Corunna Downs Project

Mine Closure Plan

179-LAH-EN-PLN-0002

Revision 3

Tenements: M45/1257, G45/339, L45/407, L45/408 and L45/410

Authorisation

Rev	Reason for Issue	Prepared	Checked	Authorised	Date
1	Regulatory requirement	Melissa Finlay	Brendan Bow	Brendan Bow	14/02/17
2	Update in response to DMIRS comments	Stacey Gregory (Mine Earth)	Brendan Bow	Brendan Bow	28/06/17
3	Update in response to DMIRS comments	Stacey Gregory (Mine Earth)	Brendan Bow	Brendan Bow	



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Q No	Mine Closure Plan (MCP) checklist	Y/N/NA	Page No.	Comments	Changes from previous version (Y/N)	Page No.	Summary
1	Has the Checklist been endorsed by a senior representative within the tenement holder/operating company? (See bottom of checklist.)	Y	vi				
Public Availability							
2	Are you aware that from 2015 all MCPs will be made publicly available?	Y					
3	Is there any information in this MCP that should not be publicly available?	N					
4	If “Yes” to Q3, has confidential information been submitted in a separate document/section?						
Cover Page, Table of Contents							
5	Does the MCP cover page include: Project Title Company Name Contact Details (including telephone numbers and email addresses) Document ID and version number Date of submission (needs to match the date of this checklist)	Y		Cover page and Inside Cover	Y		*Revision No. and date of submission was updated*
Scope and Purpose							
6	State why the MCP is submitted (e.g. as part of a Mining Proposal, a reviewed MCP or to fulfil other legal requirements)	Y	1		N		*E.g. As part of Mining Proposal*
Project Overview							
7	Does the project summary include:	Y	3 to 4		N		

Q No	Mine Closure Plan (MCP) checklist	Y/N/NA	Page No.	Comments	Changes from previous version (Y/N)	Page No.	Summary
	Land ownership details (include any land management agency responsible for the land / reserve and the purpose for which the land / reserve [including surrounding land] is being managed) Location of the project; Comprehensive site plan(s); Background information on the history and status of the project.						
Legal Obligations and Commitments							
8	Does the MCP include a consolidated summary or register of closure obligations and commitments?	Y	7		Y		Mining proposal commitments were updated
Stakeholder Engagement							
9	Have all stakeholders involved in closure been identified?	Y	12				
10	Does the MCP include a summary or register of historic stakeholder engagement with details on who has been consulted and the outcomes?	Y	12				
11	Does the MCP include a stakeholder consultation strategy to be implemented in the future?	Y	14				
Post-mining land use(s) and Closure Objectives							
12	Does the MCP include agreed post-mining land use(s), closure objectives and conceptual landform design diagram?	Y	15	Conceptual landform design diagrams are included in Section 9			*Conceptual landform designs have been updated*

Q No	Mine Closure Plan (MCP) checklist	Y/N/NA	Page No.	Comments	Changes from previous version (Y/N)	Page No.	Summary
13	Does the MCP identify all potential (or pre-existing) environmental legacies, which may restrict the post mining land use (including contaminated sites)?	Y	79		Y		*Risk assessment has been updated to include recent additional studies*
14	Has any soil or groundwater contamination that occurred, or is suspected to have occurred, during the operation of the mine, been reported to DER as required under the Contaminated Sites Act 2003?	N/A					
Development of Completion Criteria							
15	Does the MCP include an appropriate set of specific completion criteria and closure performance indicators?	Y	17		Y		*Completion criteria have been updated to address DMIRS feedback*
Collection and Analysis of Closure Data							
16	Does the MCP include baseline data (including pre-mining studies and environmental data)?	Y	24		Y		*Additional work has been summarised*
17	Has materials characterisation been carried out consistent with applicable standards and guidelines (e.g. GARD Guide)?	Y	62		Y		*Additional work has been summarised*
18	Does the MCP identify applicable closure learnings from benchmarking against other comparable mine sites?	Y	74		N		
19	Does the MCP identify all key issues impacting mine closure objectives and outcomes (including potential contamination impacts)?	Y	79		Y		*Risk assessment has been updated to include recent*

Q No	Mine Closure Plan (MCP) checklist	Y/N/NA	Page No.	Comments	Changes from previous version (Y/N)	Page No.	Summary
							additional studies
20	Does the MCP include information relevant to mine closure for each domain or feature?	Y	88		Y		
Identification and Management of Closure Issues							
21	Does the MCP include a gap analysis/risk assessment to determine if further information is required in relation to closure of each domain or feature?	Y	79		Y		*Risk assessment was updated*
22	Does the MCP include the process, methodology, and has the rationale been provided to justify identification and management of the issues?	Y	79		N		
Closure Implementation							
23	Does the MCP include a summary of closure implementation strategies and activities for the proposed operations or for the whole site?	Y	88		Y		*This section was updated in response to DMIRS comments*
24	Does the MCP include a closure work program for each domain or feature?	Y	88		Y		*This section was updated in response to DMIRS comments*
25	Does the MCP contain site layout plans to clearly show each type of disturbance as defined in Schedule 1 of the MRF Regulations?	Y	5		Y		*This section was updated in response to DMIRS comments*
26	Does the MCP contain a schedule of research and trial activities?	Y	112		Y		*This section was updated in response to DMIRS comments*

Q No	Mine Closure Plan (MCP) checklist	Y/N/NA	Page No.	Comments	Changes from previous version (Y/N)	Page No.	Summary
27	Does the MCP contain a schedule of progressive rehabilitation activities?	N			N		
28	Does the MCP include details of how unexpected closure and care and maintenance will be handled?	Y	81		Y		*Schedule of investigative tasks has been developed*
29	Does the MCP contain a schedule of decommissioning activities?	Y	1		N		
30	Does the MCP contain a schedule of closure performance monitoring and maintenance activities?	Y	116		Y		*Additional monitoring has been detailed*
Closure Monitoring and Maintenance							
31	Does the MCP contain a framework, including methodology, quality control and remedial strategy for closure performance monitoring including post-closure monitoring and maintenance?	Y	114		Y		*Additional monitoring has been detailed*
Financial Provisioning for Closure							
32	Does the MCP include costing methodology, assumptions and financial provision to resource closure implementation and monitoring?	Y	117				
33	Does the MCP include a process for regular review of the financial provision?	Y	117				
Management of Information and Data							
34	Does the MCP contain a description of management strategies including systems and processes for the retention of mine records?	Y	119		N		

Corporate Endorsement:

I hereby certify that to the best of my knowledge, the information within this Mine Closure Plan and checklist is true and correct and addresses all the requirements of the Guidelines for the Preparation of a Mine Closure Plan approved by the Director General of the Department of Mines and Petroleum.

Name: Brendan Bow **Signed**:

Position: Manager – Land Access, Heritage and Approvals **Date**: 25 May 2018

(NB: 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)

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1. Scope and Purpose

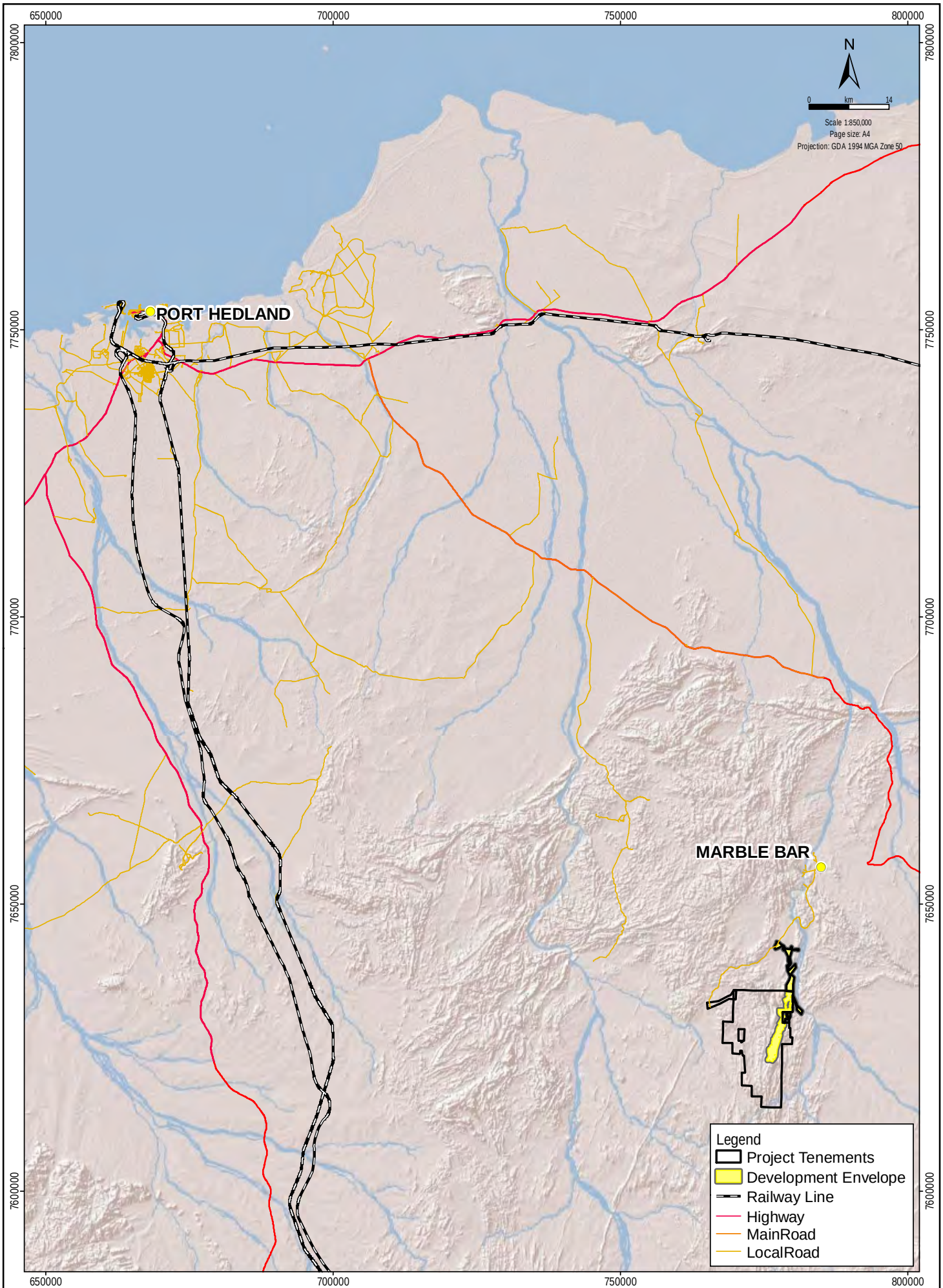
The Corunna Downs Project (the Project) is owned and operated by Atlas Iron Limited (Atlas) and is located approximately 240km south east of Port Hedland in the Pilbara region of Western Australia (Figure 1.1). This Mine Closure Plan (MCP) has been developed in compliance with the Department of Mines and Petroleum (now Department of Mines, Industry Regulation and Safety [DMIRS]) Guideline for Mining Proposals in Western Australia (2016a), Guidelines for Preparing Mine Closure Plans (2015) and tenement conditions in support of Atlas' Mining Proposal for the Project.

Originally submitted in February 2017, the MCP was updated based upon feedback received from DMIRS and was resubmitted in June 2017. Further feedback on the June 2017 submission was received from DMIRS in October 2017 (Appendix A). This version of the MCP has been updated to address the feedback received from DMIRS in October 2017.

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

Table 1-1 – Indicative Project Schedule

Development Stage	Indicative Timing
Obtain key environmental approvals	June 2018
Commence Site Construction	H2 2018
Commence Mining	H1 2019
Commence Shipping	2019
Mining Ceases	2024
Decommissioning and Closure	2025



File Name: GIS_2322.mxd Date: 24/05/2018 Author: cthatcher	Document Number : (QDMS number only) 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 Location*	Figure No: *1.1*

2. Project Summary

2.1 Project Overview

The Project is located approximately 240 km south east of Port Hedland and 33 km south of Marble Bar (Figure 1.1). The Project involves the development of five open pits (Split Rock, Razor Back, Shark Gully, Runway North and Runway South) using conventional drill and blast, load, and haul methods. It is anticipated 23.3 million tonnes (Mt) of iron ore will be mined above the groundwater table over approximately 6 years with an average strip ratio of 0.55:1 (waste:ore).

Associated infrastructure will include open pits, waste rock dumps, mine infrastructure, borefield and accommodation camp.

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 to Utah Point Bulk Commodities Berth at Port Hedland.

2.1.1 Mining

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

Pre-stripping will be required to expose the targeted ore. Topsoil and vegetation will be removed, where possible, during pre-stripping and stockpiled in adjacent well-drained areas. Topsoil stockpiles will be managed appropriately, and the materials will be used during rehabilitation.

Following pre-stripping, weathered rock will be free-dug (without blasting) where possible. Drill and 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) drillhole samples prior to drill and blast to establish ore blocks.

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 3.7 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.

As mining will be above the water table, pit dewatering will not be required.

2.1.2 Ore Processing and 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 directly. From the ROM pad ore will be crushed and screened onsite using a 5 Mtpa mobile 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. The product will then be transported using side-tipper, triple or quad-configuration road trains with a total payload up to approximately 115 tonnes 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 120 truck cycles per day (round trip).

Waste rock will initially be used to construct mine site infrastructure (e.g., access ramps, drainage structures and safety bunds) and then transported and disposed of in waste rock dumps.

2.1.3 Additional Infrastructure and Support Facilities

A number of additional infrastructure and support facilities will be required for the Project, including a mine operation centre (MOC) and administration area, mining contractors yard and workshop, haulage contractors area, explosives magazine and ammonium nitrate prill storage, water production bores and turkey nests, potable water treatment and storage, sewage treatment system, spray field, fuel storage and refuelling areas, haul roads, access roads and tracks and borrow pits. These are shown in Figure 2.1.

2.2 Land Ownership

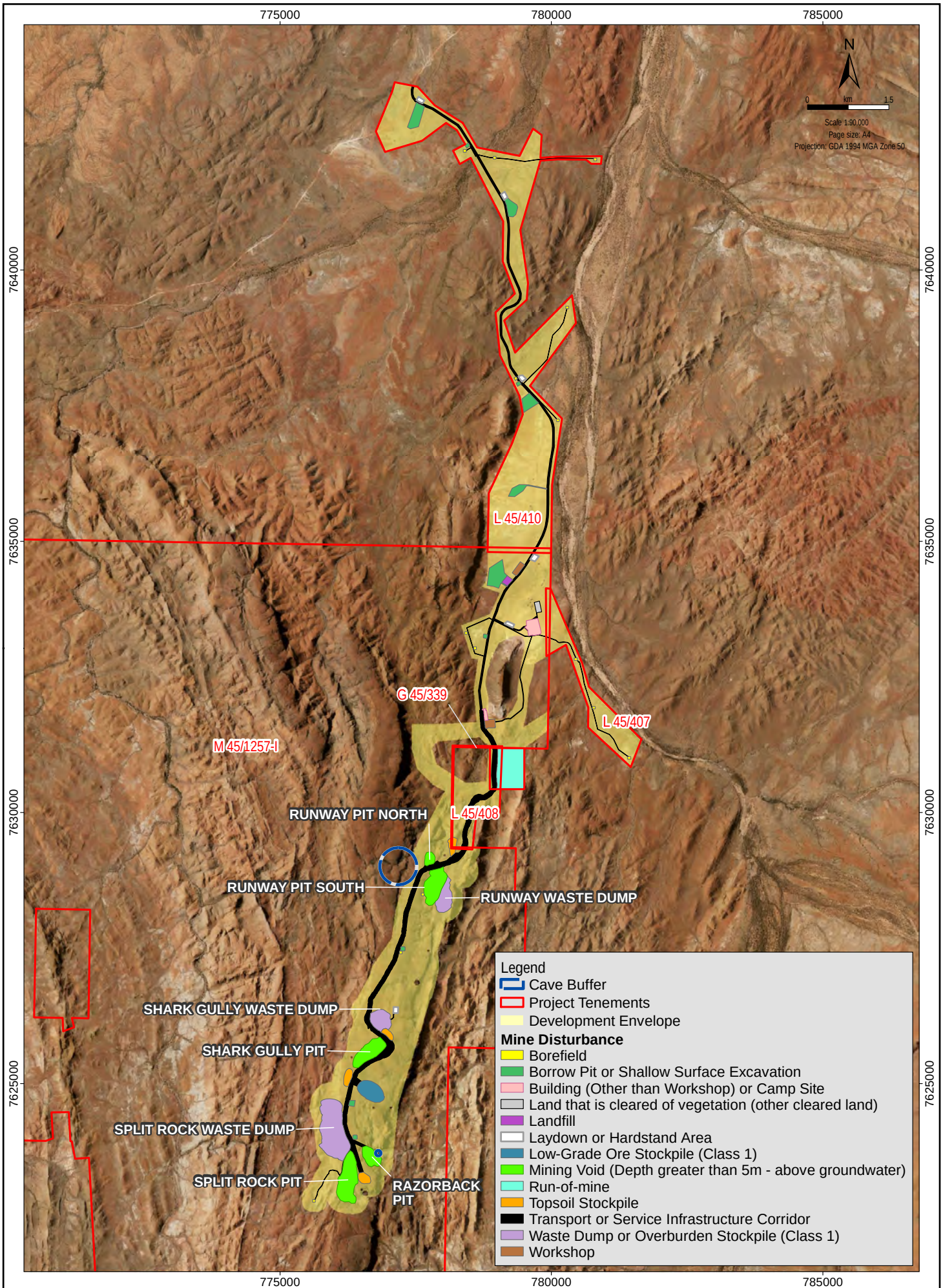
The majority of the Development Envelope lies within the Panorama and Eginbah Pastoral Stations and the remaining comprises unallocated crown land (Figure 2.2). Evidence of pastoral activity is widespread particularly around water holes and drainage lines, with cattle, pasture grasses such as Buffel Grass (*Cenchrus ciliaris*) and land degradation frequently observed in such areas.

2.3 Tenure

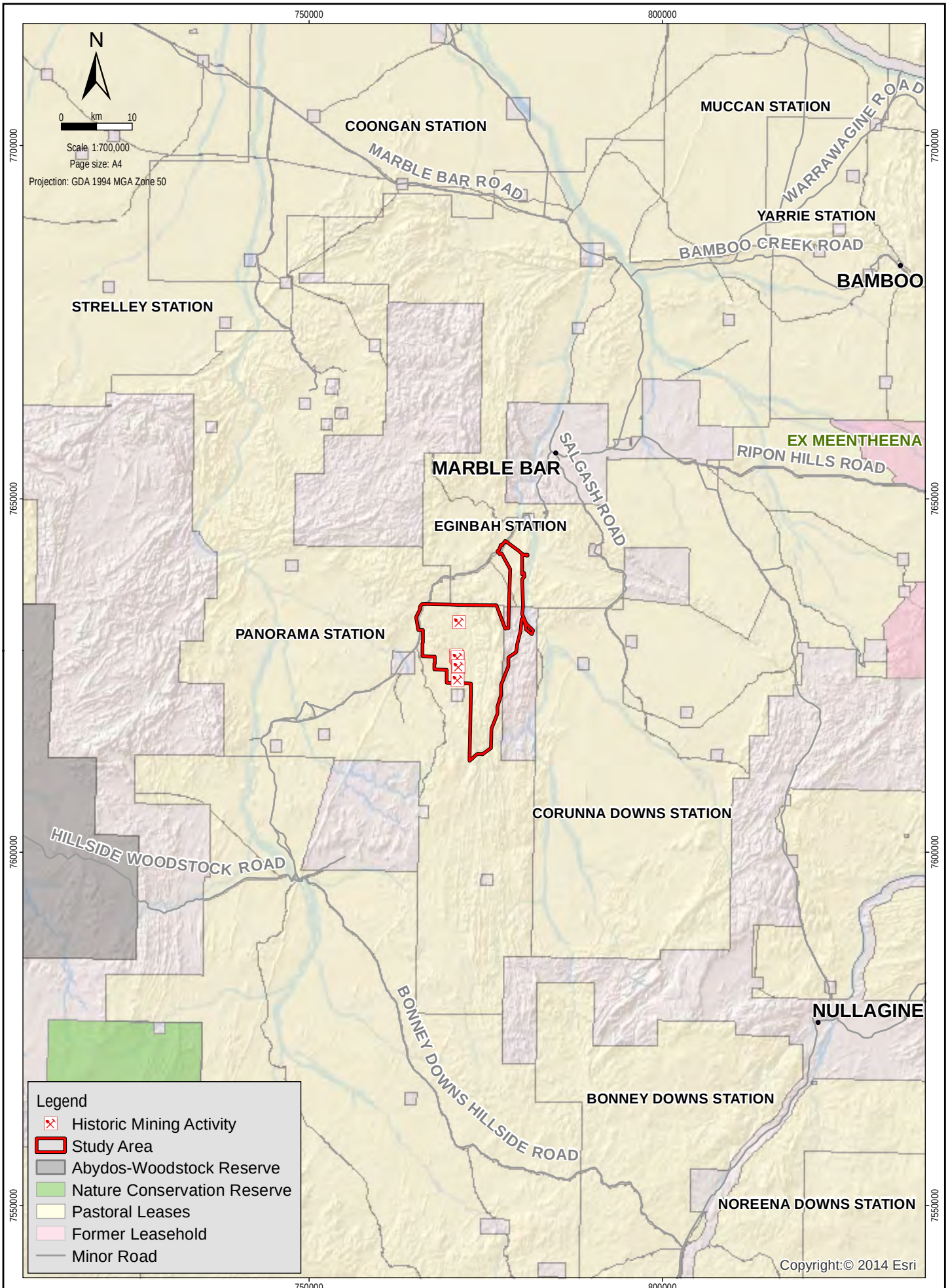
The Project occurs within the following mining tenure granted under the *Mining Act 1978* (Figure 2.2):

- M45/1257
- G45/339
- L45/407
- L45/408
- L45/410

Atlas is the sole beneficial owner of all of the above tenure.



File Name: GIS_2320.mxd Date: 24/05/2018 Author: cthatcher	Document Number : (QDMS number only) Source & Notes: *Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*	*Indicative Mine Plan*	Figure No: *2.1*



ATLAS	File Name: GIS_2217.mxd	Document Number : (QDMS number only)	Land Use	Figure No: 2.2
	Date: 13/08/2017	Source & Notes:		
	Author: cthatcher	Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.		

3. Identification of Closure Obligations and Commitments

Mine closure planning for the Project is governed by the legal framework within which Atlas operates including Commonwealth and State legislation, site specific conditions and commitments.

All legal obligations relevant to rehabilitation and closure have been identified and are present in Table 3-1 to Table 3-5.

Table 3-1 – DMIRS Tenement Conditions

Tenement No.	Condition No.	Closure Conditions
M45/1257	1	All waste materials, rubbish, plastic sample bags, abandoned equipment and temporary buildings being removed from the mining tenement prior to or at the termination of exploration program
	2	Unless the written approval of the Environmental Officer, DMIRS is first obtained, the use of drilling rigs, scrapers, graders, bulldozers, backhoes or other mechanised equipment for surface disturbance or the excavation of costeans is prohibited. Following approval, all topsoil being removed ahead of mining operations and separately stockpiled for replacement after backfilling and/or completion of operations
L45/407	3	All topsoil that may be removed ahead of pipelaying operations to be stockpiled for replacement in accordance with the directions of the Environmental Officer, DMIRS.
	12	All disturbances to the surface of the land made as a result of exploration, including costeans, drill pads, grid lines and access tracks, being backfilled and rehabilitated to the satisfaction of the Environmental Officer, Department of Mines and Petroleum (DMIRS). Backfilling and rehabilitation being required no later than 6 months after excavation unless otherwise approved in writing by the Environmental Officer, DMIRS.
	13	All waste materials, rubbish, plastic sample bags, abandoned equipment and temporary buildings being removed from the licence area prior to or at the termination of exploration program
L45/408	2	All topsoil that may be removed ahead of pipelaying operations to be stockpiled for replacement in accordance with the directions of the Environmental Officer, DMIRS.
L45/410	5	All topsoil that may be removed ahead of pipelaying operations to be stockpiled for replacement in accordance with the directions of the Environmental Officer, DMIRS.
	13	All disturbances to the surface of the land made as a result of exploration, including costeans, drill pads, grid lines and access tracks, being backfilled and rehabilitated to the satisfaction of the Environmental Officer, Department of Mines and Petroleum (DMIRS). Backfilling and rehabilitation being required no later than 6 months after excavation

Tenement No.	Condition No.	Closure Conditions
		unless otherwise approved in writing by the Environmental Officer, DMIRS.
	14	All waste materials, rubbish, plastic sample bags, abandoned equipment and temporary buildings being removed from the licence area prior to or at the termination of exploration program

Table 3-2 – Program of Work Commitments

PoW Reference Number	Closure Condition
60443 (Geotech)	All rubbish removed from site (including any hydrocarbon spills)
	Excavations (e.g. sumps, costeans etc.) backfilled and respread with topsoil and cleared vegetation
60609 (Water Exploration)	Drill holes secured immediately after drilling (capped/plugged)
	Drill holes securely plugged below ground at minimum depth of 400mm within 6 months of drilling (If not using concrete, conical plugs, please specify type in Other)
	Scarifying/Ripping of compacted areas on the contour
	All rubbish removed from site (including any hydrocarbon spills)
	Excavations (e.g. sumps, costeans etc.) backfilled and respread with topsoil and cleared vegetation
63680 (Exploration Track)	Scarifying/Ripping of compacted areas on the contour
	Blocking access to tracks
63881 (Geotech)	Scarifying/Ripping of compacted areas on the contour
	All rubbish removed from site (including any hydrocarbon spills)
	Excavations (e.g. sumps, costeans etc.) backfilled and respread with topsoil and cleared vegetation
63925 (Water Exploration)	Drill holes secured immediately after drilling (capped/plugged)
	Drill holes securely plugged below ground at minimum depth of 400mm within 6 months of drilling (If not using concrete, conical plugs, please specify type in Other)
	Scarifying/Ripping of compacted areas on the contour
	Blocking access to tracks
	Drill sample piles rehabilitated or buried
	Sample bags removed within 6 months of drilling
	All rubbish removed from site (including any hydrocarbon spills)
	Excavations (e.g. sumps, costeans etc.) backfilled and respread with topsoil and cleared vegetation

For completeness, performance criteria from the Project Mining Proposal which relate to mine closure have been included in Table 3-3. These commitments will become legally binding once the Mining Proposal is accepted by the DMIRS and will be updated as such in the next iteration of the MCP.

Table 3-3 – Mining Proposal Performance Criteria

Closure Commitment
No new declared weed species within the disturbance footprint over the life of the Project.
Weed cover (excluding *Cenchrus cilarias*) within the disturbance footprint on closure of the Project is to be equal to/less than: – 10% on landform domain. – 15% on all other rehabilitated domains (excluding pits).
No disturbance outside the approved clearing boundary (i.e., Development Envelope).
No exceedance of approved disturbance/clearing limit (423.11 ha).
No direct clearing of water source CO-WS-01.
No clearing of the flora species, *Acrostichum speciosum*.
Only one location of the following species to be cleared; *Heliotropium murinum* (P3), *Swainsona thompsoniana* (P3) & *Eragrostis crateriformis* (P3).
No unacceptable impact to GDV outside the Development Envelope in relation to drawdown (i.e., no more than1m over life of mine at a rate of 0.25 m/year, on top of seasonal variation).
No clearing to be undertaken without an approved GDP, over the life of the project.
Topsoil shall be stripped to a minimum depth of 200 mm below the natural surface unless otherwise stated in GDP conditions, during construction and operation.
Topsoil stockpiles shall not exceed 2m in height, during construction and operation.
Topsoil stripping shall only be undertaken in dry conditions
No double handling of topsoil.
Complete additional test work during infill drilling (prior to mining) to confirm the presence and spatial extent of any PAF shale in the Split Rock deposit and confirm the geochemical nature of the shale unit within the Runway South pit and any associated risk of PAF pit wall exposure and AMD.
Management of waste rock in accordance with Atlas' Waste Rock Management Strategy including: – No placement of erosive material (i.e., clay rich BIF or shale) on sloped surfaces of waste rock dumps. – NAF shale from Split Rock (i.e., elevated Hg) will be buried 10 m below final surface of profiled landform. – PAF shale if confirmed to be present and comprising more than 10% of the total shale waste unit must be suitably encapsulated within Split Rock, including: ▪ Constructed on a basal layer of geochemically benign waste rock at least 5 m thick. ▪ Covered with ~0.5 m low permeability layer of traffic compacted waste rock and 10 m of NAF material between the low permeability layer and final waste rock dump surface.

Closure Commitment
– PAF shale if confirmed to be present and comprising less than 10% of the total shale waste unit can be comingled with other NAF material but must be buried 10m below final surface of profiled landform.
In the unlikely event PAF material is confirmed to be present, intersects the pit wall and found to present an AMD risk, Atlas will develop a PAF Pit Wall Management Strategy prior to mining affected pit/s to minimise exposure and oxidation and ensure no deleterious groundwater impacts.

Atlas referred the Project to the Commonwealth Department of the Environment and Energy (DoEE) to determine if the Project will have a significant impact on matters of national environmental significance. The referral was approved with conditions in February 2018. Table 3-4 contains the conditions of the DoEE approval.

Table 3-4 – EPBC Conditions

Closure Condition
Clear no more than 423.19 ha within the disturbance footprint
implement the Significant Species Management Plan
For the protection of the Pilbara Leaf-nosed Bat the approval holder must: a) maintain at least a 340 metre buffer around the lateral extent of cave CO-CA-01 b) maintain at least a 25 metre buffer around the lateral extent of cave CO-CA-03
The approval holder must demonstrate that, both during and after mining ceases at the Razor Back Pit, cave CO-CA-03 and waterhole CO-WS-14 remain suitable habitat available for use by the Pilbara Leaf-nosed Bat.
The Monitoring Strategy must be designed to demonstrate that the structure of cave CO-CA-03 remains unchanged from the pre-mining structure during mining of the Razor Back Pit. The monitoring strategy must also be designed to demonstrate, unless otherwise justified and approved by the Minister, that: a) without anthropogenic supplementation of its water level, waterhole CO-WS-14 has water in it during and continuously for three consecutive years following the cessation of mining of Razor Back Pit; and b) the water quality of waterhole CO-WS-14 remains suitable for Pilbara Leaf-nosed Bat during and continuously for three consecutive years following the cessation of mining of Razor Back Pit; and c) cave CO-CA-03 maintains: i. humidity between 85-100 per cent relative humidity ii. temperature between 28 and 32 degrees Celsius during and continuously for five years following cessation of the mining of Razor Back Pit.

A Native Vegetation Clearing Permit (NVCP) application has been submitted to the DMIRS for assessment. Commitments made with regard to closure and rehabilitation in the application documentation has been provided in Table 3-5. This Table will be updated in the next revision of the MCP to reflect any further conditions imposed with regard to rehabilitation and closure activities.

Table 3-5 – Native Vegetation Clearing Permit Commitments

Document Name	Closure Commitment
Native Vegetation Clearing Permit	Woody material collected during land clearing will be salvaged and stockpiled for future use during rehabilitation.

Document Name	Closure Commitment
Supporting Document	A weed monitoring and management programme will be developed, to ensure that any existing and new weed infestations within areas of Project disturbance (including areas of rehabilitation) are identified and can be controlled
	Disturbed areas will be progressively rehabilitated as soon as practicable
	If required, subsoil may be salvaged to make up any shortfall in available topsoil volumes required during rehabilitation.

Under Part V of the *Environmental Protection Act* 1986 (EP Act) Atlas applied to the Department of Environmental Regulation (DER) for works approval and licence for the construction and operation of a prescribed premises. The Project is a prescribed premise under three categories listed in Schedule 1 of the Environmental Protection Regulations 1987:

- Category 5: Processing or beneficiation of metallic or non-metallic ore.
- Category 85: Sewage treatment facilities.
- Category 89: Putrescible landfill site.

The works approval was granted in September 2017. There are no commitments made in the works approval or licence application that relate to closure and rehabilitation of the Project.

Atlas has obtained a Licence to Take Water under the *Rights in Water and Irrigation Act 1914* (RIWI Act) (GWL17690(4)) for the exploration, investigation and planning phase of the Project. An amendment to this licence will be required prior to operations to ensure sufficient quantities are included and all water sources are included. Currently as the licence stands, it contains no legal obligations related to mine closure or rehabilitation. Any commitments made in the licence amendment application that relate to closure and rehabilitation will be captured and included in the next revision of the MCP.

4. Stakeholder Engagement

Atlas has proactively consulted with government and non-government stakeholders throughout the development, design and planning stages of the Project. Stakeholders consulted include, but are not limited to:

- Indigenous community groups (Njamal Native Title Claimant Group).
- Neighbouring pastoral lease owners (Hillside/Panorama, Eginbah).
- Government Departments (DMIRS, EPA, DPaW, DoEE, Department of Aboriginal Affairs (DAA), Main Roads Western Australia).
- Local Government (Shire of East Pilbara).
- Relevant tenement holders (Numerous).
- Local Community Members (Marble Bar, Marble Bar Community Resource Centre, Marble Bar Progress Association)

Atlas is committed to continuing consultation with stakeholders through the approval, construction and operational phases of the Project to ensure stakeholders are regularly informed of Project developments and address any concerns raised efficiently.

To date, the Shire of East Pilbara has been the stakeholder with whom Atlas has majority of consultation with regarding closure and rehabilitation and this has been in regard to the post Project ownership and maintenance of the upgraded Hillside-Marble Bar Road route.

Stakeholder engagement undertaken during the development of the MCP for the Project is presented in Table 4-1.

Table 4-1 – Stakeholder engagement undertaken during the closure planning process

Stakeholder	Date	Discussion points
Njamal Monitoring and Liaison Committee	September 2015	Atlas provided the committee with a brief update on Corunna Downs Project
Pastoralist	September 2016	Atlas provided the pastoralist with an overview of the Project and update on proposed activities and site access requirements for the near future
Marble Bar community members	November 2016	Community consultation presentation and open floor questions
DMIRS	June 2017	DMIRS Requested clarification on a number of matters discussed within the Corunna Downs Project Mining Proposal and MCP. A subsequent revision of both was submitted in June 2017.
DMIRS	October 2017	DMIRS requested and received additional waste characterisation work completed on the Split Rock Shale Unit.

Stakeholder	Date	Discussion points
DMIRS	March 2018	Atlas, Mine Earth and DMIRS met to discuss the outcomes of additional baseline assessments and the submission of the updated MCP.

Atlas has had detailed MCPs approved recently for a number of their projects including Pardoo, Mt Dove, Wodgina and Abydos, and closure works having been undertaken at these projects. Key learnings from the Pardoo and Mt Dove projects are detailed in Section 7.11 of this MCP. A considerable effort as part of the closure of these sites has been the development and refinement of suitable closure objectives and criteria. These have been developed with considerable stakeholder input, as described in Table 4-2.

Table 4-2 – Stakeholder engagement undertaken during the closure of Atlas' other projects

Stakeholder	Date	Discussion points	Project
Atlas, Mine Earth, Woodman environmental consultants, Trajectory (Rory Haymont) and Astron Environmental	March 2013	Internal meetings to develop and refine closure criteria for Atlas' Pardoo and Mt Dove Projects.	Pardoo and Mt Dove
DMIRS, DOW	March 2013	This meeting was used to present and provide stakeholders the opportunity to contribute to the development of the closure objectives, closure criteria and the post closure monitoring strategy.	Pardoo
DMIRS	June 2014	The DMIRS requested further information and clarification regarding vegetation closure criteria. A memo was submitted to the DMIRS describing the methods used to develop closure criteria and provide some examples of how the standards will be calculated. Subsequently the DMIRS undertook a site visit and requested some changes to the closure criteria for plant cover and species richness. Atlas submitted a secondary memo with suggested changes and updated and resubmitted the detailed MCP accordingly.	Mt Dove
DMIRS	February 2015	Atlas and DMIRS attended a meeting to discuss closure objectives and criteria for the project and planned investigations to fill knowledge gaps. Closure objectives and criteria were subsequently refined.	Wodgina

Stakeholder	Date	Discussion points	Project
DMIRS	February 2016	Atlas, DMIRS and Mine Earth attended a meeting to discuss advancements in closure criteria. Closure objectives and criteria were subsequently refined.	Abydos
DMIRS	February 2017	After the submission of the detailed MCP's for the Abydos and Wodgina projects a meeting to discuss closure criteria was held. Changes were required prior to the closure criteria being accepted.	Wodgina and Abydos

Consultation regarding the rehabilitation and closure of the Project is ongoing and will continue with key stakeholders throughout the life of the Project. Atlas will continue the stakeholder consultation program as outlined in Table 4-3 to provide an avenue for effective participation in the closure process and to ensure that stakeholder concerns and expectations are taken into account, where practicable. Stakeholder consultation outcomes will be detailed in future submissions of the AER and the MCP.

Table 4-3 – Planned closure consultation

Stakeholder	Planned consultation issue	Methods
Indigenous community groups	Post closure land use. Residual assets. Access to Project domains.	Yearly meetings
Neighbouring pastoral lease owners	Post closure land use. Residual assets. Access to Project domains.	Yearly meetings
Government departments	MCP updates. Post closure land use. Closure objectives and completion criteria. Identification and management of closure risks. Closure implementation strategies.	MCP and AER updates
Local government	Post closure land use. Residual assets. Access to Project domains.	Yearly meetings
Relevant tenement holders	Post closure land use. Residual assets. Access to Project domains.	Yearly meetings
Local community groups	Post closure land use. Residual assets. Access to Project domains.	Meetings prior to the submission of the detailed MCP

5. Post-Mining Land Use and Closure Objectives

Closure objectives provide the basis against which closure performance will be measured. The objectives set out the long-term goals for closure outcomes and provide the basis for the development of closure criteria.

5.1 Post-Mining Land Use

The current land use consists of pastoral activities and a small pocket of unallocated crown land. A number of significant fauna habitats have been recorded in the Project area including caves, and permanent/semi-permanent water sources. These features were highlighted because they provide important sources of shelter, food and water for species of conservation significance. It is anticipated that rehabilitated areas will be able to be used in a similar manner to comparable surrounding land but at a lower intensity. This post mining land use objective applies to all domains except the open pits, which will remain limited access areas. Although conceptual, this post mining land use will be updated over time in consultation with key stakeholders.

The mine closure 'vision' describes the intended future state of the Project area after mine closure and is supported by more detailed closure objectives. The mine closure vision for the Project is:

> *Rehabilitated areas will be safe and stable, and revegetation will be self-sustaining. General access to the site will be restricted and any residual infrastructure will be managed by a new owner.*

5.2 Closure Objectives

The mine closure vision is supported by closure objectives which cover a range of closure aspects. Aspects are the elements that need to be considered for closure, and the objectives describe the intent in relation to each aspect. The aspects and closure objectives for each domain for the Project are provided in Table 5-1.

If monitoring during operations indicates additional impacts such as the occurrence of a contaminated site or impacts to adjacent permanent surface water pools and waterholes, additional objectives will be developed for the Project. Closure objectives will be refined up until the submission of the detailed MCP.

Table 5-1 – Closure aspects and objectives

Aspect	Objective	Applicable domains
Safety	Closed areas will be designed to deter access	All domains
	Landforms will be constructed to ensure they are stable and non-polluting.	Landforms Non-processing infrastructure Roads, hardstand and borrow areas

Aspect	Objective	Applicable domains
Assets	Infrastructure will be removed or left in situ where agreed.	Ore processing and handling Non-process infrastructure Roads, hardstand and borrow areas
Vegetation community	Establish a self-sustaining vegetation community containing local provenance species on disturbed areas.	Landforms Ore processing and handling Non-processing infrastructure Roads, hardstand and borrow areas
Surface water	Uncontrolled surface water flows and impacts to surface water will be minimised.	All domains
Fauna	Encourage native fauna to inhabit rehabilitated areas.	Landforms Ore processing and handling Non-processing infrastructure Roads, hardstand and borrow areas
	Cave CO-CA-03 and waterhole CO-WS-14 remain suitable for use by the Pilbara Leaf nosed bat.	Landforms Ore processing and handling Non-processing infrastructure Roads, hardstand and borrow areas

6. Development of Completion Criteria

Closure performance will be measured against agreed closure objectives and criteria and will be reported to relevant stakeholders as evidence to support tenement relinquishment.

The aspects, objectives, criteria and standards required to measure closure performance relate to each other as follows:

- Aspects are the elements that need to be considered for closure.
- Objectives describe the intent of the mine closure program in relation to each aspect (see Section 5).
- Criteria describe specific elements that can be measured or certified to have occurred and that are considered to be critical to achieving the objective. Each objective may have more than one criterion.
- Standards may be either an agreed value that is measurable and is regarded as the minimum that must be achieved, or a certification that closure activities comply with an agreed plan.
- Threshold values are included for some standards and represent the level at which mitigation works and further investigation may be required.

The closure objectives, criteria and standards for the Project have been developed in consultation with the DMIRS and have been derived from other Atlas projects including Pardoo, Mt Dove and Wodgina where they were negotiated extensively and agreed with the DER, EPA, DoW, DMIRS and industry specialists (see Section 4).

Interim standard and threshold values have been developed using baseline data collected at the Project and from Atlas' other nearby projects. The criteria, standards and threshold values will be updated and further refined in subsequent iterations of the MCP as data is collected during operations and the knowledge gaps for closure are progressively filled. The objectives and criteria developed for the Project have been refined to reflect the higher ecological value of the area.

Atlas aims to meet all closure objectives and criteria and achieve lease relinquishment ten years after the completion of closure works. A relinquishment report will be developed at the end of the closure monitoring period, in conjunction with inspections by the DMIRS, to document the achievement of closure objectives.

Closure objectives and criteria for each aspect are presented below and are defined further in Appendix B.

Atlas is continually collecting rehabilitation data from their closed mines including Wodgina, Abydos, Pardoo and Mt Dove. The data collected from these closed mines will be used to inform the refinement of closure criteria, standards and thresholds for the Project.

Closure criteria for aspects including surface water, vegetation and fauna refer to works being carried out as defined in the detailed mine closure plan. Atlas will develop the detailed mine closure plan for the Project approximately 1 year to six months prior to the end of mining. The detailed MCP will include final landform designs, abandonment bund plans and all proposed closure activities for approval by DMIRS. Once closure activities have been carried out as per

the detailed MCP, close out reports will be developed to verify that works have been completed to the required standard.

6.1 Safety

The objective, criteria and standards that relate to safety for relevant domains are presented in Table 6-1.

Table 6-1 – Objective, criteria and standards for safety

Objective	Applicable Domains	Criteria	Standards
Closed areas will be designed to deter access	Open pits	Abandonment bunds will be constructed in accordance with an approved abandonment bund plan.	Close out report.
	All domains	Roads no longer required will be rehabilitated.	Close out report.
Landforms will be constructed to ensure they are stable and non-polluting.	Landforms	Problematic waste* not to be placed at or close to the surface of constructed landforms.	Close out report.
	Landforms	Erosion levels will stabilise.	The change in the proportion of the bank erosion measured annually will be less than 5%. A threshold value of 15% will apply. Where annual change in the proportion of bank erosion exceeds this threshold value, mitigation measures will be considered.
	Non-processing infrastructure Roads, hardstand and borrow areas	Contaminated soils will be removed or remediated.	Close out report.

* Problematic waste is defined as material that has the potential to generate acid or metalliferous drainage. It can also include material which is erosive such as the clay rich BIF. It should be noted that erosive material may be placed on landform flat surfaces in the event of a topsoil deficit (See Section 9.2.3).

6.2 Assets

The objective, criteria and standards that relate to assets for relevant domains are presented in Table 6-2.

Table 6-2 – Objective, criteria and standards for assets

Objective	Applicable domains	Criteria	Standards
Infrastructure will be removed or left in situ where agreed.	Ore processing and handling. Non-process infrastructure. Roads, hardstand and borrow pits.	Below ground infrastructure will be left in place where safe to do so.	Close out report.
		All above ground infrastructure will be removed unless otherwise agreed.	Close out report.
		A transfer agreement will be in place for all residual assets.	Transfer agreement.
		Residual assets will be functional at handover.	Functional report for residual assets.
		Maintenance and operational procedures will be provided to new owner.	Functional report for residual assets.

6.3 Vegetation

The objective, criteria and standards that relate to vegetation for relevant domains are presented in Table 6-3. Additional information relating to the development of vegetation closure criteria and data used to calculate threshold values, is presented in Appendix B.

Atlas will continue to refine the vegetation closure criteria, standards and thresholds over time as additional rehabilitation monitoring data becomes available from Atlas' nearby Projects. This data will be used specifically to refine plant cover, density, species richness and weed cover standards and thresholds.

Table 6-3 – Objective, criteria and standards for Vegetation

Objective	Applicable domains	Criteria	Standards
Establish self-sustaining native and local provenance vegetation community on disturbed areas.	All domains excluding open pits.	Revegetation will be implemented in accordance with the approved detailed MCP.	Close out report.
		Long lived perennial plant cover in rehabilitated areas will reach 70% of the best achievable within each rehabilitation zone.	Plant cover data will be collected in rehabilitation zones and standards will be developed using this data. Interim threshold values have been calculated using baseline vegetation data (Appendix B). A threshold value of 15% for sloped areas and 18% for flat areas will apply. Where plant cover is less than the threshold value, mitigation measures will be considered.
		Long lived perennial species richness in rehabilitated areas will reach 70% of the best achievable within each rehabilitation zone.	Species richness data will be collected in rehabilitation zones and standards will be developed using this data. Interim threshold values have been calculated using baseline vegetation data (Appendix B). A threshold value of 7 species for sloped and flat areas (in 50x50 m) will apply. Where species richness is less than the threshold value, mitigation measures will be considered.
		Representative taxa from nearby vegetation communities will be included in the rehabilitation seed mix for specific areas.	Close out report.
		Weed cover will not inhibit native vegetation.	Close out report demonstrating that all other vegetation criteria have been met.

Objective	Applicable domains	Criteria	Standards
			A standard value of 10% weed cover has been calculated on landforms and 15% for all other rehabilitated domains (except open pits). Where weed cover is greater than these values, mitigation measures and active management will be considered.
		No new declared weeds will be recorded at the Project.	Close out report.
		Atlas implement an effective weed management strategy during the operating phase of the Project.	Close out report.

6.4 Surface Water

The objective, criteria and standards that relate to surface water for relevant domains are presented Table 6-4.

Table 6-4 – Objective, criteria and standards for Surface Water

Objective	Applicable domains	Criteria	Standards
Uncontrolled surface water flows and impacts to surface water will be minimised.	All domains.	Surface water drainage structures will be installed in accordance with the approved detailed MCP.	Close out report.
		Surface water management structures will operate in accordance with their design[1]	Inspection reports.
	Landforms.	Erosion levels will stabilise.	The change in the proportion of the bank erosion measured annually will be less than 5%. A threshold value of 15% will apply. Where annual change in the proportion of bank erosion exceeds this threshold value, mitigation measures will be considered.

[1] Surface water management structures will be defined in the Atlas' detailed MCP for the Project

Objective	Applicable domains	Criteria	Standards
	All domains	Without anthropogenic supplementation of its water level, waterhole CO-WS-14 has water in it during and continuously for three consecutive years following the cessation of mining of Razor Back Pit.	Close out report
	All domains	Water quality of waterhole CO-WS-14 remains suitable for Pilbara Leaf-nosed Bat during and continuously for three consecutive years following the cessation of mining of Razor Back Pit.	Close out report

6.5 Fauna

The objective, criteria and standards that relate to fauna for relevant domains are presented in Table 6-5. Although the fauna criteria relate to the development of habitat zones and the maintenance of buffer zones the development of a functional vegetation community will be critical to the return of fauna. Therefore, vegetation criteria (see Section 6.3) will also apply to the fauna aspect.

