Corunna Downs Project: M45/1257, G45/339, L45/407, L45/408 and L45/410

Mining Proposal

179-LAH-EN-REP-0021

Revision 1

Authorisation

Rev	Reason for Issue	Prepared	Checked	Authorised	Date
A	For Drafting	Natassja Bell	-	-	08/10/2019
B	Internal QAQC	Natassja Bell	Monica Goggin, Matthew Ramsden	Monica Goggin	29/11/2019
0	Submission to DMIRS	Natassja Bell	Matthew Ramsden	Matthew Ramsden	10/12/2019
1	Response to DMIRS RFI	Natassja Bell 	Monica Goggin 	Matthew Ramsden 	24/03/2020

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1. Mining Proposal Checklist

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).**	Y		6	
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).**	NA			
4	Have contact details for questions on the Mining Proposal been provided?	Y		6	
5	Are all mining operations within granted tenement boundaries or does this Mining Proposal support a lease application?	Y			
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must be stated on the cover and a summary of changes included	Y	A previous Mining Proposal was submitted but was withdrawn (Reg ID 64209)		
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 X		

Q. No.	Mining Proposal (MP) Checklist	Y/N/ NA	Comments	Page No.	Summary
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	N			
11	If 'Yes' to Q10, has confidential information been submitted in a separate document?	NA			
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	Cover page and inside cover		
13	Has information regarding the Environmental Group Site (EGS) been provided in accordance with the requirements of Appendix G of the guidelines?	Y		6	
14	Has a disturbance table been provided in accordance with the requirements of Appendix G of the guidelines?	Y		9	
15	Has spatial data for all Mine Activity Types been provided in accordance with the specified properties and allowances (see section 3.5.3)?	Y		9, 14	
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		20, 21	

Q. No.	Mining Proposal (MP) Checklist	Y/N/ NA	Comments	Page No.	Summary
17	Do you have and maintain an Environmental Management System?	Y		121	
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		22	
19	Does the Mining Proposal trigger any criteria for referral to the EPA within the DMP/EPA Memorandum of Understanding?	N			
20	Has the Mining Proposal been referred to the EPA? If Yes, indicate date of referral in comments	Y	The Project was referred to the EPA on 29 May 2019. See Section 4 for more detail.	22	
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/A	Approved via Ministerial Statement 1125 on 12 March 2020. See Section 4 for more detail.	22	
22	Is a clearing permit required? If 'No' then explain why in space below	N			
23	If 'Yes' at Q22 then has a clearing permit been applied for?	NA			
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 Parks and Wildlife (DPaW) managed areas?	N			
26	If 'Yes' at Q25 has DPaW been consulted?	NA			
27	Will any threatened or protected flora and/or fauna be impacted by this proposal?	Y	See Sections 6.4 and 7 for details.	45, 86	
28	Have the DAA/DPC 'Aboriginal Heritage Due Diligence Guidelines' been used to identify the risk of impacts to aboriginal heritage sites?	Y	See Section 6.7	84	

Q. No.	Mining Proposal (MP) Checklist	Y/N/ NA	Comments	Page No.	Summary
29	If any aboriginal heritage sites will be impacted, has appropriate consent been sought under the Aboriginal Heritage Act 1972?	N	Consent to impact site CRD-51-16 will only be required where DPLH determines that this site meets the definition of a 'registered aboriginal site' under Section 5 of the Act. Atlas Iron is in the process of determining this requirement.	84	
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: Matthew Ramsden **Signed:**

Position: General Manager – Integrated Planning and Technical Services **Date:** 24 March 2020

(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)

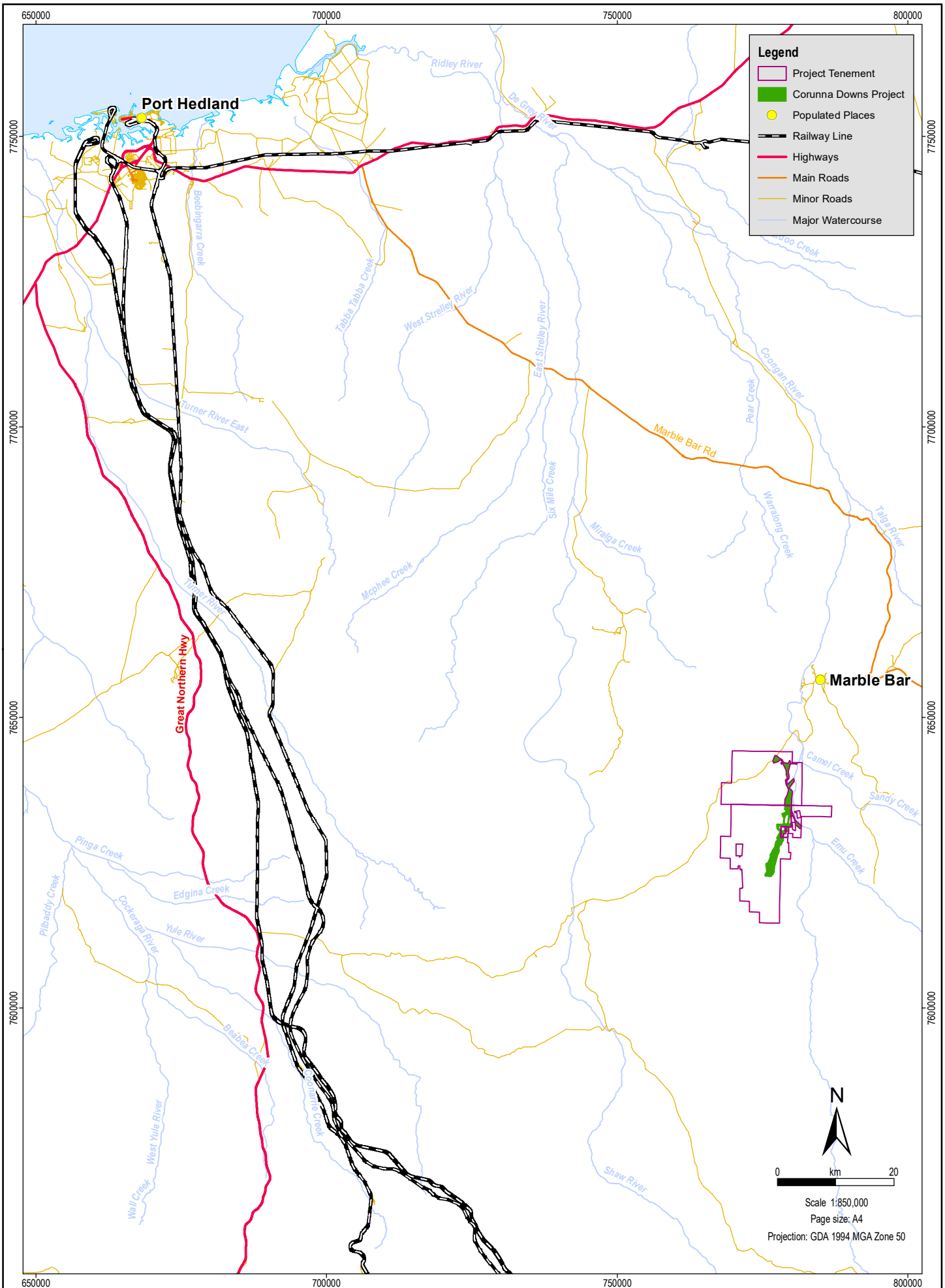
2. Environmental Group Site Details

Atlas Iron Pty Ltd (Atlas Iron) is currently seeking approval to develop the Corunna Downs Project (the Project), in the Pilbara region of Western Australia, approximately 240 km south east of Port Hedland and 33 km south of Marble Bar (Figure 2.1).

Table 2-1 provides information regarding the Environment Group Site (EGS) in accordance with Appendix G of the Department of Mines, Industry Regulation and Safety (DMIRS) Guideline for Mining Proposals in Western Australia 2016 (the Guidelines).

Table 2-1 – Environmental Group Site Details

SITE DETAILS		
EGS Name	Corunna Downs Project	
EGS Code *Code is derived from the EARS2 system.*	(New Project)	
Description of operation	Open cut mine	
Mine Status	Yet to commence	
Commodity mined	Iron ore	
Project commencement date	Q2 2020	
Estimated completion date of the project	Q2 2028	
Tenement details	Tenement	Tenement Holder
	M45/1257	Atlas Iron Limited
	G45/339	Atlas Iron Limited
	L45/407	Atlas Iron Limited
	L45/408	Atlas Iron Limited
	L45/410	Atlas Iron Limited
PROPONENT DETAILS		
Company or Individual Name	Atlas Iron Limited	
ACN:	110 396 168	
Address	Level 18, Raine Square, 300 Murray St, Perth, WA 6000	
Postal Address	PO Box 7071, Cloisters Square PO WA 6850	
Key Contact Representative *Key contact for any enquires regarding the operation of the mine site. This may be different from the key contact associated with the Mining Proposal*	Name:	Monica Goggin
	Position	Manager – Environment and Approvals
	Phone Number	6228 8000
	Email	Monica.Goggin@atlasiron.com.au



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Date: 9/12/2019			
Author: Chris.Devlin	*Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*		

In accordance with the Guidelines, Table 2-2 has been left blank as this Mining Proposal is for a new mine site.

Table 2-2 – Activities Approved

Mine Activity	Mine Activity Reference	Tenement	Current Area of Activity (Ha)	Total Approved Area (Ha)
Miscellaneous activity				
Total area for mine site			0	0

3. Activity Details

3.1 Disturbance Envelope

The Project is located within a 2,257.6 ha Development Envelope as shown in Figure 3.1. Atlas Iron is however committed to clearing no more than 423.11 ha within this Development Envelope. Further detail on the proposed area of disturbance by activity type and tenement is provided in Section 3.4.

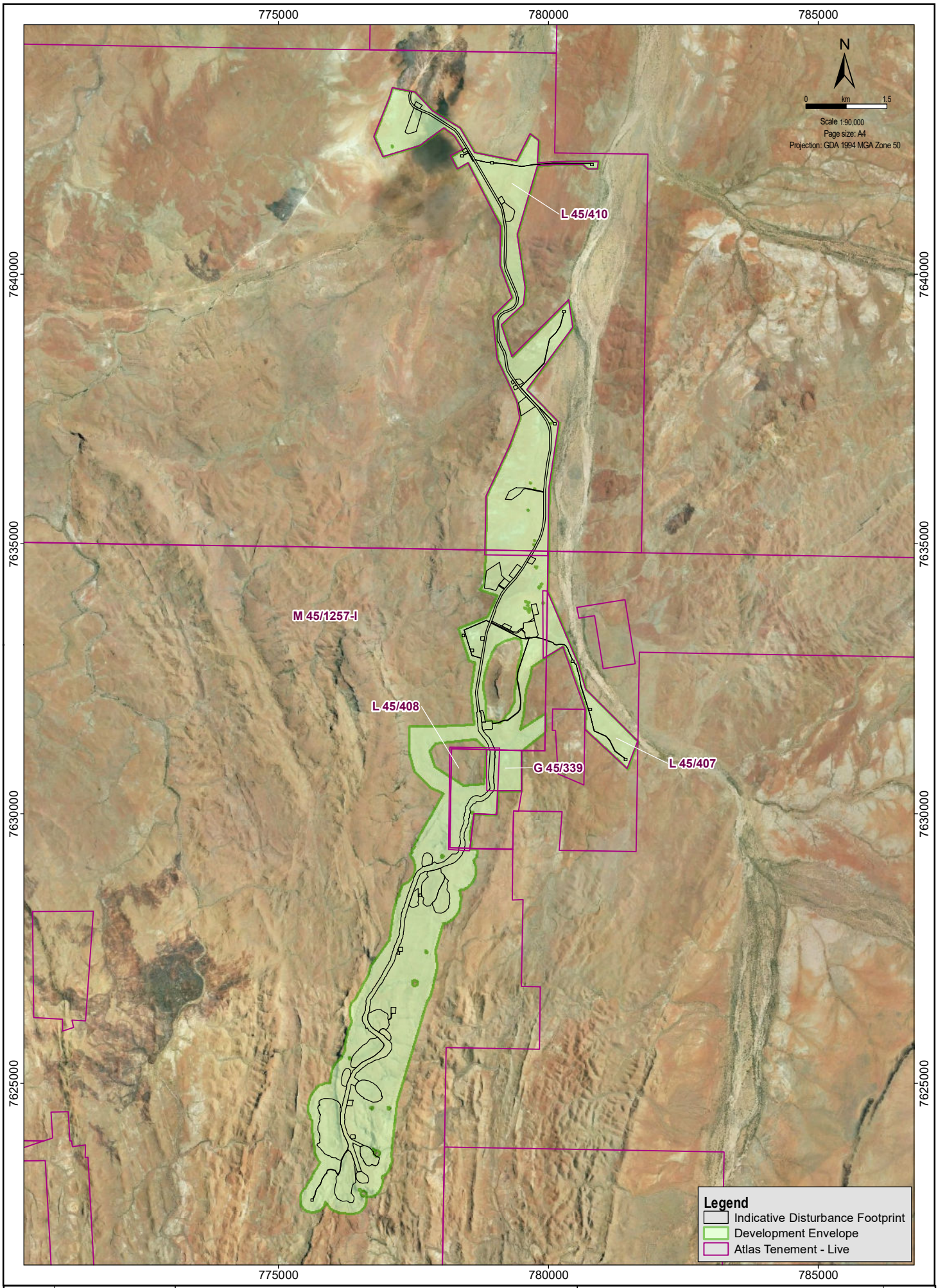
3.2 Spatial Information

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

- Development Envelope.
- Indicative Mine Disturbance Footprint.
- Significant microhabitats (i.e., caves and water sources).

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).



File Name: GIS_2621_DevEnvelope.mxd	Document Number : (QDMS number only)	**Development Envelope**	Figure No: **3.1**
Date: 9/12/2019	Source & Notes:		
Author: Chris.Devlin	*Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*		

3.3 Project Description

This Project involves the development of five open pits using conventional drill and blast, load and haul methods. It is anticipated 23.1 million tonnes of iron ore will be mined above the groundwater table over approximately 6 years with an average strip ratio of 0.5:1 (waste:ore). Associated infrastructure will include open pits, waste rock dumps, mine operation centre, borefield and accommodation camp.

The indicative development schedule for this Project is outlined in Table 3-1 and is dependent on the timing of key regulatory approvals.

Table 3-1 – Indicative Development Schedule

Development Stage	Indicative Timing (Calendar Year)
Obtain key environmental approvals	Q2 2020
Commence Site Construction	Q2 2020
Commence Mining	Q1 2021
Commence Shipping	Q2 2021
Mining Ceases	Q2 2027
Decommissioning and Closure	Q2 2028

The Project will utilise the Hillside-Marble Bar Road route from the site haul road across to the Corunna Downs Road and through to the Limestone-Marble Bar Road for haulage of final product to Utah Point Bulk Commodities Berth at Port Hedland for export.

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

3.3.1 Mining

This Project involves the mining of five open pits: Split Rock, Razorback, Shark Gully, Runway North and Runway South.

Mining will be undertaken by a reputable mining contractor and managed by Atlas Iron. The proposed mining will incorporate pre-stripping, drilling, blasting, and excavation using excavators and a dump truck fleet.

Pre-stripping will be required in some locations to expose the targeted ore, however a significant portion of the ore is exposed at surface. Topsoil and vegetation will be removed, where possible, during pre-stripping and stockpiled in adjacent well-drained areas for future use in rehabilitation.

Following pre-stripping, weathered rock will be free-dug (without blasting) where possible. Drill and blasting will be undertaken on the remaining material, using modern blasting techniques and typical pattern sizes for the expected rock conditions. Grade control will be conducted through reverse circulation (RC) drilling for the full depth of the pit prior to mining.

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 by 3.2 m and 3.0 m by 3.5 m.
- Powder factor: nominally up to 0.7 kg/m3, dependent on pattern size and blast activity.
- Explosive type: ammonium nitrate fuel oil (ANFO) emulsion.
- Typical charge size: 35 kg per hole.

All pits have been designed to sit above the current groundwater table in consideration of seasonal variation (Appendix B and Section 3.4) so no mine dewatering is required. Groundwater monitoring and grade control drilling will ensure that the maximum pit depth sits above the groundwater table inclusive of the recommended buffers.

Preliminary consideration has also been given to abandonment bund locations (Appendix C) to ensure they are built into the mine schedule, ahead of any potential loss of access (e.g., following mining of a pit).

3.3.2 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 the run of mine (ROM) pad. From the ROM pad ore will be crushed and screened onsite using a crushing and screening plant, which will provide primary, secondary and tertiary crushing and screening to produce Lump (40 – 6.3 mm) and Fines (<6.3 mm) products.

Atlas Iron has applied for a works approval and licence for the construction and operation of a number of prescribed premises, including the crushing and screening facility (Category 5). DWER granted the Works Approval (W6043) on the 6 September 2017. Approval of the associated Licence (L9045) is pending the delivery of a construction compliance report, demonstrating the construction of these premises in accordance with the Works Approval.

The product will then be transported using side-tipper, quad-configuration road trains with a total payload up to approximately 150 t to the Utah Point Bulk Commodities Berth at Port Hedland.

Product transport operations will operate on a continuous basis (24 hours per day, seven days a week) with approximately 95 truck cycles every 24 hours (round trip).

3.3.3 Waste Rock Management

Approximately 9.2 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 lithology's from each of the pits, along with their physical and geochemical properties is provided in Section 6.3.

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 Section 7.

Waste rock will initially be used to construct mine site infrastructure (e.g., land bridge, access ramps, drainage structures and safety bunds) and then transported and disposed of in one of three waste rock dumps, referred to as Runway, Shark Gully or Split Rock. All waste rock dumps have been designed:

- Outside of the potential zones of instability (refer to Appendix D).
- With broader berms and steeper batters but will be re-profiled down to rehabilitated design shapes after completion of waste mining. The conceptual shape of the final rehabilitated waste rock dump is shown in Figure 3.2.
- To retain and allow meteoric water to infiltrate into the dump or evaporate rather than to manage water flowing off the dump. This method has proven to provide a stable and long term dump by reducing the potential of long term dump erosion (Trajectory, 2013).
- With flexible limits that will be altered as required during operations taking into account the operational ability to undertake rehabilitation of outer slopes.

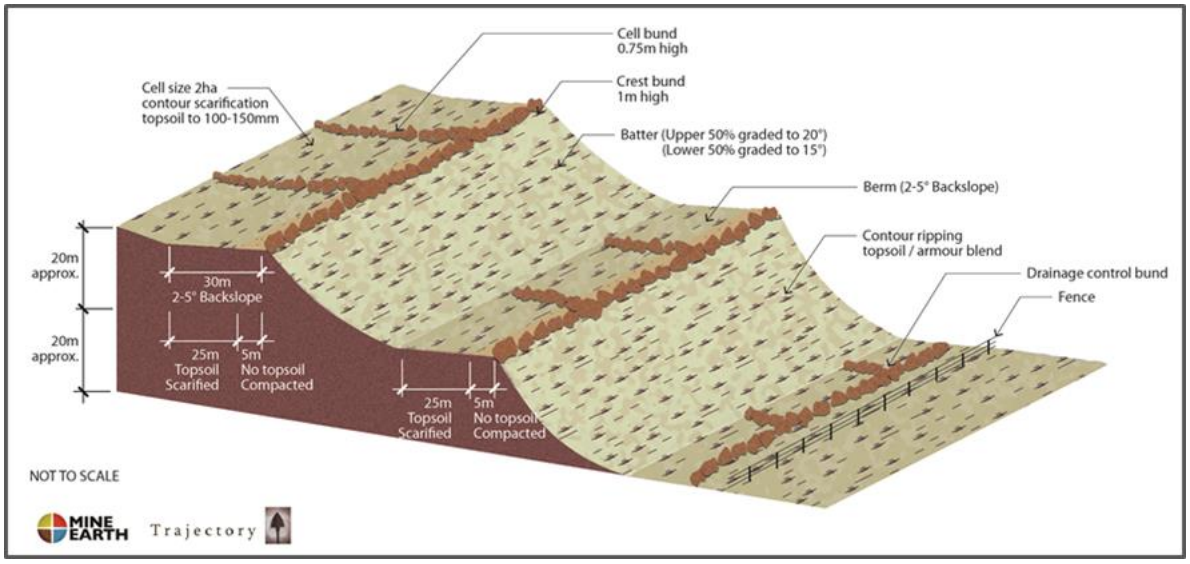


Figure 3.2 – Conceptual Rehabilitated Waste Rock Dump

3.3.4 Water Abstraction

Groundwater abstraction from a number of production bores is proposed to supply the Project's construction, operational (i.e., product conditioning and dust suppression) and potable water requirements. While water demand varies throughout the life of the mine dependent on how many pits are operational at that time, maximum annual water demand is anticipated to be approximately 1 gigalitre (GL).

3.3.5 Additional Infrastructure and Support Facilities

A number of additional infrastructure and support facilities will be required for the Project, including:

- Mine operation centre (MOC) and administration area.
- Mining contractors yard and workshop.
- Haulage contractor's area.
- Explosives magazine and AN prill storage.
- Water production bores and turkey nests.
- Potable water treatment and storage.
- Sewage facility.
- Spray field.

- Fuel storage and refuelling areas.
- Haul roads, access roads and tracks.
- Borrow pits.
- Accommodation camp.
- Communication towers.
- Landfill facility.

Atlas Iron has applied for a works approval and licence for the construction and operation of a number of prescribed premises, including the sewage facility (category 85) and landfill facility (Category 89). DWER granted the Works Approval (W6043) on the 6 September 2017. Approval of the associated Licence (L9045) is pending the delivery of a construction compliance report, demonstrating the construction of these premises in accordance with the Works Approval.

3.4 Mine Activity Types

In accordance with the Guidelines, all mine activities associated with the Project are identified in Table 3-2 and further information requirements for key mine activities are provided in Table 3-3 to Table 3-13.

Table 3-2 – Activity Details

Proposal Information	
Proposal Summary	The Corunna Downs Project is an open cut iron ore mine, operating at a rate of 5 Million tonne per annum over a six-year period, and within a 2257.75 ha Development Envelope approximately 240 km south east of Port Hedland. The Proposal involves the above water table mining of iron ore from five open pits using conventional drill and blast, load and haul methods. Ore will be trucked to the run-of-mine pad for crushing and screening with the final product hauled to Utah Point in Port Hedland for export overseas. Mined waste rock will be transported and disposed of in to one of three waste rock dumps and groundwater will be abstracted from a network of production bores to meet the Project's water demands. Project personnel and contractors will be housed at an onsite camp.

Mine Activities approval is being sought for (available for public viewing)

Only include Mine Activities which are being proposed or amended within the below table. Previously approved Mine Activities are to be displayed in the Environmental Group Site Details Section of a Mining Proposal.

Tenement	Activity Category	Mine Activity Reference	Current Area of Activity (Ha)	TOTAL Current Approved Area (Ha)	Proposed Change (Ha)	New Total Approved Area (Ha)
M45/1257	**Key Mine Activities**					
	Waste dump or overburden stockpile (class 1)	Runway Waste Rock Dump			12.52	12.52
	Waste dump or overburden stockpile (class 1)	Shark Gully Waste Rock Dump			12.06	12.06
	Waste dump or overburden stockpile (class 1)	Split Rock Waste Rock Dump			46.16	46.16
	Mining void (depth > 5m – above groundwater)	Runway Pit – South			19.06	19.06
	Mining void (depth >5m – above groundwater)	Runway Pit – North			3.90	3.90
	Mining void (depth >5m – above groundwater)	Shark Gully Pit			16.71	16.71
	Mining void (depth >5m – above groundwater)	Split Rock Pit			25.51	25.51
	Mining void (depth >5m – above groundwater)	Razorback Pit			8.66	8.66
	Low-grade ore stockpile (class 1)	Split Rock Low Grade Stockpile			14.09	14.09

Tenement	Activity Category	Mine Activity Reference	Current Area of Activity (Ha)	TOTAL Current Approved Area (Ha)	Proposed Change (Ha)	New Total Approved Area (Ha)
M45/1257 (Cont.)	**Miscellaneous Mine Activities**					
	Fuel Storage Facility	Fuel Storage	*The Guideline does not require footprints for each miscellaneous activity type.*			
	Workshop	Workshop				
	Landfill site	Landfill				
	Diversion Channel or drain	Diversion Channel/ Drain				
	Dam - fresh water	Turkeys Nest				
	Building (other than workshop) or campsite	Camp, Communications Tower, Irrigation Sprayfield				
	Transport or Service Infrastructure Corridor	Haul Road, Land Bridge, Transport and Service Infrastructure (including Borefield pipeline)				
	Laydown or Hardstand Area	Laydown Area				
	Core Yard	Core Yard				
	Borrow Pit or Shallow Surface Excavation	Borrow Pit				
	Borefield	Borefield				
	Processing Equipment or stockpile associated with basic raw material excavation	Stockpile				
	Topsoil Stockpile	Topsoil Stockpile				
	Miscellaneous Mine Activity				137.98	137.98
	TOTAL TENEMENT ACTIVITY AREA				**296.65**	**296.65**

Tenement	Activity Category	Mine Activity Reference	Current Area of Activity (Ha)	TOTAL Current Approved Area (Ha)	Proposed Change (Ha)	New Total Approved Area (Ha)
G45/339	**Key Mine Activities**					
	Run-of-mine pad	ROM Pad			37.77	37.77
	Miscellaneous Mine Activities					
	Transport or Service Infrastructure Corridor	Haul Road	*The Guideline does not require footprints for each miscellaneous activity type.*			
	Miscellaneous Mine Activity				6.90	6.90
	TOTAL TENEMENT ACTIVITY AREA				**44.67**	**44.67**
L45/407	**Key Mine Activities**					
	N/A					
	Miscellaneous Mine Activities					
	Transport or Service Infrastructure Corridor	Borefield Pipeline	*The Guideline does not require footprints for each miscellaneous activity type.*			
	Borefield	Borefield				
	Miscellaneous Mine Activity				2.12	2.12
	TOTAL TENEMENT ACTIVITY AREA				**2.12**	**2.12**
L45/408	**Key Mine Activities**					
	N/A					
	Miscellaneous Mine Activities					
	Transport or Service Infrastructure Corridor	Haul Road	*The Guideline does not require footprints for each miscellaneous activity type.*			
	Topsoil Stockpile	Topsoil stockpile				
	Miscellaneous Mine Activity				13.33	13.33
	TOTAL TENEMENT ACTIVITY AREA				**13.33**	**13.33**

Tenement	Activity Category	Mine Activity Reference	Current Area of Activity (Ha)	TOTAL Current Approved Area (Ha)	Proposed Change (Ha)	New Total Approved Area (Ha)
L45/410	**Key Mine Activities**					
	N/A					
	Miscellaneous Mine Activities					
	Dam- fresh water	Turkeys Nest	*The Guideline does not require footprints for each miscellaneous activity type.*			
	Laydown or Hardstand Area	Laydown				
	Borrow Pit or Shallow Surface Excavation	Borrow Pit				
	Borefield	Borefield				
	Transport or Service Infrastructure Corridor	Borefield Pipeline, Haul Road				
	Miscellaneous Mine Activity				66.34	66.34
	TOTAL TENEMENT ACTIVITY AREA				**66.34**	**66.34**
		TOTAL MINE ACTIVITY AREA			**423.11**	**423.11**

Table 3-3 – Runway Waste Rock Dump

Mine Activity Reference	Runway Waste Rock Dump	
Area	12.52 ha	
Area Per Tenement	M45/1257 – 12.52 ha	
Design	The waste mined from the Runway pits will be placed onto the Runway Waste Rock Dump. General waste rock dump design considerations are discussed in Section 3.3.3. Design specifications for this dump include: • Number of lifts = 2 • Maximum vertical height = 19 m • Natural angle of repose = 37º • Rehabilitated Slope Angle = 17º • Maximum lift height = 20 m • Berm width = 30 m Figure 3.3 is a plan view and schematic cross section of the Runway Waste Rock Dump from south (A) to north (A`). The cross section illustrates the longitudinal design profile as intersected with the natural topography.	
Material characteristics	Fibrous minerals	☐- Yes ☒- No
	Radioactive material	☐- Yes ☒- No
	Materials capable of generating acid and/or metalliferous drainage, including neutral drainage and saline drainage	☐- Yes ☒- No
	Highly erodible material that is capable of compromising the structure of the waste dump.	☒- Yes ☐- No
	As detailed in Section 6.3.2.4: • Negligible risk of fibrous or radioactive material. • No risk of acid/metalliferous drainage. • Presence of siltstone and shale lithology's which have displayed moderate and low erosional stability respectively. • Shale unit has also been found to contain a geochemically stable form of enriched Hg. Accordingly, waste rock will be managed (Environmental Risk Management) to ensure that: • Siltstone is not placed on final waste rock dump slopes. • Shale is conservatively buried 10 m below the final waste rock dump surface.	

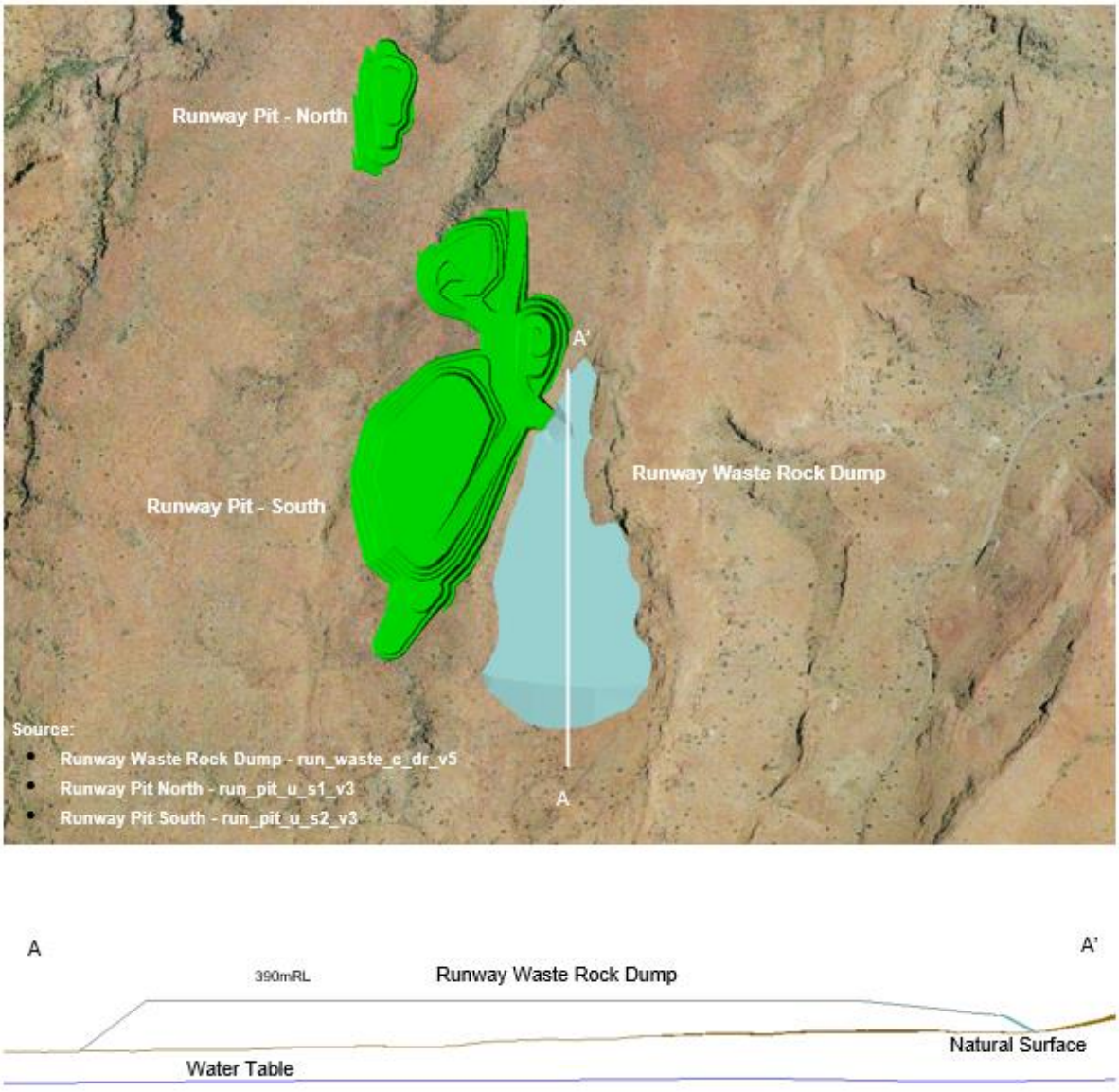


Figure 3.3 – Runway Waste Rock Dump

Table 3-4 – Shark Gully Waste Rock Dump

Mine Activity Reference	Shark Gully Waste Rock Dump	
Area	12.06 ha	
Area per tenement	M45/1257 – 12.06 ha	
Design	The waste mined from the Shark Gully pit will be placed onto the Shark Gully waste rock dump. General waste rock dump design considerations are discussed in Section 3.3.3. Design specifications for this dump include: • Number of lifts = 2 • Maximum vertical height = 35 m • Natural angle of repose = 37º • Rehabilitated slope angle = 17º • Maximum lift height = 15 m • Berm width = 40 m Figure 3.4 is a plan view and schematic cross section of the Shark Gully Waste Rock Dump from south (A) to north (A`). The cross section illustrates the longitudinal design profile as intersected with the natural topography.	
Material characteristics	Fibrous minerals	☐- Yes ☒- No
	Radioactive material	☐- Yes ☒- No
	Materials capable of generating acid and/or metalliferous drainage, including neutral drainage and saline drainage	☐- Yes ☒- No
	Highly erodible material that is capable of compromising the structure of the waste dump.	☐- Yes ☒- No
	As detailed in Section 6.3.2.4: • Negligible risk of fibrous or radioactive material. • No risk of acid/metalliferous drainage. • All waste units from the Shark Gully pit have displayed high erosional stability.	

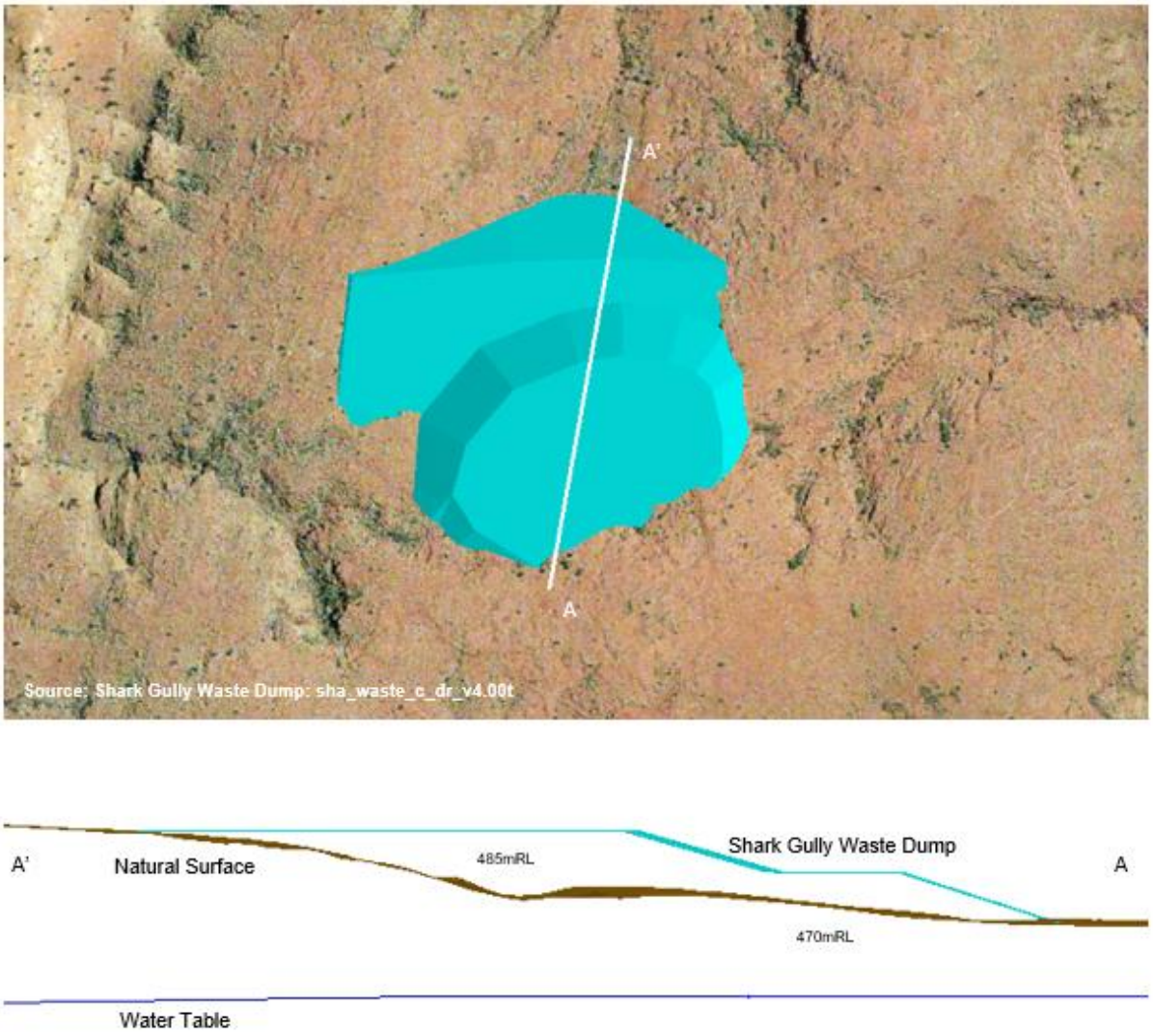
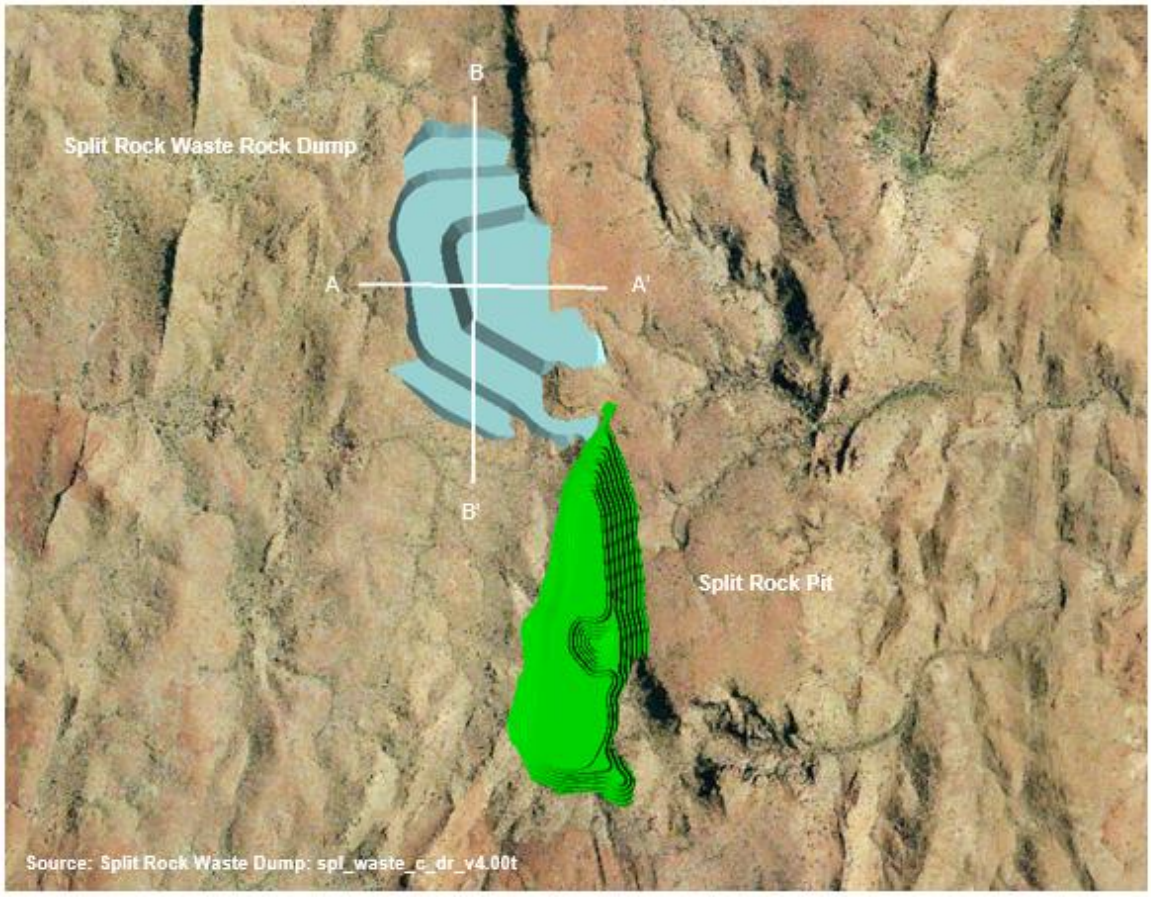


Figure 3.4 – Shark Gully Waste Rock Dump

Table 3-5 – Split Rock Waste Rock Dump

Mine Activity Reference	Split Rock Waste Rock Dump	
Area	46.16 ha	
Area per tenement	M45/1257 – 46.16 ha	
Design	The waste mined from the Split Rock and razorback pits will be placed onto the Split Rock Waste Rock Dump. General waste rock dump design considerations are discussed in Section 3.3.3. Design specifications for this dump include: • Number of lifts = 3. • Maximum vertical height = 80 m • Natural angle of repose = 37º • Rehabilitated slope a= 17º • Maximum lift height = 30 m • Berm widths = 30 m (395 mRL) and 40m (415 mRL) Figure 3.5 is a plan view schematic cross section of the Split Rock Waste Rock Dump from west (A) to east (A`) and north (B) to south (B`).	
Material characteristics	Fibrous minerals	☐- Yes ☒- No
	Radioactive material	☐- Yes ☒- No
	Materials capable of generating acid and/or metalliferous drainage, including neutral drainage and saline drainage	☐- Yes ☒- No
	Highly erodible material that is capable of compromising the structure of the waste dump.	☒- Yes ☐- No
	As detailed in Section 6.3.2.4: • Negligible risk of fibrous or radioactive material. • No risk of acid/metalliferous drainage. • Presence of shale which has displayed low erosional stability. • Shale unit has also been found to contain a geochemically stable form of enriched Hg. Accordingly, waste rock will be managed (Section 7) to ensure that shale is conservatively buried 10 m below the final waste rock dump surface.	



