Mining Proposal

Miralga Creek

15/04/2021

180-LAH-EN-REP-0001 v2

Tenements:
M45/1280, M45/1281, M45/1282,
G45/340, L45/189, L45/525, L45/538

Environmental Group Site:
J03305

Contact details:
David Morley
Atlas Iron Pty Ltd
Level 17, Raine Square
300 Murray St
Perth WA 6000
via: David.Morley@atlasiron.com.au

Authorisation

Version	Reason for Issue	Prepared	Checked	Authorised	Date
A	Internal review	S. Springer	F. Jones		01/05/2020
B	Internal review	S. Springer F. Jones	D. Morley N. Bell M. Goggin		08/05/2020
0	Submission to DMIRS	D. Morley	M. Goggin	M. Ramsden	18/05/2020
1	Address DMIRS comments	D. Morley	M. Goggin	M. Ramsden	07/09/2020
2	Issued for use	D. Morley	N. Bell	H. Nielssen	15/04/2021

Level 17, Raine Square
300 Murray Street
Perth WA 6000

T +61 8 6228 8000

E atlas@atlasiron.com.au
W atlasiron.com.au

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Abbreviations

AEP	annual exceedance probability
AER	Annual Environmental Report
ALARP	as low as reasonably practicable
ALRE	Abydos Link Road East
ANFO	ammonium nitrate fuel oil
ARI	average return interval
Atlas	Atlas Iron Pty Ltd
BAC	Barlbinbinya Aboriginal Corporation
BC Act	*Biodiversity Conservation Act 2016*
BIF	banded iron formation
CAN	Australian Company Number
cm	centimetre
DBCA	Department of Biodiversity, Conservation and Attractions
DMIRS	Department of Mines, Industry Regulation and Safety
DPLH	Department of Planning, Lands and Heritage
DSO	direct shipping ore
DWER	Department of Water and Environmental Regulation
EARS	(DMIRS) Environmental Assessment and Regulatory System
EC	electrical conductivity
EGS	Environmental Group Site
EMP	Environmental Management Plan
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ERP	Emergency Response Plan
GDP	Ground Disturbance Permit
GL	gigalitre
GLpa	gigalitre per annum
ha	hectare
HSE	health, safety and environment
HSEC	Health, Safety, Environment and Communities
HSEMS	Health, Safety and Environmental Management System
IBRA	Interim Biogeographical Regionalisation for Australia

IFD	intensity-frequency-duration
km	kilometre
kt	kilotonne
LIDAR	Light Detection and Ranging
mAHD	metres Australian Height Datum
mbgl	metres below ground level
MCP	Mine Closure Plan
mm	millimetre
mm/s	millimetres per second
MNES	matter of national environmental significance
MOC	Mine Operation Centre
mRL	metres reduced level
mS/cm	milliSiemens per centimetre
Mt	Megatonne
NAC	Njamal Aboriginal Corporation
NAF	non-acid-forming
NVIS	National Vegetation Information System
PEC	Priority Ecological Community
(the) Project	(the) Miralga Creek Direct Shipping Ore Project
PSM	Pells Sullivan Meynink
RC	reverse circulation
REGID	registered ID
RFFE	Regional Flood Frequency Estimation
RIWI Act	*Rights In Water and Irrigation Act 1914*
ROM	run of mine
SMART	specific, measurable, achievable, relevant and time-bound
SRE	short-range endemic
SSMP	Significant Species Management Plan
TDS	total dissolved solids
TEC	Threatened Ecological Community
TSF	tailing storage facility
VT	vegetation type
WA	Western Australia
WAM	Western Australian Museum

WoNS	Weeds of National Significance
WRD	waste rock dump

1 Mining Proposal Checklist

Table 1-1 is the Mining Proposal checklist as required by the Guideline for Mining Proposals in Western Australia 2020.

Table 1-1: Mining Proposal Checklist

Q. No.	Mining Proposal (MP) Checklist	Y/N /NA	Comments	Page No.	Summary
1	Has the checklist been endorsed by a tenement holder(s) or a senior representative authorised by the tenement holder(s), such as a Registered Manager or Company Director?	Y		5	
2	Are you the tenement holder of all tenements associated with the Mining Proposal /group site? **Mining Proposals which have not been submitted by the tenement holder must include an authorisation from the tenement holder or an explanation of the company linkage to the tenement holder (e.g. for subsidiary companies).**	N	Authorisations have been obtained from Venturex Resources Limited	Appendix A	
3	For tenements with multiple tenement holders, have all of the other holders consented to this proposal being submitted? **Mining Proposals which have not been submitted by the tenement holder must include an authorisation from the tenement holder or an explanation of the company linkage to the tenement holder (e.g. for subsidiary companies).**	N/A			
4	Have contact details for questions on the Mining Proposal been provided?	Y		7	
5	Are all mining operations within granted tenement boundaries or does this Mining Proposal support a lease application?	N	This Mining Proposal does not support a lease application.		

Q. No.	Mining Proposal (MP) Checklist	Y/N /NA	Comments	Page No.	Summary
6	Is this the first Mining Proposal submitted for these tenements? If **No**, the version number of the revised Mining Proposal must be stated on the cover and a summary of changes included	N	This is the third version (v2) of this Mining Proposal. Tenement L45/189 has previously had one or more Mining Proposals submitted in respect of separate project(s).		
7	Have all tenement conditions been reviewed to ensure activities proposed in the Mining Proposal are in compliance?	Y			
8	Has a Mine Closure Plan been provided? **It is a requirement that every mining proposal include a mine closure plan.**	Y		Appendix E	
Public Availability					
9	Are you aware that this Mining Proposal is publicly available?	Y			
10	Is there any information in this Mining Proposal that should not be publicly available? If **Yes**, refer to Appendix B, section 7 of the guidelines for more information. Note: A non-confidential version of all mining proposals will be made available to the public	Y	Atlas requests that the tenure authorisation letter from Venturex Resources Limited contained in Appendix A is not publicly disclosed.	Appendix A	
11	If **Yes** to Q10, has confidential information been submitted in a separate document?	Y	Tenure authorisation from Venturex Resources Limited has been included in the EARS Online submission.		

Q. No.	Mining Proposal (MP) Checklist	Y/N /NA	Comments	Page No.	Summary
Mining Proposal Details					
12	Does the Mining Proposal cover page include: • Environmental Group Site name • Environmental Group Site code • company name (including telephone numbers and email addresses) • contact details • version number • date of submission.	Y			
13	Has information regarding the Environmental Group Site (EGS) been provided in accordance with the requirements of Appendix 4 of the guidelines?	Y		7	
14	Has a disturbance table been provided in accordance with the requirements of Appendix 2 of the statutory guidelines?	Y		19	
15	Has spatial data for all Mine Activity Types been provided in accordance with the specified properties and allowances?	Y		Appendix C	
16	Has a site plan, consistent with all spatial data and activity details, been provided? The site plan must show existing and proposed activities and other relevant information including tenement boundaries and other land tenure (e.g. Reserves and pastoral lease boundaries).	Y	Figures 4.1, 4.2, 4.3, 4.4 and 4.5	10–14	
17	Do you have and maintain an Environmental Management System?	Y	HSE Policy has been included as an appendix.	146, Appendix T	
Environmental Legislative Framework					
18	Does the Mining Proposal include a list of all relevant environmental approvals that have been sought or are required before the proposal may be implemented?	Y		46	
19	Does the Mining Proposal trigger any criteria for referral to the EPA within the DMP/EPA Memorandum of Understanding?	N			

Q. No.	Mining Proposal (MP) Checklist	Y/N /NA	Comments	Page No.	Summary
20	Has the Mining Proposal been referred to the EPA?	Y	The project was referred to the EPA on 7 April 2020.		
21	Has the proposal been deemed to not warrant formal assessment under Part IV of the EP Act, is currently under assessment by the EPA, or has been approved via a Ministerial Statement? If **Yes**, ensure details of Ministerial Statement, assessment level and/or assessment number are provided within the Mining Proposal	N	The project was approved on 23 November 2020 under Ministerial Statement No. 1154.		
22	Is a clearing permit required? If **No** then explain why.	N	A clearing permit is not required because the project has been authorised under Part IV of the EP Act.		
23	If **Yes** at Q22 then has a clearing permit been applied for?	N/A			
24	Is the Mining Proposal located on reserve land? If "Yes" state reserve types.	N			
25	Is the Mining Proposal wholly or partially within Department of Biodiversity, Conservation and Attractions (DBCA) managed areas?	N			
26	If **Yes** at Q25 has DBCA been consulted?	N/A			
27	Will any threatened or protected flora and/or fauna be impacted by this proposal?	Y	Impacts to flora and fauna are regulated under Part IV of the EP Act through Ministerial Statement No. 1154.	46	
28	Have the DPLH 'Aboriginal Heritage Due Diligence Guidelines' been used to identify the risk of impacts to aboriginal heritage sites?	Y		124	
29	If any aboriginal heritage sites will be impacted, has appropriate consent been sought under the *Aboriginal Heritage Act 1972*?	N/A	No Aboriginal heritage sites will be impacted.		

Q. No.	Mining Proposal (MP) Checklist	Y/N /NA	Comments	Page No.	Summary
30	Does the Mining Proposal include a tailings storage facility? Mining Proposals that include tailings storage facilities must include the relevant design reports outlined in the DMP's Guide to the preparation of a design report for tailings storage facilities (TSFs), August 2015.	N			
31	Does the Mining Proposal include the backfilling of mine voids? If Yes, the Mining Proposal must include a Sterilisation Report.	N			
32	Is the mining proposal located on pre-1899 Crown Grant lands? (not subject to the Mining Act)	N			
33	Has the construction of an airstrip been proposed? If Yes, indicate the date when Civil Aviation Safety Authority, Airservices Australia and the Local Government Authority were advised (in writing) of the proposal to construct an airstrip.	N			

Corporate Endorsement

I hereby certify that to the best of my knowledge, the information contained within this Mining Proposal and checklist is true and correct and addresses all the requirements of the Guidelines for Mining Proposals in Western Australia approved by the Director General of Mines.

Name: Stacey Brown **Signed:**

Position: Manager Projects **Date:** 15/4/21

(Note: The corporate endorsement must be given by tenement holder(s) or a senior representative authorised by the tenement holder(s), such as a Registered Manager or Company Director)

2 Tenement Holder Authorisation

All Project tenements are held by Atlas with the exception of L45/189 held by Venturex Resources Limited. Authorisation to operate over L45/189 has been obtained and is provided in Appendix A.

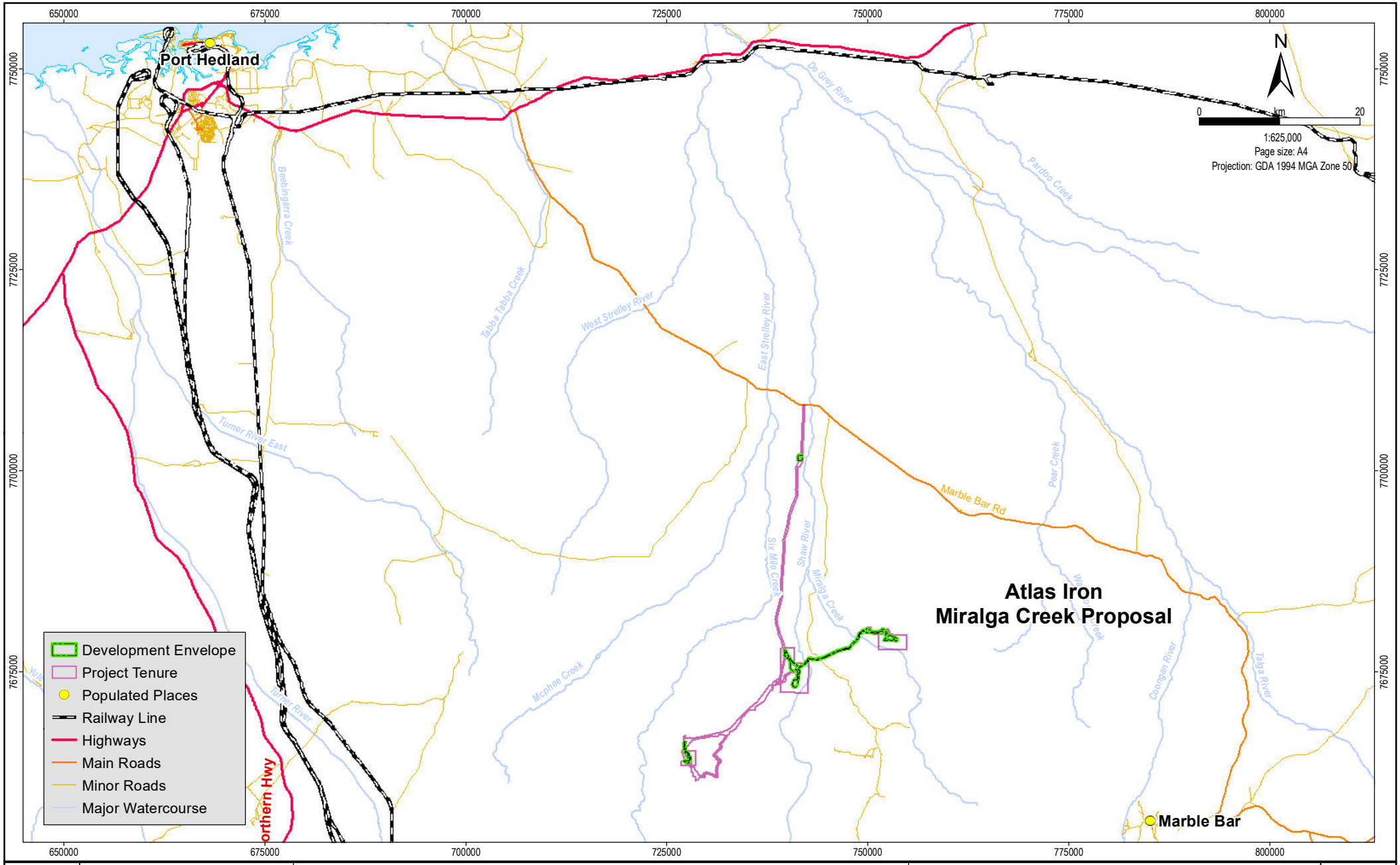
3 Environmental Group Site Details

Atlas Iron Pty Ltd (Atlas) is seeking approval to develop the Miralga Creek Direct Shipping Ore Project (the Project). The Project is an iron ore mine located in the Pilbara region of Western Australia (WA), approximately 100 km southeast of Port Hedland, along the Marble Bar Road (Figure 3-1).

Table 3-1 provides information regarding the Environment Group Site (EGS) in accordance with Appendix 4 of the Department of Mines, Industry Regulation and Safety (DMIRS) Guideline for Mining Proposals in Western Australia 2020 (the Guidelines).

Table 3-1: Environmental Group Site Details

Environmental Group Site Details		
EGS name	Miralga Creek Direct Shipping Ore Project	
EGS code	J03305	
Description of operation	Open cut mine	
Phase of mining	Yet to commence	
Commodity mined	Iron ore	
Estimated commencement date	Q1 2021	
Estimated completion date	Q3 2026	
Tenement details	**Tenement**	**Tenement Holder**
	M45/1280	Atlas Iron Pty Ltd
	M45/1281	Atlas Iron Pty Ltd
	M45/1282	Atlas Iron Pty Ltd
	G45/340	Atlas Iron Pty Ltd
	L45/189	Venturex Resources Ltd
	L45/525	Atlas Iron Pty Ltd
	L45/538	Atlas Iron Pty Ltd
Proponent Details		
Company or Individual Name	Atlas Iron Pty Ltd	
ACN	110 396 168	
Address	Level 17, Raine Square, 300 Murray St, Perth, WA 6000	
Postal Address	PO Box 7071, Cloisters Square PO WA 6850	
Key Contact Representatives	David Morley Senior Advisor – Approvals (08) 6228 8000 David.Morley@atlasiron.com.au	



ATLAS	File Name: GIS_2836.mxd Date: 14/05/2020 Author: Heath.Maconachie	Source & Notes:	**Regional Location**	Figure No: **3-1**

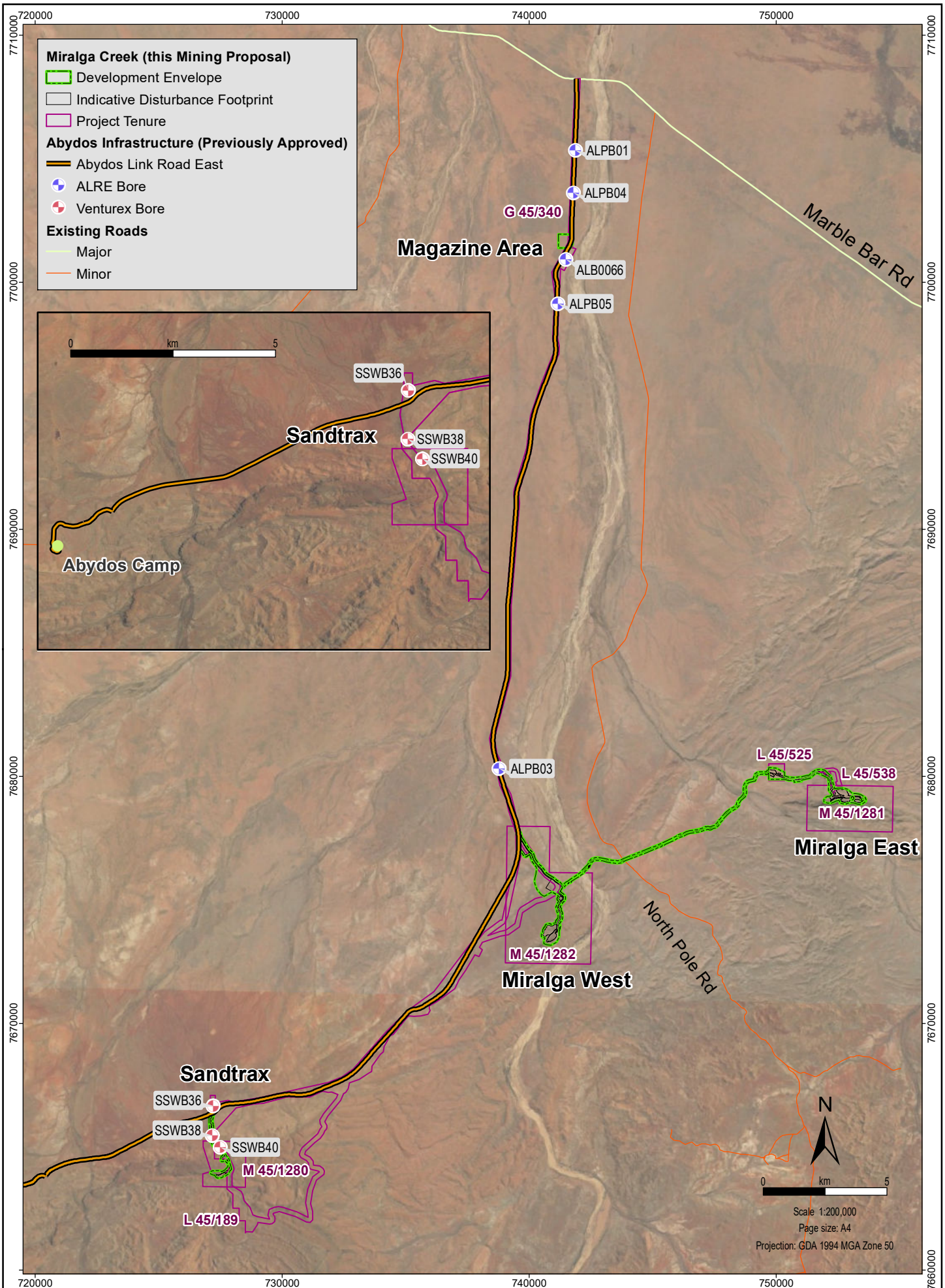
4 Project Description

Atlas is an Australian iron ore company, mining and exporting DSO from its operations in the northern Pilbara region of WA. Its current operations are at Mt Webber and Corunna Downs. In developing new projects, Atlas leverages its considerable experience with its previous iron ore DSO operations at Pardoo, Wodgina, Mt Dove and Abydos, the latter of which is in the vicinity of this Project. The Abydos operation ran successfully from 2011 to 2016 at an annualised production rate of approximately 3 Mtpa. This Project is immediately along strike from Abydos and will utilise existing infrastructure that was constructed for and used during Abydos operations. This Project and Abydos share a similar project scope, terrain and geology.

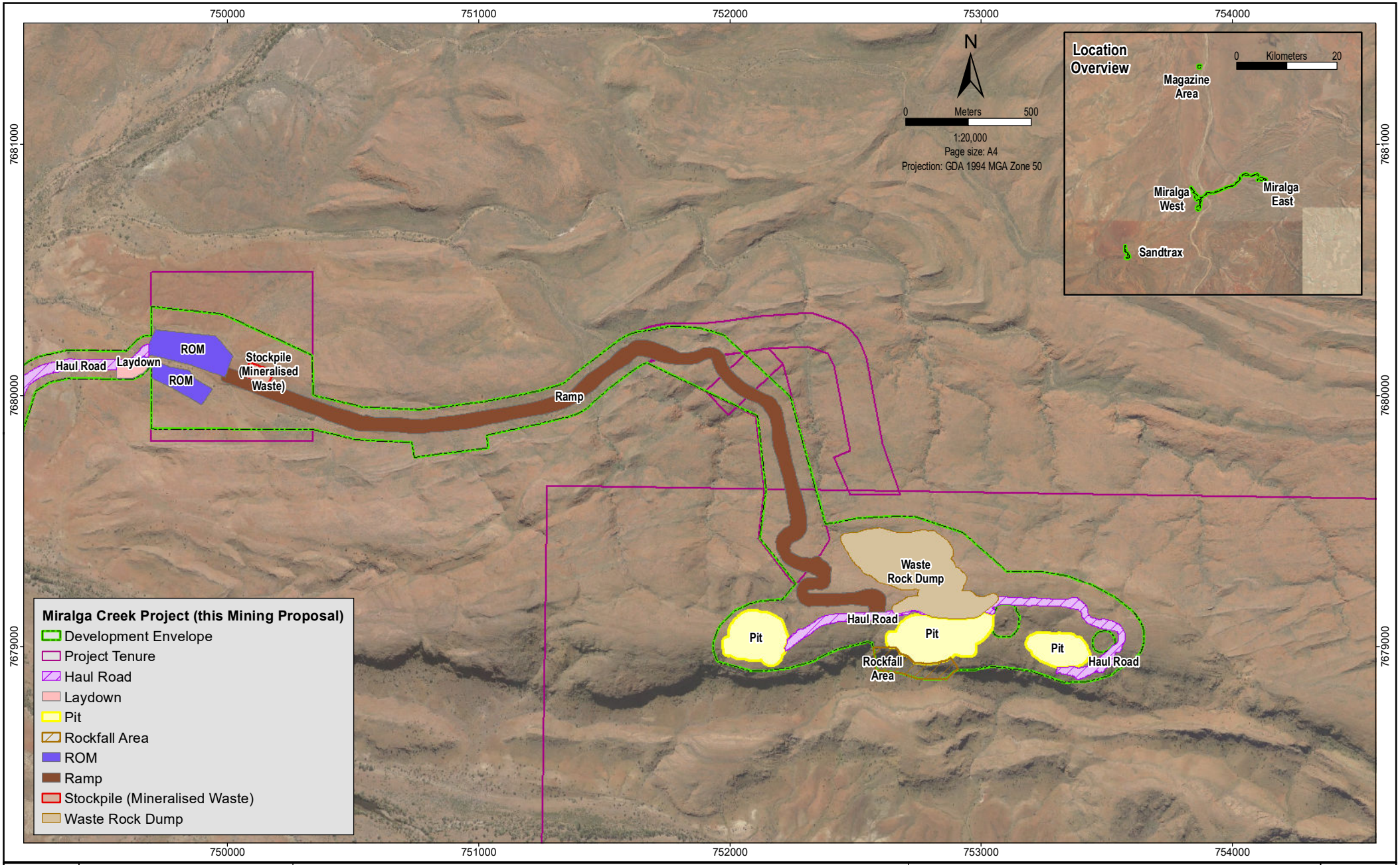
The Project comprises above water table mining of iron ore from five satellite pits within three discrete mining areas, spread over 30 km, as follows (Figure 4-1):

1. **Miralga East** (3 pits), 35 km north-east of the now closed Abydos Mine, with the three pits located along an east to west trending ridge (Figure 4-2).
2. **Miralga West** (1 large pit), 22 km north-east of Abydos, with the pit on a north-east to southwest trending ridge (Figure 4-3).
3. **Sandtrax** (1 small pit), 7 km north-east of Abydos, with the pit along an east–west ridge (Figure 4-4).

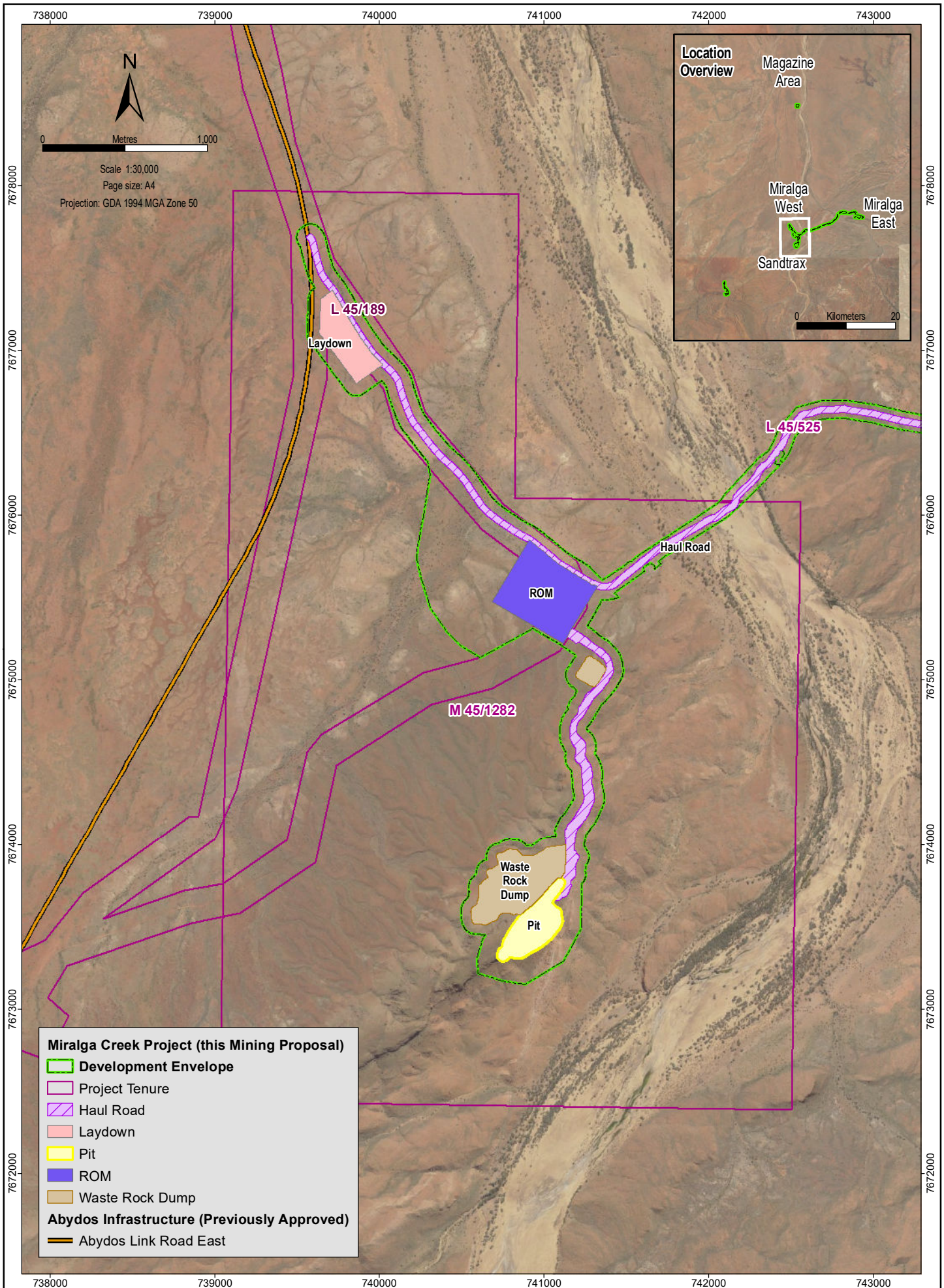
The pits will be mined in a staged manner by a small, mobile mining fleet using conventional drill and blast, load and haul methods. A new Miralga Haul Road will be constructed between Miralga West and Miralga East (Figure 4-5). The crushing plant will be established at Miralga West and other typical support infrastructure will be installed where needed (e.g. laydown areas, administration and fuel storage). The existing Abydos Link Road East (ALRE) will be used, along with the camp, landfill, wastewater treatment plant and existing licensed borefields associated with the Abydos Project (Figure 4-1; Section 4.1). Approximately 2 km of new haul road will be required to link Sandtrax with the existing ALRE. Similarly to the ALRE, this haul road is anticipated to be shared infrastructure between Venturex and Atlas, supporting Sandtrax and Venturex's proposed Sulphur Springs Project. This Mining Proposal puts forward one option for the shared road; Venturex currently has an approved Mining Proposal with an alternative alignment (REGID 87760). Only one haul road will ultimately be developed in this area. Both companies have been working together and sharing infrastructure for several years, with arrangements between the companies captured in documented agreements.



ATLAS	File Name: GIS_2837.mxd Date: 15/05/2020 Author: Heath.Maconachie	Source & Notes: See site specific maps for MIW, MIE and Sandtrax mines	**Indicative Site Plan**	Figure No: **4-1**



ATLAS	File Name: GIS_2838.mxd	Source & Notes:	Figure No:
	Date: 18/05/2020	**Indicative Site Layout - Miralga East**	**4-2**
	Author: Heath.Maconachie		



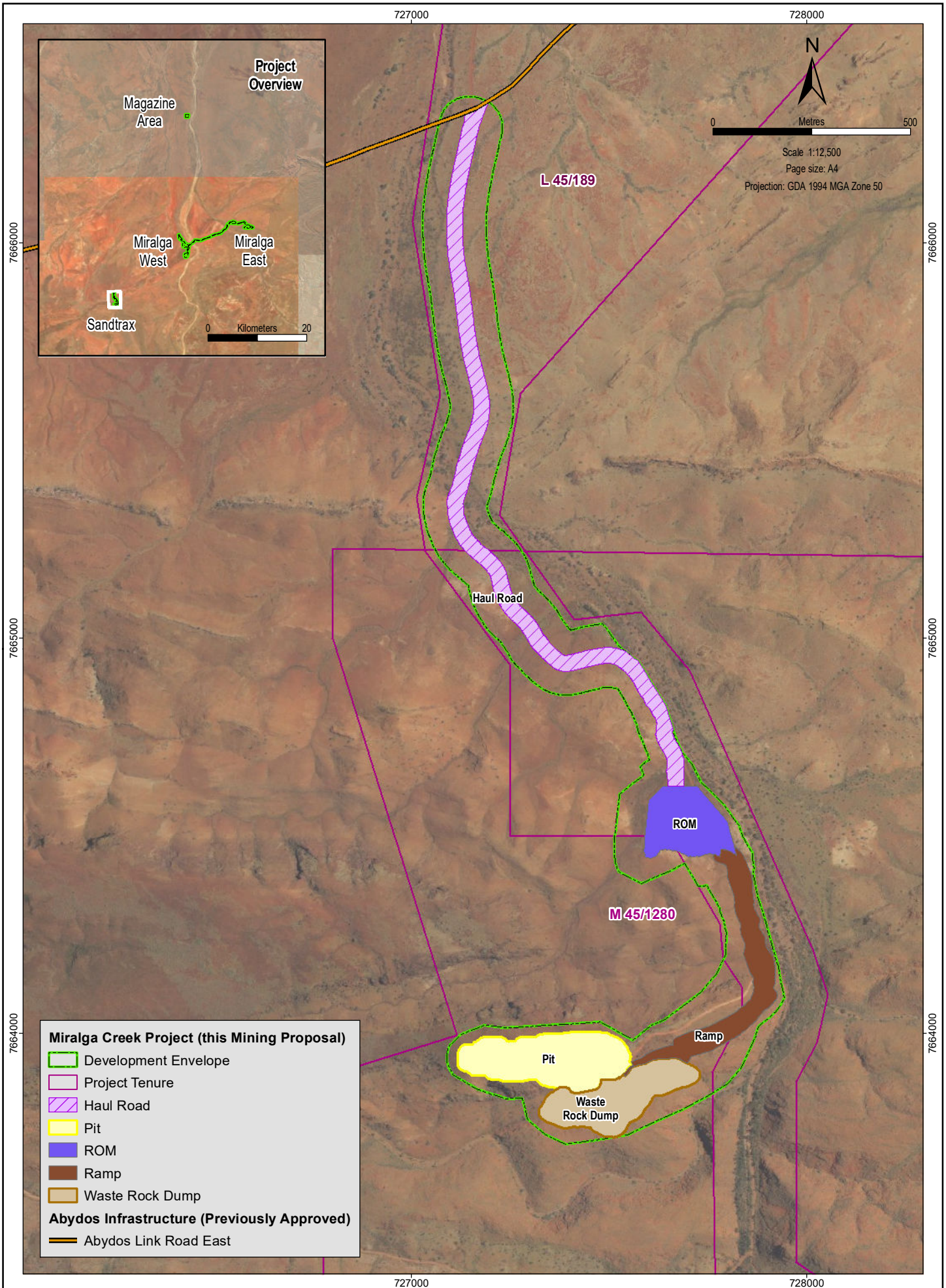
File Name: GIS_2839.mxd
Date: 18/05/2020
Author: Heath.Maconachie
Source & Notes:

Indicative Site Layout - Miralga West

Figure No: **4-3**

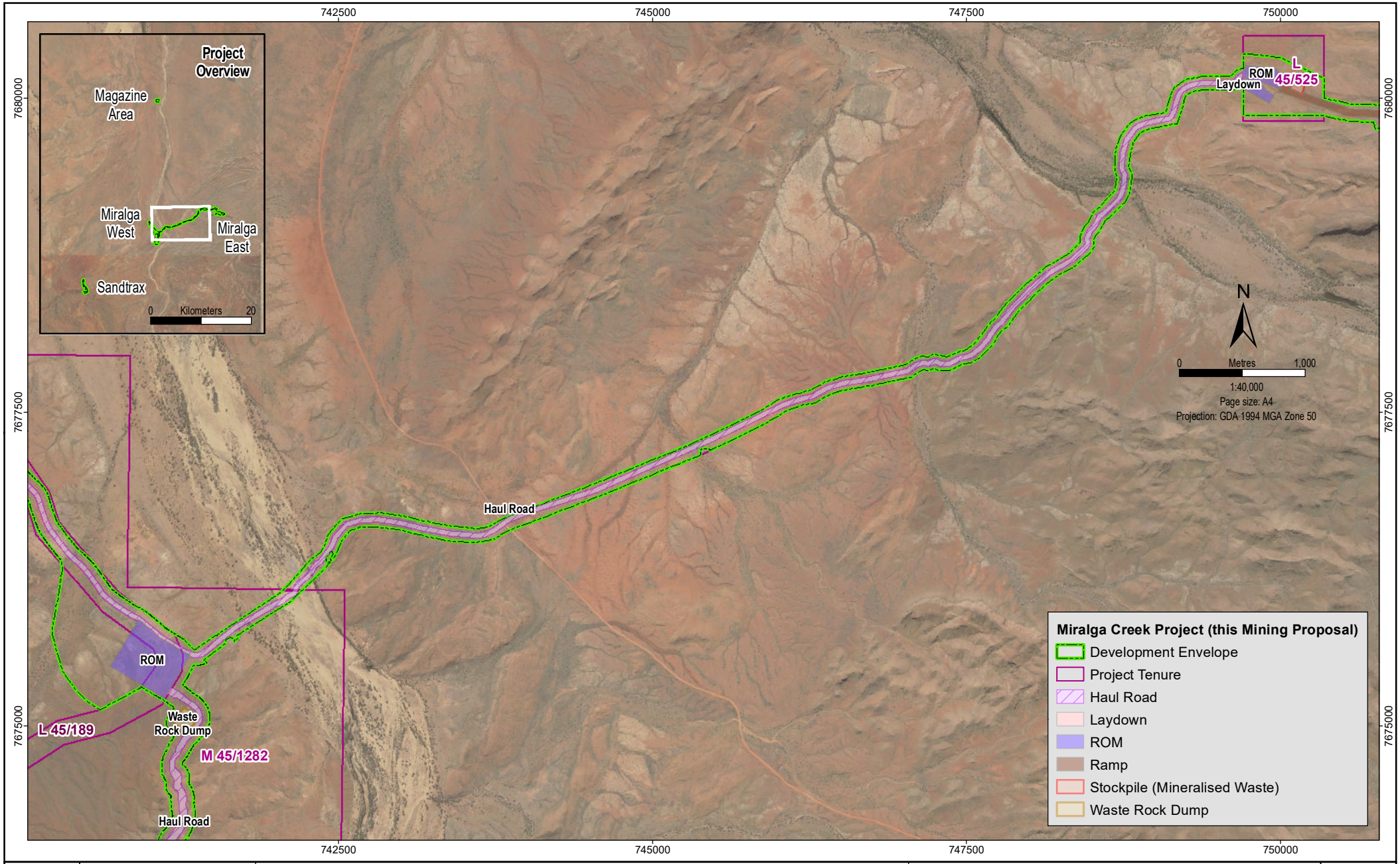
MIRALGA CREEK

Atlas



ATLAS	File Name: GIS_2840.mxd Date: 18/05/2020 Author: Heath.Maconachie	Source & Notes:	**Indicative Site Layout - Sandtrax**	Figure No: **4-4**

MIRALGA CREEK — Atlas



ATLAS	File Name: GIS_2841.mxd Date: 18/05/2020 Author: Heath.Maconachie	Source & Notes:	**Site Layout - Haul Road**

Figure No: **4-5**

4.1 Existing Approvals

The following approved items of infrastructure will support the construction, operation and closure of the Project:

- Abydos Camp (REGID 35285 and 45059), including its:
  - Sewage treatment plant (REGID 35285; Part V Licence L8733/2013/1)
  - Landfill (REGID 35285; Part V Licence L8733/2013/1)
- Existing bores and water abstraction from the:
  - ALRE Borefield (REGID 37773; GWL176408(4)) with a total allocation of 1,198,368 kL/annum.
  - Venturex Borefield (REGID 37527; GWL168045(7)) with a total allocation of 800,000 kL/annum.
- Existing ALRE Haul Road (REGID 37527 and 37773).

Impacts associated with the operation of these facilities are not discussed in this Mining Proposal as they are managed under separate Mining Proposals. They are only mentioned in this document where they provide context to the current proposal.

4.2 Disturbance Envelope

The Project is located within a 544.52 ha Development Envelope as shown in Figure 4-1. Atlas is committed to clearing no more than 207.59 ha within the Development Envelope.

The Project will include the following new components (Figure 4-1 to Figure 4-5):

- Five pits
- Haul roads
- Mine Operation Centre (MOC) and associated support facilities
- Laydown
- Run of mine pads (ROMs)
- Ramps
- Stockpiles (topsoil and mineralised waste)
- Waste rock dumps (WRDs).

The indicative development schedule for this Project is outlined in Table 4-1 and is dependent on the timing of key regulatory approvals.

Table 4-1: Indicative Development Schedule

Development Stage	Indicative Timing (Calendar Year)
Obtain key environmental approvals	Q1 2021
Commence site construction	Q2 2021
Commence mining	Q4 2021
Commence shipping	Q2 2022
Mining ceases	Q3 2026
Decommissioning and closure	Q3 2027

The following sections provide a description of the key Project elements.

4.3 Mining

Mining will be undertaken by a reputable mining contractor and managed by Atlas using a small mobile mining fleet, most likely comprised of a 120 t excavator and a small 100 t payload truck fleet. Pre-stripping will be undertaken to expose the targeted ore. Topsoil and vegetation will be removed, where possible, during pre-stripping and stockpiled in adjacent well-drained areas. The orebodies crop out at surface and do not require pre-stripping. Topsoil stockpiles will be managed appropriately and the materials will be used during rehabilitation.

Following pre-stripping, weathered rock will be free-dug (without blasting) where possible. Drill and blast will be undertaken on the remaining material, using modern mining techniques.

All pits have been designed to sit above the groundwater (Section 8.4.1) so no mine dewatering is required. Groundwater monitoring and grade control drilling will ensure that the maximum pit depth sits above the groundwater table.

Blasting will be undertaken on a daily basis in the open pits. Indicative maximum blast parameters are as follows:

- Drillhole diameter: 102 mm to 115 mm.
- Drill pattern: Between approximately 2.8 m x 3.2 m and 3.0 m x 3.5m.
- Powder factor: Nominally up to 0.7 kg/m^3, dependent on pattern size and blast activity.
- Explosive type: Ammonium nitrate fuel oil (ANFO) emulsion.
- Typical charge size: 35 kg per hole.

It is expected that approximately 7 Mt of iron ore will be mined over approximately 4 to 5 years with an average strip ratio of 0.8:1 (waste:ore). The Project will maintain approximately 2 Mtpa ore supply with a mobile mining fleet, on a day shift only basis for seven days a week.

Mine planning has considered access to intended locations for abandonment bunds (Appendix B) to ensure that they are constructed before access to those locations is cut off, e.g. by mining of a pit.

4.4 Ore Processing and Product Transport

Once blasted, ore and waste rock will be loaded separately into haul trucks. Ore will be transported via the haul road network to a ROM pad at the base of each mining area. Ore will be transported to the Miralga West ROM from Sandtrax and Miralga East as required. A crush and screen plant will be located at the Miralga West ROM (Figure 4-3). The plant will produce two products, lump (40 mm – 6.3 mm) and fines (<6.3 mm), for 100% recovery and produces no tails or waste product.

Atlas will apply for the appropriate works approval and licence for the construction and operation of the crushing and screening facility (Category 5).

4.5 Haulage

Ore will be transported by truck to the Utah Point port facility in Port Hedland via the existing ALRE, to Marble Bar Road and North West Coastal Highway. Road haulage will generally be on a 12-hour daytime basis, with the option for operation on a 24-hour seven days a week basis on occasion.

The use of existing infrastructure, where appropriate, is a significant mitigation in avoiding new impacts through the implementation of the Project.

4.6 Waste Rock Management

Approximately 4.8 Mt of waste rock will be mined throughout the life of the Project, predominantly BIF, chert and shale. Indicative volumes and proportion of mined waste lithologies from each of the pits, along with their physical and geochemical properties, is provided in Section 8.3.

Waste rock will initially be used to construct mine site infrastructure (e.g., access ramps, drainage structures and safety bunds) and then transported and disposed of in above ground waste rock dumps. Waste rock will be managed in consideration of each lithology's physical and geochemical properties to ensure waste rock dumps are stable and non-polluting. More detail on waste rock management is provided in Chapters 5 and 9.

4.7 Water Abstraction

Water will be supplied from the existing Venturex and ALRE borefields. Current licensed volumes enable approximately 2 GL per annum to be abstracted. The Project requires up to approximately 0.9 GL per annum, well within the current approved volume. There are no other significant users of these borefields. The borefield are proposed to supply the Project's construction, operational (i.e., product conditioning and dust suppression) and potable water requirements.

Water licensing is managed by DWER under the RIWI Act. As there are existing licences with more allocation than is required for the Project and the bores have previously been used for mining water supply, impacts related to drawdown are not discussed in this Mining Proposal. DMIRS has previously considered the use of these bores as part of approved Mining Proposals (REGID 37527 and 37773).

4.8 Additional Infrastructure and Support Facilities

A number of additional infrastructure and support facilities will be required for the Project, including, but not limited to:

- MOC and administration area
- Mining contractors yard and workshop
- Haulage contractor's area
- Explosives magazine
- Fuel storage and refuelling areas
- Haul roads, access roads and tracks
- Borrow pits
- Communication towers.

5 Activity Details

In accordance with the Guidelines, all mine activities associated with the Project are identified in Table 5-1. Note that tenure overlaps in some areas (e.g. at Miralga East M45/1281 overlaps with L45/538 for part of the ramp); where this occurs, the proposed disturbance has been allocated to one tenement only, not both.

5.1 Additional Detail for Key Mine Activities

Details for key mine activities at the three mining areas are provided in Table 5-2 to Table 5-13, and shown in Figure 5-1 to Figure 5-11. All pits are above the water table.

Table 5-1: Activity Details

Tenement	Activity Type	Mine Activity Reference	Proposed Area (ha)	Current Approved Area (ha) (if applicable)	Total Area (ha) (Proposed Area + Current Approved Area)
M45/1280[1]	**Key Mine Activities**				
Sandtrax	Mining void (depth greater than 5m – above groundwater)	Sandtrax Pit	4.93	N/A	4.93
	Waste dump or overburden stockpile (class 1)	Sandtrax WRD	3.98	N/A	3.98
	Run-of-mine pad	Sandtrax ROM	3.21	N/A	3.21
M45/1280	**Other Mining Activities**				
	Transport or Service Infrastructure Corridor	Haul Road, Ramp	*Areas not required to be stated.*		
	Subtotal Other Mine Activity Area (not including Key Mine Activities)		7.50	N/A	7.50
M45/1280	**TOTAL TENEMENT ACTIVITY AREA**		**19.62**		**19.62**

Tenement	Activity Type	Mine Activity Reference	Proposed Area (ha)	Current Approved Area (ha) (if applicable)	Total Area (ha) (Proposed Area + Current Approved Area)
M45/1281[1]	**Key Mine Activities**				
Miralga East	Mining void (depth greater than 5m – above groundwater)	Miralga East Pit 1	4.28	N/A	4.28
	Mining void (depth greater than 5m – above groundwater)	Miralga East Pit 2	6.05	N/A	6.05
	Mining void (depth greater than 5m – above groundwater)	Miralga East Pit 3	2.78	N/A	2.78
	Waste dump or overburden stockpile (class 1)	Miralga East WRD	12.61	N/A	12.61
M45/1281	**Other Mining Activities**				
	Land	Rockfall Area	*Areas not required to be stated.*		
	Transport or Service Infrastructure Corridor	Haul Road, Ramp			
	Subtotal Other Mine Activity Area (not including Key Mine Activities)		12.67	N/A	12.67
M45/1281	**TOTAL TENEMENT ACTIVITY AREA**		**38.40**		**38.40**

Tenement	Activity Type	Mine Activity Reference	Proposed Area (ha)	Current Approved Area (ha) (if applicable)	Total Area (ha) (Proposed Area + Current Approved Area)
M45/1282[1]	**Key Mine Activities**				
Miralga West	Mining void (depth greater than 5m – above groundwater)	Miralga West Pit	9.78	N/A	9.78
	Waste dump or overburden stockpile (class 1)	Miralga West WRD	18.63	N/A	18.63
	Run-of-mine pad	Miralga West ROM	20.34	N/A	20.34
	Plant site[2]	Crushing Area[2]	(20.34)[2]	N/A	(20.34)[2]
M45/1282	**Other Mining Activities**				
	Transport or Service Infrastructure Corridor	Haul Road	*Areas not required to be stated.*		
	Workshop	Laydown			
	Building (other than workshop) or camp site	Laydown			
	Low-grade ore stockpile (class 2)	Miralga West Mineralised Waste Stockpile			
	Laydown or Hardstand Area	Laydown			
	Land that is cleared of vegetation (other cleared land)	Laydown			
	Subtotal Other Mine Activity Area (not including Key Mine Activities)		33.93	N/A	33.93
M45/1282	**TOTAL TENEMENT ACTIVITY AREA**		**82.68**		**82.68**

Tenement	Activity Type	Mine Activity Reference	Proposed Area (ha)	Current Approved Area (ha) (if applicable)	Total Area (ha) (Proposed Area + Current Approved Area)
L45/189	**Key Mine Activities**				
	(None)		N/A	N/A	N/A
L45/189	**Other Mining Activities**				
	Transport or Service Infrastructure Corridor	Haul Road	*Areas not required to be stated.*		
	Subtotal Other Mine Activity Area (not including Key Mine Activities)		4.72	N/A	4.72
L45/189	**TOTAL TENEMENT ACTIVITY AREA**		**4.72**		**4.72**
L45/525[1]	**Key Mine Activities**				
Miralga West	Run-of-mine pad	Miralga East ROM	5.88	N/A	5.88
L45/525	**Other Mining Activities**				
	Transport or Service Infrastructure Corridor	Ramp, Haul Road	*Areas not required to be stated.*		
	Laydown or Hardstand Area	Laydown Area			
	Low-grade ore stockpile (class 2)	Miralga East Mineralised Waste Stockpile			
	Subtotal Other Mine Activity Area (not including Key Mine Activities)		51.20	N/A	51.20
L45/525	**TOTAL TENEMENT ACTIVITY AREA**		**57.08**		**57.08**

Tenement	Activity Type	Mine Activity Reference	Proposed Area (ha)	Current Approved Area (ha) (if applicable)	Total Area (ha) (Proposed Area + Current Approved Area)
L45/538	**Key Mine Activities**				
	(None)		N/A	N/A	N/A
L45/538	**Other Mining Activities**				
	Transport or Service Infrastructure Corridor	Ramp	*Areas not required to be stated.*		
	Subtotal Other Mine Activity Area (not including Key Mine Activities)		4.18	N/A	4.18
L45/538	**TOTAL TENEMENT ACTIVITY AREA**		**4.18**		**4.18**
G45/340	**Key Mine Activities**				
	(None)		N/A	N/A	N/A
G45/340	**Other Mining Activities**				
	Magazine	Magazine	*Areas not required to be stated.*		
	Subtotal Other Mine Activity Area (not including Key Mine Activities)		0.92	N/A	0.92
G45/340	**TOTAL TENEMENT ACTIVITY AREA**		**0.92**		**0.92**
	TOTAL MINE ACTIVITY AREA		**207.59**		**207.59**

1. Note that topsoil stockpiles are allocated within other areas of infrastructure (e.g. within the boundary of ROMs and laydown areas).
2. The Miralga Creek plant site (crushing plant) lies wholly within the Miralga West ROM. The size of the area is shown for information, but does not add to the total disturbance.

