



**Caval Ridge Mine –
Horse Pit Extension
Project**

BHP Mitsubishi Alliance

Horse Pit Extension Project

**Preliminary Documentation
(EPBC 2021/9031)**

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- Appendix D Habitat Descriptions for 12 Threatened Species Specific to Central Queensland
- Appendix E1 Groundwater Dependant Ecosystems Impact Assessment Report
- Appendix E2 Groundwater Dependant Ecosystems Risk Assessment
- Appendix F Groundwater Impact Assessment Report
- Appendix G Surface Water Impact Assessment Report
- Appendix H Aquatic Ecology Impact Assessment Report
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- Appendix J Third Party Technical Review - Groundwater Impact Assessment
- Appendix K Caval Ridge Mine Environmental Authority (EPML00562013)
- Appendix L Environmental Offset Strategy
- Appendix M Offset Area Management Plan – Inderi
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- Appendix O CVM Environmental Management Plans
- Appendix P Project Team
- Appendix Q Preliminary Documentation Request for Information Addendum
- Appendix R Response to Submissions

Abbreviations

%	Percentage
ACARP	Australian Coal Association Research Program
AEP	Annual Exceedance Probability
AHD	Australian height datum
ALA	Atlas of Living Australia
ANFO	Ammonium nitrate/fuel oil
AR&R	Australian rainfall and runoff
AWL	Associated water license
BCM	Bank Cubic Metre
BHP	BHP Minerals Australia
BMA	BM Alliance Coal Operations Pty Ltd
BMC	BHP Mitsui Coal
BVGs	Broad vegetation groups
CBD	Convention on Biological Diversity
CHPP	Coal handling and preparation plant
cm	Centimetre
CVM	Caval Ridge Mine
DAWE	Department of Agriculture, Water and the Environment
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DES	Department of Environment and Science
DNRME	Department of Natural Resources, Mines and Energy
DoR	Department of Resources
DoE	Department of the Environment
DTW	Depth to Water
EA	Environmental Authority
EC	Electrical conductivity
EIS	Environmental Impact Statement
EME	Earth-Moving-Equipment
EO	Environmental offsets
EOP	Environmental Offsets Policy
EP Act	Environmental Protection Act 1994 (Queensland)
EPBC Act	Environment Protection and Biodiversity Conservation Act
EPPs	Environmental protection policies
EPOLA Act	Environmental Protection (Underground Water Management) and Other Legislation Amendment Act 2016 (Queensland)
EMS	Environmental Management System
ESC	Erosion and sediment controls
ESD	Ecologically sustainable development
EV	Environmental Values
FTE	Full time equivalent
FY	Financial Year
GDEs	Groundwater dependant ecosystems
GHG	Greenhouse gases
GMA	Groundwater management areas
ha	Hectares

HVR	High value regrowth
IESC	Independent expert scientific committee
IPD	In pit spoil dumps
IRC	Isaac Regional Council
km	Kilometres
km ²	Square kilometres
LOM	Life of mine
LOX	Limit of oxidation
m	Meter
m ³	Meters cubed
MAW	Mine affected water
mbgl	Metres below ground level
MCMs	Moranbah coal measures
MERFP Act	Mineral and Energy Resources (Financial Provisioning) Act 2018 (Queensland)
mg/L	Milligrams per litre
MIA	Mine infrastructure area
ML	Mining lease
ML/day	Megalitres per day
ML/year	Megalitres per year
MNES	Matters of national environmental significance
MSES	Matters of state environmental significant
Mtpa	Million tonnes per annum
NA	Not applicable
NAF	Non-acid forming
OAMP	Offset Area Management Plan
OIA	Offset Investigation Area
OOPD	Out of pit dump
PDM	Peak Downs Mine
PMF	Probable maximum flood
PMST	Protected Matters Search Tool
PRCP	Progressive rehabilitation and closure plan
RE	Regional ecosystem
REMP	Receiving environment monitoring program
ROM	Run-of-mine
ROPs	Resource operations plans
SOPs	Standard operating procedures
SPRAT	Species Profile and Threats Database
STP	Sewage treatment plant
SWI	Standard work instruction
t/y	Tonnes/year
TARP	Trigger Action Response Plan
TDS	Total dissolved solids
TEC	Threatened Ecological Community
TGDE	Terrestrial groundwater dependant ecosystems
TLF	Train load-out facility
tph	Tonnes per hour
TSS	Total suspended solids

VM Act	Vegetation Management Act 1999 (Queensland)
WBM	Water Balance Model
WMP	Water management plan
WQO	Water quality objective
WRPs	Water resource plans
WROLA Act	Water Reform and Other Legislation Amendment Act 2014 (Queensland)
WWB	Water and wetland biodiversity

1 Introduction

This Preliminary Documentation Report has been prepared in support of the environmental approvals under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for the Horse Pit Extension Project (the Project).

The Project proposes to extend the footprint of the existing Horse Pit at the Caval Ridge Mine (the CVM). The CVM is owned and operated by BM Alliance Coal Operations Pty Ltd (BMA) and is located approximately 5 kilometres (km) south-west of Moranbah in the Bowen Basin, Queensland. As a result of exploiting efficiencies in mine sequencing and planning, mining activities are currently scheduled to reach the limit of the approved Horse Pit extent during Financial Year (FY) 2025.

The CVM commenced operation in 2014. The open cut mining operation at the CVM uses dragline and truck/shovel equipment to supply hard coking coal product for the export market. There are two (2) pits at the CVM: Horse Pit and Heyford Pit. These pits are supported by a range of existing infrastructure including the Caval Ridge rail spur (Goonyella System), Train Load-out Facility (TLF), coal stockpiles, Run-of-Mine (ROM) stockpiles, In Pit Spoil Dumps (IPD), Coal Handling and Preparation Plant (CHPP), water management infrastructure and other supporting infrastructure (i.e., roads, powerlines, laydown areas, workshops and offices). The CVM is located primarily within ML 1775, with Harrow Creek acting as the southernmost boundary of the CVM. Associated infrastructure for the CVM is located on ML 70403 and ML 70462.

The operations at the CVM are pursuant to the conditions of the Caval Ridge Coal Mine Project EPBC Act approval (2008/4417) issued by the Australian Government Department of Agriculture, Water and the Environment (DAWE), and the Environmental Authority EPML00562013 (the EA) issued by the Queensland Department of Environment and Science (DES). The responsibilities held by DAWE have since been transferred to the new Department of Climate Change, Energy, the Environment and Water (DCCEEW).

The Project was referred to the DAWE on 26th August 2021 (EPBC 2021/9031). The delegate of the Minister for the Environment determined on 19th November 2021 that the Project was a controlled action with the following controlling provisions:

- Listed threatened species and communities (section 18 and section 18A); and
- A water resource, in relation to coal seam gas development and large coal mining development (section 24D and section 24E).

The Minister's delegate determined the proposed action will be assessed by Preliminary Documentation. The information required for the Preliminary Documentation assessment was provided by the Minister's delegate and is included in **Appendix A**.

This Preliminary Documentation Report and supporting technical reports provide the information required for DCCEEW to make an assessment of the likely impacts to matters of national environmental significance (MNES). **Table 1-1** identifies where this information has been provided within the Preliminary Documentation. A detailed cross-reference table is included in **Appendix B**.

Furthermore, the Independent Expert Scientific Committee (IESC) was requested by the DCCEEW on 21st July 2022 to provide advice on the Project. The IESC provided advice on 3rd September 2022, with the Preliminary Documentation Report subsequently updated to provide clarification on matters raised (**Appendix Q**).

Table 1-1 Preliminary Documentation Cross Reference

Additional Information Requirement	Preliminary Documentation	Supporting Documentation
Description of the Action	Section 2	-
Habitat Assessment	Section 3	Appendix C Appendix D
Impact Assessment	Section 4	Appendix C Appendix E1 Appendix E2 Appendix F Appendix G Appendix H Appendix I Appendix J
Avoidance, Mitigation and Management Measures	Section 5	Appendix C Appendix E1 Appendix F Appendix G Appendix H Appendix I Appendix O
Rehabilitation Requirements	Section 6	Appendix K
Offsets	Section 7	Appendix L Appendix M Appendix N
Ecologically Sustainable Development (ESD)	Section 8	-
Economic and Social Matters	Section 9	-
Environmental Record of the Person Proposing to take the Action	Section 10	-

1.1 Publication

The draft Preliminary Documentation Report was made available for public comment in accordance with the requirements of the EPBC Act for assessment by Preliminary Documentation.

Documents were available for public comment from 18 September 2023 to close of business on 29 September 2023. BMA received 416 submissions during the notification period. Each submission on the Project was reviewed and addressed individually. Appendix R provides each of the submissions received and corresponding responses.

2 Description of the Action

2.1 Project Background

The CVM is located within ML 1775, ML 70403 and ML 70462, with Harrow Creek acting as the southernmost boundary of the CVM. Associated infrastructure for the CVM is located on ML 70403 and ML 70462. The CVM mines up to 15 million tonnes per annum (Mtpa) of ROM coal. The CVM also receives ROM coal from BMA's neighbouring Peak Downs Mine (PDM), via conveyor, for processing.

The CVM includes two (2) pits: Horse Pit (north of Peak Downs Highway) and Heyford Pit (north of Harrow Creek), both located within ML 1775, including IPD. Existing infrastructure is located primarily within ML 70403 and ML 70462 and includes the Caval Ridge rail spur (Goonyella System), TLF and coal stockpiles, ROM stockpiles, Out of Pit Spoil Dumps (OOPD), CHPP, water management infrastructure and supporting infrastructure (i.e., roads, powerlines, laydown area, workshops and offices). The CVM and Project location are presented in **Figure 2-1**.

In 2010, the CVM EPBC approval (2008/4417) was based on a 30-year mine plan across defined extents for Horse Pit and Heyford Pit. The proposed action is to extend the footprint of the existing Horse Pit and use existing supporting infrastructure as needed. The proposed Project represents a continuation of activities approved by the CVM EPBC approval for a footprint that progressively works eastward beyond the approved extent.

As a result of identifying efficiencies in mine sequencing and planning, mining activities at the CVM are currently scheduled to reach the limit of the approved Horse Pit extent during FY2025, with some supporting infrastructure potentially required to be relocated from 2023 to allow for pit progression. The extension proposed will extend the mine's life by approximately 20 years, protecting jobs and royalties into the future. Exploration activities will be ongoing for the life of the mine.

2.1.1 Operations at the CVM

In addition to the conditions of the Caval Ridge Coal Mine Project EPBC approval (2008/4417), operations at the CVM are also regulated by the Queensland DES and undertaken pursuant to the EA. The EA establishes conditions relating to aspects of:

- Overall prevention and/or minimising of likelihood of environmental harm;
- Monitoring and reporting (including notifications to Regulators);
- Air quality (particularly odour and dust);
- Noise and vibration;
- Waste management;
- Land management (including topsoil treatment, rehabilitation requirements, closure management, flora and fauna);
- Water management (including contaminants, mine affected water (MAW), releases, reuse);
- Structures (including design requirements and certification, storage allowance, decommissioning);
- Sewage treatment; and
- Groundwater monitoring.

A copy of the current CVM EA is provided in **Appendix K**. An application to amend the EA was submitted to the DES on 15 December 2021 to authorise the extension of Horse Pit and other infrastructure. The application is under assessment. For execution of the Project, management approaches and protocols are planned to remain consistent with existing operations however relevant management plans and protocols will be required to be updated to incorporate the Project infrastructure.

2.2 Project Area

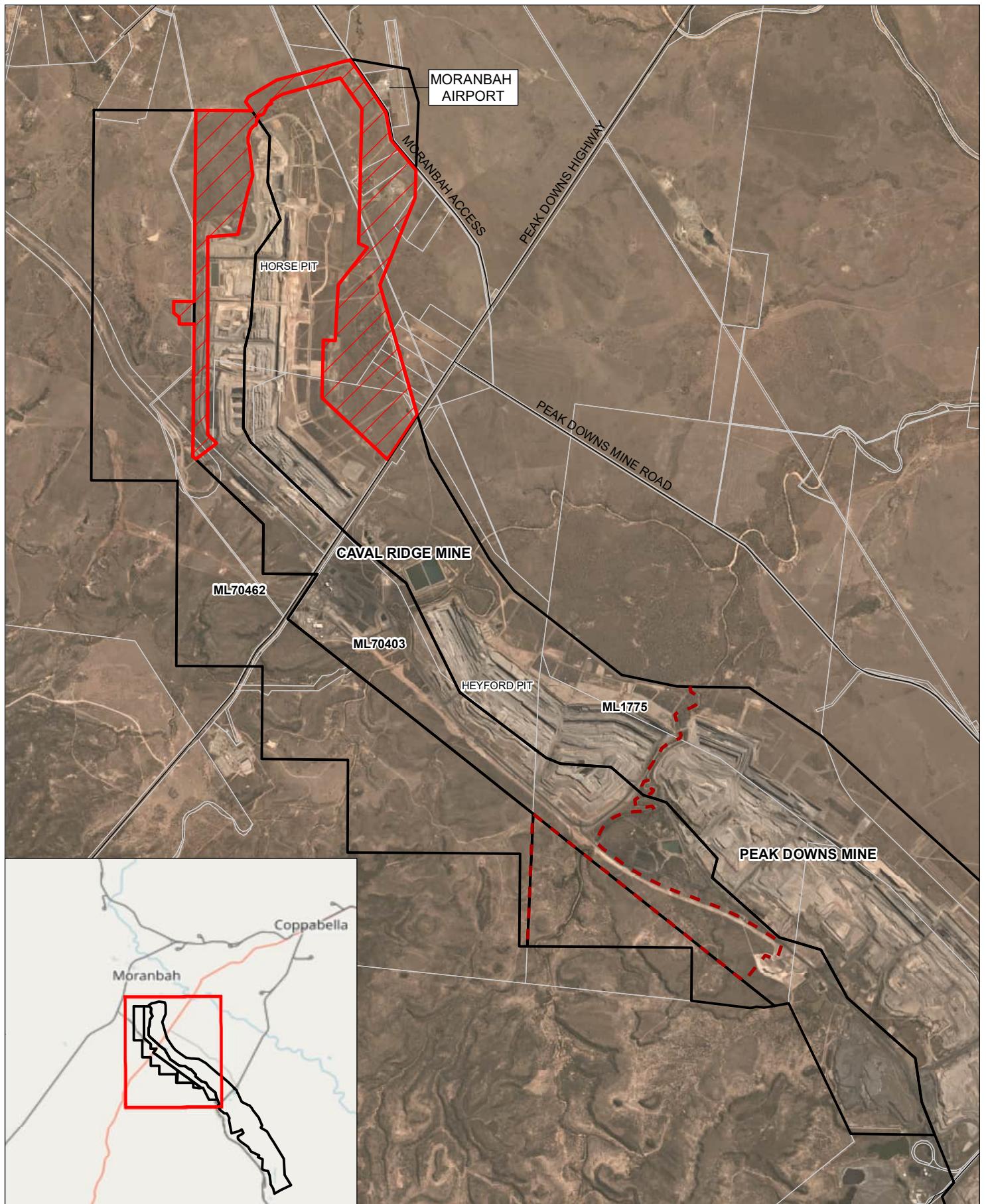
The Project Area submitted as part of the referral submission for the Project was 1,214 hectares (ha), with a disturbance area of 911 ha (comprising portions of ML 1775, ML 70403 and ML 70462). The Project Area coordinates are provided in **Table 2-1** and the Project disturbance area is outlined on **Figure 2-2**.

Table 2-1 Project Area Coordinates

ID ^A	Latitude	Longitude
1	-22.12741229	148.0373803
2	-22.10353939	148.0374127
3	-22.10361057	148.0345492
4	-22.10235311	148.0345400
5	-22.10162096	148.0334888
6	-22.09956198	148.0334570
7	-22.09952476	148.0374215
8	-22.06512570	148.0374651
9	-22.06512572	148.0482939
10	-22.06350029	148.0470683
11	-22.06105443	148.0504092
12	-22.05961869	148.0529873
13	-22.05586801	148.0672058
14	-22.06523500	148.0741352
15	-22.07024991	148.0751275
16	-22.07562509	148.0800751
17	-22.08058656	148.0799308
18	-22.09629635	148.0732376
19	-22.11959945	148.0806316
20	-22.12770741	148.0749363
21	-22.11673670	148.0622033
22	-22.10629712	148.0623529
23	-22.10635437	148.0646527
24	-22.09635453	148.0651809
25	-22.08956071	148.0708067
26	-22.08885973	148.0690512
27	-22.06470668	148.0695551
28	-22.05913064	148.0653032
29	-22.06207989	148.0541609
30	-22.06378446	148.0520766
31	-22.06451494	148.0510932
32	-22.06597730	148.0496121
33	-22.06764140	148.0491589
34	-22.06988765	148.0475798

ID ^A	Latitude	Longitude
35	-22.07162291	148.0478381
36	-22.0768154	148.0485307
37	-22.08742584	148.0457529
38	-22.08787117	148.0399480
39	-22.12343345	148.0402089
40	-22.12502802	148.0419009
41	-22.12791656	148.0379538

^A Corresponding identification points defining the Project Area are outlined on **Figure 2-2**.



0 1 2 km

Projection: GDA 1994 MGA Zone 55
 Scale: 1:100,000 at A4
 Project No.: 620.13593
 Date: 08-Apr-2022
 Drawn by: PM

Roads

Dashed red line: Caval Ridge Mine and Peak Downs Mine Boundary

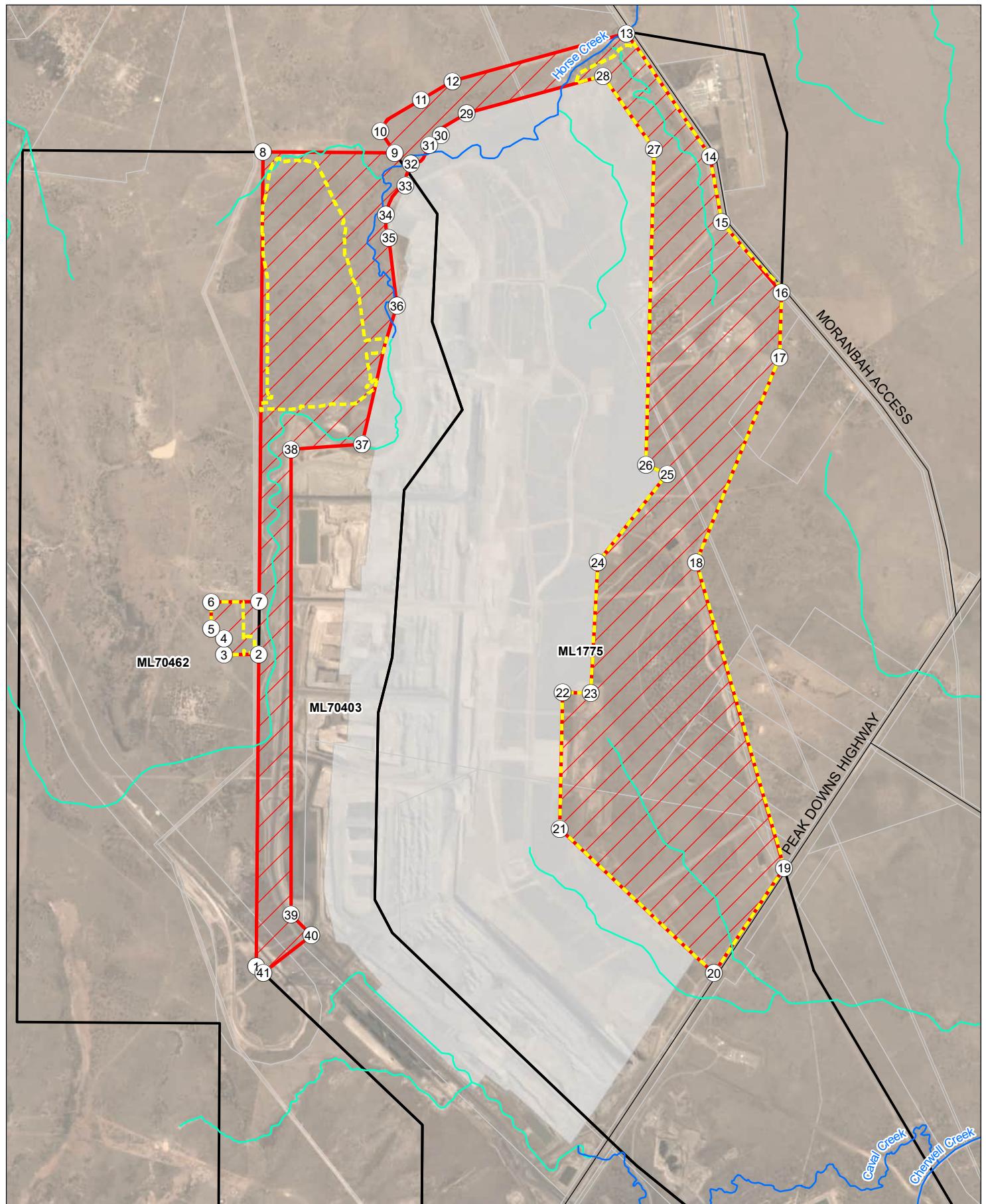
Red hatched area: Project Area

Black rectangle: BHP Tenements

White rectangle: Cadastre

Horse Pit Extension Project EPBC Act Preliminary Documentation (EPBC 2021/9031)

Project Location



0 0.5 1 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:42,500 at A4
Project No.: 620.13593
Date: 17-May-2022
Drawn by: PM

- Project Coordinate Points
- Watercourses (Water Act 2000)
- Drainage features
- Roads
- BHP Tenements
- Cadastre

- Disturbance Footprint
- Project Area
- Caval Ridge EIS Pit Boundary (2010)

**Horse Pit Extension Project
EPBC Act Preliminary
Documentation
(EPBC 2021/9031)**

Project Area and Disturbance Area

2.3 Project Overview

The Project Area covers parts of MLs: ML 1775, ML 70403 and ML 70462 and is confined to the Horse Pit area north of the Peak Downs Highway. The Project overview is shown on **Figure 2-3** and key elements of the Project are summarised below.

The Project components, disturbance and timeframes outlined in the EPBC Act Referral Submission (26 August 2021) remain unchanged at the time of the advertisement and submission of this Preliminary Documentation Report.

2.3.1 Mining

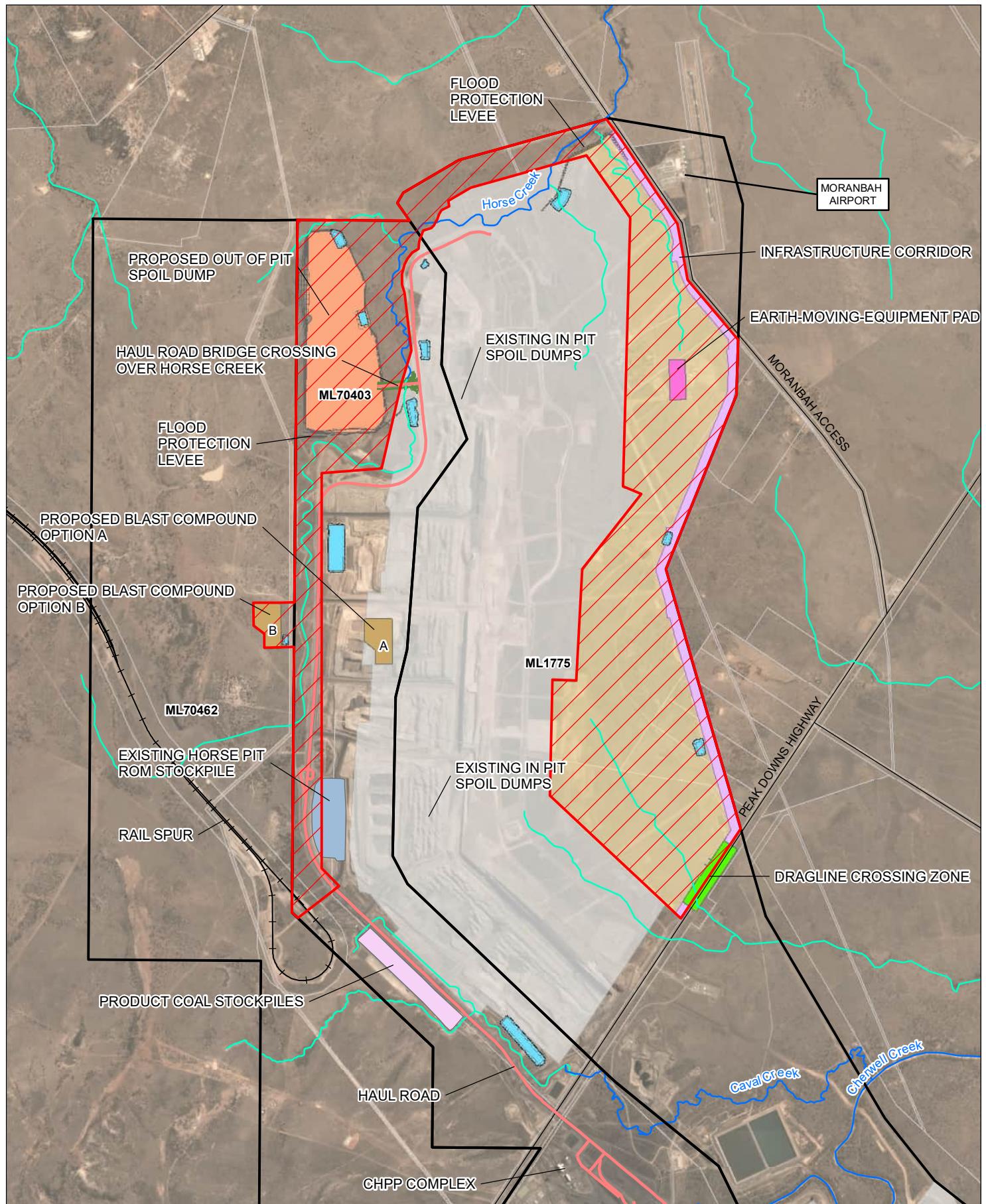
The key mining elements of the Project are detailed in **Section 2.4** and summarised below:

- Extension beyond the approved extent of the existing Horse Pit from FY2025, exclusive of Moranbah Airport and the Moranbah Access Road;
- Increase the CVM ROM coal production up to 15 Mtpa;
- Revise the CVM Life of Mine (LOM) to FY2056;
- Development of an OOPD in the north-west of ML 70403 (commencing in FY2028);
- Continuation of progressive rehabilitation of disturbed areas with the aim of progressing to a final landform design, including a final void in the far east of ML 1775 at the conclusion of mining;
- Continuation of current open cut mining techniques employed at the CVM;
- Continuation of progressive disposal of mining waste to IPDs;
- Continued use of the existing accommodation and workforce strategy; and
- Continuation of exploration activities.

2.3.2 Mine Infrastructure

The key mine infrastructure elements of the Project are detailed in **Section 2.5** and summarised below:

- Relocation of enabling infrastructure, including: an Earth-Moving-Equipment (EME) Build Pad, blasting compound (two (2) potential relocation options), go-lines, substations, back-access roads and powerlines as required by the progress of mining;
- Extension of the haul road to access to the proposed OOPD in the north-west of ML 70403 including the construction of a bridge over Horse Creek;
- Construction of two (2) flood levees: the northern levee bounds a portion of Horse Pit and the western levee is located at the south-west extent of the proposed OOPD;
- Relocation of mine water dams and pipelines as required by the progress of mining;
- Expansion of sediment dam capacities and construction of new sediment dams, clean water diversion drains and MAW drains to manage runoff associated with the proposed OOPD;
- Relocation of the Peak Downs Highway dragline crossing;
- Continued use of the CHPP complex, no upgrades to the CHPP are required as a result of the Project;
- Continued disposal of dewatered tailings and rejects within spoil; and
- Continued use of the conveyor from PDM, Caval Ridge rail spur, TLF, product coal stockpiles, ROM stockpiles, water management system and supporting infrastructure (i.e., roads, powerlines, laydown, maintenance equipment, workshops and offices).



0 0.5 1 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:50,000 at A4
Project No.: 620.13593
Date: 23-May-2022
Drawn by: PM

- Existing Road
- Existing Rail
- Zone for Dragline Crossing
- Existing Horse ROM Stockpile
- Product Coal Stockpiles
- Caval Ridge EIS Pit Boundary (2010)
- BHP Tenements
- Cadastre
- Existing Watercourses (Water Act 2000)
- Drainage features
- Proposed Water Management Infrastructure
- Bridge over Horse Creek
- Haul Roads
- Dams
- Infrastructure Corridor
- Proposed EME Build Pad
- Proposed Blast Compound Options
- Proposed Out of Pit Dump
- Horse Pit Extension
- Project Area

Horse Pit Extension Project EPBC Act Preliminary Documentation (EPBC 2021/9031)

Project Overview

2.4 Mine Planning and Design

2.4.1 Mining Method

The mining method utilised for the Project will be consistent with the current operations at the CVM, i.e., open cut mining methods utilising dragline and truck/shovel equipment. This is a proven mining method at the CVM that operates efficiently with resource geometry and offers operational flexibility. Operations will continue to run seven (7) days per week on a 24hr basis. As the Project is a continuation of the existing CVM operations, there are no distinct construction and operation phases for the Project.

Mining activities commence with vegetation clearing and topsoil stripping. All topsoil is stripped using earthmoving equipment, and relocated using front end loaders, trucks and/or scraper fleet, and will be stockpiled in preparation for progressive rehabilitation behind the active dumps. Direct respread will be the preferred method, where practical, to minimise topsoil handling, which reduces loss of viability from damage to soil structure and propagules.

Following topsoil stripping, drilling and blasting will be undertaken to assist in removal of overburden and interburden material. The removal of overburden will continue as per current methods by utilising a combination of truck/shovel fleets, dozers and draglines. At Horse Pit, all seam Limit of Oxidation (LOX) lines are mined, and mining will continue down dip to the east as target seams become deeper. Initially, overburden will be primarily removed using a dragline. In deeper extents of the pit, an increased proportion of the overburden material will be removed using truck/shovel. In general, excavated waste material will be placed in mined out voids to the west of active strip as mining operations progress down dip to the east.

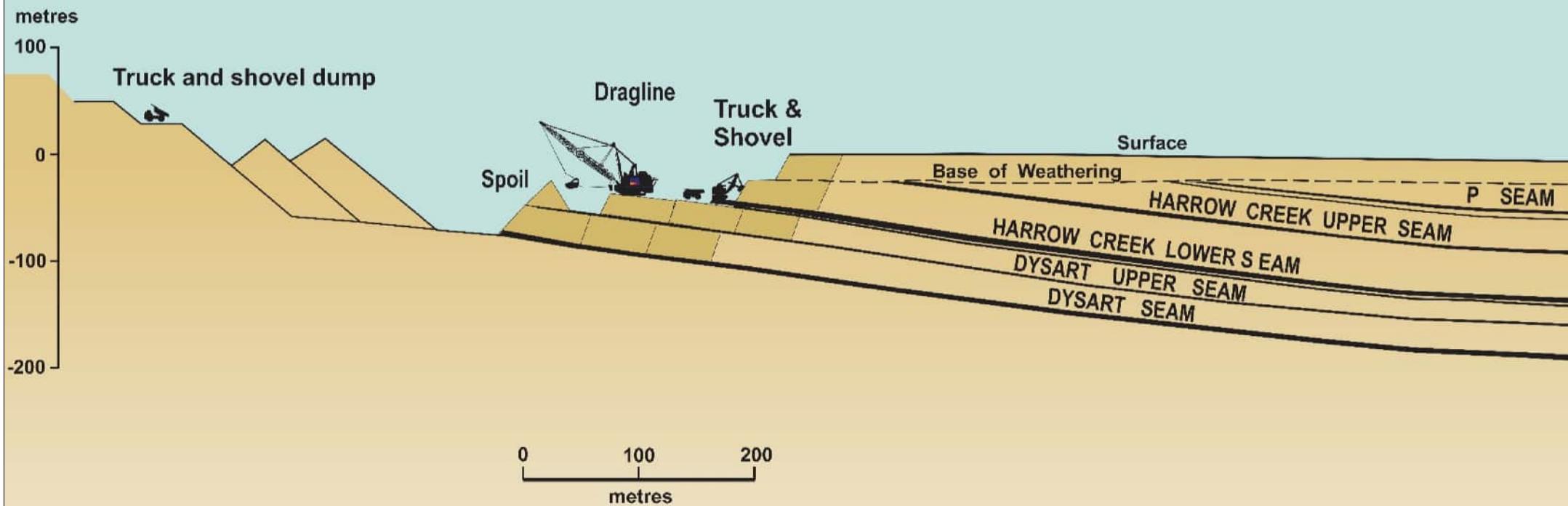
In addition, preparation for construction of a new OOPD will commence during FY2028 to the northwest of Horse Pit. Overburden material will be mined and managed via spoil disposal in existing in-pit dump area at the CVM as a priority, and the proposed OOPD location to the north-west of Horse Pit in ML 70403 when additional capacity is required.

The strip-mining technique currently in practice at the CVM will continue for the Project. The length of the strip is typically 1.5 km to 2 km, with strip widths of 60 meters (m). The strips will be constructed in a north-south direction along the strike of the coal seams. The angle of the high wall will be dependent on the nature of the high wall materials and geotechnical conditions. Coal ramps will extend into the active pits with the surface haul roads connecting them to the ROM stockpiles.

The number of strips opened at any given time depends on the coal production schedule and equipment productivity requirements. Coal mining of upper and lower seams will continue to use a combination of excavators and loaders. Once the coal has been exposed, it is loaded by excavators and loaders into trucks for hauling on the network of haul roads to the ROM coal stockpiles. The ROM coal will then be screened, crushed and stored in the raw coal stockyard for processing. Reject material from coal handling and processing is mixed with dewatered tailings and co-disposed with spoil in IPD. Final dumps are capped with clean spoil material and will not include reject materials. The product coal is conveyed from the CHPP to stockpiles and transported to the TLF for rail out via the CVM rail spur and Goonyella Line to the Hay Point Coal Terminal.

A typical mining section of the operating Horse Pit is shown in **Figure 2-4** and a schematic of the mining process at the CVM is shown in **Figure 2-5**.