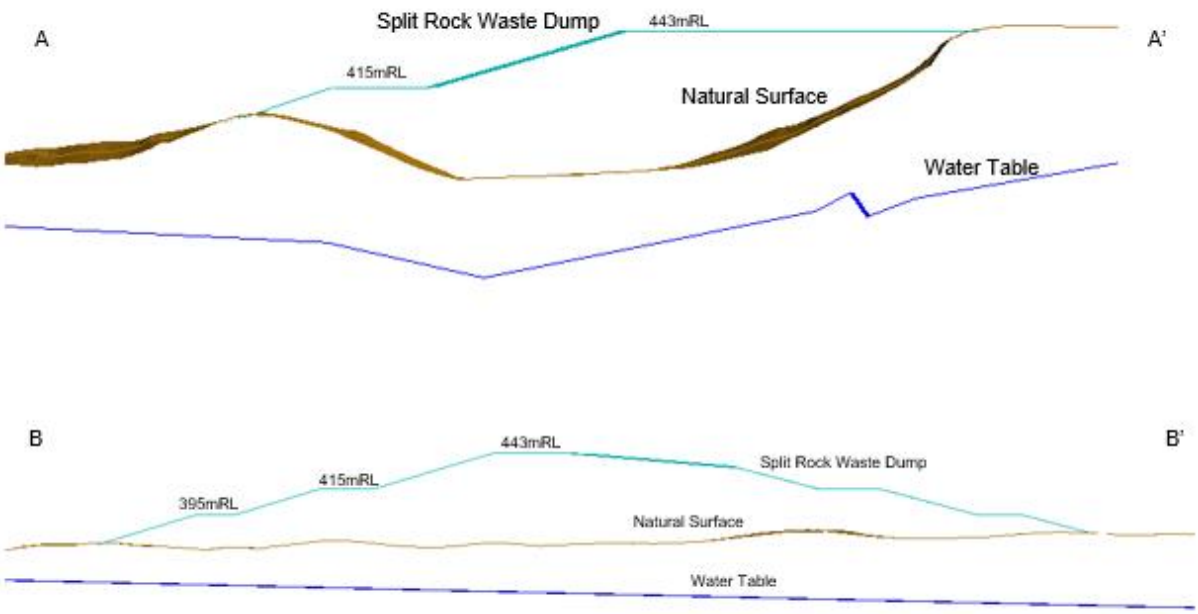


Figure 3.5 – Split Rock Waste Rock Dump Plan View and Typical Cross Sections

Table 3-6 – Runway Pit – South

Mine Activity Reference	Runway Pit South	
Area	19.06 ha	
Area per tenement	M45/1257 – 19.06 ha	
Design	The current design features for Runway Pit South are: • Dimensions of 665 m x 250 m x 50 m (Length/Width/Depth) • The pit will be mined to 360 mRL, approximately 2 to 3 m above water table. • Design batter angle = 65º • Maximum batter height = 10 m • Berm width = 5 m • Ramp grade = 1:10 Atlas is committed to maintaining a groundwater table buffer of at least 1 m to ensure there is no risk of groundwater interaction (as recommended in Appendix B. Figure 3.6 is a plan view and a schematic cross section of the Runway Pit South from south (A) to north (A`). The cross section illustrates the longitudinal design profile as intersected with the natural topography.	
Material characteristics	Fibrous minerals	☐- Yes ☒- No
	Radioactive material	☐- Yes ☒- No
	Materials capable of generating acid and metalliferous drainage, including neutral drainage and saline drainage, within pit walls or underground workings	☐- Yes ☒- No
	Highly erodible material that is capable of compromising the long-term stability of the pit or underground workings	☒- Yes ☐- No
	As detailed in Section 6.3.2.4: • Negligible risk of fibrous or radioactive material. • No risk of acid/metalliferous drainage. • Presence of siltstone and shale lithologies which have displayed moderate and low erosional stability respectively. As mining progresses towards completion, exposed waste lithologies in the pit wall will be inspected to ensure there is no risk to long-term stability.	

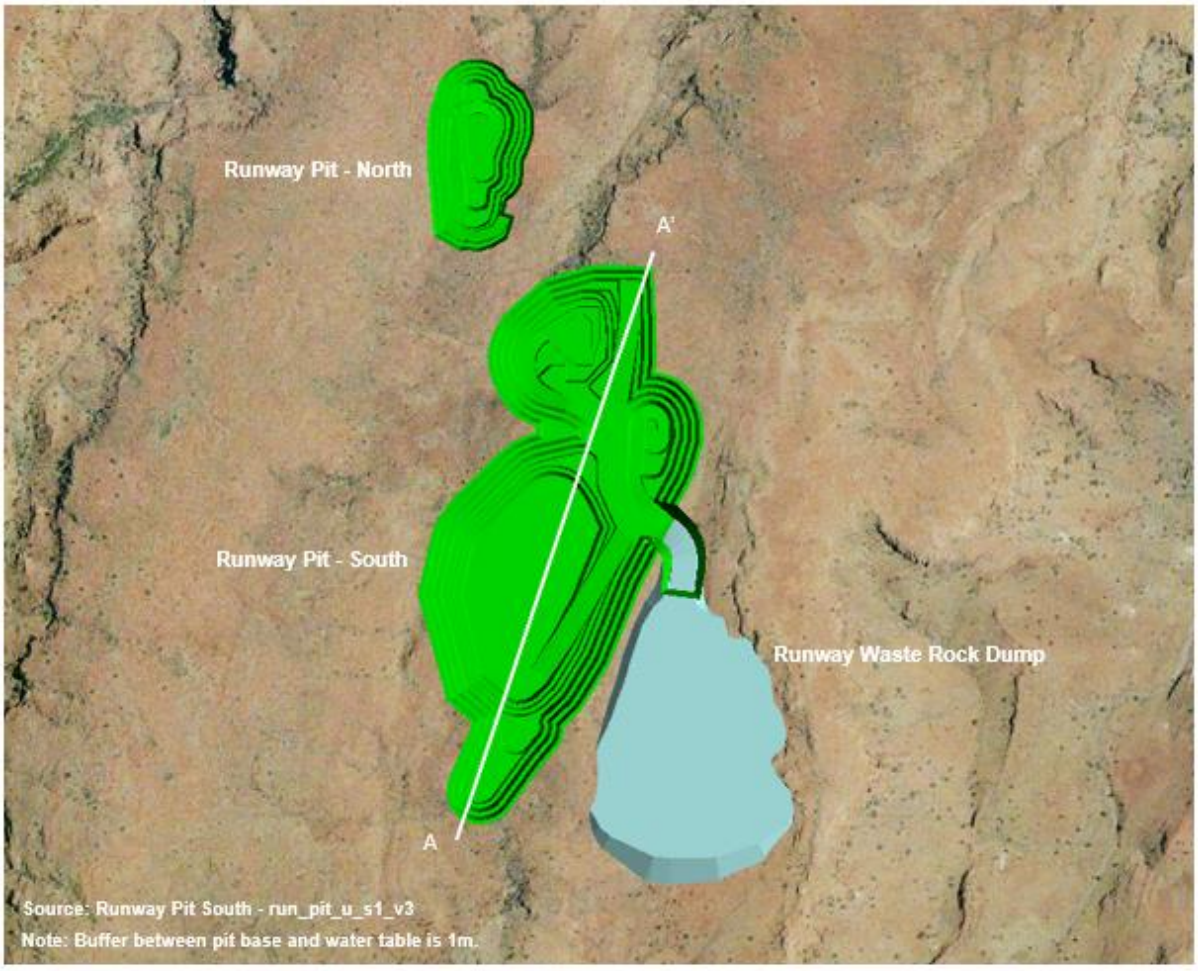


Figure 3.6 – Runway Pits Plan View and Runway Pit South Cross Section (looking west)

Table 3-7 – Runway Pit – North

Mine Activity Reference	Runway Pit North	
Area	3.90 ha	
Area per tenement	M45/1257 – 3.90 ha	
Design	The current design features for Runway Pit North are: • Dimensions of 195 m x 85 m x 26 m (Length/Width/Depth) • The pit will be mined to 375 mRL, over 10 m above water table. • Design batter angle = 65º • Maximum batter height = 10 m • Berm width = 5 m • Ramp grade = 1:10 Atlas is committed to maintaining a groundwater table buffer of at least 1 m to ensure there is no risk of groundwater interaction (as recommended in Appendix B). Figure 3.7 is a plan view and a schematic cross section of the Runway Pit North from north (B) to south (B`). The cross section illustrates the longitudinal design profile as intersected with the natural topography.	
Material characteristics	Fibrous minerals	☐- Yes ☒- No
	Radioactive material	☐- Yes ☒- No
	Materials capable of generating acid and metalliferous drainage, including neutral drainage and saline drainage, within pit walls or underground workings	☐- Yes ☒- No
	Highly erodible material that is capable of compromising the long-term stability of the pit or underground workings	☒- Yes ☐- No
	As detailed in Section 6.3.2.4: • Negligible risk of fibrous or radioactive material. • No risk of acid/metalliferous drainage. • Presence of siltstone and shale lithologies which have displayed moderate and low erosional stability respectively. As mining progresses towards completion, exposed waste lithologies in the pit wall will be inspected to ensure there is no risk to long-term stability.	

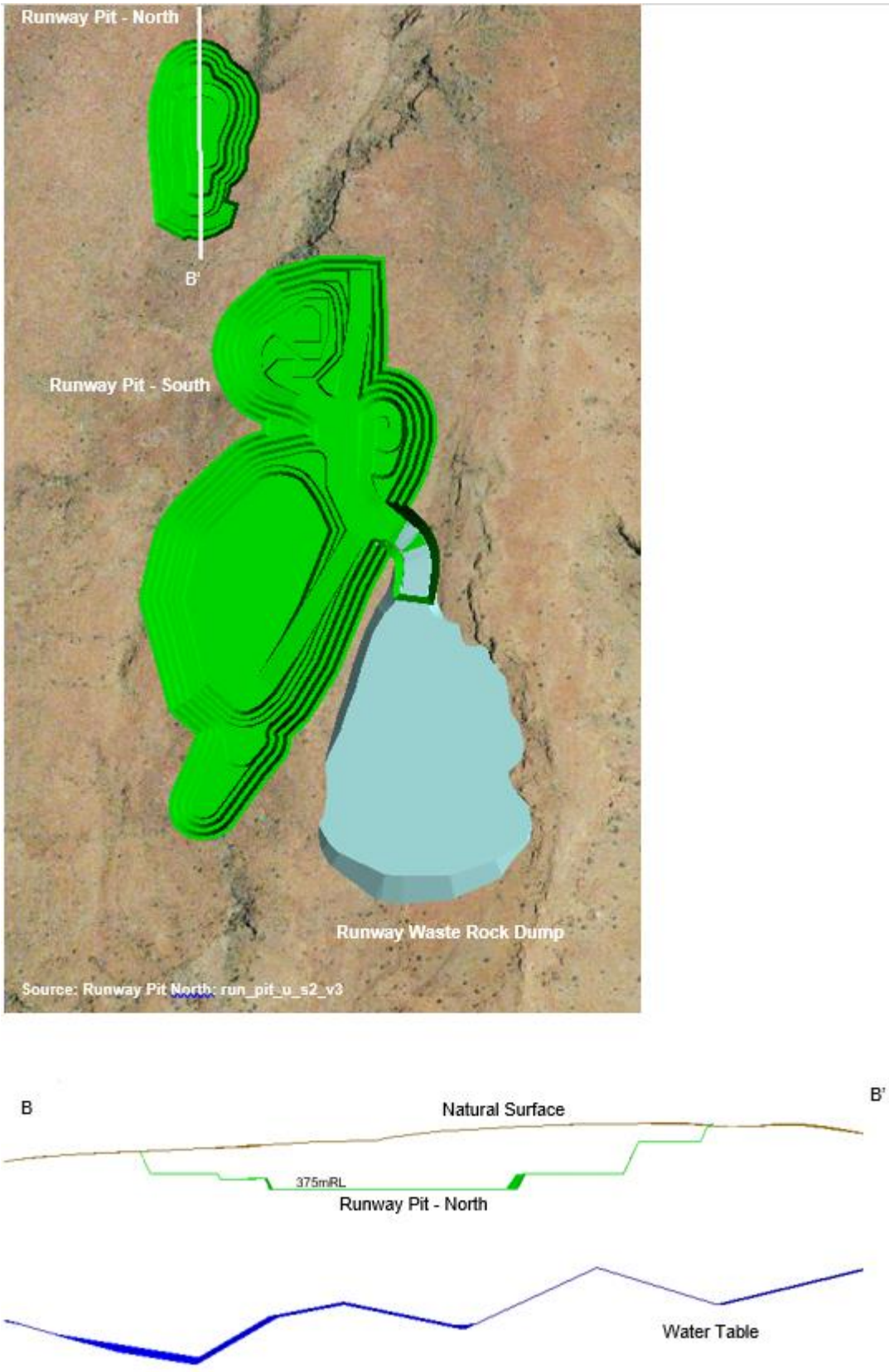
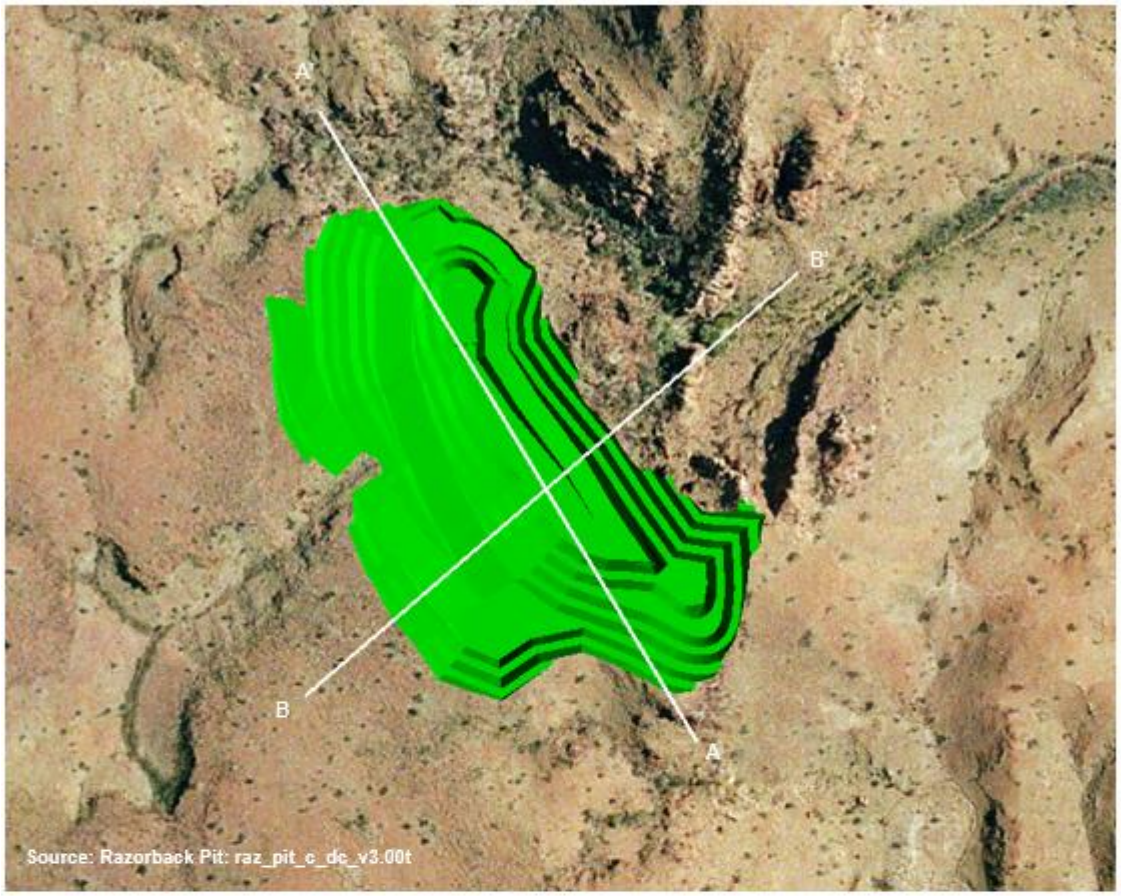
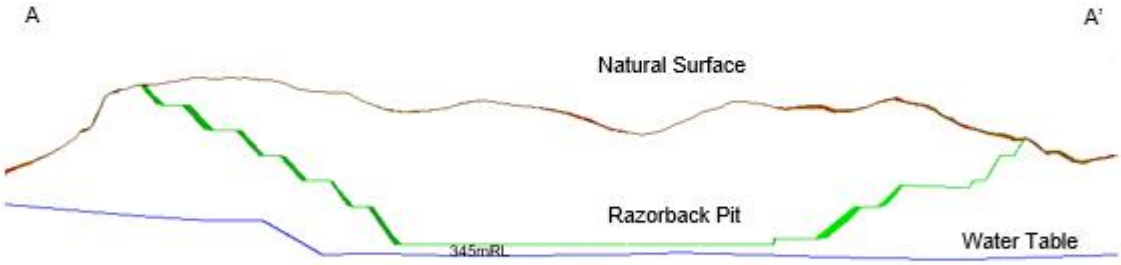


Figure 3.7 – Runway Pits Plan View and Runway Pit North Cross Section (looking west)

Table 3-8 – Razorback Pit

Mine Activity Reference	Razorback Pit	
Area	8.66 ha	
Area per tenement	M45/1257 – 8.66 ha	
Design	The Razorback pit is located on some challenging topography adjacent to the Split Rock Pit. This pit has been designed outside a 50 m exclusion zone around a non-permanent breeding roost (CO-CA-03) for the Pilbara Leaf-nosed Bat. The current design features for Razorback Pit are: • Dimensions of 370 m x 220 m x 74 m (Length/Width/Depth) • The pit will be mined to 345 mRL, approximately 2 to 3 m above water table. • Design batter angle = 60º • Maximum batter height = 10 m • Berm width = 5 m • Ramp grade = 1:10 Atlas is committed to maintaining a groundwater table buffer of at least 2 m to ensure there is no risk of groundwater interaction, as recommended in Appendix B). Figure 3.8 is a plan view and a schematic cross-section of the Razorback pit from south-east (A) to north-west (A`) and south-west (B) to south-east (B`). The latter illustrates the proximity of the pit to the back of the non-permanent breeding roost (~68 m).	
Material characteristics	Fibrous minerals	☐- Yes ☒- No
	Radioactive material	☐- Yes ☒- No
	Materials capable of generating acid and metalliferous drainage, including neutral drainage and saline drainage, within pit walls or underground workings	☐- Yes ☒- No
	Highly erodible material that is capable of compromising the long-term stability of the pit or underground workings	☐- Yes ☒- No
	As detailed in Section 6.3.2.4: • Negligible risk of fibrous or radioactive material. • No risk of acid/metalliferous drainage. • All waste units from the Razorback pit have displayed high erosional stability.	





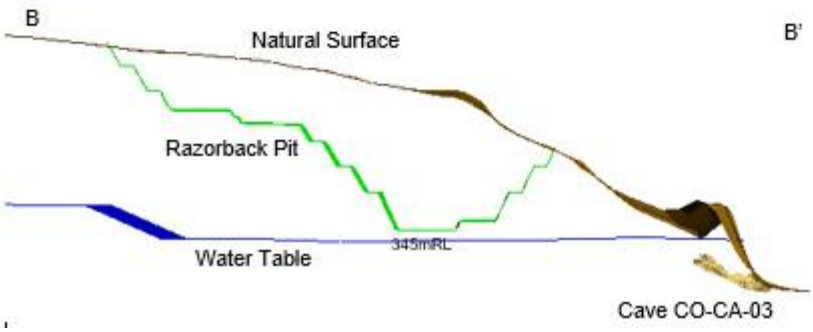


Figure 3.8 – Razorback Pit Plan View, Long-Section (looking south-west) and Cross-Section (looking north-west)

Table 3-9 – Shark Gully Pit

Mine Activity Reference	Shark Gully Pit	
Area	16.71 ha	
Area per tenement	M45/1257 – 16.71 ha	
Design	The current design features for Runway Pit South are: • Dimensions of 68 0m x 190 m x 64 m • Pit will be mined to 422 mRL, approximately 3 to 5 m above water table. • Design batter angle = 65º • Maximum batter height = 10 m • Berm width = 5 m • Ramp grade = 1:10 Atlas is committed to maintaining a groundwater table buffer of at least 1 m to ensure there is no risk of groundwater interaction, as recommended in Appendix B. Figure 3.9 is a plan view and a schematic cross section of the Shark Gully pit from south-west (A) to north-east (A'). The cross section illustrates the longitudinal design profile as intersected with the natural topography.	
Material characteristics	Fibrous minerals	☐- Yes ☒- No
	Radioactive material	☐- Yes ☒- No
	Materials capable of generating acid and metalliferous drainage, including neutral drainage and saline drainage, within pit walls or underground workings	☐- Yes ☒- No
	Highly erodible material that is capable of compromising the long-term stability of the pit or underground workings	☐- Yes ☒- No
	As detailed in Section 6.3.2.4: • Negligible risk of fibrous or radioactive material. • No risk of acid/metalliferous drainage. • All waste units from the Shark Gully pit have displayed high erosional stability.	

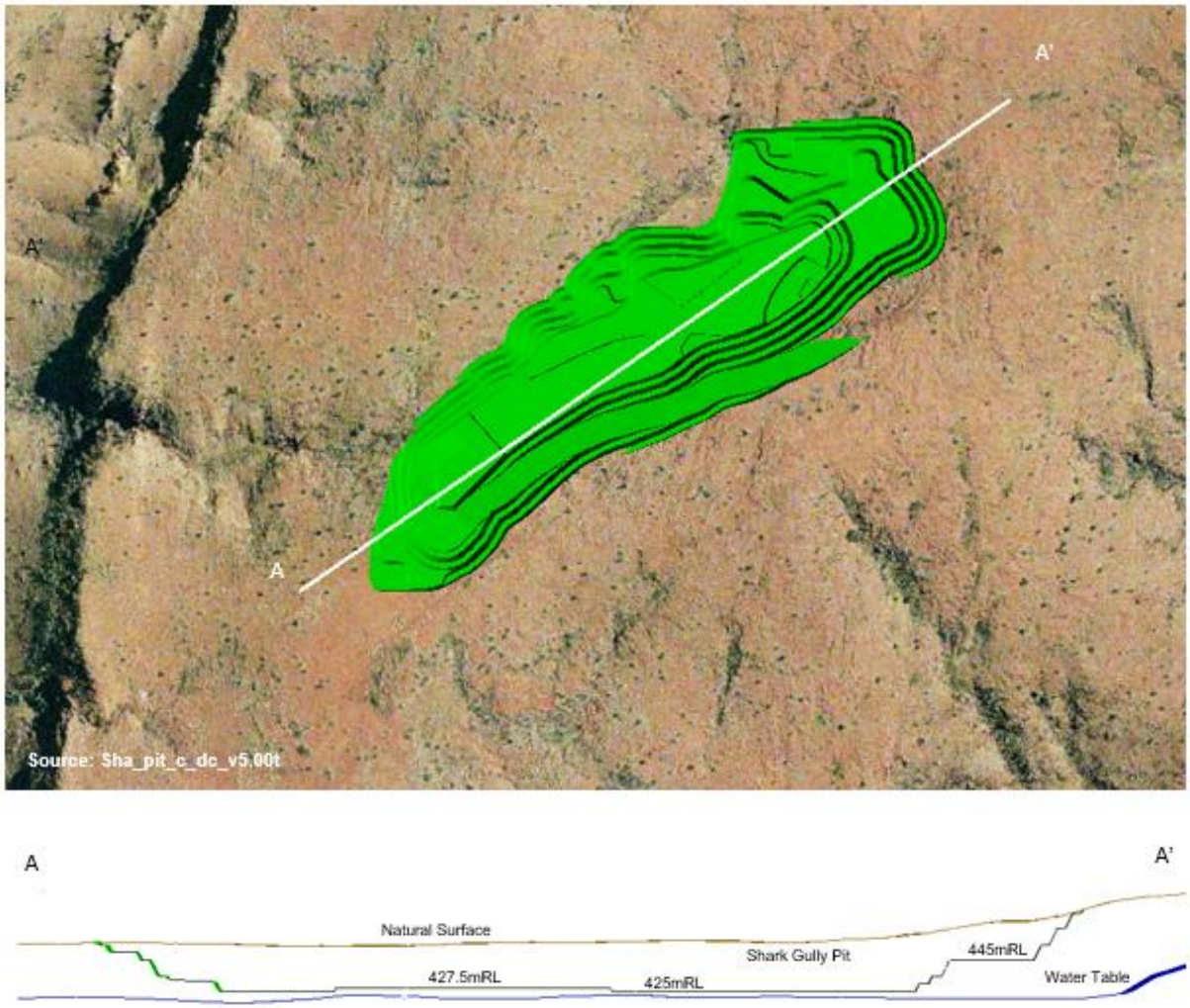


Figure 3.9 – Shark Gully Pit Plan View and Cross-Section (looking north-west)

Table 3-10 – Split Rock Pit

Mine Activity Reference	Split Rock Pit	
Area	25.51 ha	
Area per tenement	M45/1257 – 25.51 ha	
Design	The Split Rock Pit is the largest of all the pits and has more than half of the ore reserves within the Project. The current design features for Split Rock pit are: • Dimensions of 910 m x 310 m x 73.5 m (Length/Width/Depth) • Pit will be mined to 355 mRL, approximately 4 m above water table. • Design batter angle = 55 to 65º • Maximum batter height = 10 m • Berm width = 5 m • Ramp grade = 1:9.5 Atlas is committed to maintaining a groundwater table buffer of at least 2 m to ensure there is no risk of groundwater interaction, as recommended in Appendix B. Figure 3.10 is a plan view and a schematic cross-section of the Split Rock pit from south (A) to north (A`). The cross section illustrates the longitudinal design profile as intersected with the natural topography.	
Material characteristics	Fibrous minerals	☐- Yes ☒- No
	Radioactive material	☐- Yes ☒- No
	Materials capable of generating acid and metalliferous drainage, including neutral drainage and saline drainage, within pit walls or underground workings	☐- Yes ☒- No
	Highly erodible material that is capable of compromising the long-term stability of the pit or underground workings	☒- Yes ☐- No
	As detailed in Section 6.3.2.4: • Negligible risk of fibrous or radioactive material. • No risk of acid/metalliferous drainage. • Presence of shale which has displayed low erosional stability. As mining progresses towards completion, exposed waste lithologies in the pit wall will be inspected to ensure there is no risk to long-term stability.	

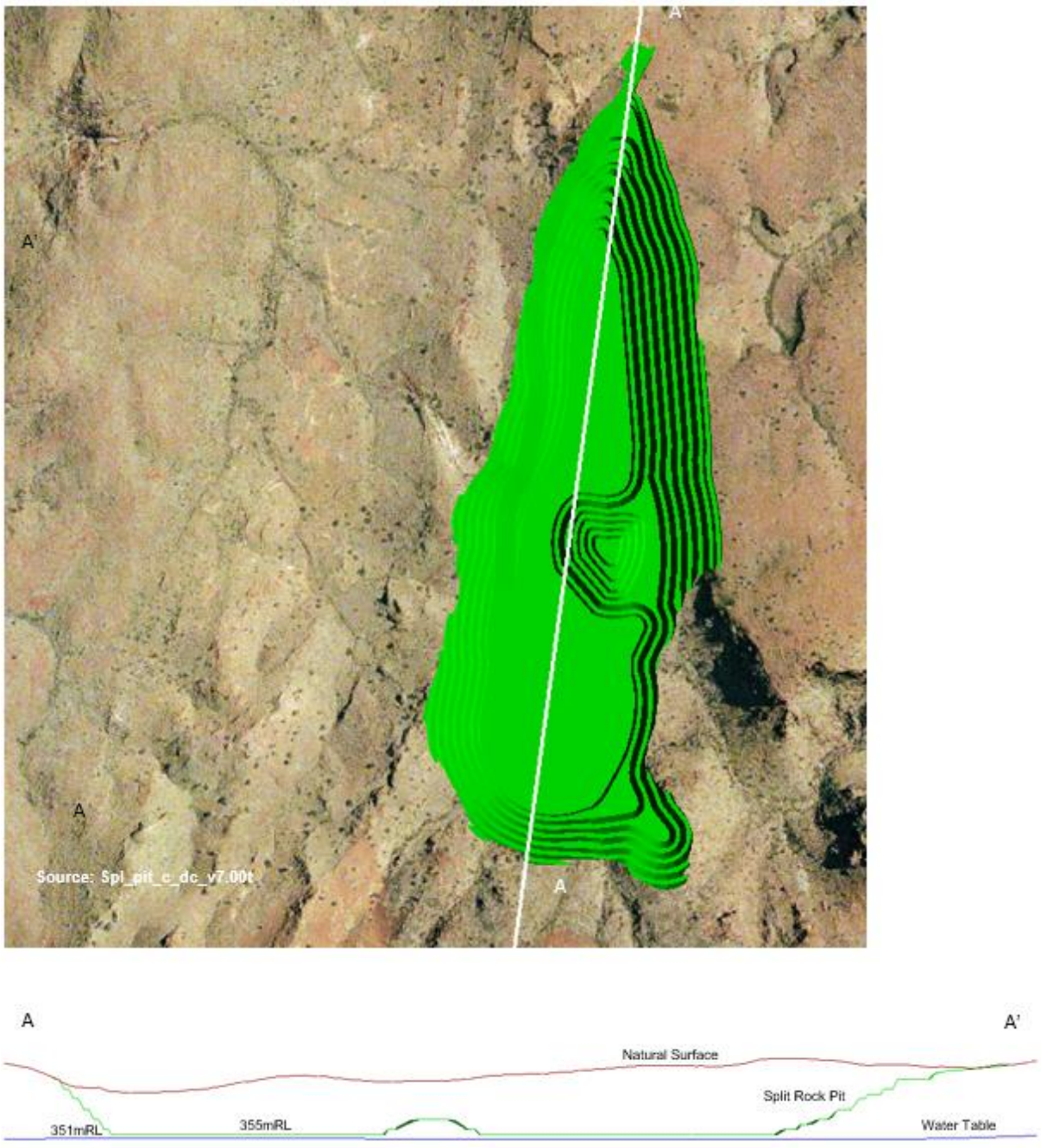


Figure 3.10 – Split Rock Pit Plan View and Cross-Section (looking west)

Table 3-11 – Split Rock Low Grade Stockpile

Mine Activity Reference	Split Rock Low Grade Ore Stockpile (Class 1)	
Area	14.09 ha	
Area per tenement	M45/1257 – 14.09 ha	
Design	Low grade ore from the pits which cannot be immediately blended will be placed on the low grade stockpiles and will be blended with high grade ore within the mine life of the Project. Design specifications: • One lift • Maximum vertical height = 30 m • Natural angle of repose = 37º Figure 3.11 is a plan view and cross section of the Split Rock Low Grade Ore Stockpile (looking northwest) and illustrates the longitudinal design profile as intersected with the natural topography.	
Material characteristics	Fibrous minerals	☐- Yes ☒- No
	Radioactive material	☐- Yes ☒- No
	Materials capable of generating acid and/or metalliferous drainage, including neutral drainage and saline drainage	☐- Yes ☒- No
	Highly erodible material	☐- Yes ☒- No
	As detailed in Section 6.3.2.4, The BIF waste unit presents: • Negligible risk of fibrous or radioactive material. • No risk of acid/metalliferous drainage. • High erosional stability.	

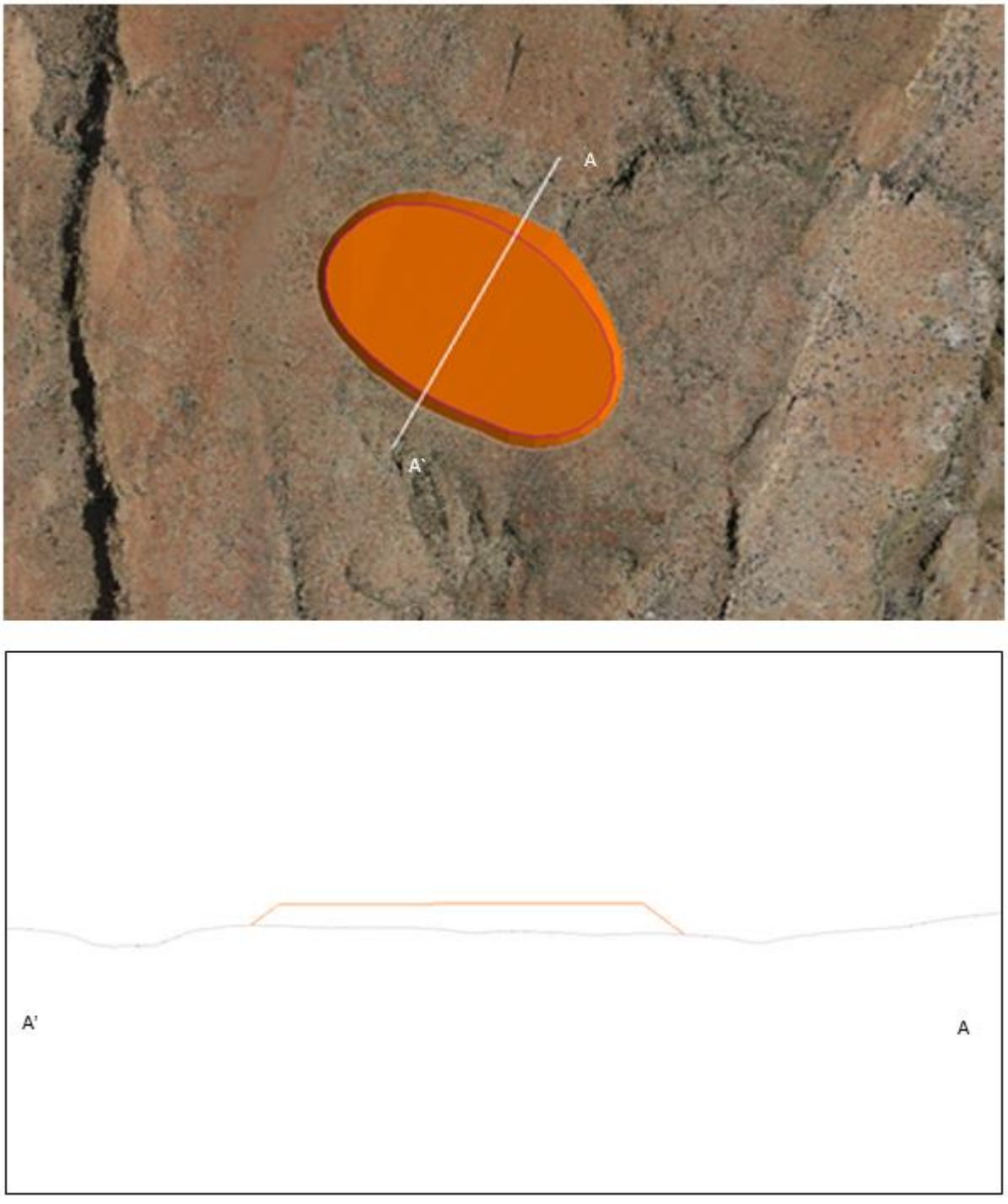


Figure 3.11 – Split Rock Low Grade Stockpile Plan View and Cross-Section (looking north-west)

Table 3-12 – Run-of-mine Pad

Mine Activity Reference	Run-of-mine (ROM) Pad
Area	37.77 ha
Area per tenement	G45/339 – 37.77 ha
Material Characteristics	The ROM pad will be constructed from cut and fill of near surface outcropping material (cut max about 5 m) from the local area.