Table 6-5 – Objective, criteria and standards for Fauna

Objective	Applicable domains	Criteria	Standards
Encourage native fauna to inhabit rehabilitated areas	All domains except open pits.	Habitat zones will be created in accordance with the approved detailed MCP.	Close out report.
		Buffer zones around recognised habitats for the Pilbara leaf-nose bat have been maintained.	As per Table 3.3, buffer zones around significant bat habitats will be maintained. This will be demonstrated via a close out report.
Cave CO-CA-03 and waterhole CO-WS-14 remain suitable for use by the Pilbara Leaf nosed bat. [2]	All domains	Buffer zones around recognised habitats for the Pilbara leaf-nose bat have been maintained.	Close out report
		Without anthropogenic supplementation of its water level, waterhole CO-WS-14 has water in it during and continuously for three consecutive years following the cessation of mining of Razor Back Pit.	Close out report

[2] These commitments may need to be adjusted depending on operational commitments during mining.

Objective	Applicable domains	Criteria	Standards
		Water quality of waterhole CO-WS-14 remains suitable for Pilbara Leaf-nosed Bat during and continuously for three consecutive years following the cessation of mining of Razor Back Pit.	Close out report
		Cave CO-CA-03 maintains: i. humidity between 85-100 per cent relative humidity ii. temperature between 28 and 32 degrees Celsius during and continuously for five years following cessation of the mining of Razor Back Pit.	Close out report

7. Collection and Analysis of Closure Data

An assessment of Project data is important for understanding potential impacts, closure risks and for providing context for closure objectives and criteria. Relevant closure data for the Project will include baseline data that has been collected prior to construction, data that will be collected during the operational phase and an assessment of learnings from Atlas projects already in the rehabilitation and closure phase.

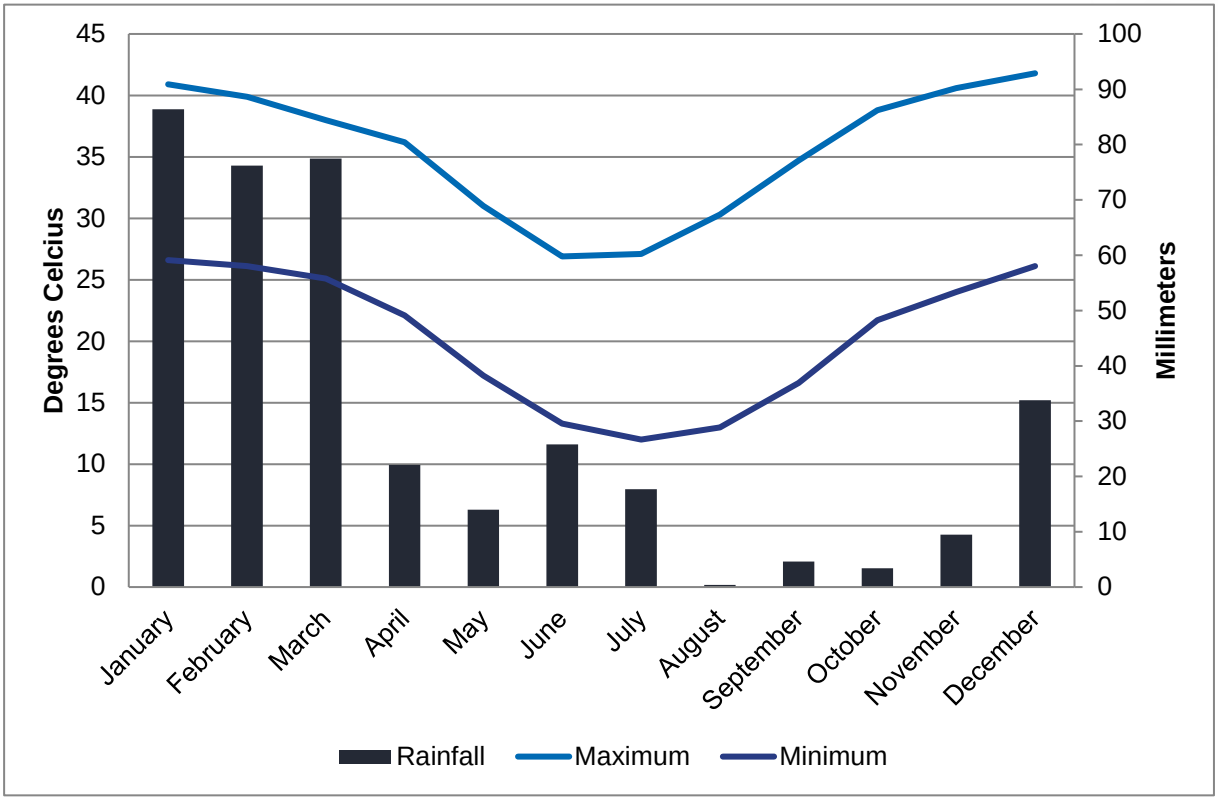
A summary of baseline data and learnings from other projects is presented below. Closure data will be refined over time as operational data and the outcomes of closure investigations become available.

7.1 Climate

The Pilbara region experiences 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 - 300mm) than the remainder of the Arid Zone. Figure 7.1 displays average monthly maximum and minimum temperatures, and average monthly rainfall, recorded for Marble Bar, the nearest meteorological station to the Project (Bureau of Meteorology 2016). Evaporation in the region is high with the average yearly evaporation exceeding yearly rainfall, due to the heat and clear skies typical of arid to semi-arid areas.

The annual wind rose for Marble Bar (as recorded by BOM between 2005-2015) shows dominant annual wind direction is from the east-southeast, with an annual mean wind speed of 16.7 km/hr and a maximum wind speed between 30 and 40 km/hr.

Figure 7-1 – Average Monthly Temperatures at Marble Bar (2000-2016)



7.2 Landscape

The Interim Biogeographical Regionalisation for Australia (IBRA) classification system represents a landscape approach to classifying the land surface, including attributes of climate, geomorphology, landform, lithology and flora and fauna characteristics. Under the 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, van Leeuwen, & Pinder, 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).

7.3 Land Systems

In 2004, the Department of Agriculture described land systems within the Pilbara IBRA region, considering general ecological information, vegetation physiognomy and composition, patterns of variation, conservation status, gradational association and land system representation (van Vreeswyk, Payne, Leighton, & Henning, 2004).

Eight land systems occur within the Development Envelope (Table 7-1) with Rocklea and Capricorn land systems encompassing much of the Project area. None of these were considered to be of conservation significance.

Table 7-1 – 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

7.4 Flora and Vegetation

Woodman Environmental Consulting (Woodman) conducted detailed flora and vegetation assessments of the Study area in 2014 and 2016 (Woodman, 2016a). The flora and vegetation assessments included the establishment of a total of 357 flora survey quadrats, targeted searches for significant flora taxa in the Study Area and other areas of potential habitat, and description of vegetation types following statistical analysis of quadrat data. In addition, Woodman completed an assessment of the potential impacts of the Project to flora and vegetation communities (Woodman, 2016b).

The results of these flora and vegetation assessments are summarised below

7.4.1 Flora

No Threatened Flora taxa listed under the *Wildlife Conservation Act 1950* (WC Act), or Threatened Species listed under the EPBC Act, were recorded within the Study Area. Eleven Department of Parks and Wildlife (DPaW) classified Priority Flora taxa were recorded within the Study Area, being:

- *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); and
- *Ptilotus mollis* (P4).

A further five species were considered significant as per EPA Guidance Statement No. 51 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*).

Eleven significant flora taxa known from the Study Area (Woodman, 2016a) were not known to occur in the Development Envelope. Woodman (2016a) reported five significant flora taxa within the Development Envelope. Atlas has since refined the Development Envelope (i.e. extracted a 10 m buffer around known locations) to avoid two species entirely and to minimise impacts to the remaining three, so that only a single location of each occurs within the Development Envelope and will be impacted by the Project (Table 7-2).

Table 7-2 – Potential Impact to Significant Flora

Flora Taxa	Application Area		Disturbance Footprint	
	No. of Locations	No. of Individuals	No. (%) of Locations	No. (%) of Individuals
Eragrostis crateriformis (P3)	14	272	1 (7.1)	10 (3.7)
Heliotropium murinum (P3)	3	3	1 (33.3)	1 (33.3)
Swainsona thompsoniana (P3)	3	3	1 (33.3)	1 (33.3)

A total of 18 introduced flora taxa were recorded within the Study Area (Woodman, 2016a). None of these taxa were Declared Pests under the *Biosecurity and Agriculture Management Act 2007*, however a number of taxa had a High environmental weeds rating under the Environmental Weed Strategy for Western Australia (CALM, 1999). Taxa with a High environmental rating typically have a high level of invasiveness, wide current or potential distribution, and a high level of environmental impact to structure, composition and function of ecosystems. The taxa recorded in the Study Area, with a High rating included:

- *Aerva javanica*
- *Calotropis procera*
- *Cenchrus ciliaris*
- *Cenchrus setiger*
- *Passiflora foetida var. hispida*
- *Vachellia farnesiana*

Species such as *Cenchrus ciliaris* and *Aerva javanica* were widespread, being recorded in 11 and six of 15 vegetation types respectively across the Study Area. Weed cover was most abundant in the drainage lines, averaging 17% across these vegetation types. Sloped vegetation types had an average weed cover of 0.1% while flat vegetation types had an average weed cover of 10%.

7.4.2 Vegetation

A combination of floristic analysis and manual dissection defined 15 VTs within the Study Area (Figure 7.2). Table 7-3 summarises the VTs and details the percentage of each within the Development Envelope and proposed Disturbance Footprint.

All 15 VTs mapped in the Study Area are located within the Development Envelope and therefore could potentially be impacted by the Project. The potential level of local impact to each of these VTs in relation to the current Disturbance Footprint is ranked as Low (Woodman, 2016a).

7.4.2.1 Conservation Significant Vegetation

None of the VTs mapped in the Study Area are considered to represent any Threatened Ecological Community as classified by Department of Parks and Wildlife (DPaW) and endorsed by the Western Australian Minister for Environment, or as listed under the EPBC Act. None of the VTs mapped in the Study Area are considered to represent any DPaW-classified Priority Ecological Community.

7.4.2.2 Vegetation Condition

The majority of the vegetation in the Study Area was ranked as being in Excellent condition, with little to no human disturbance and an absence or low levels of introduced flora taxa. However, the majority of larger drainage features, including creeks and flow lines, had lower condition scores as a result of the presence of high densities of aggressive introduced species and high grazing and trampling impacts from cattle (Woodman, 2016a).

7.4.3 Groundwater Dependent Vegetation

In response to queries raised during the environmental assessment of this Project, Atlas subsequently commissioned Woodman Environmental (2018a) to undertake an assessment of potential groundwater drawdown impacts on vegetation associated with Atlas' proposed water abstraction activities

A preliminary assessment determined that five of the VTs mapped (VTs 3, 4, 8, 14 and 15) were at least occasionally characterised by taxa that are either known or presumed obligate or facultative phreatophytes, and therefore could potentially represent groundwater dependent vegetation (GDV) either wholly or in part.

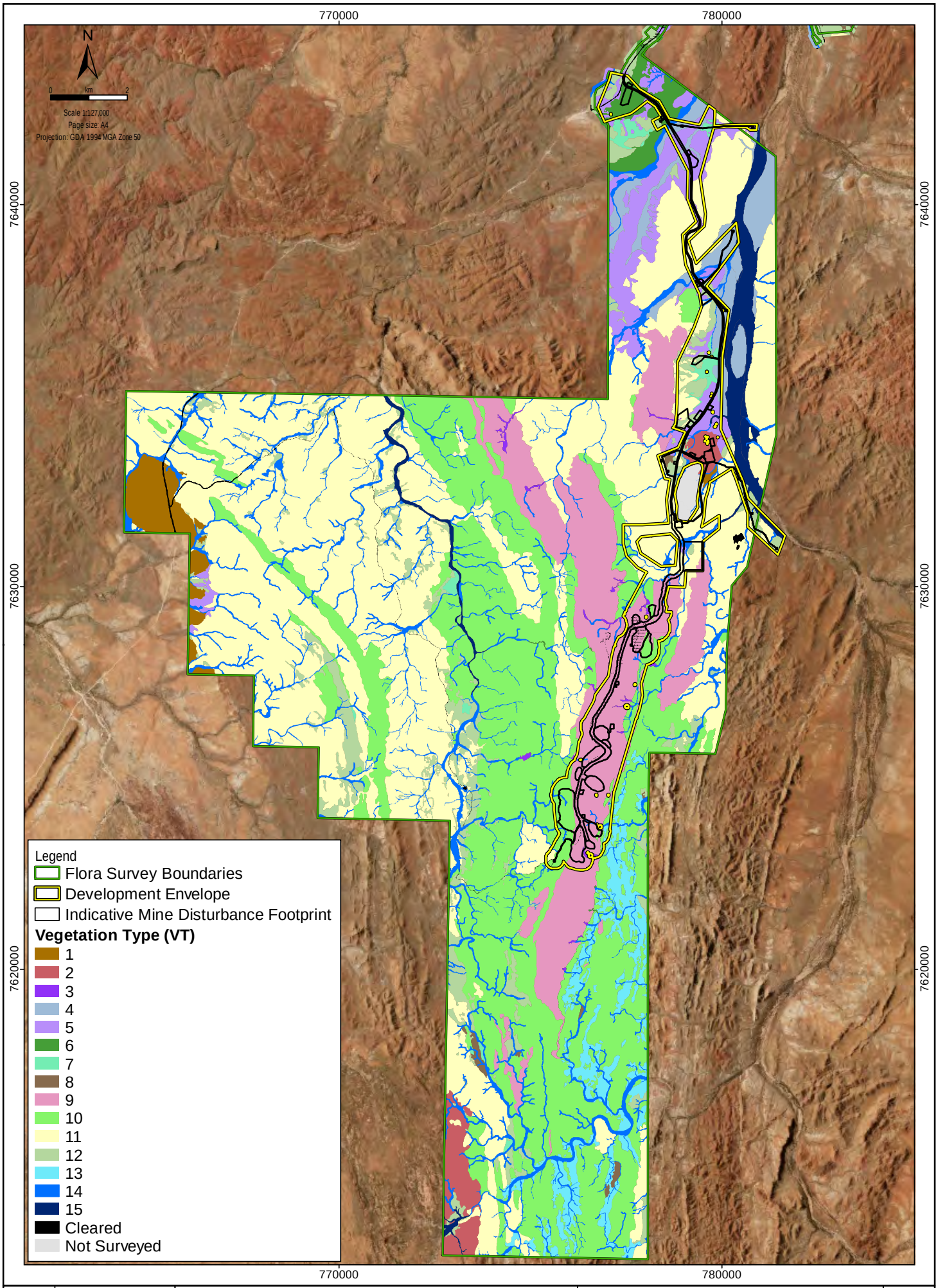
Woodman Environmental (2018b) undertook a targeted assessment of potential drawdown areas at an area identified as a potential "soak". This assessment found that vegetation within the "soak" area, mapped as VT8, may be partially dependent on groundwater, based on the presence of two species considered to be facultative phreatophytes (i.e., *Eucalyptus victrix* and *Melaleuca glomerata*)

Based on species composition, geomorphology, hydrology and soils of the soak it is considered unlikely that the predicted drawdown of 2.2 m to 4.5 m will result in impacts to vegetation at the soak. Worst-case in the unlikely instance *Eucalyptus victrix* and *Melaleuca glomerata* are accessing groundwater, and groundwater is responsible for the saturation of the clay layer, the proposed drawdown may result in the decline in health of these species, and potential loss of individuals in the longer term if significant natural recharge does not occur. Loss of individuals of *Schoenus falcatus* and *Cyperus vaginatus* may also occur. There are only a few individuals of *Eucalyptus victrix* and *Melaleuca glomerata* recorded at this location

and neither forms a significant component of the vegetation, therefore it is considered that such impacts are not likely to be significant in a local or regional context.

Atlas is committed to managing water abstraction activities to ensure there are no impacts to GDV outside the development envelope. Drawdown modelling indicates that GDV located within the Development Envelope will not be at significant risk of impact. None of the significant surface water features anticipated to support GDV and at high or moderate risk of impact occur within the Development Envelope.

Atlas is committing to ensuring that no impacts occur to GDV outside of the Development Envelope at Corunna as a result of groundwater abstraction by the operations. In accordance with the results of the DWER risk assessment, Atlas will undertake site specific investigation of the identified areas of potential high risk to refine the areas potentially at risk based on species presence and to identify where monitoring of vegetation health and groundwater levels may be required. The results of the site specific investigation and proposed monitoring program will be presented in first annual report to DWER and DMIRS.



File Name: GIS_2323.mxd	Document Number : (QDMS number only)	Vegetation Types	Figure No: 7.2
Date: 24/05/2018	Source & Notes:		
Author: cthatcher	*Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*		

Table 7-3 – Vegetation Types within Study Area

VT	Description	Total Area Mapped (ha)	Development Envelope		Disturbance Footprint	
			Area Mapped (ha)	% Impact	Area Mapped (ha)	% Impact
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	0.2	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	9.5	2.8
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	28.7	1	2.1
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	10.8	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	32.3	3.9

VT	Description	Total Area Mapped (ha)	Development Envelope		Disturbance Footprint	
			Area Mapped (ha)	% Impact	Area Mapped (ha)	% Impact
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	15	5.5
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	40.8	1.5	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	0.1	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	2694.4	423.1	15.7	195.2	7.2

VT	Description	Total Area Mapped (ha)	Development Envelope		Disturbance Footprint	
			Area Mapped (ha)	% Impact	Area Mapped (ha)	% Impact
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	6625.7	221.4	3.3	52.6	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 Co*rchorus 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	9767.1	414.8	4.2	61.3	0.6
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	1439.7	190	13.2	23.8	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	0.7	0	0

VT	Description	Total Area Mapped (ha)	Development Envelope		Disturbance Footprint	
			Area Mapped (ha)	% Impact	Area Mapped (ha)	% Impact
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	1419.4	88.5	6.2	11.8	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	4.6	0.2	0.1
C	Cleared	123.8	12	9.7	7.4	6
NS	Not Surveyed	72.4	3.9	5.4	0.4	0.6
Total		**25958.7**	**2263.3**		**423.1**	

* This assessment is based on an earlier version of the Development Envelope, which has subsequently been refined to avoid a number of significant environmental values (i.e., Reduced by approximately 5.55 ha to 2,257.75 ha).

7.5 Fauna

Atlas commissioned MWH to undertake a baseline terrestrial vertebrate fauna survey and impact assessment of the Study Area (MWH, 2016a and 2018). The results of these terrestrial vertebrate assessments are summarised below.

7.5.1 Fauna Habitat

Eleven broad fauna habitat types were identified and mapped over a Study Area, with 10 intersecting the Development Envelope and potentially being affected by land clearing during the construction and operation of the Project (Table 7-4;Figure 7-3).

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.

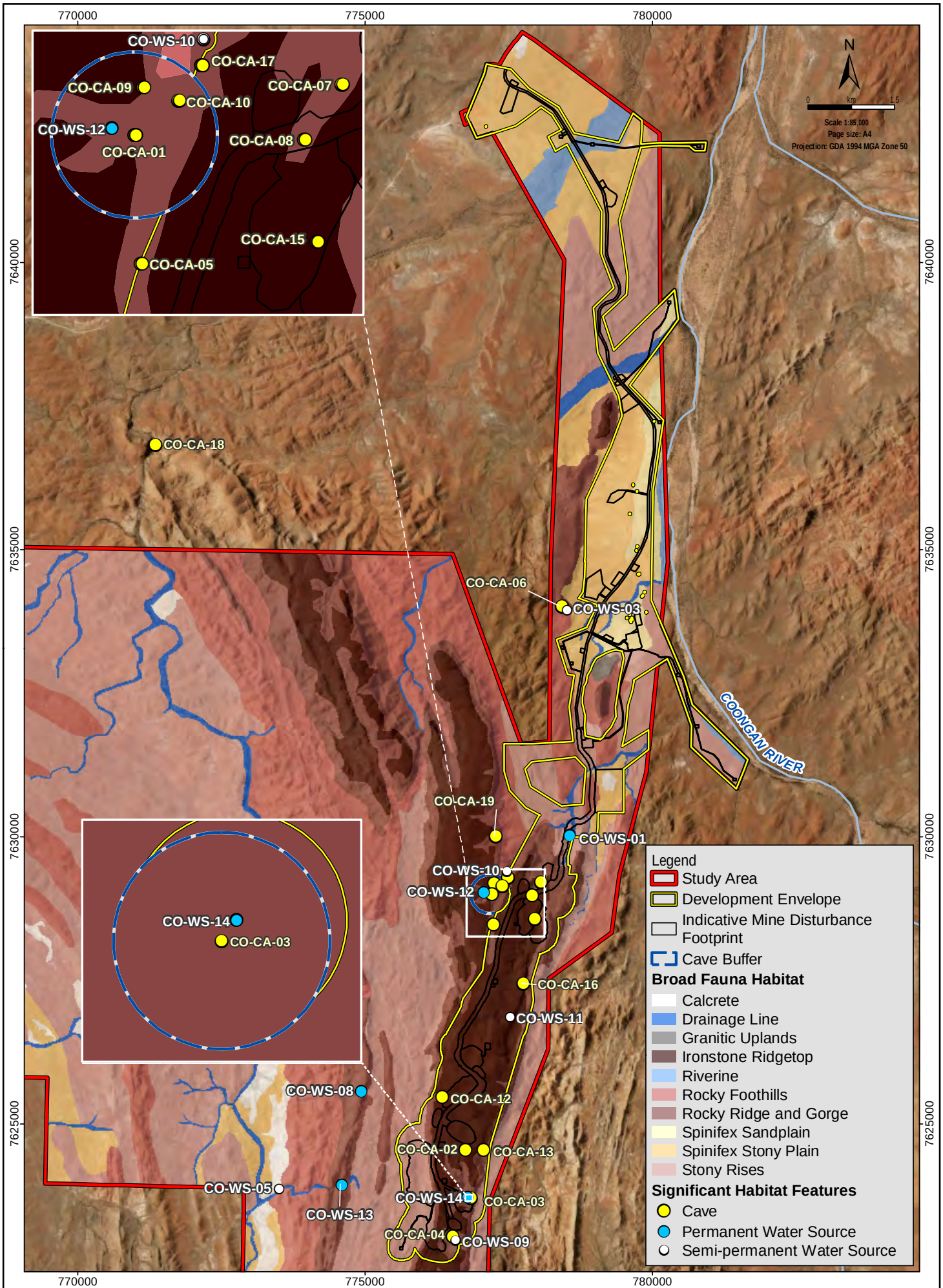
Table 7-4 – Attributes of Fauna Habitat Types within the Study Area

Fauna Habitat and Category	Vegetation Association and Substrate	Habitat Condition (Disturbance types)	Study Area (ha)	Development Envelope* (ha)	Disturbance Footprint (ha)
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%)	79.10 (1.0%)
Rocky Foothills • Widespread • Limited significance	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%)	11.04 (0.2%)
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%)	99.66 (5.3%)

Fauna Habitat and Category	Vegetation Association and Substrate	Habitat Condition (Disturbance types)	Study Area (ha)	Development Envelope* (ha)	Disturbance Footprint (ha)
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%)	42.29 (2.4%)
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%)	167.03 (10.8%)
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%)	2.70 (0.5%)
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 (19.2%)

Fauna Habitat and Category	Vegetation Association and Substrate	Habitat Condition (Disturbance types)	Study Area (ha)	Development Envelope* (ha)	Disturbance Footprint (ha)
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%)	12.86 (6.6%)
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	-	-

***** This assessment is based on an earlier version of the Development Envelope, which has subsequently been refined to avoid a number of significant environmental values (i.e., Reduced by approximately 5.55 ha to 2,257.75 ha).



ATLAS	File Name: GIS_2326.mxd Date: 24/05/2018 Author: cthatcher	Document Number : (QDMS number only) Source & Notes: *Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*	*Fauna Habitat*	Figure No: 7.3

7.5.2 Significant Microhabitat Features

A number of significant microhabitat features were recorded within the Study Area including caves, and permanent/semi-permanent water sources (MWH, 2016a, 2018a). These features were highlighted because they 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.

Seventeen of the 18 caves surveyed, were found to support the Pilbara Leaf-Nosed Bat and/or Ghost Bat during baseline surveys. A Ghost Bat scat was also opportunistically recorded in a non-surveyed cave (CO-CA-19) during baseline surveys, bringing the total number of caves known to support Pilbara Leaf-Nosed Bat and/or Ghost Bat to 18. Of these 18 caves, 11 were within the Development Envelope, however Atlas has refined the Development Envelope (i.e. extracted a 20 m buffer around nocturnal refuges, 50 m buffer around the non-permanent breeding roost for the Pilbara Leaf-nosed Bat (CO-CA-03) and 340 m buffer around the permanent diurnal roost for the Pilbara Leaf-nosed Bat (CO-CA-01)) to avoid all but two nocturnal refuges (CO-CA-08 and CO-CA-15) (Figure 7-5).

The Project is not anticipated to have a significant indirect impact on the remainder of the nocturnal refuges, due to their distance from the Project (particularly open pits) and as blasting operations will be limited to daytime operations (Table 6-11). This conclusion is based on long term monitoring of a nocturnal roost at Atlas' Mt Dove operation, which was approved to operate within 20 m of a nocturnal refuge for Pilbara Leaf-nosed Bat. Long-term monitoring of the nocturnal refuge at Mt Dove showed that while there was some minor physical damage to the entrance of the cave, mining had little to no negative effect on Pilbara Leaf-nosed Bat visitation. This long-term Mt Dove data suggests that secondary impacts to nocturnal roosts within the Corunna development envelope are expected to be low and are unlikely to negatively affect the population.

Impacts to the non-permanent breeding roost (CO-CA-03) and permanent diurnal roost (CO-CA-01) for the Pilbara Leaf-nosed Bat are also discussed in Table 6-5. Notably while Atlas has extracted a 50 m buffer from its Development Envelope around the entrance to non-permanent breeding roost CO-CA-03, recent laser scan and surveying of this cave shows that this buffer translates to an actual 3D distance between the entrance of the cave and Razorback open pit of approximately 100 m, or 68 m from the back of the cave (as depicted by the green line in Figure 7-4).

A total of eleven permanent and/or semi-permanent water sources were recorded within the Study Area, however Atlas has refined the Development Envelope (i.e. extracted 50 m buffer) around all but one of these water sources (CO-WS-01).

Figure 7-4 – Plan and Cross-section Illustrating the 2D Buffer and 3D Distance Between Non-Permanent Breeding Roost CO-CA-03 (in blue) and Razorback Pit (orange)

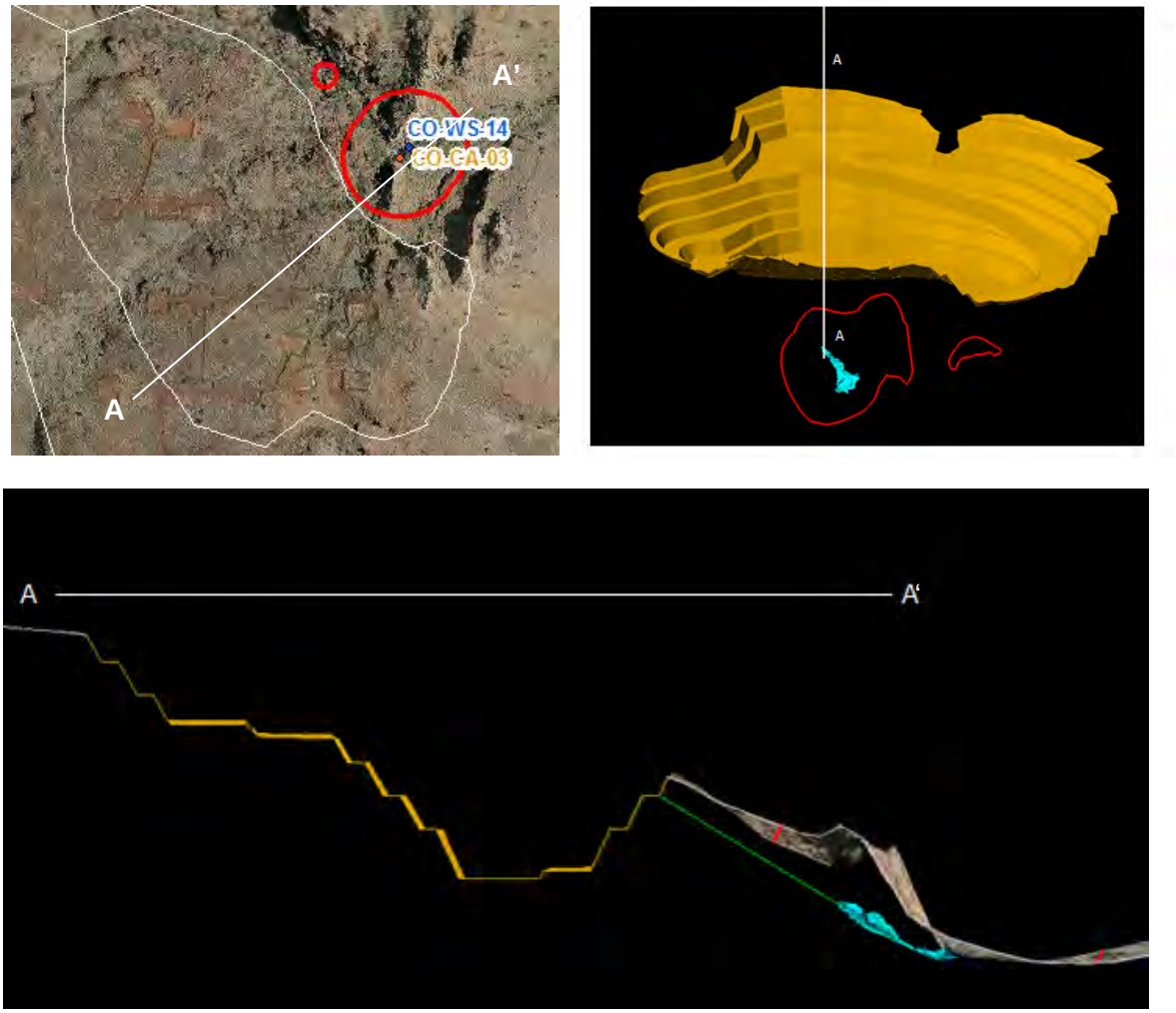


Table 7-5 – Potential Impact to Caves Known to Support the Pilbara Leaf-nosed Bat and/or Ghost Bat

Cave	Location	Pilbara Leaf-nosed Bat Value	Ghost Bat Value	Impact Summary
CO-CA-01	Outside Development Envelope. Approximately 350 m west of the haul road, and 470 m west of Runway pit- North.	Permanent diurnal roost	Nocturnal refuge	Atlas has committed to a 340 m buffer from this cave entrance. This buffer is considered to be adequate, primarily because of the topography between the cave and the project. Specifically, the project is located on a separate ridge on the opposite side of a deep gully which acts as a natural shield and prevents noise and vibration impacts (from haulage, drilling and blasting activities) from reaching the cave, furthermore blasting and associated dust impacts is limited to daytime operations (Bullen, pers. comm. 2017a).
CO-CA-02	Outside Development Envelope. Approximately 100 m south of low-grade ore stockpile, 780 m south west of Shark Gully Pit and 720 m north of Razorback pit.	Nocturnal refuge	_	No direct or indirect impact anticipated.

Cave	Location	Pilbara Leaf-nosed Bat Value	Ghost Bat Value	Impact Summary
CO-CA-03	Outside Development Envelope. The entrance to this cave is approximately 50 m north east of the Razorback pit as the crow flies, equivalent to approximately 100 m (or ~68 m from the back of the cave) in 3D (Figure 6-9).	Non-permanent breeding roost	_	Atlas had previously committed to a 50 m buffer from this cave entrance, which has subsequently been extracted from the Development Envelope. It is possible that given the proximity of this cave to the pit and the Pilbara Leaf-nosed Bats sensitivity to blasting noise, vibration and dust impacts, that this species may temporarily abandon this roost during the period over which this pit is mined (see Table 6-13 for more detail). However, following an assessment of the geology and review of Atlas' other operations, the 50 m buffer is considered to be adequate to maintain a suitable level of structural integrity of the cave in ensuring its ongoing suitability as a diurnal roost following cessation of mining. Atlas has subsequently revised and optimised the pit design outside of this 50m buffer, and surveyed and laser scanned this cave. Consequently this buffer is now known to translate to a distance of 100 m from the entrance of the cave and 68 m from the back of the cave in 3D (Figure 6-9), further reducing the risk of structural damage to this cave. Furthermore, as detailed in Section 6.5.1.2 and Section 6.5.2 the predicted level of drawdown (0.1 m) at the cave along with the catchment impacts associated with the siting/proximity of the Razorback pit is considered unlikely to have a detrimental impact on the seep within this roost (or the water level at associated pool CO-WS-14) and thus the roosts microclimate.
CO-CA-04	Outside Development Envelope. Approximately 130 m east of Split Rock Pit and 110 m south of topsoil stockpile.	Nocturnal refuge	_	No direct or indirect impact anticipated.
CO-CA-05	Outside Development Envelope. Approximately 145 m west of haul road and 440 m west of Runway Pit –South.	Nocturnal refuge	_	No direct or indirect impact anticipated.

Cave	Location	Pilbara Leaf-nosed Bat Value	Ghost Bat Value	Impact Summary
CO-CA-06	Outside Development Envelope. Approximately 440 m west of borrow pit and 640 m west of haul road.	Nocturnal refuge	Nocturnal refuge	No direct or indirect impact anticipated.
CO-CA-07	Outside Development Envelope. Approximately 180 m east of Runway Pit – North and 100 m north west of the haul road.	Nocturnal refuge	_	No direct or indirect impact anticipated.
CO-CA-08	Within disturbance footprint; Haul Road.	_	Nocturnal refuge	Directly impacted by project – Habitat removed. Low level of Ghost Bat Activity (2 calls). Cave does not appear to be of high important to the species.
CO-CA-09	Outside Development Envelope. Approximately 460 m west of Runway Pit – North and 430 m west of the haul road.	Nocturnal refuge	_	No direct or indirect impact anticipated.
CO-CA-10	Outside Development Envelope. Approximately 310 m west of Runway Pit – North and 290 m west of the haul road.	Nocturnal refuge	_	No direct or indirect impact anticipated.
CO-CA-11	Outside Development Envelope. Approximately 1.5 km south of Split Rock Pit.	Nocturnal refuge	_	No direct or indirect impact anticipated.
CO-CA-12	Outside Development Envelope. Approximately 50 m west of Shark Gully pit.	Nocturnal refuge	_	No direct or indirect impact anticipated.

Cave	Location	Pilbara Leaf-nosed Bat Value	Ghost Bat Value	Impact Summary
CO-CA-13	Outside Development Envelope. Approximately 190 m south east of low-grade ore stockpile and 950 m south west of Shark Gully Pit.	Nocturnal refuge	_	No direct or indirect impact anticipated.
CO-CA-15	Within disturbance footprint; Runway Pit – South.	Nocturnal refuge	Nocturnal refuge	Directly impacted by project – Habitat removed. Low numbers of calls of Ghost Bat (4 calls) and Pilbara Leaf-nosed Bat (23 calls) were recorded at this site.
CO-CA-16	Outside Development Envelope, outside disturbance footprint. Approximately 20 m west of minor transport corridor and 800 m south of Runway Pit-South.	Nocturnal refuge	_	No direct or indirect impact anticipated.
CO-CA-17	Outside Development Envelope Approximately 250 m west of Runway Pit – North	Nocturnal refuge	Nocturnal refuge	No direct or indirect impact anticipated.
CO-CA-18	Outside Development Envelope. Approximately 8.2 km west of the haul road and 9.9 k north-west of Runway Pit - North	Nocturnal refuge	_	No direct or indirect impact anticipated.
CO-CA-19	Outside Development Envelope. Approximately 890 m north west of Runway Pit – North and 1.1 km west of haul road.	_	Nocturnal refuge	No direct or indirect impact anticipated.

Note: Cave CO-CA-14 was not found to support Ghost Bat or Pilbara Leaf-nosed Bat during the baseline survey and so has not been included in the above table.

7.5.3 Terrestrial Vertebrate Fauna

The desktop study and field survey determined that the Study Area potentially contained up to 327 species of vertebrate fauna. Of these, 174 (58%) were recorded during the field survey including 28 native mammal, four introduced mammal, 72 bird, 66 reptile and four amphibian species. Eight of these species are of conservation significance (i.e. are listed as Threatened under the EPBC Act and/or the WC Act, or are listed as Priority fauna on the DPaW Priority Species List). Based on regional records and habitats identified within the Study Area, an additional three species were considered Likely to occur, nine were considered Possible to occur and the remaining 12 were considered unlikely to occur.

Table 6-6 summarises the species that MWH (2016a, 2018a) Confirmed and considered either Likely or Possible to occur in the Study Area and the expected localised impact of the Project on each of these species prior to the implementation of any controls.

Table 7-6 – Localised Impact Ranking of Conservation Significant Species

Species	Conservation Status		Likelihood Of Occurrence	Localised Impact ranking
	EPBC Act	In WA		
Northern Quoll (*Dasyurus hallucatus*)	En	S2	Confirmed	Moderate
Ghost Bat (*Macroderma gigas*)	Vu	S3	Confirmed	Moderate
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)	Vu	S3	Confirmed	Moderate
Pilbara Olive Python (*Liasis olivaceus barroni*)	Vu	S3	Confirmed	Moderate
Peregrine Falcon (*Falco peregrinus*)		S7	Confirmed	Low
Spectacled Hare-wallaby *(Lagorchestes conspicillatus leichardti)*		P3	Confirmed	Low
Western Pebble-mound Mouse (*Pseudomys chapmani)*		P4	Confirmed	Low
Rainbow Bee-eater (*Merops ornatus*)		P5	Confirmed	Minimal
Anilios ganei		P1	Likely	Low
Long-tailed Dunnart *(Sminthopsis longicaudata)*		P4	Likely	Low
Eastern Great Egret *(Ardea modesta)*		P5	Likely	Minimal
Greater Bilby (*Macrotis lagotis*)	Vu	S3	Possible	Minimal
Grey Falcon (*Falco hypoleucos*)		S3	Possible	Minimal
Ctenotus nigrilineatus		P1	Possible	Minimal
Ctenotus uber johnstonei		P2	Possible	Minimal
Brush-tailed Mulgara (*Dasycercus blythi*)		P4	Possible	Low
Fork-tailed Swift (*Apus pacificus*)	Mi	S5	Possible	Negligible

Species	Conservation Status		Likelihood Of Occurrence	Localised Impact ranking
	EPBC Act	In WA		
Sharp-tailed Sandpiper (*Calidris acuminate)*	Mi	S5	Possible	Negligible
Wood Sandpiper (*Tringa glareola*)	Mi	S5	Possible	Negligible
Common Sandpiper (*Actitis hypoleucos*)	Mi	S5	Possible	Negligible
Common Greenshank (*Tringa nebularia*)	Mi	S5	Possible	Negligible
Glossy Ibis (*Plegadis falcinellus*)	Mi	S5	Possible	Negligible

The four species that were considered to expect a moderate impact due to Project were the; Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python. These impacts were determined by MWH on the assumption that no management measures or mitigation strategies would be implemented. Atlas has developed a Significant Species Management Plan (SSMP) specifically for this Project (Appendix C). With the implementation of these management strategies the expected impact on these species is considered to be low.

7.5.4 Short Range Endemics Fauna

Atlas commissioned MWH to conduct a terrestrial short-range endemic (SRE) invertebrate fauna assessment of the Project (MWH, 2016b).

During the assessment habitats were categorised as having a high, medium or low potential to support terrestrial SRE taxa based on the presence of microhabitats, whether the habitat was restricted, isolated, widespread and/or connected in the landscape. Based on these criteria, two habitats, Rocky Ridge and Gorge and Granite Outcrops, were identified to have a high potential to support SRE species, and one habitat, Drainage Lines, has a medium potential.

Approximately 14.1 % of Rocky Ridge and Gorge habitat and 11.1 % of Drainage Line habitat within the Study Area occurs within the Development Envelope and therefore, has potential to be directly impacted by the Project. None of the Granite Outcrop habitat occurs within the Development Envelope therefore, this habitat will not be impacted by the Project. No invertebrate habitat was found to be restricted exclusively to the proposed Development Envelope. The Development Envelope largely comprises habitats with a low potential to support SRE species, namely Spinifex Stony Plains, Ironstone Ridgetops and Stony Rises (MWH, 2016b).

The survey of the study area resulted in the collection of 761 invertebrate specimens (from targeted groups) from 31 species. Slaters were the most diverse group to be collected (514 specimens from 9 species), followed by scorpions (147 specimens from 6 species), pseudoscorpions (80 specimens from 8 species), snails (8 specimens from 2 species), selenopid spiders (8 specimens from 3 species), mygalomorph spiders (3 specimens from 2 species) and millipedes (1 specimen). The desktop study identified a further three species with potential to occur comprising of two millipede species and one snail species (MWH, 2016e).

Within the study area, two species were considered to be Confirmed SRE species, three as Likely SRE species and 13 as Potential SRE species. Of these, two taxa considered Likely and six considered Potential SRE species were recorded within the Development Envelope (Table 7-5).

Table 7-7 – SRE Species recorded within the Development Envelope

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

All species collected within the Development Envelope for the Project have also been collected outside the Development Envelope, either locally or regionally.

7.5.5 Subterranean Fauna

Atlas commissioned MWH to undertake a subterranean fauna assessment (stygofauna and troglofauna) for the Project (MWH, 2016c). The results of this assessment are summarised in the following sections.

7.5.5.1 Stygofauna Assessment

No stygofauna specimens were collected from within the Study Area. Therefore, stygofauna do not represent an environmental factor for the Project as no stygofauna species were recorded from the sampled aquifer systems within or near the development envelope of the proposed Project (MWH, 2016c).

7.5.5.2 Troglofauna Assessment

A total of 13 species from nine higher level taxonomic groups, *Blattodea, Coleoptera, Diplura, Isopoda, Polydesmida, Polyxenida, Pseudoscorpiones, Scolopendromorpha* and *Symphyla*, were collected in litter trap and scrape samples. Troglofauna were recorded from 26 of the 110 holes sampled and 32 of the 141 samples taken (MWH, 2016c).

The troglofauna assemblage recorded from the Study Area was found to be distributed along much of the ironstone ridge that hosts the target deposits with distributions appearing to extend to, and possibly throughout the adjoining hills within the associated range system. Of the 13 species recorded, eight have been found to occur in two or more Project areas. The remaining five species that were recorded from a single Project area only were all singletons (MWH, 2016c).

The Project areas that recorded the highest species richness were Runway (10 species) and Shark Gully (6 species) deposit areas. Of the 10 species recorded from Runway, six were also collected from other Project areas: five from Shark Gully, and one shared with Split Rock, Razorback, and northern Reference. Of the six species recorded from Shark Gully, all were collected from other Project areas: five from Runway, one from Razorback.

There were no species of troglofauna recorded that were found to be confined to within only one of the proposed pit footprints. However, two species, *Curculionidae* OES11 and *Prosopodesmus* OES8, were only recorded from within both the proposed Runway and the Shark Gully pit boundaries and were not collected from any of the non-impact areas. The geological assessment of the main ironstone ridge hosting the deposits indicated that the inhabited subterranean habitats are contiguous along the ridge system. The results of the genetic analysis were congruent with the geological evidence that clearly demonstrated that the distributions of four troglofauna species, including *Curculionidae* OES11, extended along the main ridge from Runway deposit area to Split Rock. The low genetic divergence (0.4%) exhibited between the recorded locations of *Curculionidae* OES11 indicated that the Runway and the Shark Gully areas do not represent isolated populations. In addition, DNA data showed the distribution of *Tenebrionidae* OES1 to extend from Shark Gully to the northern Reference area (6.5 km north), thereby demonstrating that the relatively deep cutting valley present between the deposit areas and the northern Reference area does not act as a geographical barrier to gene flow (MWH, 2016c).

The geological (physical) and genetic (biological) evidence presented clearly indicates that the proposed Runway and Shark Gully pits do not represent isolated habitats. Instead the distributions of both *Curculionidae* OES11 and *Prosopodesmus* OES8 are considered highly likely to extend throughout much of the main ironstone ridge and to exist in non-impact areas (MWH, 2016c).

The area of likely habitat (3.7 km^2) is conservatively considered to extend along the main ridge line from around the northern Runway pit areas to the south of Shark Gully pit, of which approximately 13.2 % would be impacted by the proposed development of the Runway and Shark Gully deposits. This habitat would likely extend further south and north, given the distributions of other troglofauna species. The area of occupancy for both *Curculionidae* OES11 and *Prosopodesmus* OES8 within proposed mine pit impact areas is 13.8 and 19.1 %, respectively and does not exceed the Threatened Species Scientific 2017 guidance threshold of a potential substantial reduction (≥ 30%) in population to represent a vulnerable species (Nicholas, pers. com., 2017). Furthermore, while the excavation of these pits will lead to an initial reduction in the population size of each species, the Project is unlikely to initiate a continuing rate of decline post mining, as supported by a number of monitoring programs, and so these species are unlikely to be eligible for listing as threatened species (Nicholas, pers. com., 2017). Therefore, the proposed mining of the Runway and Shark Gully pits are not considered to pose a conservation risk to *Curculionidae* OES11 and *Prosopodesmus* OES8 (MWH, 2016c; Nicholas, pers. com., 2017).

Only one species, *Projapygidae* OES2, was considered to be of potential low conservation concern due to proposed groundwater drawdown impacts because its distribution has not been demonstrated to range beyond the modelled 0.5 m drawdown contour associated with the groundwater abstraction from the Bore CRD0071. However, the magnitude (both vertically and laterally) of the proposed groundwater drawdown occurring from the recorded location of *Projapygidae* OES2 was not considered to translate to any significant change in humidity within the troglofauna habitat overlying the aquifer. In addition, it is likely that the distribution of *Projapygidae* OES2 does extend well beyond the proposed groundwater drawdown impact zone when taking into consideration the wider extent of the unsaturated alluvial/colluvial habitat associated with the drainage system from which it was recorded. Therefore, the predicted drawdown is considered unlikely to pose a conservation risk to *Projapygidae* OES2 (MWH, 2016c).

7.6 Hydrology

7.6.1 Surface Water

Atlas commissioned Stantec/MWH to undertake a surface water environmental impact assessment (MWH, 2016d and Stantec, 2018b). The results of this assessment are summarised below.