Table 5-2: Key Activity – Miralga East Pit 1

Activity Type	Mining Void		
Mine Activity Reference	Miralga East Pit 1		
Total Area (ha)	4.28 ha		
Area Per Tenement (ha)	M45/1281: 4.28 ha		
Design Description	The design features for Miralga East Pit 1 are: • Dimensions of 133 m x 213 m x 77 m (Length/Width/Depth) • The pit will be mined to 225 mRL • Design batter angle = 70° • Maximum batter height = 15 m • Berm width = 8 m • Ramp grade = 1:9. Figure 5-1 is a plan view and a schematic cross section of the Miralga East Pit 1 from (A) to (A`) with a bearing of 250 degrees. The cross section illustrates the longitudinal design profile as intersected with the natural topography.		
Material Characteristics	Fibrous minerals	No	
	Radioactive material	No	
	Materials capable of generating acid and/or metalliferous drainage, including neutral drainage and saline drainage	No	
	Dispersive and/or erosive material that is capable of compromising the structure and stability of the activity	No	
Backfill	Will the mining void be backfilled?	No	

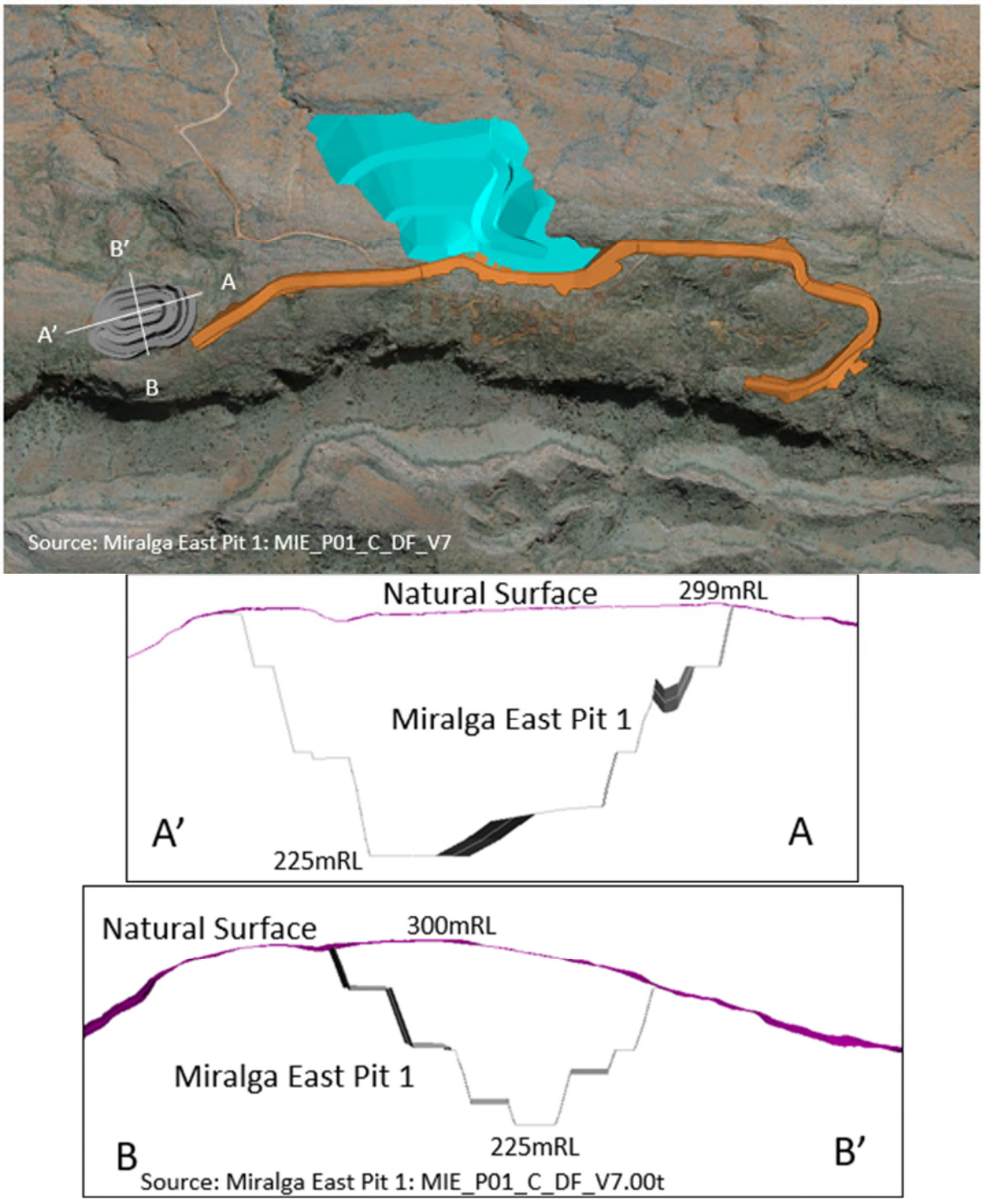
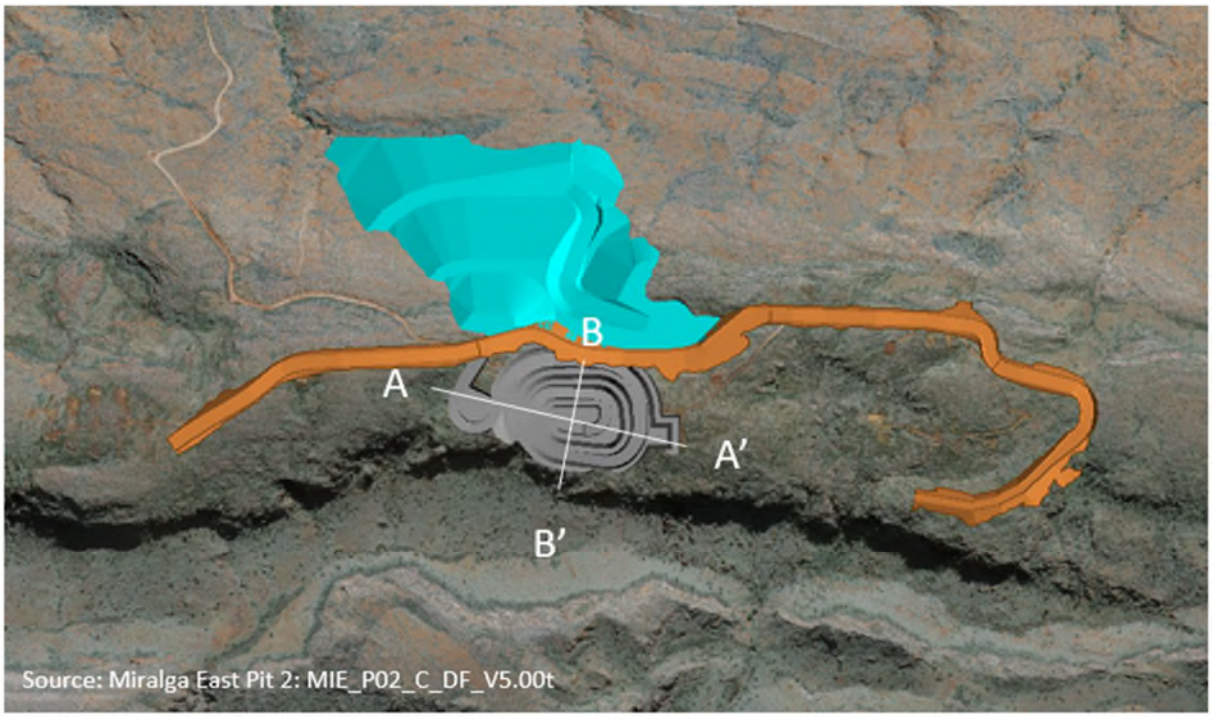


Figure 5-1: Miralga East Pit 1

Table 5-3: Key Activity – Miralga East Pit 2

Activity Type	Mining Void		
Mine Activity Reference	Miralga East Pit 2		
Total Area (ha)	6.05 ha		
Area Per Tenement (ha)	M45/1281: 6.05 ha		
Design Description	The design features for Miralga East Pit 2 are: • Dimensions of 181 m x 344 m x 94 m (Length/Width/Depth) • The pit will be mined to 210 mRL • Design batter angle = 70° • Maximum batter height = 20 m • Berm width = 8 m • Ramp grade = 1:9 Figure 5-2 is a plan view and a schematic cross section of the Miralga East Pit 2 from (A) to (A`) with a bearing of 100 degrees. The cross section illustrates the longitudinal design profile as intersected with the natural topography.		
Material Characteristics	Fibrous minerals	No	
	Radioactive material	No	
	Materials capable of generating acid and/or metalliferous drainage, including neutral drainage and saline drainage	No	
	Dispersive and/or erosive material that is capable of compromising the structure and stability of the activity	No	
Backfill	Will the mining void be backfilled?	No	



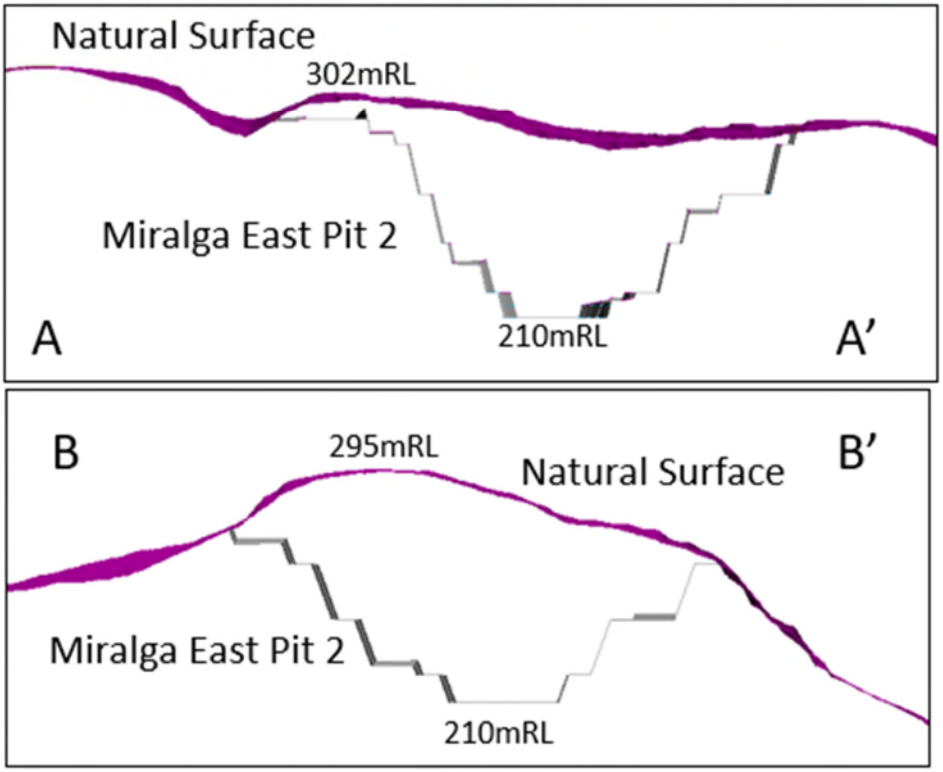


Figure 5-2: Miralga East Pit 2

Table 5-4: Key Activity – Miralga East Pit 3

Activity Type	Mining void		
Mine Activity Reference	Miralga East Pit 3		
Total Area (ha)	2.78 ha		
Area Per Tenement (ha)	M45/1281: 2.78 ha		
Design Description	The design features for Miralga East Pit 3 are: • Dimensions of 70 m x 215 m x 50 m (Length/Width/Depth) • The pit will be mined to 230 mRL, • Design batter angle = 70° • Maximum batter height = 10 - 30 m • Berm width = 5 - 20 m • Ramp grade = 1:9 Figure 5-3 is a plan view and a schematic cross section of the Miralga East Pit 3 from (A) to (A`) with a bearing of 105 degrees. The cross section illustrates the longitudinal design profile as intersected with the natural topography.		
Material Characteristics	Fibrous minerals	No	
	Radioactive material	No	
	Materials capable of generating acid and/or metalliferous drainage, including neutral drainage and saline drainage	No	
	Dispersive and/or erosive material that is capable of compromising the structure and stability of the activity	No	
Backfill	Will the mining void be backfilled?	No	

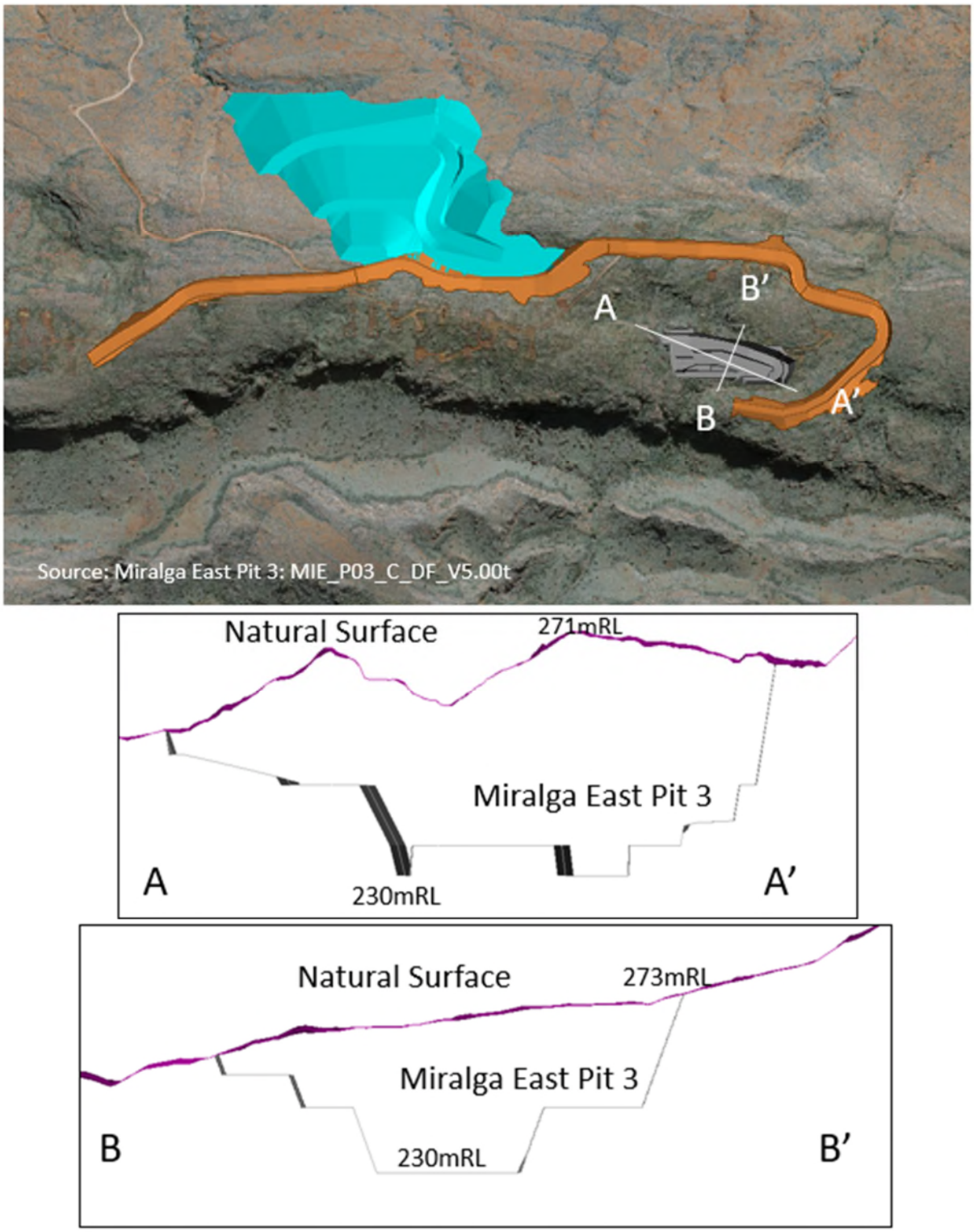


Figure 5-3: Miralga East Pit 3

Table 5-5: Key Activity – Miralga West Pit

Activity Type	Mining void		
Mine Activity Reference	Miralga West Pit		
Total Area (ha)	9.78 ha		
Area Per Tenement (ha)	M45/1282: 9.78 ha		
Design Description	The design features for Miralga West Pit are: • Dimensions of 180 m x 369 m x 113 m (Length/Width/Depth) • The pit will be mined to 180 mRL, • Design batter angle = 65 - 75° • Maximum batter height = 20 m • Berm width = 8 m • Ramp grade = 1:9 Figure 5-4 is a plan view and a schematic cross section of the Miralga West Pit from (A) to (A`) with a bearing of 35 degrees. The cross section illustrates the longitudinal design profile as intersected with the natural topography.		
Material Characteristics	Fibrous minerals	No	
	Radioactive material	No	
	Materials capable of generating acid and/or metalliferous drainage, including neutral drainage and saline drainage	No	
	Dispersive and/or erosive material that is capable of compromising the structure and stability of the activity	Yes	A small proportion of waste mined from this pit is comprised of shale. This is only 2.1% of the total waste rock volume to be mined. Low stability waste rock will not be exposed on final waste rock dump surfaces.
Backfill	Will the mining void be backfilled?	No	

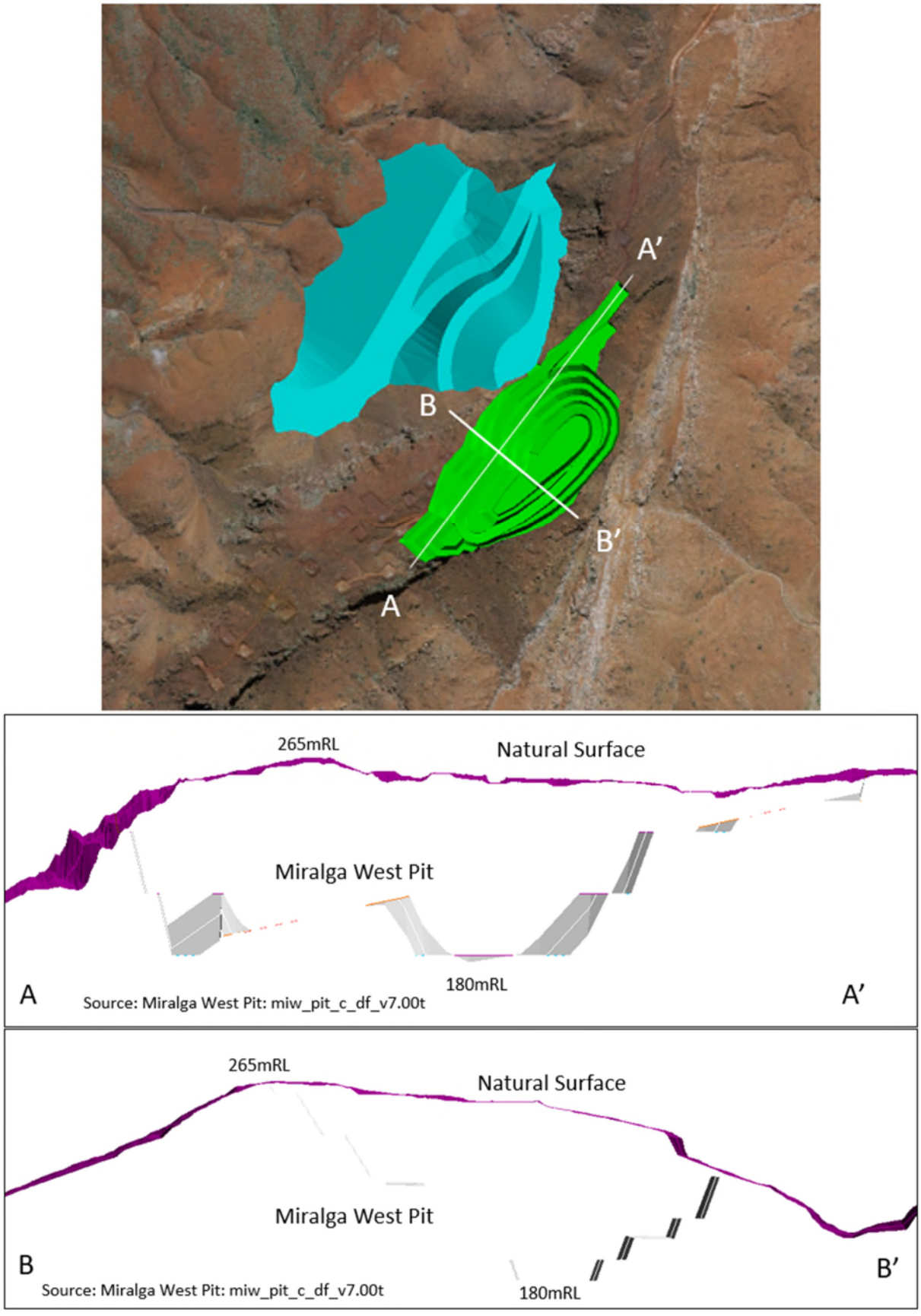


Figure 5-4: Miralga West Pit

Table 5-6: Key Activity – Sandtrax Pit

Activity Type	Mining void		
Mine Activity Reference	Sandtrax Pit		
Total Area (ha)	4.93 ha		
Area Per Tenement (ha)	M45/1280: 4.93 ha		
Design Description	The design features for the Sandtrax are: • Dimensions of 77 m x 363 m x 42 m (Length/Width/Depth) • The pit will be mined to 260 mRL, • Design batter angle = 70° • Maximum batter height = 20 m • Berm width = 5 m • Ramp grade = 1:9 Figure 5-5 is a plan view and a schematic cross section of the Sandtrax pit from (A) to (A`) with a bearing of 85 degrees. The cross section illustrates the longitudinal design profile as intersected with the natural topography.		
Material Characteristics	Fibrous minerals	No	
	Radioactive material	No	
	Materials capable of generating acid and/or metalliferous drainage, including neutral drainage and saline drainage	No	
	Dispersive and/or erosive material that is capable of compromising the structure and stability of the activity	No	
Backfill	Will the mining void be backfilled?	No	

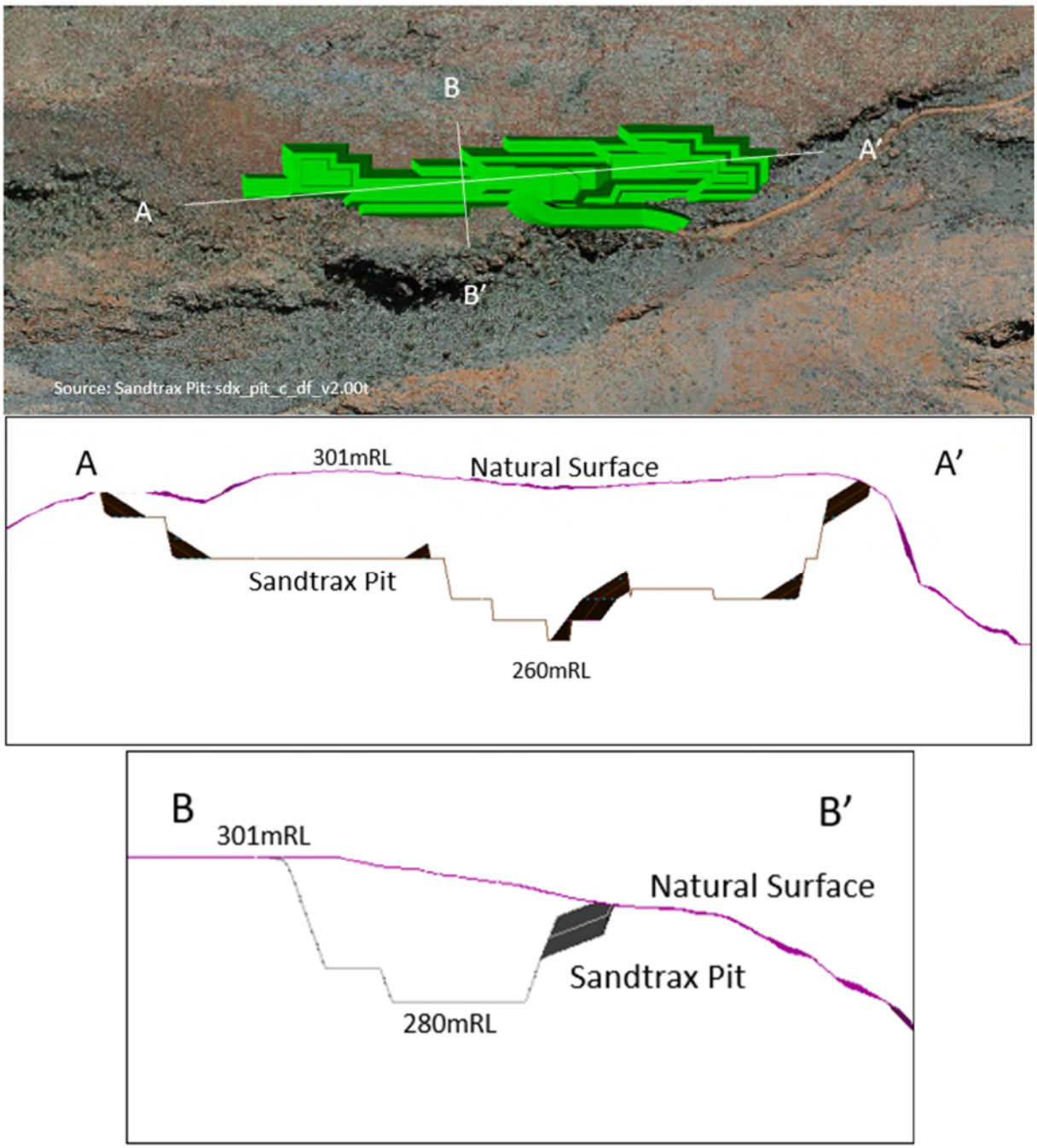


Figure 5-5: Sandtrax Pit

Table 5-7: Miralga East Waste Rock Dump

Activity Type	Waste dump or overburden stockpile (permanent landform)		
Mine Activity Reference	Miralga East WRD		
Total Area (ha)	12.61 ha		
Area Per Tenement (ha)	M45/1281: 12.61 ha		

Design Description	The waste mined from the Miralga East Pits will be placed onto the Miralga East WRD. Design specifications for this dump include:
	• Number of lifts = 3
	• Natural angle of repose = 37°
	• Rehabilitated Slope Angle = 17°
	• Lift 1 Properties:
	  • Max Vertical Height = 40 m
	  • Max Berm Width = 25 m
	• Lift 2 Properties:
	  • Max Vertical Height = 30 m
	  • Max Berm Width = 20 m
	• Lift 3 Properties:
	  • Max Vertical Height = 20 m
	  • Max Berm Width = 0 m
	Figure 5-6 is a plan view and schematic cross section of the Miralga East WRD from (A) to (A`) with a bearing of 115 degrees. The cross section illustrates the longitudinal design profile as intersected with the natural topography.		

Material Characteristics	Fibrous minerals	No	
	Radioactive material	No	
	Materials capable of generating acid and/or metalliferous drainage, including neutral drainage and saline drainage	No	
	Dispersive and/or erosive material that is capable of compromising the structure and stability of the activity	No	

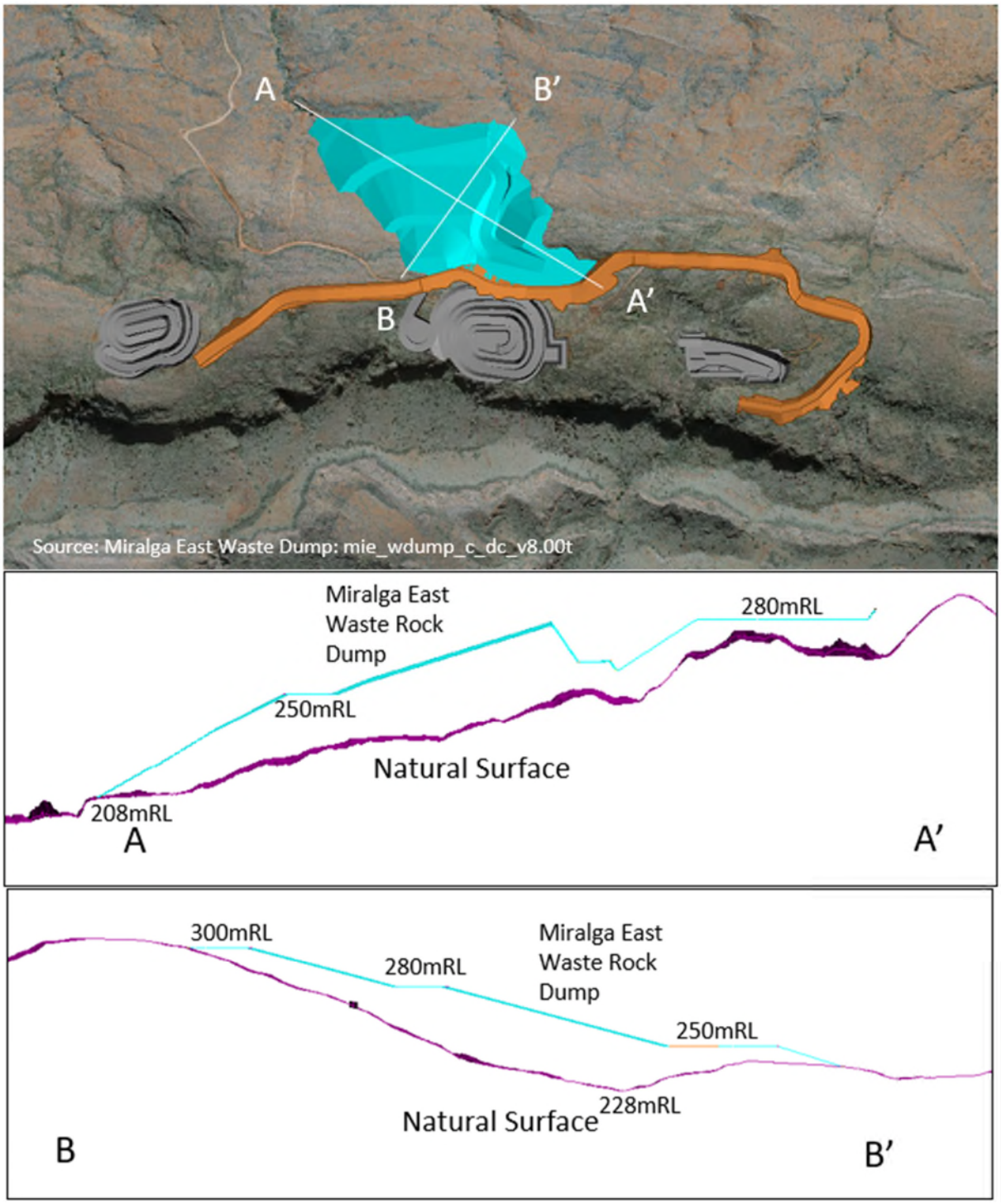


Figure 5-6: Miralga East Waste Rock Dump

Table 5-8: Miralga West Waste Rock Dump

Activity Type	Waste dump or overburden stockpile (permanent landform)		
Mine Activity Reference	Miralga West WRD		
Total Area (ha)	18.63 ha		
Area Per Tenement (ha)	M45/1282: 18.63 ha		

Design Description	The waste mined from the Miralga West Pit will be placed onto the Miralga West WRD. Design specifications for this dump include:
	• Number of lifts = 3
	• Natural angle of repose = 37°
	• Rehabilitated Slope Angle = 17°
	• Lift 1 Properties:
	  • Max Vertical Height = 40 m
	  • Max Berm Width = 45 m
	• Lift 2 Properties:
	  • Max Vertical Height = 25 m
	  • Max Berm Width = 20 m
	• Lift 3 Properties:
	  • Max Vertical Height = 20 m
	  • Max Berm Width = 0 m
	Figure 5-7 is a plan view and schematic cross section of the Miralga West WRD from (A) to (A`) with a bearing of 45 degrees. The cross section illustrates the longitudinal design profile as intersected with the natural topography.		

Material Characteristics	Fibrous minerals	No	
	Radioactive material	No	
	Materials capable of generating acid and/or metalliferous drainage, including neutral drainage and saline drainage	No	
	Dispersive and/or erosive material that is capable of compromising the structure and stability of the activity	Yes	A small proportion of waste stored in this WRD has low erosion stability. This is only 2.1% of the total waste rock volume to be stored within this WRD. Low stability waste rock will not be exposed on final waste rock dump surfaces.

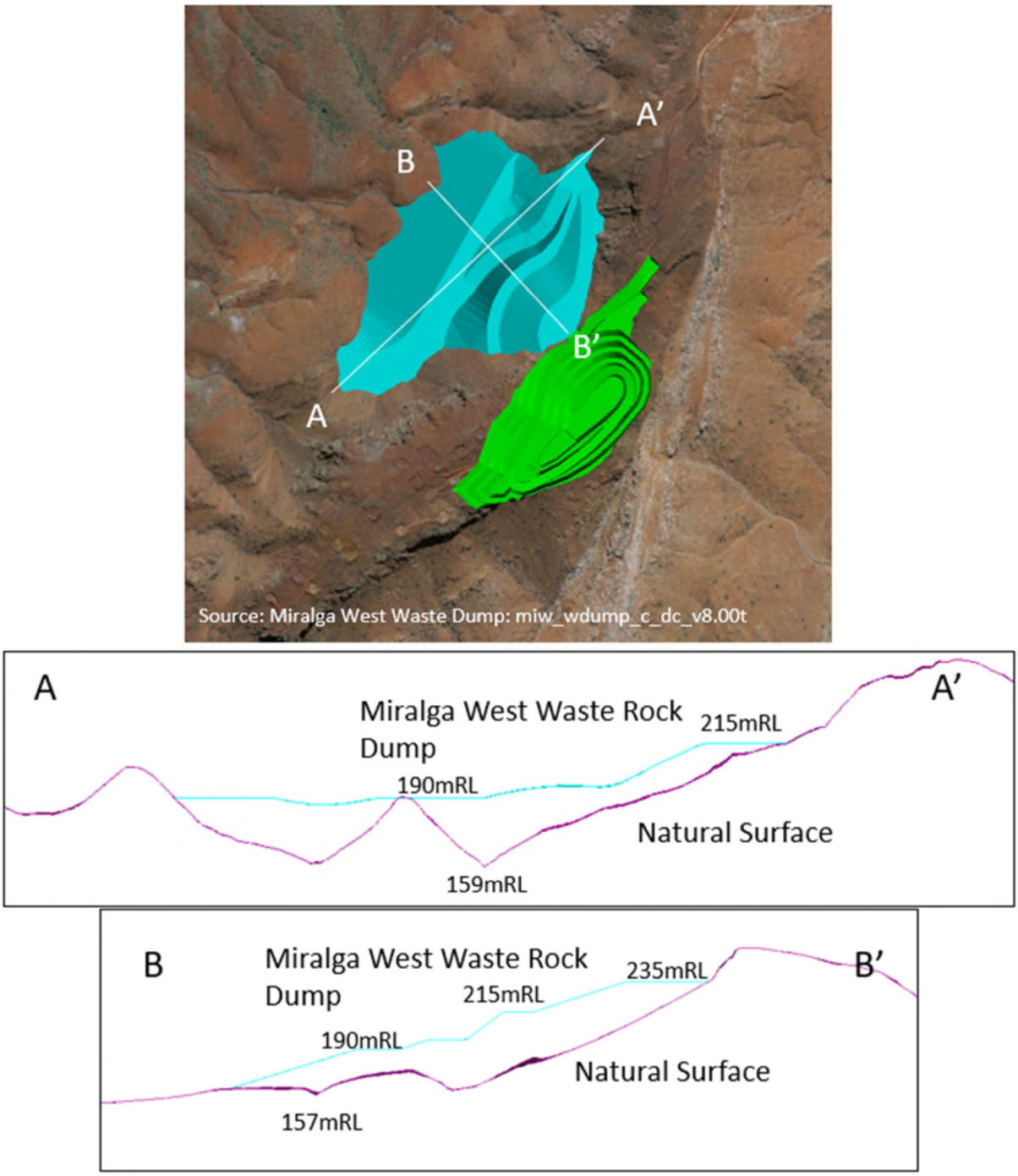


Figure 5-7: Miralga West Waste Rock Dump

Table 5-9: Sandtrax Waste Rock Dump

Activity Type	Waste dump or overburden stockpile (permanent landform)		
Mine Activity Reference	Sandtrax WRD		
Total Area (ha)	3.98 ha		
Area Per Tenement (ha)	M45/1280: 3.98 ha		

Design Description	The waste mined from the Sandtrax Pit will be placed onto the Miralga East WRD. Design specifications for this dump include:
	• Number of lifts = 2
	• Natural angle of repose = 37°
	• Rehabilitated Slope Angle = 17°
	• Lift 1 Properties:
	  • Max Vertical Height = 25 m
	  • Max Berm Width = 35 m
	• Lift 2 Properties:
	  • Max Vertical Height = 30 m
	  • Max Berm Width = 0 m
	Figure 5-8 is a plan view and schematic cross section of the Sandtrax WRD from (A) to (A`) with a bearing of 75 degrees. The cross section illustrates the longitudinal design profile as intersected with the natural topography.		

Material Characteristics	Fibrous minerals	No	
	Radioactive material	No	
	Materials capable of generating acid and/or metalliferous drainage, including neutral drainage and saline drainage	No	
	Dispersive and/or erosive material that is capable of compromising the structure and stability of the activity	No	

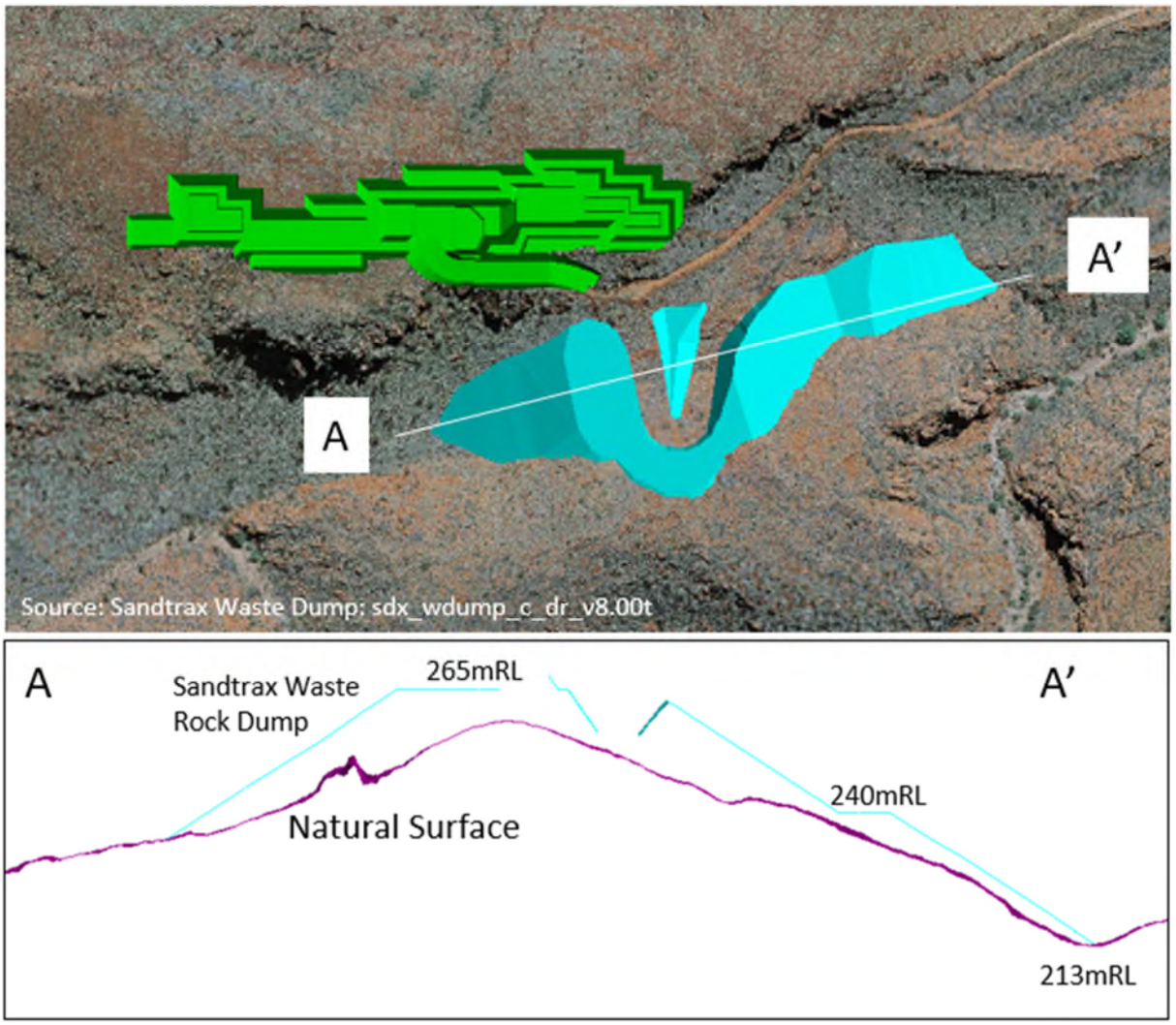


Figure 5-8: Sandtrax Waste Rock Dump

Table 5-10: Miralga East Run of Mine Pad

Activity Type	Run of mine pad		
Mine Activity Reference	Miralga East ROM		
Total Area (ha)	5.88 ha		
Area Per Tenement (ha)	L45/525: 5.88 ha		
Design Description	The Miralga East ROM pad will be constructed from cut and fill of near surface outcropping material (cut max about 5 m) from the local area. Figure 5-9 is a plan view and schematic cross section of the Miralga East ROM pad from (A) to (A`) with a bearing of 75 degrees. The cross section illustrates the longitudinal design profile as intersected with the natural topography.		
Material Characteristics	Fibrous minerals	No	
	Radioactive material	No	
	Materials capable of generating acid and/or metalliferous drainage, including neutral drainage and saline drainage	No	
	Dispersive and/or erosive material that is capable of compromising the structure and stability of the activity	No	

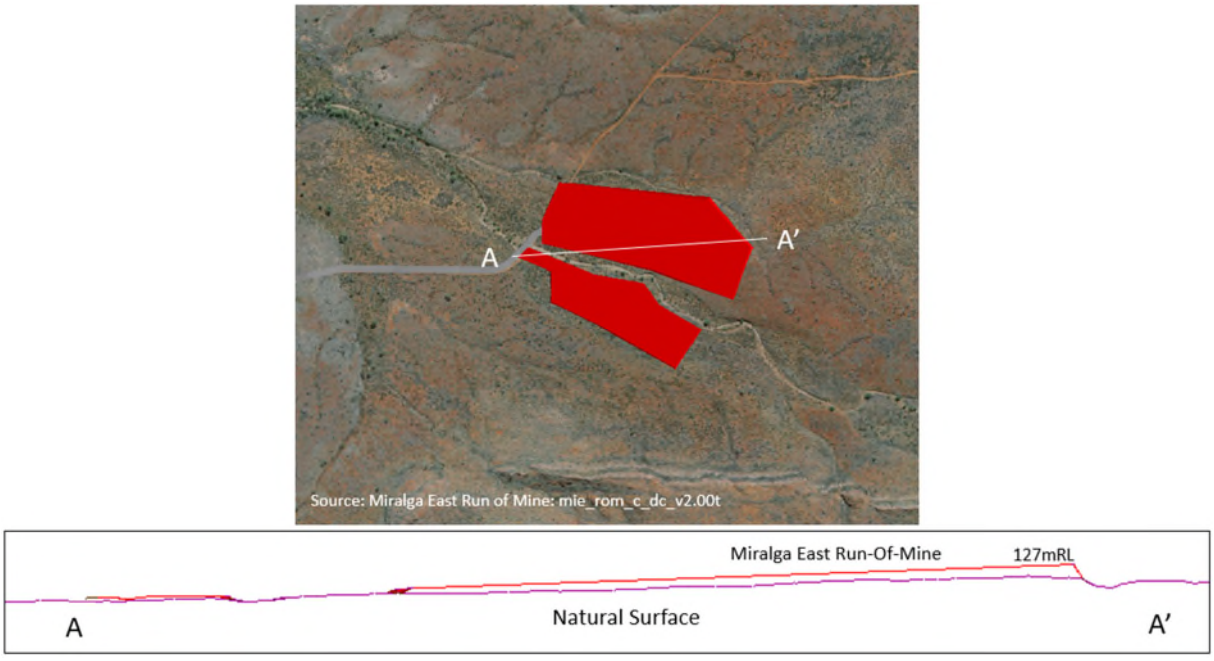


Figure 5-9: Miralga East Run of Mine Pad

Table 5-11: Miralga West Run of Mine Pad

Activity Type	Run of mine pad		
Mine Activity Reference	Miralga West ROM, Plant site		
Total Area (ha)	20.34 ha		
Area Per Tenement (ha)	M45/1282: 20.34 ha		
Design Description	The Miralga West ROM pad will be constructed from cut and fill of near surface outcropping material (cut max about 5 m) from the local area. Figure 5-10 is a plan view and schematic cross section of the Miralga East ROM pad from (A) to (A`) with a bearing of 75 degrees. The cross section illustrates the longitudinal design profile as intersected with the natural topography.		
Material Characteristics	Fibrous minerals	No	
	Radioactive material	No	
	Materials capable of generating acid and/or metalliferous drainage, including neutral drainage and saline drainage	No	
	Dispersive and/or erosive material that is capable of compromising the structure and stability of the activity	No	