Table 3-13 – Land Bridge

Mine Activity Reference	Land Bridge
Area	1.0 ha
Area per tenement	M45/1257 – 1.0 ha
Design	The land bridge is a component of the haul road (i.e., transport corridor) required to navigate/cross a steep gully between the Runway pits and provide access to the southern deposits. A detailed design report is provided as Appendix E. Some of the key operational design specifications include: • Maximum height = 30 m. • Running width = 25 m. • Batter angle = angle of repose.
Material characteristics	The land bridge will be constructed from approximately 88,100 m^3 of local cut and fill of near surface outcropping material (cut maximum about 5 m) from the local area and/or geochemically benign waste rock material from the Runway pit/s which displays high erosional stability (i.e., chert and BIF).

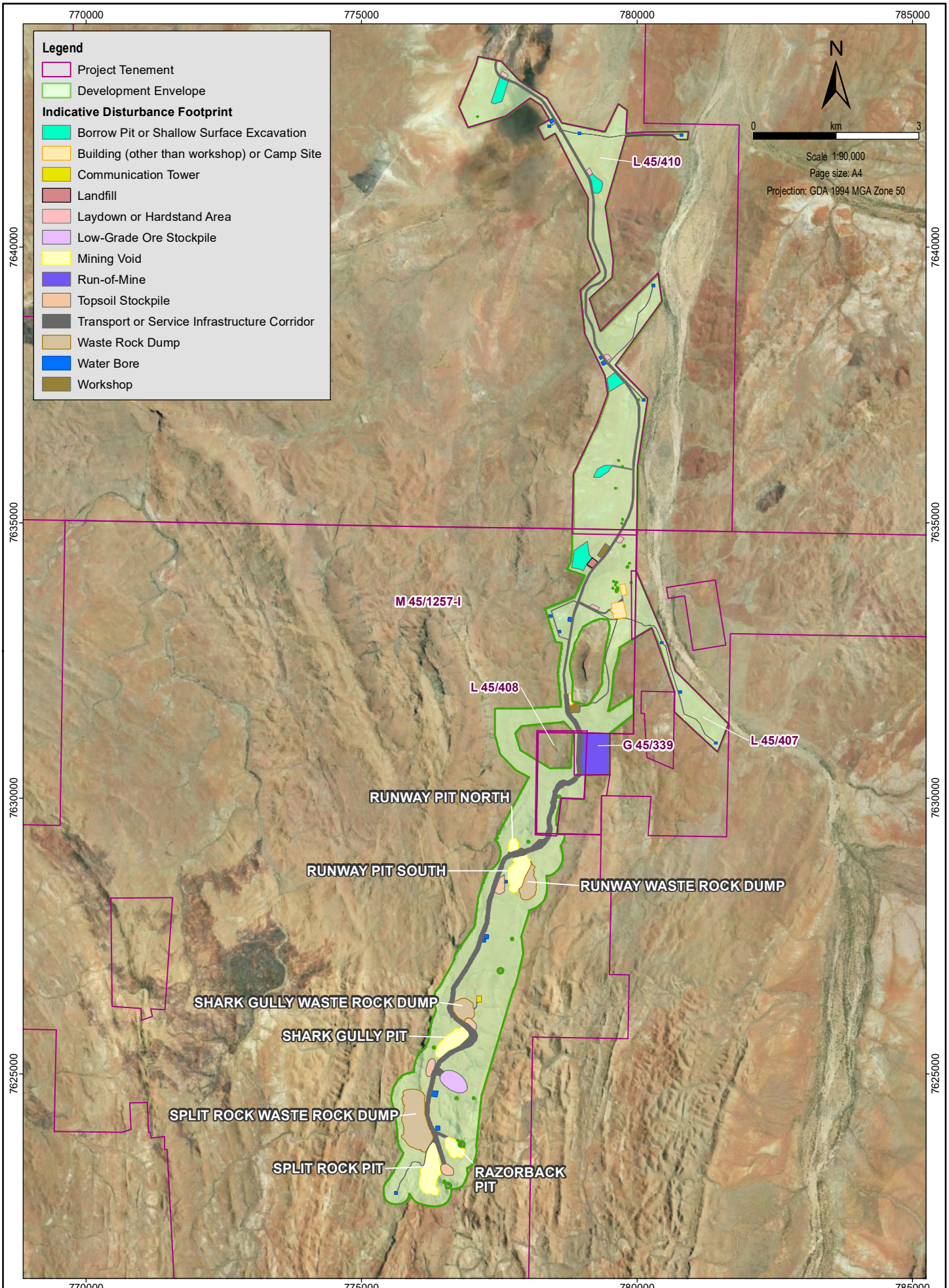
3.5 Indicative Site Plan

Figure 3.12 is an indicative site plan, depicting Project tenure and the indicative locations of proposed mine activities discussed in Section 3.4 in accordance with the Guidelines.

3.6 Detailed Design Reports

The Project does not include any significant engineered structures, including; tailings storage facility, heap leach drains, large evaporation pond/storage pond, significant water diversion structures and high waste rock dumps.

However, in response to a request from the DMIRS a detailed design report for the land bridge, discussed in Table 3-13, is provided as Appendix E.



ATLAS	File Name: GIS_2622_MineLayout.mxd	Source & Notes:	**Indicative Mine Layout**	Figure No: **3.12**
	Date: 9/12/2019			
	Author: Chris.Devlin	*Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*		

4. Environmental Legislative Framework

Table 4-1 details the environment approvals that may be required for the Project. All works will be undertaken in accordance with the relevant legislation.

Table 4-1 – Environmental Legislation and Approvals

Relevant Legislation	Environmental Factor Regulated/Affected	Relevant Approval/ Requirement
Mining Act 1978	Disturbance areas and general environmental management	This Mining Proposal addresses these requirements and follows the format outlined in the Guidelines.
Environmental Protection and Biodiversity Conservation Act 1999	Terrestrial fauna (of Commonwealth conservation significance): Presence of Northern Quoll (*Dasyurus hallucatus*), Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*, Pilbara form), Ghost Bat (*Macroderma gigas*) and Pilbara Olive Python (*Liasis olivaceus barroni*).	Controlled Action (EPBC 2017/7861) – Approved 23 February 2018.
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.	Ministerial Statement (1125) – Approved 12 March 2020.
Environmental Protection Act 1986 (Part V) (Licensing)	Terrestrial environmental quality, air quality and inland waters; specifically emissions to air, land and water Prescribed Premises Categories: (5) Processing or beneficiation of metallic or non-metallic ore; (54) Sewage facility; and (89) Putrescible landfill site	Works Approval (W6043) – Approved 6 September 2017. Licence (L9045) – Application submitted following commissioning of the prescribed premises in accordance with the above Works Approval.
Aboriginal Heritage Act 1972	Aboriginal ethnographic and archaeological sites.	Section 18 consent – where the governing department (i.e., DPLH) determine that CRD-51-16 meets the definition of a 'registered aboriginal site' under Section 5 of the Act. Atlas is in the process of determining this requirement.

Relevant Legislation	Environmental Factor Regulated/Affected	Relevant Approval/ Requirement
Health Act 1911 *Health (Treatment Of Sewage And Disposal Of Effluent And Liquid Waste) Regulations 1974*	Treatment of sewage	Approval to Construct or install an apparatus for the treatment of sewage.
Mines Safety and Inspection Act 1994	Major safety risks	Project Management Plan.
Native Title Act 1993	Protection of Native Title	Njamal Native Title Agreement
Rights in Water and Irrigation Act 1914	Inland waters/ water resources	26D Licence to construct bores 5C Licence to take groundwater (GWL176960)
Biodiversity Conservation Act 2016	Biodiversity/Flora/Fauna/ Ecosystem Scientific or other prescribed purpose licences were obtained for flora and fauna surveys to be undertaken.	Fauna taking (biological assessment) licence Regulation 62 Flora taking (biological assessment) license

The *Environmental Protection Act 1986* (EP Act) is the primary legislation that governs environmental impact assessment and protection in Western Australia. Atlas Iron has referred this Project to the EPA under Section 38 of the EP Act and received decision to assess on 7 August 2019. The level of assessment set was Assessment on Referral Information with a request for additional information (case number: CMS 17014). The EPA subsequently published their assessment Report (1665) on the 13 January 2020 and the Minister Environment approved the Project on the 12 March 2020 (Statement 1125).

5. Stakeholder Engagement

As the Project has developed, Atlas Iron has had on-going consultation with relevant stakeholders. The principal objectives of the stakeholder consultation program were 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.

5.1 Targeted Community and Engagement Strategy

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

Table 5-1 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 Iron prior to the submission of this document is summarised in the stakeholder consultation register in Appendix F. 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 impacts on bats, drawdown impacts associated with water abstraction and the risk of acid/metalliferous drainage and this feedback, along with associated conditions of approval regulated by other agencies, has been considered in the development of this document.

Table 5-1 – Project Stakeholders

Interest Group	Stakeholder	Contacted
Pastoral Stations	Panorama/Hillside Station	Yes
	Eginbah Pastoral Station	Yes
Mining Tenure Holders	Whim Creek Mining Pty Ltd	Yes
Native Title Groups	Njamal, Palyku and Kariyarra Native Title Groups	Yes
Shires and Local Governments	Shire of East Pilbara	Yes
	Town of Port Hedland	Yes
State Government	Department of Mines, Industry Regulation and Safety (previously Department of Mines and Petroleum)	Yes

Interest Group	Stakeholder	Contacted
Agencies	Department of Water and Environment Regulation (previously Department of Environment Regulation, Office of Environmental Protection Authority and Department of Water)	Yes
	Department of Biodiversity, Conservation and Attractions (previously Department of Park and Wildlife)	Yes
	Pilbara Ports Authority	Yes
	Main Roads Western Australia	Yes
	Department of Planning, Lands and Heritage (previously Department of Aboriginal Affairs and Department of Lands)	Yes
Commonwealth Government Agencies	Department of Agriculture, Water and Environment (previously Department of the Environment and Energy)	Yes
Local and Regional Groups	Marble Bar and Nullagine Community Resource Centre	Yes
	Marble Bar Progress Association	Yes

5.2 Ongoing Community and Stakeholder Engagement

Atlas Iron 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 Iron will continue its proactive consultation program until after closure of the mine, as detailed in Table 5-2 and in Table 4-3 of Appendix X for closure related consultation (e.g., consultation on post closure land use and residual assets). The details of this consultation will continue to be documented in the Project's consultation register.

Table 5-2 – Ongoing Community and Stakeholder Engagement Strategy

Interest Group/ Stakeholder	Planned Consultation Issue
Native Title Groups (Njamal)	Compliance with the Native Title Deed (5 December 2008), including (but not limited to) meetings with Njamal three times per year (MaLC), provision of employment and contracting opportunities, management of heritage protocol and protection of sites and cross cultural education.
Pastoral Stations (Panorama/Hillside and Eginbah)	Compliance with pastoral agreements (in prep.) including as a minimum quarterly reporting to discuss completed and planned activities, including cattle strikes.
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 X.

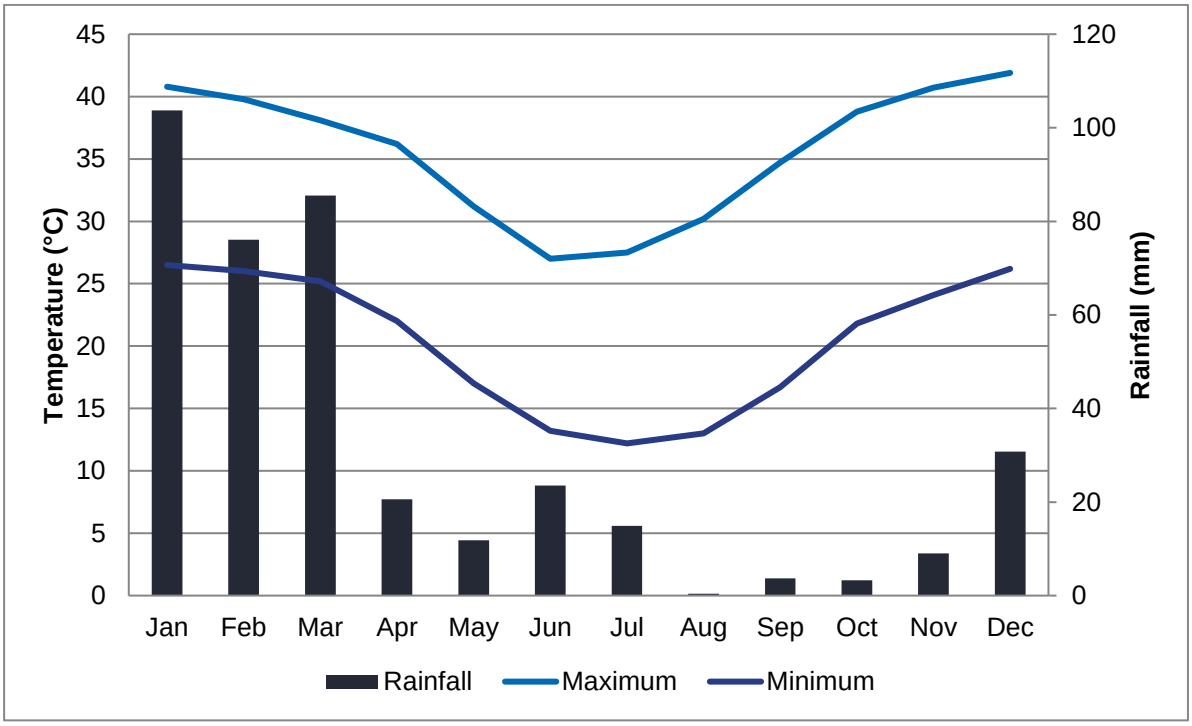
6. Baseline Environmental Data

This Chapter provides the necessary baseline data to understand the pre-existing environment and ensure the Project's risk assessment is appropriately informed and site-specific.

6.1 Climate

The climate in the Project area is characterised as an arid tropical climate with predominantly summer rainfall (Beard, 1990), and is strongly influenced by 'summer' (December – April) cyclones. The prevalence of such cyclonic events results in the Pilbara receiving slightly higher average annual rainfall (250 – 300 mm) than the remainder of the Arid Zone.

Figure 6.1 shows the climate data for the Marble Bar weather station, located approximately 33 km north of the Project area (BOM, 2019a). The average monthly maximum temperature ranges from 27°C to 41.9°C, whilst the average monthly minimum temperature ranges from 12.2°C to 26.5°C. Average monthly rainfall ranges from 0.4 mm to 103.7 mm, whilst the average annual rainfall is 394 mm.



Source: BOM (2019a) for Marble Bar station (station ID 4106)

Figure 6.1 – Average Monthly Rainfall and Temperatures at Marble Bar (2000 – 2019)

The Pilbara has the second highest inter-annual variability in rainfall in Australia (Sudmeyer, 2016). Heavy rainfall and associated flooding are the main impact for most cyclone events in the inland Pilbara.

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 Bureau of Meteorology (BoM). The design IFD table for each Average Recurrence Interval (ARI) event for the Project area are detailed in Table 6-1.

Table 6-1 – IFD Design Rainfall Intensity

	Annual exceedance probability (AEP) (mm/hour)					
Duration	**50% AEP**	**20% AEP**	**10% AEP**	**5% AEP**	**2% AEP**	**1% AEP**
5 min	90.0	126.0	150.0	174.0	204.0	228.0
10 min	75.6	107.4	128.4	148.8	175.8	195.6
20 min	56.7	80.1	95.7	110.7	130.5	145.5
1 hour	29.1	40.9	48.8	56.5	66.7	74.5
2 hour	17.7	25.2	30.4	35.4	42.2	47.5
3 hour	13.2	19.0	23.1	27.1	32.7	37.0
6 hour	8.0	11.9	14.7	17.6	21.6	24.9
12 hour	4.9	7.6	9.5	11.6	14.6	17.0
24 hour	3.1	4.8	6.1	7.5	9.5	11.1
72 hour	1.4	2.1	2.7	3.2	4.0	4.6

Source: Stantec, 2018a

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 dominant annual wind direction at the Marble Bar weather station is from the east-south-east, with an annual mean wind speed of 16.7 km/h and a maximum wind gust speeds between 61 km/h in June and 126 km/h in December (BOM, 2019a).

6.2 Landscape

Under the Interim Biogeographical Regionalisation for Australia (IBRA) classification system, the Project is situated within the Chichester subregion (Pilbara 1 subregion) of the Pilbara Biogeographic Zone (Kendrick & McKenzie, 2001).

The Pilbara Biogeographic Zone is characterised by a semi-desert tropical climate with active drainage in the Fortescue, De Grey and Ashburton river systems (McKenzie et al., 2009). The Chichester subregion is approximately 9,044,560 ha in size and 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 leucophloia* tree steppes (Kendrick & McKenzie, 2001).

Land system classifications, as defined by the WA Department of Agriculture and Food, are used to map the land according to similarities in landform, soil, vegetation, geology and geomorphology (van Vreeswyk et al., 2004). Eight land systems occur within the

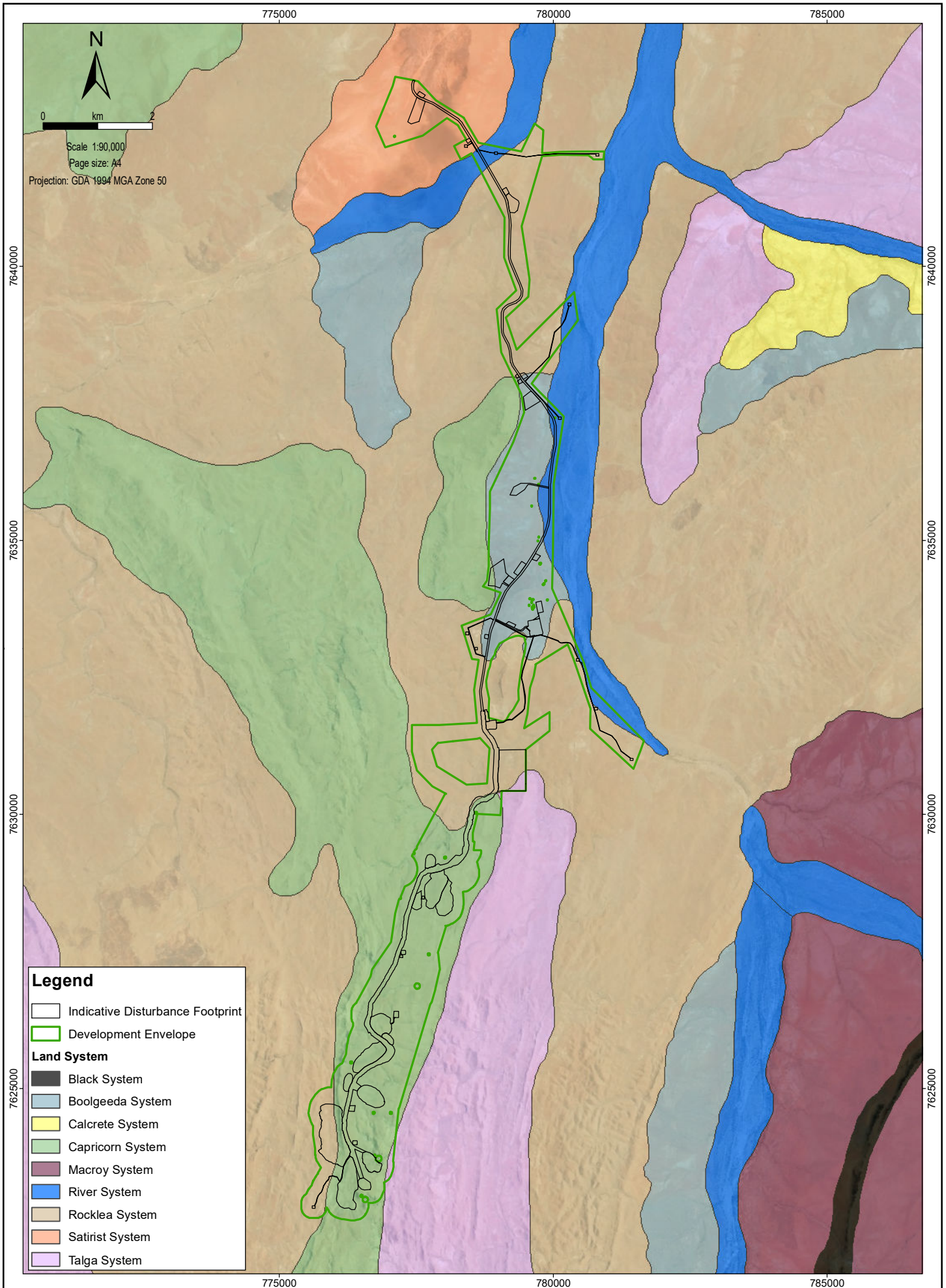
Development Envelope (Table 6-2; Figure 6.2), with Rocklea and Capricorn land systems encompassing much of the Project area. None of these are considered to be of conservation significance.

Table 6-2 – Land Systems Located within the Development Envelope

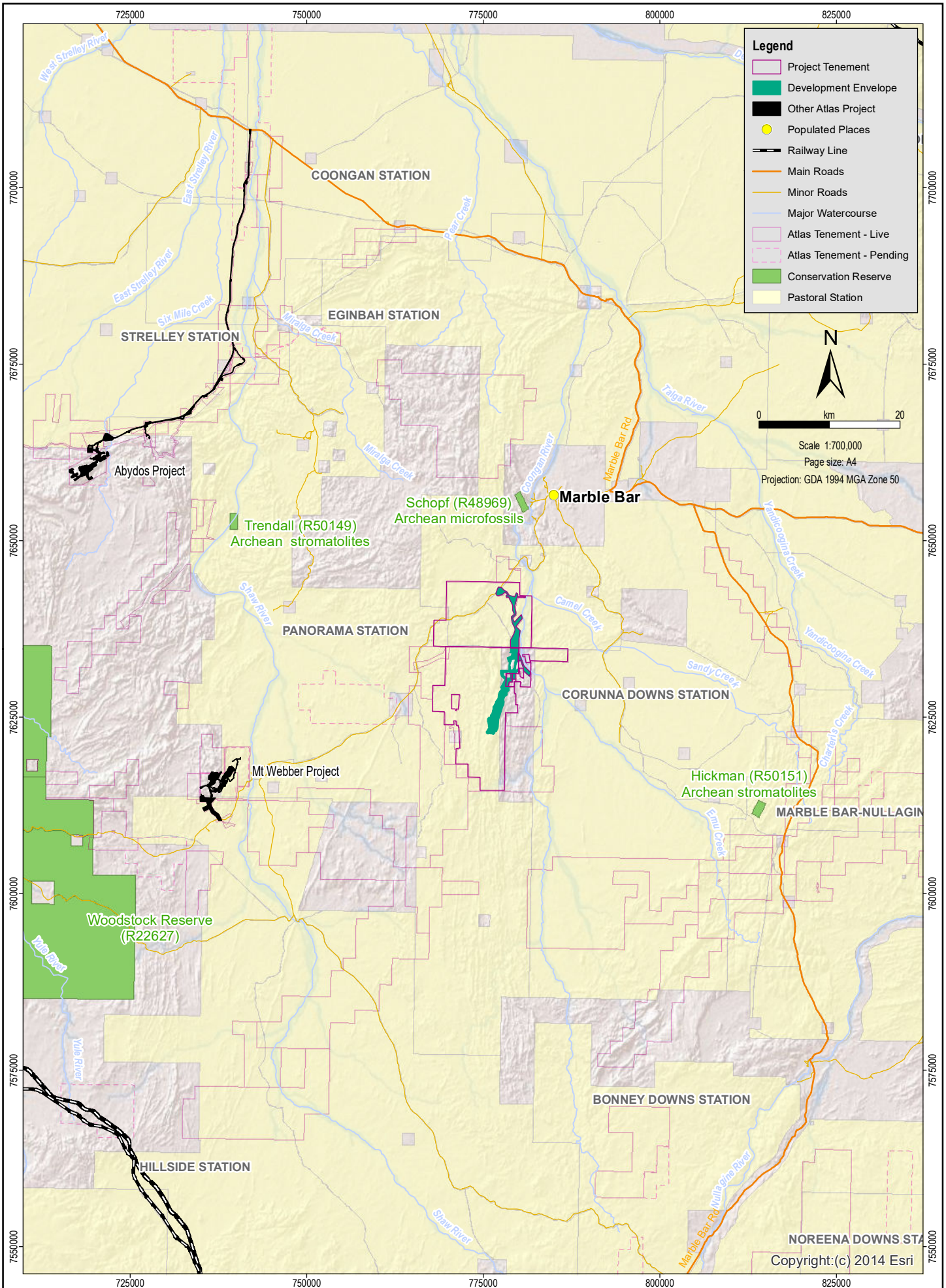
Land System	Description
Rocklea	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard (and occasionally soft spinifex) grasslands.
Capricorn	Hills and ridges of sandstone and dolomite supporting low shrublands or shrubby spinifex grasslands.
Talga	Hills and ridges of greenstone and chert and stony plains supporting hard and soft spinifex grasslands.
Boolgeeda	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands.
Satirist	Stony plains and low rises supporting hard spinifex grasslands, and gilgai plains supporting tussock grasslands.
Granitic	Rugged granitic hills supporting shrubby hard and soft spinifex grasslands.
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.
Macroy	Sandy/Stony plains and occasional tor fields based on granite supporting hard and soft spinifex shrubby grasslands.

Source: Kendrick and McKenzie (2001)

The majority of the Development Envelope lies within the Panorama and Eginbah Pastoral Stations and the remaining area comprises unallocated crown land (Figure 6.3). Evidence of pastoral activity is widespread particularly around water holes and drainage lines, with cattle, pasture grasses such as Buffel Grass (*Cenchrus ciliaris*) and land degradation frequently observed in such areas.



ATLAS	File Name: GIS_2624_LandSystem.mxd	Document Number : (QDMS number only)	**Land Systems**
	Date: 9/12/2019	Source & Notes:	Figure No: **6.2**
	Author: Chris.Devlin	*Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*	



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	Date: 9/12/2019			
	Author: Chris.Devlin	*Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*		

6.3 Materials Characterisation

The following sections summarise the findings of various material characterisation assessments that have been conducted for the Project, as summarised in Table 6-3.

Table 6-3 – Materials Characterisation – Relevant Studies

Study	Study Purpose
Soil Resource Assessment and Waste Characterisation (MWH, 2013)	The aim of the assessment was to characterise the soil and mine waste materials associated with future mining activities at the Project, to facilitate the development of an initial soil and mine waste inventory, to identify preliminary rehabilitation and landform design requirements, and associated recommendations for rehabilitation and mine closure activities.
Soil Resource Assessment and Waste Characterisation (MWH, 2016; Appendix G)	This soil assessment and mine waste characterisation aimed to assess the potential soil resources and mine waste materials present to identify potentially problematic materials and identify materials that may be suitable for use as a rehabilitation resource. It combined information from the original assessment with new information available to assist with rehabilitation, mine waste handling, landform design and mine closure planning in relation to updated Project definition.
Waste Rock Geochemical Assessment (Mine Earth, 2018)	Mine Earth undertook a smaller mine waste geochemical assessment to verify the findings of the 2016 assessment. The objectives were: • To identify shale samples from the Split Rock deposit that were representative of the two shale units to be mined. • To identify additional samples from the Razorback, Runway and Shark Gully deposit that are representative of the waste rock to be mined. • Undertake laboratory analysis on the selected sample zones to better understand their geochemical character and, in the case of Split Rock, the stability and solubility of Hg. • Review the testwork results and develop appropriate recommendations for waste rock management during mining, if required.
Revised Mine Waste Characterisation Assessment (Mine Earth, 2020a; Appendix H)	The objectives of this assessment were to: • Resolve issues with previous studies raised by DMIRS. • Work with Atlas personnel to plan a series of drillholes to complement the historic sampling. • Conduct a desktop assessment of the geological database to provide context for the current analysis. • Undertake Phase 1 (screening) and Phase 2 (detailed) laboratory analysis on samples to identify any potentially problematic mine waste materials from both geochemical and physical perspectives. • Provide management recommendations for all mine waste materials based upon the historic and current results, and incorporate the findings in a risk assessment for the Project. The investigation also incorporated and consolidated the results of the 2016 and 2018 waste characterisation assessments. This assessment supersedes the mine waste characterisation results in MWH (2013, 2016) and Mine Earth (2018).

6.3.1 Soils

6.3.1.1 Major Soils

The Cleaverville Formation is overlain by weathered iron-rich regolith and/or thin, loose Tertiary soils. The Tertiary weathering is 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), two soil types were present in the Project area (Table 6-4; Figure 6.4). The majority of the Project area is characterised by shallow, dissected stony soils (Oa11) and brown loams (Gf1). Some of the western section of the study area is characterised by the hard red (Fa12) soil units.

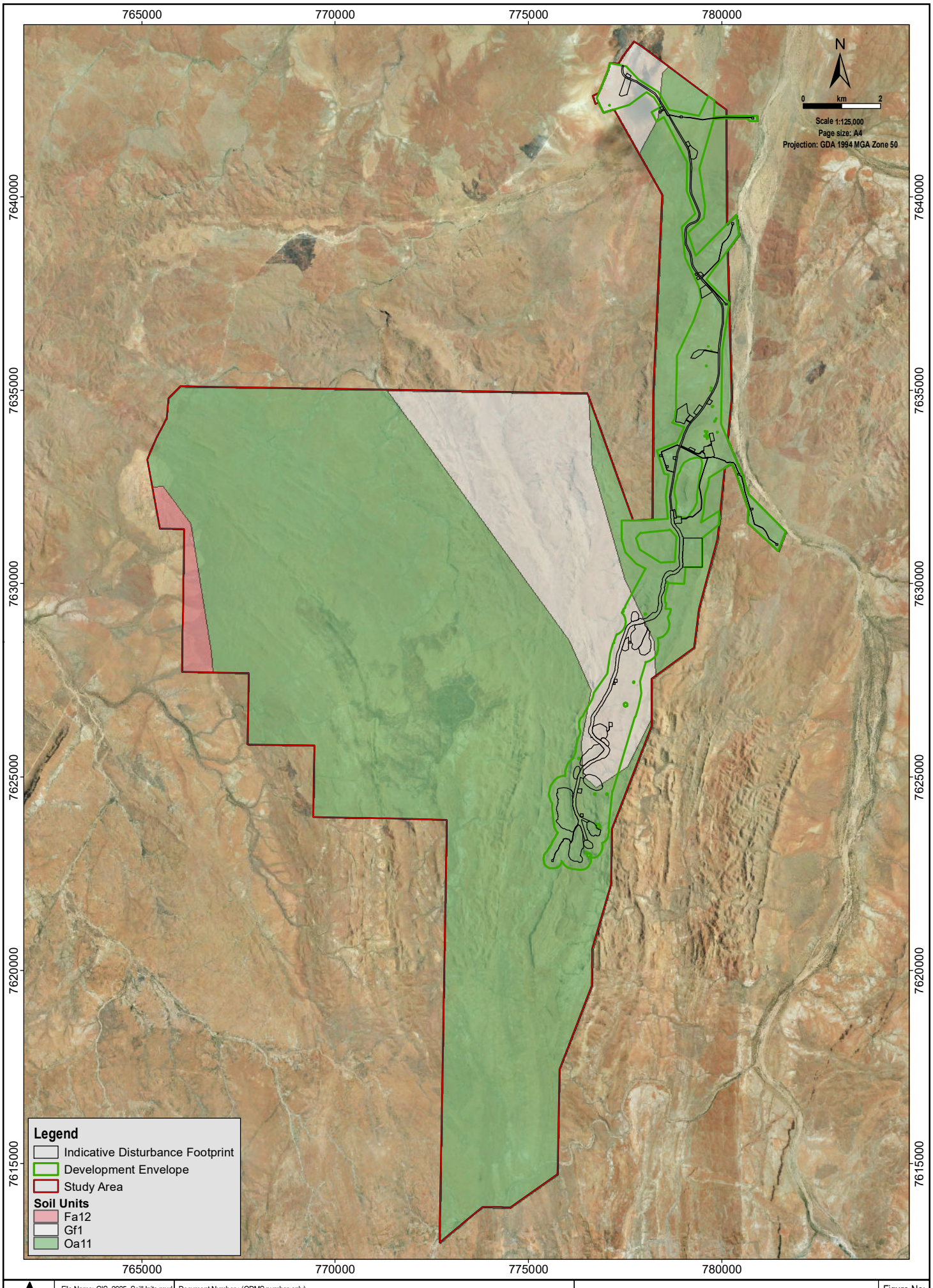
Table 6-4 – Soil Units in the Study Area

Soil Unit Code	Summary Description	Location
Fa12	Earthy loams and coarse sands overlying granite. In topographical lows, red earths may dominate, with hard red soils and coarse soils along creek lines. Minor areas of calcareous loams are associated with calcrete.	Project area and study area
Gf1	Soils are generally shallow and stony, with large areas of no soil over exposed rock outcrop. Dominant soils are brown loams with earthy loams. Slightly thicker soils may occur on lower slopes and valley floors.	Project area and study area
Oa11	Dissected stony pediments and hills occurring at the foot of unit Gf1. Soils comprise hard alkaline red soils with remnant residual mesas of basement rock. Shallow soils are associated with rock outcrops, with cracking clays and calcareous loams over basic basement rocks.	Study area

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

6.3.1.2 Soils Characterisation

MWH assessed and broadly characterised the surface soils within the Study Area. The soil survey was conducted in accordance with the Guidelines and the Commonwealth Department of the Environment and Energy Leading Practice Sustainable Development Program for the Mining Industry (DRET, 2006). Geochemical test work procedures and analytical methods were performed in accordance with the methodologies set out in the Global Acid Rock Drainage (GARD) Guide (INAP, 2009), and Department of Environment Regulation (DER) Assessment and Management of Contaminated Sites (DER, 2014).



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Date: 9/12/2019	Source & Notes:		
Author: Chris.Devlin	*Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*		

The soils were broadly characterised as follows (MWH, 2016a):

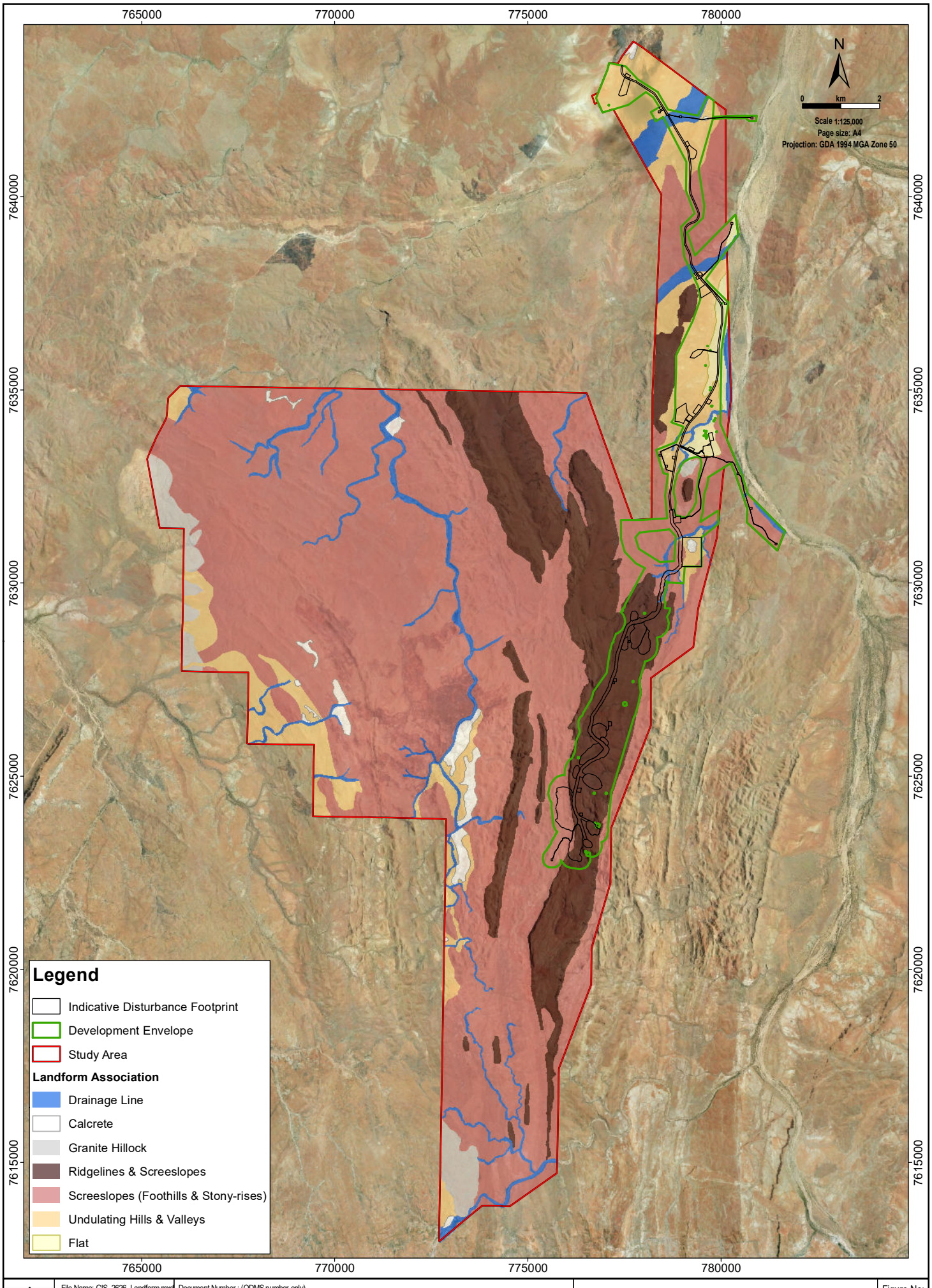
- Generally shallow (particularly within the 'scree slopes' and 'ridgelines' landform associations).
- Typically classed as 'sandy loams' or 'sandy clay loams'.
- Generally contain a high percentage of coarse material (>2 mm).
- Predominantly single-grained to weakly-aggregated in structure.
- Exhibit partial clay dispersion upon severe disturbance.
- Prone to hardsetting.
- 'Moderate' to 'moderately rapid' drainage class.
- 'Low' to 'moderate' water holding capacity.
- Neutral pH.
- Predominantly non-saline.
- Typically low in organic carbon and moderate in plant-available nutrients.
- Non-sodic.
- Typically below the limit of reporting (LOR) for the majority of total metals tested, with some samples reporting concentrations of total Cu and Ni above the site-specific Ecological Investigation Levels (EILs).