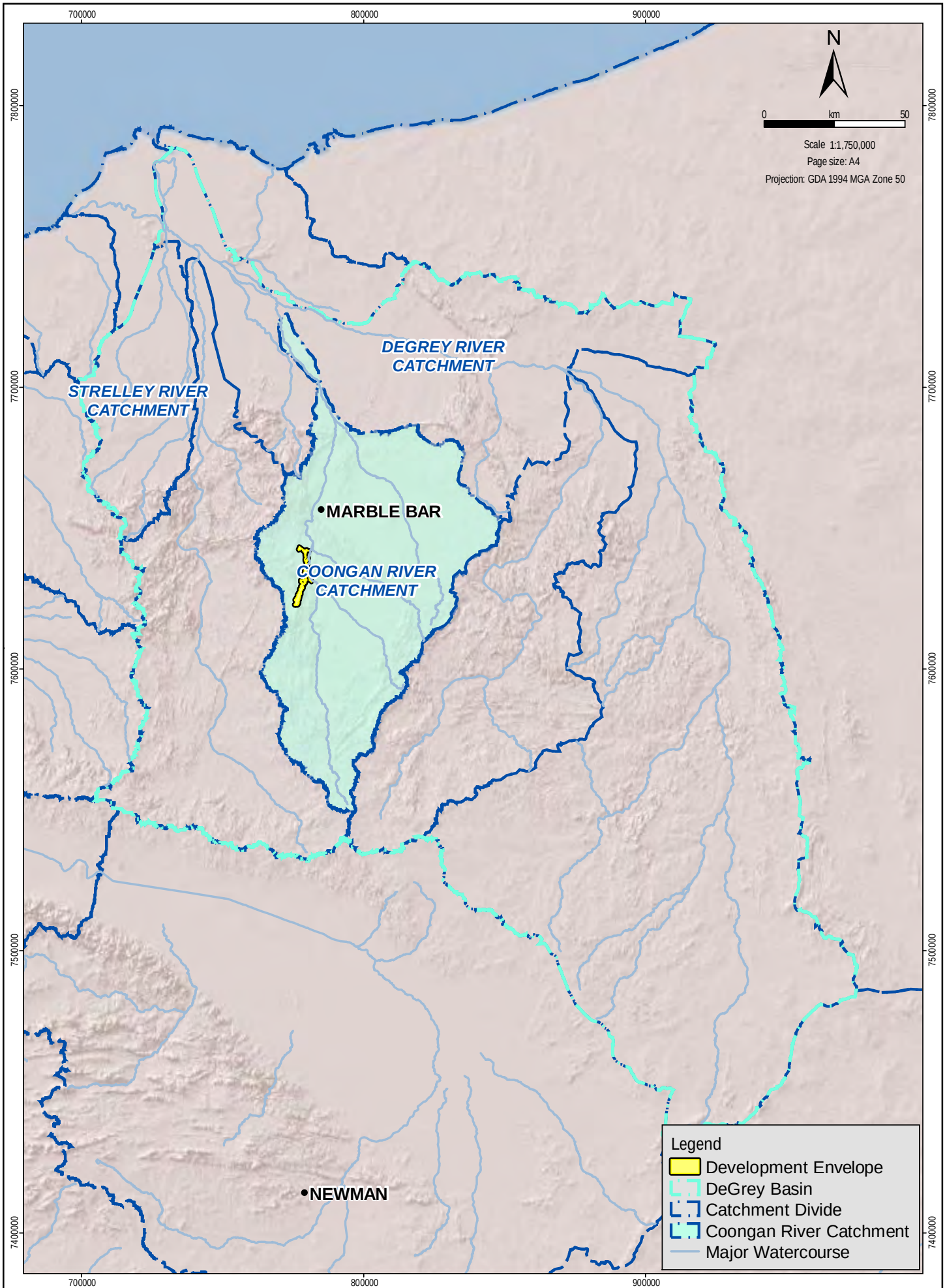
7.6.1.1 Regional Surface Water Environment

The Project area lies within the middle reaches of the Coongan River catchment, which sits within the De Grey River Basin (Figure 7-5). 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.

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.

MWH (2016d) found the Project's percentage of disturbance to the regional Coongan River catchment amounts to 0.04% of the total catchment. This is a very small percentage of the regional catchment which implies any alteration to the surface water regime as a result of Project operations will be insignificant. Alterations to the surface water regime may be noticed locally, but impacts will soon dissipate as flows from larger downstream areas contribute to the natural watercourses.

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 most likely 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). These pools are located upstream of the Project and will not be impacted by the mining operation.



File Name: GIS_2325.mxd	Document Number : (QDMS number only)	*Regional Catchments*	Figure No: 7.5
Date: 24/05/2018	Source & Notes:		
Author: cthatcher	*Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*		

Surface flow in the region occurs almost exclusively as a direct response to rainfall and is highly skewed to summer events (December to March). Flow in the smaller channels is typically of short duration and ceases soon after the rainfall event passes. In the larger river channels, which drain the larger catchments, runoff can persist for several weeks and possibly months following major rainfall events such as tropical cyclones. No perennial streams occur in the immediate vicinity of the mine site.

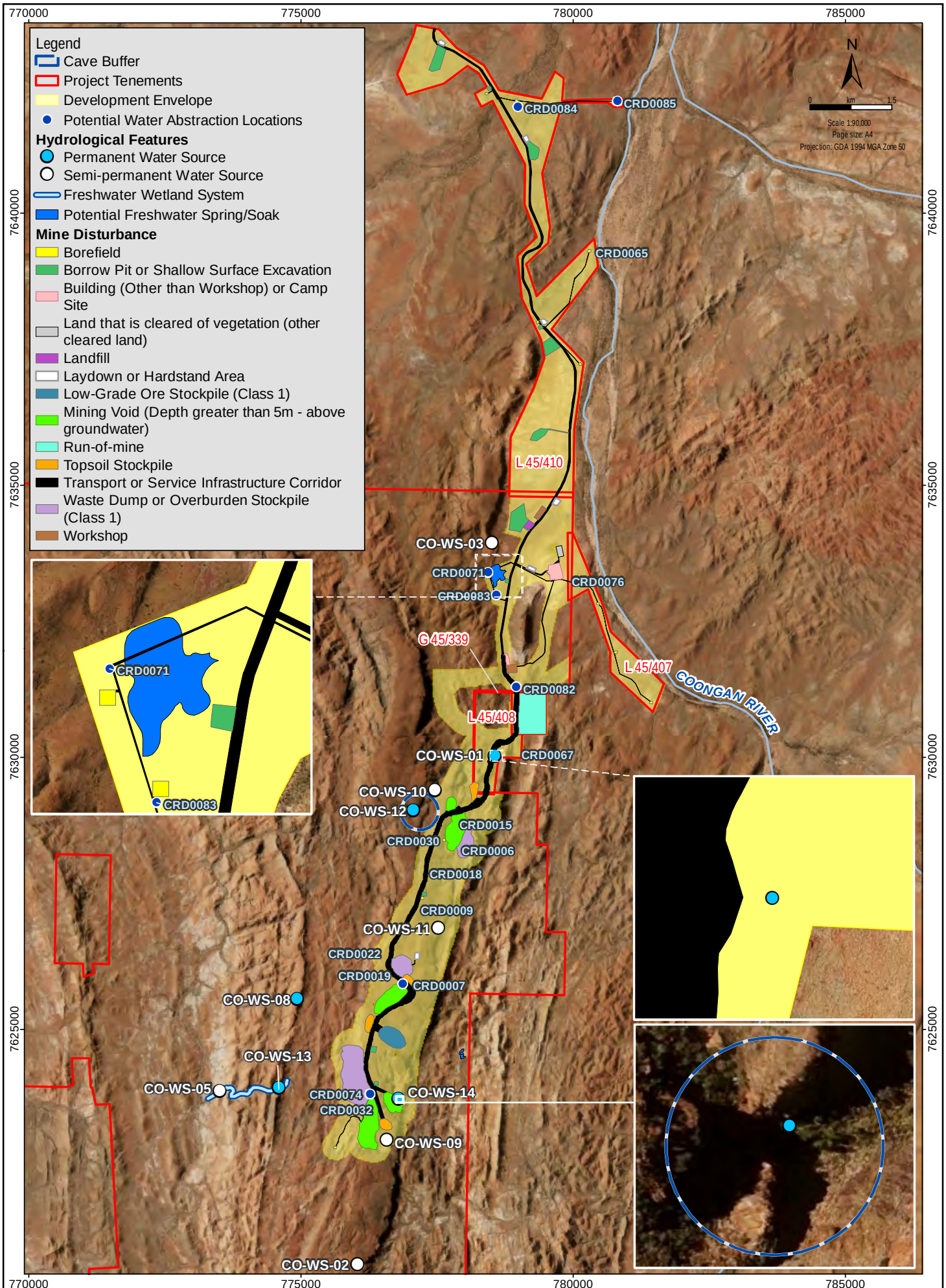
7.6.1.2 Local Surface Water Environment

Gradients along the elevated areas within the Study Area 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 proposed mine infrastructure 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 Project area towards the Coongan River.

The Coongan River (Emu Creek) 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. WRD, pits and ROM pad) (Figure 7-6). The Project will not result in any direct disturbance to the Coongan River.

Stantec (2018a) identified 11 significant water sources (i.e., pools) within the Study Area during their vertebrate fauna survey (Figure 7-6). Three of these pools were located within the Development Envelope, which has subsequently been refined to exclude a 50 m buffer around all but one pool (i.e., CO-WS-01) which persists within the Development Envelope but is outside the current Disturbance Footprint, so will not be directly impacted (Figure 7-7). Stantec (2018c) were subsequently commissioned to undertake a hydrogeological investigation for the Project, which included an assessment of these pools permanency and groundwater connectivity, as summarised in Table 7-9. Note pool CO-WS-14 is of particular importance as it is believed to be intrinsically linked to the non-permanent breeding roost for Pilbara Leaf-nosed bat (i.e., CO-CA-03).



File Name: GIS_2329.mxd Date: 24/05/2018 Author: cthatcher	Document Number : (QDMS number only) Source & Notes: Freshwater wetland system - location and extent inferred from Golder, 2010 *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: 7.6

Table 7-8 – Summary of Pool Locations and Permanency and Groundwater Connectivity Assessment

Pool	Location	Permanency	Groundwater dependency
CO-WS-01	Within Development Envelope, outside Disturbance Footprint. Approximately 20 m downstream of the haul road.	Perennial	Likely
CO-WS-02	Outside Development Envelope. Approximately 2 km south of the Split Rock pit.	Ephemeral	Unlikely
CO-WS-03	Outside Development Envelope. Approximately 430 m upstream of a borrow pit.	Ephemeral	Unlikely
CO-WS-05	Outside Development Envelope. Approximately 2.2 km downstream of the Split Rock waste rock dump.	Perennial	Likely
CO-WS-08	Outside Development Envelope. Approximately 1.4 km downstream of the Shark Gully pit.	Ephemeral	Potential seasonal contribution
CO-WS-09	Outside Development Envelope. Approximately 185 m downstream of pit and 175 m downstream of topsoil stockpile.	Ephemeral	Potential seasonal contribution
CO-WS-10	Outside Development Envelope. Approximately 280 m downstream of the Runway North pit.	Perennial	Potential seasonal contribution
CO-WS-11	Outside Development Envelope. Approximately 500m downstream of a waste rock dump, 600 m downstream of haul road and 200 m upstream of minor infrastructure corridor	Perennial	Unlikely
CO-WS-12	Outside Development Envelope. Approximately 570 m downstream of the Runway North pit and 470 m downstream of haul road.	Perennial	Potential seasonal contribution
CO-WS-13	Outside Development Envelope. Approximately 1.1 km downstream of the Split Rock waste rock dump.	Ephemeral	Potential seasonal contribution
CO-WS-14	Outside Development Envelope. Approximately 70 m downstream of the Razor Back pit.	Perennial	Likely

Source: Stantec, 2018c.

In addition to these water sources a potential freshwater "soak" (associated with VT 8) was also identified during the flora and vegetation and heritage surveys (Figure 7-7). Approximately 0.1 ha of the outer extremity of the vegetation unit (VT8) growing in association with this spring/soak will be directly impacted by the Project, less than 0.2% of the total mapped extent (Woodman, 2016b).

A freshwater wetland system made up of several permanent and temporary clear pools of variable size up to 20 m long to 2 to 3 m wide and 0.5 m deep was also recorded within the Study Area in 2010 by Golder Associates. The freshwater wetland system was found to support schools of native fish, aquatic invertebrates, a variety of wetland plants and was also accessed by cattle. A follow-up survey in 2009 by Outback Ecology did not find any standing water within this system (i.e., all pools were dry) (Golder, 2010). Two of the water sources (pools CO-WS-05 and CO-WS-13) recorded by Stantec (2018b) appear to be associated with this system. This system lies outside the Development Envelope, approximately 1 km west of the Split Rock Waste Rock Dump and 1.5 km northwest of the Split Rock Pit, and so will not be directly impacted by the Project (Figure 7-7).

Sediment runoff is likely to increase as a result of ground disturbance and vegetation removal required for the Project, however, it is unlikely to cause significant deterioration in water quality as soils within the project Development Envelope are predominantly non-saline and non-acid forming (MWH, 2016e). As discussed above, due to the location and topography of the Project, upstream catchments are small so there will be minimal upstream flows entering the disturbance footprint, and it is unlikely that there are any surrounding areas of significant sheet flow. Coupled with the installation of surface water management infrastructure, the Project is not anticipated to significantly increase levels of sediment and runoff (MWH, 2016d).

The pit and waste rock dumps are the most likely contributors to elevated levels of sediment laden runoff. Most flows will be directed around waste rock dumps and the minimal flows entering waste rock dumps will be encouraged to infiltrate internally or otherwise be directed to sedimentation ponds, where the bulk of the suspended material will be settled out prior to any discharge to the downstream environment (MWH, 2016d). Similarly, pits will be mined to minimise discharge and encourage collection of direct stormwater and settling of sediments within the pit. Atlas does not propose to discharge any accumulated stormwater collected in pit. During larger magnitude event, sediment loads during large rainfall events are naturally high, and so 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 (MWH, 2016d).

As detailed in Section 7.8, there is also a risk of deleterious impacts to surface and ground water from potential acid and metalliferous drainage associated with the potential presence of discrete locations of PAF shale waste rock material, as indicated by two recent waste rock characterisation samples, although considered unlikely. Further examination during infill and grade control drilling prior to mining will be undertaken to confirm the presence and spatial extent of any PAF shale, furthermore a Waste Rock Management Strategy and the Split Rock waste rock dump design (Figure 9-8) has been developed to ensure any PAF shale waste rock material if present is appropriately managed (i.e., encapsulated). Furthermore the risk of deleterious impacts to groundwater from potential acid and metalliferous drainage (AMD) associated with exposures of PAF rock in pit walls is considered to be low, however where PAF is confirmed to be present and found to intersect the pit wall, Atlas will undertake additional investigations to confirm AMD potential and where necessary develop a management strategy to ensure that it is appropriately managed to prevent deleterious groundwater quality impacts.

All open pits have been designed to sit approximately 0.5 m above the water table taking into consideration anticipated seasonal variation of between 0.2 to 0.4 m in the pit areas, so no mine dewatering is required. However, groundwater abstraction in support of the Project's construction, operational and potable water requirements may result in localised drawdown around pumping centres over the life of mine potentially resulting in a temporary depletion of aquifer storage, interference with spring discharge and localised upwelling of saline groundwater.

Water abstraction impacts aside, significant hydrological features most likely to be at risk of the above indirect impacts (e.g., change in quantity and quality of surface water) are those within the Development Envelope and/or in relative close proximity to (i.e., conservatively within 200 m) and downstream of the Project, comprising; CO-WS-01, CO-WS-09, CO-WS-14, the freshwater soak and the Coongan River. Project impacts on surface water quality and quantity at each of these hydrological features is not anticipated to be significant, as discussed in Table 7-9. Water abstraction impacts are discussed separately in Section 6.5.2.2.

Table 7-9 – Potential indirect surface water impacts on significant hydrological features

Significant Hydrological Feature	Potential indirect surface water impacts
CO-WS-01	Construction of the adjacent haul road will be managed to minimise the risk of overburden traveling down the embankment and entering this water source (e.g., construction of a windrow). CO-WS-01 is located within a minor drainage line. Culverts will be installed where the haul road intersects this drainage line approximately 140 m downstream, so no drainage shadowing or ponding at this location is anticipated. While the haul road may result in increased sediment load reporting to this pool during rainfall events, water quality impacts at this location are unlikely to be significant given; the haul roads location at the top of a catchment (minimal upstream flows), the naturally high sediment loads during rainfall events and the permanent flowing/flushing nature of this pool, as observed between September 2017 and March 2018 (Stantec, 2018d). Furthermore no hydrocarbon and/or chemical contamination is anticipated, given the distance to active work areas most likely to experience such an event (e.g. pits, dumps, ROM pad, workshops etc.) and the implementation of Atlas' Hydrocarbon Management Procedure (950-HSE-EN-PRO-0005) and Hydrocarbon (and Chemical) Spill Management Procedure (950-HSE-ENPRO-0007).
CO-WS-14	This water source is located at the bottom of a gorge between two ridge systems, one of which will be partially mined (i.e., Razor Back Pit lies approximately 70 m to the southwest). A catchment analysis completed by Stantec determined that mining of the Razorback pit will intersect and remove 18% of the contributing catchment for this pool, however no significant impact to the pool water level is anticipated, given: • The small volume of water required to fill this pool to overflowing, the associated loss in surface water contributions to this pool is considered negligible. • 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 pit (where not diverted by safety bunds/windrows). This will enhance the period of time surface water has to infiltrate and thereby increase groundwater table levels locally which may support seepage into the pool. Collection of surface water in pit may however lead to transient increase in TDS due to evaporative concentration (degree to which dependent on rate of infiltration), potentially

Significant Hydrological Feature	Potential indirect surface water impacts
	lowering the quality of water infiltrating water (i.e., increase the salinity of groundwater seepage into cave/pool). This pit is also the most likely source of increased sediment and runoff, and hydrocarbon and/or chemical contamination, however the Project is not anticipated to significantly impact water quality at this water source, given: • The diversion of clean runoff around the pit by safety bunds/windrows. • The minimal flows entering the pit and the mining of the pit in such a way as to allow water to collect away from active workfront areas and infiltrate and/or evaporate. No excess surface water will be discharged to the environment. • Naturally high sediment loads during large rainfall events. • The permanent flowing/flushing nature of this pool, as observed between September 2017 and March 2018 (Stantec, 2018b). • Implementation of Atlas' Hydrocarbon Management Procedure (950-HSE-EN-PRO-0005) and Hydrocarbon (and Chemical) Spill Management Procedure (950-HSE-ENPRO-0007).
CO-WS-09	This water source is located at the bottom of a gorge between two ridge systems, one of which will be partially mined (i.e., Split Rock Pit lies approximately 20 m to the west), while an area on the top of second ridge is proposed to support a topsoil stockpile. The location of this Project infrastructure will reduce the upstream catchment area, and thus the volume of surface water runoff received at this water source following rainfall events. The pit and the topsoil stockpile are also the most likely source of increased sediment and runoff, and the pit is also a potential source of hydrocarbon and/or chemical contamination and acid and metalliferous drainage, in the unlikely event PAF shale is confirmed to be present. However the Project is not anticipated to significantly impact water quality or levels at this water source, given: • The diversion of clean runoff around the pit by safety bunds/windrows. • The minimal flows entering the pit and the mining of the pit in such a way as to allow water to collect away from active workfront areas and infiltrate and/or evaporate. No excess surface water will be discharged to the environment. • The semi-permanent (ephemeral) nature of this pool, which appears to have limited/seasonal groundwater contribution/connectivity (Stantec, 2018b). • The unlikelihood PAF shale material is present at Split Rock (and intersects pit wall) and, in the instance it is confirmed to be present, Atlas commitment to ensure that it is appropriately managed to prevent deleterious groundwater quality impacts. • Atlas will reconsider this stockpile location during final mine design with the aim of finding a more suitable location within the Development Envelope, and where this is not possible will work to optimise/reduce the area of this stockpile. Where topsoil is stored at this location Atlas will implement appropriate stormwater management measures. • Naturally high sediment loads during large rainfall events. • Implementation of Atlas' Hydrocarbon Management Procedure (950-HSE-EN-PRO-0005) and Hydrocarbon (and Chemical) Spill Management Procedure (950-HSE-ENPRO-0007).
Freshwater soak	Culverts will be installed where the haul road intersects this drainage line approximately 500 m downstream, so no drainage shadowing or ponding at this location is anticipated.

Significant Hydrological Feature	Potential indirect surface water impacts
	The Project is also not anticipated to result in any significant change in water quality given: • All major Project infrastructure and disturbance is downstream of this location (i.e., haul road). • Naturally high sediment loads during large rainfall events. • Implementation of Atlas' Hydrocarbon Management Procedure (950-HSE-EN-PRO-0005) and Hydrocarbon (and Chemical) Spill Management Procedure (950-HSE-ENPRO-0007).
Coongan River	Culverts will be installed along the haul road where it intersects drainage features, to minimise drainage shadowing and/or ponding. The haul road is the most likely contributor of elevated levels of sediment laden runoff during rainfall events given its proximity to the River, however the Project is not anticipated to significantly impact water quality at the Coongan River, given: • Naturally high sediment loads during large rainfall events, when surface water may not be contained within sedimentation ponds and will pass into the downstream environment. • The separation distance between the Coongan River and key project infrastructure (e.g., over 4 km to nearest pit). • Most flows will be directed around waste rock dumps and the minimal flows entering waste rock dumps will be encouraged to infiltrate internally or otherwise be directed to sedimentation ponds, where the bulk of the suspended material will be settled out prior to any discharge to the downstream environment . • The diversion of clean runoff around the pits by safety bunds/windrows. • The minimal flows entering the pit and the mining of the pit in such a way as to allow water to collect away from active workfront areas and infiltrate and/or evaporate. No excess surface water will be discharged to the environment. • The unlikelihood PAF shale material is present at Split Rock (and intersects pit wall) and, in the instance it is confirmed to be present, Atlas commitment to ensure that it is appropriately managed to prevent deleterious groundwater quality impacts. • Implementation of Atlas' Hydrocarbon Management Procedure (950-HSE-EN-PRO-0005) and Hydrocarbon (and Chemical) Spill Management Procedure (950-HSE-ENPRO-0007).

7.6.1.3 Surface Water Management Areas

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

7.6.1.4 Surface Water Quality Characteristics

Surface water sampling of 10 sites was undertaken between July 2017 and March 2018. Surface water TDS ranges from 17 to 2,800 mg/L and was generally characterised by the same major ions as observed in groundwater. In general, the hydrochemical signatures of surface water samples are consistent with groundwater suggesting similar origin.

Of relevance is the higher TDS and sulphate concentration in ephemeral pool CO-WS-09 consistent with upgradient bores CRD0003 and CRD0031 that show proportionally higher sulphate concentration possibly suggesting the presence of sulphide oxidation in parts of the

aquifer system. Higher TDS content in this area suggests potential evapo-concentration occurring and may indicate similar origin to groundwater.

Manganese concentrations at pools CO-WS-01 and CO-WS-12 were slightly above the Australian Drinking Water Guidelines for health (NHMRC, 2012).

In October 2017 available pools were sampled for stable isotopes including Oxygen (O18), Deuterium (D), and Radon (Rn222). Radon-222 measurements indicate possible groundwater signal in pools CO-WS-05 and CO-WS-12. All other pool samples show low Rn-222 values typical for surface water. Stable isotope data also suggests potential groundwater presence in pools CO-WS-05 and CO-WS-12, however stable isotope depletion typically found in groundwater was also recorded for pools CO-WS-14 and CO-WS-01. Continuing evaporation, typical for static surface water without continuous replenishment from groundwater would preferentially remove lighter isotopes, resulting in the presence of heavier signatures.

Based on this analysis only a subset of sampled pools appear to be actively connected to or replenished by groundwater; CO-WS-01, CO-WS-5, CO-WS-12 and CO-WS-14. However, in consideration of the additional investigations and field data a number of other pools (CO-WS-08, CO-WS-09, CO-WS-10 and CO-WS-13) may also receive seasonal groundwater contributions.

Water level hydrographs from available pools suggest that pools CO-WS-08, CO-WS-10 and CO-WS-13 receive minimal contribution from groundwater (steep antecedent trend indicative of a dominant evaporative influence) whereas pools CO-WS-12 and CO-WS-14 show a more gradual decline in water level suggesting ongoing groundwater replenishment. All pools show the influence of rainfall runoff indicating surface water runoff forms a significant component of pool water (Stantec, 2018a).

7.6.1.5 Flooding Characteristics

The original surface water environmental impact assessment of the site found that given the majority of Project infrastructure was located on higher ground with small runoff catchment areas, the Project is more easily protected from flooding, however additional modelling to confirm risk of flooding at the camp was recommended (MWH, 2016d). In response to this recommendation, Atlas has completed additional hydraulic modelling using LiDAR data to establish a more detailed hydraulic model of the Coongan River/Emu Creek in the vicinity of the camp. This modelling confirmed that the camp sit's outside the 100 year flood level with a freeboard of approximately 3.5 m.

In response to DMIRS comments, the surface water environmental impact assessment was revised to provide analysis of surface water flows and associated flood risks around all current post-mining landform designs and detail any necessary surface water management to understand and address post closure risks (Stantec 2018b). In support of this investigation Atlas re-designed a number of the final landforms to further minimise scour and erosion from excessive flooding and to avoid nuisance ponding or access limitations due to inundation and associated management requirements. The assessment found that the only final landform at risk from flooding was the Split Rock waste rock dump given its topographical location and proximity to a drainage line. However, modelling of both 1% and 0.1% AEP design flood events found there will be no direct interaction between the drainage line flood flows and the toe of the dump, and therefore no surface protection is currently required.

7.6.2 Groundwater

Atlas has completed a desktop hydrogeological assessment for the Project and recently commissioned Stantec (2018c) to undertake a hydrogeological investigation in response to DMRS request for further hydrology information the results of which are both summarised below.

7.6.2.1 Overview of Regional and Local Hydrogeology

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 is predominantly recharged on the regional scale by episodic intense tropical low and cyclonic rainfall events, plus intense thunderstorm events on the local scale.

Groundwater may also occur in the upper weathered zones of all rocktypes, and where storage and transmission may be enhanced in secondary porosity associated with extensive weathering along zones, geological contacts and quartz veining.

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).

Groundwater in the Project area can be classified into two key zones separated based on elevation and hydraulic connection:

- Corunna mining area (CORU) - an elevated aquifer system characterised by higher permeability pod-like orebody aquifers surrounded by lower permeability unmineralised banded iron formation and shales.
- Coongan River valley (CVA) – a lower lying aquifer system hosted within thin alluvial sediments overlying fractured Mount Roe Basalt.

In the Corunna Downs mining area thin alluvium overlies fractured, banded iron formation (BIF), shale and metasedimentary rocks which may be variably folded and faulted. The CORU aquifer type is an unconfined to semi-confined fractured system with the primary aquifer hosted in mineralised BIF.

Iron enrichment within the BIF typically increases the porosity of the enriched zone. It is expected that the ore zones in the Project area host aquifers with higher permeability than the surrounding materials. Groundwater flow in the CORU aquifer is likely controlled by local and regional-scale stratigraphy and topography and may be impeded along faults and discontinuities such as evidenced by differing water levels and response to aquifer testing in the vicinity of the identified freshwater “Soak” area. Gradients in the CORU aquifer generally slope away from the ridge line toward the lower lying CVA potentially discharging into the CVA.

The CVA aquifer in the Coongan River valley is an unconfined to semi-confined fractured rock system with variably saturated alluvial and colluvial deposits overlying a primary aquifer hosted in fractured Mount Roe Basalt. Gradients in the CVA are generally north to northeast toward the Coongan River.

Water table elevation broadly mimics topography, lying within 25 to 60 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 352 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. Apart from the differences in water table elevation between pit areas, the variance in rates of annual recession also appears to support the presence of a perched or compartmentalised aquifer system, 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. Overall annual recession on the range averages 0.46 m/year (Stantec, 2018c).

While water table elevations and rates of recession differ between pits, similarities in geology, structure, physiography and associated drainage characteristics, and observed seasonal fluctuations suggest that the mechanism for recharge and responses to seasonal events (i.e., seasonal variation in groundwater levels) 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. While the density of data at Runway and Razorback precludes definitive resolution of seasonal fluctuation the similarities discussed above would suggest seasonal fluctuations in groundwater at these locations are likely to be of a similar magnitude (i.e., 0.2 to 0.4m) (Stantec, 2018c).

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 reharge is consdierably greater.(Stantec, 2018c).

Generally the groundwater in the CORU aquifer (on the range) flows radially away from the top axis of the range toward nearby drainages generally mimicking surface topography. Groundwater throughflow within the CORU aquifer may discharge into the lower lying CVA. Regional groundwater (CVA) flows north to northeast consistent with the direction of the major drainage networks.

Groundwater throughflow rates in the CORU aquifer are expected to be equivalent to recharge as the aquifer sits at the top of a groundwater divide. Throughflow in the lower lying CVA is more complicated and includes components of discharge from CORU aquifer, regional groundwater movement along the major drainage networks, and infiltration from direct rainfall and surface water runoff. A mass balance study conducted during the numerical model development indicated that over the modelled domain (CORU and CVA) inflows and outflows are dominated by recharge and evapotranspiration processes with a total throughflow rate of 39,801 kL/day.

Groundwater quality in the Corunna Downs area varies from fresh to slightly brackish suggesting the aquifer is recharged primarily from direct rainfall. In general, the quality of groundwater is consistent within the pit areas (CORU aquifer) of the Project area and is generally fresher than in the lower lying areas of the Coongan Valley aquifer (CVA). Naturally high levels of metals were also found to be present over the Project area and in some instances slightly exceed the Australian Drinking Water Guidelines (NHMRC, 2012) for health.

Recharge to the aquifers within the Project area occurs primarily as seepage from direct rainfall. Indirect runoff recharge from the local drainages is expected to form a smaller component of the overall recharge. Recharge rates are expected to be within 1 to 3% of annual rainfall (359 mm/annum).

All pits have been designed to sit above the current water table in consideration of seasonal variation so no mine dewatering is required. However, 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. Water demand will be greatest during construction (estimated at 3.25 ML/day) largely associated with construction of the haul road, while operational requirements will be significantly less and will vary throughout the life of the mine dependent on how many pits are operational at that time (estimated between 1.5 to 1.9 ML/day).

Atlas commisisoned Stantec to complete a Hydrogeological Investigation for the Project (Stantec 2018a), including revision of the groundwater model to account for water abstraction over the life of the mine. Potential water abstraction impacts on significant hydrological features and groundwater dependent vegetation are discussed below.

7.6.2.2 Environmental Values and Beneficial Uses

Groundwater is thought to express at a number of locations within the Project area and be an important resource for native fauna, including the Northern Quoll, Pilbara Olive Python and Pilbara Leaf-nosed Bat. A total of 11 significant water sources (i.e., pools) were identified within the study area during the vertebrate fauna investigation and a potential freshwater spring/soak and freshwater wetland system have also been identified from various flora and vegetation surveys. 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.

While no mine dewatering is required in support of the Project, groundwater abstraction from a number of production bores is proposed to supply the Project's construction, operational and potable water requirements. Pumping for supply purposes may result in localised drawdown around pumping centres over the life of mine potentially resulting in a temporary depletion of aquifer storage, interference with spring discharge and localised upwelling of saline groundwater. As no saline groundwater resource has been identified at depth to date, upwelling of saline groundwater and associated aquifer degradation is not anticipated Furthermore, there are no other groundwater users in the vicinity that would be impacted by any aquifer degradation.

Stantec (2018c) were commissioned to undertake a hydrogeological investigation for the Project, which included an assessment of pool permanency and groundwater connectivity. This assessment determined that only six of the 11 pools identified during the vertebrate fauna survey are permanent, four of which are considered likely to be groundwater dependent, one of which may receive seasonal groundwater contributions and the last of which is unlikely to be groundwater dependent. Using DWER rapid risk assessment, Stantec (2018c) determined that the risk of drawdown on these six permanent pools is considered low/acceptable (i.e., change of pool depth is <0.25 m and where permanence is maintained), with the exception of Pool CO-WS-05.

Given pool CO-WS-05 permanency and reliance on groundwater and based on an observed pool depth of 0.211m (recorded between October-November 2017), this pools permanency is anticipated to be impacted over the entire life of mine (i.e., drawdown is predicted to be 0.69m at 0.5 years increasing to 3.52 m by the end of life of mine), however it is likely this pool would persist as a semi-permanent pool in association with seasonal rainfall and runoff contributions. Atlas is however committed to ensuring that water abstraction activities are managed so that an acceptable level of drawdown is not exceeded at any of the groundwater dependent permanent pools (i.e., <0.25m at pools CO-WS-01, CO-WS-12 and CO-WS-14, and 0 m in the instance of pool CO-WS-05, so that pool permanency is not effected, as defined in DWER rapid risk assessment).

7.6.2.3 Groundwater Management Areas

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

7.6.2.4 Groundwater Quality Characteristics

Groundwater quality in the Project area varies from fresh to brackish suggesting the aquifer is recharged primarily from direct rainfall. Groundwater samples indicate marginal sodium and chloride enrichment in a northerly direction suggesting groundwater chemistry evolution from south to north along the regional groundwater flow path (Stantec, 2018c). The key major ions include sodium (43 to 630 mg/L), chloride (19 to 500 mg/L), and bicarbonate (300 to 700 mg/L). Potassium concentrations are relatively low (0.5 to 2.5 mg/L).

Comparison of all available groundwater samples in the Project area shows a broad distribution of groundwater types with the dominant anionic species being bicarbonate type water but with no overwhelmingly dominant cation. This distribution indicates a broad range of origins with mixing of groundwater of differing histories of aquifer residence time or exposure to recent recharge, and interaction with differing rock types (Stantec, 2018c).

The groundwater samples indicate marginal sodium enrichment in a northerly direction accompanied by slight chloride enrichment further suggesting groundwater chemistry evolution from south to north (Stantec, 2018c).

Several samples (CRD0003, CRD0031, and CRD0041) indicate sulphate enrichment at the expense of bicarbonate and chloride possibly suggesting the presence of sulphide oxidation in parts of the aquifer system (Stantec, 2018c).

Total dissolved solids (TDS) concentrations in groundwater range from 29 mg/L at CRD0027 to 1,800 mg/L at CRD0058. Observed TDS concentrations generally increase toward the north further along the groundwater flow path consistent with the conceptual understanding of groundwater at Corunna. Monitoring bore CRD0027 is located at the margin of the CORU and CVA aquifers in an area of suspected focussed freshwater recharge. CRD0027 is situated at the toe of the range and within a drainage line 885 meters northeast of camp bore CRD0071 and approximately 650 meters northeast (down-gradient) from the freshwater “Soak” area.

Naturally high levels of metals are present over the Project area and in some instances slightly exceed the Australian Drinking Water Guidelines for health (NHMRC, 2012). Arsenic concentrations in CRD0038 and CRD0058 slightly exceed the guidelines. CRD0038 and CRD0058 are located in the lower lying Corunna Valley Aquifer (CVA) downgradient from the proposed camp supply bore CRD0071 a distance of 14.5 and 11.7 kilometres, respectively.

Manganese concentrations in CRD0003, CRD0027, CRD0031, CRD0033, and CDRC0334 slightly exceeded the health guidelines (NHMRC, 2012). With the exception of CRD0027, all bores that exceeded the health guidelines for manganese are located on the range in the elevated regions of the Corunna aquifer (CORU).

7.7 Soils and Waste Characterisation

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);

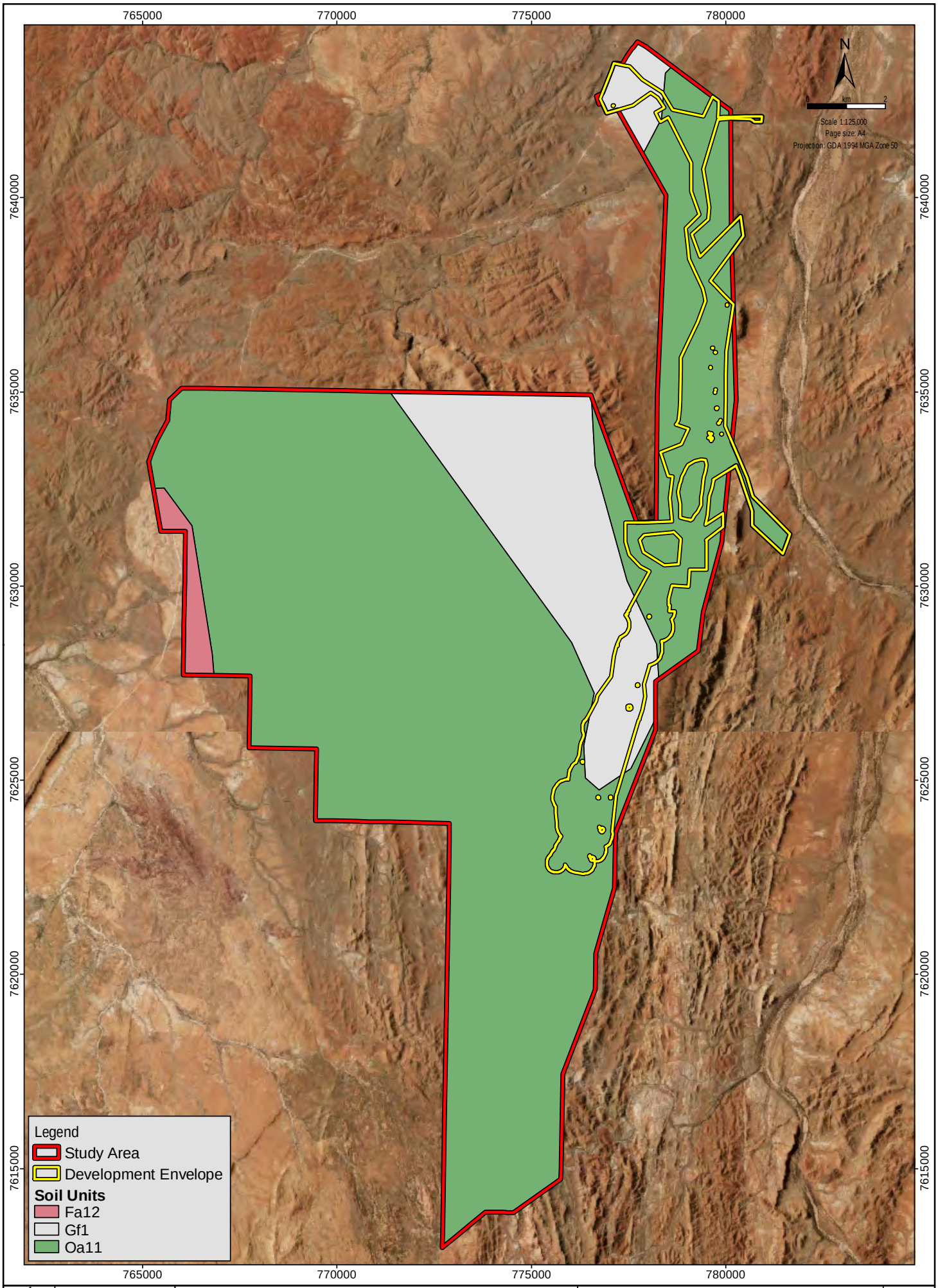
- Silcrete; and
- Quatz limontite-clay laterite.

Based on the reference Soil Units (ASRIS, 2014), two soil types were present in the Project area (Table 7-10; and Figure 7-7). 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 7-10 – Soil Units Located within the Corunna Downs Project Area

Soil Unit Code	Summary Description
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.
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.
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.

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

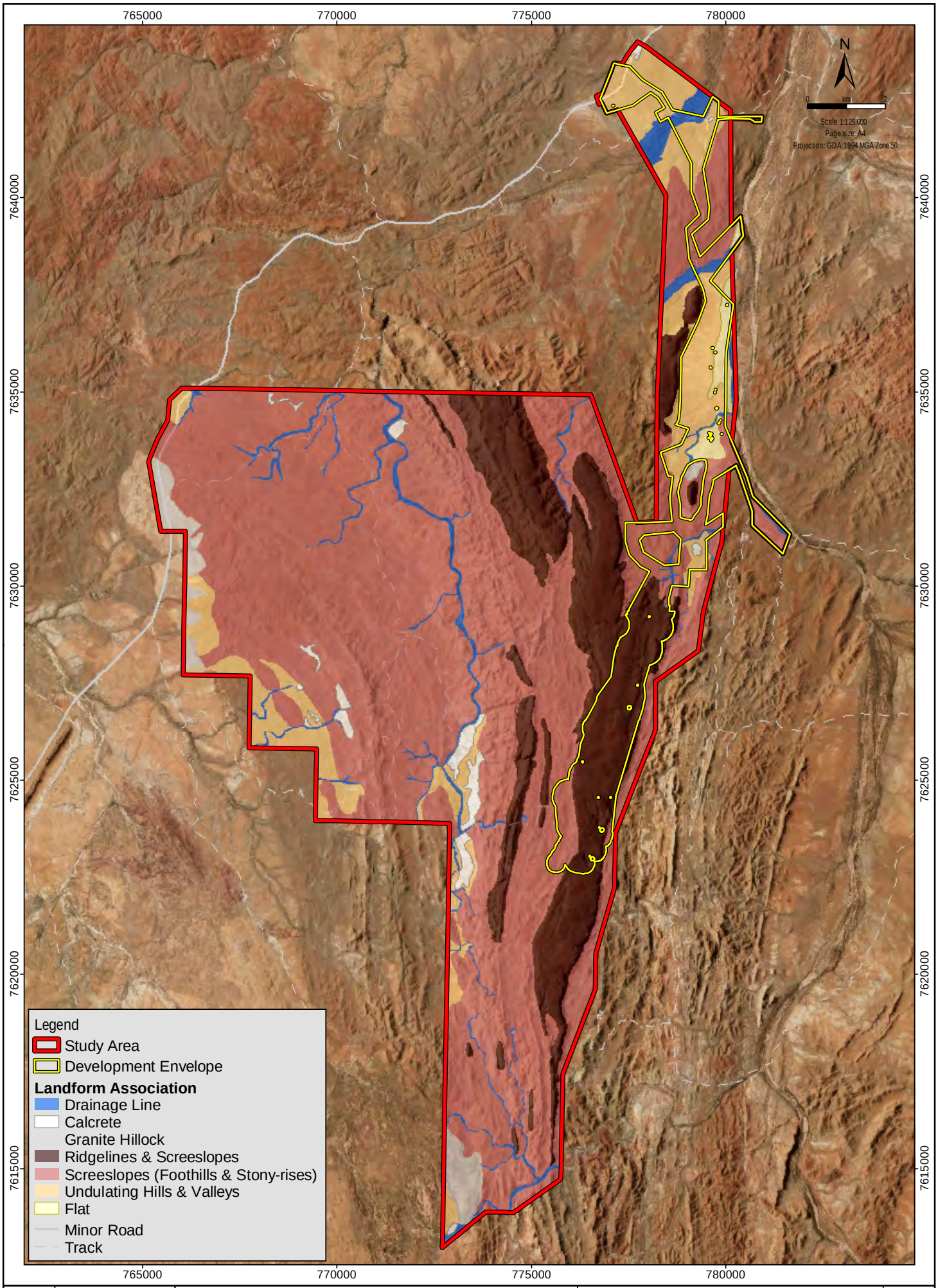


File Name: GIS_2328.mxd	Document Number : (QDMS number only)	*Soil Units*	Figure No: 7.**7**
Date: 24/05/2018	Source & Notes:		
Author: cthatcher	*Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*		

MWH assessed and broadly characterised the surface soils within the Study Area as:

- 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;
- predominately non-saline;
- typically low in organic carbon and moderate in plant-available nutrients;
- non-sodic; and
- 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)

Landform associations identified were based on field observations of morphological differences between the soil profiles and their occurrence within different landscape positions (Figure 7-8). Seven soil-landform associations were identified within the study area, namely 'calcrete', 'granite hillock' 'undulating hills and valleys', 'drainage lines', 'flats', 'scree slopes' and 'ridgelines'. 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 a high coarse fragment content.



File Name: GIS_2327.mxd Date: 24/05/2018 Author: cthatcher	Document Number : (QDMS number only) Source & Notes: *Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*	*Landform Associations*	Figure No: *7.8*

A preliminary inventory of potential soil and mine waste resources has been developed for the study area, based on the characterisation of surface soils, mine waste, and landform association mapping (Table 7-11).

Table 7-11 – Preliminary Soil Resource Inventory

Landform Association	Study Area				Suitability for salvage and rehabilitation use
	Area of Landform Association	%	Approx. topsoil stripping depth (m)	Potential volume topsoil (m^3)[1]	
Calcrete	6.71	2	-	None	Not recommended
Granite hillock[2]	12.9	3	-	None	Presence of soil unlikely
Drainage lines	4.43	1	0.2	8,858	Recommended
Ridgelines	209	49	0.2	418,639	
Scree slopes	79.1	19	0.2	158,198	
Undulating hills and valleys	99.7	24	-	None	Not recommended
Flat	11.0	3	0.2	22,073	Recommended
TOTAL	423	100		846,283	

(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', 'flats', 'scree slopes' and 'ridgelines' landform associations are considered to be a valuable resource for rehabilitation material. Generally, the soils from these landform associations had a high coarse rock fragment content, moderately rapid hydraulic conductivity, were non-hardsetting or slightly hardsetting, and were predominately non-saline and non-sodic, indicating a low inherent potential for erosion. The surface soils from within these landform associations are considered suitable for use as a surface rehabilitation material of constructed landforms.

It is likely that the Project will have a deficit of soil available for rehabilitation activities. In this instance it is likely areas will be preferentially treated with soil, and waste rock will be used as a growth medium. In the instances where waste rock is used as a growth medium, Atlas will investigate the usefulness of applying additional seed and fertiliser to these areas as has been recently undertaken at a number of Atlas' other Projects.

7.8 Subsurface Materials and Processing Waste

7.8.1 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.

7.8.2 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.

7.8.3 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 7.8).

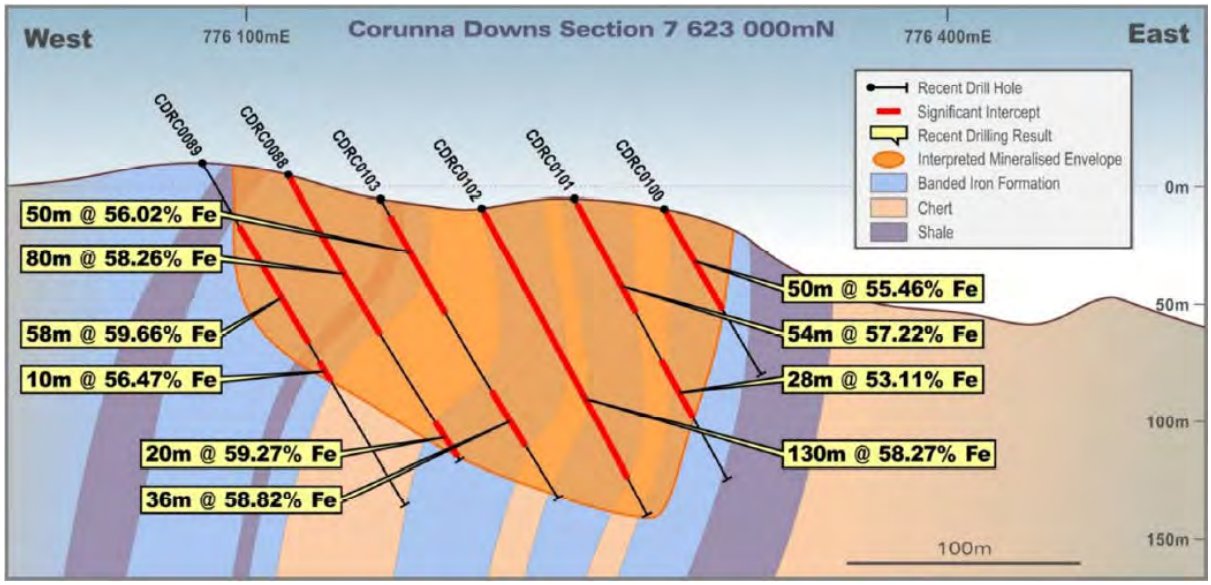


Figure 7-9 - Split Rock cross section highlighting the sub-vertically dipping BIF, Chert and Shale beds

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 banded iron formations.

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, Duuring and Hagemann, 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, Duuring & Hagemann, 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).

7.8.4 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.

7.8.5 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, Duuring & Hagemann, 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.

7.8.6 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, Duuring and Hagemann, 2014b). 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, Duuring & Hagemann, 2014). At depth there is increased hematite–martite alteration and distal carbonate alteration to the east (Teitler, Duuring & Hagemann, 2014). The majority of the surface enrichment has been replaced by supergene goethite, with bedded hematite outcropping along the east of the deposit.

7.8.6.1 Indicative volume of 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 7-12.

Table 7-12 – Indicative ore and waste material volumes to be mined

Deposit/Pit	Indicative volume to be mined (kt)		
	Ore	Waste Material	Total
Split Rock	12,168	6,721	18,889
Razorback	2,286	1,181	3,467
Runway (North and South)	4,680	1,705	6,385
Shark Gully	4,703	902	5,605

Indicative volumes and proportion of mined waste materials by lithology from each of the four deposits and a preliminary mine waste inventory is provided in Table 7-15.