HORSE PIT EXTENSION TYPICAL MINING SECTION



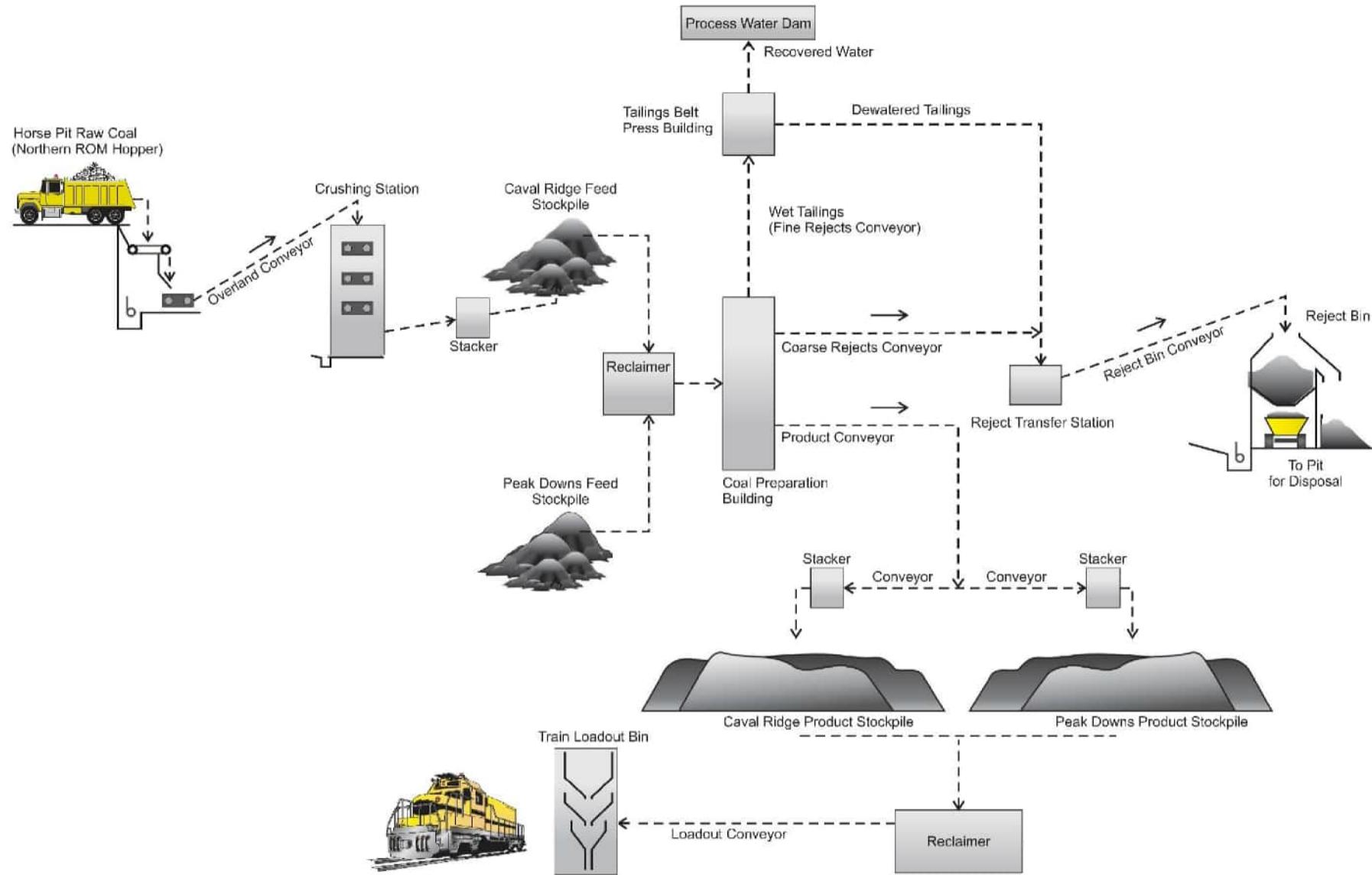
Project Number: 620.13593
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Horse Pit Extension Project
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Typical Mining Section – Horse Pit Extension

FIGURE 2-4



Project Number:	620.13593
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Mining Process Overview – Horse Pit Extension

FIGURE 2-5

2.4.2 Mine Sequence and Schedule

The mine schedule has been developed based on the prioritisation of high margin areas and maintaining a pit configuration and sequence which will allow optimal utilisation of draglines. The mine schedule has been optimised based on air quality management considerations. The mine sequence and schedule also considers a targeted saleable blend of various seams with different qualities. The anticipated commencement of activities (e.g. vegetation clearing) outside the extent approved in the CVM EPBC approval (2008/4417) is FY2025. While mining is scheduled to commence FY2027, various infrastructure items that intersect the extension of Horse Pit will require relocation prior to FY2025 in preparation for mining. The assumed date for the conclusion of mining is FY2056 and establishment of the final landform will align with the CVM Progressive Rehabilitation and Closure Plan (PRCP) (currently under development for approval by the DES). The indicative mine schedule, inclusive of the Horse Pit extension is presented in **Figure 2-6** and the mine sequence is presented in **Figure 2-7**.

Mining will continue to the east and mined-out areas in the west will be progressively rehabilitated. The mining sequence for the Project will entail the following:

- Progressive land clearing and topsoil removal;
- Topsoil from disturbed areas directly respread or stockpiled for use in future rehabilitation of the CVM;
- Drill and blasting of overburden/interburden material (including through seam blasting);
- Pre-stripping/excavation of overburden material using excavators/shovels and trucks, draglines and dozers;
- Side casting of lower overburden into the previously mined strip using a dragline;
- Removal of overburden/interburden and placement in either the IPD or OOPD;
- Loading and hauling of ROM coal using a combination of excavators, loaders and trucks (the CVM will continue to receive ROM coal via conveyor from PDM); and
- Progressive rehabilitation by backfilling the mined-out pit, reshaping dumps, topsoiling/alternate growth media and revegetation.

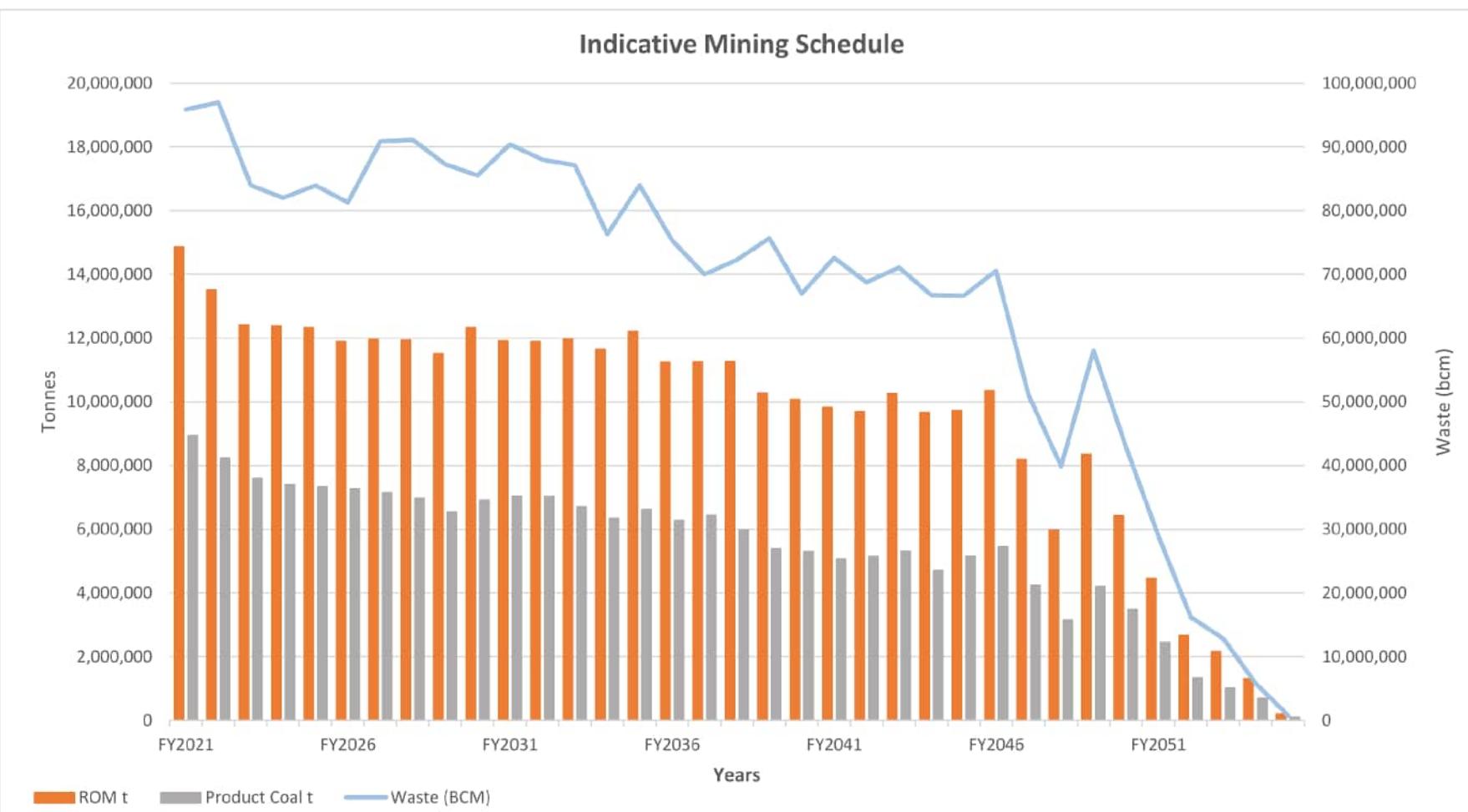
The 5-yearly mine plan outlining the proposed progressive landform is presented in **Figure 2-8** to **Figure 2-13**. The conceptual final landform including locations of elevated landforms (former OOPD) and the depressed landforms is presented in **Figure 2-14**.

2.4.3 Production Schedule

The maximum ROM coal production at the CVM is up to 15 Mtpa, with an average annual ROM coal production of 12.5 Mtpa over the LOM to FY2056. Up to 11 Mtpa of ROM coal from PDM will be transferred by conveyor to the CVM annually. Product coal output is likely to be up to 10 Mtpa, inclusive of ROM coal from PDM.

The final production sequence will depend on economic, scheduling and infrastructure constraints. Indicative ROM coal production for CVM is proposed to steadily decline from FY2038 to FY2056 from up to 15 Mtpa to less than 1 Mtpa in the final year of mining. Product coal for CVM will follow the same trend, decreasing from up to 9 Mtpa to less than 0.5 Mtpa.

The Project schedule showing ROM and product coal tonnes, and waste volume inclusive of the Horse Pit extension is presented in **Figure 2-6**.



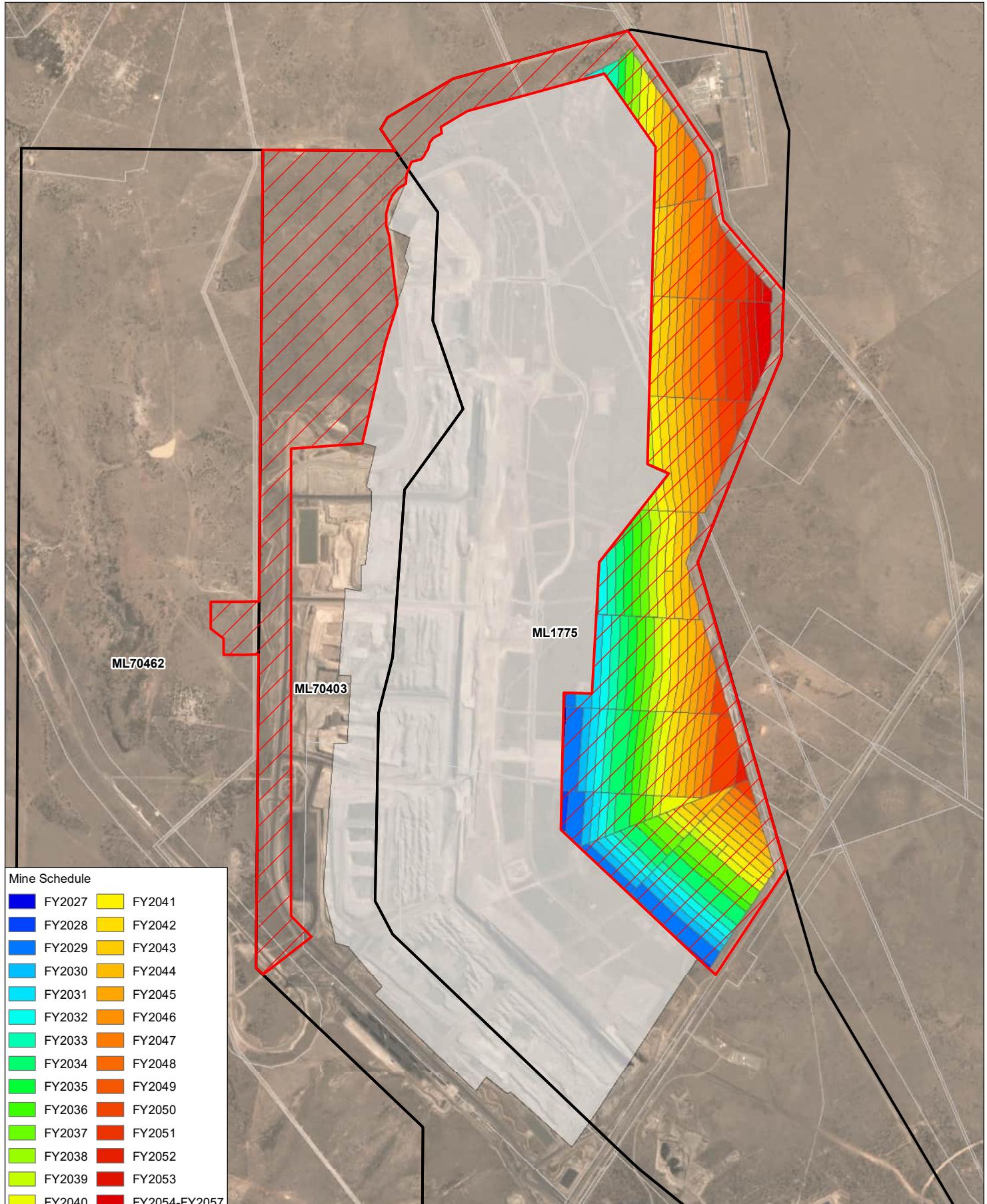
Project Number: 620.13593
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Horse Pit Extension Project
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Indicative Mine Schedule – Materials Movements

FIGURE 2-6

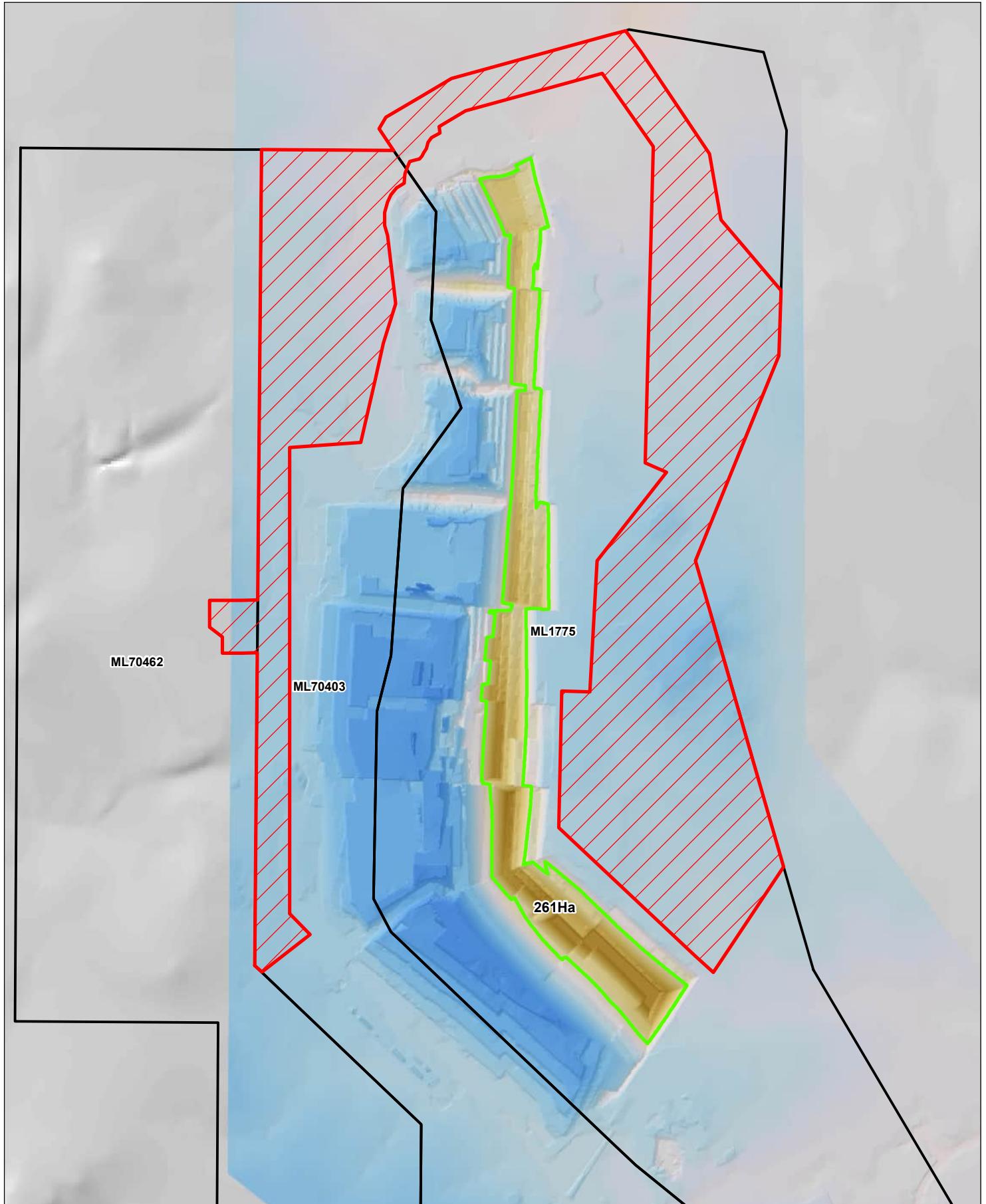


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Mine Sequence

 0 0.5 1 km
 Projection: GDA 1994 MGA Zone 55
 Scale: 1:42,500 at A4
 Project No.: 620.13593
 Date: 17-May-2022
 Drawn by: PM

 Project Area
 Caval Ridge EIS Pit Boundary (2010)
 BHP Tenements
 Cadastre



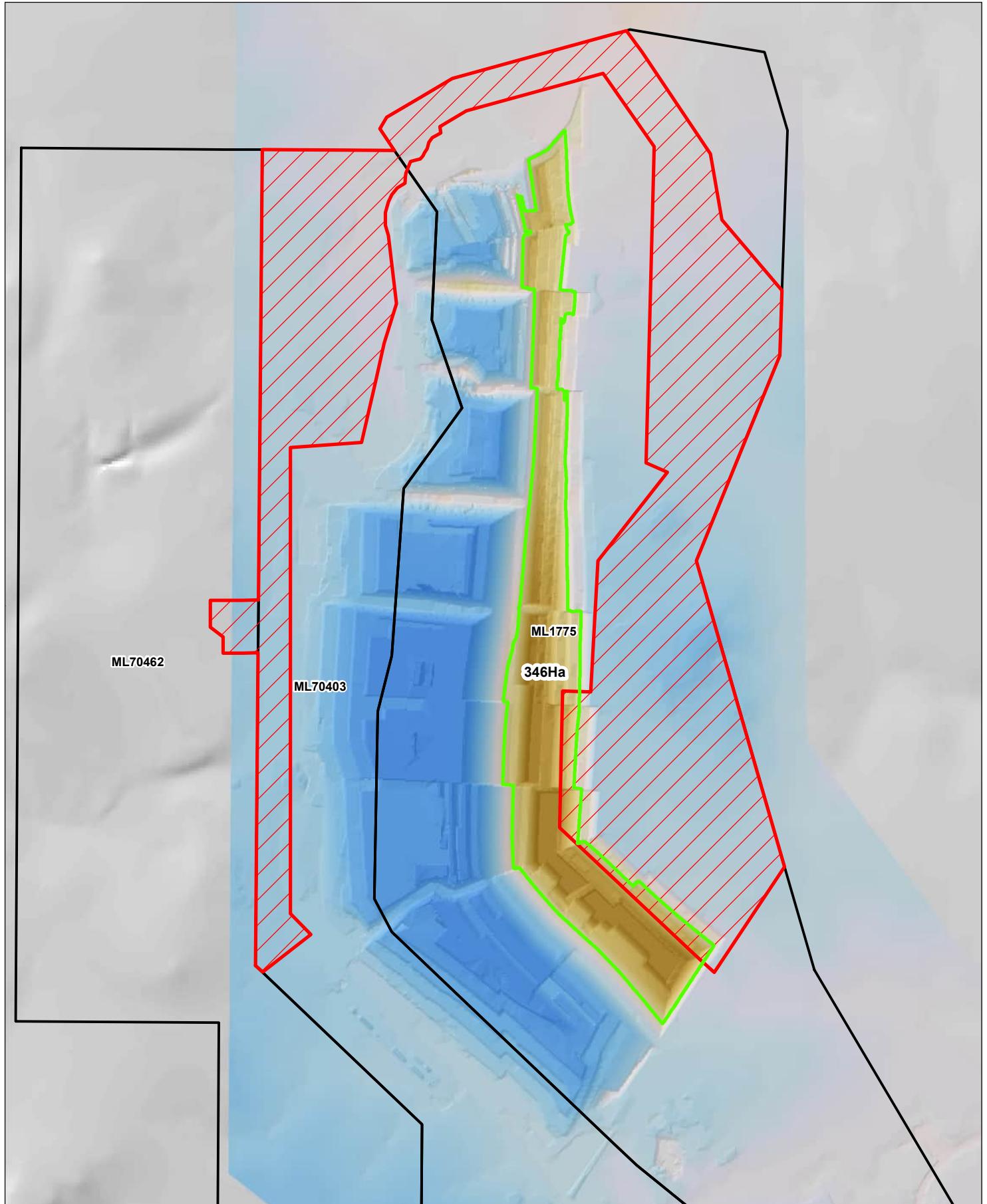
0 0.5 1 km

Projection: GDA 1994 MGA Zone 55
 Scale: 1:42,500 at A4
 Project No.: 620.13593
 Date: 30-Sep-2022
 Drawn by: PM

- Progressive Pit Extent
- Project Area
- BHP Tenements
- Elevation (mAHD)
 - High : 390
 - Low : 95

Horse Pit Extension Project
EPBC Act Preliminary Documentation
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Progressive Landform FY2025



0 0.5 1 km

Projection: GDA 1994 MGA Zone 55
 Scale: 1:42,500 at A4
 Project No.: 620.13593
 Date: 30-Sep-2022
 Drawn by: PM

- Progressive Pit Extent
- Project Area
- BHP Tenements
- Elevation (mAHD)
 - High : 390
 - Low : 95

Horse Pit Extension Project
EPBC Act Preliminary Documentation
(EPBC 2021/9031)

Progressive Landform FY2030



Projection: GDA 1994 MGA Zone 55

Scale: 1:42,500 at A4

Project No.: 620.13593

Date: 30-Sep-2022

Drawn by: PM

Progressive Pit Extent

Progressive Out of Pit Dump Extent

Project Area

BHP Tenements

Elevation (mAHD)

High : 390

Low : 95

Horse Pit Extension Project
EPBC Act Preliminary Documentation
(EPBC 2021/9031)

Progressive Landform FY2035

SLR

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0 0.5 1 km

Projection: GDA 1994 MGA Zone 55

Scale: 1:42,500 at A4

Project No.: 620.13593

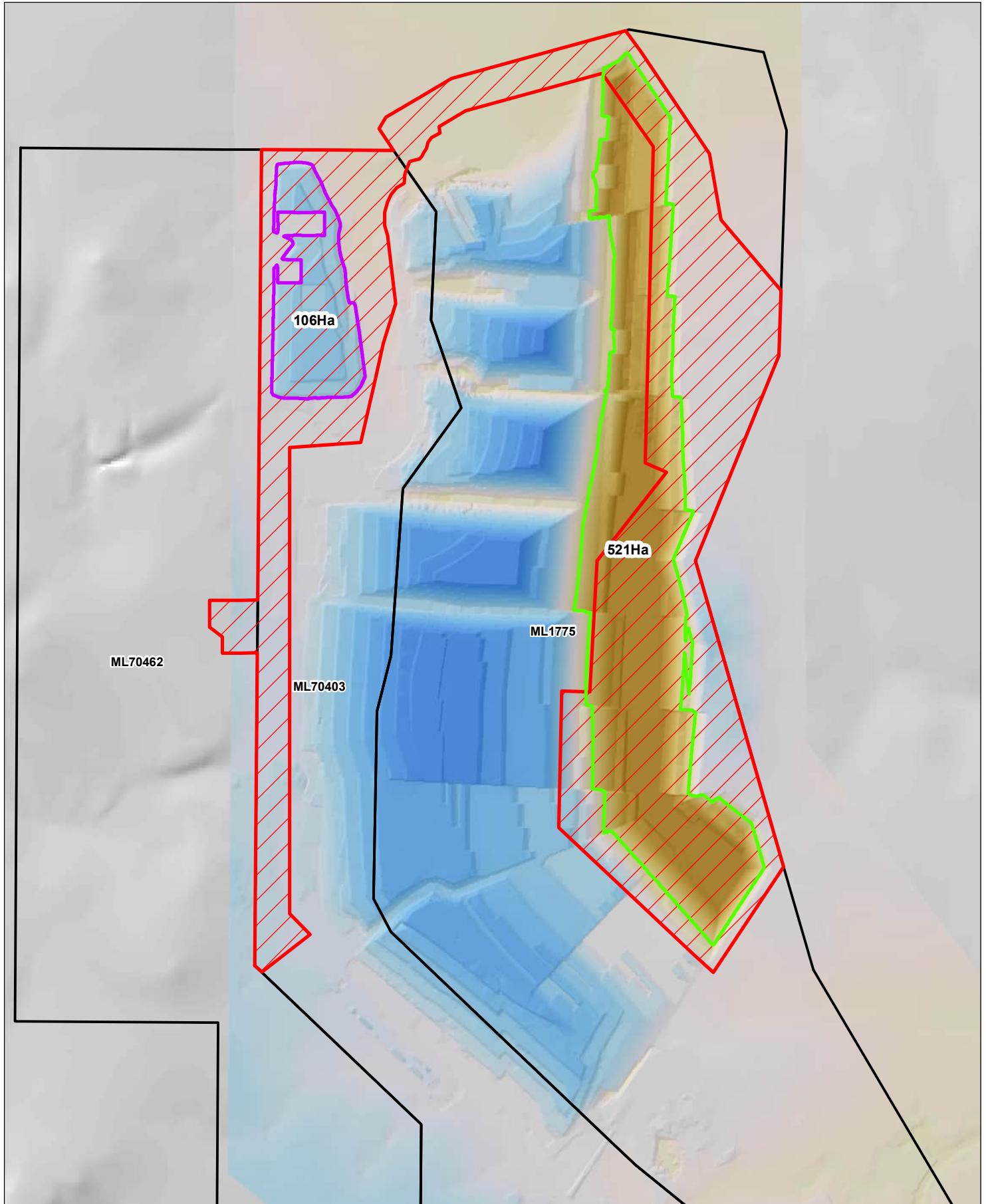
Date: 30-Sep-2022

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Horse Pit Extension Project
EPBC Act Preliminary Documentation
(EPBC 2021/9031)

Progressive Landform FY2040

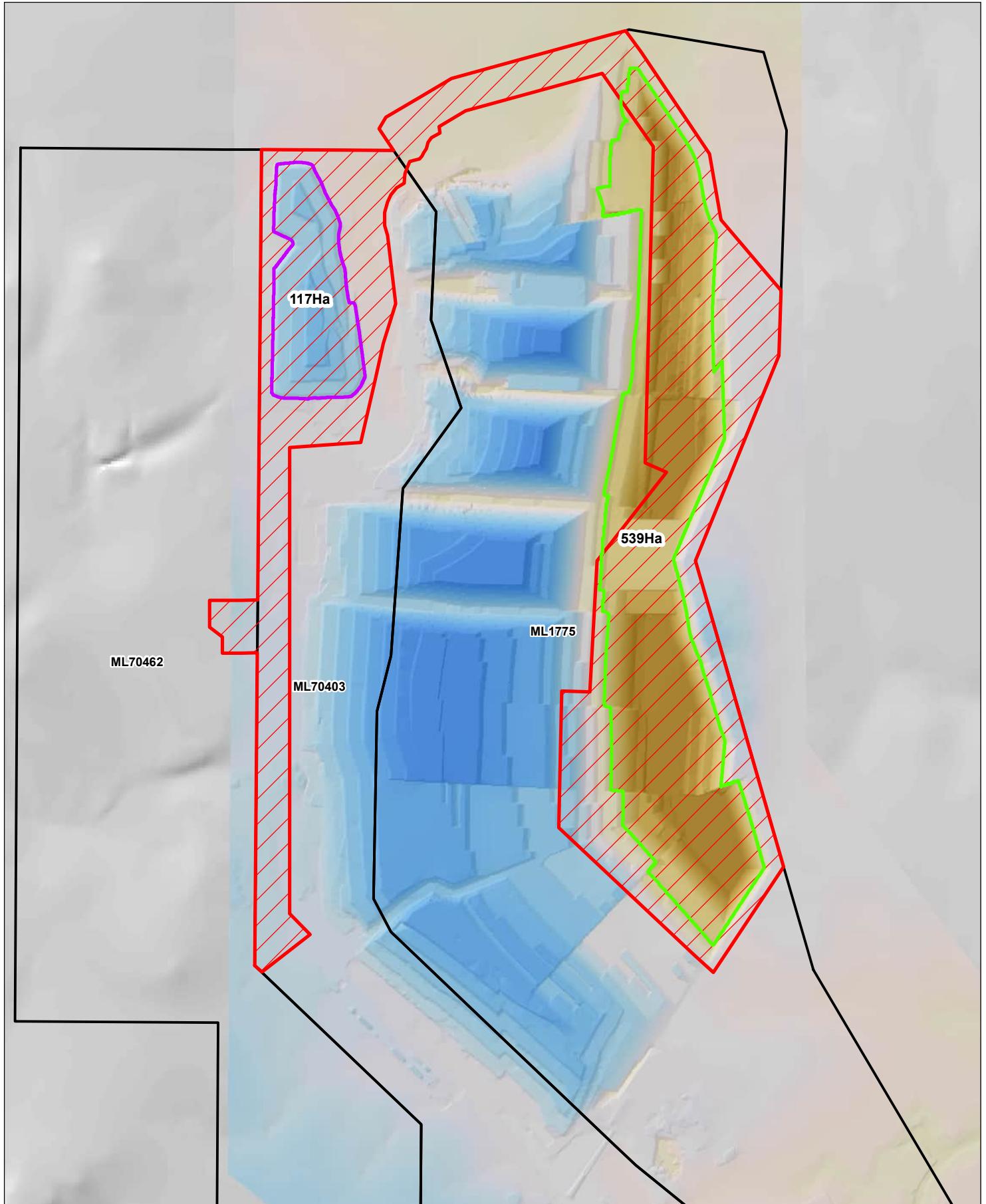


Projection: GDA 1994 MGA Zone 55
 Scale: 1:42,500 at A4
 Project No.: 620.13593
 Date: 30-Sep-2022
 Drawn by: PM

Progressive Pit Extent
Progressive Out of Pit Dump Extent
Project Area
BHP Tenements
Elevation (mAH)
 High : 390
 Low : 95

Horse Pit Extension Project
EPBC Act Preliminary Documentation
(EPBC 2021/9031)

Progressive Landform FY2045

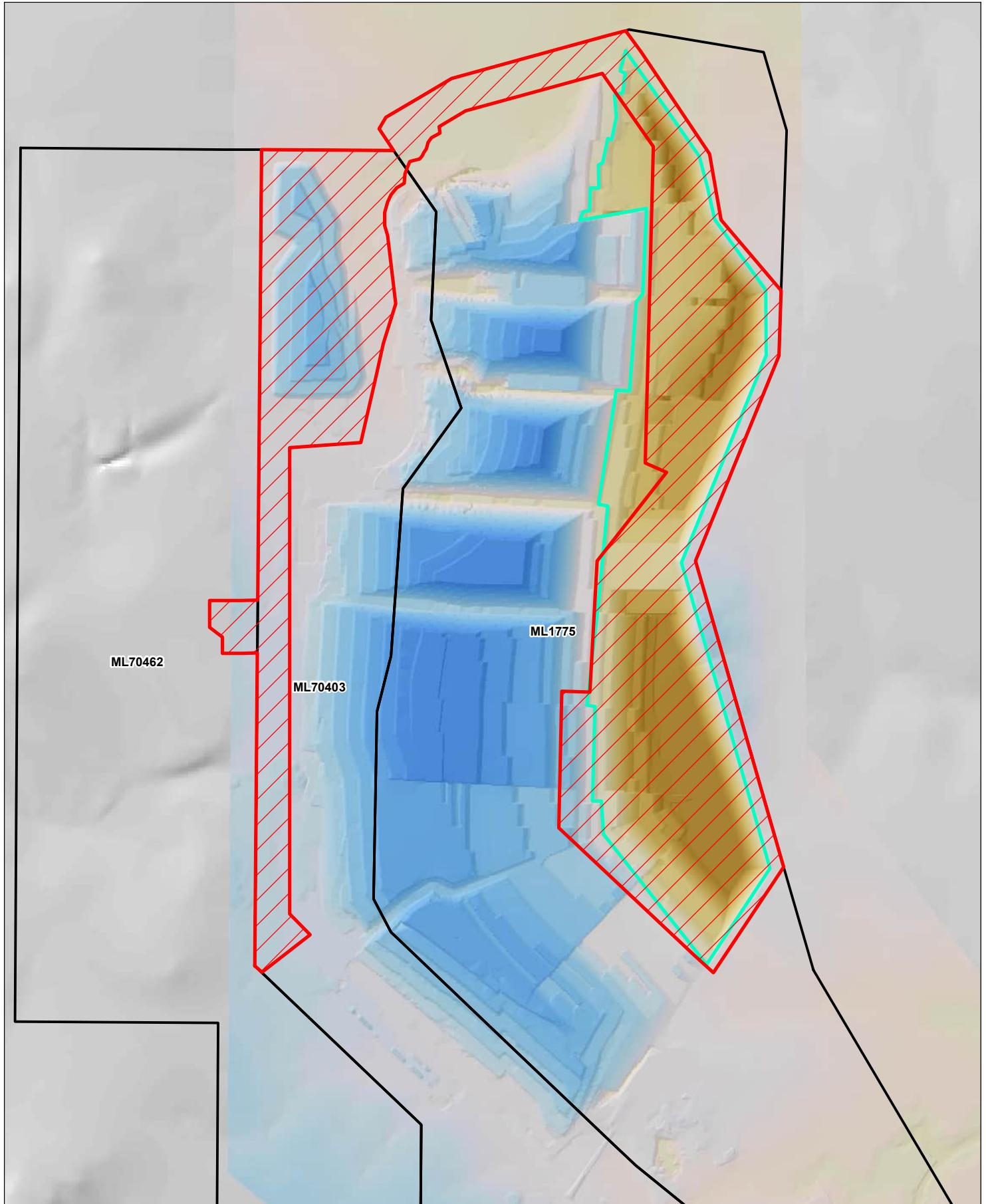


 0 0.5 1 km
 Projection: GDA 1994 MGA Zone 55
 Scale: 1:42,500 at A4
 Project No.: 620.13593
 Date: 30-Sep-2022
 Drawn by: PM


 BMA
 BHP Mitsubishi Alliance

Horse Pit Extension Project
EPBC Act Preliminary Documentation
(EPBC 2021/9031)

Progressive Landform FY2050



0 0.5 1 km

Projection: GDA 1994 MGA Zone 55
 Scale: 1:42,500 at A4
 Project No.: 620.13593
 Date: 08-Apr-2022
 Drawn by: PM

Final Void

Project Area

BHP Tenements

Elevation (mAHD)

High : 390

Low : 95

Horse Pit Extension Project
EPBC Act Preliminary Documentation
(EPBC 2021/9031)

Conceptual Final Landform

2.4.4 Mine Waste Production

Overburden material will be mined and managed via the IPDs at the CVM and the proposed OOPD to the north-west of Horse Pit in ML 70403. Where practical, overburden will be progressively backfilled into the mined-out pit as mining progresses. Estimates of overburden and parting volumes by target coal seam are outlined in **Table 2-2**.