6.3.1.3 Landform Associations

Landform associations identified were based on field observations of morphological differences between the soil profiles and their occurrence within different landscape positions (Figure 6.5). Seven soil-landform associations were identified within the Study Area, namely 'calcrete', 'granite hillock' 'undulating hills and valleys', 'drainage lines', 'ridgelines', 'scree slopes' and 'flats'. The majority of the Study Area is dominated by several ridgelines, scree slopes (foothills and stony rises) and undulating hills and valleys. Consequently, the surface soils were typically shallow and dominated by high coarse fragment content.

6.3.1.4 Soil Inventory

A preliminary inventory of potential soil resources has been developed for the Study Area (Table 6-5). It is based on the characterisation of surface soils and landform association mapping.



File Name: GIS_2626_Landform.mxd	Document Number : (QDMS number only)	**Landform Associations**	Figure No: **6.5**
Date: 9/12/2019	Source & Notes:		
Author: Chris.Devlin	*Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*		

Table 6-5 – Preliminary Soil Resource Inventory

Landform Association	Study Area				Suitability for Salvage and Reuse in Rehabilitation
	Extent (ha)	Proportion	Approx. Topsoil Stripping Depth (m)	Potential Topsoil Volume[1] (m^3)	
Calcrete	6.71	2%	–	–	Not recommended
Granite hillock[2]	12.9	3%	–	–	Presence of soil unlikely
Drainage lines	4.43	1%	0.2 m	8,858	Recommended
Ridgelines	209	49%	0.2 m	418,639	Recommended
Scree slopes	79.1	19%	0.2 m	158,198	Recommended
Undulating hills and valleys	99.7	24%	–	–	Not recommended
Flats	11.0	3%	0.2 m	22,073	Recommended
Total	**422.84**	**100%**	**–**	**607,768**	–

(1) The presence of outcropping rock and rock hardcaps may decrease the volume of salvageable topsoil material. This needs to be taken into account for rehabilitation planning.

(2) Granitic uplands and outcrops were located in the far western section of the Study Area and were dominated by rock outcrop.

The surface soils (0 to 0.2 m) from the ‘drainage lines’, ‘ridgelines’, ‘scree slopes’ and ‘flats’ landform associations are considered to be a valuable resource for rehabilitation material. Soils from these landform associations generally had a high coarse rock fragment content, moderately rapid hydraulic conductivity, were non-hardsetting or slightly hardsetting, and were predominantly non-saline and non-sodic, indicating a low inherent potential for erosion.

6.3.2 Subsurface Materials and Processing Waste

6.3.2.1 Geology and Mineralisation

6.3.2.1.1 Regional Geology

The Project area encompasses the Coongan and Kelly greenstone belt features in the Archean East Pilbara Craton. The belts extend approximately 60 km south of the Project area and are flanked by the Shaw granitoid complex to the west and the Corunna Downs granitoid complex to the east. The greenstone terrane in the East Pilbara Craton, comprises a lower greenstone sequence dominated by mafic volcanics grading irregularly into felsic volcanics and sediments. The greenstone package is assigned to the Pilbara Supergroup and includes metamorphosed mafic to ultramafic rocks, felsic to intermediate volcanics, amphibolite, clastic sediments (sandstone, shale and siltstone), mafic to ultramafic intrusive sills, chert and BIF. Metamorphic grades vary from widespread greenschist facies to amphibolite or hornblende-hornfels facies along the contacts with granitic complexes. The regional granitoid complexes are composed of gneissic granitoid and migmatite in large, dome-shaped intrusions.

6.3.2.1.2 Local Geology

Locally, the geology in the vicinity of the Project comprises Cleaverville Formation rocks of the Gorge Creek Group located in the Coongan greenstone belt. The dominant lithotypes in the Project area are BIF, chert and volcanically derived clastic sediments (commonly shales). The BIF rocks are associated with jaspilite, and interbedded cherts and goethite-rich units. Thicker shale and sandstone sediments are typically recessive and outcrop is generally limited to areas of significant relief. The shales contain variable iron content, and in the vicinity of the Spilt Rock deposit are sulfidic (contain pyrite) and carbonaceous below the weathering horizon.

6.3.2.1.3 Split Rock

Geology

The geology at Split Rock consists of westerly dipping sub-vertical beds of alternating BIF and chert. These are bounded to the east by carbonaceous shale and to the west by the komatiitic Euro basalts of the Coongan greenstone belt. There are five main BIF units to the west of the carbonaceous shale with three chert-rich units that become increasingly shale-rich to the west (Figure 6.6).

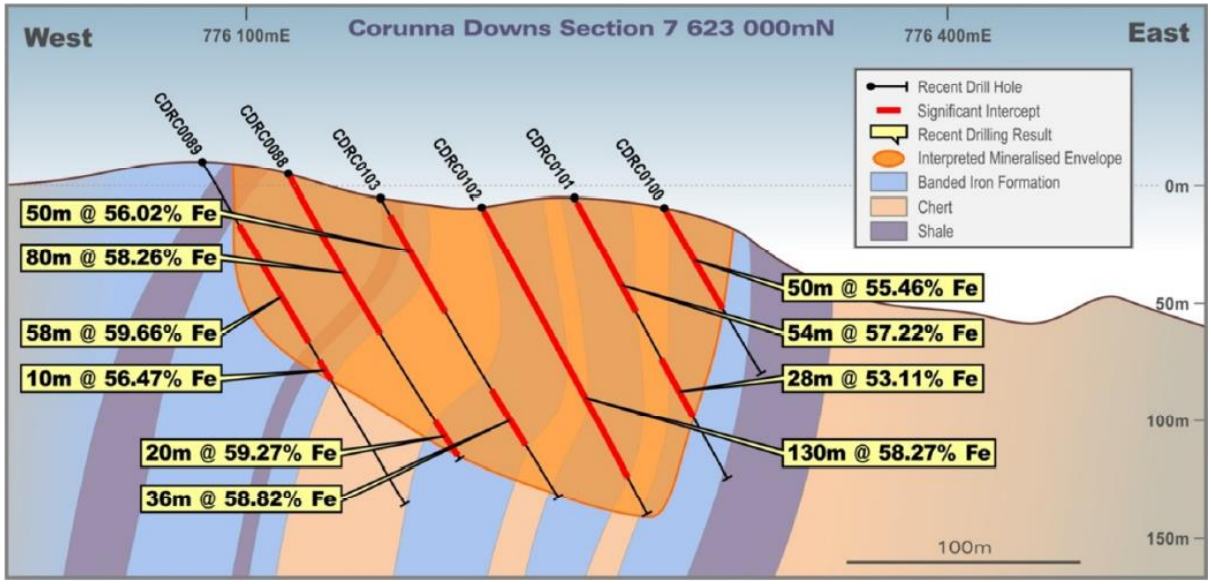


Figure 6.6 – Split Rock Cross-section Highlighting the Sub-vertically Dipping BIF, Chert and Shale Beds

Split Rock is structurally complex, with several major shear zones converging at the deposit location. The effects of these shear zones can be observed in outcrop with hydrothermal breccia and high strain zones associated with local enrichment within the surrounding BIF.

Mineralisation

At Split Rock (the largest deposit within the Project) mineralisation has been found to be related to steeply plunging folds, shear zones and cross-cutting brittle faults (Teitler, 2013). Hematite enrichment is present at depth in the west and northeast of the deposit, which is interpreted to be related to hypogene alteration along these structures and lithological contacts (Teitler, 2014). This can be observed along the contact with reducing carbonaceous shales to the east of Split Rock. Crystalline hypogene magnetite (now mostly oxidised to

martite) replacement structures are further evidence for this hypogene alteration (Teitler et al., 2014).

At surface and concentrated along bedding planes, mineralisation largely consists of goethite which has replaced the hypogene related alteration minerals and further leached the hypogene enrichment of silica (Teitler, 2014). This later supergene enrichment has largely overprinted the hypogene mineralisation in the upper portion of the deposit due to the reactivation of shear zones.

The final stage of mineralisation at Split Rock was the late stage vug infilling by ochreous goethite. This also replaced areas of vitreous goethite but is not commonly seen outcropping at surface due to its low hardness (Teitler, 2014).

Proximal to the mineralisation at Split Rock there is evidence for hypogene magnetite alteration in the protolith jaspilitic BIF, with hydrothermal breccia and high strain shear zones associated with local enrichment observed in outcrop (Teitler et al., 2014). It is theorised that a convergence of the major shear zones observed at the Split Rock deposit could have resulted in the more extensive high grade mineralisation (Teitler, 2013; Teitler, 2014).

6.3.2.1.4 Razorback

Geology

Razorback is situated within a kilometre of the Split Rock deposit to the north east. The stratigraphic sequence at Razorback comprises a mineralised series of westerly dipping sub vertical beds of alternating BIF and ferruginous chert units, bounded to the west by a steeply dipping normal fault zone. The sequence is underlain by a volcaniclastic unit and bounded to the east by another volcaniclastic unit of the Kelly greenstone belt.

Mineralisation

The mineralisation at Razorback is concentrated along the edge of a steep sided gully with goethite mineralisation dominant at surface extending to depths of beyond 100 m. The deposit is located along the same orientation as a late stage fault splay which is likely to be a controlling influence on the enrichment at Razorback.

6.3.2.1.5 Shark Gully

Geology

The Shark Gully deposit is contained entirely within the Cleaverville formation and is bounded on all sides by un-mineralised, high-magnesium BIF. Mineralisation is hosted by a single BIF unit that is locally interpreted as forming a synclinal fold. In addition to the BIF unit, clays and cherts are present through the fold hinge. These are interpreted to be largely fault related, with a high density of faults through the hinge zone.

The deposit contrasts with Split Rock and Razorback in that it has a NE-SW orientation. This orientation is in the same plane as small shear zones (associated with hydraulic breccia) that are visible in the surrounding jaspilitic BIF (Mainwaring et al., 2015). At Split Rock, these shear zones form along the hinge of parasitic folds and along bedding within the jaspilitic BIF, and are associated with minor enrichment. It is believed that Shark Gully represents a larger version of this. This is supported by structural evidence suggesting a large scale fold with the deposit at its core.

Mineralisation

The mineralisation at Shark Gully is the result of hypogene enrichment along the shear zone creating a deep zone of hematite–martite alteration which is associated with significant carbonate alteration in the BIF beneath (Teitler et al., 2014). This has been replaced by goethite in the upper 40 to 80m through supergene replacement from concentrated meteoric fluids in the topographic lows caused by silica leaching. The mineralisation thickens significantly to the west where the highest grade material exists.

6.3.2.1.6 Runway

Geology

The Runway deposit is located in a relative topographic low, bound to the west by a normal fault with a large offset, and to the east by carbonaceous shale, a thick chert unit and the Farrel Quartzite of the Gorge Creek group. Bedding dips to the west and is shallower than at Split Rock, with two main BIF units separated by an un-mineralised chert unit. In some areas it is possible to see bedding–parallel shearing along fold hinges and at fold limbs (Teitler et al., 2014). Zones of hydrothermal breccia in the west of the deposit are also visible within the jaspilitic BIF.

Mineralisation

The presence of hydrothermal breccia within the jaspilitic BIF in the west of the Runway deposit suggests that hypogene alteration of the protolith led to the initial mineralisation at Runway. Within the deposit, crystalline martite alteration has been overprinted by supergene goethite at surface. This can also be seen at depth in core samples and petrographic images (Teitler et al., 2014). At depth there is increased hematite–martite alteration and distal carbonate alteration to the east (Teitler et al., 2014). The majority of the surface enrichment has been replaced by supergene goethite, with bedded hematite outcropping along the east of the deposit.

6.3.2.2 Ore and Waste Materials

Indicative volumes of ore and waste to be mined from each deposit (based on a Fe cut-off of 50%) is summarised in Table 6-6.

Table 6-6 – Indicative Ore and Waste Material Volumes to be Mined

Deposit/Pit	Indicative Volume to be Mined (kt)		
	Ore	Waste Material	Total
Split Rock	12,745	6,031	18,776
Razorback	2,412	1,030	3,442
Runway (North and South)	4,860	1,503	6,363
Shark Gully	4,838	675	5,513
Total	**24,855**	**9,239**	**34,094**

Mine waste is expected to be predominantly BIF, shale and chert. Indicative volumes and proportion of mined waste materials by lithology from each of the four deposits is provided in Table 6-7. A preliminary mine waste inventory is provided in Table 6-8.

Table 6-7 – Indicative Tonnage and Proportion of Waste Rock Material by Lithology

Geozone Code	Waste Lithology	Volume (kbcm)	Volume (kt)	Proportion of Deposit
Split Rock				
101, 113	Jaspilite	193	413	7.1%
102, 112	Shale	628	1,316	24.2%
103/203/503, 105/505, 107/207/507, 109/209/509, 111/211/511	BIF	835	2,010	32.2%
104/204/504, 106/206/506, 108/208/508	Chert	771	1,868	29.8%
110/210/510	Shale/Chert	173	425	6.7%
	Total	**2,590**	**6,032**	**100%**
Razorback				
102, 104/204/504, 106	Chert	172	407	39.5%
103/203/503, 105/205/505	BIF	263	623	60.5%
	Total	**435**	**1,030**	**100%**
Runway (North and South)				
103, 106	Shale	12	36	2.3%
	Siltstone	1	2	0.1%
104, 109	BIF	594	1,441	95.7%
105, 108	Chert	14	33	2.3%
	Total	**621**	**1,503**	**100%**
Shark Gully				
102/202/502	BIF	257	675	100%
	Total	**257**	**675**	**100%**

Table 6-8 – Preliminary Mine Waste Inventory

Lithology	Estimated Volume (kbcm)	Estimated Tonnage (kt)	Proportion
Shale	640	1343	14.5%
Chert	957	2308	24.9%
Shale/Chert	173	425	4.6%
Jaspilite	183	413	4.5%
BIF	1949	4749	51.4%
Total	**3,902**	**9,238**	**100%**

6.3.2.3 Tailings and Other Processing Waste

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

6.3.2.4 Mine Waste Characterisation

6.3.2.4.1 Assessment Methodology and Sampling Locations

Mine Earth has incorporated results of earlier 2016 and 2018 waste characterisation test work with further test work conducted in 2019 to produce a consolidated materials characterisation assessment (Mine Earth, 2020a). The assessment adopted an approach consistent with the Draft Guidance Materials Characterisation Baseline Data Requirements for Mining Proposals (DMP, 2016). The combined results are discussed in this section.

The materials characterisation assessment work was conducted over three phases (Mine Earth, 2020a) as outlined in Table 6-9.

Table 6-9 – Phased Approach to Materials Characterisation Assessment

	Phase 0	Phase 1	Phase 2
Description	Pre-screening review of existing information and 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	Existing drillholes plus nine new geochemical drillholes. The combined dataset was a comprehensive and spatially representative dataset across all deposits (refer to Figures 2 to 5 in Appendix H).	2,144 samples from 306 drillholes 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 H for a breakdown of the number of Phase 1 samples by deposit and lithology.	56 samples were analysed as detailed in Table 6-7. Refer to Figures 6 to 9 of Appendix H 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.

Adapted from Mine Earth (2019a)

Table 6-10 sets out the total number of samples subjected to detailed analysis (i.e. Phase 2) for each deposit across all investigations.

Table 6-10 – Number of Samples Selected for Phase 2 Materials Characterisation

Deposit	Phase 2 Testwork Programs			Total Samples
	2016 (Mine Earth)	2018 (MWH)	2019 (Mine Earth)	
Split Rock	3	4	9	**16**
Razorback	0	9	2	**11**
Shark Gully	4	2	1	**7**
Runway (both pits)	9	7	6	**22**

Source: Mine Earth (2019a).
Note: Figures 6 to 9 of Appendix H illustrate the spatial distribution of these samples.

6.3.2.4.2 Assessment Results

The key characteristics of waste rock within the planned pit shells inclusive of a 10 m buffer as determined by the above assessment (Mine Earth, 2020a) are summarised below.

All waste rock types were classified as non-acid forming (NAF). No potentially acid-forming (PAF) material was identified. Multi-element analysis was undertaken on Phase 2 samples to determine enrichment relative to average crustal abundance. Isolated samples contained enriched mercury (Hg), antimony (Sb) and tungsten (W):

- Hg enrichment using a conservative threshold of 1 ppm was exhibited in three samples from Phase 1 and Phase 2 analysis: one in the Runway North pit shell (1.06 ppm) and two in the 10 m buffer around the Split Rock pit shell (1.63 ppm and 4.19 ppm). Enriched Hg was generally associated with carbonaceous shale, particularly at the Split Rock pit. However, it was identified through water extraction test work to be in geochemically stable forms with restricted solubility at circum-neutral pH and so presents a low risk of metalliferous drainage.
- Sb enrichment was exhibited in 22 samples from Phase 2 analysis. However, like Hg, water extraction test work has shown it is strongly bound to minerals and does not present a leaching risk.
- W enrichment is not considered a concern for the Project due to there being only a single enriched sample.

While GAI values greater than 3 (10 times ACA) for Arsenic (As) and Manganese (Mn) were also identified, these multi-elements are not considered significantly enriched and present a low risk of leaching. Due to the highly ferruginous groundmass of the major waste rocks and as metals will be strongly sorbed to iron oxides, metal loadings orders of magnitude above the ACA (i.e., exceeding 100 times) would be required before there is the prospect of mobility (under neutral pH conditions).

The erosional stability of waste rock was evaluated as:

- BIF and chert – high erosional stability.
- Siltstone sediments – moderate erosional stability.
- Shale (carbonaceous and non-carbonaceous) – low erosional stability.

To define the resources at Corunna Downs, Atlas has drilled over 550 drillholes totalling more than 61,000 m of drilling. All of these holes have been geologically logged by competent geologists. No asbestiform minerals have been observed.

With respect to radioactive minerals, the Corunna Downs deposits are hosted by Cleaverville Formation BIF, a unit not known for its radioactive mineral content. Accordingly, Atlas has not assayed or checked for naturally occurring radioactive minerals (NORM). Of the 61,000 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.

A summary of physical and geochemical properties for each lithology is provided in Table 6-11.

Table 6-11 – Summary of waste rock characteristics

Lithology	Acid Formation Potential	Risk of Metalliferous Drainage	Erosional Stability Classification	Risk of Asbestiform Minerals	Risk of NORM
BIF, Jaspillite	NAF	None	High	Negligible	Negligible
Chert	NAF	None	High	Negligible	Negligible
Shale, Shale/Chert	NAF	Low risk (Hg)	Low	Negligible	Negligible
Siltstone	NAF	None	Moderate	Negligible	Negligible
Ore	NAF	None	N/A	Negligible	Negligible

Source: Acid formation potential, risk of metalliferous drainage and erosional stability classification from Mine Earth (2019a). Risk of asbestiform and radioactive minerals from Atlas.

6.3.2.5 Summary of Baseline Materials Characterisation and Implications for Risk Assessment

Soils

- All surface soils (607,768 m^3) from within 'drainage lines', 'ridgelines', 'scree slopes' and 'flats' landform associations are considered suitable for use as a surface rehabilitation material of constructed landforms.
- 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.
  - Hg enrichment was detected in one sample from the Runway North pit and two samples from around the Split Rock pit shell. Enriched Hg is associated with carbonaceous shale but is considered to be geochemically stable and so presents a low risk of metalliferous drainage. Carbonaceous shale has not been differentiated from non-carbonaceous shale.
  - All other multi-elements were considered benign, as they did not exceed a GAI of 6 and for the small few that did, they were limited in number and have limited prospect of mobility (under neutral pH conditions).
- Risk of asbestiform material or NORM is negligible.
- BIF and chert will comprise the bulk of all waste rock and have high erosional stabilities. Siltstone displays moderate erosional stability. Shale displays only low erosional stability.

6.4 Biodiversity, Flora, Fauna and Ecosystems

The following sections summarise the findings of numerous detailed biological assessments that have been conducted for the Project, as summarised in Table 6-3.

Table 6-12 – Biodiversity, Flora, Fauna and Ecosystems – Relevant Studies

Study	Study Purpose
Level 2 Flora and Vegetation Assessment (Woodman, 2016a; Appendix I)	Woodman Environmental Consulting Pty Ltd (Woodman) conducted a detailed flora and vegetation assessment (i.e., Level 2 survey) in 2014 and 2016 encompassing 25,958.7 ha (referred to as the 'Study Area'). The aim of the survey was to gather background information on the flora and vegetation of the Study Area. The survey was undertaken in accordance with the technical guidance (EPA, 2016a).
Flora and Vegetation Impact Assessment (Woodman, 2016b; Appendix J)	Woodman undertook an impact assessment with the aim of assessing impacts to flora and vegetation, including species of conservation significance, identified in Woodman (2016a).
Assessment of Groundwater Drawdown Impacts to Vegetation (Woodman, 2019; Appendix K)	Woodman undertook an assessment of potential groundwater drawdown impacts on vegetation associated with the Project's water abstraction activities. This assessment was based on the results of SRK's calibrated numerical groundwater model to investigate the potential impacts of water abstraction on groundwater resources and environmental values dependent on groundwater (SRK, 2019a).
Terrestrial Vertebrate Fauna Survey (MWH, 2018; Appendix L)	MWH conducted a detailed vertebrate fauna assessment (i.e. level 2 survey) in 2014 and 2016 encompassing 18,845 ha (referred to as the 'Study Area'). The aim of the survey was to gather background biological information on the terrestrial vertebrate fauna, vertebrate fauna assemblages and fauna habitats. The survey was undertaken in accordance with the technical guidance (EPA, 2016b, c).
Vertebrate Fauna Impact Assessment (MWH, 2016b; Appendix M)	MWH undertook an impact assessment with the aim of assessing impacts to terrestrial vertebrate fauna of conservation significance, fauna assemblages and fauna habitats identified in MWH (2018).
Importance of CO-CA-03 for the Pilbara Leaf-nosed Bat (Stantec, 2017; Appendix N)	Stantec provided further data on and support assessment of usage of each cave by bats. The number of Pilbara Leaf-nosed Bat calls in June 2017 was likely to be underestimated.
Cave CO-CA-03 Pilbara leaf-nosed bat roost census (Bat Call, 2018; Appendix O)	The objectives of the census were to: • Collect high quality video and ultrasonic call recordings of the Pilbara Leaf-nosed Bat entering and exiting cave CO-CA-03. • Provide an understanding of the usage of cave CO-CA-03 at the end of the dry season bottleneck with a view to confirming why this cave is a satellite to CO-CA-01 and not a permanent diurnal roost for the Pilbara Leaf-nosed Bat.

Study	Study Purpose
Terrestrial SRE Invertebrate Fauna Survey (Outback Ecology, 2014; Appendix P)	Outback Ecology assessed the occurrence and likely distribution of short range endemic (SRE) invertebrate fauna, and identified and mapped habitat with the potential to support SRE invertebrate fauna habitat encompassing 15,797 ha (referred to as the 'Study Area'). This survey was undertaken in accordance with the technical guidance (EPA, 2016d).
Terrestrial SRE Invertebrate Fauna Impact Assessment (MWH, 2016c; Appendix Q).	MWH undertook an impact assessment with the aim of assessing impacts to terrestrial SRE invertebrate fauna and habitat identified in Outback Ecology (2014). The 'Study Area' encompassed 18,845 ha.
Subterranean Fauna Assessment (MWH, 2016d; Appendix R)	MWH investigated the subterranean fauna values (stygofauna and troglofauna) and assessed the potential direct impacts. This survey was undertaken in accordance with the technical guidance (EPA, 2016e, EPA 2016f).
Subterranean Fauna Revised Impact Assessment (Stantec, 2019; Appendix S)	Stantec revised the subterranean fauna impact assessment to include proposed groundwater drawdown impacts not considered in the previous MWH (2016d).

6.4.1 Biodiversity/Ecosystems

Communities of plants that are under threat of collapse may be formally protected as Threatened Ecological Communities (TECs) under the State *Biodiversity Conservation Act 2016* (BC Act) and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Furthermore, some communities that are under consideration for State listing as TECs but do not meet the defined criteria or are not yet adequately surveyed for a decision to be made, are added to the Department of Biodiversity, Conservation and Attractions (DBCA) list of Priority Ecological Communities (PECs).

No TECs listed under the BC Act or EPBC Act, or PECs as listed by DBCA, were recorded in the Project area.

6.4.2 Flora and Vegetation

6.4.2.1 Regional Vegetation

The Project is located within the Fortescue District of the Eremaen botanical province (Beard, 1990). The Fortescue botanical 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, 1990).

The Pilbara region was mapped by Beard (1975) at a scale of 1:1,000,000. These vegetation systems have since been updated by Shepherd et al. (2002) to conform to National Vegetation Information System (NVIS) standards (ESCAVI, 2003). The update also accounts for extensive clearing since the Beard (1975) mapping. Shepherd et al. (2002) developed a series of systems to assist in the removal of mosaics; however, some mosaics still occur.

The Project area is located within the Abydos Plain and George Ranges, which still have close to 100% of the pre-European vegetation remaining (Woodman, 2016b).

6.4.2.2 Local Vegetation

6.4.2.2.1 Vegetation Types

A combination of floristic analysis and manual dissection defined 15 vegetation types (VTs) within the Study Area as defined in Table 6-13 and Figure 6.7.

6.4.2.2.2 Vegetation Condition

The majority of the vegetation in the Study Area (90.32%) was ranked as being in Excellent condition, with little to no human disturbance and an absence or low levels of introduced flora taxa (Woodman, 2016a). However, the majority of larger drainage features, including creeks and flow lines, were in comparatively poorer condition due to high densities of aggressive introduced species and high grazing and trampling impacts from cattle. Vegetation condition in these drainage features varied from Very Good to Poor, depending on the levels of introduced taxa and trampling impacts recorded. These condition scores were often inversely correlated with the size of the drainage feature, with large creeks and rivers tending to be ranked lower than smaller flow lines and creeks. Condition was also generally poorer in the north of the Study Area closer to Marble Bar.

6.4.2.2.3 Groundwater Dependent Vegetation

Five of the VTs mapped within the Study Area (VTs 3, 4, 8, 14 and 15) are at least occasionally characterised by taxa that are either known or presumed obligate or facultative phreatophytes, and therefore have the potential to represent groundwater dependent vegetation (GDV) either wholly or in part. However, these VTs are only considered to be GDV where the groundwater is located within 10 m of ground surface (Woodman, 2019).

A site specific assessment was conducted to confirm the presence of, and refine the areas identified as GDV within the impact area (i.e., maximum extent of predicted drawdown), and categorise these areas as either obligate or facultative GDV based on the presence and distribution of phreatophytic taxa recorded (Woodman, 2019) (Figure 6.8). This assessment determined that within the impact area (i.e., maximum extent of predicted drawdown), and where groundwater is within 10 m of ground surface:

- All occurrences of VT 15 represent obligate groundwater dependent vegetation (GDV).
- All occurrences of VT 4 and VT 8 represent facultative GDV.
- VT 3 and VT 14 are obligate GDV in areas where *Melaleuca argentea* and/or *Eucalyptus camaldulensis* subsp. *refulgens* are present, but are otherwise categorised as facultative GDV.

Impacts to GDV from drawdown depend primarily on the sensitivity of groundwater dependent flora species to the extent, duration and rate of drawdown. As supported by monitoring at Atlas Iron's other sites, facultative phreatophytes are unlikely to be impacted by groundwater drawdown (Woodman, 2019). Approximately 557.3 ha of obligate GDV has been identified (Woodman, 2019) and may be at risk of impact from groundwater drawdown (Figure 6.8).

Table 6-13 – Vegetation Types

VT	Description	Extent within (ha)		
		Study Area	Development Envelope[1]	Indicative Disturbance Footprint[2]
1	Mid sparse shrubland dominated by mixed Acacia species over low sparse shrubland of mixed species including *Acacia stellaticeps*, *Pluchea tetranthera* and *Eremophila latrobei* subsp. *glabra* over low hummock grassland dominated by *Triodia epactia* on grey to brown sand to clay loam with occasional granite outcropping, on stony plains, low hills or sandy dunes.	349.6	8.1 (2.3%)	0.18 (0.1%)
2	Tall to mid open shrubland dominated by mixed Acacia species including *Acacia eriopoda* and *Acacia maitlandii* and over low sparse shrubland of mixed species including *Acacia stellaticeps*, *Corchorus parviflorus* and *Corchorus laniflorus* over low hummock grassland dominated mainly by *Triodia epactia* on red-brown sandy clay to clay loam, on granite outcrops to stony plains and drainage lines with exposed granite.	334.2	71.4 (21.4%)	11.96 (3.6%)
3	Low open woodland of mixed species dominated by species including *Corymbia ferriticola*, *Ficus brachypoda*, *Terminalia canescens* over tall sparse shrubland usually dominated by *Acacia pruinocarpa* and *Acacia tumida* var. *pilbarensis* over low open mixed grassland dominated by *Triodia epactia*, *Cymbopogon ambiguus* and *Eriachne mucronata*, on red to brown sand to clay loam on ironstone or metamorphosed granite outcropping, in steep gorges, often with semi-permanent water.	48.7	14.0 (28.7%)	0.61 (1.2%)
4	Low Open Woodland usually dominated by *Corymbia hamersleyana* over Tall Sparse Shrubland dominated by mixed Acacia species including *A. trachycarpa* and *A. ancistrocarpa* with *Dichrostachys spicata* over Low Hummock Grassland dominated by species including *Triodia wiseana* and *T. epactia* with *Eragrostis eriopoda* on brown sandy loams on plains and drainage lines.	586.6	127.7 (21.8%)	10.62 (1.8%)
5	Mid Sparse Shrubland of mixed Acacia species usually dominated by *A. synchronicia* over Low Hummock Grassland dominated by various Triodia species including *T. epactia*, *T. wiseana* and *T. longiceps* on brown clay loams on stony plains and base of low hills.	836	255.3 (30.5%)	32.54 (3.9%)
6	Tall hummock grassland dominated by *Triodia longiceps* with tall isolated shrubs of *Acacia synchronicia* on red or brown sandy to clay loams on stony plains, interspersed with low sparse forbland of mixed species including *Sida fibulifera*, *Rhynchosia minima*, *Tephrosia sp.* clay soils (S. van Leeuwen et al. PBS 0273), *Crotalaria dissitiflora* subsp. *benthamiana*, *Cullen graveolens* and *Eriachne flaccida* on brown cracking clay in clay pans.	273	76.4 (28.0%)	15.03 (5.5%)

VT	Description	Extent within (ha)		
		Study Area	Development Envelope[1]	Indicative Disturbance Footprint[2]
7	Tall sparse shrubland dominated by species including *Acacia bivenosa*, *Acacia synchronicia* and *Dichrostachys spicata* over mid hummock grassland dominated by *Triodia longiceps* over low sparse tussock grassland and chenopod shrubland dominated by *Cenchrus ciliaris* and *Sclerolaena hostilis* on brown clay loam on flats and in open depressions.	124.9	51.0 (40.8%)	1.54 (1.2%)
8	Low isolated shrubs dominated by *Melaleuca glomerata* over mid hummock grassland dominated by *Triodia longiceps* over low mixed sedgeland, grassland and forbland of mixed species including *Schoenus falcatus*, *Trianthema cusackianum* and *Stemodia grossa* on white to brown clay to clayey sand with occasional calcrete and dolerite stones, at the head of drainage lines.	65.6	6.7 (10.2%)	0.13 (0.2%)
9	Low open woodland to isolated trees of *Eucalyptus leucophloia* subsp. *Leucophloia* and/or *Corymbia hamersleyana* over tall sparse shrubland of mixed species usually dominated by *Acacia orthocarpa*, *Acacia monticola*, *Acacia tumida* var. *pilbarensis* and *Grevillea wickhamii* over low shrubland to sparse shrubland of mixed species dominated by *Acacia ptychophylla*, *Acacia spondylophylla*, *Goodenia stobbsiana*, *Dampiera candicans* and *Ptilotus calostachyus* over low hummock grassland dominated by *Triodia epactia* and occasionally *Triodia brizoides* on red to brown clay loam usually over ironstone or metamorphosed granite outcropping, on hill crests or occasionally low rises.	2,694.4	423.1 (15.7%)	196.00 (7.3%)
10	Isolated trees dominated by *Eucalyptus leucophloia* subsp. *leucophloia* and occasionally *Corymbia hamersleyana* over tall to mid sparse shrubland dominated by species including *Acacia bivenosa*, *Acacia inaequilatera*, *Acacia pyrifolia* var. *pyrifolia* and *Grevillea wickhamii* over low open to sparse shrubland of mixed species including *Indigofera monophylla*, *Acacia ptychophylla* and *Senna* spp. over low hummock grassland dominated by *Triodia brizoides*, *Triodia epactia* and/or *Triodia wiseana* over low sparse tussock grassland dominated by *Eriachne mucronata* on red or brown clay loam, usually over metamorphosed granite or occasionally dolerite, quartz or ironstone outcropping, on the upper slopes and crests of steep hills and ridges, or occasionally on low hills, undulating plains and outwashes.	6,625.7	221.4 (3.3%)	51.76 (0.8%)
11	Low isolated trees of *Corymbia hamersleyana* over tall sparse shrubland dominated by *Acacia inaequilatera* and often *Grevillea pyramidalis* subsp. *leucadendron* over low sparse shrubland dominated by *Corchorus parviflorus*, *Indigofera monophylla* and *Senna glutinosa* subsp. *glutinosa* over low hummock grassland dominated by *Triodia wiseana* and/or *Triodia epactia* on red to brown clay loam often with dolerite or occasionally quartz or metamorphosed granite outcropping, on low hills, ridges and occasionally undulating plains.	9,767.1	414.8 (4.2%)	59.73 (0.6%)

VT	Description	Extent within (ha)		
		Study Area	Development Envelope[1]	Indicative Disturbance Footprint[2]
12	Low open woodland of *Corymbia hamersleyana* over mid sparse shrubland dominated by *Acacia bivenosa* over low sparse shrubland of mixed species including *Corchorus parviflorus*, *Heliotropium cunninghamii*, *Indigofera monophylla and Pluchea ferdinandimuelleri* over low hummock grassland dominated by *Triodia wiseana* and/or *Triodia angusta* or *Triodia longiceps* on brown clay loam on stony undulating plains and low rises often with calcrete outcropping.	1,439.7	190.0 (13.2%)	23.89 (1.7%)
13	Isolated trees dominated by *Corymbia hamersleyana* over tall to mid sparse shrubland dominated by *Grevillea wickhamii* and *Acacia bivenosa* over low open to sparse shrubland dominated by *Acacia arrecta*, *Goodenia stobbsiana*, *Corchorus parviflorus* and *Heliotropium ovalifolium* over low hummock grassland dominated by *Triodia angusta* and often *Triodia wiseana* on brown clay loam on stony undulating plains, low hills and ridges with calcrete, dolerite and occasional granite or ironstone outcropping.	694.9	5.0 (0.7%)	0.00 (0.0%)
14	Mid open woodland of mixed species including *Eucalyptus victrix* and *Corymbia hamersleyana* over tall open to sparse shrubland of mixed species including *Acacia coriacea* subsp. *pendens*, *Acacia trachycarpa*, *Acacia pyrifolia* var. *pyrifolia*, *Acacia tumida* var. *pilbarensis* and *Melaleuca glomerata* over low sparse shrubland of mixed species including *Pluchea ferdinandi-muelleri*, *Cajanus pubescens* and *Stemodia grossa* over mid open grassland and sedgeland of mixed species dominated by **Cenchrus ciliaris*, *Triodia longiceps*, *Triodia epactia*, *Chrysopogon fallax* and *Cyperus vaginatus* on red to brown sand to sandy loam with riverstones in minor to medium drainage lines.	1,419.4	88.5 (6.2%)	10.83 (0.8%)
15	Mid open forest to woodland dominated by *Eucalyptus camaldulensis* subsp. *refulgens* and occasionally *Eucalyptus victrix* over tall open shrubland dominated by species including *Acacia ampliceps*, *Melaleuca glomerata* and *Acacia pyrifolia* var. *pyrifolia* over mixed mid open grassland and sedgeland dominated by **Cenchrus ciliaris*, *Cyperus vaginatus* and *Triodia longiceps* on red to brown sandy to clay loam with riverstone in major drainage lines.	502.7	23.0 (4.6%)	0.14 (0.0%)
C	Cleared (including the Hillside-Marble Bar Road, and major exploration tracks)	123.8	12.0 (9.7%)	7.64 (6.2%)
NS[3]	Not Surveyed	72.4	3.9 (5.4%)	0.44 (0.6%)
Total[4]		**25,958.7**	**2,263.3**	**423.11**

Notes to table on previous page

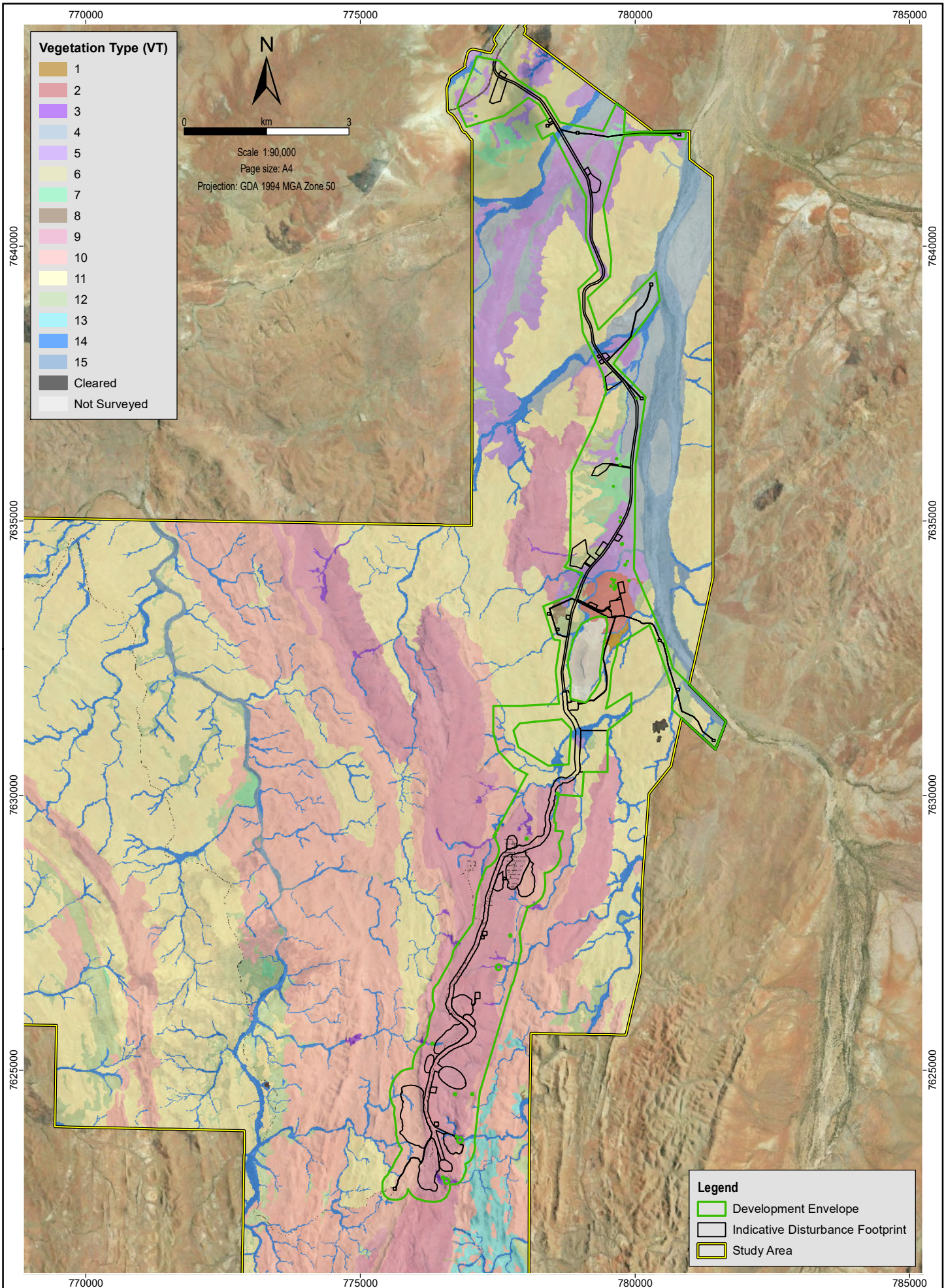
Source: adapted from Woodman (2016b)

(1) These values are calculated from an earlier 2,263.19 ha version of the Development Envelope (Woodman, 2016b), which has since been reduced to 2,257.6 ha to avoid several significant environmental values, a reduction of approximately 5.59 ha. As these impacts are overstated and thus conservative they have not been revised to reflect the current Development Envelope.