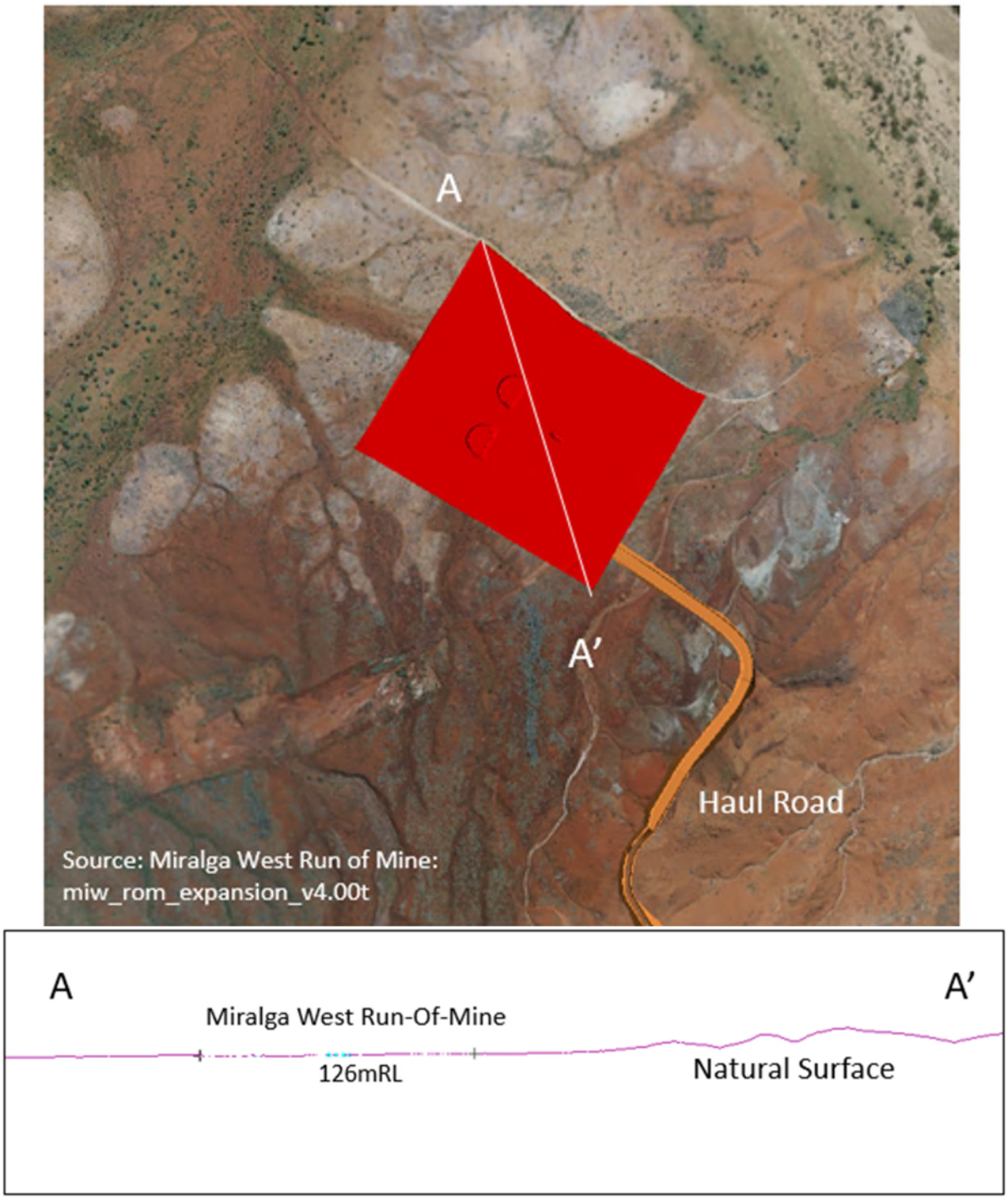


Figure 5-10: Miralga West Run of Mine Pad

Table 5-12: Sandtrax Run of Mine Pad

Activity Type	Run of mine pad		
Mine Activity Reference	Sandtrax ROM		
Total Area (ha)	3.21 ha		
Area Per Tenement (ha)	M45/1280: 3.21 ha		
Design Description	The Sandtrax ROM pad will be constructed from cut and fill of near surface outcropping material (cut max about 5 m) from the local area. Figure 5-11 is a plan view and schematic cross section of the Miralga East ROM pad from (A) to (A`) with a bearing of 75 degrees. The cross section illustrates the longitudinal design profile as intersected with the natural topography.		
Material Characteristics	Fibrous minerals	No	
	Radioactive material	No	
	Materials capable of generating acid and/or metalliferous drainage, including neutral drainage and saline drainage	No	
	Dispersive and/or erosive material that is capable of compromising the structure and stability of the activity	No	

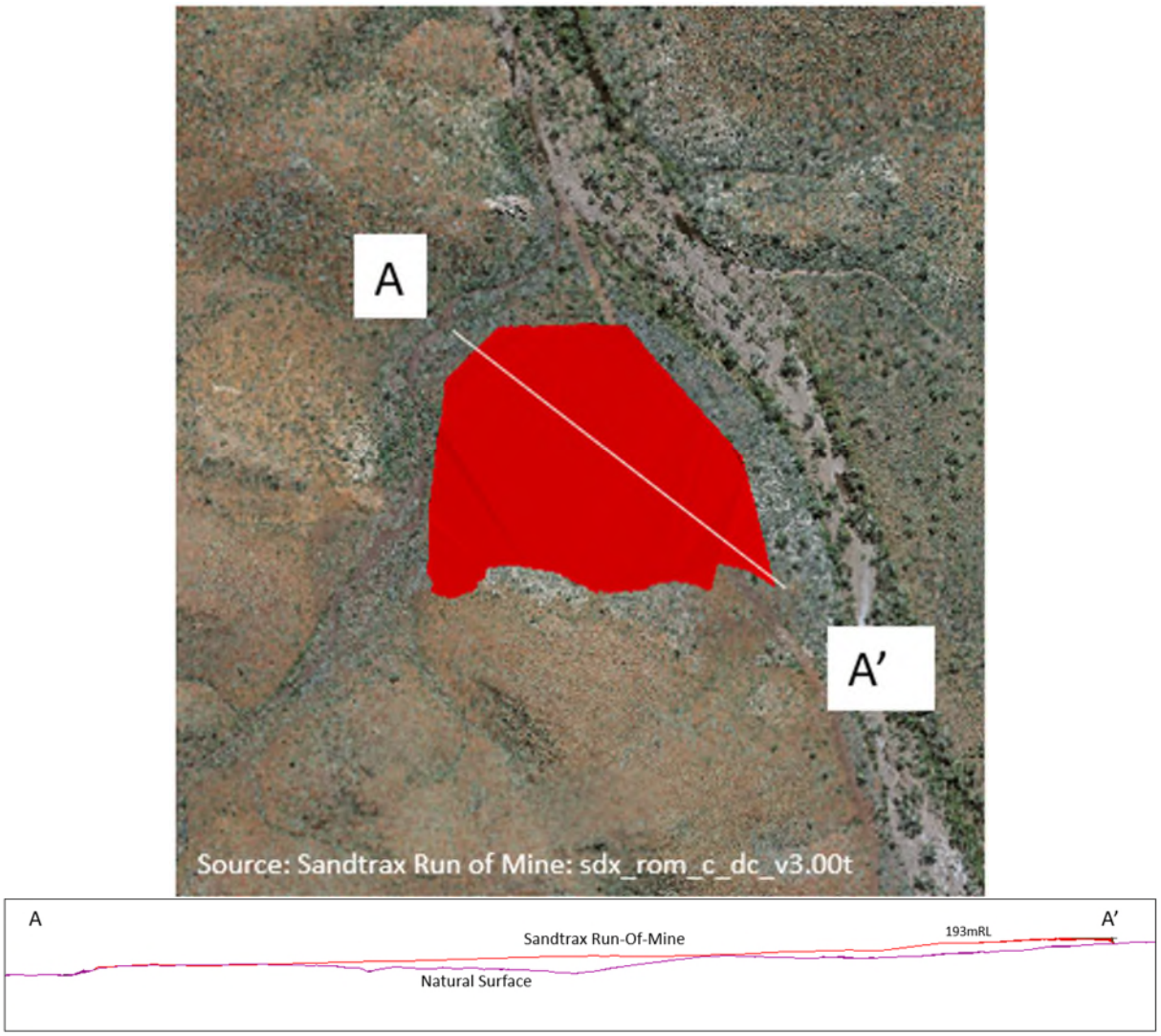


Figure 5-11: Sandtrax Run of Mine Pad

Table 5-13: Plant Site

Activity Type	Plant site
Mine Activity Reference	Miralga Creek Plant/ MOC
Total Area (ha)	Within the Miralga West ROM (Table 5-11)
Area Per Tenement (ha)	M45/1282: within the Miralga West ROM (Table 5-11)
Design Description	The plant will be a small, mobile dry crushing and screening facility, comprised of a primary crusher, a screening plant, secondary cone crusher, samples station and product stackers. The plant will produce two products, lump (40 mm – 6.3 mm) and fines (<6.3 mm), for 100% recovery and produces no tails or waste product.

5.2 Development Envelope

The Project is located within a 544.52 ha Development Envelope as shown in Figure 4-1. Atlas is committed to clearing no more than 207.59 ha within the within the Development Envelope. The current proposed area to be disturbed is the Indicative Disturbance Footprint (Figure 4-1). Further detail on the proposed area of disturbance by activity type and tenement was provided in Table 5-1.

5.3 Site Plan

Figure 4-1 is an indicative site plan, depicting Project tenure and the indicative locations of proposed mine activities discussed in Section 5.1.

5.4 Tailings Storage Facilities

No tailings or waste product will be produced and therefore no tailings storage facilities are proposed.

5.5 Spatial Information

The following spatial data for the Project has been provided digitally as part of this Mining Proposal (Appendix C):

- Development Envelope.
- Indicative Disturbance Footprint.
- Significant microhabitats (CMRC-13, -14 and -15).

The spatial files have the following properties:

- Format: ESRI Shapefile.
- Geometry Type: Polygon.
- Coordinate System: GCS GDA 1994 (Geographic).
- Datum: GDA 1994 (Geocentric Datum of Australia 1994).

5.6 Detailed Design Reports

A detailed design is report is not required as the Project does not include any significant engineered structures such as tailings storage facilities.

6 Environmental Legislative Framework

As discussed in Chapter 4, approvals are already in place for infrastructure that is shared with the Abydos Project. Those approved items are not considered further in this Mining Proposal.

This chapter details the relevant environmental approvals that have been gained, are being sought or are required before the new aspects of the Project can proceed. This includes statutory requirements that will affect the environmental management of the Project. Table 6-1 details the environment approvals that may be required for the Project. All works will be undertaken in accordance with the relevant legislation.

Table 6-1: Environmental Legislation and Approvals Relevant to This Mining Proposal

Relevant Legislation	Environmental Factor Regulated/Affected	Relevant Approval/ Requirement and Status of Relevant Approval
Aboriginal Heritage Act 1972	Aboriginal ethnographic and archaeological sites.	A Section 18 approval under the *Aboriginal Heritage Act 1972* will not be required as no sites will be impacted. However, Atlas will reconsider this requirement should new heritage sites be identified over the course of the Project's implementation, for sites that cannot be avoided.
Biodiversity Conservation Act 2016	Biodiversity/Flora/Fauna/ Ecosystem.	Scientific or other prescribed purpose licences were obtained for flora and fauna surveys to be undertaken.
Dangerous Goods Safety Act 2004	Storage handling of dangerous goods.	Licence to store fuel and chemicals on site will be obtained as required.
Environmental Protection Act 1986 (Part IV) (Environmental Impact Assessment)	Inland waters, flora and vegetation, terrestrial fauna, subterranean fauna, landforms, terrestrial environmental quality, air quality and social surroundings.	The Project was referred under section 38 on 7 April 2020. The Project was approved on 23 November 2020 under Ministerial Statement No. 1154.
Environmental Protection Act 1986 (Part V) (Licensing)	Terrestrial environmental quality, air quality and inland waters; specifically emissions to air, land and water. Prescribed Premises category: • (5) Processing or beneficiation of metallic or non-metallic ore	An application for a Works Approval was submitted on 24 December 2020. On 8 March 2021, DWER advised Atlas it intends to grant Works Approval W6494/2021/1.

Relevant Legislation	Environmental Factor Regulated/Affected	Relevant Approval/ Requirement and Status of Relevant Approval
Environment Protection and Biodiversity Conservation Act 1999	Terrestrial fauna (of Commonwealth conservation significance, either listed or pending listing). Confirmed presence of: • Northern Quoll (*Dasyurus hallucatus*) • Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*, Pilbara form) • Ghost Bat (*Macroderma gigas*) • Northern Brush-tailed Possum (*Trichosurus vulpecula arnhemensis*) • Grey Falcon (*Falco hypoleucos*). The Pilbara Olive Python (*Liasis olivaceus barroni*) was considered likely to be present, although not recorded.	The Project was referred under the EPBC Act on 23 December 2019. Approval EPBC 2019/8601 was granted on 18 February 2021 with conditions relating to the protection of Northern Quoll and Ghost Bat.
Mining Act 1978	Disturbance areas and general environmental management.	This Mining Proposal (and Mine Closure Plan) addresses these requirements and follows the format and content required under the Statutory Guidelines (2020).
Mines Safety and Inspection Act 1994	Major safety risks.	Project Management Plan.
Native Title Act 1993	Protection of Native Title.	Atlas has an existing claim-wide Native Title Agreement with Njamal. The agreement spans areas covered by two claims: Nyamal People #1 (determined, but not in full) and Nyamal People #10 (fully determined). Atlas and Njamal are currently updating this agreement.

7 Stakeholder Consultation

As the Project has developed, Atlas has had on-going consultation with relevant stakeholders. The principal objectives of the stakeholder consultation program have been to:

- Identify interested and potentially affected individuals and groups and to understand the nature of stakeholders' interest in the Project.
- Ensure that stakeholders are properly informed about the Project and that there are adequate and timely opportunities for stakeholders to provide input and raise issues.
- Ensure that any stakeholder issues or concerns are managed with respect, are given due consideration and are responded to in a timely manner.
- Meet the relevant regulatory requirements with regard to appropriate stakeholder input to the impact assessment and approvals process.

7.1 Targeted Community and Engagement Strategy

Atlas undertook an assessment to determine all stakeholders with an interest in the Project and has proactively consulted with stakeholders during the exploration, design and planning phases of the Project.

Table 7-1 provides a list of stakeholders and groups that may have interest in the Project and indicates which stakeholders have been directly contacted. The consultation undertaken by Atlas prior to the submission of this document is summarised in the stakeholder consultation register in Appendix D. No material concerns were raised during consultation prior to submission of assessment documentation. However, some concerns have been raised during the environmental assessment process, particularly with regard to potential impact on Ghost Bats at the cave complex comprised of CMRC-13, -14 and -15; this is discussed more in Section 8.5.2.

Table 7-1: Project Stakeholders

Interest Group	Stakeholder
Pastoral Stations	Strelley Station (Strelley Pastoral Co Pty Ltd)
	Hillside-Panorama Station (Hillside Station (WA) Pty Ltd)
	Coongan Station (Coongan Aboriginal Corporation)
Mining Tenure Holders	Whim Creek Mining Pty Ltd
	Fastfield Pty Ltd
	Venturex Sulphur Springs Pty Ltd
	Le Aussie
Native Title Groups	Nyamal People #1 and Nyamal People #10 Native Title Groups
Shire and Local Governments	Shire of East Pilbara
	Town of Port Hedland
State Government Agencies	Department of Mines, Industry Regulation and Safety
	Department of Water and Environmental Regulation
	Department of Biodiversity, Conservation and Attractions
	Pilbara Ports Authority
	Main Roads Western Australia
	Department of Planning, Lands and Heritage
	Department of Primary Industries and Regional Development

Interest Group	Stakeholder
Australian Government Agencies	Department of Agriculture, Water and the Environment
Local and Regional Groups	Marble Bar and Nullagine Community Resource Centre
	Marble Bar Progress Association

7.2 Stakeholder Engagement Strategy

Atlas believes in early and thorough stakeholder consultation. To this effect, Atlas introduced the Project at the concept level to all stakeholders, in particular the following key stakeholders:

- EPA (DWER)
- DAWE
- DMIRS
- Njamal Aboriginal Corporation (NAC)
- Barlbinbinya Aboriginal Corporation (BAC)
- Shire of East Pilbara
- Venturex Resources Ltd.

For transparency, Atlas has continued to provide project updates to all stakeholders appropriately throughout the process as the project has become better defined and as we have gained further detailed knowledge regarding our potential environmental impacts.

Atlas recognises that ongoing consultation with stakeholders is critical to ensuring environmental and social concerns raised and can be addressed during the life of the mine. As such, Atlas will continue its proactive consultation program until after closure of the mine, as detailed in Table 7-2 and Table 3.3 of Appendix E for closure related consultation. The details of this consultation will continue to be documented in the Project's consultation register (Appendix D).

Table 7-2: Ongoing Community and Stakeholder Engagement Strategy

Interest Group/ Stakeholder	Planned Consultation Issue
Native Title Groups (Njamal) • Nyamal People #1 • Nyamal People #10	Compliance with the Native Title Agreement (currently being updated), including (but not limited to) meetings with Njamal three times per year via the Mining Agreement Liaison Committee, provision of employment and contracting opportunities, management of heritage protocol and protection of sites and cross-cultural education.
Pastoral Stations (Panorama, Strelley and Coongan)	Compliance with pastoral Land Access agreements include as a minimum quarterly reporting to discuss completed and planned activities including cattle strikes, other notifications, compensations, notices of closure.
Government Departments	• Annual compliance reporting. • Incident/non-compliance reporting. • Any planned change in approved activity and or new or increased risk.
Local Community Groups	• Annual meeting with the Marble Bar Community Resource Centre to discuss progress and provide an opportunity to raise and discuss any issues, concerns or opportunities and provide feedback. • Marble Bar Local Emergency Management Committee meetings (as scheduled).

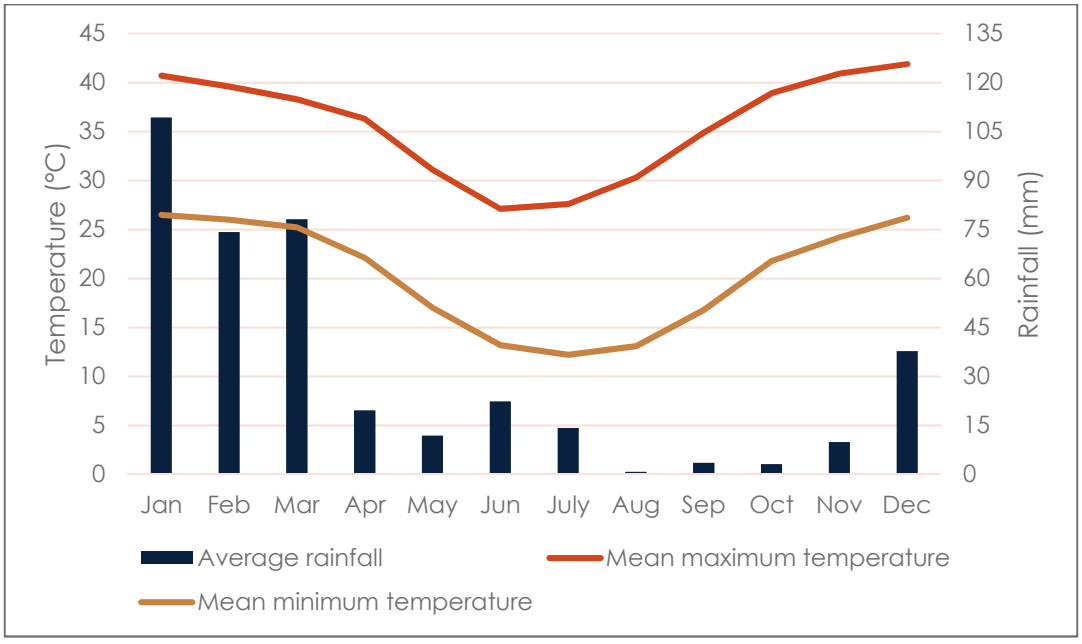
Note: Closure related consultation is captured separately in Appendix E.

8 Baseline Environmental Data

This chapter provides the necessary baseline data to understand the pre-existing environment, identify potential environmental impacts and ensure the Project's risk assessment is appropriately informed and site-specific.

8.1 Climate

The Project is located 100 km south-east of Port Hedland, along the Marble Bar Road and approximately 40 km (at its nearest point) to Marble Bar. The region has a semi-desert to tropical climate with highly variable, mostly summer rainfall (McKenzie, 2002; Leighton, 2004). The Pilbara climate is significantly influenced by tropical cyclones that develop over the Indian Ocean in Australia's north (Leighton, 2004), with typical average annual rainfall occurring predominantly from January to March. The closest official Bureau of Meteorology weather station in operation is located at Marble Bar, located approximately 40 km south-east of the Project. The average annual rainfall and average monthly minimum and maximum temperatures are provided in Figure 8-1, which also shows the climate data for the Marble Bar weather station, located approximately 33 km north of the Project area (BOM, 2021). The average monthly maximum temperature ranges from 27°C to 42°C, while the average monthly minimum temperature ranges from 12.2°C to 26.5°C. Average monthly rainfall ranges from 0.7 mm to 109.3 mm, while the average annual rainfall is 403.1 mm.



Source: BOM (2021) for Marble Bar station ID 4106

Figure 8-1: Average Monthly Rainfall and Temperatures at Marble Bar (2000 – 2021)

Analysis of rainfall data from single stations is often unreliable and is not temporally or spatially consistent. Therefore, Intensity-Frequency-Duration (IFD) design rainfall data has been derived for the whole of Australia by the Bureau of Meteorology. The design IFD values for each annual exceedance probability (AEP) event for the Project area are detailed in Table 8-1.

Table 8-1: IFD Design Rainfall Intensity

Duration	Annual Exceedance Probability (AEP) (mm/hour)						
	63% AEP	50% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
1 hour	28	32	46	56	66	79	90
2 hour	34	39	57	70	83	100	115
6 hour	45	53	81	102	123	153	177
12 hour	53	65	102	130	160	202	234
24 hour	64	78	127	163	201	255	296
72 hour	81	100	160	202	246	303	354

Source: RPS (2019)

Evaporation in the Pilbara is high with the average yearly evaporation of 3,300 mm greatly exceeding average annual rainfall of 362 mm (based on Marble Bar evaporation data), due to the heat and clear skies typical of arid to semi-arid areas (Stantec, 2018a).

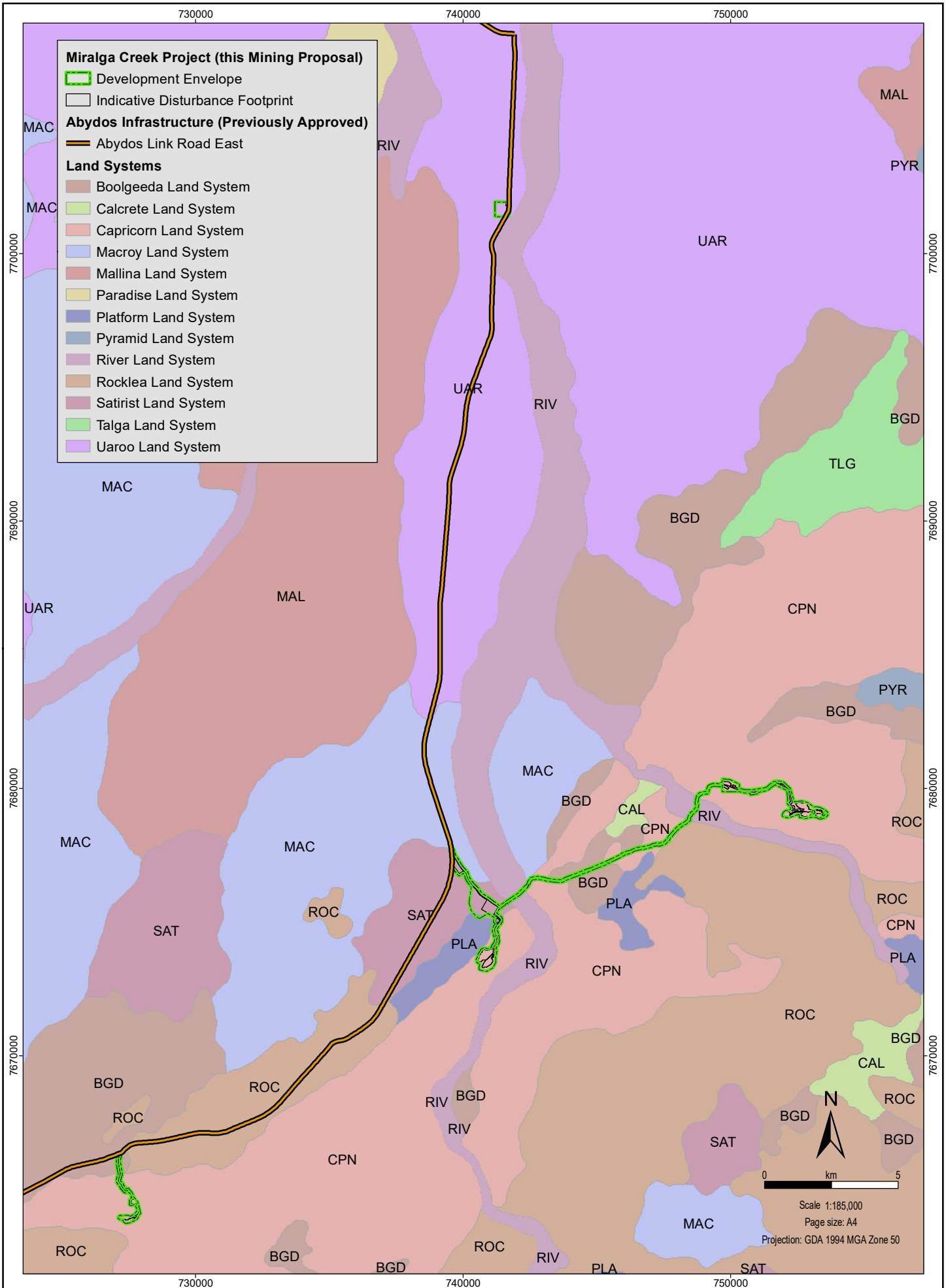
The most common afternoon wind direction at the Marble Bar weather station is from the east or south-east. Annual mean wind speed is 16.7 km/h and maximum gusts range from 61 km/h in June to 126 km/h in December (BOM, 2021).

8.2 Landscape

The Project is in the Pilbara Interim Biogeographical Regionalisation for Australia (IBRA), entirely within the Chichester subregion (Department of Sustaiability, Environment, Water, Population and Communities, 2012). The Chichester subregion is characterised by undulating granite and basalt plains with significant areas of basaltic ranges. The plains support a shrub steppe characterised by *Acacia inaequilatera* over *Triodia wiseana* (spinifex) hummock grasslands and the ranges support *Eucalyptus leuchophloia* tree steppes (Kendrick et al., 2001).

8.2.1 Land Systems

Land system classifications are used to map the land according to similarities in landform, soil, vegetation, geology and geomorphology (Van Vreeswyk, 2004). Eight land systems occur within the Development Envelope and are briefly described in Figure 8-2 and Table 8-2.



File Name: GIS_2843.mxd Date: 15/05/2020 Author: Heath.Maconachie	Source & Notes:	**Land Systems**	Figure No: **8-2**

MIRALGA CREEK

Atlas

Table 8-2: Land Systems Within the Development Envelope

Land System	Description	Mapped Extent (ha)[1]	Extent Within the Development Envelope (%)
Rocklea	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard (and occasionally soft spinifex) grasslands.	2,299,300	0.3%
Macroy	Sandy/Stony plains and occasional tor fields based on granite supporting hard and soft spinifex shrubby grasslands.	1,309,500	1.1%
Boolgeeda	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands.	774,800	7.4%
Uaroo	Broad sandy plains supporting shrubby hard and soft spinifex grasslands	768,100	5.7%
Capricorn	Hills and ridges of sandstone and dolomite supporting low shrublands or shrubby spinifex grasslands.	529,600	58.4%
River	Narrow, seasonally active flood plains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts sometimes with tussock grasses or spinifex.	408,800	3.8%
Platform	Dissected slopes and raised plains supporting spinifex grasslands	157,000	1.0%
Satirist	Stony plains and low rises supporting hard spinifex grasslands, and gilgai plains supporting tussock grasslands.	37,700	22.2%

1. Total extent of the land system, not just the portion within the Development Envelope.

8.2.2 Local Landscape

The local landscape at each of the three mining areas differs slightly. The three pits at Miralga East lie on top of a narrow ridge trending approximately east-west (Figure 4-2). The single waste rock dump at this location lies on the opposite side of the ridge to Miralga Creek. The dump is located centrally to the three pits, directly adjacent to the central pit. The ROM and laydown area for this deposit lies approximately 3 km west north-west from the mining area, off the ridge on a flatter area.

Miralga West lies west-south-west from Miralga East, on strike towards Sandtrax and Abydos (Figure 4-1 and Figure 4-3). The single pit sits on the end of a north-east to south-west trending ridge above the Shaw River. The waste rock dump is directly adjacent to the pit, on the opposite side of the ridge to the Shaw River. The ROM and laydown area are located on flatter ground, 1.7 km and 3.4 km from the mining area respectively. Both are located outside of the bed of the Shaw River.

The Sandtrax pit lies south west of Miralga West, on strike towards Abydos, adjacent to Sulphur Springs Creek (Figure 4-1 and Figure 4-4). The waste rock dump is immediately south of the single pit. The ROM is located approximately 700 m to the north, adjacent to the creek.

8.2.3 Land Tenure

The Development Envelope lies across pastoral and mining tenure (Figure 8-3). The relevant pastoral leases are:

- Magazine Area – Coongan Station and Strelley Station
- Sandtrax – Panorama Station and Unallocated Crown Land
- Miralga East – Panorama Station
- Miralga West – Panorama Station and Strelley Station
- Miralga Haul Road – Panorama Station and Strelley Station.

The majority of the tenure for the project is held by Atlas. As discussed in Chapters 2 and 3, Atlas has an agreement with Venturex Resources Ltd to develop a haul road on L45/189 (Figure 4-4).

File Name: GIS_2844.mxd	Source & Notes:	**Surrounding Land Use**	Figure No: **8-3**
Date: 15/05/2020			
Author: Heath.Maconachie			

8.3 Materials Characterisation

The following sections summarise the findings of material characterisation assessments that have been conducted for the Project, as summarised in Table 8-3.

Table 8-3: Materials Characterisation – Relevant Studies

Study	Study Purpose
Miralga Creek – Baseline Soil and Landform Assessment (Mine Earth, 2019) Appendix F	Mine Earth completed a baseline soil and landform assessment for the Project to characterise the existing surface soil materials within the Study Area. The focus was on the soils within disturbance areas associated with proposed mining activities, and to develop associated recommendations soil salvaging, management, stockpiling and application of soil resources in rehabilitation and mine closure activities.
Miralga Creek Project Mine Waste Characterisation Assessment (Mine Earth, 2020) Appendix G	Mine Earth completed an assessment of the geochemical and physical characteristics of mine waste expected to be produced from the Miralga East, Miralga West and Sandtrax deposits at the Project and to develop associated mine waste management recommendations.

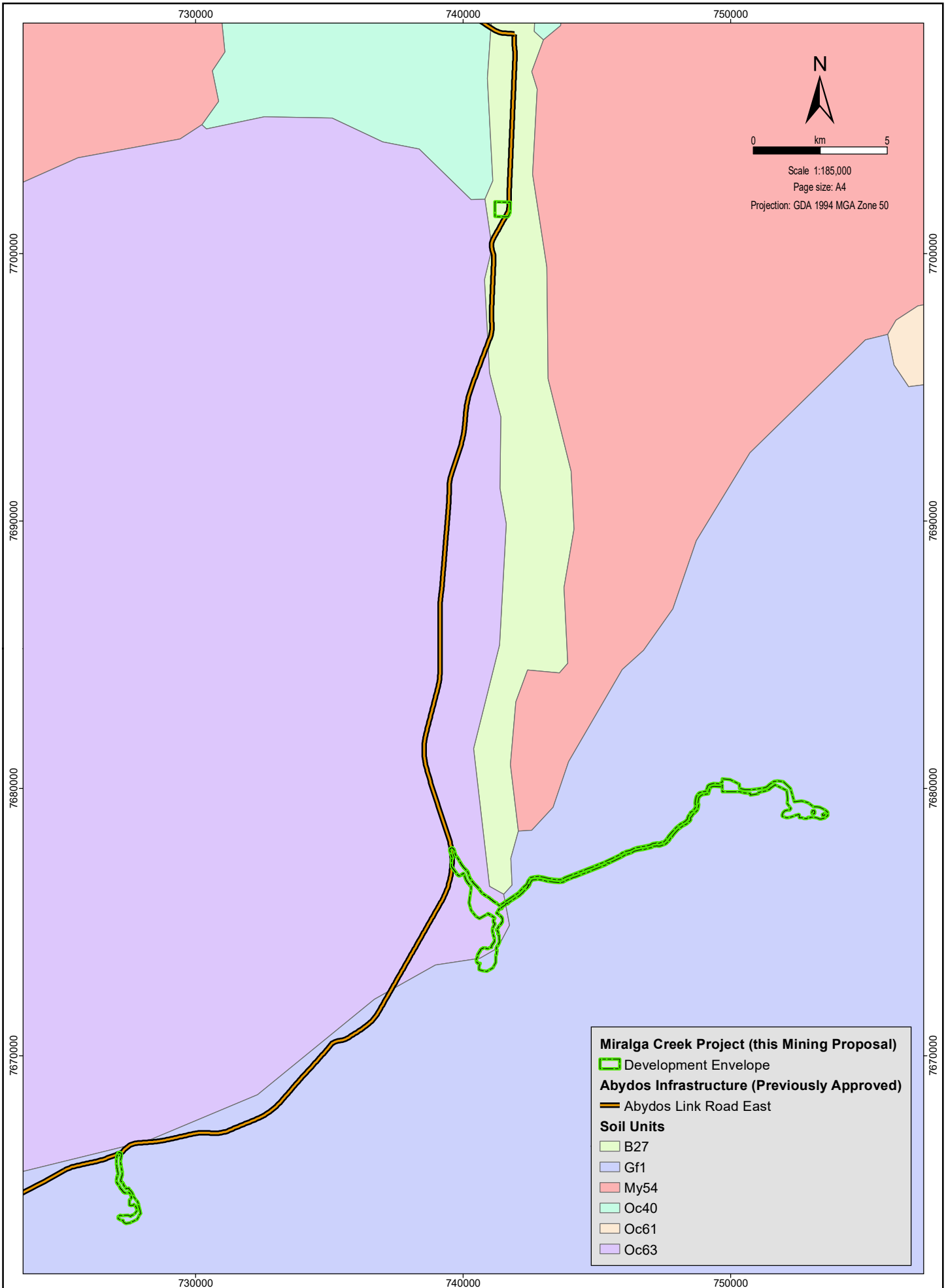
8.3.1 Soils

8.3.1.1 Major Soils

The Cleaverville Formation underlies the Project. It is overlain by weathered iron-rich regolith and/ or thin, loose tertiary soils, dominated by three regolith types:

- Massive, bedded or pisolitic goethite-limonite laterite (ferricrete).
- Silcrete.
- Quartz-limonite-clay laterite.

Based on the reference soil units (ASRIS, 2014), three soil types are present in the Project area (Figure 8-4; Table 8-4). The majority of the Project area is characterised by shallow and stony soils, brown loams (Gf1), and loose sands (B27) towards the Magazine Area at G45/340. Part of the western section of the study area is characterised by the hard red (Oc63) soil units.



ATLAS	File Name: GIS_2855.mxd Date: 15/05/2020 Author: Heath.Maconachie	Source & Notes:	**Soil Units**

Figure No: **8.4**

Table 8-4: Soil Units in the Study Area

Soil Unit Code	Summary Description
Gf1	Steep ranges on basic lavas along with dolomites, tuff, banded iron formations, and dolerite dykes, with some narrow valley plains and high-level gently undulating areas of limited extent. The soils are generally shallow and stony and there are large areas without soil cover: chief soils are brown loams (Um6.23) along with significant areas of earthy loam (Um5.51) soils. (Dr2.33) soils occur on lower slopes with (Uf6.71) and (Ug5.37) soils on valley floors
B27	Low terrace associated with main stream channels: chief soils are loose sands (Uc1.22) with some (Um5.11) soils on patches of calcrete (kunkar)
Oc63	Pediplains on granite; more dissected than unit Oc62 and usually occurring as a zone flanking the main stream courses: chief soils are hard alkaline red soils (Dr2.33) and (Dr2.43). There are more areas of (Um5.11) soils on calcrete (kunkar) than in unit Oc62 and some (Uc5.11) and (Uc1.22) soils occur along creeks.

Source: Australian Soil Resource Information system (ASRIS, 2014)

8.3.1.2 Soils Characterisation

A baseline soil assessment was undertaken by Mine Earth over a 2,600 ha Study Area covering the three mining areas and the Magazine Area (Mine Earth; Appendix F). The study involved landform association mapping, and soil sampling.

The baseline soil assessment characterised the existing surface soil from samples at 17 locations. Each sample was taken to a maximum depth of 0.25 m and then analysed for its physical and chemical characteristics.

Many of the chemical and physical characteristics of the surface soils across the Project area were relatively similar, with little consistent correlation with soil-landform association, or sample depth. All soils sampled were relatively coarse grained, with generally low clay contents (minor increase in clay with depth), were non-saline, partially dispersive upon severe disturbance, free draining (moderate hydraulic conductivity) and typically low in organic carbon and plant-available nutrients.

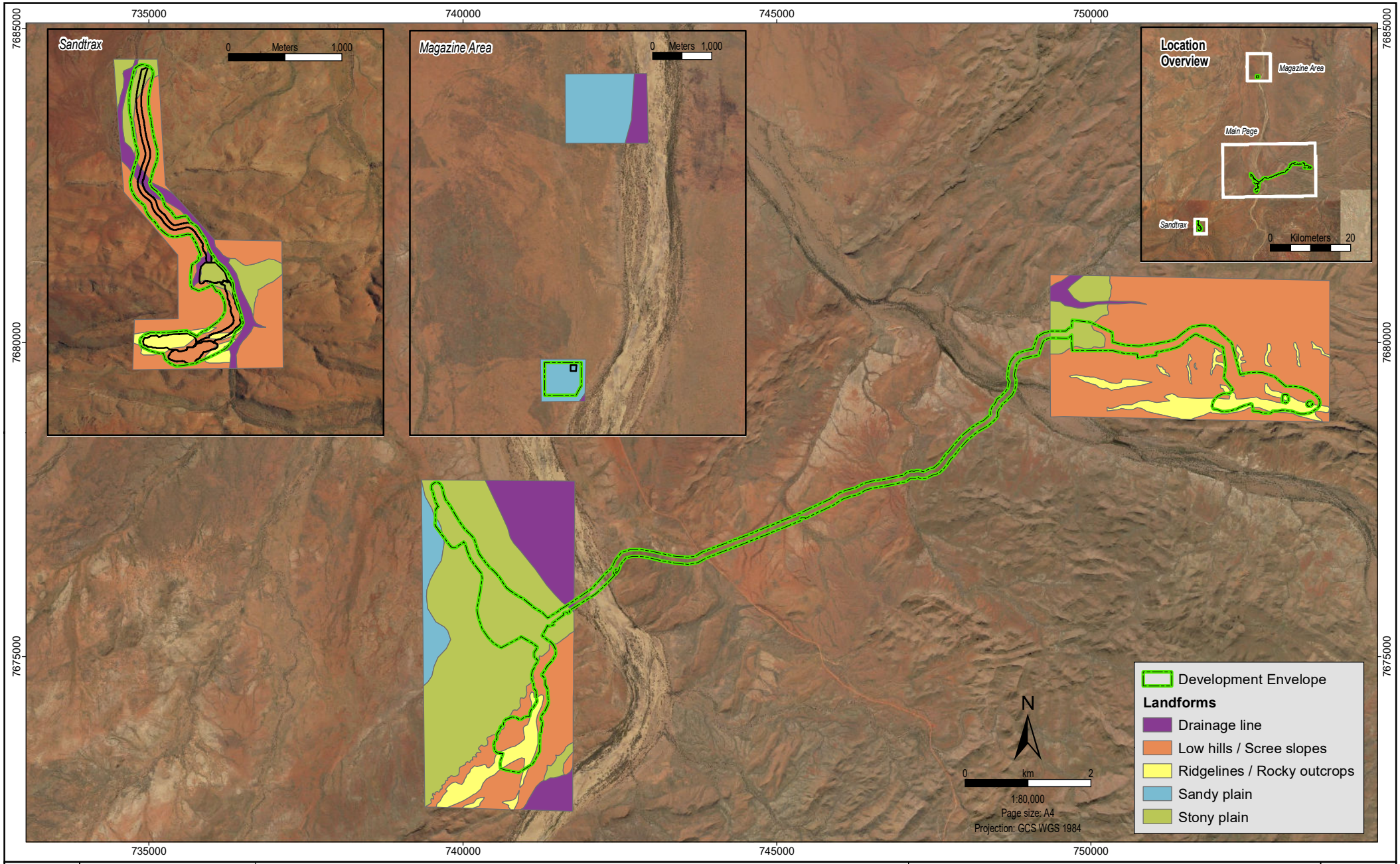
An overall consistency was identified in the soil characteristics within each of the three mining areas; the Magazine Area was the most significantly different.

Five soil-landform associations were identified and are summarised as follows (Figure 8-5):

- Ridgelines / Rocky outcrops:
  - Shallow / skeletal soils over fractured / weathered and competent rock
  - Outcropping rock present at the surface (approximately 20 to 40% cover)
  - Coarse texture with low clay contents
  - High percentage of competent rock fragments through the surface soil profile
  - Non-saline, non-sodic, low plant-available nutrient concentration
  - Moderate hydraulic conductivity
- Low hills / Scree slopes:
  - Low undulating hills with minor outcropping rock in some areas, and scree slopes below ridgelines
  - Shallow surface soils (variable depth) over fractured / weathered and competent rock
  - High percentage of competent rock fragments through the surface soil profile
  - Coarse texture with low clay contents

- Non-saline, non-sodic, low plant-available nutrient concentration
- Low plant-available nutrient concentration
- Moderate hydraulic conductivity

- Stony plains:
  - Relatively flat / low relief depositional plains with surface lag of gravel / competent rock materials
  - Deeper soil profiles than higher in the landscape
  - Moderate percentage of competent rock fragments through the surface soil profile
  - Non-saline, non-sodic, low plant-available nutrient concentration
  - Moderate hydraulic conductivity
- Sandy plains:
  - Flat, depositional areas at low points in the local landscape
  - Deep sandy soils (comparative to surrounding soil profiles)
  - Relatively low coarse fraction (>2 mm)
  - Non-saline, low plant-available nutrient concentration
  - Sodic and partially dispersive
  - Moderately slow hydraulic conductivity
- Drainage channels:
  - Large and distinct incised channels.
  - Variable particle size distribution reflecting areas of erosion and deposition in drainage channel. Typically, coarse sands comprise the bulk of the surface soil sized fraction.



ATLAS	GIS_2874.mxd	Source & Notes:	**Landform Associations**	Figure No: **8.5**
	Date: 15/05/2020			
	Author: Heath.Maconachie			

The Development Envelope is dominated by three landform associations: Low hills/ scree slopes, Stony plain and Sandy plain (Mine Earth, 2019). None of these landforms are restricted to the Development Envelope or Study Area.

In general, the topsoil materials (0 to 20 cm depth) across the Ridgelines/ Rocky outcrops, Low hills/ Scree slopes and Stony plains soil-landform associations have characteristics which indicate a relatively low inherent erodibility (i.e. low clay content, only partially dispersive, high coarse material content and free draining). The topsoils sampled from the Sandy plain soil-landform association contained relatively low amounts of coarse material (i.e. rock >2 mm) and may be prone to partial clay dispersion. While these soils were likely to be more prone to erosion than the soils from higher in the landscape, they were still considered a potential resource for use in rehabilitation activities on flat disturbance areas.

It was recommended that topsoil materials, to a depth of approximately 20 cm from within the Stony plain and Low hills / Scree slopes soil-landform associations, are salvaged from disturbance areas, for potential use as a rehabilitation resource. Topsoils from the Ridgelines/ Rocky outcrops soil-landform association are also physically and chemically suitable for salvage and use as a rehabilitation medium, however, due to accessibility and the prevalence of outcropping rock, the salvage of these topsoils is likely to be opportunistic.

It was also recommended that topsoils salvaged from disturbance areas within the Low hills/ Scree slopes soil-landform association and any topsoil able to be opportunistically salvaged from the Ridgelines / Rocky outcrops soil-landform association should be stockpiled together for use as a surface rehabilitation medium on rehabilitated slopes of constructed landforms. The high coarse fraction, low clay content, non-dispersive and free draining nature of these topsoils indicate a low inherent erodibility and suitability for use on rehabilitated sloped areas.

Topsoil materials from within the Stony plains soil-landform association of the Study Area were also considered suitable for salvage and use as a surface rehabilitation medium, particularly for flat rehabilitation areas situated low in the landscape.

8.3.1.3 Soil Inventory

A preliminary inventory of potential soil resources has been developed for the Study Area (Table 8-5). It is based on the characterisation of surface soils, mine waste and landform association mapping.

Table 8-5: Preliminary Soil Resource Inventory

Landform Association	Extent in Indicative Disturbance Footprint (ha)	Proportion of the Indicative Disturbance Footprint (%)	Approx. Topsoil Stripping Depth (m)	Potential Volume Topsoil (m^3)	Suitability for Salvage and Rehabilitation Use
Drainage channels	1.6	1	–	–	Not recommended
Sandy plains	0.9	1	0.2	1,830	Recommended for flat surfaces
Stony plains	59.1	35	0.2	118,150	Recommended
Low hills/ Scree slopes	68.8	41	0.2	137,696	
Ridgelines/ Rocky outcrops[1]	37.8	22	0.2	75,6481	
TOTAL[2]	**168.2**	**100**		**333,324**	

1. The presence of outcropping rock and accessibility issues are likely to limit the ability to salvage these topsoils and may decrease the volume of salvageable. This needs to be taken into account for rehabilitation planning.
2. This value does not add to the total Indicative Disturbance Footprint as the Miralga Creek haul road was excluded from the Landform Association mapping completed by Mine Earth.

Surface soils (0 to 0.2 m) from the Low hills/ scree slopes and Ridgelines/ Rocky outcrops landforms are considered to be a valuable resource for rehabilitation material. They generally have a high coarse rock fragment content, moderately rapid hydraulic conductivity, and are non-saline and non-sodic, indicating a low inherent potential for erosion (Mine Earth, 2019).

8.3.2 Subsurface Materials

8.3.2.1 Geology and Mineralisation

The Project is located on the northern margin of the Panorama Greenstone Belt, within the East Pilbara Terrane of Western Australia. The Cleaverville Formation (within the Gorge Creek Group) hosts the Miralga deposits and consists of packages of banded iron formation (BIF), chert, shale and sandstone (Atlas Iron, 2014).

The Paddy Market Formation (within the Soanesville Group (Geoscience Australia, 2019) – previously within the Gorge Creek Group (Atlas Iron, 2012) – correlates regionally with the Cleaverville Formation and hosts the Sandtrax deposit. A sequence of BIF units dominates the Paddy Market Formation at the Project (Atlas Iron, 2012).

Mineralisation at the Miralga East and West deposits consists of predominantly goethite (with lesser hematite) enrichment and is comprised of a hydrated zone from surface to approximately 10 m depth. Primary mineralisation underlies the hydrated zone and conforms with the bedding orientation to depths of up to 100 m (Atlas Iron, 2014).

Mineralisation at the Sandtrax deposit consists of predominantly goethite (with lesser hematite) enrichment and is comprised of a low-grade hydrated zone that dips steeply to a depth of 30 to 50 m (Atlas Iron, 2012).

The common lithology types that are observed within the Project pits shells includes banded iron formation (BIF), chert, sandstone and shale. As moderate-high weathering extends to the base of all pits, primary / fresh rock is not expected to be encountered.

Miralga East

The Miralga East area is located on the northern margin of the Panorama Greenstone Belt within the East Pilbara terrane. The Miralga East BIF-hosted iron ore mineralisation is hosted by the Cleaverville formation consisting of a package of banded iron formations, cherts and shales which locally form a prominent ridge striking approximately east to west and dipping steeply to the north.