Table 7-13 – Indicative tonnage and proportion of waste rock material by lithology

Geozone Code	Waste Lithology	Volume (kbcm)	Volume (kt)	Percentage (%)
Split Rock				
101, 113	Jaspilite	193	436	6.8
102, 112	Clastic sediment (shale)	642	1,358	22.7
103/203/503, 105/505, 107/207/507, 109/209/509, 111/211/511	Banded Iron Formation	1,054	2,600	37.2
104/204/504, 106/206/506, 108/208/508	Chert	774	1,911	27.3
110/210/510	Shale/Chert	168	416	5.9
	Total	**2,831**	**6,721**	**100**
Razorback				
102, 104/204/504, 106	Chert	177	419	35.9
103/203/503,105/205/505	Banded Iron Formation	315	762	64.1
	Total	**492**	**1,181**	**100**
Runway				
103, 106	Clastic sediment (siltstone and shale)	16	36	2.3
104,109	Banded Iron Formation	665	1,638	95.9
105, 108	Chert	13	30	1.8
	Total	**694**	**1,705**	**100**
Shark Gully				
102/202/502	Banded Iron Formation	341	902	100

Geozone Code	Waste Lithology	Volume (kbcm)	Volume (kt)	Percentage (%)
	Total	**341**	**902**	**100**

Table 7-14 – Preliminary mine waste inventory

Lithology	Estimated Volume (kbcm)	Estimated tonnage (kt)	Percentage (%)
Clastic sediment (shale)	658	1,394	13.3
Chert and Shally Chert	1,131	2,776	26.4
Jaspilite	194	436	4.2
BIF	2,375	5,902	56.2
Total	**4,358**	**10,508**	**100**

7.8.6.2 Predicted Volume of Tailings and Other Processing Waste

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

7.8.6.3 Mine Waste Characterisation

MWH (2016e) completed the original waste characterisation assessment for this Project in 2016. Following this assessment and in response to various DMIRS queries Atlas subsequently commissioned Mine Earth (2018) to refine and advance the understanding of the geochemical nature of waste rock across the Project deposits. Both of these assessments are summarised below.

The original mine waste characterisation assessment, broadly characterised 36 mine waste samples from the Split Rock, Shark Gully and Runway areas as follows (MWH, 2016e):

- <2 mm fraction typically classed as ‘loamy sands’ and ‘clay loams’;
- exhibited partial clay dispersion, some samples were stable;
- prone to hardsetting (clastic sediment (shale) and some BIF samples only);
- ‘moderate’ water holding capacity;
- neutral pH;
- predominately non-saline (highest salinity recorded for clastic sediment (shale));
- typically low-to-moderate in organic carbon and plant-available nutrients;
- predominantly non-sodic;
- variable total metal concentrations, mostly above the LOR with some concentrations above EILs for the ‘clastic sediment (shale)’. Minor exceedances of nickel were recorded at concentrations similar to topsoil; and
- non-acid forming (NAF).

Net Acid Production Potential (NAPP) and Non-Acid Generating (NAG) results are used to determine the classification of samples in relation to potential for acid generation. The majority of mine waste samples were classified as NAF. Two samples (from jaspilite and BIF waste

units) were classified as Uncertain based on conflicting NAPP and NAG results. The NAPP values for the two samples were considered to be very low (0.1 and 0.01 kg H2SO4/tonne). Both samples had acid neutralising capacity (ANC) values below detection limit, and low sulfur values. Based on the low potential for acid generation from these samples, these samples are considered to be NAF and the overall risk of acid-generation associated with waste rock samples from the Project was considered to be low (MWH, 2016e).

The likely high amount of coarse rock fragments and relatively benign nature of the waste rock (excluding that of the clastic sediment (shale) and waste units containing a high proportion of fine-grained material when mined) indicated that the majority of waste material is not likely to be 'hostile' to the growth of native vegetation and is likely to be relatively resistant to surface erosion and so is suitable for placement near-surface of waste rock landforms. The clastic sediment (shale) waste unit is likely to be the most friable and readily weathered of the waste materials, has the highest clay content, highest salinity, hardsetting characteristics and total metal concentrations

Furthermore, based on leachate test results elevated concentrations of some elements (i.e., zinc and copper) within the shale waste unit may present a risk to sensitive downstream environments. Although seepage of surface water through the waste rock dumps is likely to be negligible given appropriate and intended management; and impacts to any beneficial uses of groundwater is anticipated to be low (i.e., livestock drinking water), given the physical and chemical characteristics of the shale unit, it was recommended that this material not be deposited at, or close to the surface of constructed landforms.

On further review of the materials characterisation of the Split Rock deposit and MWH (2016e) Materials Characterisation Study (Mine Earth, 2018) Atlas and its consultants, Mine Earth Pty Ltd and Graeme Campbell and Associates (GCA), have found that the entire shale unit does not require special management as recommended by MWH, as it is likely only a minor component of the shale unit may be of concern. MWH (2016e) claimed a number of elevated metals as the reason for geochemical concerns, however on review, Mine Earth and GCA concluded that Hg (>1mg/kg) was the only metal that showed enrichment of concern (recorded within four of the 14 shale samples tested by MWH) and this would only be problematic if it were found to leach under neutral conditions.

Following this review, Atlas commissioned Mine Earth Pty Ltd and GCA to undertake further waste characterisation work to better characterise the geochemical properties of the expected waste rock (Mine Earth, 2018). An additional 18 available samples were selected and characterised, taking into consideration the dominant lithologies of each deposit and the Draft Guidance for Materials Characterisation (DMP, 2016b). This assessment found that the majority of waste rock sampled across all four deposits was entirely NAF and geochemically benign, and so has no special management requirements, with the exception of the clastic sediment/shale unit within Split Rock deposit and potentially Runway South pit (for which there was no available samples, however, only makes up a minor component (2.2%) of the expected waste rock volume from this deposit).

Mercury (Hg) concentrations varied within the shale waste rock unit samples tested at Split Rock (only two of the additional six samples were found to be elevated), however the solubility of Hg in drainage waters was found to be negligible (both under neutral and acidic leaching conditions). Contrary to MWH (2016a) assessment, which found that all 14 shale samples tested were NAF, two of the additional six shale samples tested by Mine Earth which showed elevated Hg also displayed high sulphur percentages indicating they may be PAF. Whilst the sampling methodology employed (i.e., potential magnification associated with small sample size) is likely to be a contributing factor to this classification, the limited spatial extent of these

samples suggests that in the unlikely event PAF is present it is likely to be geologically controlled with only discrete point sources, given most of the shale unit has been identified as being NAF.

Further examination during infill drilling, and grade control drilling prior to mining will be undertaken to confirm the presence and spatial extent of any PAF shale in the Split Rock deposit and confirm the geochemical nature of the shale unit in the Runway South pit (likely to be similar in nature to Runway North). Shale makes up less than 15% (652 kbcm) of the Projects total waste rock from all deposits based on current pit design, and can be adequately stored and encapsulated within the current Split Rock waste rock dump design which has the capacity to store up to 2,235 kbcm of problematic material (Figure 9-8).

The risk of deleterious impacts to groundwater from potential acid and metalliferous drainage (AMD) associated with exposures of PAF rock in pit walls is considered to be low given the low likelihood that PAF shale is present, and if found to be present will likely have limited distribution which may not correspond with planned pit walls. Furthermore should PAF shale be exposed in pit walls given the pits are above water table, while seasonal flushing may result in the seasonal collection of AMD within the pit sump these waters will largely evaporate.

Where PAF is confirmed to be present and found to intersect the pit wall, Atlas will undertake additional investigations to confirm AMD potential and where necessary develop a management strategy to ensure that it is appropriately managed to prevent deleterious groundwater quality impacts. This may include backfilling over PAF exposed pit face or redesigning the pit to ensure PAF shale material within 2 m of planned pit wall is left in-situ, or other measures that would limit exposure and oxidation.

7.9 Other Closure Related Data

Atlas has recently undertaken detailed planning and closure works at their Pardoo and Mt Dove projects in the Pilbara. Rehabilitation works at Wodgina and Abydos are also progressing. At each of these projects, gap analysis and risk assessment were used to identify and prioritise closure planning opportunities, and targeted investigations were undertaken to address gaps and risks. The outcomes from these investigations enabled the development and subsequent approval of a detailed MCP for each project. Atlas' experience from closing the Pardoo and Mt Dove projects has informed their approach to closure planning at the Project. Atlas will continue to update the learnings from these Projects as additional data becomes available.

7.9.1 Pardoo DSO Project

The Pardoo DSO project (Pardoo) is located approximately 75 km east of Port Hedland. Pardoo consisted of six deposits which were mined via eleven open pits. Mining commenced in December 2008 and ore reserves expired in March 2014. Closure planning commenced during the feasibility stage of the Project with the development of a conceptual mine closure plan in 2008. Detailed closure planning was initiated during 2010 in response to Project commitments and Atlas' aspiration to understand and manage closure risks and opportunities. Detailed closure planning for Pardoo was an inclusive process that involved transparent engagement of stakeholders. The detailed MCP was approved by the DMIRS in 2013.

Pardoo was significant to Atlas as the first producing mine and they committed to achieve a high standard for closure planning and implementation. High standards were achieved through innovative and integrated planning, open engagement of internal and external stakeholders, and external specialist review. A number of closure issues were identified for Pardoo from the

closure risk assessment and engagement with stakeholders. The main aspects that were addressed as part of the closure investigations, along with key learnings, are presented in Table 7-15.

Closure planning and implementation for Pardoo has been the subject of conference papers and presentations, most notably for the Eighth International Conference on Mine Closure (Mackenzie, et al., 2013).

Table 7-15 – Learnings from the Pardoo Closure Project

Aspect	Closure investigations	Key learnings
Groundwater	Modelling was undertaken to predict pit water quality and assess the level of impact to local receptors including Muccangarra Pool and a P1 water reserve (Bulgarene borefield).	Increases in pit lake salinity and metal concentrations were expected, however Flowpath analysis found that it was unlikely that receptors would be influenced because of low seepage rates from the pits.
Surface Water	Surface water modelling was undertaken to identify infrastructure that may be impacted by flooding during 1:100 year ARI and probable maximum precipitation (PMP) rainfall events.	Management measures such as rock armouring were implemented for relevant domain based on flooding predictions.
Soils	Soils and subsoils were investigated with the aim of determining soil stability and chemistry, to develop a soil deployment plan.	It was identified erosive soils should only be applied to flat areas and that subsoil would be best suited to WRD slopes.
	The soil inventory revealed a topsoil deficit.	Harvesting of soil during abandonment clearing and WRD reprofiling, and selective harvesting of subsoils, mitigated the topsoil deficit.
Landform design	Investigations to determine an appropriate landform design were undertaken, using slope erosion modelling, SIBERIA landform evolution modelling and a geological assessment of slope stability.	WRD's generally consisted of blocky and competent high stability waste rock. There were some areas of medium and low stability rock that required rock armouring. Specific landform designs were implemented.
Stakeholder engagement	Through effective consultation, stakeholders were actively engaged in closure investigations and the development of proposed closure plans.	All aspects of the mine closure plan including closure criteria and objectives, and post closure monitoring programs, were developed with stakeholder input.

7.9.2 Mt Dove DSO Project

The Mt Dove DSO project (Mt Dove) is located 70 km south of Port Hedland. Mining at Mt Dove commenced in October 2012 and ore reserves were exhausted in October 2013. Mt Dove consisted of an open pit mine, pit ramp, WRD, administration area, contractor area, ROM pad including crushing and screening plant, accommodation village, borrow pit, roads and associated infrastructure.

Closure works at Mt Dove have been undertaken into two stages. Stage 1 involved rehabilitation and closure works for the open pit, pit ramp and WRD, and were finalised by mid-2014. Stage 2 will involve closure of the remaining areas that are currently being utilised including the accommodation village, water infrastructure, support infrastructure and access roads. Stage 2 works are scheduled for 2024.

The first mine closure plan was developed for Mt Dove in 2012. During 2012 and 2013 detailed investigations and stakeholder engagement were undertaken to facilitate the development of the detailed MCP. These investigations included surface water hydrology, soils, fauna habitat, contaminated sites and rehabilitation planning. The detailed MCP was submitted to the DMIRS in November 2013 and is still being assessed.

A number of closure issues for Mt Dove were identified from the closure risk assessment and engagement with stakeholders. The main aspects that were addressed as part of the closure investigations, including key learnings, are presented in Table 7-16.

Table 7-16 – Learnings from Mt Dove Closure Projects

Aspect	Closure Investigations	Key Learnings
Surface water	Potential surface water impacts in relation to the WRD, pit ramp, open pit, ROM pad, sedimentation ponds and borrow pit after closure was assessed.	A number of areas were identified that required bunding, rock armouring and rock drains for long term surface water management and stability.
Soils	The majority of stockpiled topsoils were identified to be dispersive with low gravel contents. Some were identified as being suitable for use on WRD slopes; however, there was an overall deficiency of suitable topsoil.	Other potential soil resources (borrow pit subsoils) were identified and were considered to be suitable for applying to WRD slopes.
Fauna	Prior to mining, artificial Northern Quoll habitat was constructed to the west of Mt Dove and three individual quolls were relocated from the mining disturbance area. The artificial Northern Quoll habitat was generally unsuccessful.	In response, improvements were made to the design of the artificial habitat zones and these improvements were incorporated into the numerous habitat zones that were constructed as part of rehabilitation works at Mt Dove.
Contaminated sites investigations	One contaminated site was identified during the operating phase of the Project Mt Dove which resulted from a diesel spill	A contaminated sites assessment and management plan was developed and implemented during the operating phase of Mt Dove.

Atlas' Wodgina and Abydos DSO projects are also approaching closure and detailed MCP's have been developed for both projects.

7.9.3 Fauna habitat zones

During the closure of a number of Atlas' other sites including Pardoo and Mt Dove, fauna habitat zones were constructed (Figure 7-11). These areas are also planned for Atlas' Abydos and Wodgina Projects. These zones consist of structures which are made from piled boulders and sections of large diameter pipe or scrap steel to form voids, with soil covering all artificial material. Fauna habitat mounds are located in areas which will not be influenced by ponding of surface water. To date, no evidence of usage by Northern Quolls has been recorded within

these areas. However, vegetation establishment at most of the sites is only premature, and fauna habitation is likely to be directly related to the occurrence of mature vegetation on disturbed areas. Birds and small invertebrates have been noted using the habitat zones.

Figure 7-10 – Fauna habitat zones developed at Atlas' Pardoo project

7.9.4 Spatial Datasets and Databases

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.
- InViron – a database specifically design to assist in the maintenance of environmental data from monitoring site specific elements.
- Electronic document database – a database that stores all documents.

Atlas also maintains a detailed Geographical Information System (GIS) database which captures the following information:

- baseline information,
- tracks all proposed disturbances through the Project planning phase,
- approved disturbance areas, proposed clearing areas through the ground disturbance permitting (GDP) process,
- cleared areas approved through the GDP process,
- locations of topsoil, vegetation and subsoil stockpiles for rehabilitation and closure, and
- areas that have been rehabilitated.

7.10 Data Analysis and Implications for Mine Closure

Environmental monitoring will be undertaken throughout the operational phase of the Project in accordance with commitments made and licence conditions. The monitoring requirements will be detailed in the Project Activity Schedule.

Environmental inspections will also be undertaken during the operational phase to:

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

8. Identification and Management of Closure Issues

A closure risk assessment workshop was held by Atlas on September 2016 and was subsequently updated during May 2018. The risk assessment workshop was undertaken to identify and quantify mine closure risks for each domain at the Project. The risk assessment process that was adopted aligns with the Australian and New Zealand Risk Management Standard (AS/NZ 31000:2009). The risk matrices used to undertake the assessment were sourced from the International Council on Mining and Metals planning for integrated mine closure toolkit (ICMM, 2008) and are included in (Table 8-1 to Table 8-3).

The objectives of the risk assessment were to:

- Identify and rank inherent risks. Inherent risk is described as a risk event prior to implementing risk controls.
- Develop risk controls for those inherent risks that could compromise the achievement of closure objectives.
- Assess residual risk after risk controls have been implemented.

The outcomes of the risk assessment have been used to inform the development of closure plans for relevant domains (Section 9).

Table 8-1 – Consequence

Scale	Consequence
Consequential	Related to, in consequence of. Not inconsequential, but no more severe than that.
Limited	Some consequence, generally reversible in a short term and/or with modest application of resources (similar to daily operating budget for mine if financial comparisons are appropriate
Overt	Consequences may be reversible, usually requiring some time and/or significant application of resources (similar to monthly operating budget, if financial comparisons are appropriate).
Significant	Generally irreversible consequences, with impacts apparent for a prolonged period of time (similar time scale to mine life, where time-scale comparisons are appropriate)
Extreme	Irreversible consequences, impacts exceeding period similar to life of mine (where time-scale comparisons are appropriate).

Table 8-2 – Likelihood

Scale	Likelihood
Improbable	It would require a substantial change in circumstances to create an environment for this to occur, and even then this is a rare occurrence in the mining and metals industry anywhere.
Unlikely	There are no specific circumstances to suggest this could happen, but it has happened before at least once in the mining and metals industry
Possible	There is at least a 5 per cent chance it could happen, or it has happened occasionally in other areas before, or it has occurred (albeit infrequently) in the mining and metals industry in the recorded past or risk mitigation treatment cannot reduce the inherent likelihood further
Likely	There is at least a 50 per cent chance it could happen, or it has happened several times in similar areas before, or this consequence is not uncommon in the mining and metals industry or any risk mitigation treatment cannot reduce the inherent likelihood further
Almost Certain	Has happened/will probably happen during mine life and there is no reason to suspect it will not happen again or it has occurred in this area before

Table 8-3 – Risk assessment matrices

Likelihood	Consequence				
	Consequential	Limited	Overt	Significant	Extreme
Improbable	Low	Low	Medium	Medium	High
Unlikely	Low	Low	Medium	Medium	High
Possible	Low	Medium	High	High	High
Likely	Medium	Medium	High	High	Very High
Almost Certain	Medium	High	High	Very High	Very High

Table 8-4 – Closure Risk Assessment

Event	Causes	Consequences	C	L	Inherent risk	Control options	C	L	Residual risk
WASTE ROCK LANDFORMS									
Unacceptable impacts to the receiving environment.	Erodible materials on final landform slopes. Uncontrolled surface water. Seepage from geochemically reactive waste rock	Detrimental effects to the receiving environment. Erosion.	O	P	H	Non-erosive material to be used on final landform slopes. Design and construct adequate controls to manage surface water on and around landforms. Geochemical assessment of waste rock and effective management of materials. Further examination during infill drilling, and grade control drilling prior to mining will be undertaken to confirm the presence and spatial extent of any PAF shale. All clastic sediment / shale to be encapsulated within WRD's.	O	U	M
Unacceptable impacts to conservation significant fauna.	Loss of habitat. Linkages between significant fauna habitat areas are not restored. Structural damage to bat habitats including caves. Permanent water holes impacted by mining.	Fragmentation of significant fauna habitats. Loss of fauna community.	O	L	H	Rehabilitate disturbed areas with native vegetation. Maintain buffer zones around significant bat habitats. Monitoring of recognised permanent water sources in the vicinity of the Project.	O	U	M
Poor stability.	Constructed landforms located within the zone of pit instability.	Geotechnical failure of constructed landforms.	S	P	H	Position WRDs outside of the unstable zone around the open pits.	S	U	M

	Inappropriate design and construction of landforms. Uncontrolled surface water drainage. Standing water adjacent to constructed landforms.	Increase in public accessibility to open pits. Maintenance costs. Unsuccessful rehabilitation.				Design and construct landforms to meet appropriate geotechnical standards. Design and construct adequate controls to manage surface water around landforms.			
Impacts from uncontrolled surface water flow.	Surface water controls designed/constructed poorly. Poor landform design and placement. Poor materials selection and placement. Grazing pressures. Extreme rainfall events exceeding the design capacity of surface water controls.	Erosion features. Increased sediment load to surface water. Loss of growth media. Poor revegetation. Unsafe conditions.	L	L	M	Design and construct adequate controls to manage surface water on and around landforms. Reprofile embankments and place physically stable materials on the outer surface of landforms Discourage stock grazing on rehabilitated areas. Implement an appropriate rehabilitation plan.	L	P	M
Poor revegetation.	Insufficient or poor quality growth medium. Poor rehabilitation planning. Erosion of rehabilitated surfaces. Rehabilitation materials have low water holding capacity. Grazing pressures. Excessive weeds occurrence.	Limited fauna recolonisation. Requirement for ongoing remedial works. Erosion. Do not achieve self-sustaining vegetation outcome.	L	L	M	Implement appropriate landform design including surface drainage and material placement. Identify and manage adequate volumes of suitable growth medium. Implement an appropriate rehabilitation plan. Ongoing weed control. Discourage stock grazing on landforms and other disturbance areas.	L	P	M

	Extreme climatic events.								
OPEN PITS									
Unauthorised access to open pits.	Access not restricted.	Human injury or fatality.	E	U	H	Construct abandonment bunds in accordance with approved plans and relevant guidelines (where practicable). Rehabilitate access roads where they are no longer required.	E	I	H
Impacts from uncontrolled surface water flow.	Surface water controls designed/constructed poorly. Extreme rainfall events exceeding the design capacity of surface water controls.	Pit wall erosion. Increased access to open pits. Pit lake overtops.	O	P	H	Design and construct adequate controls to manage surface water on and around open pits. Most of the pits are located at the top of the catchment and will receive minimal surface water inputs.	O	U	M
Unacceptable impacts to conservation significant fauna.	Loss of habitat. Linkages between significant fauna habitat areas are not restored.	Fragmentation of significant fauna habitats. Loss of fauna community.	O	L	H	Maintain buffer zones around significant bat habitats	O	U	M
Poor pit water quality	Evapo-concentration of solutes. Seepage from PAF material in pit walls.	Fauna impacts.	L	P	H	Construct abandonment bunds in accordance with approved plans and relevant guidelines (where practicable). Rehabilitate access roads where they are no longer required. If PAF intersects the pit wall, Atlas will undertake additional investigations and will consider options such as redesign of the pit wall and backfilling if appropriate.	L	U	M
PROCESS INFRASTRUCTURE									

Impacts from uncontrolled surface water flow.	Surface water controls designed/constructed poorly. Poor landform design. Poor materials selection and placement. Inadequate rehabilitation planning. Grazing pressures. Extreme rainfall events exceeding the design capacity of surface water controls.	Erosion. Increased sediment load to surface water. Loss of growth media. Poor revegetation.	L	L	M	Design and construct adequate controls to manage surface water. Discourage stock grazing on rehabilitated areas. Implement an appropriate rehabilitation plan.	L	P	M
Poor revegetation.	Insufficient or poor quality growth medium. Poor rehabilitation planning. Erosion of rehabilitated surfaces. Rehabilitation materials have low water holding capacity. Grazing pressures. Excessive weeds occurrence. Poor climatic conditions.	Limited fauna recolonisation. Requirement for ongoing remedial works. Erosion. Do not achieve self-sustaining vegetation outcome.	L	P	M	Design and construct adequate controls to manage surface water. Identify and manage adequate volumes of suitable growth medium. Implement an appropriate rehabilitation plan. Ongoing weed control. Discourage stock grazing on rehabilitated areas.	L	U	L
Unacceptable impacts to the receiving environment.	Inadequate storage and management of hazardous materials. Hazardous material spills.	Detrimental effects to the receiving environment.	L	L	M	Manage and store hazardous materials in accordance with relevant licence conditions and requirements.	L	U	L

						Effectively manage hazardous material spills.			
Assets left intact after closure deteriorate and become a liability.	Residual assets not maintained by new owner. Liability for assets not agreed. Stakeholder expectations not defined. Asset not left with capacity to function.	Company reputation adversely affected. Assets become a liability.	L	P	M	Leave only those assets that have an agreed owner and viable future use. Transfer responsibility to the future owner. Engage stakeholders to determine their expectations for assets beyond mine closure. Where required, ensure that assets are left in good working order.	L	U	L
ROADS, BORROW PITS AND HARDSTAND AREAS									
Impacts from uncontrolled surface water flow.	Surface water controls designed/constructed poorly. Poor landform design. Poor materials selection and placement. Inadequate rehabilitation planning. Grazing pressures. Extreme rainfall events exceeding the design capacity of surface water controls.	Erosion on and around domain. Increased sediment load to surface water. Loss of growth media. Poor revegetation.	O	L	H	Design and construct adequate controls to manage surface water. Reprofile borrow pit embankments and place physically stable materials on sloped areas. Discourage stock grazing on rehabilitated areas. Implement an appropriate rehabilitation plan.	L	P	M
Poor revegetation.	Insufficient or poor quality growth medium. Poor rehabilitation planning. Erosion of rehabilitated surfaces.	Limited fauna recolonisation. Requirement for ongoing remedial works. Erosion.	L	P	M	Design and construct adequate controls to manage surface water. Identify and manage adequate volumes of suitable growth medium.	L	U	L

	Rehabilitation materials have low water holding capacity. Grazing pressures. Excessive weeds occurrence. Poor climatic conditions.	Do not achieve self-sustaining vegetation outcome.				Implement an appropriate rehabilitation plan. Ongoing weed control. Discourage stock grazing on landforms and other disturbance areas.			
Unacceptable impacts to the receiving environment.	Inadequate management of hazardous materials. Hazardous material spills.	Detrimental effects to the receiving environment.	L	L	M	Manage and store hazardous materials in accordance with relevant licence conditions and requirements. Effectively manage hazardous material spills.	L	U	L
Assets left intact after closure deteriorate and become a liability.	Residual assets not maintained by new owner. Liability for assets not agreed. Stakeholder expectations not defined. Asset not left with capacity to function.	Company reputation adversely affected. Assets become a liability.	L	P	M	Leave only those assets that have an agreed owner and viable future use. Transfer responsibility to the future owner. Engage stakeholders to determine their expectations for assets beyond mine closure. Where required, ensure that assets are left in good working order.	L	U	L
SITE WIDE									
Insufficient funds set aside for the implementation of the closure program.	Closure costs under estimated. Inadequate funds are available to implement closure works.	Substandard or incomplete closure works.	O	P	H	Develop realistic closure cost estimates and make adequate accounting provision for closure costs. Review closure costs on a periodic basis or following significant changes to the life of mine plan. Progressive rehabilitation.	L	P	M

Delay in tenement relinquishment.	Closure criteria are not achievable or not endorsed by regulators. Poor closure and rehabilitation planning and implementation. Custodial authority unwilling to accept residual liabilities.	Delay in tenement relinquishment. Uncertainty for community, State and proponent.	O	L	H	Develop acceptable and achievable closure criteria in consultation with relevant stakeholders. Continue to develop adequate closure and rehabilitation plans and implement works in accordance with approved closure designs. Consider alternatives to encourage custodial transfer of residual liabilities. Effective stakeholder engagement.	O	U	M
Unplanned or early closure.	Fall in commodity prices or increased operating costs. Significant safety / environmental / technical issue.	Substandard closure outcome. Insufficient funds available for closure works.	O	P	H	Continue to undertake progressive mine closure planning and rehabilitation. Continue to undertake regular updates to the closure cost estimate and accounting provisioning.	L	U	L
Stakeholder expectations are not met.	Inadequate stakeholder consultation. Changing stakeholder expectations. Inaccurate impact predictions.	Company reputation adversely affected. Missed opportunities to improve closure outcomes. Increased closure implementation and post-closure management costs. Extended timeframe to relinquishment.	L	L	M	Engage relevant stakeholders in the closure planning process. Continue to validate impact predictions.	L	U	L

9. Closure Implementation

This section presents the background information, closure objectives and criteria, and closure plans for each domain. The closure plan describes the tasks that will be undertaken in chronological order for each disturbed site. The outcomes of the closure risk assessment, closure investigations and stakeholder engagement will be used to further refine the development the closure plans. The identification and management of information gaps is also discussed in this section.

Within the closure plans for each domain, generic tasks are nominated, with the intent they will be refined further as the Project approaches closure. At this stage investigations such as developing detailed landform designs, surface water management plans, abandonment bund locations and rehabilitation planning have not been undertaken for specific infrastructure and are identified as closure knowledge gaps. The results of these assessments will be presented in the detailed mine closure plan which will be submitted to DMIRS in the year prior to the commencement of closure works. Atlas has undertaken this process successfully at a number of their other sites including Pardoo, Mt Dove, Wodgina and Abydos.

9.1 Open pits

9.1.1 Description

The open pits domain will consist of five open pits. The proposed design parameters for each pit are presented in Table 9-1

Table 9-1 – Proposed Pit Design Parameters

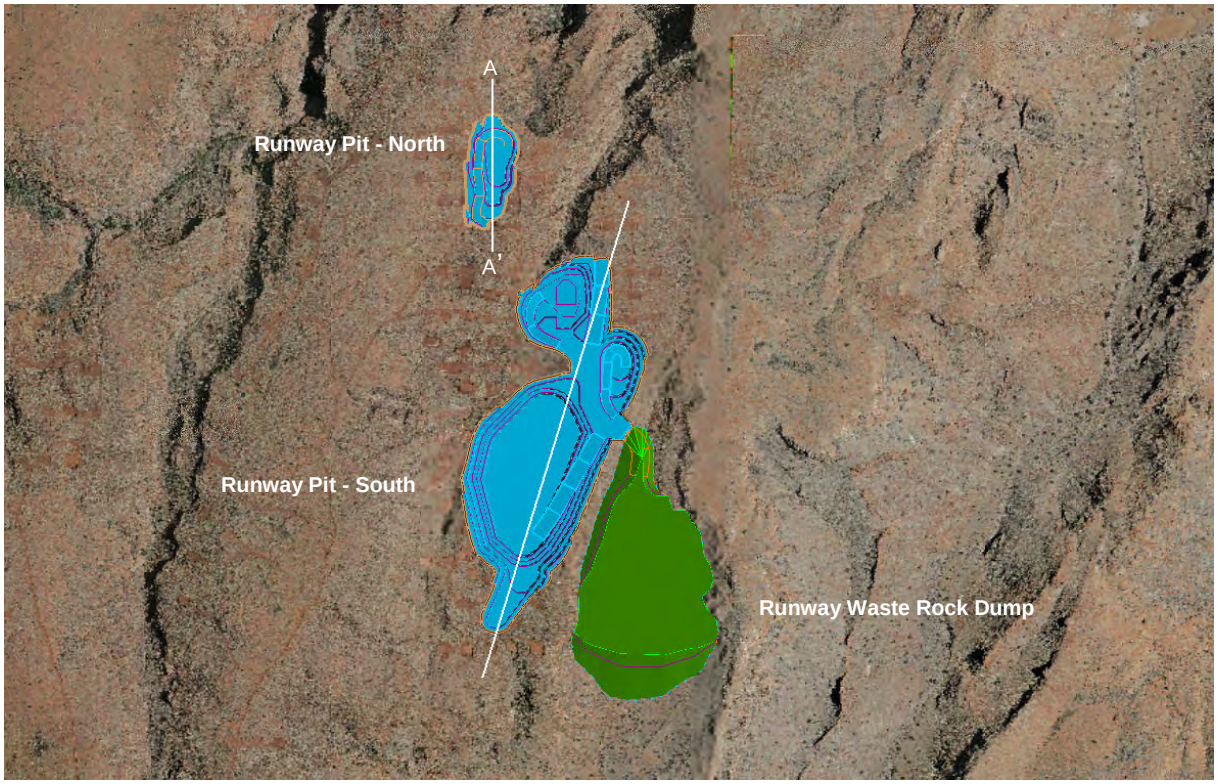
Feature	Runway Pit – South	Runway Pit – North	Shark Gully Pit	Split Rock Pit	Razor Back Pit
Maximum pit depth	50 m	26 m	65 m	71 m	74 m
Area	19.06 ha	3.9 ha	16.71 ha	25.51 ha	8.66 ha
Berm to berm batter height	10 m	10 m	10 m	10 m	10 m
Berm width	5 m	5 m	5 m	5 m	5 m
Batter angle	65º	65º	65º	65º	60º
Ramp grade	1:10	1:10	1:10	1:10	1:10
Mining depth below groundwater	0 m – Mining above groundwater table				

Dewatering will not be required as it is not anticipated that mining will intersect the groundwater table. Open pits will be located on ridgelines, and in most cases the natural topography will direct any rainfall runoff away from the pits. Therefore, in-pit pumping may only be required to remove direct rainfall or seepage as pits approach final depths.

9.1.2 Closure objectives and criteria

In terms of post-mining land use the open pits are designated as limited access areas. The closure objectives, criteria and standards for the open pits are presented in Section 6 and the schematic cross section and cross section illustrating the longitudinal design profile as intersected with the natural topography of the proposed design of the open pits is provided in Figure 9-1 to Figure 9-4.

Figure 9-1 – Runway Pits Plan View and Runway Pit North Cross-Section (looking west)



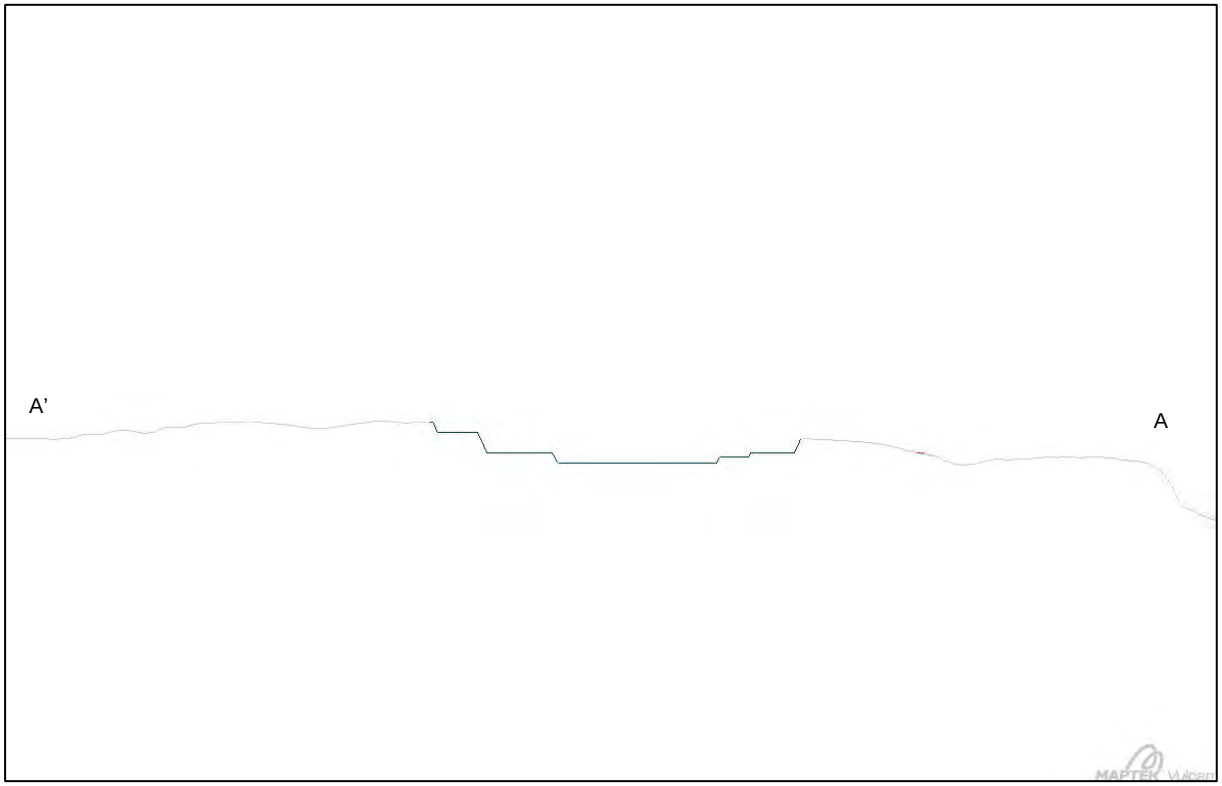
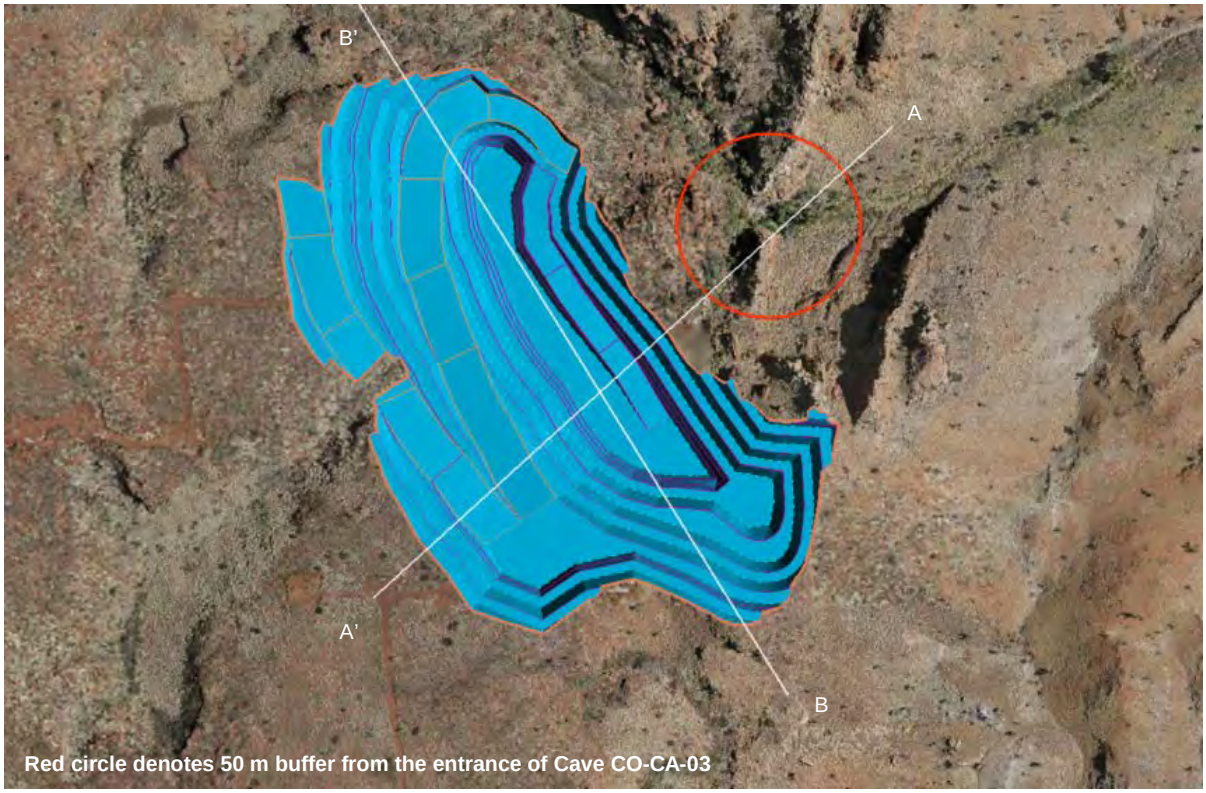


Figure 9-2 – Razorback Pit Plan View, Long-Section (Looking Southwest) and Cross-Section (Looking northwest)



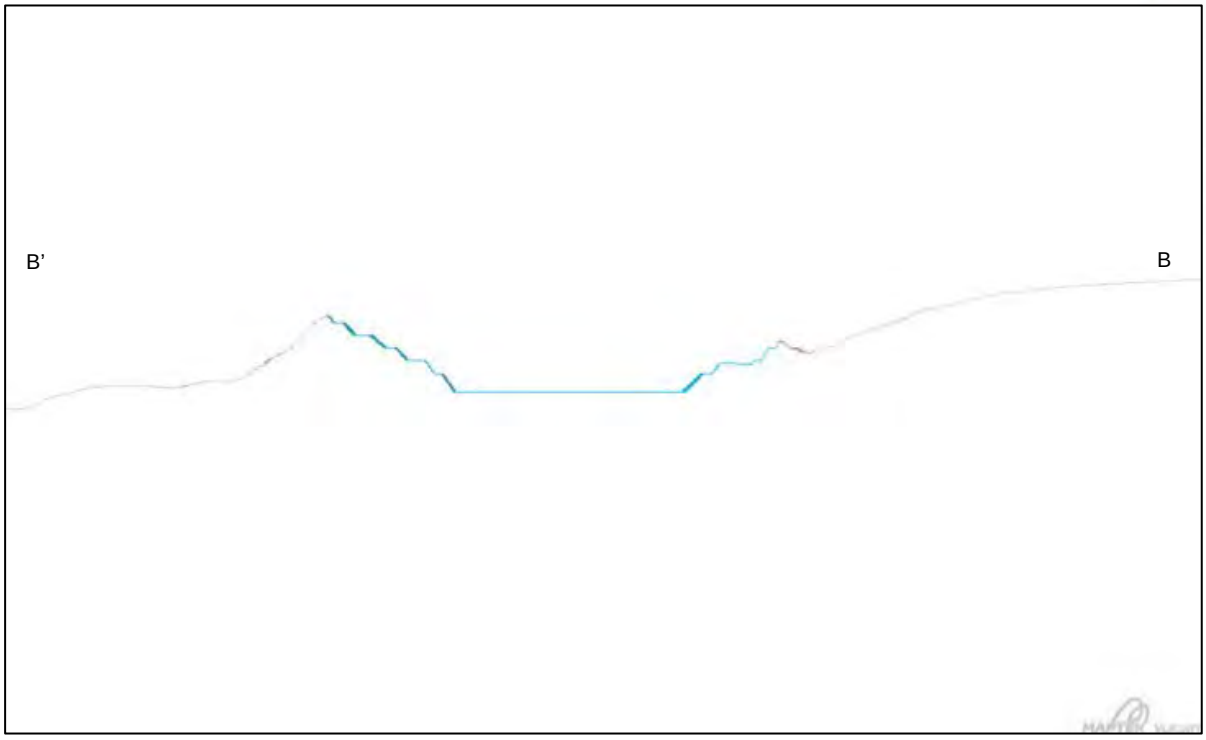
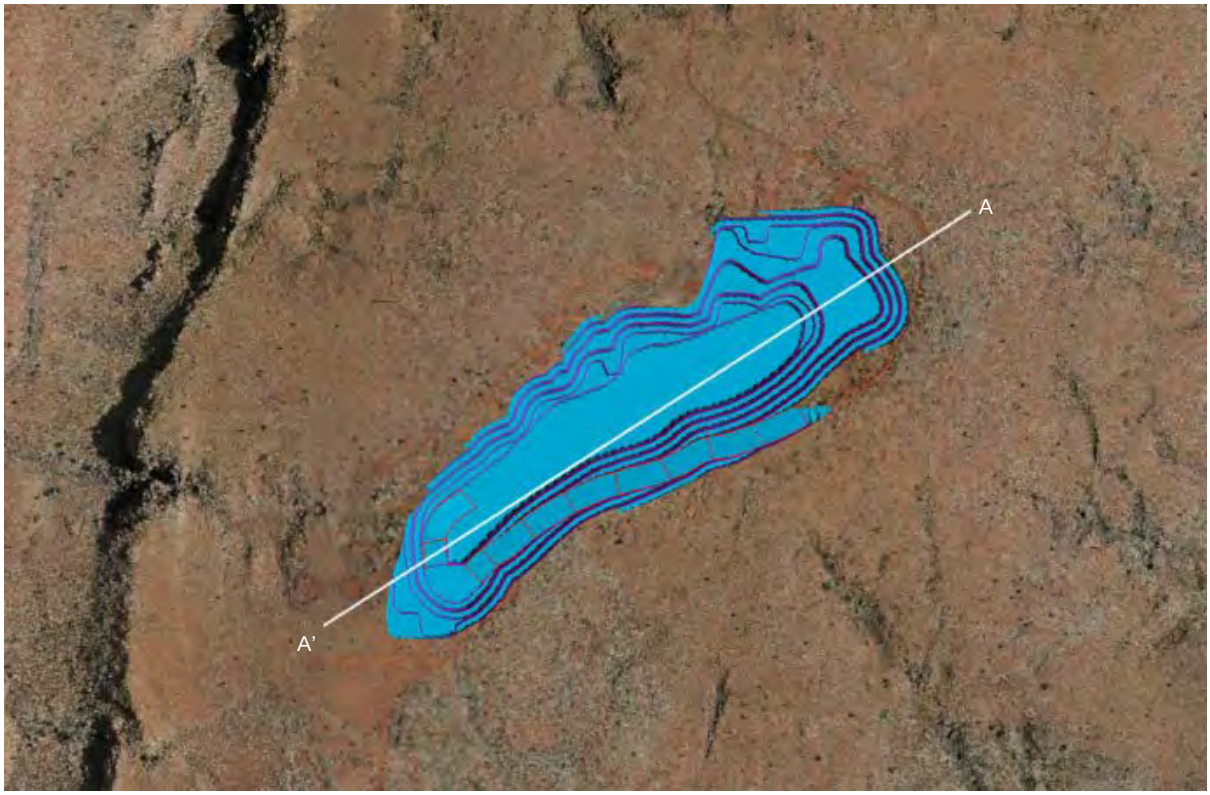

B'
B

Figure 9-3 – Shark Gully Pit Plan View and Cross-Section (Looking Northwest)



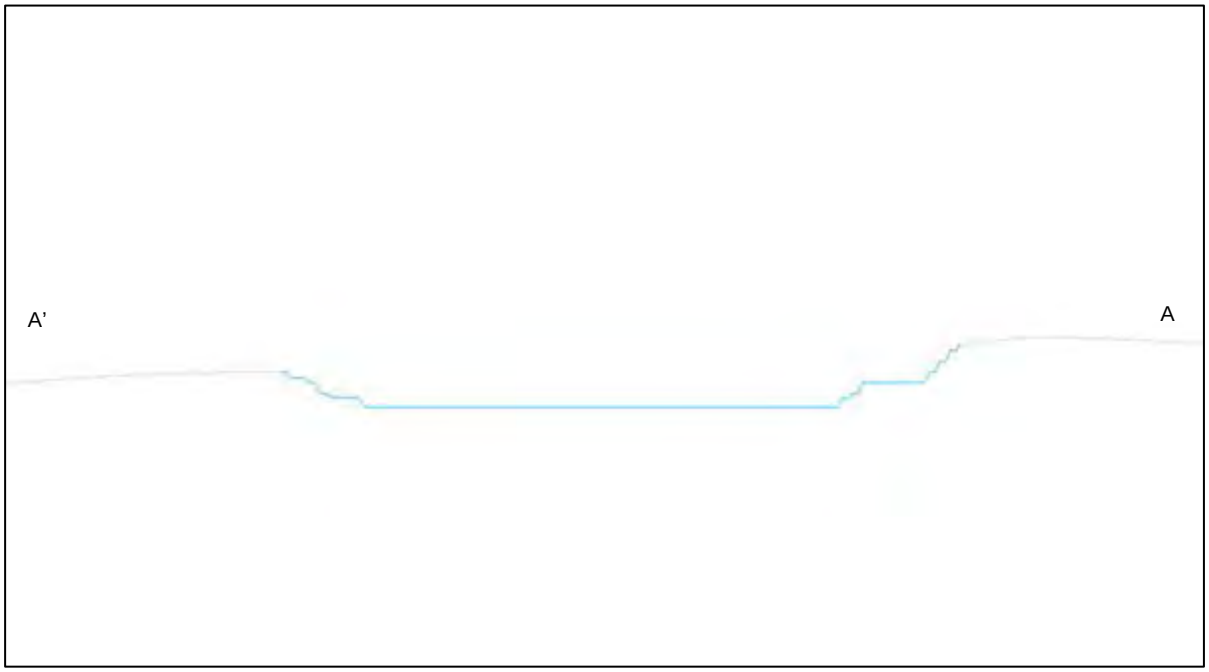
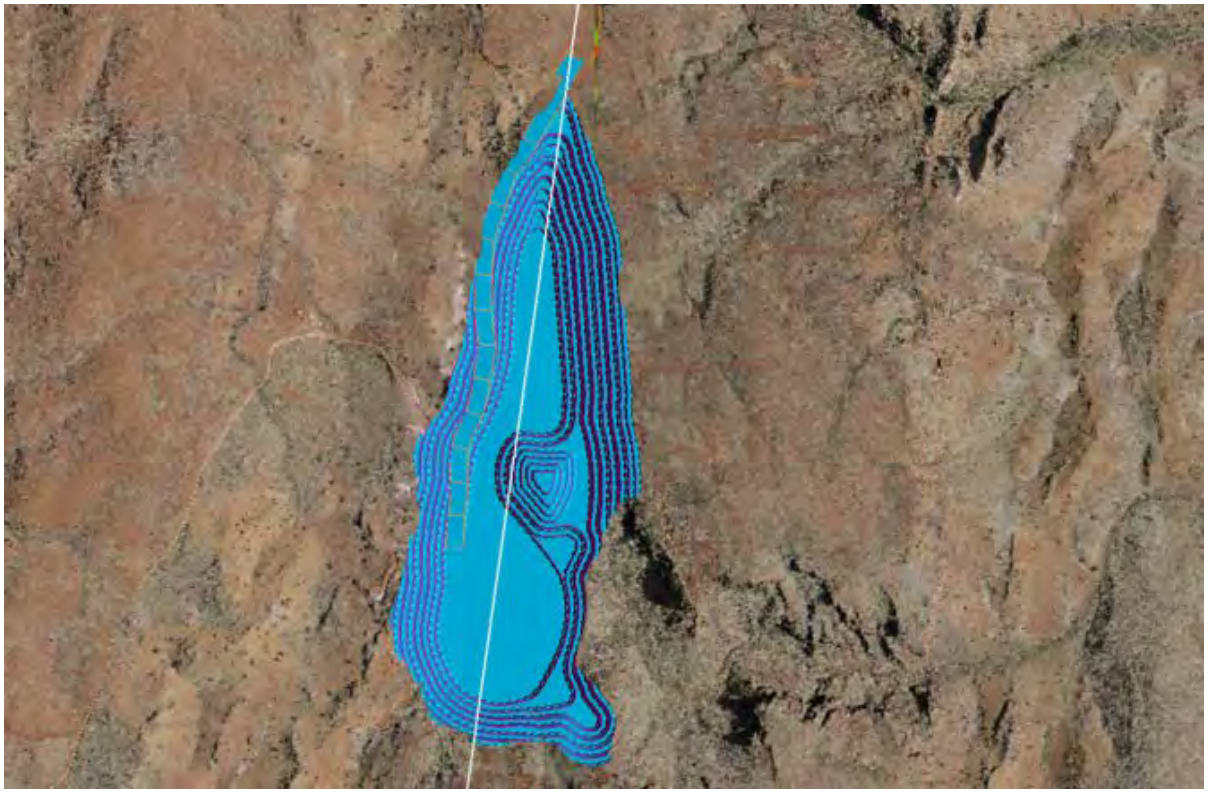
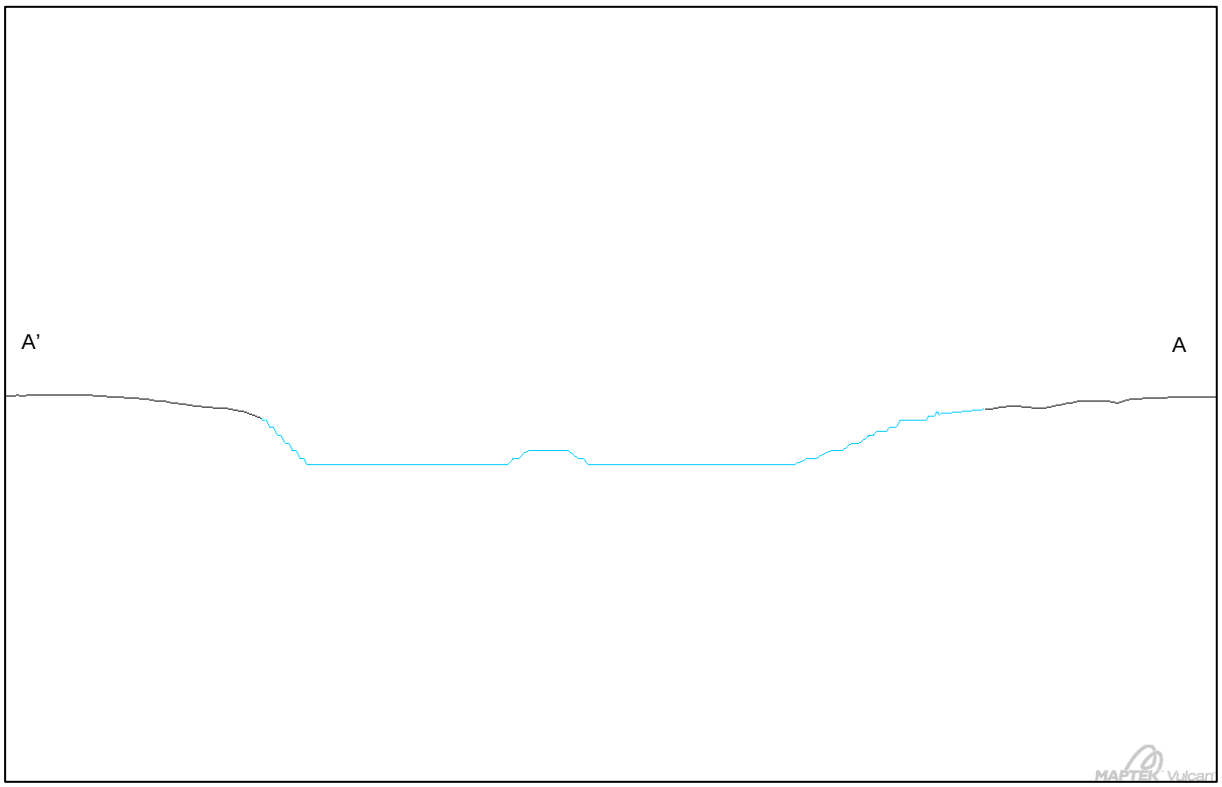


Figure 9-4 – Split Rock Pit Plan View and Cross-Section (Looking West)





9.1.3 Closure plan

The closure plan for the open pits involves reducing the potential for access by rehabilitating roads, constructing abandonment bunds and controlling local surface water drainage. Direct rainfall and surface water that occurs in the open pits will be left to evaporate and/or infiltrate.

