains are encountered during the course of activities associated with the Modification, all work in that area must cease. Remains must not be handled or otherwise disturbed except to prevent further disturbance. If the remains are thought to be less than 100 years old, the Police or the State Coroner’s Office (tel: 02 9552 4066) must be notified. If there is reason to suspect that the skeletal remains are more than 100 years old and Aboriginal, Tronox should contact the OEH’s Environmental Line (tel: 131 555) for advice. In the unlikely event that an Aboriginal burial is encountered, strategies for its management would need to be developed with the involvement of the local Aboriginal community.
- Tronox should update the HMP for the Atlas-Campaspe Mine to reflect the results and recommendations of this assessment. The HMP should continue to remain active for the life of the Modified Project and define the tasks, scope and conduct of all Aboriginal cultural heritage management activities. The HMP should be revised in consultation with the local Aboriginal community.
- Tronox should continue to provide training to all on-site personnel regarding the HMP strategies relevant to their employment tasks.
- Tronox should continue to involve the RAPs and any other relevant Aboriginal community groups or members in matters pertaining to the Modification.

## 12 REFERENCES

- Allen, H. (1974). The Bagundji of the Darling Basin: cereal gatherers in an uncertain environment. *World Archaeology* **5**: 309-322.
- Australian Heritage Commission (2002). *Ask First; A Guide to Respecting Indigenous Heritage Places and Values*.
- Australia ICOMOS (1988). *Guidelines to the Burra Charter: cultural significance*. Australia ICOMOS, Canberra.
- Australia ICOMOS (1999). *Australia ICOMOS Charter for the Conservation of Places of Cultural Significance (the Burra Charter)*. Revised edition. Australia ICOMOS, Canberra.
- Balme, J. (1995). 30,000 years of fishery in western New South Wales. *Archaeology in Oceania* **30**: 1-21.
- Balme, J. and Hope, J. (1990). Radiocarbon dates from midden sites in the lower Darling River area of western New South Wales. *Archaeology in Oceania* **25**: 85-101.
- Beveridge, P. (1889). *The Aborigines of Victoria and Riverina*. Hutchinson, Melbourne.
- Binford, L.R. (1989). *Debating Archaeology*. Academic Press, San Diego, CA.
- Blows, J.M. (1995). *Eagle and Crow: An Exploration of an Australian Aboriginal Myth*. (Garland Publishing: NY).
- Bonhomme, T. (1993). *Murray Valley Archaeological Study: Lake Victoria and Koondrook State Forests*. (NSW National Parks and Wildlife Service: Hurstville, NSW).
- Bonhomme Craib and Associates (1999). *Cultural Heritage Study for the Murray Darling Water Management Action Plan (MDWMAP)*. Report to MDWMAP.
- Bonhomme Craib and Associates (2001). *Darling Anabranch Cultural Heritage Study*. Report to Darling Anabranch Management Plan Steering Committee.
- Bowdler, S. (1983). *Aboriginal Sites on the Crown-timber Lands of New South Wales*. Report to the Forestry Commission of New South Wales.
- Bowler, J.M., Jones, R., Allen, H. and Thorne, A.G. (1970). Pleistocene human remains from Australia: a living site and human cremation from Lake Mungo, western New South Wales. *World Archaeology* **2**: 39-60.
- Bowler, J. M., Johnston, H., Olley, J. M., Prescott, J. R., Roberts, R. G., Shawcross, W. & Spooner, N. A. (2003). New ages for human occupation and climatic change at Lake Mungo, Australia. *Nature* **421**: 837-840.
- Brown, C.M. and Stephenson, A.E. (1991). *Geology of the Murray Basin, Southeastern Australia*. (Bureau of Mineral Resources Bulletin 235).
- Clark, P. (1983). *Archaeological Survey of Seismic Lines in Southwestern New South Wales*. Report to Esso Ltd.

- Coutts, P.J.F., Henderson, P. and Fullagar, R.L.K. (1979). *A Preliminary Investigation of Aboriginal Mounds in North-Western Victoria*. (Ministry for Conservation: Melbourne).
- Craib, J. (1992). *A Reconnaissance Survey of Aboriginal Archaeological Resources in the Wentworth-Gol Gol Area, Western NSW*. Report to NSW National Parks and Wildlife Service.
- Cristal Mining Australia Pty Ltd (2017). *Atlas-Campaspe Mineral Sands Project Heritage Management Plan*.
- Cupper, M.L. (2003a). *Archaeological and Aboriginal Heritage Survey: Atlas-Campaspe Mineral Sands Project Ancillary Infrastructure Modifications*. Report to BEMAX Resources NL.
- Cupper, M.L. (2003b). *Late Quaternary Environments of Playas in Southwestern New South Wales*. PhD Thesis, The University of Melbourne.
- Cupper, M.L. (2018). Analysis of Aboriginal lithic assemblages; *Atlas-Campaspe Mineral Sands Project*. Report to NSW Office of Environment and Heritage.
- Cupper, M.L. and Duncan, J. (2006). Last glacial megafaunal death assemblage and early human occupation at Lake Menindee, southeastern Australia. *Quaternary Research* **66**: 332-341.
- Department of Environment and Conservation (DEC) (2005). *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation*. New South Wales Department of Environment and Conservation, Sydney.
- Department of Environment, Climate Change and Water (DECCW) (2010a). *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (Part 6 National Parks and Wildlife Act, 1974)*. NSW Department of Environment, Climate Change and Water, Sydney.
- Department of Environment, Climate Change and Water (DECCW) (2010b). *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales*. NSW Department of Environment, Climate Change and Water, Sydney.
- Eyre, E.J. (1985 [1842]). *Reports and Letters to Governor Grey from E.J. Eyre at Moorunde*. (Sullivan's Cove: Adelaide).
- Gill, E.D. (1973). Geology and geomorphology of the Murray River Region between Mildura and Renmark, Australia. *Memoirs of the National Museum of Victoria* **34**: 1-98.
- Gott, B. (1998). *Food Plants of SFWP, NSW*. (Unpublished manuscript, Monash University: Clayton, Victoria).
- Gould, R.A. (1969). Subsistence behaviour among the Western Desert Aborigines of Australia. *Oceania* **39**, 253-274.
- Gould, R.A. (1980). *Living Archaeology*. Cambridge University Press, Cambridge.
- Hardy, M.E. (1976). *Lament for the Barkindji: The Vanished Tribes of the Darling River Region*. (Rigby: Adelaide).
- Hercus, L.A. (1982). *The Bāgandji Language*. (Pacific Linguistics B, 67. Department of Linguistics, Research School of Pacific Studies, Australian National University: Canberra).

- Hercus, L.A. (1993). *Paakantyi Dictionary*. (Australian Institute of Aboriginal and Torres Strait Islander Studies: Canberra).
- Hope, J. (ed.). (1981). *Darling Surveys 1*. (Department of Prehistory, Research School of Pacific Studies, Australian National University: Canberra).
- Hope, J. (1982). *Archaeology and Environment of the Lower Darling Region of the Murray Basin, Southwestern New South Wales: the Potential Impact of Seismic Survey*. Report to ESSO Australia Ltd.
- Hope, J. (1993). *Aboriginal Burial Sites in the Murray-Darling Basin*. Report to the Murray-Darling Basin Commission.
- Hope, J. (1998). *Lake Victoria: Finding the Balance*. (Cultural Heritage Report, Murray Darling Basin Commission: Canberra).
- Jochim, M.A. (1976). *Hunter-gatherer subsistence and settlement: a predictive model*. Academic Press, NY.
- Johnston, H. and Clark, P. (1998). Willandra Lakes archaeological investigations 1968-98. *Archaeology in Oceania* 33: 105-119.
- Krefft, G. (1865). On the manners and customs of the Aborigines of the Lower Murray and Darling. *Transactions of the Philosophical Society of New South Wales 1862-1865*: 357-374.
- Latz, P.K. (1995). *Bushfires and bushtucker: Aboriginal plant use in Central Australia*. IAD Press: Alice Springs, NT.
- McIntyre, M.L. (1981). An archaeological survey of the Mildura - Broken Hill electricity line corridor. In *Darling Surveys 1*. (Edited J. Hope). pp. 9-32. (Department of Prehistory, Research School of Pacific Studies, Australian National University: Canberra).
- McNiven, I.J. (1998). Aboriginal settlement of the saline lake and volcanic landscapes of the Corangamite Basin, western Victoria. *The Artefact* 21, 63-94.
- Marshall, B. and Smith, B. (1998). *An Aboriginal Archaeological and Geomorphological Assessment of the Proposed Construction Sites at Lakes Cawndilla and Menindee*. Draft report to NSW Department of Lands and Water Conservation.
- Martin, S., Witter, D. and Webb, C. (1994). *The Archaeology of Lakes Menindee and Cawndilla and the Impact of Artificial Water Storage*. Report to NSW National Parks and Wildlife Service and NSW Department of Water Resources.
- Mitchell, P. (1990). A palaeoecological model for the archaeological site distribution in southern Africa during the Upper Pleniglacial and Late Glacial. In *The World at 18 000 BP*. vol. 2. Low Latitudes. (ed. C. Gamble and O. Soffer). pp. 189-205. (Unwin Hyman: London).
- Mitchell, T.L. (1839). *Three Expeditions into the Interior of Eastern Australia*. (T. and W. Boone: London).
- National Parks and Wildlife Service (1997). *Aboriginal Cultural Heritage: Standards and Guidelines Kit*. National Parks and Wildlife Service, Sydney.

New South Wales Minerals Council (2010). *New South Wales Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects*. New South Wales Mineral Council, Sydney.

Niche Environment and Heritage (2012). *Aboriginal and Non-Aboriginal Cultural Heritage Assessment Report Atlas-Campaspe Mineral Sands Project, NSW*. Report to Tronox.

Office of Environment and Heritage (2011). *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW*. Office of Environment and Heritage, Sydney.

Olley, J.M., Roberts, R.G., Yoshida, H. and Bowler, J.M. (2006). Single-grain optical dating of grave-infill associated with human burials at Lake Mungo, Australia. *Quaternary Science Reviews* 25: 2469–2474.

Pardoe, C. (2003). The Menindee Lakes: A regional archaeology. *Australian Archaeology* 57: 42-53.

Pardoe, C. and Martin, S. (2002). *The Nature and Distribution of Archaeology at the Menindee Lakes*. Menindee Lakes Ecologically Sustainable Development Project Report to the NSW Department of Land and Water Conservation.

Porteners, M.F. (1993). The natural vegetation of the Hay Plain. *Cunninghamia* 3, 1-122.

Renfrew, C. and Bahn, P. (1991). *Archaeology: Theory, Methods and Practice*. Thames and Hudson, London.

Soil Conservation Service (1985). *Land Systems Series Sheet 55-1*. (NSW Soil Conservation Service: Sydney).

Soil Conservation Service (1991). *Land Systems. Ivanhoe 1:250,000 Map Sheet*. (NSW Soil Conservation Service: Sydney).

Sturt, C.N. (1982 [1833]). *Two Expeditions into the Interior of Southern Australia During the Years 1828, 1829, 1830 and 1831*. (Smith Elder: London).

Sturt, C.N. (1984 [1844-6]). *Journal of the Central Australian Expedition*. (Edited J. Waterhouse). (Caliban Books: Dover, NH).

Thorne, A., Grün, R., Mortimer, G., Simpson, J.J., McCulloch, M., Taylor, L. and Curnoe, D. (1999). Australia's oldest human remains: age of the Lake Mungo Skeleton. *Journal of Human Evolution* 36: 591-692.

Tindale, N.B. (1974). *Aboriginal Tribes of Australia: Their Terrain, Environmental Controls, Distribution, Limits and Proper Names*. (University of California: Berkeley, CA).

Witter, D.C. (2001). *Atlas-Campaspe Mineral Sands Project: Archaeological and Aboriginal Heritage Assessment*. Report to BEMAX Resources NL, Brisbane.

Yellen, J.E. (1977). *Archaeological Approaches to the Present*. Academic Press, NY.

## **APPENDICES**

Appendix 1 Glossary

Appendix 2 Consultation Log

Appendix 3 Correspondence to Aboriginal Community Stakeholders

Appendix 4 Correspondence from Aboriginal Community Stakeholders

Appendix 5 AHIMS Register Search

Appendix 6 AHIMS Site Cards

Appendix 7 Cadastre Information

## APPENDIX 1: GLOSSARY

**Archaeological site** - A place with evidence of past human activity. This evidence may include Aboriginal and/or historic artefacts, features, structures or organic traces.

**Artefact scatter** - A surface scatter of Aboriginal or historic cultural material. Scatters of stone artefacts are a common archaeological site type. These scatters may also contain charcoal, discarded animal bones, shell and ochre.

**Assemblage** - A collection of artefacts from a single archaeological site.

**Burial site** - A place with a concentration of human remains. Ochre, stone tools, charcoal and grave goods may be associated with burials. Most burial sites are found in sand dunes but dead trees, caves and rock shelters were also used.

**Ceremonial ground** - Place that may be associated with initiation ceremonies, meetings or sacred rituals. Stone arrangements may be present, including cairns, stone circles or standing slabs of rock.

**Chert** - A fine-grained opaline rock ranging in color from white to black, but most often grey, brown, grayish brown and light green to rusty red.

**Core** - A piece of stone from which flakes have been removed. They usually have negative flake scars that have resulted from the removal of flakes.

**Cultural material** - Any material remains or objects resulting from human activity.

**Debitage** - Any waste material including flakes and cores produced during the manufacture of chipped stone tools.

**Flake** - A piece of stone detached from a core that typically displays a striking platform, bulb of percussion and flake scars on the ventral surface.

**Flaked piece** - Small fragments of stone resulting from the manufacture of stone tools. A striking platform or bulb of percussion may not be evident.

**Formalized tools** - An artefact that has been deliberately shaped by flaking, retouch or grinding to produce a predetermined tool type.

**Ground surface visibility** - The amount of bare ground exposed, usually expressed as a percentage.

**Hearth** - The remains of a campfire containing charcoal, discoloured soil, and possibly, hearthstones, heat retainers or the remains of animals or shellfish cooked and consumed at the campsite.

**Hearthstone** – Stone cobble placed in a campfire to retain heat for cooking. The types of stone used as hearthstones in western Victoria includes calcrete and sandstone.

**Heat retainer** - Nodule of baked clay, thought to have been placed in campfires to retain heat for cooking.

**in situ** - An artefact or other feature that has not been disturbed from its original position.

**Mound** - Raised areas of earth ranging from 3 to 35m in diameter and from 0.5m to 2m in height. Earth oven material, stone artefacts, food refuse and the remains of hut foundations have been recovered from excavated earth mounds in the central and western parts of Victoria.

**Ochre** - Soft varieties of the iron oxides goethite, limonite or haematite usually coloured red or yellow and used as pigment for painting.

**Quarry** - An outcrop of stone or ochre where Aboriginal people have extracted the raw material for use or trade. Stone quarries are identifiable by a dense scatter of broken stone and flakes or consist of pits or hollows where material has been dug out of the ground.

**Quartz** – A silica mineral resistant to weathering because of its hardness. It is commonplace in the landscape as a consequence.

**Quartzite** - A metamorphic rock formed by the re-crystallization of quartz.

**Retouch** - A stone artefact with fine, secondary flaking along one or more edges.

**Scarred tree** - A tree with a scar on its trunk caused by bark removal.

**Shell midden** - A surface scatter or heap of discarded shell often with charcoal, animal bones and stone artefacts. Middens may be found near coastlines, rivers, creeks, swamps and ancient lakes.

**Silcrete** - A hard, fine-grained rock composed of silica cement.

**Stone feature** - Cairns, rock wells, grinding groves, stone structures, fish traps and stone arrangements are examples of stone features.

**Stratified deposit** - Material that has been laid down over time forming a sequence of events.

**Subsurface testing** - A method of excavation used for detecting cultural material below the ground surface. Testing is commonly by shovel, trowel or hand auger.

**Survey** - An inspection of land either by foot or vehicle for the purpose of identifying archaeological sites.

**Transect** - A predetermined area or a path that directs the course of a survey.

## **APPENDIX 2: CONSULTATION LOG**

DATE	ORGANISATION CONTACTED	HOW CONTACTED	CONTACTED BY	NATURE OF CONSULTATION	TIME
3/28/2019	Kullila Site Consultants*, Michael (Mick) Kelly on behalf of Ngaympaa people, Balranald Local Aboriginal Land Council*, Ivanhoe Community Working Party*, Muthi Muthi Nations Aboriginal Corporation, National Koorie Site Management, Wakool Indigenous Corporation, Maria Maher, Willandra Lakes 2 Traditional Tribal Groups Elders Council.	Email & Post*	Cristal Mining Australia (now Tronox)	Stage 2 letter notifying the RAPs of the Modification and to provide an opportunity to update their contact details.	
3/28/2019	Barkindji Elders Council and Badger Bates	Post	Cristal Mining Australia (now Tronox)	Stage 2 letter notifying the RAPs of the Modification and to provide an opportunity to update their contact details.	
3/28/2019	Cristal Mining Australia (now Tronox)	Email	Daniel Kelly	Response to Stage 2 letter indicating that he is the relevant contact regarding any proposed field surveys.	
3/28/2019	Cristal Mining Australia (now Tronox)	Email	Return Email Service	Returned email received from the Kullila Site Consultants email address (copy of Stage 2 letter). Unable to be delivered. No alternative contact details on file.	
3/28/2019	Cristal Mining Australia (now Tronox)	Email	Return Email Service	Returned email received from Andrew Rose (from the Ivanhoe Community Working Party) (copy of Stage 2 letter). Unable to be delivered. No alternative contact details on file.	
3/28/2019	Cristal Mining Australia (now Tronox)	Email	Gary Pappin, Wakool Indigenous Corporation	Gary advised that Daniel Kelly is not associated with the Wakool Indigenous incorporation and requested that he be removed from correspondence.	
3/28/2019	Cristal Mining Australia (now Tronox)	Email	Return Email Service	Returned email received from the Balranald Local Aboriginal Land Council email address (copy of Stage 2 letter). Unable to be delivered. No alternative contact details on file.	
3/28/2019	Cristal Mining Australia (now Tronox)	Email	Return Email Service	Returned email received from D. Keely (from the Muthi Muthi Nations Aboriginal Corporation) (copy of Stage 2 letter). Unable to be delivered. No alternative contact details on file.	
3/29/2019	Michael (Mick) Kelly on behalf of Ngaympaa people, Balranald Local Aboriginal Land Council, Ivanhoe Community Working Party, Muthi Muthi Nations Aboriginal Corporation, National Koorie Site Management, Wakool Indigenous Corporation, Maria Maher, Willandra Lakes 2 Traditional Tribal Groups Elders Council.	Email & Post	Cristal Mining Australia (now Tronox)	Stage 3 letter containing information regarding the proposed methodology for the Modification ACHA, an information session to be held in Ivanhoe, and a field survey of the modification area. Comments on the proposed methodology were requested by 3 May 2019.	
3/29/2019	Kullila Site Consultants, Barkindji Elders Council and Badger Bates	Post	Cristal Mining Australia (now Tronox)	Stage 3 letter containing information regarding the proposed methodology for the Modification ACHA, an information session to be held in Ivanhoe, and a field survey of the modification area. Comments on the proposed methodology were requested by 3 May 2019.	
3/29/2019	Balranald Local Aboriginal Land Council	Email	Cristal Mining Australia (now Tronox)	Copy of Stage 2 letter and email resent to updated email address. The first email sent on 28/3/19 was unable to be delivered.	
3/29/2019	Balranald Local Aboriginal Land Council and the Office of Environment and Heritage.	Email	Cristal Mining Australia (now Tronox)	Notification letters detailing the RAPs that were contacted regarding the ACMSP Optimisation Modification (Stage 2 letters).	
3/29/2019	Wakool Indigenous Corporation	Email	Cristal Mining Australia (now Tronox)	Response email indicating that Daniel Kelly was removed as a relevant contact for the Wakool Indigenous Corporation.	
3/29/2019	Cristal Mining Australia (now Tronox)	Email	Office of Environment and Heritage	Response email indicating that the OEH acknowledges that Cristal Mining is continuing consultation for the modification with the RAP's identified in the Project SEARS.	
4/1/2019	Cristal Mining Australia (now Tronox)	Post	Barkindji Elders Council	Stage 2 letter sent back marked 'return to sender' for the reason of 'left address/unknown'.	
4/1/2019	Cristal Mining Australia (now Tronox)	Post	Barkindji Elders Council	Stage 3 letter sent back marked 'return to sender' for the reason of 'left address/unknown'.	
4/3/2019	Cristal Mining Australia (now Tronox)	Email	Office of Environment and Heritage	Indicating that a search of the National Native Title Tribunal website to determine if there are any additional relevant RAPs or if there has been a change in determinations/applications relevant to the Modification.	
4/18/2019	Tara Bruton (member of the Muthi Muthi Nations Aboriginal Corporation)	Email	Tronox	Contacted to ascertain if interested in attending the proposed site survey at the Ivanhoe Rail Facility on 1 May 2019.	
4/18/2019	Tronox	Email	Tara Bruton (member of the Muthi Muthi Nations Aboriginal Corporation)	Indicated that she would not be able to attend the proposed survey of the Ivanhoe Rail Facility on 1 May 2019.	
4/18/2019	Joan Slade (Ivanhoe Community Working Party)	Telephone	Landsape (Dr Matt Cupper)	Called to enquire whether Ms Slade would be interested in attending the proposed field survey on 1 May 2019. Left message with Joan.	
4/18/2019	Landsape (Dr Matt Cupper)	Telephone	Joan Slade (Ivanhoe Community Working Party)	Returned call. Indicated that she was interested in attending the proposed field Survey on 1 May 2019.	
4/20/2019	Tara Bruton (member of the Muthi Muthi Nations Aboriginal Corporation)	Telephone	Tronox	Tara previously contacted Tronox to see if there was heritage survey work at Atlas mine. Tronox contacted Tara to see if she was interested in the heritage survey at Ivanhoe rail facility. Tara declined because she had other work on.	
4/20/2019	Maria Maher	Telephone	Tronox	Responded to phone call from Maria Maher to discuss pay rates proposed to attend consultation.	

DATE	ORGANISATION CONTACTED	HOW CONTACTED	CONTACTED BY	NATURE OF CONSULTATION	TIME
4/30/2019	Registered Aboriginal Parties	Information Session	Tronox	An information session was held to discuss the Modification and the Proposed Methodology for the ACHA. All RAPs were invited to attend. Representatives from Ivanhoe Community Working Party attended.	
5/1/2019	Registered Aboriginal Parties	Field Survey	Tronox, Landskape	A field survey of the modified Ivanhoe Rail Facility area was undertaken to allow representatives of the RAPs to inspect the area and any Aboriginal Heritage sites which may be located within or in immediate proximity to the area. Representatives from Ivanhoe Community Working Party attended the field survey.	
5/17/2019	Registered Aboriginal Parties	Post/Email	Tronox	Copies of the draft ACHA were provided to the RAPs for review and Comment. Comments on the report were requested by Friday 21 June 2019. Hard copies only were provided to Badger Bates, Arthur Kirby (Barkindji Elders Councils) and Paul Charles (Kulila Site Consultants).	
5/17/2019	Tronox	Email	Return Email Service	Bounced emails received from the Ivanhoe Community Working Party, Ali Maher (National Koorie Site Management), Warren Clarke (Wilandra Lakes 2 Traditional Tribal Groups Elders Council) and Bernadette Pappin (Muthi Muthi Nations Aboriginal Corporation).	
5/17/2019	Ivanhoe Community Working Party, Ali Maher (National Koorie Site Management), Warren Clarke (Wilandra Lakes 2 Traditional Tribal Groups Elders Council) and Bernadette Pappin (Muthi Muthi Nations Aboriginal Corporation).	Email	Tronox	Follow-up email providing the draft ACHA as a downloadable document via a link.	
5/17/2019	Tronox	Email	Return Email Service	Bounced emails again received from Ali Maher (National Koorie Site Management) and Warren Clarke (Wilandra Lakes 2 Traditional Tribal Groups Elders Council).	
5/20/2019	Tronox	Email	Fay Johnstone (Ivanhoe Community Working Party)	Email from Fay indicating she would like a hard copy of the Draft ACHA sent to a postal address.	
5/20/2019	Fay Johnstone (Ivanhoe Community Working Party)	Post	Tronox	Hard copy of the Draft ACHA sent to Fay, as per a request dated 20 May 2019.	
5/20/2019	Tronox	Post	Barkindji Elders Council	Draft ACHA and sent back marked 'return to sender' for the reason of 'left address/unknown'.	

### **APPENDIX 3: CORRESPONDENCE TO ABORIGINAL COMMUNITY STAKEHOLDERS**

## STAGE 2 CORRESPONDENCE

29 March 2019

Balranald Local Aboriginal Land Council  
Damien Aidon  
PO Box 187  
BALRANALD NSW 2715

Via Email: [ceo.blalc@gmail.com](mailto:ceo.blalc@gmail.com)

Dear Damien,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Cristal Mining Australia Limited (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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, NSW and 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 to the south-west of the township of Ivanhoe (Figure 1).

Cristal Mining is seeking environmental approvals under the EP&A Act for a proposed modification to the Project (the Modification).

The Modification would include the following:

- Extension to the Ivanhoe Rail Facility hardstand area and rail siding to accommodate longer trains.
- Revised alignment of the Ivanhoe Rail Facility access road and access road intersection.

The Modification would change the approved Ivanhoe Rail Facility surface development area. There would be no change to the approved Atlas-Campaspe Mine surface development area.

As part of the modification request, Cristal Mining will be preparing an Aboriginal Cultural Heritage Assessment to identify ways to avoid or minimise potential harm to Aboriginal objects. The subject area of the Modification and any such application is depicted as the "Indicative Location of Modification" as shown on Figure 2.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

Community consultation is an important part of this process. In accordance with the requirements as set out in the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010) (Consultation Guidelines) issued by the NSW Office of Environment and Heritage, Cristal Mining is required to conduct a community consultation process with relevant Aboriginal people to assist in the preparation of the Aboriginal Cultural Heritage Assessment. This includes:

- Contacting various government organisations and requesting a list of any Aboriginal persons or groups who may hold cultural knowledge relevant to, or who have a right or interest in, determining the cultural heritage significance of Aboriginal objects and/or places in the “Indicative Location of Modification”.
- Writing to the Aboriginal persons or groups identified by the above process to notify them of the Modification and invite them to register an interest in the community consultation process.

**Due to your previous involvement in the Aboriginal Cultural Heritage Assessment for the Atlas-Campaspe Mineral Sands Project Environmental Impact Statement, you have been automatically registered for the consultation process associated with the Modification. You do NOT need to contact Cristal Mining to re-register for the Modification.**

However, Cristal Mining would appreciate if you could please provide updated contact details for the Modification. Could you please complete the attached form and return to Cristal Mining via the contact details provided below.

Cristal Mining advises that the details of any Aboriginal person or group who registers an interest in the Modification will be forwarded to the NSW Office of Environment and Heritage and the Balranald Local Aboriginal Land Council in accordance with Section 4.1.5 of the Consultation Guidelines, unless they specify that they do not want their details released.

Should you have any queries regarding your registration, require any further clarification, or wish to discuss the Modification further please do not hesitate to contact Cristal Mining via the following contact details:

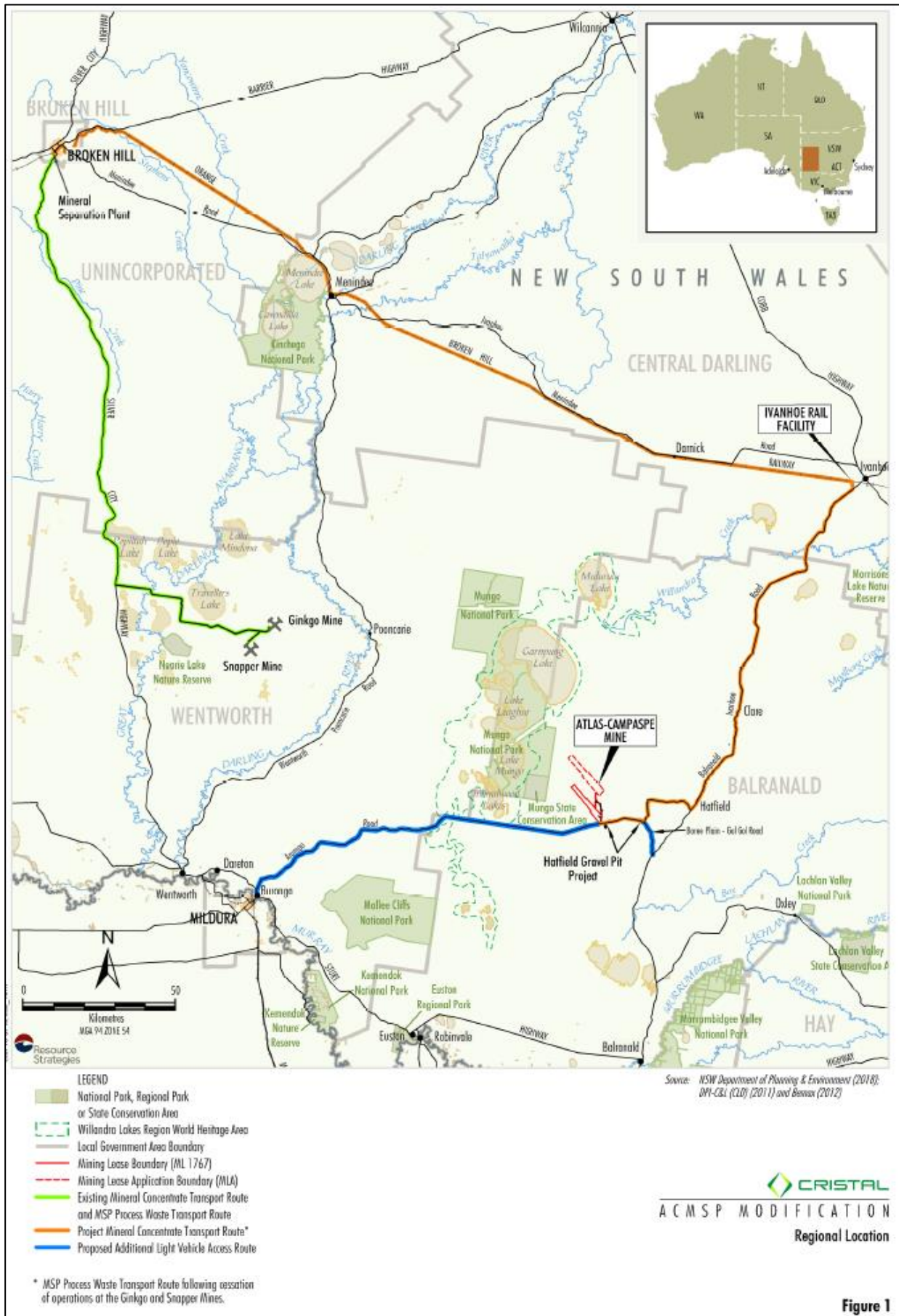
Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely

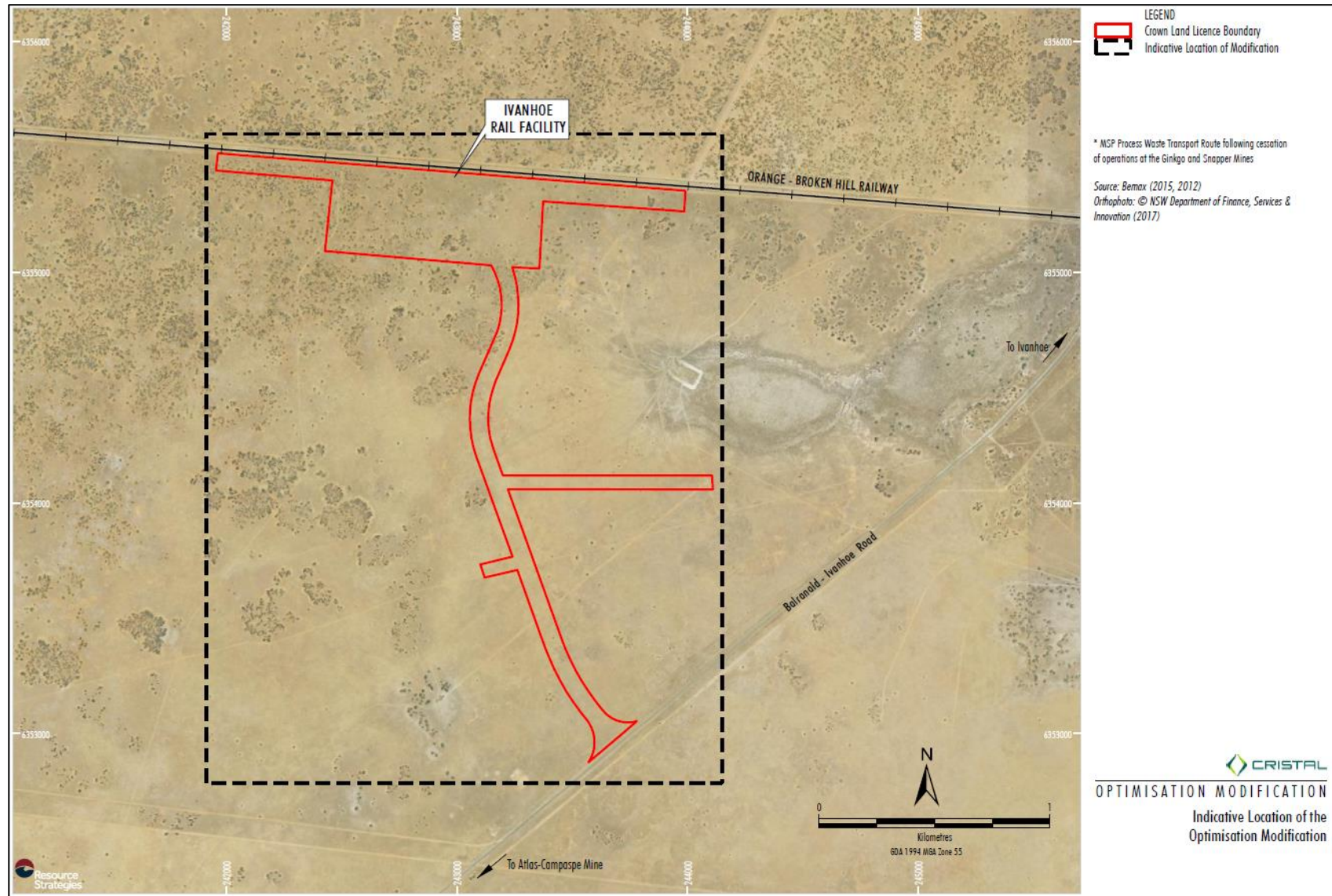


**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

## Plan Showing the Regional Location of the Project



## Plan Showing “Indicative Location of Modification”



**ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION  
UPDATED CONTACT DETAILS**

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

<b>Name</b>	
<b>Registered Aboriginal Party (if different from above)</b>	
<b>Address</b>	
<b>Postal Address (if different from above)</b>	
<b>Telephone Number</b>	
<b>Email Address</b>	

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

28 March 2019

Ivanhoe Community Working Party  
Andrew Rose and Fayne Johnson  
PO Box 29  
BOURKE NW 2840

Via Email: [Andrew.Rose5@dhs.nsw.gov.au](mailto:Andrew.Rose5@dhs.nsw.gov.au), [fay.johnstone@det.nsw.edu.au](mailto:fay.johnstone@det.nsw.edu.au) and  
[ivanhoe@mpira.com.au](mailto:ivanhoe@mpira.com.au)

Dear Andrew and Fayne,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Cristal Mining Australia Limited (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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, NSW and 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 to the south-west of the township of Ivanhoe (Figure 1).

Cristal Mining is seeking environmental approvals under the EP&A Act for a proposed modification to the Project (the Modification).

The Modification would include the following:

- Extension to the Ivanhoe Rail Facility hardstand area and rail siding to accommodate longer trains.
- Revised alignment of the Ivanhoe Rail Facility access road and access road intersection.

The Modification would change the approved Ivanhoe Rail Facility surface development area. There would be no change to the approved Atlas-Campaspe Mine surface development area.

As part of the modification request, Cristal Mining will be preparing an Aboriginal Cultural Heritage Assessment to identify ways to avoid or minimise potential harm to Aboriginal objects. The subject area of the Modification and any such application is depicted as the "Indicative Location of Modification" as shown on Figure 2.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

Community consultation is an important part of this process. In accordance with the requirements as set out in the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010) (Consultation Guidelines) issued by the NSW Office of Environment and Heritage, Cristal Mining is required to conduct a community consultation process with relevant Aboriginal people to assist in the preparation of the Aboriginal Cultural Heritage Assessment. This includes:

- Contacting various government organisations and requesting a list of any Aboriginal persons or groups who may hold cultural knowledge relevant to, or who have a right or interest in, determining the cultural heritage significance of Aboriginal objects and/or places in the “Indicative Location of Modification”.
- Writing to the Aboriginal persons or groups identified by the above process to notify them of the Modification and invite them to register an interest in the community consultation process.

**Due to your previous involvement in the Aboriginal Cultural Heritage Assessment for the Atlas-Campaspe Mineral Sands Project Environmental Impact Statement, you have been automatically registered for the consultation process associated with the Modification. You do NOT need to contact Cristal Mining to re-register for the Modification.**

However, Cristal Mining would appreciate if you could please provide updated contact details for the Modification. Could you please complete the attached form and return to Cristal Mining via the contact details provided below.

Cristal Mining advises that the details of any Aboriginal person or group who registers an interest in the Modification will be forwarded to the NSW Office of Environment and Heritage and the Balranald Local Aboriginal Land Council in accordance with Section 4.1.5 of the Consultation Guidelines, unless they specify that they do not want their details released.

Should you have any queries regarding your registration, require any further clarification, or wish to discuss the Modification further please do not hesitate to contact Cristal Mining via the following contact details:

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely



**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

## Plan Showing the Regional Location of the Project

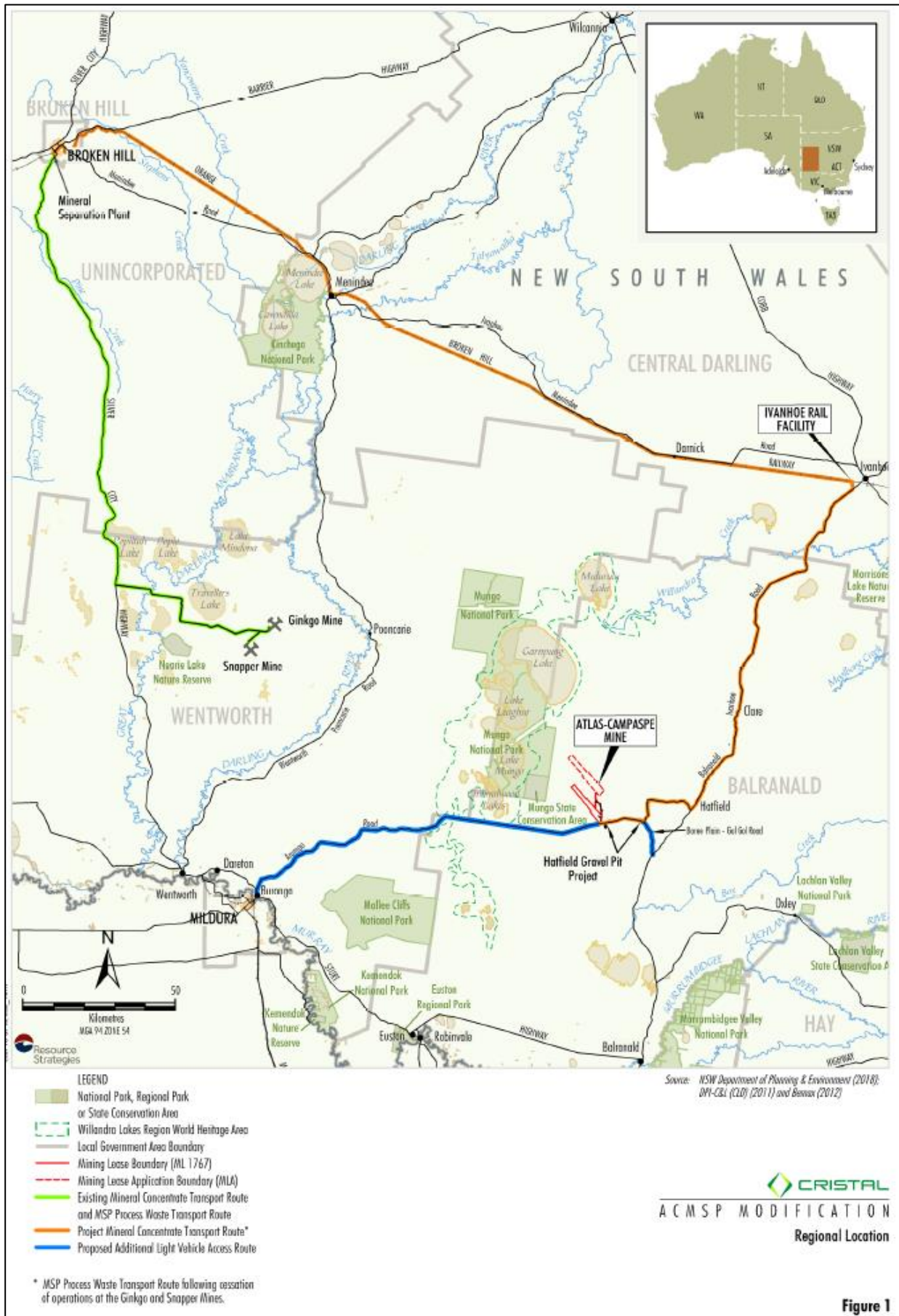
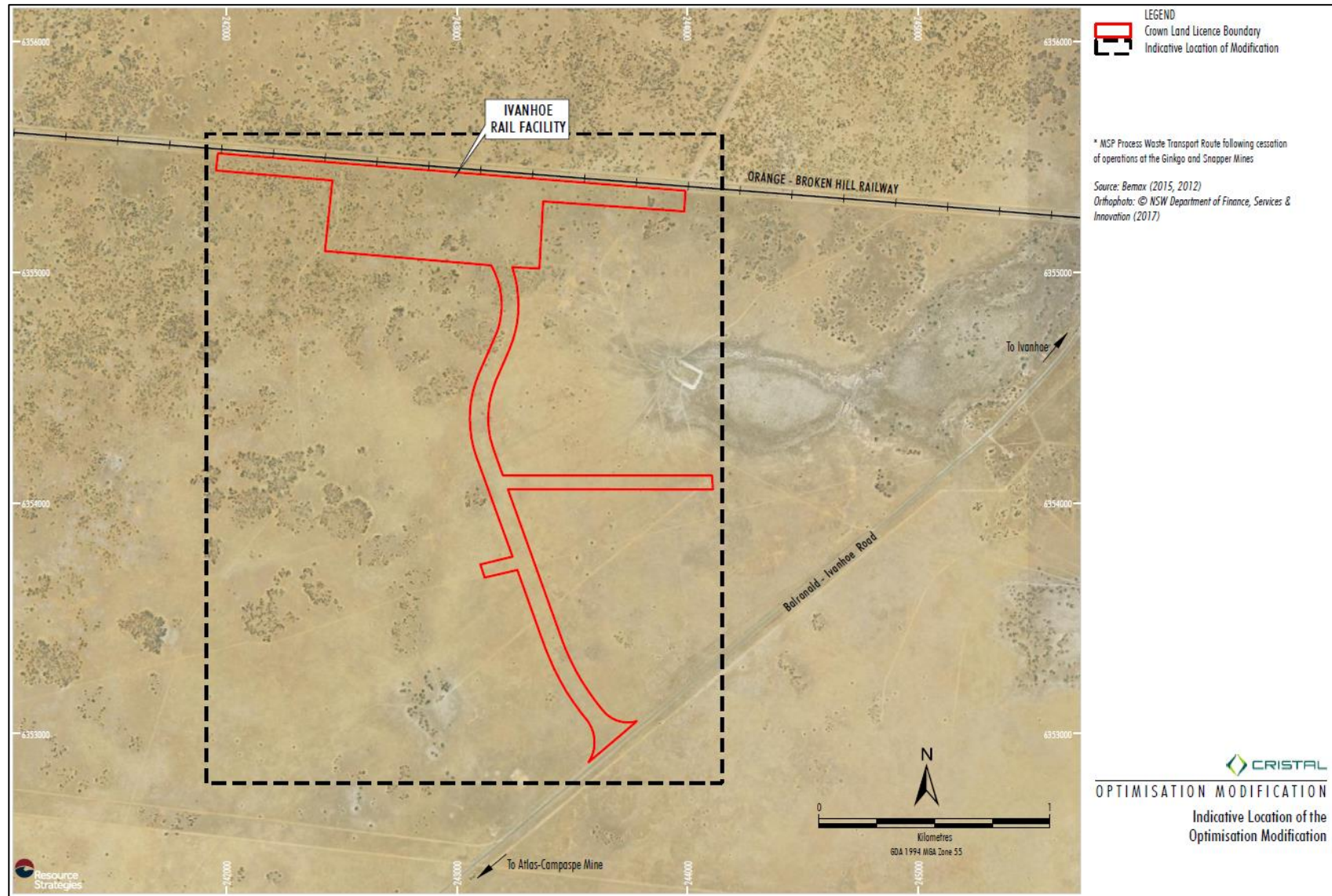


Figure 1

## Plan Showing “Indicative Location of Modification”



**ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION  
UPDATED CONTACT DETAILS**

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

<b>Name</b>	
<b>Registered Aboriginal Party (if different from above)</b>	
<b>Address</b>	
<b>Postal Address (if different from above)</b>	
<b>Telephone Number</b>	
<b>Email Address</b>	

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

28 March 2019

Badger Bates  
107 Gaffney Lane  
BROKEN HILL NSW 2880

Dear Badger,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Cristal Mining Australia Limited (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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, NSW and 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 to the south-west of the township of Ivanhoe (Figure 1).

Cristal Mining is seeking environmental approvals under the EP&A Act for a proposed modification to the Project (the Modification).

The Modification would include the following:

- Extension to the Ivanhoe Rail Facility hardstand area and rail siding to accommodate longer trains.
- Revised alignment of the Ivanhoe Rail Facility access road and access road intersection.

The Modification would change the approved Ivanhoe Rail Facility surface development area. There would be no change to the approved Atlas-Campaspe Mine surface development area.

As part of the modification request, Cristal Mining will be preparing an Aboriginal Cultural Heritage Assessment to identify ways to avoid or minimise potential harm to Aboriginal objects. The subject area of the Modification and any such application is depicted as the "Indicative Location of Modification" as shown on Figure 2.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

Community consultation is an important part of this process. In accordance with the requirements as set out in the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010) (Consultation Guidelines) issued by the NSW Office of Environment and Heritage, Cristal Mining is required to conduct a community consultation process with relevant Aboriginal people to assist in the preparation of the Aboriginal Cultural Heritage Assessment. This includes:

- Contacting various government organisations and requesting a list of any Aboriginal persons or groups who may hold cultural knowledge relevant to, or who have a right or interest in, determining the cultural heritage significance of Aboriginal objects and/or places in the “Indicative Location of Modification”.
- Writing to the Aboriginal persons or groups identified by the above process to notify them of the Modification and invite them to register an interest in the community consultation process.

**Due to your previous involvement in the Aboriginal Cultural Heritage Assessment for the Atlas-Campaspe Mineral Sands Project Environmental Impact Statement, you have been automatically registered for the consultation process associated with the Modification. You do NOT need to contact Cristal Mining to re-register for the Modification.**

However, Cristal Mining would appreciate if you could please provide updated contact details for the Modification. Could you please complete the attached form and return to Cristal Mining via the contact details provided below.

Cristal Mining advises that the details of any Aboriginal person or group who registers an interest in the Modification will be forwarded to the NSW Office of Environment and Heritage and the Balranald Local Aboriginal Land Council in accordance with Section 4.1.5 of the Consultation Guidelines, unless they specify that they do not want their details released.

Should you have any queries regarding your registration, require any further clarification, or wish to discuss the Modification further please do not hesitate to contact Cristal Mining via the following contact details:

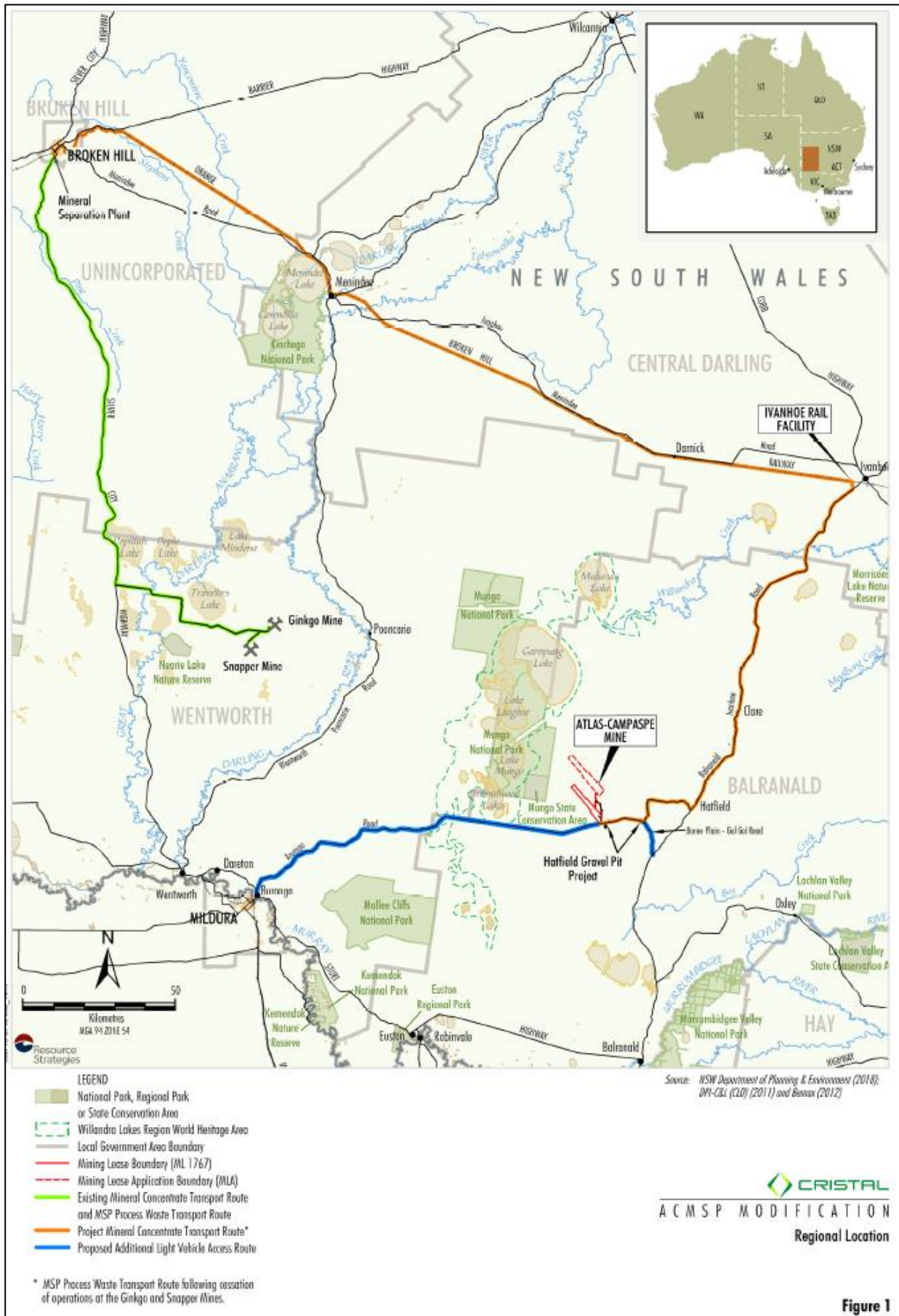
Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely

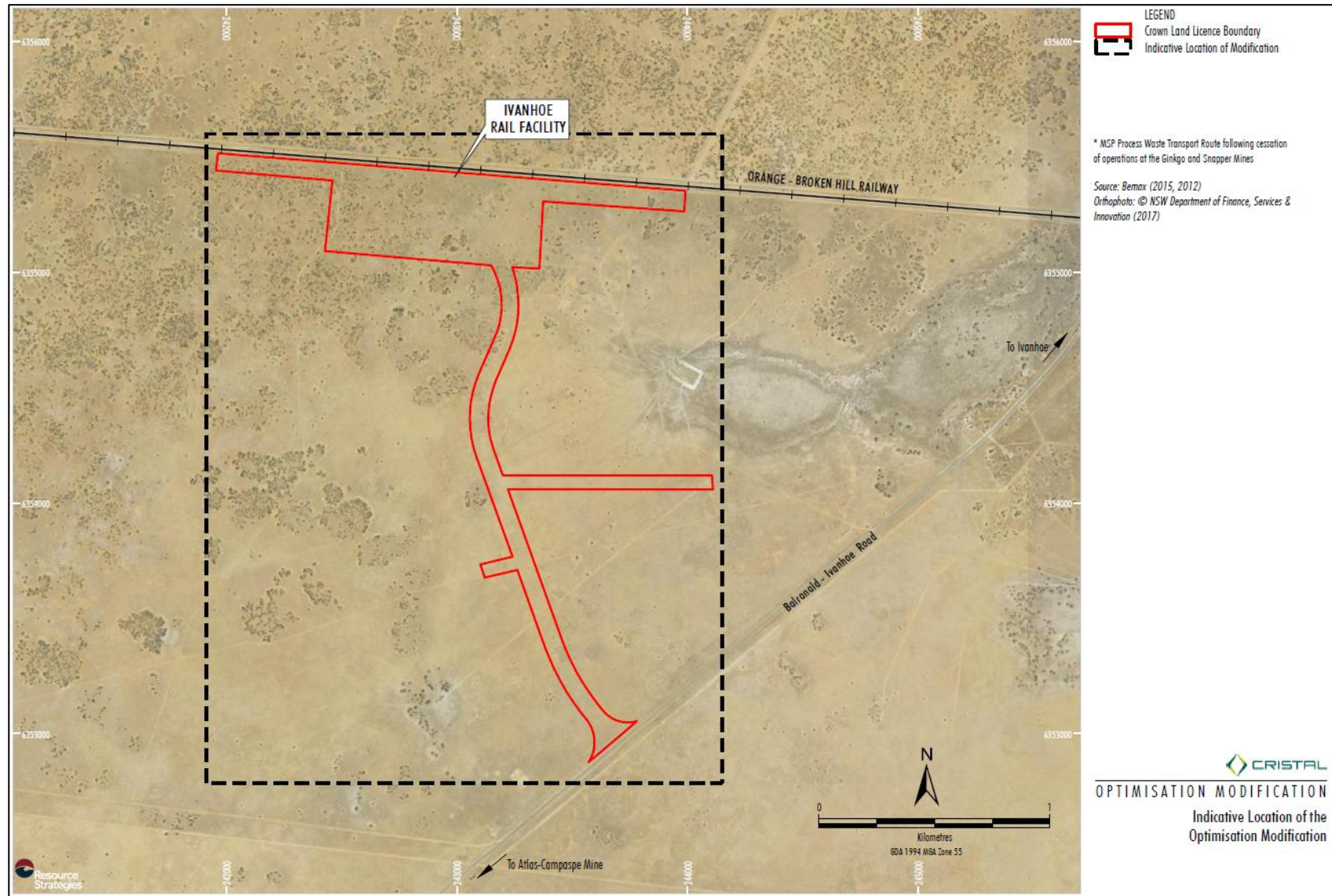


**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

## Plan Showing the Regional Location of the Project



## Plan Showing “Indicative Location of Modification”



**ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION  
UPDATED CONTACT DETAILS**

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

<b>Name</b>	
<b>Registered Aboriginal Party (if different from above)</b>	
<b>Address</b>	
<b>Postal Address (if different from above)</b>	
<b>Telephone Number</b>	
<b>Email Address</b>	

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

28 March 2019

Barkindji Elders Council  
Arthur Kirby  
c/- PO Box 87  
EUSTON NSW 2737

Dear Arthur,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Cristal Mining Australia Limited (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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, NSW and 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 to the south-west of the township of Ivanhoe (Figure 1).

Cristal Mining is seeking environmental approvals under the EP&A Act for a proposed modification to the Project (the Modification).

The Modification would include the following:

- Extension to the Ivanhoe Rail Facility hardstand area and rail siding to accommodate longer trains.
- Revised alignment of the Ivanhoe Rail Facility access road and access road intersection.

The Modification would change the approved Ivanhoe Rail Facility surface development area. There would be no change to the approved Atlas-Campaspe Mine surface development area.

As part of the modification request, Cristal Mining will be preparing an Aboriginal Cultural Heritage Assessment to identify ways to avoid or minimise potential harm to Aboriginal objects. The subject area of the Modification and any such application is depicted as the "Indicative Location of Modification" as shown on Figure 2.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

Community consultation is an important part of this process. In accordance with the requirements as set out in the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010) (Consultation Guidelines) issued by the NSW Office of Environment and Heritage, Cristal Mining is required to conduct a community consultation process with relevant Aboriginal people to assist in the preparation of the Aboriginal Cultural Heritage Assessment. This includes:

- Contacting various government organisations and requesting a list of any Aboriginal persons or groups who may hold cultural knowledge relevant to, or who have a right or interest in, determining the cultural heritage significance of Aboriginal objects and/or places in the “Indicative Location of Modification”.
- Writing to the Aboriginal persons or groups identified by the above process to notify them of the Modification and invite them to register an interest in the community consultation process.

**Due to your previous involvement in the Aboriginal Cultural Heritage Assessment for the Atlas-Campaspe Mineral Sands Project Environmental Impact Statement, you have been automatically registered for the consultation process associated with the Modification. You do NOT need to contact Cristal Mining to re-register for the Modification.**

However, Cristal Mining would appreciate if you could please provide updated contact details for the Modification. Could you please complete the attached form and return to Cristal Mining via the contact details provided below.

Cristal Mining advises that the details of any Aboriginal person or group who registers an interest in the Modification will be forwarded to the NSW Office of Environment and Heritage and the Balranald Local Aboriginal Land Council in accordance with Section 4.1.5 of the Consultation Guidelines, unless they specify that they do not want their details released.