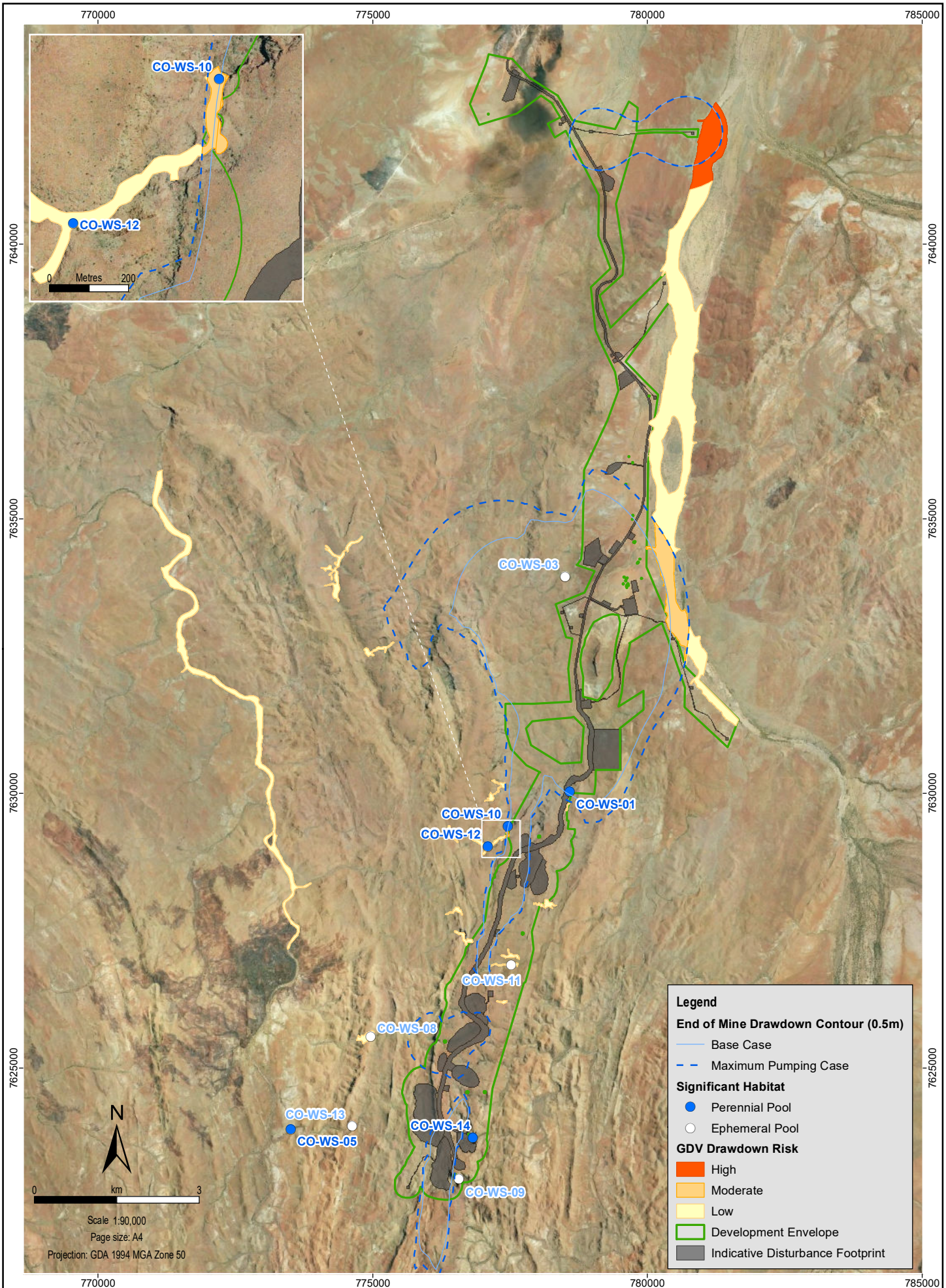
(2) Atlas Iron has recalculated impacts to VTs based on the current 423.11 ha Indicative Disturbance Footprint, which was adjusted following the Woodman (2016b) assessment in an attempt to mitigate impacts to a number of significant environmental values. While the total area of the Indicative Disturbance Footprint remains unchanged at 423.11 ha, the area of each individual VT impacted has changed slightly.

(3) This area relates to an earlier boundary around a potential Aboriginal ethnographical site, which was avoided during the time of the survey based on consultation with the Njamal traditional owners.

(4) Totals may include rounding errors.



File Name: GIS_2627_VegTypes.mxd	Source & Notes: Woodman, 2016a.	**Vegetation Types**	Figure No: **6.7**
Date: 9/12/2019			
Author: Chris.Devlin	*Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*		



File Name: GIS_2628_GDV.mxd Date: 9/12/2019 Author: Chris.Devlin	Source & Notes: 'Woodman, 2018a' for Groundwater Dependent Vegetation Risk mapping. Other hydrological data from Stantec, 2018b. Freshwater soak from Woodman 2018b. *Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*	**Groundwater Dependent Vegetation**	Figure No: **6.8**

A review of available literature on GDV in the Pilbara, including previous studies undertaken at Atlas Iron's Pardoo Direct Shipping Ore (DSO) Project, found that groundwater drawdown related impacts are primarily seen in the two recognised obligate phreatophytes that inhabit primarily riverine environments, *M. argentea* and *E. camaldulensis* subsp. *refulgens* (Woodman, 2019).

E. camaldulensis subsp. *refulgens* can tolerate up to 8 to 10 m of drawdown at rates of up to 5 m/year before experiencing loss in vigour, or death. *M. argentea* can tolerate up to 0.5 m of drawdown before experiencing loss in vigour. Tree deaths may occur where drawdown exceeds 1 m (Woodman, 2019).

6.4.2.2.4 Conservation Significant Vegetation

As stated in Section 6.4.1, no TECS or PECs were recorded in the Project area.

Woodman (2016b) ranked each VT for local conservation significance. Most were considered of limited local conservation significance, however four VTs had higher rankings of 3 and 4 (Table 6-14).

Table 6-14 – Local Conservation Significance of Vegetation

Local Conservation Significance Ranking	Representation in Study Area	Representation of Landform/Soil Type	VTs
4 (higher)	<1%	Locally uncommon and/or restricted	VT3, VT8
3	1%–10%	Locally uncommon and/or restricted	VT6, VT7
2	1%–10%	Locally common and widespread	VT1, VT2, VT4, VT5, VT12, VT13, VT14. VT15
1 (lower)	>10%	Locally common and widespread	VT9, VT10, VT11

Adapted from Woodman (2016b)

Due to a lack of knowledge regarding the regional distribution and the types of landforms upon which they occur, these four VTs are also considered to be of potential regional significance (Woodman, 2016b).

6.4.2.3 Flora Taxa

A total of 413 discrete vascular flora taxa were recorded within the Study Area (Woodman, 2016a).

While no Threatened Flora taxa listed under the BC Act or EPBC Act were recorded within the Study Area (Woodman, 2016a). Eleven DBCA classified Priority Flora taxa were recorded within the Study Area (Figure 6.9):

- Cochlospermum macnamarae (P1).
- *Rothia indica* subsp*. australis* (P1).
- *Schoenus* sp. Marble Bar (D. Coultas & S. Coultas DCSC-Opp 07) (P1).
- *Stylidium weeliwolli* (P2).
- *Acacia levata* (P3).

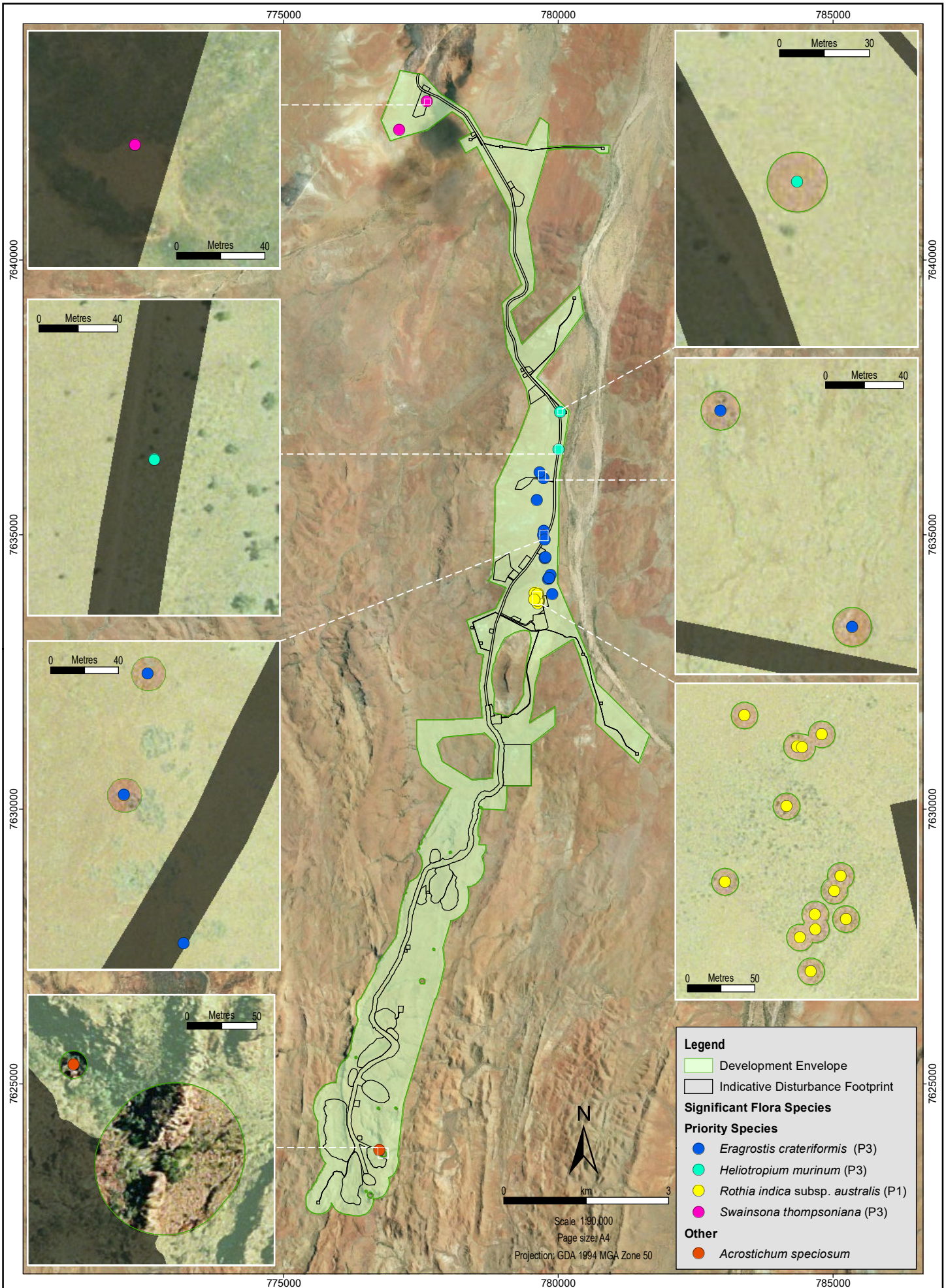
- *Eragrostis crateriformis* (P3).
- *Heliotropium murinum* (P3).
- *Nicotiana umbratica* (P3).
- *Rostellularia adscendens* var*. latifolia* (P3).
- *Swainsona thompsoniana* (P3).
- *Ptilotus mollis* (P4).

A further five species were considered significant as per EPA Guidance Statement No. 51 (EPA, 2004) due to the identification of a taxa having anomalous features (*Abutilon* aff*. Hannii, Oldenlandia* sp*.* and *Portulaca* sp*.*) or representing a range extension or outlier of the main range (*Acrostichum speciosum* and *Eriocaulon pusillum*) (Woodman, 2016a).

6.4.3 Fauna

6.4.3.1 Fauna Habitat

Eleven broad fauna habitat types were identified and mapped over the Study Area as outlined in Table 6-15 and shown on Figure 6.10. Vegetation condition ranged from Good to Excellent. Fire, infestation of weeds (particularly Buffel Grass, *Cenchrus ciliaris*) and feral grazing were the most commonly recorded disturbance factors.



ATLAS	File Name: GIS_2629_ConsSigFlora.mxd	Source & Notes: Woodman, 2016a.	**Conservation Significant Flora**	Figure No: **6.9**
	Date: 9/12/2019			
	Author: Chris.Devlin	*Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*		

Table 6-15 – Broad Fauna Habitats

Fauna Habitat and Category	Vegetation Association and Substrate	Habitat Condition (Disturbance Types)	Extent (ha)		
			Study Area	Development Envelope[2]	Disturbance Footprint[3]
Stony Rises Widespread Limited significance	Scattered *Corymbia hamersleyana* trees over, scattered-open shrubland dominated by *Grevillea wickhamii*, *Acacia inaequilatera* and/or *Hakea lorea*; over open to dense hummock grassland or *Triodia* spp. on skeletal soils of brown clay-loam	Very Good – Excellent (Recent fire, cattle grazing and trampling)	7,703	532.74 (6.9%)	75.27 (1.0%)
Rocky Foothills Widespread Significant[1]	Scattered *Corymbia hamersleyana* trees over, scattered- open shrubland dominated by *Grevillea wickhamii* and/or *Acacia inaequilatera* over hard spinifex on stony red clay loam	Good – Excellent (Recent fire, tracks)	4,458	76.27 (1.7%)	11.43 (0.3%)
Spinifex Stony Plain Widespread Limited significance	Sparse woodland of *Corymbia hamersleyana* over mixed open shrubland dominated by *Acacia pyrifolia, Acacia inaequilatera, Senna* spp, and *Grevillia wickhamii* over dense hummock grassland of *Triodia* spp. and herbs on reddish brown sandy loam	Very Good – Excellent (Recent fire, historical mining, tracks)	1,876	607.97 (32.4%)	100.45 (5.4%)
Rocky Ridge and Gorge Widespread Significant	Gorges dominated by *Eucalyptus camaldulensis* and/or *Melaleuca argentea* with scattered *Ficus* spp. Over mixed *Acacia* spp. shrubland and *Triodia* and *Eriachne* grasses. Ridges with scattered *Eucalyptus leucophloia* and *Ficus* spp. with scattered Acacia spp. over Triodia hummock grassland.	Very Good – Excellent (Recent fire, mining exploration)	1,766	249.26 (14.1%)	39.82 (2.3%)

Fauna Habitat and Category	Vegetation Association and Substrate	Habitat Condition (Disturbance Types)	Extent (ha)		
			Study Area	Development Envelope[2]	Disturbance Footprint[3]
Ironstone Ridgetop Widespread Limited significance	Sparse woodland and mallee woodland of *Eucalyptus leucophloia* scattered trees, over shrubland dominated by *Grevillea wickhamii, Acacia orthocarpa* and mixed *Acacia* spp. over open-dense *Triodia* spp. hummock grassland on red-brown skeletal soils	Good – Excellent (Recent fire, mining exploration)	1,543	537.93 (34.9%)	163.95 (10.6%)
Drainage Line Widespread Significant	Open woodland dominated by *Eucalyptus victrix* and/or *E. camaldulensis*, over open-dense shrubland of *Acacia tumida* and/or *Melaleuca glomerata* with scattered/clumps of tussock grasses, **Cenchrus ciliaris, Eriachne* spp. and *Triodia* spp. hummock grasses on river sand and alluvial loam	Good (Cattle, weeds, recent fire)	502	55.72 (11.1%)	3.40 (0.7%)
Granitic Uplands Limited extent Limited significance	Very open shrubland of slender *Acacia* spp over *Triodia* spp on shallow sandy soils over sheets and outcropping of granite stones and boulders	Very Good – Excellent (Recent fire, cattle trampling and grazing, tracks)	238	0.17 (0.1%)	–
Calcrete Limited extent Limited significance	Scattered *Corymbia hamersleyana* over scattered *Acacia inaequilatera* shrubland over low hard hummock grassland of *Triodia* spp on clay-loam with calcrete	Very Good (Recent fire and cattle adjacent)	235	7.79 (3.3%)	6.71 (2.9%)
Spinifex Sandplain Limited extent Limited significance	Low dense *Acacia* spp. shrubland over dense soft *Triodia* spp. hummock grassland on shallow red/orange sand with underlying hardpan.	Very Good – Excellent (Feral grazing, limited clearing and tracks)	195	157.60 (80.8%)	20.35 (10.4%)

Fauna Habitat and Category	Vegetation Association and Substrate	Habitat Condition (Disturbance Types)	Extent (ha)		
			Study Area	Development Envelope[2]	Disturbance Footprint[3]
Riverine Limited extent Significant	Woodland of *Eucalyptus victrix, E. camaldulensis* and/or *Melaleuca argentea* over shrubland of *Hakea Lorea, Melaleuca glomerata* and/or *Grevillea pyramidalis* with pockets of *Triodia* hummock grassland and **Cenchrus ciliaris* tussock grassland on brown sandy river sands and brown sandy loam.	Very Good to Degraded (Cattle and camel grazing, weeds)	167	37.72 (22.6%)	1.73 (1.0%)
Granite Outcrop Limited extent Significant	Very sparse *Acacia* spp. woodland over shrubland of *Acacia* spp. and *Triodia* spp. hummock grassland on stony red sand, interspersed with substantial granite boulder piles	Not assessed	163	-	-
Total[4]			18,845	2,263.19	423.11

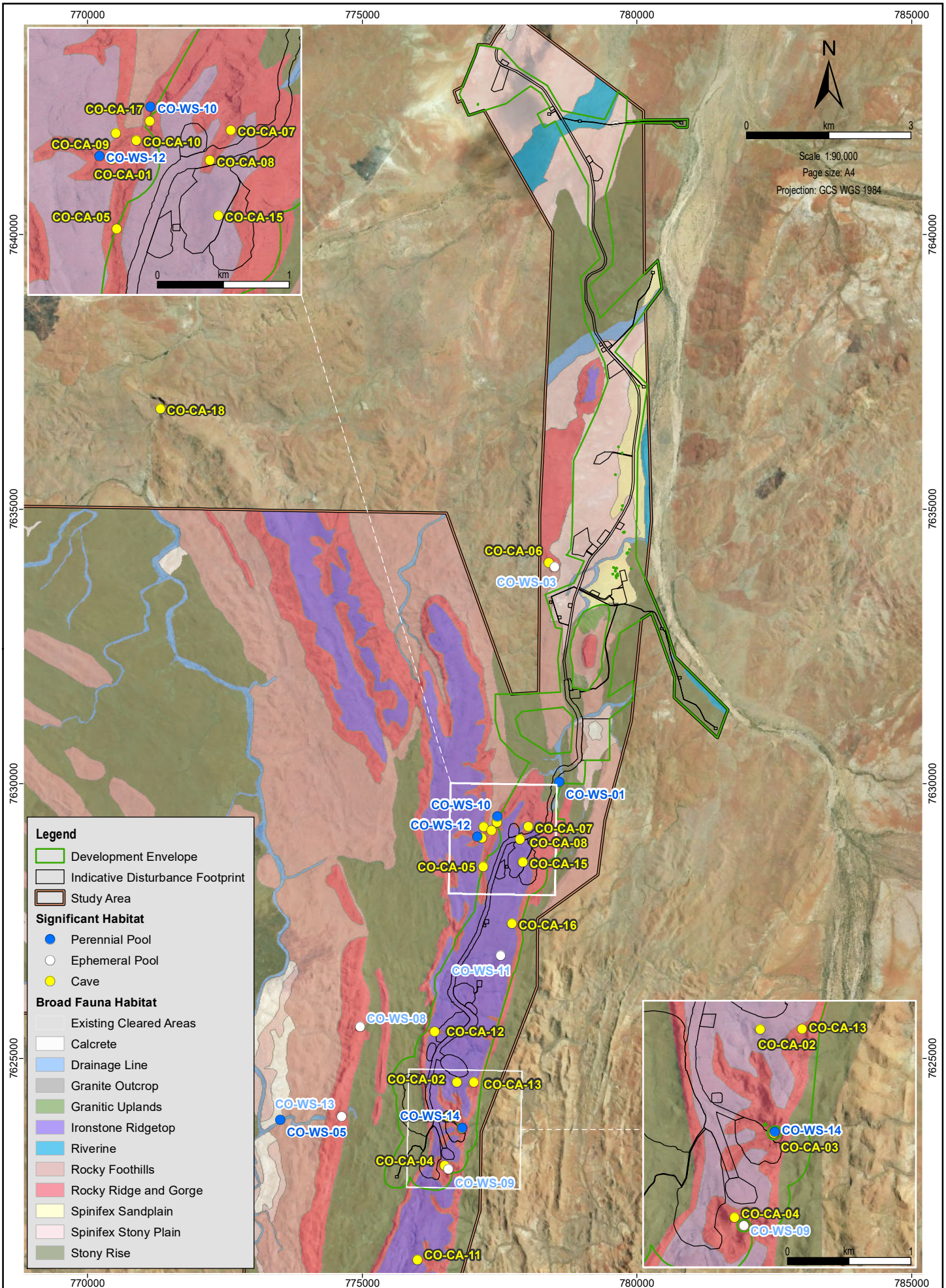
Source: adapted from MWH (2016b)

(1) MWH (2016b) reported that Rocky Foothills habitat was of limited significance. However, Atlas Iron has amended this to 'Significant' to align with conclusions of the Project's EPBC Act assessment of Northern Quoll habitat.

(2) These values are calculated from an earlier 2,263.19 ha version of the Development Envelope (MWH, 2016b), which has since been reduced to 2,257.6 ha to avoid several significant environmental values, a reduction of approximately 5.59 ha. As these impacts are overstated and thus conservative, they have not been revised to reflect the current Development Envelope.

(3) Atlas Iron has recalculated impacts to fauna habitats based on the current 423.11 ha Indicative Disturbance Footprint, which was adjusted following the MWH (2016b) assessment in an attempt to mitigate impacts to a number of significant environmental values. While the total area of the Indicative Disturbance Footprint remains unchanged at 423.11 ha, the area of each individual habitat impacted has changed slightly.

(4) Totals may include rounding errors.



ATLAS	File Name: GIS_2630_BroadFauna.mxd Date: 9/12/2019 Author: Chris.Devlin	Source & Notes: 'MWH (2018)' for fauna habitats and significant microhabitat features. Pool permanency (perennial vs emphemeral) revised (Stantect, 2018b) *Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*	**Broad Fauna Habitats**	Figure No: **6.10**

CORUNNA DOWNS *Atlas*

6.4.3.1.1 Significant Fauna Habitats

None of the habitat types recorded in the Study Area are regionally significant, although five of the fauna habitats present within the Study Area are considered locally significant due to their ability to support conservation significant species or distinct faunal assemblages (MWH, 2018). A summary of each of the significant fauna habitats values and a list of conservation significant fauna known or likely to be supported by them is provided in Table 6-16.

Table 6-16 – Significant Fauna Habitats in the Development Envelope

Significant Fauna Habitat	Summary of Value	Conservation Significant Fauna Known or Likely to be Supported
Rocky Ridge and Gorge	Contains features such as outcropping ironstone, fallen boulders, caves, overhangs, crevices and occasional water sources (i.e., pools), many of which are important microhabitats. Similar habitat of similar value is uncommon in the Chichester subregion.	Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python, Peregrine Falcon, Ghost Bat, Long-tailed Dunnart, *Anilios ganei*
Rocky Foothills[1]	Transitional habitat between Stony Rise and Rocky Ridge and Gorge habitats, which generally lacks microhabitats and features preferred by conservation significant species in Rocky Ridge and Gorge habitat, but may provide foraging resources for these species. Widespread within the region and not generally of conservation significance.	Northern Quoll, Ghost Bat, Peregrine Falcon, Western Pebble-mound Mouse
Drainage Line	Contains temporary-permanent water sources (i.e., pools). Linear form connecting to other habitat types. Widespread availability of microhabitats such as leaf litter, large trees, hollows and water sources. Well represented in region but limited in extent.	Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat, Pilbara Olive Python, Peregrine Falcon, Grey Falcon and migratory waterbirds
Riverine	Stable source of food and water in area surrounded by comparatively resource-poor spinifex plains. Flowering plants of use for some bird species. Migratory species use habitat as movement corridor.	Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat, Pilbara Olive Python
Granite Outcrop	Granite tors of the Abydos Plain are considered focal habitat for a range of fauna, including the Northern Quoll. The tors and boulder piles represent refugia in harsh climatic conditions, disturbance and predators.	Northern Quoll, Pilbara Olive Python

Source: adapted from MWH (2018)

(1) MWH (2016b) reported that Rocky Foothills habitat was of limited significance. However, Atlas Iron has amended this to 'Significant' to align with conclusions of the Project's EPBC Act assessment of Northern Quoll habitat.

6.4.3.2 Fauna Microhabitat Features

A number of important microhabitat features are present within the Study Area, including caves and water sources (i.e., pools). 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 habitat and were not commonly recorded in other broad habitat types of the Study Area.

6.4.3.2.1 Caves

Within the Study Area, 18 caves known to support the Pilbara Leaf-Nosed Bat and/or Ghost Bat, both of which are listed as Vulnerable under the BC Act and EPBC Act, have been identified. Table 6-17 summarises the values of these caves to each bat species.

Sixteen caves are of value only as nocturnal refuges to the Pilbara Leaf-nosed Bat and/or the Ghost Bat. Nocturnal refuges are typically used for foraging and night roosting. They are not considered critical habitat, but do support a species' persistence in an area, facilitating long dispersal and genetic dispersal (TSSC, 2016a; TSSC, 2016b). These caves do not appear to be of high important to the Pilbara Leaf-nosed Bat and/or the Ghost Bat. The remaining two caves are of particular significance to the Pilbara Leaf-nosed Bat:

- **CO-CA-01** has been identified as a permanent diurnal roost for the Pilbara Leaf-nosed Bat. The 407 to 600 individuals recorded during a video roost census completed in 2016 is considered average size for a permanent Pilbara roost and it is also possible, given the higher activity recorded during February and March 2014, that this permanent roost supports a maternity colony for this species. Ghost bats have also been sporadically recorded visiting this cave and so it is also recognised as a temporary diurnal roost for this species (MWH, 2016b).

  This cave is located at the top of a rocky ridge face, in the Rocky Ridge and Gorge habitat. The cave entrance is approximately 6.5 m wide and 1.5 m high and faces north into a narrow gorge, which contains multiple water pools (approximately 40 m from the entrance). The chamber adjoining the cave entrance is approximately 12 m long and 4 m high. A second, rear chamber, where Pilbara Leaf-nosed Bats roost, is approximately 16 m long, 6 m wide and 5 m high. No light penetrates the rear chamber and the walls were found to be visibly wet and seeping water (MWH, 2016b).
- **CO-CA-03** has been identified as a non-permanent breeding roost for the Pilbara Leaf-nosed Bat. No evidence of Ghost Bats was recorded at this cave (Stantec, 2017; Bat Call, 2018).

  This cave is located at the bottom of a major gorge in Rocky Ridge and Gorge habitat. There is a large pool (CO-WS-14, approximately 5 m x 5 m and 1.5 m deep) at the entrance to the cave. The cave entrance faces north-east and is approximately 6 m high and 15 m wide. It is characterised by two major chambers and numerous smaller sub-chambers that could not be defined. The chamber adjoining the entrance is triangular and extends 15 m to the rear where it constricts to 2 m wide and 3 m high. The constriction opens into a rear chamber approximately 4 m wide, 4 m high and 10 m long, with at least two smaller sub-chambers containing Pilbara Leaf-nosed Bats. Seepage of water was observed in the rear chamber on all occasions during survey. These seeps are likely to be a contributing factor to the Pilbara Leaf-nosed Bat using the cave for roosting given the species' preference for humid conditions (Armstrong, 2001 and Churchill, 1991; both cited in MWH, 2018). The cave entrance faces northeast with the rear of the cave in a south-west direction.

Table 6-17 – Caves in the Study Area Known to Support the Pilbara Leaf-nosed Bat or Ghost Bat

Cave	Value to Pilbara Leaf-nosed Bat	Value to Ghost Bat
CO-CA-01	Permanent diurnal roost	Temporary diurnal roost
CO-CA-02	Nocturnal refuge	–
CO-CA-03	Non-permanent breeding roost	–
CO-CA-04	Nocturnal refuge	–
CO-CA-05	Nocturnal refuge	–
CO-CA-06	Nocturnal refuge	Nocturnal refuge
CO-CA-07	Nocturnal refuge	–
CO-CA-08	–	Nocturnal refuge
CO-CA-09	Nocturnal refuge	–
CO-CA-10	Nocturnal refuge	–
CO-CA-11	Nocturnal refuge	–
CO-CA-12	Nocturnal refuge	–
CO-CA-13	Nocturnal refuge	–
CO-CA-15	Nocturnal refuge	Nocturnal refuge
CO-CA-16	Nocturnal refuge	–
CO-CA-17	Nocturnal refuge	Nocturnal refuge
CO-CA-18	Nocturnal refuge	–
CO-CA-19	–	Nocturnal refuge

Source: MWH (2016b)

Note: Cave CO-CA-14 is not included in this table as it was not found during the baseline survey to support Pilbara Leaf-nosed Bat or Ghost Bat.

6.4.3.2.2 Pools

Eleven significant water sources (i.e. pools), five of which are perennial, were identified during the vertebrate fauna survey within the Study Area (MWH, 2018) as illustrated in Figure 6.10. In addition to the pools, a potential freshwater ‘soak’ was also identified during the flora and vegetation and heritage surveys. These are discussed further in Section 6.5.1.

6.4.3.3 Vertebrate Fauna

The desktop study and field survey determined that the Study Area potentially contained up to 327 species of vertebrate fauna (MWH, 2016b). Of these, 174 (53%) were recorded during the field survey including 28 native mammal, four introduced mammal, 72 bird, 66 reptile and four amphibian species. The fauna assemblage was considered representative of the region (MWH, 2018).

6.4.3.3.1 Conservation Significant Fauna

Conservation significant fauna includes species listed as; Threatened or Migratory under the EPBC Act, Threatened or Specially Protected under the BC Act, or Priority species by DBCA.

Seven species recorded during the field survey are listed as conservation significant (MWH 2016b, 2018). Based on regional records and habitats identified within the Study Area, a further 23 conservation significant fauna species could have the potential to occur in the Study Area. Of these, two were considered Likely to occur and 11 were considered Possible to occur. The remaining 10 potentially conservation significant species were considered Unlikely to occur.

Table 6-18 summarises the 20 conservation significant fauna species confirmed present or considered likely or possible to occur in the Study Area (MWH 2016b, 2018). The Night Parrot has also been included given recent records and interest in this species during the Project's EPBC Act assessment, even though it is unlikely to occur.

Table 6-18 – Conservation Significant Fauna in the Study Area

Species[1]	Conservation Status[2]		Likelihood Of Occurrence
	EPBC Act	WA	
Northern Quoll (*Dasyurus hallucatus*)	EN	EN	Confirmed
Ghost Bat (*Macroderma gigas*)	VU	VU	Confirmed
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)	VU	VU	Confirmed
Pilbara Olive Python (*Liasis olivaceus barroni*)	VU	VU	Confirmed
Peregrine Falcon (*Falco peregrinus*)	–	OS	Confirmed
Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*)	–	P3	Confirmed
Western Pebble-mound Mouse (*Pseudomys chapmani*)	–	P4	Confirmed
a blind snake (*Anilios ganei*)	–	P1	Likely
Long-tailed Dunnart (*Sminthopsis longicaudata*)	–	P4	Likely
Greater Bilby (*Macrotis lagotis*)	VU	VU	Possible
Grey Falcon (*Falco hypoleucos*)	–	VU	Possible
Pin-striped Finesnout Ctenotus (*Ctenotus nigrilineatus*)	–	P1	Possible
Spotted Ctenotus (*Ctenotus uber johnstonei*)	–	P2	Possible
Brush-tailed Mulgara (*Dasycercus blythi*)	–	P4	Possible
Fork-tailed Swift (*Apus pacificus*)	MI	MI	Possible
Sharp-tailed Sandpiper (*Calidris acuminata*)	MI	MI	Possible
Wood Sandpiper (*Tringa glareola*)	MI	MI	Possible
Common Sandpiper (*Actitis hypoleucos*)	MI	MI	Possible
Common Greenshank (*Tringa nebularia*)	MI	MI	Possible

Species[1]	Conservation Status[2]		Likelihood Of Occurrence
	EPBC Act	WA	
Glossy Ibis (*Plegadis falcinellus*)	MI	MI	Possible
Night Parrot (*Pezoporus occidentalis*)	EN	CR	Unlikely

Source: MWH (2016b).

(1) The Rainbow Bee-eater (*Merops ornatus*) and Great Egret (*Ardea modesta*) are no longer listed as conservation significant and so are not shown in this table or discussed further within this document.

(2) Conservation status definitions:
EPBC Act: EN – Endangered, VU – Vulnerable, MI – 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).

The following discussion provides a brief context to conservation significant species confirmed to be present and is based on MWH (2016b, 2018).

Northern Quoll

In the Pilbara, the Northern Quoll occurs in fragmented populations primarily associated with rocky ridgeline and outcrop type habitats (Woinarski et al. 2014). It has been recorded in most surveys within the vicinity (approximately 75 km) of the Proposal.

There were 38 records of the Northern Quoll from the Study Area, nine of which were within the Development Envelope. Areas of high abundance were recorded outside the Development Envelope. The majority of records were within the Rocky Ridge and Gorge habitat, with a further eight records within the adjacent transitional Rocky Foothills habitat. Additional records were from Drainage Line, Spinifex Stony Plain and Riverine habitats. The Rocky Ridge and Gorge habitat provides foraging and denning habitat, while the other habitats provide foraging and dispersal habitat. The following four habitats are considered critical habitat for this species: Rocky Ridge and Gorge, Rocky Foothills, Drainage Line and Riverine habitats.

Ghost Bat

The Ghost Bat has a widespread but patchy distribution in the Pilbara (Armstrong and Anstee, 2000). The Klondyke Queen Mine and Comet Mine provide two regionally important maternity roosts (25 km northeast and 20 km north of the Proposal respectively). Individuals from these roosts are likely to forage within the Development Envelope (TSSC, 2016b).

There were 10 records of the Ghost Bat from six caves all within Rocky Ridge and Gorge habitat of the Study Area, four of which were within the Development. While there were no significant diurnal roosts or maternity caves identified in the Development Envelope; Cave CO-CA-01 is a temporary diurnal roost for this species. The remaining five caves were identified as nocturnal refuges for this species. While not a regular visitor in the Study Area, Rocky Ridge and Gorge habitat is generally recognised as critical habitat for this species, which may also utilise all habitats within the Study Area for foraging (MWH, 2016b). Notably, habitats important to the species within the Development Envelope are connected to similar habitat outside the Development Envelope and Study Area. The extent of the regional

population is likely to be limited by the extent and condition of diurnal roost sites rather than foraging habitat.

Pilbara Leaf-nosed Bat

The Pilbara Leaf-nosed Bat's distribution is limited by the scarcity of caves with appropriate microclimates for roosting (Armstong, 2001; Churchill, 1991). There are 30 known roosts within the Pilbara, many of which are in unstable disused mine shafts. Six permanent diurnal roosts are known to occur within 60 km of Marble Bar, as well as several non-permanent breeding roosts and transitory diurnal roosts (TSSC, 2016a). Atlas Iron has also identified two additional permanent diurnal roosts near the Mount Webber DSO Project (MW-AN-27 and MW-CA-02), approximately 45 km west of the Proposal.

This species was recorded on 41 occasions within the Study Area, including 21 records from within the Development Envelope. This species was recorded from 16 caves within the Study Area. Both Cave CO-CA-01, a permanent diurnal roost, and Cave CO-CA-03, a non-permanent breeding roost, for the Pilbara Leaf-nosed Bat are considered critical habitat for the species. The remaining 14 caves provide nocturnal refuge for the species.

Pools are also important for the persistence of local populations due to the species' dependence on humid microclimates (Baudinette et al., 2000). There are a number of important perennial pools located within the Development Envelope as discussed in Section 6.4.3.2.2. However, both cave CO-CA-01 and cave CO-CA-03 are known to contain seeps, which are more likely to control the humidity of these caves and thus the caves' suitability for this species.

Rocky Ridge and Gorge habitat is recognised as critical habitat for this species. All other habitats within the Development Envelope are considered suitable foraging habitat, given the approximately 10 km nightly foraging range of this species (Armstrong, 2007 and Cramer et al., 2016a) and the locations of both CO-CA-01 and cave CO-CA-03.

Pilbara Olive Python

The Pilbara Olive Python has a widespread but patchy distribution in the Pilbara (DPaW, 2016). Although it has been recorded from eight of eleven surveys conducted in the vicinity of the Study Area (MWH, 2018), the limited occurrence of Rocky Ridge and Gorge habitat in the surrounding area (10 km) likely limits the Pilbara Olive Python's ability to move to similar habitat in nearby areas (MWH, 2016b).