The following opportunities have been identified to progress closure planning for the open pits:

- Develop a plan to manage surface water around the open pits after closure.
- Develop a plan for the location and construction of abandonment bunds.
- Determine the spatial distribution of PAF shale in relation to the final pit walls and develop a plan to manage this if required.

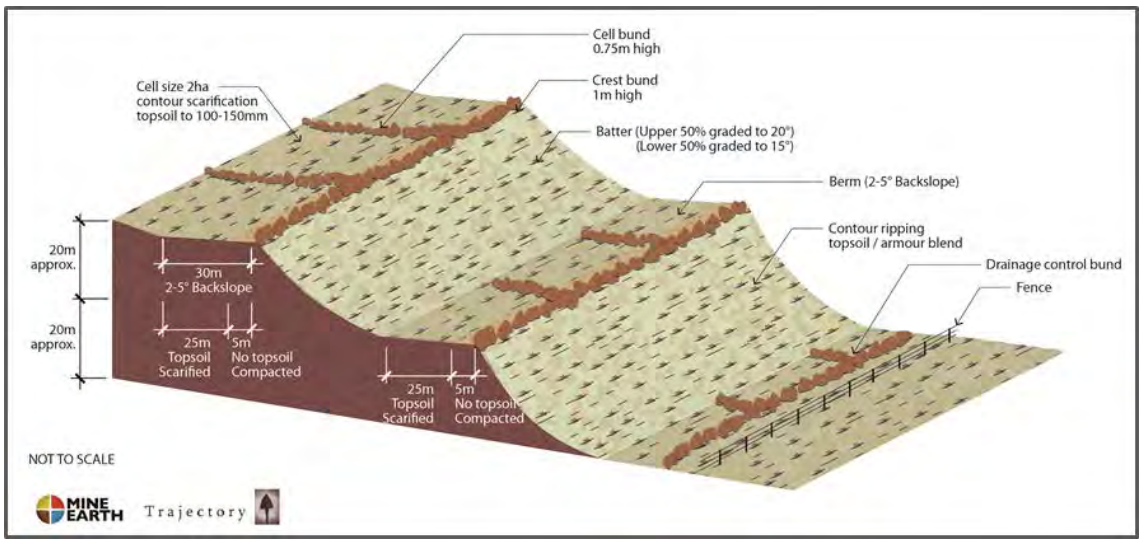
9.2 Landforms

9.2.1 Description

The landforms domain includes the Runway WRD, Shark Gully WRD, Split Rock WRD, and the Runway land bridge. The low-grade stockpile has also been included as a landform, although it is likely that it will be removed prior to closure (and the resultant area will be treated as hardstand).

The final WRD designs will have 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 dump is shown in Figure 9-5. The concept is to design dumps that retain and allow rainfall to infiltrate into the dump or evaporate rather than attempt 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).

Figure 9-5 – Conceptual rehabilitated waste dump



The design criterion is to have a final landform with an overall slope profile of 17 degrees.

The waste dumps are designed with flexible limits that will be altered as required during operations taking into account the operational ability to undertake rehabilitation of outer slopes. All WRDs have been designed with consideration of surface water flow management.

The waste mined from the pits will be placed onto waste dumps close to the respective pits.

The waste dumps are designed as per the parameters detailed in Table 9-2.

Table 9-2 – Waste dump design parameters

Description	Value
Angle of repose (Dump angle)	370
Face Height	20 m
Berm Width	30 m
Rehabilitated overall slope	170

During the waste characterisation assessment it was identified that the clastic sediment (shale) from the Split Rock deposit may require special management from a geochemical and erosion perspective (See Section 7.10). All shale material (NAF/PAF) will be buried 10 m below the final WRD surface. Clay rich BIF has also been identified to be erosive and will not be placed on sloped landform surfaces; this may however be used as a growth medium on flat areas where required.

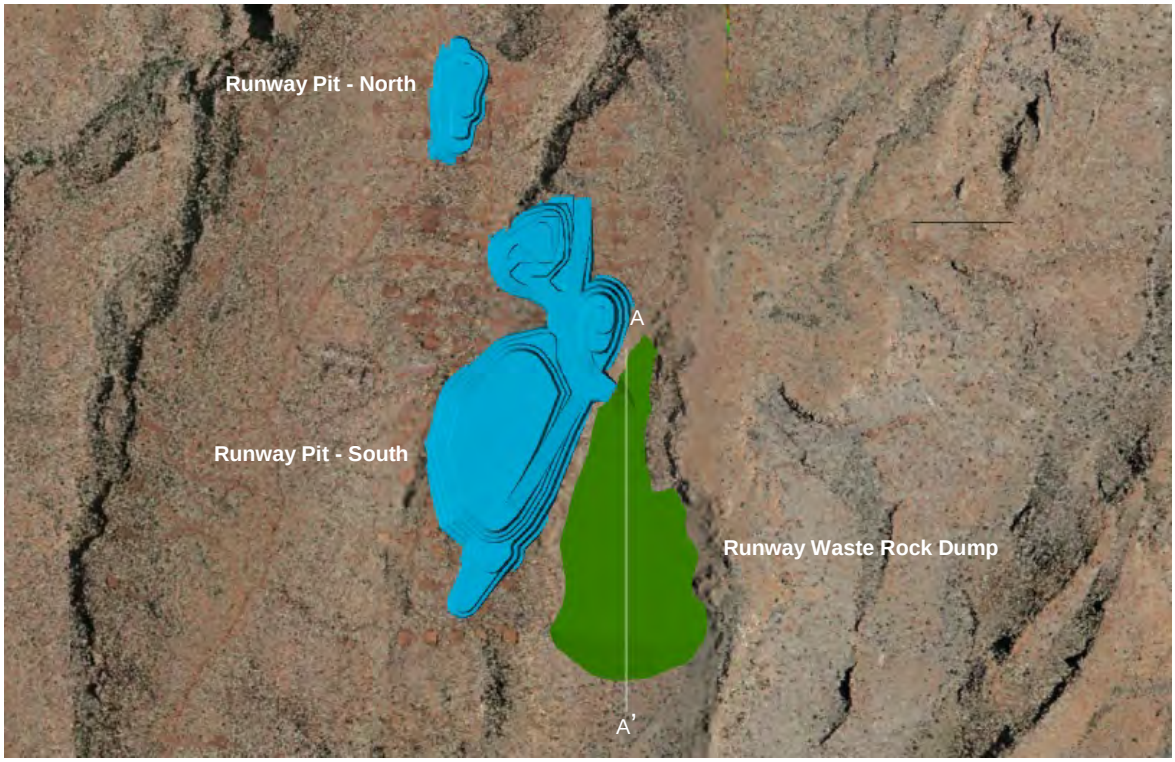
The low-grade ore from the pits which cannot be immediately blended will be placed on the low-grade stockpiles and will be blended with high grade ore within the mine life of the project. The stockpile will have a maximum vertical height of 30 m.

The land bridge will be constructed from approximately 83,368 m^3 of local cut and fill of near surface outcropping material (cut max ~5m) from the local area and/or NAF waste rock material from Runway pit.

9.2.2 Closure objectives and criteria

The closure objectives, criteria and standards for the landforms are presented in Section 6. The schematic cross-sections and cross sections illustrating the longitudinal design profile of the landforms as they intersect with the natural topography is provided in Figure 9-6 to Figure 9-10. In terms of the post mining land use objective it is anticipated that rehabilitated areas will be able to be used in a similar manner to comparable surrounding land but may be at a lower intensity.

Figure 9-6 – Runway Waste Rock Dump Cross Section



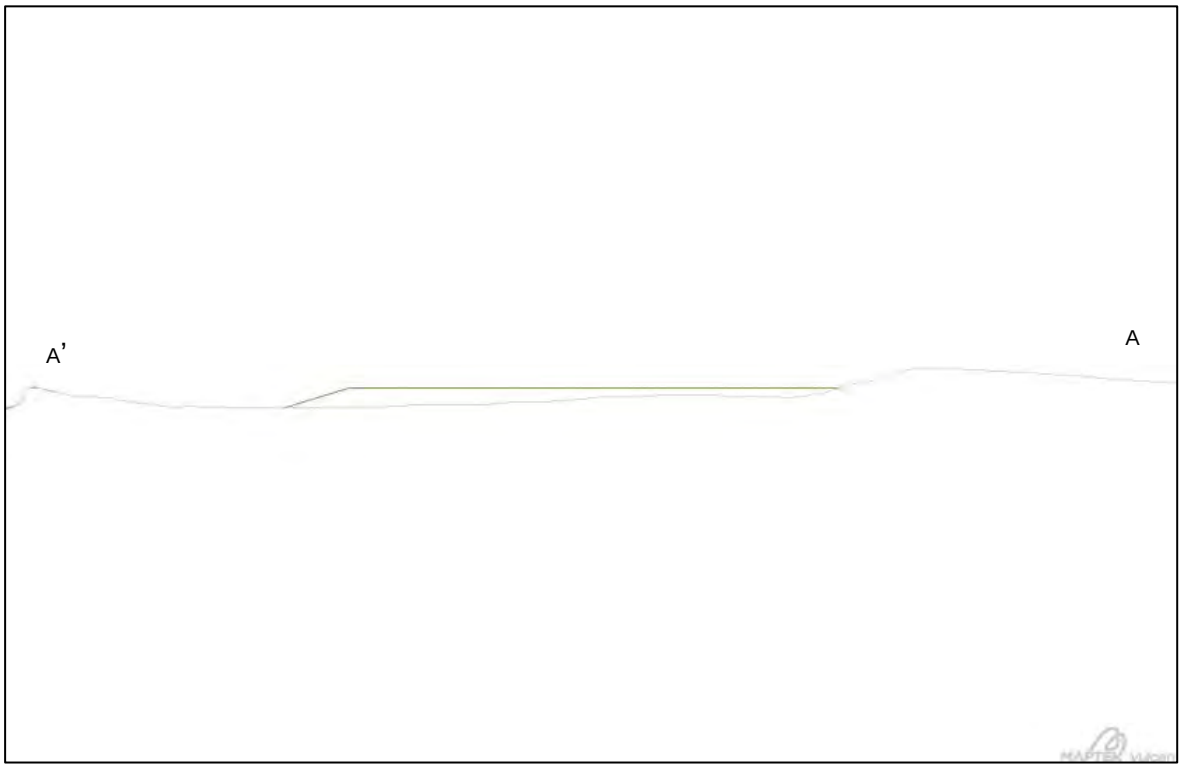


Figure 9-7 – Shark Gully Waste Rock Dump Cross Section

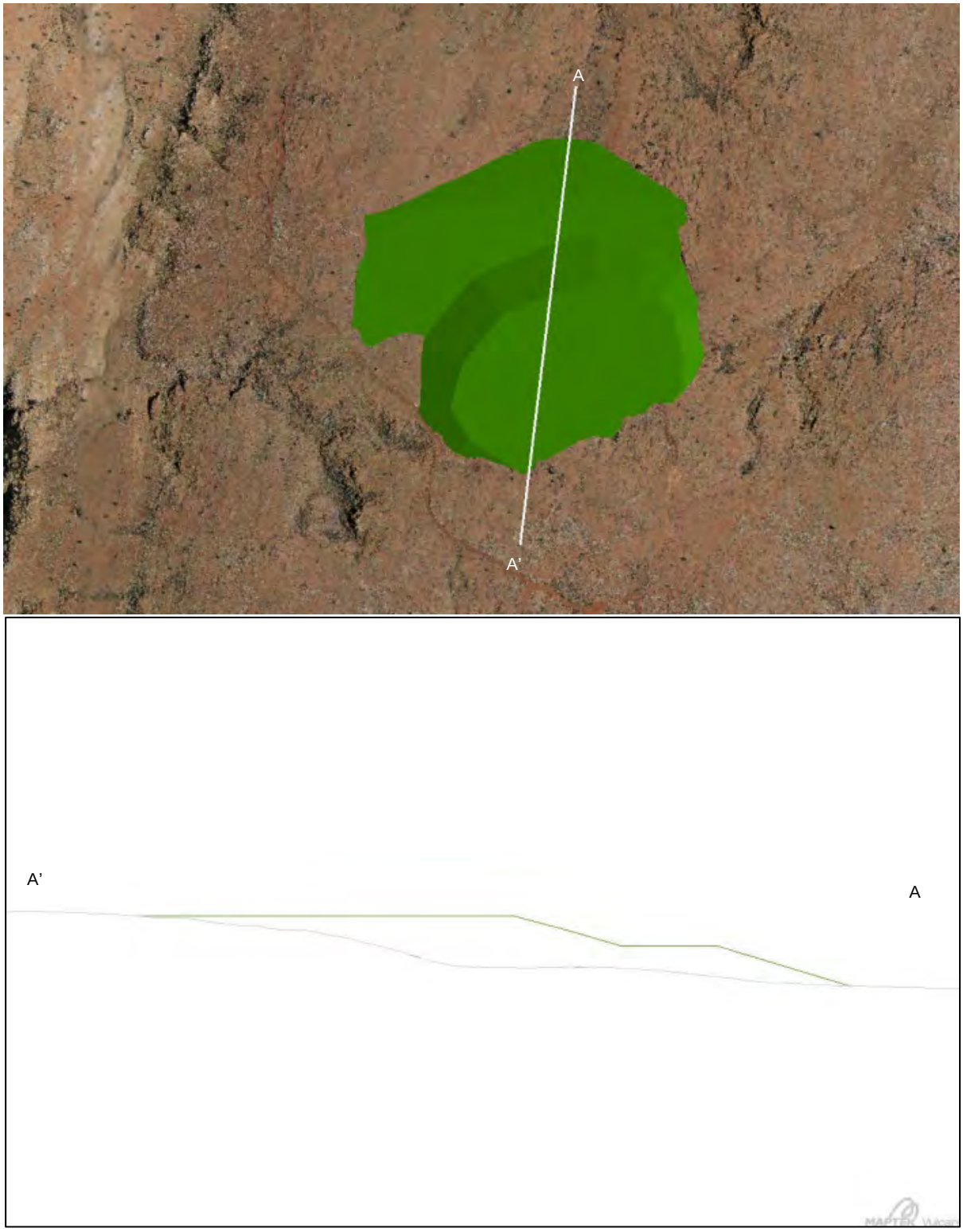
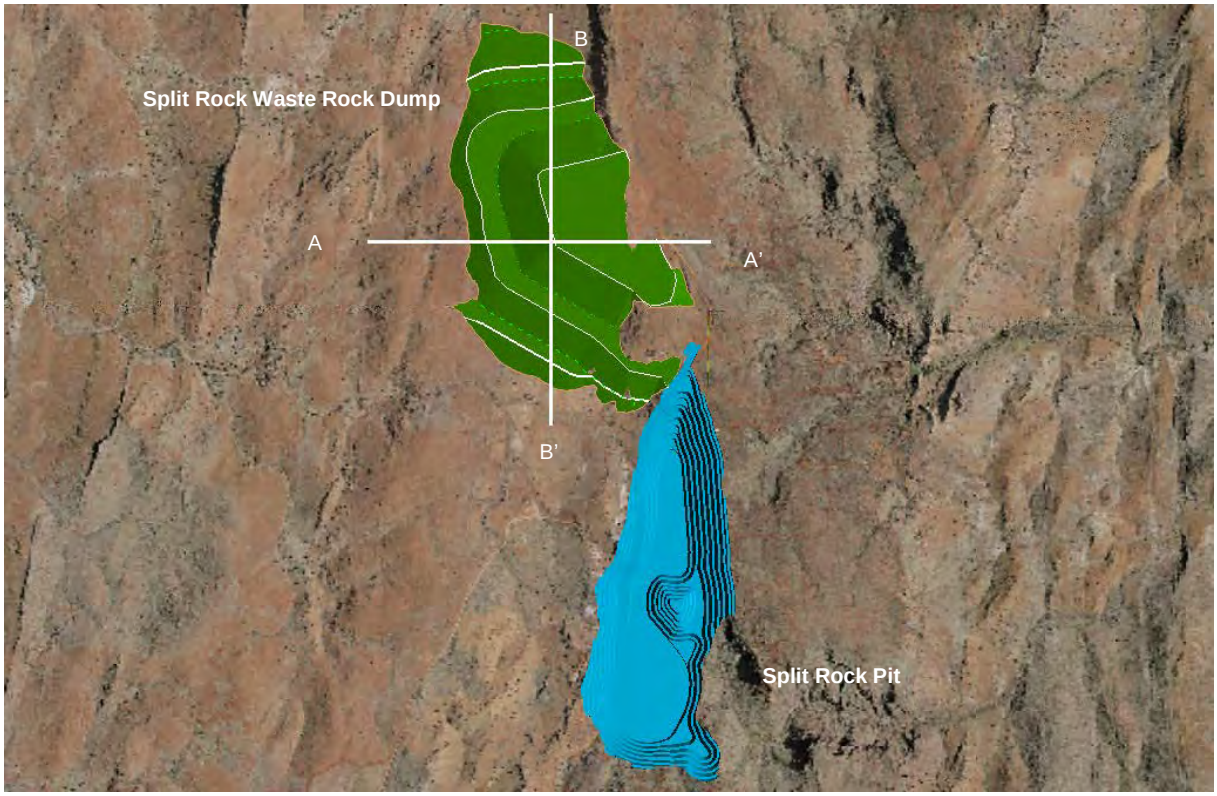
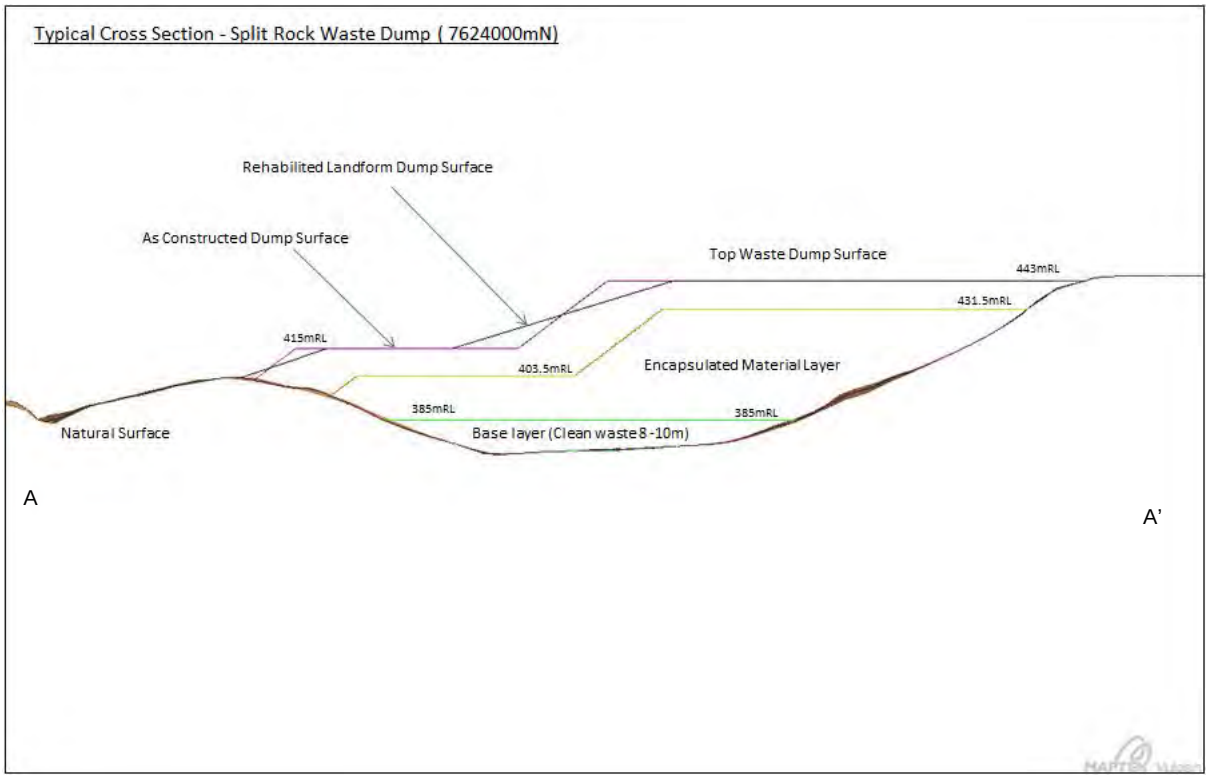


Figure 9-8 – Split Rock Waste Rock Dump Plan View and Typical Cross Sections





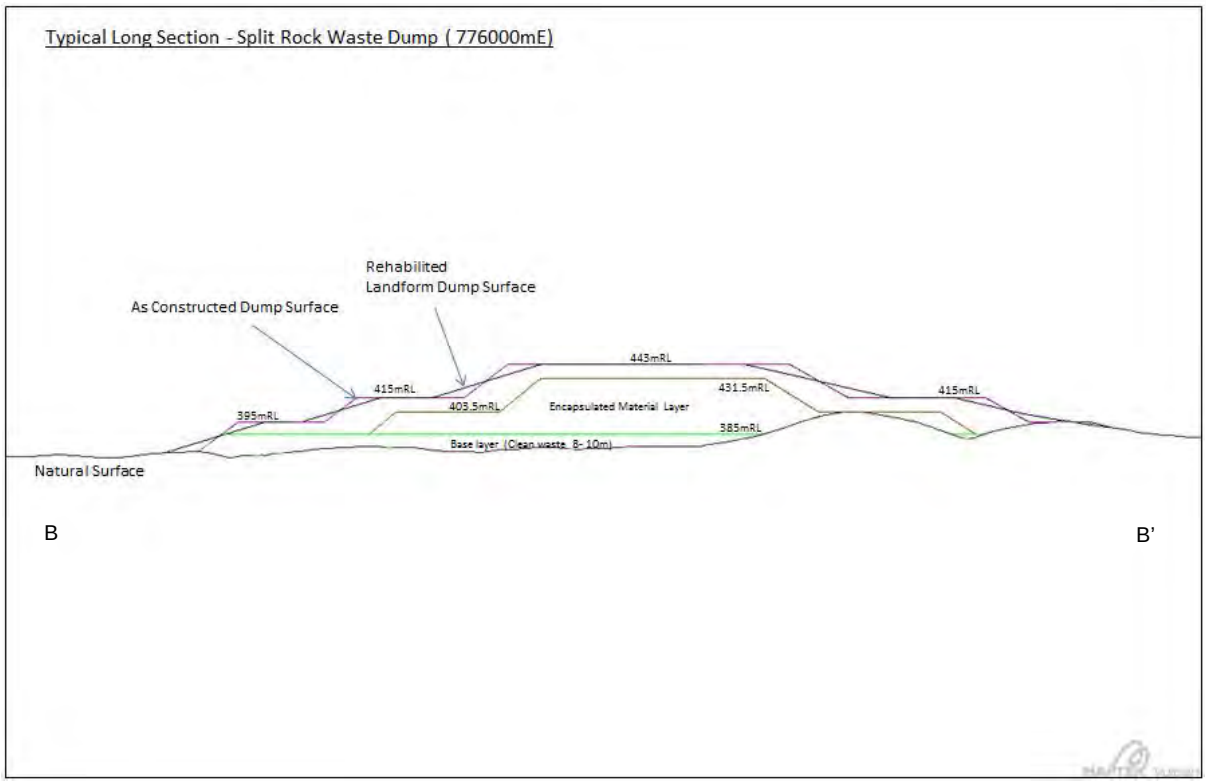
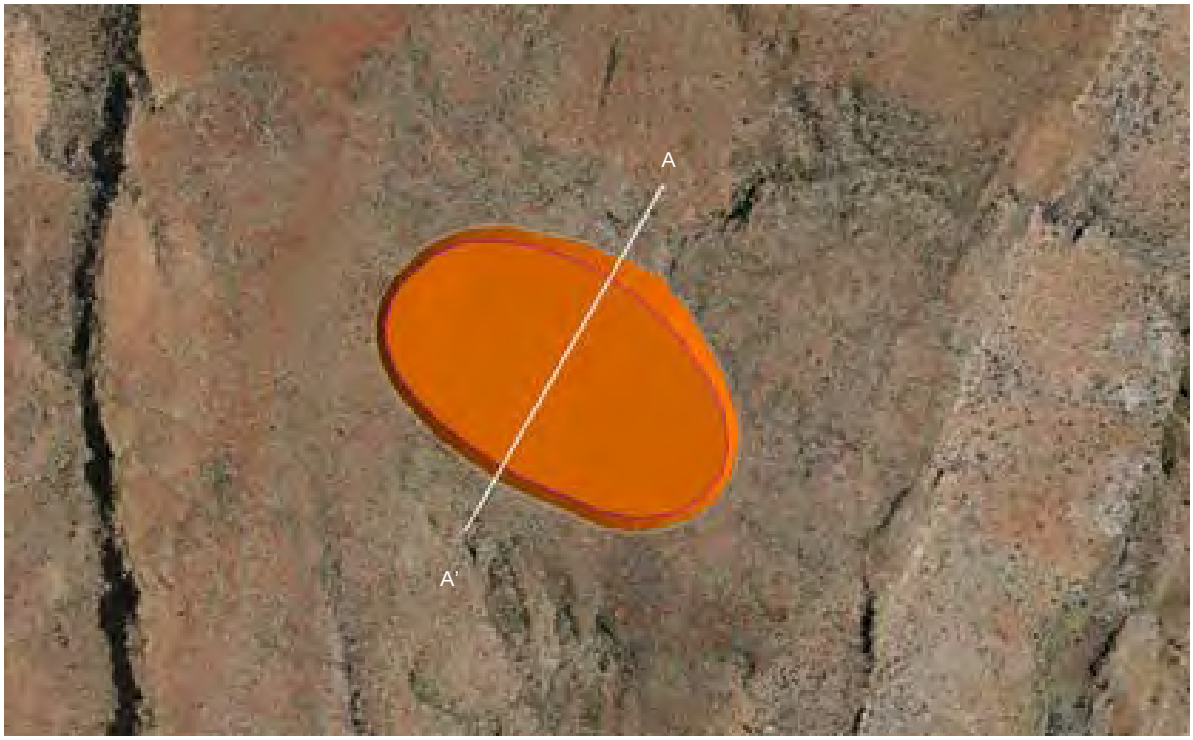

Typical Long Section - Split Rock Waste Dump (776000mE)
Rehabilited
Landform Dump Surface
As Constructed Dump Surface
443mRL
415mRL
431.5mRL
415mRL
395mRL
403.5mRL
Encapsulated Material Layer
385mRL
Base layer (Clean waste 8- 10m)
Natural Surface
B
B'

Figure 9-9 – Split Rock Low Grade Stockpile Plan View and Cross-Section (Looking Northwest)



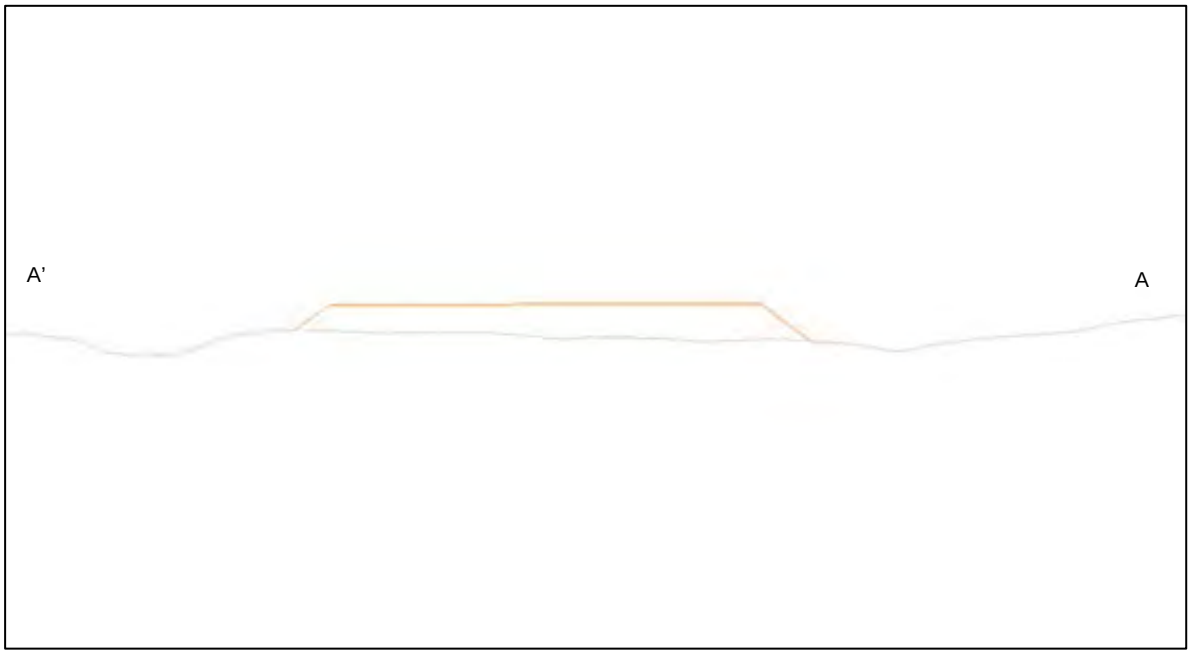
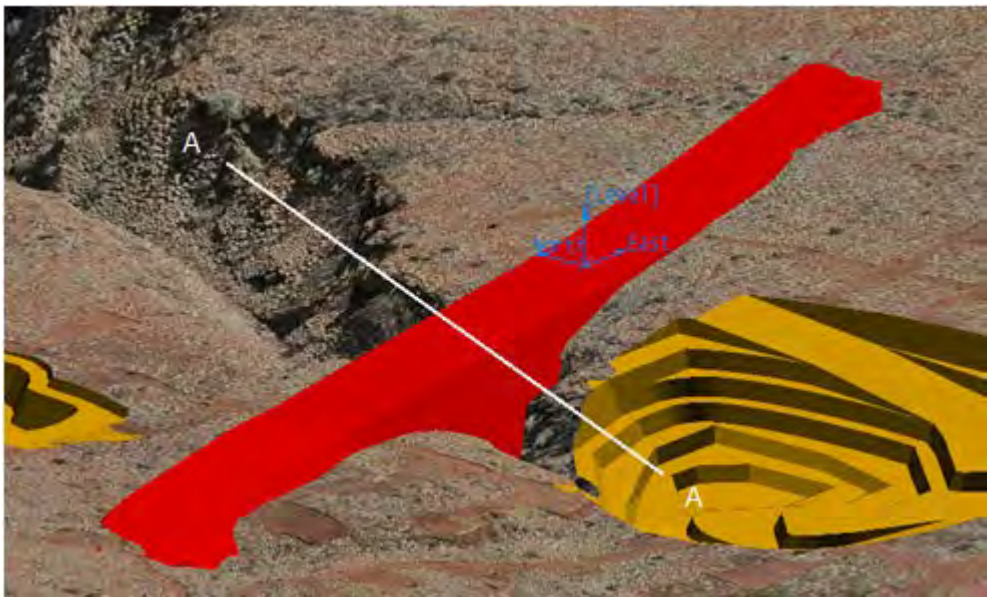
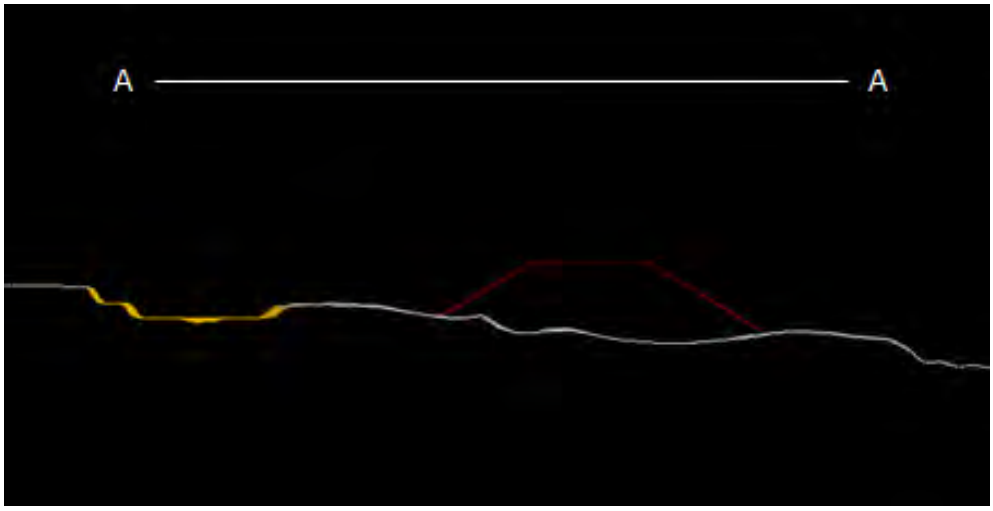


Figure 9-10 - Plan view and cross section of the land bridge (looking northwest)





9.2.3 Closure Plan

The WRD's will be reprofiled to form stable structures. Where identified, waste units with deleterious physical properties will be not placed at or close to final landform surfaces. Any shale material will be buried 10 m below the landform surface. Surface water controls will be constructed and exposures with low stability rock will be armoured. Soil will be applied where available and landforms will be ripped on the contour and seeded to attain a self-sustaining vegetation community. Where soil is not available, Atlas will investigate the plant growth properties of waste rock. At Atlas' other sites, the use of additional seed and fertiliser have been implemented to improve the plant growth where soil as a growth medium is unavailable.

In alignment with Atlas' Waste Rock Management Strategy including the following will be confirmed:

- No placement of erosive material (i.e., clay rich BIF or shale) on sloped surfaces of waste rock dumps.
- NAF shale from Split Rock (i.e., elevated Hg) will be buried 10 m below final surface of profiled landform.
- PAF shale, if confirmed to be present and comprising more than 10% of the total shale waste unit, must be suitably encapsulated within Split Rock, including:
  - Constructed on a basal layer of geochemically benign waste rock at least 5 m thick.
  - Covered with ~0.5 m low permeability layer of traffic compacted waste rock and 10 m of NAF material between the low permeability layer and final waste rock dump surface.
- PAF shale if confirmed to be present and comprising less than 10% of the total shale waste unit can be comingled with other NAF material but must be buried 10m below final surface of profiled landform.

The closure plan for the WRD's includes:

- Harvest topsoil from the reprofile zone where possible.
- Harvest and stockpile competent and durable rock from targeted areas as required.
- Implement measures to manage upstream surface water run-off.
- Trim top surfaces so they are relatively flat and internally draining.
- Re-profile individual batters as per the specifications in the detailed mine closure plan for each landform.
- Reprofile berms (where utilised) so they are backsloping.
- Verify the surface stability classification of rock exposed on the reprofiled batters.
- Apply rock armour to exposures of low stability rock on landform batters.
- Develop features to control surface water on and around landforms.
- Apply soil where available. Batters will be preferentially treated over flat areas
- Rip or scarify all areas on the contour.
- Spread seed mix and fertiliser (if required).

The closure plan for the low grade stockpile assumes that ore will be processed and removed, and the resultant area will be treated as hardstand. In the event that the low grade stockpile remains, materials characterisation work will be undertaken to determine if there are any physical or geochemical properties which require management. A surface water management plan will also be developed if the low grade ore stockpile remains.

It is likely that the land bridge will remain in place on closure, however this will be confirmed during the operating phase of the Project. If the land bridge remains in place, it will be reprofiled and stabilised where possible, and appropriate drainage controls will be implemented. Where practicable, the land bridge will be rehabilitated as per the WRDs.

The following opportunities have been identified to progress closure planning for the landforms:

- Develop a plan to manage surface water on and around landforms.
- Progress rehabilitation planning for the Project.
- Develop an inventory and assess the quality of stockpiled soil – develop a closure soil deployment plan.
- Undertake further testwork during mining to better understand the spatial distribution of the components of the clastic sediment (shale) that require special management within the waste dumps, and refine the PAF encapsulation plan as required.
- Verify the physical (erosional stability) properties of as-mined waste rock during mining and refine waste rock management procedures is required to ensure final WRD slopes are constructed from durable rock.
- Develop detailed closure designs for individual landforms. The detailed landform design for each landform will include:
  - Final landform surfaces and plan layouts including slope configuration details, berm widths and on-dump surface water management infrastructure requirements.
  - Relevant armouring specifications and or prescriptions.
  - Detailed drawings for drainage structures where appropriate.

9.3 Ore processing and handling

9.3.1 Description

The ore processing and handling infrastructure domain consists of a crushing and screening facility, the run of mine (ROM) pad, ore stockpiles and weighbridge. The ROM pad is located G45/339. The ROM pad will be constructed from cut and fill of near surface outcropping material (cut max ~5m) from the local area.

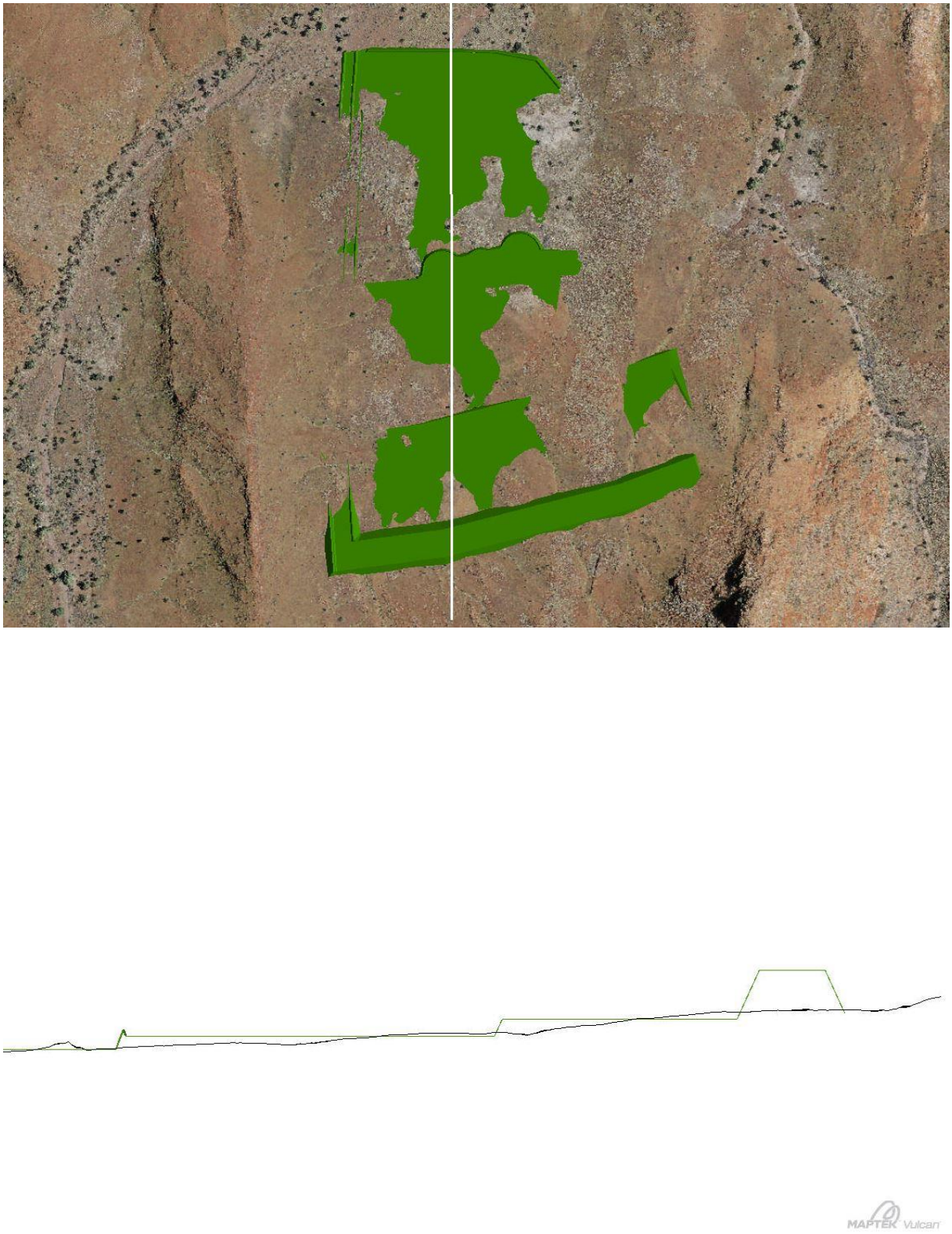
A 5 Mtpa capacity screening and crushing facility will provide primary, secondary and tertiary crushing and screening. The mining contractor will own and manage the crushing and screening plant and associated equipment. Crushed ore will be trucked from the product stockpile to Port Hedland.

Surface water diversion channels and bunds will be installed around the ROM to manage surface water flow and divert runoff to sedimentation ponds. Sedimentation ponds are sized to accommodate a five year ARI rainfall event with spillway provisions for a 100 year ARI runoff overflow.

9.3.2 Closure objectives and criteria

The closure objectives, criteria and standards for the ore processing and handling domain are presented in Section 6. The plan view and the cross section for the ROM pad are included in Figure 9-11

Figure 9-11 - Plan view and cross section of the ROM pad



9.3.3 Closure plan

The closure plan for the ore processing and handling domain will involve removing all infrastructure where required, managing surface water drainage, spreading available soil, contour ripping and applying seed. In preparation for closure works all non-fixed assets and mobile equipment will be removed, as will all consumables, wastes and hazardous materials. Any contaminated sites will be assessed and remediated during operations. Under the terms of their agreement with Atlas, the mining contractor will be responsible for removing the crushing and screening plant and associated infrastructure.

The closure plans for ore processing and handling domains include:

- Tidy disturbance areas and remove non-fixed assets.
- Decommission and remove above ground equipment and infrastructure.
- Break up and remove concrete or bury in situ.
- Remove below ground infrastructure to 0.5 m.
- Harvest topsoil from the re-profiling zone where possible.
- Identify and remediate all impacted soils.
- Re-profile ROM batters.
- Trim the top of the ROM pad.
- Install controls to manage surface water drainage.
- Complete a decompaction rip.
- Establish fauna habitat where required.
- Apply soil where applicable.
- Rip or scarify all areas on the contour.
- Spread seed mix and fertiliser on rehabilitated areas.