Table 2-2 Overburden and Parting Volumes

Parameter	Unit	Target Seams				Total
		Dysart	Harrow Creek	P Seam	Q Seam	
Overburden Volume	Mbcm	-	-	-	350	350
Thick Parting Volume	Mbcm	1,057	695	266	45	2,062
Thin Parting Volume	Mbcm	71	62	19	7	159
Total Waste Volume	Mbcm	1,128	757	285	401	2,571

Coarse rejects and dewatered tailings from the CHPP will continue to be co-disposed with overburden to IPDs, as per ongoing operations at the CVM. Further details of management of coarse rejects and tailings from the CHPP are outlined in **Section 2.5.1**.

2.4.5 Spoil Management

The primary objective of the spoil dumping strategy for the Project is to backfill the void where practical to reduce the final void area remaining at end of the Project life.

A new OOPD is proposed to the north-west of Horse Pit on ML 70403, which is considered to be a future elevated landform. The OOPD is proposed in order to provide the dump capacity required. Preparation of the land (e.g. vegetation clearing) at the proposed OOPD is expected to commence in FY2028. The location and extent of this proposed OOPD is presented on **Figure 2-3** and the indicative progressive management of spoil over the revised LOM is outlined on **Figure 2-8** to **Figure 2-14**.

2.4.6 Final Void

Mining will continue to the east and mined-out areas in the west will be progressively back-filled and rehabilitated where practical. A final void will remain in the east of ML 1775 at the conclusion of mining. The conceptual final landform including extents of the final void is presented in **Figure 2-14**.

BMA plans to explore additional opportunities to reduce the extent of the residual void through further backfilling operations over the life of the Project. Importantly, this may result in unacceptable air quality impacts and may not be economically feasible due to increased haulage involving 'double handling' spoil amongst other factors, which significantly impacts operational costs and the overall economics of the Project. Rehabilitation, including post-mining land uses and completion criteria are discussed in **Section 6**.

2.4.7 Mining Equipment

The mining equipment currently utilised at the CVM will continue to be utilised for the Project. The current fleet is sufficient to sustain stripping and ROM Coal targets for the Project Life of Mine (LOM). Additional equipment may be required on a temporary basis due to construction activities, increased stripping, haulage and mining demands. This practice is not uncommon.

The equipment fleet at the CVM is a mix of contractor and BMA owned fleets. The mining equipment in operation at the CVM is summarised in **Table 2-3**.

Table 2-3 Mining Equipment

Type	Model	Quantity
Drill	Sandvik PV235	5
	Atlas Copco D90KS	1
Dragline	Marion 8050	4
Shovel	CAT 7495	1
Excavator (600t)	Liebherr R996B	3
Excavator (400t)	CAT 6040BH	3
	Komatsu PC4000	1
	Hitachi EX3600	1
Loader 200t	CAT 994H	3
Track Dozer	CAT D10T	8
	CAT D11T	8
Wheel Dozer	CAT 854K	2
Haul Truck	CAT 797F	10
	CAT 793F	23
	CAT 789D	6
	CAT 793C	14
	CAT 789C	8

2.4.8 Blasting

Blasting will continue for the Project as currently executed at the CVM, i.e., approximately 1 to 2 times per week. Blasting is utilised for overburden and interburden, including through seam blasting, as necessary at depth ranges from 7 m to 40 m. Subject to operational requirements, blasting occurs on any day of the week prior to 5 pm.

Quantities of explosives range from 500 tonnes to 2,000 tonnes per shot and the potential blast size is approximately 200,000 bcm to 400,000 bcm for through seam blasts and 500,000 bcm to 1,500,000 bcm for overburden removal. The typical blast area is between 3 ha to 6 ha. The predominate explosive used in blasting activities at the CVM is ammonium nitrate/fuel oil (ANFO), which is the most common explosive used in the mining industry in Queensland.

The storage, transportation and use of explosives will be in accordance with Australian Standard AS 2187.2-2006 Explosives - Storage and use - Use of explosives, the *Explosives Act 1999*, BMA's policies and procedures including the CVM Standard Work Instruction (SWI) Blast Control & Blast Guard (the CVM-SWI-0275), and all other relevant legislation. All blasting activities at the CVM are undertaken by BMA.

The existing blasting compound is located in the Horse Pit extension footprint and will be relocated in advance of mining preparation activities for that area. Details of the blasting compound relocation are outlined in **Section 2.5.3**.

2.4.9 Workforce Requirements and Arrangements

The operational workforce requirements for the Project will remain consistent with current operations for the Horse Pit at the CVM. The operational workforce at the CVM is up to 1,440 full time equivalent (FTE) employees and contractors. Construction of infrastructure required to support the Project is not expected to increase the workforce, rather typical 'construction' activities (for example building access tracks or dams) are undertaken by the operational workforce as part of operation activities as needed. The current workforce arrangements at the CVM will remain in place for the Project.

2.4.10 Hours of Operation

Mine operation hours will continue as per current operations at the CVM, i.e., 24 hours per day, seven (7) days per week, 365 days per year.

2.5 Mine infrastructure

The existing key mine infrastructure at the CVM will continue to be utilised for the Project, with some changes to locations of supporting infrastructure and water management infrastructure. The following mine infrastructure will continue to operate as per existing operations at the CVM:

- Main ROM and Horse Pit ROM coal stockpiles;
- CHPP complex and product coal stockpiles;
- Conveyor that transports ROM coal from PDM to the CVM CHPP;
- TLF, stockpiles and rail spur;
- IPD;
- Haul roads; and
- Exploration infrastructure.

The infrastructure requirements for the Project, including changes and additions to existing infrastructure are outlined in the following sub-sections. The Project components, including proposed infrastructure, are shown on **Figure 2-3**.

2.5.1 Coal Handling and Preparation Plant

There is no required upgrade to the CHPP as part of this Project. The existing CHPP has installed design capacity to process up to 19.8 Mtpa of ROM coal, which is sufficient to handle the ROM coal production rates for the Project in addition to ROM coal transferred from PDM for processing. As such, there is no proposed upgrade to the CHPP as part of this Project, however the process and capacity details for the CHPP are summarised below for completeness.

ROM coal is transported by dump truck to the Northern ROM Hopper before being transported via overland conveyor to the crushing station where it is crushed, screened and stacked. The CHPP is fed by a single feed conveyor with a feed rate capacity of 2,750 tonnes per hour (tph) through two (2) modules of 1,375 tph each.

Product coal is conveyed through a transfer station to a stacking conveyor and stacker to the product coal stockpiles. The product coal is reclaimed and discharged through a batch weighing bin to the TLF. A reject conveyor discharges coarse and fine rejects to the reject bin. Process plant water is recycled to minimise raw water make-up requirements for the CVM. The CHPP layout has been designed to contain local area and stockpile runoff.

Coarse rejects and dewatered tailings from the CHPP will continue to be co-disposed with overburden to existing IPD as per ongoing operations at the CVM.

2.5.2 Train Loadout Facility

The existing TLF has sufficient installed design capacity to accommodate the product coal production rates for the Project. As such, there is no proposed upgrade to the existing TLF and no additional train movements will be required.

2.5.3 Compounds and Facilities

2.5.3.1 EME Build Pad Relocation

The EME build pad is used for shutdowns of large-scale mining equipment such as draglines. As such, the EME build pad must remain located on the highwall side, to the east of Horse Pit, as access to the pad is required directly from the Peak Downs Highway. The existing EME build pad location lies within the footprint of the

extension of Horse Pit due to be mined through in approximately FY2030. As such, the pad will be relocated to a semi-permanent location in the north-east in advance of FY2030, refer to **Figure 2-3**.

2.5.3.2 Blasting Compound Relocation

The existing blasting compound location is located within footprint of the extension of Horse Pit due to be mined through in approximately FY2031. The compound requires a 200 m equipment exclusion zone standoff distance which, based on the mine planning, will require relocation by FY2026. The compound will be decommissioned and relocated as part of the Project.

BMA is considering two (2) potential relocation options for the compound, both on the low wall side (i.e., to the west) of Horse Pit, refer to **Figure 2-3**. Location A is located west of Horse Pit in ML 70403. Location B is located further to the west in ML 70462. BMA is considering the viability of these options and impact to MNES values will be a consideration of decision making. Section 5.1 of Appendix C Terrestrial Ecology Significant Impact Assessment Report confirms Compound A is located within existing disturbance and would necessitate no further vegetation clearing. Compound B is situated within regrowth narrow-leaved ironbark woodland and would require the clearance of 10.5 ha of vegetation if developed. Neither option contains any mapped MNES.

The advantages and disadvantages of both Location A and B will be considered during the detailed design phase of the Project, with the final location considering environmental risks to nearby surface waters and extent of vegetation clearance required. Other factors such as safety will also be considered.

2.5.3.3 BMA Accommodation Camp

There is an accommodation camp in the far east of ML 1775 that is within the extension of Horse Pit in FY2045. The camp is not occupied at present, and most camp rooms have been decommissioned and removed. The remaining structures and supporting infrastructure will be decommissioned in advance of mining.

2.5.3.4 Go-Lines

Go-lines are heavy vehicle parking areas that facilitate efficient and safe shift changes and are relocated periodically with the progression of mining. Go-lines are planned and executed by the CVM Mine Operations/Mine Planning teams and generally move with relocations of back access roads (Refer to **Section 2.5.4**). Go-lines will be located on the low wall side of Horse Pit if required. Go-lines will be relocated in conjunction with back access road relocations as mining progresses.

2.5.3.5 Substations

There are several small temporary substations located across the Project Area. All substations and transformers will be relocated as required to facilitate the progress of mining or decommissioning of associated infrastructure.

2.5.4 Roads and Access Requirements

2.5.4.1 Site Access

The Project will not require changes to current site access arrangements at the CVM. Access to the CVM is via the Peak Downs Highway.

2.5.4.2 Back Access Roads

The main back access road runs north-south along the existing highwall, at the eastern side of Horse Pit. This back-access road is partially located within areas proposed to be mined out in the next five (5) years. Other existing back access roads will be mined out for the Project. These access roads will be relocated to the east.

The mine schedule progresses east and terminates approximately 100 m from the boundary of ML 1775. This 'infrastructure corridor' is sufficient to accommodate the final back access road without impacting the proposed mine schedule and provides an adequate buffer distance to the ML boundary for other potential infrastructure requirements.

2.5.4.3 Haul Roads

The existing haul road is located on the western low wall side of the existing Horse Pit and is not expected to interact with the Project, refer to **Figure 2-3**. Pit access and ramps will continue to progress east from existing alignments as Horse Pit progresses. A minor extension of the haul road will be required to access the proposed OOPD to the north-west of Horse Pit. This haul road extension will cross Horse Creek (via a bridge), refer to **Figure 2-3**.

2.5.4.4 Blasting Compound Access

The relocated blasting compound will require medium vehicle access roads. The proposed access road for Location A will be located within already disturbed areas. The most direct route to Location B will require a crossing of the drainage line flowing into Horse Creek. The alternative route runs south to connect with an existing access road that avoids the crossing of Horse Creek.

2.5.4.5 Dragline Crossing

A dragline crossing of the Peak Downs Highway will be required ahead of mining of Horse Pit in the south immediately adjacent to the Peak Downs Highway. The exact location of this crossing is yet to be finalised by BMA however, a crossing zone has been established for the purpose of the Project and is expected to be up to 45 m wide.

2.5.5 Powerline Relocation

There are three (3) key powerlines that will interact with the Project:

- 66kV BMA owned powerline and its stub lines that provide power to the CVM and PDM;
- 11kV Ergon owned powerline that is aligned with the Moranbah Access Road; and
- 11kV BMA owned powerline that is aligned with the haul road, west of Horse Pit.

These powerlines will be relocated as required to allow the mining of Horse Pit to progress.

2.5.6 Water Management

The Project will utilise the existing water management system at the CVM with proposed updates to be designed in accordance with the current water management principles at the CVM. Additional water management infrastructure and relocation of MAW dams will be required to facilitate the Project. An outline of the update to the water management system for the Project is shown in **Figure 2-15**.

The water management system at the CVM and proposed updates to water management for the Project are outlined in the following subsections. A summary of the surface water assessment, including details of water management, is provided under **Section 4.3**.

2.5.6.1 Water Management System Overview

The water management system at the CVM (and for the Project) is designed to manage the potential impacts of the Project's mining activities on water resources. The water management system has been designed in accordance with BMA's MAW and Erosion and Sediment Control (ESC) Standard (the Standard). The Standard details the basis and application of ESC and MAW control measures across all BMA Queensland operations. The Standard details the legislative context and guidelines for planning, design, construction, operations and maintenance of drainage and sediment control structures.

There are several controls that inherently form part of the water management system at the CVM through planning, design and operational procedure. The overarching approach is presented graphically in **Figure 2-16**.

Figure 2-16 illustrates how catchment planning and separation of water types is included during of the mine design process. Water types are identified and catchment boundaries delineated such that water can be managed

commensurate with the risk to the surrounding environment. During planning, water (including runoff) is classified as:

- “actually or potentially sediment laden” (ESC);
- “MAW”; or
- “undisturbed”.

Drains, pumps, pipes and storage structures are then selected to manage each type accordingly.

As the mine develops, the footprint and area of disturbance changes (via disturbance to new areas or progressive rehabilitation), and this process reoccurs. Water is routed through the appropriate water management structures accordingly. Planning these elements is essential for the operation of the system, for example calculating a sediment storage allowance in an ESC structure that is appropriate for the proposed maintenance regime of that structure. For storages, the structures are sized through calculation of a single intense event as well as through water balance modelling which considers the potential for cumulative events as well as bottlenecks in the overall system as water is transferred between storages.

The selection of specific water management control types and sizing is informed by a risk-based approach aimed to achieve a balance between capturing and treating water running off disturbed areas and redirecting good quality water around mining activities to continue to flow downstream for users and the environment. Achieving this balance, particularly allowing good quality water to flow downstream, is critical to maintaining downstream environments as well as minimising the generation of MAW or ESC water (potentially deteriorating it through evaporation and creating legacy water inventory).

For the Project, ESC structures have generally been designed at the highest control hierarchy based on the above standards, resulting in a containment design criterion of a 10% Annual Exceedance Probability (AEP) 24-hour storm. Similarly, MAW storages have been designed to achieve a minimum annual spill probability of 5%. This is based on the Queensland DES requirement from the Manual (Table 5. Hydrological design criteria for ‘failure to contain – overtopping’ scenario) for significant consequence structures. This design requirement is applied to MAW structures in this project even if they are considered low consequence structures.

The selection of a design immunity for water management infrastructure is based on industry guidelines and research including but not limited to:

- *Risk ratings based on recommendations from Australian Soils and Landscapes Handbook* (CSIRO, 2004);
- *Best Practice Erosion and Sediment Control by the International Erosion Control Association* (IECA), (IECA, 2008);
- *Structures which are dams or levee as of part of environmentally relevant activities* (DES, 2019); and
- *The Manual for Assessing Consequence Categories and Hydraulic Performance of Structures* (DEHP, 2016) (the Manual).

Following risk assessment and design, the system is supported through a number of active management controls during operation, many of these are legislated through the Project’s EA (regulated by DES) and include but are not limited to:

- A site-specific ESC Plan and Water Management Plan (WMP);
- Trigger Action Response Plan (TARP) for the system and key structures;
- Release rules, procedures and telemetry (parameters of which are regulated within the Project’s EA);
- Inspections and water level management;
- Maintenance procedures including dewatering, desilting, and inspections;
- Monitoring of water quality; and
- Wet season preparedness, including predictive water balance modelling and subsequent planning.

CVM has one authorised (under the EA) release point for the release of MAW. All MAW from the CVM ultimately being directed towards 12N Dam south of the Peak Downs Highway, positioned adjacent to Cherwell Creek. Under the CVM EA MAW must only be released from the authorised release point and there are a series of criteria that must be met in order to permit any release. Water quality release limits are defined within the EA as are receiving water flow criteria. Release events require monitoring prior to release (in order to determine if all criteria are met),

during release and following release. A decision to release is largely dependent on the water demand and storage volumes at the time when conditions are appropriate (ie when criteria are met).

Figure 2-16 also shows the monitoring which occurs through compliance activities associated with the EA, BMAs internal operational monitoring and the Receiving Environment Monitoring Program (REMP).

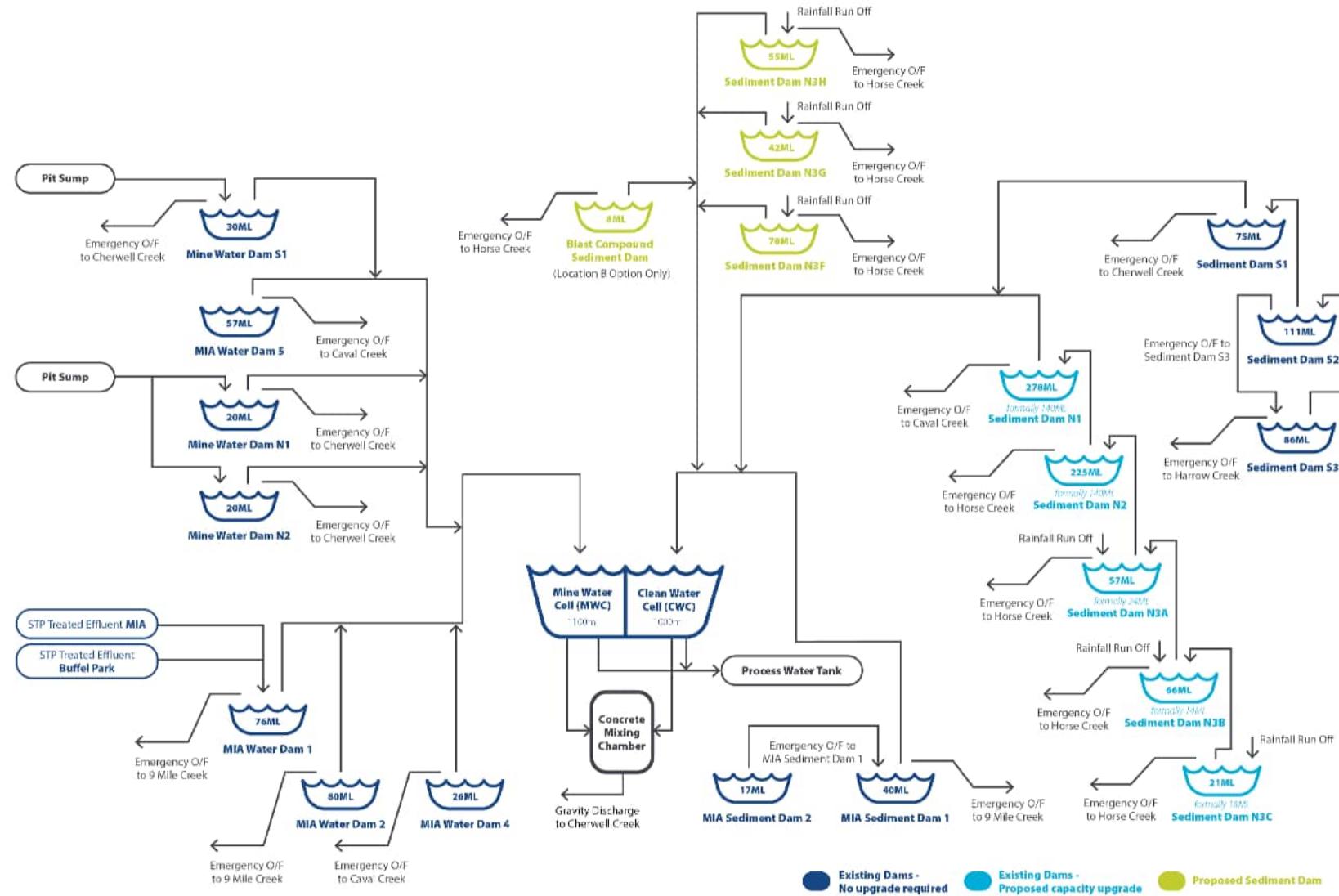
2.5.6.2 Water Demand

Water demand for the Project is not expected to increase from the existing demand at the CVM. The major water demand for the CVM arises from coal processing and dust suppression. The mine water system has been configured to maximise the re-use of water on site with the aim to reduce the amount of raw water consumed by the operation. The key CVM operational water requirements are summarised in **Table 2-4**.

Table 2-4 Mine Water Demand and Storage

	Existing at the CVM	Proposed with HPE	Predicted change
CHPP demand (for MAW)	7.0 ML/d	7.0 ML/d	none
Dust suppression demand (for MAW)	10.3 ML/d	10.3 ML/d	none
MAW storage capacity ¹	1,379 ML	1,430 ML	3.7% increase capacity
Sediment dam storage	1,750 ML	2167 ML	23.8% increase capacity

¹ not including emergency in-pit storage



Project Number: 620.13593
 Date: 08-Apr-2022
 Drawn by: PM



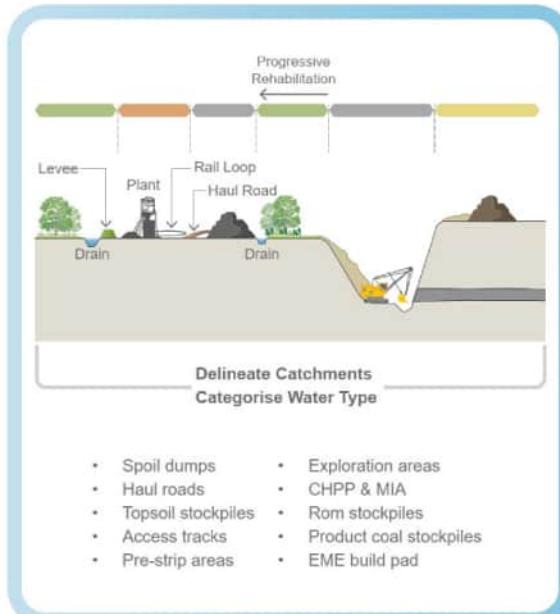
Horse Pit Extension Project EPBC Act Preliminary Documentation (EPBC 2021/9031)

Proposed Update to CVM Water Management System

FIGURE 2-15

PLANNING

(Within MLs)



Drainage infrastructure planning to minimise generation of **MAW** and to divert water away from the mine (ie. diverted water)

CATCHMENT RISK ASSESSMENT



= **3 WATER TYPES**

DESIGN

(Minimise & Avoid)

DISTURBED AREA WATER

Drains, pumps and pipes to collect and move runoff to appropriate storages based on **1ESC** and catchment risk rating

→ Design standards for containment considers risk

1 MINE AFFECTED WATER

MAW dams design standards

→ Spill way design = risk of overtopping
→ Water balance



Design Standards

2 SEDIMENT WATER / ESC

Sediment basins design standards

→ Spill way and capacity design = risk of overtopping



3 UNDISTURBED WATER / DIVERTED WATER

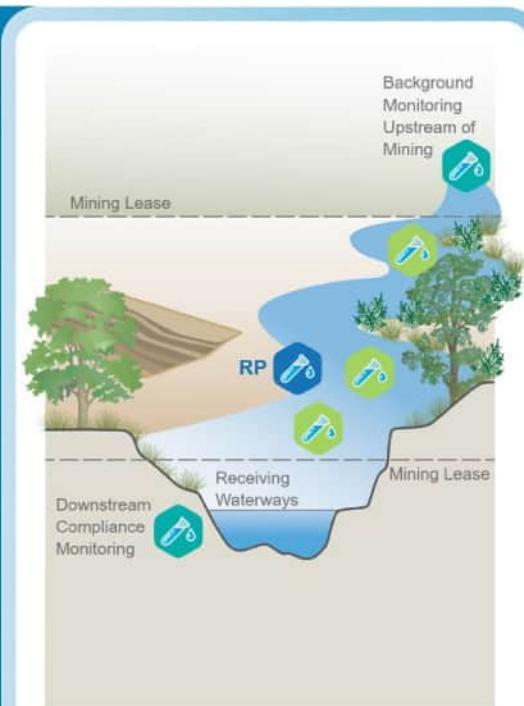
Drainage design standards

→ Divert water before it reaches the mine



MANAGEMENT & OPERATIONAL ACTIVITIES

RECEPTOR



POINTS OF MONITORING

RP Release Points

 Points of Monitoring

 Environmental Authority Monitoring Points

 Potential Sensitive Receptors

 REMP Monitoring Points

Project Number: 620.13593
Date: 07-Mar-2023
Drawn by: PM



Horse Pit Extension Project
EPBC Act Preliminary Documentation (EPBC 2021/9031)

Water Management Diagram – Horse Pit Extension

FIGURE 2-16

2.5.6.3 Water Supply

The Project will not require major changes to the existing supply at the CVM. A summary of water supply components at the CVM is provided below.

Mine Water

The major water demands for the CVM (coal processing and dust suppression) is principally met by MAW. MAW is also utilised at the CVM for firefighting purposes and is pumped into on-site water storages, mechanically filtered and stored in tanks ready for use.

Raw Water

Raw water is sourced via a branch off the Sunwater owned Burdekin pipeline. This water is sourced at the Burdekin Falls Dam and is used to fill the raw water dam as well as for potable water. The CVM has an internal allocation to draw a maximum of 5,260 ML per annum of raw water. The GoldSim Water Balance Model (WBM) for the CVM predicts an average of 3,200 ML of raw water will be required each year for the mine life extension. Raw water consumption will continue to be minimised by maximising the reuse of on-site MAW in the mining process and by employing techniques to minimise losses due to seepage and evaporation.

Potable Water

The quality of surface water runoff at the CVM is not suitable for potable water and therefore only treated raw water is used. Raw water for potable purposes is sourced via the Sunwater owned Burdekin pipeline and treated at the on-site the CVM Potable Water Treatment Plant to standards outlined in the CVM Potable and Raw Water Management Plan (WMP) and the Australian Drinking Water Guidelines (Barnett et al., 2012).

Water Transfer Agreement

A water transfer agreement exists between the CVM, Saraji South Mine, PDM and Saraji Mine. The water management systems of these individual mines are connected by the Central Regional Water Network (CRWN) Pipeline. The CRWN Pipeline is a backbone pipeline which extends from Saraji South to the CVM allowing transfer of MAW between these operations. There is a CRWN WBM that links the individual WBM's developed for each of the sites, providing information to support decision making regarding sizing of water infrastructure and management of water volumes. The agreement requires the mine sites to operate in accordance with the specific conditions of the EA, General Environmental Duty, prevention of environmental harm and keeping of rigorous monitoring records. Monthly water reports are distributed outlining Trigger Action Response Plan (TARP) levels and water volumes at each site. This information is used to monitor the need for the transfer of water to and from the CVM.

The combined model provides BMA with a tool that greatly reduces the number of unknowns, providing a greater confidence in the predictions across all operations (e.g., influence of cumulative releases on water quality and the potential need to reduce release rates). It also allows the system to transfer water between mine sites utilizing the CRWN mine affected water pipeline. This seeks to reduce the amount of raw water used on the site and reduce environmental harm by allowing water to be stored and released appropriately. This subsequently reduces the likelihood of uncontrolled releases across all sites and provides confidence in release volumes and impacts, considering cumulative releases on water quality. The model accounts for the EA conditions on all releases at all mines and considers the water quality requirements in the source / release storage and receiving waterbody.

While the CRWN pipeline does allow water to be sent to other mines this is predominantly undertaken to allow for water reuse at other operations during times of water scarcity and not for release. The ephemeral nature of all creeks which form approved release points for the CRWN mine result in a relatively short window of a potential release. The CRWN capacity varies over its length, but maximum capacity is typically in the order of 400 L/s. Even at this capacity the time required to move water to alternative release points means, coupled with infrastructure bottlenecks on the release infrastructure dams (such as their capacity), mean transfer of water to facilitate additional release of mine affected water is unlikely.

Treated Sewage Effluent

The Project will not require changes to sewage treatment management at the CVM. Sewage from the Mine Infrastructure Area (MIA) and the CHPP is collected via a system of gravity and pumped rising sewerage mains and treated via a package sewage treatment plant (STP) within the MIA. The effluent is treated to a suitable quality to allow safe and efficient reuse on-site.

2.5.6.4 Pit Dewatering

The existing water management strategy for pit dewatering will continue for the Project. MAW will be dewatered from the operational Horse North pits over the highwall and piped into either Mine Water Dam N1 or N2 throughout the operational life of the mine (**Figure 2-16**).

While pit dewatering is largely weather dependent, modelled forecast pit dewatering volumes for the Project have been established. The results demonstrated a consistent or decreasing annual dewatering volume across the CVM. As the pit dewatering volumes have been forecast to not increase as a result of the Project, the pumping strategy will not be modified beyond relocating dams and extending pipelines, as outlined in **Section 2.5.6.5**.

2.5.6.5 Water Management Infrastructure

Existing water infrastructure at the CVM will interact with the extension of Horse Pit as the mining progresses and will require relocation. Details of the existing water management infrastructure and proposed relocation or expansion of this infrastructure is outlined in the following subsections. Details of changes and expansion of the water infrastructure for the Project are outlined on **Figure 2-17**.

Sediment Dams

BMA has reviewed the capacity of existing sediment dams to ensure suitable capacities are achieved for the Project. Sediment dams have been designed in accordance with the relevant standards and guidelines with controls informed based on a risk-based approach to water management, where there is a balance between capturing water running off disturbed areas and providing for good quality water to continue to flow downstream for users and the environment.

The existing sediment dams within the Project Area will require expansion upgrades to accommodate increased catchments. In addition, the following new sediment dams are proposed:

- One (1) new sediment dam (capacity of 70 ML) is required to capture the runoff in the north of ML 1775 adjacent to the proposed northern flood levee;
- Two (2) new sediment dams (combined capacity of 97 ML) are required to capture runoff from the proposed OOPD to the north-west of Horse Pit; and
- One (1) new sediment dam (capacity of 8 ML) is required to capture runoff from around the proposed blast compound (for Location B only). Within the compound (e.g. at washdown bays or material transfer points) appropriate storage and handling of any contaminated water will be management in accordance with Conditions of the EA.

Each sediment dam will have permanent pump and pipeline infrastructure to enable dewatering to a larger storage as required. Sediment dam dewatering includes two (2) streams, both will consist of pumping infrastructure upgrades including new pumps and pipelines. Details of water transfer are provided on **Figure 2-15**.