Should you have any queries regarding your registration, require any further clarification, or wish to discuss the Modification further please do not hesitate to contact Cristal Mining via the following contact details:

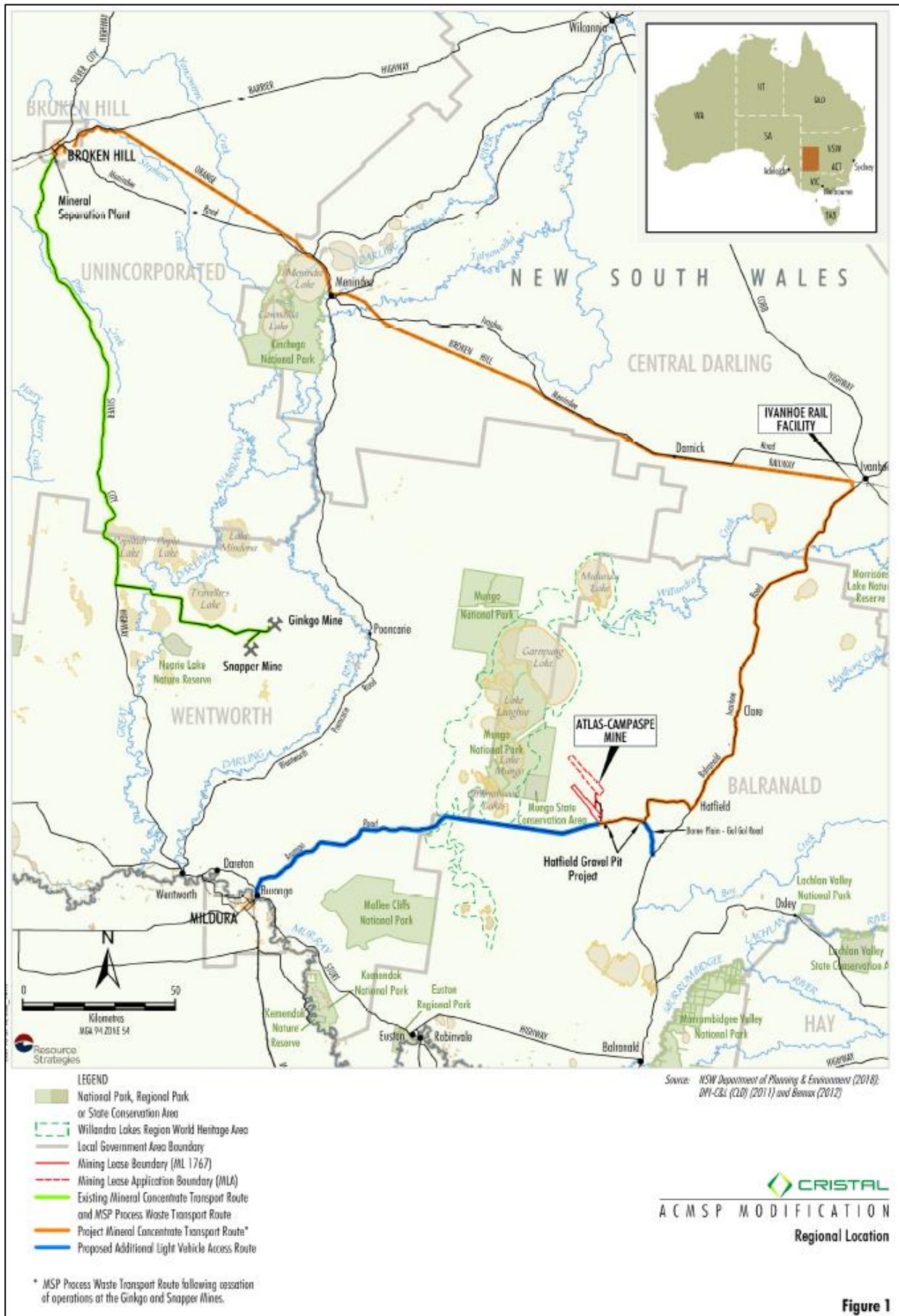
Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely

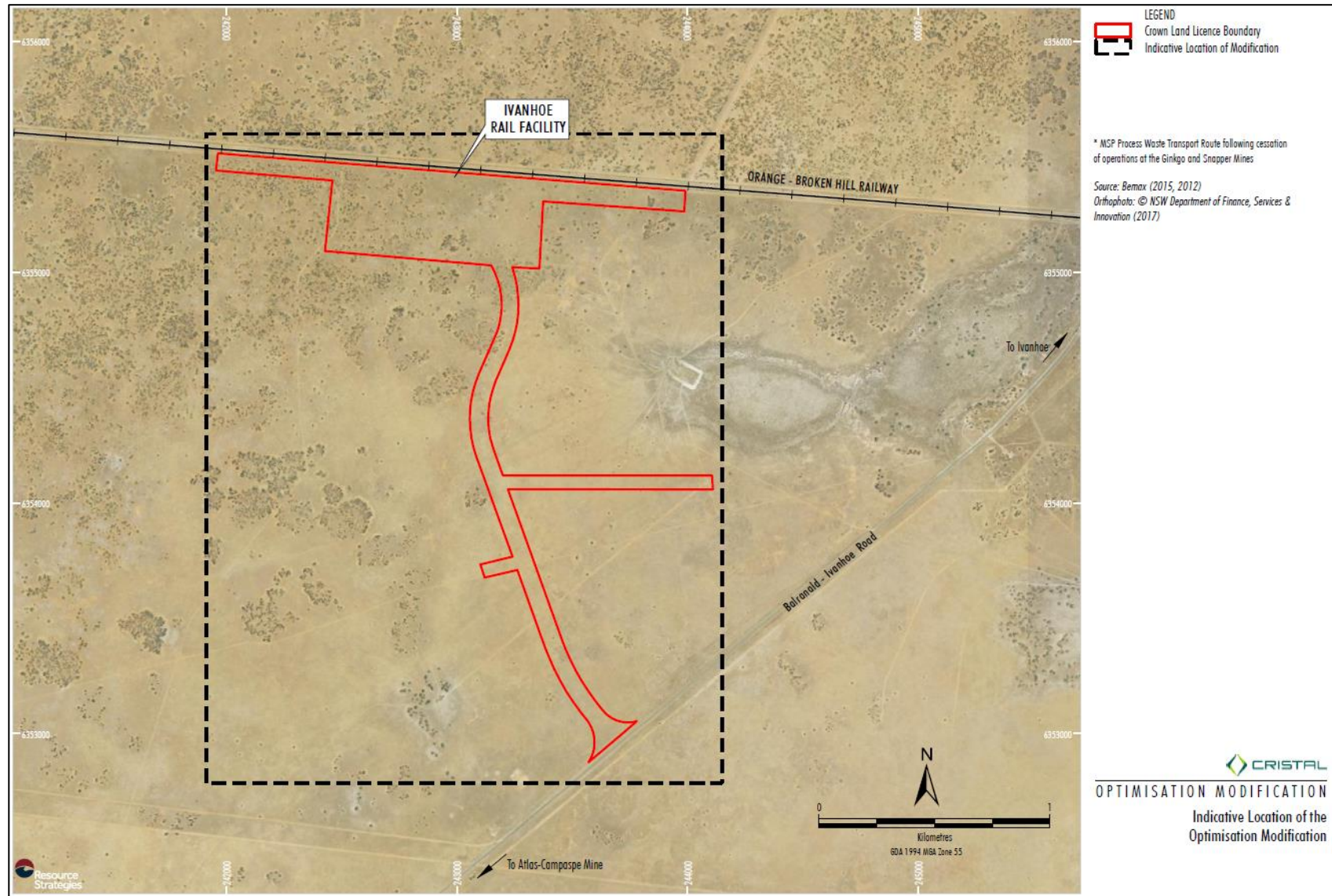


**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

## Plan Showing the Regional Location of the Project



## Plan Showing “Indicative Location of Modification”



**ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION  
UPDATED CONTACT DETAILS**

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

<b>Name</b>	
<b>Registered Aboriginal Party (if different from above)</b>	
<b>Address</b>	
<b>Postal Address (if different from above)</b>	
<b>Telephone Number</b>	
<b>Email Address</b>	

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

26 March 2019

Michael (Mick) Kelly on behalf of Ngiyampaa people  
Michael (Mick) Kelly  
C/- Office of Environment and Heritage  
PO Box 318  
BURONGA NSW 2739

Via Email: [mick.kelly@environment.nsw.gov.au](mailto:mick.kelly@environment.nsw.gov.au)

Dear Michael,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Cristal Mining Australia Limited (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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, NSW and 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 to the south-west of the township of Ivanhoe (Figure 1).

Cristal Mining is seeking environmental approvals under the EP&A Act for a proposed modification to the Project (the Modification).

The Modification would include the following:

- Extension to the Ivanhoe Rail Facility hardstand area and rail siding to accommodate longer trains.
- Revised alignment of the Ivanhoe Rail Facility access road and access road intersection.

The Modification would change the approved Ivanhoe Rail Facility surface development area. There would be no change to the approved Atlas-Campaspe Mine surface development area.

As part of the modification request, Cristal Mining will be preparing an Aboriginal Cultural Heritage Assessment to identify ways to avoid or minimise potential harm to Aboriginal objects. The subject area of the Modification and any such application is depicted as the "Indicative Location of Modification" as shown on Figure 2.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

Community consultation is an important part of this process. In accordance with the requirements as set out in the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010) (Consultation Guidelines) issued by the NSW Office of Environment and Heritage, Cristal Mining is required to conduct a community consultation process with relevant Aboriginal people to assist in the preparation of the Aboriginal Cultural Heritage Assessment. This includes:

- Contacting various government organisations and requesting a list of any Aboriginal persons or groups who may hold cultural knowledge relevant to, or who have a right or interest in, determining the cultural heritage significance of Aboriginal objects and/or places in the “Indicative Location of Modification”.
- Writing to the Aboriginal persons or groups identified by the above process to notify them of the Modification and invite them to register an interest in the community consultation process.

**Due to your previous involvement in the Aboriginal Cultural Heritage Assessment for the Atlas-Campaspe Mineral Sands Project Environmental Impact Statement, you have been automatically registered for the consultation process associated with the Modification. You do NOT need to contact Cristal Mining to re-register for the Modification.**

However, Cristal Mining would appreciate if you could please provide updated contact details for the Modification. Could you please complete the attached form and return to Cristal Mining via the contact details provided below.

Cristal Mining advises that the details of any Aboriginal person or group who registers an interest in the Modification will be forwarded to the NSW Office of Environment and Heritage and the Balranald Local Aboriginal Land Council in accordance with Section 4.1.5 of the Consultation Guidelines, unless they specify that they do not want their details released.

Should you have any queries regarding your registration, require any further clarification, or wish to discuss the Modification further please do not hesitate to contact Cristal Mining via the following contact details:

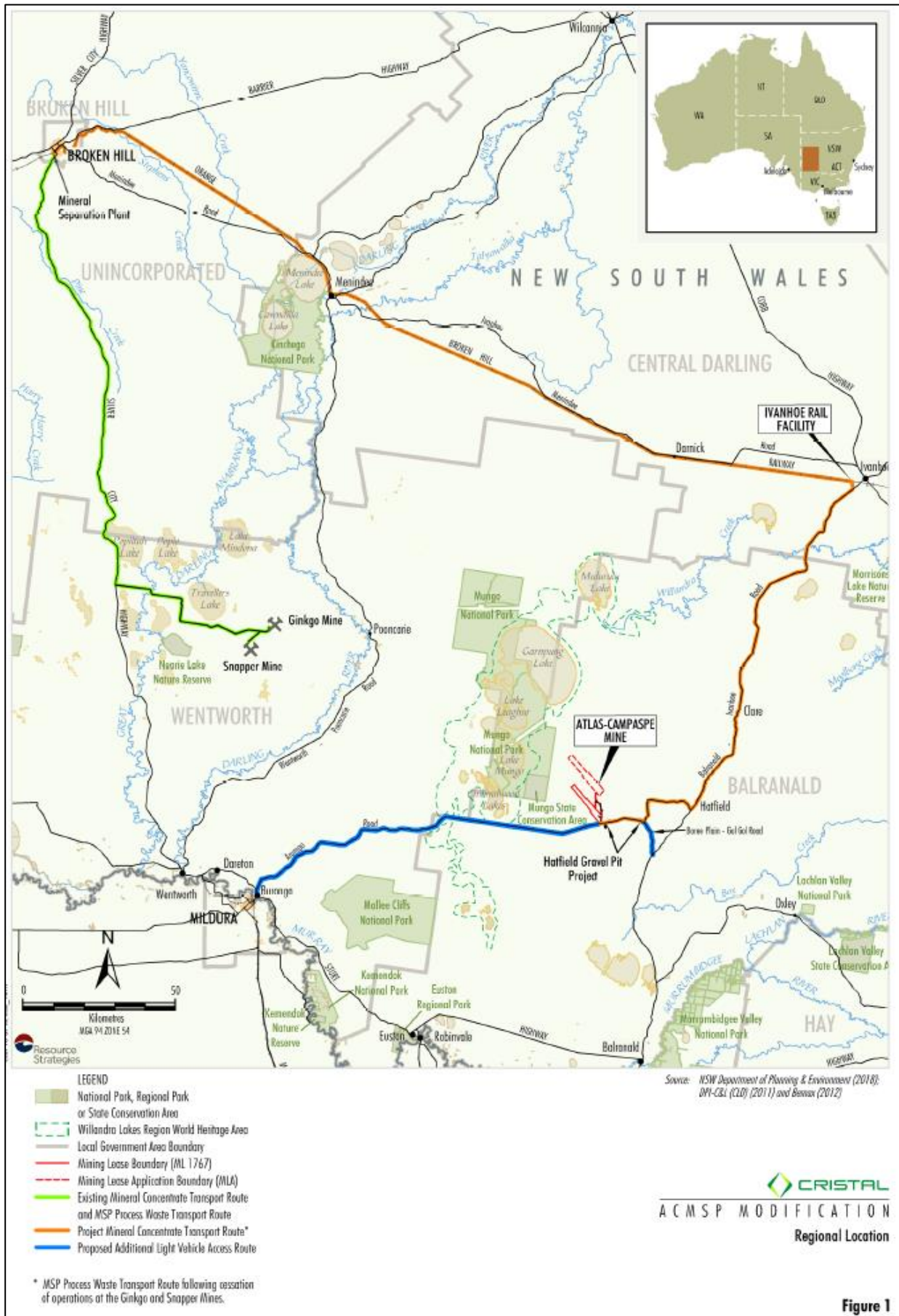
Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely

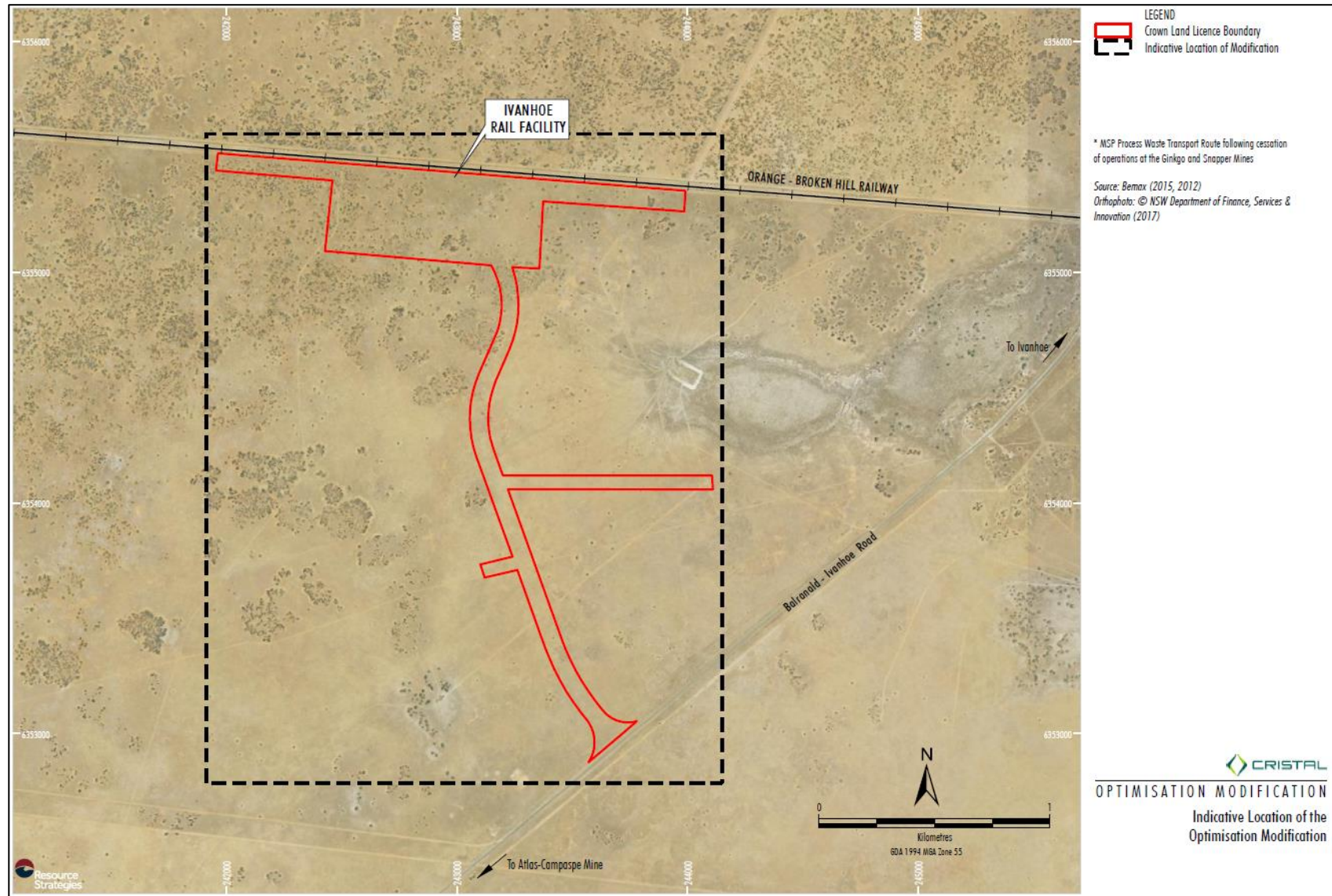


**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

## Plan Showing the Regional Location of the Project



## Plan Showing “Indicative Location of Modification”



**ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION  
UPDATED CONTACT DETAILS**

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

<b>Name</b>	
<b>Registered Aboriginal Party (if different from above)</b>	
<b>Address</b>	
<b>Postal Address (if different from above)</b>	
<b>Telephone Number</b>	
<b>Email Address</b>	

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

28 March 2019

National Koorie Site Management  
Ali Maher  
3 Cuthbert Drive  
MOUNT WARRIGAL NSW 2528

Via Email: [ali.n.maher@hotmail.com](mailto:ali.n.maher@hotmail.com)

Dear Ali,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Cristal Mining Australia Limited (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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, NSW and 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 to the south-west of the township of Ivanhoe (Figure 1).

Cristal Mining is seeking environmental approvals under the EP&A Act for a proposed modification to the Project (the Modification).

The Modification would include the following:

- Extension to the Ivanhoe Rail Facility hardstand area and rail siding to accommodate longer trains.
- Revised alignment of the Ivanhoe Rail Facility access road and access road intersection.

The Modification would change the approved Ivanhoe Rail Facility surface development area. There would be no change to the approved Atlas-Campaspe Mine surface development area.

As part of the modification request, Cristal Mining will be preparing an Aboriginal Cultural Heritage Assessment to identify ways to avoid or minimise potential harm to Aboriginal objects. The subject area of the Modification and any such application is depicted as the "Indicative Location of Modification" as shown on Figure 2.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

Community consultation is an important part of this process. In accordance with the requirements as set out in the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010) (Consultation Guidelines) issued by the NSW Office of Environment and Heritage, Cristal Mining is required to conduct a community consultation process with relevant Aboriginal people to assist in the preparation of the Aboriginal Cultural Heritage Assessment. This includes:

- Contacting various government organisations and requesting a list of any Aboriginal persons or groups who may hold cultural knowledge relevant to, or who have a right or interest in, determining the cultural heritage significance of Aboriginal objects and/or places in the “Indicative Location of Modification”.
- Writing to the Aboriginal persons or groups identified by the above process to notify them of the Modification and invite them to register an interest in the community consultation process.

**Due to your previous involvement in the Aboriginal Cultural Heritage Assessment for the Atlas-Campaspe Mineral Sands Project Environmental Impact Statement, you have been automatically registered for the consultation process associated with the Modification. You do NOT need to contact Cristal Mining to re-register for the Modification.**

However, Cristal Mining would appreciate if you could please provide updated contact details for the Modification. Could you please complete the attached form and return to Cristal Mining via the contact details provided below.

Cristal Mining advises that the details of any Aboriginal person or group who registers an interest in the Modification will be forwarded to the NSW Office of Environment and Heritage and the Balranald Local Aboriginal Land Council in accordance with Section 4.1.5 of the Consultation Guidelines, unless they specify that they do not want their details released.

Should you have any queries regarding your registration, require any further clarification, or wish to discuss the Modification further please do not hesitate to contact Cristal Mining via the following contact details:

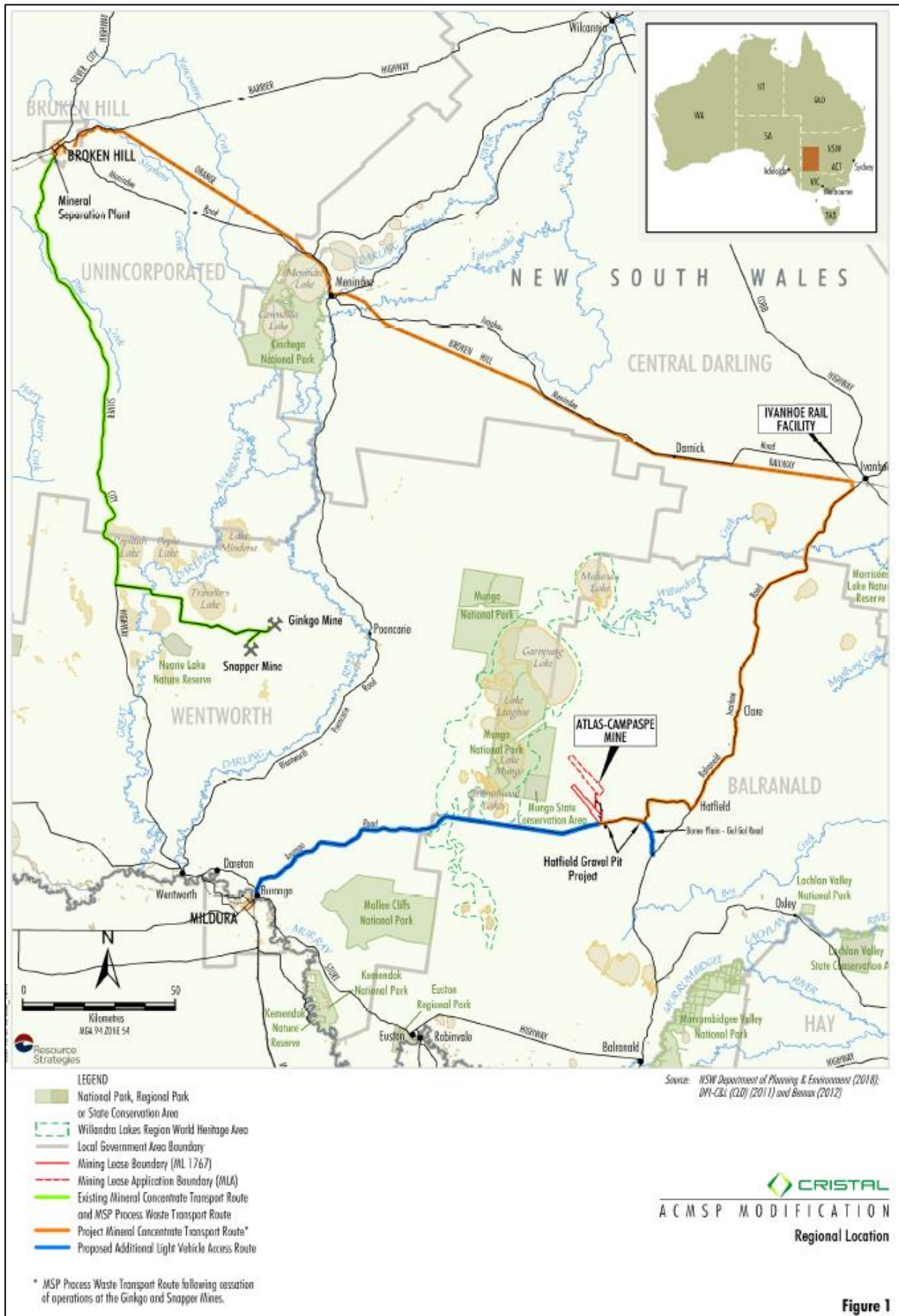
Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely

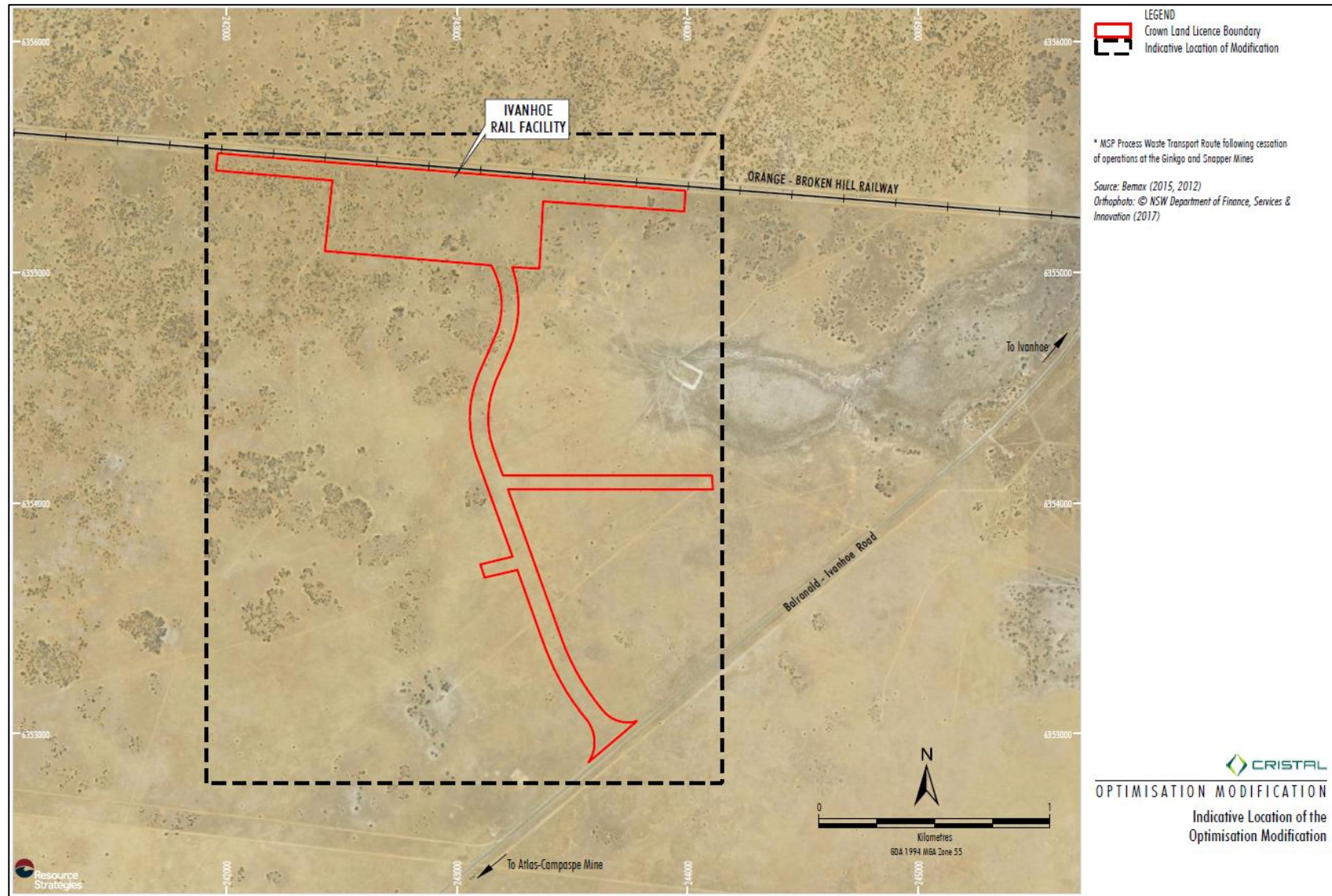


**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

## Plan Showing the Regional Location of the Project



## Plan Showing “Indicative Location of Modification”



**ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION  
UPDATED CONTACT DETAILS**

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

<b>Name</b>	
<b>Registered Aboriginal Party (if different from above)</b>	
<b>Address</b>	
<b>Postal Address (if different from above)</b>	
<b>Telephone Number</b>	
<b>Email Address</b>	

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

28 March 2019

Kullila Site Consultants  
Paul Charles  
14 Werrang Road  
PRIMBEE NSW 2502

Via Email: [kullilasiteconsultants@hotmail.com](mailto:kullilasiteconsultants@hotmail.com)

Dear Paul,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Cristal Mining Australia Limited (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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, NSW and 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 to the south-west of the township of Ivanhoe (Figure 1).

Cristal Mining is seeking environmental approvals under the EP&A Act for a proposed modification to the Project (the Modification).

The Modification would include the following:

- Extension to the Ivanhoe Rail Facility hardstand area and rail siding to accommodate longer trains.
- Revised alignment of the Ivanhoe Rail Facility access road and access road intersection.

The Modification would change the approved Ivanhoe Rail Facility surface development area. There would be no change to the approved Atlas-Campaspe Mine surface development area.

As part of the modification request, Cristal Mining will be preparing an Aboriginal Cultural Heritage Assessment to identify ways to avoid or minimise potential harm to Aboriginal objects. The subject area of the Modification and any such application is depicted as the "Indicative Location of Modification" as shown on Figure 2.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

Community consultation is an important part of this process. In accordance with the requirements as set out in the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010) (Consultation Guidelines) issued by the NSW Office of Environment and Heritage, Cristal Mining is required to conduct a community consultation process with relevant Aboriginal people to assist in the preparation of the Aboriginal Cultural Heritage Assessment. This includes:

- Contacting various government organisations and requesting a list of any Aboriginal persons or groups who may hold cultural knowledge relevant to, or who have a right or interest in, determining the cultural heritage significance of Aboriginal objects and/or places in the “Indicative Location of Modification”.
- Writing to the Aboriginal persons or groups identified by the above process to notify them of the Modification and invite them to register an interest in the community consultation process.

**Due to your previous involvement in the Aboriginal Cultural Heritage Assessment for the Atlas-Campaspe Mineral Sands Project Environmental Impact Statement, you have been automatically registered for the consultation process associated with the Modification. You do NOT need to contact Cristal Mining to re-register for the Modification.**

However, Cristal Mining would appreciate if you could please provide updated contact details for the Modification. Could you please complete the attached form and return to Cristal Mining via the contact details provided below.

Cristal Mining advises that the details of any Aboriginal person or group who registers an interest in the Modification will be forwarded to the NSW Office of Environment and Heritage and the Balranald Local Aboriginal Land Council in accordance with Section 4.1.5 of the Consultation Guidelines, unless they specify that they do not want their details released.

Should you have any queries regarding your registration, require any further clarification, or wish to discuss the Modification further please do not hesitate to contact Cristal Mining via the following contact details:

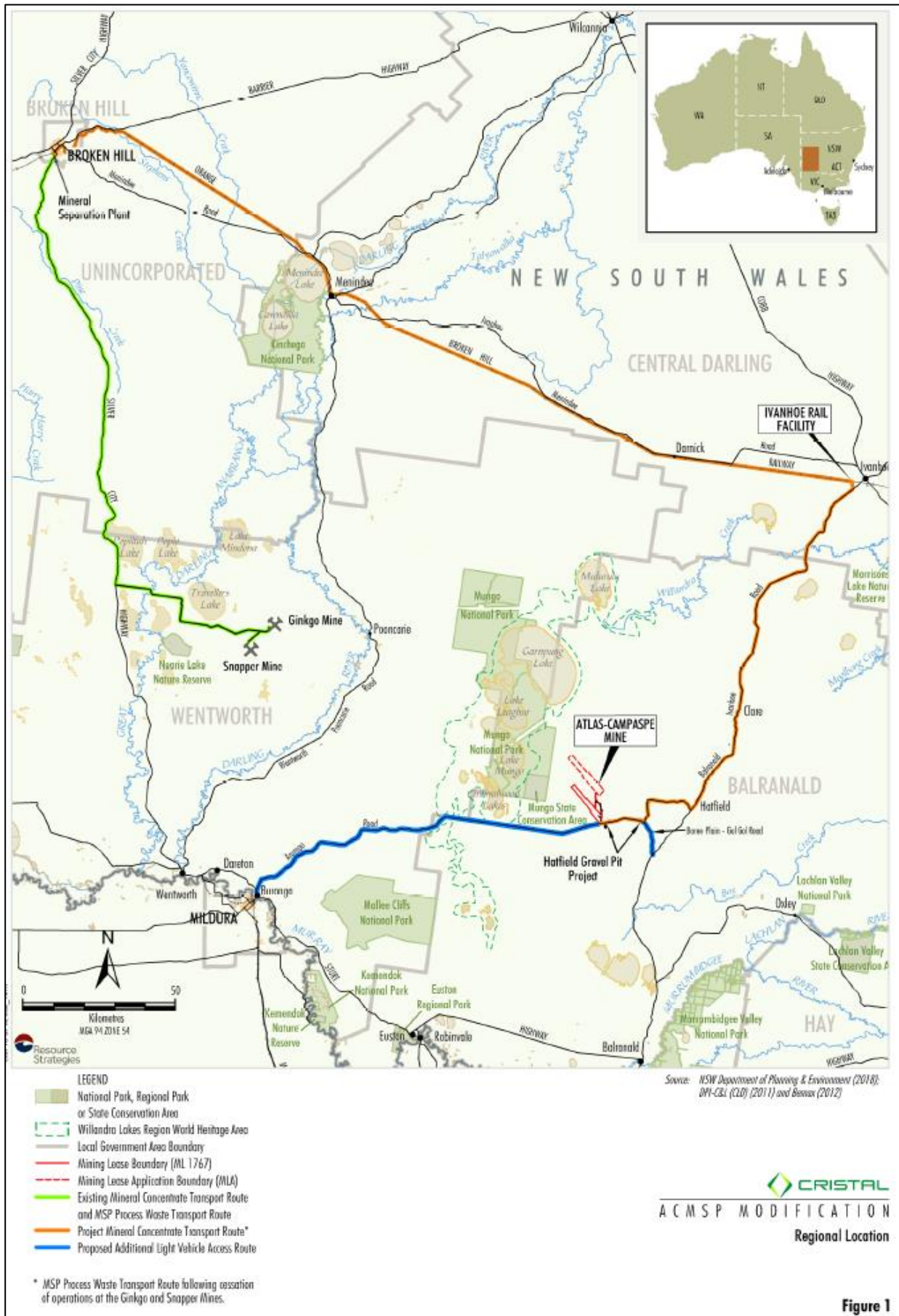
Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely

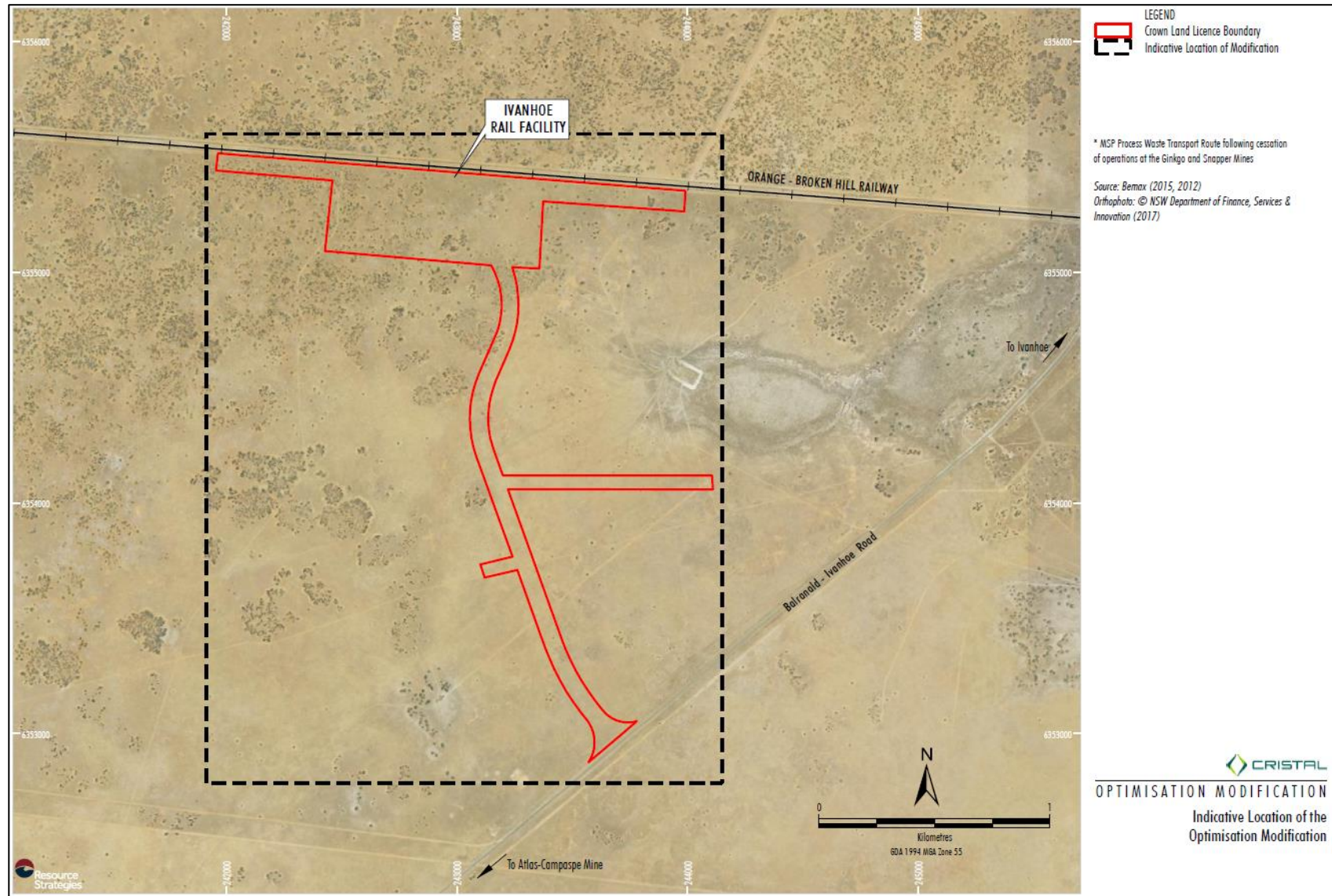


**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

## Plan Showing the Regional Location of the Project



## Plan Showing “Indicative Location of Modification”



**ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION  
UPDATED CONTACT DETAILS**

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

<b>Name</b>	
<b>Registered Aboriginal Party (if different from above)</b>	
<b>Address</b>	
<b>Postal Address (if different from above)</b>	
<b>Telephone Number</b>	
<b>Email Address</b>	

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

28 March 2019

Willandra Lakes 2 Traditional Tribal Groups Elders Council  
C/- Warren Clarke  
PO Box 318  
BURONGA NSW 2739

Via Email: [warren.clarke@environment.nsw.gov.au](mailto:warren.clarke@environment.nsw.gov.au)

Dear Warren,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Cristal Mining Australia Limited (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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, NSW and 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 to the south-west of the township of Ivanhoe (Figure 1).

Cristal Mining is seeking environmental approvals under the EP&A Act for a proposed modification to the Project (the Modification).

The Modification would include the following:

- Extension to the Ivanhoe Rail Facility hardstand area and rail siding to accommodate longer trains.
- Revised alignment of the Ivanhoe Rail Facility access road and access road intersection.

The Modification would change the approved Ivanhoe Rail Facility surface development area. There would be no change to the approved Atlas-Campaspe Mine surface development area.

As part of the modification request, Cristal Mining will be preparing an Aboriginal Cultural Heritage Assessment to identify ways to avoid or minimise potential harm to Aboriginal objects. The subject area of the Modification and any such application is depicted as the "Indicative Location of Modification" as shown on Figure 2.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

Community consultation is an important part of this process. In accordance with the requirements as set out in the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010) (Consultation Guidelines) issued by the NSW Office of Environment and Heritage, Cristal Mining is required to conduct a community consultation process with relevant Aboriginal people to assist in the preparation of the Aboriginal Cultural Heritage Assessment. This includes:

- Contacting various government organisations and requesting a list of any Aboriginal persons or groups who may hold cultural knowledge relevant to, or who have a right or interest in, determining the cultural heritage significance of Aboriginal objects and/or places in the “Indicative Location of Modification”.
- Writing to the Aboriginal persons or groups identified by the above process to notify them of the Modification and invite them to register an interest in the community consultation process.

**Due to your previous involvement in the Aboriginal Cultural Heritage Assessment for the Atlas-Campaspe Mineral Sands Project Environmental Impact Statement, you have been automatically registered for the consultation process associated with the Modification. You do NOT need to contact Cristal Mining to re-register for the Modification.**

However, Cristal Mining would appreciate if you could please provide updated contact details for the Modification. Could you please complete the attached form and return to Cristal Mining via the contact details provided below.

Cristal Mining advises that the details of any Aboriginal person or group who registers an interest in the Modification will be forwarded to the NSW Office of Environment and Heritage and the Balranald Local Aboriginal Land Council in accordance with Section 4.1.5 of the Consultation Guidelines, unless they specify that they do not want their details released.

Should you have any queries regarding your registration, require any further clarification, or wish to discuss the Modification further please do not hesitate to contact Cristal Mining via the following contact details:

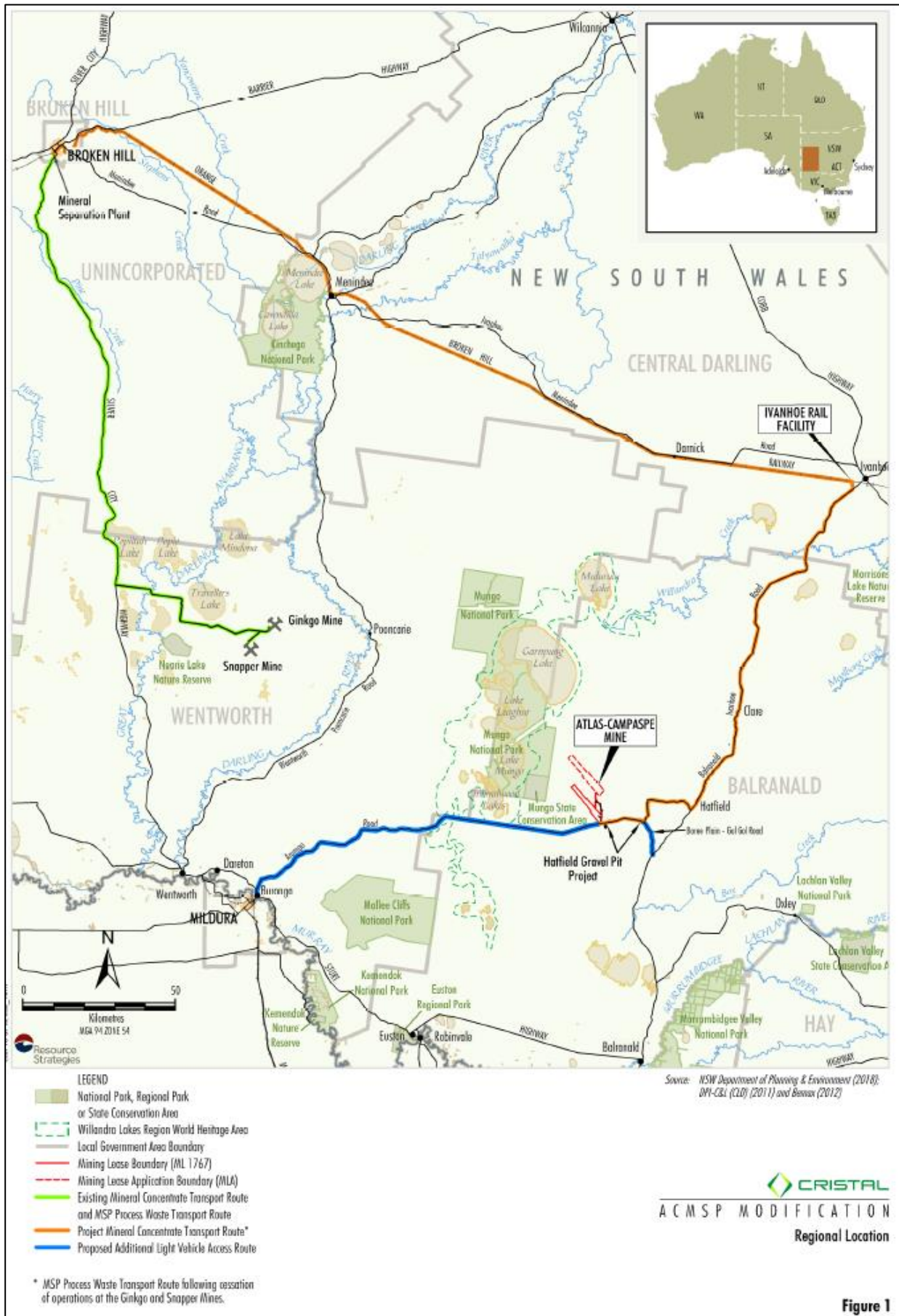
Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely

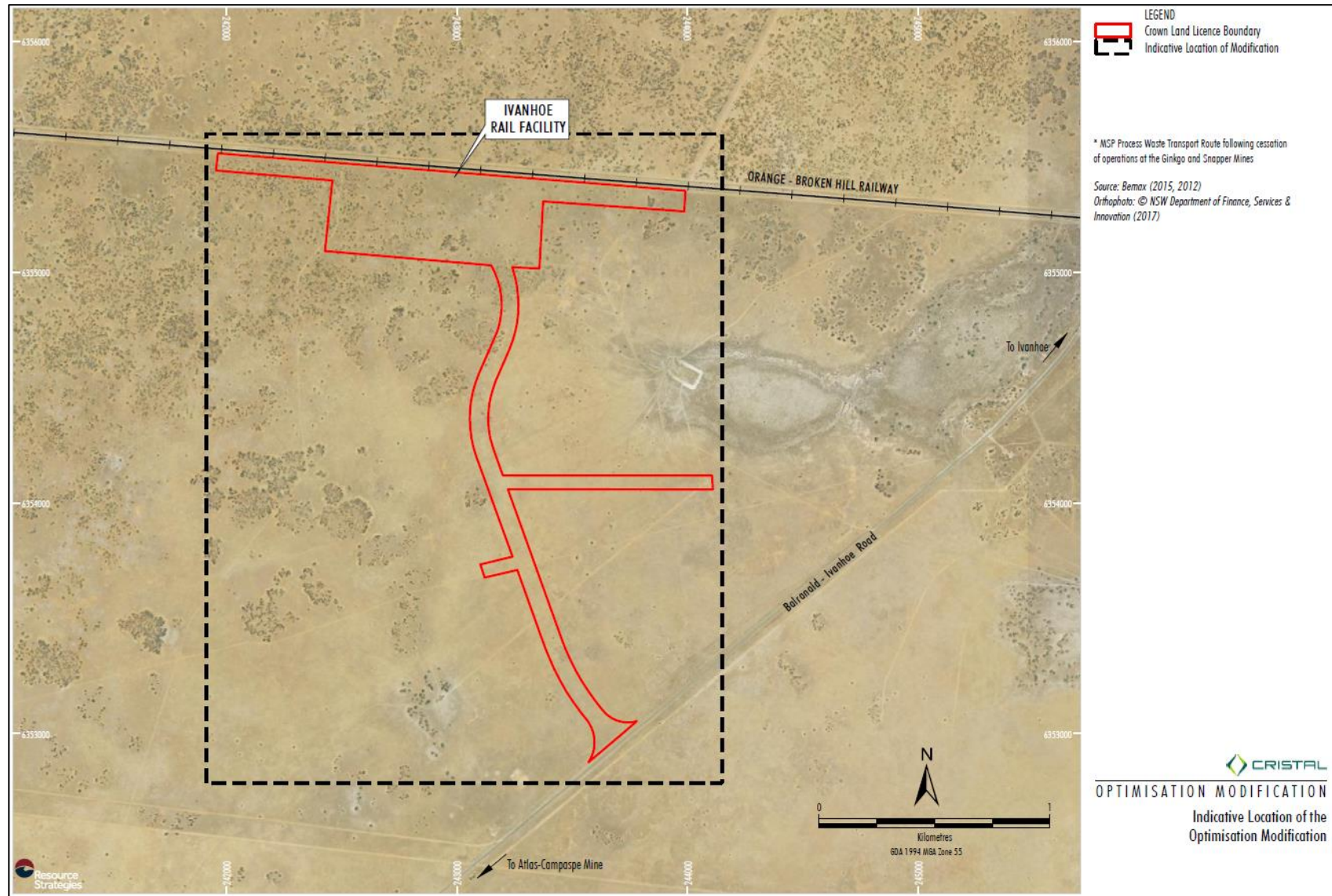


**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

## Plan Showing the Regional Location of the Project



## Plan Showing “Indicative Location of Modification”



**ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION  
UPDATED CONTACT DETAILS**

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

<b>Name</b>	
<b>Registered Aboriginal Party (if different from above)</b>	
<b>Address</b>	
<b>Postal Address (if different from above)</b>	
<b>Telephone Number</b>	
<b>Email Address</b>	

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

28 March 2019

Muthi Muthi Nations Aboriginal Corporation  
Bernadette Pappin  
PO Box 210  
BALRANALD NSW 2715

Via Email: [dkeely@macmildura.org](mailto:dkeely@macmildura.org) and [bpappin@gwahs.health.nsw.gov.au](mailto:bpappin@gwahs.health.nsw.gov.au)

Dear Bernadette,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Cristal Mining Australia Limited (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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, NSW and 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 to the south-west of the township of Ivanhoe (Figure 1).

Cristal Mining is seeking environmental approvals under the EP&A Act for a proposed modification to the Project (the Modification).

The Modification would include the following:

- Extension to the Ivanhoe Rail Facility hardstand area and rail siding to accommodate longer trains.
- Revised alignment of the Ivanhoe Rail Facility access road and access road intersection.

The Modification would change the approved Ivanhoe Rail Facility surface development area. There would be no change to the approved Atlas-Campaspe Mine surface development area.

As part of the modification request, Cristal Mining will be preparing an Aboriginal Cultural Heritage Assessment to identify ways to avoid or minimise potential harm to Aboriginal objects. The subject area of the Modification and any such application is depicted as the "Indicative Location of Modification" as shown on Figure 2.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

Community consultation is an important part of this process. In accordance with the requirements as set out in the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010) (Consultation Guidelines) issued by the NSW Office of Environment and Heritage, Cristal Mining is required to conduct a community consultation process with relevant Aboriginal people to assist in the preparation of the Aboriginal Cultural Heritage Assessment. This includes:

- Contacting various government organisations and requesting a list of any Aboriginal persons or groups who may hold cultural knowledge relevant to, or who have a right or interest in, determining the cultural heritage significance of Aboriginal objects and/or places in the “Indicative Location of Modification”.
- Writing to the Aboriginal persons or groups identified by the above process to notify them of the Modification and invite them to register an interest in the community consultation process.

**Due to your previous involvement in the Aboriginal Cultural Heritage Assessment for the Atlas-Campaspe Mineral Sands Project Environmental Impact Statement, you have been automatically registered for the consultation process associated with the Modification. You do NOT need to contact Cristal Mining to re-register for the Modification.**

However, Cristal Mining would appreciate if you could please provide updated contact details for the Modification. Could you please complete the attached form and return to Cristal Mining via the contact details provided below.

Cristal Mining advises that the details of any Aboriginal person or group who registers an interest in the Modification will be forwarded to the NSW Office of Environment and Heritage and the Balranald Local Aboriginal Land Council in accordance with Section 4.1.5 of the Consultation Guidelines, unless they specify that they do not want their details released.

Should you have any queries regarding your registration, require any further clarification, or wish to discuss the Modification further please do not hesitate to contact Cristal Mining via the following contact details:

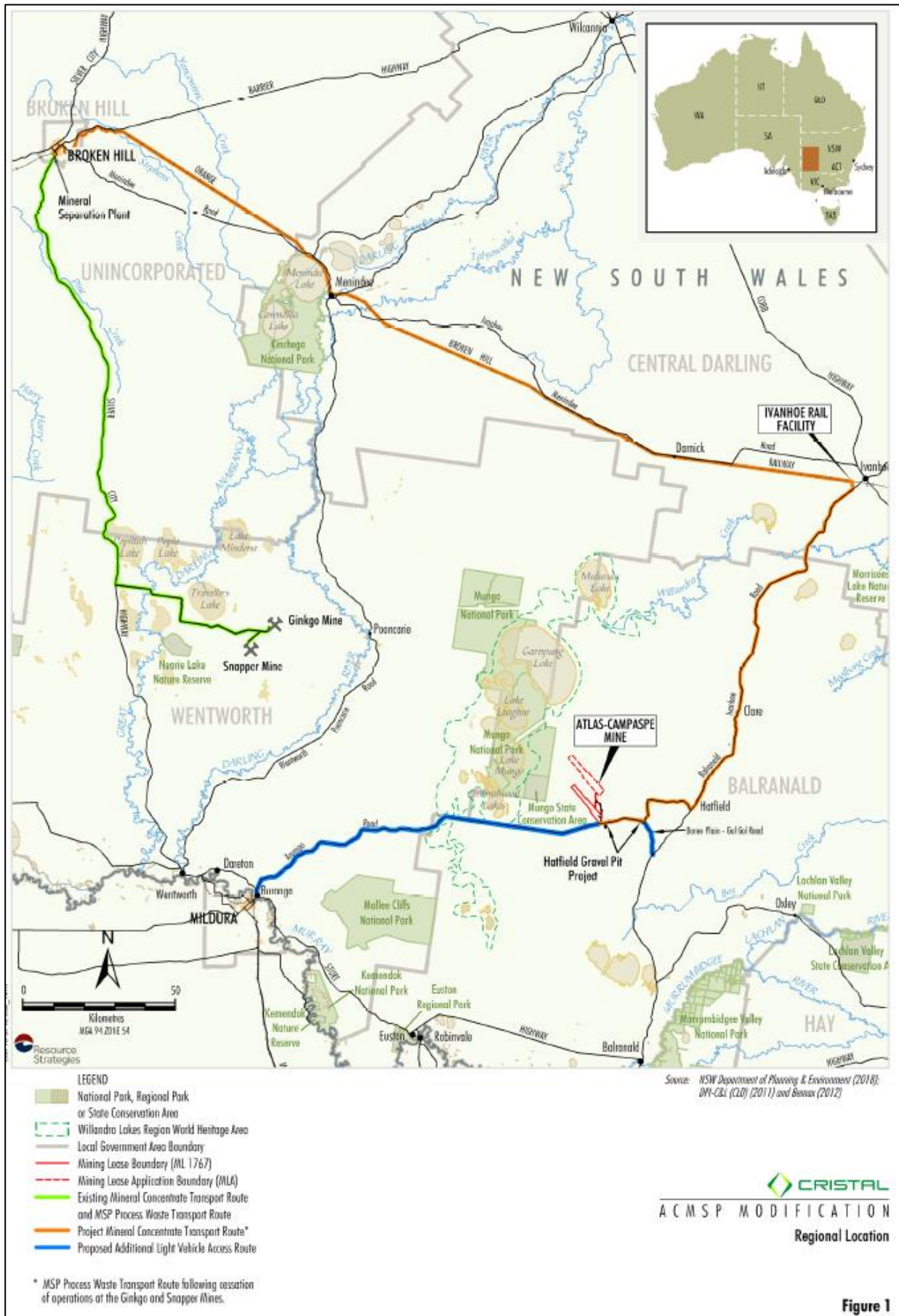
Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely

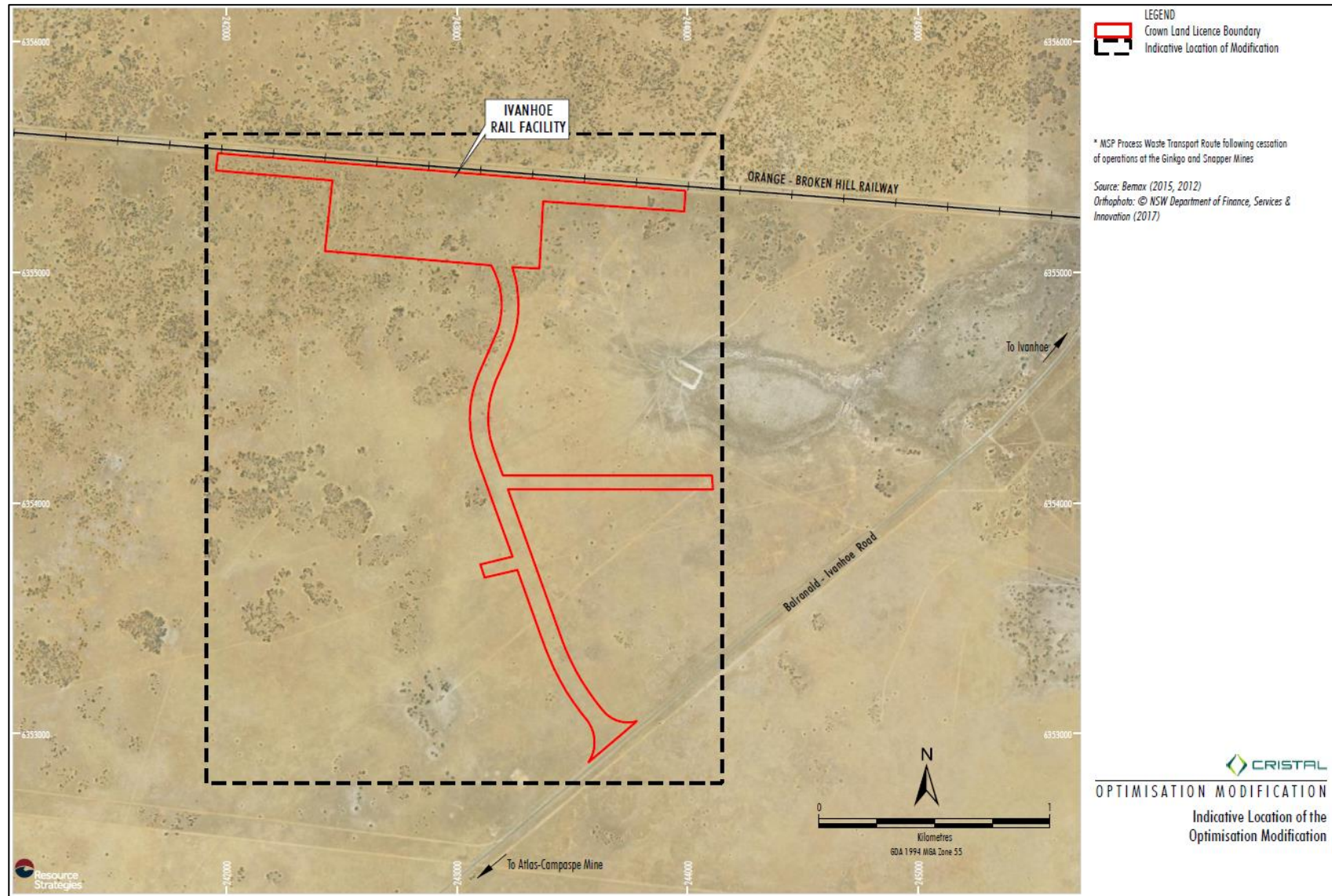


**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

## Plan Showing the Regional Location of the Project



## Plan Showing “Indicative Location of Modification”



**ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION  
UPDATED CONTACT DETAILS**

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

<b>Name</b>	
<b>Registered Aboriginal Party (if different from above)</b>	
<b>Address</b>	
<b>Postal Address (if different from above)</b>	
<b>Telephone Number</b>	
<b>Email Address</b>	

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

28 March 2019

Wakool Indigenous Corporation  
Danny Kelly  
Cynthia and Garry Pappin  
PO Box 243  
BALRANALD NSW 2715

Via Email: [danielkelly1952@gmail.com](mailto:danielkelly1952@gmail.com) and [Wakool.ic@gmail.com](mailto:Wakool.ic@gmail.com)

Dear Danny, Cynthia and Garry,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Cristal Mining Australia Limited (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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, NSW and 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 to the south-west of the township of Ivanhoe (Figure 1).

Cristal Mining is seeking environmental approvals under the EP&A Act for a proposed modification to the Project (the Modification).

The Modification would include the following:

- Extension to the Ivanhoe Rail Facility hardstand area and rail siding to accommodate longer trains.
- Revised alignment of the Ivanhoe Rail Facility access road and access road intersection.

The Modification would change the approved Ivanhoe Rail Facility surface development area. There would be no change to the approved Atlas-Campaspe Mine surface development area.

As part of the modification request, Cristal Mining will be preparing an Aboriginal Cultural Heritage Assessment to identify ways to avoid or minimise potential harm to Aboriginal objects. The subject area of the Modification and any such application is depicted as the "Indicative Location of Modification" as shown on Figure 2.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

Community consultation is an important part of this process. In accordance with the requirements as set out in the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010) (Consultation Guidelines) issued by the NSW Office of Environment and Heritage, Cristal Mining is required to conduct a community consultation process with relevant Aboriginal people to assist in the preparation of the Aboriginal Cultural Heritage Assessment. This includes:

- Contacting various government organisations and requesting a list of any Aboriginal persons or groups who may hold cultural knowledge relevant to, or who have a right or interest in, determining the cultural heritage significance of Aboriginal objects and/or places in the “Indicative Location of Modification”.
- Writing to the Aboriginal persons or groups identified by the above process to notify them of the Modification and invite them to register an interest in the community consultation process.

**Due to your previous involvement in the Aboriginal Cultural Heritage Assessment for the Atlas-Campaspe Mineral Sands Project Environmental Impact Statement, you have been automatically registered for the consultation process associated with the Modification. You do NOT need to contact Cristal Mining to re-register for the Modification.**

However, Cristal Mining would appreciate if you could please provide updated contact details for the Modification. Could you please complete the attached form and return to Cristal Mining via the contact details provided below.

Cristal Mining advises that the details of any Aboriginal person or group who registers an interest in the Modification will be forwarded to the NSW Office of Environment and Heritage and the Balranald Local Aboriginal Land Council in accordance with Section 4.1.5 of the Consultation Guidelines, unless they specify that they do not want their details released.