Rocky Ridge and Gorge habitat provides sheltering and hunting microhabitats for the Pilbara Olive Python, and represents habitat critical to the survival of the species (MWH, 2016b). It also contains pools, which attract prey. Drainage Line and Riverine habitats provide foraging and dispersal habitat for the species and are also considered to be critical habitat for the species (MWH, 2016b). The Pilbara Olive Python was recorded within the Study Area on four occasions in Rocky Ridge and Gorge, Drainage Line and Ironstone Ridgetop habitats. Three of these records were within the Development Envelope.

Spectacled Hare-wallaby

The Spectacled Hare-wallaby is considered relatively rare within the Pilbara (Woinarski et al. 2014), with very few recent records of the species (DPaW**,** 2016).

The Spectacled Hare-wallaby was recorded on one occasion from the Stony Rises habitat, outside the Development Envelope (MWH, 2016b). The Spinifex Stony Plain, Spinifex Sandplain and Stony Rises habitats are all likely to provide suitable habitat for this species in areas where the spinifex is long unburned (MWH, 2018).

Western Pebble-mound Mouse

The Western Pebble-mound Mouse is endemic to the Pilbara region (Ford and Johnson, 2007, Start et al., 2000) and has been recorded in 10 of the 11 surveys conducted in the vicinity of the Study Area (MWH, 2018).

This species was recorded 13 times within the Study Area, including one record of an active mound and two direct captures (MWH, 2016b). The remaining records were of inactive mounds. Spinifex Stony Plain and Stony Rises habitats are the most suitable habitat for the species within the Study Area, although Ironstone Ridgetop habitat may also provide suitable habitat. The Study Area is unlikely to be of particular conservation significance to the species due to the number of previous records and widespread availability of suitable habitats outside the Study Area (MWH, 2016b, 2018).

6.4.4 Short Range Endemic Fauna

The mapped terrestrial fauna habitats were categorised as having a high, medium or low potential to support SRE fauna based on the presence of microhabitats and whether the habitats were restricted, isolated, widespread and/or connected in the landscape (MWH, 2016b). The majority of the Development Envelope is comprised of habitats with a low potential to support SRE fauna. However, two habitats found within the Development Envelope have a medium or high potential to support SRE fauna: Rocky Ridge and Gorge (high potential) and Drainage Lines (medium potential). Both of these habitats were found in the wider Study Area and neither is restricted to the Development Envelope.

A total of 761 invertebrate specimens from 31 species were collected from the Study Area. Slaters were the most diverse group to be collected, followed by scorpions, pseudoscorpions, snails, selenopid spiders, mygalomorph spiders and millipedes. The desktop study identified three further species with potential to occur, including two millipede species and one snail species.

Within the Study Area, two species were considered to be Confirmed SRE species, three as Likely and 13 as Potential. Of these, two taxa considered Likely and six taxa considered Potential SRE species were recorded within the Development Envelope (Table 6-19). These species have also been collected outside the Development Envelope, either locally or regionally.

Table 6-19 – SRE Fauna Species Recorded Within the Development Envelope

SRE Status	Group	Taxa
Likely	Slater	*Buddelundiinae* 'mw'
		Philosciidae 'corunna'
Potential	Selenopid spider	*Karaops* sp. 'indet. 2'
	Snail	*Rhagada* sp. 'nov'
	Scorpion	*Lychas* 'bituberculatus complex'
		Lychas 'hairy tail complex'
	Slater	*Buddelundia* '11'
		Buddelundia '86'

Source: MWH (2016c)

6.4.5 Subterranean Fauna

No stygofauna species were recorded from the sampled aquifer system within or near the Development Envelope (MWH, 2016d).

A total of 13 troglofauna species from nine higher level taxonomic groups: *Blattodea, Coleoptera, Diplura, Isopoda, Polydesmida, Polyxenida, Pseudoscorpiones, Scolopendromorpha* and *Symphyla*, were collected from the Study Area, with eight found to occur in two or more areas (MWH, 2016d). These species are not considered to be of conservation concern as each species has records in several areas including those of minimal or no impact (Stantec, 2019). While the five remaining troglofauna species are known from only one record each, troglofauna habitat in which they (and the other eight species) occur has been demonstrated to be largely contiguous along the main ironstone ridge system. This troglofauna habitat is therefore found outside and not restricted to the Development Envelope.

6.4.6 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.
- Eleven DBCA classified Priority Flora taxa and five locally significant flora taxa were recorded in the Study Area.
- Approximately 557.3 ha of obligate GDV has been identified.
- Groundwater drawdown related impacts in the Pilbara are primarily seen in the two recognised obligate phreatophytes that inhabit primarily riverine environments;
  - *E. camaldulensis* subsp. *refulgens* can tolerate up to 8 to 10 m of drawdown at rates of up to 5 m/year before experiencing loss in vigour, or death.
  - *M. argentea* can tolerate up to 0.5 m of drawdown before experiencing loss in vigour. Tree deaths may occur where drawdown exceeds 1 m.

Terrestrial Fauna

- Five locally significant fauna habitats (Rocky Ridge and Gorge, Rocky Foothills, Drainage Line, Riverine and Granite Outcrop).
- Variety of significant microhabitats present, including:
  - Eleven pools, five of which are perennial, and one potential freshwater 'soak'.
  - Eighteen caves known to support the Pilbara leaf-nosed Bat and/or Ghost Bat. Sixteen caves are nocturnal refuges, but two caves are of particular significance to the Pilbara Leaf-nosed Bat, including; Cave CO-CA-01 (permanent diurnal roost) and Cave CO-CA-03 (non-permanent breeding roost).
  - 20 species of conservation significance with the potential to occur in the Development Envelope, seven of which have been confirmed, including the; Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat, Pilbara Olive Python, Peregrine Falcon, Spectacled Hare-wallaby and Western Pebble-mound Mouse.

SRE Fauna

- Two habitats have the potential to support SRE (Rocky Ridge and Gorge and Drainage Lines).
- None of the Confirmed/Likely/Potential SRE species recorded within the Study Area were restricted to the Development Envelope.

Subterranean Fauna

- No stygofauna specimens were collected from within the Study Area.
- Of five troglofauna known from one record each, their habitat has been demonstrated to be largely contiguous along the main ironstone ridge system.

6.5 Hydrology

The following sections summarise the findings of various hydrological assessments that have been conducted for the Project, as summarised in Table 6-3.

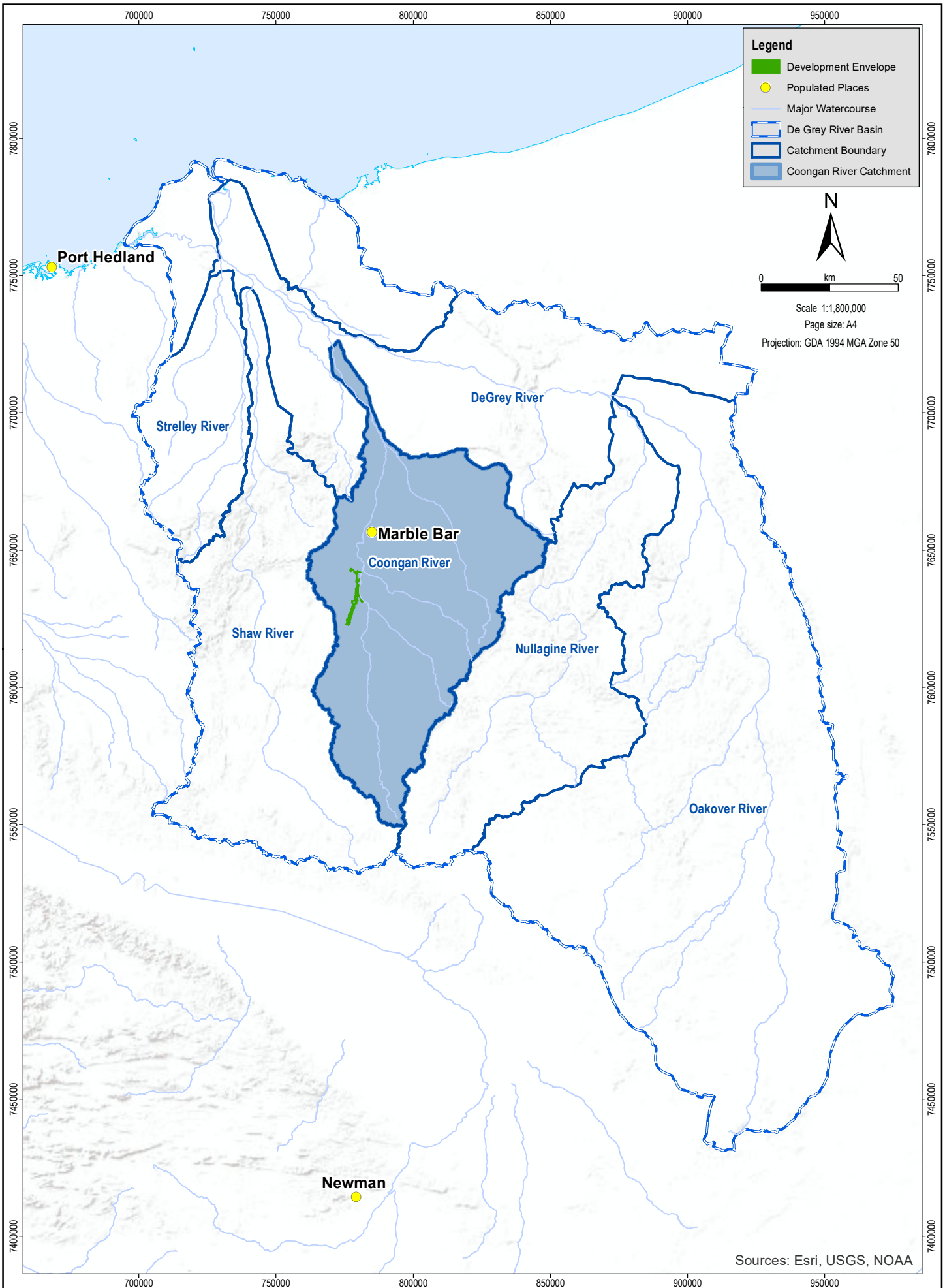
Table 6-20 – Hydrology - Relevant Studies

Study	Study Purpose
Surface Water Environmental Impact Assessment (Stantec, 2018a; Appendix T)	Stantec completed a surface water environmental impact assessment by identifying contributing catchment areas, development of design peaks and assessment of flood risk.
Hydrogeological Investigation (Stantec, 2018b)	In response to hydrogeological queries from DMIRS and DWER in September 2017, this assessment investigated: • Hydrogeology of the Razorback pit area (in relation to cave CO-CA-03 and pool CO-WS-14) • Hydrological and hydrogeological context of the 'soak'. • Drawdown predictions based on 'life of mine' at each of the GDEs, including all pools and the potential freshwater soak. • Discussion of all pools' permanency and groundwater connectivity and an assessment of Proposal impacts using DWER's Rapid Risk Assessment tool. • Catchment analysis/conceptual model demonstrating the mechanisms and sources of water discharging into cave CO-CA-03 and pool CO-WS-14 and how the Proposal may impact these (e.g., how removal of the ridge - mining of Razorback Pit may reduce seepage/water levels). (Outcomes of this assessment are largely superseded by SRK (2019a) H3 Hydrogeological Assessment report below)
H3 Hydrogeological Assessment (SRK, 2019a; Appendix U)	This study addressed DMIRS and DWER concerns around potential water abstraction impacts on environmental values (i.e., pools, soak and groundwater dependent vegetation) and support Atlas Iron's application for a 5C Licence to Take Water under the *Rights in Water and Irrigation Act 1914* (RIWI Act) and this Mining Proposal.

6.5.1 Surface Water

6.5.1.1 Regional Catchments

The Project lies within the middle reaches of the Coongan River catchment, which sits within the De Grey River Basin (Figure 6.11). The De Grey River Basin covers an area of 56,890 km^2 (Ruprecht & Ivanescu, 2000) with its major tributaries being the Strelley, Shaw, Coongan, Oakover and Nullagine Rivers.



File Name: GIS_2631_Catchments.mxd Date: 9/12/2019 Author: Chris.Devlin	Source & Notes: *Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*	**Regional Catchments**	Figure No: **6.11**

The Coongan River system has a total catchment area of around 7,090 km^2 and lies between the Chichester Ranges in the south and minor ranges on the west and east. The Coongan River has a number of tributaries, including Budjen Creek, Triberlar Creek, Boobina Creek, Emu Creek and Camel Creek. Coongan River joins the De Grey River at Mulyie Pool, about 41 km upstream of the confluence with the Shaw River.

Rivers in the Pilbara region are typically ephemeral in nature; however, surface water does exist throughout the year in pools along the main rivers and creeks. These pools are often surface expressions of locally perched groundwater within the alluvium. During periods of river flow, following significant rainfall events, the groundwater systems are recharged by the presence of surface water in the river beds. As river flows subside and river beds dry, permanent pools remain and are fed by groundwater inflow during the dry periods. Major pools on the main branch of the Coongan River are the Nandingarra, Bookargemoona and Doolena pools (Ruprecht & Ivanescu, 2000).

6.5.1.2 Local Surface Hydrology

Gradients along the elevated areas within the Development Envelope are relatively steep, reducing to flatter gradients along the valley floor. The incised drainage paths along the ridge and hill areas indicate that high flows do occur after heavy rainfall events with subsequent erosion and sediment transport. The flat areas spreading out from the ridges provide evidence of low gradient sheet flow. In these areas finer materials carried from high velocity areas would settle out as flow velocities decrease.

The Development Envelope is generally located on or near watershed divides, resulting in small contributing catchment areas. These local catchments generally drain from west to east across the Development Envelope towards the Coongan River.

The Coongan River generally lies in a north-south direction parallel to the Development Envelope and is within 50 m of minor infrastructure (i.e., infrastructure corridor), approximately 700 m from the proposed camp and over 1 km from other major project infrastructure (e.g., pits and run-of-mine).

6.5.1.2.1 Streamflow

Surface flow in the region occurs almost exclusively as a direct response to rainfall and is highly skewed to summer events (80% of flows occur from 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. No perennial streams occur in the immediate vicinity of the Project.

There are two stream flow gauging stations located on the Coongan River (Table 6-21) that can be used to provide an indication of the nature of flows within the catchment.

Table 6.21 – Coongan River Stream Flow Gauges

Station No. and Name	Location	Station Coordinates	Record Period	Catchment Area	Available Data
710006: Coongan River – Marble Bar Rd	Marble Bar road crossing	20°54'59.8" S, 119°47'15.7" E	13/12/2007 onwards	4,338 km^2	Level only
710204: Coongan River – Marble Bar	Marble Bar	21°11'33.4" S, 119°42'52.6" E	11/12/1966 onwards	3,736 km^2	Level and daily flows

Source: DWER (2019)

6.5.1.2.2 Flooding

Stantec's (2018a) surface water impact assessment included flood modelling and analysis for the Project. Most of the Corunna Downs mine infrastructure (i.e., pits, waste rock dumps and most of the access/haul roads) are located on or near the ridgelines, and therefore contributing catchments are relatively small.

The only area of the Project at risk from flooding is near the Split Rock waste rock dump, given its topographical location and proximity to a drainage line. However, modelling of annual exceedance probability (AEP) design flood events found there was no interaction between the drainage line flood flows and the toe of the dump, and therefore no surface protection is currently required (Stantec, 2018a).

Atlas also completed additional flood modelling for the camp site (Atlas Internal Memorandum – Corunna Downs Additional Flood Modelling, March 2017) which confirmed that the camp sits outside the 100-year flood level with a freeboard of approximately 3.5 m.

6.5.1.2.3 Significant Hydrological Features

There are a number of pools, seeps and springs in the vicinity of the Project. Eleven significant water sources (i.e. pools) were identified during the vertebrate fauna survey within the Study Area (MWH, 2018) (Figure 6.12). An assessment of the pools' permanency (ephemeral or perennial), connectivity to groundwater and surface water quality analysis was undertaken by SRK (2019a).

Five of the eleven pools were determined to be perennial (i.e. permanent), four of which are considered likely to be groundwater dependent. One of these groundwater dependent pools, CO-WS-14, is of particular importance as it is believed to be intrinsically linked to cave CA-CO-03, a non-permanent breeding roost for the Pilbara Leaf-nosed Bat. This pool along with an observed seep inside this cave are likely to contribute to the microclimate (i.e., humidity) and thus the suitability of this cave as a non-permanent breeding roost for the Pilbara Leaf-nosed Bat. A summary of all eleven pools is provided in Table 6 2.

6.5.1.2.4 Surface Water Quality

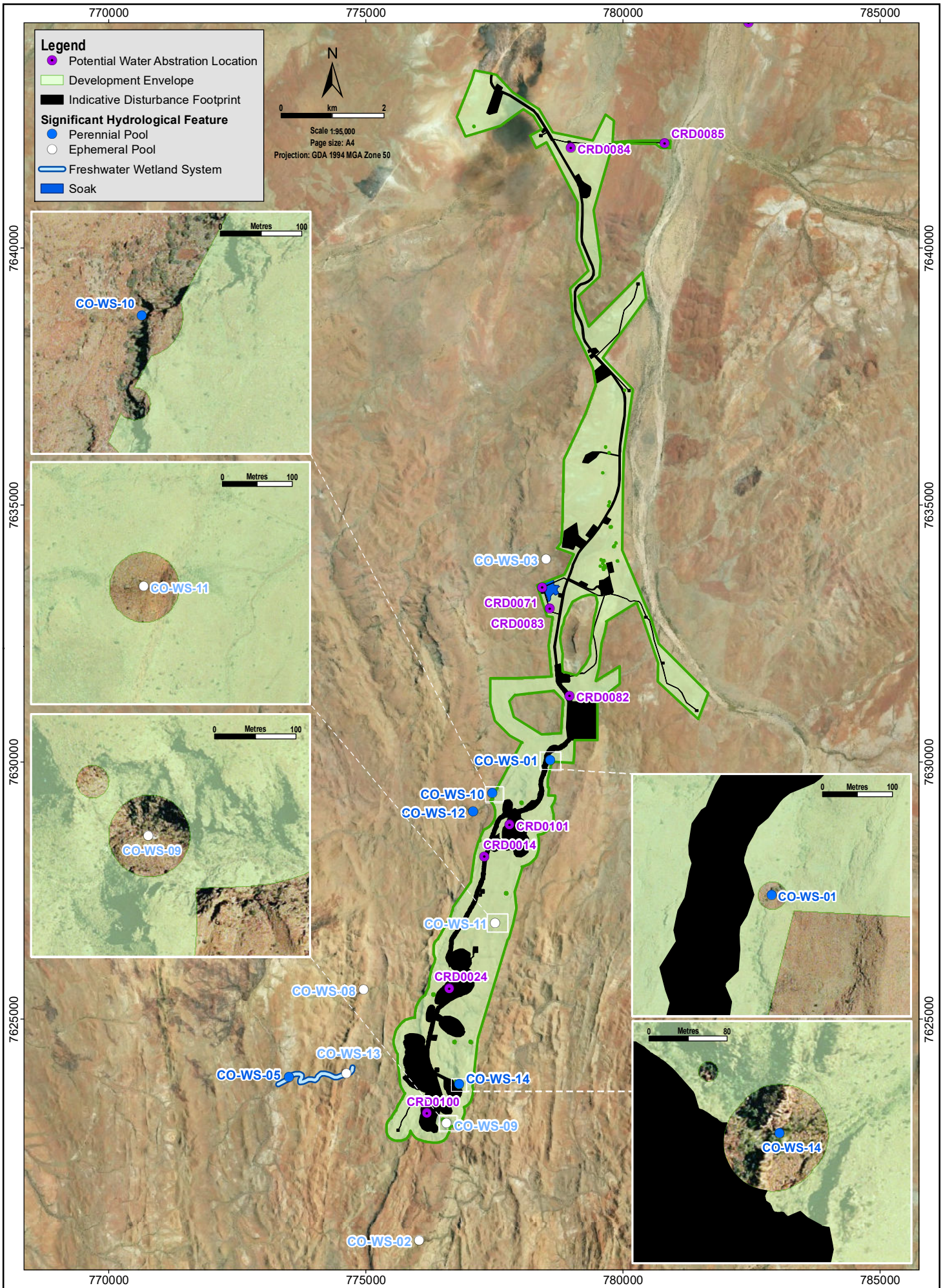
Sampling of pools with available surface water has been completed between 2017 and 2019 (SRK, 2019a). Samples were analysed for physical parameters (pH, electrical conductivity (EC), total dissolved solids (TDS)), major ions, trace elements and metals. Detailed analysis of results are provided in Attachment D of Appendix U.

Table 6-22 – Pool Permanency, Groundwater Dependency and Surface Water Quality Analysis

Pool	Location	Permanency	Groundwater Dependency	Surface Water Quality Characteristics
CO-WS-01	Within Development Envelope, outside Indicative Disturbance Footprint. Approximately 20 m downstream of the haul road.	Perennial	Likely	Bicarbonate and Magnesium dominant recharged water; same as bores within BIF near Runway pit. Stable total dissolved solids (TDS) over time.
CO-WS-02	Outside Development Envelope. Approximately 2 km south of the Split Rock pit.	Ephemeral	Unlikely	No field observations due to access restrictions.
CO-WS-03	Outside Development Envelope. Approximately 430 m upstream of a borrow pit.	Ephemeral	Unlikely	Field observations reported the pool as drying completely with no evidence of active seepage.
CO-WS-05	Outside Development Envelope. Approximately 2.2 km downstream of the Split Rock waste dump.	Perennial	Likely	Pool is consistent with groundwater in the area, but has fluctuating TDS levels over time, indicating some concentrations of analytes due to evaporation.
CO-WS-08	Outside Development Envelope. Approximately 1.4 km downstream of the Shark Gully pit.	Ephemeral	Potential seasonal contribution	Pool is consistent with groundwater in the area, but has fluctuating TDS levels over time, indicating some concentrations of analytes due to evaporation.
CO-WS-09	Outside Development Envelope. Approximately 185 m downstream of pit and 175 m downstream of topsoil stockpile.	Ephemeral	Unlikely	Pool is not consistent with groundwater in the area and has fluctuating TDS levels over time, indicating some concentrations of analytes due to evaporation.
CO-WS-10	Outside Development Envelope. Approximately 280 m downstream of the Runway North pit.	Perennial	Potential seasonal contribution	Pool is not consistent with groundwater in the area and has fluctuating TDS levels over time.

Pool	Location	Permanency	Groundwater Dependency	Surface Water Quality Characteristics
CO-WS-11	Outside Development Envelope. Approximately 500 m downstream of a waste rock dump, 600 m downstream of haul road and 200 m upstream of minor infrastructure corridor.	Ephemeral	Potential seasonal contribution	Pool is not consistent with groundwater in the area and has fluctuating TDS levels over time. The pool may be fed intermittently by infiltrating meteoric water via fractures.
CO-WS-12	Outside Development Envelope. Approximately 570 m downstream of the Runway North pit and 470 m downstream of haul road.	Perennial	Likely	Interpreted to be a source of water for pool CO-WS-10.
CO-WS-13	Outside Development Envelope. Approximately 1.1 km downstream of the Split Rock waste rock dump.	Ephemeral	Potential seasonal contribution	Pool is consistent with groundwater in the area, but has fluctuating TDS levels over time.
CO-WS-14	Outside Development Envelope. Approximately 70 m downstream of the Razorback pit; adjacent to the entrance to cave CA-CO-03.	Perennial	Likely	Seepage internal to the cave has been observed year-round. Bicarbonate and Magnesium dominant recharged water and has stable TDS levels over time.

Source: SRK (2019a)



File Name: GIS_2632_HydroFeatures.mxd Date: 9/12/2019 Author: Chris.Devlin	Source & Notes: Freshwater wetland system - location and extent inferred from Golder, 2010 Other hydrological data from Stantec, 2018b. Freshwater soak from Woodman 2018b. *Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*	**Hydrological Features**	Figure No: **6.12**

Salinity was highly variable at individual pool locations, with TDS ranging from 26 to 2,800 mg/L. High variation in salinity over time within a single pool indicates a level of analyte concentration due to evaporation that suggests recharge to those pools is inconsistent. A consistent and low salinity level over time is reflective of constant recharge/throughput, most likely from groundwater sources. Such is the case for pools CO-WS-01 and CO-WS-14, which have been determined to be perennial and groundwater dependent.

Several perennial pools are characterised as bicarbonate and magnesium dominant, indicating some contribution from groundwater. However, some samples indicate a level of mixing from time to time reflecting periods of surface water inflow following rainfall events. Water quality in other pools (CO-WS-08, -09, -11 and -13) is more reflective of surface water inflow, or end point water reflective of concentration of analytes through evaporative processes, supporting the conclusion that these pools are ephemeral.

In addition to the identified pools, two other potentially important hydrological features have been identified within the Development Envelope:

- A potential freshwater 'soak' (associated with a 6.7 ha occurrence of the vegetation unit VT 8) as recorded by Woodman (2018). The soak is a small pan at the upper reaches of a minor catchment, interpreted to be an ephemeral, perched alluvial water bearing unit based on the observation of residual encrusted evaporates and the presence of stratified sands and clays, and is likely recharged during major rainfall events (SRK, 2019a). While no active groundwater discharge or standing water has ever been observed at the soak by Atlas or its contractors, groundwater data in the vicinity of the soak suggests that the water table in the area is shallow (within 3-5m). As the connectivity of the soak with the deeper groundwater system is not well understood, reliance on groundwater cannot be completely ruled out (SRK, 2019a).
- A system of several permanent and temporary freshwater pools of variable size was recorded in 2010 by Golder Associates (Golder, 2010). The system was recorded approximately 1 km west of the Development Envelope. A survey in 2009 by Outback Ecology did not find any standing water within this system (i.e., all pools were dry). Two of the pools (CO-WS-05 and CO-WS-13) recorded by MWH (2018) appear to be associated with this system.

6.5.1.3 Environmental Values and Beneficial Uses

The significant hydrological features outlined in Section 6.5.1.2.3 are important microhabitats known to support, or have potential to support, flora and fauna. Permanent pools are important refugia from which rivers are repopulated during flood events, with the deeper pools generally showing higher levels of biodiversity due to water chemistry being more stable (Centre for Excellence in Natural Resource Management 2009).

Specifically, birds and mammals will use these areas for drinking, amphibians will use these areas to breed, and many vertebrate fauna species benefit from the increased invertebrate abundance as food (MWH, 2018). For example, the Pilbara Leaf-nosed Bat forages on invertebrates and requires drinking water regularly due to the species high metabolic expenditure (Churchill, 1994). Furthermore, a seep into the back of cave CO-CA-03 is believed to support the use of this cave by Pilbara Leaf-nosed Bat as a non-permanent breeding roost.

6.5.1.4 Surface Water Management

The Project is located within the Pilbara Surface Water Area a Department of Water (DOW) Surface Water Management area managed under the *Rights in Water and Irrigation Act 1914* (RIWI Act).

6.5.2 Groundwater

6.5.2.1 Regional Groundwater Dynamics

The hydrogeology of the northern Pilbara is typified by faulted granitoid rocks and folded Archaean greenstone belt rocks, predominantly providing a fractured rock setting in which groundwater storage and transmission is structurally controlled. Aquifers types range from unconfined to confined, with the fractured rock setting typically unconfined to semi confined. Groundwater typically occurs in zones of structurally developed secondary permeability and porosity such as fractures, zones of weathering and along bedding planes, joints and geological contacts (SRK, 2019a). Groundwater is predominantly recharged on the regional scale by episodic intense tropical low and cyclonic rainfall events, plus intense thunderstorm events on the local scale (Stantec, 2018c).

The regional groundwater likely flows to the north consistent with the drainage direction of the major surface drainage features (rivers), while local groundwater flow directions will be driven by the interaction of topography, saturation level of the phreatic surface, and the interconnectivity of the structural elements of the rock mass (Stantec, 2018c).

The Project is situated within the East Pilbara subarea of the Pilbara Groundwater Area proclaimed under the *Country Areas Water Supply Act 1947*. Mining water supply is an accepted water usage under this plan.

6.5.2.2 Local Hydrogeology

Groundwater resources in the Project area occur within two primary units; the Fractured Bedrock Aquifer (FBA) and ephemeral alluvial systems associated with surface water drainage lines (SRK, 2019a).

The alluvial groundwater system is primarily associated with the Coongan River and its tributaries which runs adjacent to the Corunna Downs ridge, east of the Project. Groundwater in this system is likely to be present during and for a period following significant rainfall events, however may persist for extended periods where the aquifer is thicker. Recharge to the FBA by leakage may be an important process in local areas.

The FBA lies below the alluvial groundwater system, and is a set of discrete, highly compartmentalised aquifers associated with zones of secondary porosity formed through faults, folding and areas of contact between geological units, and is hosted in the Project area within the BIF, Mt Roe Basalt, Hardy Formation, Dalton Suite, Wyman Formation, and Euro Basalt. FBA systems are typically highly anisotropic, with groundwater flow and hydraulic characteristics strongly controlled by bedding planes and structure. Field investigations have determined that hydraulic conductivity is highly variable, as is connectivity within the strata and with other geological units, although analysis of water levels suggest that the hydraulic connection between the BIF and surrounding units is weak.

Recharge occurs primarily through direct rainfall infiltration where fracture systems and/or geological structures are exposed at surface, and may also occur through infiltration from

overlying alluvium where present. The latter recharge mechanism is enhanced where fracture or contact zones intersect ephemeral water courses.

6.5.2.2.1 Groundwater Levels

Groundwater gradients within the elevated BIF plateau are typically a subdued reflection of surface topography (SRK, 2019a), lying within 25 to 60 m below ground level (mbgl) within pit areas and between 3 to 10 mbgl in the low lying elevations. Water table elevations between pit areas (i.e., on the range) varies by as much as 82 m and currently lies at approximately 355 metres Australian Height Datum (m AHD) at Split Rock, 339 m AHD at Razorback, 421 m AHD at Shark Gully and 353 m AHD at Runway (Stantec, 2018b). Apart from the differences in water table elevation between pit areas, the variance in rates of annual water level fluctuations also appears to support the presence of perched or compartmentalised groundwater zones, as supported by the marked decline in water levels at Runway (1.6 m/year) and to a lesser extent at Split Rock and Razorback (Stantec, 2018b).

While water table elevations and rates of seasonal decline differ between pits, similarities in geology, structure, physiography and associated drainage characteristics suggest that the mechanism for recharge and responses to seasonal events may be similar across the range. Observed response to rainfall events across the range varied from 0 to 0.2 m at Split Rock and averaged 0.42 m at Shark Gully (Stantec, 2018b). Seasonal variation within the water table is anticipated to be 2 to 3.5 m in low lying elevations where depth to water is shallower and response to rainfall recharge is considerably greater (Stantec, 2018b).

6.5.2.2.2 Groundwater Quality

Groundwater samples have been collected from across the site from 2014 to 2019, and analysed by SRK (2019a) in conjunction with samples collected during their 2019 investigation. Samples were analysed for physical parameters (pH, EC, TDS), major ions, trace elements and metals. Detailed analysis of results are provided in Attachment D of Appendix U.

Results indicate groundwater to be generally neutral with pH values ranging between 5.6 and 8.6, and fresh to marginally brackish with TDS values between 42 and 1,800 mg/L. Generally, lower salinity is recorded within the BIF units of the Corunna ridge, with the more saline water occurring within the Hardy Formation to the north of the ridge within the Coongan River valley. No saline groundwater resource has been identified at depth to date.

Groundwater sample analysis indicates a range of groundwater types, though typically bicarbonate and magnesium dominant indicating recharging water, or with no dominant cation or anion reflective of some form of mixing mechanism (i.e. between newly recharged water and older water). An exception was CRD0006, located at the northern end of the ridge which intersected sodium and chloride dominant groundwater, suggesting that this bore may intersect a discrete aquifer unit with older, end point water.

Consistently detected dissolved metals in groundwater samples include barium (0.0003–0.092 mg/L), boron (0.02–1.0 mg/L), manganese (0.6–290 mg/L), nickel (0.0001–0.037mg/L), strontium (0.022–0.73 mg/L) and zinc (0.001–0.23 mg/L) (SRK, 2019a).

6.5.2.3 Environmental Values and Beneficial Uses

Groundwater is thought to express at a number of locations within the Project area, as described in Section 6.5.1.2.3, which is an important resource for native fauna, including Northern Quoll, Pilbara Olive Python and Pilbara Leaf-nosed Bat.

Vegetation that rely on groundwater for some or all of their water requirements are classified as GDV's (outlined in Section 6.4.2.2.3). Groundwater can be the main factor controlling the distribution of vegetation types, and impact of changes in groundwater quantity and quality on GDV's is determined by the degree and nature of their groundwater dependency.

There are no other groundwater users in the vicinity of the Project.

6.5.2.4 Groundwater Management

The Project's groundwater does not occur within any gazetted groundwater management areas.

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

Surface Water

- The Development Envelope is generally located on or near watershed divides, resulting in small contributing catchment areas.
- Flooding does not represent a significant risk for the Project.
- During larger magnitude rainfall events, sediment loads are naturally high.
- Only five of the 11 identified pools are perennial, four of which are considered likely to be groundwater dependent.
- One of the perennial groundwater dependent pools, CO-WS-14, is believed to be linked to cave CA-CO-03, a non-permanent breeding roost for the Pilbara Leaf-nosed Bat.

Groundwater

- Depth to groundwater is 25 – 60 mbgl within pit areas and 3 – 10 mbgl in low lying elevations. Water table elevations between pit areas (i.e., on the range) varies by as much as 82 m and currently lies at approximately 355 m AHD at Split Rock, 339 m AHD at Razorback, 421 m AHD at Shark Gully and 353 m AHD at Runway.
- Groundwater quality varies from fresh to marginally brackish and are typically bicarbonate and magnesium dominant, suggesting the aquifer is recharged primarily from direct rainfall.
- No saline groundwater resource has been identified to date.
- There are no other groundwater users in the vicinity of the Project.

6.6 Environmental Threats and Other Factors

Threatening processes relevant to the Pilbara bioregion have been identified in the *Pilbara: State of the Environment Report* (RDA, 2013).

6.6.1 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).

Several introduced flora taxa are known to occur within or adjacent to the Development Envelope, including *Aerva javanica*, *Calotropis procera*, *Cenchrus ciliaris*, *Chloris barbata*, *Cynodon dactylon*, *Echinochloa colona* and *Passiflora foetida* var. *hispida*. None of these species are recognised as Declared Pests in WA under the *Biosecurity and Agriculture Management Act 2007* or *Weeds of National Significance* (Woodman, 2016a).

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.

The habitats within the Study Area are largely weed free (MWH, 2016), and there is potential for substantial change to occur to vegetation communities should invasive flora be introduced and become established.

6.6.2 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*), feral Cat (*Felis catus*) and House Mouse (*Mus musculus*), have been recorded in the Study Area (MWH, 2018). An additional five species have been recorded within the vicinity of the Study Area; Fox (*Vulpes vulpes*), Donkey (*Equus asinus*), Horse (*Equus caballus*), Rabbit (*Oryctolagus cuniculus*) and Pig (*Sus scrofa*) (MWH, 2018). Only three of these species – the feral Cat, House Mouse and domestic cattle – are listed as 'Declared Pests' under the *Biosecurity and Agriculture Management Act 2007* (WA).

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.

Of particular concern would be an increase in the size or density of the local population of feral Cats, which are not only a direct predator of the Northern Quoll, Pilbara Olive Python and other ground-dwelling fauna, but also compete for food resources and habitat requirements.

6.6.3 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).

The development and ongoing operation of the Project may alter the fire regime of the Development Envelope through the introduction of unplanned fire caused by vehicle movements and/or other Project activities such as hot work.

Species most at risk of direct impact include small, sedentary species which occur in homogenous, fire-prone habitats, such as the Western Pebble-mound Mouse, and species which occur primarily in fire refuge habitats, such as the Rocky Ridge and Gorge, like the Northern Quoll (Woinarski et al., 2001) and Pilbara Olive Python (Pearson, 2003). Additionally, some species, due to their life histories are susceptible to fire, such as the Ghost Bat (Bullen and McKenzie, 2011) and Spectacled Hare-wallaby (Ingleby and Westoby, 1992).

6.6.4 Noise

While regulated under the EP Act, this section provides contextual information regarding the threat of Project noise in support of Section 7.

The development and ongoing operation of the Project is likely to generate noise and vibration due to blasting, general operation of heavy machinery and vehicles, diesel generators and the presence of personnel.

The effects of noise on wildlife have been well studied, although responses vary depending on age and sex (for a comprehensive summary see Newport et al., 2014). Impacts caused by noise range from interruptions in feeding and resting behaviour, to complete abandonment of an area (Newport et al., 2014). Noise may lead to reduced population densities in small mammals, nest failure and decreased population densities in birds (Slabbekoorn and Ripmeester, 2008), abandonment of roost sites for bats (K. Armstrong pers. comm. in Woinarski et al. 2014), and reduced hunting efficiency in bats due to disturbance of their echolocation system (Siemers and Schaun, 2010). Constant levels of noise may also interfere with species communication, via acoustic interference (Parris and Scheider, 2009). Species that may be especially at risk of disturbed communication are those that use calls to communicate or navigate.

The Pilbara leaf-nosed Bat is known to be susceptible to noise, vibration and dust impacts. As these impacts are largely associated with blasting activities, which will be restricted to daytime operations, habitat most likely to be at risk are those caves that support diurnal roosting, including the permanent diurnal roost (CO-CA-01) and the non-permanent breeding roost (CO-CA-03).

Talis (2016; Appendix V) completed a noise impact assessment which concluded that received noise levels from mining operations are predicted to comply with the assigned levels at all assessed sensitive receivers.

6.6.5 Dust/Air Quality

While regulated under the EP Act, this section provides contextual information regarding the threat of Project dust emissions in support of Section 7.

The development and operation of the Proposal 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 emissions have the potential to affect surrounding vegetation and water sources which fauna rely on. High levels of dust have been associated with a reduction in plant growth and productivity and, alteration of soil chemistry leading to changes in vegetation community structure (Farmer, 1993). Such effects are likely to impact on faunal assemblages via a reduction in food resource availability and shelter.

Dust may directly pollute water bodies by increasing turbidity or potentially altering water chemistry. Water sources at risk in the Project area include CO-WS-01, CO-WS-09 and CO-WS-14 given their proximity to the Disturbance Footprint. Common dust suppression measures and management practises used in the mining industry in WA will be sufficient to minimise impacts: sprinklers, water sprays, and/or water carts on roads, stockpiles and infrastructure areas and speed limits on unsealed roads.

Pacific Environmental Limited (2017; Appendix W) completed an air quality assessment for the Project, which concluded no significant impact on the air quality in the region.