Mineralisation at Miralga East occurs in three separate zones. All three zones contain a thin layer of hydrated mineralisation from the surface down to approximately 10 m. Primary mineralisation underlies hydrated mineralisation and follows bedding orientation down dip. In some areas, mineralisation is observed as deep as 100 m. Mineralisation is predominantly goethite enrichment, with lesser amounts of hematite.

Miralga West

The Miralga West mining area consists of a massive thick volcanic sequence dominated by basaltic composition from the Double Bar Formation of the Coonterunah Subgroup. The Double Bar Formation is unconformably overlain by the younger sediments of the De Grey Supergroup. The De Grey Supergroup consists of sediments from the Gorge Creek Group and Croydon Group. The main northeast-southwest trending Miralga West range consists of BIF units from the Cleaverville Formation which is known to host significant iron ore deposits in the Pilbara.

The main iron mineralisation at Miralga West occurs in one main zone that has a strike length of approximately 340 m and a maximum width of approximately 100 m. The deposit strikes northeast-southwest and comprises a semi-continuous steeply northwest dipping zone of iron ore enrichment down to an average depth of 50 to 70 m with the deepest part down to 130 m. The dip direction is mainly steeply dipping to the northeast but appearing to the southeast in the depth.

Sandtrax

The Sandtrax Deposit is located within the Lalla Rookh Trend, which comprises a sequence of BIF within the Paddy Market Formation of the George Creek Group. The sequence of BIF lies stratigraphically above pebble conglomerates and feldspathic arenites of the George Creek Group, which in turn lie above a thick southerly dipping sequence of high magnesium basalts. The Paddy Market Formation is unconformably overlain by pebble to boulder conglomerates of the Lalla Rookh Sandstone.

The mineralisation at Sandtrax has a strike length of approximately 370 m and a maximum width of approximately 50 m. The deposit strikes east-west and comprises a continuous steeply dipping zone of iron ore enrichment down to a depth of 30 to 50 m. The dip direction is variable throughout the length of the deposit, appearing to dip to the north in some cross sections, and to the south in others. Mineralisation comprises mostly goethite enrichment with minor haematite.

8.3.2.2 Ore and Waste Materials

Indicative volumes and proportion of mined waste materials by lithology from each of the five pits is provided in Table 8-6.

Table 8-6: Preliminary Waste Inventory – Indicative Tonnage and Proportion of Waste Rock Material by Lithology

Lithology	Miralga East pit 1	Miralga East pit 2	Miralga East pit 3	Miralga West	Sandtrax	Total
Banded Iron Formation (BIF)	554 kt 97.6%	1,765 kt 99.9%	274 kt 94.5%	1,741 kt 88.5%	160 kt 100%	4,494 kt 94.6%
Chert	14 kt 2.4%	2.5 kt 0.1%	16 kt 5.5%	0.8 kt 0.04%	–	33 kt 0.7%
Shale	–	–	–	30 kt 1.53%	–	30 kt 0.6%
Sandstone	–	–	–	195 kt 9.93%	–	195 kt 4.1%
Total	**568 kt**	**1,768 kt**	**290 kt**	**1,967 kt**	**160 kt**	**4,753 kt**

To define the resources at the Project, Atlas has drilled over 163 drillholes totalling more than 13,495 m of both diamond drilling and RC drilling. All of these holes have been geologically logged by competent geologists. No asbestiform minerals have been observed.

With respect to radioactive minerals, the Sandtrax, Miralga West and Miralga East deposits are hosted by Cleaverville Formation BIF, a unit not known for its radioactive mineral content. Of the 13,495 m of drilling completed and geologically logged, no rocks more typical of hosting radioactive minerals such as granites, other acid/intermediate/alkaline intrusives, carbonatites etc., have been observed. Atlas operates other mines in similar geological units and has not previously encountered radioactive materials in those units. Accordingly, Atlas has not assayed or checked for naturally occurring radioactive minerals.

Mine Earth was commissioned by Atlas to assess the geochemical and physical characteristics of mine waste expected to be produced from the Miralga East, Miralga West and Sandtrax deposits (Mine Earth, 2020; Appendix G). Geochemical properties of ore were also analysed. The materials characterisation assessment work was conducted over three phases (Mine Earth, 2020b) as outlined in Table 8-7.

Table 8-7: Number of Samples

	Phase 0	Phase 1	Phase 2
Description	Pre-screening review of existing technical information and drilling databases to provide a broad understanding of the characteristics of a deposit. Supports targeted sample selection for later phases. Included an assessment of erosion potential.	Initial screening phase of waste characterisation, using sulphur and other elemental assays to define chemical variability of representative lithologies.	More detailed testwork involving static and kinetic tests to determine the potential for acid generation, metalliferous drainage, saline drainage and compromising physical factors.
Number of Samples	No samples were taken during Phase 0. The combined dataset was a comprehensive and spatially representative dataset across all deposits (refer to Figures 2 to 6 in (Appendix G).	3,167 samples from 127 drilholes were analysed. All samples were from within planned pit shells plus a 10 m buffer. The inclusion of the buffer allows characterisation of materials in the pit walls, to ensure a sound understanding of pit wall exposure risks. Refer to Table 1 of Appendix G for a breakdown of the number of Phase 1 samples by deposit and lithology.	33 samples from 24 drillholes were analysed as detailed in Table 8-8. Refer to Figures 7 to 11 of Appendix G for spatial distribution of these samples. Sample selection was based on obtaining a representative profile of expected waste rock types based on available Phase 1 samples and was also informed by the results of Phase 1.

Table 8-8 sets out the total number of samples subjected to detailed geochemical analysis.

Table 8-8: Number of Samples Subjected to Geochemical Analysis

Deposit	Waste Samples	Ore Samples	Total Samples
Miralga East (pits 1, 2 and 3)	14	4	**18**
Miralga West	8	1	**9**
Sandtrax	5	1	**6**

Source: Mine Earth (2020).

Assay information across all Project deposits was both comprehensive and spatially representative for all rock types. Phase 0, 1 and 2 assessments were carried out, consistent with the Draft Guidance Materials Characterisation Baseline Data Requirements for Mining Proposals (Department of Mines and Petroleum, 2016).

The assessment of the physical characteristics and erosion stability of mine waste showed the vast majority of waste rock material has moderate to high resistance to erosion, with the exception of a small proportion of shale found only in the Miralga West pit (Mine Earth, 2020):

- BIFs, cherts and sandstones will be the dominant waste rock lithology types from each deposit (>95%) and these are likely to display moderate-high erosion stability.

- Shales will only represent a minor proportion (2.1%) of the total waste rock volume from the Miralga West pit and are likely to display low erosion stability. Low stability waste rock will not be exposed on final waste rock dump surface.

Geochemical assays of waste demonstrated the following (Mine Earth, 2020):

- All mine waste types within the planned pit shells and within a 10 m buffer outside of the pit shells, were classified as non-acid-forming (NAF).
- No significant enrichment in any element was identified from multi-element and water extraction test work. All mine waste types from all deposits are expected to release negligible metals/ metalloids during weathering.

A summary of physical and geochemical properties for each lithology is provided in Table 8-9.

Table 8-9: Summary of Waste Rock Characteristics

Lithology	Acid Formation Potential	Risk of Metalliferous Drainage	Erosional Stability Classification	Risk of Asbestiform Minerals	Risk of NORM
BIF	NAF	None	Moderate-High	Negligible	Negligible
Chert	NAF	None	Moderate-High	Negligible	Negligible
Shale	NAF	None	Low	Negligible	Negligible
Sandstone	NAF	None	Moderate-High	Negligible	Negligible
Ore	NAF	None	N/A	Negligible	Negligible

Acid formation potential, risk of metalliferous drainage and erosional stability classification from Mine Earth (2020). Risk of asbestiform and radioactive minerals from Atlas.

All ore samples returned circum-neutral pH (5–9 pH) and low salinity. Negligible sulphides were present across all Phase 2 samples, with the highest sulphur results being 0.05% at Miralga East. All samples were classified as non-acid forming (NAF).

8.3.2.3 Tailings and Other Processing Waste

This Project will not produce tailings or any other mined waste requiring processing.

8.3.3 Avoidance of Impacts Through Design

The following features of soil and waste material at the Project are advantageous to its operation and closure:

- Waste rock is benign and is not anticipated to lead to enrichment or release of deleterious metals/ metalloids.
- The majority of waste rock is expected to have at least moderate erosional stability.
- The majority of soils across the Project are expected to be valuable sources of rehabilitation material.

Typical of the landforms being mined by iron ore operations in the Pilbara, and as seen at Atlas's other Pilbara operations, there is likely to be a topsoil deficit with regard to rehabilitation. Avoidance of this risk is not possible as it is intrinsically linked to the naturally low availability of topsoil.

8.3.4 Residual Impacts After Design

In relation to soils, the following residual impacts will require management:

- Soils from Sandy Plains have a lower coarse rock fraction than most other soils at the Project and have tendency for partial dispersion of the clay fraction; they are not suitable for rehabilitation of sloped surfaces (but are a valuable rehabilitation resource for flat surfaces).
- Soils from Drainage Channels are erodible and should not be salvaged for rehabilitation purposes.

In relation to waste rock, the following residual impacts will require management:

- Low stability waste rock (specifically the small proportion of Shale at Miralga West) will not be exposed on final waste rock dump surface.

Mining and support activities that can result in impacts to soils, subsoils and the natural environment that require consideration include:

- Transport, handling and storage of hydrocarbons and chemicals, which could result in the contamination of soils and subsoils.
- Poor construction of final WRDs leading to loss of waste rock material and/ or topsoil into the surrounding environment.
- The likely topsoil deficit could be compounded by poor management of available suitable

8.3.5 Summary of Materials Characterisation and Implications for Risk Assessment

Soils

- Overall general consistency in the soil characteristics within each of the three mining areas (Miralga East, Miralga West and Sandtrax).
- Topsoils from Low hills/ Scree slopes and Ridgelines/ Rock outcrops should be used for surface rehabilitation on slopes.
- Topsoils from within Stony plains and Sandy plains are suitable for rehabilitation on flat surfaces.
- Soils from Drainage Channels should not be salvaged for use in rehabilitation.
- Typical of the landforms being mined by iron ore operations in the Pilbara, and as seen at Atlas' other Pilbara operations, there is likely to be a topsoil deficit with regard to rehabilitation.

Mine Waste

- All waste rock is NAF and so does not present an acid mine drainage risk.
- All mine waste types from all deposits should release negligible metals/ metalloids during weathering.
- BIFs, cherts and sandstone will comprise the bulk of all waste rock (>95%) and have moderate-high erosional stability.
- Shale represents a minor proportion (2.1%) from Miralga West and displays only low erosional stability. Low stability waste rock will not be exposed on final waste rock dump surfaces.
- Risk of asbestiform material or NORM is negligible.

8.4 Hydrology

The following sections summarise the findings of various hydrological assessments that have been conducted for the Project, as summarised in Table 8-10.

Table 8-10: Hydrology – Relevant Studies

Study	Study Purpose
Miralga Creek Project Water Management Assessment (Atlas Iron Pty Ltd, 2020) Appendix H	The report: • Presented background/ baseline information on the regional and local setting, based on broad-scale and Project-specific information • Described the Project's water needs (i.e. inputs) • Described the potential impacts to ground and surface waters.
Miralga Creek Project Surface Water Assessment (RPS, 2020) Appendix I	The objective of this study was to provide a desktop Surface Water Assessment for the project, accounting for proposed operations and mine closure, to support impact assessment and environmental approvals.
Abydos East Haul Road - Mining Proposal: Hydrology and Hydrogeology Impact Assessment (MWH, 2012)	MWH completed a hydrology and hydrogeology impact assessment to understand hydrological regimes and groundwater quality surrounding the Abydos East Haul Road (i.e., the ALRE).

8.4.1 Groundwater

8.4.1.1 Regional Groundwater

Groundwater in the area is available in the following primary aquifers (MWH, 2012):

- Alluvial Aquifers: Generally, alluvial aquifers are associated with alluvial deposits along coastal plains and within the valleys associated with the drainage lines.
- Fractured Rock Aquifers: Fractured rock aquifers are the predominant type within and around the Development Envelope; they are likely to underlie alluvial aquifers. Fractured rock aquifers are generally associated within structural fracture zones or faulting, igneous intrusions, sedimentary rocks and banded iron formations.

8.4.1.2 Local Hydrogeology

Groundwater levels in the existing ALRE borefield (ALPB01, ALPB03, ALPB04, ALPB05 and ALB0066) range in depth from 13.98 to 16.84 mbgl. Groundwater levels range from 7.51 to 9.55 mbgl in the existing Venturex borefield (SSWB36, SSWB38, SSWB40). All bores are at low points in the local topography.

A review of the Atlas drill-hole database, investigating 180 Reverse Circulation (RC) holes, showed no water intersections during the mineral exploration program, which was focused on pit areas. Follow up interviews with the project geologist confirmed the lack of water, so the expectation was that all pits would be well above the groundwater table and that no dewatering would be required.

To further investigate groundwater levels across the Project area, a broad range of existing and open RC holes were checked for water during a site visit by Atlas hydrogeologists on 29 and 30 May 2019 (Appendix H). All but one drill hole (MRRC0116) assessed during the site visit were dry. A small amount of water was noted in MRRC0116 at Miralga East at the base of the hole. This is a shallow

hole (30 m) at a somewhat elevated part of the ridge so the small amount of water is most likely remnant drill fluid (drilled in 2019, prior to the site visit), or surface runoff which has seeped down the outside of the surface casing. MRRC0116 is located over 150 m away from the Miralga East pit 1 and pit 2, along the inter-pit haul road.

In addition to the site observations described above, below is a summary of knowledge of pit floors versus natural groundwater levels:

- Miralga East: In the absence of drilling intercepts with groundwater during exploration and the absence of water from in-pit drill-holes observed in May 2019, the nearest assumed groundwater levels are two waterholes located to the south of the pits within Miralga Creek. These waterholes (WMRC-14 and -15) are within approximately 1 to 3 km of the Miralga East pits and were considered to be permanent (Biologic 2019). The surface elevations of these waterholes are 125 to 128 mRL. This represents a gap of over 90 m between the deepest planned point in any of the three Miralga East pits and groundwater.
- Miralga West: The maximum planned pit depth is 156 mRL, approximately 20 to 30 m above the relative level of the plains to the west and north, and of the Shaw River to the east. Assuming as a worst case that the water table is at or near the elevation of the bed of the Shaw River, the pit floor will be a minimum of 30 m above the groundwater level.
- Sandtrax: SSWB40 is located approximately 1 km to the north and has a standing water level in the order of 185 mRL, approximately 70 m below the planned pit depth. If it is assumed that at its shallowest the water level in the Sulphur Springs Creek sediments 500 m to the east of the mining area is at the approximate elevation of the creek bed, it would be in the order of 203 to 205 mRL. This represents a minimum a 50 m gap between the base of the planned Sandtrax pit and the surrounding groundwater level.

Atlas collects data on seasonal fluctuation in groundwater at the Abydos Mine and along the ALRE. This data shows that groundwater fluctuations are limited to two to four metres only. A similar level of fluctuations would be expected in groundwater across the Project, thus the buffer between the pits and groundwater level is sufficient.

Based on the available information, all pits will have a minimum of 30 m to 90 m buffer to groundwater at the completion of mining.

8.4.1.3 Environmental Values and Beneficial Uses of Groundwater

Groundwater is thought to express at a number of waterholes surrounding (but not within) the Development Envelopment. These are an important resource for native fauna, including Northern Quoll, Pilbara Olive Python and Pilbara Leaf-nosed Bat and are discussed in more detail in Section 8.5.2.2.

Groundwater can be a controlling factor in the distribution of vegetation types. The impact of changes in groundwater quantity and quality is dependent on the degree and nature of groundwater dependency of vegetation. Groundwater quality and quantity is also important for subterranean fauna, although subterranean fauna is not a significant consideration for this Project (see Section 8.5.4). Impacts to potential groundwater dependent vegetation are managed under existing approvals.

As water supply for the Project will be sourced from existing borefields used to supply other mining operations, and regulated under existing Mining Proposals REGID 37527 and 37773, the impact of groundwater abstraction on the local environment is not discussed in this Mining Proposal.

8.4.1.4 Groundwater Management Areas

The Project is located within the Proclaimed Pilbara Groundwater Area.

8.4.1.5 Groundwater Quality

Groundwater samples have been collected from across the site from 2007 to 2019. Samples were analysed for physical parameters (pH, EC, TDS), major ions, trace elements and metals. Detailed results are provided in Appendix H. Results indicate groundwater within and adjacent to the area to be fresh to marginal:

- ALPB05, ALPB04, ALPB02 and ALB0066 were quite consistent with salinity <1,000 mg/L (i.e. marginal) and near neutral (field pH 7.38–7.66) (Chemcentre data, May 2019).
- Groundwater sampled from the Venturex borefield had a salinity concentration in the range of 308 to 764 mg/L of TDS (fresh to marginal). The sampled water also has pH values close to neutral. (URS, 2007, as reported in MWH (2012)).
- At the Abydos minesite, groundwater hydrochemistry ranges from near potable to brackish in nature (MWH, 2012).

8.4.2 Surface Water

8.4.2.1 Local Catchments

Miralga East is located in the Miralga Creek catchment, a sub-component of the larger Shaw River catchment (approximately 790,000 ha). Miralga West and the Magazine Area are located in the Shaw River Catchment. Sandtrax lies within the separate Strelley River catchment (approximately 280,000 ha) (Figure 8-6). At closure, the total runoff lost from the three mining areas is approximately equivalent to only 50 ha of land surface area (RPS, 2020; Appendix I)

8.4.2.2 Surface Hydrology

Major surface drainage in the area generally trends north, through dryland tributaries/ creeks (including Miralga Creek), into either the Shaw River or Strelley River (RPS, 2020). Both rivers join the De Grey River system to the north. The De Grey River Basin covers an area of 56,890 km^2 (Ruprecht, 2000) with its major tributaries being the Strelley, Shaw, Coongan, Oakover and Nullagine Rivers (Figure 8-6).

Surface flow in the region occurs almost exclusively as a direct response to rainfall and is highly skewed to summer events (December to March). Flow in the smaller channels is typically of short duration and ceases soon after the rainfall event passes. In the larger river channels, which drain the larger catchments, runoff can persist for several weeks and possibly months following major rainfall events such as tropical cyclones. There are no perennial streams occurring in the immediate vicinity of the Project. Surface water can persist throughout the year in waterholes along the main rivers and creeks (RPS, 2020).

All of the proposed mining areas are located atop high, narrow ridges. As such surface runoff into the pits will be minimal. Sump pumping to remove incident rainfall accumulation from within the pit boundaries will be required from time to time during mining. Pit volumes are significantly larger than any potential volume of surface water inflow. Stormwater accumulations in the pits post closure are expected to dissipate quickly through evaporation and infiltration. The narrow ridges would also be unlikely to support infiltration of significant amounts of surface water, so any mounding of the underlying local water table would likely be subdued.

Known waterholes in the area were visited by Atlas hydrogeologists to assess their permanency, with permanency being an indication that the waterholes and surrounding vegetation could be

groundwater fed/dependent (Appendix H). The majority of the waterholes (some initially thought to be permanent) have been determined to be non-permanent (Appendix I). All known waterholes are located outside of the Development Envelope as shown on Figure 8-7.

Miralga East

The Miralga East mining area runs along the northern side of Miralga Creek (Figure 4-2). A number of waterholes are evident within the creek and are likely maintained by saturated alluvials within the drainage channel. Waterholes WMRC-14 and -15 were considered to be permanent by Biologic (2019) and are 1 to 3 km from the three mine pits at Miralga East (Figure 8-7). These waterholes likely receive runoff from the ridge on which the Miralga East pits sit; note that the Miralga East waste rock dump is on the opposite side of the ridge, away from the creek and waterholes. All other waterholes in the area have at times been observed to be dry, or otherwise considered non-permanent (Biologic, 2019).

Runoff to the north of the ridge occurs through several small drainages which flow in a northerly direction for approximately 1.5 km before intersecting a westerly trending creek line, which in turn eventually intersects Miralga Creek. Drainage from the north will include runoff from the three pit areas and the proposed waste dump. The northerly drainages will also be intersected by the proposed Miralga Haul Road.

The Miralga East ROM pad is proposed to be located approximately 2 to 3 km to the north-west of the mining area and is situated either side of a minor drainage channel at its head.

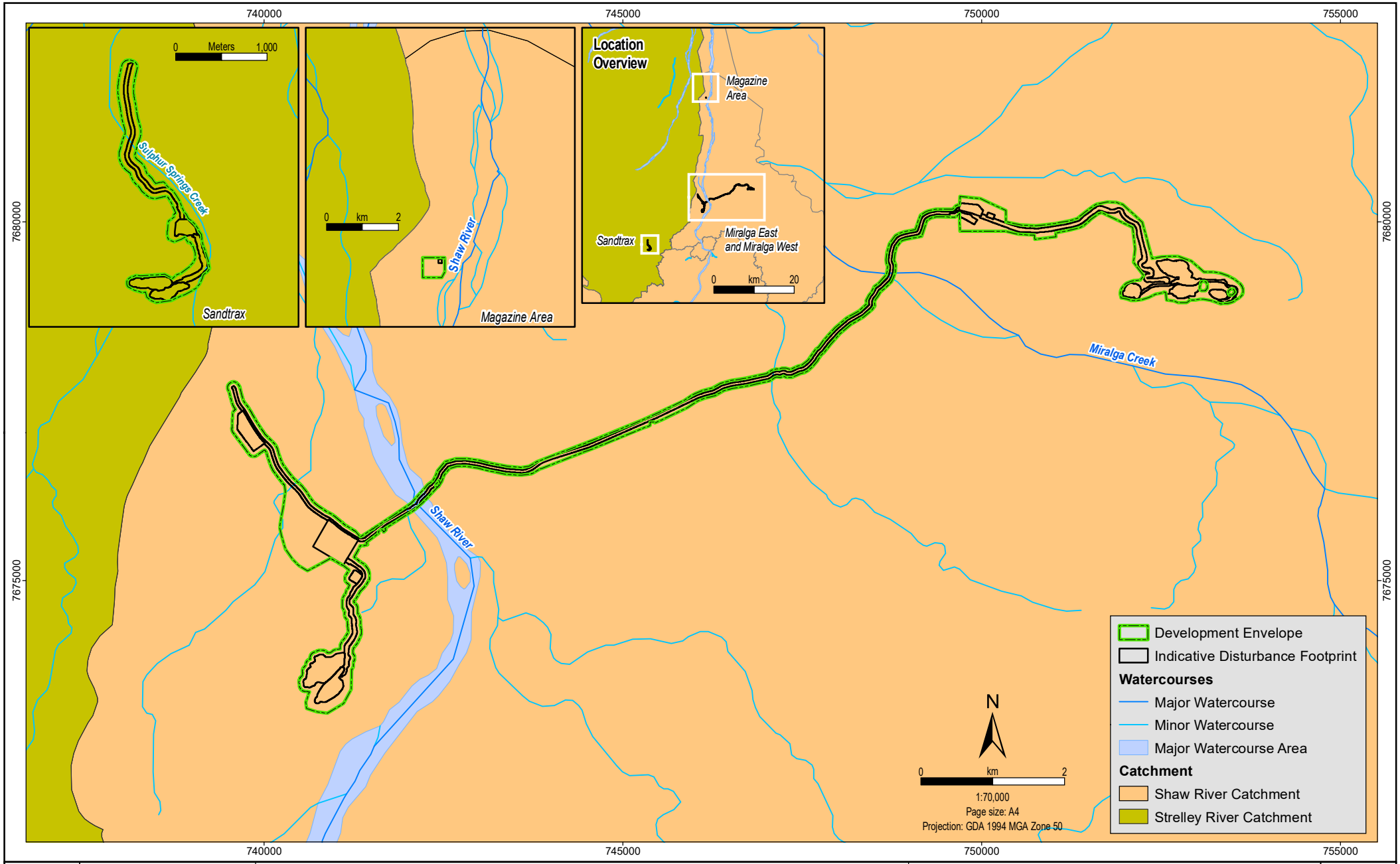
The Miralga Haul Road between the Miralga East ROM pad and the ALRE will cross Miralga Creek and the Shaw River (Figure 8-6).

Miralga West

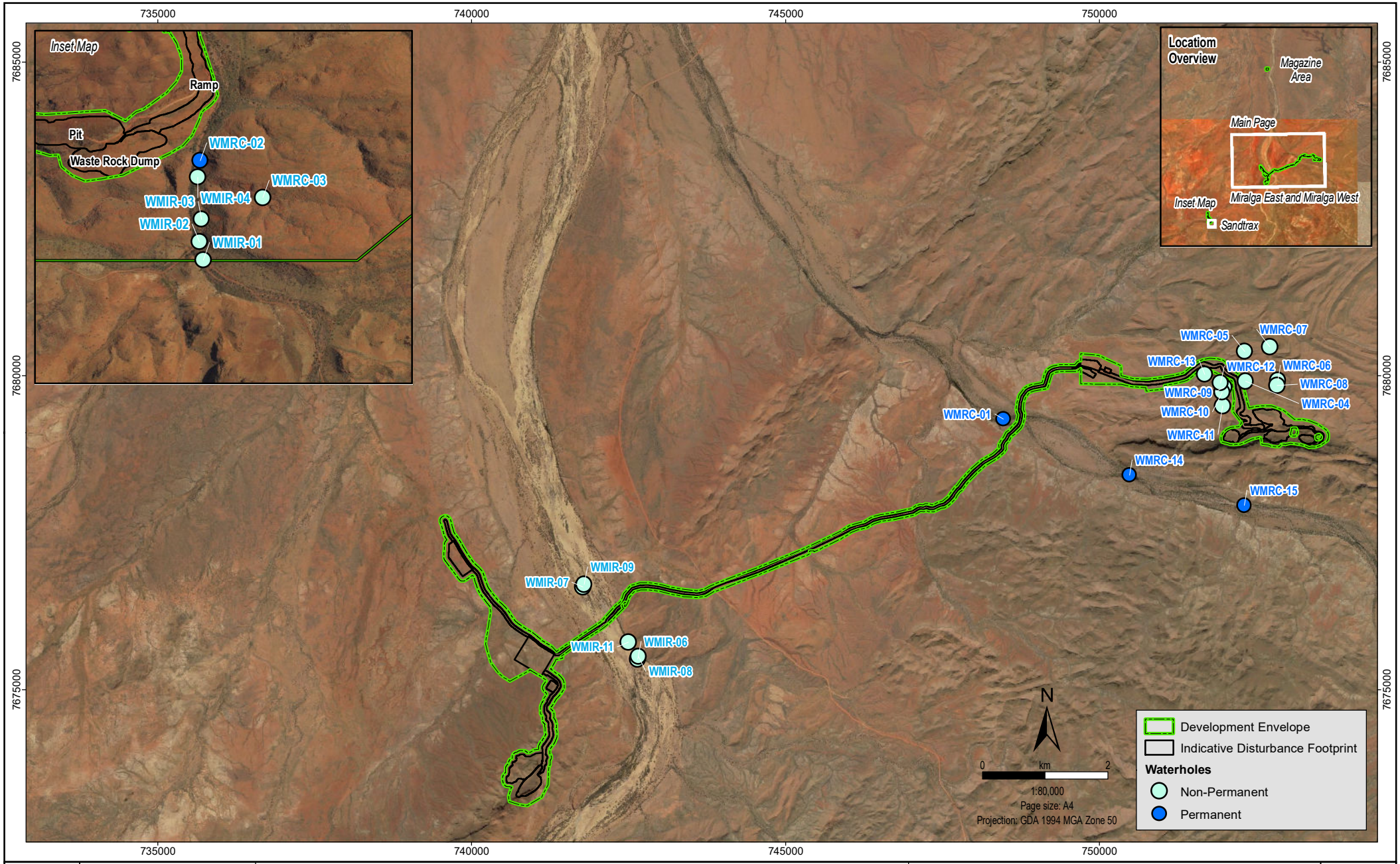
Drainage from the Miralga West ridge flows both to the south, directly to the Shaw River, and along some minor drainage lines which flow to the north and north-west before intersecting a minor tributary of the Shaw River some 1.5 km to the north of the mining area (Atlas Iron, 2020). The pit will remove the upper portion of the ridge so will not be impacted by surface flow. Several waterholes were identified within 2.5 to 3.5 km of the pit and 650 to 850 m from the new haul road (WMIR-06, -07, -08, -09 and -11) (Biologic, 2019). All are non-permanent and are located outside of the Development Envelope.

Sandtrax

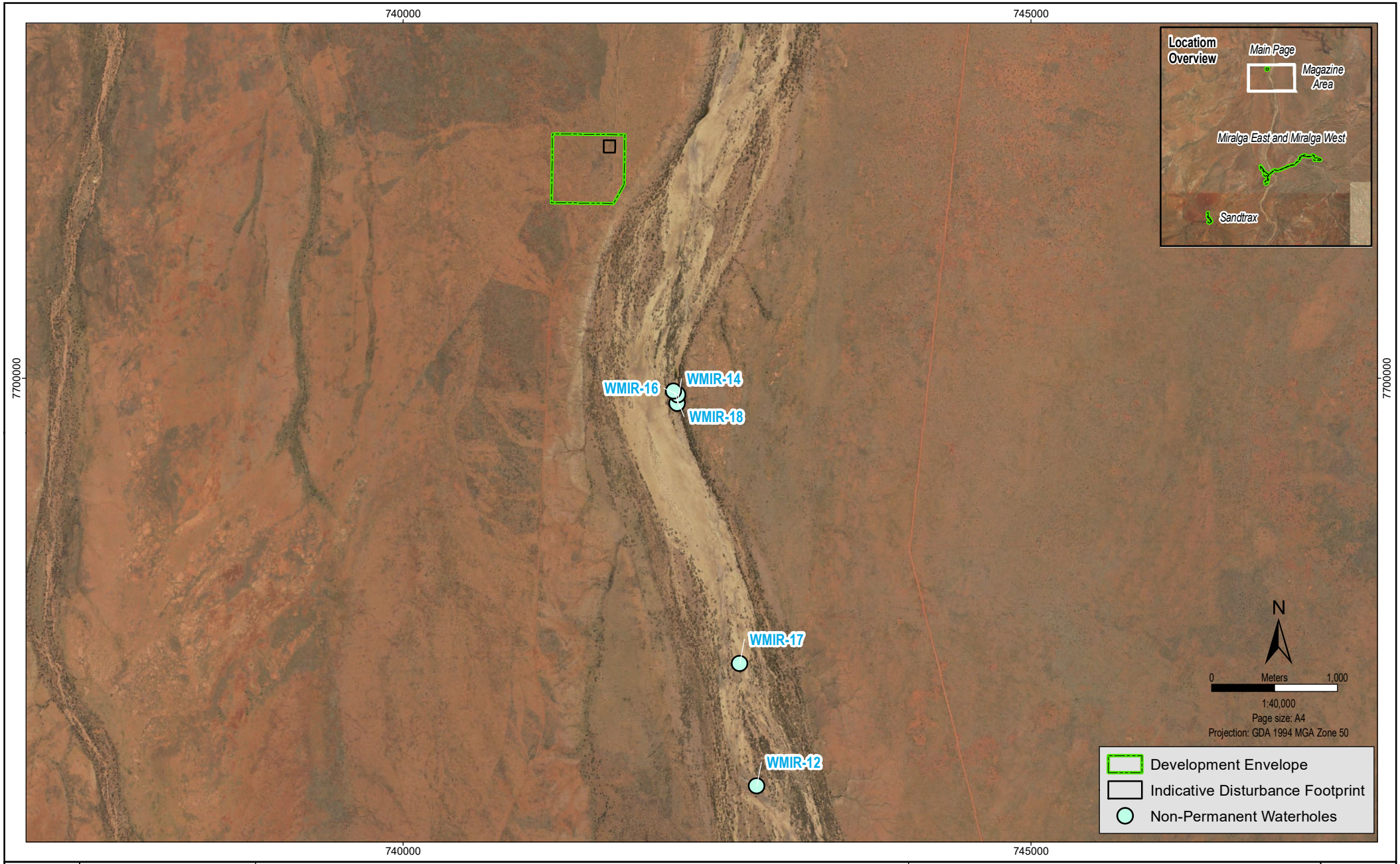
The Sandtrax pit and waste rock dump are relatively small. Runoff from both the pit area and top of the waste rock dump flows down a narrow valley in a south-westerly direction, before intersecting a drainage line flowing to the east. This drainage line the northerly flowing Sulphur Springs Creek and eventually discharges into the Shaw River (Atlas Iron, 2020). Six waterholes were surveyed (Biologic 2019; Biologic 2020a). All are located in Sulphur Springs Creek, upstream of where the drainage line from the pit area joins the creek (Figure 8-7). None of the waterholes are considered to be permanent.



ATLAS	GIS_2873.mxd Date: 15/05/2020 Author: Heath.Maconachie	Source & Notes:	**Regional Catchments** — Figure No: **8-6**



ATLAS	GIS_2858.mxd	Source & Notes:	Figure No:
	Date: 18/05/2020		**Waterholes**
	Author: Heath.Maconachie	Note: Waterholes shown on this figures are a combination of data from the Biologic GDV Study (2020) and Biologic Terrestrial Fauna Study (2020)	**8.7a**



GIS_2859.mxd	Source & Notes:	**Waterholes**	Figure No: **8.7b**
Date: 18/05/2020			
Author: Heath.Maconachie	Note: Waterholes shown on this figures are a combination of data from the Biologic GDV Study (2020) and Biologic Terrestrial Fauna Study (2020)		

8.4.2.3 Environmental Values and Beneficial Uses of Surface Water

The waterholes shown in Figure 8-7 and discussed further in Section 8.5.2.2 are important microhabitats known to support, or have the potential to support, flora and fauna. Permanent waterholes are important refugia from which rivers are repopulated during flood events, with the deeper waterholes generally showing higher levels of biodiversity due to water chemistry being more stable (Centre for Excellence in Natural Resource Management 2009). There are no waterholes in the Development Envelope.

8.4.2.4 Surface Water Management

The Project is located within the Proclaimed Pilbara Surface Water Area regulated under the *Rights in Water and Irrigation Act 1914*.

8.4.2.5 Water Quality

Given there are no permanent waterholes inside the Development Envelope, surface water quality has not been a focus of the risk assessment for the Project. Field tests from two waterholes along Miralga Creek (both outside of the Development Envelope) returned pH values of 7.99 to 8.23 and EC values of 0.64 to 0.86 mS/cm (Appendix H).

8.4.2.6 Flood Potential

Major surface drainage in the area generally trends north, through dryland tributaries / creeks, into either the Shaw River or Strelley River. Both rivers join the De Grey River system to the north. Flows (along with the ecological characteristics that depend on these flow regimes) vary erratically between drought and flood (RPS, 2020).

The Regional Flood Frequency Estimation (RFFE) method was used to understand impacts and risk at four key locations. It was based on data from 853 gauged catchments. The peak flows for selected sites calculated using this method are provided in Table 8-11 (RPS, 2020).

Table 8-11: Flood Flows (RFEE)

AEP / ARI Years	Estimated Flood Flows (m^3/s)			
	Haul Rd crossing – Shaw River (6,827 km^2)	Haul Rd crossing – Miralga Creek (480 km^2)	Sandtrax Haul Rd crossing – Sulphur Springs Creek (23 km^2)	Sandtrax ROM Pad – Sulphur Springs Creek (20 km^2)
63.2% / 1	255	58	14	13
50% / 1.44	4,362	97	25	23
20% / 4.5	1,210	269	71	66
10% / 9.5	1,930	429	115	108
5% / 20	2,820	625	168	157
2% / 50	4,030	890	243	227
1% / 100	5,070	1,120	304	284
10,000	15,000	3,300	900	850

Source: RPS (2020).

RPS (2020) also assessed potential flood volumes at each pit using the DMIRS 100-year 72-hour rainfall guideline. The modelling assumed that 80% of the rainfall would reach the bottom of the pit, and RPS concluded the pit stormwater management system and flood storage capacity in combination should be able to accommodate the 72-hour rainfall event.

8.4.3 Avoidance of Impacts Through Design

Groundwater will not be intercepted during the mining of any pits. Impacts from use of the existing Venturex and ALRE borefields are managed under existing Mining Proposals (REGID 37773 and REGID 37527) and groundwater licences (GWL176408(4) and GWL168045(7)). Water needs for the Project are within the licensed limits for the existing borefields.

The haul road between Miralga East and the Miralga East ROM was initially designed with three primary drainage crossings. Redesign of the haul road has reduced these to two crossings (Appendix H).

In addition:

- All waterholes mapped and investigated by consultants as part of the baseline surveys are located outside of the Development Envelope.
- The Project generally sits outside the major floodplains (and outside extreme floodplains), and therefore avoids the need for major diversion works and erosion protection (RPS 2020).

8.4.4 Residual Impacts After Design

Mining and support activities that can result in impacts to the hydrological regime that require management include:

- The Pilbara landscape is subject to heavy rainfall, and activities such as mining can increase the risk of erosion, generating coarse and suspended sediment from disturbed land. The largest surface water impacts relate to sediment laden run-off from WRDs and stockpiles. However, increased sediment-laden runoff is unlikely to cause significant deterioration in water quality as soils within the Development Envelope are non-saline and do not present a risk of acid or metalliferous drainage (Mine Earth 2019, 2020). Furthermore, as sediment loads are naturally high during larger magnitude rainfall events, the release of any uncontained water from Project areas (e.g., from sedimentation ponds) during these events will not significantly impact sediment loads within the regional catchment.
- Atlas will ensure appropriate surface water management (e.g., around pits, waste rock dumps and the ROM) is incorporated into the final mine design, in accordance with the objectives and design principles from Appendix H.
- Typical flood prevention measures will be required, include bunding around the infrastructure and diversion of upstream surface flows around, and into downstream water courses (RPS 2020).
- A 20-year level of flood protection has been adopted to reduce risks across the short life of mine (RPS 2020).
- Surface water shadow and ponding impacts may result through the installation of roads, particularly along the Miralga Haul Road where it crosses the Shaw River and Miralga Creek. Scour and erosion impacts will also require consideration:
    - The river crossing at Shaw River will be designed and constructed to over-top during periods of major stream flow. This will enable water flow past the crossing points and prevent significant amounts of water ponding up-stream, as well as prevent water shadow effects downstream.
    - The haul road crossing at Miralga Creek will be designed and constructed to enable water flow past the crossing point and prevent significant amounts of water ponding up-stream, as well as prevent water shadow effects downstream. This will be enabled through an over-topping design, or the installation of appropriate under-road drainage.

- Periodic site inspections and visual checks will be undertaken in the wet season to ensure appropriate mitigation measures and controls are in place. Surface water management concepts for each site are shown in Figures B-F of Appendix H.
- Transport, handling and storage of hydrocarbons and chemicals could result in the contamination of surface and/or groundwater.

Miralga East

Management controls will be put in place for the following:

- Run-off from the waste rock dump and three mining pits towards the north.
- Run-off towards Miralga Creek and the two permanent waterholes WMRC-14 and -15.
- It is likely that surface runoff from the Miralga East ROM can be managed by simple bunding and ditch drains with appropriate sediment control.

These are standard controls, routinely deployed by Atlas and others in the management of surface water on mine sites.

Miralga West

Controls will be required to capture sediment in runoff from the mining area and ramp down to the waste dump and Miralga West ROM located to the north of the mining area. Minimal other surface water controls for Miralga West will be required beyond flood protection of lower lying infrastructure close to the Shaw River.

Similar to Miralga East, these are standard controls, routinely deployed by Atlas and others in the management of surface water on mine sites.

Sandtrax

As the Sandtrax pit and waste rock dump are relatively small, they will require minimal surface water management other than sediment control infrastructure. Revision of the ROM position has simplified water and sediment controls for the area.

8.4.5 Summary of Baseline Surface Water and Groundwater Data and Implications for Risk Assessment

Surface Water

- Miralga West is located in the Shaw River Catchment. Miralga East is located in the Miralga Creek catchment, a sub-catchment of the Shaw River Catchment. Sandtrax lies within the separate Strelley River catchment. No perennial streams occur in the immediate vicinity of the Project.
- At closure, the total runoff lost from the three mining areas is approximately equivalent to only 50 ha of land surface area.
- As all of the proposed mining areas are located atop high, narrow ridges, surface runoff into the pits will be minimal.
- The Miralga East mining area runs along the northern side of Miralga Creek. A number of waterholes are evident within the creek and are likely maintained by saturated alluvials within the drainage channel. Run-off from the Miralga East WRD does not flow directly into Miralga Creek.
- All known waterholes are outside of the Development Envelope.
- River crossings have been designed over Miralga Creek and the Shaw River to over-top during periods of major stream flow to enable water flow past the crossing points.

- The largest potential impacts to surface water relate to sediment laden run-off from waste landforms and stockpiles, interruption to surface water flow patterns and hydrocarbon spills.

Groundwater

- The Project is located within the Proclaimed Pilbara Groundwater Area. Groundwater is available from Alluvial Aquifers and Fractured Rock Aquifers.
- Groundwater quality within and adjacent to the Development Envelope is Fresh to Marginal with water levels expected to fluctuate only 2 to 4 metres.
- Groundwater levels in the existing ALRE borefield (ALPB01, 03, 04, 05, and ALB0066) range in depth from 13.98 to 16.84 mbgl. Groundwater levels range from 7.51 to 9.55 mbgl in the existing Venturex borefield (SSWB36, 38, 40). All bores are at low points in the local topography.
- All pits will have at least a 30 m to 90 m buffer to groundwater at the completion of mining.

8.5 Biodiversity

The following sections summarise the findings of numerous detailed biological assessments that have been conducted for the Project, as summarised in Table 8-12.

Table 8-12: Biodiversity, Flora, Fauna and Ecosystems – Relevant Studies

Study	Study Purpose
Miralga Creek Iron Ore Project Detailed Flora and Vegetation Survey. Prepared for Atlas Iron (Woodman Environmental, 2019a) Appendix H	The overall objectives of the study were to provide relevant botanical information to support the EIA process for the Project. The study area was 21,501.4 ha.
Miralga Creek Project: Level 2 Vertebrate Fauna and Short-range Endemic Invertebrate Fauna Assessment (Biologic, 2020a) Appendix L	Biologic conducted a two-season Level 2 vertebrate and short-range endemic (SRE) invertebrate fauna survey in May and July 2019. The survey included targeted cave assessments for bats and the use of ultrasonic bat detectors.
Miralga Creek Ghost Bat Review – March 2020 (Bat Call WA, 2020) Appendix M	The purpose of this advice was to provide impact assessment and management recommendations in relation to Ghost Bat habitat. Specific advice was sought after the 2019 baseline study (Biologic, 2020a). This memo was revised in December, January and March to provide varying recommendations and expert advice on gaps to be investigated and closed as the LIDAR scanning, geotechnical studies and blast modelling progressed. This advice culminated in Bat Call WA (2020), with the conclusion that mining could be undertaken.
LIDAR Scans of Four Caves (Land Surveys 2020)	Scan of the internal dimensions of four caves at Miralga East for assistance in determining habitat value and assessing impacts to Ghost Bats. The caves were successfully scanned and accurate three-dimensional models of their interiors developed.

Study	Study Purpose
Miralga Creek - Assessment of Potential Mining Activities Impact on the Structural Integrity of the Caves (PSM Consult, 2020) Appendix N	Assess the potential impact of the proposed mining activities at Miralga East on a series of three caves (CMRC-13, -14, -15).
Assessment of Blasting at Miralga Creek Project: Preservation of Ghost Bat Habitats Post Mining Activities (Blast It Global, 2020) Appendix O	Model blast parameters to determine how blasting can be undertaken at Miralga East while maintaining the habitat values of nearby caves, in particular cave CMRC-15.
Miralga Creek: Subterranean Fauna Assessment (Biologic, 2020d) Appendix P	The objective of this work was to describe the baseline status of subterranean fauna and its habitat within the Study Area. This involved a desktop assessment followed by two rounds of sampling and habitat delineation.
Miralga Creek Project: Conservation Significant Vertebrate Fauna Impact Assessment Appendix Q	The overarching objective of this assessment was to identify and assess the potential impact of the Project on broad fauna habitats, vertebrate fauna assemblages and vertebrate fauna of conservation significance within the Study Area.
Miralga Creek Project: Short-Range Endemic Invertebrate Fauna Impact Assessment Appendix R	The objective of this impact assessment was to identify and assess the potential impact of the Project on SRE invertebrate habitat, and SRE invertebrate fauna within the Study Area.

8.5.1 Flora and Vegetation

8.5.1.1 Pre-European Vegetation

The Project is located within the Fortescue Botanical District (Beard, 1990). The District is characterised by tree (*Eucalyptus* spp. and *Corymbia* spp.) and shrub (*Acacia* spp., *Hakea* spp., *Grevillea* spp. and *Senna* spp.) steppe communities and *Triodia* spp. hummock grasslands (Beard, 1970; Beard, 1975).

The Pilbara region was mapped by Beard (1975) at a scale of 1:1,000,000. These vegetation systems have since been updated to conform to National Vegetation Information System (NVIS) standards (Executive Steering Committee for Australian Vegetation Information, 2003) (Shepherd, 2002). The Development Envelope is located within the Abydos Plain and George Ranges, which still have close to 100% of the pre-European vegetation remaining.

8.5.1.2 Local Vegetation

A combination of floristic analysis and manual dissection defined 12 vegetation types (VTs) within the Woodman Study Area as defined in Table 8-13 and Figure 8-8 and further described in Woodman (2019a), Appendix H of this report.