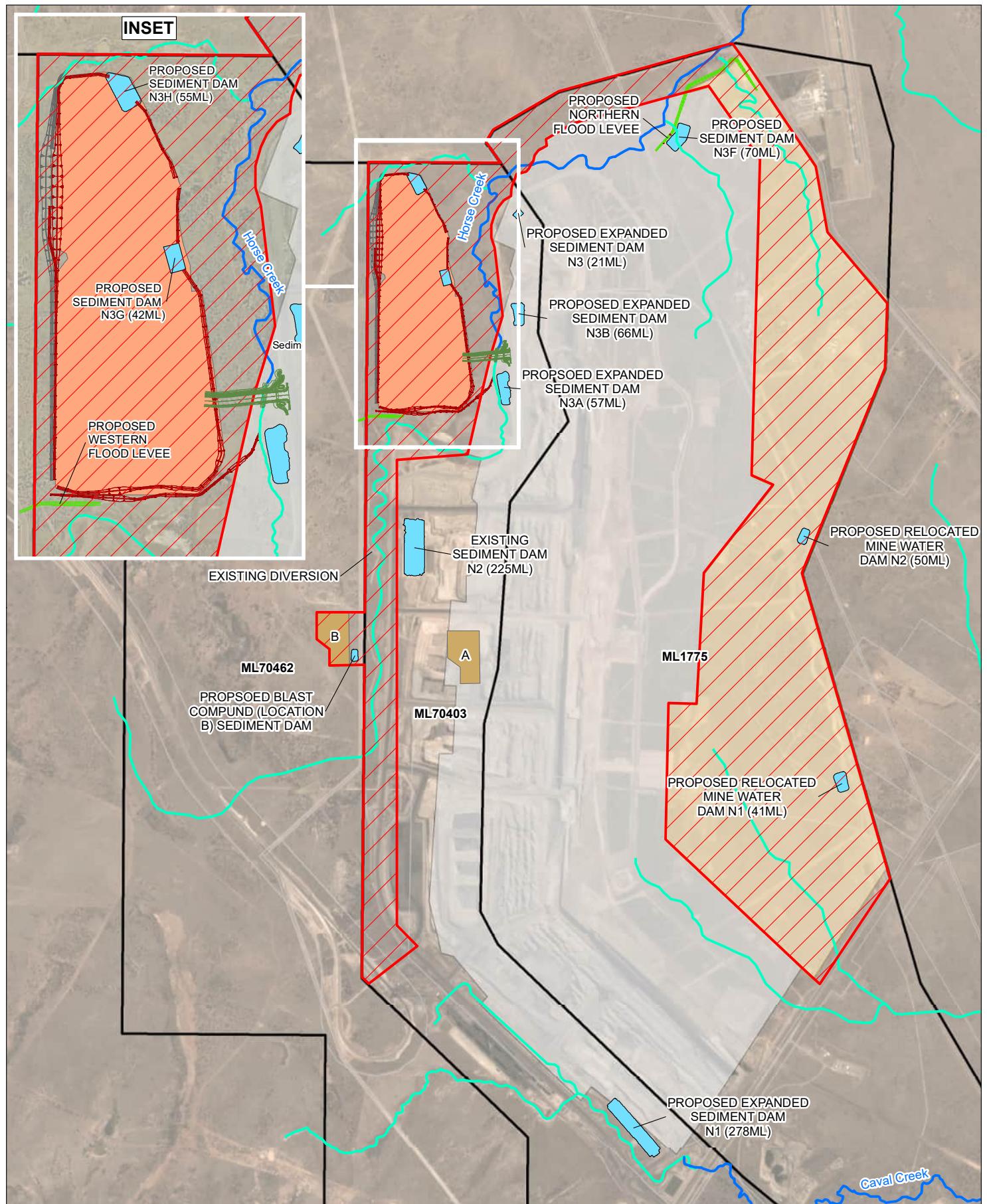
Details of the existing sediment dams proposed revised capacities and new sediment dams relevant to Horse Pit are provided in **Table 2-5**. The existing and proposed sediment dams that will manage runoff from the Project are outlined on **Figure 2-17**.

Table 2-5 *Sediment Dam Summary (Horse Pit only)*

Name	Existing Volume (ML)	Revised Volume (ML)	Location
Sediment Dam N1	140	278	Horse Pit
Sediment Dam N2 ¹	225	225	Horse Pit
Sediment dam N3A	24	57	Horse Pit North
Sediment dam N3B	14	66	Horse Pit North
Sediment Dam N3C	18	21	Horse Pit North
Sediment Dam N3F ²	NA	70	Horse Pit North
Sediment Dam N3G ²	NA	42	Proposed OOPD
Sediment Dam N3H ²	NA	55	Proposed OOPD
Blast Compound Sediment Dam ^B	NA	24	Location B Option
Total	421	838	-

¹ No expansion required. Existing sediment dam volume exceeds minimum requirements.

² Proposed new sediment dams.



A scale bar with a north arrow. The bar is divided into three segments: a short black segment for '0', a longer black segment for '0.5', and a final segment for '1 km'. To the left of the scale bar is a circular north arrow containing a white 'N' and a white arrow pointing upwards.

Projection: GDA 1994 MGA Zone 55

Scale: 1:42,500 at A4

Project No.: 620.13593

Date: 23-May-2022

Drawn by: PM

— Drainage features

Watercourses (Water Act 2000)

Water Management Infrastructure

Water Management Infrastructure

— Clean Water DIVE

— Dirty Water Drain

— Flood

— Bridge over Horse Creek

Proposed Blast Compound Options

Proposed Blast Compound

Proposed Ga

Horse Pit Extension

Project Area

Caval Ridge EIS

BHP Ten

Horse Pit Extension Project
BC Act Preliminary Documentation

Water Management Infrastructure

Mine Affected Water Dams

The volume of MAW is not expected to increase from current operations at the CVM as a result of the Project. Therefore, no expansion to volumes or additional MAW dams are required. The existing water management strategy involves the use of the MAW dams as transfer points, with all MAW from the CVM ultimately being directed towards 12N Dam south of the Peak Downs Highway. MAW will continue to be dewatered from Horse Pit over the highwall and piped into either N1 dam or N2 dam through the life of the Project.

The existing N1 and N2 MAW dams are currently used as staging dams for MAW including dewatered pit water and are located in the far east of ML 1775. The N1 and N2 MAW dams will be retained as separate structures of 41 ML and 50 ML, with no proposed increase in capacity. These dams will be relocated as close as possible to the eastern extent of ML 1775 prior to being mined through and will include the extension of pipelines to the new locations. The pipelines will be relocated in a staged manner in accordance with the progression of mining with the final alignment to be confined within the infrastructure corridor on the far eastern boundary of ML 1775. The proposed total length of pipeline extensions required for the relocated dams is approximately 7 km. Details of the existing MAW dams are provided in **Table 2-6**.

Table 2-6 Mine Affected Water Dam Summary

Name	Existing Volume (ML)	Location
Mine Water Dam N1 ¹	41	Horse Pit East
Mine Water Dam N2 ¹	50	Horse Pit East
Mine Water Dam MIA 1	76	MIA
Mine Water Dam MIA 2	80	MIA
Mine Water Dam MIA 4	26	MIA
Mine Water Dam MIA 5	57	MIA
Mine Water Dam 12N - MWC	1,100	Heyford Pit North
Total	1,430	

¹ Relocation required.

Pipelines

Raw water is piped via the Burdekin pipeline along the western boundary of ML 70403, over the Peak Downs Highway to the raw water dam in the MIA on ML 70403, south of the Peak Downs Highway. This pipeline will not interact with any elements of the Project.

The Burdekin pipeline dissects ML 1775 adjacent to the Moranbah Access Road. This pipeline corridor is within the approximately 100 m wide infrastructure corridor in the east of ML 1775 and as such there is no relocation of this pipeline required. A minor tee-junction previously used to supply raw water to the BMA accommodation village will be removed prior to interaction with mining at Horse Pit.

MAW pipelines are used to dewater operational pits and transfer water between storages. These pipelines receive MAW from operational pits and facilitate bulk transfers of MAW. The MAW pipelines will be relocated in a staged manner as required by the relocation of storages discussed above and the progress of mining. The MAW pipelines will be progressively relocated to align with the back-access roads in accordance with the mine schedule. Ultimately, the final alignment of the MAW pipeline will be within the mining infrastructure corridor in the far east of ML 1775.

Surface Water Drains

The Project will require additional surface water drains to manage clean and dirty water in addition to the existing drains at the CVM. There is one (1) proposed clean water drain designed to convey a 100-year ARI flood immunity and capture the clean water catchment to the west of the proposed OOPD. The clean water drain flows south to north and parallel to the proposed OOPD in the west. The drain is approximately 2 km in length and contains a maximum cut depth of approximately 9.0 m. This drain will direct flow to a natural drainage feature north of the proposed OOPD. The drainage feature outflows to Horse Creek approximately 1 km to the east.

There are four (4) proposed MAW drains that bound the outer extents of the proposed OOPD. The MAW water drains are designed to convey a 10-year ARI flood immunity capturing all MAW water within the stockpile area. The total length of proposed MAW water drains is approximately 7 km with a maximum cut depth of approximately 9.0 m along the outer extents of the OOPD. The drains will direct flow to two (2) proposed dams, as described above and shown on **Figure 2-15** and **Figure 2-17**.

2.5.6.6 Flood Protection

Diversions

There are no proposed watercourse diversions or modifications to existing watercourse diversions required to facilitate the Project. There are three (3) existing diversions at the CVM associated with Cherwell Creek, Caval Creek and the drainage line flowing into Horse Creek.

There are four (4) mapped minor drainage lines that traverse proposed activities at the Project. These drainage lines are not determined watercourses under the *Water Act 2000* (Water Act) and do not require formalised diversions. These drainage lines will be mined through as Horse Pit progresses. Earthworks will be required ahead of mining to convey upslope overland flow away from Horse Pit. There is also a minor drainage line that interacts with the north-west corner of the proposed OOPD. This drainage line will be realigned around the toe of the OOPD.

Flood Levees

Existing flood protection at the CVM is provided via the road running adjacent the drainage line flowing into Horse Creek and levees bounding various sections of the perimeter of Horse Pit. Flood immunity at the CVM has been designed to prevent pit inundation up to 0.1% AEP.

To facilitate the Project and maintain pit protection at the CVM, there are two (2) proposed flood levees required to maintain a 0.1% AEP flood immunity during operations. The proposed levees are designed to prevent ingress of clean water from Horse Creek to the mine pits. The two (2) proposed flood levees have been designed to a concept level for the purpose of the EA Amendment for the Project. In accordance with the existing EA definitions, the two (2) levees will be regulated structures and will be designed and constructed in accordance with the relevant requirements. The proposed levee locations and extents are summarised below:

- The northern levee bounds a portion of Horse Pit in the far north of ML 1775. This levee is approximately 1.4 km in length. The levee is to be constructed in a staged approach to allow free draining of the clean highwall catchment while providing pit protection.
- The western levee is located at the south-west extent of the proposed OOPD on the boundary of ML 70403 and ML 70462. This levee is approximately 400 m in length and is designed to protect the proposed OOPD from flooding.

The basis of design for the levees is outlined in **Table 2-7** and the locations of the proposed flood protection levees are outlined on **Figure 2-17**. Assessment of final landform flood immunity is discussed in **Section 5.2.2.3**.

Table 2-7 Flood Levee Basis of Design

Component	Basis of Design
Flood Immunity	0.1% AEP with 0.5 m freeboard
Crest Width	10.0 m (as per current site levees)
Batter Slopes	1V:3H (no safety bunds)
Key Trench Width	3.0 m
Crest Treatment	100 mm gravel capping and guideposts (trafficable)
Batter Treatment	Topsoil/alternate growth media, ameliorate and seed

3 Habitat Assessment

The habitat assessment presented below is a summary of the Significant Impact Assessment Report – Terrestrial Ecology (E2M, 2021), included in **Appendix C**.

Habitat assessment was a key component of ecological studies to establish the basis for assessing the potential impact to threatened species and communities.

3.1 Methodology of Assessment

3.1.1 Desktop Assessment

The desktop assessment involved the review of relevant environmental documents, databases, maps and legislation to identify potential ecological values that may occur within the survey area. This included the following resources:

- Environmental Impact Statement (EIS). 2009. The CVM Project. BMA;
- BMA and BMC Conservation Significant Species Register (Client supplied);
- Protected Matters Search Tool (PMST) Database;
- Atlas of Living Australia (ALA) species search;
- Wildlife Online Search;
- Protected Plants Flora Survey Trigger mapping;
- draft Central Queensland fauna habitat definitions (BHP unpublished document);
- HERBRECS data;
- Regulated Vegetation mapping;
- Regional Ecosystem (RE) mapping;
- Property Map of Assessable Vegetation mapping;
- Pre-clearance RE mapping;
- Environmentally Sensitive Area Map;
- Queensland Matters of State Environmental Significance (MSES) mapping;
- Essential Habitat mapping;
- Queensland historical imagery;
- Queensland wetland data series;
- Referrable Wetland mapping;
- Groundwater Dependant Ecosystem (GDE) Atlas;
- *Vegetation Management Act 1999* (VM Act) Wetland data; and
- VM Act watercourse and drainage feature map (Version 4).

Where applicable, database search results returned records within a 50 km radius of the centre of the Project Area (e.g. PMST and Wildlife Online reports). This 50 km radius reflects/accounts for the:

- Size of the Project Area;
- Clumped distribution of habitat features dispersed across a highly modified landscape; and
- Inclusion of data recorded in correlation with the development of neighbouring mines.

Results of desktop searches are found in Appendix A – Terrestrial Ecology Assessment Report of **Appendix C**.

3.1.1.1 Latest PMST Report

The Additional Information Required for the Preliminary Documentation (**Appendix A**) requires that a recent Protected Matters Search Tool (PMST) is generated and considered prior to finalising the Preliminary Documentation Report. To this end, a recent PMST Report (January 2022) has been generated. This recent PMST Report was considered relative to the original PMST report (2019) utilised for the Significant Impact Assessment Report – Terrestrial Ecology (**Appendix C**) and the key items to note are outlined below:

- One (1) MNES has been added in the 2022 report: grey falcon (*Falco hypoleucus*) – Not relevant to the Project as per section 158A of the EPBC Act;

- Four (4) MNES have been removed from the 2022 report: grey-headed flying fox (*Pteropus poliocephalus*), a cycad species (*Cycas ophiolitica*), black-faced monarch (*Monarcha melanopsis*) and great egret (*Ardea alba*) – in any case, these species are unlikely to occur;
- One (1) invasive species has been removed from the 2022 report: nutmeg mannikin (*Lonchura punctulata*); and
- There were no changes to TECs.

3.1.2 Field Surveys

Field surveys were conducted to identify and characterise the presence, extent and condition of contemporary terrestrial ecological values within the Project Area. The Project Area encompasses ML 1775, ML 70403 and ML 70462 north of the Peak Downs Highway (excluding the Moranbah Airport), as shown on **Figure 2-3**. The methods employed adhere to the guidelines and methodologies prescribed or supported by the Queensland and Commonwealth governments. The field survey measures employed are summarised below and detailed under Section 2.3 of Appendix A – Terrestrial Ecology Assessment Report under **Appendix C**.

3.1.2.1 Survey Timing

Two (2) field surveys were conducted as part of the terrestrial ecology assessment. The first survey was conducted in the late dry season (25 November to 2 December 2019). The survey conditions during this time were unseasonably hot and dry with daily temperatures exceeding 35°C, augmented by below average rainfall (a total of 30 mm rain was recorded in September, October and November 2019 as compared to 89 mm over the same period in 2018 and 126 mm in 2017).

A subsequent wet season survey was conducted between 19 March and 27 March 2020 during more favourable survey conditions. During the six (6) weeks preceding the wet season survey, the Project Area received approximately 230 mm of rainfall, resulting in the emergence of annual herbs, grasses and the presence of reproductive material on many species of flora. At the time of survey, Horse Creek and its tributaries had standing pools of water and the gilgai scattered throughout the Project Area were inundated with water providing optimal survey conditions for ornamental snake (*Denisonia maculata*). The optimal survey condition for these target species corresponds with the wet season when species are more detectable.

3.1.2.2 Survey Methodologies

The objective of the surveys was to determine the presence of TECs and threatened species protected under the EPBC Act. Specifically, the terrestrial ecology survey involved:

- Ground-truthing vegetation communities (type and condition);
- Validating habitat values, particularly for species protected under EPBC Act such as *Dichanthium queenslandicum*, ornamental snake (*Denisonia maculata*), squatter pigeon (*Geophaps scripta scripta*) and Australian painted snipe (*Rostratula australis*) – (Refer to **Section 3.2** for details of survey effort for these species);
- Assessing the condition and extent of TECs in the Project Area; and
- Targeted surveys for *Dichanthium queenslandicum*, ornamental snake, squatter pigeon and Australian painted snipe.

Flora Surveys

The flora survey effort included categorisation of the following elements:

- Broad Vegetation Group (BVG);
- REs;
- BioCondition;
- Threatened Ecological Communities (TECs); and
- Threatened flora.

Ground-truthing and validating of REs within the Project Area was conducted in accordance with the Queensland Government's Methodology for Surveying and Mapping of Regional Ecosystems and Vegetation Communities in Queensland (Neldner et al., 2019). Tertiary and Quaternary vegetation surveys were carried out as per the

Queensland Herbarium's CORVEG database. Vegetation communities were categorised into four (4) classes based on RE description and vegetation structure and condition:

- **Remnant** – a vegetation community that achieves remnant status as defined in the VM Act and referenced by Neldner et al. (2019b).
- **High Value Regrowth (HVR)** – vegetation communities that have not been cleared within the last 15 years or are degraded (e.g. dieback, selectively cleared) to the extent that it does not meet the canopy cover and/or height (8) thresholds for remnant status. Species composition was still consistent with a RE.
- **Regrowth** – communities that have been cleared/disturbed within the last 15 years and while may lack comparable structure (i.e. woodland, forest etc), contain floristic composition consistent with a RE.
- **Non-remnant** – communities that have been historically cleared/disturbed or heavily modified (i.e. improved pastures, weed encroachment, etc.) and are not consistent with a particular RE.

In conjunction, an additional assessment was undertaken in the field within relevant vegetation communities to verify if key diagnostic characteristics and condition thresholds for the EPBC Act listed TECs were met. Specific condition criteria and characteristics used for the assessment are based on respective information provided within each 'approved listing advice' published for each TEC identified within the desktop assessment.

The random meander technique (Cropper, 1993) was used to survey for potential threatened flora throughout the Project Area.

Fauna Surveys

The fauna survey included categorisation of the following elements:

- the species richness and general fauna assemblages within the Project Area;
- the type and quality of fauna habitat present within the Project Area; and
- fauna Matters of National Environmental Significance (MNES).

The fauna survey methodology included:

- Systematic trap sites;
- Nocturnal spotlighting;
- Bird surveys;
- Anabat survey;
- Diurnal active searches;
- Opportunistic surveys; and
- Fauna habitat assessments.

3.1.3 Habitat Definitions

Habitat mapping within the Project Area was undertaken with the guidance of multiple data inputs including: habitat assessments collected during the field survey, species records (previous and survey records) and ground-truthed vegetation mapping. In general terms, ground-truthed vegetation communities were confirmed as species habitat where vegetation condition or microhabitat values required for the species were present.

The habitat definitions adopted for listed threatened species likely to be impacted are presented in **Table 3-1**. The habitat definitions for threatened fauna are consistent with the report 'Habitat descriptions for 12 threatened species, specific to Central Queensland' (Kerswell et al., 2020), included in **Appendix D**, and Approved Conservation Advice where noted. The report 'Habitat descriptions for 12 threatened species, specific to Central Queensland' (Kerswell et al., 2020) was compiled to develop habitat definitions specific to central Queensland that can be consistently applied when considering impacts to threatened species. The definitions have been developed based on available data and literature as well as consultation with a variety of specialists (including Steve Wilson, Brad Dreis (E2M), Lindsay Agnew (Austecology), Penn Lloyd (BAAM), Greg Ford, Berlinda Ezzy & Andy Jensen (EMM), Craig Eddie (Boobook) and Liz Fisher (AECOM)). The report documents the information (and sources) to provide justification for habitat definitions that deviate from the DAWE supplied definitions as part of a joint initiative undertaken by DAWE and BMA to develop central Queensland specific definitions.

Table 3-1 *Habitat definitions for MNES likely to be impacted by Project*

Threatened Species / Community	Habitat/Structure Definitions
King bluegrass <i>Dichanthium queenslandicum</i>	<p>Habitat consists of native grasslands and open woodlands characterised by a grassy understorey and a canopy composed of mountain coolibah (<i>Eucalyptus orgadophila</i>), <i>Corymbia erythrophloia</i> and coolibah (<i>E. coolabah</i>) (DAWE 2020). King bluegrass co-occurs with other bluegrass species (<i>Dichanthium spp.</i> and <i>Bothriochloa spp.</i>) as well as other native grasses associated with heavy, black soil types. The distribution of the species also overlaps with the Brigalow TEC and the Natural Grasslands TEC (although no TECs were identified in the Project Area).</p>
Ornamental snake <i>Denisonia maculata</i>	<p>Preferred ornamental snake habitat in Central Queensland is defined as:</p> <ul style="list-style-type: none"> • gilgai depressions, mounds and wetlands on cracking clays (predominantly land zone 4) where essential microhabitat features are present including an abundance of deep soil cracks and fallen woody debris; and • seasonal flooding of habitat areas is a requirement. <p>Suitable ornamental snake habitat in Central Queensland is defined as:</p> <ul style="list-style-type: none"> • Dispersal areas within 1 km of preferred habitat currently or previously dominated by brigalow or coolabah communities where gilgais or soil cracks are infrequent or are shallow or non-remnant areas. <p>Marginal ornamental snake habitat in Central Queensland is defined as:</p> <ul style="list-style-type: none"> • areas currently or previously dominated by brigalow or coolabah communities where gilgai or soil cracks are infrequent or shallow; • non-remnant areas where threats are high (weed incursion, livestock soil compaction); and • areas where ornamental snake has the potential to occur, especially when water is present and prey abundance (frogs) is high.
Squatter pigeon (southern) <i>Geophaps scripta scripta</i>	<p>Preferred squatter pigeon habitat in Central Queensland is defined as:</p> <ul style="list-style-type: none"> • Remnant or regrowth grassy open forest to woodland dominated by <i>Eucalyptus</i>, <i>Corymbia</i>, <i>Callitris</i> or <i>Acacia</i> with patchy, relatively sparse ground cover vegetation (<33 %) and sparse shrub layer on well-draining sandy, loamy or gravelly soils within 1 km of a suitable permanent waterbody; • Preferred habitat may be located on land zones 3, 5, 7, 8, 9 and 10; and • Excludes areas dominated by introduced pasture grasses. <p>Suitable squatter pigeon habitat in Central Queensland is defined as:</p> <ul style="list-style-type: none"> • Remnant or regrowth grassy open forest to woodland dominated by <i>Eucalyptus</i>, <i>Corymbia</i>, <i>Callitris</i> or <i>Acacia</i> with patchy, relatively sparse ground cover vegetation (<33 %) on well-draining sandy, loamy or gravelly soils between 1 and 3 km of a suitable permanent or seasonal waterbody; • Non-remnant areas within 100 m of preferred habitat; and • Suitable habitat may be located on land zones 3, 5, 7, 8, 9 and 10. <p>Marginal squatter pigeon habitat in Central Queensland is defined as:</p> <ul style="list-style-type: none"> • Non-remnant areas, regrowth and remnant woodland or forest areas more than 3 km from a permanent or seasonal waterbody that facilitates the movement of the species between patches of preferred or suitable habitat.
Poplar Box Grassy Woodland on Alluvial Plains TEC	<p>Key diagnostic criteria and condition thresholds outlined within the Conservation Advice (including listing advice) for the Poplar Box Grassy Woodland on Alluvial Plains (DoEE, 2019), which states that the community must have the following structure:</p> <ul style="list-style-type: none"> • a tree crown cover >10% at patch scale; • a tree canopy that shows the following characteristics: <ul style="list-style-type: none"> ◦ canopy trees can reach a potential height (8) of at least 10 m or more; ◦ a dominance of poplar box (<i>Eucalyptus populnea</i>) within the canopy layer; ◦ hybrids of poplar box with other <i>Eucalyptus spp.</i> must be counted as part of the poplar box component when assessing the previous criterion; ◦ a crown cover of shrubs to small trees (1 - 10 m height (8)) less than 30%; and • a ground cover dominated by perennial native grasses, other native herbs and sometimes chenopods.

3.2 Historical Records

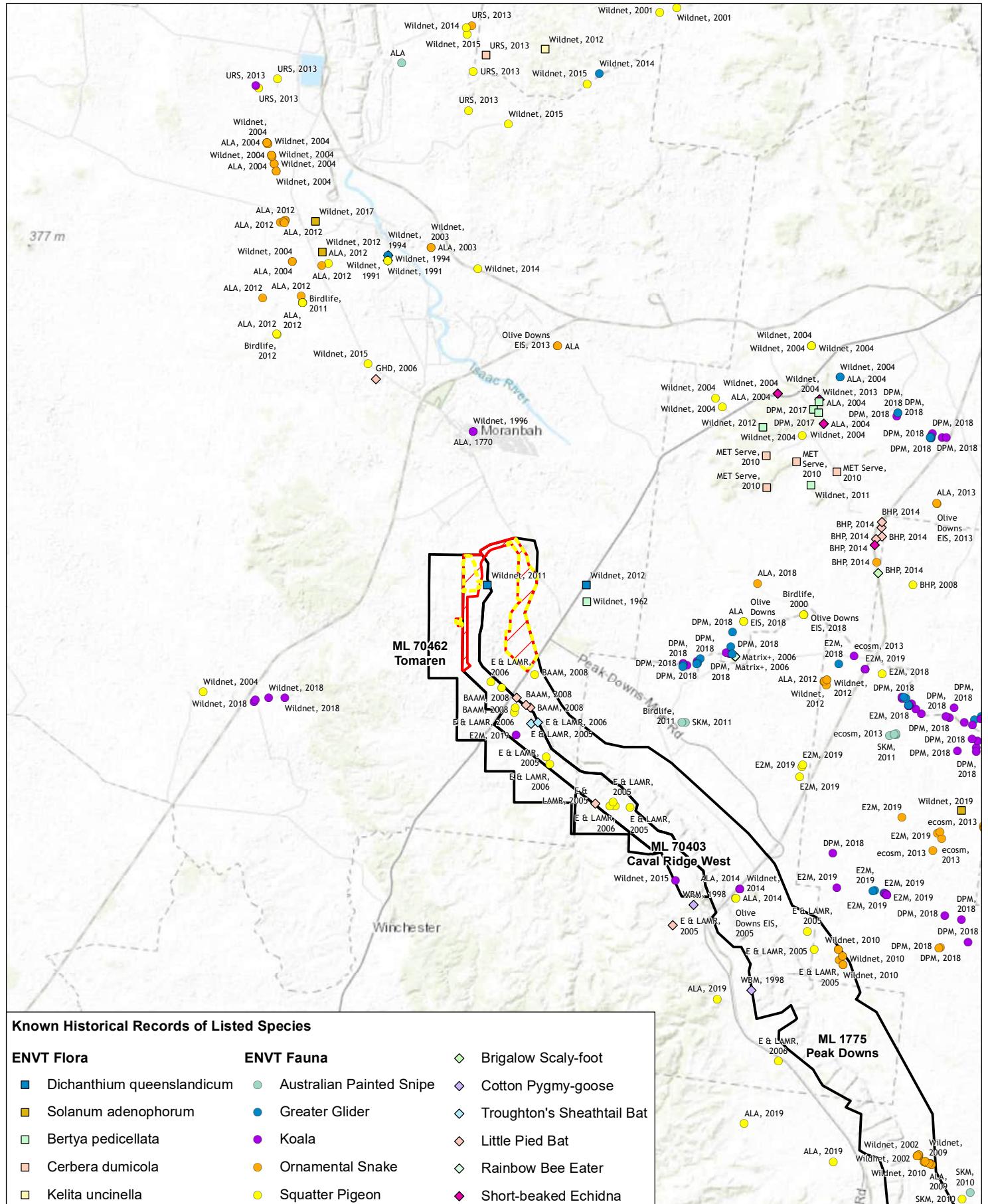
Historical records of listed threatened species and ecological communities in the broader region were sourced from:

- Protected Matters Search Tool (PMST) Database as issued by the Commonwealth Department of Agriculture, Water and the Environment (DAWE) (2020a);
- Regulated Vegetation Management Map issued by the Department of Natural Resources, Mines and Energy (DNRME) (Version 11.0) (DNRME, 2020b);
- Queensland Remnant Regional Ecosystem mapping provided by DES (Version 11) (DES, 2018c) and associated Regional Ecosystem Description Database (Version 11.1) (Queensland Herbarium, 2019);
- DNRME Vegetation Management watercourse and drainage feature mapping (Version 4.0) (DNRME, 2020d);
- Wildlife Online Extract and WildNet data provided by the DES (DES, 2018d, 2020d);
- Queensland Herbarium HERBRECS Specimen database (Queensland Herbarium, 2017);
- DNRME Detailed Surface Geology Mapping (DNRME, 2018) and Geoscience Australia 1:250,000 geology mapping series (Geoscience Australia, 2020a);
- DES Biodiversity Planning Assessment mapping (DES, 2018a);
- Map of ESAs for Mining Leases, provided by DES (DES, 2019a);
- Protected Plants Flora Survey Trigger Map (DES, 2019b);
- Atlas of Living Australia species search (Atlas of Living Australia [ALA], 2020);
- BirdLife Australia (BLA) species search (BLA, 2020);
- GeoScience Australia 1:100,000 drainage network of Queensland (Geoscience Australia, 2020b); and
- DES Wetland Systems Mapping (Version 5.0) (DES, 2019c).

In addition, publicly available survey reports detailing the environmental values (EVs) of adjacent/local projects were reviewed, including:

- Winchester South Project (EcoSM 2013) - Terrestrial flora and fauna baseline reports;
- Olive Downs Project (DPM Envirosciences 2018) - Baseline offset survey investigation report, terrestrial fauna assessment and terrestrial flora assessment;
- Arrow Bowen Gas Project - Environmental Impact Statement – Terrestrial Ecology Report (3D Environmental 2012);
- Red Hill Mining Lease - Terrestrial Fauna Technical Report (URS Australia, 2013);
- Saraji East Coal Mine Project - Baseline environmental studies, terrestrial flora and fauna baseline study (SKM, 2011);
- BMA Bowen Basin Coal Growth Project:
 - The CVM;
 - Goonyella Riverside Mine Expansion; and
 - Daunia Mine;
- Dyno Nobel Asia Pacific Ltd. Moranbah Ammonium Nitrate Manufacturing Facility - Environmental Impact Statement (GHD 2006);
- Stanmore Coal Isaac Downs Project (Stanmore IP South 2020);
- Lake Vermont Coal Project - EIS Assessment Report (Environment and Natural Resource Regulation, 2005); and
- Millennium Expansion Project - Environmental Impact Statement (Peabody Energy Inc., 2011).

The historical records of listed threatened species in the broader region are provided on **Figure 3-1**. Note the ecological communities (i.e. Poplar Box TEC) cannot be mapped without field verification to indicate if the characteristic REs meet key diagnostic and condition thresholds to qualify as a TEC.



Known Historical Records of Listed Species

ENVT Flora

- Dichanthium queenslandicum
- Solanum adenophorum
- Bertia pedicellata
- Cerbera dumicola
- Kelita uncinella

ENVT Fauna

- Australian Painted Snipe
- Greater Glider
- Koala
- Ornamental Snake
- Squatter Pigeon

- ◆ Brigalow Scaly-foot
- ◆ Cotton Pygmy-geese
- ◆ Troughton's Sheathtail Bat
- ◆ Little Pied Bat
- ◆ Rainbow Bee Eater
- ◆ Short-beaked Echidna



0 2.5 5 km

Projection: GDA 1994 MGA Zone 55

Scale: 1:300,000 at A4

Project No.: 620.13593

Date: 17-May-2022

Drawn by: JG

Project Area

BHP Tenements

Disturbance Footprint

**Horse Pit Extension Project
EPBC Act Preliminary Documentation
(EPBC 2021/9031)**

Known Historical Records



FIGURE 3-1

3.3 Habitat Values

Desktop and field assessments undertaken identified a number of threatened species listed under the EPBC Act considered known, likely or potential to occur. The Significant Impact Assessment Report, provided under **Appendix C**, identifies and describes habitat values for the following MNES that may be significantly impacted by the Project: king bluegrass, ornamental snake and squatter pigeon.

The habitat assessment for each MNES identifies the habitat values, based on the habitat definitions in **Section 3.1.3** for the Project Area.

The information requirements for the Preliminary Documentation includes further assessment requirements for the following MNES:

- Ornamental snake (**Section 3.3.1**);
- King bluegrass (**Section 3.3.2**);
- Squatter pigeon (**Section 3.3.3**); and
- Poplar Box Grassy Woodland on Alluvial Plains (**Section 3.3.4**).

The habitat assessment information requested for these MNES is outlined in the following subsections.

3.3.1 Ornamental snake

Status

Vulnerable under the EPBC Act.

Regional Distribution

Ornamental snakes are habitat specialists closely associated with gilgai. Gilgai form in soils with a high clay content typical of Land Zone 4 in Queensland's RE framework. The Commonwealth SPRAT database (citing the Brigalow Belt Reptiles Workshop 2010) list the most common REs in which ornamental snake has been recorded all occur on Land Zone 4 (i.e. 11.4.3, 11.4.6, 11.4.8 and 11.4.9).

Prior to this assessment, the species had not been recorded within the CVM MLs, but had been detected at the neighbouring Peak Downs Mine in 2005 (BMA 2009) as well as numerous localities across the Moranbah area (Atlas of Living Australia records).

Project Area

Potential ornamental snake habitat was initially identified within the Project Area during the study's desktop assessment using (in part) State vegetation mapping databases and aerial photographic interpretation (API) where gilgai were clearly distinguishable. Field surveys ground-truthed the potential habitat to verify the presence of gilgai and microhabitat features such as: coarse woody debris (CWD), aquatic vegetation and/or fringing groundcover vegetation, frog abundance, connectivity and threatening processes. In addition, targeted surveys were also conducted comprising spotlighting, funnel trapping and active searches. The ornamental snake habitat assessment excluded areas (as habitat) that lacked gilgai, had no or limited connectivity, cleared areas (e.g., soil stockpiles and lay down areas), sandy soil areas (e.g., the riparian areas adjacent to Horse Creek and its tributaries) and areas exposed to regular traffic. The habitat assessment was guided by the Queensland RE mapping during the desktop assessment phase but not determined in consideration of only Queensland RE mapping.

Approximately 12 ha within the study area was mapped by DNRME (2020) as Essential Habitat for the ornamental snake (two (2) relatively small and fragmented patches). Ground-truthing during the wet season survey confirmed the mapped area did not contain the microhabitat attributes necessary to provide suitable ornamental snake habitat and thus the area is not considered habitat for the species.