6.6.6 Artificial Light

Exposure of fauna to artificial light may interfere with biological and behavioural activities that are governed by the length of day (photoperiod), including reproduction, dormancy, foraging and migration (Bradshaw and Holzapfel, 2007; Le Corre et al., 2002; Stone et al., 2015).

As aspects of the Project will be in operation on a 24-hour basis, the presence of artificial lighting for night operations may have an impact on mammal, bird, reptile and amphibian species occurring within the vicinity of the light sources. Excessive light is likely to have an effect on the natural foraging behaviour of bats, in particular the Pilbara Leaf-nosed Bat, which is thought to be attracted to light sources (Cramer et al., 2016a). Long-term studies at Mt Dove have however shown that Pilbara Leaf-nosed Bat activity is not impacted by artificial illumination, and perhaps contributed to increased species activity, presumably due to increased foraging resources (C. Knuckey, unpub. data).

6.7 Heritage

The Project is located entirely within the Njamal Native Title claim area (WC 1999/08). Atlas has a Deed of Agreement with Njamal, signed on 5 December 2008. This Deed of 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 the Claimant Group and the Representative Body.

The Aboriginal Heritage Due Diligence Guidelines (DAA, 2013) have been considered in the development of this agreement and the works undertaken to date in support of this Project, including the completion of various archaeological and ethnological surveys over the entire Indicative Disturbance Footprint, as shown in Figure 6.13.

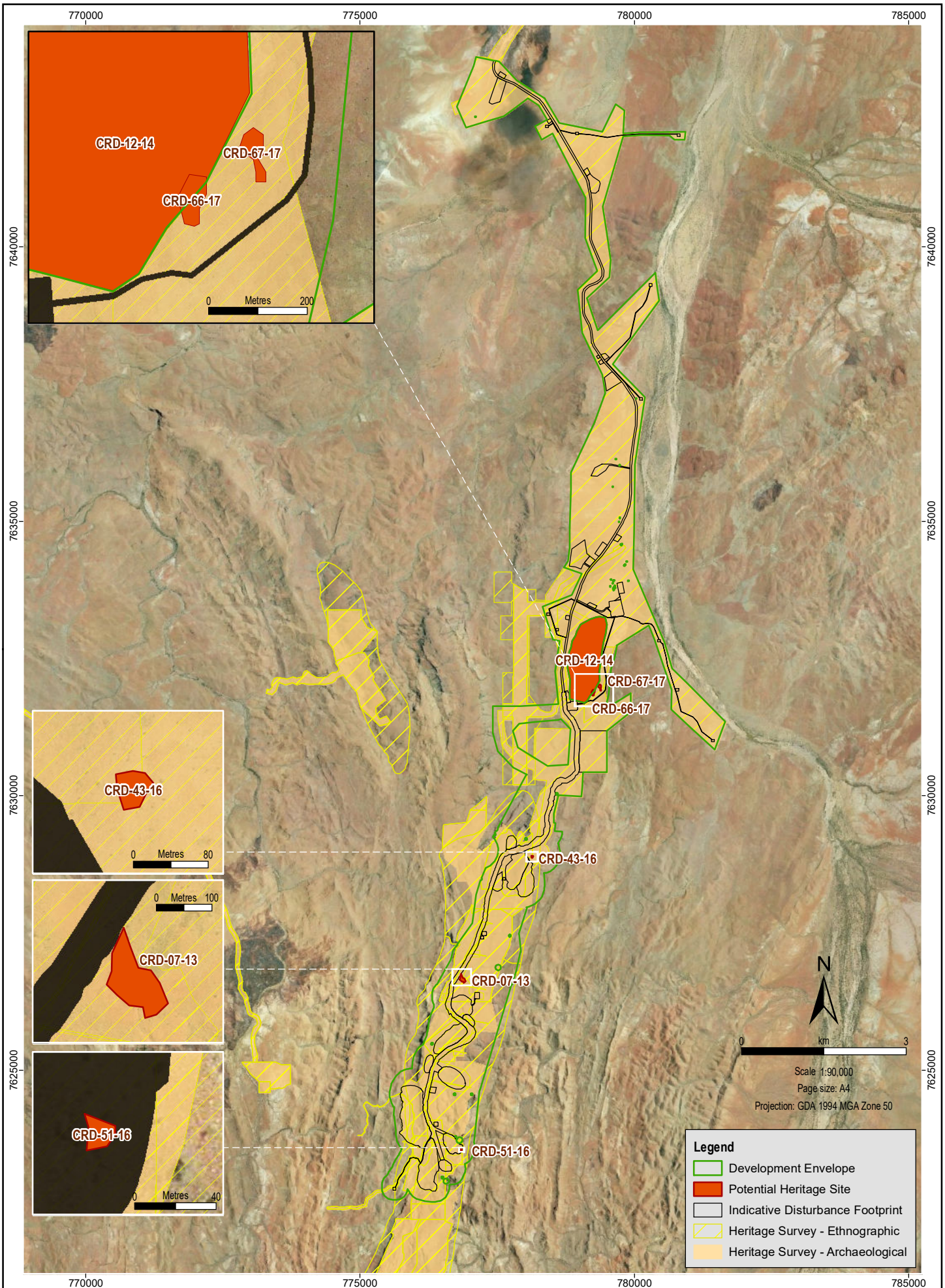
No registered Aboriginal heritage sites have been identified within the Development Envelope, however six potential sites have been identified which are likely to meet the definition of a 'registered aboriginal site' under Section 5 of the *Aboriginal Heritage Act 1972* (Terra Rosa Consulting, 2019; Terra Rosa Consulting, 2016; Gavin Jackson CRM & Daniel de Gand & Associates, 2014; Gavin Jackson, 2014a, b, c, d; Big Island Research, 2013a, b, c, d; SJC Heritage Consultants, 2010):

- CRD-07-13: Artefact scatter believed to be associated with an ancestral camp.
- CRD-12-14: A mesa which is a mythological site and forms part of an important songline.
- CRD-43-16: Quarry containing numerous artefacts believed to have been used to source material and make tools necessary for subsistence living.
- CRD-51-16: Artefact scatter (including macroblades and knapping floors).
- CRD-66-17: Artefact scatter (including blades and knapping floors).
- CRD-67-17: Artefact scatter (including blades and knapping floors) with a single engraved motif.

Should the DPLH determine that any of these sites meet the definition of a 'registered aboriginal site' under Section 5 of the *Aboriginal Heritage Act 1972,* Section 18 consent from the Minister for Indigenous Affairs under this Act would be required prior to disturbance.

6.8 Summary of Baseline Heritage Data and Implications for Risk Assessment

- The Project is located entirely within the Njamal Native Title claim area (WC 1999/08).
- The current Indicative Disturbance Footprint has been surveyed for both archaeological and ethnographical heritage sites and values.
- There are no registered Aboriginal heritage sites within the Development Envelope.
- Six potential sites have been identified which are likely to meet the definition of a 'registered aboriginal site' under Section 5 of the *Aboriginal Heritage Act 1972*.
- Should the DPLH determine that any of these sites meet the definition of a 'registered aboriginal site, Section 18 consent from the Minister for Indigenous Affairs under this Act would be required prior to disturbance.



File Name: GIS_2633_Heritage.mxd Date: 9/12/2019 Author: Chris.Devlin	Source & Notes: Heritage data provided by Gavin Jackson Cultural Resource Management Pty Ltd (2014) *Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*	**Aboriginal Heritage**	Figure No: **6.13**

7. Environmental Risk Management

This Chapter identifies, evaluates and proposes 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.

This environmental risk assessment was undertaken in accordance with Atlas' Risk and Hazard Management Standard (950-HSE-HS-STA-0016). A separate closure and rehabilitation risk assessment and further discussion regarding its findings are provided separately in the Mine Closure Plan (Appendix X).

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' 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 7-1, 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 DMIRS objectives for environmental factors (Table 7-2) 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 detailed in the following sections and summarised in Table 7-3 (Risks regulated by DMIRS) and Table 7-4 (Risks regulated by another agency). Notably the risks relating to biodiversity and water resources are generally addressed and regulated by other agencies.

Table 7-1 – Risk Assessment Matrix

LIKELIHOOD	CONSEQUENCES				
	Insignificant **1** Limited damage to minimal area of low significance	**Minor** **2** Minor effects on biological or physical environment	**Moderate** **3** Moderate, short-term effects but not effecting ecosystem functions	**Major** **4** Serious medium term environmental effects	**Catastrophic** **5** Very serious, long-term environmental impairment of ecosystem function.
A Chronic or 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, "I've heard of it happening (Less than once a year but more than once per 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 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 7-2 – DMIRS Objectives for Environmental Factors

Factor	Objective
Biodiversity/Flora/ Fauna/Ecosystem	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.
Landforms	Mining will not result in appreciable land degradation, or the contamination or pollution of the land.
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 an agreed post-mining land use, and without unacceptable liability to the State.

Source: Draft Environmental Objectives Policy for Mining in Western Australia (September 2019) (DMIRS 2019)

7.1 Clearing and Other Vehicle/Machinery Movements Resulting in the Loss or Damage of Significant Environmental and Heritage Values

7.1.1 Risk Treatment

Atlas Iron will comply with the Project's EPBC Act Approval (EPBC 2017/7861) and Ministerial Statement issued under the EP Act (1125), including the following avoidance and mitigation.

Avoidance

The Development Envelope was altered to avoid:

- Eight of 11 significant flora taxa and the locally significant taxa *Acrostichum speciosum* inclusive of a 10 m buffer. While the remaining three significant flora taxa (*Eragrostis crateriformis* (P3), *Heliotropium murinum* (P3) and *Swainsona thompsoniana* (P3) could not be entirely avoided, more than 66% of their known locations were also avoided inclusive of the 10 m buffer.
- A permanent diurnal roost (cave CA-CO-01) for the Pilbara Leaf-nosed Bat, inclusive of a 340 m buffer.
- A non-permanent breeding roost (cave CA-CO-03) for the Pilbara Leaf-nosed Bat, inclusive of a 50 m buffer (lateral distance), which effectively provides a 68 m buffer from the rear of the cave to the Razorback pit.
- 14 of the 16 nocturnal refuges for the Pilbara Leaf-nosed Bat and/or Ghost Bat, inclusive of a 20 m buffer.
- All pools inclusive of a 50 m buffer, except for pool CO-WS-01, which is limited to a 20 m buffer.
- Potential heritage site CRD-12-14 (mythological site), which may meet the definition of a 'registered aboriginal site' under Section 5 of the *Aboriginal Heritage Act 1972*. The Indicative Disturbance Footprint was also altered to avoid impacts to four of the other five potential sites.

Mitigation

The following plans and procedures will be implemented to assist in minimising impacts:

- Ground Disturbance Permit (GDP) Procedure (950-HSE-EN-PRO-0001).
- Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004).
- Flora Management Procedure (950-HSE-EN-PRO-0010).
- Significant Species Management Plan (SSMP) (Appendix Y).

Key management measures, including those from the abovementioned plans and procedures, include:

- Clearing/disturbing no more than 423.11 ha of vegetation/habitat within the 2,257.6 ha Development Envelope.
- Restricting clearing to the minimum necessary for safe construction and operation of the Proposal and to within approved areas through GDP Procedure.
- Surveying and delineation of the GDP boundary in the field prior to any works commencing, including all buffers and values to be avoided and weed infested areas.
- Prohibition of off-road driving unless otherwise authorised by Senior Management.
- Speed limits on roads will be 50 km/h south of the run-of-mine pad (i.e., where it intersects the majority of significant fauna habitat) and 80 km/h north of the run-of-mine pad.
- Night-time vehicle movements will be restricted where possible to minimise potential vehicle strikes.
- Atlas Iron will continue to work in accordance with the Njamal Deed of Agreement including:
  - In the event that an Aboriginal heritage site cannot be avoided, Atlas Iron will submit a Section 18 application and obtain consent from the Minister for Aboriginal Affairs under the *Aboriginal Heritage Act 1972* prior to disturbance.
  - In the event that an item of indigenous heritage interest is identified during construction or operations, ground disturbance will cease and the item of interest will be left in-situ until such time that the area can be appropriately assessed by a qualified heritage constant and a Njamal representative notified.

7.1.2 Impact Considerations

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

- Loss of up to 423.11 ha (19%) of native vegetation within the 2,257.6 ha Development Envelope.
- Removal of up to 6% of each of the locally significant VTs (3, 6, 7 and 8) from the Study Area. This is unlikely to result in a significant regional impact for each of these VTs.
- Loss of a single location of *Eragrostis crateriformis* (P3), *Heliotropium murinum* (P3) and *Swainsona thompsoniana* (P3), including up to 6% of each of their habitats. The level of impact on each of these species is likely to be low to moderate on a local level and low on a regional level.

- Loss of two nocturnal refuges (CO-CA-08 and CO-CA-15), both of which support the Ghost Bat and one of which supports the Pilbara Leaf-nosed Bat.
- Loss of up to 56.39 ha of critical habitat (less than 3% of the mapped extent of each contributing habitat types) for the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python and another 366.73 ha of foraging and/or dispersal habitat for both bat species.
- Removal of CRD-51-16, one of the six potential sites which may meet the definition of a 'registered aboriginal site' under Section 5 of the *Aboriginal Heritage Act 1972*.

This risk addresses potential impacts, in exceedance of or in addition to, those discussed above, including:

- *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, which may alter vegetation quality and composition.*

  Clearing would reduce the size and quality of vegetation types, both directly and indirectly through edge effects and fragmentation, and is likely to heighten the effects of other threatening processes such as introduced flora (discussed in Section 7.2). Exclusion of significant flora from the Development Envelope inclusive of a 10 m buffer helps mitigate against direct and indirect impacts of clearing on significant flora populations.
- *Long-term impact on the local population of any conservation significant fauna, resulting from loss of significant habitats and microhabitats (i.e., pools and caves).*

  Less than 23% of the mapped extent of each significant fauna habitat occurs within, and are all well connected to areas outside, the Development Envelope.

  All remaining caves and pools have been excluded from the Development Envelope, in recognition of their importance to conservation significant fauna as a source of shelter, food and water.
- *Long-term impact on the local population of any conservation significant fauna, resulting from vehicle interactions.*

  The construction and operation of roads within the Development Envelope poses a risk to fauna through mortalities arising from vehicle collisions. Mortalities may occur during initial clearing works, particularly for smaller and/or less mobile species that are unable to disperse from the Indicative Disturbance Footprint once construction works have commenced. During operations, collisions with animals along roads are more likely to occur at night (Rowden et al., 2008). The presence of roadkill may attract species that feed on roadkill, potentially driving other species away from the area and altering the species assemblage at a localised scale (Dickman, 1996).

  Ground-dwelling species that forage within intersecting habitat are most likely to be at risk, including species of conservation significance such as the Northern Quoll (Cramer et al., 2016b), Pilbara Olive Python (Burbidge, 2004; Pearson, 2003), macropods such as the Spectacled Hare-wallaby (Rowden et al., 2008) and larger reptiles. Aerial species, such as the Pilbara Leaf-nosed Bat and the Ghost Bat, may also be at risk when foraging at low altitudes. The Pilbara Leaf-nosed Bat in particular has a curiosity for light sources, which has on occasion resulted in an extensive number of vehicle collisions (Cramer et al., 2016a; van Dyck and Strahan, 2008).

- *Loss/damage to potential heritage site (known/unknown).*

  The majority of potential heritage sites are identified during archaeological and ethnographical surveys undertaken prior to disturbance, however there is the risk that clearing may uncover buried artefacts or remains.

It is anticipated following the implementation of the above treatments the residual risk of the above impacts will meet the DMIRS environmental objective for biodiversity (Table 7-2).

7.2 Clearing and Other Vehicle/Machinery Movements Resulting in the Spread and/or Introduction of Weeds

7.2.1 Risk Treatment

Atlas Iron will comply with the Project's Ministerial Statement (1125) issued under the EP Act, including the following avoidance and mitigation.

Avoidance

The Development Envelope was altered to avoid the majority of significant flora inclusive of a 10 m buffer (refer to Section 7.1 for the three exceptions).

Mitigation

The following plans and procedures will be implemented to assist in minimising impacts:

- GDP Procedure (950-HSE-EN-PRO-0001).
- Weed Hygiene Procedure (950-HSE-EN-PRO-0002).
- Flora Management Procedure (950-HSE-EN-PRO-0010).

Key management measures, including those from the above-mentioned plans and procedures, 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.
- Weeds and weed contaminated topsoil will be cleared, handled and stockpiled separately to native vegetation and 'clean' topsoil.
- Regular and targeted weed control (e.g. by spraying, physical removal) will be undertaken as appropriate (during all stages of operation including care and maintenance).
- Disturbed/cleared areas will be rehabilitated as soon as practicable to avoid colonisation by weed species.

7.2.2 Impact Considerations

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.*

  As discussed in Section 5.6.1, 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 inclusive of a 10 m buffer 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.

It is anticipated following the implementation of the above treatments the residual risk will meet the DMIRS environmental objective for biodiversity (Table 7-2).

7.3 Mining of the Razorback Pit Resulting in Major Structural Damage to Cave CO-CA-03

7.3.1 Risk Treatment

Atlas Iron will comply with the Project's EPBC Act Approval (EPBC 2017/7861) and Ministerial Statement (1125) issued under the EP Act (pending), including the following avoidance and mitigation.

Avoidance

The Development Envelope was altered to avoid a non-permanent breeding roost (cave CO-CA-03) for the Pilbara Leaf-nosed Bat inclusive of a 50 m buffer (lateral distance), which effectively provides a 68 m buffer from the rear of the cave to the Razorback pit.

Mitigation

The following plans and procedures will be implemented to assist in minimising and monitoring impacts:

- Razorback Blast Management Procedure. This procedure will consider alternative blasting methods including electric detonation. It will detail the modelling and monitoring requirements prior to/during each blast with the aim of minimising the blast speed velocity and associated ground and air vibration reporting to cave CO-CA-03. A geotechnical engineer will be engaged to support the blast modelling and monitoring.
- Significant Species Management Plan (Appendix Y), which includes monitoring of the Pilbara Leaf-nosed Bat.

- Cave CO-CA-03 and pool CO-WS-14 Monitoring Strategy. In adhering to the conditions of EPBC Act Approval EPBC 2017/7861, Atlas Iron will prepare and seek approval from the federal Minister for the Environment for this monitoring strategy prior to mining of the Razorback pit, to demonstrate that the structure of this cave remains unchanged during mining and to ensure this cave continues to provide suitable habitat for the Pilbara Leaf-nosed Bat. This plan will include monitoring of cave structure and micro-climate and pool water quality and levels.

7.3.2 Impact Considerations

Mining of the Razorback pit could result in the following potential impacts:

- *Major structural damage to the cave resulting in a long-term impact on the local population of Pilbara Leaf-nosed Bat*.

  Vibration from drilling and blasting within the Razorback pit has the potential to result in major structural damage to cave CO-CA-03, including rock fall/collapse of the cave entry or the opening of fractures, which may alter the internal microclimate. This damage may prevent the ongoing use of this roost by Pilbara Leaf-nosed Bat following the cessation of mining, and ultimately result in a long-term impact to the local population. Impacts of the Project on this species associated with noise, vibration and dust are discussed separately in Section 7.12.

  Specialist bat advice (Bat Call, 2016; Bullen pers. comm. 2017a, b, c), supported by geotechnical (Atlas Iron, 2017) and hydrogeological assessments (SRK, 2019a; Stantec, 2018b) and a review of Atlas Iron's other operations has identified that a 50 m buffer between the Razorback pit and the cave should be adequate to maintain its structural integrity and ensure its ongoing suitability for, and recolonisation by, Pilbara Leaf-nosed Bat following the cessation of mining.

  Atlas Iron has proven experience in managing blasting impacts on sensitive caves within 20 to 50 m of an open pit at both its Abydos and Mt Dove mines, which it will draw on in the development of the cave CO-CA-03 and pool CO-WS-14 Monitoring Strategy.

It is anticipated following the implementation of the above treatments the residual risk will meet DMIRS environmental objective for biodiversity (Table 7-2).

7.4 Water Abstraction Resulting in Reduced Groundwater Availability or Quality (i.e., Localised Upwelling of Saline Water)

7.4.1 Risk Treatment

Mitigation

Atlas Iron will comply with the Project's EPBC Act Approval (EPBC 2017/7861), Ministerial Statement (1125) issued under the EP Act and 5C Licence to take groundwater granted under the RIWI Act (GWL176960, currently under amendment).

Water abstraction will be managed by 5C Licence and associated Water Management Plan and Site Water Operating Plan. These documents contain a detailed monitoring program, site-specific trigger values and management response actions (e.g., altering water abstraction rates and/or sourcing water from alternative water abstraction locations) developed in collaboration with the relevant regulatory agencies (i.e., DWER).

Cave CO-CA-03 and pool CO-WS-14 will also be monitored in accordance with the Cave CO-CA-03 and Pool CO-WS-14 Monitoring Strategy.

7.4.2 Impact Considerations

A calibrated numerical groundwater model was developed to investigate the potential impacts of water abstraction on groundwater resources and environmental values dependent on groundwater (SRK, 2019a). Full model construction details (e.g., model domain, conditions, aquifer parameters and calibration) and results can be found in Attachment C of Appendix U. Two scenarios were modelled:

- Base case – with anticipated flow rates from eight production bores (under the most likely operating regime) to assess the drawdown impacts of water abstraction over the life of the Project (April 2021 to July 2026).
- Maximum pumping case – nine production bores operating at their maximum pumping capacity for the period that those bores would be in operation. This scenario was modelled to see how far the system could be stressed, significantly over and above the likely operating regime. This provides an estimate of 'worst case' impact to afford Atlas the flexibility to proactively manage water abstraction over the life of the Project (e.g., alter abstractions rates and/or locations) to ensure the Project's environmental objectives and water demands are met. This scenario includes an additional (ninth) production bore (CRD0024).

Atlas Iron acknowledges that water abstraction may result in the following unavoidable impacts:

- Loss of vigour and/or tree death in a single species, *Melaleuca argentea*, in up to 112.80 ha of obligate GDV (Figure 6.8). Given the short duration of the predicted impact in these areas (1 to 2 years), and as *M. argentea* is the only species within the GDV predicted to experience a decline in health (given its limited tolerance to drawdown), the overall predicted impact is not considered significant in a local or regional context. Furthermore, these impacts will be temporary with groundwater within the deeper aquifer expected to recover within 2.5 years (Woodman, 2019).
- Up to 4.64 and 6.70 m of drawdown at the 'soak', which may result in tree stress or death where drawdown results in a loss of moisture within the soil matrix at this site (Woodman, 2019).

This risk addresses potential impacts, in exceedance of or in addition to, those discussed above, including:

- *Declining groundwater availability/quality for local existing users*.

  There are no other groundwater users in the vicinity of the Proposal that would be impacted by reduced groundwater availability or any aquifer degradation.
- *Loss of vigour and/or tree death in areas of GDV above that anticipated*.

  Where the actual extent of drawdown exceeds the model prediction (vertically or laterally) the area of *M. argentea* potentially impacted (i.e., experiencing a loss of vigour and/or tree death) may exceed that predicted and approved (112.80 ha). Furthermore, if drawdown over the area of obligate GDV was to exceed 8 to 10 m at a rate of more than 5 m/year, drawdown impacts may extend to *E. camaldulensis* subsp. *refulgens*.
- *Change in pool water quality/levels (including changes in pool permanency), reduced water resource availability for fauna and associated alteration in fauna behaviour*.

The model predicted that two groundwater dependent pools (CO-WS-01 and CO-WS-10) had the potential to be impacted by drawdown. However, these impacts are considered unlikely to be realised given (SRK, 2019a):

  - Based on groundwater signatures and water level monitoring, pool CO-WS-01 is thought to be fed by groundwater from the BIF unit, while water abstraction will be from the Mt Roe Basalt unit. The two units are interpreted to be in poor hydraulic connection with each other.
  - Drawdown at pool CO-WS-10 is predicted to be low (0.05 and 0.10 m in the base and maximum pumping cases respectively). Further, water in pool CO-WS-10 is thought to originate via surface water flow as groundwater expressed at pool CO-WS-12, which is outside the predicted area of drawdown.

- *Drying up of the groundwater seep within cave CO-CA-03, which may affect the microclimate and ongoing suitability of this cave as a non-permanent breeding roost for the Pilbara Leaf-nosed Bat*.

  A change in this cave's microclimate may prevent the ongoing use of this roost by Pilbara Leaf-nosed Bat and ultimately result in a long-term impact to the local population. However, no drawdown impact is predicted at cave CO-CA-03, even in the unlikely maximum pumping scenario (SRK, 2019a).

- *Pose a risk to the long-term conservation of subterranean fauna*.

  The Project is already expected to pose a low risk to the long-term conservation of troglofauna species on the basis that habitat is highly likely to occur beyond the modelled extent of drawdown (both lateral and vertical) (Stantec, 2019). Any additional impact to troglofauna resulting from this risk would therefore be insignificant.

- *Dispersion of saline water during dust suppression resulting in reduction in vegetation quality and composition*.

  No saline groundwater resource has been identified at depth to date, however the potential for increases in salinity due to long-term abstraction is uncertain (SRK, 2019b).

It is anticipated following the implementation of the above treatments the residual risk of the above impacts will meet DMIRS environmental objective for water resources and biodiversity (Table 7-2).

7.5 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

7.5.1 Risk Treatment

Atlas Iron will comply with the Project's EPBC Act Approval (EPBC 2017/7861) and Ministerial Statement (1125) issued under the EP Act, including the following avoidance and mitigation.

Avoidance

The Development Envelope was altered to avoid all significant pools inclusive of a 50 m buffer, except for CO-WS-01, where a 20 m buffer has been applied.

Control

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 summarised below from Appendix T:

- Diverting naturally occurring local surface water around mine infrastructure by means of drainage channels, earth bunds, and road culverts with adequate scour protection where necessary.
- Isolating the waste dump areas from external runoff (i.e., clean stormwater) by bunding around the perimeter and channelling internal flows to a sedimentation pond, where the bulk of the suspended material will be settled out prior to any discharge to the downstream environment.
- Protecting pit walls at concentrated inflow locations by channelling or piping inflows away from the crest or down the slope with adequate energy dissipation where required.
- Pits will be mined in such a way as to allow water to collect away from active work front areas and infiltrate and/or evaporate. Atlas will not discharge any accumulated stormwater collected within the pits.
- At mine closure to leave waste dumps with a capping layer of inert, durable, compacted non-fines material to minimise infiltration and leachate development, and to resist erosion and sediment migration to the downstream environment.

The camp will also be located above the 1 in 100 ARI flood event.

Mitigation

The following plans and procedures will be implemented to assist in mitigating impacts:

- GDP Procedure (950-HSE-EN-PRO-0001).
- Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004).

Other key management measures include:

- Manage haul road construction to minimise the risk of overburden travelling down embankments into pool CO-WS-01 (e.g., using windrows).
- Routine inspections of all surface water infrastructure, including daily inspections following periods of high rainfall.

7.5.2 Impact Considerations

Where surface water flows are intercepted or modified there is an increase in the potential for localised ponding to occur immediately upstream, water shadows to develop immediately downstream and increased scour and erosion (i.e., sediment laden run-off), particularly from the pits, waste rock dumps and the land bridge. Surface water impacts are likely to be localised and insignificant, largely associated with the minimal upstream flows entering the Project (given its location at the top of the catchment) and in the absence of any significant areas of sheet flow across the Development Envelope (Stantec, 2018a; Mine Earth, 2019c).

The pits, waste rock dumps and land bridge are also the most likely contributors to elevated levels of sediment-laden runoff. However, increased sediment-laden runoff is unlikely to cause significant deterioration in water quality as soils within the Development Envelope are

predominantly non-saline and do not present a risk of acid or metalliferous drainage (Stantec, 2018a; Mine Earth, 2020a).

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 (Stantec, 2018a).

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. However, as discussed above, this impact is likely to be localised and insignificant given the minimal upstream flows entering the Proposal and in the absence of any significant areas of sheet flow.

  Exclusion of significant flora from the Development Envelope inclusive of a 10 m buffer may also help mitigate against these edge effects on significant flora populations.

- *Reduction in pool water levels or quality that may impact their suitability as a resource for conservation significant fauna.*

  The physical presence of the Project has the potential to alter the local hydrological regime and so may reduce the volume of and quality of surface water reporting to these pools, particularly those in close proximity to (e.g., within 200 m) and downstream of the Project (i.e., pools CO-WS-01, CO-WS-09 and CO-WS-14). However, as discussed above impacts, are likely to be insignificant given the minimal upstream flows entering the Project. During large magnitude rainfall events, any sediment contributions from the Project will be negligible compared to levels of naturally mobilised sediment.

  Given the potential significance of pool CO-WS-14, associated with its potential to support a non-permanent breeding roost for Pilbara Leaf-nosed Bat (cave CO-CA-03), a catchment analysis was completed by Stantec (2018b) for this area. The analysis determined that the proposed mining of the Razorback pit would intersect and remove 18% of the contributing catchment for this pool and internal groundwater seep within cave CO-CA-03, an insignificant impact, given:

  - Only a small volume of water is required to fill this pool to overflowing, and the loss of 18% of surface water catchment area is negligible in this regard.
  - The current mine plan does not allow for active redirection of surface water around the pit, instead allowing surface water flows to drain into and collect within the pit (where not diverted by safety bunds/windrows). This will enhance the period of time surface water has to infiltrate locally and thereby increase groundwater table levels locally, which may support seepage into the pool and cave.

- *Drying up of the groundwater seep within cave CO-CA-03, associated with a loss in catchment, affecting the microclimate and ongoing suitability of this cave as a non-permanent breeding roost for the Pilbara Leaf-nosed Bat*.

  As described above, a catchment analysis determined that there was no significant risk to the groundwater seep within cave CO-CA-03, associated with the physical presence of the Project and corresponding loss of catchment. As such, no change to the cave's microclimate preventing its ongoing use by the Pilbara Leaf-nosed Bat is predicted.

It is anticipated following the implementation of the above treatments the residual risk of the above impacts will meet DMIRS environmental objective for water resources and biodiversity (Table 7-2).

7.6 Inadequate Transport, Handling and Storage of Hydrocarbons and Chemicals Leading to Contamination of the Environment

7.6.1 Risk Treatment

Atlas Iron will comply with the Project's EPBC Act Approval (2017/7861), Ministerial Statement (1125), Works Approval (W6043), Operating Licence (pending) including the following mitigation.

Mitigation

The following plans and procedures will be implemented to assist in minimising impacts:

- Hydrocarbon Management Procedure (950-HSE-EN-PRO-0005).
- Hydrocarbon (and Chemical) Spill Management Procedure (950-HSE-EN-PRO-0007).
- Bioremediation Management Procedure (950-HSE-EN-PRO-0013).
- Water Management Plan.
- Site Water Operating Plan.
- Cave CO-CA-03 and pool CO-WS-14 Monitoring Strategy.

Key management measures, including those from the above-mentioned plans and procedures, include:

- Containment of hydrocarbons in accordance with *AS1940:2004 – The Storage and Handling of Flammable and Combustible Liquids*. This standard includes siting and bunding/containment restrictions, provision and maintenance of relevant MSDS and regular inspections.
- Stormwater management of containment bunds.
- 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.
- Spill recovery and clean up materials maintained at all hazardous material storage areas. Relevant employees and contractors will be trained in the use of this equipment.
- Equipment maintenance and servicing procedures (including the use of drip trays) and management of, and treatment of hydrocarbons at the wash pad.
- 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 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.
- Contaminated soil shall be taken to the site bioremediation facility (where present), or stockpiled for removal offsite by a licenced controlled waste contractor.

7.6.2 Impact Considerations

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

- *Reduction in pool water quality that may impact their suitability as a resource for conservation significant fauna.*

  Contamination of pool water with hydrocarbons or chemicals in appreciable concentrations could lead to abandonment of the pool as a water source, or fauna injury or mortality. Contamination pathways could be direct (e.g. via a spill into surface water) or indirect (e.g. via infiltration into groundwater supplying a pool).
- *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.

It is anticipated following the implementation of the above treatments the residual risk will meet the DMIRS environmental objectives for biodiversity, water resources, landforms and mine closure (Table 7-2).

7.7 Poor Pit Water Quality

Atlas Iron will comply with the Project's EPBC Act Approval (2017/7861) and Ministerial Statement (1125) issued under the EP Act, including the following avoidance and mitigation.

7.7.1 Risk Treatment

The following plans and procedures will be implemented to assist in minimising impacts:

- Hydrocarbon Management Procedure (950-HSE-EN-PRO-0005).
- Hydrocarbon (and Chemical) Spill Management Procedure (950-HSE-EN-PRO-0007).
- Bioremediation Management Procedure (950-HSE-EN-PRO-0013).
- Cave CO-CA-03 and pool CO-WS-14 Monitoring Strategy.
- Razorback Hydrocarbon (and Chemical) Spill Management Procedure, which will include the requirement for immediate internal reporting, faster spill response (i.e., within 12 hours), requirement for spill response equipment (i.e., spill kits) to be stored locally (e.g., at entry to pit) and the pumping out of any stormwater that collects in pit during the period between the spill event and completion of spill response for disposal offsite.

Avoidance

There will be no refuelling or maintenance of mobile equipment/plant within the Razorback pit.

Stormwater accumulated in pits will be left to evaporate or infiltrate and will not be discharged to the environment.

Mitigation

Key management measures, including those from the above-mentioned plans and procedures are listed in Section 7.6.1, which relates to handling and disposal of hydrocarbons and chemicals, as well as the prevention, containment and clean-up of spills.

7.7.2 Impact Considerations

Poor pit water quality could result in the following potential impacts:

- *Degradation of pool CO-WS-14 and cave CO-CA-03 seep water quality and alteration of Pilbara Leaf-nosed Bat behaviour.*

  All pits have been designed above the water table inclusive of a suitable buffer to account for potential seasonal variation and ensure no groundwater interaction and/or expression in pit (Appendix B).

  Waste characterisation investigations have determined that there is no risk of acid/metalliferous drainage at the Razorback deposit (Mine Earth, 2020a). The most likely contributor to poor pit water quality would be hydrocarbon spills. Depending on the rate of infiltration, the collection of surface water in the Razorback pit may also lead to transient increase in TDS due to evaporative concentration. Overall surface water inflow to Razorback pit will be minimal given its location.

  As any accumulated stormwater collected in pit will not be discharged to the environment (e.g. via pumping), the most likely pathway for contamination is the infiltration of collected stormwater through the pit floor to the groundwater table. Pool CO-WS-14 and the groundwater seep within cave CO-CA-03 are the most likely values at risk given their groundwater connectivity and proximity to the Razorback pit (SRK, 2019b).

  The seep within cave CO-CA-03 (and potentially pool CO-WS-14) is likely to contribute to the humidity (i.e., microclimate) in the cave necessary to support non-permanent diurnal roosting by the Pilbara Leaf-nosed Bat. While the change in water quality is not anticipated to result in any change in humidity within this cave, the potential impact of increased salinity and/or the presence and accumulation of hydrocarbons in the pool and/or seep on this species is not well understood.

It is anticipated following the implementation of the above treatments the residual risk of the above impacts will meet the DMIRS environmental objective for biodiversity and water resources (Table 7-2).

7.8 Unauthorised Pit Access

7.8.1 Risk Treatment

Mitigation

Construction of abandonment bunds as detailed in Appendix C will be built into the mine schedule to ensure they are constructed before any potential loss of access resulting from mining of the pits.

7.8.2 Impact Considerations

This risk was included as requested by DMIRS however as it does not specifically result in any environmental impacts it has not been included in the ERA (Table 7-3).

7.9 Poor Stability of Waste Rock Dumps

7.9.1 Risk Treatment

Mitigation

Atlas Iron has designed all waste rock dumps:

- Outside of the zones of potential pit instability (Appendix D).
- 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 Mine Earth.

Atlas Iron will also manage the placement of waste rock as follows:

- All shale waste rock (both carbonaceous and non-carbonaceous) will be placed at least 10 m beneath final WRD slopes.
- Siltstone waste rock will not be placed on final WRD slopes.
- Final WRD slopes will be constructed from BIF and chert waste rock types.

7.9.2 Impact Considerations

Poor stability of waste rock dumps could result in the following potential impacts:

- *Erosion of waste rock dump surfaces leading to loss of waste rock material and/or topsoil into the surrounding environment, resulting in degradation of pool water quality.*

  The BIF and chert units have a high erosional stability and are suitable for use on final WRD slopes. The siltstone and shale units have a moderate to low erosional stability and are therefore considered unsuitable for placement on final WRD slopes.

  There are no significant pools located downstream and in close proximity (200 m) to waste rock dump locations.
- *Poor revegetation success.*

  Erosion of waste rock dump surfaces may lead to a loss of topsoil and poor revegetation success.

It is anticipated following the implementation of the above treatments the residual risk of the above impacts will meet the DMIRS environmental objective for biodiversity, landforms and mine closure (Table 7-2).

7.10 Poor Management of Shale Waste Rock

7.10.1 Risk Treatment

Mitigation

All shale waste rock (both carbonaceous and non-carbonaceous) will be placed at least 10 m beneath final WRD slopes to minimise uptake by plants and/or animals.

7.10.2 Impact Considerations

Hg enrichment was identified in samples from carbonaceous shale located within the Runway North pit and within the Split Rock 10 m pit buffer. Poor or inadequate handling of shale waste rock could result in the following potential impacts:

- *Metalliferous drainage resulting in degradation of groundwater and/or pool water quality and poor rehabilitation success.*

  Water extraction test work has identified that enriched Hg is in a geochemically stable form with restricted solubility at circum-neutral pH and so presents a low risk of metalliferous drainage.
- *Mercury (Hg) toxicity.*

  There is a risk that plants and/or burrowing animals could be exposed to Hg-enriched material leading to Hg toxicity if placed near surface/within the root uptake zone (approximately the first 10 m).

It is anticipated following the implementation of the above treatments the residual risk will meet the DMIRS environmental objective for biodiversity, landforms and mine closure (Table 7-2).

7.11 Inadequate Waste Management and/or Landfill Management

7.11.1 Risk Treatment

Atlas Iron will comply with the Project's EPBC Act Approval (EPBC 2017/7861), Ministerial Statement (1125), Works Approval (W6043) and Operating Licence (pending), including the following avoidance and mitigation.

The following plans and procedures will be implemented to assist in minimising impacts:

- Waste Management Procedure (950-HSE-EN-PRO-0023).
- Wastewater Treatment Plant (WWTP) Management Plan (950-HSE-EN-PLN-0002).
- WWTP Care and Maintenance Plan (950-HSE-EN-PLN-0001).
- WWTP Sampling Procedure (950-HSE-EN-PRO-0025).
- Landfill Management Procedure (950-HSE-EN-PRO-0020).
- Introduced Fauna / Pest Control Management Procedure (950-HSE-EN-PRO-0022).
- Fauna Management Procedure (950-HSE-EN-PRO-0012).
- SSMP (Appendix Y).