The following opportunities have been identified to progress closure planning for the ore processing and handling domain:

- Develop a plan to manage surface water on and around ore processing and handling infrastructure areas after closure.
- Clarify roles and responsibilities for closure obligations with contractors.
- Progress rehabilitation planning for the domain.
- Develop an inventory and assess the quality of stockpiled soil – develop a closure soil deployment plan.

9.4 Non-process infrastructure

9.4.1 Description

The non-process infrastructure domain includes all workshops, offices and buildings, power infrastructure, fuel storage, the explosives magazine, storage yards, landfill facility, water infrastructure and communication infrastructure.

Offices and buildings

The following offices and buildings will be established by Atlas and their contractors:

- A contractor administration area including offices, laboratory, first aid room and ablutions.
- A mine operations centre (MOC), this area will be utilised by Atlas and contractor staff to facilitate the day to day running of the operation. The MOC will include offices, laboratory, ablution facilities, first aid facilities, a crib room, wastewater treatment plant, potable water treatment and storage facilities, and light vehicle parking.
- Additional offices, workshops, power supply, and ablutions located at the ROM pad to support the mining contractor and crushing and screening operations.
- Offices, parking, laydown and an assembly area to support the haulage contractor.
- An accommodation village, ablution, mess and recreational facilities.

Workshop

A workshop will support the Project maintenance activities. A wash-down facility will be situated adjacent to the workshop and built on concrete pads equipped with an oil-water separator and grit interceptor. Hazardous materials including but not limited to solvents, lubricants, brake fluids and coolants, will be stored in above ground, bunded storage areas adjacent to the workshop.

Fuel storage

Diesel will be stored on site in self-bunded tanks. Tanks are likely to be located at the accommodation village, crushing and screening facility, mining operations centre and heavy vehicle refuelling bay. Small diesel generators with double-skinned fuel tanks will be used to power remote equipment (e.g. lighting towers and borefields). Bunded refuelling pads will be situated adjacent to the fuel storage areas.

Power infrastructure

Power will be supplied by diesel generators at the MOC, crusher and accommodation village. Small diesel generator sets with internal fuel tanks will power remote equipment including bores and water pumps.

Explosives magazine

An explosives magazine for storage of detonators and boosters will be constructed on site. The magazine will be fenced and have protective earthen bunds. The magazine will be supplied by the mining contractor. Ammonium nitrate prill will be stored separately in a purpose built facility.

Water infrastructure

Water infrastructure at the Project will include water bores, monitoring bores, pipelines, storage ponds, potable water treatment, and sewage treatment facilities.

Landfill facility

A landfill facility will be established to receive putrescible and inert waste. Recyclable, hazardous and industrial wastes will be transported offsite for disposal.

Communications infrastructure

The Project communications system will comprise of a two-way digital ultra-high frequency radio for intra-mine voice communications, and satellite voice and data communication to provide fax, telephone and internet connectivity.

9.4.2 Closure objectives and criteria

The closure objectives, criteria and standards for the non-processing infrastructure domain are presented in Section 6.

9.4.3 Closure plan

The closure plan for the non-process infrastructure will involve removing all above and below ground assets and infrastructure to below the depth of contour ripping (nominally 0.5 m), managing surface water drainage, contour ripping, spreading available soil and applying seed. Impacted soils will be remediated and the landfill will be covered in accordance with relevant licence conditions and/or standards.

In preparation for closure all assets and mobile equipment will be removed, as will all consumables, wastes and hazardous materials. Under the terms of their agreements with Atlas, contractors will be responsible for deconstructing and removing relevant facilities and infrastructure at closure. All Atlas owned items will be removed unless an agreement is reached with relevant stakeholders to retain assets. Atlas will only leave assets intact permanently if:

- Assets have an agreed owner who is responsible for their maintenance and they have a viable future use.
- The owner accepts responsibility for removing the assets, if required, to a standard nominated by Atlas.
- The State agrees with the proposal.
- Atlas is indemnified against future liability.

The closure plans for non-process infrastructure includes:

- Decommission and remove above ground equipment and infrastructure.
- Break up and remove concrete or bury in situ.
- Decommission bores.
- Remove below ground infrastructure (to below 0.5 mbgl).
- Identify and treat impacted soils.
- Re-profile any voids or built up areas.
- Decommission landfill facility in accordance with relevant licence conditions and/or standards.
- Install surface water drainage features.
- Complete a decompaction rip of compacted areas.
- Apply soil as required.
- Establish fauna habitat.

- Rip or scarify on the contour.
- Spread seed mix and fertiliser on rehabilitated areas.

The following opportunities have been identified to progress closure planning for the non-process infrastructure domain:

- Determine the expectations of primary stakeholders regarding assets after closure.
- Develop a plan to manage surface water on and around non-processing infrastructure areas after closure if required.
- Design a landfill cover in accordance with relevant standards.
- Clarify roles and responsibilities for closure obligations with contractors.
- Progress rehabilitation planning for the domain.

9.5 Roads, hardstand and borrow pits

9.5.1 Description

This domain consists of haul roads, access roads, borrow pits and hardstand areas.

Haul roads

Haul roads will be constructed between the open pits, waste rock dumps and the ROM pad, and also between the ROM pad and the Hillside-Marble Bar road. Haul roads will have a running width of approximately 22 m. Where possible, haul roads will be installed to follow natural terrain. In steeper areas cut and fill earthworks will be required to achieve the desired road grade.

Access roads

Access roads will be unsealed and will be constructed for dry weather operation only. A number of smaller access tracks will be developed to provide general access.

Borrow pits

Atlas will establish a number of borrow pits around the Project area. They will range in size depending on borrow resource requirements and availability. The borrow pits will be designed to be self-draining where practicable. Most borrow pits will be rehabilitated progressively.

Hardstand

Hardstand areas will be cleared of vegetation and stripped of topsoil, and have various uses including vehicle parking and equipment laydown.

9.5.2 Closure objectives and criteria

The closure objectives, criteria and standards for the roads, hardstand and borrow pit domain are presented in Section 6.

9.5.3 Closure plan

The closure plan for roads, hardstand areas and borrow pits aims to manage surface water drainage and revegetate disturbed areas.

Some roads will be required after closure to provide access for post closure monitoring and maintenance. Roads that will remain will be reduced in size to single lane. It is assumed that all roads will be completely removed at the end of the post closure monitoring and maintenance period. It is likely however that stakeholders may want some roads left intact permanently. Atlas will only leave roads intact permanently if:

- The roads have an agreed owner who is responsible for their maintenance and roads have a viable future use.
- The owner accepts responsibility for removing the roads, if required, to a standard nominated by Atlas.
- The State agrees with the proposal.
- Atlas is indemnified against future liability.

In terms of the rehabilitation material stockpiles, it is assumed that these will be removed for rehabilitation efforts around site and only the remaining stockpile footprint (i.e. hardstand area) will require rehabilitation.

The closure plans for the roads, hardstand areas and borrow pits includes:

- Tidy disturbance areas and remove non-fixed assets.
- Remove all signage and road furnishings.
- Remove culverts, floodways and other drainage structures where no longer required.
- Identify and remove all impacted soils.
- Batter down built up sections or high walls.
- Install surface water drainage features.
- Complete a decompaction rip.
- Apply soil as required.
- Establish fauna habitat.
- Rip or scarify on the contour.
- Spread seed mix.

The following opportunities have been identified to progress closure planning for the roads, hardstand and borrow pits domain:

- Develop agreements with primary stakeholders where required, regarding roads after closure.
- Develop a plan to manage surface water on and around roads, hardstand and borrow pits after closure if required.
- Progress rehabilitation planning for the domain.

9.6 Schedule of investigative tasks

A summary of the closure planning opportunities that have been identified in Section 9 are presented in Table 9-3 as tasks that will be undertaken prior to the submission on the detailed MCP (i.e. around 2024). Tasks have been prioritised and scheduled based upon risk.

Table 9-3 - Schedule of investigative tasks to fill closure knowledge gaps

Year	Tasks
2019 - 2021	Progress rehabilitation planning for the Project.
	Develop an inventory and assess the quality of stockpiled soil – develop a closure soil deployment plan.
	Develop a plan for the location and construction of abandonment bunds.
	Determine the spatial distribution of PAF shale in relation to the final pit walls and develop a plan to manage this if required.
	Undertake further testwork during mining to better understand the spatial distribution of the components of the clastic sediment (shale) that require special management within the waste dumps.
2022 - 2023	Verify the physical (erosional stability) properties of as-mined waste rock during mining and refine waste rock management procedures is required to ensure final WRD slopes are constructed from durable rock.
	Determine the expectations of primary stakeholders regarding assets after closure.
	Design a landfill cover in accordance with relevant standards.
	Clarify roles and responsibilities for closure obligations with contractors.
	Progress rehabilitation planning for the domain.
2023 - 2024	Develop a plan to manage surface water on and around domains post closure.
	Develop agreements with primary stakeholders where required, regarding assets post closure.
	Develop detailed closure designs for individual landforms. The detailed landform design for each landform will include: – Final landform surfaces and plan layouts including slope configuration details, berm widths and on-dump surface water management infrastructure requirements. – Relevant armouring specifications and or prescriptions. Detailed drawings for drainage structures where appropriate.

9.7 Progressive Rehabilitation

Atlas is committed to progressively rehabilitating disturbed areas as soon as practicable.

Atlas has committed to only clearing sufficient land to ensure safe operations and rehabilitate cleared areas progressively when applicable. All clearing and rehabilitation will be undertaken in accordance with Atlas' Health Safety and Environmental Management System (HSEMS),

where by the Site Surveyor will pick up ground disturbance and rehabilitation activities and update the GIS database. This will allow accurate annual reporting to the DMIRS as required through Annual Environmental Reporting requirements and the Mine Rehabilitation Fund reporting requirements.

9.8 Premature Closure – Permanent Closure or Suspended Operations Under Care and Maintenance

In the event that Atlas decides to suspend operations or put the Project into care and maintenance Atlas will:

- notify the relevant Environmental Officer at the DMIRS of its intentions;
- notify the district inspector of mines as required under the *Mines Safety Inspection Act 1994;*
- undertake a risk assessment and an audit of the Project;
- commit to making the site safe;
- continue to undertake monitoring;
- prepare a Care and Maintenance Plan and submit to the DMIRS within three months of notification;
- establish an inspection/monitoring schedule; and
- update the Emergency Response Plan.

10. Closure Monitoring and Maintenance

Once the closure program of works has been implemented for each domain as described in Section 9, closure performance will be measured against agreed closure objectives and criteria. Post closure performance will be reported to relevant stakeholders as evidence to support tenement relinquishment. The post closure monitoring and maintenance plan are presented for each closure aspect below.

10.1 Safety

Post closure monitoring to assess the performance of the objective and criteria relating to safety will include:

- The development of a close out report to demonstrate that abandonment bunds have been constructed in accordance with an approved MCP.
- The development of a close out report to demonstrate that redundant roads and tracks have been rehabilitated.
- The development of a close out report to demonstrate that problematic waste is not placed at or close to the surface of constructed landforms
- Visual inspections of abandonment bund integrity and rehabilitated roads during annual closed site inspections.
- An erosion assessment of the perimeter of each landform will be conducted to determine whether erosion levels are stabilising. Erosion assessments are scheduled to be undertaken annually for the first three years after closure works and biennially thereafter.
- The development of a close out report to demonstrate that contaminated soil (if identified during operation has been removed or remediated)

If monitoring indicates that the safety objective is not be met, the following mitigation will be implemented:

- Abandonment bunds and rehabilitated roads will be reworked if necessary.
- Additional roads will be progressively rehabilitated if they are no longer required.
- If surface water structures do not function as they were designed or if erosion levels on landforms do not meet designated standards, then corrective measures and remedial works will be undertaken where required.

10.2 Assets

Monitoring to assess the performance of the objective and criteria relating to assets will involve compiling close out reports to demonstrate that above and below ground infrastructure have been removed or made safe in accordance with the approved detailed MCP, and to demonstrate that transfer agreements and functional reports are in place for any residual assets.

In the event that a transfer agreement cannot be reached for a potential residual asset, the asset will be removed by Atlas and the area will be rehabilitated.

10.3 Vegetation

Post closure monitoring to assess the performance of the objective and criteria relating to vegetation will include:

- The development of a close out report to demonstrate that rehabilitation has been implemented according to the approved detailed MCP.
- Vegetation monitoring in rehabilitated areas will be undertaken for 8 years to assess plant cover, density, species richness and potential weed populations. Natural analogue sites will also be monitored to confirm climatic factors and other influences to vegetation health. Rehabilitated areas will be divided into rehabilitation zones depending on surface treatments, substrate composition, position in the landscape and age of rehabilitation. The number of transects required in each rehabilitation zone will be determined after consultation with the vegetation monitoring specialist. Vegetation parameters will be assessed using standard methods.
- Buffel grass (*Cenchrus cillaris*) will not be classified as a weed or long-lived perennial plant in vegetation monitoring as it occurred in the area prior to mining and it plays an important role in pastoral activities.
- During annual site inspections factors such as poor drainage, damage from fauna and climate will be noted to determine any negative influences on rehabilitation. If substantial populations of weeds are identified, targeted annual weed spraying will be implemented.
- Seed and weed inspections to be undertaken prior to any machinery undertaking rehabilitation works at the Project.
- Monitoring of potential topsoil or subsoil harvesting locations to avoid areas with a considerable weed presence.

If plant cover and diversity standards do not meet threshold values or particular areas of rehabilitation does not meet calculated standards the following mitigation measures will be considered:

- Soil testing.
- Reseeding.
- Remedial works.
- Weed management.

10.4 Surface Water

Post closure monitoring to assess the performance of the objective and criteria relating to surface water will include:

- Annual site inspections will be conducted and will consist of visual inspections of drains and bunds.
- Surface water quality and level monitoring of permanent pool CO-WS-14.
- Photo monitoring of key surface water management structures will be undertaken annually for the first three years after closure works and biennially thereafter (i.e. year 1, 2, 3, 5 and 7). Event based monitoring will be undertaken if the opportunity arises.

- An erosion assessment of the perimeter of each landform will be conducted to determine whether erosion levels are stabilising. Erosion assessments are scheduled to be undertaken annually for the first three years after closure works and biennially thereafter.

If surface water structures do not function as they were designed or if erosion levels on landforms do not meet designated standards, then corrective measures and remedial works will be undertaken where required.

10.5 Fauna

Northern Quoll, Pilbara Leaf-nosed and Ghost Bat assessments will be undertaken in line with the Significant Species Management Plan (SSMP) and will occur at year's one, four and seven post closure (Appendix C).

A close out report will be developed to demonstrate that the buffer zone around recognised habitats have been maintained during both operations and closure works.

10.6 Summary

A summary of the post closure monitoring plan and reporting schedule for the Project is presented in Table 10-1.

Table 10-1 – Summary of post closure monitoring and reporting

Monitoring and reporting	Years after closure works								
	1	2	3	4	5	6	7	8	9
Site inspections	✓	✓	✓	✓	✓	✓	✓	✓	
Vegetation / weeds	✓	✓		✓		✓		✓	
Surface water	✓	✓	✓			✓			
Photo monitoring of surface water structures	✓	✓		✓		✓		✓	
Fauna assessment	✓			✓			✓		
Close out reports	✓								
Annual environmental report	✓	✓	✓	✓	✓	✓	✓	✓	✓
DMIRS inspection and relinquishment report.									✓

11. Financial Provision for Closure

Atlas developed a detailed closure cost estimate (CCE) as part of the Definitive Feasibility Study (2017) for the Project. The CCE was prepared by Mine Earth Pty Ltd with the addition of mining demobilisation costs by Atlas.

The CCE was developed on a first principles basis, and utilised a bill of quantities for each closure activity multiplied by an activity rate. Activity rates were calculated from a range of sources including productivity rates from earthmoving machinery handbooks, contractor rates and experience from recent closure projects in the region. The key assumptions of the estimate include:

- Costs are based on 2015 rates
- Costs have been estimated on planned disturbances.
- The various rates for reprofiling, deconstruction, rehandling, post closure management and post closure monitoring have used the rates developed for Abydos and Wodgina and the actual rates used at Mt Dove.
- There will be no rehabilitation requirements for local public roads.

The CCE was developed by applying a schedule of rates to relevant groups of closure tasks, in accordance with the scope of closure works outlined in Section 9. The CCE accounts for the following costs:

- Deconstruction (Atlas owned assets):
  - Preparing assets for deconstruction.
  - Deconstructing above ground assets.
  - Packing assets for offsite transport.
  - Transporting equipment offsite.
  - Removal of scrap.
- Earthworks:
  - Breaking up concrete slabs and footings.
  - Removing concrete slabs and footings as required.
  - Remediation of impacted soils.
  - Re-profiling landforms.
  - Spreading topsoils and subsoils.
  - Contouring for surface water management.
  - Construction of abandonment bunds and surface water control features.
  - Ripping and scarifying compacted surfaces.
- Revegetation:
  - Seeding.
- Management costs for the closure program of works.
- Contractor mobilisation and demobilisation costs.

- Post closure costs including maintenance, monitoring, reporting and management.
- Contingency.

The CCE will be progressively updated to ensure that cost settings reflect the most recent level of understanding. Atlas maintains thorough documentation of the CCE and has made adequate provision within company accounts for the full cost of mine closure.

12. Management of Information and Data

Atlas will capture all relevant information associated with closure planning, implementation and post closure monitoring and maintenance, within future updates of the MCP. Atlas will communicate progress in relation to closure implementation, post closure monitoring and the achievement of closure objectives and criteria, to the regulators via the AER and updates to the MCP.

All closure related information is stored on a confidential intranet server in accordance with existing Atlas standards and procedures as documented in the Mining Proposal and in Atlas' Environmental Management System. After tenement relinquishment Atlas will transfer all relevant closure information to the DMIRS in electronic format.

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Appendix A DMIRS request for additional information

Government of Western Australia
Department of Mines, Industry Regulation and Safety
Environment

Our ref REG ID 64209
Enquiries Demelza Dravnieks
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Ms Natassja Bell
Senior Approvals Advisor
Atlas Iron Limited
Sent by email
Natassja.Bell@atlasiron.com.au

Dear Ms Bell

REG ID 64209 – REVIEW OF CORUNNA DOWNS MINING PROPOSAL AND MINE CLOSURE PLAN

I write with reference to the meeting held at the Department of Mines, Industry Regulation and Safety (DMIRS) office on 6 October 2017. At this meeting, I indicated that I would compile the various outstanding information requirements for the Corunna Downs Mining Proposal (MP) and Mine Closure Plan (MCP) (REG ID 64209) into one request to aid Atlas Iron Limited (Atlas) in providing revised documents that addresses all outstanding queries. Please find below two tables, Table 1 for information requirements for the MP and Table 2 for information requirements of the MCP.

Please note that DMIRS originally requested further information in relation to the Corunna Downs MP/MCP in June 2017, and there have been a number of further information requests sent in response to the revised MP/MCP that Atlas provided in late August 2017. This letter is intended to outline the full information requirements required to be submitted with a revised MP/MCP (replacing previous requests).

It is recommended that prior to submitting a revised MP and MCP, detail of how the identified issues are going to be addressed is discussed with DMIRS (and other agencies as appropriate) via a return letter or meeting, to ensure that the final MP and MCP meets DMIRS requirements. Failure to adequately consult prior to resubmitting a final MP and MCP risks the documents being refused if inadequate information is supplied.

Table 1

#	Section:	Information Requirements for the Revised Proposal
1	Disturbance Envelope, site plan and spatial files	Revised disturbance envelope, site plan and spatial files required to show that all areas of significance that are not proposed to be disturbed have been removed from the disturbance envelope (bat caves, microhabitats, permanent and semi-permanent pools etc). Given Atlas are doing this revision work, it would also be advisable to excise from the disturbance envelope any heritage sites that are not proposed to be impacted.
2	Environmental Legislative Framework (ELF)	Update the ELF to provide the detail of other approvals that have been obtained or are underway (especially in relation to heritage). The detail in the ELF should link to the outcomes section in relation to outcomes which are being regulated by other agencies.
3	Stakeholder Engagement	The Stakeholder engagement register should be up to date, especially in relation to engagement with government departments such as DMIRS, Department of Water and Environmental Regulation (DWER – both the EPA

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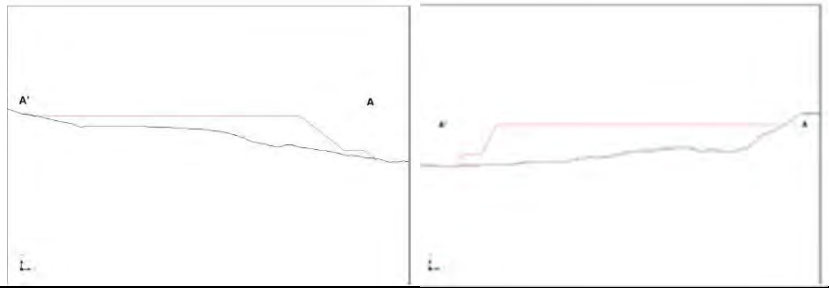
		& Water sections), Department of Biodiversity, Conservation and Attractions (DBCA), and the Department of Planning, Lands and Heritage.
4	Landform disturbance tables	The waste characterisation information needs to be correct for each pit/waste dump landform, especially in relation to the presence of waste which may be dispersive and/or cause metalliferous drainage. It is noted that the waste dump diagrams do not appear to match the textual information on the design of the waste dump (and one or the other should be clarified to ensure they are consistent). The text indicates the maximum height of each waste dump lift is intended to be 20m and the berms are to be a minimum of 30m. The diagrams provided appears to show berms that are narrower than batter height (see snips below from pp 18 and 19 of the MP below). It is noted that batters on an 'as-dumped' landform are likely to be wider than the rehabilitated landform. 
5	Landform disturbance tables	Provide pit depth in relation to water table at each pit location.
6	Landform disturbance tables	ROM – Please provide material characteristics (page 27 of the MP)
7	Baseline environmental data: Overall Hydrology	Baseline data and analysis to address all the hydrology queries outlined during the 6/10/2017 meeting which were also detailed in the email sent by Rob Irwin to Atlas on 20/09/2017 (Records Manager Doc ID: 5281033). This should include information on how the groundwater level and quality has been determined at each pit location, and specific information about the connection between groundwater and permanent pools. The estimated depth to groundwater at each pit location can be provided in the pit landform disturbance tables (as detailed above). Please see the MP requirements in relation to groundwater listed in the MP Guidelines (Snip below):

		ii. Groundwater • an overview of the regional and local hydrogeology and groundwater dynamics (flow directions, relative pressures/levels, interconnection, quality, recharge zones and size) • a description of the environmental values (eg. groundwater dependent ecosystems) and beneficial uses of groundwater in the area • details of any groundwater management areas that the project intersects or may impact • the water quality characteristics of the groundwater resources. For projects with minimal interaction with groundwater, or where risks are considered negligible to low, the characterisation can be limited to broad indicators (eg. salinity and pH). Where risks are present above a low level, the characterisation must be more detailed and focus on the nature of the risks (eg. if acid and/or metalliferous drainage is a risk then baseline levels of relevant anions and cations may be appropriate). The characterisation of pre-existing conditions must be adequate to enable any mining impacts to be detected. Where groundwater will be intercepted by the project the following information must be provided: • a map of the inferred groundwater resources • the water quality and pressure, recharge areas, aquitards, aquifer details, water gradient (include seasonal fluctuations if known), flow directions and rates and discharge areas for each aquifer potentially affected by mining activities • a description of the interconnectivity between the ore body, water supply aquifers, dewatered aquifers and lateral, overlying and underlying aquifers and surface water • interpretation of baseline data and broad implications for risk assessment and treatments • relevant technical reports attached as appendices. For further guidance refer to the 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)', the Department of Water's 'Quality Protection Guidelines No. 1-11 for Mining and Mineral Processing' and the Department of Water's 'Western Australian water in mining guideline (May 2013).
8	Baseline environmental data: Surface Water	Detail and analysis of surface water flows around all post-mining landforms is required to understand the risk of these landforms post-closure. This is especially relevant for the Split Rock Waste Dump, given this waste dump appears to form a condensed valley area with the adjacent natural slope and could contain waste material of a problematic nature. If the toe area of this dump (or any other post-mining landform) pools water or is likely to experience surface water flows then there will need to be an understanding of toe armouring requirements, and if water pooling next to this waste dump will pose any stability and leaching issues. (see snip below from pp 20 of the MP below)

		Figure 3.7 – Split Rock Waste Dump Cross Section 
9	Baseline environmental data: Waste Characterisation	Based on the information within Appendix C, and additional information provided by Atlas on 17/10/2017 and 23/10/2017 I have a number of serious concerns about the adequacy of waste rock characterisation for this proposal. The MP guidelines require adequate characterisation of subsurface materials to ensure the risk posed can be determined, and there is no clear justification in the MP for the level of sampling that has been done. Areas of particular concern are as follows: • The sampling does not appear to be spatially representative both horizontally and vertically throughout the different deposits, and the number of samples does not appear sufficient to represent the variability within each geological unit and material type. • Based on the data provided on 23/10/2017, Split Rock appears to be the most sampled pit, but the additional information provided on 17/10/2017 indicates the samples from Spilt Rock are unlikely to be representative of the actual waste material to be removed from the pit (see snip below - page 2 of letter from Atlas dated 17/10/2017). • No samples appeared to be obtained from Razorback pit. It is not clear how the risk assessment for this pit has been conducted without any sample data, especially given the sample variability shown at the Split Pock pit, which is the closest pit in proximity to Razorback. • The Runway and Shark Gully pits appear to only be sampled from 2 drill holes each (with none in the outlier Runway pit). Snip of Atlas Letter dated 17/10/2017: All but one sample from the five drill holes selected for the characterisation programme were located outside the designed pit shell. This situation is at times unavoidable because of the limited availability of drill samples from the waste rock zone within the pit shell. The further a sample is located from the pit shell, the less representative it will be of waste rock that will be generated during mining. Due to the distance of samples from their represented waste rock (and the internal variability within major domains) the questions raised above regarding sample representativeness resulted in the conclusion that the significance of individual sample results should not be applied as broadly across multiple domains as was done within the MWH report. Unless Atlas has additional sampling data that has not yet been presented it does not appear that there has been adequate waste rock characterisation to determine the risk posed by the material to be mined. Given that the pit shell would have most certainly be drilled during the exploration phase it appears unusual that there is a *"limited availability of drill samples from the waste rock zone within the pit shell*." (page 2 of Atlas letter dated 17/10/2017). If Atlas does have additional information, or feels that the current information has not been adequately presented/reviewed, it is recommended that this section be revised to provide a clear demonstration of how the waste sampling is truly representative, in relation to the different lithologys within each pit. Please refer to the MP guidelines for the information required (snip from MP guidelines below), and if further information is required there is the draft guidance on the Materials Characterisation Baseline Data Requirements for

		Mining Proposals available here: http://www.dmp.wa.gov.au/Documents/Environment/ENV-DraftGuideance_MaterialsCharacterisationDataProposal.pdf Snip of MP Guidelines – page 25. **(b) Subsurface materials and processing waste** The Mining Proposal shall contain: • a description of the geology and mineralisation of the project area • the indicative volume of ore and waste materials that will be mined • the predicted volume of tailings or any other processing waste, where applicable • the indicative tonnages and proportion of each lithology • adequate characterisation of the subsurface materials and processing waste to ensure that the risk(s) posed by adverse components can be determined • diagram(s) and map(s) of the sampling locations to indicate, the location of mine activities and the 3D spatial distribution of samples and proximity to the water table (where applicable) • a description of the methodology used to characterise the materials • interpretation of baseline data and broad implications for risk assessment, treatments and environmental outcomes • relevant technical reports attached as appendices. It has also been indicated in prior correspondence that Atlas obtained a third party review of the MWH waste characterisation report provided with the original MP, which throws doubt on the conclusions made in the original report. If Atlas wish to dispute the conclusions presented in the original report, DMIRS will need to be provided with the third party review, and ideally MWH's response to that review, in order to understand the context of the discrepancies between the two consultants.
10	Baseline environmental data: Waste Characterisation Analysis	MWH indicates that shale material should not be placed on waste dump surfaces due to both the physical and chemical properties of the waste (Appendix C - Section 7.4 : *Based on the physical and chemical characteristics of the materials, it is recommended that the clastic sediment (shale) waste is not deposited at, or close to the surface of constructed landforms.*) It is therefore not clear why Atlas will be placing this material at surface on flat sections of the waste dump, as this does not appear conducive to the best possible rehabilitation outcome. Given the shale unit appears to make up 33% of the waste from Split Rock, the overall design of this dump in relation to whether there is enough competent, geochemically benign material to encapsulate the shale unit needs to be further detailed (this can be provided in the MCP). The MWH report also indicates that the clay rich BIF unites should not be placed near surface, but identification and management of the clay BIF units does not appear to be addressed in relation to the waste dump design (clarification in relation to this could provided in the risk assessment and MCP)
11	Baseline environmental data: Flora	Based on the hydrological studies being conducted the information in relation to potential impacts to Groundwater Dependant Ecosystems (GDEs) will need to be updated.
12	Baseline environmental data:	The MP guidelines require "interpretation of baseline data and broad implications for risk assessment, treatments and environmental outcomes". Therefore, please update the baseline fauna section in relation to

	Fauna	implications for the risk assessment of the additional hydrological information (and other baseline data as relevant). The additional information should be inform on the connection between the humidity and conditions with the bat caves and sustainability of conservation significant permanent pools after the proposed mining operation.
13	Risk Assessment	Comments provided by Rob Irwin dated 19/09/2017 (Doc ID 5279198) should be addressed in the revised section. The risk assessment should also be revised to take into account the revised baseline data information (especially the revised hydrological process data).
14	Outcomes	The outcomes section needs to be revised to address comments provided by Rob Irwin dated 19/09/2017 (Doc ID 5279198) and further comments provided below. Please note the draft guidance around environmental outcomes that was also provided on 19/09/2017. When revising these outcomes, please note that they will form defacto 'tenement conditions' and therefore need to be worded accordingly. It is expected that reporting against these outcomes and performance criteria will be included in each years Annual Environmental Report (AER). The outcomes and performance criteria need to be SMART (specific, measureable, achievable, realistic, time bound) and the performance criteria defined at the correct level (i.e. a 50L hydrocarbon spill being included as a performance criteria is not a pragmatic approach. It would be better to define this at a higher level, such as a spill that cannot be immediately contained and remediated within a set period of time, such as 24 hrs). The current outcomes use several undefined words ('minimise', 'manage', 'maximise', 'significant') and ideally specific wording would be used. Notwithstanding, if this wording is used there must be a detailed definition of how this outcome will be measured with the performance criteria. It is noted that the outcomes that are regulated by another agencies have been provided in a separate table (8.2), which is good practice to prevent duplication in compliance requirements. I would be helpful to provide details of the regulatory mechanisms for each of the outcomes and performance criteria within Table 2 (i.e. clearly specify the detail of the other approval requirements in the outcome – ideally include a link to the other approval). It is considered likely that there will be outcomes defined under the Native Vegetation Clearing Permit (NVCP) that should be included in Table 8.2 The following aspects should be covered in outcomes: • Impacts to riparian vegetation adjacent to Coogan River or other potential GDEs, if these are outside the areas proposed to be cleared under the NVCP. If it is considered that there will be no impact on these GDEs this should be stated as an outcome/performance criteria. • Specific limits around the impacts of mining on the seepage into, and humidity within, cave CO-CA-03 (it was not clear if this is specifically covered under the EPBC Act approval?). • Outcomes and Performance criteria related to maintenance of the quality and quantity of water resources within all permanent or semi-permanent pools within the development envelope. • The outcomes table should specify that closure outcomes are defined as per Tables 6-1 to 6-5 in the MCP (if that is what is intended), or otherwise include the specific closure outcomes and performance criteria within the MP. The weed outcome is poorly defined and the level of 15% weed cover is not justified based on the baseline data. The MP on page 48 indicates "*The majority of the vegetation in the Study Area was ranked as being in Excellent condition, with little to no human disturbance and an absence or*

		low levels of introduced flora taxa". The MP also indicates on page 83 that the introduction of weeds even at low densities can have a significant effect on flora and fauna, so it is incumbent that Atlas maintain the current low weed levels within the mine areas (snip from MP page 83 below). Invasion by non-native species typically can result in declines in native plant species richness, but the response of fauna may be more complicated, with individual invasions potentially resulting in increase, decrease or no-change scenarios for different 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 & Schlesinger, 2015). 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.

Table 2

#	MCP Section	Information Requirements for the Revised MCP
-	Overall	Overall the additional MCP information requested by Rob Irwin on 2/06/2017 (000458.Rob.Irwin) does not appear to have been adequately addressed in the revised MCP.
1	Commitments	Update this section based on changes to MP commitments, EPBC commitments, DoW licencing requirements, NVCP commitments, etc
2	Stakeholder Engagement	Update the stakeholder engagement table to detail closure aspects discussed with various government agencies, especially around completion criteria.
3	Objectives	There needs to be inclusion of water quality, and specific fauna habitat objectives (i.e., bats are able to return and use caves as per pre mining, humidity and water supply to caves and pools is retained)
4	Completion criteria: Safety	• 'problematic waste' needs to be more clearly defined, • The distance that 'problematic waste' will be located to the surface should be defined clearly, or at a minimum, the criteria that will be used to determine this distance should be provided. • A criteria, measurement and proposed monitoring strategy in relation to stability of landforms is required (stability is referenced in the outcome but not the criteria).
5	Completion criteria: Assets	• All infrastructure within the top 30-40cm underground should be removed to prevent this material being brought to the surface with deep ripping.
6	Completion criteria: Vegetation	I have concerns with the "best achievable" rehabilitation criteria being used for this project as there does not appear to be enough baseline data and planning work undertaken to demonstrate that Atlas have a good understanding of how to achieve the "best achievable" rehabilitation at this site. The short mine life means that there will be limited opportunity for Atlas to obtain this information between the commencement of mining and the placement of waste into the final landform footprint. This mine is in a different region to Atlas's other mines and the MCP does not appear to provide any analysis of the differences this may present to the landform design (the MCP proposes a generic waste dump design for all landforms). The rehabilitation planning in the closure implementation section is very generic/high level and there appears to be limited information to inform a good understanding of all waste streams (limited specific volumes and no information about waste movement schedules to show that competent material will be located on the outer waste dump slopes). There is also no detail around the rehabilitation planning and onsite control measures (such as how there will be selective placement of waste and supervision of staff during rehabilitation activities) that would be needed to ensure "best achievable rehabilitation". Given the very low level of weeds in most areas of the project (with the exception of riparian areas) – the criteria that weed cover will be less than

		long lived perennial plant cover is not acceptable. The threshold value of 15% weeds within the mining areas is also not justified with consideration of the baseline data for this project. For all areas except near the river, which had a higher weed load, the expectation should be to have no new weed species and to keep the weed level to less or equal to baseline data. Given the difference in baseline data, Atlas could propose a different weed criteria for differing domains. Note: the closure weed criteria should be consistent with the operational weed criteria detailed in the MP. The threshold value for vegetation cover and species richness is not acceptable (too low), and is also not clearly justified. Why has 75% of the minimum plant cover/species richness been chosen as a threshold? Why is the minimum value being used rather than a percentage of the average cover? Please also include a more detailed reference to the data used in these calculations.
7	Completion criteria: Water	The criteria indicates that surface water structures will be installed in accordance with the detail in the MCP, but the MCP does not appear to include detail of surface water structures. Criteria are required around surface water quality and maintenance of pools post-closure. Depending on the additional baseline data being obtained, there may also need to be criteria around groundwater quality.
8	Completion criteria: Fauna	There should be a criterion around the provision/maintenance of significant fauna habitat post-closure.
9	Baseline Data	The information in the MCP should be updated in line with the information requested in Table 1 above (especially hydrology and waste characterisation information). The baseline data should be analysed and any implications for closure clearly detailed
10	Closure implementation	Overall Comment: There is a lot of duplication of objectives and criteria within the closure implementation section of the MCP. It is suggested that a central table which indicates which criteria are relevant to which domains would be an easier way to display this information, and is less likely to result in errors/discrepancies when the MCP is revised in the future. Another way to present this information would be to list criteria by exception, as the criteria that do not apply are more likely to be the ones that require specific justification and stakeholder agreement. The terminology in the implementation section includes some vague wording such as ‘where applicable’ or ‘where appropriate’ without a clear definition of who will determine what is applicable or appropriate. Vague wording creates uncertainty in relation to what actions are actually going to be conducted at closure.
11	Closure implementation: Waste dumps	The information in the MCP is high level, conceptual and generic (not specific to the Corruna Downs project). The information is not what DMIRS would expect to justify rehabilitation is going to be the “best achievable” at this project. Given the mine life is only 6 years, a number of the ‘future tasks’ in relation to waste dumps listed on page 73 should have already been conducted, including; • Development of a plan to manage surface water around landforms • Rehabilitation planning • Waste characterisation and erosion modelling test work • Development of detailed closure designs for individual landforms. The MCP does not provide clear detail of the volumes, mining schedule and proposed placement (or even criteria around placement) for problematic

		waste materials. The MCP indicates (page 72) that 'soil will be applied where available', but there is no indication of how vegetation growth will be supported in areas where topsoil is not available. The risk assessment indicates that Atlas will "identify alternative growth medium" to address the risk of a lack of topsoil but there is no detail around this identification work in the rest of the MCP. Detailed waste dump rehabilitation design information should be provided. The waste dump design should be based upon the baseline data and specific ratio of waste to form each dump (not a generic/ same design for all dumps). This is especially important to justify that the rehabilitation to be conducted will be the "best achievable" for each waste dump. The MCP indicates (page 72) that what dumps will be re-profiled 'where appropriate'. This terminology only appears necessary if there are some dumps that will not be re-profiled, and in these circumstances the dumps that are not intended to be profiled should be clearly detailed with justification. It is noted that there is a minor error with waste dump design details on page 69 which could be corrected when the rest of the document is being revised (issue with symbols for slope angles).

Yours sincerely

Demelza Dravnieks

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Demelza Dravnieks | Senior Environmental Officer
Operations
01 November 2017

Appendix B Closure criteria technical note

TECHNICAL NOTE

Development of closure criteria and standards

This technical note provides additional detail for and descriptions of Atlas completion criteria and associated standards and threshold values for the following aspects:

1. Safety and assets
2. Vegetation
3. Surface water
4. Fauna

The methods undertaken to calculate standards and threshold values have also been described where appropriate.

The standards and thresholds required to measure closure performance for objectives and criteria, relate to each other as follows:

- Standards may be either an agreed value that is measurable and is regarded as the minimum that must be achieved, or a certification that closure works comply with an agreed design.
- Threshold values are included for selected standards and represent the level at which further investigation and mitigation works may be required.

1.0 SAFETY AND ASSETS COMPLETION CRITERIA

Completion criteria for the Safety aspect centre around limiting the potential for inadvertent access to open pits by creating abandonment bunds and limiting access to all other domains by rehabilitating roads that are no longer required.

The safety criteria for landforms relates to problematic waste not being placed close to the surface of the constructed landforms, and erosion levels on landforms stabilising over time.

A safety criterion also has been developed in the event that a contaminated site has been identified and states that the contaminated soil will be removed or remediated.

Completion criteria for the Assets aspect focus on the removal of above and below ground infrastructure and the transfer of residual assets.

1.1 Safety and assets standards

Standards for the aspects Safety and Assets include the production of close out reports, transfer agreements and functional reports.

Close out reports will describe the closure works that were completed at a domain, to verify that works were undertaken in accordance with the design presented within the approved MCP. Justification will be provided where any works deviated from the approved design.

Close out reports are required to demonstrate:

- Abandonment bunds have been constructed in accordance with an approved abandonment bund plan.

- Roads that are no longer required have been rehabilitated.
- All above ground infrastructure has been removed unless otherwise agreed.
- Problematic waste has not been placed at or close to the surface of the constructed landform
- Contaminated soil will be removed and remediated if a contaminated site is identified.

For assets which remain after closure, a transfer agreement between Atlas and the new owner will be developed. Assets will be functional at handover and maintenance and operating procedures will be provided to the new owner – these will be detailed in a functional report developed by Atlas.

Erosion monitoring reports will be developed to demonstrate that erosion levels on landforms are stabilising over time.

2.0 VEGETATION COMPLETION CRITERIA

Completion criteria for the Vegetation aspect focus on: revegetation being completed in accordance with the approved detailed MCP; representative taxa being used in seed mixes; plant cover and species richness reaching agreed standards; weed cover not inhibiting native vegetation; and no new declared weeds being recorded at the Project.

Atlas has adopted the approach of using the best achievable rehabilitation as the benchmark against which to compare rehabilitation performance for perennial plant cover and species richness. This approach has been adopted at a number of Atlas' Pilbara projects after extensive stakeholder consultation and peer review from industry leading revegetation scientists and practitioners.

Natural / undisturbed analogue sites will not be used as the benchmark against which to compare rehabilitation performance for perennial plant cover and species richness, to avoid developing unrealistic and unachievable completion criteria and standards. Natural analogue sites will be monitored after closure however, to confirm climatic factors and other influences to vegetation health. Data collected from natural analogue sites has also been used to develop threshold values for vegetation performance. If vegetation performance falls below the agreed threshold value, appropriate mitigation measures will be undertaken.

The concept of using best achievable rehabilitation as the benchmark has been proposed for a number of reasons:

- The substrates of rehabilitation sites are markedly different in comparison to natural sites.
- Rehabilitated sites are relatively new in comparison to natural sites.
- The quality of suitable natural analogue sites within pastoral stations is questionable in some ares due to grazing pressures.
- To avoid applying arbitrary standards where no site-specific data is available.

The concept has the advantages of:

- Using rehabilitation as a benchmark. Monitoring will demonstrate what is achievable with the site specific materials (waste rock and soil) that are available and the effort that has been made in developing and implementing the detailed mine closure plan.

- Revegetation performance is linked to substrate materials, age of rehabilitation, rehabilitation zones (e.g. flats and slopes) and aspect, and recognises that these factors can influence rehabilitation outcomes considerably.
- Standards are calculated using site specific rehabilitation data and these evolve over time according to rehabilitation practices and environmental considerations.

2.1 Vegetation standards

For Vegetation completion criteria, close out reports will be produced, and plant cover and species richness standards and thresholds will be calculated to demonstrate that the completion criteria have been met. Vegetation standards represent an agreed value that is the minimum that must be achieved to demonstrate adequate closure performance.

For selected criteria close out reports will be developed to demonstrate:

- Revegetation has been implemented in accordance with the approved detailed MCP.
- Representative taxa from nearby vegetation communities have been included in the rehabilitation seed mix for specific areas.
- Standards for plant cover and species richness are to be calculated using data collected from rehabilitation zones. Rehabilitation zones will be determined based upon substrate materials, age of rehabilitation, topography (e.g. flats and slopes) and aspect.

Figure 1 provides an example of plant cover data for a particular rehabilitation zone. Initially, outliers are removed from the data set (i.e. those sites which are ±3 standard deviations from the mean) and the sites are grouped according to a rehabilitation zone (i.e. waste landform slope, waste landform top surface or flat areas). To calculate the standard for the example in Figure 1, values from the top three sites (Site 6, 7 and 8) are averaged (65.3%). The standard for this data set (or 70% of that total) would be 45.7%. In this instance, all rehabilitation sites would meet the standard (45.7%) except for Site 3.

Standards are updated each time the rehabilitation data is collected and as the vegetation ages. If a site does not meet the standard over a three year period, a high level assessment investigating trends over time and potential issues restricting revegetation success will be conducted.

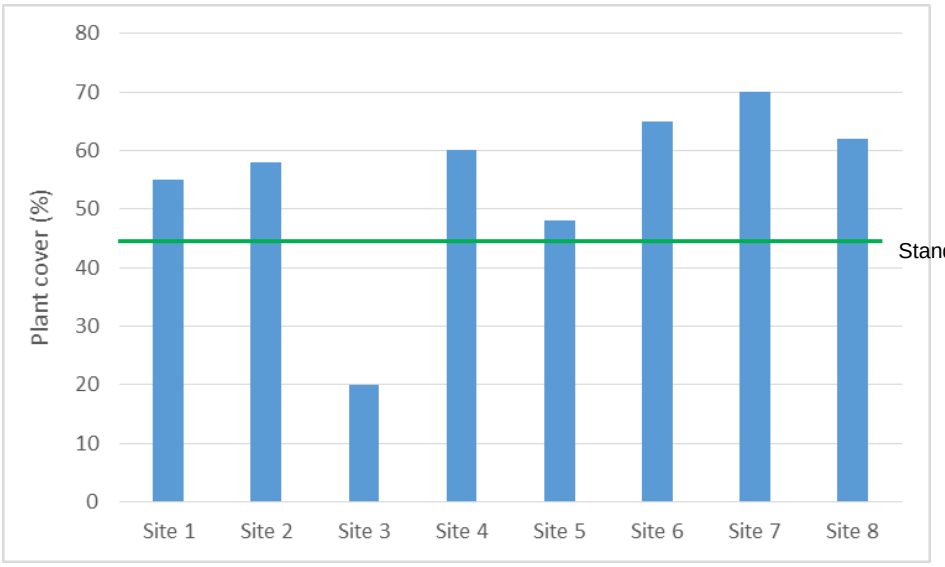

Figure 1 Example of standard for plant cover

2.1.1 Vegetation threshold values

Due to the short term nature of the Project, Atlas has calculated threshold values for vegetation parameters based on a combination of baseline data collected at the Project, and values set at Atlas' other Projects. Threshold values represent minimum values that will be acceptable for plant cover, species richness and weed cover. If performance falls below threshold values then detailed investigations will be undertaken and mitigation measures will be considered. The method for developing thresholds for plant cover, species and richness are described below.

2.1.1.2 Plant cover threshold

Due to the absence of rehabilitated areas at the Project, baseline perennial plant data (Woodman, 2016) from a similar landscape position (i.e. sloped area or flat area) has been used to calculate threshold values for plant cover. The threshold value was determined by averaging the minimum value for plant cover within each vegetation community (Table 1). This was then averaged to obtain a threshold value for plant cover on sloped areas (15%) and flat areas (18%).

Inability to achieve threshold values will trigger the need to consider investigation and mitigation once the rehabilitation is approximately 5 years old.

Table 1 Perennial plant cover and threshold values for vegetation (Woodman, 2016)

Vegetation community	Average plant cover (%)	Minimum plant cover (%)	Threshold (%)
Slopes			
VT3	50	18	15%
VT5	60	34	
VT9	57	18	

Vegetation community	Average plant cover (%)	Minimum plant cover (%)	Threshold (%)
VT10	55	12	
VT11	59	13	
VT12	55	1.5	
VT13	56	5	
Flats			
VT1	61	42	18%
VT2	46	11	
VT4	50	5	
VT6	54	16	
VT7	45	23	
VT8	31	8	

Figure 2 provides an example of plant cover values in comparison to the standard and the threshold for this particular dataset. In this example Site 3 does not meet the minimum threshold value. If this continued to occur after year five of revegetation, an investigation would be undertaken, with mitigation actions likely to occur.