The field survey verified the presence of 167.84 ha of 'preferred habitat' within the Project disturbance footprint (no habitat was identified to meet the definition of suitable or marginal habitat). The 'preferred habitat' features abundant gilgai on cracking clay soils with a high-water retention capacity amongst a regrowth brigalow (*Acacia harpophylla*) shrubland on Land Zone 4. CWD is abundant throughout the preferred habitat, groundcover was high

and, at the time of survey, frogs (i.e. prey source) were abundant within and between the gilgai. Two (2) ornamental snakes were recorded within the 'preferred habitat' during the March 2020 field surveys.

The 167.84 ha of preferred ornamental snake habitat recorded within the Project disturbance footprint represents verified, ground-truthed habitat based on the known habitat requirements and associations of the species in Queensland as well as confirmed sightings on site and site general context.

The extent of ornamental snake habitat and individual records is outlined on **Figure 3-2**.

Vegetation Composition and Structure

A discussion of vegetation composition and structure on relevant land zones (i.e., riparian vegetation, gilgai mounds and depressions, Brigalow TEC, cracking clay soils and microhabitat features) as they relate to ornamental snake habitat in Project Area is provided in **Table 3-2**.

Table 3-2 Vegetation Composition and Structure – Ornamental Snake Habitat

Vegetation composition and structure on Land Zone 4	Discussion
Riparian vegetation	Gilgai were largely inundated with native sesbania pea (<i>Sesbania cannabina</i>) (below). 
Gilgai mounds and depressions	Gilgai were abundant throughout ornamental snake habitat and varied in size (area) and depth (volume) (one example pictured below). 

Vegetation composition and structure on Land Zone 4	Discussion
Brigalow TEC	<p>The brigalow (<i>Acacia harpophylla</i>) shrubland within the Project disturbance footprint does not meet the key diagnostic characteristics or condition thresholds to currently qualify as a Brigalow TEC. Brigalow regrowth is approximately 2-4 m tall.</p> <p>The vegetation community within mapped ornamental snake habitat is characteristic of RE 11.4.9.</p>
Cracking clay soils	<p>Soil cracks within the gilgai varied in depth (from shallow to deep) and width (narrow to wide). The cracking clay soils within ornamental snake habitat are considered suitable refuge habitat.</p> 
Microhabitat features	<p>Ornamental snake habitat within the Project disturbance footprint (and broader Project Area) contains microhabitat features such as: abundant coarse woody debris (CWD), riparian/fringing groundcover vegetation, an abundance of native frogs (prey), connectivity and soil cracks</p>

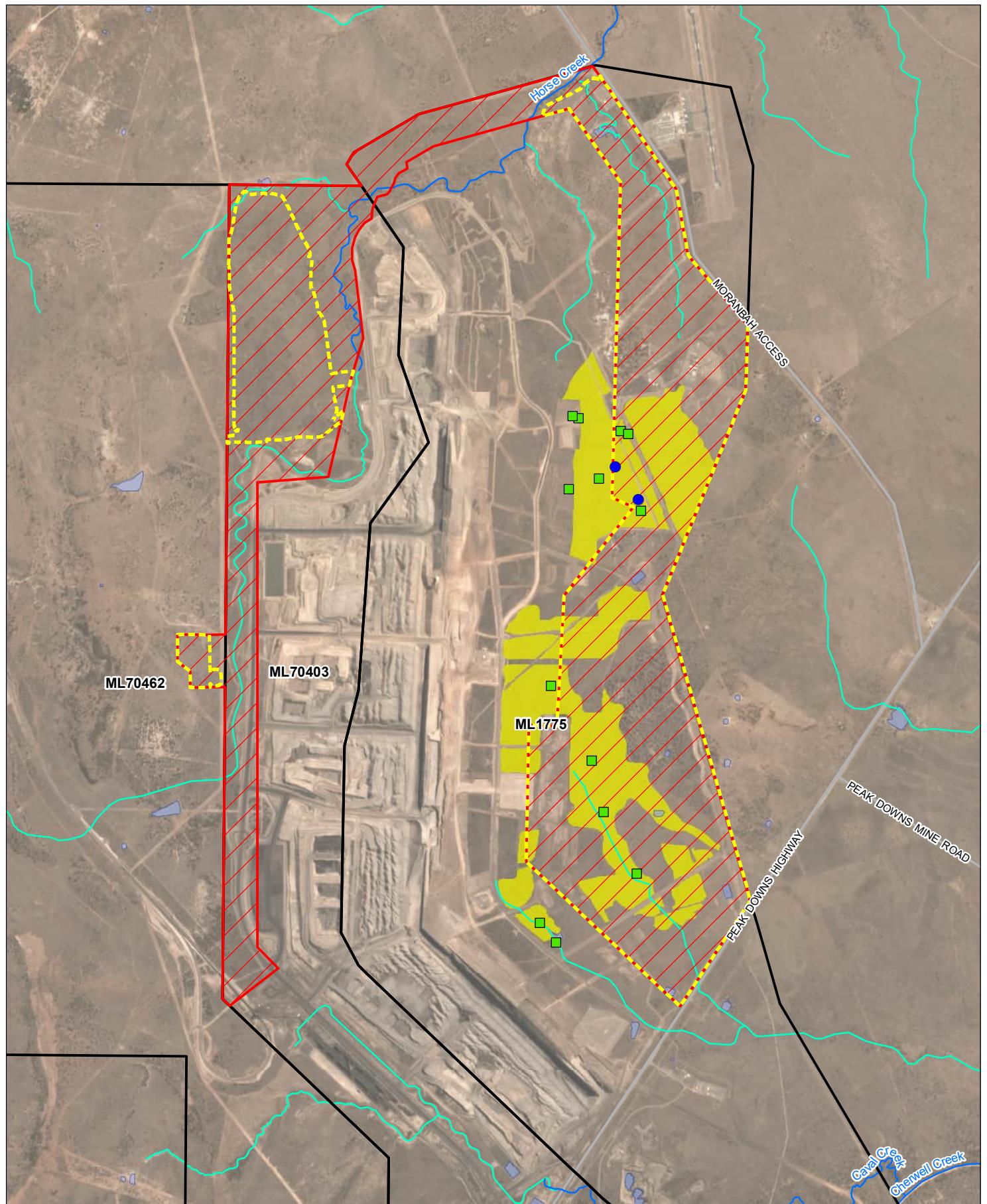
Food Sources

Ornamental snake foraging habitat overlaps with the currently mapped 'preferred habitat' discussed above. Five (5) species of native frog were seen/heard within the inundated wetlands, drainage lines and gilgai in the Project Area during the wet season survey. Most pools of standing water contained amphibians at various stages of development (i.e. tadpole, metamorph, adult). The most encountered species were green tree frogs (*Litoria caerulea*) and greenstripe frogs (*Cyclorana alboguttata*). Frogs were distributed throughout the area delineated as preferred ornamental snake habitat. The extent of ornamental snake habitat, including locations of frog records, is outlined on **Figure 3-2**.

Habitat Use Requirements

DSEWPaC (2011) states that "suitable habitat for any one of the listed Brigalow Belt reptiles is considered important if it is habitat where the species has been identified during a survey". As ornamental snake was positively identified during the 2020 wet season survey, the ground-truthed ornamental snake habitat mapped within the Project disturbance footprint (i.e. 167.84 ha) qualifies as 'important'. Shelter/refuge habitat, foraging habitat, breeding habitat and dispersal habitat are all collocated and collectively mapped as 'preferred ornamental snake habitat'.

Gilgai provide foraging habitat for ornamental snake during the wet season when soils with a high-water holding capacity become inundated and attract breeding frogs. During the dry season, the gilgai soils, with a high clay content, crack and provide shelter/refuge habitat. Dispersal habitat provides safe passage among gilgai. The abundance of gilgai, supported by groundcover vegetation, regrowth brigalow and abundant CWD throughout the mapped Project Area facilitates dispersal habitat.



0 0.5 1 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:42,500 at A4
Project No.: 620.13593
Date: 13-Jul-2022
Drawn by: JG

Watercourses (Water Act 2000)

Drainage features

Project Area

BHP Tenements

Disturbance Footprint

Ornamental Snake Record (E2M 2020)

Frog Record (E2M 2020)

Ornamental Snake Preferred Habitat

Horse Pit Extension Project
EPBC Act Preliminary
Documentation
(EPBC 2021/9031)

Ornamental Snake Habitat



3.3.2 King Bluegrass

Status

Endangered under the EPBC Act.

Regional Distribution

King bluegrass occurs in natural tussock bluegrass grasslands on black cracking clay soils within three (3) known disjunct populations in central and southern Queensland (Commonwealth Listing Advice (TSSC 2013); Approved Conservation Advice (DSEWPaC, 2013)). The distribution of the species overlaps with the Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin threatened ecological community (referred to as the Natural Grasslands TEC).

Project Area

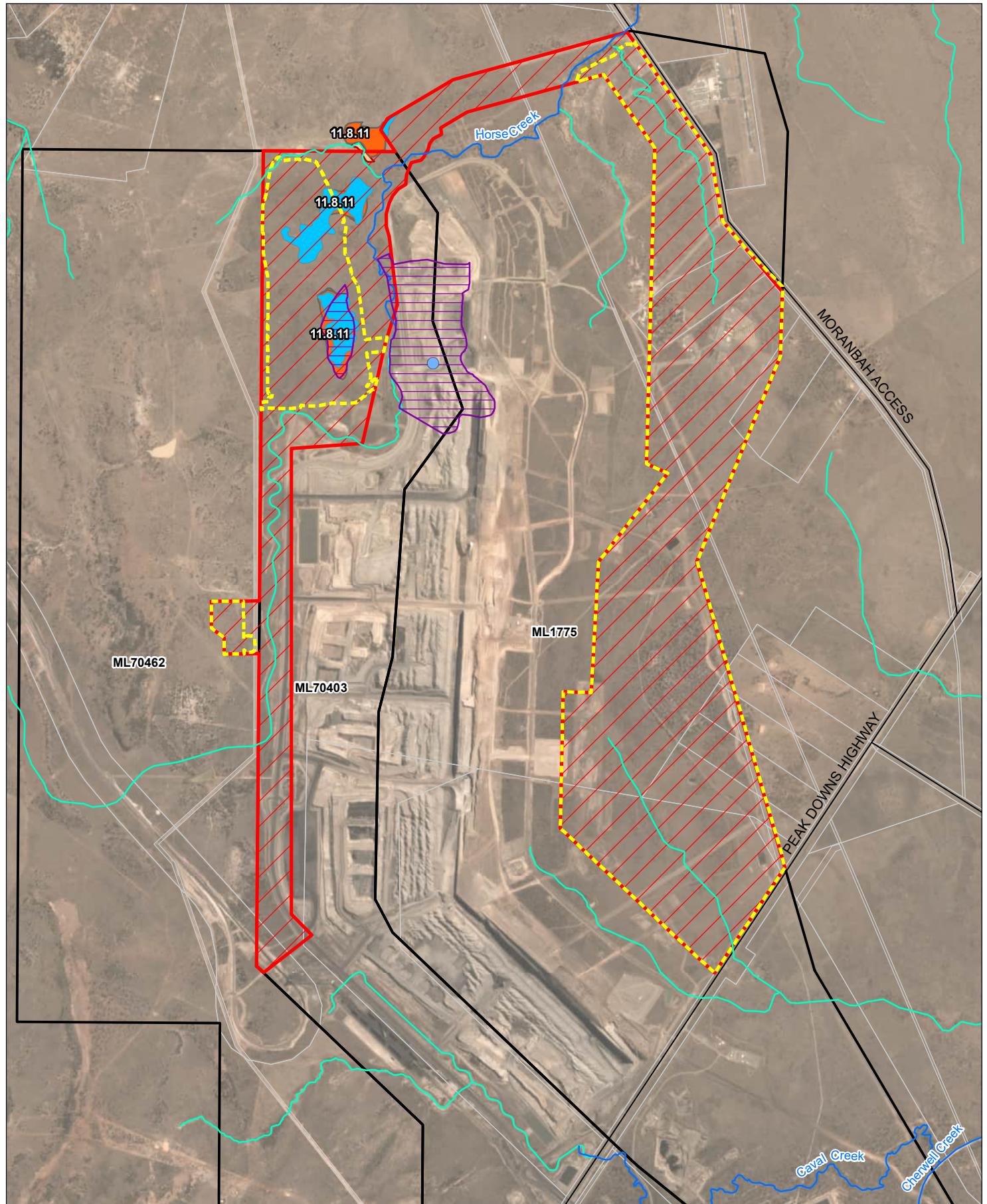
The Desktop Assessment identified the potential for king bluegrass habitat within the Project Area based on:

- Mapped RE 11.8.11 (natural tussock bluegrass grasslands);
- Species was confirmed during environmental studies completed for the CVM EIS (URS, 2008); and
- DNRME mapped essential habitat.

The habitat assessment was guided by the Queensland RE mapping during the desktop assessment but the delineation of the mapped RE 11.8.11 (i.e. king bluegrass habitat) polygon is based on ground-truthed field survey data.

The field survey verified 23.40 ha of king bluegrass suitable habitat (i.e. remnant natural tussock bluegrass grasslands - RE 11.8.11) within the Project disturbance footprint. The survey confirmed the presence and extent of remnant natural tussock bluegrass grasslands (RE 11.8.11), however king bluegrass was not detected within the habitat during field survey.

The extent of king bluegrass habitat and historical individual record is outlined on **Figure 3-3**.



0 0.5 1 km
 Projection: GDA 1994 MGA Zone 55
 Scale: 1:42,500 at A4
 Project No.: 620.13593
 Date: 24-May-2022
 Drawn by: JG

- Existing Road
- Watercourses (Water Act 2000)
- Drainage features
- Proposed Disturbance Footprint
- Project Area
- BHP Tenements

- Dianthium queenslandicum (King Bluegrass) record (CVM EIS, 2008)
- Dianthium queenslandicum (King Bluegrass) habitat
- Essential Habitat DNRME v9.13
- Vegetation Management Regional Ecosystem Map - Version 11**
- Remnant 11.8.11 (Of Concern)
- HVR 11.8.11 (Of Concern)

Horse Pit Extension Project
EPBC Act Preliminary Documentation
(EPBC 2021/9031)

King Bluegrass Habitat

3.3.3 Squatter pigeon

Status

Vulnerable under the EPBC Act.

Regional Distribution

Squatter pigeon inhabit a broad range of habitats within many different vegetation communities on numerous land zones. The species does however have specific breeding, foraging and dispersal microhabitat requirements pertaining to water availability, ground cover density and open areas, respectively.

Project Area

The Desktop Assessment focussed on identifying permanent and ephemeral water sources with suitable access (e.g. excludes mining dams) as well as areas that may serve as a barrier to movement. The habitat assessment was guided by the Queensland RE mapping during the desktop assessment, but the delineation of the mapped habitat is based on ground-truthed microhabitat data collected during field survey as well as proximity to essential habitat features (as determined by spatial analysis and field data).

Whilst the Project is within the known distribution for the squatter pigeon (southern subspecies), targeted field surveys (across two seasons and in accordance with relevant survey guidelines) of the study area did not detect the subspecies, indicating reduced or intermittent utilisation of habitat within the study area or few individuals within the immediate vicinity. The most recent sighting within the CVM mining lease for the species were recorded over a decade ago (i.e. 2006 and 2008) as part of terrestrial ecology studies for the CVM EIS (BMA, 2009).

The lack of squatter pigeon observations on-site (recorded systematically or opportunistically) suggests any resident population (should there be any) is small.

The field surveys ground-truthed the Project Area, assessing the suitability of squatter pigeon habitat in accordance with the microhabitat features outlined under **Table 3-1**. The surveys found that the Project disturbance footprint includes the following habitat extents for squatter pigeon:

- 54.82 ha of preferred (aka breeding and foraging) habitat;
- 28.71 ha of suitable (aka foraging) habitat; and
- 0 ha of marginal (aka dispersal) habitat.

Squatter pigeon habitat is outlined on **Figure 3-4**.

Vegetation Composition and Structure

A discussion of vegetation composition and structure on relevant land zones (i.e., riparian vegetation, gilgai mounds and depressions, Brigalow TEC, cracking clay soils and microhabitat features) as they relate to squatter pigeon habitat in Project Area is provided in **Table 3-3**.

Table 3-3 Vegetation Composition and Structure – Squatter Pigeon Habitat

Squatter pigeon habitat	Vegetation Composition and Structure with specific tree and grass species
<i>Acacia harpophylla</i> (brigalow) open forests to woodlands on clays	<p>The community is typically dominated by brigalow (<i>Acacia harpophylla</i>) and occasionally co-dominant with Dawson's gum (<i>Eucalyptus camaganeana</i>), ranging from 8-15 m and 11-20% cover. Other associated canopy species include <i>E. thozetiana</i>, poplar box (<i>E. populnea</i>) and narrow-leaved ironbark (<i>E. crebra</i>). A subcanopy of younger brigalow (<i>A. harpophylla</i>) and associated ebony (<i>Lysiphyllum carronii</i>), whitewood (<i>Atalaya hemiglaucia</i>) and yellowwood (<i>Terminalia oblongata</i>) is typically present. A sparse to moderate shrub layer containing currant bush (<i>Carissa ovata</i>), wilga (<i>Geijera parviflora</i>), scrub bonaree (<i>Alectryon diversifolia</i>), lime bush (<i>Citrus glauca</i>) and juvenile canopy species is also present. The ground layer is dominated by buffel grass (<i>Cenchrus ciliaris</i>*) with Indian bluegrass (<i>Bothriochloa pertusa</i>*), windmill grass (<i>Chloris divaricata</i>), pigweed (<i>Portulaca oleracea</i>), blue trumpet (<i>Brunoniella australis</i>) and ruby saltbush (<i>Enchyalaena tomentosa</i>).</p> 
Eucalypt dominated open forest and woodlands on drainage lines and alluvial plains	<p>The community is characterised by a tree canopy (~14 m in height (8) and 10-15% cover) dominated by river red gum (<i>Eucalyptus camaldulensis</i>). Other associated species in the tree layer include Sally's wattle (<i>Acacia salicina</i>), Queensland ebony (<i>Lysiphyllum hookeri</i>), yellowwood (<i>Terminalia oblongata</i>) and weeping melaleuca (<i>Melaleuca fluviatalis</i>). A sparse shrub layer containing juvenile canopy species as well as dysentery bush (<i>Grewia latifolius</i>) and Leichhardt bush (<i>Cassia brewsteri</i>) was also observed. The ground layer is typically dominated by exotic grasses, such as Guinea grass (<i>Megathyrsus maximus</i>), buffel grass (<i>Cenchrus ciliaris</i>*) and red Natal grass (<i>Melinis repens</i>), with associated species including <i>Bothriochloa bladhii</i>, <i>Aristida ramosa</i> and <i>Parthenium hysterophorus</i>. </p> 

Squatter pigeon habitat	Vegetation Composition and Structure with specific tree and grass species
Dry eucalypt open forests to woodlands mainly on basalt areas	<p>The community is characterised by a tree canopy (~15 m in height (8) and 11-15% cover) dominated by <i>Corymbia dallachiana</i>, and <i>Eucalyptus orgadophila</i> with associated Sally's wattle (<i>Acacia salicina</i>), and yellowwood (<i>Terminalia oblongata</i>). A sparse shrub layer containing juvenile canopy species as well as dysentery bush (<i>Grewia latifolius</i>), ebony (<i>Lyssiphyllyum caronii</i>), dead finish (<i>Archidendropsis basaltica</i>) and currant bush (<i>Carissa ovata</i>) was also observed.</p> <p>The ground layer is dominated by exotic grasses, including buffel grass* (<i>Cenchrus ciliaris</i>*) and red Natal grass* (<i>Melinis repens</i>*) with associated native forbs and grasses including feathertop wiregrass (<i>Aristida latifolia</i>), black speargrass (<i>Heteropogon contortus</i>), <i>Melhania oblongifolia</i>, <i>Cucumis melo</i> and bladder ketmia (<i>Hibiscus verdcourtii</i>).</p> <p>This community was excluded as breeding and foraging habitat in areas with dense groundcover (pictured).</p> 
<i>Eucalyptus populnea</i> dominated woodlands to open woodlands on sandplains or depositional plains	<p>The vegetation community contained a tree canopy (11-20 m in height (8) and 10-20% cover) dominated by poplar box (<i>E. populnea</i>) with occasional Dallachy's gum (<i>Corymbia dallachiana</i>), Sally's wattle (<i>Acacia salicina</i>) and red ash (<i>A. excelsa</i>). A sparse shrub layer containing ironwood (<i>Acacia excelsa</i>), scrub bonaree (<i>Alectryon diversifolia</i>), yellowwood (<i>Terminalia oblongifolia</i>), currant bush (<i>Carissa ovata</i>) and dead finish (<i>Archidendropsis basaltica</i>) was also observed. The ground layer comprises a combination of native and exotic pasture grasses, including buffel grass (<i>Cenchrus ciliaris</i>), golden crown-beard grass (<i>Chrysopogon fallax</i>), purple wire-grass (<i>Aristida ramosa</i>), <i>A. calycina</i> and associated forbs such as <i>Melhania oblongifolia</i>, <i>Sida</i> spp. and <i>Rostellaria adscendens</i>.</p> 

Squatter pigeon habitat	Vegetation Composition and Structure with specific tree and grass species
Native tussock grasslands	<p>The community is dominated by native grasses (50-60%) including red Flinders grass (<i>Iseilema vaginiflorum</i>), native millet (<i>Panicum decompositum</i>), Queensland bluegrass (<i>Dichanthium sericeum</i>), feathertop wiregrass (<i>Aristida latifolia</i>), white speargrass (<i>A. leptopoda</i>) and early spring grass (<i>Eriochloa pseudoacrotricha</i>). Occurrences of exotic pasture grasses were common throughout these areas (sometimes dominant) and include buffel grass (<i>Cenchrus ciliaris</i>), red Natal grass (<i>Melinis repens</i>) and Indian bluegrass (<i>Bothriochloa pertusa</i>). Native forb species frequently recorded include native rosella (<i>Abelmoschus ficulneus</i>), <i>Phyllanthus</i> spp., bladder ketmia (<i>Hibiscus verdcourtii</i>), and Ipomoea spp. Scattered emergent shrubs (0-5% cover) are at times present comprising white wood (<i>Atalaya hemiglaucha</i>), mimosa bush (<i>Vachellia farnesiana</i>) and ebony (<i>Lyssiphyllo caronii</i>).</p> 

Breeding, Foraging and Dispersal Habitat

The report 'Habitat descriptions for 12 threatened species, specific to Central Queensland' (Kerswell et al., 2020) was compiled to develop habitat definitions specific to central Queensland that can be consistently applied when considering impacts to threatened species. Definitions of squatter pigeon habitat developed by Kerswell et al. (2020) are summarised below.

Squatter pigeon breeding habitat requirements are as follows:

- Remnant or regrowth grassy open forest to woodland dominated by Eucalyptus, Corymbia, Callitris or Acacia with patchy, relatively sparse ground cover vegetation (<33%) and sparse shrub layer on well-draining sandy, loamy or gravelly soils within 1 km of a suitable permanent waterbody;
- Includes land zones 3, 5, 7, 8, 9 and 10; and
- Excludes areas dominated by introduced pasture grasses (i.e. buffel grass).

Permanent and seasonal water sources are located within and adjacent to the Project Area. Permanent and seasonal water sources within 1 km of the disturbance footprint of breeding habitat are depicted in **Figure 3-4**.

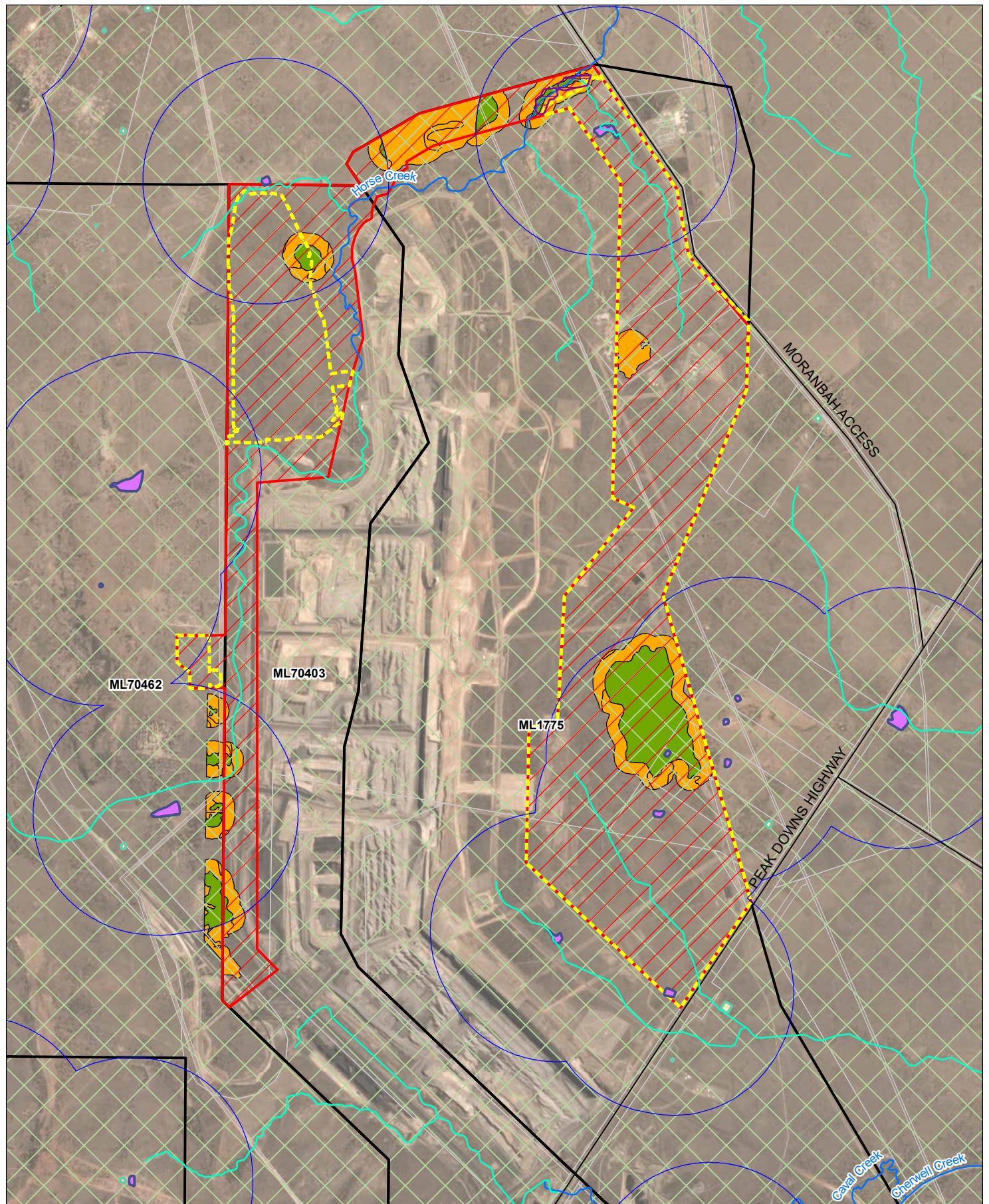
Squatter pigeon foraging habitat requirements:

- Remnant or regrowth grassy open forest to woodland dominated by Eucalyptus, Corymbia, Callitris or Acacia with patchy, relatively sparse ground cover vegetation (<33%) on well-draining sandy, loamy or gravelly soils between 1 and 3 km of a suitable permanent or season waterbody;
- Non-remnant areas within 100 m of preferred habitat; and
- Includes land zones 3, 5, 7, 8, 9 and 10.

Permanent and seasonal water sources are located within and adjacent to the Project Area. Permanent and seasonal water sources within 3 km of the disturbance footprint of foraging habitat are depicted in **Figure 3-4**.

Squatter pigeon dispersal habitat requirements:

- Non-remnant areas, regrowth and remnant woodland or forest areas more than 3 km from a permanent or seasonal waterbody that facilitates the movement of the species between patches of preferred or suitable habitat; and
- ≤ 100m wide.



Projection: GDA 1994 MGA Zone 55

Scale: 1:42,500 at A4

Project No.: 620.13593

Date: 23-May-2022

Drawn by: JG

- Existing Road
- Watercourses (Water Act 2000)
- Drainage features
- Disturbance Footprint
- Project Area
- BHP Tenements

- Essential Habitat DNRME v9.13
- 1km Buffer of Permanent Water
- Seasonal Waterbody
- Permanent Waterbody
- 3km Watersource Buffer
- Squatter Pigeon Habitat**
- Preferred
- Suitable

Horse Pit Extension Project
EPBC Act Preliminary
Documentation
(EPBC 2021/9031)



Squatter Pigeon Habitat

FIGURE 3-4

3.3.4 Poplar Box Grassy Woodland on Alluvial Plains

Status

Endangered under the EPBC Act.

Regional Distribution

Within the specified Brigalow Belt bioregion, the Poplar Box Grassy Woodland on Alluvial Plains TEC is typically associated with several specific REs. Each vegetation community comprising one (1) of the REs associated with the TEC was assessed to determine whether it fits the classification of the TEC (DoEE, 2019).

Project Area

No REs that correspond with the Poplar Box Grassy Woodland on Alluvial Plains TEC (Poplar Box TEC) diagnostic characteristics and conditions threshold criteria (outlined in **Table 3-4** and **Table 3-5** respectively) were identified within the Project disturbance footprint or Project Area. Refer to **Appendix C**.

Predicted Groundwater Drawdown Extent

An assessment of Poplar Box TEC was conducted as part of field surveys of the Groundwater Dependent Ecosystem (GDE) assessment to consider any potential for indirect impacts as a result of groundwater drawdown. Two (2) polygons comprising RE 11.3.2 (an RE associated with the TEC), including remnant and HVR vegetation, were ground-truthed within the Predicted Drawdown Extent of the Project. The patch of remnant RE 11.3.2 spans approximately 4.64 ha, of which 3.85 ha is located within the Predicted Drawdown Extent. The HVR vegetation containing RE 11.3.2 covers approximately 15.32 ha, of which 0.78 ha is located within the Predicted Drawdown Extent. The extent of RE 11.3.2 identified in the Predicted Drawdown Extents is depicted on **Figure 3-5**.

Poplar Box TEC key diagnostic characteristics and conditions threshold criteria are outlined in **Table 3-4** and

Table 3-5 respectively. The GDE assessment is discussed further under **Section 4.4** and the GDE Assessment Report is provided in **Appendix E1**.

Table 3-4 Assessment against the Poplar Box TEC Key Diagnostic Characteristics

Key diagnostic characteristics	Comment
<i>Occurs in the Brigalow Belt North, Brigalow Belt South, Southeast Queensland, Cobar Peneplains, Darling Riverine Plains, NSW South Western Slopes, Riverina and Murray Darling Depression IBRA bioregions.</i>	Diagnostic characteristic met The Project Area is located within the Brigalow Belt North IBRA bioregion.
<i>Associated with ancient and recent depositional alluvial plains with clay, clay-loam, loam and sandy loam, typically duplex soils or sodosols. This includes areas that may not be part of currently defined floodplains</i>	Diagnostic characteristic met The vegetation comprising RE 11.3.2 was located on the alluvial plain associated with Cherwell Creek (Stream Order 5).
<i>A grassy woodland to grassy open woodland with a tree crown cover of 10% or more at patch scale.</i>	Diagnostic characteristic met The vegetation observed was characterised by open woodland to woodlands and tree crown cover ranging from 17 m to 25 m.
<i>A tree canopy must be present that shows these features:</i> <ul style="list-style-type: none"> • <i>Canopy tree species are capable of reaching 10 m or more in height (8)</i> • <i>Eucalyptus populnea (Poplar Box) must be present in the canopy and is the dominant tree species, and</i> • <i>Where hybrids of Poplar Box with other Eucalyptus spp. are present, they should be counted as part of the Eucalyptus populnea component of the tree canopy when assessing the previous criterion.</i> 	Diagnostic characteristic met The vegetation communities observed were dominated by <i>E. populnea</i> (14 m to 16 m median height (8)).

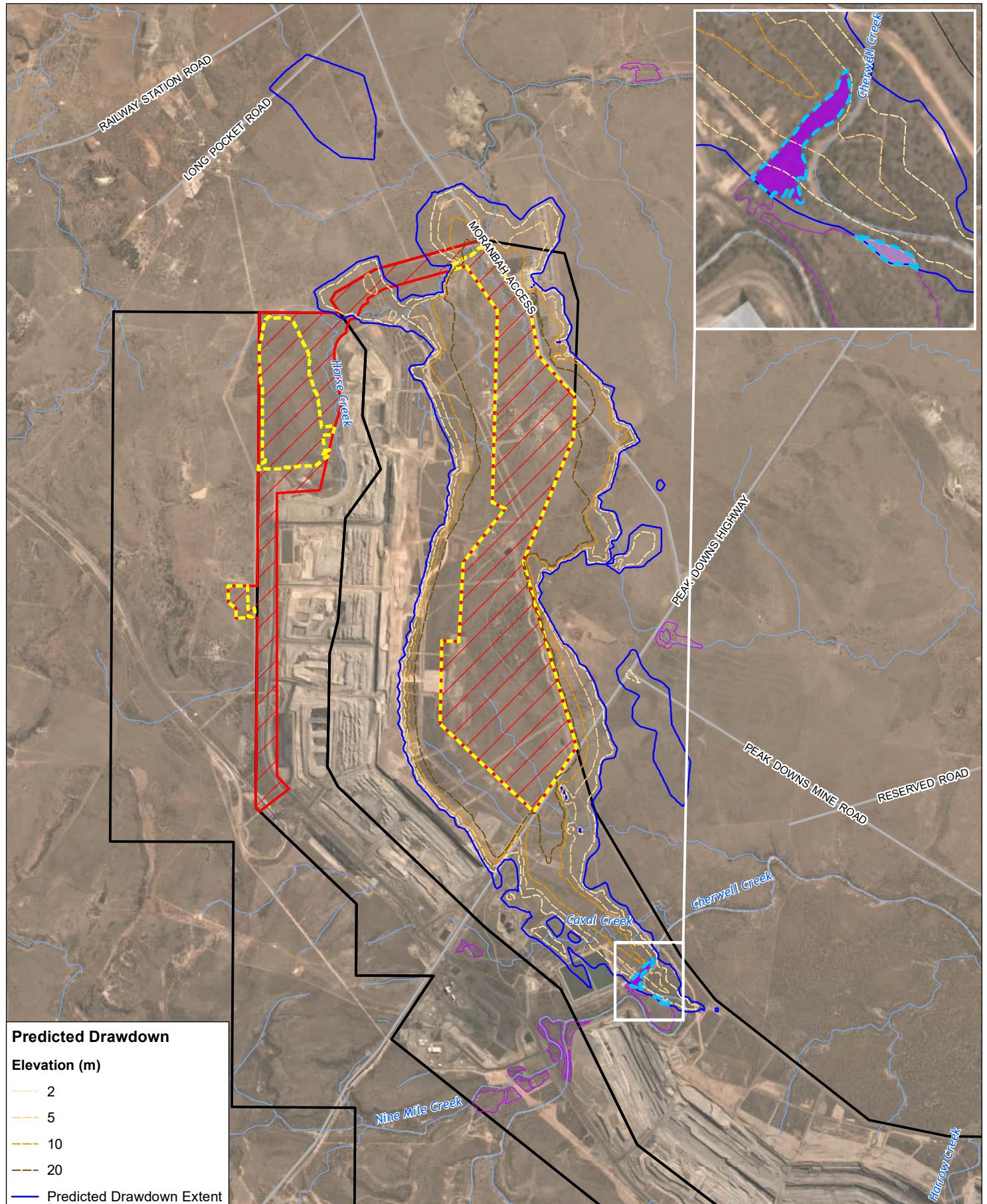
Key diagnostic characteristics	Comment
Mid layer (1-10 m) crown cover of shrubs to small trees is low, about 30% or less.	Diagnostic characteristic met The vegetation communities observed contained a sparse to very sparse subcanopy and shrub layer ranging in cover from 6 m to 13.5 m.