Table 8-13: Vegetation Types

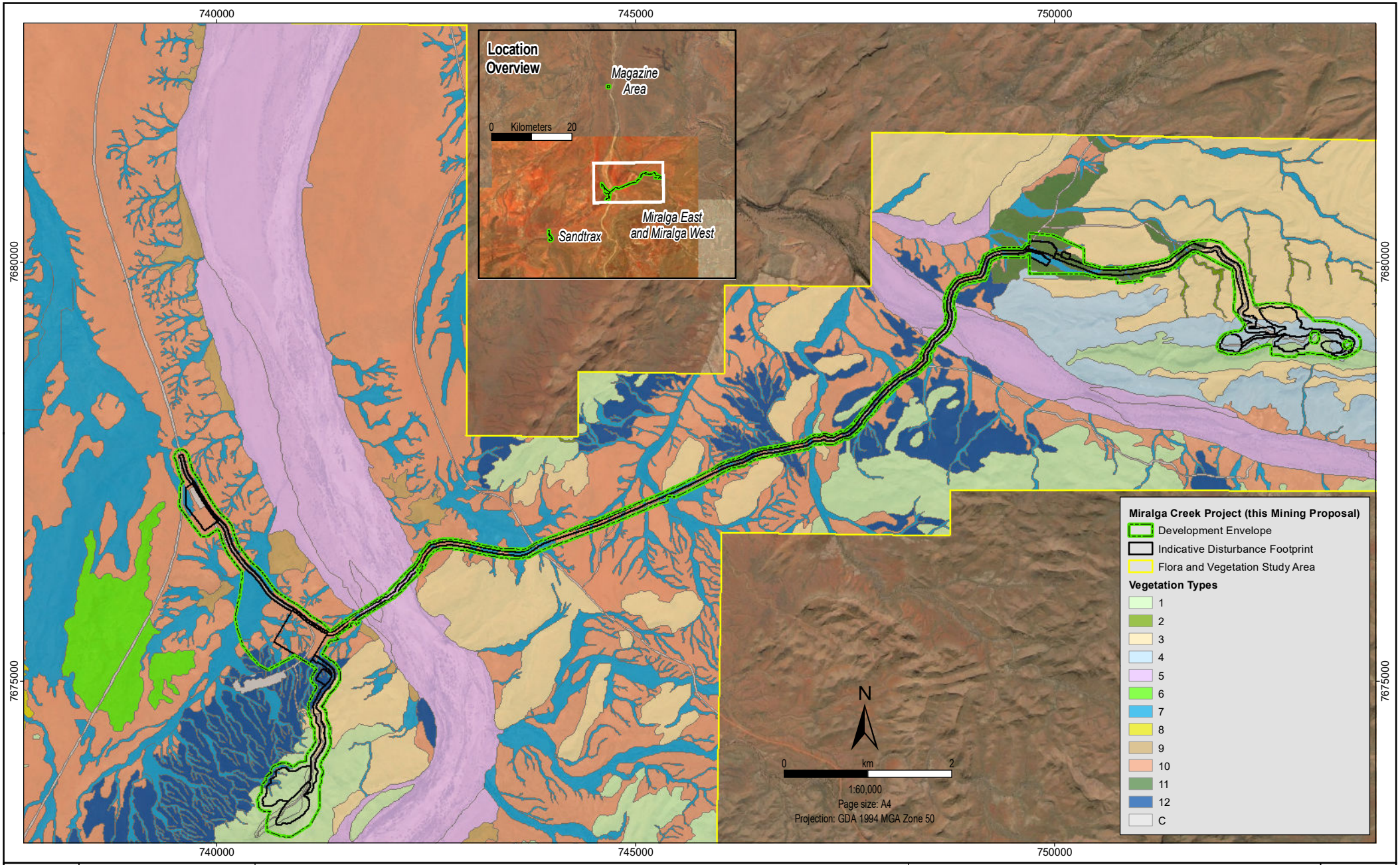
Broad Group	VT	Description	Extent (ha)		
			Study Area	Development Envelope	Indicative Disturbance Footprint
Granite and dolorite hills and ranges	VT 1	Isolated clumps of trees, mainly represented by *Eucalyptus leucophloia*, *Corymbia hamersleyana* or *Corymbia ferriticola*, over mid to tall isolated shrubs of mixed *Acacia* species including *Acacia inaequilatera*, *A. tumida* var. *pilbarensis* and *A. orthocarpa*, and *Grevillea wickhamii* subsp. *hispidula* over low sparse shrubland of *Solanum phlomoides*, *Senna glutinosa* subsp. *glutinosa* and *Clerodendrum tomentosum* var. *lanceolatum* over hummock grassland to open hummock grassland dominated by *Triodia brizoides*, and less commonly *Triodia wiseana* and *Triodia epactia*, over isolated clumps of tussock grasses of *Cymbopogon ambiguus*, *Eriachne mucronata* and *Cyperus hesperius* on steep mid to upper slopes, usually adjoining cliff faces, with exposed granite, dolerite, ironstone or occasional quartz bedrock with skeletal red-brown sandy loam.	1,836.1	85.5	39.8
	VT 2	Low woodland of *Terminalia circumalata* over tall isolated clumps of shrubs to tall shrubland of *Acacia tumida* var. *pilbarensis* and *Ehretia saligna* var. *saligna* over low isolated clumps of hummock grasses to mid open hummock grassland of *Triodia epactia* on red-brown sandy loam with granite or sandstone outcropping in drainage lines of gorges.	33.0	0.3	0.0
Hills and steep slopes on ironstone	VT 3	Open to sparse tall shrubland of *Acacia orthocarpa*, *Acacia tumida* var. *pilbarensis* and *Grevillea wickhamii* subsp. *hispidula* over hummock grassland of *Triodia epactia* on moderate to steep upper slopes and crests of metamorphic quartz, sandstone and granite hills and ridges with red-brown sandy loam soils.	2,134.7	59.7	22.9

Broad Group	VT	Description	Extent (ha)		
			Study Area	Development Envelope	Indicative Disturbance Footprint
	VT 4	Mid to tall isolated clumps of shrubs of *Acacia tumida* var. pilbarensis, Grevillea wickhamii subsp. hispidula and *Acacia orthocarpa* with occasional emergent *Eucalyptus leucophloia* over open hummock grassland to hummock grassland dominated by *Triodia basitricha* (P3) and/or *Triodia epactia* with isolated clumps of low shrubs including *Ptilotus calyostachyus* and *Bonamia pilbarensis* mainly on gentle but occasionally on steep crests, influenced by ironstone or granite and occasionally quartz or jasper, on red-brown sandy clay loam soils.	595.1	46.1	23.9
Rivers and claypans on alluvial sediments	VT 5	Mid to low woodland dominated by *Eucalyptus camaldulensis*, *Eucalyptus victrix*, *Melaleuca glomerata* and/or *Melaleuca argentea* over tall open shrubland of *Atalaya hemiglauca* , *Flueggea virosa* subsp. *melanthesoides* and *Acacia trachycarpa* over sparse low shrubland and grassland of mixed species, occasionally dominated by **Cenchrus ciliaris* on major drainage lines or rivers on brown sandy to clay loam with alluvial river stones, with occasional tall shrubland of *Acacia pyrifolia*, *Acacia trachycarpa* and *Atalaya hemiglauca* with sparse *Corymbia hamersleyana* over low mixed shrubs and grassland dominated by **Cenchrus ciliaris* on brown sandy-clay loam on floodplains associated with river systems. All or portions of this vegetation type may be groundwater dependent ecosystems.	2,820.8	25.8	8.3
	VT 6	Open shrubland to sparse shrubland of *Acacia synchronicia* over open grassland and herbfield of mixed species, dominated by *Eragrostis setifolia*, *Cullen graveolens*, *Cynodon convergens*, *Desmodium filiforme*, *Dichanthium sericeum* subsp. *humilius*, *Neptunia dimorphantha*, *Sida fibulifera* and *Triodia epactia* on red sandy clay in claypans.	186.5	0.0	0.0

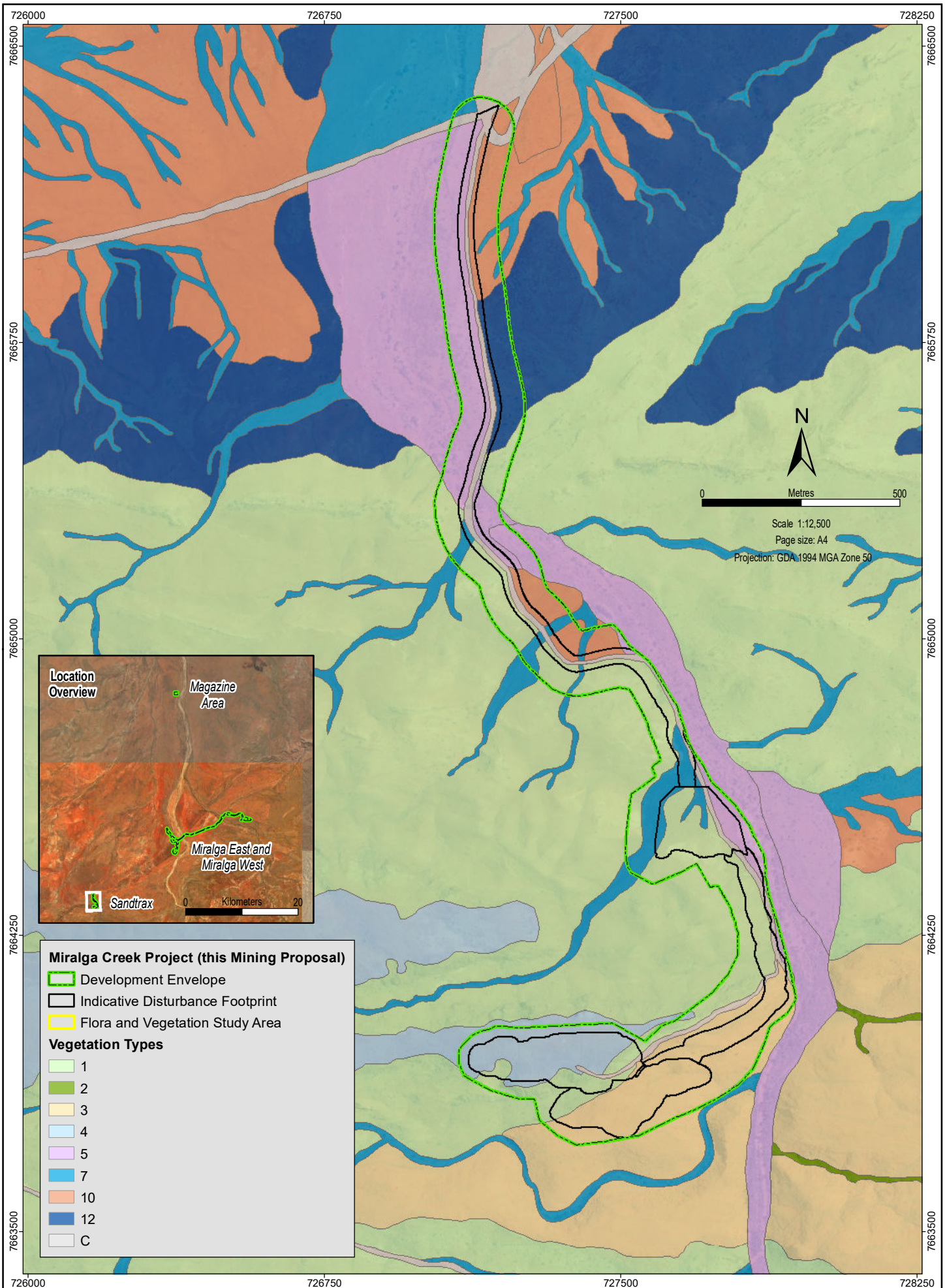
Broad Group	VT	Description	Extent (ha)		
			Study Area	Development Envelope	Indicative Disturbance Footprint
	VT 12	Isolated shrubs of mixed *Acacia* species over hummock grassland of *Triodia epactia* and occasionally *Triodia brizoides* on low rises and lower slopes on red-brown sandy loam with granite or ironstone influence.	1,161.5	33.0	10.0
Minor drainage lines and sheet flow on flood plains	VT 7	Open woodland of *Corymbia hamersleyana* and occasionally *Corymbia flavescens* or *Terminalia circumalata* over tall open shrubland to sparse shrubland of mixed *Acacia* species dominated by *Acacia tumida* var. *pilbarensis*, *Acacia acradenia* and *Acacia pyrifolia* var. *pyrifolia* over low sparse shrubland of mixed species including *Corchorus parviflorus*, *Hybanthus aurantiacus* and *Indigofera monophylla* over sparse grassland and sparse hummock grassland of species including *Chrysopogon fallax*, *Eriachne tenuiculmis*, *Triodia epactia* and occasionally **Cenchrus ciliaris* on minor drainage lines and plains on red-brown sandy loam to clay loam.	2,648.0	85.4	23.4
	VT 8	Isolated clumps of *Corymbia hamersleyana* over low open shrubland to sparse shrubland of *Acacia stellaticeps* over hummock grassland of *Triodia lanigera* and occasionally *Triodia epactia* on red-brown sand to sandy loam on plains.	3,111.6	26.3	0.9
	VT 9	Occasional low open shrubland of *Acacia stellaticeps* over hummock grassland usually dominated by *Triodia longiceps* and/or *Triodia epactia* and occasionally **Cenchrus ciliaris* on red brown sands and clay loam in basins and open depressions on plains.	192.6	0.0	0.0

Broad Group	VT	Description	Extent (ha)		
			Study Area	Development Envelope	Indicative Disturbance Footprint
Sandy and stony plains	VT 10	Tall isolated shrubs of mixed *Acacia* species including *Acacia inaequilatera* and *Acacia bivenosa* with occasional isolated trees of *Corymbia hamersleyana* over hummock grassland dominated by *Triodia lanigera*, and occasionally *Triodia epactia*, *Triodia wiseana* and/or *Triodia brizoides* with isolated small shrubs on red-brown clay loam to sandy-clay loam on undulating plains, midslopes to crests of low gentle rises influenced by ironstone, granite, dolerite and occasionally calcrete.	6,522.8	115.5	41.2
	VT 11	Sparse shrubland to isolated shrubs of *Acacia stellaticeps* and *Acacia spondylophylla* over hummock grassland of *Triodia lanigera* with isolated shrubs including *Goodenia stobbsiana* on red-brown sandy clay loam on flats to low rises underlain by granite or dolerite.	11.7	33.3	12.6
Total			**21,254.4**	**510.9[1]**	**183.01**

Source: Woodman (2019) (Appendix K)
1. Totals are slightly lower total area than the Development Envelope and Indicative Disturbance Footprint due to the presence of already cleared land (33.7 ha within the Development Envelope and 24.5 ha within the Indicative Disturbance Footprint).



ATLAS	GIS_2845.mxd Date: 18/05/2020 Author: Heath.Maconachie	Source & Notes:	**Vegetation Types - Miralga East and Miralga West**	Figure No: **8.8a**



ATLAS	File Name: GIS_2846.mxd Date: 18/05/2020 Author: Heath.Maconachie	Source & Notes:	**Vegetation Types - Sandtrax**	Figure No: **8.8b**

8.5.1.3 Vegetation Condition

The majority of the vegetation in the Study Area (80.0%) was ranked as being in Excellent condition, with little to no human disturbance and an absence or low levels of introduced flora taxa (Table 8-14). It was noted in the field that introduced taxa such as *Cenchrus ciliaris* and *Aerva javanica* were common when adjacent to tracks and roads within the study area (Woodman Environmental, 2019a). These species are not listed as WoNS and are typical of disturbed sites in the Pilbara region.

Areas of VT 5 and VT 7 were typically not in Excellent condition (Woodman Environmental, 2019a). These areas recorded a lower condition score as a result of the presence of high densities of aggressive introduced flora taxa, and high grazing and trampling impacts from cattle. These condition scores were often correlated with the size of the drainage feature, with large creeks and rivers tending to be ranked lower than smaller flow lines and creeks. These scores varied from Good to Degraded, depending on the levels of introduced taxa and trampling impacts recorded.

Table 8-14: Vegetation Condition

Vegetation Condition	Extent (ha)	Proportion of Study Area
Excellent	17,196.7	80.0%
Very Good	1,170.1	5.4%
Good	2,618.2	12.2%
Poor	20.3	0.1%
Degraded	349	1.6%
Completely Degraded	147	0.7%

8.5.1.4 Conservation Significant Vegetation

None of the VTs mapped in the Study Area are considered to represent any Threatened Ecological Community (TEC) protected under the *Biodiversity Conservation Act 2016*, or as listed under the EPBC Act. None of the VTs mapped in the Study Area are considered to represent any DBCA-classified Priority Ecological Community (PEC) (Woodman Environmental, 2019a). In addition, no TECs or PECs occur within, or have previously been recorded within 100 km of, the Biologic Study Area (Biologic, 2020a).

Four VTs (VT 2, 6, 9 and 11) are potentially locally significant because they were locally uncommon (present in less than 1% of the Study Area) and/or restricted within the Study Area and/ or were known to provide habitat for significant flora. These four VTs may also be regionally significant given their uncommon and/or restricted distribution regionally or in the absence of regional distribution data:

- VT 2: occurs in shallow gorge/creek areas and provides habitat for significant flora taxa
- VT 6: is mapped on a claypan, which is a limited habitat and supports significant flora taxa, it also has limited representation in the Study Area
- VT 9: has an unknown regional extent and has limited representation in the Study Area
- VT 11: has an unknown regional extent and has limited representation in the Study Area.

8.5.1.5 Flora Taxa

A total of 380 discrete vascular flora taxa, one known hybrid and one putative hybrid were recorded in the Study Area during this survey, including 360 native taxa and 20 introduced taxa (Woodman Environmental, 2019a). The most well-represented families were Fabaceae (73 taxa), Poaceae (61

taxa) and Malvaceae (35 taxa), and Cyperaceae (21 taxa). Of the discrete flora taxa recorded, the life-cycle of 135 taxa (36%) were classified as annual, and 245 taxa (64%) were classified as perennial.

While no Threatened Flora taxa listed under the BC Act or EPBC Act were recorded within the Study Area (Woodman Environmental, 2019a), eight DBCA classified Priority flora taxa were recorded within the Study Area (Figure 8-9):

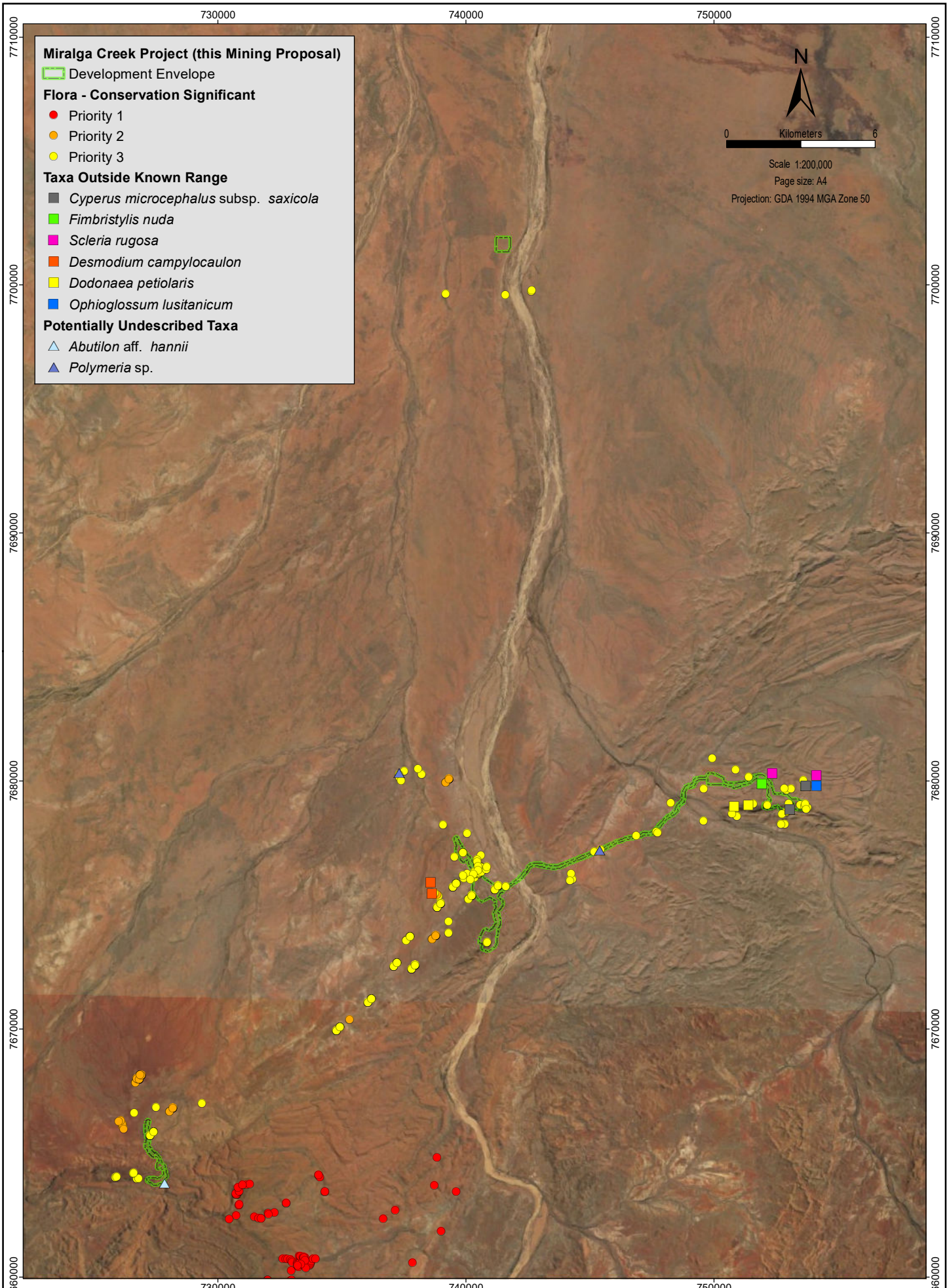
- *Corchorus* sp. Yarrie (J. Bull & D. Roberts CAL 01.05) (P1)
- *Eragrostis crateriformis* (P3)
- *Euphorbia clementii* (P3)
- *Euphorbia inappendiculata* var. *inappendiculata* (P2)
- *Goodenia nuda* (P4)
- *Oldenlandia* sp. Hamersley Station (A.A. Mitchell PRP 1479) (P3)
- *Triodia basitricha* (P3)
- *Triodia chichesterensis* (P3).

EPA (2016f) allows for additional, non-listed taxa being considered of conservation significance due to:

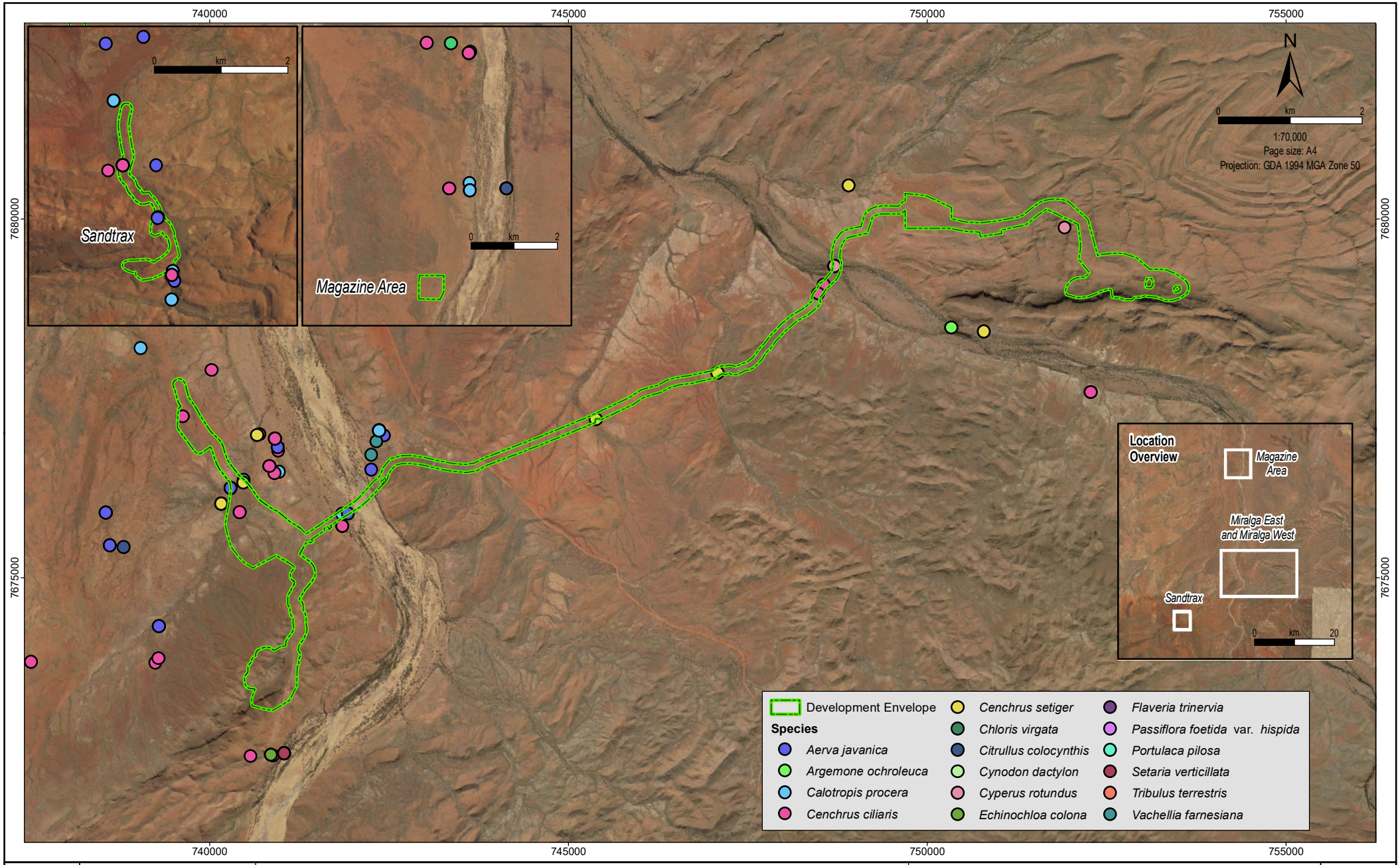
- The taxa having anomalous features, and therefore potentially being undescribed:
  - *Abutilon* aff. *hannii*
  - *Polymeria* sp.
- Or, representing a range extension or outlier of the main range:
  - *Cyperus microcephalus* subsp. *saxicola*
  - *Desmodium campylocaulon*
  - *Dodonaea petiolaris*
  - *Fimbristylis nuda*
  - *Ophioglossum lusitanicum*
  - *Scleria rugosa* (Woodman Environmental, 2019a).

A total of 20 introduced flora taxa were recorded within the Study Area, including one Declared Pest, **Caltropis procera* (Figure 8-10). This taxon was recorded at 24 locations within the Study Area, however it is exempt from management or control requirements with regard to agriculture (Woodman Environmental, 2019a).

No introduced taxa listed as Weeds of National Significance (WoNS) were recorded in the Study Area (Woodman Environmental, 2019a).



ATLAS	File Name: GIS_2848.mxd Date: 11/09/2020 Author: Chris.Maude	Source & Notes: Some species are recorded in the same location, only one is visible in the figure.	**Conservation Significant Flora** — Figure No: **8-9**



GIS_2849.mxd

Date: 11/09/2020

Author: Chris.Maude

Source & Notes:

Introduced Flora

Figure No: **8-10**

8.5.1.6 Avoidance of Impacts Through Design

The Development Envelope was altered to:

- Avoid impact to VT 6 and VT 9, both of which are considered to be of conservation interest as they support conservation significant flora species.
- Avoid all known locations of the following conservation significant flora:
  - *Corchorus* sp. Yarrie
  - *Euphorbia inappendiculata* var. *inappendiculata*
  - *Oldenlandia* sp. Hamersley Station
  - *Triodia chichesterensis*
  - *Goodenia nuda*
  - *Desmodium campylocaulon*
  - *Fimbristylis nuda*
  - *Scleria rugosa*
  - *Abutilon* aff. *hannii*
  - *Cyperus microcephalus* subsp. *saxicola*
  - *Dodonaea petiolaris*
  - *Ophioglossum lusitanicum*.
  - A potentially undescribed species *Polymeria* sp.

In addition, the clearing required for the Project has been minimised through the use of existing ALRE, camp, waste water treatment plant, landfill and water infrastructure built for the Abydos Link Project, and regulated under Abydos Link Mining Proposals REGID 37527 and 37773).

8.5.1.7 Residual Impacts After Design

Atlas acknowledges that clearing will result in the following unavoidable impacts:

- Loss of up to 207.59 ha of native vegetation within the 544.52 ha Development Envelope.
- Removal of up to 30% of potentially locally and regionally significant VT 11 from the Study Area.
- Loss of 42 out of 807 mapped locations of Priority flora (approximately 5%).

Clearing and other vehicle/machinery movements resulting in the spread and/or introduction of weeds could result in the following potential impacts:

- Reduction in vegetation quality and composition and potential deterioration of significant flora populations.
  A number of introduced flora are present within the Study Area. Weeds are known to colonise and proliferate in post-disturbance environments, ultimately altering the composition and structure of native vegetation communities. Exclusion of significant flora from the Development Envelope helps mitigate against edge effects (including weed invasion) on these significant flora populations.
- Poor rehabilitation success.
  Vehicles and machinery undertaking rehabilitation works have the potential to spread weeds to areas intended for or undergoing rehabilitation, e.g. through movement/placement of topsoil, re-profiling of WRDs. They also have the potential to contaminate material destined for rehabilitation areas if they have been previously operating in areas with weeds present or with material containing weeds/seeds.

Physical presence of the Project and/or poor surface water management could result in the following potential impacts:

- Reduction in quality and composition of significant vegetation, and potential deterioration of significant flora populations.
- Altered hydrological regimes (i.e., drainage shadowing and ponding) may alter the composition and structure of native vegetation communities.

Inadequate transport, handling and storage of hydrocarbons and chemicals could result in the following potential impacts:

- Reduction in vegetation quality and composition and potential deterioration of significant flora populations.
- Flora and vegetation may be affected via the uptake of hydrocarbons or chemicals from contaminated soil or water (e.g. direct spills, infiltration to groundwater).
- Poor rehabilitation success.
- Vegetation may be difficult to establish, or its growth compromised, if rehabilitation areas or soil intended for rehabilitation cover is contaminated.

Inadequate fire management could result in the following potential impacts:

- Loss of conservation significant flora.

8.5.1.8 Summary of Baseline Data and Broad Implications for Risk Assessment

Flora and Vegetation

- No Threatened Flora taxa, Threatened Ecological Communities or Priority Ecological Communities have been recorded within the Study Area.
- Eight DBCA classified Priority Flora taxa and eight locally significant flora taxa were recorded in the Study Area. Approximately 5% of mapped Priority flora locations will be cleared.
- Over 70% of the potentially locally and regionally significant VT 11 vegetation type will be retained outside of the Development Envelope.
- Retention of approximately 95% of known Priority flora locations outside of the Development Envelope.

8.5.2 Vertebrate Fauna

8.5.2.1 Fauna Habitat

Six broad fauna habitat types were identified in the Biologic Study Area. These habitat types are described in Table 8-15 and shown on Figure 8-11. The most common habitats present in the Study Area are of least significance to conservation significant vertebrates (Biologic, 2020a; 2020b) (Appendix L; Appendix Q). None of the habitat types mapped in the Study Area are unique to the region.

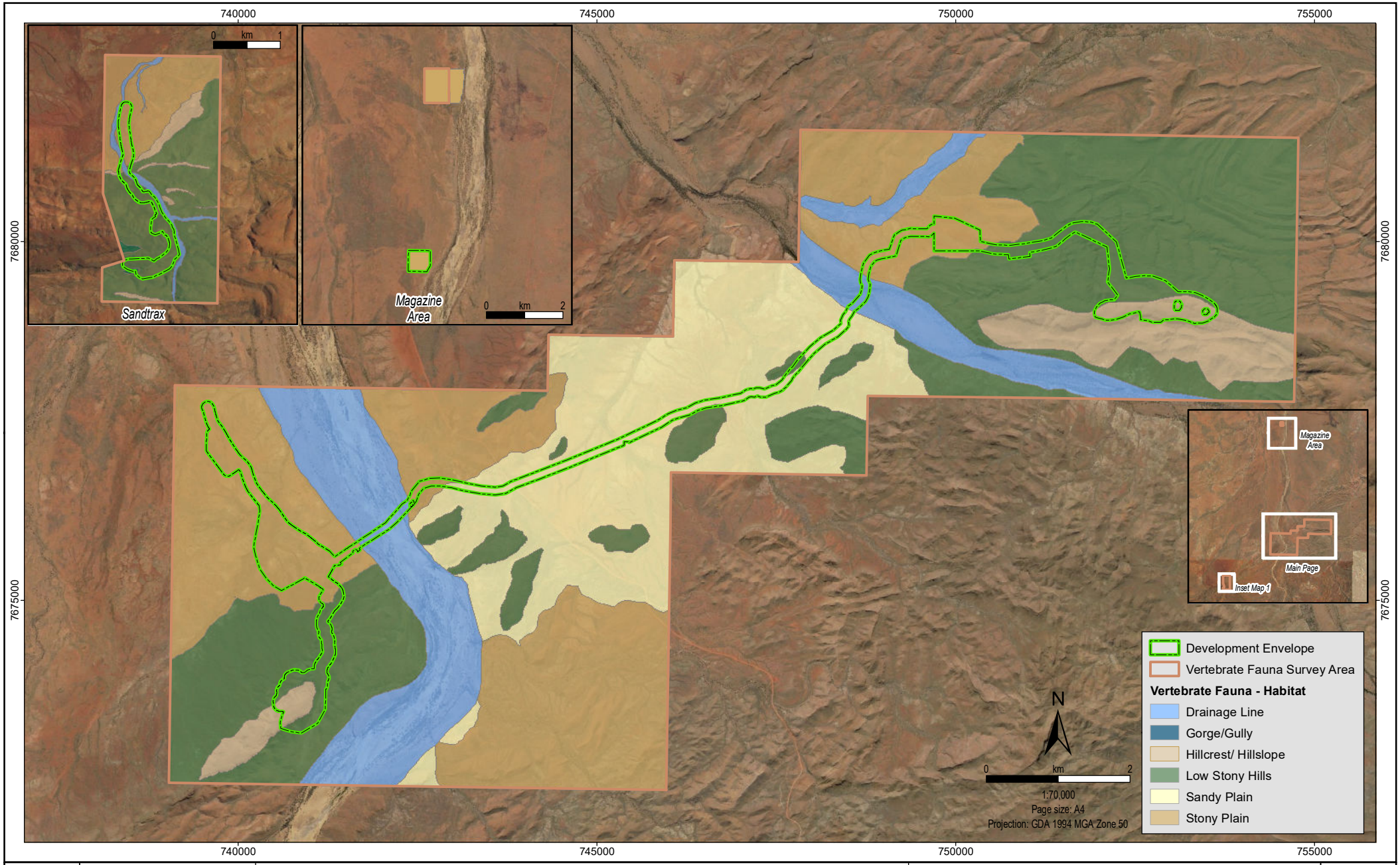
Table 8-15: Vertebrate Fauna Habitats

Fauna Habitat (Significance to Vertebrate Fauna[1])	Vegetation Association and Substrate	Habitat Condition (Disturbance Types)	Extent (ha)		
			Mapped	Development Envelope	Indicative Disturbance Footprint
Low Stony Hills (Low)	Low undulating stony hills often dominated by *Triodia* spp. grassland and/or sparse open shrubland understory with sparsely scattered *Corymbia* species on gravelly clay loam substrate. Low Stony Hills is broadly distributed across the Pilbara region and is a common habitat throughout.	Excellent to Very Good[2] (Recently burnt, little to no vegetation remaining in some areas)	2,586.30	162.68	66.68
Stony Plain (Low)	Stony Plain habitat comprises areas with vegetation dominated by *Triodia* hummock grasses of various life stages and scattered patches of various small to medium shrub species on gravelly clay loam substrates. This habitat is widespread within the study area and more broadly across the Pilbara region.	Excellent to Very Good[2] (Large patches of recently burnt areas with little to no vegetation remaining in some areas)	2,328.41	196.73	66.52
Sandy Plain (Moderate)	Vegetation within Sand Plain habitat is variable, often comprising a mosaic of open *Eucalyptus* woodland or sparsely scattered individual trees over an understory dominated by small to medium *Acacia* shrubs and/or *Triodia* hummock grasses. Sand Plain is regionally common for the Pilbara region and is widespread in portions of the Study Area.	Excellent to Very Good[2]	1,535.85	67.48	25.95

Fauna Habitat (Significance to Vertebrate Fauna[1])	Vegetation Association and Substrate	Habitat Condition (Disturbance Types)	Extent (ha)		
			Mapped	Development Envelope	Indicative Disturbance Footprint
Major Drainage (High)	Large permanently or seasonally fed drainage lines with fringing riparian vegetation comprising scattered *Eucalyptus* species over a patchy understory often dominated by *Acacia* spp. and small ephemerals grasses and herbs. There are two major drainage lines dissecting parts of the Study Area, the Shaw River and Miralga Creek. These drainage lines are continuous outside of the Study Area and are representative of Major Drainage habitat occurring across the Pilbara.	Good to Degraded[2]	996.32	19.76	7.24
Hillcrest/ Hillslope (High)	Hillcrest/Hillslope habitat tends to be more open and structurally simple due to their position in the landscape than other fauna habitats and are dominated by varying species of hummock grasses. A common feature of these habitats is a rocky substrate, often with exposed bedrock, and skeletal red soils. These are usually dominated by open scattered Eucalyptus woodlands, *Acacia* and *Grevillea* scrublands and *Triodia* low hummock grasslands. Hillcrest/ Hillslope habitat is broadly represented across the Pilbara region and accounts for the majority of the elevated areas within the Study Area.	Excellent to Very Good[2] (Historical mining, tracks present)	429.79	66.21	40.13

Fauna Habitat (Significance to Vertebrate Fauna[1])	Vegetation Association and Substrate	Habitat Condition (Disturbance Types)	Extent (ha)		
			Mapped	Development Envelope	Indicative Disturbance Footprint
Gorge/ Gully Widespread	Gorge/ Gully habitat comprises rugged, steep-sided rocky valleys incised into the surrounding landscape forming shallow gullies and gorges. Gorges tend to be deeply incised, with vertical cliff faces, while gullies are more open (but not as open as Major Drainage Line). Caves and rock waterholes are most often encountered in this habitat type. Vegetation can be dense and complex in areas of soil deposition or sparse and simple where erosion has occurred. The Gorge/ Gully habitat is commonly associated with the ranges, and occurs in small areas within the Study Area.	Very Good to Good[2]	4.58	0.00	0.00
Total[3]			**7,881.25**	**512.68[3]**	**206.52[3]**

Source: Biologic (2020a) Appendix L
1. As determined by Biologic (2020a).
2. As determined by Woodman (2019).
3. Slightly lower total area than the Development Envelope and Indicative Disturbance Footprint due to the presence of already cleared land.



ATLAS	GIS_2850.mxd	Source & Notes:	**Surveyed Vertebrate Fauna Habitats**	Figure No: **8-11**
	Date: 11/09/2020			
	Author: Chris.Maude			

8.5.2.2 Fauna Microhabitat Features

A number of important microhabitat features are present within the Study Area, including caves and water sources. These features provide important sources of shelter, food and water for species of conservation significance. Many of these features were located within the Rocky Ridge and Gorge/ Gully habitat and were not commonly recorded in other broad habitat types of the Study Area.

Caves

Caves can be particularly important features within arid zone systems, often providing stable microclimates, shelter and protection (Medellin, 2017).

Sixteen caves were recorded across the Study Area (Figure 8-12). Usage of these caves by Ghost Bats and Pilbara Leaf-nosed Bats is summarised in Table 8-16.

Table 8-16: Caves Recorded in the Study Area

Cave	Distance to Nearest Proposed Pit[1]	Habitat Value and Use of Caves	
		Ghost Bat[2]	Pilbara Leaf-nosed Bat[3]
CMRC-01[4]	50 m	Nocturnal roost	Unknown
CMRC-02	Within pit	Potential nocturnal roost	Unknown
CMRC-03	172 m	Nocturnal roost	Nocturnal refuge
CMRC-04	340 m	Nocturnal roost	Nocturnal refuge
CMRC-06	400 m	Diurnal roost	Nocturnal refuge
CMRC-07	211 m	Diurnal roost	Unknown
CMRC-08	470 m	Nocturnal roost	Unknown
CMRC-10	450 m	Nocturnal roost	Unknown
CMRC-12	340 m	No usage	Unknown
CMRC-13	95 m	Nocturnal roost	Unknown
CMRC-14	117 m	Diurnal roost	Unknown
CMRC-15	55 m	Diurnal roost/ possible maternity roost	Nocturnal refuge
CMRC-16	~1,000 m	No usage	Unknown
CMRC-17	~1,000 m	No usage	Unknown
CMRC-18	~1,000 m	Potential diurnal roost	Unknown
CMRC-19	381 m	Night roost	Nil
Unsurveyed cave[5]	151 m	Potential diurnal roost	Unknown

1. Distances are measured from nearest edge of proposed pit disturbance to cave entrance, except for caves CMRC-13, -14 and -15, which have been measured to the nearest internal cave wall based on internal LIDAR mapping.
2. Biologic (2020a).
3. Biologic (2020a).
4. Note that the location of cave CMRC-01 was incorrectly reported in Biologic (2020a) as being on the edge of pit 3 at Miralga East and was assumed to be at risk of direct impact. Its true location was confirmed in the field by Land Surveys (2019). CMRC-01 is actually located midway between pits 2 and 3 at Miralga East, approximately 100 m from the previously reported location. Its coordinates are 20.97131°S, 119.43425°E and its actual location is shown in Figure 8-12.
5. Identified by field personnel in a subsequent heritage survey.

The 'unsurveyed cave' referred to in Table 8-16 was identified during a heritage survey outside of the Development Envelope. A number of Ghost Bats were flushed from this cave, however it was not

inspected by Biologic during their site work due to earthquake activity in the area (Biologic, 2020a). As it is outside the Development Envelope and beyond 100 m from the closest part of the Indicative Disturbance Footprint (a ramp) it is not considered further in this impact assessment.

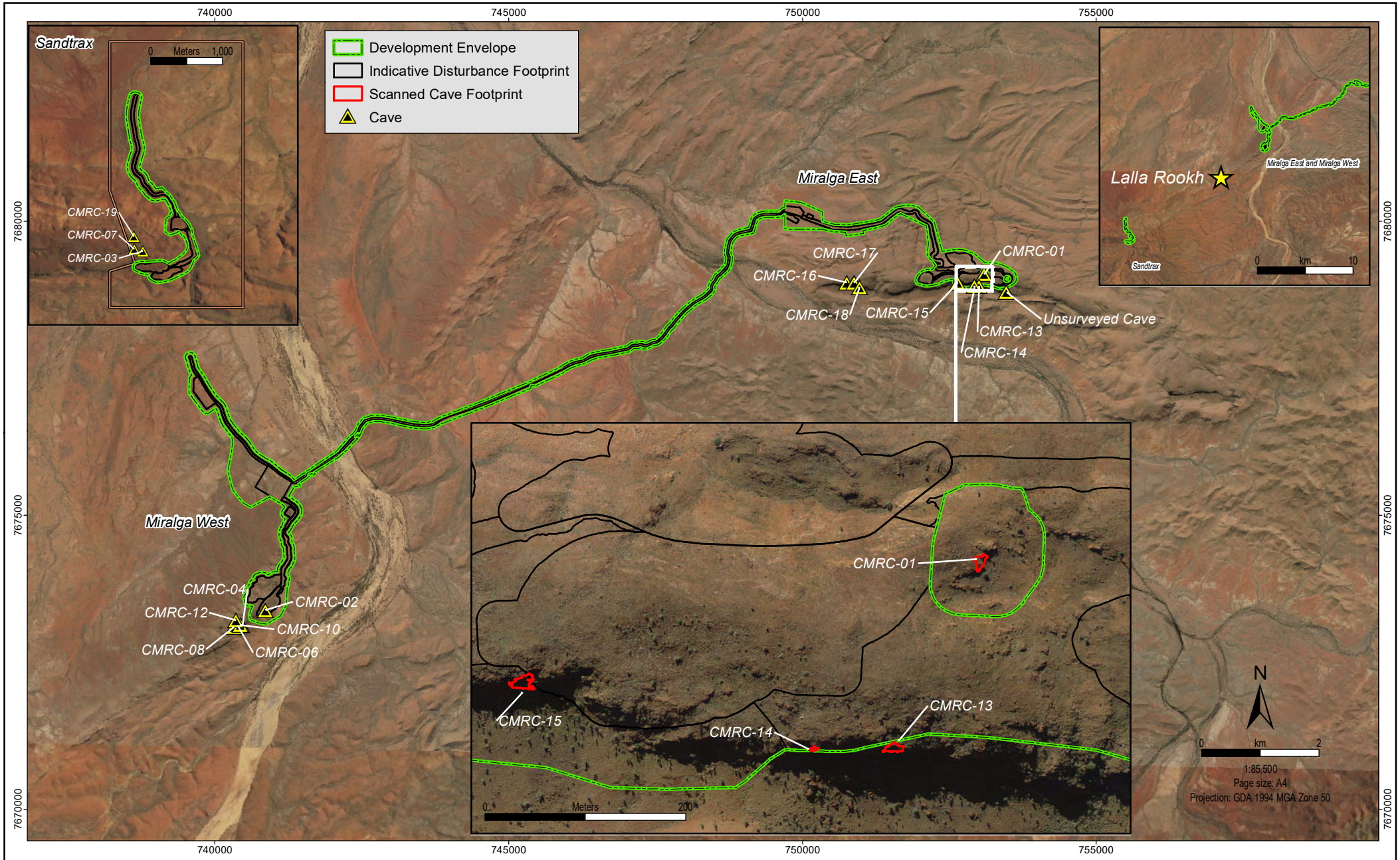
Bat Call WA (2020) has classified Ghost Bat caves into four categories (Bat Call WA, 2020) as follows:

- Category 1 – diurnal roosts with permanent occupancy
- Category 2 – diurnal roosts with regular occupancy
- Category 3 – roosts with occasional occupancy (diurnal and/or nocturnal)
- Category 4 – nocturnal roosts with opportunistic usage.

Full definitions are provided in Appendix A of Bat Call WA (2020; Appendix M). More details about the classification of Ghost Bat roosts are provided later in the discussion on Ghost Bats (see Section 8.5.2.3). The following discussion relates to the physical features of some of these caves.

A number of caves at Miralga East have internal chambers extending back into the ridge, close to proposed pits. Figure 8-13 shows the conceptual layout of pits and ramps at Miralga East with respect to Ghost Bat roost caves:

- Category 2 roosts:
  - CMRC 15
- Category 3 roosts:
  - CMRC-14
- Category 4 roosts:
  - CMRC-13
  - CMRC-01 (technically an overhang rather than a cave).



ATLAS	GIS_2851.mxd	Source & Notes:	**Caves**	Figure No: **8-12**
	Date: 20/05/2020			
	Author: Chris.Maude			

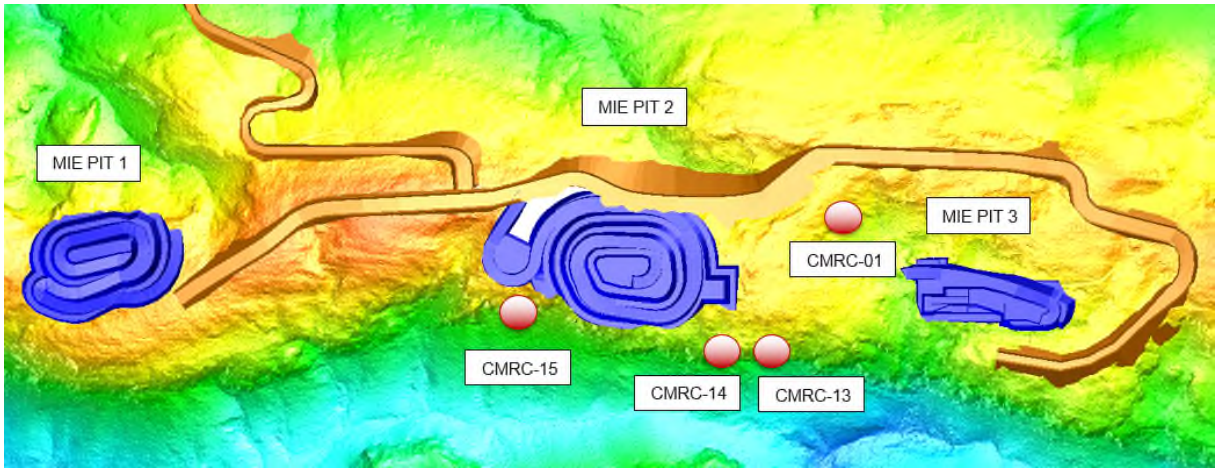
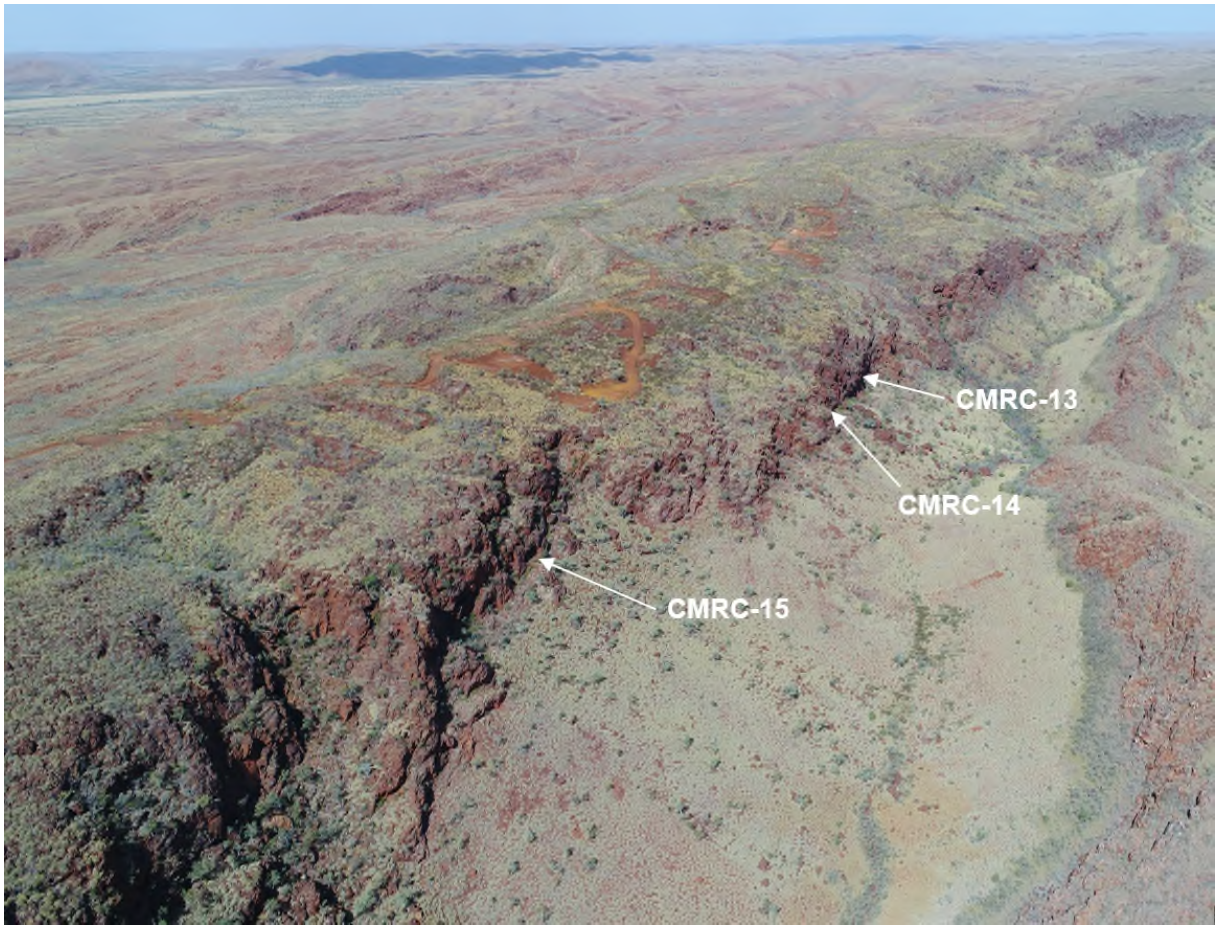


Figure 8-13: Conceptual Layout of Pits, Ramps and Caves at Miralga East

Figure 8-14 shows an aerial view of the ridge. The locations of three caves of particular interest – caves CMRC-13, -14 and -15 – are indicated along the bottom of the southern side of the ridge.