Should you have any queries regarding your registration, require any further clarification, or wish to discuss the Modification further please do not hesitate to contact Cristal Mining via the following contact details:

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely



**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

## Plan Showing the Regional Location of the Project

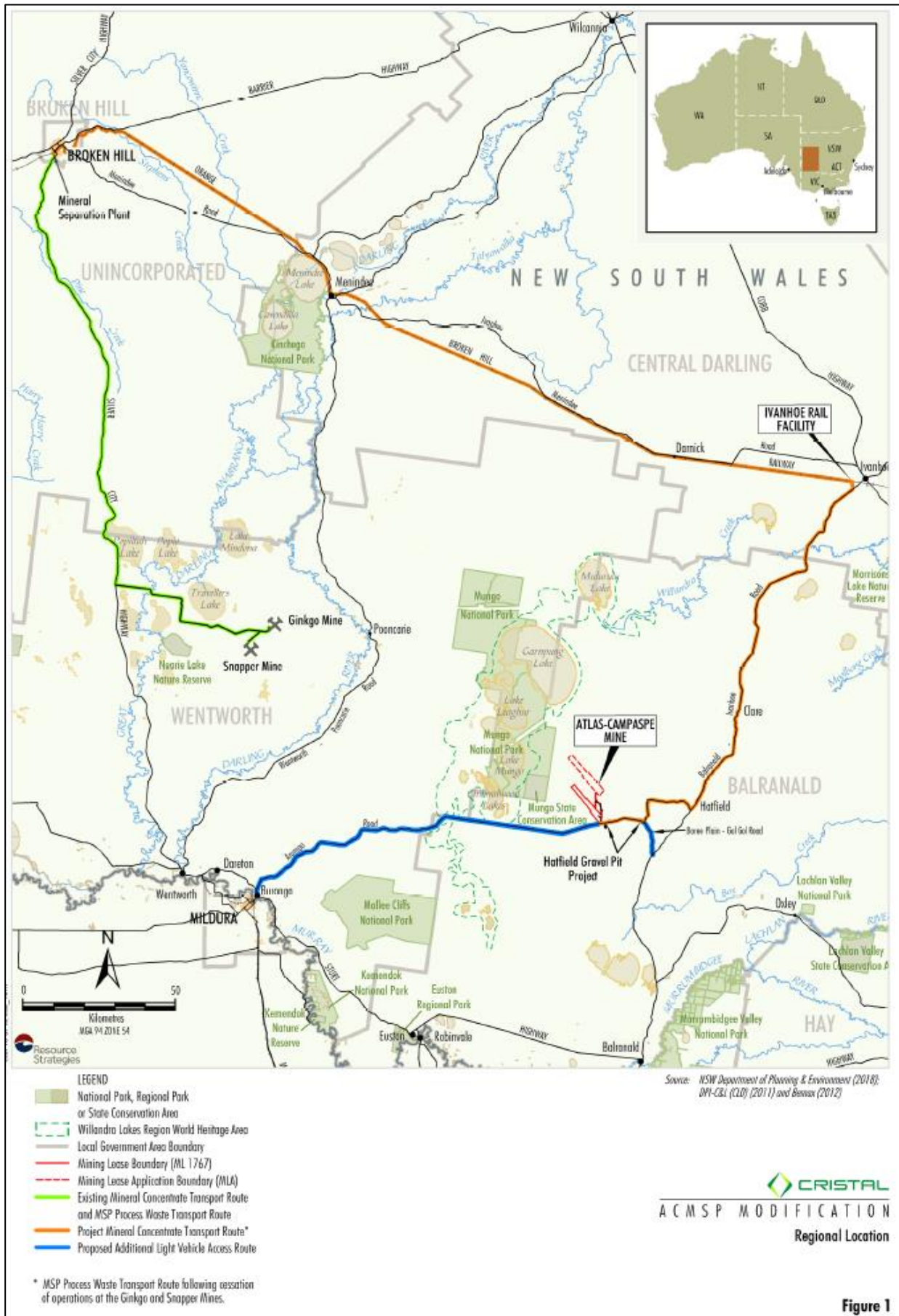
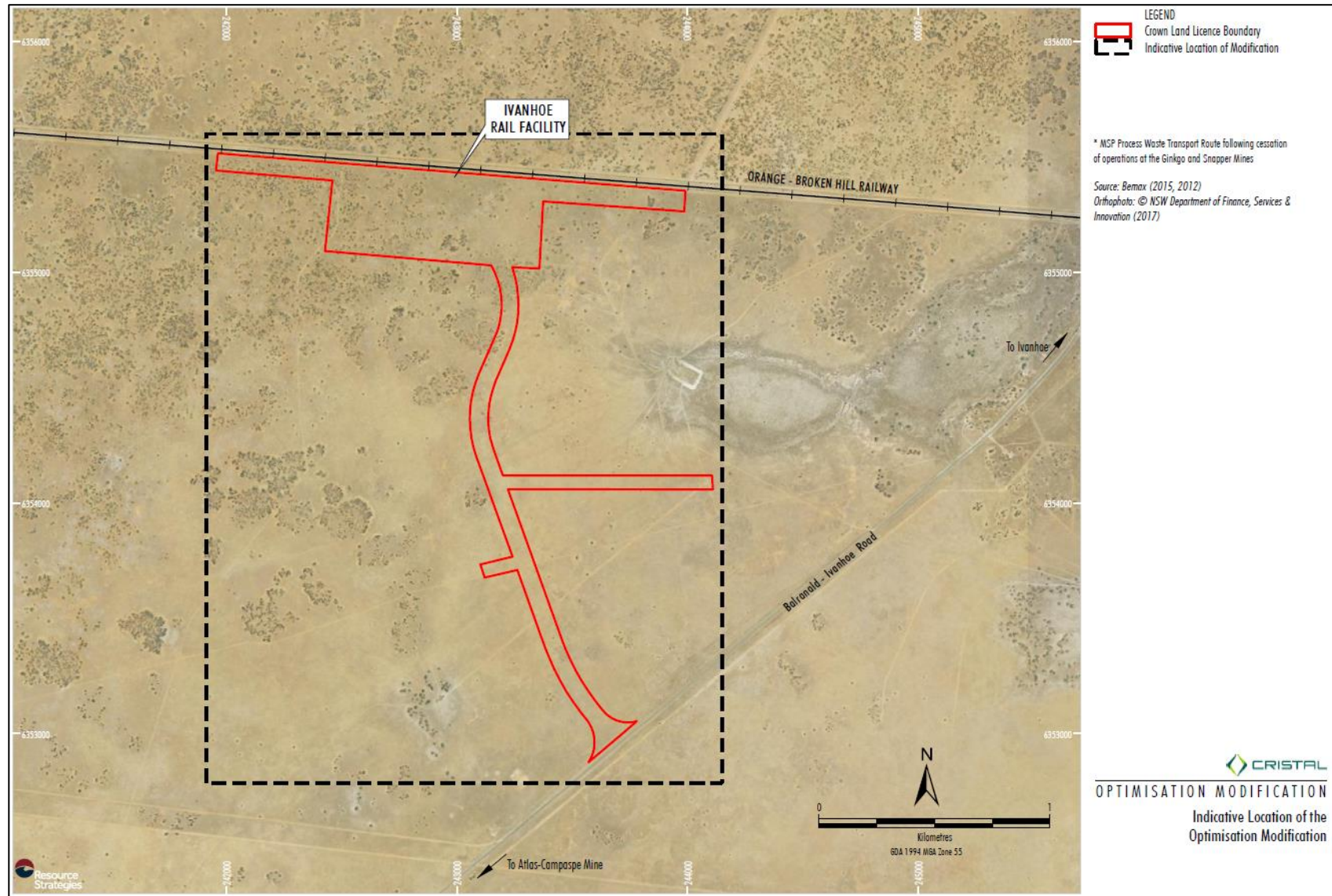


Figure 1

## Plan Showing “Indicative Location of Modification”



**ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION  
UPDATED CONTACT DETAILS**

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

<b>Name</b>	
<b>Registered Aboriginal Party (if different from above)</b>	
<b>Address</b>	
<b>Postal Address (if different from above)</b>	
<b>Telephone Number</b>	
<b>Email Address</b>	

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

28 March 2019

Maria Maher

Via Email: [g.m.maher@hotmail.com](mailto:g.m.maher@hotmail.com)

Dear Maria,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Cristal Mining Australia Limited (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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, NSW and 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 to the south-west of the township of Ivanhoe (Figure 1).

Cristal Mining is seeking environmental approvals under the EP&A Act for a proposed modification to the Project (the Modification).

The Modification would include the following:

- Extension to the Ivanhoe Rail Facility hardstand area and rail siding to accommodate longer trains.
- Revised alignment of the Ivanhoe Rail Facility access road and access road intersection.

The Modification would change the approved Ivanhoe Rail Facility surface development area. There would be no change to the approved Atlas-Campaspe Mine surface development area.

As part of the modification request, Cristal Mining will be preparing an Aboriginal Cultural Heritage Assessment to identify ways to avoid or minimise potential harm to Aboriginal objects. The subject area of the Modification and any such application is depicted as the "Indicative Location of Modification" as shown on Figure 2.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

Community consultation is an important part of this process. In accordance with the requirements as set out in the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010) (Consultation Guidelines) issued by the NSW Office of Environment and Heritage, Cristal Mining is required to conduct a community consultation process with relevant Aboriginal people to assist in the preparation of the Aboriginal Cultural Heritage Assessment. This includes:

- Contacting various government organisations and requesting a list of any Aboriginal persons or groups who may hold cultural knowledge relevant to, or who have a right or interest in, determining the cultural heritage significance of Aboriginal objects and/or places in the “Indicative Location of Modification”.
- Writing to the Aboriginal persons or groups identified by the above process to notify them of the Modification and invite them to register an interest in the community consultation process.

**Due to your previous involvement in the Aboriginal Cultural Heritage Assessment for the Atlas-Campaspe Mineral Sands Project Environmental Impact Statement, you have been automatically registered for the consultation process associated with the Modification. You do NOT need to contact Cristal Mining to re-register for the Modification.**

However, Cristal Mining would appreciate if you could please provide updated contact details for the Modification. Could you please complete the attached form and return to Cristal Mining via the contact details provided below.

Cristal Mining advises that the details of any Aboriginal person or group who registers an interest in the Modification will be forwarded to the NSW Office of Environment and Heritage and the Balranald Local Aboriginal Land Council in accordance with Section 4.1.5 of the Consultation Guidelines, unless they specify that they do not want their details released.

Should you have any queries regarding your registration, require any further clarification, or wish to discuss the Modification further please do not hesitate to contact Cristal Mining via the following contact details:

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely



**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

## Plan Showing the Regional Location of the Project

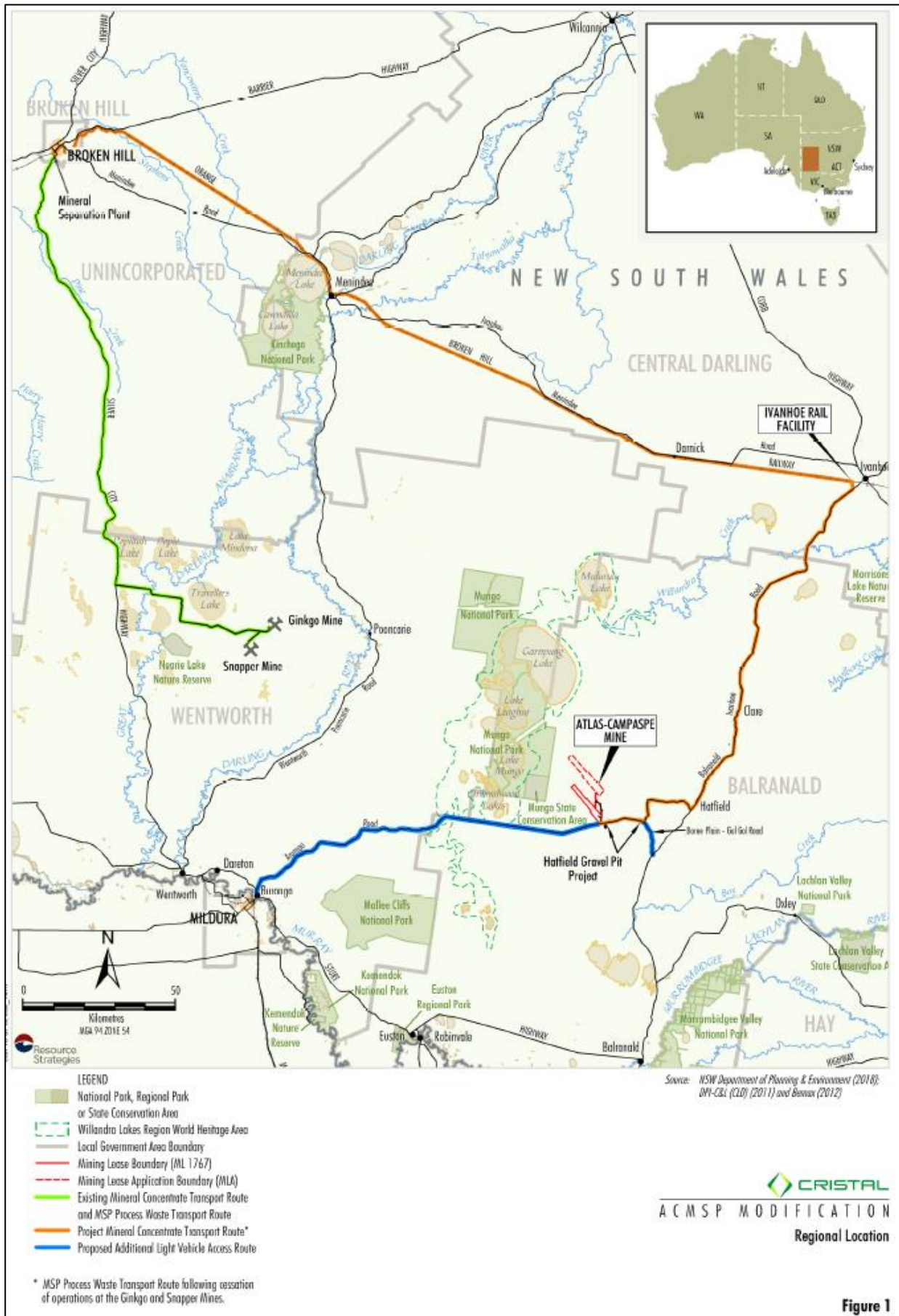
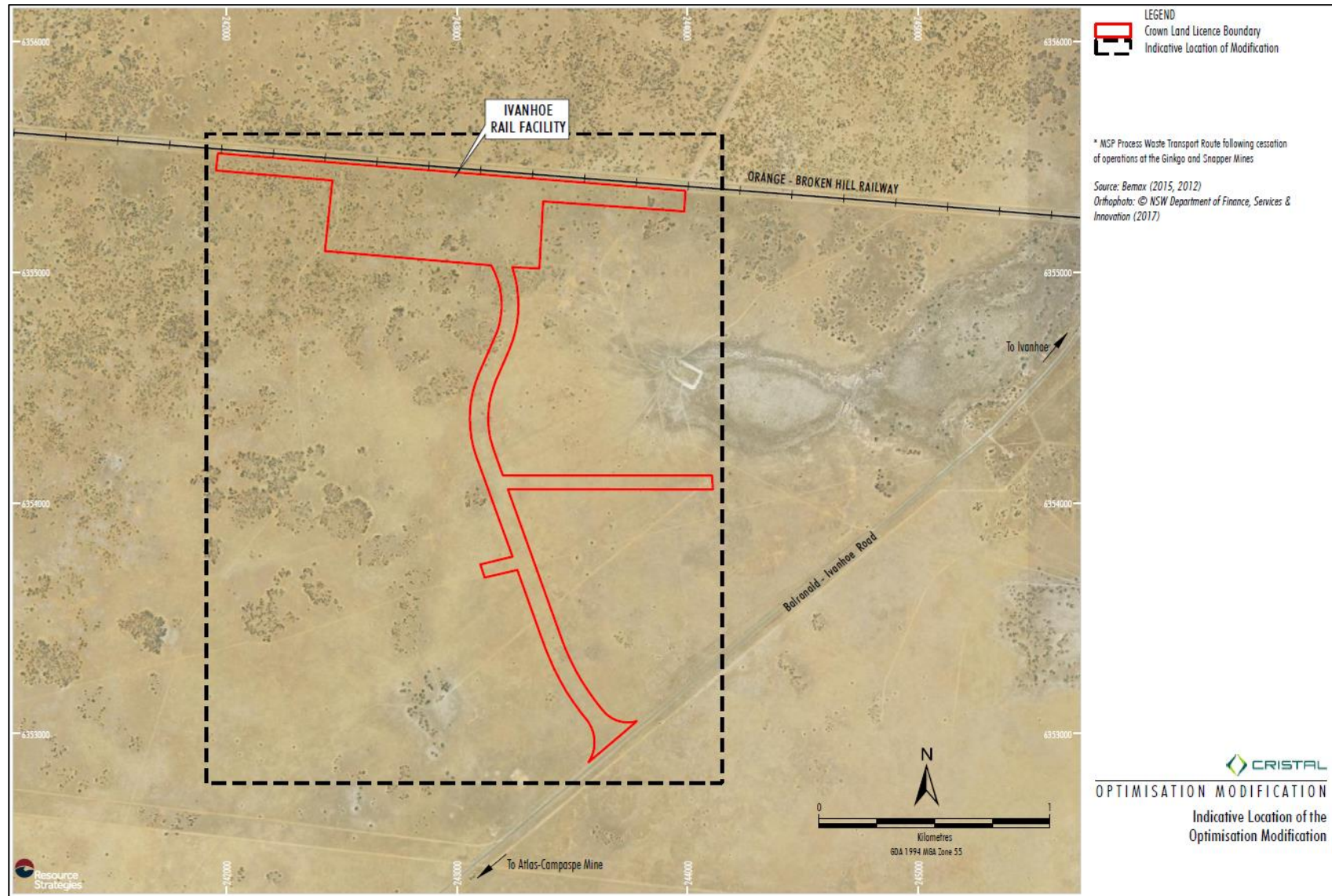


Figure 1

## Plan Showing “Indicative Location of Modification”



**ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION  
UPDATED CONTACT DETAILS**

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 4032, Mildura VIC 3502  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

<b>Name</b>	
<b>Registered Aboriginal Party (if different from above)</b>	
<b>Address</b>	
<b>Postal Address (if different from above)</b>	
<b>Telephone Number</b>	
<b>Email Address</b>	

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

### STAGE 3 CORRESPONDENCE

29 March 2019

Balranald Local Aboriginal Land Council  
Damien Aidon  
PO Box 187  
BALRANALD NSW 2715

Via Email: [ceo.blalc@gmail.com](mailto:ceo.blalc@gmail.com)

Dear Damien,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT PROPOSED METHODOLOGY, INFORMATION SESSION AND FIELD SURVEY**

Thank you for registering an interest in the Aboriginal consultation process for the Atlas-Campaspe Mineral Sands Project Optimisation Modification (the Modification). As you are aware, the Atlas-Campaspe Mineral Sands Project is being developed by Cristal Mining Australia Ltd (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

The Atlas-Campaspe Mine is located approximately 80 kilometres (km) north of Balranald, NSW and 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 to the south-west of the township of Ivanhoe.

**Proposed Methodology**

Please find enclosed for your review, a copy of the Proposed Methodology for the Aboriginal Cultural Heritage Assessment for the Modification (Enclosure A).

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (New South Wales [NSW] Department of Environment, Climate Change and Water, 2010) issued by the NSW Office of Environment and Heritage, we have provided the Proposed Methodology for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the Proposed Methodology.

If you wish to provide input on the following, please provide feedback to Cristal Mining (via the contact details provided at the end of this letter) by **5:00 pm Friday 3 May 2019**:

- The nature of the Proposed Methodology.
- Any Aboriginal objects or places of cultural value within the Modification area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

All comments received will be taken into consideration as the Methodology is finalised.

### **Information Session**

An information session with all Registered Aboriginal Parties, the consulting archaeologist and Cristal Mining representatives will be held on **Tuesday 30 April 2019** to discuss the Modification and the Proposed Methodology. The information session will be held at the Ivanhoe RSL (51 Columbus Street, Ivanhoe), and will commence at 3:00 pm and conclude at approximately 5:00 pm.

At the information session, Cristal Mining will provide a presentation on the nature and scale of the Modification, an overview of the impact assessment process and will discuss the roles, functions and responsibilities of participants and protocols for the management of any sensitive cultural heritage information.

The information session will also provide Registered Aboriginal Parties with an opportunity to raise any cultural issues or comments/perspectives regarding the Modification or the Proposed Methodology. Note that issues can also be raised at any point during the consultation process.

Light refreshments and drinks will be provided.

Cristal Mining will pay out of pocket travel expenses for Aboriginal representatives, from their home address to the meeting location and return (note that Cristal Mining will pay 75 cents per kilometre, up to a maximum of \$300 per Registered Aboriginal Party). Registered Aboriginal Parties seeking to claim payment will need to provide proof of transport and sign a payment declaration form.

Cristal Mining will arrange for payment to be made via direct deposit after the meeting. Bank account details must be supplied to Cristal Mining (with confirmation of details from the bank and/or the Registered Aboriginal Party prior to payment). However, please note that Cristal Mining will not be paying for attendance at the information session.

Can you please indicate whether you are interested in attending the information session by **5:00 pm Friday 12 April 2019** via the contact details provided below.

### **Field Survey**

As part of the Aboriginal Cultural Heritage Assessment for the Modification, Cristal Mining will be facilitating a field survey of the Modification area, to allow representatives of the Registered Aboriginal Parties to inspect the area and any Aboriginal heritage sites which may be located within or in immediate proximity to the area.

Regardless of participation in the surveys, all Registered Aboriginal Parties will be invited by Cristal Mining to attend a site inspection of the Modification area and a selection of the recorded sites following completion of the field surveys.

Please find enclosed the survey application form for completion and return by **5.00 pm Friday 12 April 2019**, for those Registered Aboriginal Parties who are seeking consideration for paid involvement in the field investigation associated with the Modification.

In order to be considered for paid involvement in the field surveys, Registered Aboriginal Parties will need to complete the attached Field Survey Application Form (Enclosure B) and provide it to Cristal Mining by the closing date.

Aboriginal representatives will be selected by Cristal Mining based upon the merits of the application with respect to the selection criteria, which are indicated by the questions in the application form. Applications will be assessed against all criteria including cultural knowledge of the Modification area, the representation of others within the community and experience in providing cultural heritage advice.

Where a response is not received by 5.00 pm Friday 12 April 2019, it will be assumed that you do not wish to seek consideration for paid involvement in the field investigation. Incomplete applications may not be accepted by Cristal Mining. Please note that Cristal Mining reserves the right to request any further information/clarification or supporting documentation from you in respect to your application.

Assistance in the completion of the application form can be provided to you upon request. Please use the contact details provided below.

The field survey is expected to take place on **Wednesday 1 May 2019** (i.e. the day following the Information Session). Further details will be provided to the successful applicants as soon as possible.

### **Contact Details**

To provide any feedback with respect to the Proposed Methodology and/or to indicate your attendance at the information session, please contact Cristal Mining via the following contact details

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 444, Broken Hill NSW 2880  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely



**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

ENCLOSURE A

PROPOSED METHODOLOGY FOR THE ABORIGINAL CULTURAL HERITAGE ASSESSMENT  
FOR THE MODIFICATION

ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION

PROPOSED METHODOLOGY  
FOR THE  
ABORIGINAL CULTURAL HERITAGE ASSESSMENT



MARCH 2019  
Project No. CMA-18-07  
Document No. 970715

## 1 INTRODUCTION

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Cristal Mining Australia Limited (CMA), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* in 2014.

### 1.1 Approved 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, NSW and 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 to the south-west of the township of Ivanhoe (Figure 1).

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 existing Broken Hill Mineral Separation Plant (the MSP) (Figure 1).

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

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

The Project general arrangements and activities associated with the two main development components of the Project are described in the following sub-sections.

#### ***Atlas-Campaspe Mine***

The main activities associated with the development of the Atlas-Campaspe Mine include:

- ongoing exploration activities;
- sequential development and operation of two separate mineral sands ore extraction areas within the Mining Leases;
- use of conventional mobile equipment to mine and place mineral sands ore into dry mining units at a maximum ore production rate of up to 7.2 million tonnes per annum (Mtpa);
- mineral processing infrastructure including the primary gravity concentration unit, salt washing facility and a wet high intensity magnetic separation (WHIMS) circuit;
- mineral concentrate stockpiles and materials handling infrastructure (e.g. towers and stackers);
- progressive backfilling of mine voids with overburden behind the advancing ore extraction areas or in overburden emplacements adjacent to the mine path;
- placement of sand residues and coarse rejects (and MSP process wastes) following mineral processing to either the active mining area (behind the advancing ore extraction area) or in sand residue dams;

- development of a groundwater borefield at the Atlas deposit and localised dewatering systems (bores, spearfields and trenches) at both the Atlas and Campaspe deposits, including associated pump and pipeline systems;
- reverse osmosis plant to supply the salt washing facility and potable water;
- progressive development of water storage dams, sediment basins, pumps, pipelines and other water management equipment and structures;
- administration/office buildings, car parking facilities, workshop and stores;
- on-site accommodation camp;
- sewage treatment plant;
- diesel powered generators, electricity distribution station and associated internal electricity transmission lines;
- site access road, internal access roads and haul roads;
- roadworks along the proposed mineral concentrate transport route to the Ivanhoe Rail Facility;
- transport of mineral concentrates along the mineral concentrate transport route to the Ivanhoe Rail Facility;
- road transport of MSP process waste in sealed storage containers from the Ivanhoe Rail Facility to the Atlas-Campaspe Mine for subsequent unloading, stockpiling and placement behind the advancing ore extraction areas;
- development of soil stockpiles and laydown areas;
- monitoring and rehabilitation; and
- other associated minor infrastructure, plant, equipment and activities.

### ***Ivanhoe Rail Facility***

The main activities associated with the construction and operation of the Ivanhoe Rail Facility located approximately 4.5 km south-west of Ivanhoe, will include:

- development of a rail siding for:
  - loading of train wagons with mineral concentrate for rail transport to the MSP via the Orange – Broken Hill railway; and
  - unloading of MSP process waste in sealed storage containers (transported via the Orange – Broken Hill railway) from train wagons;
- site access road and internal haul roads/pavements;
- hardstand areas for mineral concentrate and MSP process waste unloading, stockpiling/sealed container storage and loading;
- a retention basin, drains, pumps, pipelines and other water management equipment and structures;
- site office and car parking facilities;
- extension to existing 11 kilovolt powerline;
- monitoring, landscaping and rehabilitation; and
- other associated minor infrastructure, plant, equipment and activities.

## 1.2 Optimisation Modification

CMA proposes to modify Development Consent (SSD\_5012) to allow for changes to optimise the Project (herein preferred to as the Optimisation Modification or Modification). The Modification would include:

- Increased ore production rate from 7.2 Mtpa to 10.6 Mtpa.
- Addition of conveyors to transfer overburden (haul trucks are currently approved).
- Increased mineral concentrate production from 450,000 tonnes per annum (tpa) to 635,000 tpa.
- Increased mineral concentrate transport truck trips from 24 per day to 35 per day.
- Increased mineral concentrate transport train length (from 600 metres [m] to 800 m) and frequency (from 6 to 8 train movements per week [i.e. 4 arrivals, 4 departures]).
- Extension to the Ivanhoe Rail Facility hardstand area and rail siding to accommodate the longer trains.
- Revised alignment of the Ivanhoe Rail Facility access road and access road intersection.
- Addition of the Ivanhoe Rail Facility bore as a water supply for the Ivanhoe Rail Facility.
- Increased MSP process waste disposal rate from 50,000 tpa to 65,000 tpa.
- Use of other local roads other than the haulage route to access site (i.e. Arumpo Road).
- Addition of an on-site landfill (inside approved surface development area).
- Addition of on-site solar power generation infrastructure (inside the approved surface development area).
- Addition of an airstrip on the site access road (inside the approved surface development area).

The Modification would change the approved Ivanhoe Rail Facility surface development area. The indicative location of additional surface development areas associated with the Modification is provided on Figure 2.

There would be no change to the approved mine site surface development area.

It is proposed that the Modification will be sought under section 4.55(2) of the EP&A Act.

CMA are seeking to engage with the Aboriginal community as part of the preparation for an Aboriginal Cultural Heritage Assessment (ACHA). Consultation with Aboriginal people and communities will be guided by the NSW Office of Environmental and Heritage's (OEH) *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water [DECCW], 2010).

## 1.3 Structure of this Document

Section 2 of this document describes the previous archaeological investigations undertaken for the approved Project, while Section 3 outlines the Proposed Methodology for the cultural and archaeological assessment of Aboriginal objects, places and/or Aboriginal cultural heritage values within the approved Modification area.

Section 4 outlines the sensitive cultural information management protocol and Section 5 provides further information on the preparation of the ACHA report. Relevant personnel and critical timeframes for the assessment are outlined in Sections 6 and 7, respectively.

## **2 PREVIOUS ARCHAEOLOGICAL INVESTIGATIONS**

A previous Aboriginal Cultural Heritage Assessment was conducted in November 2012 by Niche Environment and Heritage (Niche) on behalf of CMA, for the (now) approved Project.

A total of 100 Aboriginal cultural heritage sites were identified within the Project area and surrounds. This includes 78 Aboriginal cultural heritage sites identified at the Atlas-Campaspe Mine area (including the mineral concentrate transport route) and 22 Aboriginal cultural heritage sites identified at the Ivanhoe Rail Facility area (Niche, 2012).

Aboriginal cultural heritage sites identified within the Project area and surrounds comprise 48 stone artefact scatters, 13 stone artefact scatters with hearths, two stone artefact scatters with hearths and non-human bone, one stone artefact scatter with hearths and freshwater mussel shell, 35 isolated finds of stone artefacts and one culturally modified tree (Niche, 2012).

## **3 PROPOSED ASSESSMENT METHODOLOGY**

The Proposed Methodology for the cultural and archaeological assessment for the ACHA is as follows:

- Conduct a desktop assessment to delineate areas of known and predicted Aboriginal objects, places and/or Aboriginal cultural heritage values, including a detailed review of the previous assessment prepared by Niche (2012).
- Identify the Aboriginal cultural heritage values associated with the relevant area through consulting with Aboriginal people with cultural knowledge or responsibilities for Country in which the Modification occurs, utilising written, oral research and field investigations.
- The conduct of a cultural and archaeological assessment with representatives of local Aboriginal community, to identify Aboriginal objects, places and/or Aboriginal cultural heritage values. The field investigation would be carried out by the project archaeologist with the assistance of Aboriginal representatives.
- Record/document any Aboriginal objects, places and/or Aboriginal cultural heritage values within the relevant area and assessment of their significance with representatives of the Registered Aboriginal Parties (RAPs).
- In consultation with the RAPs, develop recommended management and mitigation measures for Aboriginal objects, places and/or Aboriginal cultural heritage values, including documentation (where relevant) of previous management and mitigation measures described for the approved Project (Niche, 2012).
- Provide a consideration of the potential impacts of the Modification on Aboriginal objects, places and/or Aboriginal cultural heritage values within the Modification area.
- Describe and justify the outcomes and alternatives.
- Document the Aboriginal cultural heritage impact assessment and the recommendations to minimise potential impacts on Aboriginal cultural heritage.
- Provide a copy of the draft ACHA to the RAPs for their review and feedback.
- Documentation of feedback received as part of the cultural assessment from RAPs for presentation in the final ACHA report (subject to the sensitivity of the information provided).

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW, 2010), CMA requests that RAPs provide, where relevant during the conduct of the ACHA, cultural information regarding:

- whether there are any Aboriginal sites/objects of cultural value to Aboriginal people in the relevant area or surrounds; and
- whether there are any places of cultural value to Aboriginal people in the relevant area or surrounds.

This may include places of social, spiritual and cultural value, historic places with cultural significance, and potential places/areas of historic, social, spiritual and/or cultural significance.

#### **4 SENSITIVE CULTURAL INFORMATION – MANAGEMENT PROTOCOL**

In the event that a RAP has sensitive or restricted public access information, it is proposed that CMA would manage this information (if provided by the Aboriginal community) in accordance with a sensitive cultural information management protocol.

It is anticipated that the protocol would include making note of and managing the material in accordance with the following key limitations/requirements as advised by the relevant RAP at the time of the information being provided:

- any restrictions on access to the material;
- any restrictions on communication of the material;
- any restrictions on the location/storage of the material;
- any cultural recommendations on handling the material;
- any contextual information;
- any names and contact details of persons authorised by the relevant Aboriginal party to make decisions concerning the Aboriginal material and the degree of authorisation;
- any details of any consent given in accordance with customary law;
- the level of confidentiality to be accorded to the material; and
- any access and use by the RAP, of the cultural information in the material.

All RAPs should be aware of the mandatory OEH requirement that all feedback provided must be documented in the final ACHA, including copies of any submissions received and the proponents response to the issues raised.

#### **5 ABORIGINAL CULTURAL HERITAGE ASSESSMENT**

Following consultation on the Proposed Methodology of the cultural and archaeological assessment, and undertaking any required field components, a draft ACHA report will be prepared. The draft ACHA will be provided to all RAPs for their review and comment, and will include:

- details of the Aboriginal objects, places and/or Aboriginal cultural heritage values within the Modification area and how they will be impacted by the Modification;
- details of the consultation undertaken and how comments received at various times were considered; and

- management and mitigation recommendations drawing on information provided by RAPs and the results of the cultural and archaeological assessments.

## **6 PERSONNEL**

*Project Archaeologist:* Dr Matt Cupper would be the project archaeologist. Matt has a wide range of experience in cultural and natural heritage management and an academic background in archaeology, geology and botany, including a PhD in the palaeoecology and early Aboriginal occupation of the Darling River. His particular area of expertise is the interaction of Aboriginal people and arid ecosystems in the interior of Australia. As a consultant archaeologist he has been engaged in many management and research-oriented studies of the Murray Darling Basin for industry and government. These have included investigation of the cultural heritage of the dunefields of western NSW for petroleum and mineral sands developments, and archaeological surveys of water supply and irrigation infrastructure along the Lachlan, Murray and Darling Rivers.

*Aboriginal Field Representatives:* It is anticipated that Aboriginal field representatives would be engaged by CMA for the duration of the cultural heritage field survey (although this number may be subject to change based on the extent of the area requiring survey or due to workplace health and safety constraints). Aboriginal field representatives (including community leaders and Elders attending community consultation meetings) would invoice and, where appropriate, negotiate with CMA directly in relation to engagement for the field surveys. Aboriginal field personnel may be engaged on a rotational basis (e.g. a different team of representatives each day) as required.

## **7 CRITICAL TIMEFRAMES**

Critical timeframes for the ACHA are outlined below:

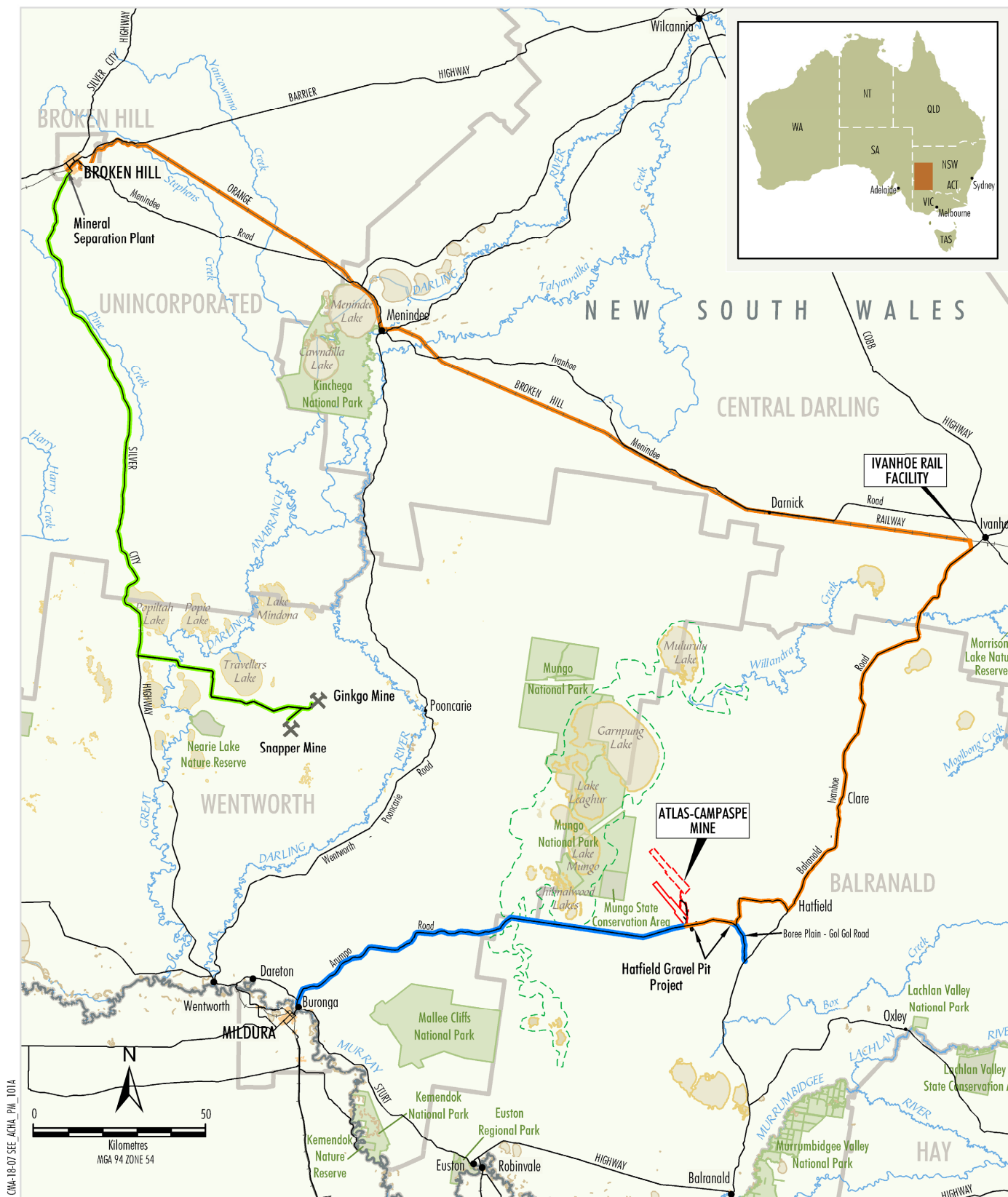
1. Collation of cultural significant information – ongoing throughout process until the end of the draft ACHA review period.
2. Provision of comments on the Proposed Methodology to CMA – April 2019.
3. Field survey – anticipated to occur in April 2019 (noting that survey dates will be confirmed with relevant representatives of the RAPs as required).
4. Provision of a draft ACHA (including proposed management and mitigation measures) to RAPs for review and comment – anticipated to occur April/May 2019 (following field survey).
5. Provision of comments from RAPs on draft ACHA to CMA – anticipated to occur May 2019.
6. Finalise ACHA in consideration of comments received – May 2019.

## **8 REFERENCES**

Niche (2012) *Atlas-Campaspe Mineral Sands Project Aboriginal and Non-Aboriginal Cultural Heritage Assessment*. Report prepared for Cristal Mining Australia Ltd.

Department of Environment, Climate Change and Water (2010) *Aboriginal cultural heritage consultation requirements for proponents 2010*.

## FIGURES



#### LEGEND

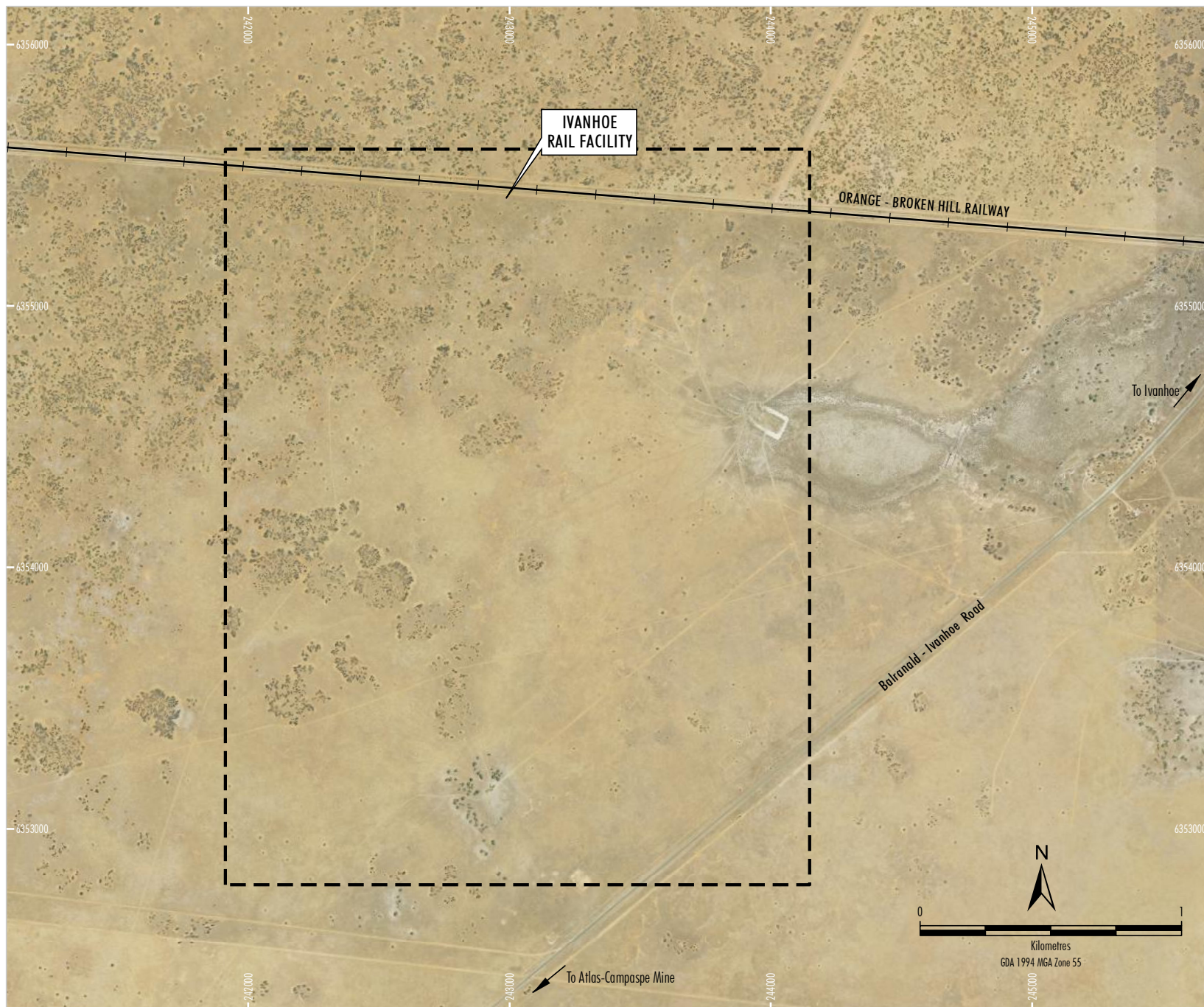
- National Park, Regional Park or State Conservation Area
- Willandra Lakes Region World Heritage Area
- Local Government Area Boundary
- Mining Lease Boundary (ML 1767)
- Mining Lease Application Boundary (MLA)
- Existing Mineral Concentrate Transport Route and MSP Process Waste Transport Route
- Project Mineral Concentrate Transport Route\*
- Proposed Additional Light Vehicle Access Route

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

Source: NSW Department of Planning & Environment (2018); DPI-C&L (CLD) (2011) and Bemax (2012)

**CRISTAL**  
ACMSP MODIFICATION  
Regional Location

**Figure 1**



LEGEND  
Indicative Location of Modification

Source: Bemax (2015, 2012)  
Orthophoto: © NSW Department of Finance, Services & Innovation (2017)

 **CRISTAL**  
OPTIMISATION MODIFICATION  
Indicative Location of the  
Optimisation Modification

ENCLOSURE B  
FIELD SURVEY APPLICATION FORM

**ENCLOSURE B**  
**FIELD SURVEY ENGAGEMENT APPLICATION FORM**

If you wish to be considered for paid participation in any field surveys, please address the following criteria which will be used to determine field survey engagement.

1. Are you a member of a Native Title group?

☐ Yes                      ☐ No

If yes, please provide further details:

---

---

2. Are you a member of the following Local Aboriginal Land Council?

☐ Balranald

3. Do you have any specific cultural knowledge of the Modification area or of any Aboriginal place(s) or object(s) within it?

☐ Yes                      ☐ No

If yes, please provide further details:

---

---

---

4. How many adult members does your Registered Aboriginal Party represent?

---

5. Please provide documented verification of your response to Question 4 (above) (e.g. please list all adult members).

---

---

---

7. How many years of experience does each of your proposed fieldworker(s) have in Aboriginal cultural heritage surveys? Please provide the corresponding name and projects previously involved in.

---

---

---

---

---

8. Does your proposed fieldworker(s) have any specialist skills or knowledge which might assist in the investigation?

☐ Yes ☐ No

If yes, please specify:

---

---

---

9. Is your proposed fieldworker(s) 'fit for duty', including the ability to survey rugged terrain, all day in various weather conditions?

☐ Yes ☐ No

*(Please note that Cristal Mining may require a medical certificate if Cristal Mining considers that an individual may not be fit for work).*

10. Are your proposed fieldworker(s) willing to undertake random Drug and Alcohol testing (including the provision of mouth swabs and urine samples) at their induction and/or at any time during the field survey?

☐ Yes ☐ No

11. Do you hold the following Certificates of Currency (if yes, please attach them to your application):

☐ Public Liability ☐ Workers Compensation

*(Please note that registered groups will need to provide Certificates of Currency for both public liability and workers compensation. Registered individuals will only need to provide a Certificate of Currency for public liability).*

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 444, Broken Hill NSW 2880  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

29 March 2019

Ivanhoe Community Working Party  
Andrew Rose and Fayne Johnson  
PO Box 29  
BOURKE NSW 2840

Via Email: [fay.johnstone@det.nsw.edu.au](mailto:fay.johnstone@det.nsw.edu.au) and [ivanhoe@mpr.com.au](mailto:ivanhoe@mpr.com.au)

Dear Andrew and Fayne,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT PROPOSED METHODOLOGY, INFORMATION SESSION AND FIELD SURVEY**

Thank you for registering an interest in the Aboriginal consultation process for the Atlas-Campaspe Mineral Sands Project Optimisation Modification (the Modification). As you are aware, the Atlas-Campaspe Mineral Sands Project is being developed by Cristal Mining Australia Ltd (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

The Atlas-Campaspe Mine is located approximately 80 kilometres (km) north of Balranald, NSW and 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 to the south-west of the township of Ivanhoe.

**Proposed Methodology**

Please find enclosed for your review, a copy of the Proposed Methodology for the Aboriginal Cultural Heritage Assessment for the Modification (Enclosure A).

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (New South Wales [NSW] Department of Environment, Climate Change and Water, 2010) issued by the NSW Office of Environment and Heritage, we have provided the Proposed Methodology for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the Proposed Methodology.

If you wish to provide input on the following, please provide feedback to Cristal Mining (via the contact details provided at the end of this letter) by **5:00 pm Friday 3 May 2019**:

- The nature of the Proposed Methodology.
- Any Aboriginal objects or places of cultural value within the Modification area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

All comments received will be taken into consideration as the Methodology is finalised.

### Information Session

An information session with all Registered Aboriginal Parties, the consulting archaeologist and Cristal Mining representatives will be held on **Tuesday 30 April 2019** to discuss the Modification and the Proposed Methodology. The information session will be held at the Ivanhoe RSL (51 Columbus Street, Ivanhoe), and will commence at 3:00 pm and conclude at approximately 5:00 pm.

At the information session, Cristal Mining will provide a presentation on the nature and scale of the Modification, an overview of the impact assessment process and will discuss the roles, functions and responsibilities of participants and protocols for the management of any sensitive cultural heritage information.

The information session will also provide Registered Aboriginal Parties with an opportunity to raise any cultural issues or comments/perspectives regarding the Modification or the Proposed Methodology. Note that issues can also be raised at any point during the consultation process.

Light refreshments and drinks will be provided.

Cristal Mining will pay out of pocket travel expenses for Aboriginal representatives, from their home address to the meeting location and return (note that Cristal Mining will pay 75 cents per kilometre, up to a maximum of \$300 per Registered Aboriginal Party). Registered Aboriginal Parties seeking to claim payment will need to provide proof of transport and sign a payment declaration form.

Cristal Mining will arrange for payment to be made via direct deposit after the meeting. Bank account details must be supplied to Cristal Mining (with confirmation of details from the bank and/or the Registered Aboriginal Party prior to payment). However, please note that Cristal Mining will not be paying for attendance at the information session.

Can you please indicate whether you are interested in attending the information session by **5:00 pm Friday 12 April 2019** via the contact details provided below.

### Field Survey

As part of the Aboriginal Cultural Heritage Assessment for the Modification, Cristal Mining will be facilitating a field survey of the Modification area, to allow representatives of the Registered Aboriginal Parties to inspect the area and any Aboriginal heritage sites which may be located within or in immediate proximity to the area.

Regardless of participation in the surveys, all Registered Aboriginal Parties will be invited by Cristal Mining to attend a site inspection of the Modification area and a selection of the recorded sites following completion of the field surveys.

Please find enclosed the survey application form for completion and return by **5.00 pm Friday 12 April 2019**, for those Registered Aboriginal Parties who are seeking consideration for paid involvement in the field investigation associated with the Modification.

In order to be considered for paid involvement in the field surveys, Registered Aboriginal Parties will need to complete the attached Field Survey Application Form (Enclosure B) and provide it to Cristal Mining by the closing date.

Aboriginal representatives will be selected by Cristal Mining based upon the merits of the application with respect to the selection criteria, which are indicated by the questions in the application form. Applications will be assessed against all criteria including cultural knowledge of the Modification area, the representation of others within the community and experience in providing cultural heritage advice.

Where a response is not received by 5.00 pm Friday 12 April 2019, it will be assumed that you do not wish to seek consideration for paid involvement in the field investigation. Incomplete applications may not be accepted by Cristal Mining. Please note that Cristal Mining reserves the right to request any further information/clarification or supporting documentation from you in respect to your application.

Assistance in the completion of the application form can be provided to you upon request. Please use the contact details provided below.

The field survey is expected to take place on **Wednesday 1 May 2019** (i.e. the day following the Information Session). Further details will be provided to the successful applicants as soon as possible.

### **Contact Details**

To provide any feedback with respect to the Proposed Methodology and/or to indicate your attendance at the information session, please contact Cristal Mining via the following contact details

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 444, Broken Hill NSW 2880  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely



**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

ENCLOSURE A

PROPOSED METHODOLOGY FOR THE ABORIGINAL CULTURAL HERITAGE ASSESSMENT  
FOR THE MODIFICATION

ENCLOSURE B  
FIELD SURVEY APPLICATION FORM

29 March 2019

Badger Bates  
107 Gaffney Lane  
BROKEN HILL NSW 2880

Dear Badger,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT PROPOSED METHODOLOGY, INFORMATION SESSION AND FIELD SURVEY**

Thank you for registering an interest in the Aboriginal consultation process for the Atlas-Campaspe Mineral Sands Project Optimisation Modification (the Modification). As you are aware, the Atlas-Campaspe Mineral Sands Project is being developed by Cristal Mining Australia Ltd (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

The Atlas-Campaspe Mine is located approximately 80 kilometres (km) north of Balranald, NSW and 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 to the south-west of the township of Ivanhoe.

**Proposed Methodology**

Please find enclosed for your review, a copy of the Proposed Methodology for the Aboriginal Cultural Heritage Assessment for the Modification (Enclosure A).

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (New South Wales [NSW] Department of Environment, Climate Change and Water, 2010) issued by the NSW Office of Environment and Heritage, we have provided the Proposed Methodology for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the Proposed Methodology.

If you wish to provide input on the following, please provide feedback to Cristal Mining (via the contact details provided at the end of this letter) by **5:00 pm Friday 3 May 2019**:

- The nature of the Proposed Methodology.
- Any Aboriginal objects or places of cultural value within the Modification area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

All comments received will be taken into consideration as the Methodology is finalised.

### Information Session

An information session with all Registered Aboriginal Parties, the consulting archaeologist and Cristal Mining representatives will be held on **Tuesday 30 April 2019** to discuss the Modification and the Proposed Methodology. The information session will be held at the Ivanhoe RSL (51 Columbus Street, Ivanhoe), and will commence at 3:00 pm and conclude at approximately 5:00 pm.

At the information session, Cristal Mining will provide a presentation on the nature and scale of the Modification, an overview of the impact assessment process and will discuss the roles, functions and responsibilities of participants and protocols for the management of any sensitive cultural heritage information.

The information session will also provide Registered Aboriginal Parties with an opportunity to raise any cultural issues or comments/perspectives regarding the Modification or the Proposed Methodology. Note that issues can also be raised at any point during the consultation process.

Light refreshments and drinks will be provided.

Cristal Mining will pay out of pocket travel expenses for Aboriginal representatives, from their home address to the meeting location and return (note that Cristal Mining will pay 75 cents per kilometre, up to a maximum of \$300 per Registered Aboriginal Party). Registered Aboriginal Parties seeking to claim payment will need to provide proof of transport and sign a payment declaration form.

Cristal Mining will arrange for payment to be made via direct deposit after the meeting. Bank account details must be supplied to Cristal Mining (with confirmation of details from the bank and/or the Registered Aboriginal Party prior to payment). However, please note that Cristal Mining will not be paying for attendance at the information session.

Can you please indicate whether you are interested in attending the information session by **5:00 pm Friday 12 April 2019** via the contact details provided below.

### Field Survey

As part of the Aboriginal Cultural Heritage Assessment for the Modification, Cristal Mining will be facilitating a field survey of the Modification area, to allow representatives of the Registered Aboriginal Parties to inspect the area and any Aboriginal heritage sites which may be located within or in immediate proximity to the area.

Regardless of participation in the surveys, all Registered Aboriginal Parties will be invited by Cristal Mining to attend a site inspection of the Modification area and a selection of the recorded sites following completion of the field surveys.

Please find enclosed the survey application form for completion and return by **5.00 pm Friday 12 April 2019**, for those Registered Aboriginal Parties who are seeking consideration for paid involvement in the field investigation associated with the Modification.

In order to be considered for paid involvement in the field surveys, Registered Aboriginal Parties will need to complete the attached Field Survey Application Form (Enclosure B) and provide it to Cristal Mining by the closing date.

Aboriginal representatives will be selected by Cristal Mining based upon the merits of the application with respect to the selection criteria, which are indicated by the questions in the application form. Applications will be assessed against all criteria including cultural knowledge of the Modification area, the representation of others within the community and experience in providing cultural heritage advice.

Where a response is not received by 5.00 pm Friday 12 April 2019, it will be assumed that you do not wish to seek consideration for paid involvement in the field investigation. Incomplete applications may not be accepted by Cristal Mining. Please note that Cristal Mining reserves the right to request any further information/clarification or supporting documentation from you in respect to your application.

Assistance in the completion of the application form can be provided to you upon request. Please use the contact details provided below.

The field survey is expected to take place on **Wednesday 1 May 2019** (i.e. the day following the Information Session). Further details will be provided to the successful applicants as soon as possible.

### **Contact Details**

To provide any feedback with respect to the Proposed Methodology and/or to indicate your attendance at the information session, please contact Cristal Mining via the following contact details

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 444, Broken Hill NSW 2880  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely



**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

ENCLOSURE A

PROPOSED METHODOLOGY FOR THE ABORIGINAL CULTURAL HERITAGE ASSESSMENT  
FOR THE MODIFICATION

ENCLOSURE B  
FIELD SURVEY APPLICATION FORM

29 March 2019

Barkindji Elders Council  
Arthur Kirby  
c/- PO Box 87  
EUSTON NSW 2737

Dear Arthur,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT PROPOSED METHODOLOGY, INFORMATION SESSION AND FIELD SURVEY**

Thank you for registering an interest in the Aboriginal consultation process for the Atlas-Campaspe Mineral Sands Project Optimisation Modification (the Modification). As you are aware, the Atlas-Campaspe Mineral Sands Project is being developed by Cristal Mining Australia Ltd (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

The Atlas-Campaspe Mine is located approximately 80 kilometres (km) north of Balranald, NSW and 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 to the south-west of the township of Ivanhoe.

**Proposed Methodology**

Please find enclosed for your review, a copy of the Proposed Methodology for the Aboriginal Cultural Heritage Assessment for the Modification (Enclosure A).

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (New South Wales [NSW] Department of Environment, Climate Change and Water, 2010) issued by the NSW Office of Environment and Heritage, we have provided the Proposed Methodology for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the Proposed Methodology.

If you wish to provide input on the following, please provide feedback to Cristal Mining (via the contact details provided at the end of this letter) by **5:00 pm Friday 3 May 2019**:

- The nature of the Proposed Methodology.
- Any Aboriginal objects or places of cultural value within the Modification area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

All comments received will be taken into consideration as the Methodology is finalised.

### Information Session

An information session with all Registered Aboriginal Parties, the consulting archaeologist and Cristal Mining representatives will be held on **Tuesday 30 April 2019** to discuss the Modification and the Proposed Methodology. The information session will be held at the Ivanhoe RSL (51 Columbus Street, Ivanhoe), and will commence at 3:00 pm and conclude at approximately 5:00 pm.

At the information session, Cristal Mining will provide a presentation on the nature and scale of the Modification, an overview of the impact assessment process and will discuss the roles, functions and responsibilities of participants and protocols for the management of any sensitive cultural heritage information.

The information session will also provide Registered Aboriginal Parties with an opportunity to raise any cultural issues or comments/perspectives regarding the Modification or the Proposed Methodology. Note that issues can also be raised at any point during the consultation process.

Light refreshments and drinks will be provided.

Cristal Mining will pay out of pocket travel expenses for Aboriginal representatives, from their home address to the meeting location and return (note that Cristal Mining will pay 75 cents per kilometre, up to a maximum of \$300 per Registered Aboriginal Party). Registered Aboriginal Parties seeking to claim payment will need to provide proof of transport and sign a payment declaration form.

Cristal Mining will arrange for payment to be made via direct deposit after the meeting. Bank account details must be supplied to Cristal Mining (with confirmation of details from the bank and/or the Registered Aboriginal Party prior to payment). However, please note that Cristal Mining will not be paying for attendance at the information session.

Can you please indicate whether you are interested in attending the information session by **5:00 pm Friday 12 April 2019** via the contact details provided below.

### Field Survey

As part of the Aboriginal Cultural Heritage Assessment for the Modification, Cristal Mining will be facilitating a field survey of the Modification area, to allow representatives of the Registered Aboriginal Parties to inspect the area and any Aboriginal heritage sites which may be located within or in immediate proximity to the area.

Regardless of participation in the surveys, all Registered Aboriginal Parties will be invited by Cristal Mining to attend a site inspection of the Modification area and a selection of the recorded sites following completion of the field surveys.

Please find enclosed the survey application form for completion and return by **5.00 pm Friday 12 April 2019**, for those Registered Aboriginal Parties who are seeking consideration for paid involvement in the field investigation associated with the Modification.

In order to be considered for paid involvement in the field surveys, Registered Aboriginal Parties will need to complete the attached Field Survey Application Form (Enclosure B) and provide it to Cristal Mining by the closing date.

Aboriginal representatives will be selected by Cristal Mining based upon the merits of the application with respect to the selection criteria, which are indicated by the questions in the application form. Applications will be assessed against all criteria including cultural knowledge of the Modification area, the representation of others within the community and experience in providing cultural heritage advice.

Where a response is not received by 5.00 pm Friday 12 April 2019, it will be assumed that you do not wish to seek consideration for paid involvement in the field investigation. Incomplete applications may not be accepted by Cristal Mining. Please note that Cristal Mining reserves the right to request any further information/clarification or supporting documentation from you in respect to your application.

Assistance in the completion of the application form can be provided to you upon request. Please use the contact details provided below.

The field survey is expected to take place on **Wednesday 1 May 2019** (i.e. the day following the Information Session). Further details will be provided to the successful applicants as soon as possible.

### **Contact Details**

To provide any feedback with respect to the Proposed Methodology and/or to indicate your attendance at the information session, please contact Cristal Mining via the following contact details

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 444, Broken Hill NSW 2880  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely



**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

ENCLOSURE A

PROPOSED METHODOLOGY FOR THE ABORIGINAL CULTURAL HERITAGE ASSESSMENT  
FOR THE MODIFICATION

ENCLOSURE B  
FIELD SURVEY APPLICATION FORM

29 March 2019

Michael (Mick) Kelly on behalf of Ngiyampaa people  
Michael (Mick) Kelly  
C/- Office of Environment and Heritage  
PO Box 318  
BURONGA NSW 2739

Via Email: [mick.kelly@environment.nsw.gov.au](mailto:mick.kelly@environment.nsw.gov.au)

Dear Michael,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT PROPOSED METHODOLOGY, INFORMATION SESSION AND FIELD SURVEY**

Thank you for registering an interest in the Aboriginal consultation process for the Atlas-Campaspe Mineral Sands Project Optimisation Modification (the Modification). As you are aware, the Atlas-Campaspe Mineral Sands Project is being developed by Cristal Mining Australia Ltd (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

The Atlas-Campaspe Mine is located approximately 80 kilometres (km) north of Balranald, NSW and 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 to the south-west of the township of Ivanhoe.