Table 3-5 Assessment Against the Poplar Box TEC Condition Threshold Criteria

Criteria	Class A		Class B	Class C	Comment
	A.1	A.2			
Percentage of crown cover of canopy trees	$\geq 10\%$ AND	$\geq 10\%$ AND	$\geq 10\%$ AND	$\geq 10\%$ AND	Remnant area: Condition threshold met HVR area: Condition threshold met Crown cover within communities ranged from 17 to 25 %.
Percentage of perennial vegetation cover in the ground layer	$\geq 90\%$ AND	$>70\%$ AND	$\geq 50\%$ AND	<i>If <50% of perennial vegetation cover in ground layer is native, then the remaining condition criteria must be met</i>	Remnant area: Condition threshold met HVR area: Condition threshold not met The ground layer comprised <50% native perennial cover. The ground layer was dominated by exotic species including <i>Cenchrus ciliaris</i> , <i>Urochloa mosambicensis</i> , <i>Bidens pilosa</i> , and <i>Parthenium hysterophorus</i> .
Native plant species richness per patch in the ground layer	≥ 30 species AND	≥ 30 species AND	≥ 20 species AND	≥ 20 species AND	Remnant area: Condition threshold not met HVR area: Condition threshold not met Native species richness within the communities ranged from 6 to 15 native species. Species recorded included <i>Chrysopogon fallax</i> , <i>Alloteropsis semialata</i> , <i>Panicum effusum</i> , <i>Melhania oblongifolia</i> , <i>Setaria surgens</i> , <i>Crotalaria medicaginea</i> , <i>Desmodium</i> sp. and <i>Evolvulus alsinoides</i> .
Number of mature trees+ per ha with ≥ 30 cm diameter at breast height (8) (DBH) (and/or hollows)	N/A	N/A	≥ 10 mature trees/ha AND	≥ 10 mature trees/ha AND	Remnant area: Condition threshold met The remnant patch of RE 11.3.2 identified 10 mature trees/ha. HVR area: Condition threshold not met The patch of HVR RE 11.3.2 had <10 mature trees/ha and did not contain any hollows.

An assessment was completed against the key diagnostic characteristics and condition thresholds defined within the *DAWE Conservation Advice (including listing advice) for the Poplar Box Grassy Woodland on Alluvial Plains* (2019). Areas containing RE 11.3.2 within the Predicted Drawdown Extent achieved the diagnostic characteristics of the Poplar Box Woodland TEC, however both of the patches failed to meet the condition thresholds for any of the classes identified within the TEC Conservation Advice (i.e., Class A, B and C). This was largely attributed to following:

- The high density of exotic species within the ground layer, including *Cenchrus ciliaris* (buffel grass), *Urochloa mosambicensis* (sabi grass), *Megathyrsus maximus* (Guinea grass) *Bidens pilosa* (cobbler's pegs), *Melinis repens* (red natal grass), *Stylosanthes* spp. and *Parthenium hysterophorus* (parthenium);
- Low native species richness within the ground layer. This is likely to be influenced by the dominance and high density of exotic species;
- Insufficient mature trees density within the HVR community; and
- Small patch size (<5 ha) for the remnant community.



Horse Pit Extension Project
EPBC Act Preliminary Documentation
(EPBC 2021/9031)

**Poplar Box Grassy Woodland
on Alluvial Plains**



0 0.5 1 km

Projection: GDA 1994 MGA Zone 55

Scale: 1:70,000 at A4

Project No.: 620.13593

Date: 13-Apr-2022

Drawn by: JG



4 Impact Assessment

4.1 Threatened Species and Communities

4.1.1 Overview of Impacts

The Project has the potential to result in direct and indirect impacts including the following:

- Permanent removal of native vegetation, including:
 - 84.19 ha of remnant vegetation;
 - 0.09 ha of HVR vegetation; and
 - 510.75 ha of regrowth vegetation;
- Permanent fauna habitat removal and disturbance to animal breeding places;
- Increased risk of fauna injury and mortality due to vehicle/equipment strike and/or vegetation clearing; and
- Habitat degradation, including edge effects; introduction and spread of weeds and pests; and proliferation of noise, light and dust.

Threatened species and habitat was identified as potentially occurring within the Project Area. Significant residual impacts are expected to ornamental snake and king blue-grass habitat and is discussed in detail in **Section 4.1.2** and **Section 4.1.3** respectively. Squatter pigeon habitat was identified in the Project Area, however significant residual impacts to this species and its habitat are unlikely. This finding was based on the lack of observations, the poor habitat quality, and the fact that squatter pigeon within the Project disturbance footprint and the broader Moranbah region is not considered to be an 'important population' or an important subpopulation (as per the EPBC Act definition). Potential impacts to squatter pigeon are discussed further in **Section 4.1.4**.

No significant impacts to TECs have been identified in the Project Area or the predicted drawdown area. Potential areas of Poplar Box TEC were identified, however ground-truthing determined these areas do not comply with the respective diagnostic characteristics and/or condition threshold criteria.

No EPBC Act-listed aquatic species have been identified within the Project Area or downstream potential impact area.

Details of the impact assessment and mitigation measures are outlined in the following subsections. The Significant Residual Impact Assessment Report is provided under **Appendix C**.

4.1.2 Ornamental Snake

The ornamental snake habitat identified within the Project Area comprises regrowth brigalow (*Acacia harpophylla*) shrublands characteristic of RE 11.4.9 (brigalow shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains) and supports abundant gilgai throughout. The gilgai are a range of sizes and depths with a diversity of soil cracks. A total of 325.69 ha of preferred habitat was identified in the Project Area. Most gilgai at the time of the wet season survey (March 2020) were inundated and observed to support a diversity of native frog species (i.e. ornamental snake main prey).

Two (2) ornamental snakes were detected after 60 person hours of spotlighting and 120 funnel trap nights.

The effects of past vegetation clearing and cultivation of pasture grass (primarily buffel grass (*Cenchrus ciliaris*)) on ornamental snake habitat are still evident throughout the ground layer within the regrowth brigalow community. More recent clearing, causing interim fragmentation, initiated an increased edge effect throughout previously contiguous habitat promoting the spread of non-native flora and pest animals such as feral cats and cane toads. The lack of movement corridors and/or connectivity with adjacent ornamental snake habitat effectively isolates the existing ornamental snake population confirmed present during field surveys (March 2020) to the regrowth brigalow identified. The BioCondition survey site data input into the Habitat Quality score calculator, returned a Habitat quality score of 4/10. Refer to **Photo 4-1** below for an example of typical ornamental snake habitat observed in the Project disturbance footprint.

The Project will result in the direct and permanent loss of 167.84 ha of preferred ornamental snake habitat. Clearing will occur as part of pre-stripping activities as the Horse Pit high wall progresses. Potential indirect impacts

to the species and potential habitat outside of the Project Area may include risk of fauna injury and mortality due to vehicle/equipment strike, habitat degradation associated with edge effects including encroachment of invasive species, erosion to gilgai and/or sedimentation of gilgai, and such impacts to food sources.

Based on the mitigation measures to be applied (see **Section 4.1.9**) to the Project it is expected that the indirect impacts on suitable habitat within the Project Area and adjacent areas will be minimal. Ornamental snake habitat is depicted on **Figure 3-2**, and the area within the disturbance footprint will be directly impacted. The Significant Residual Impact Assessment, provided under **Appendix C**, determined that the Project is likely to have a significant residual impact on the ornamental snake.

Photo 4-1 *Ornamental snake habitat: Project Disturbance Footprint*



4.1.3 King Bluegrass

King bluegrass habitat is characterised by natural grasslands and open woodlands on black cracking clay soils throughout areas within the Southeast Queensland, Brigalow Belt, Central Queensland Coast, Desert Uplands, Mitchell Grass Downs and Einasleigh Uplands Bioregions (SEWPaC), 2013). Within the Project Area, approximately 31.44 ha of suitable habitat was observed in association with RE 11.8.11. Initial assessment by Accad et al. (2008) estimated a reduction in the extent of the species occurrence from 1,100 km² to 245 km², resulting from continued expansion of agriculture, mining and infrastructure development.

King bluegrass (*Dichanthium queenslandicum*), listed as 'endangered' under the EPBC Act, was not detected within the Project Area grassland community during 2019/2020 terrestrial ecology field assessments but had been recorded as part of studies conducted for the original the CVM EIS (BMA 2009).

BioCondition survey data indicates that the overall site-attribute indices to be low relative to the corresponding benchmark. In particular, non-native plant cover within the grassland community is in excess of 30% (benchmark: 0%), native perennial grass cover is on average less than half (19%) of the benchmark (43%) and native grass and forb species richness is also relatively low. The Habitat Quality score, based on the BioCondition survey data, is a 3/10.

Of the 31.44 ha of suitable habitat identified for king bluegrass, the proposed action will result in the direct and permanent loss of 23.40 ha. Potential indirect impacts on the remaining habitat (8.04 ha) are largely associated with edge effects including weed encroachment, erosion and sedimentation and dust deposition. Based on the mitigation measures currently in place at the CVM and the ongoing implementation during the Project, potential indirect impacts on the remaining habitat for king bluegrass are considered limited.

The direct impact to king bluegrass suitable habitat is outlined on **Figure 3-3**. The Significant Residual Impact Assessment, summarised in **Section 4.6** and provided under **Appendix C**, took a precautionary approach and determined that the Project is likely to have a significant residual impact on king bluegrass based on the occurrence of the species in the past and the presence of suitable habitat. Although no individuals were recorded during the terrestrial ecology assessment undertaken by E2M (2021), the species was recorded within the CVM ML during baseline ecological assessments in 2011. Native grassland habitat adjacent to the 2011 record was confirmed as suitable for king bluegrass habitat during 2020 field studies. At a local scale, this habitat is considered to be 'habitat critical to the survival of the species', as defined under the *MNES Significant Impact Guidelines* (DotE, 2013), for king bluegrass occurring within the Project area. However, this habitat is not considered to be 'habitat critical to the survival of the species' for the species as a whole.

4.1.4 Squatter pigeon

Whilst the Project is within the known distribution for the squatter pigeon (southern subspecies), field surveys of the study area did not detect the subspecies. Field assessments included targeted surveys in accordance with the Survey Guidelines for Australia's Threatened Birds (Department of the Environment, Water, Heritage and the Arts, 2010) (i.e. diurnal area or transect surveys) and DCCEEW Species Profile and Threats Database (DCCEEW, 2022) (i.e. slow driving transects). While no species-specific guidelines are provided under the Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre et al., 2018), field surveys were also consistent with bird survey methods described.

Two field surveys were conducted over the study area, including:

- From 25 November to 2 December 2019, conditions consistent with a late 'dry season'; and
- From 19 to 27 March 2020, conditions consistent with a 'wet season'.

Area searches and driving transects were conducted across the study area totalling 168 hours of active searches and 66 hours of dedicated bird survey over two (2) field surveys, consistent with prescribed survey guidelines.

Despite survey effort undertaken, the subspecies was not detected within the study area, indicating reduced or intermittent utilisation of habitat within the study area or few individuals within the immediate vicinity. The most recent sighting within the CVM mining lease for the species were recorded over a decade ago (i.e. 2006 and 2008) as part of terrestrial ecology studies for the CVM EIS (BMA, 2009).

The lack of squatter pigeon observations on-site (recorded systematically or opportunistically) suggests any resident population (should there be any) is small.

A total of 74.12 ha of preferred habitat (breeding and foraging) and 155.60 ha of suitable habitat (foraging habitat) was identified in the Project Area. The majority (96%, 52.63 ha) of breeding habitat within the Project disturbance footprint is characterised by remnant mixed acacia/eucalypt woodland on Land Zone 7. An additional 25 ha of squatter pigeon habitat is mapped as non-remnant foraging habitat. All habitat within the Project Area is within 1 km to 3 km of a water source (i.e., no dispersal habitat). Ground cover density (mostly non-native weeds) degraded the habitat quality across much of the Project disturbance footprint. Densely vegetated areas were excluded from habitat mapping.

Suitable habitat within the study area was also considered to be of degraded quality, potentially influencing utilisation by the subspecies. Habitat assessments undertaken as part of the field surveys identified suitable habitat areas to contain dense groundcover, ranging from 40% to 90%, dominated largely by exotic pasture grasses such as buffel grass (*Cenchrus ciliaris*), red natal grass (*Melinis repens*) and Indian bluegrass (*Bothriochloa pertusa*). Suitable foraging and breeding habitat for the species is considered patchy, rarely exceeding 33% vegetative cover within the ground layer (DCCEEW, 2022). The high density of exotic grasses within the ground layer recorded within the study area may also contribute to the low utilisation by the species. Habitat within the study area was

also of reduced quality due to the surrounding fragmentation associated with agricultural and mining activities, few permanent water sources and the presence of feral predators (i.e. feral cat).

The proposed action will result in the direct and permanent loss of 54.82 ha of preferred habitat (i.e., breeding and foraging) and 28.71 ha of suitable habitat (foraging). As detailed within the Significant Impact Assessment Report (refer to **Appendix C**), the Project disturbance footprint is not considered to comprise an 'important population' or an important subpopulation as per the EPBC Act definition. Furthermore, the Project was not considered to:

- Adversely affect habitat critical to the survival of the species;
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent the species is likely to decline; or
- Interfere substantially with the recovery of the species.

Indirect impacts to retained habitat within the Project Area may include:

- Habitat degradation associated with edge effects (i.e. invasive species encroachment and sedimentations of these areas);
- Species mortality and/or injury resulting from interactions with vehicles/equipment; and
- Potential for increased predation by feral animals.

Based on the mitigation measures currently in place at the CVM and the ongoing implementation during the Project, potential indirect impacts on the remaining habitat for the squatter pigeon are considered to be minimal.

As detailed within the Significant Impact Assessment Report for the Project (**Appendix C**), the disturbance footprint is also not considered to comprise an 'important population' or an important subpopulation as per the definitions under the EPBC Act Significant Impact Guidelines 1.1 - Matters of National Environmental Significance (Department of the Environment, 2013). Important populations for the subspecies, as identified under the Species Profile and Threats Database, comprises relatively small, isolated and sparsely distributed sub-populations occurring south of the Carnarvon Ranges (DCCEEW, 2022).

Based on the low or intermittent utilisation of habitat within the Project area, the degraded nature of habitat observed and the Project Disturbance footprint not considered to comprise an 'important population', the Project is considered unlikely to be important, notable or of consequence, having regard to the context or intensity, as defined under the EPBC Act. As such, the Project is considered unlikely to result in a significant residual impact on the subspecies.

Squatter pigeon habitat, including the location of potential water sources, is outlined on **Figure 3-4**. The Significant Residual Impact Assessment (**Appendix C**) determined that the Project is unlikely to have a significant residual impact on squatter pigeon based on the lack of observations, the poor habitat quality, and the fact that squatter pigeon within the Project disturbance footprint and the broader Moranbah region is not considered to be an 'important population' or an important subpopulation as per the EPBC Act definition.

4.1.5 Habitat Fragmentation

The Project Area is located within a disturbed and largely fragmented landscape as a result of historical and existing land use management, including agricultural and mining development. The greater landscape is bounded by major roads, including the Peak Downs Highway to the south and Moranbah Access Road to the east, as well as the existing Goonyella rail network to the west. The Project disturbance footprint is located within predominantly non-remnant vegetation and abuts the existing the CVM. As such, the disturbance and the delineation of the clearing boundary (extension eastward of an existing pit) for the Project minimises the possibility of fragmenting of one (1) contiguous area of habitat into two (2) or more disjunct areas.

Furthermore, the habitat of target species, such as ornamental snake identified in the Project Area is not connected with movement corridors to adjacent ornamental snake habitat effectively isolating the existing population to their current habitat. While the proposed action will extend into the suitable habitat, resulting in the direct removal of habitat, it is unlikely to fragment habitat into multiple areas.

The method of pollination/seed dispersal for king bluegrass occurs via wind. As such, while the habitat of the species will be disturbed by the Project, it is considered unlikely to disrupt the breeding cycle of undisturbed populations of the species (if present) by fragmenting them into two (2) or more populations.

4.1.6 Duration of Impacts

As the Project is a continuation of the existing CVM operations, there are no distinct construction and operation phases for the Project. The direct impacts to MNES values are predominantly associated with the vegetation clearing and habitat removal during the early stages of operation of the Project. The direct loss of habitat associated with the operation of the Project is likely to occur as the Horse Pit progresses, and pre-stripping occurs or as infrastructure is relocated. The PRCP requirement in Queensland, under the EP Act, requires that progressive rehabilitation occur throughout the Project's operation.

Indirect impacts such as environmental degradation (dust, noise, light, vibration) will extend through the life of the Project. However, as mentioned in response item 3.1.2, areas of suitable habitat for MNES species located outside of the Project disturbance footprint are likely to be currently subjected to similar indirect impacts associated with the existing operational mine. As such, the Project is considered unlikely to introduce any new indirect impacts to retained vegetation and habitat. Instead, the Project may result in a change in the relative intensity of edge effects currently exhibited due to proximity to the Project's Disturbance footprint. However, the implementation of the mitigation and management measures already in place, as per the CVM environmental management framework, is considered likely to minimise the potential indirect impacts on the retained habitat in the landscape during the operation of the Project.

4.1.7 Potential Unknown, Unpredictable or Irreversible Impacts

The environmental/receptors and potential impacts associated with the Project are well understood following a comprehensive ecological study and the nature of the proposed action (extension of an existing, operational mine). As such, there are no direct impacts that are likely to be unknown or unpredictable. The implementation of mitigation measures outlined within the existing CVM environmental management framework includes ongoing monitoring of associated air quality, groundwater, surface water and other aspects of the receiving environment to assist in identifying any unpredicted variation in the levels of potential threats to MNES values retained (e.g. habitat degradation from noise, dust and exotic pests).

4.1.8 International Conventions & Recovery Plans

4.1.8.1 International Conventions

The Project will not violate Australia's obligation to its international environmental commitments, as discussed below.

Convention on Biological Diversity

The Convention on Biological Diversity (CBD) was established at the United Nations Conference on Environment and Development (UNCED) in 1992. The CBD is dedicated to promoting sustainable development. The CBD recognizes that biological diversity incorporates plants, animals, microorganisms, ecosystems, people, food security, medicines, air quality, water and shelter. The Post-2020 Global Biodiversity Framework is currently under development but is likely to carry forward most of the Aichi Biodiversity Targets. Australia's obligations (Aichi Biodiversity Targets) under the CBD Strategic Plan for Biodiversity 2011-2020 are, most notably:

- Target 3: By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the CBD and other relevant international obligations, considering national socio-economic conditions;
- Target 5: By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced; and
- Target 12: By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.

The purpose of these targets is to drive policy change by governments to drive positive biodiversity outcomes on a macro scale. As such the targets are not directly relevant to the scale of the Project. However, the measures proposed to avoid, mitigate and manage the Project's impact to the environment are not inconsistent with the CBD, as the measures proposed align with Target 3, Target 5 and Target 12 outlined above. The CVM operations are conducted in line with current approvals and the following management plans put in place by BMA:

- Land and Biodiversity Management Plan (the CVM-PLN-0021);
- Weed and Feral Animal Management Plan (BHP-PRO-0001. 2019); and
- Threatened Flora and Fauna and Ecological Communities Management Plan (the CVM-PLN-0019).

In addition, BMA will secure land-based offsets for impacts to MSES and MNES. Refer to **Section 7**.

Further, given the nature of the historical land uses at the Project (i.e. agriculture and open cut mining), degradation and fragmentation of natural habitats is negligible in the context of the Impacts have been mitigated, as outlined under **Section 4.1.9**.

The Convention on Conservation of Nature in the South Pacific

The Convention on Conservation of Nature in the South Pacific (Apia Convention) was entered into force in 1990. The main objective of the Apia Convention is to commit the Parties to take action for the conservation, utilisation and development of the natural resources of the South Pacific region through careful planning and management for the benefit of present and future generations. Under the Apia Convention, Australia's obligations include:

- Undertake to create protected areas to safeguard representative samples of natural ecosystems, superlative scenery, striking geological formations and regions and objects of aesthetic, historic, cultural or scientific value;
- Commit to not alter national parks so as to reduce their area except after the fullest investigation; their resources are not to be subject to commercial exploitation; hunting and collection of species are to be prohibited and provision is to be made for visitors;
- Agree to maintain lists of indigenous fauna and flora in danger of extinction and to give such species as complete protection as possible; and
- Provision may be made as appropriate for customary use of areas and species in accordance with traditional cultural practices.

The purpose of these obligations is to drive policy change by governments to drive conservation outcomes in the south pacific. As such the objectives are not relevant to the Project, yet the Project is not inconsistent with the Apia Convention. The Project includes extensive mitigation and management measures (**Section 4.1.9**) and will not impact Category A or Category B Environmentally Sensitive Areas, or species close to extinction.

Convention on International Trade in Endangered Species of Wild Fauna and Flora

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES agreement) was entered into force in 1975. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species. No CITES listed species occur within or near the Project and the Project is not inconsistent with the CITES agreement.

4.1.8.2 Recovery & Threat Abatement Plans

There is currently no recovery plan for ornamental snake or squatter pigeon. There is however a draft recovery plan for king bluegrass that recommends the following management actions:

- Promote landholder awareness of sustainable management practices, especially rest from grazing, and their importance to the preservation of bluegrass grasslands' environmental and pastoral values;
- Encourage landholders to enter into conservation agreements over bluegrass grasslands;
- Increase the area of bluegrass grassland in the conservation estate;
- help graziers to reduce overall grazing pressure on bluegrass grasslands and to spell grasslands during the summer growing season;

- Help graziers to fence bluegrass grasslands out from other land types and to subdivide bluegrass grasslands to facilitate sound grazing management, including rest from grazing during critical periods in the summer growing season; and
- Research and develop and monitoring.

These management actions are included in the draft Offset Area Management Plan, as discussed in **Section 7.1.3**.

No further draft or approved Threat Abatement Plans are identified in the species profile and threats database (SPRAT) for these relevant species.

4.1.9 Mitigation Measures

The direct clearing of vegetation and habitat has been minimised through Project design. Areas of suitable habitat located outside of the Project disturbance footprint are likely to be currently subjected to similar indirect impacts associated with the existing operational mine. As such, the Project's indirect environmental impacts during the extension are likely to be reduced via the implementation of the mitigation and management measures already in place as per the CVM environmental management framework. Mitigation measures are outlined under **Section 5**.

4.2 Water Resource: Groundwater

4.2.1 Legislative Requirements

4.2.1.1 Legislation

The relevant Commonwealth and Queensland legislation in relation to taking or interfering with groundwater resources for the Project are summarised below.

Environment Protection and Biodiversity Act 1999 (Commonwealth)

The EPBC Act is designed to protect national environmental assets, known as MNES. Under the 2013 amendment to the EPBC Act, potentially significant impacts on groundwater resources were included as a MNES where it pertains to a coal seam gas or large coal mine development, known as the 'water trigger'.

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) is a statutory committee established under the EPBC Act that provides scientific advice to the Commonwealth Environment Minister and relevant state ministers. Guidelines have been developed to assist the IESC in reviewing coal seam gas or large coal mining development proposals that are likely to have significant impacts on water resources. This includes completion of an independent peer review of numerical groundwater modelling in accordance with the Australian Groundwater Modelling Guidelines (Barnett et al., 2012). The Project was determined a 'Controlled Action' on 19 November 2021 and enacted the 'water trigger'.

The assessment has addressed the requirements of the IESC, specifically shown in:

- Table 2-1 of **Appendix F** outlining the Groundwater Impact Assessment's responses to the IESC Guideline: *Information guidelines for proponents preparing coal seam gas and large coal mining development proposals* (IESC, 2018); and
- The independent peer review completed by Dr. Noel Merrick (HydroAlgorithmics Pty Ltd) of the Groundwater Impact Assessment under **Appendix J**.

Water Act 2000 (Queensland)

The *Water Act 2000* (Water Act) and subordinate *Water Regulation 2016* is the primary legislation regulating groundwater resources in Queensland. The purpose of the Water Act is to advance sustainable management and efficient use of water resources by establishing a system for planning, allocation and use of water.

The Water Act was amended in 2014 with introduction of the *Water Reform and Other Legislation Amendment Act 2014* (WROLA Act). Changes to this legislation included giving new mines a limited statutory right to take groundwater they intercept through routine mining activities ('associated water'); for example, the groundwater

contained within coal seams that is removed with extraction of the coal. The WROLA Act was later amended in 2016 with the introduction of the *Water Legislation Amendment Act 2015* and the *Environmental Protection (Underground Water Management) and Other Legislation Amendment Act 2016* (EPOLA Act), which came into effect on 6 December 2016. The EPOLA Act amends the EP Act and Water Act (Chapter 3), and removes the statutory right to water, requiring applicants to quantify and be licenced for the take of 'associated water'. That is, project proponents may be required to apply for and obtain an Associated Water License (AWL) under the Water Act. A component of the AWL application process includes greater emphasis on baseline data collection for environmental assessments. In addition, mine applications that are granted an AWL can be required to verify and update groundwater impact predictions through an underground water impact report three (3) years following project approval, or at a frequency prescribed by the chief executive.

The Project will affect groundwater within the Isaac Connors Groundwater Management Area (GMA – Zone 34) of the Fitzroy Basin under the Water Plan (Fitzroy Basin) 2011. This relates to both Groundwater Unit 1 (containing aquifers of the Quaternary alluvium) and Groundwater 2 (sub-artesian aquifers). The extent of Groundwater Unit 1 (Isaac Connors Alluvium Groundwater Sub-area) is based on the mapped extent of Quaternary alluvium, which, whilst not mapped within the Project footprint, may be connected and interact with aquifers within the Project Area.

As part of the Project, BMA is proposing to exercise underground water rights during the period in which resource activities will be carried out at ML 1775 and as such an Associated Water License will not be required.

BMA holds Water License 608364 for dewatering activities at the CVM (issued under the Water Act).

Management framework relevant to the Project

The Water Act is enacted under a framework of catchment specific Water Resource Plans (WRPs). A WRP provides a management framework for water resources in a plan area, and includes outcomes, objectives, and strategies for maintaining balanced and sustainable water use in that area. Resource Operations Plans (ROPs) implement the outcomes and strategies of WRPs. Groundwater Management Areas (GMAs) and their component groundwater units are defined under WRPs. Authorisation is required to take non-associated groundwater from a regulated GMA or groundwater unit for specified purposes. The specified purposes are defined under a WRP, the *Water Regulation 2016* or a local water management policy.

Water resources within the Project Area are captured under the Water Plan (Fitzroy Basin) 2011. The plan covers surface water (zone WQ1301) associated with Isaac River, and groundwaters (zone WQ1310 – Fitzroy Basin groundwaters).

As part of the Project, BMA is proposing to exercise underground water rights during the period in which resource activities will be carried out at ML 1775. The Project will affect groundwater within the Isaac Connors GMA (GMA – Zone 34) of the Fitzroy Basin under the Water Plan (Fitzroy Basin) 2011. This relates to both Groundwater Unit 1 (containing aquifers of the Quaternary alluvium) and Groundwater Unit 2 (sub-artesian aquifers). The extent of Groundwater Unit 1 (Isaac Connors Alluvium Groundwater Sub-area) is based on the mapped extent of Quaternary alluvium.

Water Act declared watercourses and drainage

The Water Act includes criteria for determining watercourses that require authorisation to take water, interfere with the flow of water, take quarry material or excavate and place fill in a watercourse. The Water Act also includes criteria for drainage features that may require authorisation to take or interfere with overland flow. Reaches of the Isaac River, Horse Creek and Cherwell Creek are defined as a watercourse under the Water Act criteria, and several small tributaries of these watercourses that traverse the Project Area are defined as drainage features. These declared watercourses and drainage features may be relevant to the groundwater assessment for the Project if there is a component of surface water-groundwater interaction associated with them.

Environmental Protection (Water and Wetland Biodiversity) Policy 2019

The *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP (WWB)) aims to achieve objectives set out by the EP Act and applies to all waters of Queensland. EPP Water provides a framework to protect and/or enhance the suitability of Queensland waters for various beneficial uses by:

- Identifying EVs and management goals for Queensland waters;
- Providing state water quality guidelines and Water quality objective (WQO) to enhance or protect the EVs;
- Providing a framework for making consistent, equitable and informed decisions; and
- Monitoring and reporting on the condition of Queensland waters.

Groundwater resources within the vicinity of the Project are scheduled under the EPP (WWB) as Isaac Groundwaters of the Isaac River Sub-basin of the Fitzroy Basin water plan (WQ1310). The legislated EVs for these groundwaters are:

- Biological integrity of aquatic ecosystems
- Human use EVs:
 - Suitability of water supply for irrigation;
 - Farm water supply/use;
 - Stock watering;
 - Primary recreation;
 - Drinking water supply; and
 - Cultural and spiritual values.

The EPP (WWB) also provides limited WQOs for underground aquatic ecosystem protection in Fitzroy Basin groundwaters. These WQOs provided in the EPP (WWB) are classified by groundwater depth and regional chemistry zone. Surface water resources within the vicinity of the Project are scheduled under the EPP (WWB) as:

- Waters of the Isaac northern tributaries of the Isaac River Sub-basin of the Fitzroy Basin water plan (WQ1301); and
- Waters of the Isaac and lower Connors River main channel of the Isaac River Sub-basin of the Fitzroy Basin water plan (WQ1301).

The legislated EVs for these surface waters are:

- Biological integrity of aquatic ecosystems
- Human use EVs:
 - Suitability of water supply for irrigation;
 - Farm water supply/use;
 - Stock watering;
 - Human consumption;
 - Primary recreation;
 - Secondary recreation;
 - Visual recreation;
 - Drinking water supply;
 - Industrial water supply; and
 - Cultural and spiritual values.

The surface water WQOs for both the Isaac northern tributaries of the Isaac River Sub-basin of the Fitzroy Basin water plan and the Isaac and lower Connors River main channel of the Isaac River Sub-basin of the Fitzroy Basin water plan (WQ1301) may be relevant to the Project. Impacts are discussed further under **Section 4.2.6**.

4.2.1.2 Relevant Guidelines

There are several available guidelines designed to assist project proponents to meet the relevant legislative requirements to complete a groundwater assessment for coal mining proposals such as this Project. These guidelines are:

- Queensland DES Guideline - Requirements for site-specific and amendment applications—underground water rights - EP Act;
- Queensland DES Guideline - Underground water impact reports and final reports - Water Act;
- Information guidelines for proponents preparing coal seam gas and large coal mining development proposals – EPBC Act;
- Information Guidelines explanatory note. Uncertainty analysis—Guidance for groundwater modelling within a risk management framework – EPBC Act;

- Information Guidelines Explanatory Note. Assessing groundwater-dependent ecosystems – EPBC Act; and
- Australian groundwater modelling guidelines. Waterlines report. National Water Commission, Canberra, 2012.

4.2.2 Hydrogeological Regime at the Project

The hydrogeological regime relevant to the Project comprises the following hydrogeological units:

- Isaac River Alluvium;
- Regolith;
- Tertiary-Quaternary Alluvium;
- Tertiary Basalt;
- Triassic Strata; and
- Permian Coal Measures (Blackwater Group).

The geology and hydrogeology of the Project Area are detailed under Section 4 and Section 5 of the Groundwater Impact Assessment located in **Appendix F**.

4.2.3 Project Groundwater Model

The numerical model was developed using GIS in conjunction with MODFLOW-USG. MODFLOW-USG is the latest version of industry standard MODFLOW code and was chosen as the most suitable modelling code for accomplishing the model objectives. The numerical groundwater model for the Project builds on the Olive Downs Project EIS model (the foundational regional Bowen Basin model) (HydroSimulations, 2018). The foundational model was subsequently updated for the Moorvale South Project in 2019 (SLR, 2019b), for the Winchester South Project EIS in 2020 (SLR, 2020), and most recently for the Lake Vermont North Project (in conjunction with the Project). BMA has established groundwater data sharing agreements with the owners of each of these projects/mines, which allows for the sharing of groundwater data, models and documentation. Under these agreements, the groundwater models developed as part of each project/mine's groundwater assessment have been adopted as a basis for the Project's groundwater assessment where relevant. Of note, the current update of the groundwater model reported herein is the first iteration to include data and information from the Lake Vermont North Project as well as several BHP mine sites (the CVM, Poitrel, Daunia and Saraji). A range of model updates were required to ensure that the regional Bowen Basin model was fit-for-purpose for the Project, including extension of the model, grid and updated layers of mined seams and strata at the CVM. The Project groundwater model is discussed in Section 6 of the Groundwater Impact Assessment located in **Appendix F**.