Source: PSM Consult (2019)

Figure 8-14: Aerial View Looking East Along the Escarpment Showing Locations of Caves at Miralga East

In November 2019, Land Surveys Pty Ltd carried out a LIDAR survey of caves CMRC-01, -13, -14 and -15 (Land Surveys, 2019). The internal dimensions were mapped and a three-dimensional model generated for each cave, accurate to approximately 6 cm. A plan view of the extent of the four mapped caves is shown in Figure 8-12.

Cave CMRC-13 is a category 4 shallow cave located at the bottom of a ridge line on the opposite face of the ridge to Miralga East pit 2 (Figure 8-15). It is approximately 101 m from the edge of pit 2 and approximately level with the base of the pit.

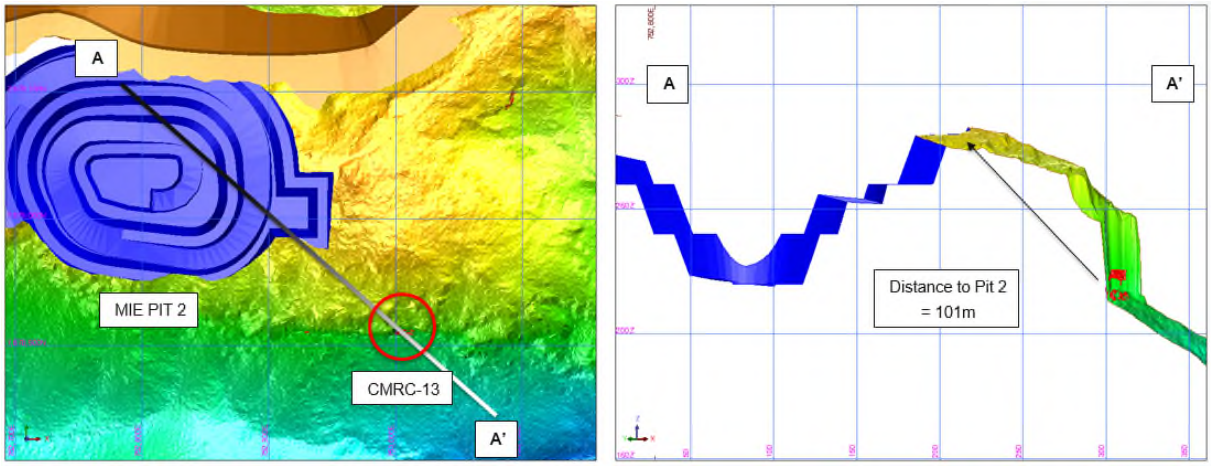


Figure 8-15: Cross-section of Cave CMRC-13 (Category 4) and Miralga East Pit 2

Cave CMRC-14 is a shallow category 3 overhang immediately west of CMRC-13. It is approximately 85 m from the nearest part of the pit shell at Miralga East pit 2 (Figure 8-16).

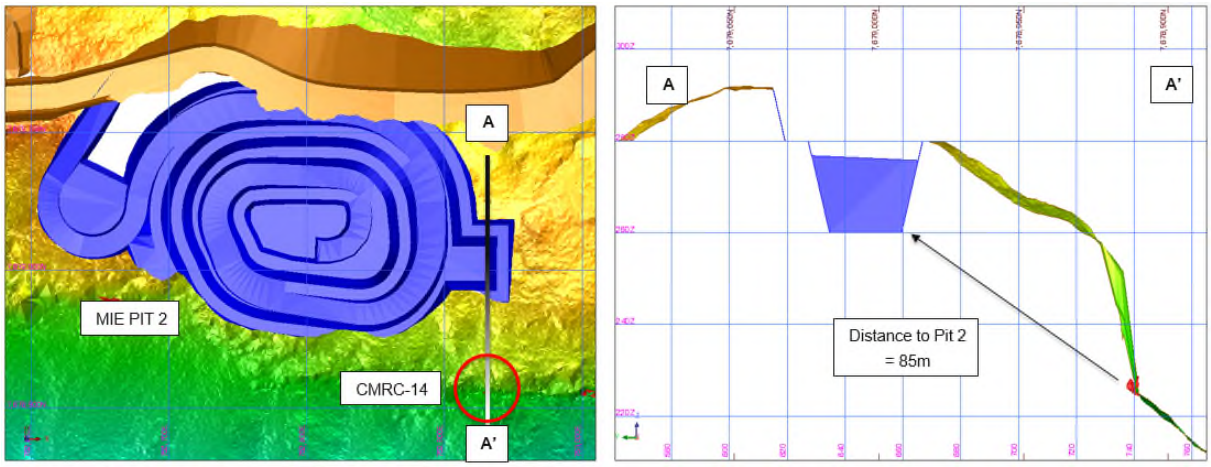


Figure 8-16: Cross-section of Cave CMRC-14 (Category 3) and Miralga East Pit 2

Cave CMRC-15 is a deep, category 2 cave located southwest of Miralga East pit 2. It is approximately 300 m west of caves CMRC-13 and -14, which are further along the base of the same ridge. The cave extends backwards and upwards into the ridge, its internal chamber measuring approximately 16 m from the entrance to the innermost extremity. The rear of the cave is separated from the closest part of Miralga East pit 2 by 23 m (Figure 8-17).

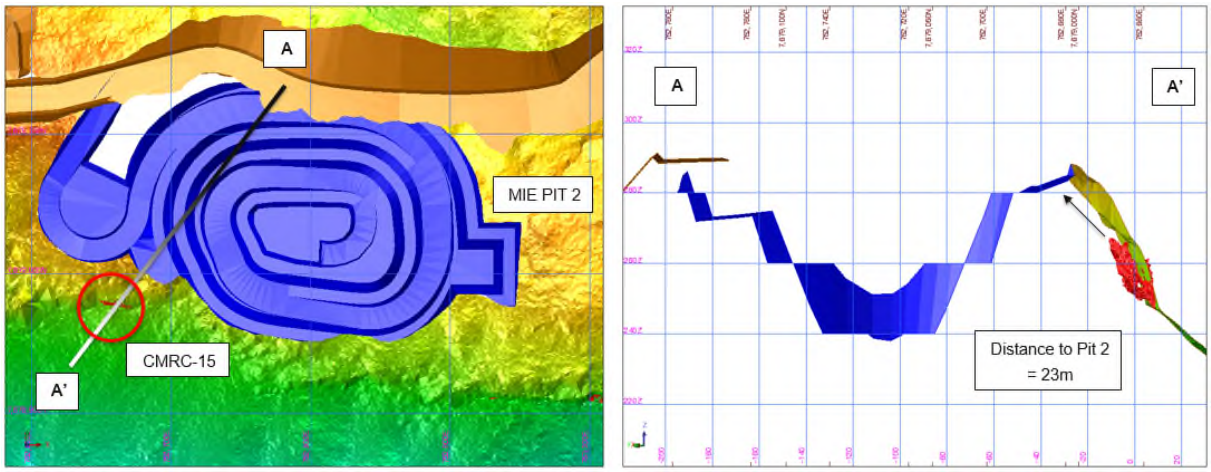


Figure 8-17: Cross-section of Cave CMRC-15 (Category 2) and Miralga East Pit 2

Pells Sullivan Meynink (PSM) conducted a geotechnical assessment of caves CMRC-13, -14 and -15 (PSM, 2019; Appendix N), followed by a review of the available geological, geotechnical and cave information to qualitatively assess the potential impact of proposed mining activities (primarily drilling and blasting) on the structural integrity of the three caves. The review concluded that (PSM, 2020):

- Caves CMRC-13 and -14 have a low risk of mine-induced structural instability.
- Cave CMRC-15 has a higher risk of mine-induced structural instability compared to CMRC-13 and CMRC-14, principally due to the shorter distance to mining activities and the presence of a geological structure (shear zone) at the rear of the cave. While the risk is higher than for the other two caves, the risk more likely represents the possibility of hanging blocks of rock in the roof or walls falling or collapsing. It is less likely that the cave would collapse (either partially or wholly) or that a new surface entrance would be opened.

As this was a qualitative review, PSM recommended that the effect of blasting be predicted and evaluated to determine a blasting strategy to mitigate any effects on cave CMRC 15. In consultation with Bob Bullen, Atlas commissioned Blast It Global to model blasting impacts, which are discussed in more detail in Sections 8.5.2.3 and 8.5.2.5.

Note that caves are an evolving (albeit over long timescales) feature of the environment. The natural structure of banded iron formations and cherts, being heavily jointed, provide the ideal setting for small localised failures and loose rocks dropping out of the walls and roofs of the caves (Blast It Global, 2020). Evidence of the evolution of caves relevant to the Project was observed, particularly at CMRC-15, were naturally accumulated rock debris lie on the floor of the cave. The rock debris are a result of the natural weathering processes (PSM Consultants, 2019; Blast It Global, 2020).

Water Sources

Water sources are a limiting factor for arid-zone ecosystems such as the Pilbara (Burbidge, 2010) (Doughty, 2011); they often represent areas of comparatively high ecological productivity (Murray, 2003). These features are highlighted because they may provide important sources food and water for species of conservation significance.

Fifteen natural water sources (other than creeks and rivers) were recorded by Biologic during the fauna survey plus a turkeys nest (dam). An additional 17 were mapped during a later field survey (Figure 8-7). WMRC-02 was investigated in both field surveys (Biologic, 2019). It is important to note that significant rainfall was recorded in March 2019 as a result of Cyclone Veronica (246.2 mm; 324%

above the long-term average). This event may have influenced the size of these water sources at the time of the first phase of the fauna survey (Biologic, 2020a). Many of the water sources were heavily impacted by cattle with algae presence and turbidity high (Biologic, 2019). Biologic (2020a) initially considered four of the natural water sources were likely to be semi-permanent to permanent sources of water. However, follow-up site visits observed water to be absent from two of these locations WMRC-01 and -02. Appendix I details observations for each of the waterholes identified during the four field surveys by Biologic and Atlas. The majority of waterholes have been determined to be non-permanent. WMRC-14 and -15 may be permanent based on site observations to date.

8.5.2.3 Vertebrate Fauna

The desktop study and field survey identified that approximately 343 vertebrate species occurred in the study area. A total of 154 vertebrate fauna species comprising 24 native and four introduced mammal species, 84 bird species, 39 reptile species, and three amphibian species were recorded during the survey (Biologic, 2020a). This number of species is comparable with other surveys of equivalent scope and size in the vicinity of the Study Area (Biologic, 2020a). A summary of the vertebrate fauna assemblage recorded within the Study Area is provided in Table 8-17 see Appendix L for further details. No unusual or unexpected species were recorded during the survey; all species had been recorded in the area by at least two previous surveys considered in the literature review.

Table 8-17: Native Vertebrate Fauna Assemblage

Group	Number of Species	Number of Families	Description
Mammals (573 records)	28	12	The most commonly recorded groups were: • Bats (244 records) • Rodents (157 records) • Dasyurids (103 records). The most abundantly recorded species was Common Rock Rat (*Zyzomys argurus*), with 138 records, followed by Northern Quoll with 89 records. This is largely attributed to the targeted sampling (trapping and motion camera trap transects) for Northern Quoll, during which Common Rock Rat was frequently recorded as bycatch. The following conservation significant mammals were recorded within the Study Area during the survey: • Northern Quoll (89 records) • Pilbara Leaf-nosed Bat (35 records) • Ghost Bat (11 records) • Western Pebble-mound Mouse (15 records) • Northern Brushtail Possum (2 records).

Group	Number of Species	Number of Families	Description
Birds (641 records)	84	42	The most commonly recorded families were: • Honeyeaters and allies (family Meliphagidae) (97 records) • Crows (family Corvidae) (64 records) of a single species (Torresian Crow, *Corvus orru*) which was the most commonly recorded species during the survey. • Woodswallows and butcherbirds (family Artamidae) (28 records) • Hawks and eagles (family Accipitridae) (16 records). Species diversity, abundance and complexity was highly variable throughout the Study Area, particularly due to the variable presence and abundance of vegetation between sites. Two conservation significant birds were recorded during the current survey: • Grey Falcon: recorded once during the Phase 1 from direct observation of a group of four individuals (two adults and two young) and twice during the Phase 2 survey from direct observation of a single individual. • Peregrine Falcon: recorded once during both Phases of the survey, both from direct observation of a single individual.
Amphibians (13 records)	3	2	Amphibians were only recorded from six locations, all of which had water present in varying capacities at the time of the record. The most commonly recorded amphibian during the survey was the Little Red Tree Frog (*Litoria rubella*), recorded a total of seven times. No frog species of conservation significance were recorded during the survey, nor are any known to occur within the Pilbara bioregion.

Group	Number of Species	Number of Families	Description
Reptiles (117 records)	39	11	The most common groups were: • Skinks (55 records) • Agamids (dragon lizards) (16 records) • Varanids (monitor lizards) (8 records with a high diversity of 7 species. The most commonly recorded species were the Inornate Ctenotus (*Ctenotus inornatus*), recorded 20 times from seven sites. Species diversity, composition and abundance was variable between sites. Note that three species of gecko, *Gehyra macra*, *Gehyra media*, and *Gehyra montium* were recorded for the first time in the area. This is due to revision of the *Gehyra punctata* species complex, where *G. macra* and *G. media* were previously known as *G. punctata*. The *Gehyra variegata* species complex was also revised and resulting in the distribution of *G. montium* being redefined. No conservation significant reptile species were recorded within the Study Area during the current survey.

Seven vertebrate species listed as conservation significant were recorded during the field survey:

- Northern Quoll (89 records from 15 sites)
- Pilbara Leaf-nosed Bat (35 records from 14 sites)
- Western Pebble-mound Mouse (15 records from 15 sites)
- Ghost Bat (11 records from six sites)
- Northern Brushtail Possum (two records from one site)
- Grey Falcon (four records from one site)
- Peregrine Falcon (two records from two sites).

Biologic (2020a) determined the likelihood of occurrence of conservation significant species being present in the Study Area, based on regional records and habitats identified during the field surveys. Table 8-18 summarises the 28 conservation significant fauna species that Biologic (2020a) confirmed were present or considered Likely or Possible to occur in the Study Area.

Table 8-18: Conservation Significant Fauna in the Study Area

Common Name	Species Name	Conservation Status[1]			Likelihood of Occurrence
		EPBC Act	BC Act	DBCA	
Mammals					
Northern Quoll	*Dasyurus hallucatus*	EN	EN	–	Confirmed
Pilbara Leaf-nosed Bat	*Rhinonicteris aurantius* 'Pilbara form'	VU	VU	–	Confirmed
Ghost Bat	*Macroderma gigas*	VU	VU	–	Confirmed
Northern Brushtail Possum	*Trichosurus vulpecula arnhemensis*	–	VU	–	Confirmed

Common Name	Species Name	Conservation Status[1]			Likelihood of Occurrence
		EPBC Act	BC Act	DBCA	
Western Pebble-mound Mouse	*Pseudomys chapmani*	–	–	P4	Confirmed
Brush-tailed Mulgara	*Dasycercus blythi*	–	–	P4	Likely
Spectacled Hare-wallaby	*Lagorchestes conspicillatus leichardti*	–	–	P4	Likely
Greater Bilby	*Macrotis lagotis*	VU	VU	–	Possible
Long-tailed Dunnart	*Sminthopsis longicaudata*	–	–	P4	Possible
Short-tailed Mouse	*Leggadina lakedownensis*	–	–	P4	Possible
Birds					
Grey Falcon	*Falco hypoleucos*	–	VU	–	Confirmed
Peregrine Falcon	*Falco peregrinus*	–	OS	–	Confirmed
Night Parrot[2]	*Pezoporus occidentalis*	EN	CR	–	Possible
Osprey	*Pandion haliaetus*	MI	MI	–	Possible
Fork-tailed Swift	*Apus pacificus*	MI	MI	–	Possible
Oriental Plover	*Charadrius veredus*	MI	MI	–	Possible
Sharp-tailed Sandpiper	*Calidris acuminate*	MI	MI	–	Possible
Pectoral Sandpiper	*Calidris melanotos*	MI	MI	–	Possible
Black-tailed Godwit	*Limosa limosa*	MI	MI	–	Possible
Wood Sandpiper	*Tringa glareola*	MI	MI	–	Possible
Common Sandpiper	*Tringa hypoleucos*	MI	MI	–	Possible
Common Greenshank	*Tringa nebularia*	MI	MI	–	Possible
Marsh Sandpiper	*Tringa stagnatilis*	MI	MI	–	Possible
Glossy Ibis	*Plegadis falcinellus*	MI	MI	–	Possible
Reptiles					
Pilbara Olive Python	*Liasis olivaceus barroni*	VU	VU	–	Likely
Gane's Blind Snake	*Anilios ganei*	–	–	P1	Possible
Black-lined Ctenotus	*Ctenotus nigrilineatus*	–	–	P1	Possible
Spotted Ctenotus	*Ctenotus uber johnstonei*	–	–	P2	Possible

Source: Biologic (2019).
1. Conservation status definitions:
EPBC Act: EN – Endangered, VU – Vulnerable, MIG – Migratory.
WA (BC Act): CR – Critically Endangered, EN – Endangered, VU – Vulnerable, MI – Migratory species not otherwise listed as threatened, OS – Other specially protected fauna.
WA (DBCA lists): P1 – Priority 1 (species that are known from one or a few locations (generally five or less) which are potentially at risk), P2 – Priority 2 (species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation), P3 – Priority 3 (species that are known from several locations, and the species does not appear to be under imminent threat, or from few or widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat), P4 – Priority 4 (rare, near threatened and other species in need of monitoring).
2. The Night Parrot has been added to this table given recent records of this species and resulting increased interest in the species during the Project's assessment under the EPBC Act.

Vertebrate species protected as Threatened under the BC Act and/or EPBC Act that were either Confirmed or Likely to be present based on Biologic (2019) are discussed in more detail below.

Northern Quoll

The Northern Quoll is listed as Endangered under the EPBC Act and BC Act. Quolls are carnivorous marsupials endemic to Australia and occur in Queensland, Northern Territory and WA. The Northern Quoll has undergone a rapid decline from cumulative effects of inappropriate fire regimes, predation, habitat loss and invasion of its habitat by cane toads (*Rhinella marina*) (Department of the Environment and Energy, 2019).

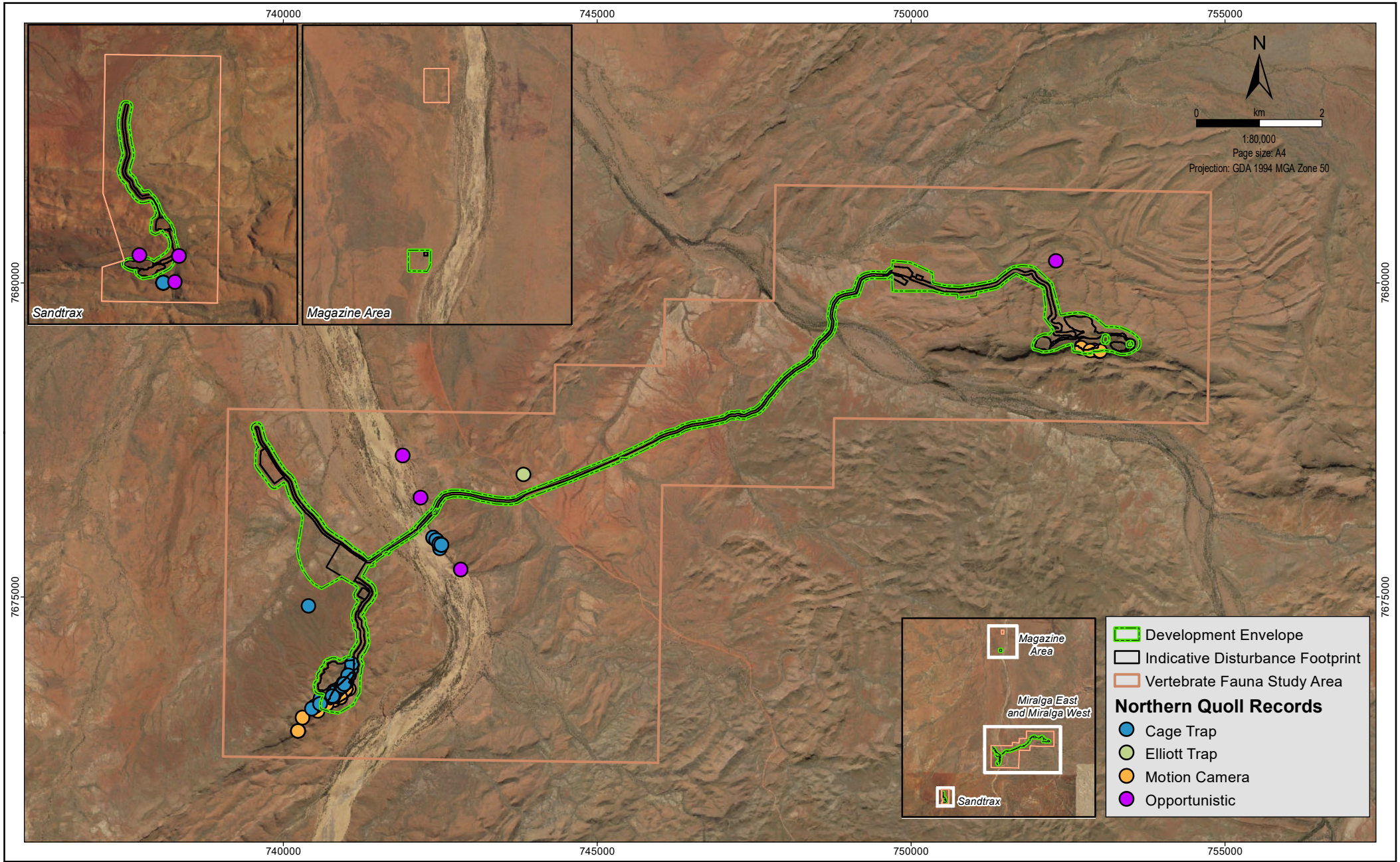
The species was originally found across northern Australia from the North-West Cape of Western Australia to south-east Queensland; however, its abundance has significantly declined in recent years. This species is now restricted to five regional populations across Queensland, the Northern Territory and Western Australia on both the mainland and offshore islands (Department of the Environment, 2016). Northern Quoll are known to occur within a range of habitats, including ironstone and sandstone ridges, scree slopes, granite boulders and outcrops, drainage lines, riverine habitats dissected rocky escarpments, open forest of lowland savannah and woodland. Rocky habitats tend to support higher densities, as they offer protection from predators and are generally more productive in terms of availability of resources (Biologic, 2020a).

Of the five conservation significant mammal species recorded within the Study Area, Northern Quoll was the most commonly recorded species, with 89 records from 15 sites across the whole Study Area, including nine opportunistic locations. This number of records is considered to represent a permanent and important population of Northern Quoll (Biologic, 2020b). Evidence of Quolls (including scats and individuals) was identified in Gorge/ Gully, Major Drainage Line, Low Stony Hills, Hillcrest/ Hillslope and Sand Plain habitats. The Hillcrest/ Hillslope and Gorge/ Gully habitat provides foraging and denning habitat, while the other habitats provide foraging and dispersal habitat.

Records were as follows (Figure 8-18):

- 44 times from trapped individuals (comprising 28 unique individuals),
- 35 times from motion camera captures (comprising 10 or 11 unique individuals) and
- 10 times from secondary evidence (six scats and four tracks).

The species showed a strong association with Hillcrest/ Hillslope and Gully/ Gorge habitats, where suitable denning and/or foraging habitat is more available, with the majority of records occurring within these habitats. Northern Quoll are likely to occur throughout the Study Area, particularly within Gorge/ Gully and Hillcrest/ Hillslope habitats where suitable denning/ shelter and/or foraging habitat is present. These two habitats form part of the core habitats critical to the survival of Northern Quoll (Department of the Environment, 2016).



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	Date: 20/05/2020	Source & Notes:	**Northern Quoll Records** 8-18
	Author: Chris.Maude		

PROJECT NAME Atlas

Ghost Bat

The Ghost Bat is listed as Vulnerable under the EPBC Act and BC Act. As reported in Biologic (2020a), Ghost Bats roost in deep, complex caves beneath bluffs of low, rounded hills, granite rock piles and abandoned mines. These features often occur within Gorge/ Gully, Hillcrest/ Hillslope and Low Hills.

Ghost Bats are known to require a number of suitable caves throughout their home ranges, due to both temporal factors (i.e. night/feeding roosts for feeding throughout the duration of the night, as well as day roosts for resting) and seasonal factors (use of certain caves as maternity roosts, depending on the right environmental conditions). The presence of day roosts and/or maternity roosts in an area is the most important indicator of suitable habitat for Ghost Bats, and these caves are generally the primary focus of conservation and/or monitoring (Threatened Species Scientific Committee, 2016).

Foraging habitat includes gullies and gorges with vertical vegetation complexity, presence of water including riparian drainage lines that are within a 5 to 10 km radius of roosts. Ghost Bats generally return to the same foraging areas each night. Information on the home ranges of Ghost Bats is limited; however, one report indicates a mean foraging area of 61 ha, centred on average approximately 1.9 km from daytime roosts (Threatened Species Scientific Committee, 2016), with the flight capability to travel up to 25 km in a single night (Bat Call WA, 2020).

In the first stage of assessing the potential for impacts to the Ghost Bat, Atlas commissioned Biologic (2020a) to conduct baseline survey work, and sought additional specific advice from Bat Call WA, commencing in November 2019. This advice has been updated as additional studies and modelling were completed, and culminates in Bat Call WA (2020).

Biologic (2020a) recorded the Ghost Bat across four habitats types in the Study Area:

- Major Drainage
- Hillcrest/ Hillslope
- Gorge/ Gully
- Stony Plain.

Ghost Bat is likely to occur in all six broad habitats in the Study Area as follows (Biologic, 2020a):

- Low Stony Hills – foraging
- Stony Plain – foraging
- Sand Plain – primary foraging
- Major Drainage – foraging / dispersal
- Hillcrest/ Hillslope – foraging / roosting
- Gorge/ Gully – foraging / roosting.

The species was recorded five times from direct observation (individuals observed at night and within or flushed from caves), ten times from ultrasonic call recordings and ten times from secondary evidence (scats). These observations were made at caves and standardised trapping sites (Biologic, 2020a).

Sixteen caves have been recorded in the Study Area, 13 of which are confirmed or potential roost caves for Ghost Bat. Table 8-19 provides more details on each cave, specific to Ghost Bat use. Bat Call WA (2020) determined there are four groups of caves important for the persistence of the Ghost Bat in the local area, including the Miralga East grouping containing caves CMRC 15 (a category 2 potential maternity roost), CMRC 13 (category 4) and CMRC-14 (category 3).

Timing of calls from most sites were consistent with bats originating from Lalla Rookh (Biologic, 2020a). Lalla Rookh is a permanent bat roost (category 1) which lies outside of the Development Envelope,

approximately 700 m south of the existing ALRE, which runs between Sandtrax and Miralga West. From Lalla Rookh, Sandtrax is approximately 9 km southwest, Miralga West 3 km northeast and Miralga East 19 km northeast.

Ghost Bat breeding populations inhabit a small number of maternity roosts across the Pilbara, with category 1 abandoned mine shafts comprising the largest of these populations (Bat Call WA, 2020). Numbers vary between roosts and over time, ranging from several hundreds to the low thousands (Bat Call WA, 2020). The population of Ghost Bat at the caves nearby the Project is likely to be an important population of at least 200 individuals that is based at the Lalla Rookh breeding site (Bat Call WA, 2020).

Atlas commissioned the following additional studies to further investigate the potential for impacts to this species:

- Internal LIDAR mapping of CMRC -13, -14 and -15 by Land Surveys.
- Geotechnical assessment (including site visit) of caves CMRC-13, -14 and -15 by PSM (PSM, 2019), followed by an assessment of potential mining activities on the structural integrity of those caves (PSM, 2020).
- Assessment of blasting impacts and determination of appropriate blasting parameters to preserve Ghost Bat caves during mining activities (Blast It Global, 2020).

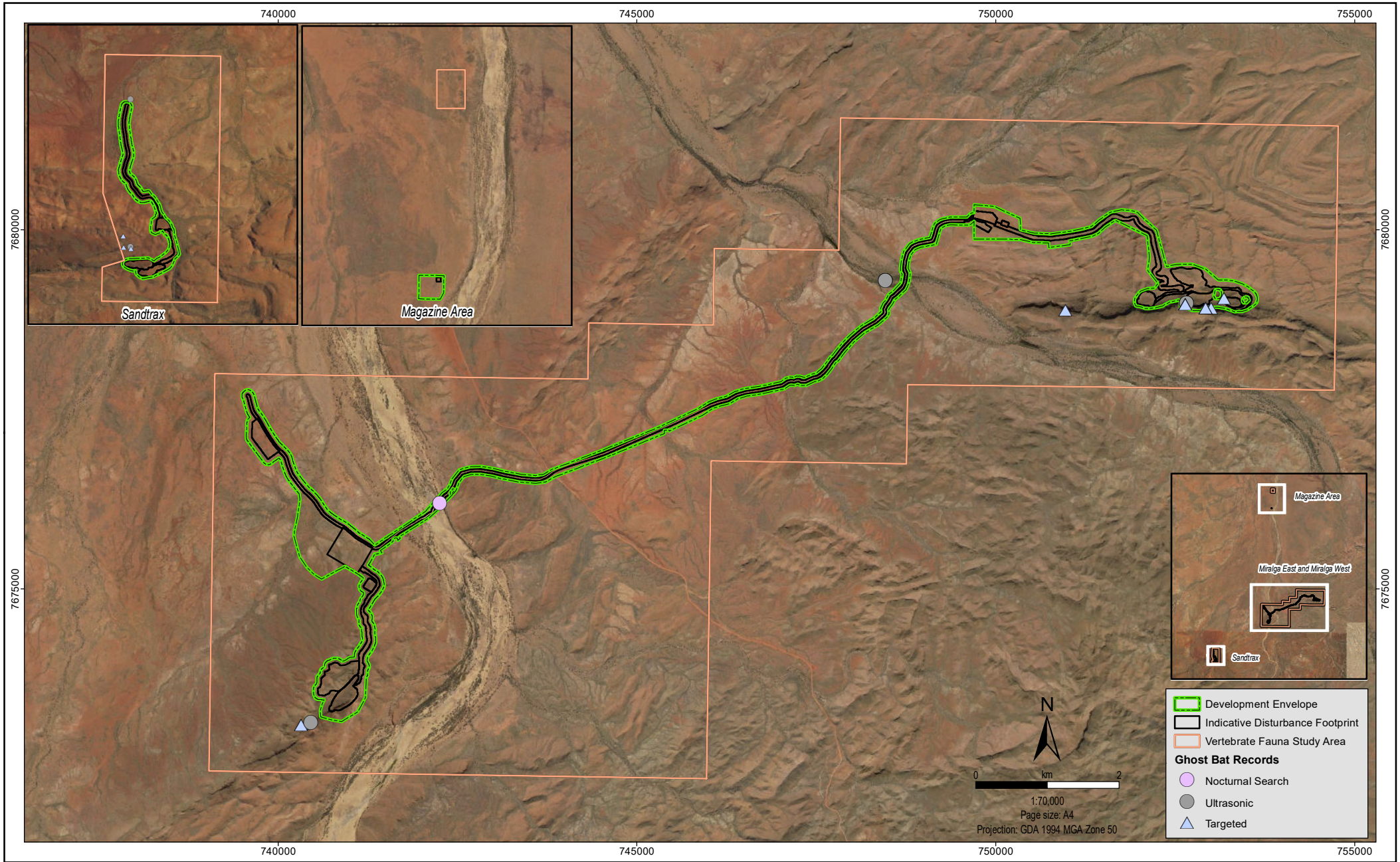
Table 8-19: Ghost Bat Caves Recorded in the Study Area

Cave	Habitat Value to and Use by Ghost Bat	Roost Category[1]				Distance From Cave Entrance to Nearest Proposed Pit[2]
		1	2	3	4	
Sandtrax						
CMRC-03	Nocturnal roost			✓		172 m
CMRC-07	Diurnal roost			✓		211 m
CMRC-19	Night roost				✓	381 m
Miralga West						
CMRC-02	Potential nocturnal roost				✓	Within pit
CMRC-04	Nocturnal roost				✓	340 m
CMRC-06	Diurnal roost		✓			400 m
CMRC-08	Nocturnal roost			✓		470 m
CMRC-10	Nocturnal roost			✓		450 m
CMRC-12	No usage				✓	340 m
Miralga East (near pits 2 and 3)						
CMRC-01	Nocturnal roost				✓	50 m (3)
CMRC-13	Nocturnal roost				✓	95 m
CMRC-14	Diurnal roost			✓		117 m
CMRC-15	Diurnal roost / possible maternity roost		✓			55 m
Miralga East (west of pits)						
CMRC-16	No usage				✓	~1,000 m
CMRC-17	No usage				✓	~1,000 m
CMRC-18	Potential diurnal roost			✓		~1,000 m

Sources: Biologic (2020a), Bat Call WA (2020).
1. Cave category definitions (full definitions in Appendix A of Bat Call WA (2020)):

Category 1 – diurnal roosts with permanent occupancy
Category 2 – diurnal roosts with regular occupancy
Category 3 – roosts with occasional occupancy
Category 4 – nocturnal roosts with opportunistic usage

2. Distance is measured from nearest edge of proposed pit disturbance to the cave entrance, except for caves CMRC-13, -14 and -15, which have been measured to the nearest internal cave wall based on internal LIDAR mapping.
3. Cave CMRC-01 was previously incorrectly reported as being on the edge of pit 3 at Miralga East. It is actually located midway between pits 2 and 3, approximately 50 m from pit 2 and 100 m from pit 3.



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Pilbara Leaf-nosed Bat

The Pilbara Leaf-nosed Bat is listed as Vulnerable under the EPBC Act and BC Act. Pilbara Leaf-nosed Bat roost in undisturbed caves, deep fissures or abandoned mine shafts. The Pilbara Leaf-nosed Bat's limited ability to conserve heat and water means it requires warm (28–32°C) and very humid (85–100%) roost sites in caves and/or mine shafts, as these enable individuals to persist in arid climates by limiting water loss and energy expenditure (Biologic, 2020a). Such caves are relatively uncommon in the Pilbara, which limits the availability of diurnal roosts for this species, and these caves are therefore considered critical habitat (Threatened Species Scientific Committee, 2016).

Foraging habitat is diverse and includes gorges, gullies, water courses, riparian vegetation, hummock grassland and sparse tree and shrub savannah (Department of the Environment and Energy, 2019). Typically, Pilbara Leaf-nosed Bat emerge at dusk from their roosting sites to forage up to 10 km from their roosts.

During the dry season (approximately March to August), Pilbara Leaf-nosed Bat aggregate in colonies within caves that provide a suitably warm, humid microclimate. The species disperses from these main colonies during the wet season (approximately September to February) when suitably humid caves are more widely available (Threatened Species Scientific Committee, 2016).

The population of Pilbara Leaf-nosed Bat in the Pilbara and upper Gascoyne is identified as an important population. It comprises one isolated interbreeding population of national significance, which shows evidence of genetic divergence (Threatened Species Scientific Committee, 2016). The following roosts are defined as critical habitat for the survival of the species (Threatened Species Scientific Committee, 2016):

- Priority 1: Permanent diurnal roosts – occupied year-round and likely utilised for the nine-month breeding cycle
- Priority 2: Non-permanent breeding roosts – used during some part of the breeding cycle, but not occupied year round
- Priority 3: Transitory diurnal roosts – occupied for part of the year, outside of the breeding season and could facilitate long distance dispersal in the region.

Nocturnal refuges (Priority 4) are occupied at night for resting, feeding or other purposes and are not considered critical habitat, but are important for persistence in a local area.

Pilbara Leaf-nosed Bat were recorded a total of 35 times from 14 sites within the Study Area (Biologic, 2020a). All records of the species were identified from ultrasonic call recorders. The species was recorded within all broad fauna habitats mapped within the Study Area. Call recordings suggest the species forages widely throughout the Study Area and is likely to forage nightly within the Study Area (Biologic, 2020a).

The number of Pilbara Leaf-nosed Bat calls at each record site ranged between two and 1,160 calls, with the greatest number of calls recorded near cave CMRC-15, within the Hillcrest/ Hillslope habitat. One site adjacent to an artificial water source (turkeys nest) had the second most recorded calls at 416. All other sites recorded less than 100 calls.

No evidence of diurnal roosting by the Pilbara Leaf-nosed Bat was observed within the caves in the Study Area or indicated by ultrasonic call recordings (Biologic, 2020a).

Based on the analysis of call recording data, timing of all the calls are consistent with bats originating from the Lalla Rookh roost located approximately 6 km southwest of Miralga West and 10 km northeast of the Sandtrax deposit (Biologic, 2020a). Data and current survey effort suggest that none of the caves recorded within the Study Area is likely to represent a roosting cave for Pilbara

Leaf-nosed Bat. Calls recorded near caves CMRC-15, -04, -11, -03, -07 and -19 are likely to be classed as nocturnal refuges, which are not considered critical habitat for Pilbara Leaf-nosed Bat but are important for their persistence in the local area (Threatened Species Scientific Committee, 2016). Additionally, all broad fauna habitats within the Study Area are likely to provide foraging habitat for the Pilbara Leaf-nosed Bat. This can be summarised as follows:

- Gorge/ Gully – nocturnal refuge and primary foraging habitat
- Hillcrest/ Hillslope – nocturnal refuge and primary foraging habitat
- Major Drainage Line – primary foraging habitat
- Sand Plain – foraging habitat
- Stony Plain – foraging habitat
- Low Stony Plains – foraging habitat.

Pilbara Olive Python

The Pilbara Olive Python is listed as Vulnerable under the EPBC Act and BC Act. The Pilbara subspecies of the Olive Python is endemic to Western Australia and is known only from ranges within the Pilbara region. This species is often associated with drainage systems, including areas with localised drainage and watercourses. In the inland Pilbara, the species is most often encountered near permanent waterholes in rocky ranges or among riverine vegetation (Department of the Environment, Water, Heritage and the Arts, 2008).

No evidence of Pilbara Olive Python was recorded within the Biologic Study Area during the survey. However, the species is considered likely to occur due to presence of habitats known to support the species in Gorge/ Gully, Hillcrest/ Hillslope and Major Drainage habitats mapped within the Study Area (Figure 8-11) and the species' scattered but widespread distribution within the Pilbara region (Biologic, 2020a).

Within the Study Area, the species is likely to occur as a resident, but may also disperse into and from the area via dispersal corridors. Occurrence is likely to be associated with waterbodies, particularly permanent or long-standing waterbodies such as spring-fed systems which occur within Gorge/ Gully and Major Drainage habitats. The species may also utilise these habitats as dispersal corridors to other areas within and outside of the Study Area (Biologic, 2020a). The species has previously been recorded multiple times approximately 11 km southwest of the Study Area (Biologic, 2020a).

Grey Falcon

The Grey Falcon is listed as Vulnerable under the BC Act and is not considered to be a matter of national environmental significance (MNES) under the EPBC Act. Its preferred habitat is timbered lowlands, particularly Acacia shrublands and along inland drainage systems. It also frequents spinifex and tussock grassland (Burbidge, 2010; Olsen, 1986).

Grey Falcon were recorded three times during the survey, once from direct observation of a group of four individuals (two adults and two young) during the Phase 1 survey and twice during the Phase 2 survey, both times from direct observation of a single individual (Biologic, 2020a).

Within the Study Area, all records of Grey Falcon were recorded within or in close proximity to Major Drainage habitat. It is possible the species is nesting within the Study Area within this habitat, particularly where riparian vegetation comprises large tall trees providing suitable nesting opportunities and vantage points for the species (Biologic, 2020a).

The species is likely to occur as a resident within or within a broader area encompassing the Study Area, with nesting potentially occurring within the continuous Major Drainage habitat occurring within the Study Area. Due to the large foraging range of the species, the species is likely to occur

within the Study Area to forage, particularly within Sand Plain, Stony Plain and Major Drainage habitats.

Peregrine Falcon

The Peregrine Falcon is listed as Other Specially Protected Fauna under the *BC Act* and is not considered to be MNES under the EPBC Act. In arid areas, it is most often encountered along cliffs above rivers, ranges and wooded watercourses where it hunts birds (Storr, 1998). It typically nests on rocky ledges occurring on tall, vertical cliff faces between 25 m and 50 m high (Olsen P. D., 1989) (J. Olsen, 2004).

The Peregrine Falcon was recorded once during both phases of the field survey (Biologic, 2020a), both times as a direct observation of a single individual.

Within the Study Area, cliff areas within the fauna habitat type Hillcrest/ Hillslope may provide potential breeding areas; the habitat types Sand Plain, Major Drainage and Stony Plain provide foraging habitat (Biologic, 2020a).

Northern Brushtail Possum

The Northern Brushtail Possum is listed as Vulnerable under the *BC Act* but is not considered to be MNES under the EPBC Act. Within the Pilbara region the species generally exhibits flexibility in its habitat preferences and occupy an array of habitat types provided enough tree hollows and ground refuges (such as hollow logs, rockpiles and the burrows of other animals) are available (Kerle, 1992). It is largely known from gorges and major drainage lines with Eucalypt woodland (Department of Biodiversity, Conservation and Attractions, undated) (van Dyck, 2008). However, within the Pilbara region, the species is sparsely distributed and often only encountered in low abundance (Department of Biodiversity, Conservation and Attractions, 2019). The nearest record of the species to the Study Area is located approximately 80 km southwest (Department of Biodiversity, Conservation and Attractions, 2019).

A single adult female was recorded twice in cage traps along Miralga Creek, near waterhole WMRC-01 (Biologic, 2020a) (Figure 8-7). The individual was trapped in riparian vegetation within Major Drainage habitat with scattered *Eucalyptus* and *Melaleuca* species over a varied understory, often dominated by tussock grasses. Suitable habitat for the species is present within all Major Drainage habitat within the Study Area, in addition to suitable rocky habitat being present within Gorge/Gully habitat. It is unknown if the species' occurrence within the Study Area represents a resident individual or population, or a transient individual which may be utilising Major Drainage habitat dissecting the Study Area (Biologic, 2020a).

8.5.2.4 Avoidance of Impacts Through Design

Measures undertaken to avoid impacts to flora and vegetation values (Section 8.5.1.6) have benefit to fauna and their habitat. Specifically for vertebrate fauna values, the Development Envelope has avoid direct impacts to Gorge/ Gully habitat type which is important for a number of conservation significant species including the Northern quoll and bat species. All waterholes identified by Biologic are outside of the Development Envelope.

Atlas has avoided the loss of Ghost Bat roosting caves at Miralga East, despite their close proximity to mining activities. The Development Envelope has been modified to exclude cave CMRC-01, and other controls are in place to avoid directly disturbing caves CMRC-13, -14 and -15 despite being on the boundary of the Development Envelope.

8.5.2.5 Residual Impacts After Design

Mining at Miralga East could result in rockfall to the south (see Rock Fall Area on Figure 4-2) of the ridge. The area that rock fall could impact has been included in the Indicative Disturbance Footprint as a conservative measure. Rock fall has the potential to cause very localised impact to vegetation and fauna habitat if blasting results in flyrock coming out of the pit and down the ridge at this location. It is not anticipated to result in any impact to CMRC-13, -14 or -15 as the cave openings are oriented away from the pit, so flyrock will project over and past the opening, rather than into the caves.

Physical presence of the Project could result in the following potential impacts:

- Artificial lighting altering fauna behaviour and leading to a long-term impact on the local population of conservation significant fauna.
- Poor management of waste can also attract feral animals.

Inadequate fire management could result in the following potential impact:

- Loss of conservation significant fauna and their habitat.
  Species most at risk of direct impact include small sedentary species, which occur in homogenous, fire-prone habitats, and species which occur primarily in fire refuge habitats, such as the Gorge/ Gully habitat.

8.5.2.6 Summary of Baseline Data and Broad Implications for Risk Assessment

Vertebrate Fauna

- Six vertebrate fauna habitats were identified in the Study Area, four of which have Moderate to High levels of significance to vertebrate fauna (Sandy Plain, Major Drainage, Hillcrest/ Hillslope, and Gorge/ Gully).
- Variety of significant microhabitats present, including:
  - Several waterholes were identified in the Study Area, only two are considered to be potentially permanent. Both of these are located outside of the Development Envelope and will not be impacted by dewatering.
  - Sixteen caves were identified in the Study Area, most of which had evidence of use by Pilbara leaf-nosed Bat and/or Ghost Bat. CMRC-13, -14 and -15 are of particular importance to the Ghost Bat.
- Twenty-eight species of conservation significant fauna have potential to occur in the Development Envelope. Seven were confirmed during field surveys including the Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat, Pilbara Olive Python, Peregrine Falcon, Grey Falcon and Northern Brush-tailed Possum.
- The key risk to be managed in relation to conservation significant fauna is vibrational damage to the cacve group CMRC-13, -14 and- 15. Accordingly, blast management and monitoring will involve:
  - Design blasts to achieve <85 mm/s (below the assigned limit of 100 mm/s as set out in Blast It Global (2020).
  - Conduct a cave inspection after any blast exceeding 85 mm/s. If damage is noted conduct an investigation to determine the root cause for the exceedance. Re-establish controls and/ or lower blast vibration limits.
  - Establish vibration monitors in (or as close as practicable to) the nearest cave for all blasting at Miralga East pits 2 and 3.