**Proposed Methodology**

Please find enclosed for your review, a copy of the Proposed Methodology for the Aboriginal Cultural Heritage Assessment for the Modification (Enclosure A).

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (New South Wales [NSW] Department of Environment, Climate Change and Water, 2010) issued by the NSW Office of Environment and Heritage, we have provided the Proposed Methodology for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the Proposed Methodology.

If you wish to provide input on the following, please provide feedback to Cristal Mining (via the contact details provided at the end of this letter) by **5:00 pm Friday 3 May 2019**:

- The nature of the Proposed Methodology.
- Any Aboriginal objects or places of cultural value within the Modification area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

All comments received will be taken into consideration as the Methodology is finalised.

### **Information Session**

An information session with all Registered Aboriginal Parties, the consulting archaeologist and Cristal Mining representatives will be held on **Tuesday 30 April 2019** to discuss the Modification and the Proposed Methodology. The information session will be held at the Ivanhoe RSL (51 Columbus Street, Ivanhoe), and will commence at 3:00 pm and conclude at approximately 5:00 pm.

At the information session, Cristal Mining will provide a presentation on the nature and scale of the Modification, an overview of the impact assessment process and will discuss the roles, functions and responsibilities of participants and protocols for the management of any sensitive cultural heritage information.

The information session will also provide Registered Aboriginal Parties with an opportunity to raise any cultural issues or comments/perspectives regarding the Modification or the Proposed Methodology. Note that issues can also be raised at any point during the consultation process.

Light refreshments and drinks will be provided.

Cristal Mining will pay out of pocket travel expenses for Aboriginal representatives, from their home address to the meeting location and return (note that Cristal Mining will pay 75 cents per kilometre, up to a maximum of \$300 per Registered Aboriginal Party). Registered Aboriginal Parties seeking to claim payment will need to provide proof of transport and sign a payment declaration form.

Cristal Mining will arrange for payment to be made via direct deposit after the meeting. Bank account details must be supplied to Cristal Mining (with confirmation of details from the bank and/or the Registered Aboriginal Party prior to payment). However, please note that Cristal Mining will not be paying for attendance at the information session.

Can you please indicate whether you are interested in attending the information session by **5:00 pm Friday 12 April 2019** via the contact details provided below.

### **Field Survey**

As part of the Aboriginal Cultural Heritage Assessment for the Modification, Cristal Mining will be facilitating a field survey of the Modification area, to allow representatives of the Registered Aboriginal Parties to inspect the area and any Aboriginal heritage sites which may be located within or in immediate proximity to the area.

Regardless of participation in the surveys, all Registered Aboriginal Parties will be invited by Cristal Mining to attend a site inspection of the Modification area and a selection of the recorded sites following completion of the field surveys.

Please find enclosed the survey application form for completion and return by **5.00 pm Friday 12 April 2019**, for those Registered Aboriginal Parties who are seeking consideration for paid involvement in the field investigation associated with the Modification.

In order to be considered for paid involvement in the field surveys, Registered Aboriginal Parties will need to complete the attached Field Survey Application Form (Enclosure B) and provide it to Cristal Mining by the closing date.

Aboriginal representatives will be selected by Cristal Mining based upon the merits of the application with respect to the selection criteria, which are indicated by the questions in the application form. Applications will be assessed against all criteria including cultural knowledge of the Modification area, the representation of others within the community and experience in providing cultural heritage advice.

Where a response is not received by 5.00 pm Friday 12 April 2019, it will be assumed that you do not wish to seek consideration for paid involvement in the field investigation. Incomplete applications may not be accepted by Cristal Mining. Please note that Cristal Mining reserves the right to request any further information/clarification or supporting documentation from you in respect to your application.

Assistance in the completion of the application form can be provided to you upon request. Please use the contact details provided below.

The field survey is expected to take place on **Wednesday 1 May 2019** (i.e. the day following the Information Session). Further details will be provided to the successful applicants as soon as possible.

### **Contact Details**

To provide any feedback with respect to the Proposed Methodology and/or to indicate your attendance at the information session, please contact Cristal Mining via the following contact details

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 444, Broken Hill NSW 2880  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely



**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

ENCLOSURE A

PROPOSED METHODOLOGY FOR THE ABORIGINAL CULTURAL HERITAGE ASSESSMENT  
FOR THE MODIFICATION

ENCLOSURE B  
FIELD SURVEY APPLICATION FORM

29 March 2019

National Koorie Site Management  
Ali Maher  
3 Cuthbert Drive  
MOUNT WARRIGAL NSW 2528

Via Email: [ali.n.maher@hotmail.com](mailto:ali.n.maher@hotmail.com)

Dear Ali,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT PROPOSED METHODOLOGY, INFORMATION SESSION AND FIELD SURVEY**

Thank you for registering an interest in the Aboriginal consultation process for the Atlas-Campaspe Mineral Sands Project Optimisation Modification (the Modification). As you are aware, the Atlas-Campaspe Mineral Sands Project is being developed by Cristal Mining Australia Ltd (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

The Atlas-Campaspe Mine is located approximately 80 kilometres (km) north of Balranald, NSW and 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 to the south-west of the township of Ivanhoe.

**Proposed Methodology**

Please find enclosed for your review, a copy of the Proposed Methodology for the Aboriginal Cultural Heritage Assessment for the Modification (Enclosure A).

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (New South Wales [NSW] Department of Environment, Climate Change and Water, 2010) issued by the NSW Office of Environment and Heritage, we have provided the Proposed Methodology for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the Proposed Methodology.

If you wish to provide input on the following, please provide feedback to Cristal Mining (via the contact details provided at the end of this letter) by **5:00 pm Friday 3 May 2019**:

- The nature of the Proposed Methodology.
- Any Aboriginal objects or places of cultural value within the Modification area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

All comments received will be taken into consideration as the Methodology is finalised.

### **Information Session**

An information session with all Registered Aboriginal Parties, the consulting archaeologist and Cristal Mining representatives will be held on **Tuesday 30 April 2019** to discuss the Modification and the Proposed Methodology. The information session will be held at the Ivanhoe RSL (51 Columbus Street, Ivanhoe), and will commence at 3:00 pm and conclude at approximately 5:00 pm.

At the information session, Cristal Mining will provide a presentation on the nature and scale of the Modification, an overview of the impact assessment process and will discuss the roles, functions and responsibilities of participants and protocols for the management of any sensitive cultural heritage information.

The information session will also provide Registered Aboriginal Parties with an opportunity to raise any cultural issues or comments/perspectives regarding the Modification or the Proposed Methodology. Note that issues can also be raised at any point during the consultation process.

Light refreshments and drinks will be provided.

Cristal Mining will pay out of pocket travel expenses for Aboriginal representatives, from their home address to the meeting location and return (note that Cristal Mining will pay 75 cents per kilometre, up to a maximum of \$300 per Registered Aboriginal Party). Registered Aboriginal Parties seeking to claim payment will need to provide proof of transport and sign a payment declaration form.

Cristal Mining will arrange for payment to be made via direct deposit after the meeting. Bank account details must be supplied to Cristal Mining (with confirmation of details from the bank and/or the Registered Aboriginal Party prior to payment). However, please note that Cristal Mining will not be paying for attendance at the information session.

Can you please indicate whether you are interested in attending the information session by **5:00 pm Friday 12 April 2019** via the contact details provided below.

### **Field Survey**

As part of the Aboriginal Cultural Heritage Assessment for the Modification, Cristal Mining will be facilitating a field survey of the Modification area, to allow representatives of the Registered Aboriginal Parties to inspect the area and any Aboriginal heritage sites which may be located within or in immediate proximity to the area.

Regardless of participation in the surveys, all Registered Aboriginal Parties will be invited by Cristal Mining to attend a site inspection of the Modification area and a selection of the recorded sites following completion of the field surveys.

Please find enclosed the survey application form for completion and return by **5.00 pm Friday 12 April 2019**, for those Registered Aboriginal Parties who are seeking consideration for paid involvement in the field investigation associated with the Modification.

In order to be considered for paid involvement in the field surveys, Registered Aboriginal Parties will need to complete the attached Field Survey Application Form (Enclosure B) and provide it to Cristal Mining by the closing date.

Aboriginal representatives will be selected by Cristal Mining based upon the merits of the application with respect to the selection criteria, which are indicated by the questions in the application form. Applications will be assessed against all criteria including cultural knowledge of the Modification area, the representation of others within the community and experience in providing cultural heritage advice.

Where a response is not received by 5.00 pm Friday 12 April 2019, it will be assumed that you do not wish to seek consideration for paid involvement in the field investigation. Incomplete applications may not be accepted by Cristal Mining. Please note that Cristal Mining reserves the right to request any further information/clarification or supporting documentation from you in respect to your application.

Assistance in the completion of the application form can be provided to you upon request. Please use the contact details provided below.

The field survey is expected to take place on **Wednesday 1 May 2019** (i.e. the day following the Information Session). Further details will be provided to the successful applicants as soon as possible.

### **Contact Details**

To provide any feedback with respect to the Proposed Methodology and/or to indicate your attendance at the information session, please contact Cristal Mining via the following contact details

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 444, Broken Hill NSW 2880  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely



**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

ENCLOSURE A

PROPOSED METHODOLOGY FOR THE ABORIGINAL CULTURAL HERITAGE ASSESSMENT  
FOR THE MODIFICATION

ENCLOSURE B  
FIELD SURVEY APPLICATION FORM

29 March 2019

Kullila Site Consultants  
Paul Charles  
14 Werrang Road  
PRIMBEE NSW 2502

Dear Paul,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT PROPOSED METHODOLOGY, INFORMATION SESSION AND FIELD SURVEY**

Thank you for registering an interest in the Aboriginal consultation process for the Atlas-Campaspe Mineral Sands Project Optimisation Modification (the Modification). As you are aware, the Atlas-Campaspe Mineral Sands Project is being developed by Cristal Mining Australia Ltd (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

The Atlas-Campaspe Mine is located approximately 80 kilometres (km) north of Balranald, NSW and 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 to the south-west of the township of Ivanhoe.

**Proposed Methodology**

Please find enclosed for your review, a copy of the Proposed Methodology for the Aboriginal Cultural Heritage Assessment for the Modification (Enclosure A).

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (New South Wales [NSW] Department of Environment, Climate Change and Water, 2010) issued by the NSW Office of Environment and Heritage, we have provided the Proposed Methodology for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the Proposed Methodology.

If you wish to provide input on the following, please provide feedback to Cristal Mining (via the contact details provided at the end of this letter) by **5:00 pm Friday 3 May 2019**:

- The nature of the Proposed Methodology.
- Any Aboriginal objects or places of cultural value within the Modification area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

All comments received will be taken into consideration as the Methodology is finalised.

### **Information Session**

An information session with all Registered Aboriginal Parties, the consulting archaeologist and Cristal Mining representatives will be held on **Tuesday 30 April 2019** to discuss the Modification and the Proposed Methodology. The information session will be held at the Ivanhoe RSL (51 Columbus Street, Ivanhoe), and will commence at 3:00 pm and conclude at approximately 5:00 pm.

At the information session, Cristal Mining will provide a presentation on the nature and scale of the Modification, an overview of the impact assessment process and will discuss the roles, functions and responsibilities of participants and protocols for the management of any sensitive cultural heritage information.

The information session will also provide Registered Aboriginal Parties with an opportunity to raise any cultural issues or comments/perspectives regarding the Modification or the Proposed Methodology. Note that issues can also be raised at any point during the consultation process.

Light refreshments and drinks will be provided.

Cristal Mining will pay out of pocket travel expenses for Aboriginal representatives, from their home address to the meeting location and return (note that Cristal Mining will pay 75 cents per kilometre, up to a maximum of \$300 per Registered Aboriginal Party). Registered Aboriginal Parties seeking to claim payment will need to provide proof of transport and sign a payment declaration form.

Cristal Mining will arrange for payment to be made via direct deposit after the meeting. Bank account details must be supplied to Cristal Mining (with confirmation of details from the bank and/or the Registered Aboriginal Party prior to payment). However, please note that Cristal Mining will not be paying for attendance at the information session.

Can you please indicate whether you are interested in attending the information session by **5:00 pm Friday 12 April 2019** via the contact details provided below.

### **Field Survey**

As part of the Aboriginal Cultural Heritage Assessment for the Modification, Cristal Mining will be facilitating a field survey of the Modification area, to allow representatives of the Registered Aboriginal Parties to inspect the area and any Aboriginal heritage sites which may be located within or in immediate proximity to the area.

Regardless of participation in the surveys, all Registered Aboriginal Parties will be invited by Cristal Mining to attend a site inspection of the Modification area and a selection of the recorded sites following completion of the field surveys.

Please find enclosed the survey application form for completion and return by **5.00 pm Friday 12 April 2019**, for those Registered Aboriginal Parties who are seeking consideration for paid involvement in the field investigation associated with the Modification.

In order to be considered for paid involvement in the field surveys, Registered Aboriginal Parties will need to complete the attached Field Survey Application Form (Enclosure B) and provide it to Cristal Mining by the closing date.

Aboriginal representatives will be selected by Cristal Mining based upon the merits of the application with respect to the selection criteria, which are indicated by the questions in the application form. Applications will be assessed against all criteria including cultural knowledge of the Modification area, the representation of others within the community and experience in providing cultural heritage advice.

Where a response is not received by 5.00 pm Friday 12 April 2019, it will be assumed that you do not wish to seek consideration for paid involvement in the field investigation. Incomplete applications may not be accepted by Cristal Mining. Please note that Cristal Mining reserves the right to request any further information/clarification or supporting documentation from you in respect to your application.

Assistance in the completion of the application form can be provided to you upon request. Please use the contact details provided below.

The field survey is expected to take place on **Wednesday 1 May 2019** (i.e. the day following the Information Session). Further details will be provided to the successful applicants as soon as possible.

### **Contact Details**

To provide any feedback with respect to the Proposed Methodology and/or to indicate your attendance at the information session, please contact Cristal Mining via the following contact details

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 444, Broken Hill NSW 2880  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely



**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

ENCLOSURE A

PROPOSED METHODOLOGY FOR THE ABORIGINAL CULTURAL HERITAGE ASSESSMENT  
FOR THE MODIFICATION

ENCLOSURE B  
FIELD SURVEY APPLICATION FORM

29 March 2019

Willandra Lakes 2 Traditional Tribal Groups Elders Council  
C/- Warren Clarke  
PO Box 318  
BURONGA NSW 2739

Via Email: [warren.clarke@environment.nsw.gov.au](mailto:warren.clarke@environment.nsw.gov.au)

Dear Warren,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT PROPOSED METHODOLOGY, INFORMATION SESSION AND FIELD SURVEY**

Thank you for registering an interest in the Aboriginal consultation process for the Atlas-Campaspe Mineral Sands Project Optimisation Modification (the Modification). As you are aware, the Atlas-Campaspe Mineral Sands Project is being developed by Cristal Mining Australia Ltd (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

The Atlas-Campaspe Mine is located approximately 80 kilometres (km) north of Balranald, NSW and 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 to the south-west of the township of Ivanhoe.

**Proposed Methodology**

Please find enclosed for your review, a copy of the Proposed Methodology for the Aboriginal Cultural Heritage Assessment for the Modification (Enclosure A).

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (New South Wales [NSW] Department of Environment, Climate Change and Water, 2010) issued by the NSW Office of Environment and Heritage, we have provided the Proposed Methodology for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the Proposed Methodology.

If you wish to provide input on the following, please provide feedback to Cristal Mining (via the contact details provided at the end of this letter) by **5:00 pm Friday 3 May 2019**:

- The nature of the Proposed Methodology.
- Any Aboriginal objects or places of cultural value within the Modification area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

All comments received will be taken into consideration as the Methodology is finalised.

### **Information Session**

An information session with all Registered Aboriginal Parties, the consulting archaeologist and Cristal Mining representatives will be held on **Tuesday 30 April 2019** to discuss the Modification and the Proposed Methodology. The information session will be held at the Ivanhoe RSL (51 Columbus Street, Ivanhoe), and will commence at 3:00 pm and conclude at approximately 5:00 pm.

At the information session, Cristal Mining will provide a presentation on the nature and scale of the Modification, an overview of the impact assessment process and will discuss the roles, functions and responsibilities of participants and protocols for the management of any sensitive cultural heritage information.

The information session will also provide Registered Aboriginal Parties with an opportunity to raise any cultural issues or comments/perspectives regarding the Modification or the Proposed Methodology. Note that issues can also be raised at any point during the consultation process.

Light refreshments and drinks will be provided.

Cristal Mining will pay out of pocket travel expenses for Aboriginal representatives, from their home address to the meeting location and return (note that Cristal Mining will pay 75 cents per kilometre, up to a maximum of \$300 per Registered Aboriginal Party). Registered Aboriginal Parties seeking to claim payment will need to provide proof of transport and sign a payment declaration form.

Cristal Mining will arrange for payment to be made via direct deposit after the meeting. Bank account details must be supplied to Cristal Mining (with confirmation of details from the bank and/or the Registered Aboriginal Party prior to payment). However, please note that Cristal Mining will not be paying for attendance at the information session.

Can you please indicate whether you are interested in attending the information session by **5:00 pm Friday 12 April 2019** via the contact details provided below.

### **Field Survey**

As part of the Aboriginal Cultural Heritage Assessment for the Modification, Cristal Mining will be facilitating a field survey of the Modification area, to allow representatives of the Registered Aboriginal Parties to inspect the area and any Aboriginal heritage sites which may be located within or in immediate proximity to the area.

Regardless of participation in the surveys, all Registered Aboriginal Parties will be invited by Cristal Mining to attend a site inspection of the Modification area and a selection of the recorded sites following completion of the field surveys.

Please find enclosed the survey application form for completion and return by **5.00 pm Friday 12 April 2019**, for those Registered Aboriginal Parties who are seeking consideration for paid involvement in the field investigation associated with the Modification.

In order to be considered for paid involvement in the field surveys, Registered Aboriginal Parties will need to complete the attached Field Survey Application Form (Enclosure B) and provide it to Cristal Mining by the closing date.

Aboriginal representatives will be selected by Cristal Mining based upon the merits of the application with respect to the selection criteria, which are indicated by the questions in the application form. Applications will be assessed against all criteria including cultural knowledge of the Modification area, the representation of others within the community and experience in providing cultural heritage advice.

Where a response is not received by 5.00 pm Friday 12 April 2019, it will be assumed that you do not wish to seek consideration for paid involvement in the field investigation. Incomplete applications may not be accepted by Cristal Mining. Please note that Cristal Mining reserves the right to request any further information/clarification or supporting documentation from you in respect to your application.

Assistance in the completion of the application form can be provided to you upon request. Please use the contact details provided below.

The field survey is expected to take place on **Wednesday 1 May 2019** (i.e. the day following the Information Session). Further details will be provided to the successful applicants as soon as possible.

### **Contact Details**

To provide any feedback with respect to the Proposed Methodology and/or to indicate your attendance at the information session, please contact Cristal Mining via the following contact details

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 444, Broken Hill NSW 2880  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely



**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

ENCLOSURE A

PROPOSED METHODOLOGY FOR THE ABORIGINAL CULTURAL HERITAGE ASSESSMENT  
FOR THE MODIFICATION

ENCLOSURE B  
FIELD SURVEY APPLICATION FORM

29 March 2019

Muthi Muthi Nations Aboriginal Corporation  
Bernadette Pappin  
PO Box 210  
BALRANALD NSW 2715

Via Email: [bpappin@gwahs.health.nsw.gov.au](mailto:bpappin@gwahs.health.nsw.gov.au)

Dear Bernadette,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT PROPOSED METHODOLOGY, INFORMATION SESSION AND FIELD SURVEY**

Thank you for registering an interest in the Aboriginal consultation process for the Atlas-Campaspe Mineral Sands Project Optimisation Modification (the Modification). As you are aware, the Atlas-Campaspe Mineral Sands Project is being developed by Cristal Mining Australia Ltd (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

The Atlas-Campaspe Mine is located approximately 80 kilometres (km) north of Balranald, NSW and 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 to the south-west of the township of Ivanhoe.

**Proposed Methodology**

Please find enclosed for your review, a copy of the Proposed Methodology for the Aboriginal Cultural Heritage Assessment for the Modification (Enclosure A).

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (New South Wales [NSW] Department of Environment, Climate Change and Water, 2010) issued by the NSW Office of Environment and Heritage, we have provided the Proposed Methodology for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the Proposed Methodology.

If you wish to provide input on the following, please provide feedback to Cristal Mining (via the contact details provided at the end of this letter) by **5:00 pm Friday 3 May 2019**:

- The nature of the Proposed Methodology.
- Any Aboriginal objects or places of cultural value within the Modification area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

All comments received will be taken into consideration as the Methodology is finalised.

### **Information Session**

An information session with all Registered Aboriginal Parties, the consulting archaeologist and Cristal Mining representatives will be held on **Tuesday 30 April 2019** to discuss the Modification and the Proposed Methodology. The information session will be held at the Ivanhoe RSL (51 Columbus Street, Ivanhoe), and will commence at 3:00 pm and conclude at approximately 5:00 pm.

At the information session, Cristal Mining will provide a presentation on the nature and scale of the Modification, an overview of the impact assessment process and will discuss the roles, functions and responsibilities of participants and protocols for the management of any sensitive cultural heritage information.

The information session will also provide Registered Aboriginal Parties with an opportunity to raise any cultural issues or comments/perspectives regarding the Modification or the Proposed Methodology. Note that issues can also be raised at any point during the consultation process.

Light refreshments and drinks will be provided.

Cristal Mining will pay out of pocket travel expenses for Aboriginal representatives, from their home address to the meeting location and return (note that Cristal Mining will pay 75 cents per kilometre, up to a maximum of \$300 per Registered Aboriginal Party). Registered Aboriginal Parties seeking to claim payment will need to provide proof of transport and sign a payment declaration form.

Cristal Mining will arrange for payment to be made via direct deposit after the meeting. Bank account details must be supplied to Cristal Mining (with confirmation of details from the bank and/or the Registered Aboriginal Party prior to payment). However, please note that Cristal Mining will not be paying for attendance at the information session.

Can you please indicate whether you are interested in attending the information session by **5:00 pm Friday 12 April 2019** via the contact details provided below.

### **Field Survey**

As part of the Aboriginal Cultural Heritage Assessment for the Modification, Cristal Mining will be facilitating a field survey of the Modification area, to allow representatives of the Registered Aboriginal Parties to inspect the area and any Aboriginal heritage sites which may be located within or in immediate proximity to the area.

Regardless of participation in the surveys, all Registered Aboriginal Parties will be invited by Cristal Mining to attend a site inspection of the Modification area and a selection of the recorded sites following completion of the field surveys.

Please find enclosed the survey application form for completion and return by **5.00 pm Friday 12 April 2019**, for those Registered Aboriginal Parties who are seeking consideration for paid involvement in the field investigation associated with the Modification.

In order to be considered for paid involvement in the field surveys, Registered Aboriginal Parties will need to complete the attached Field Survey Application Form (Enclosure B) and provide it to Cristal Mining by the closing date.

Aboriginal representatives will be selected by Cristal Mining based upon the merits of the application with respect to the selection criteria, which are indicated by the questions in the application form. Applications will be assessed against all criteria including cultural knowledge of the Modification area, the representation of others within the community and experience in providing cultural heritage advice.

Where a response is not received by 5.00 pm Friday 12 April 2019, it will be assumed that you do not wish to seek consideration for paid involvement in the field investigation. Incomplete applications may not be accepted by Cristal Mining. Please note that Cristal Mining reserves the right to request any further information/clarification or supporting documentation from you in respect to your application.

Assistance in the completion of the application form can be provided to you upon request. Please use the contact details provided below.

The field survey is expected to take place on **Wednesday 1 May 2019** (i.e. the day following the Information Session). Further details will be provided to the successful applicants as soon as possible.

### **Contact Details**

To provide any feedback with respect to the Proposed Methodology and/or to indicate your attendance at the information session, please contact Cristal Mining via the following contact details

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 444, Broken Hill NSW 2880  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely



**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

ENCLOSURE A

PROPOSED METHODOLOGY FOR THE ABORIGINAL CULTURAL HERITAGE ASSESSMENT  
FOR THE MODIFICATION

ENCLOSURE B  
FIELD SURVEY APPLICATION FORM

29 March 2019

Wakool Indigenous Corporation  
Cynthia and Garry Pappin  
PO Box 243  
BALRANALD NSW 2715

Via Email: [Wakool.ic@gmail.com](mailto:Wakool.ic@gmail.com)

Dear Cynthia and Garry,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT PROPOSED METHODOLOGY, INFORMATION SESSION AND FIELD SURVEY**

Thank you for registering an interest in the Aboriginal consultation process for the Atlas-Campaspe Mineral Sands Project Optimisation Modification (the Modification). As you are aware, the Atlas-Campaspe Mineral Sands Project is being developed by Cristal Mining Australia Ltd (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

The Atlas-Campaspe Mine is located approximately 80 kilometres (km) north of Balranald, NSW and 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 to the south-west of the township of Ivanhoe.

**Proposed Methodology**

Please find enclosed for your review, a copy of the Proposed Methodology for the Aboriginal Cultural Heritage Assessment for the Modification (Enclosure A).

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (New South Wales [NSW] Department of Environment, Climate Change and Water, 2010) issued by the NSW Office of Environment and Heritage, we have provided the Proposed Methodology for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the Proposed Methodology.

If you wish to provide input on the following, please provide feedback to Cristal Mining (via the contact details provided at the end of this letter) by **5:00 pm Friday 3 May 2019**:

- The nature of the Proposed Methodology.
- Any Aboriginal objects or places of cultural value within the Modification area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

All comments received will be taken into consideration as the Methodology is finalised.

### **Information Session**

An information session with all Registered Aboriginal Parties, the consulting archaeologist and Cristal Mining representatives will be held on **Tuesday 30 April 2019** to discuss the Modification and the Proposed Methodology. The information session will be held at the Ivanhoe RSL (51 Columbus Street, Ivanhoe), and will commence at 3:00 pm and conclude at approximately 5:00 pm.

At the information session, Cristal Mining will provide a presentation on the nature and scale of the Modification, an overview of the impact assessment process and will discuss the roles, functions and responsibilities of participants and protocols for the management of any sensitive cultural heritage information.

The information session will also provide Registered Aboriginal Parties with an opportunity to raise any cultural issues or comments/perspectives regarding the Modification or the Proposed Methodology. Note that issues can also be raised at any point during the consultation process.

Light refreshments and drinks will be provided.

Cristal Mining will pay out of pocket travel expenses for Aboriginal representatives, from their home address to the meeting location and return (note that Cristal Mining will pay 75 cents per kilometre, up to a maximum of \$300 per Registered Aboriginal Party). Registered Aboriginal Parties seeking to claim payment will need to provide proof of transport and sign a payment declaration form.

Cristal Mining will arrange for payment to be made via direct deposit after the meeting. Bank account details must be supplied to Cristal Mining (with confirmation of details from the bank and/or the Registered Aboriginal Party prior to payment). However, please note that Cristal Mining will not be paying for attendance at the information session.

Can you please indicate whether you are interested in attending the information session by **5:00 pm Friday 12 April 2019** via the contact details provided below.

### **Field Survey**

As part of the Aboriginal Cultural Heritage Assessment for the Modification, Cristal Mining will be facilitating a field survey of the Modification area, to allow representatives of the Registered Aboriginal Parties to inspect the area and any Aboriginal heritage sites which may be located within or in immediate proximity to the area.

Regardless of participation in the surveys, all Registered Aboriginal Parties will be invited by Cristal Mining to attend a site inspection of the Modification area and a selection of the recorded sites following completion of the field surveys.

Please find enclosed the survey application form for completion and return by **5.00 pm Friday 12 April 2019**, for those Registered Aboriginal Parties who are seeking consideration for paid involvement in the field investigation associated with the Modification.

In order to be considered for paid involvement in the field surveys, Registered Aboriginal Parties will need to complete the attached Field Survey Application Form (Enclosure B) and provide it to Cristal Mining by the closing date.

Aboriginal representatives will be selected by Cristal Mining based upon the merits of the application with respect to the selection criteria, which are indicated by the questions in the application form. Applications will be assessed against all criteria including cultural knowledge of the Modification area, the representation of others within the community and experience in providing cultural heritage advice.

Where a response is not received by 5.00 pm Friday 12 April 2019, it will be assumed that you do not wish to seek consideration for paid involvement in the field investigation. Incomplete applications may not be accepted by Cristal Mining. Please note that Cristal Mining reserves the right to request any further information/clarification or supporting documentation from you in respect to your application.

Assistance in the completion of the application form can be provided to you upon request. Please use the contact details provided below.

The field survey is expected to take place on **Wednesday 1 May 2019** (i.e. the day following the Information Session). Further details will be provided to the successful applicants as soon as possible.

### **Contact Details**

To provide any feedback with respect to the Proposed Methodology and/or to indicate your attendance at the information session, please contact Cristal Mining via the following contact details

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 444, Broken Hill NSW 2880  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely



**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

ENCLOSURE A

PROPOSED METHODOLOGY FOR THE ABORIGINAL CULTURAL HERITAGE ASSESSMENT  
FOR THE MODIFICATION

ENCLOSURE B  
FIELD SURVEY APPLICATION FORM

29 March 2019

Maria Maher

Via Email: [g.m.maher@hotmail.com](mailto:g.m.maher@hotmail.com)

Dear Maria,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION ABORIGINAL CULTURAL HERITAGE ASSESSMENT PROPOSED METHODOLOGY, INFORMATION SESSION AND FIELD SURVEY**

Thank you for registering an interest in the Aboriginal consultation process for the Atlas-Campaspe Mineral Sands Project Optimisation Modification (the Modification). As you are aware, the Atlas-Campaspe Mineral Sands Project is being developed by Cristal Mining Australia Ltd (Cristal Mining), which is wholly owned by Cristal Australia Pty Ltd. Cristal Australia Pty Ltd is a wholly-owned subsidiary of The National Titanium Dioxide Company Limited.

The Atlas-Campaspe Mine is located approximately 80 kilometres (km) north of Balranald, NSW and 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 to the south-west of the township of Ivanhoe.

**Proposed Methodology**

Please find enclosed for your review, a copy of the Proposed Methodology for the Aboriginal Cultural Heritage Assessment for the Modification (Enclosure A).

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (New South Wales [NSW] Department of Environment, Climate Change and Water, 2010) issued by the NSW Office of Environment and Heritage, we have provided the Proposed Methodology for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the Proposed Methodology.

If you wish to provide input on the following, please provide feedback to Cristal Mining (via the contact details provided at the end of this letter) by **5:00 pm Friday 3 May 2019**:

- The nature of the Proposed Methodology.
- Any Aboriginal objects or places of cultural value within the Modification area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

**Cristal Mining Australia Limited**

ABN 60 009 247 858  
Gingko Mine via Nob Road Wentworth NSW 2648, Australia  
PO Box 444, Broken Hill NSW 2880, Australia  
T 61.3.5074.8900 F 61.3.5074.8999  
[www.cristalmining.com](http://www.cristalmining.com)

All comments received will be taken into consideration as the Methodology is finalised.

### **Information Session**

An information session with all Registered Aboriginal Parties, the consulting archaeologist and Cristal Mining representatives will be held on **Tuesday 30 April 2019** to discuss the Modification and the Proposed Methodology. The information session will be held at the Ivanhoe RSL (51 Columbus Street, Ivanhoe), and will commence at 3:00 pm and conclude at approximately 5:00 pm.

At the information session, Cristal Mining will provide a presentation on the nature and scale of the Modification, an overview of the impact assessment process and will discuss the roles, functions and responsibilities of participants and protocols for the management of any sensitive cultural heritage information.

The information session will also provide Registered Aboriginal Parties with an opportunity to raise any cultural issues or comments/perspectives regarding the Modification or the Proposed Methodology. Note that issues can also be raised at any point during the consultation process.

Light refreshments and drinks will be provided.

Cristal Mining will pay out of pocket travel expenses for Aboriginal representatives, from their home address to the meeting location and return (note that Cristal Mining will pay 75 cents per kilometre, up to a maximum of \$300 per Registered Aboriginal Party). Registered Aboriginal Parties seeking to claim payment will need to provide proof of transport and sign a payment declaration form.

Cristal Mining will arrange for payment to be made via direct deposit after the meeting. Bank account details must be supplied to Cristal Mining (with confirmation of details from the bank and/or the Registered Aboriginal Party prior to payment). However, please note that Cristal Mining will not be paying for attendance at the information session.

Can you please indicate whether you are interested in attending the information session by **5:00 pm Friday 12 April 2019** via the contact details provided below.

### **Field Survey**

As part of the Aboriginal Cultural Heritage Assessment for the Modification, Cristal Mining will be facilitating a field survey of the Modification area, to allow representatives of the Registered Aboriginal Parties to inspect the area and any Aboriginal heritage sites which may be located within or in immediate proximity to the area.

Regardless of participation in the surveys, all Registered Aboriginal Parties will be invited by Cristal Mining to attend a site inspection of the Modification area and a selection of the recorded sites following completion of the field surveys.

Please find enclosed the survey application form for completion and return by **5.00 pm Friday 12 April 2019**, for those Registered Aboriginal Parties who are seeking consideration for paid involvement in the field investigation associated with the Modification.

In order to be considered for paid involvement in the field surveys, Registered Aboriginal Parties will need to complete the attached Field Survey Application Form (Enclosure B) and provide it to Cristal Mining by the closing date.

Aboriginal representatives will be selected by Cristal Mining based upon the merits of the application with respect to the selection criteria, which are indicated by the questions in the application form. Applications will be assessed against all criteria including cultural knowledge of the Modification area, the representation of others within the community and experience in providing cultural heritage advice.

Where a response is not received by 5.00 pm Friday 12 April 2019, it will be assumed that you do not wish to seek consideration for paid involvement in the field investigation. Incomplete applications may not be accepted by Cristal Mining. Please note that Cristal Mining reserves the right to request any further information/clarification or supporting documentation from you in respect to your application.

Assistance in the completion of the application form can be provided to you upon request. Please use the contact details provided below.

The field survey is expected to take place on **Wednesday 1 May 2019** (i.e. the day following the Information Session). Further details will be provided to the successful applicants as soon as possible.

### **Contact Details**

To provide any feedback with respect to the Proposed Methodology and/or to indicate your attendance at the information session, please contact Cristal Mining via the following contact details

Haakon Nielssen  
Environmental Manager  
Cristal Mining Australia Limited  
0427 419 273  
PO Box 444, Broken Hill NSW 2880  
[hnielssen@cristal.com](mailto:hnielssen@cristal.com)

Yours sincerely



**Haakon Nielssen**  
Environmental Manager  
Cristal Mining Australia Limited

ENCLOSURE A

PROPOSED METHODOLOGY FOR THE ABORIGINAL CULTURAL HERITAGE ASSESSMENT  
FOR THE MODIFICATION

ENCLOSURE B

FIELD SURVEY APPLICATION FORM

## STAGE 4 CORRESPONDENCE



17 May 2019

Badger Bates  
107 Gaffney Lane  
BROKEN HILL NSW 2880

Dear Badger,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION - DRAFT ABORIGINAL CULTURAL HERITAGE  
ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Tronox Limited (Tronox). Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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).

Tronox proposes to modify Development Consent (SSD\_5012) for the Project to allow for changes to optimise the Project (herein referred to the Optimisation Modification or Modification).

**Draft Aboriginal Cultural Heritage Assessment**

Please find enclosed for your review, a copy of the draft Aboriginal Cultural Heritage Assessment (ACHA) for the Atlas-Campaspe Mineral Sands Project Optimisation Modification.

# TRONOX

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010), we have provided the draft ACHA for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the draft ACHA.

If you wish to provide input on the following, please make a submission to Tronox by **5.00 pm Friday 21 June 2019** (via the contact details provided below):

- Identification of issues.
- Any aboriginal objects or places of cultural value within the investigation area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

All comments received will be taken into consideration as the draft ACHA is finalised.

Please submit any feedback regarding the draft ACHA to Tronox via the following contact details by 5.00 pm Friday 21 June 2019:

Tronox  
Haakon Nielssen  
375-381 Benetook Ave, Mildura VIC 3500  
Mobile: 0427 419 273  
Email: [haakon.nielssen@tronox.com](mailto:haakon.nielssen@tronox.com)

Yours sincerely,



**Haakon Nielssen**  
**Manager Environment AUS-Murray Basin**  
**Tronox Limited**



ATTACHMENT 1

ATLAS-CAMPASPE MINERAL SANDS PROJECT  
OPTIMISATION MODIFICATION – DRAFT ABORIGINAL CULTURAL  
HERITAGE ASSESSMENT



17 May 2019

Arthur Kirby  
Barkindji Elders Council  
c/- PO Box 87  
EUSTON NSW 2737

Dear Arthur,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION - DRAFT ABORIGINAL CULTURAL HERITAGE  
ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Tronox Limited (Tronox). Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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).

Tronox proposes to modify Development Consent (SSD\_5012) for the Project to allow for changes to optimise the Project (herein referred to the Optimisation Modification or Modification).

**Draft Aboriginal Cultural Heritage Assessment**

Please find enclosed for your review, a copy of the draft Aboriginal Cultural Heritage Assessment (ACHA) for the Atlas-Campaspe Mineral Sands Project Optimisation Modification.

# TRONOX

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010), we have provided the draft ACHA for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the draft ACHA.

If you wish to provide input on the following, please make a submission to Tronox by **5.00 pm Friday 21 June 2019** (via the contact details provided below):

- Identification of issues.
- Any aboriginal objects or places of cultural value within the investigation area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

All comments received will be taken into consideration as the draft ACHA is finalised.

Please submit any feedback regarding the draft ACHA to Tronox via the following contact details by 5.00 pm Friday 21 June 2019:

Tronox  
Haakon Nielssen  
375-381 Benetook Ave, Mildura VIC 3500  
Mobile: 0427 419 273  
Email: [haakon.nielssen@tronox.com](mailto:haakon.nielssen@tronox.com)

Yours sincerely,



**Haakon Nielssen**  
**Manager Environment AUS-Murray Basin**  
**Tronox Limited**



ATTACHMENT 1

ATLAS-CAMPASPE MINERAL SANDS PROJECT  
OPTIMISATION MODIFICATION – DRAFT ABORIGINAL CULTURAL  
HERITAGE ASSESSMENT



17 May 2019

Damien Aidon  
Balranald Local Aboriginal Land Council  
PO Box 187  
BALRANALD NSW 2715

Via email: [ceo.blalc@gmail.com](mailto:ceo.blalc@gmail.com)

Dear Damien,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION - DRAFT ABORIGINAL CULTURAL HERITAGE  
ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Tronox Limited (Tronox). Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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).

Tronox proposes to modify Development Consent (SSD\_5012) for the Project to allow for changes to optimise the Project (herein referred to the Optimisation Modification or Modification).

**Draft Aboriginal Cultural Heritage Assessment**

Please find enclosed for your review, a copy of the draft Aboriginal Cultural Heritage Assessment (ACHA) for the Atlas-Campaspe Mineral Sands Project Optimisation Modification.

# TRONOX

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010), we have provided the draft ACHA for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the draft ACHA.

If you wish to provide input on the following, please make a submission to Tronox by **5.00 pm Friday 21 June 2019** (via the contact details provided below):

- Identification of issues.
- Any aboriginal objects or places of cultural value within the investigation area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

All comments received will be taken into consideration as the draft ACHA is finalised.

Please submit any feedback regarding the draft ACHA to Tronox via the following contact details by 5.00 pm Friday 21 June 2019:

Tronox  
Haakon Nielssen  
375-381 Benetook Ave, Mildura VIC 3500  
Mobile: 0427 419 273  
Email: [haakon.nielssen@tronox.com](mailto:haakon.nielssen@tronox.com)

Yours sincerely,



**Haakon Nielssen**  
**Manager Environment AUS-Murray Basin**  
**Tronox Limited**



ATTACHMENT 1

ATLAS-CAMPASPE MINERAL SANDS PROJECT  
OPTIMISATION MODIFICATION – DRAFT ABORIGINAL CULTURAL  
HERITAGE ASSESSMENT



17 May 2019

Andrew Rose and Fay Johnson  
Ivanhoe Community Working Party  
PO Box 29  
BOURKE NSW 2840

Via email: [fay.johnstone@det.nsw.edu.au](mailto:fay.johnstone@det.nsw.edu.au) and [ivanhoe@mpira.com.au](mailto:ivanhoe@mpira.com.au)

Dear Andrew and Fay,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION - DRAFT ABORIGINAL CULTURAL HERITAGE  
ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Tronox Limited (Tronox). Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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).

Tronox proposes to modify Development Consent (SSD\_5012) for the Project to allow for changes to optimise the Project (herein referred to the Optimisation Modification or Modification).

**Draft Aboriginal Cultural Heritage Assessment**

Please find enclosed for your review, a copy of the draft Aboriginal Cultural Heritage Assessment (ACHA) for the Atlas-Campaspe Mineral Sands Project Optimisation Modification.

# TRONOX

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010), we have provided the draft ACHA for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the draft ACHA.

If you wish to provide input on the following, please make a submission to Tronox by **5.00 pm Friday 21 June 2019** (via the contact details provided below):

- Identification of issues.
- Any aboriginal objects or places of cultural value within the investigation area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

All comments received will be taken into consideration as the draft ACHA is finalised.

Please submit any feedback regarding the draft ACHA to Tronox via the following contact details by 5.00 pm Friday 21 June 2019:

Tronox  
Haakon Nielssen  
375-381 Benetook Ave, Mildura VIC 3500  
Mobile: 0427 419 273  
Email: [haakon.nielssen@tronox.com](mailto:haakon.nielssen@tronox.com)

Yours sincerely,



**Haakon Nielssen**  
**Manager Environment AUS-Murray Basin**  
**Tronox Limited**



ATTACHMENT 1

ATLAS-CAMPASPE MINERAL SANDS PROJECT  
OPTIMISATION MODIFICATION – DRAFT ABORIGINAL CULTURAL  
HERITAGE ASSESSMENT



17 May 2019

Paul Charles  
Kullila Site Consultants  
14 Werrang Road  
PRIMBEE NSW 2502

Dear Paul,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION - DRAFT ABORIGINAL CULTURAL HERITAGE  
ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Tronox Limited (Tronox). Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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).

Tronox proposes to modify Development Consent (SSD\_5012) for the Project to allow for changes to optimise the Project (herein referred to the Optimisation Modification or Modification).

**Draft Aboriginal Cultural Heritage Assessment**

Please find enclosed for your review, a copy of the draft Aboriginal Cultural Heritage Assessment (ACHA) for the Atlas-Campaspe Mineral Sands Project Optimisation Modification.

# TRONOX

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010), we have provided the draft ACHA for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the draft ACHA.

If you wish to provide input on the following, please make a submission to Tronox by **5.00 pm Friday 21 June 2019** (via the contact details provided below):

- Identification of issues.
- Any aboriginal objects or places of cultural value within the investigation area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

All comments received will be taken into consideration as the draft ACHA is finalised.

Please submit any feedback regarding the draft ACHA to Tronox via the following contact details by 5.00 pm Thursday 20 June 2019:

Tronox  
Haakon Nielssen  
375-381 Benetook Ave, Mildura VIC 3500  
Mobile: 0427 419 273  
Email: [haakon.nielssen@tronox.com](mailto:haakon.nielssen@tronox.com)

Yours sincerely,



**Haakon Nielssen**  
**Manager Environment AUS-Murray Basin**  
**Tronox Limited**



ATTACHMENT 1

ATLAS-CAMPASPE MINERAL SANDS PROJECT  
OPTIMISATION MODIFICATION – DRAFT ABORIGINAL CULTURAL  
HERITAGE ASSESSMENT



17 May 2019

Maria Maher

Via email: [g.m.maher@hotmail.com](mailto:g.m.maher@hotmail.com)

Dear Maria,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION - DRAFT ABORIGINAL CULTURAL HERITAGE  
ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Tronox Limited (Tronox). Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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).

Tronox proposes to modify Development Consent (SSD\_5012) for the Project to allow for changes to optimise the Project (herein referred to the Optimisation Modification or Modification).

**Draft Aboriginal Cultural Heritage Assessment**

Please find enclosed for your review, a copy of the draft Aboriginal Cultural Heritage Assessment (ACHA) for the Atlas-Campaspe Mineral Sands Project Optimisation Modification.

# TRONOX

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010), we have provided the draft ACHA for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the draft ACHA.

If you wish to provide input on the following, please make a submission to Tronox by **5.00 pm Friday 21 June 2019** (via the contact details provided below):

- Identification of issues.
- Any aboriginal objects or places of cultural value within the investigation area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

All comments received will be taken into consideration as the draft ACHA is finalised.

Please submit any feedback regarding the draft ACHA to Tronox via the following contact details by 5.00 pm Friday 21 June 2019:

Tronox  
Haakon Nielssen  
375-381 Benetook Ave, Mildura VIC 3500  
Mobile: 0427 419 273  
Email: [haakon.nielssen@tronox.com](mailto:haakon.nielssen@tronox.com)

Yours sincerely,



**Haakon Nielssen**  
**Manager Environment AUS-Murray Basin**  
**Tronox Limited**



ATTACHMENT 1

ATLAS-CAMPASPE MINERAL SANDS PROJECT  
OPTIMISATION MODIFICATION – DRAFT ABORIGINAL CULTURAL  
HERITAGE ASSESSMENT



17 May 2019

Michael (Mick) Kelly  
Michael (Mick) Kelly on behalf of Ngiyampaa people  
C/- Office of Environment and Heritage  
PO Box 318  
BURONGA NSW 2739

Via email: [mick.kelly@environment.nsw.gov.au](mailto:mick.kelly@environment.nsw.gov.au)

Dear Michael,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION - DRAFT ABORIGINAL CULTURAL HERITAGE  
ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Tronox Limited (Tronox). Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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).

Tronox proposes to modify Development Consent (SSD\_5012) for the Project to allow for changes to optimise the Project (herein referred to the Optimisation Modification or Modification).

**Draft Aboriginal Cultural Heritage Assessment**

Please find enclosed for your review, a copy of the draft Aboriginal Cultural Heritage Assessment (ACHA) for the Atlas-Campaspe Mineral Sands Project Optimisation Modification.

# TRONOX

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010), we have provided the draft ACHA for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the draft ACHA.

If you wish to provide input on the following, please make a submission to Tronox by **5.00 pm Friday 21 June 2019** (via the contact details provided below):

- Identification of issues.
- Any aboriginal objects or places of cultural value within the investigation area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

All comments received will be taken into consideration as the draft ACHA is finalised.

Please submit any feedback regarding the draft ACHA to Tronox via the following contact details by 5.00 pm Friday 21 June 2019:

Tronox  
Haakon Nielssen  
375-381 Benetook Ave, Mildura VIC 3500  
Mobile: 0427 419 273  
Email: [haakon.nielssen@tronox.com](mailto:haakon.nielssen@tronox.com)

Yours sincerely,



**Haakon Nielssen**  
**Manager Environment AUS-Murray Basin**  
**Tronox Limited**



ATTACHMENT 1

ATLAS-CAMPASPE MINERAL SANDS PROJECT  
OPTIMISATION MODIFICATION – DRAFT ABORIGINAL CULTURAL  
HERITAGE ASSESSMENT



17 May 2019

Bernadette Pappin  
Muthi Muthi Nations Aboriginal Corporation  
PO Box 210  
BALRANALD NSW 2715

Via email: [bpappin@gwahs.health.nsw.gov.au](mailto:bpappin@gwahs.health.nsw.gov.au)

Dear Bernadette,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION - DRAFT ABORIGINAL CULTURAL HERITAGE  
ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Tronox Limited (Tronox). Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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).

Tronox proposes to modify Development Consent (SSD\_5012) for the Project to allow for changes to optimise the Project (herein referred to the Optimisation Modification or Modification).

**Draft Aboriginal Cultural Heritage Assessment**

Please find enclosed for your review, a copy of the draft Aboriginal Cultural Heritage Assessment (ACHA) for the Atlas-Campaspe Mineral Sands Project Optimisation Modification.

# TRONOX

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010), we have provided the draft ACHA for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the draft ACHA.

If you wish to provide input on the following, please make a submission to Tronox by **5.00 pm Thursday 20 June 2019** (via the contact details provided below):

- Identification of issues.
- Any aboriginal objects or places of cultural value within the investigation area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

All comments received will be taken into consideration as the draft ACHA is finalised.

Please submit any feedback regarding the draft ACHA to Tronox via the following contact details by 5.00 pm Friday 21 June 2019:

Tronox  
Haakon Nielssen  
375-381 Benetook Ave, Mildura VIC 3500  
Mobile: 0427 419 273  
Email: [haakon.nielssen@tronox.com](mailto:haakon.nielssen@tronox.com)

Yours sincerely,



**Haakon Nielssen**  
**Manager Environment AUS-Murray Basin**  
**Tronox Limited**



ATTACHMENT 1

ATLAS-CAMPASPE MINERAL SANDS PROJECT  
OPTIMISATION MODIFICATION – DRAFT ABORIGINAL CULTURAL  
HERITAGE ASSESSMENT



17 May 2019

Ali Maher  
National Koorie Site Management  
3 Cuthbert Drive  
MOUNT WARRIGAL NSW 2528

Via email: [ali.n.maher@hotmail.com](mailto:ali.n.maher@hotmail.com)

Dear Ali,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION - DRAFT ABORIGINAL CULTURAL HERITAGE  
ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Tronox Limited (Tronox). Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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).

Tronox proposes to modify Development Consent (SSD\_5012) for the Project to allow for changes to optimise the Project (herein referred to the Optimisation Modification or Modification).

**Draft Aboriginal Cultural Heritage Assessment**

Please find enclosed for your review, a copy of the draft Aboriginal Cultural Heritage Assessment (ACHA) for the Atlas-Campaspe Mineral Sands Project Optimisation Modification.

# TRONOX

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010), we have provided the draft ACHA for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the draft ACHA.

If you wish to provide input on the following, please make a submission to Tronox by **5.00 pm Friday 21 June 2019** (via the contact details provided below):

- Identification of issues.
- Any aboriginal objects or places of cultural value within the investigation area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

All comments received will be taken into consideration as the draft ACHA is finalised.

Please submit any feedback regarding the draft ACHA to Tronox via the following contact details by 5.00 pm Friday 21 June 2019:

Tronox  
Haakon Nielssen  
375-381 Benetook Ave, Mildura VIC 3500  
Mobile: 0427 419 273  
Email: [haakon.nielssen@tronox.com](mailto:haakon.nielssen@tronox.com)

Yours sincerely,



**Haakon Nielssen**  
**Manager Environment AUS-Murray Basin**  
**Tronox Limited**



ATTACHMENT 1

ATLAS-CAMPASPE MINERAL SANDS PROJECT  
OPTIMISATION MODIFICATION – DRAFT ABORIGINAL CULTURAL  
HERITAGE ASSESSMENT



17 May 2019

Cynthia and Garry Pappin  
Wakool Indigenous Corporation  
PO Box 243  
BALRANALD NSW 2715

Via email: [Wakool.ic@gmail.com](mailto:Wakool.ic@gmail.com)

Dear Cynthia and Garry,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION - DRAFT ABORIGINAL CULTURAL HERITAGE  
ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Tronox Limited (Tronox). Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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).

Tronox proposes to modify Development Consent (SSD\_5012) for the Project to allow for changes to optimise the Project (herein referred to the Optimisation Modification or Modification).

**Draft Aboriginal Cultural Heritage Assessment**

Please find enclosed for your review, a copy of the draft Aboriginal Cultural Heritage Assessment (ACHA) for the Atlas-Campaspe Mineral Sands Project Optimisation Modification.

# TRONOX

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010), we have provided the draft ACHA for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the draft ACHA.

If you wish to provide input on the following, please make a submission to Tronox by **5.00 pm Friday 21 June 2019** (via the contact details provided below):

- Identification of issues.
- Any aboriginal objects or places of cultural value within the investigation area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

All comments received will be taken into consideration as the draft ACHA is finalised.

Please submit any feedback regarding the draft ACHA to Tronox via the following contact details by 5.00 pm Friday 21 June 2019:

Tronox  
Haakon Nielssen  
375-381 Benetook Ave, Mildura VIC 3500  
Mobile: 0427 419 273  
Email: [haakon.nielssen@tronox.com](mailto:haakon.nielssen@tronox.com)

Yours sincerely,



**Haakon Nielssen**  
**Manager Environment AUS-Murray Basin**  
**Tronox Limited**



ATTACHMENT 1

ATLAS-CAMPASPE MINERAL SANDS PROJECT  
OPTIMISATION MODIFICATION – DRAFT ABORIGINAL CULTURAL  
HERITAGE ASSESSMENT



17 May 2019

C/- Warren Clarke  
Willandra Lakes 2 Traditional Tribal Groups Elders Council  
PO Box 318  
BURONGA NSW 2739

Via email: [warren.clarke@environment.nsw.gov.au](mailto:warren.clarke@environment.nsw.gov.au)

Dear Warren

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION - DRAFT ABORIGINAL CULTURAL HERITAGE  
ASSESSMENT**

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Tronox Limited (Tronox). Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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).

Tronox proposes to modify Development Consent (SSD\_5012) for the Project to allow for changes to optimise the Project (herein referred to the Optimisation Modification or Modification).

**Draft Aboriginal Cultural Heritage Assessment**

Please find enclosed for your review, a copy of the draft Aboriginal Cultural Heritage Assessment (ACHA) for the Atlas-Campaspe Mineral Sands Project Optimisation Modification.

# TRONOX

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010), we have provided the draft ACHA for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the draft ACHA.

If you wish to provide input on the following, please make a submission to Tronox by **5.00 pm Friday 21 June 2019** (via the contact details provided below):

- Identification of issues.
- Any aboriginal objects or places of cultural value within the investigation area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

All comments received will be taken into consideration as the draft ACHA is finalised.

Please submit any feedback regarding the draft ACHA to Tronox via the following contact details by 5.00 pm Friday 21 June 2019:

Tronox  
Haakon Nielssen  
375-381 Benetook Ave, Mildura VIC 3500  
Mobile: 0427 419 273  
Email: [haakon.nielssen@tronox.com](mailto:haakon.nielssen@tronox.com)

Yours sincerely,



**Haakon Nielssen**  
**Manager Environment AUS-Murray Basin**  
**Tronox Limited**



ATTACHMENT 1

ATLAS-CAMPASPE MINERAL SANDS PROJECT  
OPTIMISATION MODIFICATION – DRAFT ABORIGINAL CULTURAL  
HERITAGE ASSESSMENT



20 May 2019

Fay Johnstone  
Ivanhoe Community Working Party  
PO Box 50  
IVANHOE NSW 2878

Dear Auntie Fay,

**RE: ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION  
MODIFICATION - DRAFT ABORIGINAL CULTURAL HERITAGE  
ASSESSMENT (HARD COPY)**

As requested in your correspondence dated 20 May 2019, please find enclosed for your review a hard copy of the draft Aboriginal Cultural Heritage Assessment (ACHA) for the Atlas-Campaspe Mineral Sands Project Optimisation Modification.

If you wish to provide input on the following, please make a submission to Tronox by **5.00 pm Friday 21 June 2019** (via the contact details provided below):

- Identification of issues.
- Any aboriginal objects or places of cultural value within the investigation area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

All comments received will be taken into consideration as the draft ACHA is finalised.



Please submit any feedback regarding the draft ACHA to Tronox via the following contact details by 5.00 pm Friday 21 June 2019:

Tronox  
Haakon Nielssen  
375-381 Benetook Ave, Mildura VIC 3500  
Mobile: 0427 419 273  
Email: [haakon.nielssen@tronox.com](mailto:haakon.nielssen@tronox.com)

Yours sincerely,

**Haakon Nielssen**  
**Manager Environment AUS-Murray Basin**  
**Tronox Limited**



ENCLOSURE 1

ATLAS-CAMPASPE MINERAL SANDS PROJECT  
OPTIMISATION MODIFICATION – DRAFT ABORIGINAL CULTURAL  
HERITAGE ASSESSMENT

## **APPENDIX 4: CORRESPONDENCE FROM ABORIGINAL COMMUNITY STAKEHOLDERS**

**From:** Fay Johnstone <>  
**Sent:** Monday, 20 May 2019 8:39 AM  
**To:** Haakon Nielssen <>  
**Subject:** Re: Atlas-Campaspe Mineral Sands Project Optimisation Modification - Draft ACHA

Morning Haakon, Please send me a draft hard copy of the ACHA to PO Box 50 Ivanhoe 2878 Please.

Auntie Fay

**Fay Johnstone**  
Aboriginal Education Officer  
Ivanhoe Central School

---

**From:** Haakon Nielssen <>  
**Sent:** Friday, 17 May 2019 3:59 PM  
**To:** Fay Johnstone;  
**Subject:** Atlas-Campaspe Mineral Sands Project Optimisation Modification - Draft ACHA

Dear Andrew and Aunty Fay,

Please see attached correspondence regarding the draft Aboriginal Cultural Heritage Assessment (ACHA) for the Atlas-Campaspe Mineral Sands Project Optimisation Modification. The draft ACHA can be downloaded at the following link: <https://resourcestrategies.sharefile.com/d-sa718ed1fb1b47e08>

Please advise if you would like a hardcopy of the draft ACHA provided to a postal address.

Please do not hesitate to contact me if you have any queries.