Predicted groundwater inflows to the Project's pit average 0.55 ML/day over the duration of mining, reaching a predicted maximum of 0.75 ML/day during 2044. The predicted inflows are within the same order of magnitude as the groundwater inflows recorded at Horse Pit and Heyford Pit during 2018/2019 and are therefore considered realistic predictions for the Project.

Maximum drawdown impacts are predicted to exceed 1 m and are discussed in **Section 4.2.4**.

The maximum predicted drawdown associated with the Project within the Regolith is shown in Figure 5-14 of **Appendix F**. The drawdown extent within the Regolith (Layer 2) is largely confined to the Project Area and is influenced by the distribution of predicted saturated zones in the Regolith. The coal seams of the Moranbah coal measures (MCMs) are the primary groundwater bearing units intercepted by the Project and will experience drawdowns as a direct result of mining at the Project. Groundwater level drawdown within the mined coal seams is influenced by unit structure and is confined to unit extents. Figure 5-15 to Figure 5-18 of the Groundwater Impact Assessment located in **Appendix F** show the maximum predicted incremental drawdown for Q, P, H and D seams respectively in the MCMs. These figures show the extent of maximum predicted depressurization of the Permian coal measures is limited to the west of the Project Area due to the structural geology (i.e., coal seams subcrop and the units do not exist west of the subcrop). The extents of maximum predicted incremental drawdown in the MCMs seams are between 10 to 12 km to the east and northeast of the Project boundary. The cone of depression is predicted to be steepest at the working coal face.

4.2.4 Predicted Maximum Drawdown

The process of mining typically reduces water levels in the surrounding groundwater units of the impacted areas. The extent of the area affected is dependent on the properties of the aquifers/aquitards and is referred to as the

zone of drawdown. Aquifer drawdown is generally the greatest at the active coal-face. This gradually decreases with distance from the active mining operations. The maximum drawdown figure for the Project was obtained by comparing the difference in groundwater levels for different aquifers in the impact assessment groundwater model.

Through this process, it was determined that no drawdown is predicted to occur in the Quaternary alluvium as a result of the Project. Furthermore, the drawdown extent within the Regolith is largely confined to the Project Area and is influenced by the distribution of the predicted saturated zones in the Regolith. At the northern end of the Project Area's ML, a 1 m drawdown influence is predicted to extend up to 2.9 km north of the ML boundary in the Regolith. This predicted drawdown intercepts with basalt deposits located to the northeast of the Project Area. Figure 6-2 of the Groundwater Impact Assessment located in **Appendix F** presents this finding.

The coal seams of the MCMs are the primary groundwater bearing units intercepted by the Project and are expected to experience drawdowns as a direct result of mining at the Project. The extents of maximum predicted incremental drawdown in the MCMs seams are between 10 km to 12 km to the east and northeast of the Project. The maximum predicted incremental drawdown in the MCMs is shown on Figure 6-3 to Figure 6-6 of the Groundwater Impact Assessment located in **Appendix F**.

4.2.5 Predicted Cumulative Drawdown

The cumulative drawdown predictions presented below outline the impacts based on the groundwater model parameters such as, the existing approved works and entitlements within the model domain. The simulated cumulative drawdown predictions also shows whether the zone of impact from the approved neighbouring operations is predicted to interact with the zone of impact from the Project in the different aquifers.

The surrounding mines included within the model are the Olive Downs Project (Olive Downs South and Willunga), Moorvale South Project, Poitrel Mine, Daunia Mine, Peak Downs Mine, Grosvenor Mine, Lake Vermont Mine, Eagle Downs Mine, Saraji Mine, Saraji East Project and the Winchester South Project. The vast majority of the predicted cumulative drawdown impacts are not related to the Project but result from these other approved mining activities represented in the model.

There are no cumulative drawdown impacts predicted for the Quaternary alluvium within or around the Project Area. Maximum predicted cumulative drawdown impacts are predicted within the extents of the Isaac River alluvium in the south of the model domain near the Olive Downs South operations, which are more than 32 km southeast from the Project.

Cumulative impacts within the Regolith are observed connecting the Project-related drawdown to drawdown impacts at Peak Downs, south of the Project. For the Leichhardt and Vermont coal seams, there is no drawdown interaction between the Project and the neighbouring mines that target the Rangal Coal Measures which are not present within the Project Area. The extents of maximum predicted cumulative drawdown in the MCMs coal seams are approximately 13 km to the east and 10 km to the north of the Project.

The Maximum predicted cumulative drawdown impact predictions are shown in Figure 6-7 to Figure 6-14 of the Groundwater Impact Assessment located in **Appendix F**.

4.2.6 Impact Assessment

The impacts on groundwater from the development, operation, closure and post-closure of the Project have been evaluated. Potential impacts from the mine on the regional groundwater regime were assessed and are detailed in the Groundwater Impact Assessment in **Appendix F**. The groundwater impact assessment is summarised in the following sections.

4.2.6.1 Incidental Water Impacts

There will be no direct interception of the alluvium, including that associated with the Isaac River, by the proposed open cut pit for the Project. Any predicted interference of alluvial groundwater largely relates to the potential for increased leakage from the alluvium to the underlying Permian coal measures that are depressurised because of the Project. Over the extent of Quaternary alluvium, model predictions show that there is zero predicted loss of water from the alluvium because of exercising the underground water rights for the Project, i.e., there is no

predicted direct or indirect interference with alluvial groundwater because of the Project. Refer to Section 6.2 and Section 3.6.1 of Appendix B of the Groundwater Impact Assessment located in **Appendix F**.

The model predicts that over the LOM, the change in the average rate of seepage from the Isaac River to the alluvium is insignificant and considered within the error threshold of model predictions (less than 3.65 ML/year). The model estimates less than 0.01% increased seepage from the Isaac River to the alluvium because of mining at the Project, an insignificant potential for flow rate reduction. There is also no change in net flow predicted in the creeks located within the vicinity of the Project Area. Refer to Section 6.4 and Section 7.3 of the Groundwater Impact Assessment located in **Appendix F**.

4.2.6.2 Cumulative Impacts

Cumulative impacts associated with approved and foreseeable open cut and underground coal mines surrounding the Project were assessed in accordance with IESC requirements, refer to Table 2-1 of **Appendix F** outlining the Groundwater Impact Assessment's responses to the IESC Guideline (IESC, 2018). The results confirm that most of the predicted cumulative drawdown impacts are not related to the Project but result from these other existing and approved mining activities represented in the model. Maximum cumulative drawdown impact predictions are detailed in Section 6.5 of the of the Groundwater Impact Assessment located in **Appendix F**.

4.2.6.3 Isaac Connors Groundwater Management Area

The Project does not directly intercept groundwater from Isaac Connors Groundwater Unit 1 (Quaternary alluvium) under the Water Plan (Fitzroy Basin) 2011. All direct 'groundwater take' because of open cut pits for the Project is from Isaac Connors Groundwater Unit 2 (sub-artesian aquifers). Project 'groundwater take' because of open cut pits would be on average 133.9 ML/year from Groundwater Unit 2. The model predicts that for the long-term equilibrium condition post mining, there is negligible groundwater take from Groundwater Unit 1, and 146.5 ML/year groundwater take from Groundwater Unit 2 to the final voids. Refer to Section 6.2 and Section 7.1 of the Groundwater Impact Assessment located in **Appendix F**.

4.2.6.4 Potential Impacts to Third Party Bores

Chapter 3 of the Water Act provides bore drawdown threshold triggers of 2 m for unconsolidated aquifers, and 5 m for consolidated aquifers. There are no known privately-owned bores within the unconsolidated (Alluvium and Regolith) or consolidated (Permian coal measures) aquifers that lie within the predicted extent of Project related drawdown greater than 1 m.

The uncertainty results showed that no water supply bores in the alluvium are predicted to experience drawdowns greater than 1 m due to the Project even at the 95th percentile confidence interval. The uncertainty results showed that the 95th percentile maximum cumulative drawdown is predicted to be greater than 5 m at two (2) water supply bores. Both bores are located to the west of the Project and are screened within the Fort Cooper Coal Measures. As per Table 2 of the IESC guidelines (2020), in terms of likelihood of exceedance, a percentile greater than 90% means that it is very unlikely that the maximum cumulative drawdown will be greater than 5 m at these bores.

Refer to Section 7.2 of the Groundwater Impact Assessment located in **Appendix F**.

4.2.6.5 Potential Impacts on Groundwater Quality

Potential sources that may result in impacts to groundwater quality include:

- OOPD;
- In pit waste rock emplacement areas; and
- Final void.

The OOPD may produce seepage because of rainfall inundation, that theoretically could alter the existing groundwater quality. A geochemical assessment has been prepared by Terrenus Earth Sciences (2021), refer to **Appendix I**, presenting the 'assumed worst case' scenario that included leachate analysis of waste rock material. The analysis found waste rock material is generally Non-Acid Forming (NAF), with the leachate averaging an EC of 391 $\mu\text{S}/\text{cm}$ and low in sulfur content. The inward hydraulic flow gradients from the waste emplacement areas

(comprising the OOPD and in pit waste rock disposal) to the open cut void would inhibit seepage to the alluvium and Cainozoic sediments present between the alluvium and Regolith and the OOPD generally comprise surficial soil and clays, up to 10 m thick. The clays will inhibit potential seepage from the OOPD to the underlying Regolith and alluvium. Therefore, there would be no mechanism for seepage from the OOPD to impact on groundwater quality in the alluvium and Regolith. Notwithstanding, leachate from the OOPD would generally be fresh and low in sulfur content, minimising the potential for a change in groundwater quality in the unlikely event seepage enters the groundwater system.

The Project will involve progressively backfilling and rehabilitating the open cut pit as space becomes available with water levels within backfilled areas predicted to recover back towards pre-mining levels. Leachate will generally be fresh and low in sulfur content, minimising the potential for a change in groundwater quality in the unlikely event seepage enters the groundwater system.

A final void is proposed within the Project Area to remain in perpetuity. Modelling predicts that the final void water levels will equilibrate to 120 mAHD. The predicted equilibrated final void water levels are approximately between 70 m and 90 m below the pre-mining groundwater levels, which means the final void would act as a sink to groundwater flow. Water within the final void will evaporate from the final void water body surface and draw in groundwater from the surrounding strata and runoff from the final void catchment areas. As the final void will act as a sink, evaporation from the final void water body will overtime, concentrate salts in the final void water body. However, the gradual increase in salinity of the final void water body is not predicted to pose a risk to the surrounding groundwater regime as the final void will remain as a groundwater sink in perpetuity. This is further considered by the Surface Water Impact Assessment provided in **Appendix G**.

All workshop and fuel/chemical storage areas at the CVM are developed in accordance with the requirements of the CVM EA and current Australian Standards. This includes refuelling areas and chemical storage areas to be designed with adequate bunding and equipped for immediate spill clean-up. These controls represent standard practice and a legislated requirement at mining operations for preventing the contamination of the groundwater regime. Therefore, it is unlikely groundwater contamination will occur with relation to workshops and fuel/chemical storage.

Refer to Section 7.4 of the Groundwater Impact Assessment located in **Appendix F**.

4.2.6.6 Groundwater Dependent Ecosystems

The Project is not predicted to have any significant impacts on likely GDEs due to changes in groundwater quality or resources. Technical assessments have been undertaken addressing GDEs in detail and the findings of these assessment are discussed further under **Section 4.4**.

4.2.6.7 Interaction between Final Voids

The Project's groundwater assessment predicted void lake levels will remain relatively deep, significantly below the pre-mining groundwater level and void crest level. The depth from the void crest to the long-term equilibrated water level in the final void was predicted to be approximately 100 m. The deep long term void lake levels are a function of high evaporation rates in comparison to low groundwater inflow rates and the management (diversion) of surface runoff away from the voids.

The CVM is not unique in the Bowen Basin. The hydrogeologic and hydrologic environment is similar at all nearby mines, as are water management practices. It would therefore be expected that final voids at other nearby mines would function similarly; that is, have relatively deep void lake levels that remain well below natural groundwater levels. Therefore, similar to the Project's final void, these other voids would be expected to function as hydraulic sinks and not groundwater recharge sources. Nearby mine final voids, since they are expected to function as sinks, may interact with the Project final void, in terms of overlapping radius of groundwater drawdown influence within the regional groundwater system; the Project's groundwater model indicates that this will be the case for the Project's final void and the adjacent Heyford Pit void at the CVM, as well as the PDM final voids further to the south. However, none of these voids are expected to form groundwater recharge sources for the reasons described above. Therefore, the potential for interacting (cumulative) recharge to the groundwater system from these interacting void lakes is considered minimal to none. Likewise, there is unlikely to be groundwater quality impacts from void lakes that are groundwater sinks.

4.2.6.8 Recharge Rate on Spoil applied in the Groundwater Model

Estimation of likely recharge rates through coal mine spoil was a specific topic explored by Mackie (2009). Though this study was completed in the Hunter Coalfield, it is considered applicable to the Bowen Basin and the Project as the geologic environment is similar and therefore spoil properties are expected to be similar (i.e. Permian aged coal measures). As documented by Mackie (2009), there is little information examining rainfall recharge through rehabilitated spoils. Modelling undertaken by Mackie (2009) suggested deep percolation rates (i.e. recharge rates) ranging from 1% to 5.5% of long-term rainfall. The recharge rate adopted in the Project's groundwater model of 1% therefore is entirely consistent with available published literature study of Permian coal measures spoil recharge rates.

As discussed in Section 4 of the Groundwater Impact Assessment Report (**Appendix F**), void lake levels were not predicted by the groundwater model but by the Project's GoldSim water balance model reported in Section 5 and Section 7 of the Surface Water Assessment (**Appendix G**). The water balance model results were then iterated with the groundwater model to arrive at consensus between the two (2) models for groundwater inflow. Analysis of the GoldSim water balance results for the Project final void indicates that the groundwater contribution to the final void approximates 4% of the total water inflow to the void that includes surface water runoff and direct rainfall (**Table 4-1**), i.e. the influence of groundwater inflow on final void lake levels is minimal to negligible in comparison to surface water sources contributing the void lakes. Therefore, adoption of higher spoil recharge rates in the groundwater model is unlikely to significantly affect the predicted void lake levels.

Table 4-1 Project Void Water Inputs derived from the Water Balance Model

Input to Void Lake	Relative Contribution
Groundwater Inflow	4%
Direct Rainfall	35%
Surface Runoff	61%

Regardless, as discussed above it was demonstrated in the Project's groundwater assessment that predicted void lake levels will remain relatively deep, significantly below the pre-mining groundwater level and void crest level, with the difference in elevation between the long-term equilibrated water level in the final void and the surrounding crest elevation being approximately 100 m. Significant inwards hydraulic gradients to the void are maintained in the long term post-mining with head differences in the order of at least 50 m between the void lake (~120 mAHD) and the surrounding groundwater system (~170 to 190 mAHD) (see Figures 6-22 and 6-23 of the Project's Groundwater Assessment Report (**Appendix F**)). Therefore, recognising that groundwater inflow is only approximately 4% of the total water contribution to the void lakes, it is very unlikely that a change in the void lake level that may result from adoption of alternate spoil recharge rates would manifest in a predicted void lake level that would have the potential for environmental impact (i.e. result in an outwards groundwater flow gradient).

4.3 Water Resource: Surface Water

The Project Area is primarily located within the Horse Creek Catchment with a small portion within the Cherwell Creek Catchment. Horse Creek and Cherwell Creek are tributaries of the Isaac River. The Isaac River is part of the Isaac-Connors sub-catchment, which is part of the Fitzroy River Basin.

Horse Creek is located on the western side of the existing Horse Pit. The creek flows in a northerly direction towards the boundary of ML 1775 before flowing northeast towards the confluence with Grosvenor Creek.

Horse Creek converges with Grosvenor Creek approximately 2.3 km downstream from the ML boundary. Horse Creek flows into Grosvenor Creek infrequently due to a weir located at the downstream end of Horse Creek. The catchment area of Horse Creek to the junction with Grosvenor Creek is 57 km² with the Project covering just over 4 km² of that catchment.

The headwaters of Cherwell Creek are located to the west of the current MLs. Cherwell Creek has a total catchment area of over 700 km² and flows north easterly from the headwaters, through the existing MLs to the confluence with Isaac River. The Project Area is located on a small, unnamed tributary of Cherwell Creek, located upstream of the confluence of Cherwell Creek and Harrow Creek. The Project Area intersects approximately 3 km²

of the overall 700 km² Cherwell Creek catchment. **Figure 4-1** illustrates the location of the Project Area relative to the local waterways.

No licenced surface water users were identified within a 10 km radius of the Project area.

4.3.1 Project Water Demands

Operational water demand at the CVM is detailed in **Section 2.5.6**. The demand for MAW is not calculated to increase from existing, however the catchments that contribute to runoff volumes are calculated to increase (as the mine pit progresses and flood levees are constructed).

4.3.2 Potential Impact to Surface Water

The Surface Water Impact Assessment (**Appendix G**) considered potential changes to streamflow and hydrology, flooding, water quality and impacts and mitigation measures. An Aquatic Ecology Assessment (**Appendix H**) considered the impact on aquatic species and ecosystem functions of waterways within and downstream of the CVM. A table of references to the IESC requirements are outlined under Table 2-1 of **Appendix F** and a Geochemistry report (**Appendix I**) provides an assessment of the geochemical risk.

4.3.2.1 Flooding

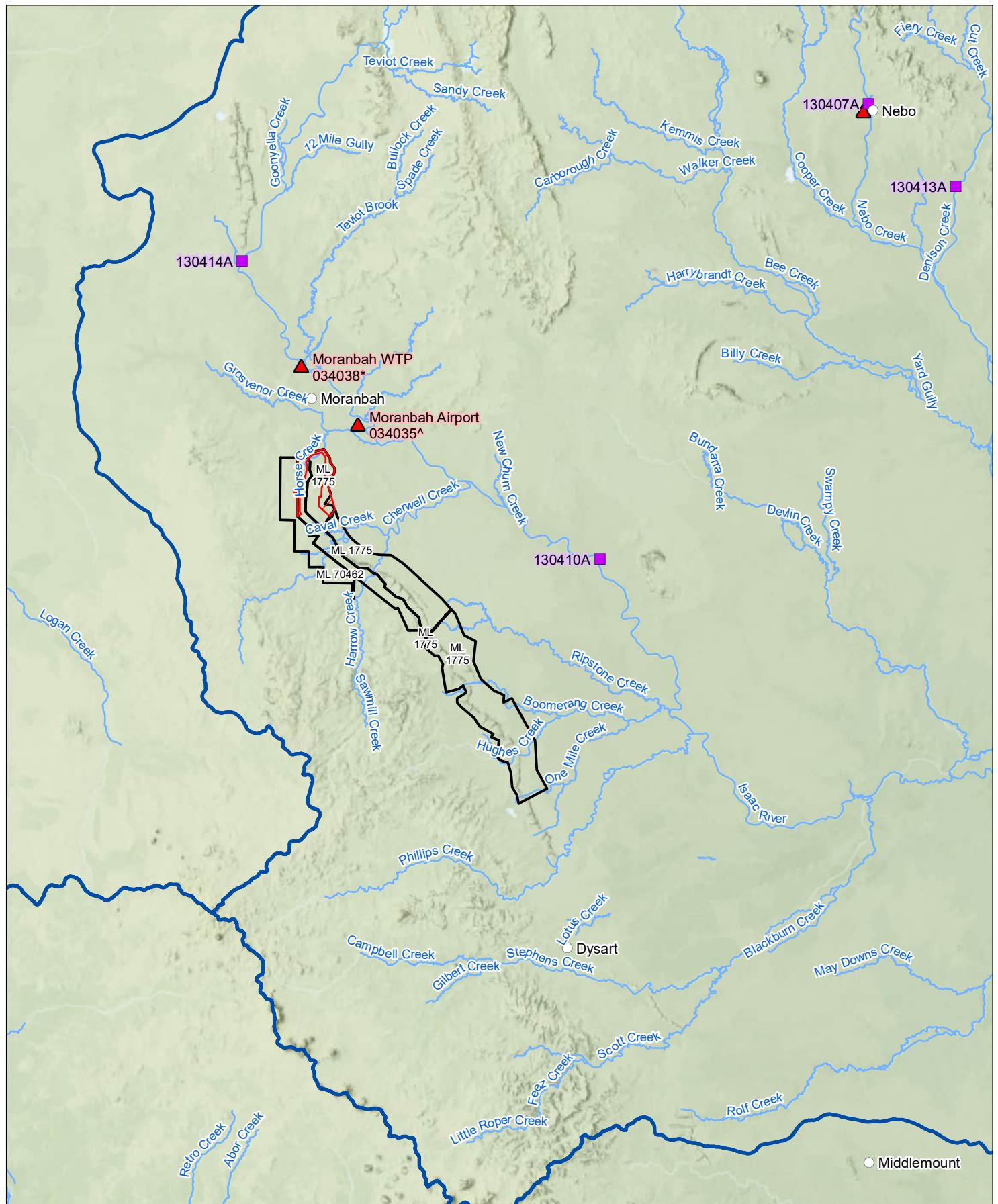
A flooding assessment of Horse Creek was conducted for the 50%, 10%, 5%, 2%, 1%, 0.1% AEP and Probable Maximum Flood (PMF) events. The flood assessment was conducted using current industry standards (Australian Rainfall and Runoff (AR&R)) for hydrology and the most up-to-date topographical information from 2019. Flood modelling was completed to determine flood extents and depth for rare events along with stream power, bed shear stress and velocities for the 50% and 2% AEP events. Details of the flood modelling are provided in Section 4 of the Surface Water Resources Assessment located in **Appendix G**.

Protecting the pit from flood ingress and OOPD will require the construction of the Horse Pit North and Horse Pit West levees. Flood modelling determined that this infrastructure achieves 0.1% AEP flood immunity and does not result in impacts to infrastructure, pit inundation or impacts to areas downstream. Modelling also determined the proposed action would not result in significant changes to flood velocities. Flood immunity is achieved with minimal impacts to flood behaviour and impacts from flooding are limited to within the Project Area.

The proposed road crossing of Horse Creek to the OOPD provides a 0.1% AEP flood immunity to the haul road and the OOPD during operations. Results of the flood modelling indicate the culverts of the road crossing will cause flood affluxes upstream in the 0.1% AEP event, however, the afflux is contained within the extents of the Horse Creek floodplain, contained on the ML and has no impact on existing mine infrastructure. Modelling indicates the Horse Pit North Levee will result in some flood afflux to the north of the levee of up to 500 mm. The afflux is wholly contained within the existing flood extent of Horse Creek, with no additional flood areas observed.

The flood behaviour within the Horse Creek channel was also reviewed against the Australian Coal Industry's Research Program (ACARP) design criteria. The results indicate that the construction of the levees does not change the key stability criteria stated in the ACARP design criteria. Erosion protection for the levees will need to be considered as part of the detailed design process to account for the sodic nature of the soils in the region.

Flood modelling results for all AEPs are presented in Appendix B of the Surface Water Resources Assessment located in **Appendix G**.



Projection: GDA 1994 MGA Zone 55

Scale: 1:600,000 at A4

Project No.: 620.13593

Date: 23-May-2022

Drawn by: PM



- Localities
- DNR Streamflow Gauges
- ▲ Gauge Location
- Watercourses
- Regional Subcatchment
- Project Area
- BHP Tenements

Horse Pit Extension Project

Regional Surface Water Features

FIGURE 4-1

4.3.2.2 Catchment Area Reduction

The Horse Creek catchment will be reduced by 4 km² (7%) as a result of the Project. However, the impact diminishes immediately downstream as flow is significantly altered by the weir at the confluence with Grosvenor Creek, resulting in negligible flow impacts downstream. The Cherwell Creek catchment will be reduced by only 0.4% as a result of the Project.

The Isaac River has a catchment area of approximately 3,400 km² at the confluence of Grosvenor Creek, and therefore, the catchment area reduced by the Project is in the order of 0.2%. This represents an insignificant reduction in catchment area due the Project.

Impacts to downstream flow as a result of the Project are very minor, including changes to the occurrences of higher or medium flows. As such, the Project is unlikely to cause changes to the flow regime that would result in impacts to downstream users.

4.3.2.3 Water Quality Impacts

The Project has the potential to impact on water quality and subsequently the downstream environment through its construction and operation. Impacts on water quality and aquatic ecology are discussed further in the Aquatic Ecology Impact Assessment located in **Appendix H**. Changes to water quality in watercourses generally have the potential to impact on aquatic ecosystems through the following processes:

- Influencing the success of the life cycles of aquatic species (i.e., affecting cues for movement, migration and breeding);
- Changing the diversity of habitats through sedimentation and contamination; and
- Sedimentation and contamination influences habitat condition and further affects water quality.

As discussed in Section 5.1.5.8 of the Aquatic Ecology Impact Assessment located in **Appendix H**, clean water captured on site in clean water storages is expected to have the similar water quality as the receiving environment waterways and is not expected to have any impacts to the water quality. In addition, MAW will be captured in existing storage facilities with sufficient capacity and freeboard to accommodate for the Project water requirements.

Specific to the OOPD, the spoil placed in the dump has been assessed as being generally benign (very low/negligible acid mine drainage risk). The reject material has a slightly higher risk, however when buried in spoil the risk of contamination is mitigated. This information indicates that runoff from the OOPD would generally be fresh and low in sulfur content. Modelling indicates uncontrolled overflows from any dams within the system including sediment dams are infrequent and typically occur 1 to 3 times during the 20-year simulation period. The magnitude of these overflows when they do occur is small (less than 1 m³/s). The water balance model reports flow in the Isaac River at this same time in excess of 600 m³/s and as such, impacts to the downstream environment are predicted to be minimal.

4.3.2.4 Creek Geomorphology

The drainage channels and watercourses in and around the Project Area are ephemeral in nature and therefore a significant rainfall event is typically required in order to restore flow.

The geomorphology assessment identified that Horse Creek has a consistent cross section and long section with an overall slope of 0.3 per cent and has mostly a sandy bed with vegetated banks. Moderate to extreme bank erosion was evident with erosion observed on the outer banks as well as aggradation of sediments on the riverbed, particularly as a result of grazing activities.

In most cases, it was apparent that a localised change in flow regime (such as concentration of a flow path from a dam outlet or along a cattle track) allowed gully and sheet erosion to take place due to the highly dispersive nature of the soils. The highly dispersive nature of the soils will need to be noted and managed for any proposed waterway works (in accordance with the CVM EA condition F11).

Overall, the study undertaken found that the existing waterways of Horse Creek and other unnamed tributaries running through the Project Area, were largely unchanged from those observed by URS in 2009 as part of the CVM

EIS (URS, 2009) and provided existing management practices are implemented, no significant impacts on creek geomorphology are expected as a result of the Project.

4.3.2.5 Cumulative Impacts

The surface water assessment incorporated both the existing (and already approved) activities at the CVM in addition to the proposed activities (and amendments to existing infrastructure) for the Project. As a result, the cumulative impacts due to the Project and the CVM have been accounted for in this assessment.

The design of the Project is such that surface water impacts, such as flooding and releases of MAW, will be managed in accordance with the existing the CVM EA conditions.

The water management system and the likelihood and magnitude of releases and spills have been examined using a water balance model. The basis of this water balance model was BMAs CRWN model. The CRWN model is a linked water balance model which includes modelling of all four (4) BMA mines in the vicinity of the Project, including CVM, PDM, Saraji Mine and South Saraji Mine (formally Norwich Park Mine). The model also includes a good representation of the receiving waterways including impacts of upstream water storage on flow patterns.

The model considers climate variability and is based on 500 replicates of probabilistic rainfall data to allow for uncertainties and variability associated with the climate.

The combined mine model provides BMA with a tool that greatly reduces the number of unknowns, providing a greater confidence to the predictions across all operations (e.g., influence of cumulative releases on water quality and the potential need to reduce release rates). It also allows the system to transfer water between mine sites utilising the CRWN MAW pipeline. This seeks to reduce the amount of raw water used on the site and reduce environmental harm by allowing water to be stored and released appropriately. This subsequently reduces the likelihood of uncontrolled releases across all sites and provides confidence in release volumes and impacts, considering cumulative releases on water quality. The model accounts for the EA conditions on all releases at all mines and considers the water quality requirements in the source / release storage and receiving waterbody.

While the CRWN pipeline does allow water to be sent to other mines this is predominantly undertaken to allow for water reuse at other operations during times of water scarcity and not for release. The ephemeral nature of all creeks which form approved release points for the CRWN mine result in a relatively short window of a potential release. The CRWN capacity varies over its length, but maximum capacity is typically in the order of 400 L/s. Even at this capacity the time required to move water to alternative release points means, coupled with infrastructure bottlenecks on the release infrastructure dams (such as their capacity), transfer of water to facilitate additional release of MAW is unlikely.

The assessment presents results for dry, average and wet years. These are based on the 500 probabilistic climate records simulated in the water balance model where the dry years is the 5th percentile result across all records, average the 50th percentile and wet the 95th percentile. The average is typical of historical climate observations. The modelling predicts that when these events are occurring the quantum of flows in the receiving waterway (based on the gauge at Deverill) would be between 20 m³/s and 250 m³/s for average and wet climate conditions. These are presented graphically against the daily flow frequency curve from the DNRM Deverill Gauge in **Figure 4-2**. That is, during the average or wet events the receiving waterways will be flowing in significant volumes. In context, typical releases during these events would be 0.3 m³/s and 1 m³/s.

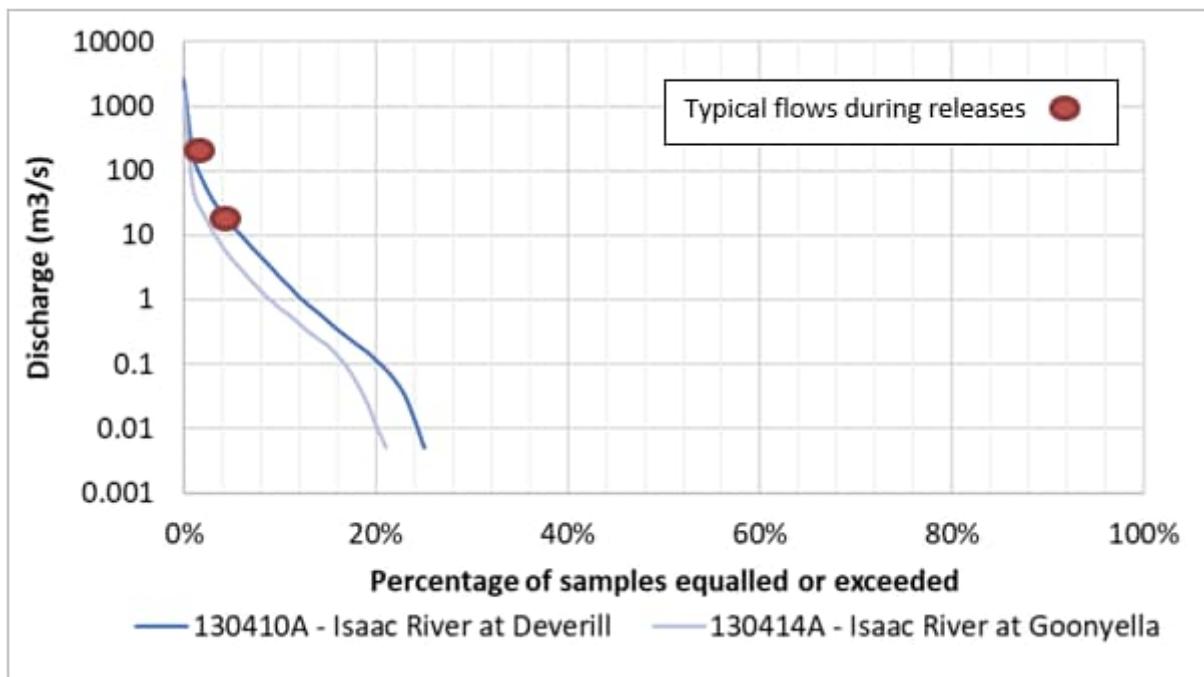


Figure 4-2 Daily Discharge Exceedance Curves (Figure 2.6, Surface water technical report)

Salinity studies for the Fitzroy Partnership on River Health in 2011 (Jones, 2013) also indicate that although cumulative mine water releases in the Fitzroy River Basin accounted for 9% to 25% of the total salinity, the actual water quality monitoring within existing storages on site was within acceptable limits (Kafle et al. 2018).

Overall, the disturbance footprint for the Project is a very small portion of the catchment:

- 7 % of Horse Creek;
- 0.5 % of Grosvenor Creek;
- 0.4 % of Cherwell Creek; and
- 0.2 % of the Isaac River catchment at the Grosvenor Creek confluence.

Groundwater input to the system is even smaller, with 198 ML/annum vs the 1,600 ML/annum of surface water runoff from rainfall in an average year and 6,000 to 7,000 ML/annum in a very wet year. Of this between 1,100 ML/annum and 800 ML/annum is lost to evaporation (depending on climate) with only 60 ML/annum released during a median year and 1,200 ML/annum during a very wet year (releases and overflows).

Groundwater inflow to the CVM pits generally occurs as damp or low flow seeps in the mining faces, making the direct measurement of the groundwater inflow virtually impossible. Most of the groundwater inflow evaporates directly from the mining face, and it is only any remaining groundwater that pools at the base of pits. This water is then left to evaporate, or is pumped out of the pit, along with any captured surface water runoff. The inflow estimate provided by the groundwater model includes groundwater that evaporates from the pit floor and face before being 'seen'.

This means the groundwater inflow numbers provided by the model are, at best, a highly conservative upper limit estimate of the volumes that might report to the mine water management system and need to be considered in a physical mine water balance.

4.3.3 Surface Water Management at the CVM

4.3.3.1 Management Framework

Management of surface water at the CVM incorporates both design and operation components to ultimately minimise the amount of water that is actively handled and released. The approach to management of water can be summarised using a hierarchy (**Figure 4-3**) that integrates design principles, water management controls and operational decision making.