- Avoid blasting within 100 m of a cave until the results of monitoring validate predictions with a reasonable degree of confidence.
- If vibration exceeds 100 mm/s, blasting should cease until the cause has been determined and steps to prevent a reoccurrence have been taken. A cave inspection is required to assess any impacts.
- Periodically inspect caves to confirm the vibration limits are fit for purpose (annually and in response to vibration exceeding 85 mm/s).
- Establish a Blast Exclusion Zone of 50 m around CMRC-13, -14 and -15.

8.5.3 Short-range Endemic Fauna

A desktop study undertaken by Biologic (2020b) identified a total of 668 invertebrate records that belonged to taxonomic groups that are prone to short-range endemism within 40 km of the Biologic Study Area. Of these, four are regarded as Confirmed SRE:

- Two millipedes (*Antichiropus apricus* and *Antichiropus forcipatus*) – both recorded within the Development Envelope near Sandtrax
- One pseudoscorpion (*Faella tealei*)
- One gastropod (*Camaenidae* Gen. nov. cf. `Z` n. sp.).

Habitat for invertebrate fauna was mapped in the field by Biologic (2020a); 6 habitat types were identified. These habitat types are described in Table 8-20 and shown on Figure 8-20. Although habitat descriptions are broadly the same between vertebrate and invertebrate habitat types (see Figure 8-11 and Table 8-15), the mapping differs because of the different way that SRE invertebrates, which typically have limited dispersal abilities, interact with their habitat. The most common habitats present in the Study Area are of least significance to SRE invertebrates (Biologic, 2020a; 2020c) (Appendix L; Appendix R).

Each of the habitat-types important to SRE fauna are connected to similar habitat outside of the Development Envelope. None of the habitat types are considered to be restricted to the Development Envelope (Biologic 2020c).

A total of 184 invertebrate fauna specimens were collected within the Study Area (Biologic, 2020b):

- One mygalomorph spider
- Seven selenopid spiders
- 48 pseudoscorpions
- Eight scorpions
- 90 snails
- 29 isopods.

No Confirmed SRE taxa were recorded during the field survey (Biologic, 2020b). However, 18 Potential SRE taxa were recorded, four of which were recorded within the Development Envelope:

- *Karaops* sp. indet. (a spider)
- Olpiidae sp. indet. (a pseudoscorpion)
- *Xenolpium* sp. indet. (a pseudoscorpion)
- *Buddelundia* 'sp. 11'. (an isopod/ slater).

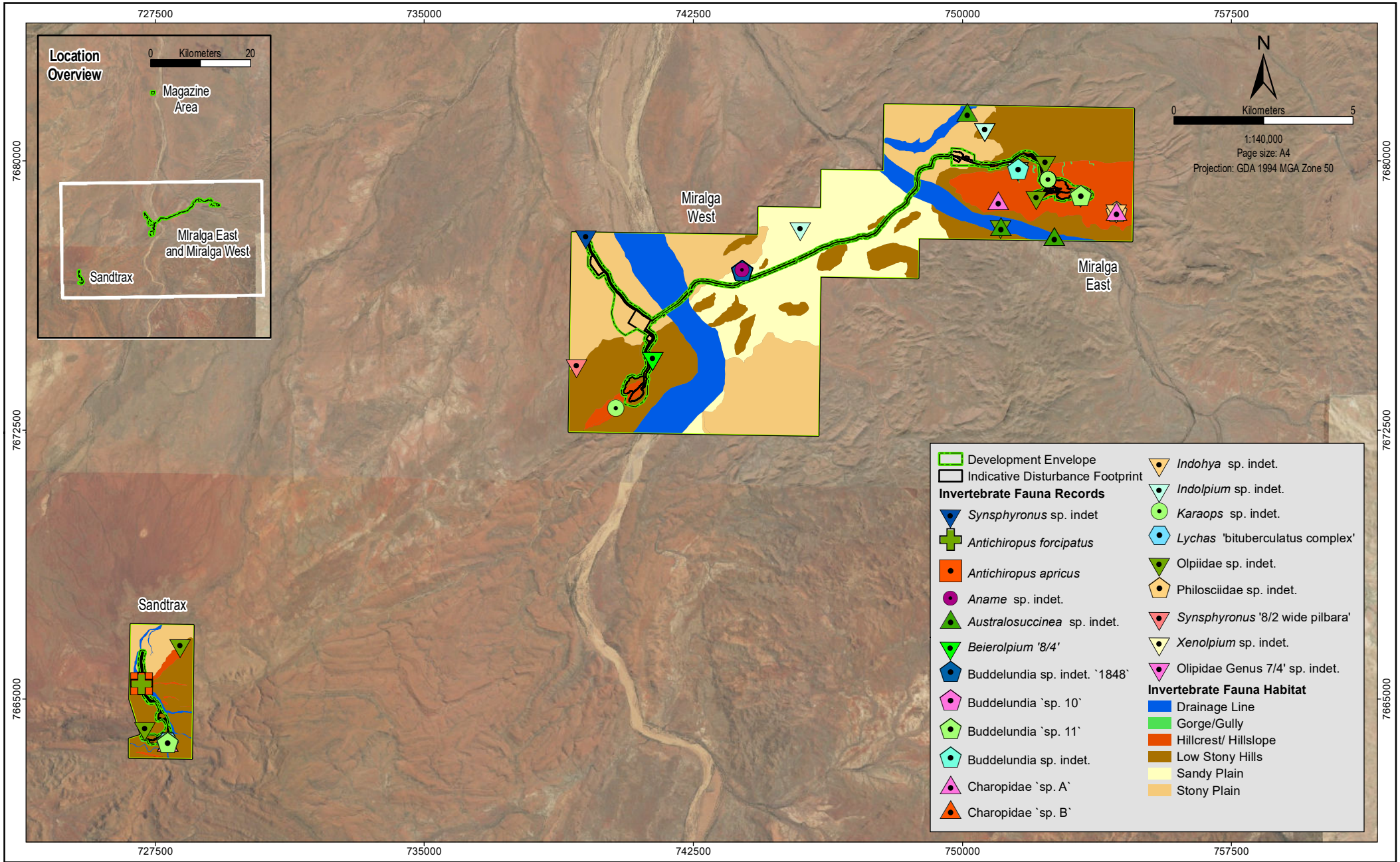
Table 8-20: Invertebrate Fauna Habitats

Fauna Habitat (Significance to Vertebrate Fauna[1])	Vegetation Association and Substrate	Habitat Condition (Disturbance Types)	Extent (ha)		
			Mapped	Development Envelope	Indicative Disturbance Footprint
Low Stony Hills (Low)	Low undulating stony hills often dominated by *Triodia* spp. grassland and/or sparse open shrubland understory with sparsely scattered *Corymbia* species on gravelly clay loam substrate. Low Stony Hills is broadly distributed across the Pilbara region and is a common habitat throughout.	Excellent to Very Good[2] (Recently burnt, little to no vegetation remaining in some areas)	2,213.78	125.63	50.47
Stony Plain (Low)	Stony Plain habitat comprises areas with vegetation dominated by *Triodia* hummock grasses of various life stages and scattered patches of various small to medium shrub species on gravelly clay loam substrates. This habitat is widespread within the study area and more broadly across the Pilbara region.	Excellent to Very Good[2] (Large patches of recently burnt areas with little to no vegetation remaining in some areas)	2,223.98	196.73	66.52
Sandy Plain (Low–Moderate)	Vegetation within Sand Plain habitat is variable, often comprising a mosaic of open *Eucalyptus* woodland or sparsely scattered individual trees over an understory dominated by small to medium *Acacia* shrubs and/or *Triodia* hummock grasses. Sand Plain is regionally common for the Pilbara region and is widespread in portions of the Study Area.	Excellent to Very Good[2]	1,640.13	98.42	23.87

Fauna Habitat (Significance to Vertebrate Fauna[1])	Vegetation Association and Substrate	Habitat Condition (Disturbance Types)	Extent (ha)		
			Mapped	Development Envelope	Indicative Disturbance Footprint
Major Drainage (Moderate)	Large permanently or seasonally fed drainage lines with fringing riparian vegetation comprising scattered *Eucalyptus* species over a patchy understory often dominated by *Acacia* spp. and small ephemerals grasses and herbs. There are two major drainage lines dissecting parts of the Study Area, the Shaw River and Miralga Creek. These drainage lines are continuous outside of the Study Area and are representative of Major Drainage habitat occurring across the Pilbara.	Good to Degraded[2]	1,000.13	19.76	7.24
Hillcrest/ Hillslope (Moderate–High)	Hillcrest/Hillslope habitat tends to be more open and structurally simple due to their position in the landscape than other fauna habitats and are dominated by varying species of hummock grasses. A common feature of these habitats is a rocky substrate, often with exposed bedrock, and skeletal red soils. These are usually dominated by open scattered Eucalyptus woodlands, *Acacia* and *Grevillea* scrublands and *Triodia* low hummock grasslands. Hillcrest/ Hillslope habitat is broadly represented across the Pilbara region and accounts for the majority of the elevated areas within the Study Area.	Excellent to Very Good[2] (Historical mining, tracks present)	791.47	102.83	56.29

Fauna Habitat (Significance to Vertebrate Fauna[1])	Vegetation Association and Substrate	Habitat Condition (Disturbance Types)	Extent (ha)		
			Mapped	Development Envelope	Indicative Disturbance Footprint
Gorge/ Gully (High)	Gorge/ Gully habitat comprises rugged, steep-sided rocky valleys incised into the surrounding landscape forming shallow gullies and gorges. Gorges tend to be deeply incised, with vertical cliff faces, while gullies are more open (but not as open as Major Drainage Line). Caves and rock waterholes are most often encountered in this habitat type. Vegetation can be dense and complex in areas of soil deposition or sparse and simple where erosion has occurred. The Gorge/ Gully habitat is commonly associated with the ranges, and occurs in small areas within the Study Area.	Very Good to Good[2]	11.64	1.16	0.14
Total[3]			**7,881.25**	**512.68[3]**	**206.52[3]**

Source: Biologic (2020a) Appendix L
1. As determined by Biologic (2020a, 2020c).
2. As determined by Woodman (2019).



ATLAS	File Name: GIS_2852.mxd	Source & Notes:	**Surveyed Invertebrate Fauna Habitats and Records**
	Date: 20/05/2020		Figure No: **8-20**
	Author: Chris.Maude		

The following sections describe the six confirmed or potential SRE taxa identified as occurring in the Development Envelope, either during the field survey, or by others prior to the desktop assessment. Locations of these records are shown on Figure 8-20. Note that no species (or supporting habitat types) are considered to be restricted to the Development Envelope.

Antichiropus apricus

There is a single record of this recently described millipede from within the Development Envelope (Car, 2019). It was collected from Drainage Line habitat in the Sandtrax region of the Study Area. However, Biologic (2020b) concluded it was more likely that this individual was dispersing through the drainage lines rather than using them as core habitat. It is likely that the species' preferred habitat is the surrounding more highly suitable habitats, such as Gorge/ Gully and Hillcrest/ Hillslope habitats where more stable, protected leaf litter microhabitats are available (Biologic, 2020b). All *Antichiropus* millipedes described from the Pilbara so far have highly restricted ranges, and all are considered Confirmed SRE. While no other records were found in the database search, *A. apricus* has been recorded from Marble Bar, 55 km to the east of this record (Car, 2019).

This species is a confirmed SRE.

Antichiropus forcipatus

Similar to the above, there is a single record of this millipede, also recently described (Car, 2019) from the same location in the Sandtrax area. This millipede was not found elsewhere in the Study Area; however, there are 21 records of *A. forcipatus* from the WAM database search at several locations up to 14 km south-west of the Study Area, predominantly from the nearby Abydos minesite (Biologic, 2020b).

This species is a confirmed SRE.

***Karaops* sp. indet.**

Selenopid spiders including those in the genus *Karaops* are generally considered to have a reasonable likelihood of being SRE, due to their habitat specialisation within the cracks and crevices of rocky outcrops. *Karaops* sp. indet., were collected from two sites within the Development Envelope, a Gorge/ Gully site and a Hillcrest/ Hillslope site. The five specimens collected were juveniles or females and could not be identified to species level.

Karaops sp. indet. were also collected outside the Development Envelope, at a Hillcrest/ Hillslope site and a Gorge/ Gully site. There is another record of a *Karaops* sp. indet. from the WAM database at Abydos.

The specimens are classified as Potential SRE, WAM categories 'A' (Data Deficient) and 'E' (Research and Expertise) (Biologic, 2020b).

Olpiidae sp. indet.

There are two records of this pseudoscorpion taxon from within the Development Envelope in Hillcrest/ Hillslope habitat. These and seven other records of Olpiidae sp. indet. from within the Study Area are likely to represent multiple species from the genera of either *Indolpium* or *Euryolpium*, both of which contain Potential SRE taxa (Biologic, 2020b).

***Xenolpium* sp. indet.**

A single specimen of this pseudoscorpion taxon was recorded from within the Development Envelope, in Gorge/ Gully habitat (SMRC-021) at Miralga Creek. Two more specimens were collected in Hillcrest/ Hillslope habitat (SMRC-105) within the Study Area. The genus *Xenolpium* is

found throughout the Pilbara and is poorly known taxonomically; however, it is regarded as likely to contain SRE species (Biologic, 2020b).

***Buddelundia* 'sp. 11'**

A single female specimen of this isopod was recorded from Hillcrest/ Hillslope habitat within the Development Envelope, and from Gorge/ Gully habitat in the broader Study Area. *Buddelundia* 'sp. 11' is regarded as a species complex containing species with restricted distributions (S. Judd, pers. comm. as reported in Biologic (2020b)). While this taxon is considered a Potential SRE, 36 records of this species complex were found in the WAM database search, from several sites to the south-west of the Study Area (Biologic, 2020b).

8.5.3.1 Avoidance of Impacts Through Design

Measures undertaken to avoid impacts to flora, vegetation and vertebrate fauna values (Sections 8.5.1.6 and 8.5.2.4) have benefit to SRE fauna and their habitat. Specifically for SRE values, the Development Envelope has avoided direct impacts to Gorge/ Gully habitat which has the highest value to SRE species in the Study Area.

8.5.3.2 Residual Impacts After Design

Atlas acknowledges that clearing will result in the following unavoidable impacts:

- Loss of up to 123.75 ha of moderate to high value habitats.

Inadequate fire management could result in the following potential impact:

- Loss of conservation significant fauna and their habitat.

8.5.3.3 Summary of Baseline Data and Broad Implications for Risk Assessment

Short-range Endemic Fauna

- Six SRE fauna habitats were identified in the Study Area, four of which have Moderate to High levels of significance to vertebrate fauna (Drainage Line, Hillcrest/ hillslope and Gorge/ Gully).
- Four confirmed SREs were identified as being recorded within 40 km of the Study Area. No confirmed SREs were identified during the survey; 18 Potential SREs were recorded.
- No SRE species or supporting habitat types are considered to be restricted to the Development Envelope.

8.5.4 Subterranean Fauna

Prior to the two-season Level 2 subterranean fauna undertaken by Biologic (2020c; Appendix P) no previous subterranean fauna sampling had been undertaken within the area around the Project. The nearest subterranean fauna survey had been conducted 4 km south-east of the Project at Sulphur Springs where a diverse stygofauna assemblage but depauperate troglofauna assemblage was identified.

Database searches revealed seven troglofauna (including potential troglofauna) and 55 stygofauna (including potential stygofauna) taxa within 40 km of the Project. None of the troglofauna or stygofauna taxa recorded from the database searches were recorded during field sampling for the Project.

Field sampling involved 148 bores and holes throughout subterranean Study Area, resulting in 292 troglofauna samples and 110 stygofauna samples. A total of 5,266 subterranean fauna specimens were recorded, comprising approximately 96% stygofauna and 4% troglofauna.

Twenty-five morphospecies of troglofauna (including potential troglofauna) taxa were identified:

- Two taxa were known to be widespread in the Pilbara
- Six taxa were recorded from multiple locations within the Study Area
- Fourteen troglofauna taxa were singleton records or taxa known only from single sites

The remaining three groups represented indeterminate taxa that could not be resolved to species-level due to specimens being immature, in poor/damaged condition or the wrong sex for species-level identifications.

Taxonomic identifications of stygofauna (including potential stygofauna) revealed 60 morphospecies and 22 indeterminate:

- 19 were widespread taxa known to occur regionally or throughout the Pilbara
- 16 taxa were recorded from multiple locations within the Study Area, of these:
    - 13 taxa were recorded more widely throughout the Study Area, with linear ranges ranging from 15 to 49 km
    - The remaining three taxa recorded from multiple locations had more restricted distributions, with linear ranges ranging from 0.2 to 10 km.
- Twenty-two stygofauna taxa were singleton records or taxa known only from single sites
- Three taxa represented unique higher-level taxa that could not be identified to species level.

Biologic (2020c) consider the Project to be at worst a low-moderate risk to subfauna taxa as follows:

- a low risk to all sampled stygofauna
- a low-moderate risk for two troglofauna taxa (*Tyrannochthonius* 'BPS228' and *Tyrannochthonius*? sp. indet. (Sandtrax).
- a low risk for an additional four troglofauna taxa.

Habitat for both groups is likely to extend beyond the Development Envelope (Biologic 2020c).

8.5.4.1 Avoidance of Impacts Through Design

Impacts to subterranean fauna from mining are unlikely given mining is above the water table only. Impacts from use of the existing Venturex and ALRE borefields are managed under existing Mining Proposals (REGID 37773 and REGID 37527) and groundwater licences (GWL176408(4) and GWL168045(7)).

8.5.4.2 Summary of Baseline Data and Broad Implications for Risk Assessment

Subterranean Fauna

- Twenty-five morphospecies of troglofauna and 60 of stygofauna were collected from within the Study Area.
- Mining is above water table only.
- Habitat for both groups is likely to extend beyond the Development Envelope.

8.6 Heritage

8.6.1 Native Title

The Project is located within one Determination Area and one Native Title Claim Area (Figure 8-21). These areas are protected and managed by the *Native Title Act 1993*:

- Determined Area "Nyamal People #10" (WCD2019/011) encompasses the Magazine Area, the majority of Miralga West and the western portion of the Miralga Haul Road. This area was determined in September 2019
- Native Title Claim Area "Nyamal People #1" (WCD2019/010) across Sandtrax, Miralga East and the southernmost portion of Miralga West including the eastern portion of the Miralga Haul Road. This claim has been determined in part.

Atlas has an existing claim-wide Native Title Agreement with Njamal. The agreement spans areas covered by both of the above claims. Atlas and Njamal are updating the agreement with the Nyamal Aboriginal Corporation (NAC) as the Registered Body Corporate since the recent determination. The Agreement includes (but is not limited to) consultation, heritage survey requirements and protocols, provision of environmental assessments, accountability schedules and compensation. Atlas conducts all activities in accordance with these prescribed and agreed protocols resulting in a sound working relationship with Njamal and the NAC. The Aboriginal Heritage Due Diligence Guidelines (DAA, 2013) have been considered in the development of the agreement and the works undertaken to date in support of this Project, including the completion of various archaeological and ethnological surveys over the Project area that are described in more detail in the following section.

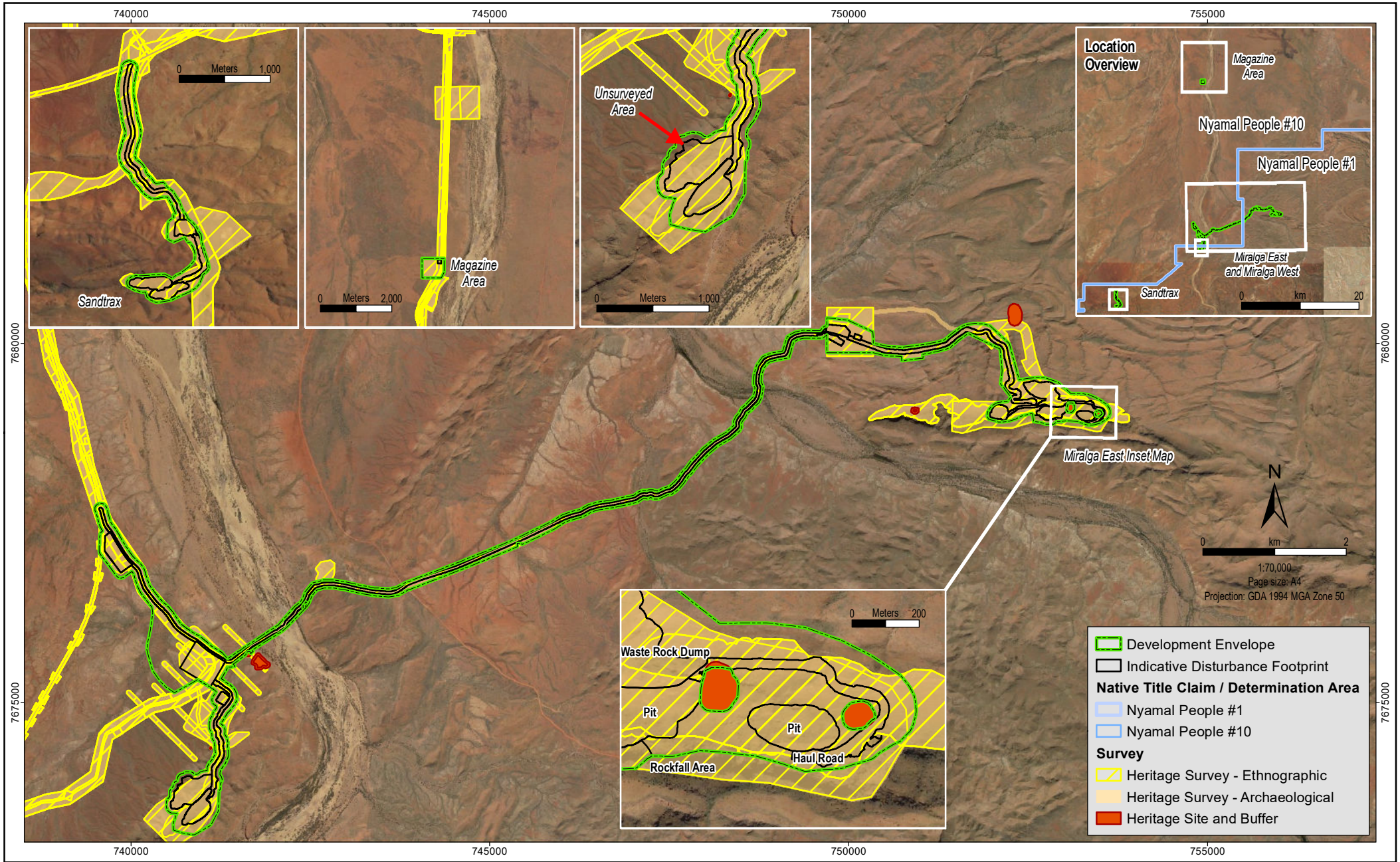
8.6.2 Heritage

A desktop analysis of the Department of Planning, Lands and Heritage (DPLH) database did not identify any Registered Aboriginal heritage sites within the Development Envelope. The nearest registered site is Sulphur Spring (REG ID 6046), approximately 2 km south of Sandtrax, outside of the Development Envelope.

Subsequent to the desktop assessment, and in line with DAA (2013), archaeological and ethnographical surveys have been completed across the Development Envelope by Atlas in cooperation with the relevant Traditional Owners and their consultants.

These surveys identified a number of sites of interest that will require management during the Project's construction and operations (Figure 8-21). The (confidential) details of these sites and Traditional Owners involved in the surveys are documented in Terra Rosa Consulting (2019), Terra Rosa Consulting (2019), Gavin Jackson Cultural Resource Management (2017), Gavin Jackson Cultural Resource Management (2014) and Glendenning (2011).

Atlas acknowledges a small gap in survey coverage as a result of changes to the Project after the current heritage surveys were completed. Figure 8-21 shows this gap, which results from a redesign of the waste rock dump at Miralga West. Atlas is completing heritage surveys in April 2021 across that part of the Development Envelope in accordance with the relevant guidelines and the agreement with Njamal, prior to commencing works on the Project.



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	Date: 20/05/2020			
	Author: Chris.Maude			

8.6.3 Avoidance of Impacts Through Design

Based on the surveys completed to date, no registered sites managed under the *Aboriginal Heritage Act 1972* will be impacted by the construction or operation of the Project. Modifications to the design of the Project were used to ensure all sites of interest to the Traditional Owners (including an appropriate buffer) have been excluded from the Development Envelope. For example, the Development Envelope was redesigned to avoid a site of interest (plus a buffer) at Miralga East, and a number of sites (plus buffers) adjacent to the Miralga Haul Road.

8.6.4 Residual Impacts After Design

In the event that an item or area of Indigenous heritage interest is identified during construction or operations, ground disturbance will cease and the item/area will be left in-situ until it can be appropriately assessed. Approval for the recommencement of ground disturbing activities will only occur after consultation with Native Title claimants or their representatives and the DPLH as required. Should the DPLH determine that any of these sites meet the definition of a 'registered site', under Section 5 of the *Aboriginal Heritage Act 1972*, Section 18 consent from the Minister for Indigenous Affairs would be required prior to disturbance.

As shown on Figure 8-21, existing heritage surveys do not currently cover the entirety of the Development Envelope. If a future design modification impinges onto land not already surveyed, Atlas will conduct a heritage clearance survey in consultation with the Traditional Owners to identify potential heritage sites and ensure they are avoided or, if not possible to avoid, then appropriate approvals are obtained to impact them.

8.6.5 Summary of Baseline Data and Implications for Risk Assessment

Heritage

- The Project is located across two Native Title areas; Nyamal People #1 (WCS2019/010) and Nyamal People #10 (WCD2019/011).
- There are no registered Aboriginal heritage sites within the Development Envelope.
- The Development Envelope has been designed to avoid all sites of interest to the Traditional Owners, with appropriate buffers around those sites.
- Atlas has planned additional heritage surveys to ensure the current Indicative Disturbance Footprint has been surveyed.
- Should a future survey identify a registered site, a Section 18 consent from the Minister for Indigenous Affairs would be required prior to disturbance.

8.7 Environmental Threats and Other Factors

8.7.1 Introduced Flora

Weed invasion can fundamentally alter the composition and structure of native vegetation communities (Cowie and Werner, 1993; Gordon, 1998). In the extreme, entire ecosystems can be modified directly (Sodhi and Ehrlich, 2010), and indirectly through increased fuel loads which in-turn alter the local fire regime (Miller et al., 2010).

Individual invasions may potentially result in increase, decrease or no-change scenarios for different fauna assemblages (Grice, 2006). For example, even at low densities, Buffel Grass (*Cenchrus ciliaris*) can affect the composition of ground vegetation and birds (Smyth et al., 2008; Younge and Schlesinger, 2015).

Twenty introduced flora are already known to occur within or adjacent to the Development Envelope (Woodman Environmental, 2019a) including:

- *Aerva javanica*
- *Argemone ochroleuca*
- *Calotropis procera*
- *Cenchrus ciliaris*
- *Cenchrus setiger*
- *Chenopodium* sp.
- *Chloris virgata*
- *Citrullus colocynthis*
- *Cynodon dactylon*
- *Cyperus rotundus*
- *Echinochloa colona*
- *Flaveria trinervia*
- *Malvastrum americanum*
- *Passiflora foetida* var. *hispida*
- *Portulaca pilosa*
- *Setaria verticillata*
- *Solanum nigrum*
- *Stylosanthes hamata*
- *Tribulus terrestris*
- *Vachellia farnesiana.*

The Declared Pest **Caltropis procera* was recorded at 24 locations within the Study Area, however it is exempt from management or control requirements under the *Biosecurity and Agricuture Management Act 2007* (Woodman Environmental, 2019a). No introduced taxa listed as Weeds of National Significance (WoNS) were recorded in the Study Area (Woodman Environmental, 2019a).

Weeds already present in the Development Envelope may be spread due to increased vehicle movements and new weed species may be brought into the Development Envelope by mobile equipment during construction and operation of the Project.

8.7.2 Introduced Fauna

Introduced fauna, both herbivorous and predatory, can cause fundamental changes to ecosystems and are thought to have contributed to the decline and extinction of many species in Australia (Abbott, 2002; Burbidge and McKenzie, 1989; Ford et al., 2001). Predation by the Red Fox (*Vulpes vulpes*) and the feral Cat (*Felis catus*) are known to have major negative impacts on small and medium-sized native vertebrates in Australia (Dickman, 1996).

European Cattle (*Bos taurus*), Camel (Camelus dromedarius) and dog/dingo (*Canis familiaris*) were recorded in the Project area during the 2020 Biologic survey (2020a).

The Project may provide additional resources or habitat which may attract and support a greater abundance of feral animals in the area. Introduced predators may also be attracted into the Development Envelope as a result of the scavenging opportunities generated by the presence of road kill along roads (Dickman, 1996), which may in turn adversely affect populations of native fauna.

8.7.3 Altered Fire Regimes

Fire may impact fauna via direct contact, or indirectly by long-term habitat modification brought about by inappropriate fire frequency and intensity (Woinarski et al., 2001). The value of many habitats to fauna lies in the mosaic of ages (Parr and Andersen, 2006; Southgate et al., 2007; Woinarski, 1999). Introduction of too frequent, hot or extensive fires during hot, dry times of the year can eliminate this mosaic, and reduce the capacity of these habitats to support diverse assemblages of vertebrate (Law and Dickman, 1998).

Although difficult to predict, it is possible that implementation of the Project may increase the frequency of fires due to increased incidences of ignition caused by an expanded traffic network and increased traffic movements or an increase in grassy fuel load. Conversely, implementation may instead reduce the scale/extent of natural wildfires due to infrastructure acting as firebreaks and on-site management (i.e. fire suppression).

8.7.4 Noise and Vibration

Species using audible cues for breeding activity, especially birds and amphibians, may experience disruption to breeding cycles or reduced breeding success due to increased noise. For example, traffic noise is thought to negatively impact on bird and amphibian communities by masking territorial or mate attracting calls (Parris, 2009) (Shannon, 2014). Other behavioural responses to increased noise levels are reduced foraging time, through minimisation to exposure and by increased vigilance behaviour (Shannon, 2014).

Increased noise and vibration will be associated with all elements of the Project, particularly around the pit area and roads. Eleven caves are located within 500 m of the proposed mining pits and will be subject to noise and/ or vibrational impacts.

Any bats exhibiting short-term abandonment from caves within the Project area as a result of mining activities are expected to utilise Lalla Rookh as their preferred location (Bat Call WA, 2020). Vibration and other potential impacts CMRC-13, -14 and -15 will be managed as described in Blast It (2020) and the Significant Species Management Plan (Appendix S).

8.7.5 Dust/Air Quality

The development and operation of the Project will create dust emissions due to construction, blasting, haulage and general traffic activities, the impacts of which may not be confined to the Development Envelope.

Dust can indirectly affect fauna by altering the structure and composition of native vegetation (Farmer, 1993). Dust interferes with photosynthesis, respiration and transpiration and allows penetration of gaseous pollutants (Farmer, 1993). Most plant communities can be adversely affected by dust deposition, resulting in alteration of plant community structure (Prajapati, 2012). A decline in vegetation quality can impact faunal assemblages by reducing both food and habitat resources. However, no prior studies have been able to detect a significant adverse impact of airborne dust on plant function in the Pilbara (Grierson, 2015) (Matsuki, 2016).

Dust may directly pollute water bodies by increasing turbidity or potentially altering water chemistry. Waterholes most at risk include the non-permanent waterholes to the north of Miralga East given their proximity to the Indicative Disturbance Footprint. This may in turn affect fauna and flora dependent on these waterholes including but not limited to the Pilbara Olive Python and Pilbara Leaf-nosed Bat.

Given the duration and size of the Project, it is not anticipated that there will be significant impact at a regional level.

8.7.6 Artificial Light

Altered light environments may affect foraging, reproduction, migration, and communication (Longcore, 2004). The most likely disturbance responses of native fauna from increases in light spill are the avoidance of illuminated areas previously used for foraging by light-sensitive species, or changes to prey item aggregation for insectivorous species resulting in changes to foraging behaviour. However, there is a lack of research into the impact of these factors on native fauna in the Pilbara. Temporary mobile lighting will be installed in active mine pits and active operational areas.

Mining and crushing will be on a day-shift only so light impacts will be low. Haulage may periodically occur 24 hours per day.

8.7.7 Implications for Risk Assessment

All of the above threats and factors are addressed in standard Atlas management measures and procedures (discussed further in Section 9.1). Where these factors have the potential to significantly impact the natural environment treatments have been applied in, as described in Section 9.2.

9 Environmental Risk Management

Chapter 8 identified the potential impacts of the Project to environmental factors and values. Each impact can be considered as arising through one or more Project activities (e.g. clearing, mining, inappropriate handling of chemicals and hydrocarbons). This chapter assesses those activities against the existing environment to identify, evaluate and propose treatments for all plausible environmental risks and associated impacts that may occur over the life of the Project. This includes consideration of accidents/ unplanned events and the various phases of the Project, including construction, operation and care and maintenance. Risks during closure are covered separately by the Mine Closure Plan (Appendix E).

9.1 Atlas Standard Management Measures

Atlas has in place a HSEMS supported by an Environmental Management Plan (EMP), which defines Atlas's approach to environmental management and integrates regulatory and HSEMS requirements. Atlas has been operating iron ore mines in the Pilbara since 2008. During this time, Atlas has developed, implemented and refined its Environmental Management Plans and Procedures.

Atlas will comply with the Project's EPBC Act Approval (EPBC 2019/8601), Ministerial Statement No. 1154 and all other relevant environmental approvals and permits.

The following plans and procedures contain the key management measures and controls for this Project and will be implemented to assist in minimising impacts across the Project:

- Ground Disturbance Permit (GDP) Procedure (950-EN-PRO-0006).
- Clearing and Grubbing Procedure (950-EN-PRO-0002).
- Dust Management Procedure (950-EN-PRO-0003)
- Flora Management Procedure (950-EN-PRO-0005).
- Introduced Fauna Control Procedure (950-EN-PRO-0009).
- Fauna Management Procedure (950-EN-PRO-0004).
- Significant Species Management Plan (SSMP) (Appendix S).
- Waste Management Procedure (950-EN-PRO-0013).
- Weed Hygiene Procedure (950-EN-PRO-0015).
- Hydrocarbon Management Procedure (950-EN-PRO-0008).
- Hydrocarbon (and Chemical) Spill Management Procedure (950-EN-PRO-0007).
- Bioremediation Management Procedure (950-EN-PRO-0001).
- Hot Work Standard (SA-STD-009)
- Mine Closure Plan (Appendix E).

Please note that the SSMP (Appendix S) is currently subject to assessment and review as part of the EPBC Act and EP Act assessment processes, and is likely to be updated. Later revisions of this Mining Proposal will include the version of the SSMP current at that time.

9.2 Risk Assessment

This environmental risk assessment was undertaken in accordance with Atlas's Risk and Hazard Management Standard (950-HS-STA-0024). A separate closure and rehabilitation risk assessment and further discussion regarding its findings are provided separately in the Mine Closure Plan (Appendix E).

The purpose of this Standard is to ensure a uniform approach to risk management is applied for identifying, analysing, evaluating and treating HSE operational risks by:

- Determining when it is appropriate to conduct a formal risk assessment.
- Ensuring appropriate participation in risk assessments.
- Applying standard risk assessment processes.
- Considering a range of potential HSE hazards and risks and credibly evaluating them.
- Selecting and implementing a hierarchy of control measures to reduce risks to acceptable levels.
- Learning from incidents and updating processes as required.

Atlas's approach to health, safety, environment and community related risk management is proactive and ongoing, through the establishment of current and relevant risk registers.

The likelihood and consequence of each impact was rated using the definitions in Table 9-1, as adapted from Standards Australia's HB 203:2006, and then combined to determine the inherent (i.e., pre-treatment) level of risk.

The evaluation of risks is based on the findings from specific investigations conducted in support of this Mining Proposal, knowledge of the existing environment likely to be affected, the Project description, experience at similar operations elsewhere and professional judgment.

The inherent risks were then evaluated against the DMIRS objectives for environmental factors (Table 9-2) to determine the requirement for treatment and subsequently revaluate the residual risk, including demonstrating that the principle of As Low As Reasonably Practicable (ALARP) has been met. The hierarchy of control (avoid, substitute, control and mitigate) was followed in the selection of treatments to be applied, although it was neither possible nor practicable to deploy treatments at every level of the hierarchy for every risk.

The outcomes of this risk assessment are summarised in Table 9-3 (risks regulated by DMIRS) and Table 9-4 (risks regulated by another agency). The risks relating to biodiversity and water resources in particular are generally addressed and regulated by other agencies.

Note that Table 9-3 and Table 9-4 show only the primary risk treatments that are key to achieving the residual risk levels.

It is anticipated that following the implementation of the nominated treatments in Table 9-3 and Table 9-4, the residual risks will meet the DMIRS environmental objectives for biodiversity, water resources, land and soils, and rehabilitation and mine closure (Table 9-2).

Table 9-1: Risk Assessment Matrix

Likelihood	Consequences				
	Insignificant 1	**Minor 2**	**Moderate 3**	**Major 4**	**Catastrophic 5**
	Limited damage to minimal area of low significance	Minor effects on biological or physical environment	Moderate, short-term effects but not affecting ecosystem functions	Serious medium-term environmental impacts	Very serious, long-term environmental impairment of ecosystem function
A Chronic of Almost Certain Common or repeating occurrence (Once a week or more)	**M (11)**	**H (16)**	**E (20)**	**E (23)**	**E (25)**
B Likely Known to occur or "it's happened" (Once a month to once a year)	**M (7)**	**H (12)**	**H (17)**	**E (21)**	**E (24)**
C Possible Could occur or "I've heard of it happening" (Less than once a year but more than once in 5 years)	**L (4)**	**M (8)**	**H (13)**	**H (18)**	**E (22)**
D Unlikely Not likely to occur (Less than once in 5 years)	**L (2)**	**L (5)**	**M (9)**	**H (14)**	**H (19)**
E Rare Practically impossible (May occur but only in exceptional circumstances)	**L (1)**	**L (3)**	**L (6)**	**M (10)**	**H (15)**

Matrix Legend:			
	E	**Extreme Risk**	Immediate action required
	H	**High Risk**	Senior management attention needed
	M	**Moderate Risk**	Management responsibility must be specified
	L	**Low Risk**	Manage by routine procedures

Table 9-2: DMIRS Objectives for Environmental Factors

Factor	Objective
Biodiversity	To maintain representation, diversity, viability and ecological function at the species, population and community level.
Water Resources	To maintain the hydrological regimes, quality and quantity of groundwater and surface water to the extent that existing and potential uses, including ecosystem maintenance, are protected.
Land and Soils	To maintain the quality of land and soils so that environmental values are protected.
Rehabilitation and Mine Closure	Mining activities are rehabilitated and closed in a manner to make them physically safe to humans and animals, geo-technically stable, geo-chemically non-polluting/ non-contaminating, and capable of sustaining an agreed post-mining land use, and without unacceptable liability to the State.

Source: Environmental Objectives Policy for Mining (March 2020) (DMIRS 2020).

Table 9-3: Environmental Risk Assessment (Risks Regulated by DMIRS)

Risk Pathway / Unwanted Event	Relevant Phase[1]	Potential Impacts	Inherent Risk				Risk Treatments	Applicable Phases[1] for Applying Treatments	Residual Risk			Environmental Objective[3]
			Likelihood	Consequence	Risk Rating	Data Certainty[2]			Likelihood	Consequence	Risk Rating	
Physical presence of the Project and/or poor surface water management resulting in interruption to natural flows, drainage shadowing and ponding, flooding, scour and erosion	All phases	Reduction in quality and composition of significant vegetation, and potential deterioration of significant flora populations	C	3	H (13)	H	Managed via the EPBC Act Approval (EPBC 2019/8601), Ministerial Statement No. 1154 and the following Atlas plans and procedures as discussed in Section 9.1 and including incorporation of appropriate surface water management into final mine design: • GDP Procedure (950-EN-PRO-0006). • Clearing and Grubbing Procedure (950-EN-PRO-0002). The river crossing at Shaw River will be designed and constructed to over-top during periods of major stream flow. This will enable water flow past the crossing points and prevent significant amounts of water ponding up-stream, as well as prevent water shadow effects downstream. The haul road crossing at Miralga Creek will be designed and constructed to enable water flow past the crossing point and prevent significant amounts of water ponding up-stream, as well as prevent water shadow effects downstream. This will be enabled through an over-topping design, or the installation of appropriate under-road drainage. Atlas will ensure appropriate surface water management (e.g., around pits, waste rock dumps and the ROM) is incorporated into the final mine design, in accordance with the objectives and design principles from Appendix H.	Design, Construct and Operations	D	3	M (9)	1
		Ponding, shadowing, erosion and/or scouring effects caused by the Shaw River and Miralga Creek watercourse crossings.	B	3	H (17)	H			C	3	H (13)	
Inadequate transport, handling and storage of hydrocarbons and chemicals leading to contamination of the environment	All phases	Reduction in vegetation quality and composition and potential deterioration of significant flora populations	C	3	H (13)	H	Managed via the EPBC Act Approval (EPBC 2019/8601), Ministerial Statement No. 1154, Works Approval (W6494/2021/1, pending), Operating Licence (application pending) and the following Atlas plans and procedures as discussed in Section 9.1: • Hydrocarbon Management Procedure (950-EN-PRO-0008). • Hydrocarbon (and Chemical) Spill Management Procedure (950-EN-PRO-0007). • Bioremediation Management Procedure (950-EN-PRO-0001). • Water Management Plan. • Site Water Operating Plan.	All phases	D	3	M (9)	2
		Poor rehabilitation success	C	2	M (8)	H	Key management measures include: • Containment of hydrocarbons in accordance with AS1940:2004 – The Storage and Handling of Flammable and Combustible Liquids. • Transport to and from site of all hydrocarbons/chemicals by experienced licenced contractors in accordance with the Dangerous Goods Safety (Road and Rail Transport of Non-explosives) Regulations 2007. • Refuelling procedures, including the provision of a spill kit at all refuelling stations. • All spills, irrespective of volume, will be reported internally. Spills to ground / outside of a bund are reported as an environmental incident and cleaned up appropriately. Spills inside a bund are reported as a hazard and cleaned up appropriately.		C	1	L (4)	N/A

Risk Pathway / Unwanted Event	Relevant Phase[1]	Potential Impacts	Inherent Risk				Risk Treatments	Applicable Phases[1] for Applying Treatments	Residual Risk			Environmental Objective[3]
			Likelihood	Consequence	Risk Rating	Data Certainty[2]			Likelihood	Consequence	Risk Rating	
Poor stability of waste rock dumps	All phases	Erosion of waste rock dump surfaces leading to loss of waste rock material and/or topsoil into the surrounding environment. The volume of erodible waste is very small, and from one pit only.	D	2	L (5)	H	Atlas has designed all waste rock dumps: • Outside of the zones of potential pit instability. • To mitigate against impacts from and to surface water (e.g., to prevent ponding up against the edge of the dump). • To meet appropriate geotechnical standards. • With preliminary consideration of closure requirements (e.g., re-profiling) in consultation with mine closure specialist. • Dump designs will be revised as the physical and geotechnical properties of as-mined waste is determined, following the commencement of mining, as per the recommendation in Mine Earth (2020). Low stability waste rock will not be exposed on final waste rock dump surfaces, as discussed in Section 9.1.	Operations and Closure	D	2	L (5)	N/A
Insufficient topsoil or growth medium for rehabilitation	Operations and Closure	Poor rehabilitation success, and/ or unsuccessful relinquishment of closed project.	A	2	H (16)	H	Atlas will implement a four-step topsoil management approach as follows: 1. Maximise the volumes of topsoil recovered during clearing. 2. Manage recovered topsoil to minimise losses to erosion (e.g. wind, drainage) or contamination (e.g. weeds). 3. Prioritise the use of topsoil in areas of rehabilitation where rehabilitation and/or revegetation success is most likely. 4. Consider preferential topsoil placement where possible in ongoing mine closure planning. The following plans and procedures will be implemented to assist in minimising impacts as discussed in Section 9.1: • GDP Procedure (950-EN-PRO-0006). • Flora Management Procedure (950-EN-PRO-0005). • Weed Hygiene Procedure (950-EN-PRO-0015). • Clearing and Grubbing Procedure (950-EN-PRO-0002). Key management measures include: • Establish designated vegetation and topsoil stockpiles in suitable locations, preferentially away from areas subject to excessive surface water flow/ drainage and as close to the area of disturbance as possible. • Topsoil stripping shall only be undertaken in dry conditions. • Where practicable, topsoil shall be stripped to a minimum depth of 200 mm below the natural surface unless otherwise stated in GDP conditions. Topsoil (and subsoil) shall be stripped to a greater depth where available and necessary. • Topsoil shall be paddock dumped into stockpiles not exceeding 2 m in height.	Operations and Closure	C	2	M (8)	4

Risk Pathway / Unwanted Event	Relevant Phase[1]	Potential Impacts	Inherent Risk				Risk Treatments	Applicable Phases[1] for Applying Treatments	Residual Risk			Environmental Objective[3]
			Likelihood	Consequence	Risk Rating	Data Certainty[2]			Likelihood	Consequence	Risk Rating	
Project related fire	All phases	Loss of conservation significant flora/fauna species and their habitat	C	3	H (13)	H	• Clearing machinery will be fitted with automated fire suppression. • Fire breaks will be maintained in accordance with the local government fire-break notice under section 33 of the *Bush Fires Act 1954*. • Smoking will only be allowed in permitted areas, which will be appropriately signed and contain self-arresting cigarette butt disposal containers. • Off-road driving will be prohibited unless otherwise authorised by Senior Management. • All vehicles and machinery will be fitted with fire extinguishers. Fire control equipment (i.e. fire extinguishers). • No parking of hot vehicles/ machinery over vegetation. • Implementation of Hot Work Standard (SA-STD-009). • Emergency Response Plan. • All ERT members will be trained in Certificate III - Mine Emergency Response and Rescue and will ensure sufficient operationally ready fire suppression equipment is in place.	All phases	E	3	L (6)	3
Extreme weather events resulting in flooding, failure of surface water controls and damage to or loss of project infrastructure and materials	All phases	Exceedance of surface water control structure design capacities, resultant uncontrolled surface water flows leading to significant sediment deposition downstream and impacts to vegetation	C	2	M (8)	H	• Floodway has been designed to allow for overtopping during flood events, rock armouring, etc. • Surface water control structures will be inspected routinely. • Topsoil inventory to manage any loss of topsoil or erosion. • All storage vessels (bins) containing putrescible waste shall be fitted with a lid that can be secured. • All buildings shall be constructed to relevant cyclonic wind standards (Building Code of Australia, Australian Standards) applicable to the Project location.	All phases	C	2	M (8)	N/A
		Generation of windblown waste	D	1	L (2)	H		All phases	D	1	L (2)	

1. Phases: (Design), Construction, Operations, Care & Maintenance, (Closure)
2. Data certainty:
   Low – Baseline data/information has limitations, with only general conclusions and requires further work. Risk rating is based on subjective opinion.
   Moderate – Baseline data/information has some gaps, minor further work required. Risk rating is based on relevant past experience/ similar conditions observed previously.
   High – Baseline data/information is complete and analysis appropriate for level of risk. Risk rating is based on testing, modelling or experiments.
3. Any inherent risks rated moderate (M10) or above have been assigned an environmental outcome in Chapter 10. The ID presented in this column links the risk to the relevant environmental outcome in Table 10-1.