Regards,

**Haakon Nielssen**  
Manager Environment  
AUS-Murray Basin  
[www.tronox.com](http://www.tronox.com)



This email is for use by the intended recipient(s) and may contain privileged, confidential or copyrighted information. Unauthorized use, copying or distribution of this e-mail, in whole or in part, is strictly prohibited. If you should not be an intended recipient of this e-mail, please notify the sender by return e-mail and delete this e-mail. The information transmitted in electronic mail does not necessarily represent the views of TRONOX. E-mail transmission cannot be

## **APPENDIX 5: AHIMS REGISTER SEARCH**

LandScape - Natural & Cultural Heritage Management

Date: 10 May 2019

P O Box 246

Merbein Victoria 3505

Attention: Matt Cupper

Email: landscape@telstra.com

Dear Sir or Madam:

**AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 208000 - 306000,  
Northings : 6310000 - 6390000 with a Buffer of 1000 meters, conducted by Matt Cupper on 10 May 2019.**

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

<b>51</b>	<b>Aboriginal sites are recorded in or near the above location.</b>
<b>0</b>	<b>Aboriginal places have been declared in or near the above location. *</b>

# AHIMS Web Services (AWS)

## Extensive search - Site list report

Your Ref/PO Number : Ivanhoe

Client Service ID : 419820

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
41-2-0014	Mossgiel 1	GDA	55	279145	6317372	Open site	Valid	Artefact : -, Hearth : -		
	<u>Contact</u> Searle	<u>Recorders</u>		Mr.Michael Kelly				<u>Permits</u>		
41-2-0015	Mossgiel 2	GDA	55	279143	6317316	Open site	Valid	Artefact : -, Hearth : -		
	<u>Contact</u> Searle	<u>Recorders</u>		Mr.Michael Kelly				<u>Permits</u>		
41-2-0016	Mossgiel 3	GDA	55	279168	6317276	Open site	Valid	Artefact : -, Hearth : -		
	<u>Contact</u> Searle	<u>Recorders</u>		Mr.Michael Kelly				<u>Permits</u>		
33-4-0001	Ivanhoe Rd 1	GDA	55	259518	6346939	Open site	Valid	Artefact : -, Hearth : -		
	<u>Contact</u> Searle	<u>Recorders</u>		Mr.Michael Kelly				<u>Permits</u>		
33-4-0002	Ivanhoe Rd 2	GDA	55	259537	6347003	Open site	Valid	Artefact : -, Hearth : -		
	<u>Contact</u> Searle	<u>Recorders</u>		Mr.Michael Kelly				<u>Permits</u>		
33-4-0003	Ivanhoe Rd 3	GDA	55	259433	6347200	Open site	Valid	Artefact : -, Hearth : -		
	<u>Contact</u> Searle	<u>Recorders</u>		Mr.Michael Kelly				<u>Permits</u>		
41-2-0023	Wilderness Area 7	GDA	55	302580	6319111	Open site	Valid	Hearth : -		
	<u>Contact</u> Searle	<u>Recorders</u>		Mr.Michael Kelly,Mr.Mark Brettschneider				<u>Permits</u>		
41-2-0024	Wilderness Area 8	GDA	55	304511	6319640	Open site	Valid	Artefact : -, Hearth : -		
	<u>Contact</u> Searle	<u>Recorders</u>		Mr.Michael Kelly,Mr.Mark Brettschneider				<u>Permits</u>		
41-2-0025	Wilderness Area 9	GDA	55	303002	6321721	Open site	Valid	Artefact : -, Hearth : -		
	<u>Contact</u> Searle	<u>Recorders</u>		Mr.Michael Kelly,Mr.Mark Brettschneider				<u>Permits</u>		
41-2-0026	Wilderness Area 10	GDA	55	302615	6322348	Open site	Valid	Artefact : -, Hearth : -		
	<u>Contact</u> Searle	<u>Recorders</u>		Mr.Michael Kelly,Mr.Mark Brettschneider				<u>Permits</u>		
41-2-0027	Wilderness Area 11	GDA	55	302649	6322765	Open site	Valid	Artefact : -, Hearth : -		
	<u>Contact</u> Searle	<u>Recorders</u>		Mr.Michael Kelly,Mr.Mark Brettschneider				<u>Permits</u>		
41-1-0241	WNP IF1	GDA	55	239828	6329745	Open site	Valid	Artefact : -		
	<u>Contact</u> Searle	<u>Recorders</u>		OzArk Environmental and Heritage Management				<u>Permits</u>		
41-1-0242	GOS IF1	GDA	55	231498	6324113	Open site	Valid	Artefact : -		
	<u>Contact</u> Searle	<u>Recorders</u>		OzArk Environmental and Heritage Management				<u>Permits</u>		
41-1-0243	GOS OS1	GDA	55	229927	6322281	Open site	Valid	Artefact : -		
	<u>Contact</u> Searle	<u>Recorders</u>		OzArk Environmental and Heritage Management				<u>Permits</u>		
41-1-0001	Mossgiel;	AGD	55	257848	6317309	Open site	Valid	Burial : -	Burial/s	
	<u>Contact</u>	<u>Recorders</u>		ASRSYS				<u>Permits</u>		
41-2-0002	Mossgiel;	AGD	55	272477	6317449	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>		ASRSYS				<u>Permits</u>		
41-2-0003	Mossgiel Tank;	AGD	55	272442	6321106	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>		ASRSYS				<u>Permits</u>		

Report generated by AHIMS Web Service on 10/05/2019 for Matt Cupper for the following area at Datum :GDA, Zone : 55, Eastings : 208000 - 306000, Northings : 6310000 - 6390000 with a Buffer of 1000 meters. Additional Info : Identify Aboriginal objects in study area. Number of Aboriginal sites and Aboriginal objects found is 51

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

# AHIMS Web Services (AWS)

## Extensive search - Site list report

Your Ref/PO Number : Ivanhoe

Client Service ID : 419820

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
41-2-0004	Holey Box Well;	AGD	55	265885	6337505	Open site	Valid	Artefact : -	Open Camp Site	605
	<u>Contact</u>	<u>Recorders</u>	ASRSYS					<u>Permits</u>		
41-2-0005	Contour 100;	AGD	55	302752	6322254	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>	Mr.M Harris					<u>Permits</u>		
41-2-0006	Wilderness Rabbits;	AGD	55	302645	6322510	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>	Mr.M Harris					<u>Permits</u>		
41-2-0007	Warringah Tree;	AGD	55	303002	6318880	Open site	Valid	Modified Tree (Carved or Scarred) : -	Scarred Tree	
	<u>Contact</u>	<u>Recorders</u>	Mr.M Harris					<u>Permits</u>		
41-2-0010	Wilderness 3	AGD	55	303288	6320829	Open site	Valid	Hearth : 1, Artefact : -		
	<u>Contact</u> T Russell	<u>Recorders</u>	Mr.Pat Faulkner					<u>Permits</u>		
41-2-0012	Wirringa 1	AGD	55	300680	6320690	Open site	Valid	Artefact : 6, Hearth : 1		
	<u>Contact</u> T Russell	<u>Recorders</u>	Mr.Pat Faulkner					<u>Permits</u>		
41-2-0013	Wirringa 2	AGD	55	302040	6320220	Open site	Valid	Hearth : -, Artefact : -		
	<u>Contact</u> T Russell	<u>Recorders</u>	Mr.Pat Faulkner					<u>Permits</u>		
33-4-0005	Ivanhoe RLF6	GDA	55	245522	6355587	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Mr.Jamie Reeves					<u>Permits</u>		
33-4-0006	Ivanhoe RLF7	GDA	55	243707	6353654	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		
33-4-0007	Ivanhoe RLF 8	GDA	55	243668	6353753	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		
33-4-0008	Ivanhoe RLF 9	GDA	55	243586	6354064	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		
33-4-0009	Ivanhoe RLF 10	GDA	55	243398	6354485	Open site	Valid	Art (Pigment or Engraved) : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		
33-4-0010	Ivanhoe RLF 11	GDA	55	243462	6354855	Open site	Valid	Artefact : 1, Hearth : 1, Potential Archaeological Deposit (PAD) : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		
33-4-0011	Ivanhoe RLF 12	GDA	55	243290	6354506	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		

Report generated by AHIMS Web Service on 10/05/2019 for Matt Cupper for the following area at Datum :GDA, Zone : 55, Eastings : 208000 - 306000, Northings : 6310000 - 6390000 with a Buffer of 1000 meters. Additional Info : Identify Aboriginal objects in study area. Number of Aboriginal sites and Aboriginal objects found is 51

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

# AHIMS Web Services (AWS)

## Extensive search - Site list report

Your Ref/PO Number : Ivanhoe

Client Service ID : 419820

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
33-4-0012	Ivanhoe RLF 13	GDA	55	243215	6354362	Open site	Valid	Artefact : 1, Hearth : 1, Potential Archaeological Deposit (PAD) : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		
33-4-0013	Ivanhoe RLF 14	GDA	55	243319	6354068	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		
33-4-0014	Ivanhoe RLF 15	GDA	55	243326	6353952	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		
33-4-0015	Ivanhoe RLF 16	GDA	55	243487	6353679	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		
33-4-0016	Ivanhoe RLF 17	GDA	55	243337	6355144	Open site	Valid	Artefact : 1, Hearth : 1, Potential Archaeological Deposit (PAD) : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		
33-4-0017	Ivanhoe RLF 18	GDA	55	243006	6355048	Open site	Valid	Artefact : 1, Hearth : 1, Potential Archaeological Deposit (PAD) : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		
33-4-0018	Ivanhoe RLF 19	GDA	55	243426	6355275	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		
33-4-0019	Ivanhoe RLF 20	GDA	55	243372	6354954	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		
33-4-0020	Ivanhoe RLF 21	GDA	55	243345	6354857	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		
33-4-0021	Ivanhoe RLF 22	GDA	55	243283	6354883	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		
33-4-0022	Ivanhoe RLF 23	GDA	55	243119	6354817	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		
33-4-0023	Ivanhoe RLF 24	GDA	55	243157	6354953	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		
33-4-0024	Ivanhoe RLF 25	GDA	55	243567	6355036	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		
33-4-0025	Ivanhoe RLF 26	GDA	55	243736	6355069	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		

Report generated by AHIMS Web Service on 10/05/2019 for Matt Cupper for the following area at Datum :GDA, Zone : 55, Eastings : 208000 - 306000, Northings : 6310000 - 6390000 with a Buffer of 1000 meters. Additional Info : Identify Aboriginal objects in study area. Number of Aboriginal sites and Aboriginal objects found is 51

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

# AHIMS Web Services (AWS)

## Extensive search - Site list report

Your Ref/PO Number : Ivanhoe

Client Service ID : 419820

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
33-4-0026	Ivanhoe RLF 27	GDA	55	243836	6355094	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>	Niche Environment and Heritage,Ms.Clare Anderson					<u>Permits</u>		
41-3-0022	Pebble Mound	AGD	55	304588	6319583	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>	Mr.M Harris					<u>Permits</u>		
33-5-0002	Canoble;Blake's Waterhole;	AGD	55	286740	6355992	Open site	Valid	Ceremonial Ring (Stone or Earth) : -, Modified Tree (Carved or Scarred) : -	Bora/Ceremonial,C arved Tree	
	<u>Contact</u>	<u>Recorders</u>	David Bell					<u>Permits</u>		
33-5-0004	Kajuligah 2;	AGD	55	276300	6383400	Open site	Valid	Modified Tree (Carved or Scarred) : -	Scarred Tree	
	<u>Contact</u>	<u>Recorders</u>	J Brickhill					<u>Permits</u>		
33-5-0005	Kajuligah_1;	AGD	55	276100	6383900	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>	J Brickhill					<u>Permits</u>		
41-1-0244	94MStru37/38	GDA	55	221944	6315505	Open site	Valid	Artefact : -		
	<u>Contact</u>	<u>Recorders</u>	Mrs.Angela Besant,Insite Heritage Pty Ltd					<u>Permits</u>		

Report generated by AHIMS Web Service on 10/05/2019 for Matt Cupper for the following area at Datum :GDA, Zone : 55, Eastings : 208000 - 306000, Northings : 6310000 - 6390000 with a Buffer of 1000 meters. Additional Info : Identify Aboriginal objects in study area. Number of Aboriginal sites and Aboriginal objects found is 51

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

**APPENDIX 6: AHIMS SITE CARDS**

# Aboriginal Site Recording Form

AHIMS Registrar  
PO Box 1967, Hurstville 2220 NSW

AHIMS site ID: 33-4-0031

Date recorded: 10-06-2019

## Site Location Information

Site name: Ivanhoe Rail Load Facility 29 (RLF29)

Easting: 242862 Northing: 6355330 Coordinates must be in GDA (MGA)

Horizontal Accuracy (m): 5

Zone: 55 Location method: Differential GPS

## Recorder Information

(The person responsible for the completion and submission of this form)

Title Surname First name  
Dr. Cupper Matt

Organisation: Landscape

Address: 178 Midgen Flat Road Broken Head 2481

Phone: 0408006690 E-mail: landscape@telstra.com

## Site Context Information

Land Form Pattern: Undulating Plain Land Use: Farming Low Intensity

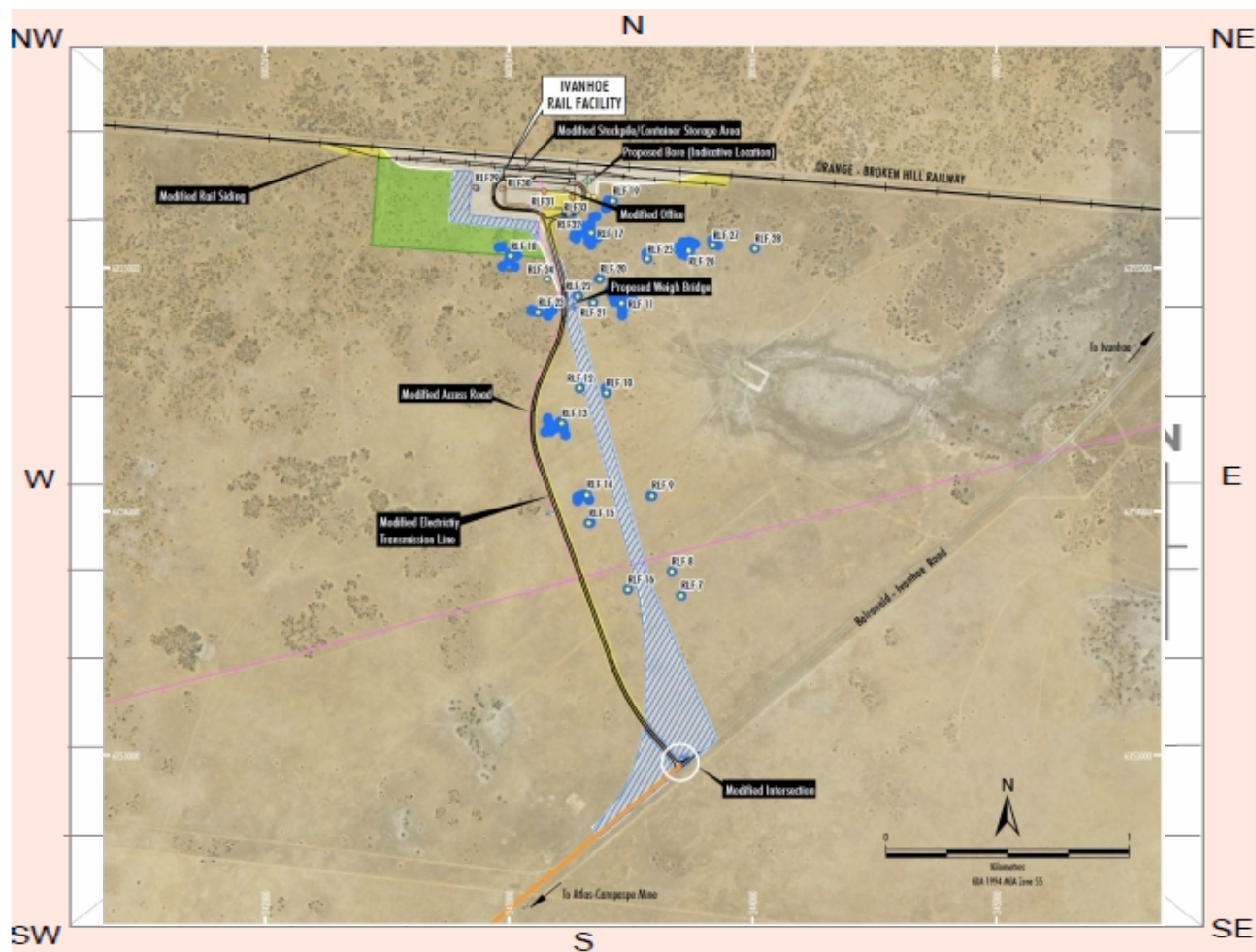
Land Form Unit: Plain Vegetation: Isolated clumps of trees

Distance to Water (m): 2000 Primary Report: Cupper, M. (2019). Atlas Campaspe Heritage Assessment.

How to get to the site: Site is located approximately 1 km north of Balranald Road and west of railway line.

Other site information:

## Site location map



## Site contents information

open/closed site:

Site condition:

### Features:

Features:	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
1. <input type="text" value="Artefact"/>	<input type="text" value="3"/>	<input type="text" value="5"/>	<input type="text" value="5"/>

### Description:

2 silcrete angular fragments, 1 silcrete flake.

### Scarred Trees

Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

### Features:




Features:	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
2. <input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

### Description:

### Scarred Trees

Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>




3. \_\_\_\_\_

Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
		

Scarred Trees			
Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species

--

4. \_\_\_\_\_

Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
		

Scarred Trees			
Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species

--

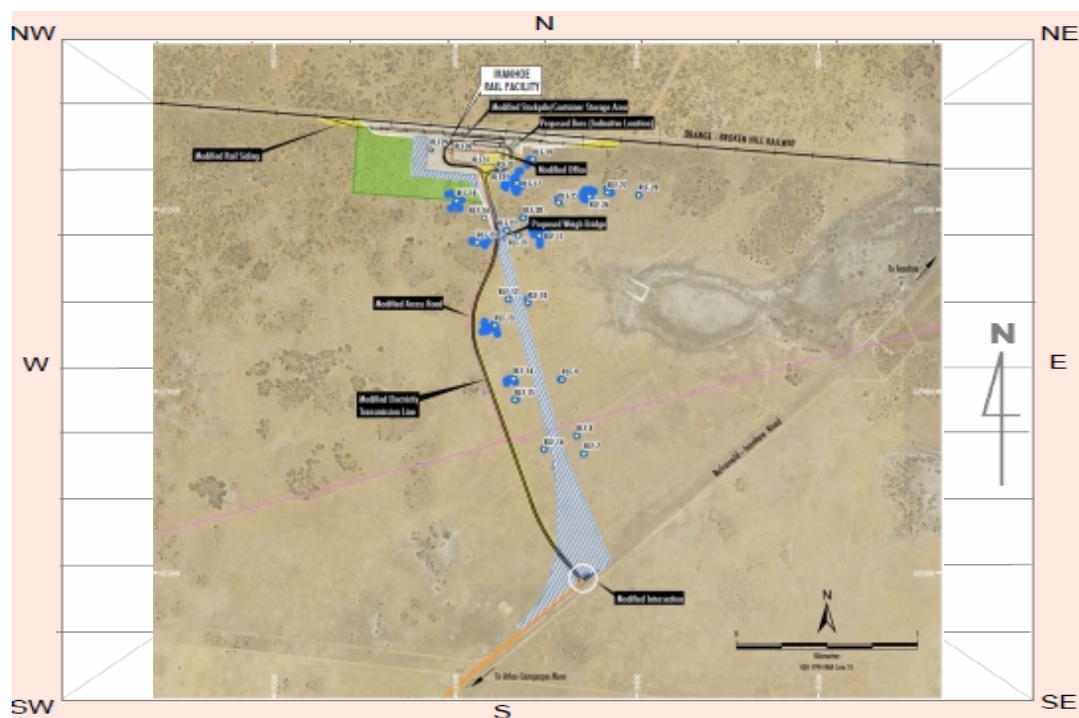
5.

Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Scarred Trees			
Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species

--

\_\_\_\_\_

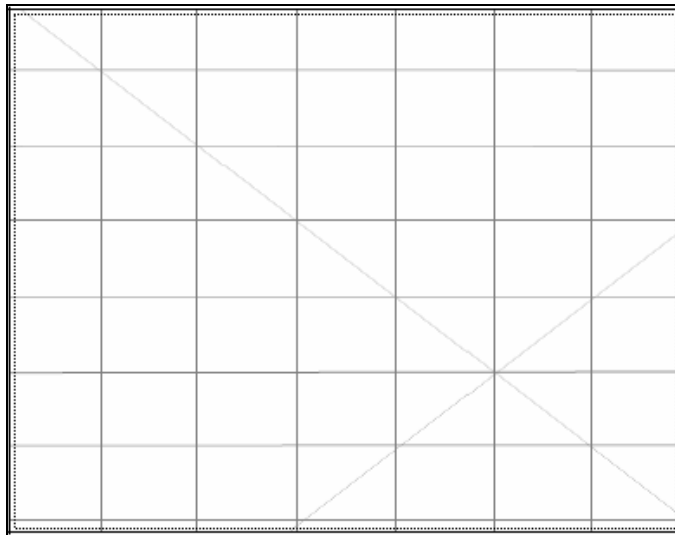


## Site photographs

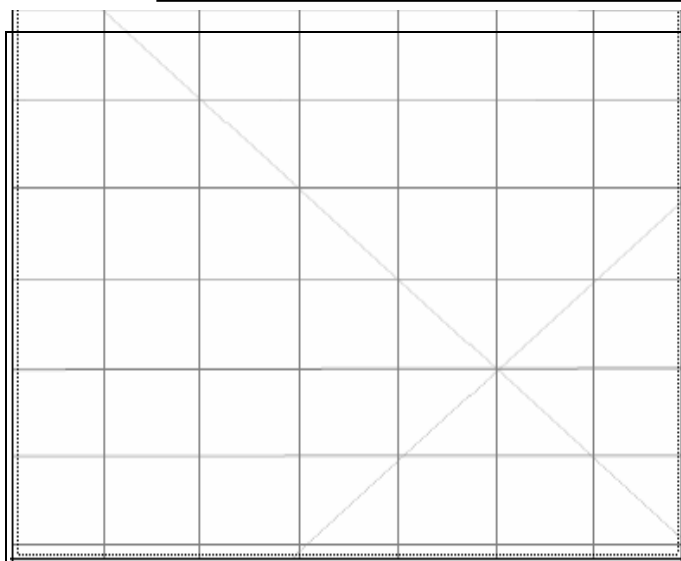


Description:

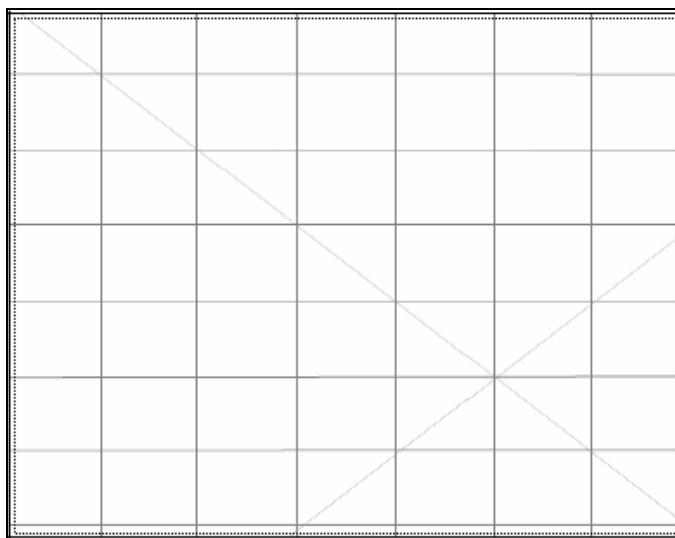
RLF29



Description:



Description:



Description:

## Site restrictions

Do you want to  
Restrict this site?: ☐

Restriction type: ☐ Gender ☐ General ☐ Location

Why is this site restricted?:

## Further information contact

Title  Surname  First name

Organisation:

Address:

Phone:  E-mail:

# Aboriginal Site Recording Form

AHIMS Registrar  
PO Box 1967, Hurstville 2220 NSW

AHIMS site ID: 33-4-0030

Date recorded: 10-06-2019

## Site Location Information

Site name: Ivanhoe Rail Load Facility 30 (RLF30)

Easting: 242971

Northing: 6355324

Coordinates must be in GDA (MGA)

Horizontal Accuracy (m):

5

Zone: 55

Location method:

Non-Differential GPS

## Recorder Information

(The person responsible for the completion and submission of this form)

Title

Surname

First name

Dr.

Cupper

Matt

Organisation:

Landscape

Address:

178 Midgen Flat Road Broken Head 2481

Phone:

0408006690

E-mail:

landscape@telstra.com

## Site Context Information

Land Form  
Pattern:

Undulating Plain

Land Use:

Farming Low Intensity

Land Form  
Unit:

Plain

Vegetation:

Isolated clumps of trees

Distance to  
Water (m):

2000

Primary  
Report:

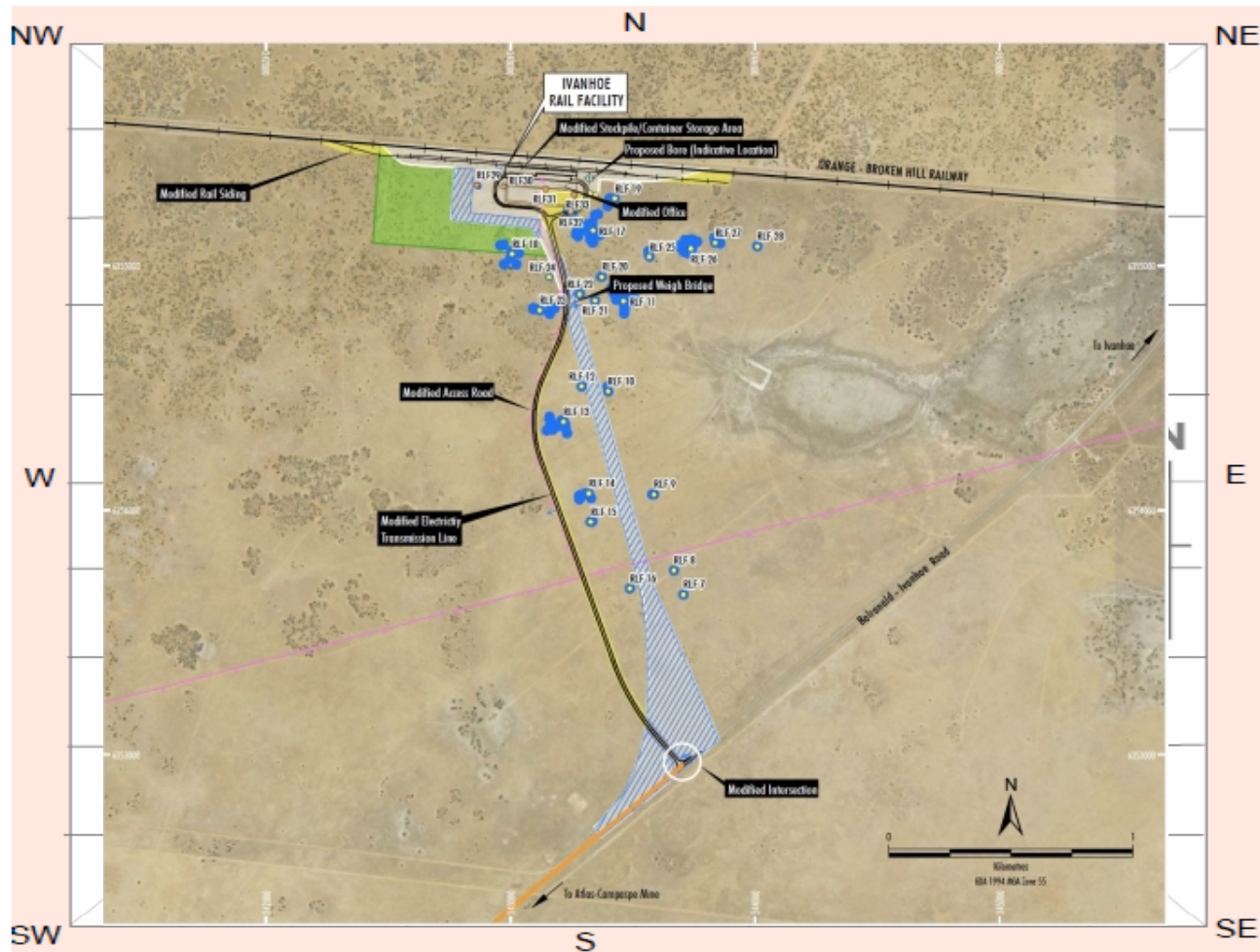
Cupper, M. (2019). Atlas Campaspe Heritage Assessment.

How to get  
to the site:

Site is located approximately 1 km north of Balranald Road and west of railway line.

Other site  
information:

## Site location map



## Site contents information

open/closed site:

Site condition:

### Features:

Features:	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
1. <input type="text" value="Artefact"/>	<input type="text" value="1"/>	<input type="text" value="1"/>	<input type="text" value="1"/>

### Description:

1 silcrete flake.

### Scarred Trees

Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

### Features:




Features:	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
2. <input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

### Description:

### Scarred Trees

Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>




3. \_\_\_\_\_

Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
		

Scarred Trees			
Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species

--

4. \_\_\_\_\_

Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
		

Scarred Trees			
Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species

--

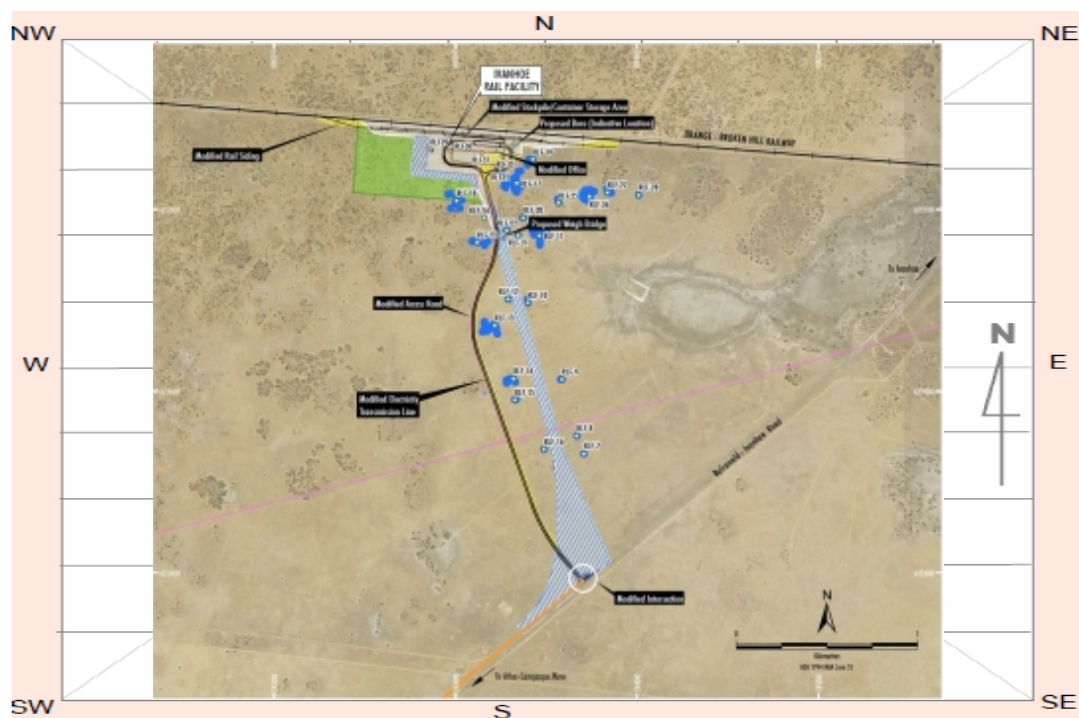
5.

Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

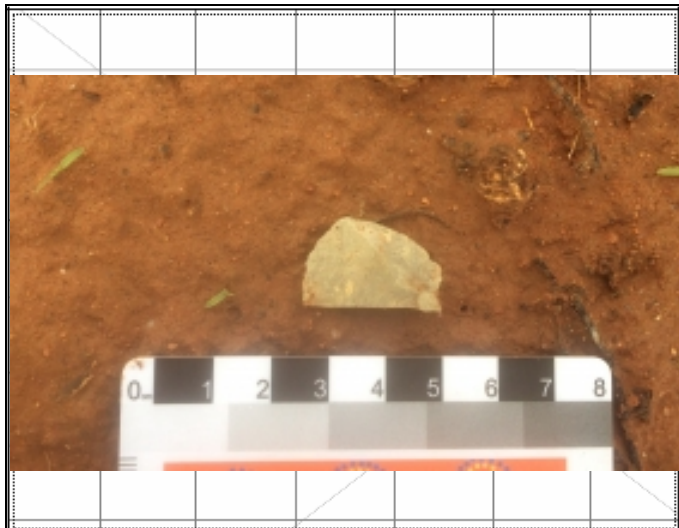
Scarred Trees			
Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species

--

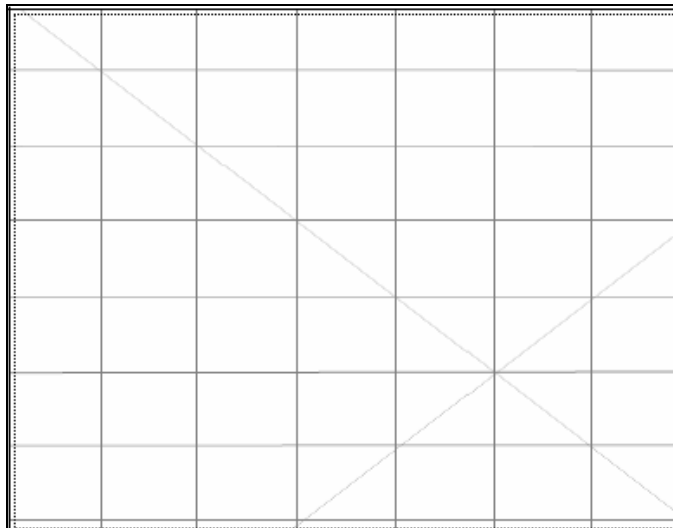
\_\_\_\_\_



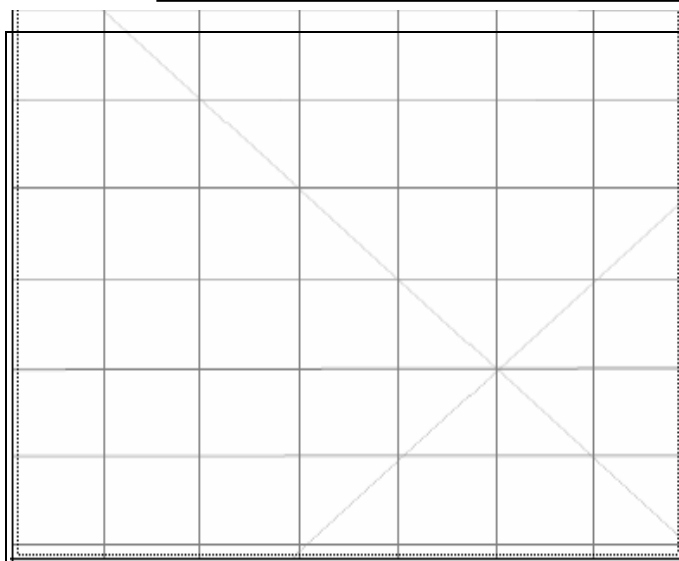
## Site photographs



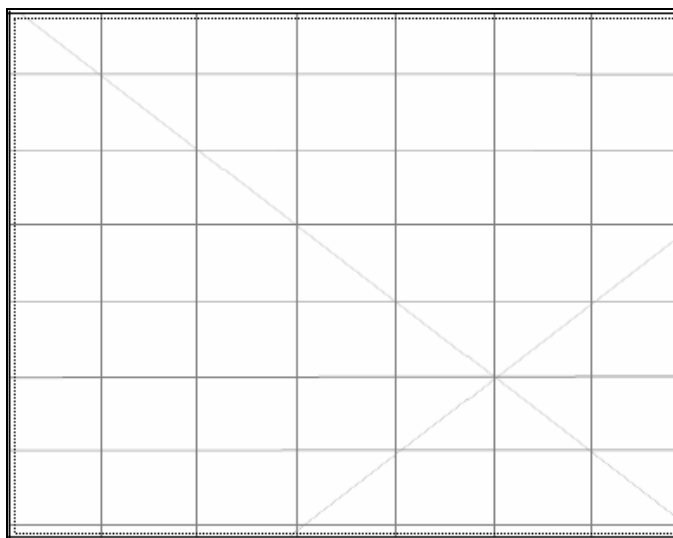
Description: RLF30



Description:



Description:



Description:

## Site restrictions

Do you want to  
Restrict this site?: ☐

Restriction type: Gender ☐ General ☐ Location ☐

Why is this site restricted?:

## Further information contact

Title  Surname  First name

Organisation:

Address:

Phone:  E-mail:

# Aboriginal Site Recording Form

AHIMS Registrar  
PO Box 1967, Hurstville 2220 NSW

AHIMS site ID: 33-4-0029

Date recorded: 10-06-2019

## Site Location Information

Site name: Ivanhoe Rail Load Facility 31 (RLF31)

Easting: 243143 Northing: 6355314 Coordinates must be in GDA (MGA)

Horizontal Accuracy (m): 5

Zone: 55 Location method: Non-Differential GPS

## Recorder Information

(The person responsible for the completion and submission of this form)

Title Surname First name  
Dr. Cupper Matt

Organisation: Landskape

Address: 178 Midgen Flat Road Broken Head 2481

Phone: 0408006690 E-mail: landskape@telstra.com

## Site Context Information

Land Form Pattern: Undulating Plain Land Use: Farming Low Intensity

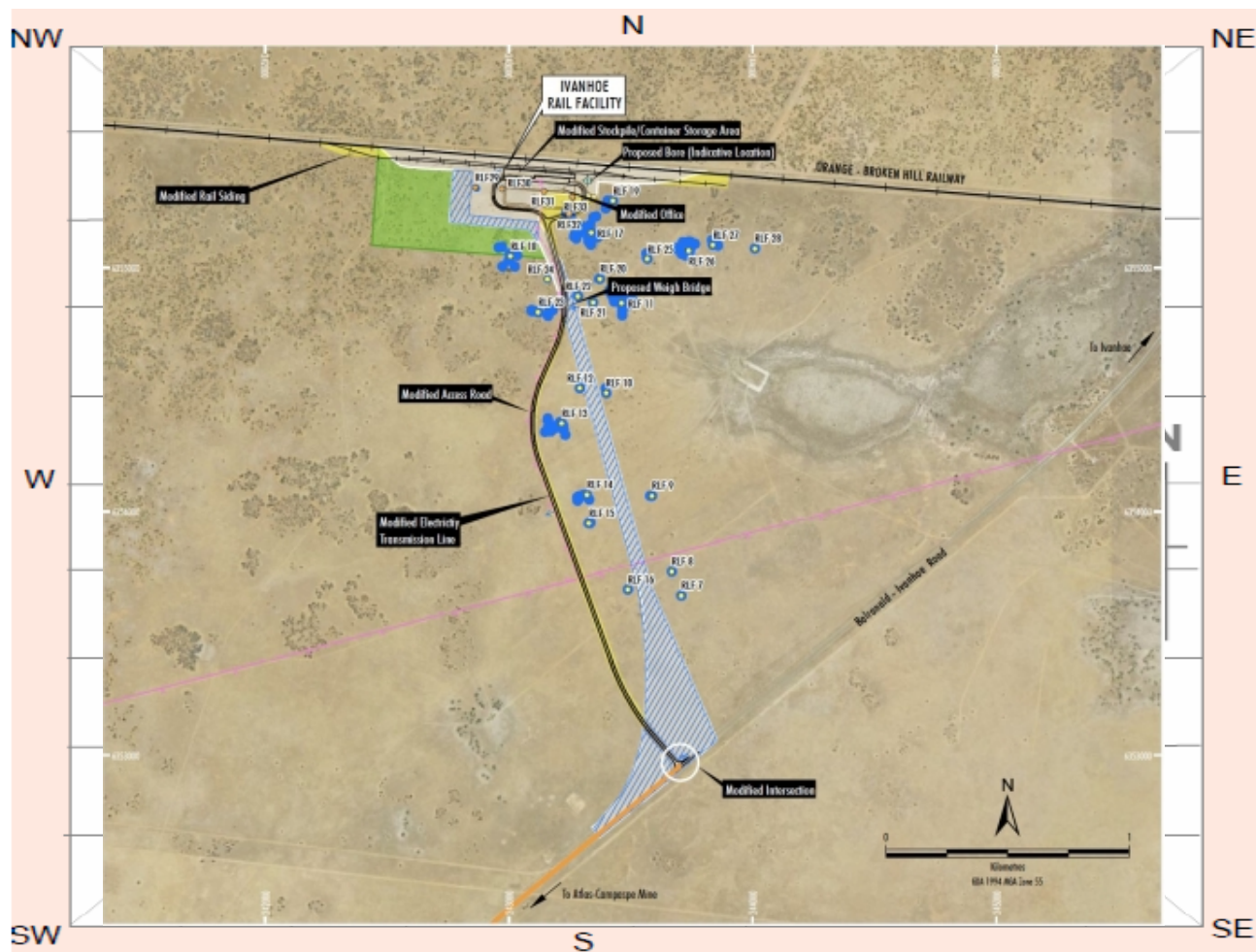
Land Form Unit: Plain Vegetation: Isolated clumps of trees

Distance to Water (m): 2000 Primary Report: Cupper, M. (2019). Atlas Campaspe Heritage Assessment.

How to get to the site: Site is located approximately 1 km north of Balranald Road and west of railway line.

Other site information:

## Site location map



## Site contents information

open/closed site:

Site condition:

### Features:

Features:	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
1. <input type="text" value="Artefact"/>	<input type="text" value="1"/>	<input type="text" value="1"/>	<input type="text" value="1"/>

### Description:

1 silcrete angular fragment.

### Scarred Trees

Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

### Features:

Features:	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
2. <input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

### Description:

### Scarred Trees

Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

### Features:

	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
3. <input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Description:

### Scarred Trees

Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
-----------------	---------------	------------	--------------

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
----------------------	----------------------	----------------------	----------------------

### Features:

	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
4. <input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Description:

### Scarred Trees

Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
-----------------	---------------	------------	--------------

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
----------------------	----------------------	----------------------	----------------------

### Features:

	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
5. <input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Description:

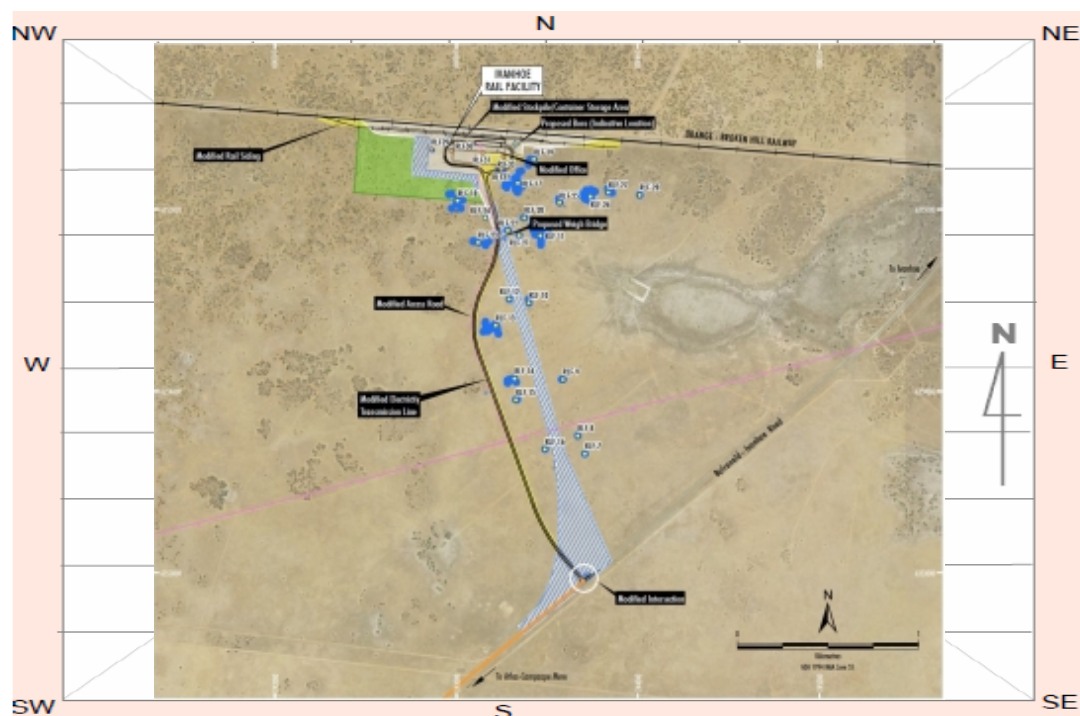
### Scarred Trees

Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
-----------------	---------------	------------	--------------

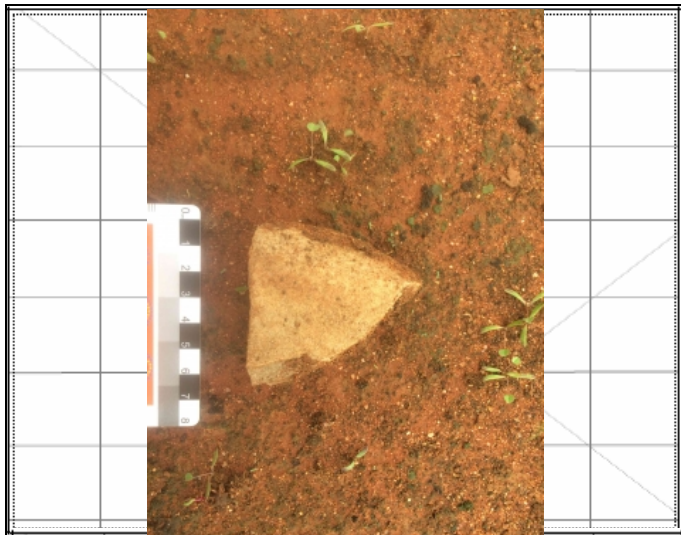
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
----------------------	----------------------	----------------------	----------------------

Other Site Info:

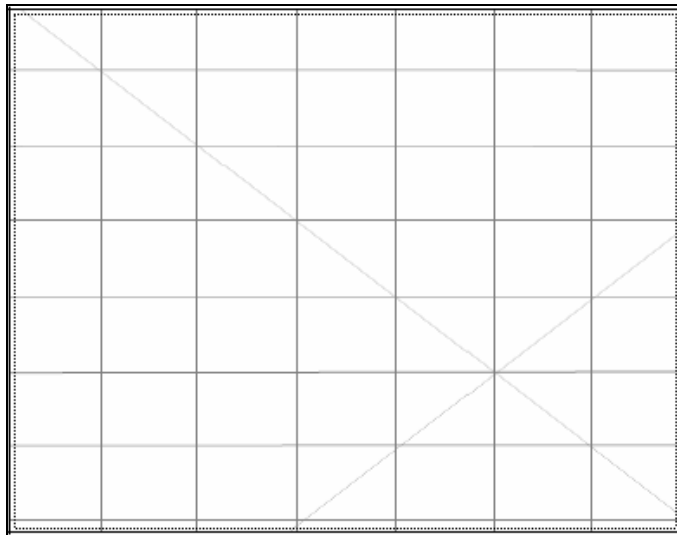
## Site plan



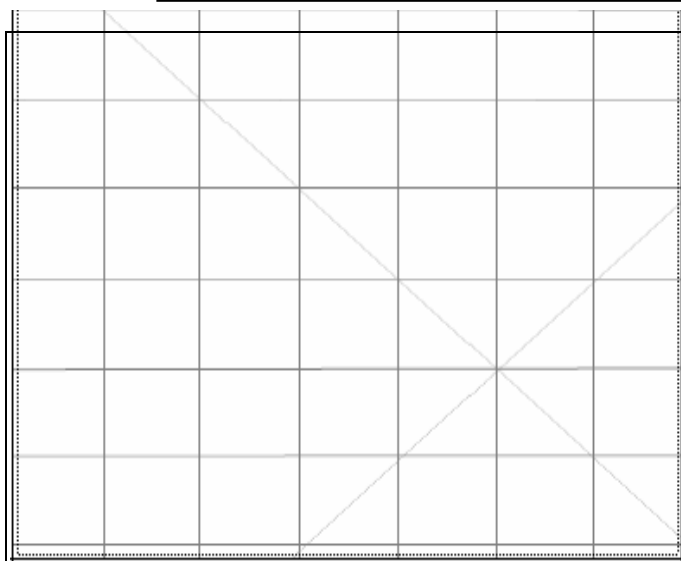
## Site photographs



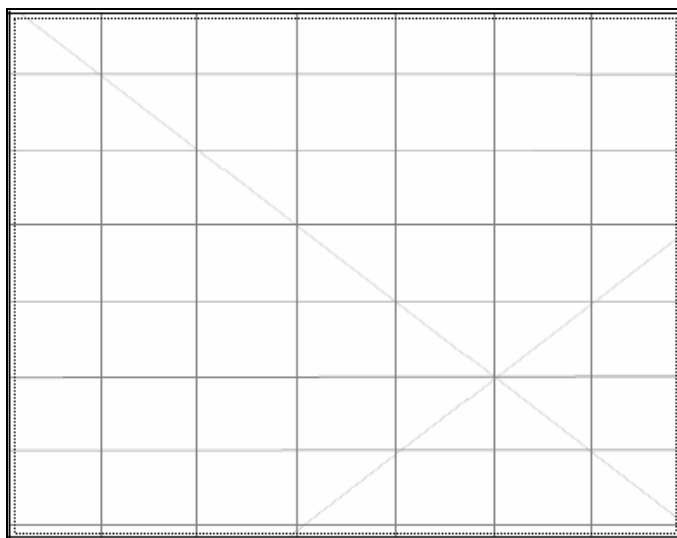
Description: RLF31



Description:



Description:



Description:

## Site restrictions

Do you want to  
Restrict this site?: ☐

Restriction type: Gender ☐ General ☐ Location ☐

Why is this site restricted?:

## Further information contact

Title  Surname  First name

Organisation:

Address:

Phone:  E-mail:

# Aboriginal Site Recording Form

AHIMS Registrar  
PO Box 1967, Hurstville 2220 NSW

AHIMS site ID: 33-4-0028

Date recorded: 10-06-2019

## Site Location Information

Site name: Ivanhoe Rail Load Facility 32 (RLF32)

Easting: 243246 Northing: 6355220 Coordinates must be in GDA (MGA)

Horizontal Accuracy (m): 5

Zone: 55 Location method: Non-Differential GPS

## Recorder Information

(The person responsible for the completion and submission of this form)

Title Surname First name  
Dr. Cupper Matt

Organisation: Landskape

Address: 178 Midgen Flat Road Broken Head 2481

Phone: 0408006690 E-mail: landskape@telstra.com

## Site Context Information

Land Form Pattern: Undulating Plain Land Use: Farming Low Intensity

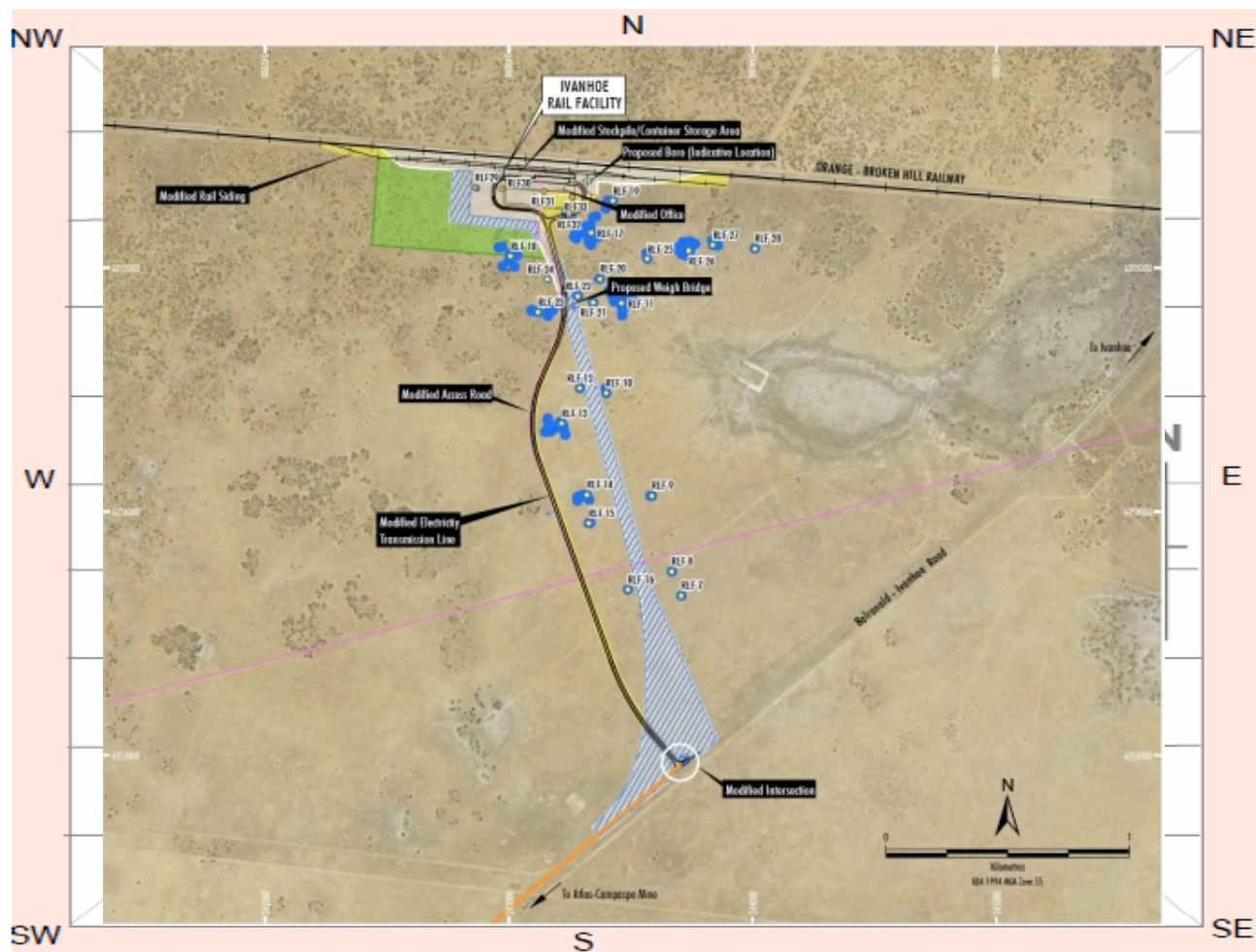
Land Form Unit: Plain Vegetation: Isolated clumps of trees

Distance to Water (m): 2000 Primary Report: Cupper, M. (2019). Atlas Campaspe Heritage Assessment.

How to get to the site: Site is located approximately 1 km north of Balranald Road and west of railway line.

Other site information:

## Site location map



## Site contents information

open/closed site:

<b>Site condition:</b>	Erosion
------------------------	---------

### Features:

1. Artefact

Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
--------------------	---------------------------------	---------------------------------

3

10

10

## Scarred Trees

Scar Depth Regrowth (cm)	Scar shape	Tree Species
0.0	0.0	0.0
0.1	0.1	0.1
0.2	0.2	0.2
0.3	0.3	0.3
0.4	0.4	0.4
0.5	0.5	0.5
0.6	0.6	0.6
0.7	0.7	0.7
0.8	0.8	0.8
0.9	0.9	0.9
1.0	1.0	1.0
1.1	1.1	1.1
1.2	1.2	1.2
1.3	1.3	1.3
1.4	1.4	1.4
1.5	1.5	1.5
1.6	1.6	1.6
1.7	1.7	1.7
1.8	1.8	1.8
1.9	1.9	1.9
2.0	2.0	2.0
2.1	2.1	2.1
2.2	2.2	2.2
2.3	2.3	2.3
2.4	2.4	2.4
2.5	2.5	2.5
2.6	2.6	2.6
2.7	2.7	2.7
2.8	2.8	2.8
2.9	2.9	2.9
3.0	3.0	3.0
3.1	3.1	3.1
3.2	3.2	3.2
3.3	3.3	3.3
3.4	3.4	3.4
3.5	3.5	3.5
3.6	3.6	3.6
3.7	3.7	3.7
3.8	3.8	3.8
3.9	3.9	3.9
4.0	4.0	4.0
4.1	4.1	4.1
4.2	4.2	4.2
4.3	4.3	4.3
4.4	4.4	4.4
4.5	4.5	4.5
4.6	4.6	4.6
4.7	4.7	4.7
4.8	4.8	4.8
4.9	4.9	4.9
5.0	5.0	5.0
5.1	5.1	5.1
5.2	5.2	5.2
5.3	5.3	5.3
5.4	5.4	5.4
5.5	5.5	5.5
5.6	5.6	5.6
5.7	5.7	5.7
5.8	5.8	5.8
5.9	5.9	5.9
6.0	6.0	6.0
6.1	6.1	6.1
6.2	6.2	6.2
6.3	6.3	6.3
6.4	6.4	6.4
6.5	6.5	6.5
6.6	6.6	6.6
6.7	6.7	6.7
6.8	6.8	6.8
6.9	6.9	6.9
7.0	7.0	7.0
7.1	7.1	7.1
7.2	7.2	7.2
7.3	7.3	7.3
7.4	7.4	7.4
7.5	7.5	7.5
7.6	7.6	7.6
7.7	7.7	7.7
7.8	7.8	7.8
7.9	7.9	7.9
8.0	8.0	8.0
8.1	8.1	8.1
8.2	8.2	8.2
8.3	8.3	8.3
8.4	8.4	8.4
8.5	8.5	8.5
8.6	8.6	8.6
8.7	8.7	8.7
8.8	8.8	8.8
8.9	8.9	8.9
9.0	9.0	9.0
9.1	9.1	9.1
9.2	9.2	9.2
9.3	9.3	9.3
9.4	9.4	9.4
9.5	9.5	9.5
9.6	9.6	9.6
9.7	9.7	9.7
9.8	9.8	9.8
9.9	9.9	9.9
10.0	10.0	10.0

--	--	--	--

Description:

3 silcrete angular fragments.

### Features:

2.

Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
--------------------	---------------------------------	---------------------------------

7

7

7

## Scarred Trees

Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
0.5	1.5	1	1
0.5	1.5	1	2
0.5	1.5	1	3
0.5	1.5	1	4
0.5	1.5	1	5
0.5	1.5	1	6
0.5	1.5	1	7
0.5	1.5	1	8
0.5	1.5	1	9
0.5	1.5	1	10
0.5	1.5	1	11
0.5	1.5	1	12
0.5	1.5	1	13
0.5	1.5	1	14
0.5	1.5	1	15
0.5	1.5	1	16
0.5	1.5	1	17
0.5	1.5	1	18
0.5	1.5	1	19
0.5	1.5	1	20
0.5	1.5	1	21
0.5	1.5	1	22
0.5	1.5	1	23
0.5	1.5	1	24
0.5	1.5	1	25
0.5	1.5	1	26
0.5	1.5	1	27
0.5	1.5	1	28
0.5	1.5	1	29
0.5	1.5	1	30
0.5	1.5	1	31
0.5	1.5	1	32
0.5	1.5	1	33
0.5	1.5	1	34
0.5	1.5	1	35
0.5	1.5	1	36
0.5	1.5	1	37
0.5	1.5	1	38
0.5	1.5	1	39
0.5	1.5	1	40
0.5	1.5	1	41
0.5	1.5	1	42
0.5	1.5	1	43
0.5	1.5	1	44
0.5	1.5	1	45
0.5	1.5	1	46
0.5	1.5	1	47
0.5	1.5	1	48
0.5	1.5	1	49
0.5	1.5	1	50
0.5	1.5	1	51
0.5	1.5	1	52
0.5	1.5	1	53
0.5	1.5	1	54
0.5	1.5	1	55
0.5	1.5	1	56
0.5	1.5	1	57
0.5	1.5	1	58
0.5	1.5	1	59
0.5	1.5	1	60
0.5	1.5	1	61
0.5	1.5	1	62
0.5	1.5	1	63
0.5	1.5	1	64
0.5	1.5	1	65
0.5	1.5	1	66
0.5	1.5	1	67
0.5	1.5	1	68
0.5	1.5	1	69
0.5	1.5	1	70
0.5	1.5	1	71
0.5	1.5	1	72
0.5	1.5	1	73
0.5	1.5	1	74
0.5	1.5	1	75
0.5	1.5	1	76
0.5	1.5	1	77
0.5	1.5	1	78
0.5	1.5	1	79
0.5	1.5	1	80
0.5	1.5	1	81
0.5	1.5	1	82
0.5	1.5	1	83
0.5	1.5	1	84
0.5	1.5	1	85
0.5	1.5	1	86
0.5	1.5	1	87
0.5	1.5	1	88
0.5	1.5	1	89
0.5	1.5	1	90
0.5	1.5	1	91
0.5	1.5	1	92
0.5	1.5	1	93
0.5	1.5	1	94
0.5	1.5	1	95
0.5	1.5	1	96
0.5	1.5	1	97
0.5	1.5	1	98
0.5	1.5	1	99
0.5	1.5	1	100

--	--	--	--

Description:

### Features:

	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
3. <input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Description:

### Scarred Trees

Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

### Features:

	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
4. <input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Description:

### Scarred Trees

Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

### Features:

	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
5. <input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

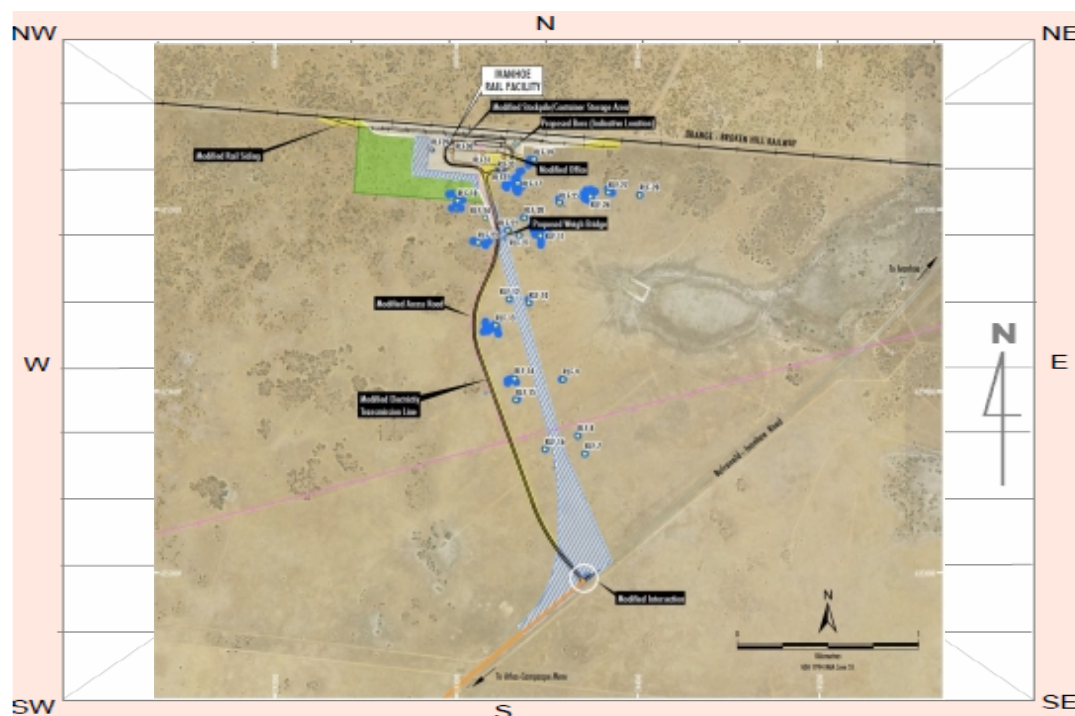
Description:

### Scarred Trees

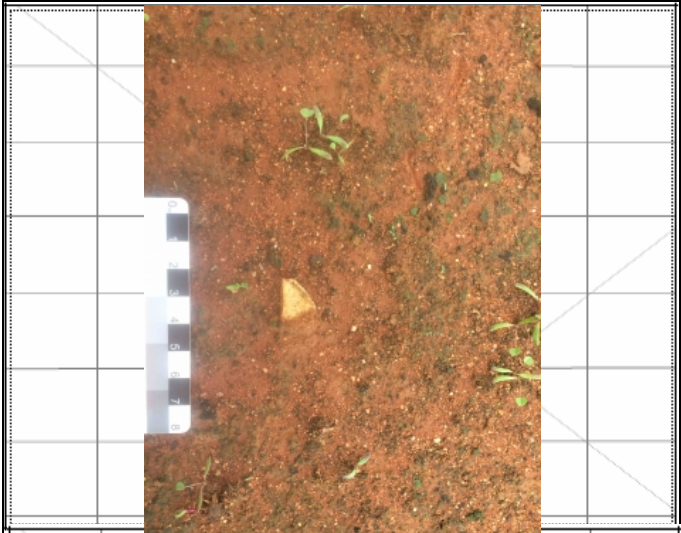
Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Other Site Info:

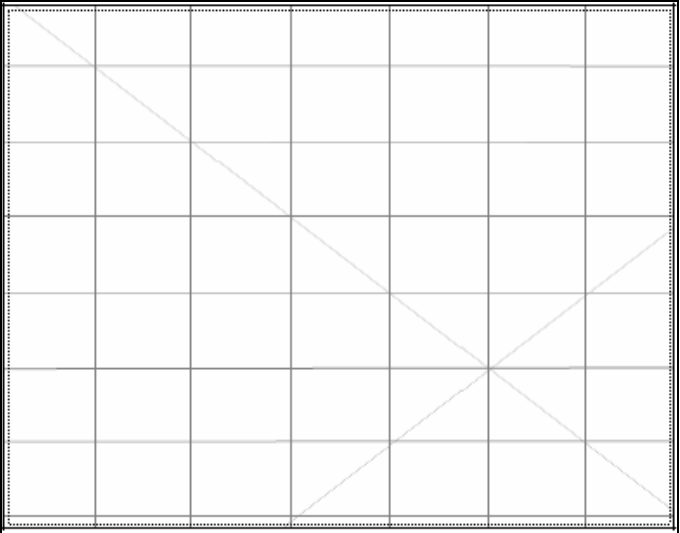
## Site plan



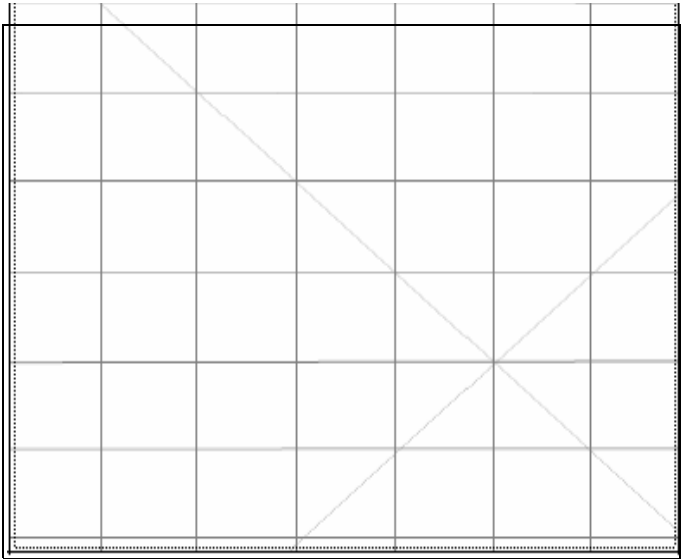
Site photographs



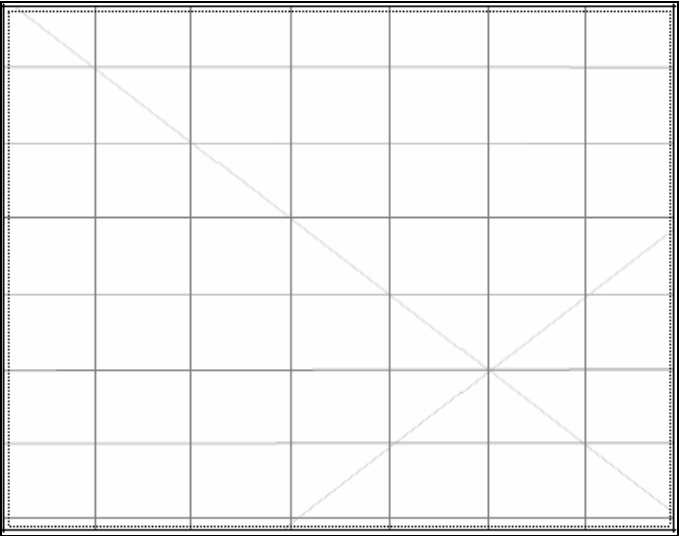
Description: RLF32



Description:



Description:



Description:

Site restrictions

Do you want to Restrict this site?: ☐ Restriction type: Gender ☐ General ☐ Location ☐

Why is this site restricted?:

Further information contact

Title  Surname  First name

Organisation:

Address:

Phone:  E-mail:

# Aboriginal Site Recording Form

AHIMS Registrar  
PO Box 1967, Hurstville 2220 NSW

AHIMS site ID: 33-4-0027

Date recorded: 10-06-2019

## Site Location Information

Site name: Ivanhoe Rail Load Facility 33 (RLF33)

Easting: 243260 Northing: 6355292 Coordinates must be in GDA (MGA)

Horizontal Accuracy (m): 5

Zone: 55 Location method: Non-Differential GPS

## Recorder Information

(The person responsible for the completion and submission of this form)

Title Surname First name  
Dr. Cupper Matt

Organisation: Landskape

Address: 178 Midgen Flat Road Broken Head 2481

Phone: 0408006690 E-mail: landskape@telstra.com

## Site Context Information

Land Form Pattern: Undulating Plain Land Use: Farming Low Intensity

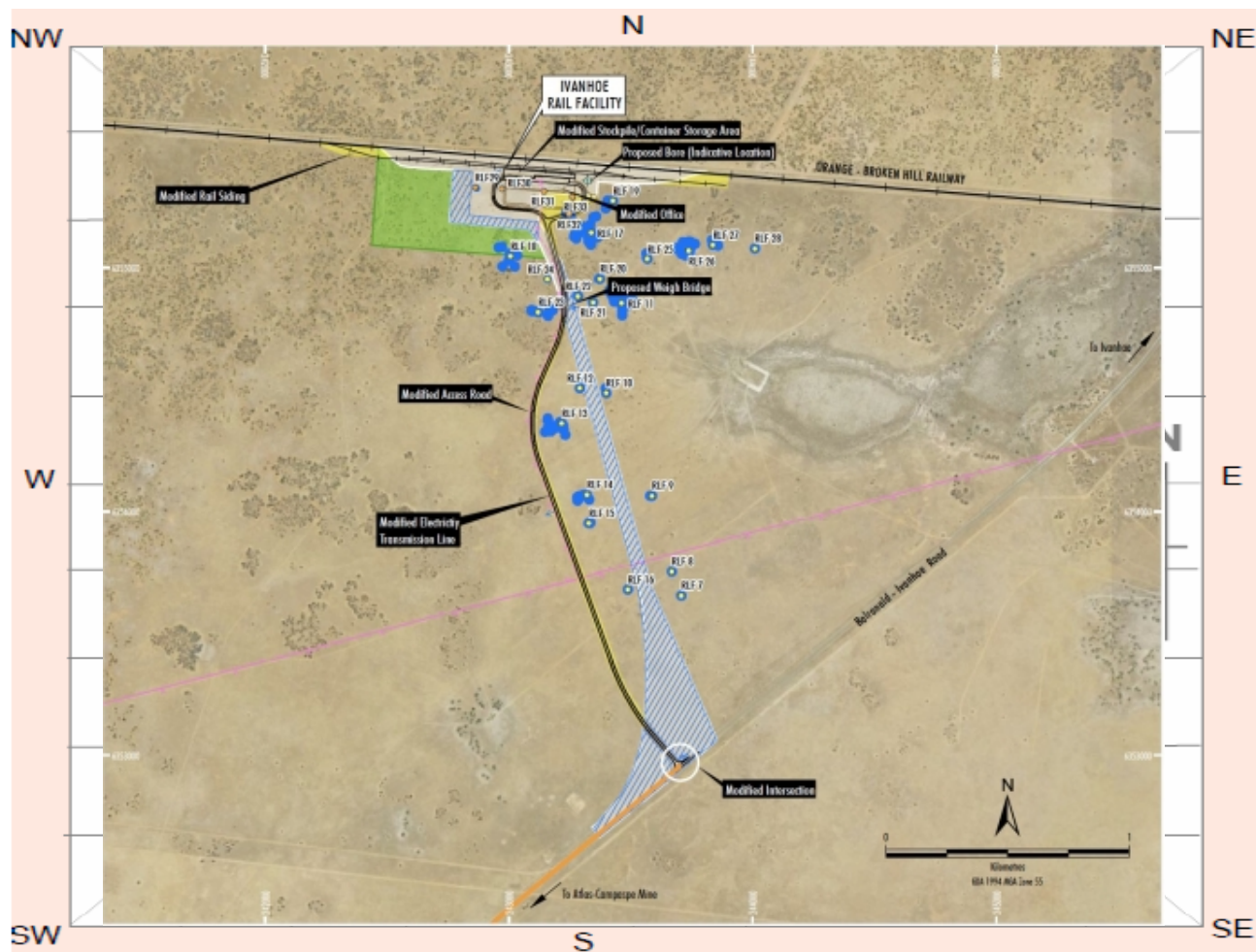
Land Form Unit: Plain Vegetation: Isolated clumps of trees

Distance to Water (m): 2000 Primary Report: Cupper, M. (2019). Atlas Campaspe Heritage Assessment.

How to get to the site: Site is located approximately 1 km north of Balranald Road and west of railway line.

Other site information:

## Site location map



## Site contents information

open/closed site:

Site condition:

### Features:

Features:	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
1. <input type="text" value="Artefact"/>	<input type="text" value="1"/>	<input type="text" value="1"/>	<input type="text" value="1"/>

### Description:

1 silcrete angular fragment.

### Scarred Trees

Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

### Features:

Features:	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
2. <input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

### Description:

### Scarred Trees

Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

### Features:

	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
3. <input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Description:

### Scarred Trees

Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

### Features:

	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
4. <input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Description:

### Scarred Trees

Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

### Features:

	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
5. <input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

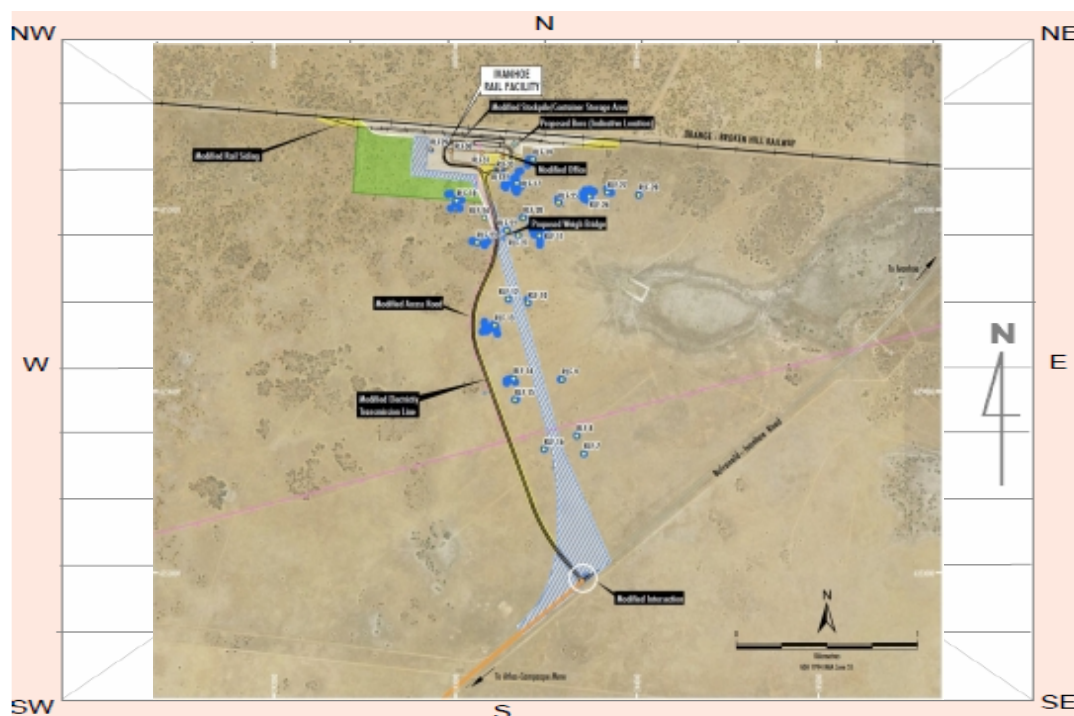
Description:

### Scarred Trees

Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Other Site Info:

## Site plan

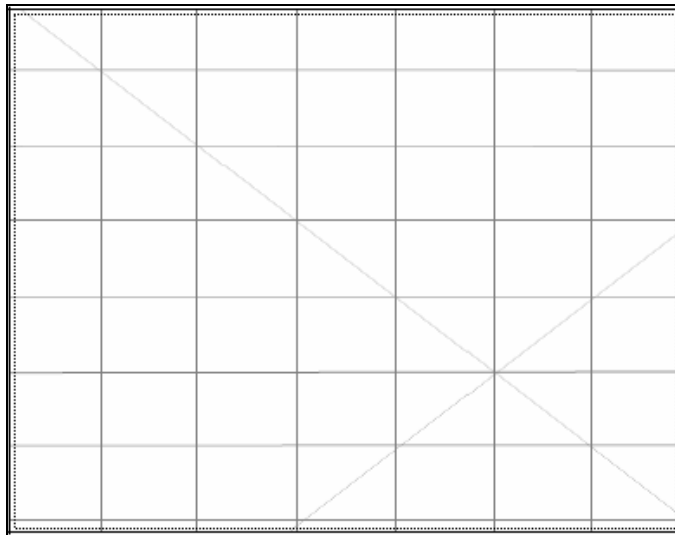


## Site photographs

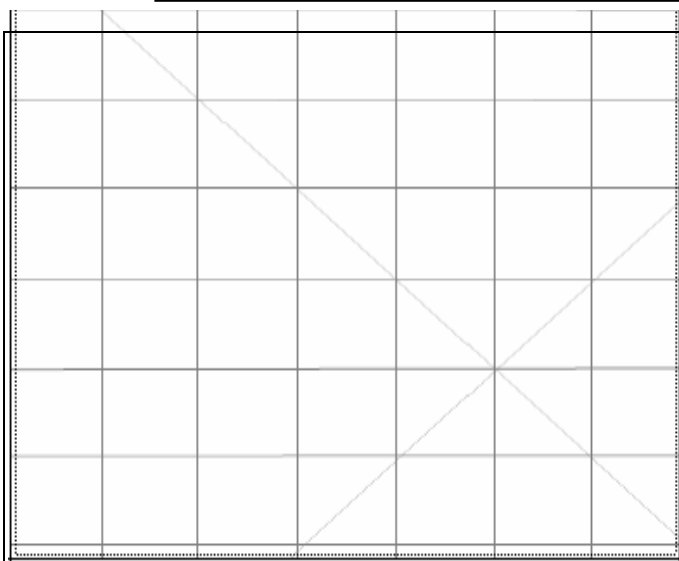


Description:

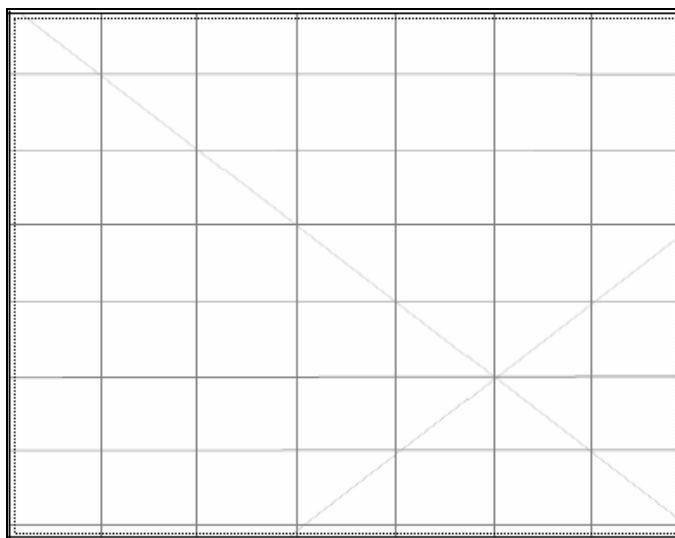
RLF33



Description:



Description:



Description:

## Site restrictions

Do you want to  
Restrict this site?:

☐

Restriction type:

Gender

☐

General

☐

Location

☐

Why is this site restricted?:

## Further information contact

Title

Surname

First name

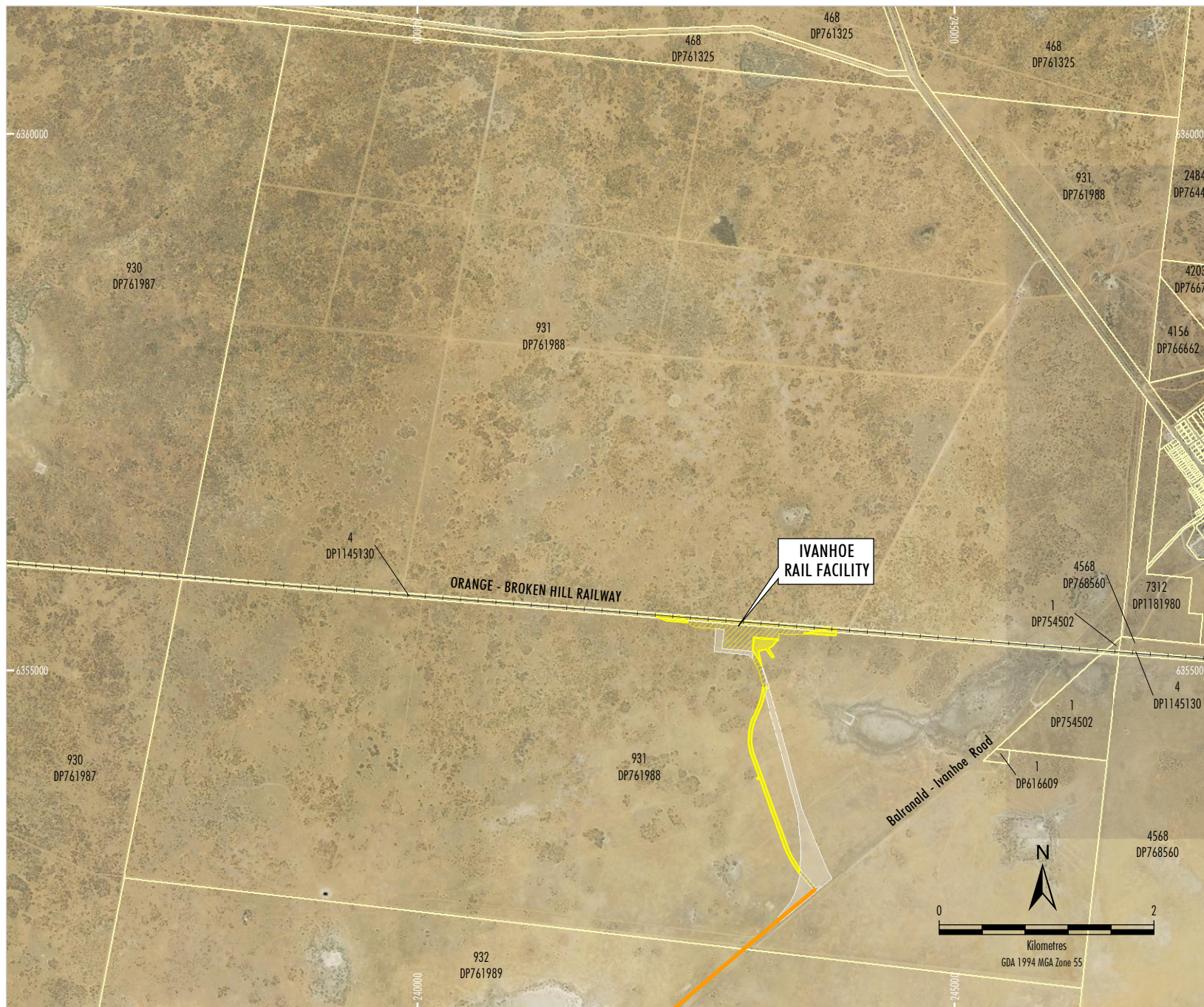
Organisation:

Address:

Phone:

E-mail:

## **APPENDIX 7: CADASTRE INFORMATION**



**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) and Landscape (2019)  
 Orthophoto: © NSW Department of Finance, Services & Innovation (2017)

**TRONOX**   
 OPTIMISATION MODIFICATION  
 Cadastral Information

**Figure A7-1**

## APPENDIX F

### GROUNDWATER REVIEW



# ATLAS-CAMPASPE MINERAL SANDS PROJECT OPTIMISATION MODIFICATION

## APPENDIX F

### GROUNDWATER REVIEW

TRONOX MINING AUSTRALIA LIMITED  
ATLAS-CAMPASPE MINERAL SANDS PROJECT  
OPTIMISATION MODIFICATION  
GROUNDWATER REVIEW

## TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1 INTRODUCTION	1
1.1 OVERVIEW OF THE MODIFICATION	1
1.2 IVANHOE RAIL FACILITY GROUNDWATER SUPPLY BORE	4
2 HYDROGEOLOGICAL SETTING	6
2.1 TOPOGRAPHY AND DRAINAGE	6
2.2 RAINFALL AND EVAPORATION	7
2.3 LAND USE	7
2.4 STRATIGRAPHY AND LITHOLOGY	7
2.5 LICENSING	8
2.6 GROUNDWATER BORE CENSUS	11
2.7 GROUNDWATER DEPENDENT ECOSYSTEMS	11
2.8 BASELINE GROUNDWATER LEVEL DATA	12
2.9 BASELINE GROUNDWATER CHEMISTRY DATA	13
2.10 RAINFALL RECHARGE	13
2.11 HYDROGEOLOGICAL PARAMETERS	14
3 GROUNDWATER MODEL	15
3.1 GROUNDWATER MODEL CONCEPTUALISATION	15
3.2 MODEL SOFTWARE AND COMPLEXITY	15
3.3 IVANHOE RAIL FACILITY WATERSUPPLY BORE SCENARIO	16
3.4 PARAMETERS ADOPTED	16
3.5 MODEL RESULTS	16
4 ASSESSMENT OF POTENTIAL IMPACTS	18
4.1 AQUIFER DRAWDOWN	18
4.2 GROUNDWATER USERS	18
4.3 GROUNDWATER QUALITY	18
4.4 GROUNDWATER DEPENDENT ECOSYSTEMS	18
4.5 CUMULATIVE IMPACTS	18
4.6 CONSIDERATION OF THE AQUIFER INTERFERENCE POLICY	18
4.7 CONSIDERATION OF THE WATER SHARING PLAN FOR THE LOWER LACHLAN GROUNDWATER SOURCE 2003	21
4.8 CONSIDERATION OF THE DRAFT WATER SHARING PLAN FOR THE LACHLAN ALLUVIAL GROUNDWATER SOURCES 2019	23
5 RECOMMENDED MANAGEMENT AND MONITORING PROGRAMME	26
5.1 GROUNDWATER MANAGEMENT PLAN	26
5.2 MONITORING	26
5.3 COMPENSATORY WATER SUPPLY	26
5.4 GROUNDWATER MODEL VALIDATION AND REVIEW	27
5.5 GROUNDWATER LICENSING	27

6	GROUNDWATER MODEL LIMITATIONS	28
7	CONCLUSIONS	29
8	BIBLIOGRAPHY	31

## LIST OF FIGURES

Figure 1	Regional Location
Figure 2	Modified Ivanhoe Rail Facility General Arrangement
Figure 3	Ivanhoe Rail Facility Bore Census Results
Figure 4	GW036919 Groundwater Level Records

## LIST OF TABLES

Table 1	GW036919 Geological Record
Table 2	Hydrogeological Parameters
Table 3	Modelled Groundwater Drawdown After 20 Years at Radial Distances
Table 4	Less Productive Alluvial Aquifer – Minimal Impact Considerations
Table 5	Management of Local Impact Considerations
Table 6	Rules for Water Supply Work Approvals

## LIST OF ATTACHMENTS

Attachment A	Ivanhoe Rail Facility Bore Census
Attachment B	AQTESOLV Predictive Analyses

## 1 INTRODUCTION

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Cristal Mining Australia Limited, which will be renamed Tronox Mining Australia Limited (Tronox) on 25 July 2019. Development Consent (SSD\_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* in 2014.

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, NSW and 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 to the south-west of the township of Ivanhoe (Figure 1).

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 existing Broken Hill Mineral Separation Plant (the MSP) (Figure 1).

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

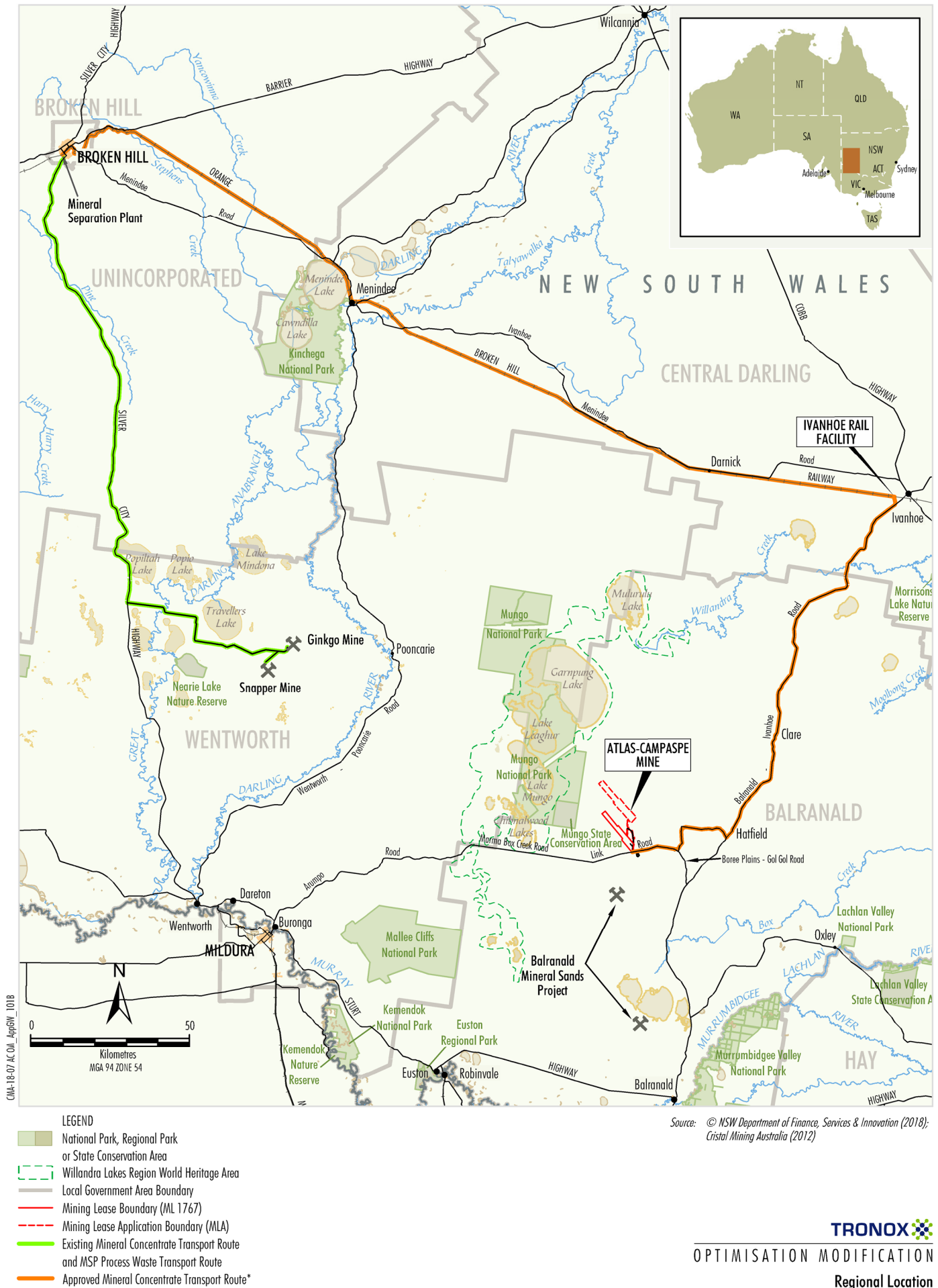
- The MSP – located in Broken Hill approximately 270 km north-west of the Atlas-Campaspe Mine
- Snapper Mine – located approximately 105 km to the west of the Atlas-Campaspe Mine
- Ginkgo Mine – located approximately 100 km to the west of the Atlas-Campaspe Mine.

This Groundwater Review has been prepared to support the application to modify Development Consent (SSD\_5012) for the Project.

### 1.1 OVERVIEW OF THE MODIFICATION

Tronox proposes to modify Development Consent (SSD\_5012) for the Project to allow for changes to optimise the Project (herein referred to the Optimisation Modification or Modification). The Modification 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;



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

Figure 1

- 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]);
- Increased MSP process waste disposal from 50,000 tonnes per annum (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.

There would be no change to the following key components of the approved Project due to the Modification:

- 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.

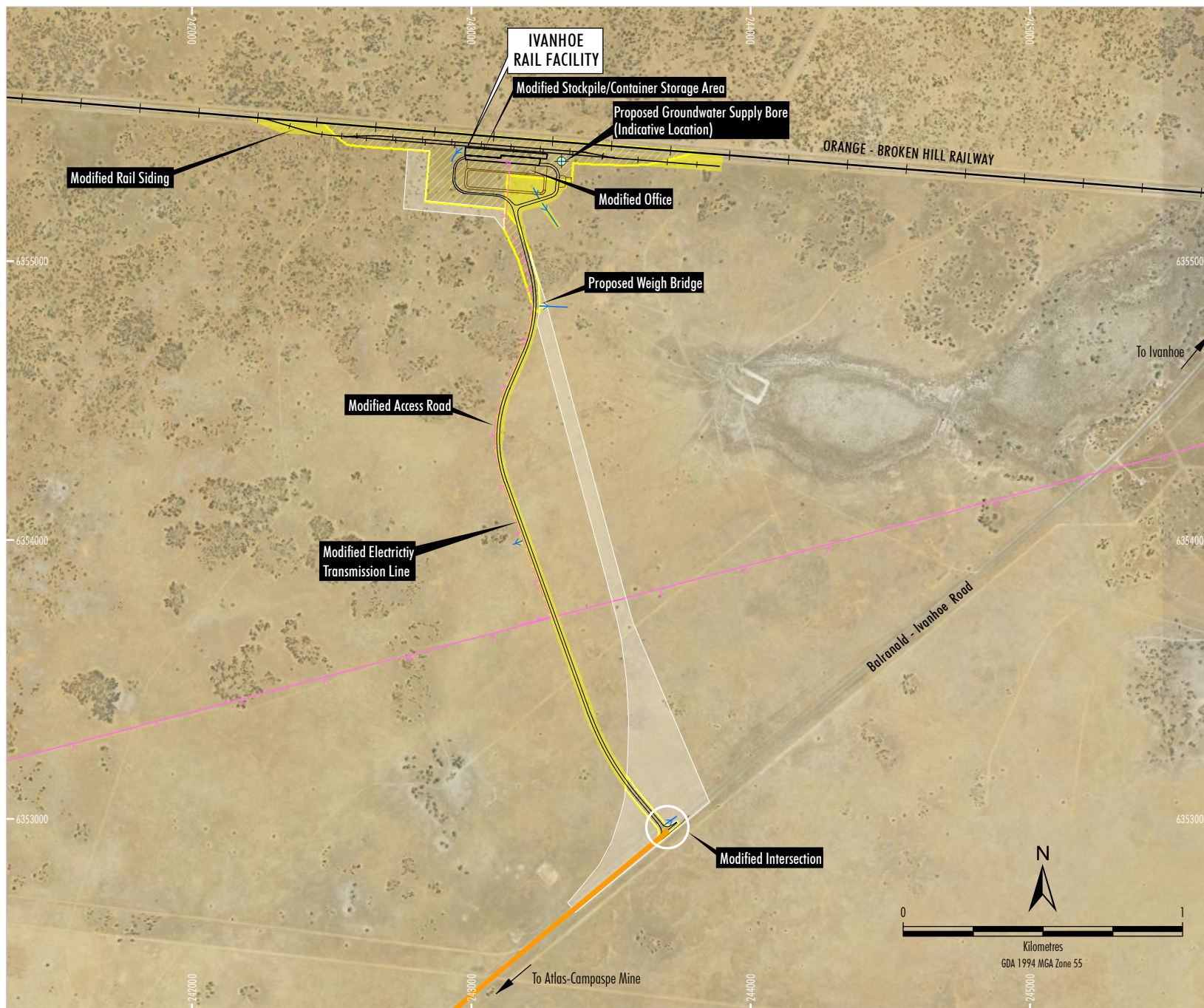
A detailed description of the Modification is provided in the main text of the Modification Report.

As the Modification would not have a significant change to the potential groundwater impacts at the Atlas-Campaspe Mine, this Groundwater Review focusses on the potential groundwater impacts associated with the proposed Ivanhoe Rail Facility groundwater supply bore.

## **1.2 IVANHOE RAIL FACILITY GROUNDWATER SUPPLY BORE**

The Modification includes the installation of a groundwater supply bore at the Ivanhoe Rail Facility (Figure 2). The water would be utilised at the Ivanhoe Rail Facility for wash down purposes and dust suppression on the access road and mineral concentrate stockpiles.

The groundwater supply bore would provide up to approximately 60 million litres per year (ML/yr) (1.9 litres per second [L/s]) over the Project life. The bore would be designed to provide a peak demand of up to about 5 L/s.



- 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 2**

## 2 HYDROGEOLOGICAL SETTING

A description of the hydrogeological setting at the Ivanhoe Rail Facility is provided in this section based on the following sources:

- Murray Basin Hydrogeological Map Series.<sup>1</sup>
- Lachlan Fan/Ivanhoe Block Steady State Groundwater Model.<sup>2</sup>
- Lower Lachlan Groundwater Model.<sup>3</sup>
- NSW Government PINNEENA Groundwater Database.<sup>4</sup>
- Bureau of Meteorology (BOM) Australian Groundwater Explorer.<sup>5</sup>
- Bore census of local groundwater use (Attachment A).<sup>6</sup>
- Regional topographic data.
- Anecdotal information from local drilling contractor.

The Lower Lachlan Groundwater Model provides the most recent hydrogeological assessment of the area, and calibrated parameters from this model have been used as the primary source for the groundwater assessment.

### 2.1 TOPOGRAPHY AND DRAINAGE

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<sup>7</sup>. Flows into Willandra Creek are primarily controlled by Willandra Weir on the Lachlan River, and like most unregulated streams in western NSW experience long periods of no flow interspersed with rare flows of varying magnitude.

There are no permanent surface water bodies in the Ivanhoe area.

- 
1. Australian Geological Survey Organisation (AGSO) and Bureau of Mineral Resources, Geology and Geophysics (BMR) (1991-1994) Murray Basin Hydrogeological Map Series 1:250,000 *Map Sheets, Mildura, Balranald, Pooncarie, Manara, Hay and Booligal*
  2. Kellet, J. R. (1997) *Lachlan Fan / Ivanhoe Block Steady State Groundwater Model*. Australian Geological Survey Organization, Canberra.
  3. Mampitiya, D. (2010) *Lower Lachlan Groundwater Model*. NSW Office of Water, April 2010.
  4. NWS Department of Industry (2014) PINNEENA 10.1,
  5. <[www.bom.gov.au/water/groundwater/explorer/](http://www.bom.gov.au/water/groundwater/explorer/)>
  6. Tronox (2019) *Ivanhoe Rail Facility Bore Census*.
  7. Green, D., Petrovic, J., Moss, P., And Burrell, M. (2011) *Water resources and management overview – Lachlan catchment*. NSW Office of Water, Sydney.

The Ivanhoe Rail Facility area is relatively flat lying and sparsely vegetated, characterised by stabilised sand dunes and Native Grassland/Sparse Acacia/Chenopod Shrubs and Belah-Rosewood/Acacia Woodland vegetation communities (Australian Museum Business Services, 2013). The landform at the Ivanhoe Rail Facility is flat at approximately 100 metres Australian Height Datum (m AHD).

## 2.2 RAINFALL AND EVAPORATION

The climate in the Ivanhoe area is semi-arid with low and sporadic rainfall and high evaporation. Annual rainfall at Ivanhoe is both low (average 306 millimetres [mm]) as well as highly variable (minimum 69 mm and maximum 880 mm).<sup>8</sup>

Average areal actual evapotranspiration has been estimated by the BOM to be about 300 millimetres per year (mm/year) for data obtained from 1961 to 1990.<sup>9</sup> The average areal potential evaporation is estimated by the BOM to be about 1,200 mm/yr, and the average point potential evapotranspiration is indicated to be about 2,100 mm/yr.

The thin surficial Quaternary sediments (Section 2.4) are quite variable in terms of infiltration potential including both clayey and sandy layers. The Shepparton Formation tends to be clayey, reducing the potential for infiltration, while the Calivil Sands include a mixture of sand and clay.

## 2.3 LAND USE

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. The township of Ivanhoe is located approximately 4.5 km to the north-east of the Ivanhoe Rail Facility.

## 2.4 STRATIGRAPHY AND LITHOLOGY

The stratigraphy of the Ivanhoe area is described below in descending order.<sup>10</sup>

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

8. BOM Climate Data Online. Ivanhoe Post Office Station 049019. 1884—2016. <  
[http://www.bom.gov.au/climate/averages/tables/cw\\_049019.shtml](http://www.bom.gov.au/climate/averages/tables/cw_049019.shtml)>

9. BOM *Average Annual and Monthly Evapotranspiration*.  
Website: <[http://www.bom.gov.au/jsp/ncc/climate\\_averages/evapotranspiration/index.jsp?maptype=1&period=an](http://www.bom.gov.au/jsp/ncc/climate_averages/evapotranspiration/index.jsp?maptype=1&period=an)>

10. Brown, C.M. and Stephenson, A.E. (1991). *Geology of the Murray Basin, Southeastern Australia*. Bureau of Mineral Resources, Australia. Bulletin 235.

- The Tertiary Renmark Group (Ter) comprises sands and clays and is a significant aquifer in the region.
- The Cretaceous Monash Formation (Kl) includes sands, sandstone, siltstone and shale, with minor coal.
- The Devonian basement rock includes sandstones and metasediments.

At the Ivanhoe Rail Facility site, potential groundwater targets include sand zones within the Calivil Formation and Renmark Group and possibly in the deeper Monash Formation.

The geological log for NSW Government monitoring bore GW036919, located approximately 4.4 km to the north-east of the proposed Ivanhoe Rail Facility groundwater supply bore (Figure 3) is reproduced in Table 1.

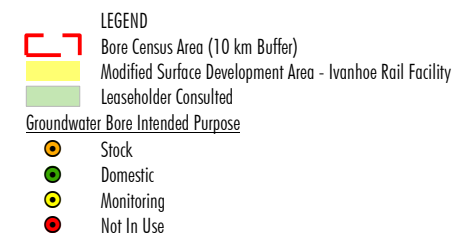
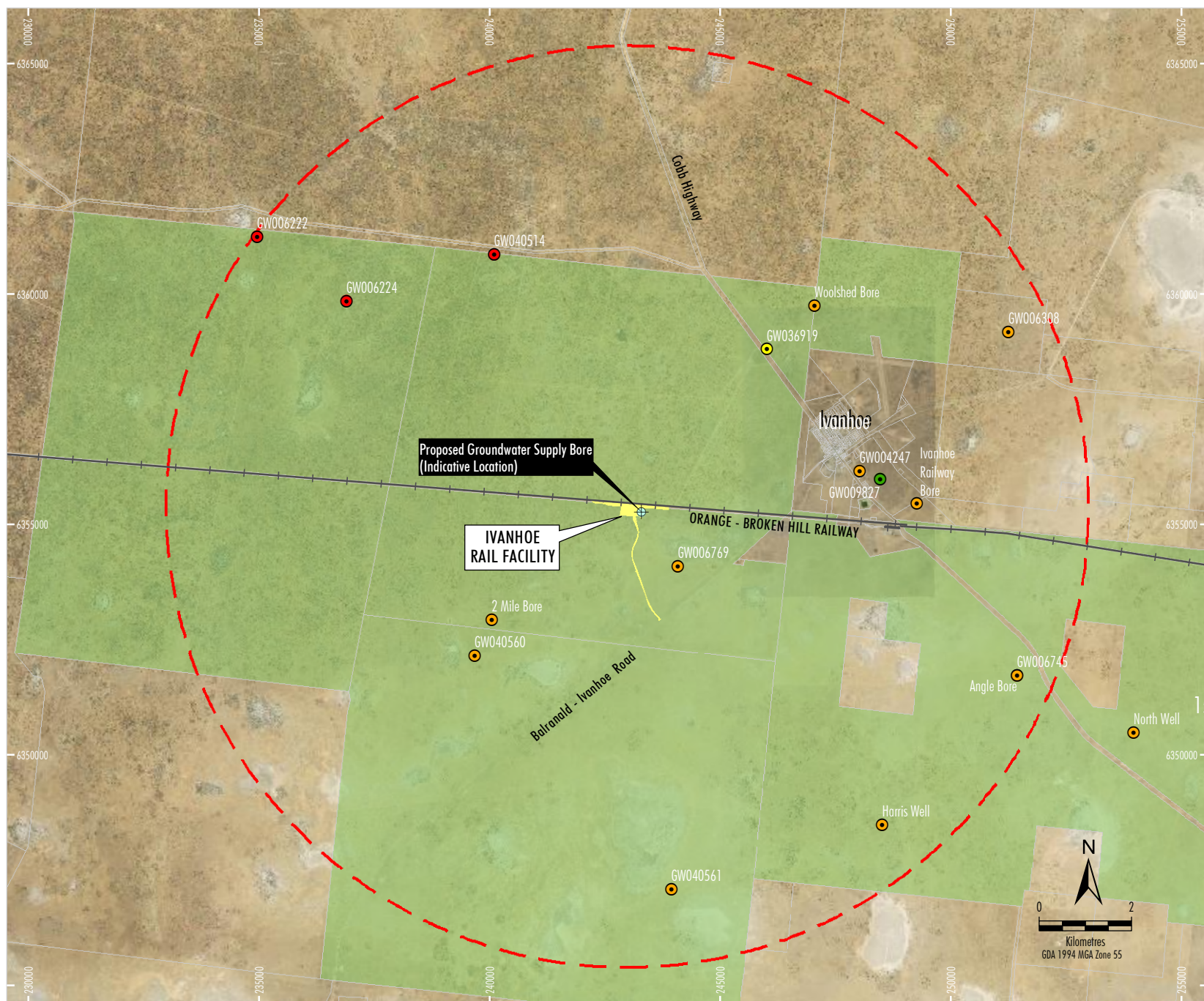
Based on the drilling log for GW036919, it is expected that reasonable water yields could be obtained at a depth of about 50 m to 70 m. The Lower Lachlan Groundwater model indicates the Renmark Group Aquifer is between about 38 m and 84 m depth. The Renmark Group Aquifer is the target aquifer for the proposed Ivanhoe Rail Facility groundwater supply bore.

## 2.5 LICENSING

The Ivanhoe Rail Facility is located within the Lower Lachlan Alluvium Groundwater Source (GS30) as defined in the *Water Sharing Plan for the Lower Lachlan Groundwater Source 2003* under the NSW *Water Management Act, 2000*. It is noted that the draft *Water Sharing Plan for the Lachlan Alluvial Groundwater Sources 2019* has been published on the NSW Department of Industry website and is scheduled to commence on 1 July 2019. The Ivanhoe Rail Facility remains in the Lower Lachlan Alluvium Groundwater Source under the draft *Water Sharing Plan for the Lachlan Alluvial Groundwater Sources 2019*.

The long-term annual extraction limit stipulated in the *Water Sharing Plan for the Lower Lachlan Groundwater Source 2003* for the Lower Lachlan Alluvium Groundwater Source, in addition to basic landholder rights, is 108,000 ML/yr and is fully allocated. The majority of water use in the Lower Lachlan Alluvium Groundwater Source is along the Lachlan River, and in the eastern portion of the catchment, where water quality is good.

Tronox has obtained a total of 100 share components (units or million litres) in the Lower Lachlan Alluvium Groundwater Source for the Ivanhoe Rail Facility. In accordance with Condition 24, Schedule 3 of Development Consent (SSD\_5012), Tronox will hold sufficient water entitlements under the NSW *Water Management Act, 2000* for all stages of the Project.



Source: © NSW Department of Finance, Services & Innovation (2019), WaterNSW (2019).  
 Orthophoto: © NSW Department of Finance, Services & Innovation (2019)

**TRONOX**  
 OPTIMISATION MODIFICATION  
 Ivanhoe Rail Facility Bore Census Results

**Figure 3**

Table 1. GW036919 Geological Record.

Depth (m)		Lithology
From	To	
0	3	Sandy clay; red-brown, grading to clayey sand with nodular calcrete
3	5.5	Silcrete/ferricrete; massive, red-brown, yellow-brown and pale grey, very hard drilling
5.5	16	Sandstone; coarse, soft, white-grey, sub-rounded, moderately sorted, quartz, with some thin hard silcrete bands
16	21	Sandstone; coarse, soft, white, slightly clayey, sub-rounded, poorly sorted, quartz, with white pigmentation due to kaolinitic matrix and grain coatings
21	23	Sandstone; banded white and pale pink-grey, soft, clayey, coarse, (with quartz, sub-angular, poorly sorted, 10% opaque and frosted grains) and minor white kaolinitic bands
23	26	Clay & sand; interbedded, clay, kaolinitic, white, and sand, weakly cemented, medium to coarse, quartz, sub-rounded, poorly sorted, with some pink-grey sand beds and pink pigmentation, possibly due to chamosite grain coatings
26	31	Sand & sandy clay; sand, medium, clayey, white-grey, with bands of sandy clay, white, kaolinitic, with minor pink-grey fine sand grains in 29-31m
31	32	Sandy clay & clayey sand; interbedded, sandy clay, pink-grey and pale grey, and clayey sand, fine
32	33	Silty clay; yellow-brown, with thin dark grey-brown clay bands and some pale grey fine sand beds
33	35	Sandy clay; grey, with some yellow-brown, weakly ferruginised clayey, fine sand bands
35	37	Clay; mottled, pale grey and yellow-brown, with a trace of fine sand bands
37	39	Sand; fine, clayey, yellow-grey
39	41	Silty clay & clayey sand; interbedded, silty clay, pale grey, and clayey sand, fine, with minor yellow-grey clayey fine sand bands
41	42	Sandy clay; dark grey
42	43	Sandy clay; pale brown-grey, with fine to medium sand, in bands
43	44	Sandy clay; mottled, pale grey and yellow-brown, with fine sand bands
44	45	Clay; dark grey with minor bronze, possibly pyritic fine sand bands
45	47	Silty clay; pale grey, with yellow-brown fine sand bands
47	49	Sandy clay; plastic, slightly carbonaceous, dark grey
49	51	Silty clay; pale grey, with fine sand bands, and minor yellow-brown mottles
51	61	Sand & sandy clay; interbedded, sand, fine, yellow-grey, and sandy clay, pale grey, with a trace of thin, black, carbonaceous clay bands
61	62	Sandy clay & sand; sandy clay, mottled, pale grey and yellow-brown, and sand, in beds, medium, sub-angular to sub-rounded, poorly sorted, quartz
62	72	Sand; sand, coarse, sub-rounded, very poorly sorted, quartz, pale brown, and clay, in bands throughout, but mostly in 62-64m and 71-72m
72	91	Mudstone; pale blue-grey, very softy, with minor fine sand bands throughout and trace of brown carbonaceous clay bands
91	92	Sandstone; fine, pale grey, becoming hard
92	95	Sandstone; core, mostly massive, pale grey quartzose sandstone (quartz grains, sub-rounded to sub-angular, poorly sorted). diffuse dark grey carbonaceous zone 92.4-92.55m with the carbonaceous material appearing entirely in the matrix

Sand zones highlighted in grey.

## 2.6 GROUNDWATER BORE CENSUS

A bore census in the vicinity of the Ivanhoe Rail Facility was conducted by Tronox in April 2019 (Attachment A). The bore census covered a 10 km radial buffer around the Ivanhoe Rail Facility groundwater supply bore (or approximately 314 square kilometres) and included a review of NSW Government records and consultation with surrounding landholders.

The bore census confirmed the existence of 10 groundwater bores. The closest groundwater bore is located approximately 2 km south-east of the proposed Ivanhoe Rail Facility groundwater supply bore (Figure 3).

Of the 10 groundwater bores, seven were confirmed to be in use and three are not in use (Attachment A). The purposes of the seven groundwater bores in use included (Figure 3):

- monitoring (one bore); and
- stock (six bores).

The lack of active bores in the region is understandable given the poor quality of the groundwater (Section 2.9).

## 2.7 GROUNDWATER DEPENDENT ECOSYSTEMS

There are currently no high priority groundwater dependent ecosystems (GDEs) identified in the Lower Lachlan Alluvium Groundwater Source defined in the *Water Sharing Plan for the Lower Lachlan Groundwater Source 2003* or the draft *Water Sharing Plan for the Lachlan Alluvial Groundwater Sources 2019* under the NSW *Water Management Act, 2000* within which the Ivanhoe Rail Facility is located.

The *Groundwater Dependent Ecosystems Atlas* (BOM, 2019) identifies potential GDEs at locations of dry lake beds, which occasionally capture rainfall run-off, in the vicinity of the Ivanhoe Rail Facility as having a low potential for groundwater interaction.<sup>11</sup> As these surface features are disconnected from the groundwater table, which is located approximately 30 m below ground level, it is considered that they are not groundwater dependent.

Notwithstanding, *NSW State Groundwater Dependent Ecosystems Policy* (Department of Land and Water Conservation, 2002) recognises the four Australian GDE types (Hatton and Evans, 1998) that can be found in NSW, namely:

- Terrestrial vegetation;
- Baseflows in streams;
- Aquifer and cave ecosystems; and
- Wetlands.

11. Bureau of Meteorology, *Groundwater Dependent Ecosystems Atlas*.  
<<http://www.bom.gov.au/water/groundwater/gde/map.shtml>> accessed March 2019.

The *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (NSW Office of Water [NOW], 2012) also identifies four above ground ecosystems that are considered GDEs, as follows:

- Groundwater dependent wetlands;
- Baseflow streams (surface water ecosystems);
- Estuarine and near shore marine ecosystems; and
- Phreatophytes – groundwater dependent terrestrial ecosystems.

No GDEs are considered to be present within the locality of the proposed Ivanhoe Rail Facility groundwater supply bore.

## 2.8 BASELINE GROUNDWATER LEVEL DATA

NSW Government monitoring bore GW036919 is located about 3 km north-west of Ivanhoe and approximately 4.4 km NE of the proposed Ivanhoe Rail Facility groundwater supply bore (Figure 3). The surface level is approximately RL 89 m AHD. It is a nested pair monitoring bore and the upper bore screen is indicated to be set at 39 m to 45 m depth (about RL 44 m to RL 50 m AHD) in sandy-clay and clayey sand zone (possibly the base of the Calivil Formation). The lower bore screen is indicated to be set at about 58 m to 70 m depth (RL 19 m to RL 31 m AHD) in a section with fine to coarse sand bands (likely within the Renmark Group Aquifer).

Hydrographs for the shallow (s) and deep (d) standpipes at GW036919 are shown in Figure 4.

The water levels in the two bores are very similar, and have risen by only about 0.1 m, over 20 years since construction, indicating stable groundwater conditions (Figure 4).

It is likely that the shallow screen is poorly connected to the regional aquifer(s) as the geological log indicates the screen was placed in a sandy clay zone. This could explain the slow recovery of about 0.2 m since construction in 1995, to a relatively stable level since 2002 (Figure 4).

Since 2003 the groundwater levels in both standpipes have been fairly stable. The fluctuation in levels is very small and likely primarily due to changes in atmospheric pressure at the time of readings. The difference in level between the two standpipes is about 2 cm and may indicate a small upward gradient, or inaccuracy in measurements. There is a very small long-term trend of rising water level of about 0.1 m in the lower standpipe between 1995 and 2015 (Figure 4).

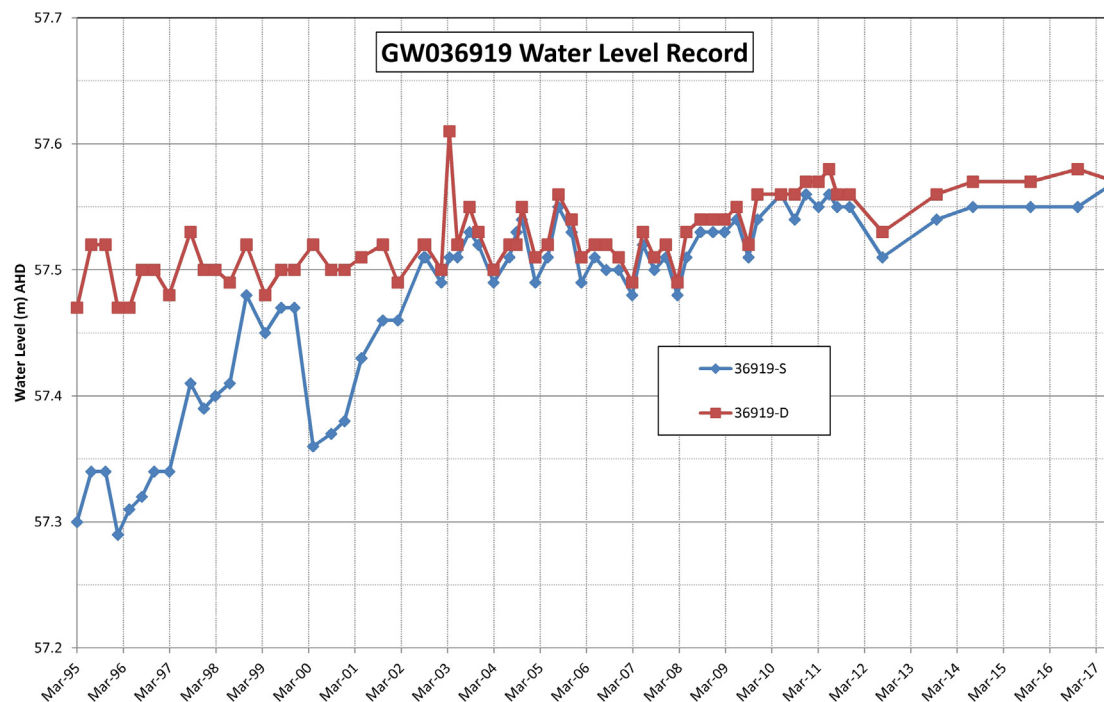


Figure 4. GW036919 Groundwater Level Records.

## 2.9 BASELINE GROUNDWATER CHEMISTRY DATA

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

This elevated salinity is consistent with the limited groundwater use in the Ivanhoe area (Section 2.6).

## 2.10 RAINFALL RECHARGE

Based on studies of chlorine input from rainfall, Kellet (1997) indicates that recharge varies from about 0.1% to 1.0% of rainfall, with the lowest infiltration over the western mallee of about 0.1 mm/year. Kellet (1997) estimated recharge across the Riverine Plain and Willandra Lakes depression to be up to 1.8 mm/year, with recharge of up to 3 mm/year along the Murray River boundary area (Kellet, 1997).

Mampitiya (2010) used a recharge rate of 1% of rainfall, which is equivalent to about 3 mm/year over the western part of the current groundwater model area, which overlaps with the Lower Lachlan Groundwater Model. Mampitiya (2010) noted that:

*“Potential evaporation exceeds annual rainfall by a ratio of nearly 5:1 in the model area. Therefore, much of the rain received in the area is likely to evaporate before significant surface ponding, infiltration and runoff. Clay rich topsoil has a very low permeability resulting in low deep drainage from rainfall. The water table in most parts of the study area is about 25 m below ground level. All of these factors indicate that the model area is generally experiencing dry conditions and relatively low rates of rainfall recharge. Monitoring bore hydrographs do not indicate any noticeable response to rainfall, not even for sporadic high intensity events.”*

## 2.11 HYDROGEOLOGICAL PARAMETERS

Hydrogeological parameters from the Lower Lachlan Groundwater Model for the proposed bore location are provided in Table 2.

Table 2. Hydrogeological Parameters.

	<b>m AHD</b>	<b>K (m/d)</b>	<b>SY%</b>	<b>Ss</b>	<b>Leakance (1/d)</b>
<b>Surface</b>	83.07				
<b>Shepparton</b>	69.97	1	7.24		1.14E-04
<b>Calivil</b>	45.06	13.4		1.00E-04	9.73E-05
<b>Renmark</b>	-1.33	15.61		1.00E-04	

Levels for base of formation.

K: Horizontal Hydraulic Conductivity

SY: Specific Yield

Ss: Specific Storage

Leakance: Measure of flow between layers.

### 3 GROUNDWATER MODEL

#### 3.1 GROUNDWATER MODEL CONCEPTUALISATION

The conceptual understanding of the regional groundwater regime is based on the Lower Lachlan Groundwater Model and a review of existing hydrogeological data (Section 2).

The Lower Lachlan Groundwater Model indicates a relatively flat regional groundwater gradient flowing to the west at about 1 vertical (V) to 4,500 horizontal (H). The groundwater table in the vicinity of the Ivanhoe Rail Facility is approximately 32 m below ground level and generally sits in the Calivil Formation. The hydrographs in Figure 4 indicate relatively stable water level conditions, which is matched by the Lower Lachlan Groundwater Model simulated water levels.

Given these hydrogeological conditions and an assumed uniform confined aquifer the pumping effect from the proposed Ivanhoe Rail Facility water supply bore would be a localised symmetric cone.

#### 3.2 MODEL SOFTWARE AND COMPLEXITY

An analytical model (axi-symmetric analytical methods for leaky confined aquifers) has been used to simulate the drawdown from the proposed Ivanhoe Rail Facility groundwater supply bore. The model type is considered appropriate given:

- The hydrogeological conditions at the Ivanhoe Rail Facility (i.e. uniform confined aquifer, with a very low regional gradient) as discussed in Section 3.1.
- The limited groundwater use in the vicinity of the Ivanhoe Rail Facility (Section 2.6).
- The expected limited drawdown associated with the proposed Ivanhoe Rail Facility groundwater supply bore.

Analysis has been carried out using AQTESOLV software (Duffield, G.M., 2007), using the Hantush solution for leaky confined aquifers.

The use of an analytical model is also consistent with the Murray-Darling Basin Commission (MDBC) Guideline. Under the MDBC Guideline, a “*simple model*” is considered appropriate to “*predict the long term drawdown due to abstractions from a proposed water supply bore*” (e.g. the proposed Ivanhoe Rail Facility groundwater supply bore). The MDBC Guideline states that the complexity of a “*simple model*” is “*basic*” and “*often uses analytical modelling approach*”.

The use of an analytical model is also consistent with Australian Groundwater Modelling (AGM) Guideline. Based on Table 2-1 (Model confidence level classification) of the AGM Guideline, as the model is required to provide predictions of *"long-term impacts of proposed developments in low-value aquifers"*, a "Class 1" model is appropriate. The AGM Guideline states that the confidence level of the "Class 1" model is low. The confidence level of the model could be considered to be low as the parameters adopted in the model are based on the Lower Lachlan Groundwater Model which has been carried out over a very large region, with minimal specific information for the Ivanhoe location. While the confidence in the model predictions could be low, the consequence of likely variance in those predictions is also low, given the low value of the aquifer and the significant distance to any receiving environment or groundwater users.