Avoidance

The wastewater spray field has been located to avoid priority flora and locally significant VTs.

Control

Key controls, including those from the above-mentioned plans and procedures, include:

- Diversion of stormwater around the WWTP and the perimeter of the spray field to divert clean stormwater and contain any potentially contaminated run-off within the facilities.

- Installation of additional tanks to allow at least two days of treated effluent to be stored in the event of an emergency or heavy rainfall.
- Stormwater diversion structures will be constructed to divert runoff away from the landfill and prevent it entering and infiltrating within the landfill facility.
- All storage vessels (bins) containing putrescible waste shall be fitted with a lid that can be secured.

Mitigation

Key management measures, including those from the above-mentioned plans and procedures, include:

- Daily inspection of the wastewater treatment plant for evidence of leaks or spills.
- The WWTP will be equipped with audible and visual alarms.
- Regular maintenance of the WWTP in accordance with the manufacturer's recommendations.
- Regular monitoring of treated effluent to ensure operating performance.
- Removal of sludge offsite by a licenced controlled waste carrier for offsite disposal at a suitably licensed facility in accordance with the *Environmental Protection (Controlled Waste) Regulations 2004*.
- In the event of an untreated spill the incident and any contaminated soil is to be excavated as soon as possible to minimise infiltration. All contaminated soil to be taken off-site by a licensed controlled waste carrier.
- The storage and regular disposal offsite by a licenced controlled waste contractor, of waste hydrocarbons (e.g., waste oil and used oil filters).
- The landfill will be designed, operated and managed in accordance with the *Environmental Protection (Rural Landfill) Regulations 2002*. This will include fencing to reduce the potential for attracting fauna and contain/minimise windblown waste.
- Record all introduced fauna sightings and the implement feral animal control program, as required (i.e., where sightings are regular and/or if nuisance or dangerous individuals are recorded).
- Regular collection of any windblown waste outside the landfill facility.
- Ensure all putrescible waste is bagged prior to being disposed at the landfill.
- All waste disposed of within the landfill shall be levelled and compacted as soon as practicable (at least monthly) and covered with a dense, inert, incombustible material.
- Implementation of a feral animal control program, as required (e.g., trapping of feral cats and/or mice where sightings are regular).

7.11.2 Impact Considerations

Inadequate wastewater/landfill management could result in the following potential impacts:

- *Reduction in vegetation quality and composition and potential deterioration of significant flora populations.*

  The irrigation of wastewater if not appropriately treated could contaminate soil and alter the composition and structure of native vegetation in the area of the spray field.

  The nearest locations of conservation significant flora are located over 50 m to the east and upstream of the irrigation spray field.

- *Generation of windblown waste*.

  Windblown waste reduces visual amenity and may present an entanglement threat to fauna resulting in injury/death. Waste can also attract feral animals.

- *Attraction of feral fauna leading to increased predation upon and/or competition for resources against native fauna.*

  Putrescible waste generated by the Project and disposed of in the landfill may attract and support a greater abundance of feral animals in the area, which may adversely affect populations of native fauna. Of particular concern would be an increase in the size or density of the local population of feral cats.

It is anticipated following the implementation of the above treatments the residual risk for the above impacts will meet the DMIRS environmental objectives for biodiversity and landforms (Table 7-2).

7.12 Generation of Excessive Dust, Noise, Vibration or Light

7.12.1 Risk Treatment

Atlas Iron will comply with the Project's EPBC Act Approval (EPBC 2017/7861), Ministerial Statement (1125), Works Approval (W6043) and Operating Licence (pending), including the following avoidance and mitigation.

The following plans and procedures will be implemented to assist in minimising impacts:

- Significant Species Management Plan (Appendix Y).
- Cave CO-CA-03 and Pool CO-WS-14 Monitoring Strategy, as discussed in Section 7.3.1.
- Dust Management Procedure (950-HSE-EN-PRO-0026).
- Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004).
- Flora Management Procedure (950-HSE-EN-PRO-0010).
- Fauna Management Procedure (950-HSE-EN-PRO-0012).

Avoidance

Due to operational and safety requirements and the nature of the mining activity, sources of dust, noise, vibration and light cannot be eliminated.

However, the following environmental values and buffers have been excluded from the Development Envelope, which will increase the distance between these values and the Project sources of dust, noise, vibration and light:

- 340 m buffer (lateral distance) from permanent diurnal roost (cave CO-CA-01) for Pilbara Leaf-nosed Bat.
- 50 m buffer (lateral distance) from the non-permanent breeding roost (cave CO-CA-03) for the Pilbara Leaf-nosed Bat, which effectively provides a 68 m buffer from the rear of the cave to the Razorback pit.
- 20 m buffer from all nocturnal refuges for the Pilbara Leaf-nosed Bat and/or Ghost Bat, excluding CO-CA-08 and CO-CA-15.
- 50 m buffer from all water sources, excluding CO-WS-01.
- 10 m buffer from all known significant flora locations, with the exception of the three impacted locations.

Control

Key controls, including those from the above-mentioned procedure, include:

- The crushing and screening facility will include enclosed transfer points, strategically located water sprays and sprinklers.
- Road train trailers will be fitted with covers during product transport to port.

Mitigation

Key management measures, including those from the above-mentioned plans and procedures, include:

- Clearing will be kept to the minimum necessary for safe construction and operation of the Project and planned so that only the area of land required for immediate use (within 6 months) is cleared and exposed.
- Disturbed areas will be rehabilitated as soon as possible.
- Unsealed roads shall be appropriately constructed to minimise dust emissions.
- Speed limits on roads will be 50 km/h south of the run-of-mine pad (i.e., where it intersects the majority of significant fauna habitat) and 80 km/h north of the run-of-mine pad.
- Off-road driving will be prohibited unless otherwise authorised by Senior Management.
- Blasting plans shall consider meteorological conditions to control dust generation and dispersion.
- Clearing and blasting activities will be restricted to daytime operations.
- Implementation of standard dust suppression techniques shall be used on roads, stockpiles and infrastructure areas (e.g., water carts, sprinklers).
- Lights will be directed to working areas and shielded where possible to reduce excess light spill and glow.
- 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.

- The Pilbara Leaf-nosed Bat will be monitored in accordance with the SSMP and the Cave CO-CA-03 and Pool CO-WS-14 Monitoring Strategy.
- All employees and contractors on site must complete a site induction prior to undertaking any work.

7.12.2 Impact Considerations

Excessive levels of dust, noise, vibration or light 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.*

  As aspects of the Proposal will be in operation on a 24-hour basis, the presence of artificial lighting for night operations may have an impact on mammal, bird, reptile and amphibian species occurring within the vicinity of the light sources. Excessive light is likely to have an effect on the natural foraging behaviour of bats, in particular the Pilbara Leaf-nosed Bat, which is thought to be attracted to light sources (Cramer et al., 2016a). Long-term studies at Mt Dove have however shown that Pilbara Leaf-nosed Bat activity is not impacted by artificial illumination, and perhaps increase species activity presumably due to increased foraging resources (C. Knuckey, unpub. data).

- *Temporary abandonment of bat roosts during mining leading to a long-term impact on the local population of Pilbara Leaf-nosed Bat.*

  The Pilbara Leaf-nosed Bat is known to be susceptible to noise, vibration and dust impacts. These impacts are generally associated with blasting and drilling activities, which will be limited to daytime operations. Habitats most likely to be at risk are nearby caves supporting diurnal roosting, including the permanent diurnal roost CO-CA-01 and the non-permanent breeding roost CO-CA-03. The permanent diurnal roost CO-CA-01 is on a separate ridge to the Project 340 m outside the Development Envelope, and is unlikely to be abandoned due to low expected noise and vibration impacts (Bullen, pers. comm. 2017a).

  The minimum distance between the non-permanent diurnal roost CA-CO-03 and the Razorback pit shell (the nearest part of the Development Envelope) is 68 m. The Pilbara Leaf-nosed Bat may abandon the roost during this time. However, it is probable that this species will continue to use this cave as a nocturnal refuge during this time.

  The temporary avoidance of this cave as a diurnal roost during operation is not anticipated to have a significant impact on the population given the likely relocation of individuals to the permanent diurnal roost CO-CA-01 and the proximity of other permanent diurnal roosts in the region (Bullen, pers. comm. 2017b).

  Indirect noise and vibration impacts to other nocturnal refuges for the Pilbara Leaf-nosed Bat and Ghost Bat are not expected based on the results of long-term monitoring of similar caves and bat populations, including at Atlas Iron's Mount Dove operations (MWH, 2015, 2016b).

- *Reduction in vegetation quality and composition.*

  High levels of dust have been associated with a reduction in plant growth and productivity and, alteration of soil chemistry leading to changes in vegetation community structure (Farmer, 1993).

- *Reduction in pool water quality.*

  Dust may directly pollute water bodies by increasing turbidity or potentially altering water chemistry. Water sources at risk in the Project area include CO-WS-01, CO-WS-09 and CO-WS-14 given their proximity to the Disturbance Footprint.

It is anticipated following the implementation of the above treatments the residual risk of the above impacts will meet the DMIRS environmental objectives for biodiversity and water resources (Table 7-2).

7.13 Insufficient Topsoil or Growth Medium for Rehabilitation

7.13.1 Risk Treatment

Avoidance

No avoidance is possible as the risk is linked intrinsically to the naturally occurring availability of topsoil.

Mitigation

Due to the limited availability of topsoil, and the likelihood that there will be a topsoil deficit for rehabilitation, Atlas will implement a three-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.

The following plans and procedures will be implemented to assist in minimising impacts:

- Ground Disturbance Permit Procedure (950-HSE-EN-PRO-0001).
- Flora Management Procedure (950-HSE-EN-PRO-0010).
- Weed Hygiene Procedure (950-HSE-EN-PRO-0002).
- Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004).
- Mine Closure Plan (Appendix X).

Key management measures, including those from the above-mentioned plans and procedures, include:

- The removal and stockpiling of all vegetation matter during clearing for future use in rehabilitation.
- Establishment of designated vegetation and topsoil stockpiles in suitable locations during the GDP process to ensure they are not subject to excessive surface water flow/drainage or wind and as close to the area of disturbance as possible.
- Erosion controls will be established around stockpiles where necessary.
- Topsoil stripping shall only be undertaken in dry conditions (wet topsoil becomes compacted and results in poor seed viability).

- 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 (i.e. when the site has a topsoil deficit).
- Develop an inventory and assess the quality of stockpiled soil – develop a closure soil deployment plan.
- Topsoil shall be paddock dumped into stockpiles not exceeding 2 m in height.
- All stockpiles will be signposted, surveyed and shown on mine plans. The volume of vegetation in each stockpile is also recorded.
- Weeds and weed contaminated topsoil will be cleared, handled and stockpiles separately to native vegetation and 'clean' topsoil.
- Regular and targeted weed control (e.g. by spraying, physical removal) will be undertaken as appropriate, including weed contaminated topsoil stockpiles.
- Topsoil will only be used for rehabilitation and will not be used for earthworks (i.e., construction of windrows).
- The use/placement of the salvaged topsoil on waste rock landforms will be strategic in that it will only occur in areas likely to be successful in vegetation establishment in the long term.

7.13.2 Impact Considerations

A lack of topsoil or other suitable plant growth medium for use in rehabilitation could result in the following potential impacts:

- *Poor rehabilitation success.*

  Surface soils (0 to 0.2 m) from the drainage lines, flats, scree slopes and ridgelines landform associations are considered to be a valuable resource for rehabilitation material, and generally have a high coarse rock fragment content, moderately rapid hydraulic conductivity, are non-hardsetting or slightly hardsetting, and are predominately non-saline and non-sodic, indicating a low inherent potential for erosion (MWH, 2016a). However, typical of the landforms being mined by iron ore operations in the Pilbara, and as seen at Atlas Iron's other Pilbara operations, there is likely to be a topsoil deficit with regard to rehabilitation. The mitigations identified aim to maximise the recovery and reuse of topsoil encountered during clearing.

It is anticipated following the implementation of the above treatments the residual risk will meet the DMIRS environmental objective for mine closure (Table 7-2).

7.14 Project Related Fire

7.14.1 Risk Treatment

Control

Atlas will apply the following controls:

- Clearing machinery will be fitted with automated fire suppression.
- Fire breaks will be incorporated into mine layout planning in accordance with the local government fire-break notice under section 33 of the *Bush Fires Act 1954*.

Mitigation

Atlas will undertake/implement the following to ensure the risk of project related fire is minimised and appropriate emergency response processes and resources are in place should a fire occur:

- Smoking will only be allowed in permitted areas. All smoking areas will be appropriately signed and self-arresting cigarette butt disposal containers provided.
- 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) will also be located within the landfill facility.
- Implementation of Hot Work Standard (SA-STD-009) to ensure all hazards associated with hot works (including fire) are identified assessed and controlled.
- Preparation and implementation of an Emergency Response Plan.
- All Emergency Response Team (ERT) members will be trained in Certificate III - Mine Emergency Response and Rescue.
- The ERT will ensure sufficient operationally ready fire suppression equipment is in place.

7.14.2 Impact Considerations

Inadequate fire management could result in the following potential impacts:

- *Loss of conservation significant flora/fauna species 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 Rocky Ridge and Gorge and the Northern Quoll.

It is anticipated following the implementation of the above treatments the residual risk will meet the DMIRS environmental objective for biodiversity (Table 7-2).

7.15 Extreme Weather Events Resulting in Flooding and Failure of Surface Water Controls and Damage or Loss of Project Infrastructure and Materials

7.15.1 Risk Treatment

Mitigation

Atlas will implement the following treatments:

- Surface water control structures (e.g. drains, culverts, sedimentation ponds, windrows, etc.) will be inspected routinely.
- 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.

7.15.2 Impact Considerations

Extreme weather events could result in the following potential impacts:

- *Exceedance of surface water control structure design capacities, resultant uncontrolled surface water flows leading to significant sediment deposition downstream and impacts to vegetation and pool water quality.*

  Modelling was used to estimate floods of certain magnitudes (5% and 1% annual exceedance probability (AEP)). Flood protection is designed to the 20% AEP (5 year) event for most areas given impacts to the mine and environment are anticipated to be low (MWH, 2018a). The WRD bunds and drains were designed to the 1% AEP event. Excess sediments associated with overtopping or exceedance of these design capacities in even larger events would be insignificant given naturally high sediment loads during such events. The environmental impact of infrastructure failure during extreme weather events is therefore anticipated to be minimal.

- *Generation of windblown waste*.

  Windblown waste reduces visual amenity and may present an entanglement threat to fauna resulting in injury/death. Waste can also attract feral animals.

It is anticipated following the implementation of the above treatments the residual risk will meet the DMIRS environmental objectives for biodiversity and water resources (Table 7-2).

Table 7-3 – Environmental Risk Assessment – Risks Regulated by DMIRS

ID	Risk Pathway / Unwanted Event	Relevant Phase[1]	Potential Impacts	Inherent Risk				Risk Treatments	Applicable Phases For Applying Treatments[1]	Residual Risk			
				Likelihood	Consequence	Risk Rating	Data Certainty[2]			Likelihood	Consequence	Risk Rating	Environmental Outcome[3]
21	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 and resulting in degradation of pool water quality	B	3	H (17)	H	Atlas Iron has designed all waste rock dumps: • Outside of the zones of potential pit instability (Appendix D). • 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 Atlas Iron will also manage the placement of waste rock to ensure shale and siltstone units are not placed on final waste rock dump slopes, as discussed in Section 7.9.1.	All phases	D	3	M (9)	5
22	Poor management of shale waste rock resulting in exposure of plants/animals to enriched mercury	All phases	Potential uptake of soluble mercury (Hg) by plants and/or animals	C	3	H (13)	H	All shale waste rock (both carbonaceous and non-carbonaceous) will be placed at least 10 m beneath final WRD slopes to minimise uptake by plants and/or animals.	All phases	E	3	L (6)	3
30	Insufficient topsoil or growth medium for rehabilitation	Closure	Poor rehabilitation success	B	2	H (12)	H	Atlas will implement a three-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. The following plans and procedures will be implemented to assist in minimising impacts as discussed in Section 7.13.1: • GDP Procedure (950-HSE-EN-PRO-0001). • Flora Management Procedure (950-HSE-EN-PRO-0010). • Weed Hygiene Procedure (950-HSE-EN-PRO-0002). • Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004). • Mine Closure Plan (Appendix X).	All phases	C	2	M (8)	6

ID	Risk Pathway / Unwanted Event	Relevant Phase[1]	Potential Impacts	Inherent Risk				Risk Treatments	Applicable Phases For Applying Treatments[1]	Residual Risk			
				Likelihood	Consequence	Risk Rating	Data Certainty[2]			Likelihood	Consequence	Risk Rating	Environmental Outcome[3]
31	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) will also be located within the landfill facility. • 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)	2
32	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 and pool water quality	D	2	L (5)	H	• Surface water control structures will be inspected routinely. • 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	D	2	L (5)	N/A
33			Generation of windblown waste	D	1	L (7)	H			D	1	L (7)	N/A

(1) Phases – Construction, Operation, Care & Maintenance (C&M)
(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 Section 8, The ID presented in this column links the risk to the relevant environmental outcome in Table 8.1 or Table 8.2.

Table 7-4 – Environmental Risk Assessment – Risks Regulated by Another Agency

ID	Risk Pathway / Unwanted Event	Relevant Phase[1]	Potential Impacts	Inherent Risk				Risk Treatments	Applicable Phases For Applying Treatments[1]	Residual Risk			
				Likelihood	Consequence	Risk Rating	Data Certainty[2]			Likelihood	Consequence	Risk Rating	Environmental Outcome[3]
1	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	Managed via the EPBC Act Approval (2017/7861), Ministerial Statement (1125) and the following Atlas Iron plans and procedures as discussed in Section 7.1.1: • Ground Disturbance Permit (GDP) Procedure (950-HSE-EN-PRO-0001). • Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004). • Flora Management Procedure (950-HSE-EN-PRO-0010). • Significant Species Management Plan (SSMP) (Appendix Y).	All phases	E	4	M (10)	8
2			Long-term impact on the local population of any conservation significant fauna, resulting from loss of significant habitats and microhabitats (i.e., pools and caves)	C	4	H (18)	H			E	4	M (10)	8
3			Long-term impact on the local population of any conservation significant fauna, resulting from vehicle interactions	D	4	H (18)	H			E	4	M (10)	8
4			Loss/damage to potential heritage site (known/unknown)	C	3	H (13)	M			D	3	M (9)	N/A
5	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 the Ministerial Statement (1125) and the following Atlas Iron plans and procedures as discussed in Section 7.2.1: • GDP Procedure (950-HSE-EN-PRO-0001). • Weed Hygiene Procedure (950-HSE-EN-PRO-0002). • Flora Management Procedure (950-HSE-EN-PRO-0010).	All phases	D	3	M (9)	8
6			Poor rehabilitation success	B	2	H (12)	H			C	2	M (8)	6
7	Mining of the Razorback pit resulting in major structural damage to cave CO-CA-03	Operation	Major structural damage to the cave resulting in a long-term impact on the local population of Pilbara Leaf-nosed Bat	C	4	H (18)	H	Managed via the EPBC Act Approval (2017/7861), Ministerial Statement (1125) and the following Atlas Iron plans and procedures as discussed in Section 7.3.1: • Razorback Blast Management Procedure. • Significant Species Management Plan (Appendix Y). • Cave CO-CA-03 and pool CO-WS-14 Monitoring Strategy.	All phases	D	4	H (14)	8
8	Water abstraction resulting in reduced groundwater availability or quality (i.e., localised upwelling of saline water)	All phases	Declining groundwater availability/quality for existing local users.	C	1	L (4)	H	Managed via the EPBC Act Approval (2017/7861), Ministerial Statement (1125), 5C Licence to take groundwater (GWL176960) and the following Atlas Iron plans and procedures as discussed in Section 7.4.1: • Water Management Plan. • Site Water Operating Plan. • Cave CO-CA-03 and pool CO-WS-14 Monitoring Strategy.	All phases	E	1	L (1)	N/A
9			Loss of vigour and/or tree death in areas of GDV above that anticipated	B	3	H (17)	H			D	3	M (9)	8
10			Change in pool water quality/levels (including changes in pool permanency), reduced water resource availability for fauna and associated alteration in fauna behaviour	C	3	H (13)	H			D	3	M (9)	7&8
11			Drying up of the groundwater seep within cave CO-CA-03, which may affect the microclimate and ongoing suitability of this cave as a non-permanent breeding roost for the Pilbara Leaf-nosed Bat	C	4	H (18)	H			D	4	H (14)	8
12			Pose a risk to the long-term conservation of subterranean fauna	D	3	M (9)	H			E	3	L (6)	N/A

ID	Risk Pathway / Unwanted Event	Relevant Phase[1]	Potential Impacts	Inherent Risk				Risk Treatments	Applicable Phases For Applying Treatments[1]	Residual Risk			
				Likelihood	Consequence	Risk Rating	Data Certainty[2]			Likelihood	Consequence	Risk Rating	Environmental Outcome[3]
13			Dispersion of saline water during dust suppression resulting in a reduction in vegetation quality and composition	C	1	L (4)	H			D	1	L (2)	N/A
14	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 (2017/7861), Ministerial Statement (1125) and the following Atlas Iron plans and procedures as discussed in Section 7.5.1and including incorporation of appropriate surface water management into final mine design: • GDP Procedure (950-HSE-EN-PRO-0001). • Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004).	All phases	D	3	M (9)	8
15			Reduction in pool water levels or quality that may impact their suitability as a resource for conservation significant fauna	C	3	H (13)	H			D	3	M (9)	7&8
16			Drying up of the groundwater seep within cave CO-CA-03, associated with a loss in catchment, affecting the microclimate and ongoing suitability of this cave as a non-permanent breeding roost for the Pilbara Leaf-nosed Bat	C	4	H (18)	H			E	4	M (10)	8
17	Inadequate transport, handling and storage of hydrocarbons and chemicals leading to contamination of the environment	All phases	Reduction in pool water quality that may impact their suitability as a resource for conservation significant fauna	C	3	H (13)	H	Managed via the EPBC Act Approval (2017/7861), Ministerial Statement (1125), Works Approval (W6043), Operating Licence (pending) and the following Atlas Iron plans and procedures as discussed in Section 7.6.1: • Hydrocarbon Management Procedure (950-HSE-EN-PRO-0005). • Hydrocarbon (and Chemical) Spill Management Procedure (950-HSE-EN-PRO-0007). • Bioremediation Management Procedure (950-HSE-EN-PRO-0013). • Cave CO-CA-03 and pool CO-WS-14 Monitoring Strategy. • Water Management Plan. • Site Water Operating Plan.	All phases	D	3	M (9)	7&8
18			Reduction in vegetation quality and composition and potential deterioration of significant flora populations	C	3	H (13)	H			D	3	M (9)	8
19			Poor rehabilitation success	C	2	M (8)	H			C	1	L (4)	N/A
20	Poor pit water quality	Operation C&M	Degradation of pool CO-WS-14 and cave CO-CA-03 seep water quality and alteration of Pilbara Leaf-nosed Bat behaviour	C	3	H (13)	M	Managed via the EPBC Act Approval (2017/7861) and Ministerial Statement (1125) and the following Atlas Iron plans and procedures as discussed in Section 7.7.1: • Hydrocarbon Management Procedure (950-HSE-EN-PRO-0005). • Hydrocarbon (and Chemical) Spill Management Procedure (950-HSE-EN-PRO-0007). • Bioremediation Management Procedure (950-HSE-EN-PRO-0013). • Cave CO-CA-03 and pool CO-WS-14 Monitoring Strategy. • Razorback Hydrocarbon (and Chemical) Spill Management Procedure. Furthermore, there will be no refuelling or maintenance of mobile equipment within the Razorback pit.	All phases	E	3	L (6)	8

ID	Risk Pathway / Unwanted Event	Relevant Phase[1]	Potential Impacts	Inherent Risk				Risk Treatments	Applicable Phases For Applying Treatments[1]	Residual Risk			
				Likelihood	Consequence	Risk Rating	Data Certainty[2]			Likelihood	Consequence	Risk Rating	Environmental Outcome[3]
23	Inadequate waste management and/or landfill management	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 (2017/7861), Ministerial Statement (1125), Works Approval (W6043), Operating Licence (pending) and the following Atlas Iron plans and procedures as discussed in Section 7.11.1: • Waste Management Procedure (950-HSE-EN-PRO-0023). • Wastewater Treatment Plant (WWTP) Management Plan (950-HSE-EN-PLN-0002) • WWTP Care and Maintenance Plan (950-HSE-EN-PLN-0001) • WWTP Sampling Procedure (950-HSE-EN-PRO-0025) • Landfill Management Procedure (950-HSE-EN-PRO-0020) • Introduced Fauna / Pest Control Management Procedure (950-HSE-EN-PRO-0022). • Fauna Management Procedure (950-HSE-EN-PRO-0012). • SSMP (Appendix Y).	All phases	R	3	L (6)	8
24			Generation of windblown waste	B	1	M (7)	H			C	1	L (4)	N/A
25			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)	8
26	Generation of excessive dust, noise, vibration or light	Construction Operation	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 (2017/7861), Ministerial Statement (1125), Works Approval (W6043), Operating Licence (pending) and the following Atlas Iron plans and procedures as discussed in Section 7.12.1: • SSMP (Appendix Y). • Cave CO-CA-03 and Pool CO-WS-14 Monitoring Strategy. • Dust Management Procedure (950-HSE-EN-PRO-0026). • Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004). • Flora Management Procedure (950-HSE-EN-PRO-0010). • Fauna Management Procedure (950-HSE-EN-PRO-0012).	All phases	D	3	M (9)	8
27			Temporary abandonment of bat roosts during mining leading to a long-term impact on the local population of Pilbara Leaf-nosed Bats	D	4	H (14)	H			E	4	M (9)	8
28			Reduction in vegetation quality and composition	B	2	H (12)	H			C	2	M (8)	8
29			Reduction in pool water quality	B	2	H (12)	H			C	2	M (8)	7

(3) Phases – Construction, Operation, Care & Maintenance (C&M)
(4) 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 Section 8, The ID presented in this column links the risk to the relevant environmental outcome in Table 8.1 or Table 8.2.

8. Environmental Outcomes and Reporting

8.1 Environmental Outcomes, Performance Criteria and Monitoring

Atlas Iron has defined environmental outcomes for the more significant risks identified in the Project's risk assessment (see Section 7 and Table 7-3). 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 8-1 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 closure phase please refer to the Mine Closure Plan (Appendix X).

For environmental factors regulated or considered by other regulatory processes and approvals, please refer to Table 8-2. Notably the risks relating to biodiversity and water resources are generally addressed and regulated by other agencies as detailed in Section 7 and summarised in Table 8-2. However, a number of environmental outcomes and performance criteria relevant to these factors are detailed in Table 8-1, where not explicitly captured by these approvals (e.g., Project related fire).

8.2 Environmental Reporting

Reporting against the performance criteria provided in Table 8-1 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 full reporting requirements including those required by other agencies are detailed in Section 9.10.

Table 8-1 – 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	**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	Contamination of land minimised, and actively remediated if it occurs.	• No single spill of hydrocarbon over 1,000 L outside a bunded/contained area and within 50 m of a permanent pool or known location of priority flora. • All hydrocarbon and chemical spills are controlled, contained and actively remediated.	• All spills to be reported using the Unscheduled Liquid Discharge Form (950-HSE-EN- FRM-0007) and entered as an incident/hazard into reporting database (InControl) as per the HSE Incident Management Procedure (950-HSE-HS-PRO-0002). • Monthly environmental inspections during construction and operation.
2	**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 of the Development Envelope.	• All fires will be reported, investigated and entered as an incident into reporting database (InControl) as per the HSE Incident Management Procedure (950-HSE-HS-PRO-0002). • Monthly environmental inspections during construction and operation. •
3		Poor management of shale waste rock	Limit exposure of plants and animals to Hg enriched waste material.	• All shale waste rock will be placed at least 10 m beneath final WRD slopes.	• As-built inspection, prior to re-profiling/rehabilitation works,

ID	Environmental Factor and DMIRS Objective	Risk Pathway	Environmental Outcome	Performance Criteria	Monitoring
4	**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*	Poor pit water quality	To maintain suitable buffer between the base of the pit and the groundwater table during mining.	• Maintenance of recommended groundwater buffer for each pit as detailed in Appendix B and summarised in Table 3-6 to Table 3-10.	• Quarterly groundwater level monitoring in accordance with the 5C Licence and associated SWOP. • Monitoring of groundwater levels during advanced blast hole and grade control drilling.
5		Poor stability of waste rock dumps	No adverse impacts to permanent pool water quality.	• No shale or siltstone waste rock placed on final WRD slopes.	• As-built inspection, prior to re-profiling/rehabilitation works.
6	**Mine Closure** *Mines are 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 agreed post-mining land use, and without unacceptable liability to the State.*	Poor topsoil management Clearing and other machinery movements resulting in the spread and/or introduction of weeds	To maximise recovery and retention of clean topsoil for rehabilitation	• All ground engaging equipment and machinery must not enter site without a weed certificate, in accordance with Weed Hygiene Procedure (950-HSE-EN-PRO-0002). • No ground disturbance without an approved GDP in accordance with the GDP Procedure (950-HSE-EN-PRO-0001). • 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 in accordance with Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004).	• Topsoil register • Monthly environmental inspections during construction and operation. • All non-conformances with these procedures will be reported, investigated and entered as an incident into reporting database (InControl) as per the HSE Incident Management Procedure (950-HSE-HS-PRO-0002).

Table 8-2 – Environmental Outcomes, Performance Criteria and Monitoring for Risks Regulated by Another Agency

ID	Environmental Factor and DMIRS Objective	Risk Pathway	Environmental Outcome	Performance Criteria	Monitoring
7	**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*	• Clearing • Water abstraction • Physical presence of the Project and/or poor surface water management • Poor pit water quality • Transport, handling and storage of hydrocarbons and chemicals • Inadequate waste and/or landfill management • Generation of excessive dust	No adverse impacts to permanent pool water quality and levels	Adherence to: • EPBC Act Approval (2017/7861). • Ministerial Statement (pending). • 5C Licence (GWL176960). • Works Approval (W6043). • Operating Licence (pending). Note these approvals include the following environmental outcomes/performance criteria: • No direct impact on any of the 11 pools. • No significant change to pool water quality or levels.	• SSMP • Cave CO-CA-03 and pool CO-WS-14 Monitoring Strategy • WMP and SWOP

ID	Environmental Factor and DMIRS Objective	Risk Pathway	Environmental Outcome	Performance Criteria	Monitoring
8	**Biodiversity/ Flora/ Fauna/ Ecosystem** *To maintain representation, diversity, viability and ecological function at the species, population and community level*	• Clearing and other vehicle/ machinery movements • Mining of the Razorback pit • Water abstraction • Physical presence of the Project and/or poor surface water management • Poor pit water quality • Transport, handling and storage of hydrocarbons and chemicals • Inadequate waste and/or landfill management • Attraction of feral fauna • Generation of excessive dust, noise, vibration and light • Project related fire	No long-term impact on conservation significant fauna or flora	Adherence to: – EPBC Act Approval (2017/7861). – Ministerial Statement (pending). – 5C Licence (GWL176960). – Works Approval (W6043). – Operating Licence (pending). Note these approvals include the following environmental outcomes/performance criteria: • No clearing outside the Development Envelope. • No more than 423.11 ha of clearing within the Development Envelope. • Loss of no more than a single known location of each of the following Priority 3 species: *Eragrostis crateriformis*, *Heliotropium murinum* and *Swainsona thompsoniana.* • Loss of only two nocturnal refuges: CO-CA-08 and CO-CA-15. • Loss of no more than 56.39 ha of critical habitat for the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python. • Loss of vigour and/or tree death in a single species, *Melaleuca argentea*, in no more than 112.80 ha of obligate GDV. • No major structural damage to and/or change in microclimate of cave CO-CA-03 impacting its ongoing use by Pilbara Leaf-nosed Bat post-mining (temporary abandonment during mining anticipated). • No significant decline in Pilbara Leaf-nosed Bat population. • Persistence of the Northern Quoll in the Study Area during operations. • No introduction of new weed species.	• SSMP • Cave CO-CA-03 and pool CO-WS-14 Monitoring Strategy • WMP and SWOP

9. Environmental Management System

9.1 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 Y).

Atlas conducts business in accordance with our six core values (Table 9-1). These values reinforce our culture, guide our behaviours and help to articulate the way we approach all aspects of our business.

Table 9-1 – Atlas Values

Atlas Values	
Work Safety	Incidents are preventable
Do the Right Thing	Never walk past an environmental hazard
Work as a Team	Foster a positive culture that engages and supports everyone
Strive for Business Excellence	Environmental excellence ensures our licence to operate
Think Win-Win	Sustainable decisions
Indomitable Spirit	Our people are determined to achieve

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 9.1.

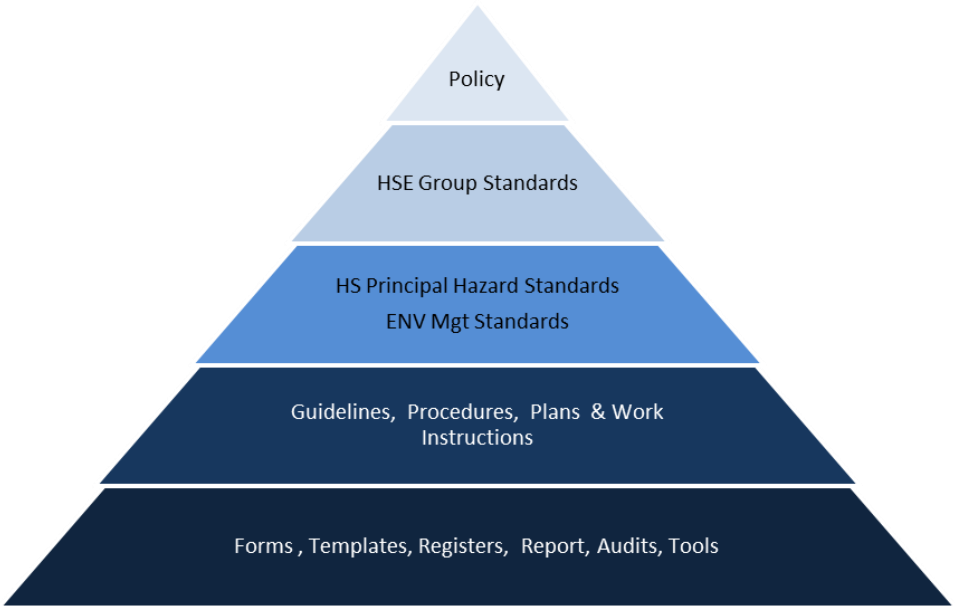


Figure 9.1 – HSE Management System

9.2 Risk Identification Throughout the Life of The Project

9.2.1 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.

9.2.2 Risk Assessment

In all of its activities Atlas is committed to managing risk to a level as low as reasonably practicable (ALARP).

Environmental risk has been assessed for this Project as per the Atlas HSE Group Risk and Hazard Standard (950-HSE-HS-STA-0016) 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.

9.3 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.

9.4 Incorporating Goals and Targets, and Legal Obligations

9.4.1 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.

9.4.2 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.
- 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.

9.5 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 9-2 and detailed in the EMP. Specific responsibilities are incorporated into position descriptions where applicable.

Table 9-2 – Environmental Management Responsibilities

Role	Responsibility
Chief Executive Office	Overall responsibility for the Corunna Downs Project.
General Manager – Operations	Ultimate responsibility for the successful completion and closure of the Project, including adequate closure provisioning.

Role	Responsibility
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.
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 Environmental Department regarding any environmental incident/issue that requires external notification to the environmental regulatory body.

9.6 Training

9.6.1 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.

9.6.2 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.

9.6.3 Training Records

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

9.6.4 Contractors

Contractors and suppliers will be selected and engaged in accordance with the Contractor HSE Requirements Manual (950-HSE-HS-MAN-0002). 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.

9.7 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 Iron's Document Control System to ensure adequate tracking and management of a document metadata to ensure consistent:

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

9.8 Monitoring and Management of Performance

9.8.1 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 particular aspect.

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

9.8.2 Monitoring

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.

9.8.3 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.

9.9 Non-Compliances and Corrective Actions

9.9.1 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-HSE-HS-PRO-0002).

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.

9.9.2 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.

9.9.3 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.

9.10 Internal and External Reporting of Performance

9.10.1 Internal Reporting

Internal reporting is mainly based around incident reporting events. Internal reporting occurs as set out in Table 9-3.

Table 9-3 – 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.

9.10.2 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 9-4 summarises the expected reporting requirements for the Project, these may vary depending on approvals received and legislative requirements.

Table 9-4 – Expected External Reporting Requirements for Corunna Downs

Reporting Source	Government Department	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
Environmental Protection and Biodiversity Act 1999 – Controlled Action Approval	Department of Environment and Energy	Compliance Report	Annually
Environmental Protection Act 1986 – Native Vegetation Clearing Permit	DMIRS	Clearing Report	Annually

Reporting Source	Government Department	Type	Frequency
Environmental Protection Act 1986 – Ministerial Statement	EPA	Annual Environment Report	Annually
Environmental Protection Act 1986 – Part V Licence	DWER	Annual Audit Compliance report	Annually
Environmental Protection Act 1986 – Part V Licence	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
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

9.11 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.

9.12 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.

9.13 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.

9.13.1 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 Procedure (950-OHS-HS-PRO-0001) will be implemented and environmental aspects will be considered for every change.

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Appendix A Spatial Data

Appendix B Addendum to the H3 Hydrogeological Assessment

Appendix C Abandonment Bund Report

Appendix D Zone of Instability Report

Appendix E Land Bridge Assessment

Appendix F Stakeholder Consultation Register

Appendix G Soil Resource Assessment and Waste Characterisation

Appendix H Revised Mine Waste Characterisation Assessment

Appendix I Baseline Flora and Vegetation Assessment

Appendix J Flora and Vegetation Impact Assessment

Appendix K Assessment of Groundwater Drawdown Impacts to Vegetation

Appendix L Terrestrial Vertebrate Fauna Survey

Appendix M Vertebrate Fauna Impact Assessment

Appendix N Importance of CO-CA-03 for the Pilbara Leaf-nosed Bat

Appendix O Cave CO-CA-03 Pilbara Leaf-nosed Bat Roost Census

Appendix P Terrestrial SRE Invertebrate Fauna Survey

Appendix Q Terrestrial SRE Invertebrate Fauna Impact Assessment

Appendix R Subterranean Fauna Assessment

Appendix S Subterranean Fauna Revised Impact Assessment

Appendix T Surface Water Environmental Impact Assessment

Appendix U H3 Hydrogeological Assessment

Appendix V Noise Impact Assessment

Appendix W Air Quality Assessment

Appendix X Mine Closure Plan

Appendix Y Significant Species Management Plan

Appendix Z Atlas HSE Policy