Table 9-4: Environmental Risk Assessment (Risks Regulated by Another Agency)

Risk Pathway / Unwanted Event	Relevant Phase[1]	Potential Impacts	Inherent Risk				Risk Treatments	Applicable Phases[1] for Applying Treatments	Residual Risk			Environmental Objective[3]
			Likelihood	Consequence	Risk Rating	Data Certainty[2]			Likelihood	Consequence	Risk Rating	
Clearing and other vehicle/machinery movements resulting in the loss or damage of significant environmental and heritage values	All phases	Long-term impact on the local population of any conservation significant flora, resulting directly from clearing and indirectly in association with edge effects and fragmentation	C	4	H (18)	H	Position the Development Envelope to avoid known locations of priority flora. Managed via the EPBC Act Approval (EPBC 2019/8601), Ministerial Statement No. 1154 and the following Atlas plans and procedures as discussed in Section 9.1: • Ground Disturbance Permit (GDP) Procedure (950-EN-PRO-0006). • Clearing and Grubbing Procedure (950-EN-PRO-0002) • Flora Management Procedure (950-EN-PRO-0005). • Significant Species Management Plan (Appendix S). Key management measures include: • Clearing/ disturbing no more than 207.59 ha of vegetation/habitat within the 544.52 ha Development Envelope. • Restricting clearing to the minimum necessary for safe construction and operation of the Project and to within approved areas through GDP Procedure. • Additional heritage surveys to ensure the current Indicative Disturbance Footprint has been surveyed.	Construct and Operations	E	4	M (10)	5
		Long-term impact on the local population of any conservation significant fauna, resulting from loss of significant habitats and microhabitats (e.g. permanent loss of significant cave habitats)	C	4	H (18)	H			E	4	M (10)	
		Long-term impact on the local population of any conservation significant fauna, resulting from vehicle interactions	D	4	H (14)	H			E	4	M (10)	
		Loss/damage to potential heritage site (known/unknown)	C	3	H (13)	H			D	3	M (9)	
Clearing and other vehicle/machinery movements resulting in the spread and/or introduction of weeds	All phases	Reduction in vegetation quality and composition and potential deterioration of significant flora populations	B	3	H (17)	H	Managed via Ministerial Statement No. 1154 and the following Atlas plans and procedures as discussed in Section 9.1: • GDP Procedure (950-EN-PRO-0006). • Weed Hygiene Procedure (950-EN-PRO-0015). • Flora Management Procedure (950-EN-PRO-0005). Key management measures include: • Weed hygiene inspections and certification to ensure all mobile equipment arriving on site is clean and free of material. • Weed-infested areas within planned clearing areas will be identified through the GDP process and then delineated in the field.	Construct and Operations	D	3	M (9)	5
		Poor rehabilitation success	B	2	H (12)	H			C	2	M (8)	

Risk Pathway / Unwanted Event	Relevant Phase[1]	Potential Impacts	Inherent Risk				Risk Treatments	Applicable Phases[1] for Applying Treatments	Residual Risk			Environmental Objective[3]
			Likelihood	Consequence	Risk Rating	Data Certainty[2]			Likelihood	Consequence	Risk Rating	
Mining (including drilling and blasting) at Miralga East pit resulting in structural damage to cave CMRC-15	Operations	Partial or complete structural damage to the cave resulting in permanent abandonment of the cave by the local population of Ghost Bat	B	4	E (21)	H	Managed via the EPBC Act Approval (EPBC 2019/8601), Ministerial Statement No. 1154 and the following Atlas plans and procedures as discussed in Section 9.1: • Significant Species Management Plan (Appendix S) • Blast management and monitoring will involve: • Design blasts to achieve <85 mm/s (below the assigned limit of 100 mm/s as set out in Blast It Global (2020). • Conduct a cave inspection after any blast exceeding 85 mm/s. If damage is noted conduct an investigation to determine the root cause for the exceedance. Re-establish controls and/ or lower blast vibration limits. • Establish vibration monitors in (or as close as practicable to) the nearest cave for all blasting at Miralga East pits 2 and 3. • Avoid blasting within 100 m of a cave until the results of monitoring validate predictions with a reasonable degree of confidence. • If vibration exceeds 100 mm/s, blasting should cease until the cause has been determined and steps to prevent a reoccurrence have been taken. A cave inspection is required to assess any impacts. • Periodically inspect caves to confirm the vibration limits are fit for purpose (annually and in response to vibration exceeding 85 mm/s). • Establish a Blast Exclusion Zone of 50 m around CMRC-13, -14 and -15.	Operations	D	4	H (14)	5
Inadequate waste management	All phases	Generation of windblown waste	B	1	M (7)	H	Managed via the EPBC Act Approval (EPBC 2019/8601), Ministerial Statement No. 1154, Works Approval (W6494/2021/1, pending), Operating Licence (application pending) and the following Atlas plans and procedures as discussed in Section 9.1: • Waste Management Procedure (950-EN-PRO-0013). • Introduced Fauna Control Procedure (950-EN-PRO-0009). • Fauna Management Procedure (950-EN-PRO-0004). • SSMP (Appendix S). A key management measure is: • Waste hydrocarbons (e.g., waste oil and used oil filters) shall be stored in a designated area and periodically taken offsite by licenced controlled waste contractor.	All phases	C	1	L (4)	N/A
		Attraction of feral fauna leading to increased predation upon and/or competition for resources against native fauna	B	3	H (17)	H			C	3	H (13)	5
Generation of excessive dust, noise, vibration or light	All phases	Artificial lighting altering fauna behaviour and leading to a long-term impact on the local population of conservation significant fauna	C	3	H (13)	H	Managed via the EPBC Act Approval (EPBC 2019/8601), Ministerial Statement No. 1154, Works Approval (W6494/2021/1, pending), Operating Licence (application pending) and the following Atlas plans and procedures as discussed in Section 9.1: • SSMP (Appendix S). • Blast Management Procedure/Plan • Dust Management Procedure (950-EN-PRO-0003). • Clearing and Grubbing Procedure (950-EN-PRO-0002). • Flora Management Procedure (950-EN-PRO-0005).	All phases	D	3	M (9)	5
		Abandonment of bat roosts during mining leading to a long-term impact on the local population of Ghost Bats	D	4	H (14)	H			E	4	M (10)	
		Reduction in vegetation quality and composition	B	2	H (12)	H			C	2	M (8)	

Risk Pathway / Unwanted Event	Relevant Phase[1]	Potential Impacts	Inherent Risk				Risk Treatments	Applicable Phases[1] for Applying Treatments	Residual Risk			Environmental Objective[3]
			Likelihood	Consequence	Risk Rating	Data Certainty[2]			Likelihood	Consequence	Risk Rating	
		Impacts to human health	C	2	M (8)	H	• Fauna Management Procedure (950-EN-PRO-0004). In addition to the points noted above in relation to CMRC-15, the following key management measures will be implemented: • Where practicable, the crushing and screening plant will contain fully enclosed transfer points and strategically located water sprays and sprinklers. • Blasting plans shall consider meteorological conditions to control dust generation and dispersion. • Ore will be preconditioned to the required moisture content. • Environmentally friendly and biodegradable dust suppression additives will be investigated and implemented if excessive dust is on-going.		D	2	L (5)	N/A

1. Phases: (Design), Construction, Operations, Care & Maintenance, (Closure)
2. Data certainty:
   Low – Baseline data/information has limitations, with only general conclusions and requires further work. Risk rating is based on subjective opinion.
   Moderate – Baseline data/information has some gaps, minor further work required. Risk rating is based on relevant past experience/ similar conditions observed previously.
   High – Baseline data/information is complete and analysis appropriate for level of risk. Risk rating is based on testing, modelling or experiments.
3. Any inherent risks rated moderate (M10) or above have been assigned an environmental outcome in Chapter 10. The ID presented in this column links the risk to the relevant environmental outcome in Table 10-2.

10 Environmental Outcomes and Reporting

10.1 Environmental Outcomes, Performance Criteria and Monitoring

Atlas has defined environmental outcomes for the more significant risks identified in the Project's risk assessment (see Section 9 and Table 9-3). In general, environmental outcomes are set for risk pathways that:

- Have a moderate (M10) or higher inherent risk rating;
- Are not regulated by another agency or approval; and
- Require measurement to ensure that the Project will not have an unacceptable environmental impact.

For each environmental outcome, one or more performance criteria have been established to measure progress towards meeting this environmental outcome and to demonstrate that an acceptable level of impact will not be exceeded or a level of protection will be achieved. Performance criteria have been developed to be simple and SMART (specific, measurable, achievable, relevant and time-bound).

Monitoring arrangements have than been specified to set out how the performance criteria will be measured. Monitoring programs may be altered as opportunities for improvement are identified or technology changes.

Table 10-1 sets out the environmental outcomes, performance criteria and monitoring for the more significant risks during the Project's construction, operation and care and maintenance phases which are not regulated by another agency. For environmental outcomes, performance criteria and monitoring applicable to the closure phase, please refer to the Mine Closure Plan (Appendix E).

Risks relating to biodiversity and water resources are generally addressed and regulated by other agencies as detailed in Chapter 9 and summarised in Table 10-2. However, a number of environmental outcomes and performance criteria relevant to these factors are detailed here, where not explicitly captured by these approvals (e.g., Project related fire). For environmental factors regulated or considered by other regulatory processes and approvals, please refer to Table 10-2.

Further explanatory description on the selection of the environmental outcomes, performance criteria and monitoring provisions in Table 10-1 and Table 10-2 is provided following the tables.

Table 10-1: Environmental Outcomes, Performance Criteria and Monitoring for Risks Managed by DMIRS

ID	Environmental Factor and DMIRS Objective	Risk Pathway	Environmental Outcome	Performance Criteria	Monitoring
1	**Water Resources** To maintain the hydrological regimes, quality and quantity of groundwater and surface water to the extent that existing and potential uses, including ecosystem maintenance, are protected	Physical presence of the Project and/or poor surface water management resulting in interruption to natural flows, drainage shadowing and ponding, flooding, scour and erosion	No adverse impact to riparian vegetation related to ponding, shadowing, erosion and/or scouring at the Shaw River/ Miralga Creek watercourse crossings.	• Design and construction of both crossings to enable overtopping. • Maintenance of both crossings after heavy rainfall/ high local streamflow to reinstate design flow conditions.	• Monthly environmental inspections during construction and operation. • Inspections after high-flow events.
2	**Landforms** Mining will not result in appreciable land degradation, or the contamination or pollution of the land	Transport, handling and storage of hydrocarbons and chemicals	No adverse impact from spills to environmental values including flora and vegetation	• All hydrocarbon and chemical spills are controlled and contained immediately, and actively cleaned up. • No single spill of hydrocarbon over 1,000 L outside a bunded/contained area and within 50 m of a known location of priority flora.	• All spills to be reported and entered as an incident/hazard into the site event reporting database. • Monthly environmental inspections during construction and operation.

ID	Environmental Factor and DMIRS Objective	Risk Pathway	Environmental Outcome	Performance Criteria	Monitoring
3	**Biodiversity** To maintain representation, diversity, viability and ecological function at the species, population and community level	Project related fire	No adverse impact to the environment outside the Development Envelope resulting from Project-related fire	• Maintenance of fire breaks in accordance with the local government fire-break notice under section 33 of the *Bush Fires Act 1954*. • No occurrence of Project-related fire outside the Development Envelope.	• Monthly inspections of fire breaks during construction and operation. • All fires will be reported, investigated and entered into the site event reporting database.
4	**Rehabilitation and Mine Closure** Mines are closed in a manner to make them physically safe to humans and animals, geotechnically stable, geochemically non-polluting/non-contaminating, and capable of sustaining agreed post-mining land use, and without unacceptable liability to the State.	Insufficient topsoil or growth medium for rehabilitation.	Recovery and retention of topsoil for rehabilitation is maximised.	• Topsoil will be stripped to a minimum of 200 mm below natural surface (where available) and paddock dumped into stockpiles not exceeding 2 m in height.	• Topsoil register. • Monthly environmental inspections during construction and operation. • All non-conformances with this procedure will be reported, investigated and entered as an incident into the site event reporting database.

Table 10-2: Environmental Outcomes, Performance Criteria and Monitoring for Risks Managed by Other Agencies

ID	Environmental Factor and DMIRS Objective	Risk Pathway	Environmental Outcome	Performance Criteria	Monitoring
5	**Biodiversity** To maintain representation, diversity, viability and ecological function at the species, population and community level	Clearing and other vehicle/machinery movements Mining of Miralga East pits Physical presence of the Project and/or poor surface water management Transport, handling and storage of hydrocarbons and chemicals Inadequate waste management Generation of excessive dust, noise, vibration and light	No long-term impact on conservation significant fauna or flora	Adherence to: • EPBC Act Approval (EPBC 2019/8601). • Ministerial Statement No. 1154. • Works Approval (W6494/2021/1, pending). • Operating Licence (application pending). Note these approvals include the following environmental outcomes/performance criteria (not an exhaustive list): • No clearing outside the Development Envelope. • Loss of no more than 207.59 ha of vegetation/habitat within the Development Envelope (544.52 ha). • Loss of only one category 4 Ghost Bat cave (CMRC-02). • Loss of no more than 85.96 ha of important habitat for the Northern Quoll and Ghost Bat. • All blasts monitored are <100 mm/s vibration as monitored at the nearest cave to all blasting at Miralga East pits 2 and 3. No significant damage to cave CMRC-15 (short-term abandonment during mining is anticipated). • No entry to category 2 and 3 caves, except for the purposes of bat surveys or cave monitoring. • Persistence of the Northern Quoll in the Study Area during operations. The criterion is Northern Quoll is not absent from more than 50% of monitoring sites for more than two consecutive annual monitoring periods. • The entrance to CMRC-15 is closed to Ghost Bats for blasting and drilling activities at Miralga East pits 2 and 3 in accordance with the requirements of the SSMP approved by DWER and DAWE.	• SSMP (Appendix S)

Water Resources

The river crossings of Shaw River and Miralga Creek will be designed and constructed to overtop during periods of major stream flow. This will enable water to flow past the crossings without significant ponding of water upstream, as well as preventing shadow effects downstream. This will be enabled through an overtopping design, and/or the installation of appropriate under-road drainage.

The crossings will be of a sacrificial design that will intentionally be lost during larger flood events, rather than impounding water or obstructing flow. Following large flow events, maintenance of crossings is required to ensure that flow conditions are restored as per the design, e.g. any culverts are not blocked, large flow events will continue to overtop the road.

Given the importance of the controls and the design of the performance criteria to reflect the implementation of the controls, monitoring is targeted at ensuring the controls are implemented and the risk pathway is not realised.

Landforms

As the primary risk pathway for landforms is from pollution caused by spills, the central performance criterion is centred on responding to a spill event. This focuses on ensuring all spills are:

- controlled – the source of the spill is stopped;
- contained – the spilled material is prevented from spreading further; and
- cleaned up – the spilled material plus any material contaminated by the spill (e.g. soil) is removed and disposed of appropriately.

A second performance criterion has been added to impose a higher standard of performance to be achieved in areas near sensitive environmental values such as waterholes and priority flora.

The performance criteria and monitoring requirements are supported by the following Atlas corporate documents:

- Hydrocarbon (and Chemical) Spill Management Procedure (950-EN-PRO-0007).
- Unscheduled Liquid Discharge Form (950-EN-FRM-0007).
- HSE Incident Management Procedure (950-HS-PRO-0016).

Biodiversity

Project-related fire poses an inherent risk to flora and fauna, particularly if it spreads beyond the Development Envelope. If a fire occurs, preventing its spread is key. The performance criteria have accordingly been set to ensure fire breaks are in place and, if a fire occurs, to determine whether the spread of fire has been prevented.

All other risks to biodiversity with inherent risk ratings of Moderate (M10) or above are regulated by other agencies. An overarching outcome for these risks is provided in Table 10-2.

The performance criteria and monitoring requirements are supported by Atlas's corporate HSE Incident Management Procedure (950-HS-PRO-0016).

Rehabilitation and Mine Closure

The performance criteria and monitoring requirements are supported by the following Atlas corporate documents:

- Clearing and Grubbing Procedure (950-EN-PRO-0002).
- HSE Incident Management Procedure (950-HS-PRO-0016).

10.2 Environmental Reporting

Reporting against the performance criteria provided in Table 10-1 will be by way of the Annual Environmental Report (AER), submitted online via the DMIRS Environmental Assessment and Regulatory System (EARS). Breaches of the performance criteria may require DMIRS to be notified within 24 hours of identification of the breach.

Atlas's full reporting requirements including those required by other agencies are detailed in Section 11.10.

11 Environmental Management System

11.1 Management System Design

Atlas is committed to minimising harm to the environment and leaving an enduring positive legacy in the communities in which it operates. Atlas considers excellence in environmental management essential to our future. This commitment is documented in the Atlas HSE Policy (Appendix T).

Atlas conducts business in accordance with our five core values (Table 11-1). These values reinforce our culture, guide our behaviours and help to articulate the way we approach all aspects of our business.

Table 11-1: Atlas Values

Excellence	Whether looking at safety, sustainability, marketing, mining operations, haulage or port a commitment to **excellence** shines through in everything we do.
Indomitable Spirit	Our **indomitable spirit** is who we are. We are resilient, determined, courageous and passionate people who thrive on thinking outside the box.
Win-Win	Think **win-win** is our approach across our operations to achieve mutually beneficial outcomes. We value and respect each other so that together we accomplish more.
Agility	**Agility** is at the heart of what makes us different. We pride ourselves on being adaptable and nimble due to our lean structure and unique operating model.
Trust	We earn the **trust** with our people, suppliers, customers and communities by being fair and always acting with integrity.

The Atlas Health Safety and Environmental Management System (HSEMS) has been designed in accordance with the requirements AS/NZS ISO 14001:2004 and is depicted in Figure 11.1.

Figure 11-1: HSE Management System

11.2 Risk Identification Throughout the Life of the Project

11.2.1 Planning

Planning for environmental management starts with a risk assessment process to define key risk exposures. The planning process involves an understanding of relevant environmental aspects, impacts and legal requirements along with the development of objectives, targets, plans and procedures.

11.2.2 Risk Assessment

In all of its activities Atlas is committed to managing risk to ALARP.

Environmental risk has been assessed for this Project as per the Atlas HSE Group Risk and Hazard Management Standard (950-HS-STA-0024) and is consistent with the Australian Standard for Risk Management AS/NZS ISO 31000:2009.

The risk assessment document (Environmental Risk Register) will be made available on site during the life of the project. The Environmental Risk Register will be reviewed and updated on a biannual basis by the site Environmental Advisor and on an annual basis by the site Management Team.

11.3 Implementing Environmental Management Programs

The Environmental Management Plan (EMP) defines Atlas's approach to environmental management and integrates regulatory and HSEMS requirements.

The plan is applicable to Atlas employees, contractors and visitors.

11.4 Incorporating Goals and Targets, and Legal Obligations

11.4.1 Environmental Objectives and Targets

Site environmental objectives/outcomes and targets will be developed and reviewed on a regular basis to ensure targets are on track for completion. Objectives/ outcomes and targets will be:

- Specific.
- Measurable.
- Achievable.
- Relevant.
- Time bound.

In addition, the site environmental objectives/outcomes and targets will be consistent with the HSE Policy, consider relevant legislation and align to the HSEC Business Plan.

11.4.2 Legal and Other Requirements

Understanding and documenting legal and other obligations is critical to achieving compliance. The site specific environmental legal and other obligations register includes, but is not limited to:

- Mining Proposal commitments.
- Mine Closure Plan commitments.
- Prescribed Premises Works Approval and Licence conditions.
- Water Abstraction Licence conditions.
- Ministerial Statement conditions.
- Native Vegetation Clearing Permit.
- EPBC Act Approval conditions.

- Tenement conditions.
- Heritage commitments and conditions.

The environmental legal and other obligations register will be reviewed on an annual basis and updated as required. The evaluation of compliance process will be mapped to the obligations register and undertaken via audits and inspections.

A summary of environmental legislation relevant to the project business is detailed in the HSE Legal and Other Register.

Current copies of applicable licences / permits will be maintained on site.

11.5 Structure and Responsibility

The Registered Manager will be responsible for ensuring all activities associated with the Project are undertaken in full compliance with statutory regulations and are consistent with Atlas's Health, Safety and Environmental Policy.

Environmental management responsibilities for all employees and contractors are summarised in Table 11-2 and detailed in the EMP. Specific responsibilities are incorporated into position descriptions where applicable.

Table 11-2: Environmental Management Responsibilities

Role	Responsibility
Chief Executive Officer	Overall responsibility for the Miralga Creek DSO Project.
General Manager – Operations	Ultimate responsibility for the successful completion and closure of the Project, including adequate closure provisioning.
Registered Manager	Overall responsibility for site-specific implementation of environmental policy, systems and management measures. Ensure that all contractors fulfil their contractual obligations with regards to environmental requirements. Sign-off on Ground Disturbance permits. Management of the action register. Successful completion and closure of the Project, including adequate financial provisioning.
Environmental Advisor	Ensure the environmental component of the HSEMS is implemented and maintained. Monitor and review contractor compliance to contract and legislative requirements. Implement induction procedures and appropriate training. Ensure compliance with licence conditions and company policy via the establishment and maintenance of appropriate reporting systems and databases. Undertake environmental monitoring as required. Undertake environmental inspections and audits as required. Provide environmental advice as required to other Project personnel. Signoff on and set conditions on Ground Disturbance permits.
Mine Geologist	Ascertain whether fibrous asbestiform minerals are present in ore and coordinate the management of asbestiform minerals with respect to its environmental and health responsibilities.

Role	Responsibility
Mine Engineer	Ensure that mineral wastes are dumped in appropriate locations according to its lithological characteristics.
Site Surveyors	Conduct regular surveys of the topsoil storage areas and areas of disturbance to facilitate audits against approved ground disturbance permits. Provide data to be used in rehabilitation planning and monitoring.
Contractor Managers	Work with the Environmental Advisor to ensure compliance to regulatory and contractual requirements. Support and promote key issues regarding environmental management within the mine site and ensure that personnel implement requirements of the EMP where relevant.
All Contractors and Personnel	Adhere to the procedures outlined in the EMP where relevant. Provide assistance in implementing the EMP and report any non-compliance to their respective manager. Correct use of the incident reporting system.

The Registered Manager will liaise with the Environment, Heritage and Approvals team regarding any environmental incident/issue that requires external notification to the environmental regulatory body.

11.6 Training

11.6.1 Site Induction

Atlas employees and contractors are required to attend a site induction addressing environmental management requirements and responsibilities prior to commencing duties. Environmental information covered includes:

- HSE Policy.
- Our Values.
- HSE Management System.
- Legal responsibilities and requirements.
- Significant risks.
- Conservation significant flora and fauna and their habitats.
- Heritage matters.
- Procedures for reporting incidents.

All personnel (employees and contractors) are required to attend the site induction and acceptance of their environmental responsibilities is done by way of signing the register of attendance.

11.6.2 Site Training and Awareness Sessions

In addition to the site specific induction, further environmental training may be developed for specific tasks carried out by the workforce; this will be detailed in the site Training Needs Analysis.

Environmental information is also communicated via toolbox sessions.

11.6.3 Training Records

Training records are to be maintained and filed in accordance with Atlas requirements.

11.6.4 Contractors

Contractors and suppliers will be selected and engaged in accordance with the Contractor HSE Requirements Manual (950-HS-MAN-0001). Only those who have been evaluated and deemed acceptable by Atlas will be engaged to perform contract works or provide services or/and supplies.

All Contractors will be required to comply with the Atlas HSEMS.

Atlas staff will liaise with suppliers and contractors on a regular basis to ensure environmental compliance to legal and other obligations. Contractors are required to consider environmental aspects during the preparation of a task specific job safety analyses for all work carried out.

Wherever practicable, the environmental impact of goods and services will be considered at the time of procurement and less hazardous alternatives to hazardous substances considered.

11.7 Operational Control (Procedures)

Atlas has been operating iron ore mines in the Pilbara since 2008. During this time Atlas has developed, implemented and refined its Environmental Management Plans and Procedures.

The Environmental Management Documentation is regularly reviewed and updated with relevant information. Documentation is required to be revised in the following instances:

- A new approval being issued with new conditions/requirements.
- Changes to existing approvals/conditions.
- Changes to legislation.
- The result of high potential or reoccurring environmental incidents.
- As a result of an investigation into an environmental incident.

All plans and procedures are managed through Atlas's Document Control System to ensure adequate tracking and management of a document metadata to ensure consistent:

- Document numbering.
- Document revisions.
- Dating.
- Status.

11.8 Monitoring and Management of Performance

11.8.1 Inspections

Environmental inspections are undertaken to:

- Ensure appropriate risk control measures are in place.
- Proactively identify environmental hazards.
- Identify any non-compliance with legal or other requirements.

The Registered Manager will ensure environmental inspections are undertaken, documented and resulting actions are closed out. The frequency of inspection will depend on the magnitude of risk associated with the aspect.

The environmental inspection schedule will be documented in the site Environmental Activity Schedule / Planner.

The environmental monitoring requirements for each site are detailed in the Activity Schedule.

Should calibration of equipment be required, this shall be performed in accordance with the manufacturer recommendations.

Prior to using environmental monitoring equipment, relevant personnel are instructed on the correct handling and use of the equipment to ensure measurements are accurate and prevent damage to equipment.

11.8.2 Audits

An Audit Schedule will be developed for the Project and include detail on the required frequency of environmental audits to be performed during the course of the Project.

Corrective and preventative actions resulting from audits are recorded in the site action register.

11.9 Non-compliances and Corrective Actions

11.9.1 Environmental Incidents and Complaints

All environmental incidents are reported, investigated and entered into the site event reporting database (InControl) as per the HSE Incident Management Procedure (950-HS-PRO-0016).

All environmental incidents which require external notification will be reported to the Registered Manager (or delegate) as soon as practicable. The Registered Manager will liaise with the Environmental Advisor to coordinate the external reporting to the relevant regulatory body.

Any complaints received onsite will be documented and reported to the Registered Manager as soon as practical.

11.9.2 Emergency Response

The Project Emergency Response Plan (ERP) will include responses to environmental emergencies. The ERP shall include responsibilities, contact details, and contact details of emergency services. The Emergency Response Plan will be made available and accessible to all personnel.

The ERP will be tested through biannual emergency response drills and this will include at least one mock emergency with a potential environmental impact annually.

Training in emergency response procedures will be provided as per the site Training Needs Analysis.

11.9.3 Corrective Actions Management

The site action register will be used to ensure effective tracking and closure of all action items. Action items may be generated from audits, inspections, non-conformances, incident findings and hazard near-miss reports.

The Registered Manager will be responsible for the management of the action register. Any item that has been entered into the action register will remain an action item until it has been addressed to the satisfaction of the Registered Manager.

11.10 Internal and External Reporting of Performance

11.10.1 Internal Reporting

Internal reporting is mainly based around incident reporting events. Internal reporting occurs as set out in Table 11-3.

Table 11-3: Internal Reporting

Timing	Details
As reported	All environmental incidents are forwarded to the appropriate direct line manager and escalated as appropriate up the managerial chain.
Daily	A summary of incidents reported in the previous 24 hours is emailed to all appropriate personnel
Weekly	A High Potential or Recordable/Reportable Incident Summary is prepared and emailed to appropriate personnel. The report provides a summary of all incidents classified as having high or extreme potential risk or those where an Incident occurred which is externally reportable.
Monthly	A HSE end of month report summarises all environmental incidents for the month, environmental milestones achieved during the month and update on develops in to the HSE Management System, including notification of any amendments to environmental documentation.

11.10.2 External Reporting

Atlas maintains a reporting register of all reporting requirements. The register is continually updated as new approvals are received and reporting conditions are applied to the Project. Table 11-4 summarises the expected reporting requirements for the Project, these may vary depending on approvals received and legislative requirements.

Table 11-4: Expected External Reporting Requirements for Miralga Creek

Reporting Source	Government Agency	Type	Frequency
Mining Act 1978 – Tenement Condition	DMIRS	Annual Environment Report	Annually
Mining Act 1978 – Tenement Condition	DMIRS	Incident or performance criteria breach	As required
Mining Rehabilitation Fund Regulations 2013	DMIRS	Disturbance and Rehabilitation Data	Annually
Environment Protection and Biodiversity Conservation Act 1999 (EPBC 2019/8601)	DAWE	Compliance Report	Annually
Environmental Protection Act 1986 – Ministerial Statement (Ministerial Statement No. 1154)	EPA	Annual Environment Report	Annually
Environmental Protection Act 1986 – Part V Licence (Pending)	DWER	Annual Audit Compliance report	Annually
Environmental Protection Act 1986 – Part V Licence (Pending)	DWER	Annual Environment Report	Annually
Environmental Protection (Unauthorised Discharge) Regulations 2004	DWER	Unauthorised discharge report	As required
Rights in Water and Irrigation Act 1914	DWER	Annual Water Report	Annually

Reporting Source	Government Agency	Type	Frequency
Biodiversity Conservation Act 2016	DBCA	Fauna Survey Return Report	Within one month of licence expiry
Biodiversity Conservation Act 2016	DBCA	Fauna Report Form	As required

11.11 Keeping Records

Atlas has three essential databases that maintain effective control of all required environmental records. They are:

- InControl – an incident reporting database that records, tracks and manages incident reporting, investigation and action management as a result of incidents reported at any of Atlas' sites.
- Electronic storage system – storing all documents.

A summary of specific environmental records that are maintained are listed below:

- Approval documents.
- Environmental risk register.
- Environmental legal and other obligations register.
- Environmental objectives/outcomes and targets.
- Induction attendance.
- Training needs analysis.
- Training records.
- Stakeholder consultation.
- Environmental Incidents and investigations.
- External reporting schedule.
- Monitoring schedule.

11.12 Auditing Performance

Environmental audits will be performed during the course of the Project. An Audit Schedule will be maintained which will contain further information regarding areas of audits and the frequency of environmental audits.

Corrective and preventative actions resulting from audits will be recorded in the site action register.

11.13 Continual Improvement

The Atlas HSEMS is periodically reviewed to reflect continuous improvements and legislative changes. Approved modifications resulting from reviews are integrated into the management system and actively communicated to promote consistent, best practice standards and continual improvement across all our operations.

The Atlas EMP will be reviewed annually or whenever there is a significant change to the scope of the works.

11.13.1 Change Management

Atlas recognises that significant hazards can be created when changes are implemented in the business or on site. These include but are not limited to:

- Equipment changes.
- Legislative changes.
- Procedural changes.
- Personnel changes.

The Change Management Standard (950-CR-STA-0001) will be implemented and environmental aspects will be considered for every change.

12 References

Allen, G. R. (2006). Field Guide to the Freshwater Fishes of Australia. Perth, Western Australia: Western Australian Museum.

Atlas Iron Pty Ltd. (2014). Miralga Creek - Mineral Resource Estimate, Perth.

Atlas Iron Pty Ltd. (2012). Sandtrax Deposit, Abydos: Mineral Resource Report, Perth.

Atlas Iron Pty Ltd. (2020). Miralga Creek Project: Water Management Assessment. Perth.

Bat Call WA. (2020). Miralga Creek Review.

Beard, J. (1990). Plant Life of Western Australia. Perth: Kangaroo Press.

Beard, J. S. (1975). Vegetation Survey of Western Australia, Pilbara 1:1 000 000. Map and Explanatory Notes to Sheet 7. University of Western Australia Press.

BHP. (1997). Newman satellite development mining of orebody 23 below the water table.

Biologic. (2017). Pilbara Ghost Bat Genetic Project 2017.

Biologic. (2019). Miralga Groundwater Dependent Vegetation Assessment.

Biologic. (2020a). Miralga Creek Level 2 Terrestrial Fauna and SRE Survey. Perth.

Biologic. (2020b). Miralga Creek Project: Conservation Significant Vertebrate Fauna Impact Assessment.

Biologic. (2020c). Miralga Creek Project: Short-Range Endemic Invertebrate Fauna Impact Assessment.

Biologic. (2020d). Miralga Creek: Subterranean Fauna Assessment.

Blast It Global. (2020). Assessment of Blasting at Miralga Creek Project: Preservation of Ghost Bat Habitats Post Mining Activities.

Bullen, R., & McKenzie, N. (2002). Scaling bat wingbeat frequency and amplitude. Journal of Experimental Biology, 2615-2626.

Burbidge, A. A. (1989). Patterns in modern decline of Western Australia's vertebrate fauna: causes and conservation implications. Biological Conservation, 50, 143-198.

Burbidge, A. H. (2010). Birds in a vast arid upland: avian biogeographical patterns in the Pilbara region of Western Australian. Records of the Western Australian Museum Supplement, 78, 247-270.

Bureau of Meteorology. (2021). Climate statistics for Australian locations: Marble Bar. Retrieved 8 April 2021 from Bureau of Meteorology: http://www.bom.gov.au/climate/averages/tables/cw_004020.shtml

Burrows, N. D. (2006). Evidence of altered fire regimes in the Western Desert region of Australia. Conservation Science Western Australia, 5(3), 282-284.

Calver, M. C. (1989). Assessment of an approximate lethal dose technique for determining the relative susceptibility of non-target species to 1080-toxin. Australian Wildlife Research, 16(1), 33-40.

Car, C. A. (2019). The millipede genus Antichiropus (Diplopoda: Polydesmida: Paradoxosomatidae), Part 3: species of the Pilbara bioregion of Western Australia. Zootaxa, 4617, 1-71.

Carwardine, J. N. (2014). Priority Threat Management for Pilbara Species of Conservation Significance. .

Department of Biodiversity Conservation and Attractions. (2019). How does Parks and Wildlife manage weeds? . Retrieved from https://www.dpaw.wa.gov.au/plants-and-animals/plants/weeds/156-how-does-dpaw-manage-weeds

Department of Biodiversity, Conservation and Attractions. (2014). Ecological Impact and Invasiveness Ratings from the Department of Parks and Wildlife Pilbara Region Species Prioritisation Process 2014. Retrieved from https://www.dpaw.wa.gov.au/plants-and-animals/plants/weeds/156-how-does-dpaw-manage-weeds

Department of Biodiversity, Conservation and Attractions. (2017). Standard Operating Procedure – Transport and Temporary Holding of Wildlife. Perth: Government of Western Australia.

Department of Biodiversity, Conservation and Attractions. (2019). NatureMap: Mapping Western Australia's Biodiversity (custom search). Retrieved 2019, from http://naturemap.dec.wa.gov.au./default.aspx

Department of Biodiversity, Conservation and Attractions. (undated). Brushtail Possum Trichosurus vulpecula (Kerr 1792). Retrieved from https://library.dbca.wa.gov.au: https://library.dbca.wa.gov.au/static/FullTextFiles/071547.pdf

Department of Environment. (2013). Matters of National Environmental Significance Significant impact guidelines 1.1. Retrieved from https://www.environment.gov.au/system/files/resources/42f84df4-720b-4dcf-b262-48679a3aba58/files/nes-guidelines_1.pdf

Department of Environment Regulation. (2016). Draft Guideline on Environmental Noise for Prescribed Premises. Government of Western Australia.

Department of Mines and Petroleum. (2016). Draft Guidance: Materials characterisation baseline data requirements for mining proposals.

Department of Mines, Industry Regulation and Safety. (2020). Guidelines for Mine Closure Plans in Western Australia: Statutory Guidelines under the Mining Act 1978.

Department of Parks and Wildlife. (2017a). Interim guideline for preliminary surveys of night parrot (Pezoporus occidentalis) in Western Australia.

Department of Parks and Wildlife. (2017b). Pilbara Northern Quoll Research Program. Perth: Government of Western Australia.

Department of Planning, Lands and Heritage. (2013). Aboriginal Heritage Due Diligence Guidelines. Government of Western Australia.

Department of Sustainability, Environment, Water, Population and Communities. (2012). Interim Biogeographic Regionalisation for Australia, Version 7. Commonwealth of Australia.

Department of the Environment. (2016). EPBC Act referral guideline for the endangered northern quoll Dasyurus hallucatus. Canberra: Commonwealth of Australia.

Department of the Environment and Energy. (2019a). Consultation Document on Listing Eligibility and Conservation Actions Falco hypoleucos (Grey Falcon). Retrieved from https://www.environment.gov.au/biodiversity/threatened/nominations/comment/grey-falcon

Department of the Environment and Energy. (2019b). Rhinonicteris aurantia (Pilbara form) — Pilbara Leaf-nosed Bat. Retrieved from Species Profile and Threats Database: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=82790

Department of the Environment and Energy. (2019c). Species Profile and Threats Database Dasyurus hallucatus Northern Quoll. Retrieved from http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=331

Department of the Environment, Water, Heritage and the Arts. (2008). Approved Conservation Advice for Liasis olivaceus barroni (Olive Python – Pilbara subspecies). Retrieved from http://www.environment.gov.au/biodiversity/threatened/species/pubs/66699-conservation-advice.pdf

Department of Water. (2010). Lower De Grey River: ecological values and issues. Environmental Water Report series (12).

Department of Water. (2013). Western Australian Water in Mining Guideline. Government of Western Australia.

Dickman, C. R. (1996). Overview of the impacts of feral cats on Australian native fauna. National Parks and Wildlife Australian Nature Conservation Agency.

Doherty, T. S. (2016). Ecosystem responses to fire: Identifying cross-taxa contrasts and complementarities to inform management strategies. Ecosystems, 20, 872-884.

Doughty, P. R. (2011). Herpetological assemblages of the Pilbara biogeographic region, Western Australia: ecological associations, biogeographic patterns and conservation. Records of the Western Australian Museum, Supplement, 78, 315-341.

Ellis, R. J. (2013). Pilbara olive python (Liasis olivaceus barroni): a (sub)species overview. EPBC Act Threatened Species Workshop: Pilbara Olive Python. Kensington.

Environmental Protection Authority. (2004). Technical Guidance - Terrestrial fauna surveys. Government of Western Australia.

Environmental Protection Authority. (2007). Technical Guidance - Sampling methods for subterranean fauna. Government of Western Australia.

Environmental Protection Authority. (2009). Technical Guidance - Sampling of short range endemic invertebrate fauna. Government of Western Australia.

Environmental Protection Authority. (2010). Technical Guidance - Sampling methods for terrestrial vertebrate fauna. Government of Western Australia.

Environmental Protection Authority. (2013). Technical Guidance - Subterranean fauna survey. Government of Western Australia.

Environmental Protection Authority. (2016a). Environmental Factor Guideline - Air Quality. Government of Western Australia.

Environmental Protection Authority. (2016b). Environmental Factor Guideline - Social Surroundings. Government of Western Australia.

Environmental Protection Authority. (2016c). Environmental Factor Guideline - Subterranean Fauna. Government of Western Australia.

Environmental Protection Authority. (2016d). Environmental Factor Guideline - Terrestrial Environmental Quality. Government of Western Australia.

Environmental Protection Authority. (2016e). Environmental Factor Guideline - Terrestrial Fauna. Government of Western Australia.

Environmental Protection Authority. (2016f). Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment. Government of Western Australia.

Environmental Protection Autority. (2016g). Environmental Factor Guideline - Human Health. Government of Western Australia.

Environmental Protection Authority. (2018a). Environmental Factor Guideline - Inland Waters. Government of Western Australia.

Environmental Protection Authority. (2018b). Environmental Factor Guideline - Landforms. Government of Western Australia.

Environmental Protection Authority. (2018c). Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual. Government of Western Australia.

Environmental Protection Authority. (2018d). Instructions for the referral of a Proposal to the Environmental Protection Authority under Section 38 of the Environmental Protection Act 1986. Government of Western Australia.

Environmental Protection Authority. (2018e). Instructions on how to prepare an Environmental Review Document. Government of Western Australia.

Environmental Protection Authority. (2018f). Statement of Environmental Principles, Factors and Objectives. Government of Western Australia.

Environmental Protection Authority. (undated). Instructions on how to define the key characteristics of a proposal. Government of Western Australia.

Environmental Technologies & Analytics. (2019). Atlas Iron Miralga Creek Air Quality Assessment.

Executive Steering Committee for Australian Vegetation Information. (2003). Australian Vegetation Attribute Manual: National Vegetation Information System. Canberra: Department of the Environment and Heritage.

Farmer, A. F. (1993). The effects of dust on vegetation - a review. Environmental Pollution, 79, 63-75.

Gavin Jackson Cultural Resource Management. (2014). Report of an Aboriginal archaeological and ethnographic survey of the Farrell Well: Miralga Creek Prospect, Pilbara, Western Australia.

Gavin Jackson Cultural Resource Management. (2017). Report of an Aboriginal Archaeological and Ethnographic Site Avoidance Work Area Assessment of the AI156 Miralga Creek West (p1 AND p2) Exploration Survey Area, in the Pilbara, Western Australia.

Geoscience Australia, 2019. Stratigraphic Unit Details - Paddy Market Formation.

Glendenning, W. (2011). Report of an Aboriginal Heritage Survey with Representatives of the Njamul People of a Proposed Mineral Exploration Project at Miralga Creek and Miralga West, Near Port Hedland.

Graham, J. (2001). The root hydraulic architecture of Melaleuca argentea. The University of Western Australia.

Grierson, P. F. (2015). Dust suppression and likelihood of adverse impact on Acacia sp. East Fortescue at Orebody 31.

Harvey, M. S. (2002). Short range endemism in the Australian fauna: some examples from non-marine environments. Invertebrate Systematics, 16, 555-570.

Hill, B., & Ward, S. (2010). National Recovery Plan for the Northern Quoll (Dasyurus hallucatus). Darwin: Department of Natural Resources, Environment, the Arts and Sport.

J. Olsen, S. D. (2004). Breeding success, cliff characteristics and diet of Peregrine Falcons at high altitude in the Australian Capital Territory. Corella, 28(2), 33-37.

Kendrick, P. &. (2001). A Biodiversity Audit of Western Australia's 53 Biogeographic Subregions in 2002 - Pilbara 1 (PIL1 – Chichester Subregion). Department of Conservation and Land Management.

Kerle, J. F. (1992). The decline of the Brushtail Possum, Trichosurus vulpecul (Kerr 1798), in arid Australia. The Rangeland Journal, 14(2), 107-127. Retrieved from https://doi.org/10.1071/RJ9920107

Leighton, K. (2004). Climate. . In A. P. A.M.E. van Vreeswyk (Ed.), An Inventory and Condition Survey of the Pilbara Region, Western Australia. (pp. 19-38). Department of Agriculture.

Longcore, T. &. (2004). Ecological light pollution. Frontiers in Ecology and the Environment, 2(4), 191-198.

Matsuki, M. e. (2016). Impacts of Dust on Plant Health, Survivorship and Plant Communities in Semi-Arid Environments. Austral Ecology, 41, 417–427.

McKenzie, N. L. (2002). Bioregional Summary of the 2002 Biodiversity Audit for Western Australia. . Department of Conservation and Land Management.

Medellin, R. A.-H. (2017). Conservation relevance of bat caves for biodiversity and ecosystem services. . Biological Conservation, 211(B), 45-50.

Mine Earth. (2019). Miralga Creek Baseline Soil Assessment. Perth.

Mine Earth. (2020). Miralga Creek Project Mine Waste Characterisation Assessment.

Murray, B. R. (2003). Groundwater-dependent ecosystems in Australia: It's more than just water for rivers. Ecological Management & Restoration, 4(2), 110-113.

MWH. (2012). Abydos East Haul Road - Mining Proposal: Hydrology and Hydrogeology Impact Assessment.

MWH. (2015). Mt Dove DSO Project: Pilbara Leaf-nosed Bat Monitoring Survey 2015, Unpublished report prepared by MWH Australia Pty Ltd for Atlas Iron Limited, Perth, Western Australia.

National Environment Protection Council. (2016). Variation to the National Environment protection (Ambient Air Quality) Measure - Impact statement.

Olsen, P. D. (1989). Breeding og the Peregrine Falcon Falco peregrinus. III. Weather, nest quality and breeding success. Emu, 89(1), 6-14.

Olsen, P. O. (1986). Distribution, status, movement and breeding of the Grey Falcon Falco hypoleucos. Emu, 86, 47-51.

Parris, K. &. (2009). Impacts of traffic noise and traffic volume on birds of roadside habitats. Ecology and Society, 14(1), 29.

Pearson, D. J. (2006). Giant Pythons of the Pilbara. Landscope, 19(1), 32-39.

Ponder, W. F. (2002). What makes a narrow range taxon? Insights from Australian fresh-water snails. Invertebrate Systematics, 16(5), 571-582.

Port Hedland Industries Council. (2018). Annual Report – FY 2017/18 Port Hedland Ambient Air Quality Monitoring Program .

Prajapati, S. K. (2012). Ecological effect of airborne particulate matter on plants. Environmental Skeptics and Critics, 1(1), 12-22.

Prugh, L. S. (2009). The rise of the mesopredator. BioScience, 59, 779-791.

PSM Consult. (2020). Miralga Creek - Assessment of Potential Mining Activities Impact on the Structural Integrity of the Caves.

Rowden, P. S. (2008). Road crashes involving animals in Australia. Accident Analysis and Prevention, 40(6), 1865–1871.

RPS. (2019). Miralga Creek Project Surface Water Assessment.

Ruprecht, J. &. (2000). Surface Hydrology of the Pilbara Region, Summary Report. Surface Water Hydrology Report Series, SWH32.

Schoenjahn, J. (2018). Adaptations of the rare endemic Grey Falcon Falco hypoleucos that enable its permanent residence in the arid zone of Australia. The University of Queensland.

Shannon, G. A. (2014). Road traffic noise modifies behaviour of a keystone species. Animal Behaviour, 94, 135-141.

Shepherd, D. B. (2002). Native Vegetation in Western Australia. Extent, Type and Status. . Department of Agriculture.

Spencer, P. B. (2013). Genetic Analysis of Northern Quolls from the Pilbara Region of Western Australia - Final Report. Murdoch University.

Storr, R. J. (1998). Handbook of Western Australian Birds Volume 1 - Non-passerines (Emu to Dollarbird). Perth: Western Australian Museum.

Talis. (2019). Miralga Creek: Environmental Noise Impact Assessment .

Terra Rosa Consulting. (2019a). Archaeological and ethnographic site avoidance heritage survey of Atlas Iron's Miralga Creek Infrastructure and additional areas, with the Njamal Traditional Owners.

Terra Rosa Consulting. (2019b). Results of the archaeological and ethnographic survey of Atlas Iron's Miralga Creek Project Areas (AI160 and AI166), conducted with Njamal Traditional Owners.

Threatened Species Scientific Committee. (2008). Approved conservation advice for Liasis olivaceus barroni (Olive Python – Pilbara subspecies). Commonwealth of Australia.

Threatened Species Scientific Committee. (2005). Listing Advice for the Northern Quoll (Dasyurus hallucatus). Department of the Environment.

Threatened Species Scientific Committee. (2016a). Conservation Advice Macroderma gigas Ghost Bat. Department of the Environment. Department of the Environment.

Threatened Species Scientific Committee. (2016b). Conservation Advice Rhinonicteris aurantia Pilbara Leaf-nosed Bat. Department of the Environment.

Tutt, M. S. (2004). Unravelling the mysteries of Pilbara Olive Python ecology. Nickol Bay Naturalists' Club/WA CaLM.

van Dyck, S. &. (2008). Mammals of Australia. (3rd, Ed.) Sydney, New South Wales: Australian Museum.

van Vreeswyk, A. P. (2004). An Inventory and Condition Survey of the Pilbara Region of Western Australia. Government of Western Australia.

Woinarski, J. C. (2014). The Action Plan for Australian Mammals 2012. CSIRO Publishing.

Woodman Environmental. (2019a). Miralga Creek Iron Ore Project: Detailed Flora and Vegetation Survey 2019.

Woodman Environmental. (2019b). Desktop Review of Potential Groundwater Dependent Vegetation.

Woolley, P. A. (2015). Phylogenetic relationships within Dasyurus (Dasyuromorphia: Dasyuridae): quoll systematics based on molecular evidence and male characteristics. Journal of Mammalogy, 96, 37-46.

Appendix A. Authorisation from Venturex Resources Limited

Appendix B. Abandonment Bund Assessment

Appendix C. Spatial Data

Appendix D. Stakeholder Consultation Register

Appendix E. Mine Closure Plan

Appendix F. Baseline Soil and Landform Assessment

Appendix G. Materials Characterisation

Appendix H. Water Management Assessment

Appendix I. Surface Water Assessment

Appendix J. Waterholes Summary

Appendix K. Flora and Vegetation Assessment

Appendix L. Level 2 Baseline Fauna Assessment

Appendix M. Ghost Bat Review

Appendix N. Geotechnical Review of Caves

Appendix O. Blast Impact Assessment

Appendix P. Subterranean Fauna Assessment

Appendix Q. Vertebrate Fauna Impact Assessment

Appendix R. SRE Impact Assessment

Appendix S. Significant Species Management Plan

Appendix T. Atlas HSE Policy