Given the above, the use of AQTESOLV software (Duffield, G.M., 2007), using the Hantush solution for leaky confined aquifers, is considered appropriate for the Ivanhoe Rail Facility groundwater supply bore.

### 3.3 IVANHOE RAIL FACILITY WATERSUPPLY BORE SCENARIO

The Modification includes the installation of a groundwater supply bore at the Ivanhoe Rail Facility (Figure 2). The groundwater supply bore would provide up to approximately 60 ML/yr (1.9 L/s) over the Project life (a 20 year period has been adopted for the model).

### 3.4 PARAMETERS ADOPTED

The following parameters for the Renmark Group Aquifer from the Lower Lachlan Groundwater Model (Section 2.10) have been adopted in the model:

- Hydraulic Conductivity (K)=15.6 m/d.
- Aquifer Thickness(B)=46 m.
- Specific Storage (Ss)=0.0001.
- Leakage from Calivil=9.7E-5 1/d.

### 3.5 MODEL RESULTS

The predicted maximum drawdown after 20 years at the Ivanhoe Rail Facility groundwater supply bore and 10 m, 20 m and 100 m from the bore is presented in Table 3.

Table 3 also includes the results of a sensitivity analysis that was carried out by varying several of the parameters by one order of magnitude. The Specific Storage (Ss) and Leakage parameters were not sensitive and were only varied towards the maximum case direction. Two values for the productive aquifer thickness (B) were considered based on the geological log for GW036919 (i.e. 11 m – Table 1) and the aquifer thickness adopted in the Lower Lachlan Groundwater Model (i.e. 46 m).

Table 3. Modelled Groundwater Drawdown After 20 Years at Radial Distances.

Scenario	K (m/d)	B (m)	T (m <sup>2</sup> /d)	Ss	Leakance (1/d)	Maximum Drawdown			
						@Bore	10m	20m	100m
1	15.6	46	724	0.0001	9.7e-5	19cm	4cm	2cm	-
2	1.56	46	72.4	0.0001	9.7e-5	190cm	40cm	20cm	-
3	15.6	11	172	0.0001	9.7e-5	80cm	17cm	9cm	-
4	1.56	11	17.2	0.0001	9.7e-5	790cm	170cm	85cm	2cm
5	1.56	11	17.2	0.0000 1	9.7e-5	790cm	170cm	85cm	2cm
6	1.56	11	17.2	0.0001	9.7e-6	790cm	170cm	85cm	2cm
7	156	11	1717	0.0001	9.7e-5	8cm	2cm	1cm	-

K: Horizontal Hydraulic Conductivity

B: Aquifer Thickness.

T: Transmissivity

Ss: Specific Storage

The results show that drawdowns are low, stabilises quickly and are not significant beyond 100 m.

Comparison was made to the pumping test results for Bore AB1 in the Calivil/Loxton-Parilla Formation at the Atlas-Campaspe Mine site, which showed a similar characteristic to the drawdown curves (at a higher flow rate).

## 4 ASSESSMENT OF POTENTIAL IMPACTS

### 4.1 AQUIFER DRAWDOWN

Extraction of groundwater from the Ivanhoe Rail Facility groundwater supply bore would form a localised groundwater sink. As described in Section 3.5, the maximum predicted drawdown is low, stabilises quickly and is not significant beyond 100 m (i.e. predicted maximum drawdown 100 m from the bore is 2 cm) (Figure 5).

### 4.2 GROUNDWATER USERS

The closest groundwater bore to the proposed Ivanhoe Rail Facility groundwater supply bore is located approximately 2 km to the south-east (Section 2.6). The drawdown at this bore due to the proposed Ivanhoe Rail Facility groundwater supply bore is predicted to be negligible.

### 4.3 GROUNDWATER QUALITY

Given the limited drawdown impact of the proposed Ivanhoe Rail Facility groundwater supply bore and the poor (saline) quality of the groundwater resource, there is expected to be no significant change in groundwater quality as a result of the Modification.

### 4.4 GROUNDWATER DEPENDENT ECOSYSTEMS

As there are no GDEs present within the locality of the proposed Ivanhoe Rail Facility groundwater supply bore and the limited predicted drawdown, no impacts on GDEs are expected as a result of the Modification.

### 4.5 CUMULATIVE IMPACTS

As there are no significant groundwater users in the vicinity of the proposed Ivanhoe Rail Facility groundwater supply bore and the limited predicted drawdown, no cumulative impacts are expected as a result of the Modification.

### 4.6 CONSIDERATION OF THE AQUIFER INTERFERENCE POLICY

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

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

### ***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*.

The draft *Water Sharing Plan for the Lachlan Alluvial Groundwater Sources 2019*, which has been published on the NSW Department of Industry website (Section 2.5) would become the relevant Water Sharing Plan for the Ivanhoe Rail Facility when it comes into force.

### ***Licensing Requirements***

The *Water Management Act, 2000* makes it an offence to "take" water without a water licence or in accordance with a lawful exemption.

The AIP states that all water taken by aquifer interference activities needs to be accounted for within the extraction limits set by the relevant water sharing plan.

As described in Section 2.5, Tronox has obtained a total of 100 share components (units or million litres) in the Lower Lachlan Alluvium Groundwater Source under the *Water Sharing Plan for the Lower Lachlan Groundwater Source 2003* for the proposed Ivanhoe Rail Facility groundwater supply bore. Tronox therefore has adequate licences available to account for the proposed take of water associated with the Ivanhoe Rail Facility groundwater supply bore (i.e. 60 ML/yr).

### ***Minimal Impact Considerations***

The AIP establishes minimal impact considerations for groundwater categories of both 'highly productive' and 'less productive' groundwater. 'Highly productive groundwater' is defined by the AIP as groundwater which (NOW, 2012):

*...is defined in this Policy as a groundwater source that is declared in the Regulations and will be based on the following criteria:*

- a) has total dissolved solids of less than 1,500 mg/L, and*
- b) contains water supply works that can yield water at a rate greater than 5 L/sec.*

The AIP further groups groundwater in to categories (e.g. alluvial, porous rock).

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. Table 4 provides an assessment of the watertable, water pressure and water quality minimal impact considerations.

The Modification would have "minimal impact" (as defined by the AIP) (Table 4).

Table 4. Less Productive Alluvial Aquifer – Minimal Impact Considerations

Level 1 Minimal Impact Consideration	Assessment
<p><u>Water Table</u></p> <p>1. <i>Less than or equal to 10% cumulative variation in the water table, allowing for typical climatic “post-water sharing plan” ... variations, 40m from any:</i></p> <p>(a) <i>high priority groundwater dependent ecosystem; or</i></p> <p>(b) <i>high priority culturally significant site; listed in the schedule of the relevant water sharing plan; or</i></p> <p><i>A maximum of a 2m decline cumulatively at any water supply work unless make good provisions should apply.</i></p>	<p><u>There are no high priority GDEs listed in the Water Sharing Plan for the Lower Lachlan Groundwater Source 2003 or the draft Water Sharing Plan for the Lachlan Alluvial Groundwater Sources 2019.</u></p> <p><u>There are no high priority culturally significant sites listed in the Water Sharing Plan for the Lower Lachlan Groundwater Source 2003 or the Water Sharing Plan for the Lachlan Alluvial Groundwater Sources 2019.</u></p> <p><u>Predicted drawdown at all privately-owned bores would be less than 2 m.</u></p> <p><u>There are no other relevant water supply works.</u></p> <p><b>Complies with Level 1 minimal impact considerations.</b></p>
<p><u>Water Pressure</u></p> <p>1. <i>A cumulative pressure head decline of not more than 40% of the “post-water sharing plan”... pressure head above the base of the water source to a maximum of a 2m decline, at any water supply work.</i></p> <p>2. <i>If the predicted pressure head decline is greater than requirement 1. above, then appropriate studies are required to demonstrate to the Minister’s satisfaction that the decline will not prevent the longterm viability of the affected water supply works unless make good provisions apply.</i></p>	<p><u>Predicted water pressure decline at all privately-owned bores would be less than 2 m.</u></p> <p><u>There are no other relevant water supply works.</u></p> <p><b>Complies with Level 1 minimal impact considerations.</b></p>

Level 1 Minimal Impact Consideration	Assessment
<p><u>Water Quality</u></p> <p>(a) <i>Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity; and</i></p> <p>(b) <i>No increase of more than 1% per activity in long-term average salinity in a highly connected surface water source at the nearest point to the activity. Redesign of a highly connected ... surface water source that is defined as a “reliable water supply”... is not an appropriate mitigation measure to meet considerations 1.(a) and 1.(b) above.</i></p> <p>(c) <i>No mining activity to be below the natural ground surface within 200m laterally from the top of high bank or 100m vertically beneath (or the three dimensional extent of the alluvial material - whichever is the lesser distance) of a highly connected surface water source that is defined as a “reliable water supply”</i></p>	<p>Negligible impacts on groundwater quality are expected and therefore no change to the beneficial use category of the groundwater source.</p> <p><u>There are no highly connected surface water sources in the vicinity of the Ivanhoe Rail Facility.</u></p> <p><u>No mining activities are proposed at the Ivanhoe Rail Facility.</u></p> <p><b>Complies with Level 1 minimal impact considerations.</b></p>

#### 4.7 CONSIDERATION OF THE WATER SHARING PLAN FOR THE LOWER LACHLAN GROUNDWATER SOURCE 2003

Division 3 of Part 10 of the *Water Sharing Plan for the Lower Lachlan Groundwater Source 2003* relates to the management of local impact on the groundwater resource. An assessment against the relevant provisions of Division 3 of Part 10 is provided in Table 5.

Section 4.41(1) of the *NSW Environmental Planning and Assessment Act, 1979* provides that water use approvals under section 89, water management work approvals under section 90 (which include water supply work approvals), or an activity approval (excluding an aquifer interference approval) under section 91 of the *Water Management Act, 2000* are not required for an approved State Significant Development Project. Therefore, restrictions set out in clause 36 of the *Water Sharing Plan for the Lower Lachlan Groundwater Source 2003* do not apply to a bore approved as part of the Project. Notwithstanding the above, clause 36 is still considered in Table 5.

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*.

Table 5. Management of Local Impact Considerations

Requirement	Assessment	
<b>36 Extraction interference between neighbouring bores</b>		
<p>1. <i>To minimise interference between extraction under different access licences in this groundwater source, extraction from a water supply work (bore) nominated by an access licence will not be permitted within:</i></p> <p>(a) <i>1,000 metres of another water supply work (bore) nominated by an access licence authorised to extract up to, and including, 10 ML/day,</i></p> <p>(b) <i>2,000 metres of another water supply work nominated by an access licence authorised to extract greater than 10 ML/day, and up to and including 15 ML/day, and</i></p> <p>(c) <i>3,000 metres of another water supply work nominated by an access licence authorised to extract greater than 15 ML/day.</i></p>	<p>Extraction from the proposed Ivanhoe Rail Facility groundwater supply bore would be less than 10 ML/day.</p> <p>No groundwater bores are located within 1,000 m of the proposed Ivanhoe Rail Facility groundwater supply bore.</p>	
<b>37 Water level management</b>		
<p>1. <i>The Minister may declare that, in order to protect water levels within this groundwater source, local access rules are to apply in a defined area known as a local impact area. ...</i></p>	<p>The proposed Ivanhoe Rail Facility groundwater supply bore is not located within a local impact area, therefore clause 37 is not applicable to any dealing for the proposed Ivanhoe Rail Facility groundwater supply bore.</p>	
<b>38 Water quality management</b>		
<p>1. <i>The beneficial uses of this groundwater source based on the Australian and New Zealand Environment and Conservation Council Water Quality Guidelines 2000, and the National Health and Medical Research Council Raw Water for Drinking Purposes Guidelines 1996, are raw water for drinking supplies, and agriculture water.</i></p> <p>2. <i>Water quality decline will be deemed unacceptable if extraction is likely to cause water quality to decline to a lower beneficial use class.</i></p>	<p>Negligible impacts on groundwater quality are expected and therefore no change to the beneficial use category of the groundwater source. Clauses 38(1) and 38(2) are therefore not applicable to any dealing for the Ivanhoe Rail Facility groundwater supply bore.</p>	
<p>3. <i>The Minister may declare that, in order to protect water quality within this groundwater source, local access rules are to apply in a defined area known as a local impact area.</i></p>		
1906B	PAGE 22 OF 34	GEO-ENG

Requirement	Assessment
<b>39 Protection of groundwater dependent ecosystems and Aboriginal cultural heritage values</b>	
<p>(1) <i>Extraction of groundwater from a new or replacement water supply work (bore) is excluded:</i></p> <p>(a) <i>for works nominated by an access licence, within 200 metres of high priority groundwater dependent ecosystems, or where impact may occur on Aboriginal cultural heritage values,</i></p> <p>(b) <i>for those exercising basic landholder rights, within 100 metres of high priority groundwater dependent ecosystems, or where impact may occur on Aboriginal cultural heritage values, and</i></p> <p>(c) <i>within 40 metres of any river for any works.</i></p>	<p>There are no high priority GDEs listed in the <i>Water Sharing Plan for the Lower Lachlan Groundwater Source 2003</i>.</p> <p>There are no high priority culturally significant sites listed in the <i>Water Sharing Plan for the Lower Lachlan Groundwater Source 2003</i>.</p> <p>There is no river in the vicinity of the Ivanhoe Rail Facility groundwater supply bore.</p>
<b>40 Protection of aquifer integrity</b>	
<p>(1) <i>The Minister may declare that, in order to protect the integrity of the aquifers within this groundwater source, local access restrictions are to apply in a defined area known as a local impact area.</i></p>	<p>The proposed Ivanhoe Rail Facility groundwater supply bore is not located within a local impact area, therefore clause 40 is not applicable to any dealing for the Ivanhoe Rail Facility groundwater supply bore.</p>

#### 4.8 CONSIDERATION OF THE DRAFT WATER SHARING PLAN FOR THE LACHLAN ALLUVIAL GROUNDWATER SOURCES 2019

Part 9 of the draft *Water Sharing Plan for the Lachlan Alluvial Groundwater Sources 2019* relates to rules for granting water supply work approvals.

As noted in Section 2.5, the draft *Water Sharing Plan for the Lachlan Alluvial Groundwater Sources 2019* is scheduled to commence on 1 July 2019. Notwithstanding, an assessment against the relevant provisions of Part 9 is provided in Table 6.

Table 6. Rules for Water Supply Work Approvals

Requirement	Assessment
<b>40 - Rules to minimise interference between water supply works</b>	
<p>(2) <i>A water supply work approval must not be granted or amended in the Lower Lachlan Groundwater Source if located within:</i></p> <p>(d) <i>400 metres of a water supply work located on another landholding that is authorised to take water from the same groundwater source for basic landholder rights only, or</i></p> <p>(e) <i>200 metres from the boundary of the landholding on which the water supply work is located, unless the owner of the landholding adjoining the boundary has provided consent in writing, or</i></p> <p>(f) <i>600 metres of a water supply work that is nominated by a local water utility access licence or a major utility access licence to take water from the same groundwater source, unless the holder of the local water utility access licence or major utility access licence has provided consent in writing, or</i></p> <p>(g) <i>500 metres of a Government observation or monitoring bore, or</i></p> <p>(h) <i>1,000 metres of a water supply work located on another landholding within the same groundwater source that is authorised to take up to and including 2,000 ML/year, or</i></p> <p>(i) <i>2,000 metres of a water supply work located on another landholding within the same groundwater source that is authorised to take between 2,000 ML/year and 3,000ML/year, or</i></p> <p>(j) <i>3,000 metres of a water supply work located on another landholding within the same groundwater source that is authorised to take over 3,000ML/yr</i></p>	<p>No water supply works are located within 600 m of the proposed Ivanhoe Rail Facility groundwater supply bore.</p> <p>The proposed Ivanhoe Rail Facility groundwater supply bore is not located within 200 m of the boundary of the relevant landholding (i.e. Lot 931, DP761988).</p> <p>No Government observation or monitoring bores are located within 500 m of the proposed Ivanhoe Rail Facility groundwater supply bore.</p> <p>No water supply works are located on another landholding within 3,000 m of the proposed Ivanhoe Rail Facility groundwater supply bore which are authorised to take up to 3,000 ML/yr or over.</p>

Requirement	Assessment
<b>41 Rules for water supply works located near contamination sources</b>	
<p>(1) A water supply work approval must not be granted or amended if the water supply work is located:</p> <ul style="list-style-type: none"> <li>(a) within 500 metres of a contamination source listed in Schedule 1, or</li> <li>(b) within 250 metres of the edge of a plume associated with a contamination source listed in Schedule 1, or</li> <li>(c) between 250 metres and 500 metres from the edge of a plume associated with a contamination source listed in Schedule 1, unless the Minister is satisfied that no drawdown will occur within 250 metres of that plume.</li> </ul>	<p>The proposed Ivanhoe Rail Facility groundwater supply bore is not located within 500 m of a contamination source or the plume associated with a contamination source listed in Schedule 1.</p>
<b>42 Rules for water supply works located near groundwater-dependent ecosystems</b>	
<p>(2) A water supply work approval must not be granted or amended for the following water supply works:</p> <ul style="list-style-type: none"> <li>(a) a water supply work that is located within 40 metres of the top of the high bank of a river,</li> <li>(b) a water supply work for basic landholder rights that is located within 100 metres of any other high priority groundwater-dependent ecosystem shown on the GDE Map,</li> <li>(c) a water supply work, other than solely for basic landholder rights, that is located within 200 metres of any other high priority groundwater-dependent ecosystem shown on the GDE Map</li> </ul>	<p>There is no river in the vicinity of the Ivanhoe Rail Facility groundwater supply bore.</p> <p>There are no high priority GDEs listed in the draft <i>Water Sharing Plan for the Lachlan Alluvial Groundwater Sources 2019</i>.</p>
<b>43 Rules for water supply works located near groundwater-dependent culturally significant areas</b>	
<p>(1) A water supply work approval must not be granted or amended if located within:</p> <ul style="list-style-type: none"> <li>(a) 100 metres of a groundwater-dependent culturally significant area, for a water supply work that will be used take water for basic landholder rights only, or</li> <li>(b) 200 metres of a groundwater-dependent culturally significant area, for a water supply work that is intended to be nominated by an access licence.</li> </ul>	<p>There are no groundwater-dependent culturally significant areas listed in the draft <i>Water Sharing Plan for the Lachlan Alluvial Groundwater Sources 2019</i>.</p>

## 5 RECOMMENDED MANAGEMENT AND MONITORING PROGRAMME

### 5.1 GROUNDWATER MANAGEMENT PLAN

A Groundwater Management Plan has been prepared for the Project in accordance with Condition 26(f), Schedule 3 of Development Consent (SSD\_5012). The Groundwater Management Plan includes:

- Groundwater assessment criteria and associated trigger levels;
- Groundwater monitoring program;
- Plan to respond to Groundwater assessment criteria exceedances; and
- Program to validate the groundwater model.

It is recommended that the Groundwater Management Plan be revised to incorporate the Ivanhoe Rail Facility groundwater supply bore.

### 5.2 MONITORING

The revised Groundwater Management Plan should include the following additional monitoring:

- Meteorological data from the existing Atlas-Campaspe Mine automated weather station and from the BOM site at Ivanhoe.
- Groundwater level at the Ivanhoe Rail Facility groundwater supply bore (quarterly).
- Groundwater quality (Electrical Conductivity (EC), pH, standard anions and cations, and metals) at the Ivanhoe Rail Facility groundwater supply bore (quarterly).

### 5.3 COMPENSATORY WATER SUPPLY

Conditions 25, Schedule 3 of Development Consent (SSD\_5012) state the following:

#### ***Compensatory Water Supply***

*The Applicant shall provide a compensatory water supply to any landowner or leaseholder of privately-owned land whose water supply is adversely and directly impacted (other than an impact that is negligible) as a result of the development, in consultation with NOW, and the satisfaction of the Secretary.*

*The compensatory water supply measures must provide an alternative long term supply of water that is equivalent to the loss attributed to the development.*

*The extent of adverse impact on water supply must be investigated in accordance with the procedures outlined in Condition 4 of Schedule 5. The compensatory water supply measures must provide an alternative long term supply of water that is equivalent to the loss attributable to the project. Equivalent water supply should be provided (at least on an interim basis) within 24 hours of the loss being identified, unless otherwise agreed with the landowner/leaseholder.*

*If the Applicant and landowner/leaseholder cannot agree on the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Secretary for resolution.*

*If the Applicant is unable to provide an alternative long term supply of water, then the Applicant shall provide alternative compensation to the satisfaction of the Secretary.*

In the unlikely event that a leaseholder's water supply is adversely and directly impacted (other than an impact that is negligible) as a result of the Ivanhoe Rail Facility groundwater supply bore, Tronox would provide a compensatory water supply in accordance with Conditions 25, Schedule 3 of Development Consent (SSD\_5012).

#### **5.4 GROUNDWATER MODEL VALIDATION AND REVIEW**

The groundwater model should be used as a management tool for the periodic review and calibration of predicted groundwater drawdown from the Ivanhoe Rail Facility groundwater supply bore during the life of the Project.

Revised outputs from the groundwater model will be reported periodically over the life of the Project. In the event that the actual groundwater drawdown levels exceed the predicted groundwater drawdown levels over the life of the Project, the groundwater model will be further refined using any new data available to characterise the aquifer system.

#### **5.5 GROUNDWATER LICENSING**

Tronox has obtained a total of 100 share components (units or million litres) in the Lower Lachlan Alluvium Groundwater Source of the *Water Sharing Plan for the Lower Lachlan Groundwater Source 2003* for the Ivanhoe Rail Facility.

In accordance with Condition 24, Schedule 3 of Development Consent (SSD\_5012), Tronox will hold sufficient water entitlements under the *NSW Water Management Act, 2000* for all stages of the Project.

## **6 GROUNDWATER MODEL LIMITATIONS**

The predictive ability of groundwater modelling is generally related to the availability of geological and hydrogeological data (i.e. knowledge) of the area. Given the remote location of the site, substantial historic datasets are not available. Notwithstanding, sensitivity variations were modelled for conservative (i.e. maximum case) conditions (Section 3.5) to identify an envelope of maximum potential limit of impact. Given the conservative nature of the assessment undertaken in this report, the model accuracy is expected to be adequate for the required purpose of assessing the range of potential impacts surrounding the proposed Ivanhoe Rail Facility groundwater supply bore.

## 7 CONCLUSIONS

Tronox proposes to modify Development Consent (SSD\_5012) for the Project to allow for changes to optimise the Project. The Modification would include the installation of a groundwater supply bore at the Ivanhoe Rail Facility that would provide up to approximately 60 ML/yr (1.9 L/s) over the Project life.

This Groundwater Review has assessed the potential groundwater impacts associated with the proposed Ivanhoe Rail Facility groundwater supply bore and concluded the following:

- 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 as a result of the proposed groundwater bore;
- The closest groundwater bore to the proposed Ivanhoe Rail Facility bore is located approximately 2 km to the south-east and the drawdown at this bore due to the proposed IRF bore is predicted to be negligible;
- There no GDEs present within the locality of the proposed Ivanhoe Rail Facility groundwater supply bore and therefore 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;
- The proposed IRF groundwater supply bore would have “minimal impact” as defined in the NSW AIP;
- 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*;
- The proposed Ivanhoe Rail Facility groundwater supply bore would meet relevant rules for granting water supply work approvals in Part 9 of the draft *Water Sharing Plan for the Lachlan Alluvial Groundwater Sources 2019*;
- Tronox has obtained a total of 100 share components (units or million litres) in the Lower Lachlan Alluvium Groundwater Source under the *Water Sharing Plan for the Lower Lachlan Groundwater Source 2003* for the proposed Ivanhoe Rail Facility groundwater supply bore and therefore has adequate licences available to account for the proposed take of water associated with the Ivanhoe Rail Facility groundwater supply bore (i.e. 60 ML/yr); and

- It is recommended that the Groundwater Management Plan be revised to incorporate the Ivanhoe Rail Facility groundwater supply bore and include the following additional monitoring:
  - Meteorological data from the existing Atlas-Campaspe Mine automated weather station and from the BOM site at Ivanhoe.
  - Groundwater level at the Ivanhoe Rail Facility groundwater supply bore (quarterly).
  - Groundwater quality (EC, pH, standard anions and cations, and metals) at the Ivanhoe Rail Facility groundwater supply bore (quarterly).

## 8 BIBLIOGRAPHY

- Agriculture and Resource Management Council of Australia and New Zealand and Australian and New Zealand Environment and Conservation Council (1995) *National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia*.
- Australian Geological Survey Organisation and Bureau of Mineral Resources, Geology and Geophysics (1991-1994) *Murray Basin Hydrogeological Map Series 1:250,000 Map Sheets*, Ivanhoe.
- Australian Museum Business Services (2013) *Atlas-Campaspe Mineral Sands Project Flora Assessment*. Prepared by Australian Museum Business Services for Cristal Mining Australia Limited.
- Brown, C.M. and Stephenson, A.E., (1991) *Geology of the Murray Basin, Southeastern Australia*. Bureau of Mineral Resources Geology and Geophysics, Australia. Bulletin 235.
- Bureau of Meteorology (2019) *Groundwater Dependent Ecosystems Atlas*. Website: <http://www.bom.gov.au/water/groundwater/gde/map.shtml>> Accessed March 2019.
- Bureau of Meteorology (2012) Average Annual and Monthly Evapotranspiration. Website: [http://www.bom.gov.au/jsp/ncc/climate\\_averages/evapotranspiration/index.jsp?maptype=1&period=an](http://www.bom.gov.au/jsp/ncc/climate_averages/evapotranspiration/index.jsp?maptype=1&period=an)
- Department of Environment and Conservation (2007) *Guidelines for the Assessment and Management of Groundwater Contamination*.
- Department of Environment, Climate Change and Water (1996) *NSW Wetlands Policy*.
- Department of Land and Water Conservation (1997) *The NSW State Groundwater Policy Framework Document*.
- Department of Land and Water Conservation (1998a) *The Draft NSW Groundwater Quality Protection Policy*.
- Department of Land and Water Conservation (1998b) *The NSW Groundwater Quantity Management Policy*.
- Department of Land and Water Conservation (2002) *NSW State Groundwater Dependent Ecosystems Policy*.
- Duffield, G.M., (2007) *AQTESOLV for Windows Version 4.5 User's Guide*, HydroSOLVE, Inc., Reston, VA.

Freeze, R.A. and Cherry, J.A., (1979) *Groundwater*. Prentice-Hall, Inc. Englewood Cliffs, NJ.

GEO-ENG (2010) *Section 75W Modification, Snapper & Ginkgo Mines - Hydrogeological Assessment, Pooncarie, NSW*. March 2010.

Hatton T, Evans R (1998) *Dependence of ecosystems on groundwater and its significance to Australia*. Occasional Paper No. 12/98. Land and Water Resources Research and Development Corporation, CSIRO Australia.

Kellett, J. R., (1997) *Lachlan Fan/Ivanhoe Block Steady State Groundwater Model*. Australian Geological Survey Organisation, Canberra.

Mampitiya, D., (2010) *Lower Lachlan Groundwater Model*. NSW Office of Water, April 2010.

Murray Darling Basin Authority (2008) Groundwater Salinity  
Website: [http://mdba.gov.au/files/cartographicmapping/298\\_Salinity\\_of\\_GW\\_in\\_Murray\\_Basin.pdf](http://mdba.gov.au/files/cartographicmapping/298_Salinity_of_GW_in_Murray_Basin.pdf)

Murray Darling Basin Commission (undated) *Murray-Darling Basin Groundwater Quality Sampling Guidelines: Technical Report No 3*.

NSW Government (1999) *NSW Farm Dams Policy*.

NSW Office of Water (2014) PINNEENA 10.1.

NSW Office of Water (2012) Controlled activities on waterfront land.  
Website: <http://www.water.nsw.gov.au/Water-Licensing/Approvals/Controlled-activities/default.aspx>

NSW Office of Water (2012) *Groundwater*.  
Website: <http://www.water.nsw.gov.au/Water-management/Water-availability/Groundwater/Groundwater/default.aspx>

NSW Office of Water (2012) *Aquifer Interference Policy*.

NSW Office of Water (2012) *Risk assessment guidelines for groundwater dependent ecosystems*.

Attachment A

Ivanhoe Rail Facility Bore Census

ATLAS-CAMPASPE OPTIMISATION MODIFICATION

IVANHOE RAIL FACILITY GROUNDWATER BORE CENSUS REPORT



MAY 2019  
Project No. CMA 18-07  
Document No. Version 1  
ID: 00975426

**TABLE OF CONTENTS**

<u>Section</u>	<u>Page</u>
1 INTRODUCTION	1
2 CENSUS AREA	1
3 DESKTOP ANALYSIS	1
3.1 WATERNSW GROUNDWATER DATABASE	1
3.2 AERIAL IMAGERY AND TOPOGRAPHIC MAPPING	3
3.3 PREVIOUS REPORTS	3
4 CONSULTATION	3
5 BORE CENSUS RESULTS SUMMARY	5
6 REFERENCES	5

**LIST OF FIGURES**

Figure 1	Potential Groundwater Bores Identified by Desktop Analysis
Figure 2	Bore Census Results

**LIST OF APPENDICES**

Appendix A	WaterNSW Works Summaries
Appendix B	Landholder/leaseholder Consultation Summary
Appendix C	Groundwater Bore Census Database

## 1 INTRODUCTION

The Atlas-Campaspe Mineral Sands Project (the Project) operates in accordance with Development Consent (SSD\_5012) issued under Part 4 of the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2014.

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

Tronox proposes to modify Development Consent (SSD\_5012) for the Project to allow for changes to optimise the Project (herein referred to the Optimisation Modification or Modification). The Modification would, among other things, include the installation of a groundwater bore at the modified Ivanhoe Rail Facility.

This report presents the findings of a groundwater bore census conducted by Tronox for the area surrounding the Ivanhoe Rail Facility. The findings of the Bore Census will assist in understanding groundwater use within the vicinity of the Ivanhoe Rail Facility.

## 2 CENSUS AREA

The Bore Census Area consists of a 10 km radial buffer centred on the Ivanhoe Rail Facility (the Bore Census Area). The Bore Census Area covers approximately 314 square kilometres (km<sup>2</sup>).

The Bore Census Area includes the town of Ivanhoe, while the remainder of land in the Bore Census Area is dominated by agricultural land uses (predominantly grazing). Groundwater use within the Bore Census Area is understood to be sparse and primarily used for domestic and agricultural purposes.

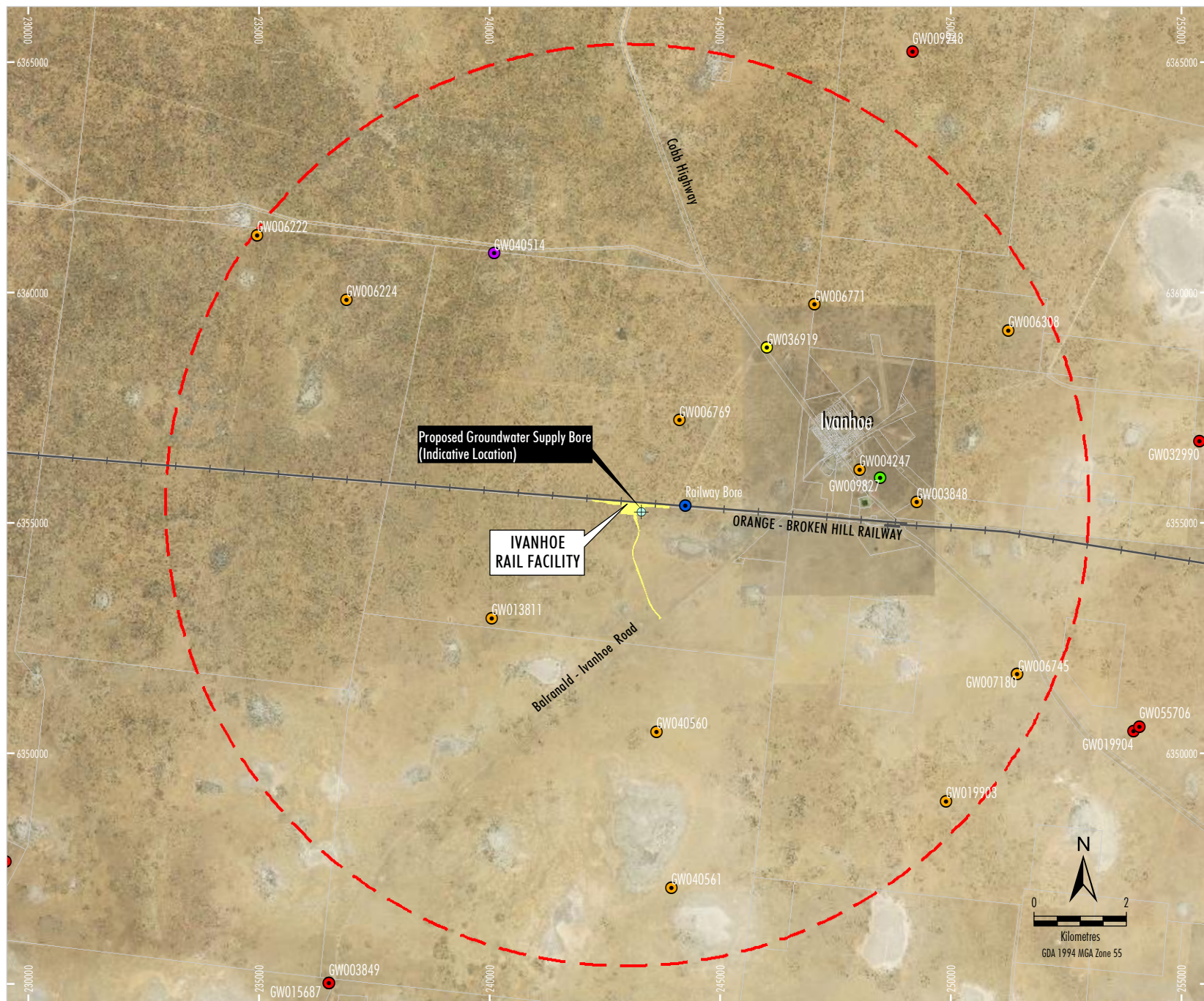
## 3 DESKTOP ANALYSIS

A desktop analysis was undertaken to identify any potential groundwater bores within the Bore Census Area. The sources of information reviewed for the desktop analysis are described in Sections 3.1–3.3. Potential groundwater bores identified during the desktop analysis are shown on Figure 1.

### 3.1 WATERNSW GROUNDWATER DATABASE

Registered groundwater bores within the Bore Census Area were identified through a search of the WaterNSW 'Real-time Data' database (WaterNSW, 2019) to provide a basis for consultation with relevant landholders and/or leaseholders in the Bore Census Area.

16 registered groundwater bores (Appendix A) were identified through the WaterNSW groundwater database within the Bore Census Area (Figure 1).



- LEGEND**
- Bore Census Area (10 km Buffer)
  - Modified Surface Development Area - Ivanhoe Rail Facility
- NSW Pineena Groundwater Database**
- Stock
  - Domestic
  - Monitoring
  - Irrigation
  - Groundwater Bore outside Bore Census Area
- Topographic Mapping**
- Potential Bore

Source: Tronox (2019), © NSW Department of Finance, Services & Innovation (2019), WaterNSW (2019).  
 Orthophoto: © NSW Department of Finance, Services & Innovation (2019)

**TRONOX**  
 OPTIMISATION MODIFICATION  
 Potential Groundwater Bores  
 Identified by Desktop Analysis

**Figure 1**

The following intended purposes were attributed to the registered groundwater bores in the Bore Census Area (Figure 1):

- Monitoring (one bore).
- Domestic (one bore).
- Irrigation (one bore).
- Stock (13 bores).

### **3.2 AERIAL IMAGERY AND TOPOGRAPHIC MAPPING**

The Bore Census Area was investigated for infrastructure typically associated with groundwater bores such as windmills, wells and pumps, through an analysis of current and historical NSW Government Topographic Mapping (SIX Maps) (NSW Department of Finance Services and Innovation, 2019). Each identified location was then validated via high-resolution aerial imagery (Google Earth and Six Maps) to confirm the presence of a potential groundwater bore.

The Railway Bore (Figure 1) was identified on topographic mapping as a potential additional bore within the Bore Census Area. No registered bore details are available for the Railway Bore and no infrastructure could be located through aerial imagery. Further, consultation with the leaseholder (Richard Gates) did not indicate that the groundwater bore exists. For the purposes of this Bore Census, the Railway Bore is taken to not exist at the location shown on Figure 1, and is not referred to further in this report.

### **3.3 PREVIOUS REPORTS**

It is understood that the Bore Census Area has not been subject to any recent groundwater studies.

## **4 CONSULTATION**

The leaseholders/landholders of the Lots/DP's within the Bore Census Area were identified through a tenure search to provide contact details for consultation purposes. Seven Lots/DP's containing registered groundwater bores were identified within the Bore Census Area. The leaseholders of four lots (Richard Gates and Gregory Turner) were contacted to validate the location of any groundwater bores identified on their properties from the desktop analysis (Section 3) and to provide any further information (i.e. depth to water, pumping rate, etc.) where possible.

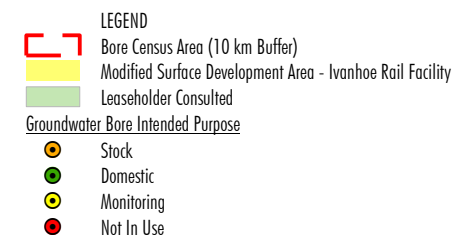
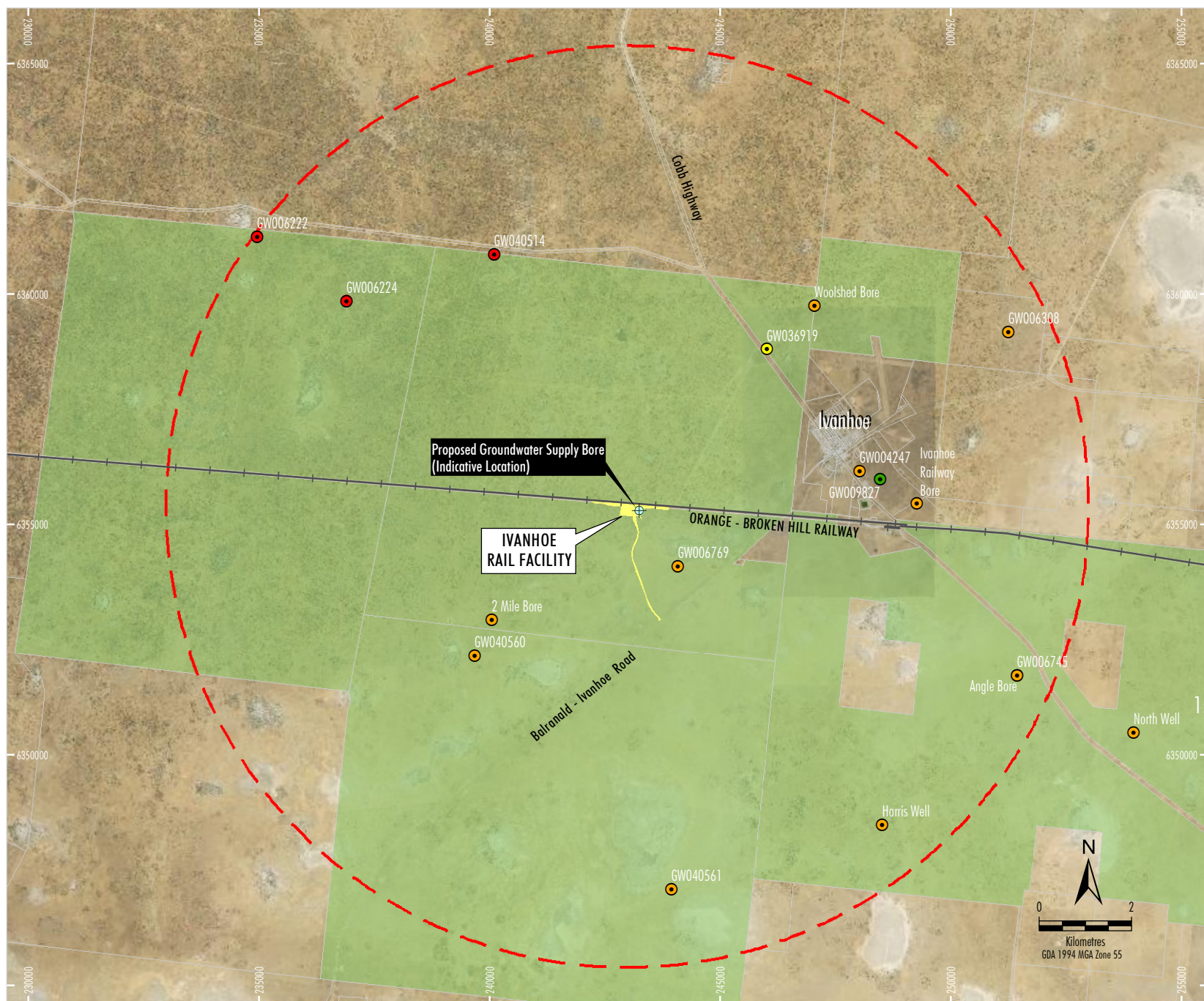
The following landholders/leaseholders did not participate in the consultation process:

- Robert Newnham.
- The State of NSW.

Details of 10 of the 16 registered groundwater bores identified in the Bore Census Area were able to be verified through consultation with Richard Gates and Gregory Turner<sup>1</sup>. Approximately 70% (219 km<sup>2</sup>) of the Bore Census Area was accounted for through consultation with the leaseholders (Figure 2). Details of six bores identified in the Bore Census Area (Section 3) were unable to be verified through consultation with the relevant landholders/leaseholders.

---

<sup>1</sup> Gregory Turner provided information on an additional two bores (namely GW019904 and GW055706) located outside the Bore Census Area (Appendices B and C). Gregory Turner also provided information on one bore (GW004247) located on land owned by the State of NSW.



Source: © NSW Department of Finance, Services & Innovation (2019), WaterNSW (2019).  
 Orthophoto: © NSW Department of Finance, Services & Innovation (2019)

**TRONOX**  
 OPTIMISATION MODIFICATION  
 Ivanhoe Rail Facility Bore Census Results

**Figure 2**

## 5 BORE CENSUS RESULTS SUMMARY

A summary of the Bore Census findings are presented below. Detailed results are provided in Appendix C.

Through consultation with the relevant leaseholders, and the WaterNSW groundwater database (for bores that were not able to be verified with the relevant landholder/leaseholder), the 16 registered bores identified within the Bore Census Area were defined as either:

- in use (i.e. currently accessing groundwater) (13 bores); or
- not in use (i.e. not currently accessing groundwater or not capable of accessing groundwater i.e. collapsed) (three bores).

As described in Section 4, the details of six bores in the Bore Census Area were unable to be verified with the relevant landholder/leaseholder. This Bore Census conservatively assumes these bores are in use (Figure 2 and Appendix C). The Bore Census Database (Appendix C) therefore adopts the information from the relevant WaterNSW Works Summary for these six bores (Appendix A).

Of the 10 verified groundwater bores located in the Bore Census Area, the location of three groundwater bores was corrected during consultation and verified through aerial imagery (Sections 3.2 and 4), namely:

- GW006769;
- GW040560; and
- GW019903.

Information provided by the relevant leaseholders and/or WaterNSW Works Summaries indicated that the 13 groundwater bores defined as 'in-use' are drilled to the following depths:

- 30 – 50 meters below ground level (mbgl) (three bores)
- 51 – 70 mbgl (six bores)
- >71 mbgl (two bores)
- No depth recorded (two bores).

## 6 REFERENCES

WaterNSW (2019) *Real-time water data*.

Website: <https://realtimedata.watarnsw.com.au/>

Dates Accessed: 24 April to 8 May 2019

NSW Department of Finance Services and Innovation (2019) *Spatial Information Exchange (SIX Maps)*.

Website: <https://six.nsw.gov.au/content/about>

Dates Accessed: 24 April to 8 May 2019

APPENDIX A  
WATERNSW WORKS SUMMARIES

WaterNSW  
Work Summary

GW003848

Licence:	Licence Status:
Authorised Purpose(s): Intended Purpose(s): STOCK	
Work Type: Bore open thru rock	
Work Status:	
Construct.Method: Cable Tool	
Owner Type: Other Govt	
Commenced Date:	Final Depth: 54.90 m
Completion Date: 01/12/1943	Drilled Depth: 54.90 m
Contractor Name: (None)	
Driller:	
Assistant Driller:	
Property:	Standing Water Level (m):
GWMA:	Salinity Description: 3001-7000 ppm
GW Zone:	Yield (L/s):

Site Details

Site Chosen By:		
County Form A: MOSSGIEL Licensed:	Parish invalid code	Cadastre TS&CR 66171
Region: 70 - Lachlan	CMA Map: 7732	
River Basin: 412 - LACHLAN RIVER Area/District:	Grid Zone:	Scale:
Elevation: 0.00 m (A.H.D.) Elevation Source: (Unknown)	Northing: 6355456.000 Easting: 249265.000	Latitude: 32°54'37.5"S Longitude: 144°19'08.5"E
GS Map: -	MGA Zone: 55	Coordinate Source: GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	Threaded Steel	-0.50	52.10	152			Suspended in Clamps

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
38.10	38.40	0.30	(Unknown)	30.50		0.10			
51.80	54.80	3.00	Consolidated	30.50		0.63			

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	1.22	1.22	Driller	(Unknown)	
1.22	4.27	3.05	Clay	Clay	
4.27	6.10	1.83	Sandstone	Sandstone	
6.10	7.92	1.82	Sand	Sand	
7.92	9.75	1.83	Sand Hard	Sand	
9.75	12.19	2.44	Sandstone Soft	Sandstone	
12.19	13.72	1.53	Sandstone Solid	Sandstone	
13.72	17.68	3.96	Sand Coarse Dry	Sand	
17.68	21.34	3.66	Sand	Sand	
21.34	22.56	1.22	Sandstone	Sandstone	
22.56	28.65	6.09	Sand	Sand	
28.65	29.87	1.22	Sandstone	Sandstone	
29.87	33.22	3.35	Sand	Sand	
33.22	36.58	3.36	Pipe Clay	Clay	
36.58	38.10	1.52	Clay	Clay	
38.10	38.40	0.30	Sand Water Supply	Sand	
38.40	51.82	13.42	Clay	Clay	
51.82	54.86	3.04	Sandstone Soft Water Supply	Sandstone	

Remarks

30/06/1982: PWP 66 ADJACENT IVANHOE RAILWAYSTATION  
02/11/1987: RAILWAY BORE IVANHOE

\*\*\* End of GW003848 \*\*\*

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

WaterNSW  
Work Summary

GW004247

Licence:

Licence Status:

Authorised Purpose(s):  
Intended Purpose(s): STOCK

Work Type: Bore open thru rock

Work Status:

Construct.Method: Cable Tool

Owner Type: Private

Commenced Date:  
Completion Date: 01/06/1909

Final Depth: 63.70 m  
Drilled Depth: 63.70 m

Contractor Name: (None)

Driller:

Assistant Driller:

Property:  
GWMA:  
GW Zone:

Standing Water Level (m):  
Salinity Description: Good Stock  
Yield (L/s):

Site Details

Site Chosen By:

County  
Form A: MOSSGIEL  
Licensed:

Parish  
invalid code

Cadastre  
TSR 1418

Region: 70 - Lachlan

CMA Map: 7732

River Basin: 412 - LACHLAN RIVER  
Area/District:

Grid Zone:

Scale:

Elevation: 0.00 m (A.H.D.)  
Elevation Source: (Unknown)

Northing: 6356164.000  
Easting: 248024.000

Latitude: 32°54'13.5"S  
Longitude: 144°18'21.5"E

GS Map: -

MGA Zone: 55

Coordinate Source: GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	Threaded Steel	0.00	47.50	152			

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
15.80	17.00	1.20	(Unknown)						
27.00	27.00	0.00	(Unknown)						
34.70	34.90	0.20	(Unknown)						
37.60	38.40	0.80	(Unknown)						
40.20	40.80	0.60	(Unknown)						
47.50	49.30	1.80	(Unknown)	26.20		0.63			
54.90	54.90	0.00	(Unknown)						

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	3.66	3.66	Clay Hard Gypsum	Clay	
3.66	4.57	0.91	Pebbles White Red	Gravel	
4.57	14.94	10.37	Sand White Very Fine Some Cemented Layers	Sand	
14.94	15.85	0.91	Sandstone Hard Cemented	Sandstone	
15.85	17.98	2.13	Drift Coarse Soak Water Supply	Sand	
17.98	24.99	7.01	Sand Drift Pink	Sand	
24.99	25.60	0.61	Clay Sandy	Clay	
25.60	26.82	1.22	Pipe Clay White	Clay	
26.82	26.97	0.15	Sand Drift Water Supply	Sand	
26.97	28.04	1.07	Clay Yellow Sandy	Clay	
28.04	30.78	2.74	Clay Yellow	Clay	
30.78	31.09	0.31	Ironstone Rusty Nodular	Ironstone	
31.09	32.92	1.83	Clay White Yellow	Clay	
32.92	34.44	1.52	Clay White	Clay	
34.44	34.90	0.46	Sand Drift Water Supply	Sand	
34.90	35.20	0.30	Sandstone Yellow Hard	Sandstone	
35.20	35.51	0.31	Clay Yellow Sandy	Clay	
35.51	36.12	0.61	Clay	Clay	
36.12	37.03	0.91	Clay White	Clay	
37.03	37.34	0.31	Sandstone Nodular	Sandstone	
37.34	37.64	0.30	Sand Drift	Sand	
37.64	40.69	3.05	Clay Sandy	Clay	
40.69	40.84	0.15	Sand Drift Water Supply	Sand	
40.84	41.15	0.31	Stones Hard Nodular	Gravel	
41.15	43.89	2.74	Clay Sandy	Clay	
43.89	44.50	0.61	Clay	Clay	
44.50	45.11	0.61	Pipe Clay	Clay	
45.11	47.55	2.44	Pipe Clay White	Clay	
47.55	49.38	1.83	Sand Drift Water Supply	Sand	
49.38	49.99	0.61	Clay White	Clay	
49.99	54.86	4.87	Sand Drift	Sand	
54.86	59.13	4.27	Clay Sandy Some Very Hard Water Supply	Clay	
59.13	60.05	0.92	Clay Sandy	Clay	
60.05	61.26	1.21	Clay White	Clay	
61.26	63.70	2.44	Clay Dark Blue	Clay	

Remarks

09/05/1979: ADJACENT IVANHOE ASTRON. STATION  
09/05/1979: ABADONED HOLE CLOSEBY WITH CASSTUCK IN SWELLING CLAY

\*\*\* End of GW004247 \*\*\*

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

# WaterNSW

## Work Summary

GW006222

Licence:	Licence Status:
	Authorised Purpose(s): Intended Purpose(s): STOCK
Work Type: Bore	
Work Status:	
Construct.Method: Cable Tool	
Owner Type: Private	
Commenced Date:	Final Depth: 32.60 m
Completion Date: 01/08/1937	Drilled Depth: 32.60 m
Contractor Name: (None)	
Driller:	
Assistant Driller:	
Property:	Standing Water Level (m):
GWMA:	Salinity Description: Poor Stock
GW Zone:	Yield (L/s):

### Site Details

Site Chosen By:			
	County Form A: MANARA Licensed:	Parish invalid code	Cadastre WLL 2851
Region: 70 - Lachlan	CMA Map: 7732		
River Basin: 412 - LACHLAN RIVER Area/District:	Grid Zone:	Scale:	
Elevation: 0.00 m (A.H.D.) Elevation Source: (Unknown)	Northing: 6361248.000 Easting: 234962.000	Latitude: 32°51'17.5"S Longitude: 144°10'04.5"E	
GS Map: -	MGA Zone: 55	Coordinate Source: GD.,ACC.MAP	

### Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	Threaded Steel	0.00	30.50	152			
1	1	Opening	Screen	29.60	32.60			1	

### Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
27.40	27.40	0.00	(Unknown)	19.20		0.86			

### Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.61	0.61	Loam Red	Loam	
0.61	5.49	4.88	Clay Light Reddish	Clay	
5.49	6.71	1.22	Clay Grey Gypsum	Clay	
6.71	8.23	1.52	Clay Light Yellow	Clay	
8.23	9.14	0.91	Clay White Hard Slippery	Clay	
9.14	10.97	1.83	Clay Grey Hard Crumbly	Clay	

10.97	14.63	3.66	Sandstone Grey	Sandstone	
14.63	17.98	3.35	Clay Light Yellow	Clay	
17.98	19.20	1.22	Sand White	Sand	
19.20	20.12	0.92	Sandstone	Sandstone	
20.12	20.73	0.61	Clay Yellow	Clay	
20.73	21.95	1.22	Clay Dark Coloured	Clay	
21.95	22.56	0.61	Clay Light Yellow Sandy	Clay	
22.56	27.43	4.87	Sand Yellow Fine	Sand	
27.43	32.61	5.18	Drift Yellow Fine Water Supply	Invalid Code	
32.61	32.63	0.02	Clay Yellow Hard	Clay	

\*\*\* End of GW006222 \*\*\*

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

# WaterNSW

## Work Summary

GW006224

Licence:

Licence Status:

Authorised Purpose(s):

Intended Purpose(s): STOCK

Work Type: Bore

Work Status:

Construct.Method: Cable Tool

Owner Type: Private

Commenced Date:

Completion Date: 01/07/1937

Final Depth: 86.30 m

Drilled Depth: 86.30 m

Contractor Name: (None)

Driller:

Assistant Driller:

Property:

Standing Water Level (m):

GWMA:

Salinity Description: Stock

GW Zone:

Yield (L/s):

### Site Details

Site Chosen By:

County

Form A: MANARA

Parish

Cadastre

Licensed:

invalid code

WLL 2851

Region: 70 - Lachlan

CMA Map: 7732

River Basin: 412 - LACHLAN RIVER

Grid Zone:

Scale:

Area/District:

Elevation: 0.00 m (A.H.D.)

Northing: 6359850.000

Latitude: 32°52'04.5"S

Elevation Source: (Unknown)

Easting: 236899.000

Longitude: 144°11'17.5"E

GS Map: -

MGA Zone: 55

Coordinate Source: GD.,ACC.MAP

### Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	Threaded Steel	0.00	83.80	152			
1	1	Opening	Screen	83.20	86.20	76		1	

### Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
27.40	27.40	0.00	Unconsolidated						
39.60	39.60	0.00	Unconsolidated						
74.10	74.10	0.00	Unconsolidated						
86.30	86.30	0.00	Unconsolidated	26.80		0.82			

### Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.91	0.91	Loam Red	Loam	
0.91	4.57	3.66	Clay Light Grey	Clay	
4.57	9.75	5.18	Sand White Coarse	Sand	

9.75	10.97	1.22	Clay Light Grey Soft	Clay	
10.97	12.80	1.83	Sandstone Hard	Sandstone	
12.80	14.33	1.53	Clay Black Yellow Dark Sandy	Clay	
14.33	17.07	2.74	Clay Light Grey Yellow	Clay	
17.07	18.29	1.22	Clay White Sandy	Clay	
18.29	21.34	3.05	Clay Yellow	Clay	
21.34	23.16	1.82	Sand Red	Sand	
23.16	27.43	4.27	Clay Yellow	Clay	
27.43	32.00	4.57	Clay Purple Water Bearing	Clay	
32.00	32.61	0.61	Clay White	Clay	
32.61	34.14	1.53	Clay Grey Crumbly	Clay	
34.14	36.27	2.13	Clay Red	Clay	
36.27	36.88	0.61	Clay Black White Red	Clay	
36.88	37.80	0.92	Clay White Soft	Clay	
37.80	39.62	1.82	Drift White	Invalid Code	
39.62	51.82	12.20	Drift Red Water Bearing	Invalid Code	
51.82	54.86	3.04	Drift Yellow	Invalid Code	
54.86	60.96	6.10	Sand Grey Coarse	Sand	
60.96	61.87	0.91	Clay White Soft	Clay	
61.87	62.48	0.61	Clay Light Grey	Clay	
62.48	74.07	11.59	Drift White Coarse Water Bearing	Invalid Code	
74.07	79.25	5.18	Clay Soft Light Coloured	Clay	
79.25	82.30	3.05	Clay White Drift	Clay	
82.30	86.26	3.96	Drift White Fine Water Supply	Invalid Code	
0.00	0.91	0.91	Clay Green Yellow	Clay	

\*\*\* End of GW006224 \*\*\*

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

# WaterNSW

## Work Summary

GW006308

Licence:

Licence Status:

Authorised Purpose(s):

Intended Purpose(s): STOCK

Work Type: Bore

Work Status: Supply Obtained

Construct.Method: Cable Tool

Owner Type: Private

Commenced Date:

Completion Date: 01/01/1938

Final Depth: 54.90 m

Drilled Depth: 54.90 m

Contractor Name: (None)

Driller:

Assistant Driller:

Property:

GWMA:

GW Zone:

Standing Water Level (m):

Salinity Description: 10001-14000 ppm

Yield (L/s):

### Site Details

Site Chosen By:

County

Parish

Cadastre

Form A: MOSSGIEL

invalid code

WLL 6614

Licensed:

Region: 70 - Lachlan

CMA Map: 7732

River Basin: 412 - LACHLAN RIVER

Grid Zone:

Scale:

Area/District:

Elevation: 0.00 m (A.H.D.)

Northing: 6359174.000

Latitude: 32°52'38.5"S

Elevation Source: (Unknown)

Easting: 251251.000

Longitude: 144°20'28.5"E

GS Map: -

MGA Zone: 55

Coordinate Source: GD.,ACC.MAP

### Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	Threaded Steel	0.00	54.90	127			
1	1	Opening	Screen	51.80	54.80			1	

### Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
44.20	44.20	0.00	Unconsolidated						
53.30	54.80	1.50	(Unknown)	35.10					

### Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	6.10	6.10	Loam	Loam	
6.10	42.67	36.57	Sand Red Coarse	Sand	
42.67	44.20	1.53	Sandstone White	Sandstone	
44.20	50.29	6.09	Clay Red White Water Bearing	Clay	
50.29	53.34	3.05	Clay White	Clay	

53.34	54.86	1.52	Drift Fine Water Bearing	Invalid Code	
-------	-------	------	--------------------------	--------------	--

\*\*\* End of GW006308 \*\*\*

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

# WaterNSW

## Work Summary

GW006745

Licence:	Licence Status:
	Authorised Purpose(s): Intended Purpose(s): STOCK
Work Type: Bore	
Work Status:	
Construct.Method: Cable Tool	
Owner Type: Private	
Commenced Date:	Final Depth: 41.10 m
Completion Date: 01/11/1940	Drilled Depth: 41.20 m
Contractor Name: (None)	
Driller:	
Assistant Driller:	
Property:	Standing Water Level (m):
GWMA:	Salinity Description: 3001-7000 ppm
GW Zone:	Yield (L/s):

### Site Details

Site Chosen By:			
	County Form A: MOSSGIEL Licensed:	Parish invalid code	Cadastre WLL 283
Region: 70 - Lachlan	CMA Map: 7732		
River Basin: 412 - LACHLAN RIVER Area/District:	Grid Zone:	Scale:	
Elevation: 0.00 m (A.H.D.) Elevation Source: (Unknown)	Northing: 6351719.000 Easting: 251439.000	Latitude: 32°56'40.5"S Longitude: 144°20'28.5"E	
GS Map: -	MGA Zone: 55	Coordinate Source: GD.,ACC.MAP	

### Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	Threaded Steel	0.00	39.00	127			
1	1	Opening	Screen	35.10	38.10			1	Copper Alloy

### Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.30	0.30	Soil Gibbers	Soil	
0.30	1.83	1.53	Clay	Clay	
1.83	2.44	0.61	Clay Sandy	Clay	
2.44	25.60	23.16	Sandstone Gravel	Sandstone	
25.60	32.61	7.01	Sandstone	Sandstone	
32.61	32.92	0.31	Clay Sandy	Clay	
32.92	35.05	2.13	Clay	Clay	
35.05	38.71	3.66	Drift Clay Bands Water Bearing	Invalid Code	
38.71	41.15	2.44	Drift Water Supply	Invalid Code	

### Remarks

30/06/1982: WHEN YIELD DROPPED IN 1944 R/C ATTEMPT ABAND DVE SCRIN

**\*\*\* End of GW006745 \*\*\***

**Warning To Clients:** This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

# WaterNSW

## Work Summary

GW006769

Licence:

Licence Status:

Authorised Purpose(s):

Intended Purpose(s): STOCK

Work Type: Bore

Work Status: Needs Reconditioning

Construct.Method: Cable Tool

Owner Type: Private

Commenced Date:

Completion Date: 01/01/1941

Final Depth: 46.90 m

Drilled Depth: 80.20 m

Contractor Name: (None)

Driller:

Assistant Driller:

Property:

GWMA:

GW Zone:

Standing Water Level (m):

Salinity Description: Salty

Yield (L/s):

### Site Details

Site Chosen By:

County

Form A: MANARA

Parish

Cadastre

Licensed:

invalid code

WLL 3339

Region: 70 - Lachlan

CMA Map: 7732

River Basin: 412 - LACHLAN RIVER

Grid Zone:

Scale:

Area/District:

Elevation: 0.00 m (A.H.D.)