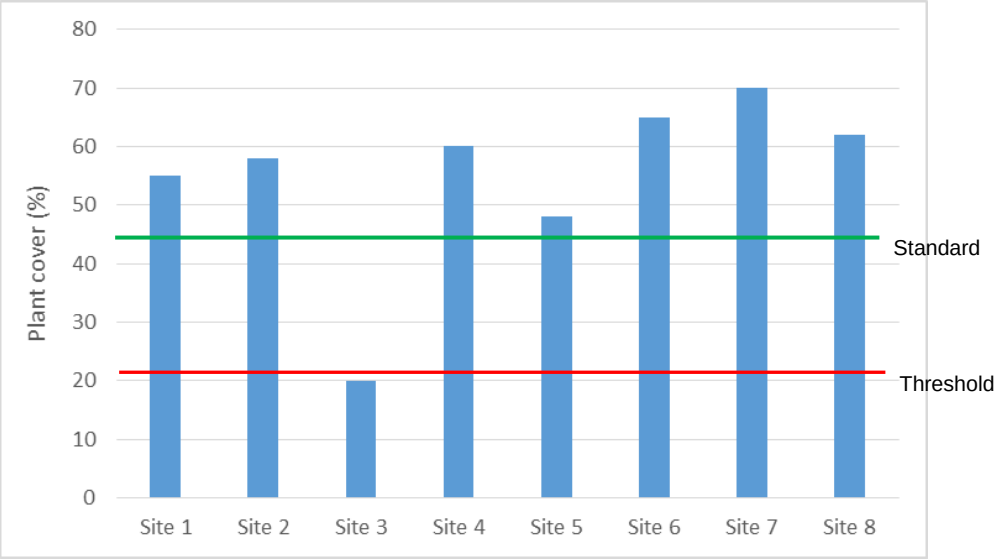

Figure 2 Example of standard and threshold for plant cover

2.1.1.3 Species richness thresholds

Due to the absence of rehabilitated areas at the Project, baseline perennial plant data (Woodman, 2016) from a similar landscape position (i.e. sloped area or flat area) has been used to calculate threshold values for species richness. The threshold value was calculated by averaging the minimum species richness of each vegetation type. The threshold value for

species richness on sloped areas and flat areas was calculated as seven species within a 50x50 m quadrat.

Inability to achieve threshold values will trigger the need to consider investigation and mitigation once the rehabilitation is approximately 5 years old.

Table 2 Plant species richness (50x50 m) and threshold values for vegetation (Woodman, 2016)

Vegetation community	Average species richness (%)	Minimum species richness(%)	Threshold (%)
Slopes			
VT3	27	19	7
VT5	8	3	
VT9	15	7	
VT10	19	7	
VT11	13	5	
VT12	15	3	
VT13	11	5	
Flats			
VT1	15	7	7
VT2	18	10	
VT4	19	8	
VT6	13	6	
VT7	10	3	
VT8	10	8	

2.2 Weed completion criteria and standards

Due to historical and existing pastoral land use, weed species were found to be widespread throughout Atlas' tenure. Eighteen species of introduced flora were recorded, none of which were Declared Pests under the *Biosecurity and Agriculture Management Act 2007*, however a number of taxa had a High environmental weeds rating under the Environmental Weed Strategy for Western Australia (CALM, 1999) (Woodman, 2016):

- *Aerva javanica*
- *Calotropis procera*
- *Cenchrus ciliaris*
- *Cenchrus setiger*

- *Passiflora foetida var. hispida*
- *Vachellia farnesiana*

Raw data collected during the baseline assessment (Woodman, 2016) was reviewed to determine the occurrence of weeds throughout the Project Area. Weed taxa were reported in 113 of the 357 plots that were assessed. The plant cover of weeds in these plots ranged from 0% to 90% (in plot CE-178). Average weed cover (across the 357 plots) was approximately 4.4%.

Species such as *Cenchrus ciliaris* and *Aerva javanica* were widespread, being recorded in 11 and six of 15 vegetation types respectively across the Project Area. Weed cover was most abundant in the drainage lines (VT14 and VT15), averaging 17% across these vegetation types. Sloped vegetation types (VT10 – VT13, VT3, VT5 and VT9) had an average weed cover of 0.1% while flat vegetation types (VT1, VT2, VT4, VT6 – VT8) had an average weed cover of 10%.

The completion criteria for weeds states that "weed cover will not inhibit native vegetation," "no new declared weeds will be recorded at the Project" and "Atlas will implement and effective weed management strategy during the operating phase of the Project.".

To achieve the criterion that "no new declared weeds" is met, a close out report will be developed to demonstrate that no additional declared weeds have been reported at the Project. Given the increased traffic into the area associated with the Project, and ongoing pastoral and prospecting activities outside of Atlas' control, it is unreasonable to expect that no new weed species will be introduced to the Project. Atlas will however ensure that if declared weeds are identified at the Project that these will be identified and managed accordingly. To achieve the criterion that "during operations weeds will be managed according to Atlas' weed management strategy" is met, a close out report will be developed to demonstrate this.

With regards to the criterion "weed cover will not inhibit native vegetation" this will be demonstrated by a close out report which states that all other vegetation criteria have been met. Standards have been developed for the Project, which are the levels of weed cover that will be acceptable (10% for sloped areas and 15% for flat areas). If weed cover exceeds these levels, weed management strategies will be developed.

As per guidance statement No. 6 the EPA (2006) state that "monitoring standards would normally be based on the relative abundance of weeds in reference locations. However, lower targets should be set if weeds are abundant in these areas." The weed standards for the Project were developed in consideration of baseline weed levels and Atlas' nearby mine sites that have been rehabilitated.

An assessment of Atlas' other rehabilitated mines in the Pilbara (Pardoo and Mt Dove) shows that weed cover on sloped rehabilitation transects ranges from 0 to 11.7% (average of 0.8%) at Pardoo and 0 to 6.2% (average 1.68%) at Mt Dove (MWH, 2016a and 2016b). Baseline weed cover at Pardoo ranged from 0.01% to 70.8%, with weed taxa being reported in 60 of 73 plots. Weed taxa were much less widespread at Mt Dove with ranging from 0.6% to 20% cover, with weed taxa being reported in 5 of 49 plots.

Using this data for comparison and considering ongoing pastoral land use, prospecting activities outside of Atlas' control and current vegetation condition a weed standard of 10% is considered appropriate for landforms (i.e. new landforms less at risk of weed spread and

introduction) and 15% for all other rehabilitated areas (i.e. those areas that are highly trafficked, excluding pits). Active weed management will be considered where weed cover exceeds these standards.

It should be noted that given the widespread nature of *Cenchrus ciliaris* throughout the Project area this species will not be included in the assessment of weeds. It should be noted that it will not be considered a perennial species and included in the assessment of native vegetation.

3.0 SURFACE WATER COMPLETION CRITERIA

Completion criteria for the Surface water aspect focus on surface water controls being constructed and operating as per their final approved design. Additionally, there is a surface water criterion relating to stabilisation of erosion levels on landforms.

3.1 Surface Water standards

Standards for the aspect of Surface water include the production of close out reports, inspection reports and erosion monitoring reports.

Close out reports will be developed to demonstrate:

- Surface water controls are constructed as per the approved MCP.
- Landforms are constructed in accordance with an approved design.
- Without anthropogenic supplementation of its water level, waterhole CO-WS-14 has water in it during and continuously for three consecutive years following the cessation of mining of Razor Back Pit.
- Water quality of waterhole CO-WS-14 remains suitable for Pilbara Leaf-nosed Bat during and continuously for three consecutive years following the cessation of mining of Razor Back Pit.

Annual inspection reports will be used to check that surface water controls are operating as designed.

A standard for the criterion “erosion levels on the landforms stabilise” was developed using erosion data collected from rehabilitation at Atlas’ nearby Pardoo and Mt Dove Projects. While no active erosion was recorded at Mt Dove, at Pardoo, the proportion of the bank eroded ranged from 0.7% to 2.6%. Given the low erosion rates on rehabilitation, a rate of change between assessments of 5% over three consecutive assessment periods was considered a suitable standard. This standard may be revised once erosion data is collected on the rehabilitated landforms at the Project.

In the example presented in Figure 3, the standard is met in 2021, where the rate of change has been less than 5% for three consecutive years.

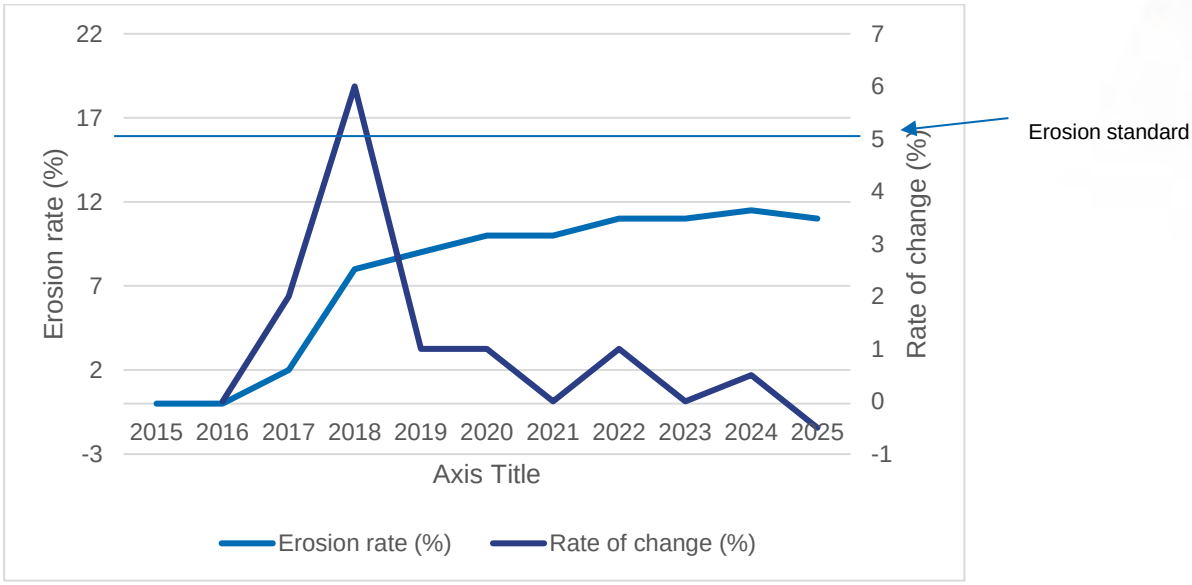

Figure 3 Erosion data example

3.2 Surface water threshold

For the criterion “erosion levels on the landforms stabilise” a threshold value of 15% of bank erosion has been applied. This represents the proportion of bank erosion that will trigger investigation and the development of mitigation strategies. Figure 4 represents the change in erosion levels over time. In this instance the threshold value is not exceeded in any years.

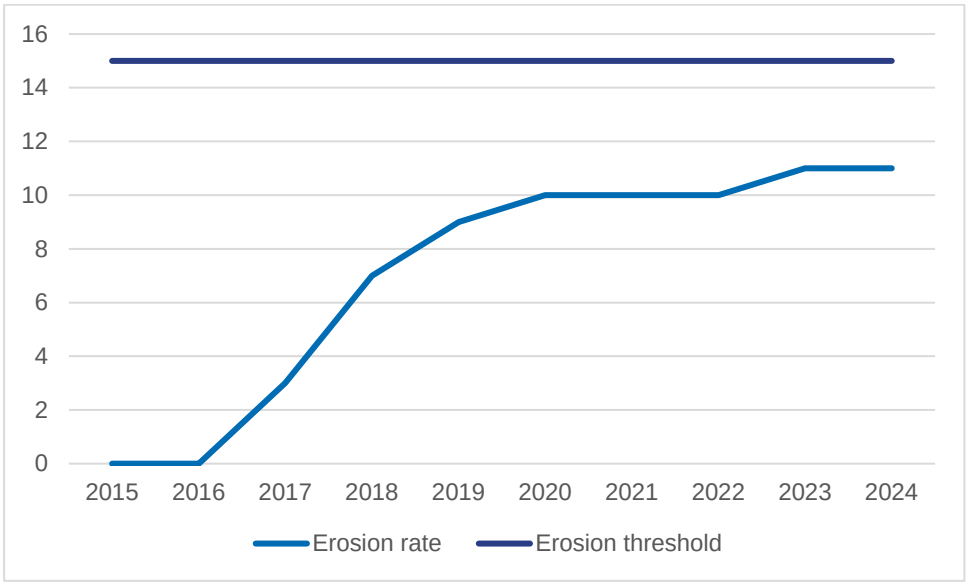

Figure 4 Erosion data example

5.0 FAUNA COMPLETION CRITERIA AND STANDARDS

The criteria for fauna prescribe the creation of habitat zones on all domains (except the open pits) and the maintenance of buffer zones around significant bat roosts. Fauna monitoring is detailed in Atlas’ SSMP (Appendix C).

Close out reports will be developed to demonstrate:

- That habitats zones have been constructed on landforms.
- That buffer zones have been maintained around significant bat roosts including the previously identified Pilbara Leaf-nosed bat diurnal root and the non-permanent breeding roost.
- Without anthropogenic supplementation of its water level, waterhole CO-WS-14 has water in it during and continuously for three consecutive years following the cessation of mining of Razor Back Pit.
- Water quality of waterhole CO-WS-14 remains suitable for Pilbara Leaf-nosed Bat during and continuously for three consecutive years following the cessation of mining of Razor Back Pit.
- Cave CO-CA-03 maintains:
  - humidity between 85-100 per cent relative humidity
  - temperature between 28 and 32 degrees Celsius

during and continuously for five years following cessation of the mining of Razor Back Pit.

References

EPA (2006). Guidance for the assessment of environmental factors – rehabilitation of terrestrial ecosystems.

MWH (2016a). Pardoo 2016 rehabilitation monitoring assessment.

MWH (2016b). Mt Dove 2016 rehabilitation monitoring assessment.

Woodman (2016). Baseline assessment of vegetation and flora in the Corunna Downs project area.

Appendix C SSMP

Significant Species Management Plan

Corunna Downs

179-LAH-EN-PLN-0001

Revision 3

Authorisation

Rev	Reason for Issue	Prepared	Checked	Authorised	Date
1	Compliance	Melissa Finlay	Esme Wink	Brendan Bow	10/01/17
2	Regulator Comment	Natassja Bell	Brendan Bow	Brendan Bow	16/05/17
3	Regulator Comment	Natassja Bell	Brendan Bow	Brendan Bow	09/06/2017



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1. Introduction

1.1 Project Overview

The Corunna Downs Project (Project) is located 241km south east of Port Hedland, as shown in Figure 1. Mining will be via conventional open cut, crushing and screening mining methods above the groundwater table. Associated infrastructure will include open pits, waste rock dumps, mine infrastructure, borefield and accommodation camp.

1.2 Purpose

The Project has the potential to impact conservation significant species which are protected under the *Environment Protection and Biodiversity Conservation Act 1999* and *Wildlife Conservation Act 1950*. A desktop study identified 32 terrestrial fauna species considered to be of conservation significance that may potentially occur within a study area. Eight species of conservation significance were recorded in the Study Area during the multiple field surveys which were designed in accordance with the guidelines detailed in Chapter 3.

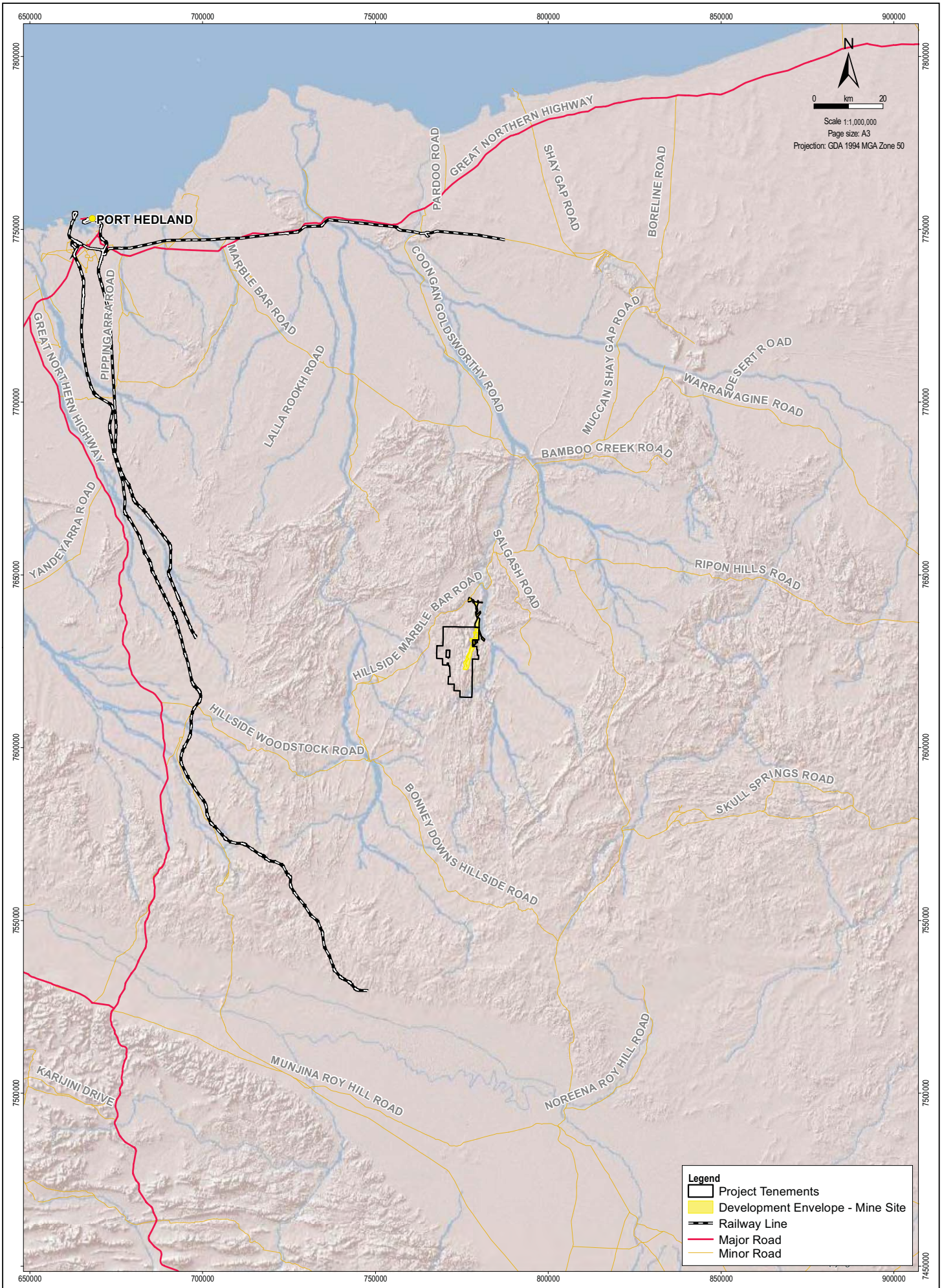
The purpose of this Significant Species Management Plan (SSMP) is to mitigate potential impacts to conservation significant fauna species and ensure the Project is developed in an environmentally acceptable manner.

The objectives of this SSMP are to:

- Maintain an inventory of conservation significant species that have the potential to be impacted by the Project.
- Maintain records of conservation significant species observed within the Project area.
- Avoid or minimise impacts to conservation significant species and habitats.
- Monitor for potential impacts to conservation significant species.
- Detail the reporting requirements relating to conservation significant species.

1.3 Legislative Context

Environmental legislation relevant to this management plan includes the Commonwealth *Environment Protection and Biodiversity Act 1999* (EPBC Act) and the State *Environmental Protection Act 1986* (EP Act), *Wildlife Conservation Act 1950* (WC Act) and *Mining Act 1978* (Mining Act).



File Name: GIS_2115.mxd	Document Number : (QDMS number only)	**Corunna Downs Mine Site**
Date: 11/01/2017	Source & Notes:	**Regional Plan**
Author: thatchc	*Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*	

1.3.1 Environment Protection and Biodiversity Act 1999

The EPBC Act provides for the protection of matters of national environmental significance. Actions likely to cause a significant impact to matters of national environmental significance are assessed under the EPBC Act. The main authority under this Act is the Department of the Environment and Energy (DoEE).

Nationally threatened species listed under the EPBC Act are considered to be matters of national environmental significance. Migratory species listed under international conventions and agreements that Australia is a party to, are also protected under the EPBC Act. Definitions of the various conservation categories for nationally threatened species and migratory species are provided in Appendix A.

Threatened species and migratory species have been confirmed as present in the vicinity of the Project.

1.3.2 Environmental Protection Act 1986

The EP Act is the primary legislation that governs environmental impact assessment and protection in Western Australia. The aim of this Act is to prevent, control and abate environmental pollution for the conservation, preservation, protection, enhancement and management of the environment. Authorities under this Act include the Department of Environment Regulation (DER) and the Environmental Protection Authority (EPA).

Approvals can be required under two parts of the Act: Part IV, Environmental Impact Assessment; and Part V, Environmental Regulation. The criteria for referral/assessment under Part IV of the Act, is detailed within the Memorandum of Understanding (MoU) established between the Department of Mines and Petroleum (DMP) and the Environmental Protection Authority (EPA).

The EP Act also specifically deals with the clearing of native vegetation and is supported by the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. Under this framework clearing of native vegetation is considered an offense unless a clearing permit is obtained or the clearing is exempt under the EP Act. Native vegetation clearing permits can be assessed by the Department of Mines and Petroleum under delegation from DER in accordance with the provisions of the EP Act and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004.*

1.3.3 Wildlife Conservation Act 1950

The WC Act provides for the protection of native flora and fauna if they are under identifiable threat of extinction, rare, or generally in need of protection. The main authority under this Act is the Department of Parks and Wildlife (DPaW).

Threatened fauna are listed in government gazettes as Specially Protected Fauna. Definitions of the various conservation categories are provided in Appendix A.

1.3.4 Mining Act 1978

The Mining Act regulates mineral exploration and mining in Western Australia. The main authority under this Act is the Department of Mines and Petroleum (DMP). Under this Act the DMP prescribes environmental protection conditions on Mining Tenure through the assessment of Mining Proposals and Mine Closure Plans which outline the potential environmental impacts and management practices for individual projects.

1.4 Terminology and Definitions

1.4.1 Conservation Significant

For the purpose of this SSMP, conservation significant species are defined as species listed under Commonwealth or State legislation or listed as priority species by the DPaW, or considered by qualified specialists to be locally important.

Commonwealth and State-listed species are discussed in Section 3 and related conservation category definitions are provided in Appendix A. Species of concern (i.e. those species that are poorly known, uncommon, rare or otherwise threatened) that are not listed under legislation may be prioritised by the DPaW and have been included in this SSMP. Their conservation significance is reviewed by the DPaW on a regular basis.

1.4.2 Likelihood of Occurrence

The following definitions of likelihood of occurrence are used in this SSMP:

- **Confirmed** – the presence of the species in the Study Area has been recorded unambiguously during the last ten years (i.e. during recent surveys of the Study Area or from recent records obtained via database searches).
- **Very Likely** – the Study Area lies within the known distribution of the species and contains suitable habitat(s), plus the species generally occurs in suitable habitat and has been recorded nearby within the last 20 years.
- **Likely** – the Study Area lies within the known distribution of the species and the species has been recorded nearby within the last 20 years; however, either:
  - the Study Area contains only a small area of suitable habitat, or habitat that is only marginally suitable; or
  - the species is generally rare and patchily distributed in suitable habitat.
- **Possible** – Outside chance of occurrence based on:
  - the Study Area is just outside the known distribution of the species, but it does contain suitable and sufficient habitat (the species may be common, rare, or patchily distributed); or
  - the Study Area lies within the known distribution of the species, but the species is very rare and/or patchily distributed; or
  - the Study Area lies on the edge of, or within, the known distribution and has suitable habitat, but the species has not been recorded in the area for over 20 years.

- **Unlikely** – the Study Area lies outside the known distribution of the species, the Study Area does not contain suitable habitat, and the species has not been recorded in the area for over 20 years.

1.4.3 Project Terminology

Project terminology is as follows:

- The Project refers to the Corunna Downs Project.
- Survey area is defined as the area over which field surveys have been conducted (>15,000 ha), as described in Chapter 3 and depicted in Figure 2.
- Development Envelope refers to the 2263.19 ha area within which Atlas intends to clear no more than 423.12 ha (Figure 2).
- Project footprint is defined as the area of ground disturbance (423.12 ha).

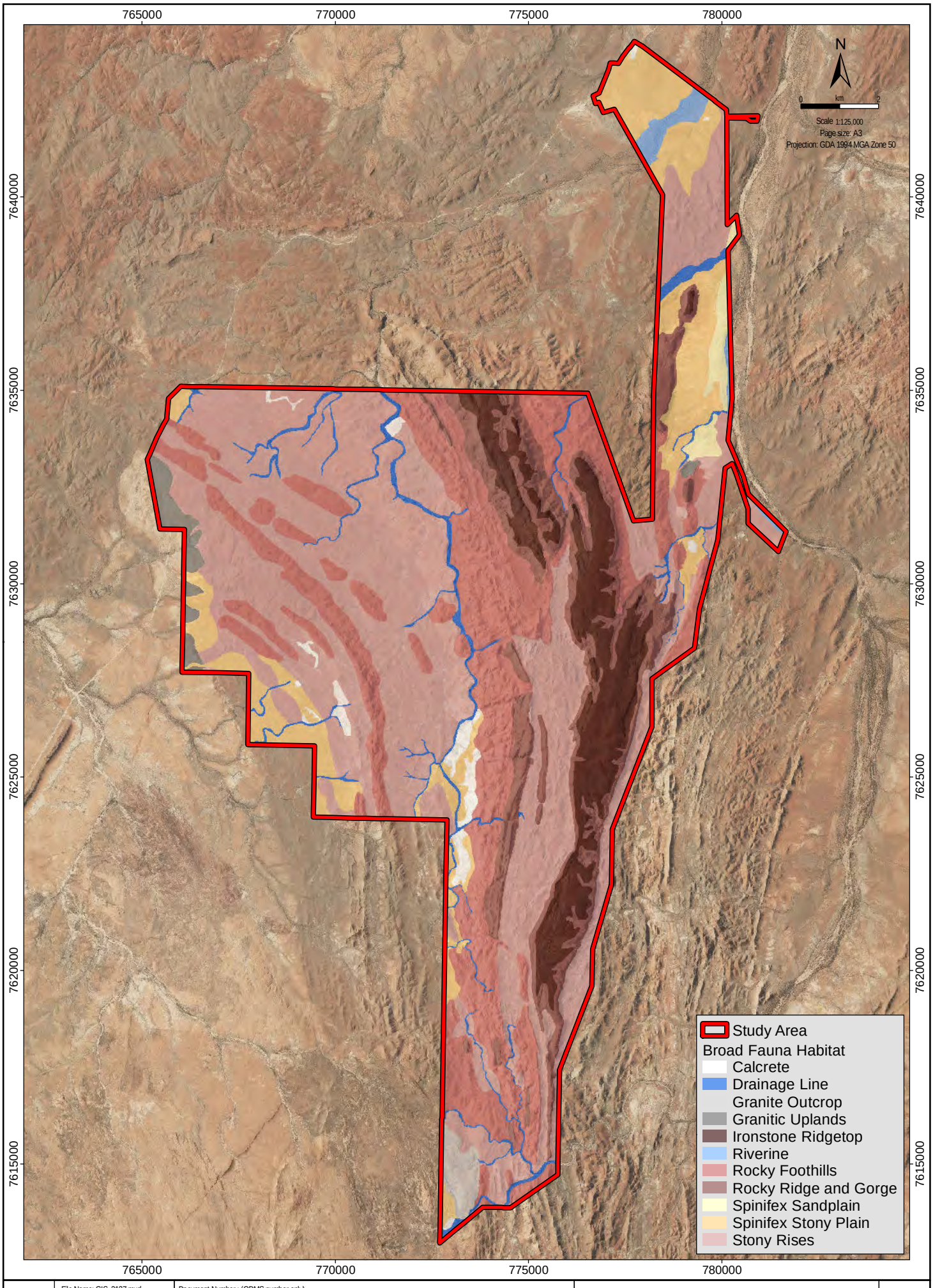
2. Roles and Responsibilities

Atlas is committed to managing its activities in an environmentally and socially responsible manner, as reflected in Atlas's Health, Safety and Environment Policy. This policy is based on the recognition that mining projects affect the environment. Through prudent planning and excellence in management, most significant impacts can be avoided or mitigated.

Atlas' roles and responsibilities for the implementation of this SSMP are outlined in Table 1.

Table 1 – Atlas' roles and responsibilities for SSMP implementation

Role	Responsibility
Senior Environmental Advisor	Implement and maintain the SSMP. Review the SSMP. Annual Audit of Compliance. Review and update, where applicable, the conservation status of fauna within the study area annually.
Corunna Downs Environmental Advisor	Implement monitoring programs. Maintain monitoring records. Deliver monitoring/reporting data to the DoEE, DPaW, DMP and DER. Implement and deliver awareness training programs to personnel, contactors and visitors. Record all sightings of or incidents involving conservation significant fauna. Assess ground disturbance and access applications. Ensure all personnel involved in fauna surveys are appropriately licensed and qualified. Investigate any incidents involving conservation significant species and implement findings where relevant.



File Name: GIS_2127.mxd	Document Number : (QDMS number only)	Broad Fauna Habitat
Date: 11/01/2017	Source & Notes:	
Author: thatchc	*Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*	

Role	Responsibility
Construction and Operation Managers	Endorse implementation of the SSMP by Project personnel and contractors.
All personnel, contractors and visitors	Participate in awareness training prior to commencing duties. Implement SSMP in daily activities, where relevant. Report all sightings and/or incidents involving conservation significant fauna.

3. Fauna Values

MWH Australia Pty Ltd (MWH) conducted multiple field surveys in accordance with a Level 2 terrestrial fauna assessment for the Project. The survey methodology was aligned with the relevant sections of the following guidelines:

- EPA (2002), *Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection;*
- EPA (2004), *Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia;*
- EPA and DEC (2010), *Technical Guide: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment;*
- DEWHA (2010a), *Survey Guidelines for Australia's Threatened Bats;*
- DEWHA (2010b), *Survey Guidelines for Australia's Threatened Birds;*
- DSEWPaC (2011a), *Survey Guidelines for Australia's Threatened Mammals*;
- DSEWPaC (2001b), *Survey Guidelines for Australia's Threatened Reptiles;* and
- DotE (2016), EPBC Act Policy Statement: *EPBC Act Referral Guidelines for the Endangered Northern Quoll* Dasyurus hallucatus

The overall objective of the surveys was to gather background information on the terrestrial fauna, fauna assemblages and fauna habitats of the Study area. The specific objectives were to:

- Develop an inventory of the terrestrial vertebrate fauna identified or likely to occur in the Study area and surrounds;
- Assess the occurrence and likely distribution of fauna assemblages and fauna of conservation significance within the Study area;
- Identify, describe and map fauna habitat and any significant habitat in the Study area;
- Assess the survey findings in a regional context by comparing them with available data from other localities within the Pilbara bioregion; and
- Accumulate baseline population information on those species that may require referral under the EPBC Act.

3.1 Habitats

Eleven broad habitat types were identified and mapped over the Study area. These were consistent with habitat types known to occur elsewhere in the Chichester subregion. No habitat types identified were considered regionally significant, although four habitat types were considered locally significant:

- Rocky Ridge and Gorge;
- Drainage Line;
- Riverine; and
- Granite Outcrop.

These habitat types were identified as locally significant due to a variety of factors, including:

- Their importance as a refuge habitat for fauna of conservation significance;
- Their potential to host permanent and semi-permanent water sources which are important for a diverse range of fauna, and/or
- Their ability to support a diverse fauna assemblage.

The remaining seven habitat types; Stony Rises, Rocky Foothills, Spinifex Stony Plain, Ironstone Ridge Top, Granitic Uplands, Calcrete and Spinifex Sandplain, were noted as being widespread and/or being of limited importance to species of conservation significance and/or do not support a diverse fauna assemblage.

Several significant microhabitat features in the Development Envelope should be considered regionally significant as they are known to support, or have the potential to support, species of conservation significance. These features include a non-permanent breeding roost for the Pilbara Leaf-nosed Bat, four nocturnal refuges, two semi-permanent water sources and two permanent water sources, which provide potential habitat for the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python.

3.2 Conservation Significant Species

Eight species of conservation significance recorded in the survey study area and are detailed in Table 2.

Table 2 – Conservation Significant Species Confirmed Present

Common name (Species name)	Conservation Status	
	EPBC	In WA
Northern Quoll (*Dasyurus hallucatus)*	EN	S2
Pilbara Olive Python (*Liasis olivaceus barroni*)	VU	S3
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantius*)	VU	S3
Ghost Bat (*Macroderma gigas*)	VU	S3
Peregrine Falcon (*Falco peregrinus*)	-	S7
Western Pebble-mound Mouse (*Pseudomys chapmani*)	-	P4
Spectacled Hare-wallaby (*L. conspicillatus leichardti*)	-	P3
Rainbow Bee-eater (*Merops ornatus*)	M	S5

Further information regarding each conservation significant species either known to occur or potentially occurring in the survey area is provided in Appendix B.

4. Potential Impacts

Each stage of the Project (construction, operation and closure/rehabilitation) has the potential to affect the abundance, distribution and condition of conservation significant fauna within the Project area and surrounds. Potential impacts of the Project on terrestrial fauna of conservation significance include:

- Loss and/or degradation of fauna habitat, resulting in a direct loss of species, habitat fragmentation and a reduction in the extent of breeding and/or foraging habitat.
- Injuries to and mortalities of fauna caused by interactions with vehicles, infrastructure, machinery and the workforce.
- Reduced diversity or abundance of foraging resources due to altered hydrological regimes.
- Alteration in behaviour of fauna due to dust, noise, vibration and light emissions.
- Increased presence of non-indigenous fauna species due to introduction of workforce and vehicles, inappropriate waste collection and storage practices, and inadequate rehabilitation of disturbed land, resulting in terrestrial vertebrate fauna mortality and/or competition for resources.
- Alteration to fire regimes (e.g. increased frequency, intensity, extent) from the presence of human activity in the area, resulting in the modification or loss of fauna habitat and conservation significant terrestrial vertebrate fauna.
- Loss and/or degradation of terrestrial vertebrate fauna habitat due to increased presence of weed species.

5. Management Measures

Management measures have been developed to control and mitigate impacts to conservation significant fauna from the Project. The management measures in this section have been classified as either Standard Management Measures; which are measures developed and implemented to manage and mitigate impacts to all conservation significant terrestrial vertebrate fauna, or Species-Specific Management Measures which are measures developed and implemented for a conservation significant fauna species that has been confirmed as present in the Project area and may potentially be impacted by the Project.

5.1 Standard Management Measures

This section details the management measures relevant to all conservation significant terrestrial vertebrate fauna. These management measures have been developed in consideration of baseline studies (Section 3), identified potential Project impacts (Section 4), specialist advice and industry best practices.

The following management measures will be implemented:

- Clearing in/of sensitive habitats including caves, cliff lines, waterholes, gorges, ridges, outcrops, drainage lines, scree slopes and crevices will be kept to the minimum necessary for safe construction and operation of the Project.
- Signage identifying the presence of conservation significant fauna will be installed along the roads, where they intersect suitable habitat, specifically:
  - Drainage line habitat.
  - Riverine habitat.
  - Rocky Ridge and gorge habitat.
- Borrow pits will be designed and constructed to permit egress of fauna.
- Turkey's nests will be fenced to at least 1.8m (to prevent fauna entry / mortality) and constructed to ensure a point of fauna ingress/egress.
- The landfill will be operated and managed in accordance with the *Environmental Protection (Rural Landfill) Regulations 2002. This will* include fencing to reduce the potential for attracting fauna.
- The Corunna Downs Environmental Advisor will maintain a database and maps detailing, the location of:
  - Conservation significant species and habitat.
  - Impact exclusion zones.
  - Cleared areas.
  - Rehabilitated areas.
- The following vehicle speed limits will be imposed and enforced on Project roads:
  - 80 km/hr north of the Run-of mine pad.
  - 50 km/hr south of the Run-of-mine pad.
- Off-road driving will be prohibited unless otherwise authorised by Senior Management.
- Night-time vehicle movements will be restricted where possible to minimise the potential vehicle strikes.
- Noise, dust and light emissions will be controlled where possible to avoid excessive disturbance to native fauna, including directing lights to working areas, shielding lights to reduce glow, and using conventional dust suppression techniques (i.e. water trucks).
- All bins storing putrescible waste will have tightly secured lids to avoid fauna attraction and entry.

- Awareness training will identify conservation significant fauna and habitat and discuss relevant management measures, personnel/contractor responsibilities, and incident reporting requirements (i.e. reporting of fauna observations and/or incidents).
- All fauna mortalities and injuries will be reported to the Corunna Downs Environmental Advisor within 24 hours and recorded within Atlas's incident reporting system.
- All sightings of non-indigenous fauna and conservation significant fauna will be reported to the Corunna Downs Environmental Advisor.
- The Corunna Downs Environmental Advisor will report all conservation significant fauna injuries and mortalities to DPaW within one week.
- Where required, fauna will be handled and transported in accordance with the procedures outlined in the DPaW Standard Operating Procedure No 11.1, *Transport and Temporary Holding of Wildlife*.
- Interactions with fauna (e.g. feeding, harassment, capture, killing) are not permitted unless specifically authorised by the Senior Environmental Advisor.
- Domestic pets are prohibited.
- Implementation of Atlas' Introduced Fauna / Pest Control Procedure (950-HSE-EN-PRO-0022), including recording all introduced fauna sightings and the implementation of a feral animal control program, as required (i.e., where sightings are regular and/or if nuisance or dangerous individuals are recorded).
- No more than 423.12 ha of vegetation within the 2263.19 ha Development Envelope will be cleared/ disturbed.
- Clearing and disturbance of vegetation will be kept to the minimum necessary for safe construction and operation of the Project.
- Clearing will occur in accordance with Atlas' Ground Disturbance Permit Procedure. No clearing will occur without prior authorisation from Atlas' Ground Disturbance Permitting System.
- Implementation of the following procedures to ensure weeds are controlled, as far as practicable:
  - Ground Disturbance Permit Procedure (950-HSE-EN-PRO-0001).
  - Flora Management Procedure (950-HSE-EN-PRO0010).
  - Weed Hygiene Procedure (950-HSE-EN-PRO-0002).
- Disturbed areas will be progressively rehabilitated as soon as practicable.

5.2 Species-Specific Management Measures

This section details management measures specific to species which have been confirmed to be present within the study area and are likely to be impacted by the Project; namely, the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python.

Following the implementation of the Standard Management Measures, the Project impacts on a local and regional scale to all other species confirmed to be present within the survey area (Table 3.1), are likely to be minimal (no population/ species decline expected) or negligible (no perceived effect on population/species). As a

result species specific management measures have not been developed for these species; namely the Western Pebble-mound Mouse, Rainbow Bee-eater, Peregrine Falcon and Spectacled Hare-wallaby.

5.2.1 Northern Quoll

The presence of Northern Quolls (*Dasyurus hallucatus*) within the survey area was confirmed from 38 records, including four records from Phase 1 (one opportunistic motion-sensor camera and three scat records), and 34 records from Phase 2 (eight direct captures, eight scat records and 18 motion sensor camera records).

This species was recorded in all 11 previous surveys conducted within the vicinity of the study area and was identified by two databases. The large number of previous records within the vicinity of the Study Area suggests that the species is relatively common in the local region. Additionally, the presence of two females indicated the presence of nearby den sites and confirms that a breeding population occurs within the study area. However, the lack of captures at targeted trapping sites suggests that the population's distribution is confined to specific systems (i.e. important gorge and rocky ridge systems) rather than uniform occurrence throughout broad habitat types. Such systems appear to be located in the central – eastern, northern and south-eastern areas of the study area within the Rocky Ridge and Gorge, Rocky Foothills habitat and in many cases in association with significant microhabitat features such as permanent and semi-permanent water sources.

In addition to the implementation of the Standard Management Measures, Atlas is committed to implementing the following Species-Specific Management Measures for the Northern Quoll:

- Implementation of a Northern Quoll monitoring program (Appendix C).
- Inductions will provide detailed information about the Northern Quoll, including identification of employee and contractor responsibilities.
- Northern Quoll sightings, injuries and mortalities will be reported to the Corunna Downs Environmental Advisor in accordance with Atlas' HSE Incident Management Procedure.

5.2.2 Pilbara Leaf-nosed Bat and Ghost Bat

The presence of the Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) within the survey area was confirmed with 41 records during the survey, including four direct sightings, 37 echolocation recordings and one night of via video-census. The most important features identified in the Study area, and relevant to the species is CO-CA-01, a permanent diurnal roost, and CO-CA-03 a non-permanent breeding roost. These two roosts are supported by a large number of foraging resources, both nocturnal refuges and water sources, and extensive coverage of preferred foraging habitat. The objective of the management recommendations is for the long term protection of the Pilbara Leaf-nosed Bat colony at Corunna Downs.

The Ghost Bat was recorded on 10 occasions during the survey, comprising two sightings, three scat and five echolocation records. Echolocation recordings suggested low levels of activity at these sites and confirmed night-time visitation only. This species forages using echolocation during flight, but will also use passive sit and wait hunting techniques visually scanning and ambushing prey from high structures, such as rocky overhangs and trees (Churchill 2008). This species may

therefore forage over all habitats within the Study area, although the Rocky Ridge and Gorge is likely to be of particular importance for both foraging and roosting.

In addition to the implementation of the Standard Management Measures, Atlas is committed to implementing a number of species-specific management measures for the Pilbara Leaf-nosed Bat and Ghost Bat. These include:

- Implementation of a Pilbara Leaf-nosed Bat and Ghost Bat monitoring program (Appendix D).
- Bat roosts will be recorded in a site database and mapped on all mine plans. The database will be accessible to all Atlas departments.
- A 340 m buffer will be maintained around Cave CO-CA-01.
- A 50 m buffer will be maintained around Cave CO-CA-03.
- Access to caves known to be occupied by the Pilbara Leaf-nosed Bat and/or Ghost Bat will be restricted.
- Atlas will not install barbed-wire fences or other fences that could cause bat entanglements.
- Blasting techniques will be implemented to lower vibration levels in the vicinity of sensitive areas. This may include:
  - Minimising the number of holes being detonated at any one time within each blast;
  - Increasing initiation delays between holes;
  - Lowering hole charge weights; and
  - Firing to free faces or into broken material where practicable.
- No trapping of bats is to be undertaken.
- Mine site inductions will provide detailed information about Pilbara Leaf-nosed Bats and Ghost Bats and employee and contractor responsibilities.

5.2.3 Pilbara Olive Python

The Pilbara Olive Python (*Liasis olivaceus barroni*) was recorded in the Study area on four occasions, comprising of one direct sighting during the survey, two direct sightings by Atlas personnel and one record of an individual's skin sloth. This species commonly inhabits moist areas such as gorges, rivers, pools and surrounding hills but can be found in a range of habitats.

In addition to the implementation of the Standard Management Measures Atlas is committed to implementing Species-Specific Management Measures for the Pilbara Olive Python. These include:

- Pilbara Olive Pythons will be captured and relocated to suitable habitat by trained personnel should they be encountered during ground disturbance or operational activities.
- Inductions will provide detailed information about the Pilbara Olive Python and employee and contractor responsibilities.
- Pilbara Olive Python sightings, injuries and mortalities will be reported to the Corunna Downs Environmental Advisor in accordance with Atlas' HSE Incident Management Procedure.

6. Performance Criteria and Corrective Actions

Performance criteria for this SSMP are provided in Table 3. Should the performance criteria not be met, corrective actions will be implemented.

Table 3 – Performance criteria and corrective actions for conservation significant fauna

Performance Objective	Key Performance Indicators	Corrective Actions
No road kill incidents of conservation significant fauna.	No incident reports of road kill incidents of conservation significant fauna.	• Identify likely cause of incident. • Review speed limits and driving procedures. • Review number of and locations of fauna signposts. • Undertake further education and awareness training.
No more than 423.12 ha will be cleared within the Development Envelope.	Clearing of no more than 423.12 ha. No clearing outside the Development Envelope.	• Check demarcation of areas to be cleared/not cleared has been undertaken and is obvious to those on the ground. • Identify likely cause of incident. • Implement relevant corrective actions. • Report to relevant government authorities. • Undertake corrective rehabilitation. • Undertake further education and awareness training.
Persistence of the Northern Quoll within the Study Area during operations.	Absence of Northern Quoll at 50% of monitoring sites over two consecutive annual monitoring periods.	• Review likely cause[1]. • Review monitoring procedure; frequency and methodology. • Review northern quoll management within this plan. • Report to relevant Commonwealth and state agencies. • Undertake any corrective rehabilitation.
No unauthorised access to bat cave exclusion zones.	No ground disturbance within cave buffers. No incident reports of unauthorised access to cave buffers.	• Review training and induction programs. • Review number and locations of fauna signposts. • Review the size of and need for barriers to exclusion zone (e.g. fencing).

Performance Objective	Key Performance Indicators	Corrective Actions
No significant damage to identified caves that would prevent their ongoing use by Pilbara Leaf-nosed Bats.	No significant damage to Cave CA-CO-01 and Cave CA-CO-03. Ongoing use of Cave CA-CO-01 by Pilbara Leaf-nosed Bats during operation. Use of Cave CA-CO-03 by Pilbara Leaf-nosed Bats, following cessation of mining.	• Increase cave inspection and monitoring frequency. • Review blasting requirements. • Undertake any practical corrective rehabilitation (e.g., removal of significant rock fall or sealing of significant fractures), where any identified damage is considered likely to affect ongoing use by bats (i.e., damage which may prevent exit/entry or alter microclimate).
No significant decline in Pilbara Leaf-nosed Bat population.	No greater than 50 % decline of Pilbara Leaf-nosed Bat activity levels in CO-CA-01 over two consecutive monitoring periods compared to the average baseline level (between 2014 to 2017).	• Review likely cause[1]. • Review monitoring procedure; frequency and methodology. • Review bat management within this plan. • Review blasting requirements. • Report to relevant Commonwealth and state agencies.
	Recolonisation of CO-CA-03 by Pilbara Leaf-nosed Bat post-mining[2].	• Review likely cause. • Review monitoring procedure; frequency and methodology. • Undertake any practical corrective rehabilitation (e.g., removal of significant rockfall or sealing of significant fractures). • Report to relevant Commonwealth and state agencies.
Effective waste management procedures.	No records of feral animals within camp or administrative and landfill facilities (due to poor waste management).	• Identify likely cause of incident. • Review the Waste Management (950-HSE-EN-PRO-0023) and Landfill Management (950-HSE-EN-PRO-0020) Procedures. • Review/implement the Introduced Fauna / Pest Control Procedure (950-HSE-EN-PRO-0022. • Undertaking further education and awareness training.

Performance Objective	Key Performance Indicators	Corrective Actions
Effective operation of the Project to minimise the risk of Project related fire	No records of Project-related fires.	• Identify likely cause of incident. • Review any relevant procedures or guidelines (e.g., Hydrocarbon Management Procedure (950-HSE-EN-PRO-0005), Hydrocarbon (and Chemical) Spill Management Procedure (950-HSE-ENPRO-0007), Hot Work Guideline (SA_GDL_009). • Undertake further education and awareness training.
Effective weed control.	No new species of weeds recorded within the Project area.	• Identify likely cause of incident. • Review the Weed Hygiene Procedure (950-HSE-EN-PRO-0002) and the Flora Management Procedure (950-HSE-EN-PRO-0010). • Undertaking further education and awareness training.

1. If performance indicator is triggered, but the change is recorded regionally (across both impact and non-impact/control sites) and found to be indicative of a regional rather than project related change/impact (e.g., influencing environmental factor) no further corrective action is required.
2. Performance against this criteria only needs to be measured, where annual monitoring finds that the Pilbara Leaf-nosed Bat temporarily abandons cave CO-CA-03 during mining (as predicted).

7. Auditing and Review

7.1 Audits

The Senior Environmental Advisor will be responsible for ensuring a compliance audit against the requirements of this SSMP is conducted every 12 months over the life of the Project.

7.2 Reviews

Atlas will undertake an initial review of the SSMP once the Project has received final environmental approvals to ensure all approval conditions, recommendations and commitments are covered. The SSMP will then be reviewed every 12 months or as required. All reviews will consider:

- Outcomes of monitoring programs.
- Changes to the conservation status of fauna species.
- Specialist advice and stakeholder consultation.

- Implementation and effectiveness of management measures and monitoring programs.
- Performance indicators and any corrective actions.
- Changes to relevant legislation, policy, guidelines, management plans and industry practices.
- The identification of a conservation significant fauna species not previously confirmed within the Project area.
- Reoccurring incidents of death/injury to any conservation significant fauna.

8. Reporting

This section provides details of Atlas' reporting requirements by this SSMP. A summary of reporting requirements is provided in Table 4.

Table 4 – Reporting Requirements

Department	Detail	Timing
Atlas Internal	Incident Reporting	As required
Atlas Internal	Opportunistic Reporting	As required
Atlas Internal	Northern Quoll Monitoring Report	Annually
Atlas Internal	Bat Monitoring Report	Annually
DoEE	Annual Environment Report	Annually
DMP	Annual Environment Report	Annually
DPaW	Fauna injury or mortality Report	As Required

8.1 Internal Reporting

8.1.1 Incident Reporting

All fauna injuries and mortalities within the Project area will be reported to the Corunna Downs Environmental Advisor, in accordance Atlas' HSE Incident Management Procedure.

All incidents are reported through Atlas' Incident Reporting System (InControl) and will be investigated appropriately with additional management measures implemented where required to prevent reoccurrences.

All fauna incidents are also recorded in the InControl database and summaries are included in Atlas's Annual Environmental Report (AER).

8.1.2 Opportunistic Reporting

All fauna sightings are reported through Atlas' Incident Reporting System (InViron) and will be investigated appropriately with additional management measures implemented where required.

A summary will be included in Atlas's Annual Environmental Report (AER).

8.1.3 Fauna Specialist Reports

The fauna specialist conducting monitoring for conservation significant species for which species-specific management has been implemented will report to Atlas on each monitoring event. The specialist reports will be reviewed internally to ensure compliance with the SSMP objectives and performance criteria.

These specialist reports will be attached to the AER.

8.2 External Reporting

8.2.1 Department of the Environment and Energy

The AER will provide a summary of conservation significant fauna sightings, injuries and mortalities within the Project area, as well as performance in accordance with the objectives, key performance indicators and corrective actions listed in Table 3.

The AER will report on the results of the following monitoring programs:

- Northern Quoll Monitoring Program (detailed in Appendix C).
- Pilbara Leaf-nosed Bat and Ghost Bat Monitoring Program (detailed in Appendix D).

Any significant changes to this SSMP will be also noted in the AER.

8.2.2 Department of Mines and Petroleum

DMP's AER will include a summary of the significant fauna monitoring results and compliance with DoEE approval conditions.

8.2.3 Department of Parks and Wildlife

Any mortality to conservation significant fauna will be reported to the DPaW, with their standard Fauna Report Form. This will determine if further action are appropriate.

9. References

DEWHA 2010(a), Survey Guidelines for Australia's Threatened Bats, Department of Environment Water Heritage and Arts, Commonwealth of Australia, Canberra, Australian Capital Territory.

DEWHA 2010(b), Survey Guidelines for Australia's Threatened Birds, Department of Environment Water Heritage and Arts, Commonwealth of Australia, Canberra, Australian Capital Territory.

DotE 2016, EPBC Act Policy Statement: EPBC Act Referral Guidelines for the Endangered Northern Quoll *Dasyurus hallucatus*, Department of the Environment and Energy, Commonwealth of Australia, Canberra, Australian Capital Territory

EPA. 2004. Guidance Statement No. 56. Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. Environmental Protection Authority. Perth, Western Australia.

EPA 2002, Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection, Environmental Protection Authority. Perth, Western Australia.

EPA and DEC 2010, Technical Guide: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment, Environmental Protection Authority and Department of Environment and Conservation, Perth, Western Australia.

DSEWPaC 2011(a), Survey Guidelines for Australia's Threatened Mammals, Department of Sustainability, Environment, Water Population and Communities, Commonwealth of Australia, Canberra, Australian Capital Territory.

DSEWPaC 2001(b), Survey Guidelines for Australia's Threatened Reptiles Department of Sustainability, Environment, Water Population and Communities, Commonwealth of Australia, Canberra, Australian Capital Territory.

Appendix A Definitions of Conservation Significance Status for Flora and Fauna

Table A.1 – Definition of State and Commonwealth Conservation Codes for Fauna

Status	Code	Description
Categories used in Environment Protection and Biodiversity Act 1999		
Endangered	E	A taxon is Endangered when the best available evidence indicates that it is considered to be facing a very high risk of extinction in the wild.
Vulnerable	V	A taxon is Vulnerable when the best available evidence indicates that it is considered to be facing a high risk of extinction in the wild.
Migratory	M	Species migrate to, over and within Australia and its external territories.
Schedules of the Western Australian Wildlife Conservation Act 1950		
Schedule 1	S1	Fauna that is rare or likely to become extinct.
Schedule 2	S2	Fauna that is presumed to be extinct.
Schedule 3	S3	Birds that are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds.
Schedule 4	S4	Fauna that is in need of special protection, otherwise than for the reasons mentioned above.
Priority Fauna Codes used by the Western Australian DPaW		
Priority 1: Taxa with few, poorly known populations on threatened lands.	P1	Taxa which are known from few specimens or sight records from one or a few localities on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 2: Taxa with few, poorly known populations on conservation lands.	P2	Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 3: Taxa with several, poorly known populations,	P3	Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction

Status	Code	Description
some on conservation lands		or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 4: Taxa in need of monitoring	P4	Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.
Priority 5: Taxa in need of monitoring	P5	Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Appendix B Likelihood of Conservation Listed Vertebrate Species Occurring over the Study Area

Common name (*Scientific name*)	Conservation status		Broad habitat type	Likelihood of occurrence
	EPBC Act	In WA		
Curlew Sandpiper *Calidris ferruginea*	Cr, Mi	S3, S5	The Curlew Sandpiper occurs in intertidal mudflats of estuaries, lagoons, mangroves, as well as beaches, rocky shores and around lakes, dams and floodwaters (Geering *et al.* 2007).	Unlikely Nearest DPaW (2016a) record located ~250 km south of the Study Area, at Ophthalmia Dam and very few inland records of the species. Species only recorded from DoEE Protected Matters database, which is based on estimated species distribution, rather than actual field records.
Northern Quoll *Dasyurus hallucatus*	En	S2	In the Pilbara, ironstone ridges, scree slopes of sandstone or ironstone and granite boulders and outcrops (Cramer *et al.* 2016, Molloy *et al.* 2016).	Confirmed Five individuals were trapped from eight capture events during the Phase 2 survey. An additional 19 records were retrieved from motion-sensor cameras and another eleven scat records. All records were collected within Rocky Ridge and Gorge, Drainage Line, Riverine and Rocky Foothill (within the vicinity of Rocky Ridge and Gorge) habitats.
Night Parrot *Pezoporus occidentalis*	En	S1	Known to inhabit treeless or sparsely wooded long unburnt spinifex hummock plains often interspersed with chenopods (Davis and Metcalf 2008, Pyke and Ehrlich 2014).	Unlikely Nearest DPaW (2016a) record located ~135 km south-west from near the Fortescue Marsh (Davis and Metcalf 2008). Species only recorded from DoEE Protected Matters database, which is based on estimated species distribution, rather than actual field records.

Common name (*Scientific name*)	Conservation status		Broad habitat type	Likelihood of occurrence
	EPBC Act	In WA		
Australian Painted Snipe *Rostratula australis*	En	S2	Shallow, well-vegetated temporary or infrequently filled inland wetlands (Garnett *et al.* 2011, Knuckey *et al.* 2013).	Unlikely Nearest DPaW (2016a) record located ~170 km south of the Study Area, near Fortescue Marsh, but otherwise very few records within the Pilbara region (Knuckey et al. 2013). N Species only recorded from DoEE Protected Matters database, which is based on estimated species distribution, rather than actual field records.
Greater Bilby *Macrotis lagotis*	Vu	S3	Variety of habitats including spinifex hummock grassland and *Acacia* shrubland, on soft soils (Burrows *et al.* 2012). In the Pilbara often associated with major drainage line sandy terraces (How *et al.* 1991).	Possible Populations of the species are scattered and rare within its distribution (van Dyck and Strahan 2008). Nearest DPaW (2016b) records located ~30 km south-west of the Study Area and ~45 km south-east at McPhee Creek (Outback Ecology 2014). Species requires sandy substrates for burrowing and although such habitat was present in the Study Area (Spinifex Sandplain), this habitat did not contain deep sands suitable for deep burrows. Additionally substantial targeted search effort failed to record evidence of the species, which is relatively easy to identify (Burrows *et al.* 2012).
Ghost Bat *Macroderma gigas*	Vu	S3	The species roosts within deep humid caves, rock crevice and abandoned mines (Armstrong and Anstee 2000). The species will forage in most habitat types and will travel 2 km from a roost to hunt (Churchill	Confirmed The species was confirmed from 10 records within the Study Area, including one observation of a

Common name (*Scientific name*)	Conservation status		Broad habitat type	Likelihood of occurrence
	EPBC Act	In WA		
			2008).	roosting individual at cave CO-CA-01 and one individual observed flaying into CO-CA-01 at night. Low level activity was also recorded by SM units from five caves, and scats were found at three locations. All records were within Rocky Ridge and Gorge and Ironstone Ridgetop habitats.
Pilbara Leaf-nosed Bat *Rhinonicteris aurantia*	Vu	S3	Species roosts within caves and abandoned mines with high humidity (95%) and temperature (32 °C). Species forages in caves and along waterbodies with fringing vegetation (Armstrong 2001, DoE 2016b).	Confirmed The species was confirmed from 41 records, including four direct sightings of 10-200 individuals. Two diurnal roosts recorded of the species, in addition to seven Nocturnal Refuges, within Rocky Ridge and Gorge habitat. Rocky Ridge and Gorge habitat provides suitable foraging habitat for the species.
Pilbara Olive Python *Liasis olivaceus barroni*	Vu	S3	Species commonly recorded along watercourses and areas of permanent water, particularly in rocky gorges, escarpments and gullies (Pearson 1993).	Confirmed The species was confirmed from four records within the Study Area. From three direct sightings and the remains of one skin sloth. The species is likely to reside in the Rocky Ridge and Gorge habitat and utilise Drainage Line and Riverine habitats for foraging and dispersal.
Grey Falcon *Falco hypoleucos*	-	S3	Timbered lowlands, particularly Acacia shrubland and along inland drainage systems. Also frequent spinifex and tussock grassland (Burbidge *et al.* 2010,	Possible Nearest DPaW (2016b) records located ~45 km east from 1994, ~45 km north from 2005 and ~60 km

Common name (*Scientific name*)	Conservation status		Broad habitat type	Likelihood of occurrence
	EPBC Act	In WA		
			Olsen and Olsen 1986).	north-east from 1999. Species is generally scarce within region. If present, the species is likely to forage and nest within the Drainage Line and Riverine habitats of the Study Area.
Peregrine Falcon *Falco peregrinus*	-	S7	The species occurs along coastal cliffs, rivers and ranges as well as wooded watercourses and lakes nesting on cliffs, granite outcrops, quarries (Johnstone and Storr 1998).	Confirmed One individual was observed during this Survey within the Rocky Ridge and Gorge habitat. The species has was also recorded at Abydos-Woodstock Reserve by (How *et al.* 1991). The species may utilise the Rocky Ridge and Gorge habitat for nesting and foraging, and the Drainage Line and Riverine habitats for foraging only.
- *Anilios ganei*	-	P1	This species is endemic to the Pilbara and known from a relatively small number of specimens. Records are sparse and widespread, but it is thought to be linked to moist gorge and gully habitats (Doughty *et al.* 2011, Wilson and Swan 2014).	Likely Nearest DPaW (2016a) records located ~200 km south of the Study Area within the Hamersley Ranges. The species was however recorded during three surveys conducted within 30 km of the Study Area, in habitats equivalent to Rocky Ridge and Gorge (Outback Ecology 2010, 2013, 2014).
- *Ctenotus nigrilineatus*	-	P1	Little is known about the habitat preferences of the species. Previous records have however been collected from spinifex plains at the base of granite outcrops (How *et al.* 1991).	Possible Nearest DPaW (2016a) record located ~65 km west of the Study Area, from Abydos-Woodstock Reserve in 1990 (How *et al.* 1991), and ~85 km south near

Common name (*Scientific name*)	Conservation status		Broad habitat type	Likelihood of occurrence
	EPBC Act	In WA		
				Nullagine. Specific habitat requirements of the species are not confirmed but the species may occur within the Spinifex Stony Plains of the Study Area.
- *Ctenotus uber johnstonei*	-	P2	The habitat requirements of the species are largely unknown although it is believed the species is associated compacted clayey soil with sparse plant cover (Wilson and Swan 2014).	Possible Nearest DPaW (2016a) record located ~20 km south of the Study Area. The species was also recorded at Mt Webber Outback Ecology (2014). Its habitat preferences are poorly understood, and in the absence of additional information it is considered unlikely to occur in the Study Area.
Spectacled Hare-wallaby *Lagorchestes conspicillatus leichardti*	-	P3	The Spectacled Hare-wallaby in tussock and hummock grasslands and *Acacia* shrublands (Ingleby and Westoby 1992).	Confirmed An abandoned shelter site, with scats, was recorded within the Stony Rises habitat of the Study Area, and the species was also recorded during three previous surveys in the vicinity of the Study Area. The species is likely to utilise the Spinifex Stony Plain and Spinifex Sandplain habitats within the Study Area.
Brush-tailed Mulgara *Dasycercus blythi*	-	P4	Sand plains and gibber plains with moderately dense spinifex with 'runways' between clumps (van Dyck and Strahan 2008).	Possible Nearest DPaW (2016a) record located ~15 km east of the Study Area from 1959. Signs of this species (i.e. diggings/burrows) were recorded in three previous surveys in the vicinity of the Study Area.

Common name (*Scientific name*)	Conservation status		Broad habitat type	Likelihood of occurrence
	EPBC Act	In WA		
				The Spinifex Sandplain habitat of the Study Area provides suitable habitat for the species.
Long-tailed Dunnart *Sminthopsis longicaudata*	-	P4	Typically occurs on plateaus near breakaways and scree slopes, and on rugged boulder-strewn scree slopes (Gibson and McKenzie 2009). Once considered rare but now shown to be relatively common and widespread in rocky habitats (van Dyck and Strahan 2008).	Likely Nearest DPaW (2016b) records located ~35 km east of the Study Area. The species was recently recorded at McPhee Creek (Outback Ecology 2012b), located 45 km from the Study Area. The Rocky Ridge and Gorge and Rocky Foothills habitat provides suitable habitat for the species.
Lakeland Downs Mouse *Leggadina lakedownensis*	-	P4	Tussock and hummock grassland, *Acacia* shrubland, and savannah woodland, on cracking clays and alluvial clays (Kutt and Kemp 2005, Moro and Morris 2000).	Unlikely Nearest DPaW (2016b) record, a WAM specimen, located ~20 km west of the Study Area. However suitable habitat for the species does not occur within the Study Area.
Western Pebble-mound Mouse *Pseudomys chapmani*	-	P4	Spurs and rocky hills with many small pebbles vegetated by spinifex islands (Anstee 1996, Anstee and Armstrong 2001, Anstee *et al.* 1997).	Confirmed The species was recorded on 13 occasions during the Survey, including 10 inactive mounds, one active mound and two direct captures. Nine of the records were recorded within Stony Rises habitat, three within Ironstone Ridgetop habitat and one within Spinifex Stony Plain. The species was recorded in ten of the 11 surveys conducted within the region and from two database searches. The species is likely to

Common name (*Scientific name*)	Conservation status		Broad habitat type	Likelihood of occurrence
	EPBC Act	In WA		
				be widespread through the Stony Rises, Spinifex Stony Plains and Rocky Foothill habitats
Fork-tailed Swift *Apus pacificus*	Mi	S5	The Fork-tailed Swift is an aerial specialist that overflies numerous habitats (Pizzey and Knight 2012).	Possible Nearest DPaW (2016a) record located ~75 km north-west of the Study Area from 2011. The species was also recorded by How et al. (1991). The species may flyover the Study Area on an irregular basis, but is not dependent on habitats within the Study Area.
Oriental Plover *Charadrius veredus*	Mi	S5	Species occurs as a non-breeding summer migrant which occurs throughout the region. Species predominantly occurs within near-coastal samphire and grass flats, also beaches, tidal creeks, saltwork ponds and sewage ponds (Johnstone et al. 2013).	Unlikely Nearest DPaW (2016a) record located ~25 km north-east of the Study Area. Preferred habitat for the species does not occur within the Study Area and the species is generally uncommon in region
Oriental Pratincole *Glareola maldivarum*	Mi	S5	Species occurs as a non-breeding summer migrant which occurs throughout the region. Species favours open grassy plains (including airfields and sports ovals), samphire and open mudflats and beaches (Johnstone et al. 2013).	Unlikely Nearest DPaW (2016a) record located ~150 km north-west of the Study Area, from Port Hedland and no inland records of the species. Species only recorded from DoEE Protected Matters database, which is based on estimated species distribution, rather than actual field records.

Common name (*Scientific name*)	Conservation status		Broad habitat type	Likelihood of occurrence
	EPBC Act	In WA		
Sharp-tailed Sandpiper *Calidris acuminata*	Mi	S5	Species occurs as a non-breeding summer migrant which occurs throughout the region. Species favours flooded samphire flats and grasslands, mangrove creeks, mudflats, beaches, river pools, saltwork ponds (where commonly located on hypersaline ponds) sewage ponds, and freshwater soaks (Johnstone et al. 2013).	Possible Nearest DPaW (2016a) record located ~25 km north-east of the Study Area, from freshwater pools east of Marble Bar. The species may occur as an irregular visitor to pools within the Riverine and Drainage Line habitats of the Study Area, but is not dependent on habitats within the Study Area.
Wood Sandpiper *Tringa glareola*	Mi	S5	Species occurs as a non-breeding summer migrant which occurs throughout the region. Occurs mainly in river pools, sewage ponds, flooded claypans, freshwater lagoons and bore overflows (Johnstone et al. 2013).	Possible Nearest DPaW (2016a) record located ~25 km north-east of the Study Area, from freshwater pools east of Marble Bar. The species may occur as an irregular visitor to pools within the Riverine and Drainage Line habitats of the Study Area, but is not dependent on habitats within the Study Area.
Common Sandpiper *Actitis hypoleucos*	Mi	S5	Species occurs as a non-breeding summer migrant which occurs throughout the region. Species favours tidal and reef flats, beaches, saltwork ponds, river pools, flooded claypans, freshwater soaks and ephemeral waters (Johnstone et al. 2013).	Possible Nearest DPaW (2016a) records located ~25 km north-east of the Study Area at Marble Bar from 2005. The species may occur as an irregular visitor to pools within the Riverine and Drainage Line habitats of the Study Area, but is not dependent on habitats within the Study Area.

Common name (*Scientific name*)	Conservation status		Broad habitat type	Likelihood of occurrence
	EPBC Act	In WA		
Common Greenshank *Tringa nebularia*	Mi	S5	Species occurs as a non-breeding summer migrant which occurs throughout the region. Occurs mainly in Tidal mudflats, mangrove creeks, flooded samphire flats, beaches, river pools, and saltwork and sewage ponds (Johnstone et al. 2013).	Possible Nearest DPaW (2016a) record located ~25 km north-east of the Study Area, from freshwater pools east of Marble Bar. The species may occur as an irregular visitor to pools within the Riverine and Drainage Line habitats of the Study Area, but is not dependent on habitats within the Study Area.
Glossy Ibis *Plegadis falcinellus*	Mi	S5	Freshwater wetlands, irrigated areas, margins of dams, floodplains, brackish and saline wetlands, tidal mudflats, pastures, lawns and public gardens (Johnstone et al. 2013).	Possible Nearest DPaW (2016a) record located ~50 km north of the Study Area, from the Coongan Riverine system. The species may occur as an irregular visitor to pools within the Riverine and Drainage Line habitats of the Study Area, but is not dependent on habitats within the Study Area.
Barn Swallow *Hirundo rustica*	Mi	S5	Open country in coastal lowlands, often near water, towns and cities. Also over freshwater wetlands, paperbark woodland, mesophyll shrub thickets and grasslands (Pizzey and Knight 2012).	Unlikely Nearest DPaW (2016a) record located ~150 km north-west of the Study Area, from Port Hedland and no inland records of the species. Species only recorded from DoEE Protected Matters database, which is based on estimated species distribution, rather than actual field records.

Common name (*Scientific name*)	Conservation status		Broad habitat type	Likelihood of occurrence
	EPBC Act	In WA		
Grey Wagtail *Motacilla cinerea*	Mi	S5	Little is known about the biology of the Grey Wagtail. This species occurs near fast-flowing water(Pizzey and Knight 2012).	Unlikely Nearest DPaW (2016a) record located ~550 km north-west of the Study Area, from Broome. Species only recorded from DoEE Protected Matters database, which is based on estimated species distribution, rather than actual field records.
Yellow Wagtail *Motacilla flava*	Mi	S5	Little is known about the biology of the Yellow Wagtail. This species occurs near salt works, paddocks and marshes (Pizzey and Knight 2012).	Unlikely No previous surveys in the vicinity of the Study Area have recorded the species and it was reported only by the DoE Protected Matters database, which is based on estimated species distributions rather than actual field records.
Cattle Egret *Ardea ibis*		S5	Occurs in a wide range of habitats including, marshes, reservoirs, lakes, swamps, and riverside woodlands and often forage in fields with grazing livestock (Pizzey and Knight 2012{Johnstone, 1998 #1545)}.	Unlikely Nearest DPaW (2016a) record located ~160 km south of the Study Area, from the Fortescue Marsh and generally very few inland records of the species. Species only recorded from DoEE Protected Matters database, which is based on estimated species distribution, rather than actual field records.
Eastern Great Egret *Ardea modesta*		S5	Forages in a wide range of wetland habitats including, flooded claypans, flooded samphire (inundated by rain or high tides), river pools, sewage ponds, mangrove	Likely Nearest DPaW (2016b) records located ~8 km east

Common name (*Scientific name*)	Conservation status		Broad habitat type	Likelihood of occurrence
	EPBC Act	In WA		
			creeks and saltwork ponds (Johnstone et al. 2013). Breeding recorded in treed drainages lines and inland islands (Johnstone et al. 2013).	of the Study Area within Emu Creek, the same Riverine system that runs adjacent to the Study Area. Species also recorded by Outback Ecology (2010). Species is likely to forage and potentially nest within the Riverine and Drainage Line habitats occurring within the Study Area.
Rainbow Bee-eater *Merops ornatus*		S5	Lightly wooded, often sandy country, preferring areas near water (Johnstone et al. 2013).	Confirmed The species was recorded from 61 records within the Study Area. Species recorded from most habitat types within the Study Area. Species likely to forage and breed within the Drainage Line and Riverine habitats of the Study Area.

Appendix C Northern Quoll Monitoring Program

Northern Quoll Monitoring Program

Corunna Downs

179-LAH-EN-REP-0002

Revision 2

Authorisation

Rev	Reason for Issue	Prepared	Checked	Authorised	Date
1	Compliance	Melissa Finlay	Esme Wink	Brendan Bow	10/01/17
2	Regulator Comments	Natassja Bell	Brendan Bow	Brendan Bow	16/05/2017



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Northern Quoll Monitoring Program

The Northern Quoll (*Dasyurus* hallucatus) was recorded during the Corunna Downs Baseline Surveys from 38 records including, four records from Phase 1 (one motion-sensor camera and three scat records), and 34 records from Phase 2 comprising eight direct captures, eight scat records and 18 motion-sensor camera records (15 targeted site deployments, two opportunistic site deployments, and one systematic trapping site). The Northern Quoll was also recorded in all 11 previous surveys conducted within the vicinity of the study area and was identified by two databases. The large number of records within the vicinity of the Study Area suggests that the species is relatively common in the local region. Atlas is therefore committed to implementing the following monitoring program.

1. Overview

This monitoring program aims to monitor the presence of Northern Quoll during the life of the Corunna Downs Project and to ensure the effectiveness of Atlas' management measures.

This monitoring program includes:

- **Baseline population survey**: A level 2 terrestrial fauna survey to determine to presence of a Northern Quoll population within the Study area.
- **Annual monitoring**: The aim of this program is to monitor Northern Quoll population trends during the life of the Project.
- **Opportunistic monitoring**: The aim of this program is to provide additional data collected by site personnel to supplement the annual monitoring program and further the protection of the Northern Quoll.
- **Rehabilitation monitoring**: The aim of this program is to determine Northern Quoll recolonisation in rehabilitated Project areas and rehabilitation success.

2. Monitoring Methods

Atlas will undertake monitoring of Northern Quoll throughout the life of the Project. The various monitoring methods that have been and will be deployed to ensure the continued presence of the Northern Quoll within the Development Area and wider region are discussed below.

2.1 Baseline Population Survey

A desktop study, comprising of database searches and literature reviews, was conducted prior to the initial field survey. The objective of the desktop study was to gather background information on the local region, to provide an indication of fauna species and habitats likely to be present, suitable survey methodology, and to provide a regional context to inform the analysis of field survey findings.

Prior to any field work, broad habitat types within the Study Area were identified from aerial photography, satellite imagery and topographical maps. A reconnaissance visit was used to acquire a more detailed understanding of the geology, landforms, terrestrial fauna habitats and vehicular access within the Study Area. During this reconnaissance visit, habitat types in the Study Area were ground-truthed and mapped at a broad scale using an iterative approach that combined rapid on-ground assessment points in the field, satellite imagery, aerial photography and digital elevation models.

Subsequent to the identification and ground-truthing of broad habitat types, sites for systematic sampling and targeted survey effort were identified. The indicative placement of sampling sites broadly followed a stratified random sampling design, although it was ensured that sites were placed in representative habitat types, had good spatial coverage across the Study Area, and considered access restrictions and the likelihood of supporting species of conservation significance. All locations were ground-truthed in the field prior to site establishment to ensure locations were in representative habitats and avoided disturbances such as drill pads, tracks and recent fire.

Systematic sampling sites were established in the Study Area. The sampling program implemented at each of these sites consisted of standardised trapping, fixed-time avifauna census, systematic searching (active searching), nocturnal spotlighting, motion-sensor camera deployments and bat echolocation recordings.

Full baseline population monitoring results can be found in the Corunna Downs Project: Terrestrial Vertebrate Fauna Baseline Survey report (MWH, 2016).

2.2 Annual Monitoring

Monitoring will be undertaken annually for the life of the Project, exceeding the recommendations of the EPBC Act Policy Statement 3.2, which recommends monitoring to be undertaken annually for the first two years of operations and then once every three years after that for the life of the Project (DoE, 2016).

Atlas will undertake annual Northern Quoll Monitoring between April and September in line with relevant guidelines (Dunlop 2014, DOE 2016). The dates for the survey will be aligned with the most appropriate moon phase to maximise activity while pertaining to the most appropriate sampling season for Northern Quolls (and Pilbara Leaf-nosed Bat).

Eight locations, selected on their basis as previously recorded locations for this species, will be monitored (Attachment 1). Ten cameras will be established at each monitoring site over four nights. Each camera will be established on permanent mounting posts or similar, to ensure the same locations can be monitored each year and will be baited with a perforated piece of PVC pipe containing universal bait. This method has been successful in detecting Northern Quolls at other Atlas sites where population's densities are thought to be low.

The setup of the remote sensor cameras will be undertaken in accordance with the Department of Environment and Conservation (now Department of Parks and Wildlife) Standard Operating Procedure – Remote operation of cameras (SOP No:5.2) (April 2011).

The benefits for this type of monitoring are:

- Maximise the chance of detecting the species;
- Positioned in habitat critical for the survival of the species;

- Monitor all representative habitat types;
- Less labour intensive, more practical for working in remote areas;
- Becoming the preferred form of monitoring;
- Detect other species present as well, which may pose a threat to the Northern Quoll (e.g. Cats) and allow for further management measures to be implemented to protect the Northern Quoll;
- More effective at capturing shy wildlife;
- Monitor how many different species are in the area; and
- Non-invasive.

Absence/presence of Northern Quolls will be recorded using motion cameras across all sites. Cameras can also document patterns of movement and activity, and in certain circumstances individual Northern Quolls can be distinguished based on the timing of photos and the size and other physical characteristics of individuals captured (Hohnen et al. 2012).

Photo monitoring points will also be established at each monitoring location to document any changes to the site over time. The following parameters will be assessed and measured, where present:

- Landscape, soil features and structural composition.
- Vegetation cover, condition and species composition.
- The presence or absence of habitat structures.
- The presence or absence of water.
- Types of disturbance and levels of disturbance.

2.3 Opportunistic Monitoring

Targeted opportunistic surveys will also be undertaken at each of the monitoring sites (i.e., 10 hours per site) to obtain direct visual records of Northern Quolls, or indirect records such as bones, carcasses, tracks and scats. Any opportunistic observations of Northern Quolls will be documented. Other species of conservation significance will also be recorded, if observed.

Northern Quoll sightings (including scats and tracks), injuries and mortalities will be reported to the Site Environmental Advisor. All records will be entered into a site database (InViron) and summaries will be included in the Annual Environmental Report (AER).

2.4 Rehabilitation Monitoring

Permanent monitoring sites established during operations will continue to be monitored in accordance with the approved mine closure plan. Additional monitoring sites will be established in rehabilitated areas when they become available to determine re-colonisation trends and rehabilitation effectiveness.

3. Reporting

A standalone report at the conclusion of each annual monitoring period will be prepared. This report will include the following sections; methods, results, discussion and recommendations. This report will also be appended to Atlas' AER.

4. Performance Criteria and Corrective Actions

Performance criteria for the Northern Quoll have been provided in the SSMP. Should this monitoring program indicate that these performance criteria are not being met; the relevant corrective actions will be implemented.

5. References

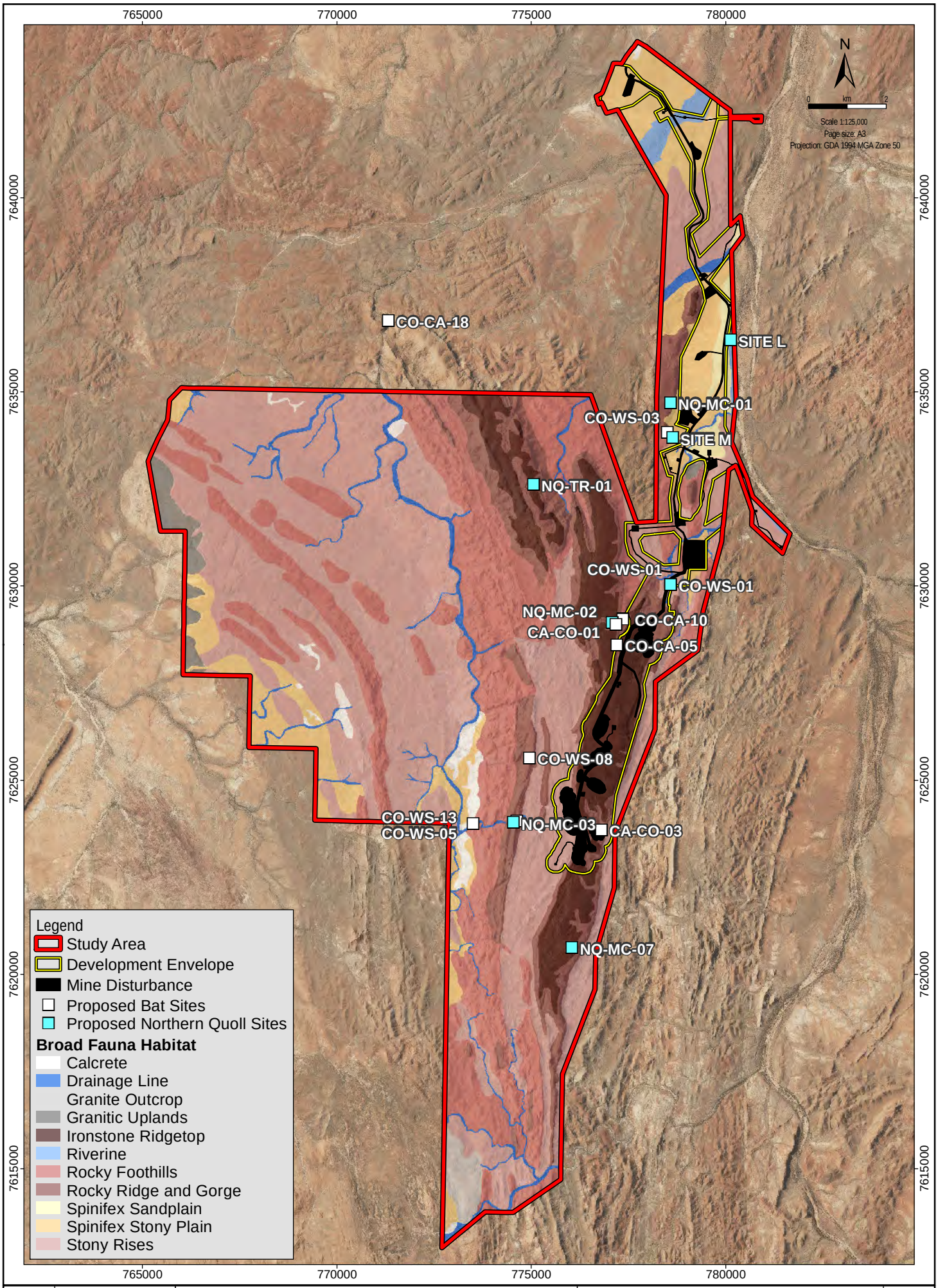
Davis, M. J. (2011). Standard Operating Procedure: Remote Operation of Cameras. Version 1.0 (April 2011). Prepared for Department of Environment and Conservation.

DoE. 2016. EPBC Act referral guideline for the endangered Northern Quoll *Dasyurus hallucatus*; EPBC Act Policy Statement. Department of the Environment. Canberra, ACT.

Dunlop, J., Cook, A. and Morris, K. (2014) Pilbara Northern Quoll project; Surveying and monitoring *Dasyurus hallucatus* in the Pilbara. Department of Parks and Wildlife, Perth, WA.

Hohnen, R., Ashby, J., Tuft, K. and McGregor, H. (2012) Individual identification of Northern Quolls (*Dasyurus hallucatus*) using remote cameras. *Australian Mammalogy* 35(2): 131-135.

Appendix A Proposed Monitoring Locations



ATLAS	File Name: GIS_2179.mxd Date: 16/05/2017 Author: cthatcher	Document Number : (QDMS number only) Source & Notes: *Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or omissions. It is not intended for publication.*	*Proposed Monitoring Locations*	Figure: 2.6

Appendix D Pilbara Leaf-nosed Bat and Ghost Bat Monitoring Program

Pilbara Leaf-nosed Bat and Ghost Bat Monitoring Program

Corunna Downs

179-LAH-EN-REP-0003

Revision 3

Authorisation

Rev	Reason for Issue	Prepared	Checked	Authorised	Date
1	Compliance	Melissa Finlay	Esme Wink	Brendan Bow	10/01/17
2	Regulator Comments	Natassja Bell	Brendan Bow	Brendan Bow	16/05/2017
3	Regulator Comments	Natassja Bell	Brendan Bow	Brendan Bow	09/06/2017



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Pilbara Leaf–nosed Bat and Ghost Bat Monitoring Program

The Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) and the Ghost Bat (*Macroderma gigas*) have both been recorded at various sites within the Study Area, however the focus of the monitoring will be on the Pilbara Leaf-nosed Bat, given the occurrence of important roosts for this species within the Study Area. The lack of echolocation calls and secondary evidence of the Ghost Bat during the surveys suggests that it is unlikely that important roosts for this species occur within the Study Area, particularly given the intensity of sampling during the surveys.

The most important features identified in the Study area, are cave CO-CA-01, a permanent diurnal roost for the Pilbara Leaf-nosed Bat, and cave CO-CA-03 a non-permanent breeding roost for the Pilbara Leaf-nosed Bat. A 340 m buffer will be maintained around Cave CO-CA-01 and a 50 m buffer will be maintained around Cave CO-CA-03.

1. Overview

This monitoring program aims to document changes to Pilbara Leaf-nosed Bat population over the life of the Project, assess the effectiveness of Atlas' management measures and more generally to build on the knowledge of the Pilbara Leaf-nosed Bat and Ghost Bat across its operations for future management planning and approval.

This monitoring program will include:

- **Baseline population survey:** level 2 terrestrial fauna survey and a targeted survey of significant caves for the Pilbara Leaf-nosed Bat and Ghost Bat populations within the Project area.
- **Annual monitoring:** The aim of this program is to assess bat activity levels within significant caves during the life of the Project.
- **Opportunistic monitoring:** The aim of this program is to provide additional data and information collected by site personnel to supplement the annual monitoring program, and to generate interest amongst site personnel in the protection of the Pilbara Leaf-nosed Bat and Ghost Bat.
- **Rehabilitation monitoring**: The aim of this program is to determine Pilbara Leaf-nosed Bat recolonisation in Cave CO-CA-03 post-mining.

2. Monitoring Method

Atlas will undertake monitoring of Pilbara Leaf-nosed Bat and Ghost Bat throughout the life of the Project. The various monitoring methods that have been and will be deployed to ensure the continued presence of these species within the Development Area and wider region are discussed below.

2.1 Baseline Population Survey

A desktop study, comprising of database searches and literature reviews, was conducted prior to the initial field survey. The objective of the desktop study was to gather background information on the local region, to provide an indication of fauna species and habitats likely to be present, suitable survey methodology, and to provide a regional context to inform the analysis of field survey findings.

Prior to any field work, broad habitat types within the Study Area were identified from aerial photography, satellite imagery and topographical maps. A reconnaissance visit was used to acquire a more detailed understanding of the geology, landforms, terrestrial fauna habitats and vehicular access within the Study Area. During this reconnaissance visit, habitat types in the Study Area were ground-truthed and mapped at a broad scale using an iterative approach that combined rapid on-ground assessment points in the field, satellite imagery, aerial photography and digital elevation models.

Subsequent to the identification and ground-truthing of broad habitat types, sites for systematic sampling and targeted survey effort were identified. The indicative placement of sampling sites broadly followed a stratified random sampling design, although it was ensured that sites were placed in representative habitat types, had good spatial coverage across the Study Area, and considered access restrictions and the likelihood of supporting species of conservation significance. All locations were ground-truthed in the field prior to site establishment to ensure locations were in representative habitats and avoided disturbances such as drill pads, tracks and recent fire.

Systematic sampling sites were established in the Study Area. The sampling program implemented at each of these sites consisted of standardised trapping, fixed-time avifauna census, systematic searching (active searching), nocturnal spotlighting, motion-sensor camera deployments and bat echolocation recordings.

Full baseline population monitoring results can be found in the Corunna Downs Project: Terrestrial Vertebrate Fauna Baseline Survey report (MWH, 2016).

2.2 Annual Monitoring

Pilbara Leaf-nosed Bat and Ghost Bat will be monitored annually between April and September. The dates for each monitoring event will be aligned with the most appropriate moon phase to maximise activity while pertaining to the most appropriate sampling season for Pilbara Leaf-nosed Bat (and Northern Quolls).

An SM2BAT device will be established at each of the ten monitoring sites (i.e., caves and waterholes) during the initial annual monitoring survey (Attachment 1). Sites were selected on their basis as a previously recorded location for these species (particularly Pilbara Leaf-nosed Bats, as they appear to be more reliant on habitat within the study area than Ghost Bats) and to ensure geographical coverage over the Study Area. The number or monitoring sites may be reduced for subsequent monitoring surveys once appropriate caves for annual monitoring have been selected similar to the approach taken at Atlas' other operations. All SM2BAT devices will be deployed for a minimum of seven nights.

The deployed SM2 units record Pilbara Leaf-nosed Bat activity and Ghost Bat presence during the monitoring period. Individual bat calls are identified from the SM2 echolocation recordings using COOL EDIT 2000 (now available as AUDITION from Adobe Systems Inc.). Once calls are identified, the species is confirmed by an experienced observer with reference to a database of reference calls. When quantified, calls are referred to as "passes'. For Pilbara Leaf-nosed Bats, the number of passes is an approximate reflection of the species activity at the location as individuals emit navigation calls in the vicinity of the microphone. Often one individual is responsible for multiple passes if it is active in close proximity to the SM2 for a period of time; as such, the number of calls recorded is not necessarily related to the number of individuals inhabiting or visiting a structure. Estimates of activity based on passes should therefore be considered as minimum, as an unknown percentage of the call sequence counted may have two or more bats present.

Ghost Bats are discussed in presence-absence terms only, as individuals of this species are capable of hunting and navigating entirely visually without recourse to calling, and are known to hang from cave walls for many minutes calling both socially and ultrasonically (Armstrong and Anstee 2000). Additionally, Ghost Bats may depart important day roost caves on dusk and not return until dawn (Armstrong and Anstee 2000), meaning that activity levels quantified using passes do not necessarily have any relationship with the significance of the cave to the species.

As with Atlas' other monitoring programs, the Pilbara Leaf-nosed Bat echolocation data collected during each monitoring event will be statistically compared to the baseline survey and any previous monitoring event using Analysis of Variance (ANOVA) (Minitab 2010). Due to the uneven numbers of control and impact caves and uneven numbers of recording nights among caves, the ANOVA will be conducted using a General Linear Model (GLM), with two factors of greatest interest:

- 'category'- which groups data according to whether they are from impact or control caves.
- 'year'- which groups data according to whether they are from the current or previous survey.'

Because of the substantial difference in the number of calls between nocturnal refuge cave and permanent diurnal roosts, these two types of features will be analysed separately. Tukey post-hoc test will be used to verify where significant differences lay.

As a decline in bat activity has been observed at roosts in this area of the Pilbara in 2015/2016 potentially as a result of very low rainfall, the 2016 monitoring event may not represent a baseline level of activity under good conditions. To address this issue the monitoring program will incorporate baseline data for CO-CA-01 from 2014 (pre-drought), 2015 and 2016 and 2017 (planned for July 2017 ahead of Project commencement). Project performance (i.e., changes in bat activity) will be measured against the baseline average across these four years.

Annual monitoring will also compare any changes in activity at this cave to changes in activity at regional caves (MW-AN-27 monitored from 2014 – current, R2 (Lalla Rookh) monitored from 2012 – current and newly discovered regional cave near Mt Webber (MW-CA-02 aka Daltons)), to understand whether any changes in activity are occurring at a local or regional scale. Habitat assessments and photo monitoring points will also be established at all bat monitoring locations to document any changes to the site over time. The following parameters will be assessed and measured, where applicable:

- Presence of bats, scat material and/or odours.
- Roost characteristics and condition (for example, rock falls, cracking etc.).

- Surrounding landscape, vegetation and presence of water.
- Noise and vibration levels (where mining activity comes within close proximity to any significant roosts). Monitoring of these parameters may occur separately to the scheduled annual monitoring program on an as needs basis.
- Presence and/or the impact of any artificial light sources.
- Bat behaviour in response to noise, vibration and light emissions (on an as needs basis in line with the two points above).

2.3 Opportunistic Monitoring

During the activities on site it is possible to obtain direct visual records of Pilbara Leaf-nosed Bats and/or Ghost Bats, or indirect records such as carcasses and scats. Any opportunistic observations of Pilbara Leaf-nosed Bats or Ghost Bats will be documented.

Pilbara Leaf-nosed Bats or Ghost Bats sightings (including scats), injuries and mortalities will be reported to the Corunna Downs Environmental Advisor. All records will be entered into a site database (InViron) and summaries will be included in the Annual Environmental Report (AER).

2.4 Rehabilitation Monitoring

Cave CO-CA-03 will continue to be monitored post mining in accordance with Section 2.2, should Pilbara Leaf-Nosed Bats be found to temporarily abandon this roost during mining, in accordance with the approved mine closure plan.

3. Reporting

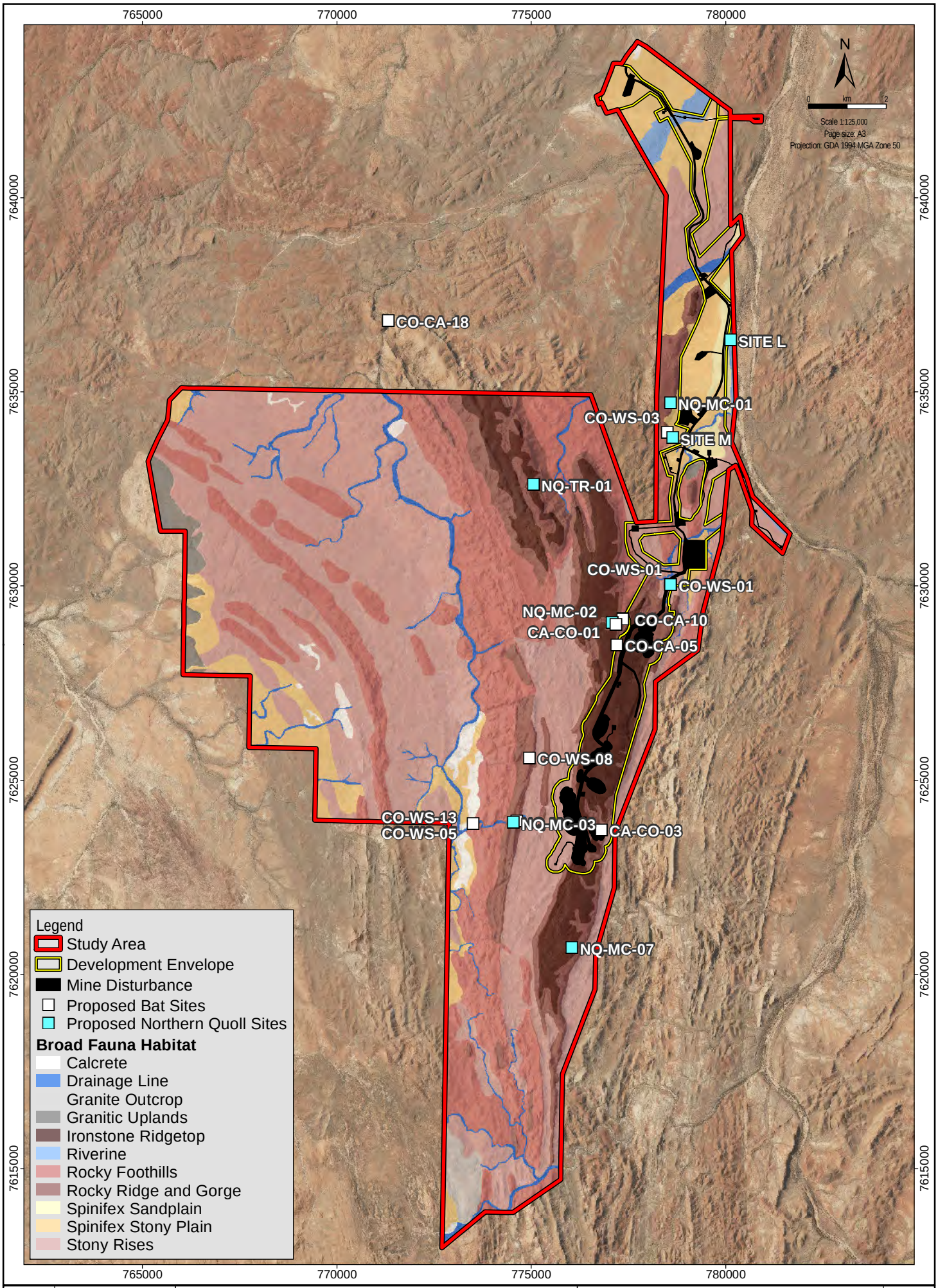
A standalone report at the conclusion of each annual monitoring period will be prepared. This report will include the following sections; methods, results, discussion and recommendations. This report will also be appended to Atlas' AER.

4. Performance Criteria and Corrective Actions

Performance criteria for the Pilbara Leaf-nosed Bat have been provided in the SSMP. Should this monitoring program indicate that these performance criteria are not being met; the relevant corrective actions will be implemented.

As surveys to date suggest that it is unlikely that important roosts for the Ghost Bat occur within the Study Area, no species specific performance criteria has been established for this species, rather the objective of monitoring for this species is to build on Atlas' knowledge of this species across its operations for future management planning and approval.

Appendix A Proposed Monitoring Locations



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