Northing: 6357235.000

Latitude: 32°53'35.5"S

Elevation Source: (Unknown)

Easting: 244122.000

Longitude: 144°15'52.5"E

GS Map: -

MGA Zone: 55

Coordinate Source: GD.,ACC.MAP

### Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Backfill	Backfill	46.90	80.10	127			
1	1	Casing	Withdrawn	0.00	0.00	127			
1	1	Casing	Threaded Steel	0.00	46.90	152			

### Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
46.90	46.90	0.00	Unconsolidated						
53.60	56.00	2.40	Unconsolidated						
64.60	65.20	0.60	Unconsolidated						
70.10	70.70	0.60	Unconsolidated						
73.80	74.40	0.60	Unconsolidated						
80.20	80.20	0.00	(Unknown)	28.00					

### Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	46.94	46.94	Water Bearing	(Unknown)	
46.94	48.16	1.22	Clay Sandy	Clay	
48.16	53.64	5.48	Clay	Clay	
53.64	56.08	2.44	Drift Water Bearing	Invalid Code	
56.08	59.13	3.05	Clay Very Sandy	Clay	
59.13	64.62	5.49	Clay	Clay	
64.62	65.23	0.61	Clay Porous Water Bearing	Clay	
65.23	70.10	4.87	Clay	Clay	
70.10	70.71	0.61	Clay Porous Water Bearing	Clay	
70.71	73.76	3.05	Clay Sandy	Clay	
73.76	74.37	0.61	Sandstone Water Bearing Wash	Sandstone	
74.37	79.55	5.18	Clay Very Sandy	Clay	
79.55	80.16	0.61	Clay	Clay	
80.16	80.18	0.02	Drift Water Bearing	Invalid Code	

### Remarks

30/06/1982: R/C 23/1/42-DEEPENED TO 80.2M-WATER WORSE-SEE CAS 2&3

\*\*\* End of GW006769 \*\*\*

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

# WaterNSW

## Work Summary

GW006771

Licence:

Licence Status:

Authorised Purpose(s):

Intended Purpose(s): STOCK

Work Type: Bore

Work Status:

Construct.Method: Cable Tool

Owner Type: Private

Commenced Date:

Completion Date: 01/02/1942

Final Depth: 53.00 m

Drilled Depth: 53.00 m

Contractor Name: (None)

Driller:

Assistant Driller:

Property:

GWMA:

GW Zone:

Standing Water Level (m):

Salinity Description: Good

Yield (L/s):

### Site Details

Site Chosen By:

County

Form A: MOSSGIEL

Parish

Cadastre

Licensed:

invalid code

WLL 4578

Region: 70 - Lachlan

CMA Map: 7732

River Basin: 412 - LACHLAN RIVER

Grid Zone:

Scale:

Area/District:

Elevation: 0.00 m (A.H.D.)

Northing: 6359746.000

Latitude: 32°52'16.5"S

Elevation Source: (Unknown)

Eastings: 247048.000

Longitude: 144°17'47.5"E

GS Map: -

MGA Zone: 55

Coordinate Source: GD,ACC.MAP

### Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	Threaded Steel	0.00	53.00	127			
1	1	Opening	Screen	51.50	53.00	76		1	

### Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
38.40	38.40	0.00	(Unknown)			0.04			
40.80	40.80	0.00	Consolidated			0.06			
53.00	53.00	0.00	(Unknown)	35.10					

### Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.30	0.30	Soil Clayey	Soil	
0.30	1.22	0.92	Clay Kopi (copi)	Clay	
1.22	2.74	1.52	Clay	Clay	
2.74	4.57	1.83	Clay Pebbles/pebbly	Clay	
4.57	7.01	2.44	Clay Gravel	Clay	
7.01	20.73	13.72	Sandstone	Sandstone	
20.73	23.16	2.43	Clay	Clay	
23.16	27.13	3.97	Clay Sandy	Clay	
27.13	28.65	1.52	Sandstone	Sandstone	
28.65	33.53	4.88	Sandstone Clayey	Sandstone	
33.53	38.10	4.57	Clay	Clay	
38.10	38.40	0.30	Sandstone	Sandstone	
38.40	40.23	1.83	Clay Sandy	Clay	
40.23	40.84	0.61	Sandstone Water Supply	Sandstone	
40.84	44.20	3.36	Clay Sandy	Clay	
44.20	49.38	5.18	Clay	Clay	
49.38	53.04	3.66	Drift Water Supply	Invalid Code	

\*\*\* End of GW006771 \*\*\*

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

# WaterNSW

## Work Summary

GW007180

Licence:

Licence Status:

Authorised Purpose(s):

Intended Purpose(s): STOCK

Work Type: Bore

Work Status:

Construct.Method: Cable Tool

Owner Type: Private

Commenced Date:

Completion Date: 01/02/1946

Final Depth: 47.90 m

Drilled Depth: 47.90 m

Contractor Name: (None)

Driller:

Assistant Driller:

Property:

Standing Water Level (m):

GWMA:

Salinity Description: Good Stock

GW Zone:

Yield (L/s):

### Site Details

Site Chosen By:

County

Parish

Cadastre

Form A: MOSSGIEL

invalid code

WLL 283

Licensed:

Region: 70 - Lachlan

CMA Map: 7732

River Basin: 412 - LACHLAN RIVER

Grid Zone:

Scale:

Area/District:

Elevation: 0.00 m (A.H.D.)

Northing: 6351719.000

Latitude: 32°56'40.5"S

Elevation Source: (Unknown)

Easting: 251439.000

Longitude: 144°20'28.5"E

GS Map: -

MGA Zone: 55

Coordinate Source: GD.,ACC.MAP

### Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	Threaded Steel	-0.30	44.80	127			Suspended in Clamps
1	1	Opening	Screen	44.80	47.80			1	

### Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
37.90	38.10	0.20	(Unknown)						
44.80	44.80	0.00	(Unknown)	28.30		0.38			

### Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	6.10	6.10	Loam	Loam	
6.10	13.72	7.62	Sand Dry Coarse	Sand	
13.72	16.76	3.04	Sandstone Grey	Sandstone	
16.76	18.29	1.53	Sand Dry Coarse	Sand	
18.29	19.20	0.91	Sandstone	Sandstone	

19.20	19.81	0.61	Clay White Sand Seams	Clay	
19.81	22.25	2.44	Sandstone White	Sandstone	
22.25	34.44	12.19	Sand Dry Very Coarse	Sand	
34.44	35.05	0.61	Clay Grey	Clay	
35.05	37.49	2.44	Clay Yellow	Clay	
37.49	37.95	0.46	Clay White	Clay	
37.95	38.10	0.15	Drift Water Bearing	Invalid Code	
38.10	38.40	0.30	Clay Grey	Clay	
38.40	42.98	4.58	Sand Clay Bands	Sand	
42.98	47.85	4.87	Sand Drift Water Supply	Sand	

\*\*\* End of GW007180 \*\*\*

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

WaterNSW
Work Summary

GW009827

Licence: Licence Status:
Authorised Purpose(s):
Intended Purpose(s): DOMESTIC
Work Type: Bore
Work Status:
Construct.Method: Cable Tool
Owner Type: Private
Commenced Date: Final Depth: 46.90 m
Completion Date: 01/08/1951 Drilled Depth: 46.90 m
Contractor Name: (None)
Driller:
Assistant Driller:
Property:
GWMA:
GW Zone: Standing Water Level (m):
Salinity Description: Fair
Yield (L/s):

Site Details

Site Chosen By:
County Form A: MOSSGIEL Parish invalid code Cadastre TS&CR 9781
Region: 70 - Lachlan CMA Map: 7732
River Basin: 412 - LACHLAN RIVER Grid Zone: Scale:
Area/District:
Elevation: 0.00 m (A.H.D.) Northing: 6355990.000 Latitude: 32°54'19.5"S
Elevation Source: (Unknown) Easting: 248471.000 Longitude: 144°18'38.5"E
GS Map: - MGA Zone: 55 Coordinate Source: GD,ACC.MAP

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	Threaded Steel	-0.30	43.00	127			
1	1	Opening	Screen	43.00	46.00	89		1	Copper Alloy

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
30.50	32.30	1.80	(Unknown)	30.50					
40.20	42.30	2.10	(Unknown)	30.50					
45.70	46.90	1.20	(Unknown)	30.50		0.38			

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	3.66	3.66	Loam	Loam	
3.66	7.62	3.96	Clay	Clay	
7.62	10.36	2.74	Sandstone Limestone	Sandstone	
10.36	13.41	3.05	Sandstone Clay Bands	Sandstone	
13.41	28.65	15.24	Sand Dry Gravel	Sand	
28.65	35.66	7.01	Sand Drift Clay Bands Water Bearing	Sand	
35.66	46.02	10.36	Clay Sandy Bands Water Supply	Clay	
46.02	46.94	0.92	Drift Water Supply	Invalid Code	
0.00	3.66	3.66	Limestone Stones	Limestone	
3.66	7.62	3.96	Ironstone Rock	Ironstone	

\*\*\* End of GW009827 \*\*\*

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

# WaterNSW

## Work Summary

GW013811

Licence:

Licence Status:

Authorised Purpose(s):

Intended Purpose(s): STOCK

Work Type: Bore

Work Status:

Construct.Method: Cable Tool

Owner Type: Private

Commenced Date:

Completion Date: 01/01/1959

Final Depth: 51.80 m

Drilled Depth: 51.80 m

Contractor Name: (None)

Driller:

Assistant Driller:

Property:

GWMA:

GW Zone:

Standing Water Level (m):

Salinity Description: Stock

Yield (L/s):

### Site Details

Site Chosen By:

County

Form A: MANARA

Parish

Cadastre

Licensed:

invalid code

WLL 3339

Region: 70 - Lachlan

CMA Map: 7732

River Basin: 412 - LACHLAN RIVER

Grid Zone:

Scale:

Area/District:

Elevation: 0.00 m (A.H.D.)

Northing: 6352935.000

Latitude: 32°55'51.5"S

Elevation Source: (Unknown)

Easting: 240047.000

Longitude: 144°13'11.5"E

GS Map: -

MGA Zone: 55

Coordinate Source: GD.,ACC.MAP

### Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	Threaded Steel	-0.30	51.20	127			Suspended in Clamps

### Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
29.90	30.20	0.30	Unconsolidated	28.00		0.13			
32.00	32.30	0.30	Unconsolidated	28.00		0.13			
37.80	38.10	0.30	Consolidated	28.00		0.13			
40.80	42.30	1.50	Unconsolidated	27.40		0.25			
50.90	51.80	0.90	(Unknown)	27.40		0.63			

### Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	3.05	3.05	Clay Red	Clay	
3.05	3.35	0.30	Gypsum	Gypsum	
3.35	25.60	22.25	Clay Grey Sand	Clay	
25.60	28.96	3.36	Clay Yellow	Clay	
28.96	29.87	0.91	Clay Yellow Sand	Clay	
29.87	30.18	0.31	Clay Sand Water Supply	Clay	
30.18	32.00	1.82	Clay Yellow Sand	Clay	
32.00	32.31	0.31	Clay Sand Water Supply	Clay	
32.31	35.36	3.05	Clay Yellow Sand	Clay	
35.36	36.58	1.22	Clay Yellow	Clay	
36.58	37.80	1.22	Clay Yellow Sand	Clay	
37.80	38.10	0.30	Sandstone Grey Water Supply	Sandstone	
38.10	39.62	1.52	Drift Grey	Invalid Code	
39.62	40.84	1.22	Clay Yellow	Clay	
40.84	42.37	1.53	Drift Grey Water Supply	Invalid Code	
42.37	50.29	7.92	Clay Yellow	Clay	
50.29	50.90	0.61	Sandstone Yellow	Sandstone	
50.90	51.82	0.92	Sandstone Drift Water Supply	Sandstone	

\*\*\* End of GW013811 \*\*\*

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

# WaterNSW

## Work Summary

GW019903

Licence:	Licence Status:
	Authorised Purpose(s): Intended Purpose(s): STOCK
Work Type: Bore	
Work Status:	
Construct.Method: Cable Tool	
Owner Type: Private	
Commenced Date:	Final Depth: 55.80 m
Completion Date: 01/06/1962	Drilled Depth: 55.80 m
Contractor Name: (None)	
Driller:	
Assistant Driller:	
Property:	Standing Water Level (m):
GWMA:	Salinity Description:
GW Zone:	Yield (L/s):

### Site Details

Site Chosen By:			
	County Form A: MOSSGIEL Licensed:	Parish invalid code	Cadastre WLL 283
Region: 70 - Lachlan	CMA Map: 7732		
River Basin: 412 - LACHLAN RIVER Area/District:	Grid Zone:	Scale:	
Elevation: 0.00 m (A.H.D.) Elevation Source: (Unknown)	Northing: 6348967.000 Easting: 249898.000	Latitude: 32°58'08.5"S Longitude: 144°19'26.5"E	
GS Map: -	MGA Zone: 55	Coordinate Source: PR.,ACC.MAP	

### Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	Threaded Steel	-0.30	53.20	152			Suspended in Clamps
1	1	Opening	Screen	52.10	54.80	102		1	A: 0.25mm

### Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
39.60	55.10	15.50	(Unknown)	29.30		0.94			

### Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.91	0.91	Sand	Sand	
0.91	3.35	2.44	Clay Grey	Clay	
3.35	4.27	0.92	Gravel	Gravel	
4.27	16.76	12.49	Sand	Sand	
16.76	18.29	1.53	Sandstone	Sandstone	
18.29	39.62	21.33	Clay	Clay	

39.62	55.17	15.55	Sand Water Supply	Sand	
55.17	55.47	0.30	Clay	Clay	
55.47	55.78	0.31	Sand	Sand	

Remarks

30/06/1982: 1M OF STONES PLACED IN BASE OF HOLE

\*\*\* End of GW019903 \*\*\*

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

# WaterNSW

## Work Summary

GW019904

Licence:	Licence Status:
Authorised Purpose(s): Intended Purpose(s): STOCK	
Work Type: Bore	
Work Status:	
Construct.Method: Cable Tool	
Owner Type: Private	
Commenced Date:	Final Depth: 49.40 m
Completion Date: 01/06/1962	Drilled Depth: 49.40 m
Contractor Name: (None)	
Driller:	
Assistant Driller:	
Property:	Standing Water Level (m):
GWMA:	Salinity Description:
GW Zone:	Yield (L/s):

### Site Details

Site Chosen By:			
County		Parish	Cadastre
Form A: MOSSGIEL	invalid code	WLL 283	
Licensed:			
Region: 70 - Lachlan		CMA Map: 7732	
River Basin: 425 - DARLING RIVER	Grid Zone:	Scale:	
Area/District:			
Elevation: 0.00 m (A.H.D.)	Northing: 6350488.000	Latitude: 32°57'22.5"S	
Elevation Source: (Unknown)	Easting: 253965.000	Longitude: 144°22'04.5"E	
GS Map: -	MGA Zone: 55	Coordinate Source: PR.,ACC.MAP	

### Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	Threaded Steel	0.00	46.30	152			Suspended in Clamps

### Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
43.60	43.60	0.00	Unconsolidated						
46.30	46.30	0.00	Unconsolidated	32.00		0.76			

### Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.91	0.91	Topsoil	Topsoil	
0.91	5.49	4.58	Clay Red	Clay	
5.49	13.41	7.92	Clay Grey	Clay	
13.41	32.31	18.90	Clay Sandy	Clay	
32.31	41.45	9.14	Clay	Clay	
41.45	41.76	0.31	Sand	Sand	

41.76	49.38	7.62	Clay	Clay	
-------	-------	------	------	------	--

\*\*\* End of GW019904 \*\*\*

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

WaterNSW
Work Summary

GW036919

Licence: Licence Status:
Authorised Purpose(s):
Intended Purpose(s): MONITORING BORE
Work Type: Bore - Nested (2)
Work Status: Manual Observations,Monthly
Construct.Method: Rotary Mud
Owner Type: NSW Office of Water
Commenced Date: Final Depth: 95.00 m
Completion Date: 20/08/1991 Drilled Depth:
Contractor Name: DWR GROUNDWATER DRILLING
Driller: Gerard Anthony Smit
Assistant Driller:
Property: Standing Water Level (m): 30.360
GWMA: Salinity Description:
GW Zone: Yield (L/s): 1.500

Site Details

Site Chosen By:
County: MANARA
Parish: YELTY
Cadastre: 931/761988
Form A: Licensed:
Region: 85 - Far West
CMA Map: 7732
River Basin: 412 - LACHLAN RIVER
Grid Zone: Scale:
Area/District:
Elevation: 89.33 m (A.H.D.)
Northing: 6358808.000
Latitude: 32°52'46.1"S
Elevation Source: (unknown) Easting: 246017.000 Longitude: 144°17'06.9"E
GS Map: - MGA Zone: 55 Coordinate Source: Surveyed

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	52.00	200			Rotary Mud
1		Annulus	Waterworn/Rounded	0.00	52.00	200	100		Q:1.000m3
1		Backfill	Backfill	51.00	52.00	200			
1	1	Casing	Steel	-1.20	1.80	200			Cemented, Driven into Hole
1	1	Casing	Pvc Class 12	-1.00	51.00	100			
1	1	Opening	Slots - Diagonal	39.00	45.00	100		1	Sawn, PVC Class 12, SL: 200.0mm, A: 1.50mm
2		Hole	Hole	0.00	92.00	200			Rotary Mud
2		Hole	Hole	92.00	95.00	100			Other
2		Annulus	Waterworn/Rounded	40.00	95.00	100			Q:2.000m3
2		Backfill	Backfill	76.00	95.00				
2	2	Casing	Steel	-1.20	1.80	200			Cemented
2	2	Casing	Pvc Class 12	-1.00	76.00	100			
2	2	Opening	Slots - Diagonal	58.00	70.00	100		2	Sawn, PVC Class 12, SL: 200.0mm, A: 1.50mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
39.00	45.00	6.00	Unknown	30.56		0.50			
58.00	70.00	12.00	Unknown	30.36		1.50			

Remarks

13/10/2008: Nat Carling, 13-Oct-2008: Updated RL's & coordinates, based in info provided in State Water Survey database, provided by Jim Salmon.
31/03/2011: Karla Abbs, 31-Mar-2011: Entered geology log

\*\*\* End of GW036919 \*\*\*

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

# WaterNSW

## Work Summary

GW040514

Licence:	Licence Status:
	Authorised Purpose(s): Intended Purpose(s): IRRIGATION
Work Type: Bore	
Work Status:	
Construct.Method:	
Owner Type:	
Commenced Date:	Final Depth:
Completion Date:	Drilled Depth:
Contractor Name: (None)	
Driller:	
Assistant Driller:	
Property:	Standing Water Level (m):
GWMA:	Salinity Description:
GW Zone:	Yield (L/s):

### Site Details

Site Chosen By:			
	County Form A: MANARA Licensed:	Parish invalid code	Cadastre WLL 3339
Region: 70 - Lachlan	CMA Map: 7732		
River Basin: 412 - LACHLAN RIVER Area/District:	Grid Zone:	Scale:	
Elevation: 0.00 m (A.H.D.) Elevation Source: (Unknown)	Northing: 6360860.000 Easting: 240099.000	Latitude: 32°51'34.5"S Longitude: 144°13'21.5"E	
GS Map: -	MGA Zone: 55	Coordinate Source: GD.,ACC.MAP	

### Remarks

06/11/2009: Reviewed data - nothing to update.

\*\*\* End of GW040514 \*\*\*

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

WaterNSW

Work Summary

GW040560

Licence:	Licence Status:
	Authorised Purpose(s): Intended Purpose(s): STOCK
Work Type: Bore	
Work Status:	
Construct.Method:	
Owner Type:	
Commenced Date:	Final Depth:
Completion Date:	Drilled Depth:
Contractor Name: (None)	
Driller:	
Assistant Driller:	
Property:	Standing Water Level (m):
GWMA:	Salinity Description:
GW Zone:	Yield (L/s):

Site Details

Site Chosen By:			
	County Form A: MANARA Licensed:	Parish invalid code	Cadastre WLL 2853
Region: 70 - Lachlan	CMA Map: 7732		
River Basin: 412 - LACHLAN RIVER	Grid Zone:	Scale:	
Area/District:			
Elevation: 0.00 m (A.H.D.)	Northing: 6350470.000	Latitude: 32°57'14.5"S	
Elevation Source: (Unknown)	Easting: 243622.000	Longitude: 144°15'26.5"E	
GS Map: -	MGA Zone: 55	Coordinate Source: GD,ACC.MAP	

Remarks

06/11/2009: Reviewed data - nothing to update.

\*\*\* End of GW040560 \*\*\*

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

# WaterNSW

## Work Summary

GW040561

Licence:	Licence Status:
	Authorised Purpose(s): Intended Purpose(s): STOCK
Work Type: Bore	
Work Status:	
Construct.Method:	
Owner Type:	
Commenced Date:	Final Depth:
Completion Date: 19/06/1992	Drilled Depth:
Contractor Name: (None)	
Driller:	
Assistant Driller:	
Property:	Standing Water Level (m):
GWMA:	Salinity Description:
GW Zone:	Yield (L/s):

### Site Details

Site Chosen By:			
	County Form A: MANARA Licensed:	Parish invalid code	Cadastre WLL 2853
Region: 70 - Lachlan	CMA Map: 7732		
River Basin: 412 - LACHLAN RIVER Area/District:	Grid Zone:	Scale:	
Elevation: 0.00 m (A.H.D.) Elevation Source: (Unknown)	Northing: 6347087.000 Easting: 243944.000	Latitude: 32°59'04.5"S Longitude: 144°15'35.5"E	
GS Map: -	MGA Zone: 55	Coordinate Source: GD.,ACC.MAP	

### Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	5.50	0			(Unknown)
1	1	Casing		0.00	0.00				

### Remarks

06/11/2009: Reviewed data - nothing to update.  
16/08/2013: Nat Carling, 16-Aug-2013; Added hole (based on deepest water level reading) & casing details, to enable data migration to HydstraGW.

**Warning To Clients:** This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

# WaterNSW

## Work Summary

GW055706

Licence:

Licence Status:

Authorised Purpose(s):  
Intended Purpose(s): STOCK

Work Type: Bore

Work Status:

Construct.Method: Cable Tool

Owner Type: Private

Commenced Date:  
Completion Date: 01/09/1981

Final Depth: 7.60 m  
Drilled Depth: 76.20 m

Contractor Name: (None)

Driller:

Assistant Driller:

Property:

Standing Water Level (m):  
Salinity Description: Good Stock  
Yield (L/s):

GWMA:  
GW Zone:

### Site Details

Site Chosen By:

County  
Form A: MOSSGIEL  
Licensed:

Parish  
invalid code

Cadastre  
WLL 283

Region: 70 - Lachlan

CMA Map: 7732

River Basin: 412 - LACHLAN RIVER  
Area/District:

Grid Zone:

Scale:

Elevation: 0.00 m (A.H.D.)  
Elevation Source: (Unknown)

Northing: 6350583.000  
Easting: 254093.000

Latitude: 32°57'19.5"S  
Longitude: 144°22'09.5"E

GS Map: -

MGA Zone: 55

Coordinate Source: GD.,ACC.MAP

### Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	P.V.C.	0.00	73.50	114			Suspended in Clamps
1	1	Opening	Screen	73.20	76.20	81		1	Stainless Steel, A: 0.25mm

### Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
36.60	41.20	4.60	Unconsolidated	31.40					
73.20	76.20	3.00	Unconsolidated	31.40		3.03			

### Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	7.62	7.62	Clay	Clay	
7.62	32.00	24.38	Clay Sandy	Clay	
32.00	36.58	4.58	Clay Variegated	Clay	
36.58	41.15	4.57	Sand Fine Dirty	Sand	
41.15	57.91	16.76	Clay Sandy	Clay	

57.91	64.01	6.10	Clay	Clay	
64.01	73.15	9.14	Clay Sandy	Clay	
73.15	76.20	3.05	Sand Water Supply	Sand	

\*\*\* End of GW055706 \*\*\*

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

APPENDIX B  
LANDHOLDER/LEASEHOLDER CONSULTATION SUMMARY

Appendix B  
Landholder Consultation

Ground Water ID	Local Bore Name	Lot	DP	Consultee	Bore Census Findings		
					Status	Location	TDS/Pumping Rate
GW004247	GW004247	56	DP767383	Gregory Turner	In Use.	Confirmed	Unknown
GW006222	GW006222	930	DP761987	Gregory Turner	Not in use.	Confirmed	-
GW006224	GW006224	930	DP761987	Gregory Turner	Not in use.	Confirmed	-
GW006769	GW006769	931	DP761988	Richard Gates	In Use.	Incorrect Location. Corrected to 32551745 S, 144154795 E	4500ppm/ 800G/hr (3,637L/hr).
GW006771	Woolshed Bore	931	DP761988	Richard Gates	In Use.	Confirmed	8000ppm/ 700G/hr (3182L/hr)
GW013811	2 Mile Bore	931	DP761988	Richard Gates	In Use.	Confirmed	4500ppm/ 800G/hr (3,671L/hr).
GW036919	GW036919	931	DP761988	Richard Gates	In Use.	Confirmed	-
GW040514	GW040514	931	DP761988	Richard Gates	Not in use.	Confirmed	-
GW040560	GW040560	932	DP761989	Gregory Turner	In Use.	Aerial imagery indicates the bore is incorrectly located and should be relocated to to 32561646 S, 144125645 E	6000ppm
GW019903	Harris Well	4568	DP768560	Gregory Turner	In Use.	Aerial imagery indicates the bore is incorrectly located and should be relocated to 32583832 S, 144185438 E.	1000 to 1200ppm.
GW019904	North Well	4568	DP768560	Gregory Turner	In Use	Confirmed	1000 to 1200ppm.
GW055706	Osbornes Bore	4568	DP768560	Graham Holbrook Turner and Judith Mary Turner	In Use	Aerial imagery indicates the bore is incorrectly located and should be relocated to 32581418 S, 144234570 E.	1000 to 1200ppm.
GW006745	GW006745	4568	DP768560	Gregory Turner	Leaseholder did not discuss bore.		
GW007180	Angle Bore	4568	DP768560	Gregory Turner	Leaseholder did not discuss bore.		
GW040561	GW040560	932	DP761989	Gregory Turner	Leaseholder did not discuss bore.		
GW003848	Ivanhoe Railway Bore	56	DP767383	The State of New South Wales	No consultation with landholder.		
GW009827	GW009827	56	DP767383	The State of New South Wales	No consultation with landholder.		
GW006308	GW006308	2140	DP765875	RI, AR Hiscock and MV and LJ Newnham	Leaseholder unable to be contacted.		

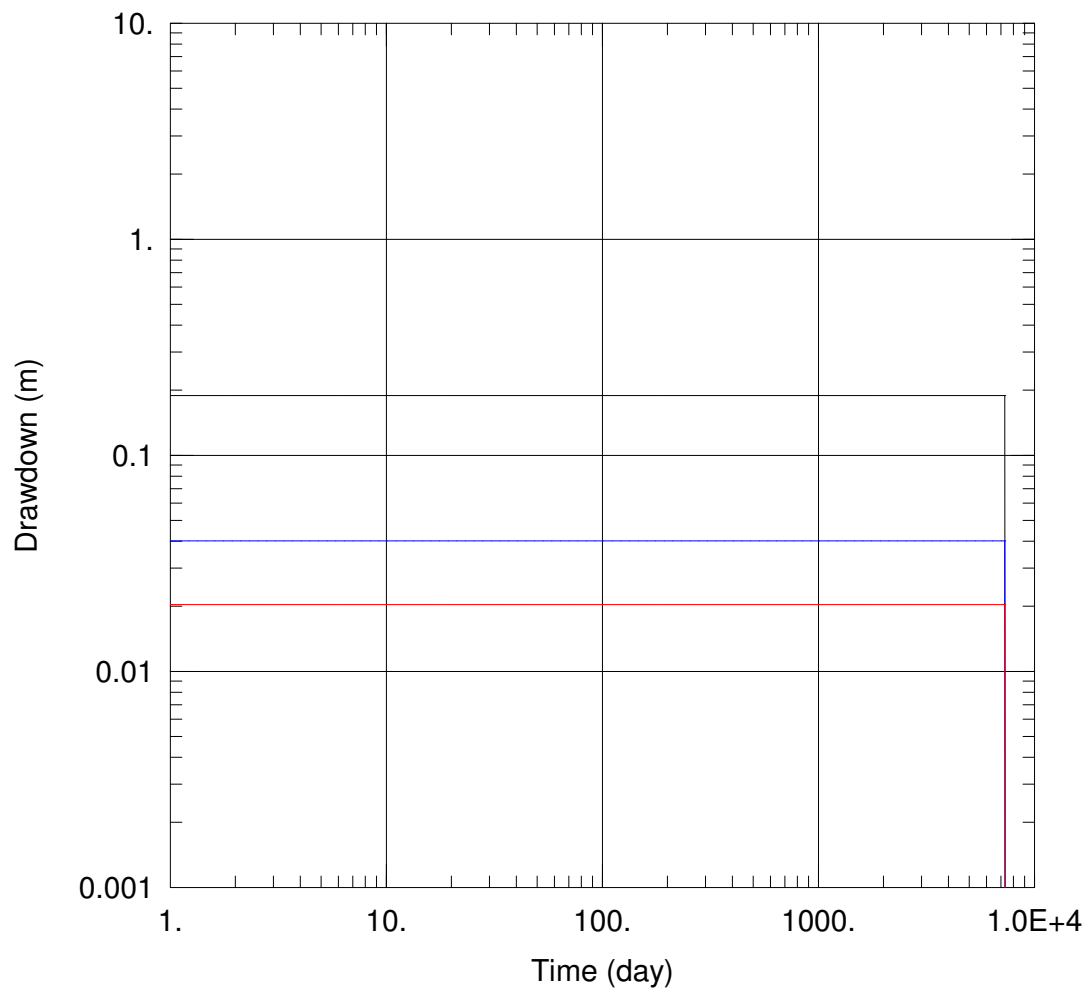
TDS = Total dissolved solids

APPENDIX C  
GROUNDWATER BORE CENSUS DATABASE

Appendix C  
Groundwater Bore Census Database

Groundwater ID	Local Bore Name	Easting	Northing	Zone (MGA 94)	Lot	DP	Ownership	Intended Purpose	Bore Census Status	SWL (m)	Depth Drilled (m)	Date Drilled
GW003848	Ivanhoe Railway Bore	249265	6355456	55	56	DP767383	The State of New South Wales	Stock	In Use	-	54.9	1/12/1943
GW004247	GW004247	248024	6356164	55	56	DP767383	The State of New South Wales	Stock	In Use	-	63.7	1/06/1909
GW009827	GW009827	248471	6355990	55	56	DP767383	The State of New South Wales	Domestic	In Use	-	46.9	1/08/1951
GW006222	GW006222	234962	6361248	55	930	DP761987	Graham Holbrook Turner and Judith Mary Turner	Stock	Not In Use	-	32.6	1/08/1937
GW006224	GW006224	236899	6359850	55	930	DP761987	Graham Holbrook Turner and Judith Mary Turner	Stock	Not In Use	-	86.3	1/07/1937
GW006769	GW006769	244084	6354091	55	931	DP761988	Graham Holbrook Turner and Judith Mary Turner	Stock	In Use	-	80.2	1/01/1941
GW006771	Woolshed Bore	247048	6359746	55	931	DP761988	Richard Darel Gates and Joanne Dee Gates	Stock	In Use	-	53	1/02/1942
GW013811	2 Mile Bore	240047	6352935	55	931	DP761988	Richard Darel Gates and Joanne Dee Gates	Stock	In Use	-	51.8	1/01/1959
GW036919	GW036919	246017	6358808	55	931	DP761988	Richard Darel Gates and Joanne Dee Gates	Monitoring Bore	In Use	30.36	95	20/08/1991
GW040514	GW040514	240099	6360860	55	931	DP761988	Richard Darel Gates and Joanne Dee Gates	Irrigation	Not In Use	-	-	-
GW040560	GW040560	239676	6352156	55	932	DP761989	Gregory James Turner	Stock	In Use	-	-	-
GW006308	GW006308	251251	6359174	55	2140	DP765875	Robert Ian, Andrew Robert Hiscock and Mark Vivian, Lee Jane Newnham	Stock	In Use	-	54.9	1/01/1938
GW006745	GW006745	251439	6351719	55	4568	DP768560	Graham Holbrook Turner and Judith Mary Turner	Stock	In Use	-	41.2	1/11/1940
GW007180	Angle Bore	251439	6351719	55	4568	DP768560	Graham Holbrook Turner and Judith Mary Turner	Stock	In Use	-	47.9	1/02/1946
GW019903	Harris Well	249898	6348967	55	4568	DP768560	Graham Holbrook Turner and Judith Mary Turner	Stock	In Use	-	55.8	1/06/1962
GW040561	GW040561	243944	6347087	55	932	DP761989	Gregory James Turner	Stock	In Use	-	-	19/06/1992
GW019904	North Well	253965	6350488	55	4568	DP768560	Graham Holbrook Turner and Judith Mary Turner	Stock	In Use	-	49.4	1/06/1962
GW055706	Osbornes Bore	256633	6348961	55	4568	DP768560	Graham Holbrook Turner and Judith Mary Turner	Stock	In Use	-	76.2	1/09/1981
Key												
	Verified by Leaseholder											
	Outside Bore Census Area											

Attachment B  
AQTESOLV Predictive Analyses



### IVANHOE RAIL SIDING BORE

#### AQUIFER DATA

Saturated Thickness: 11. m  
Aquitard Thickness (b'): 10. m

Anisotropy Ratio (Kz/Kr): 0.1  
Aquitard Thickness (b''): 20. m

#### WELL DATA

##### Pumping Wells

Well Name	X (m)	Y (m)
IV1	243126	6355388

##### Observation Wells

Well Name	X (m)	Y (m)
□ IV1	243126	6355388
□ +10	243136	6355388
□ +20	243146	6355388
□ +100	243226	6355388

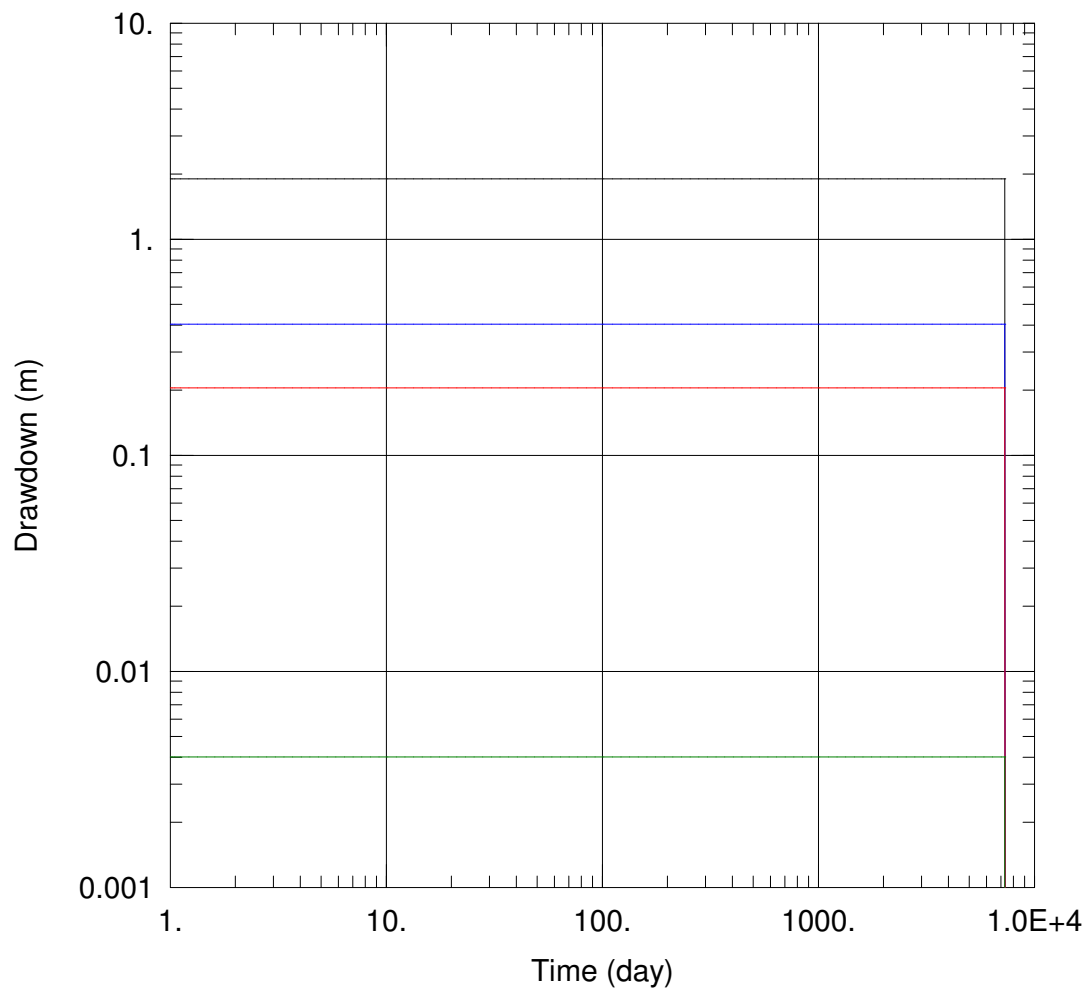
#### SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush

$T = 724. \text{ m}^2/\text{day}$   
 $1/B' = 0.0401 \text{ m}^{-1}$   
 $1/B'' = 0. \text{ m}^{-1}$

$S = 0.0001$   
 $B'/r = 9.16\text{E-}5 \text{ m}^{-1}$   
 $B''/r = 0. \text{ m}^{-1}$



### IVANHOE RAIL SIDING BORE

#### AQUIFER DATA

Saturated Thickness: 11. m  
Aquitard Thickness (b'): 10. m

Anisotropy Ratio (Kz/Kr): 0.1  
Aquitard Thickness (b''): 20. m

#### WELL DATA

##### Pumping Wells

Well Name	X (m)	Y (m)
IV1	243126	6355388

##### Observation Wells

Well Name	X (m)	Y (m)
□ IV1	243126	6355388
□ +10	243136	6355388
□ +20	243146	6355388
□ +100	243226	6355388

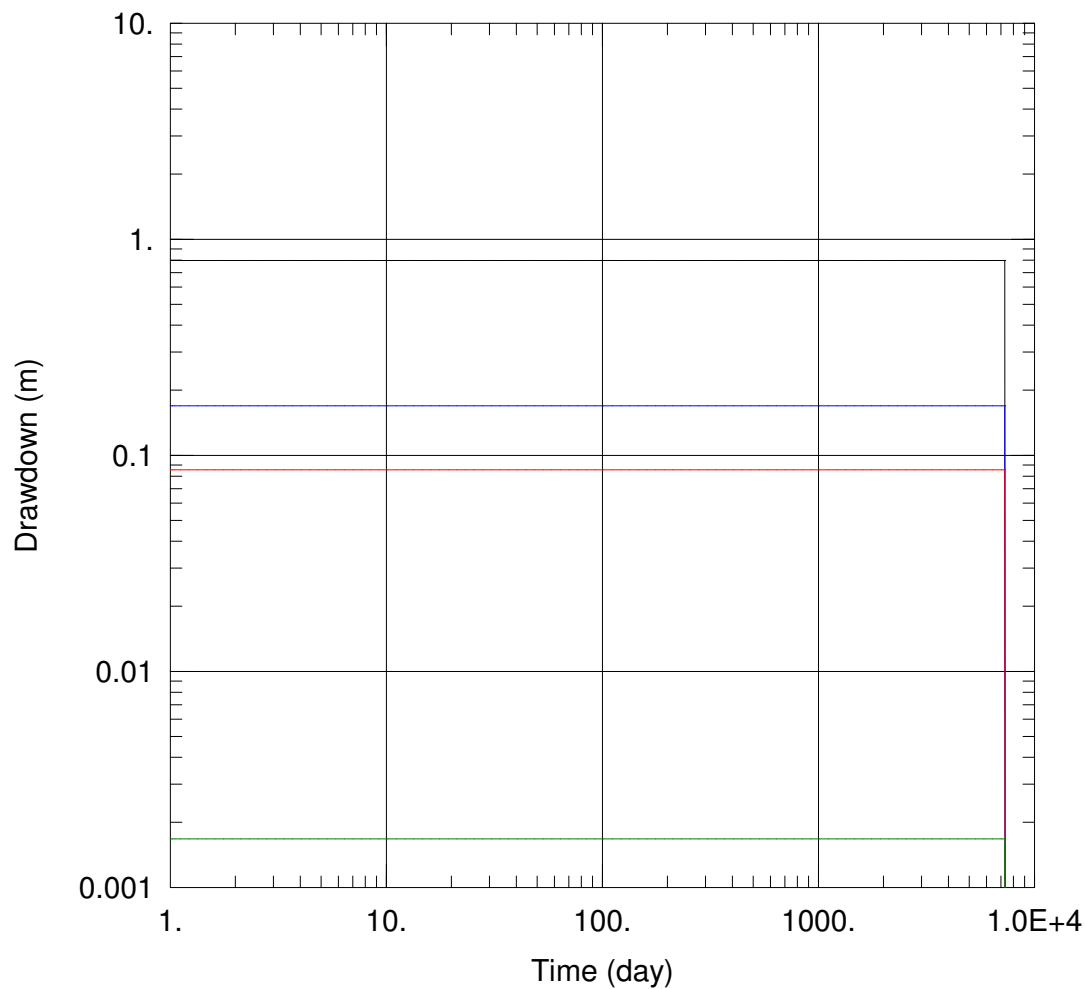
#### SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush

$T = 71.81 \text{ m}^2/\text{day}$   
 $1/B' = 0.0401 \text{ m}^{-1}$   
 $1/B'' = 0. \text{ m}^{-1}$

$S = 0.0001$   
 $B'/r = 0.000291 \text{ m}^{-1}$   
 $B''/r = 0. \text{ m}^{-1}$



### IVANHOE RAIL SIDING BORE

#### AQUIFER DATA

Saturated Thickness: 11. m  
Aquitard Thickness (b'): 10. m

Anisotropy Ratio (Kz/Kr): 0.1  
Aquitard Thickness (b''): 20. m

#### WELL DATA

##### Pumping Wells

Well Name	X (m)	Y (m)
IV1	243126	6355388

##### Observation Wells

Well Name	X (m)	Y (m)
□ IV1	243126	6355388
□ +10	243136	6355388
□ +20	243146	6355388
□ +100	243226	6355388

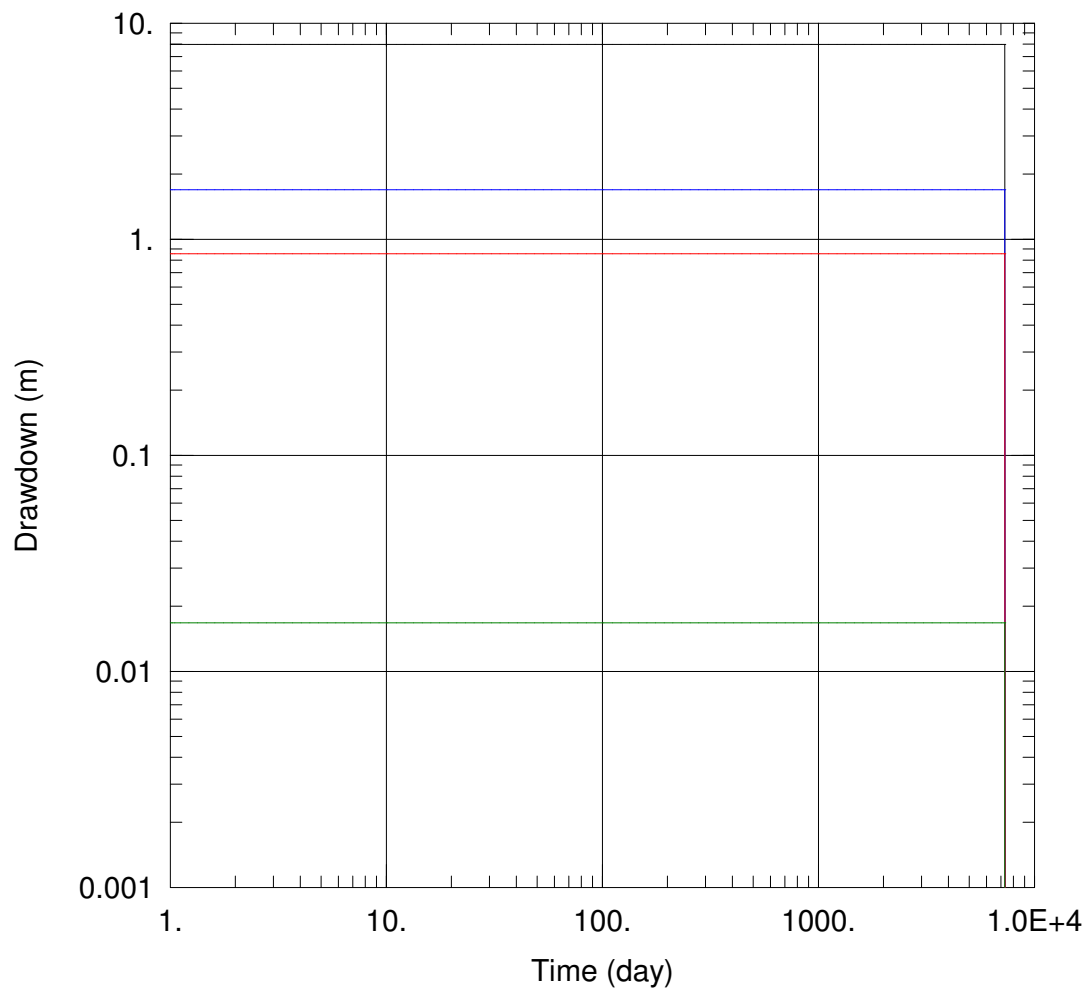
#### SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush

$T = 171.7 \text{ m}^2/\text{day}$   
 $1/B' = 0.0401 \text{ m}^{-1}$   
 $1/B'' = 0. \text{ m}^{-1}$

$S = 0.0001$   
 $B'/r = 0.000188 \text{ m}^{-1}$   
 $B''/r = 0. \text{ m}^{-1}$



### IVANHOE RAIL SIDING BORE

#### AQUIFER DATA

Saturated Thickness: 11. m  
Aquitard Thickness (b'): 10. m

Anisotropy Ratio (Kz/Kr): 0.1  
Aquitard Thickness (b''): 20. m

#### WELL DATA

##### Pumping Wells

Well Name	X (m)	Y (m)
IV1	243126	6355388

##### Observation Wells

Well Name	X (m)	Y (m)
□ IV1	243126	6355388
□ +10	243136	6355388
□ +20	243146	6355388
□ +100	243226	6355388

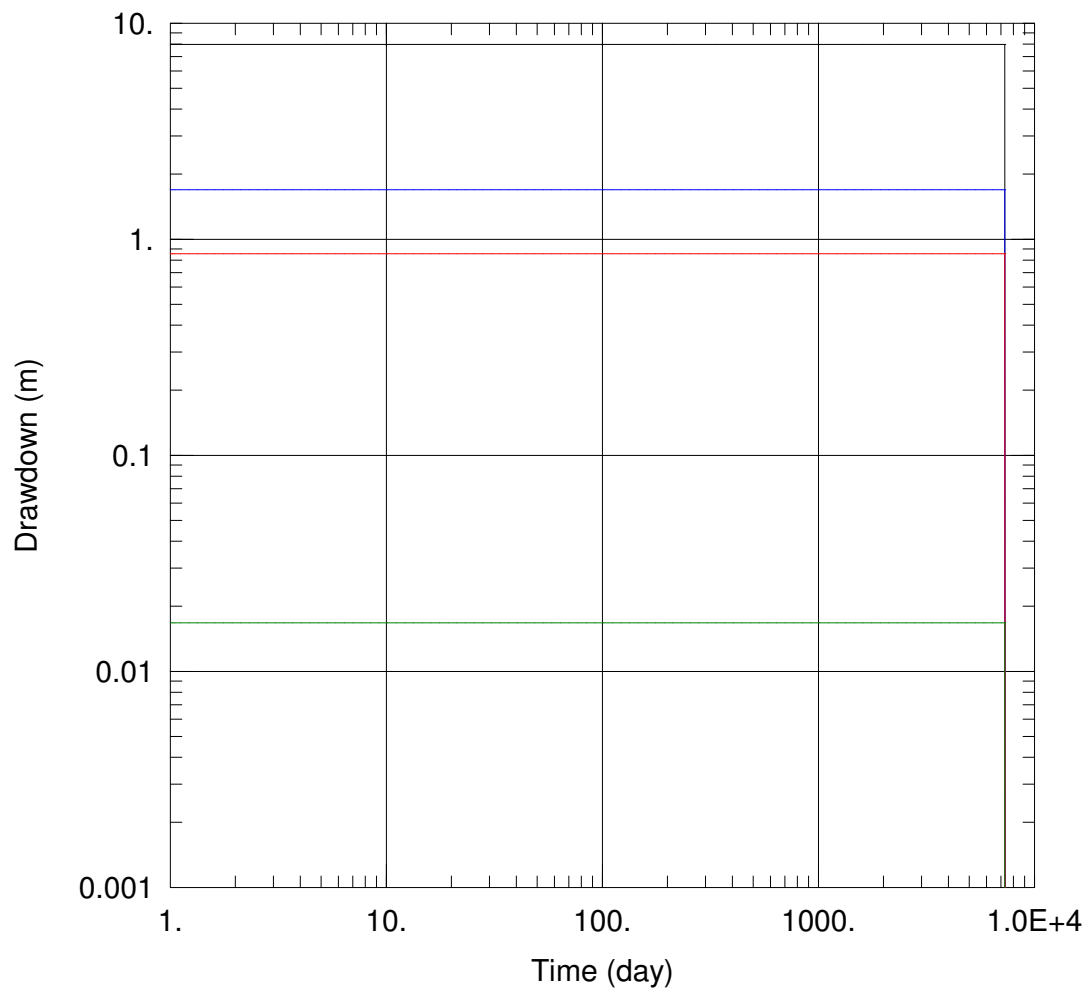
#### SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush

$T = 17.17 \text{ m}^2/\text{day}$   
 $1/B' = 0.0401 \text{ m}^{-1}$   
 $1/B'' = 0. \text{ m}^{-1}$

$S = 0.0001$   
 $B'/r = 0.000595 \text{ m}^{-1}$   
 $B''/r = 0. \text{ m}^{-1}$



### IVANHOE RAIL SIDING BORE

#### AQUIFER DATA

Saturated Thickness: 11. m  
Aquitard Thickness (b'): 10. m

Anisotropy Ratio (Kz/Kr): 0.1  
Aquitard Thickness (b''): 20. m

#### WELL DATA

##### Pumping Wells

Well Name	X (m)	Y (m)
IV1	243126	6355388

##### Observation Wells

Well Name	X (m)	Y (m)
□ IV1	243126	6355388
□ +10	243136	6355388
□ +20	243146	6355388
□ +100	243226	6355388

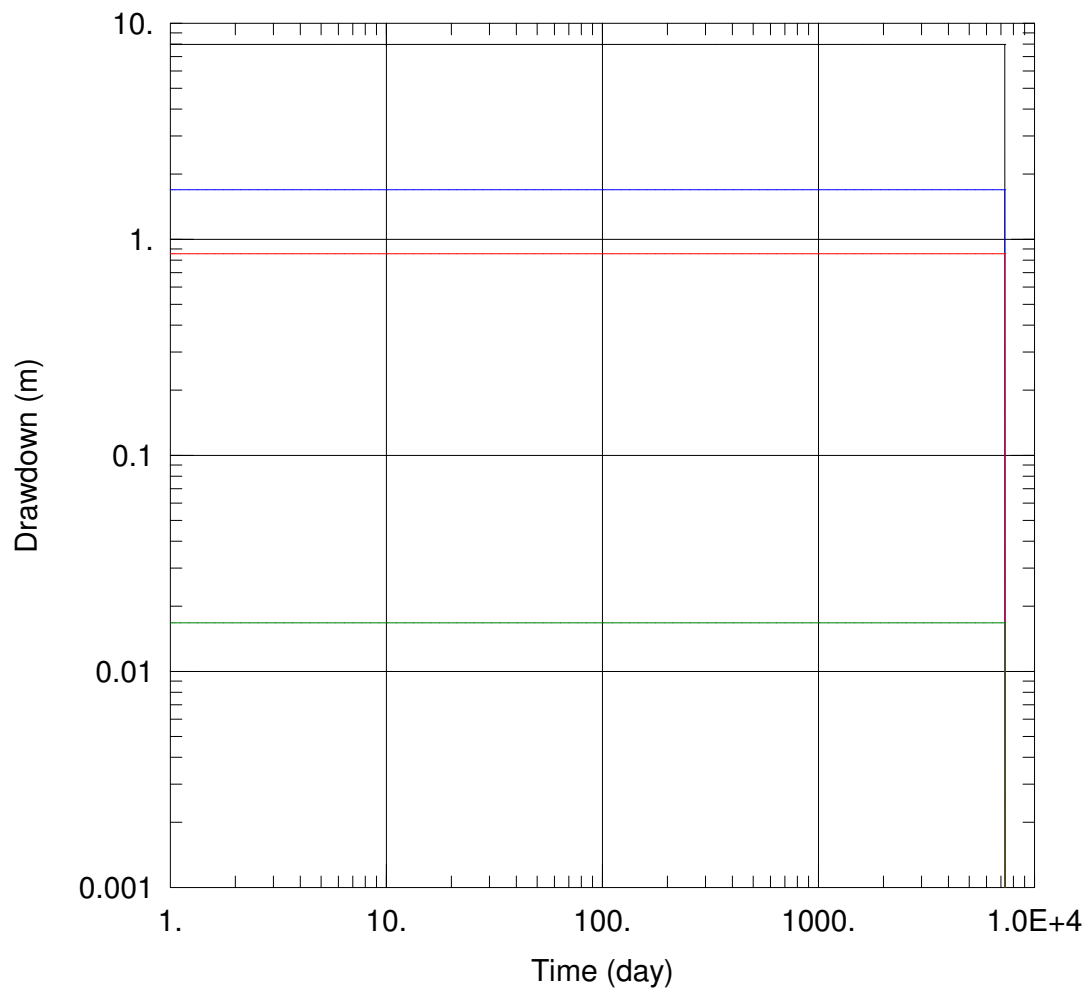
#### SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush

$T = 17.17 \text{ m}^2/\text{day}$   
 $1/B' = 0.0401 \text{ m}^{-1}$   
 $1/B'' = 0. \text{ m}^{-1}$

$S = 1.0\text{E-}5$   
 $B'/r = 0.00188 \text{ m}^{-1}$   
 $B''/r = 0. \text{ m}^{-1}$



### IVANHOE RAIL SIDING BORE

#### AQUIFER DATA

Saturated Thickness: 11. m  
Aquitard Thickness (b'): 10. m

Anisotropy Ratio (Kz/Kr): 0.1  
Aquitard Thickness (b''): 20. m

#### WELL DATA

##### Pumping Wells

Well Name	X (m)	Y (m)
IV1	243126	6355388

##### Observation Wells

Well Name	X (m)	Y (m)
□ IV1	243126	6355388
□ +10	243136	6355388
□ +20	243146	6355388
□ +100	243226	6355388

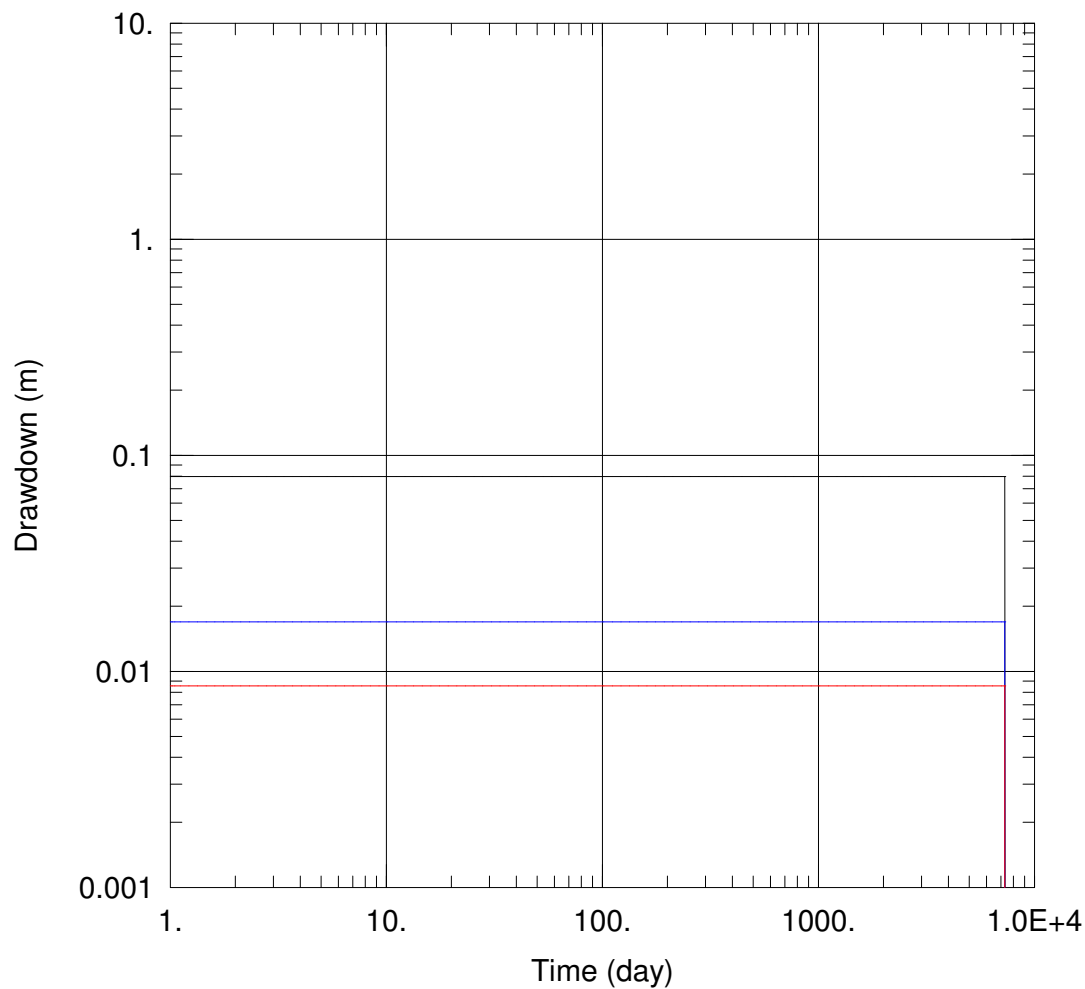
#### SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush

$T = 17.17 \text{ m}^2/\text{day}$   
 $1/B' = 0.0401 \text{ m}^{-1}$   
 $1/B'' = 0. \text{ m}^{-1}$

$S = 0.0001$   
 $B'/r = 0.000188 \text{ m}^{-1}$   
 $B''/r = 0. \text{ m}^{-1}$



### IVANHOE RAIL SIDING BORE

#### AQUIFER DATA

Saturated Thickness: 11. m  
Aquitard Thickness (b'): 10. m

Anisotropy Ratio (Kz/Kr): 0.1  
Aquitard Thickness (b''): 20. m

#### WELL DATA

##### Pumping Wells

Well Name	X (m)	Y (m)
IV1	243126	6355388

##### Observation Wells

Well Name	X (m)	Y (m)
□ IV1	243126	6355388
□ +10	243136	6355388
□ +20	243146	6355388
□ +100	243226	6355388

#### SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush

$T = 1717. \text{ m}^2/\text{day}$   
 $1/B' = 0.0401 \text{ m}^{-1}$   
 $1/B'' = 0. \text{ m}^{-1}$

$S = 1.0\text{E-}5$   
 $B'/r = 5.95\text{E-}5 \text{ m}^{-1}$   
 $B''/r = 0. \text{ m}^{-1}$