The CVM is part of the CRWN which is an arrangement whereby water inventories at four (4) BMA mine sites (the CVM, Peak Downs Mine, Saraji Mine, and Saraji South Mine) are managed similar to a single site through transfers between sites. The CRWN enables greater opportunity for avoidance, as sites with an excess of water can transfer water to sites such as the CVM that operates in a water deficit.

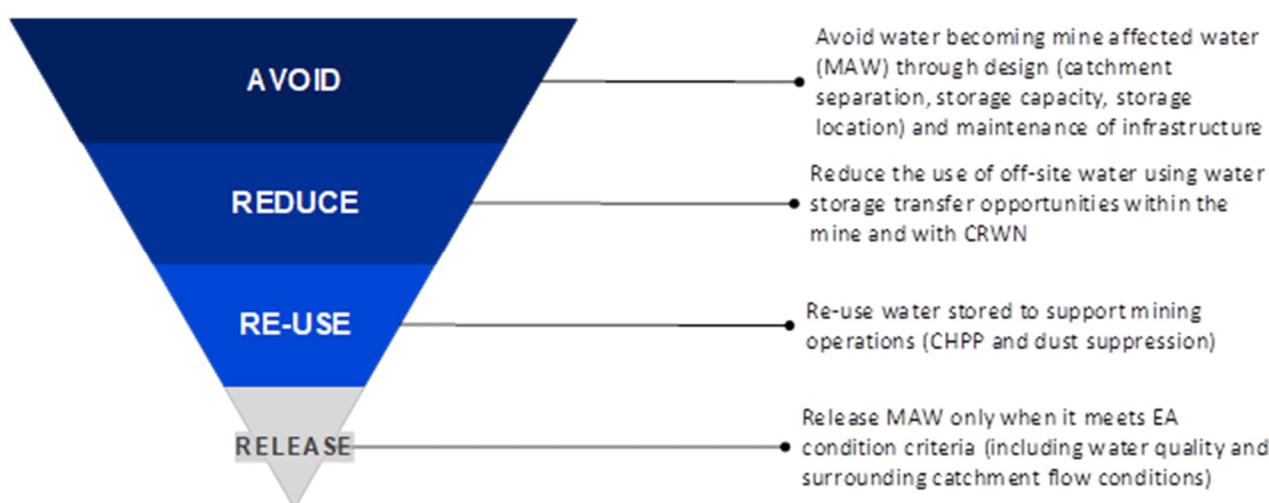


Figure 4-3 Hierarchy of Surface Water Management

4.3.3.2 Water Management Regulation

The CVM EA, regulated under the *Environmental Protection Act 1994* (EP Act) and the DES, includes conditions specifically relating to the management of surface water. Schedule F of the EA, provided in full in **Appendix K**, outlines conditions specifically relating to water. Schedule F includes identification of authorised release points, release limits, trigger levels, monitoring requirements and reporting requirements. MAW is defined by the EA as follows:

Mine affected water means the following types of water:

- a) means the following types of water:
 - i. pit water, tailings dam water, processing plant water;
 - ii. water contaminated by a mining activity which would have been an environmentally relevant activity under Schedule 2 of the *Environmental Protection Regulation 2008* if it had not formed part of the mining activity;
 - iii. rainfall runoff which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated, excluding rainfall runoff discharging through release points associated with erosion and sediment control structures that have been installed in accordance with the standards and requirements of an *Erosion and Sediment Control Plan* to manage such runoff, provided that this water has not been mixed with pit water, tailings dam water, processing plant water or workshop water;
 - iv. groundwater which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated;

v. groundwater from the mine's dewatering activities; or

vi. a mix of mine affected water (under any of paragraphs i to v) and other water.

b) does not include surface water runoff which, to the extent that it has been in contact with areas disturbed by mining activities that have not yet been completely rehabilitated, has only been in contact with:

- i. land that has been rehabilitated to a stable landform and either capped or revegetated in accordance with the acceptance criteria set out in the environmental authority but only still awaiting maintenance and monitoring of the rehabilitation over a specified period of time to demonstrate rehabilitation success; or
- ii. land that has partially been rehabilitated and monitoring demonstrates the relevant part of the landform with which the water has been in contact does not cause environmental harm to waters or groundwater, for example:
 - a. areas that are been capped and have monitoring data demonstrating hazardous material adequately contained with the site;
 - b. evidence provided through monitoring that the relevant surface water would have met the water quality parameters for mine affected water release limits in this environmental authority, if those parameters had been applicable to the surface water runoff; or
- iii. both.

In addition to Schedule F, Schedule G outlines requirements specific to structures at the CVM. It includes requirements relating to assessing hydraulic performance of structures, certification of design and construction of regulated structures, design storage allowances, inspection requirements and other reporting.

4.3.3.3 The Central Region Water Network

The CRWN is primarily managed through maintenance of a network WBM. The CRWN WBM links each individual WBM for the four (4) BMA mines sites. The water balance modelling takes into consideration rainfall/runoff, evaporation, storage volumes, water demands releases, location and capacity of pump/pipe infrastructure, operating regimes and off-site water pipeline. The model also includes representation of the receiving water catchments in order to identify likely coincident flows in the Isaac River and its tributaries (as this flow is important to determining if a release would be authorised under the EA). The CRWN WBM has an internal quality assurance process to ensure the robustness of the model. The Sustainable Minerals Institute (SMI) from the University of Queensland was also engaged to provide quality assurance and review of the CRWN model development, initial model outputs and final model outcomes. Findings from their review have been incorporated in the model.

A network of pipeline and pumps physically facilitate the movement of water between the sites to meet water operational demands (e.g., for the CHPP or dust suppression), minimising need for use of off-site water as well as managing levels at each storage.

On a daily basis the CRWN WBM assesses the performance of each mine's water management system against the conditions of their EA and any other internal water management standards. The objectives of the CRWN water management systems are to:

- Control and manage separation and use of clean and MAW;
- Use MAW preferentially to meet the site's water demands for the CHPP as well as dust suppression;
- Maximise pit operability; and
- Control the release of water from the storage dam's so that releases occur in accordance with the EA conditions and therefore in a manner that minimise impacts upon downstream users and the environment.

The use of the CRWN WBM is an integral tool in the 'AVOID' piece of the management hierarchy. Among other aspects, it allows for catchment sizes (clean water catchments separated from mine affected catchments), rainfall predictions, soil types, slopes etc to be used to inform development of practical hydraulic design parameters for water management structures. By introducing the Horse Pit progression and associated infrastructure to the current model, locations and capacity of existing the CVM water storages could be reviewed for suitability. Results of analysis for Project identified that in order to maintain the existing controls around re-use and release of water, a reconfiguration of water infrastructure is required (also see Section 3.4 of the Surface Water Impact Assessment Report 2021, **Appendix G**). The Project analysis, using the CRWN WBM, identified a requirement to relocate a number of MAW storages and expand the capacity for ESC dams given the increase in disturbed surface area.

Relocated or new supporting infrastructure (e.g., pipelines and drains) will also be constructed, in order to maintain operational water demands and achieve EA release conditions. Using the model to inform Horse Pit design works to AVOID the generation of MAW where possible and design an infrastructure network that supports efficient RE-USE of water where possible. An informed design also supports a managed approach to RELEASE (including preventing unauthorised discharge) and the decision-making process to trigger any release.

4.4 Water Resource: Groundwater Dependent Ecosystems

A GDE Assessment was undertaken to identify and evaluate the GDE values associated with the Project and to determine whether GDEs would be significantly impacted. An assessment was undertaken in accordance with the IESC guidelines (**Appendix E1**) and was subsequently built on with additional information captured in the section below.

GDEs are those ecosystems that depend on direct access to groundwater for ongoing maintenance and survival (Eamus, et al., 2006). A community that comprises some groundwater dependent species (i.e. indicator species), is typically considered to be a community that is groundwater-dependent (Eamus, et al., 2006).

There are three (3) main types of GDE as defined by Eamus et al. (2006), including:

- Aquifer/cave ecosystems, occupied by stygofauna (Subterranean GDEs);
- Ecosystems dependant on the surface availability (discharge) of groundwater. These ecosystems are characterised by permanent provision of surface water (Aquatic GDEs); and
- Ecosystems dependent on access to subsurface groundwater, which includes many riparian communities (Terrestrial GDEs (TGDEs)).

GDE communities can be determined by flora species composition and their relative dependence on groundwater for survival (Eamus, Froend, et al., 2006). Riparian and floodplain tree species are highly dependent on access to reliable water sources, including surface flows, soil moisture and groundwater (Kath et al., 2014). Particular flora species can be reliant on permanent access to groundwater and are considered to have 'obligate groundwater dependency' (Eamus, Hatton, et al., 2006). These species tend to occupy areas of the landscape that optimise access to groundwater, such as along the lower banks of waterways. For example, obligate species may include *Eucalyptus camaldulensis* (river red gum), *Melaleuca leucadendra* and *M. fluviatilis* (O'Grady et al., 2006; Roberts & Marston, 2000).

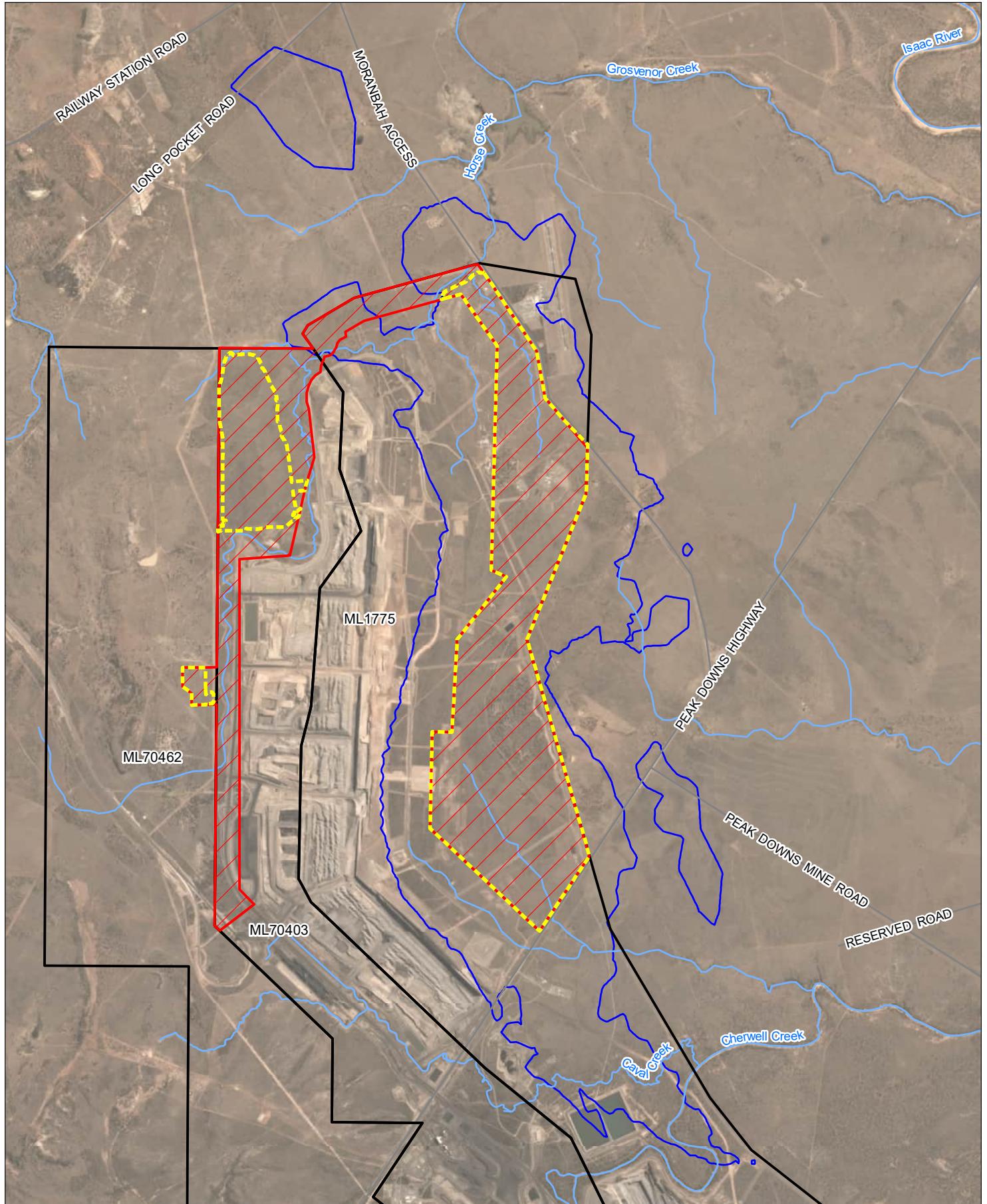
Other species have adapted to occasional access to groundwater, usually following floods when groundwater levels rise. These 'facultative' groundwater dependent species can utilise groundwater when it is available; however, can survive without (Eamus, Froend, et al., 2006). Facultative groundwater dependent species are usually located on the upper banks and floodplains of waterways, such as river she-oak (*Casuarina cunninghamiana*) and coolibah (*E. coolabah*) (Eamus, Hatton, et al., 2006; Roberts & Marston, 2000).

4.4.1 Groundwater Dependent Ecosystems Assessment

An assessment was conducted to determine the presence of GDEs and potential impact of the Project on GDEs. This assessment involved a desktop assessment followed by field surveys for potential TGDEs and stygofauna within the modelled, predicted drawdown area (the Predicted Drawdown Extent – ie the modelled extent to which the depth to water will increase). The preliminary groundwater drawdown extent determined by groundwater impact analysis (herein referred to as Predicted Drawdown Extent) and used for the GDE assessment comprises the north-eastern extent of ML 1775 and adjacent properties along the Peak Downs Highway, Moranbah Access Road and Peak Downs Mine Road (as presented in **Figure 4-4**). The objective of the assessment was to identify and evaluate the potential GDE values associated with the Project and to determine whether any potential GDEs would be significantly impacted by the Project.

To identify potential impact to GDEs the assessment comprised:

- Identification and characterisation of GDEs within the Predicted Drawdown Extent, including mapping;
- Understanding the potential change in groundwater as a result of the Project (i.e., the drawdown); and
- Assessment of the impact to GDEs as a result of the potential change (i.e., the significance of the impact).



Projection: GDA 1994 MGA Zone 55

Scale: 1:60,000 at A4

Project No.: 620.13593

Date: 01-Mar-2023

Drawn by: PM

— Road

— Watercourse

□ Predicted Drawdown Extent

□ Disturbance Footprint

□ Project Area

□ BHP Tenements

Horse Pit Extension Project EPBC Act Preliminary Documentation (EPBC 2021/9031)

Project Predicted Drawdown Extent

4.4.1.1 Subterranean GDEs (Stygofauna)

The generally high salinity of groundwater throughout the broader region suggests that the groundwater environment of the Isaac River catchment is not ideal for stygofauna (FRC Environmental, 2020; SLR Consulting Australia Pty Ltd, 2020).

For the Project, two (2) stygofauna pilot studies were undertaken (April and November 2020) in accordance with the Guideline for the Environmental Assessment of Subterranean Aquatic Fauna (DES, 2019) across a total of 23 bores distributed through the Project area and comparable bores nearby. A detailed account of the pilot studies completed is shown in **Appendix H**.

Regionally, sampling for stygofauna at the Winchester South Project, just downstream of the confluence of Cherwell Creek and the Isaac River, was undertaken in 2019 and 2020 as part of the project's Aquatic Ecology Assessment (Ecological Service Professionals (ESP), 2022). The sampling was conducted consistent with the Guideline for the Environmental Assessment of Subterranean Aquatic Fauna (Department of Science, Information Technology and Innovation, 2015). A total of 11 bores were sampled as part of the stygofauna assessment, including three (3) bores installed into the Isaac River Alluvium. No stygofauna species were recorded from any of the bores sampled during the Winchester South Project's stygofauna field survey (ESP, 2022).

Two (2) bores in the Isaac River alluvium further downstream of the Winchester South Project were also sampled recently as part of the Olive Downs Coking Coal Project Aquatic Ecology Assessment (DPM Envirosciences, 2018c). Again, no stygofauna were recorded during the study.

Along the Isaac River just upstream of the Cherwell Creek confluence, FRC Environmental (2020) undertook stygofauna sampling in 2019 for the Isaac Downs Project. Only one (1) bore of 10 sampled in the Isaac River Alluvium contained stygofauna. Both identified taxa in the bore were stygoxenes (i.e. not obligate inhabitants of groundwater ecosystems). Stygofauna occurrence near to the project was therefore reported as 'limited'.

The previous studies discussed above demonstrate that the Isaac River Alluvium should not be considered a significant or widespread habitat for stygofauna, with stygofauna only identified in one (1) of 15 bores installed into the alluvium in the vicinity of the Cherwell Creek confluence. Furthermore, the stygofauna taxa that were identified in the one (1) bore were not obligate groundwater inhabitants (i.e. may also be found within surface water features) and therefore any impacts to the alluvium groundwater system itself would be unlikely to materially affect the stygofauna community at this bore.

The study results determined the Project area to have a low likelihood of supporting stygofauna communities and as such the aquifer/cave ecosystem GDE has not been assessed further.

4.4.1.2 Aquatic GDEs

The aquatic ecology study (**Appendix H**) also considered the presence of Aquatic GDEs. The results of aquatic indicators surveyed as part of the assessment were consistent with results from previous aquatic ecology surveys at the CVM and in the broader region. Field assessments concluded that aquatic habitat condition at mapped potential surface-expression GDE sites in the vicinity of the Project were representative of ephemeral waterway and wetland sites, with no obvious surface-expression of groundwater at these sites. The assessment found that the aquatic ecological value of mapped potential surface-expression expression GDEs was low to moderate at wetland sites and waterway sites. No differences were observed in aquatic ecological indicators between sites on mapped potential surface-expression GDEs compared with those that are not mapped (**Appendix H**). As a result, aquatic GDEs were not considered further.

4.4.1.3 Terrestrial GDEs

Desktop assessment and literature review did identify potential for TGDEs to occur within the Predicted Drawdown Extent and the remainder of this section provides more detail on the identification and assessment of impact to TGDEs.

4.4.2 Identifying TGDEs

To identify potential TGDE vegetation and determine reliance on groundwater a cumulative evidence-based decision approach (CEDA) was applied. Using best available data the approach draws on:

- Plant physiology and community mapping – vegetation community mapping has been collected via field surveys within the Predicted Drawdown Extent. Literature and data review of the key communities and species present has been undertaken to identify those known to use groundwater (and similarly, those that may use groundwater or are very unlikely to use groundwater). Where species/communities are very unlikely to use groundwater this is used as diagnostic evidence;
- Groundwater depth – groundwater is recognised as the limiting factors as it must be accessible to deep roots of vegetation. Where groundwater is too deep this region is used as diagnostic evidence; and
- Plant relative persistent greenness and wetness (remote sensing-based Groundwater-dependent Ecosystem Mapping (GEM) data). The assessment identifies areas likely to be using groundwater and helps identify positive areas of TGDE.

These information sources in combination allowed for likely TDGEs to be identified for the Project locality and described in order to undertake impact assessment.

4.4.3 Describing the Change in Groundwater

As part of groundwater modelling undertaken for the Project, a Predicted Drawdown Extent was identified based on 1 m drawdown area from the detailed groundwater model.

The groundwater table for the Predicted Drawdown Extent was modelled as part of groundwater impact assessment undertaken for the Project (**Appendix F**). Modelling depicted the current depth-to-water (DTW) and the likely maximum drawdown associated with the Project.

The Project's groundwater model, used as the basis of the assessment of TGDEs, is a refinement and update of an earlier groundwater model that was developed for the Olive Downs Project EIS and the Moorvale South Project Associated Water License Application. The groundwater modelling for these projects was subject to scrutiny and review by both State (both projects) and Commonwealth (Olive Downs Project) regulators and technical advisors. In both cases, the groundwater modelling was found to be appropriate for the purpose of mining impact assessment and particularly assessment of possible impacts to potential shallow groundwater system receptors. The Olive Downs Project and Moorvale South Project versions of the groundwater model were also subject to an update/refinement as part of the Winchester South Project EIS, with that model also subject to scrutiny and review by both State and Commonwealth regulators and technical advisors. The Project's groundwater model represents a further updated version of the Winchester South Project model.

The Project version of the groundwater model incorporated a number of new datasets and sources including:

- CVM geological model;
- CVM drilling logs;
- CVM Alluvium mapping; and
- CVM Groundwater Monitoring bore data.

The robustness and appropriateness of the Project's updated version of the groundwater model was further validated by an independent peer review by expert hydrogeologist/modeller Dr Noel Merrick. This review concluded the Project's groundwater model is fit for the purpose of meeting the objectives defined in Section 1.3 of the Project's Groundwater Assessment report. Dr Merrick also found that the Project's groundwater modelling has been conducted to a very high standard and the modelling methodology is "state-of-art". This model is therefore considered appropriate and robust to inform the assessment of groundwater for the Project.

While drawdown of the groundwater aquifer is the major impact pathway for GDEs, the sensitivity of the GDE potentially impacted by changing groundwater regimes also needs to be considered. The complication is that TGDEs are often sustained by multiple sources of water, including direct rainfall, flooding, stored soil moisture and groundwater. The ratio of water requirements from these sources, coupled with the degree of adaptability of GDE vegetation to change dictates ecosystem sensitivity. Sensitivity to groundwater drawdown is likely to be less for a facultative GDE when compared to an obligate community. However, a combination of factors, such as

groundwater drawdown resulting from mining activities and prolonged drought may result in impacts to additional areas of TGDEs than those under stand-alone instances. For example, under typical dry conditions (excluding anthropogenic activities), GDE indicator species, such as *Eucalyptus camaldulensis*, may still access the alluvial aquifer, in addition to any available surface flows to maintain functioning (Figure 4-5). While seasonal loss of canopy vigour and associated loss of foliage cover during extended drought may be observed, recovery of riparian condition following rainfall or river high flow would occur.

When coupled with groundwater drawdown, the water table may fall below the vegetation rooting depth, resulting in continued loss of leaf moisture via transpiration and limited uptake from the root systems (Figure 4-6). This can result in canopy dieback within TGDEs and further degradation of habitat, such as:

- Increased abundance of weed species within the ground layer from increase light penetration resulting from canopy dieback (Figure 4-6); and
- Changes in the ground strata (shrub, grass cover etc) from increase light penetration resulting from canopy dieback.

The Project's groundwater model has a mild tendency to overestimate the groundwater levels, particularly at lower elevation, than the actual levels (HydroAlgorithmics Pty Ltd, 2021). That is, the model has a tendency to predict shallower groundwater levels than reality. Since the model predicted depth to groundwater is a key input to the identification of potential TGDEs, the extent of likely TGDEs mapped in the Project's GDE assessment is considered conservative, incorporating a potentially larger area of terrestrial communities that may access groundwater than what is measured in reality (i.e. potential overestimation of TGDEs present). Consequently, the potential impacts to TGDEs based on the predicted drawdown extent is likely to also be an overestimation, with the actual impacts a subset of the identified GDE extent.

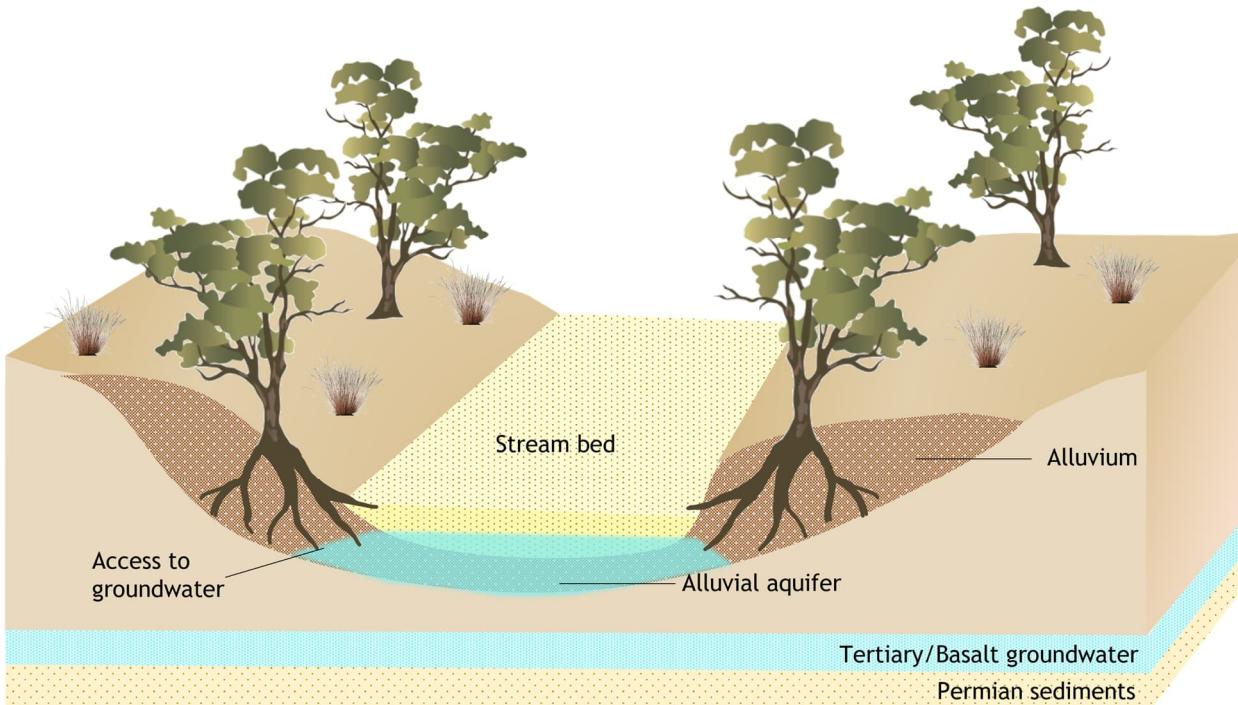


Figure 4-5 TGDE during dry conditions (no mining)

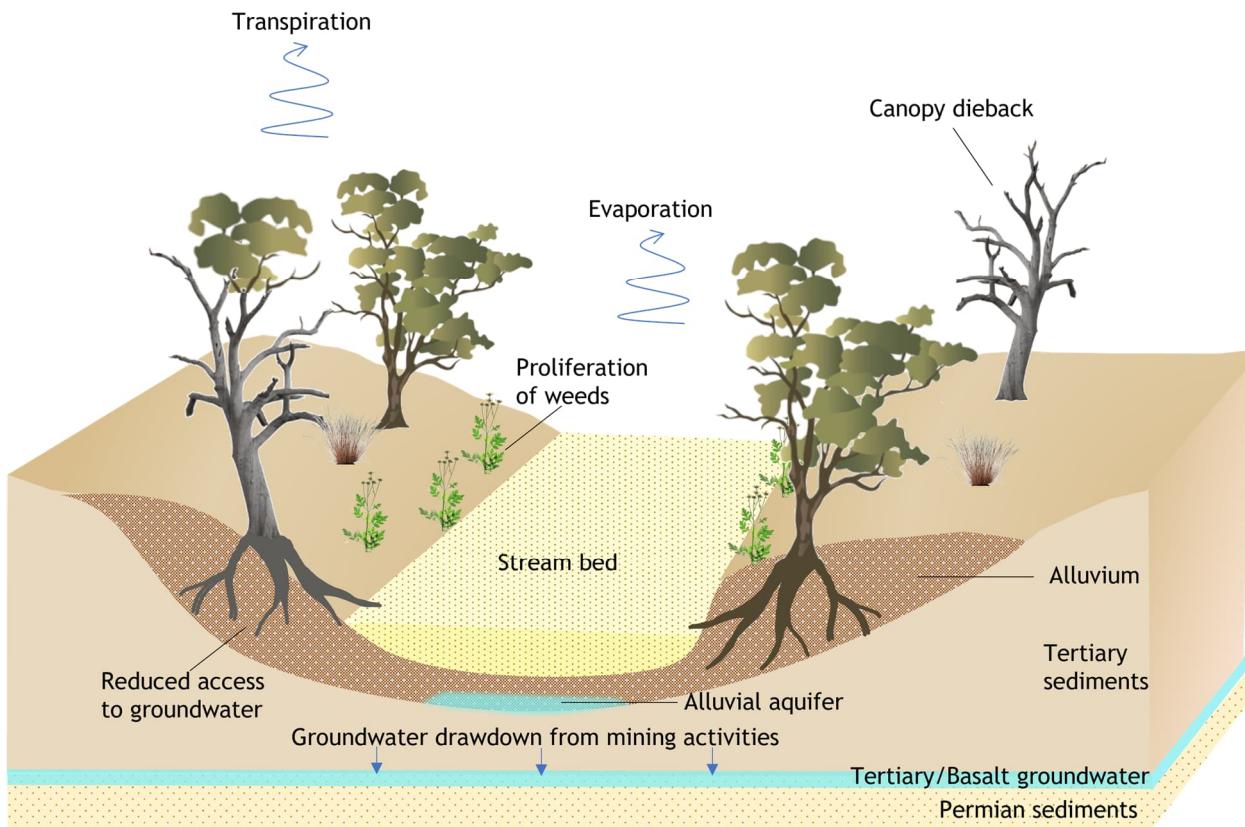


Figure 4-6 TGDE under mining and prolonged drought

4.4.4 Identification of Vegetation Reliant on Groundwater

Determining the extent to which terrestrial vegetation communities are groundwater dependent is complex and generally relies on a number of lines of evidence. This assessment has been based on several data sources, including existing information from Commonwealth and Queensland mapping, remote sensing data analysed using IESC recommended methods and field-based surveys. The lines of evidence and how they assisted decision making around if communities are reliant on groundwater (i.e. potential TGDEs) is presented in **Table 4-2**.

Table 4-2 TGDE Assessment Data Sources

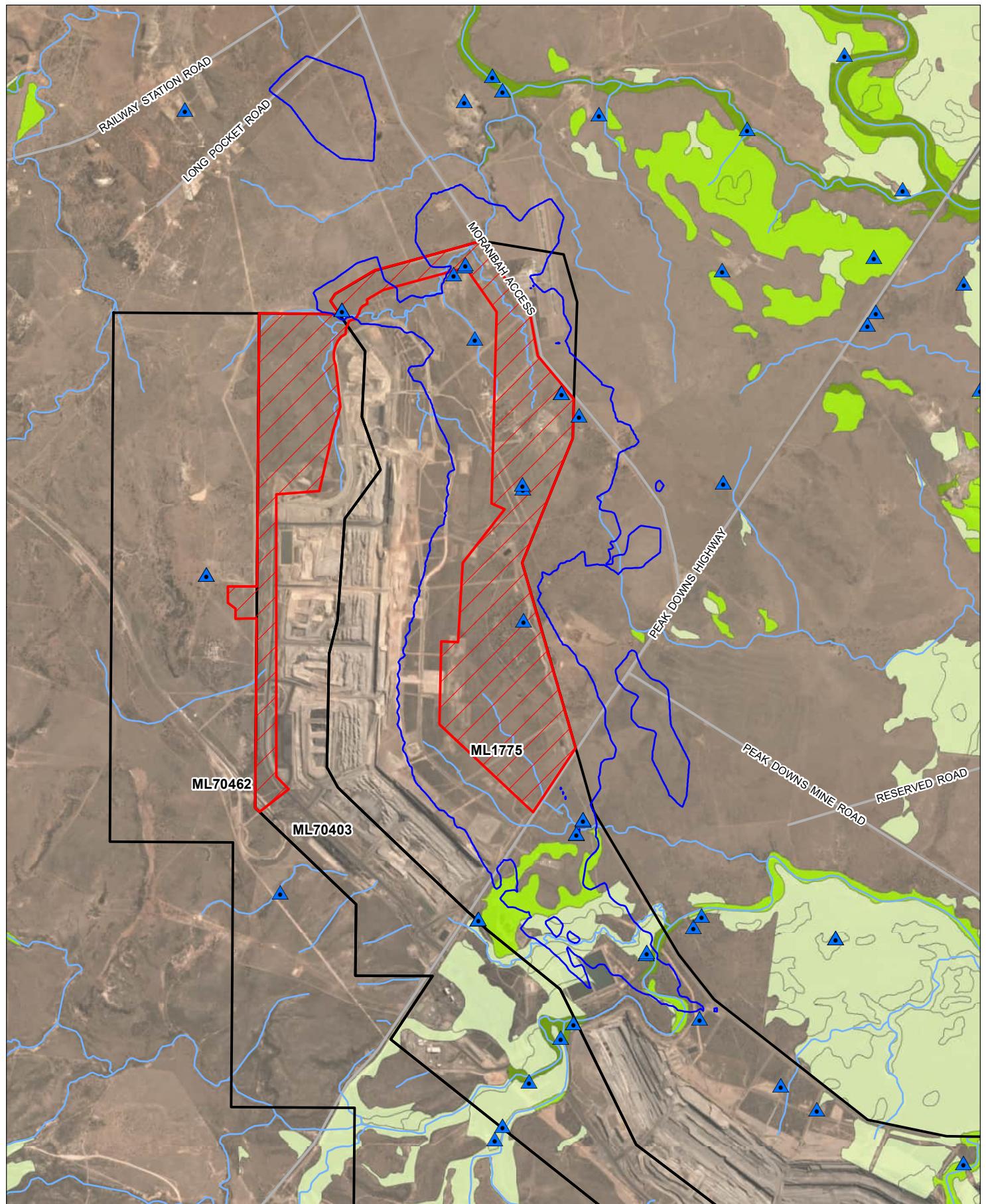
Line of evidence	Data source for this study	Use in decision making
Commonwealth & state government mapping products	Bureau of Meteorology GDE Atlas Regional ecosystem mapping Map of Queensland Wetland Environmental Values (DES, 2021) Queensland Wetland Data (DES, 2021a)	Data provided at a variety of scales and used for: <ul style="list-style-type: none"> Identifying wetlands and other potential GDEs; Targeting areas for field verification; Understanding surface geology and likelihood of interactions between vegetation and groundwater; and All data contributes to decision making but not definitive in isolation.
Vegetation types	Field surveys Scientific literature	Critical information about vegetation communities and their ecological attributes, particularly: <ul style="list-style-type: none"> Known reliance on groundwater; and Likely rooting depth of key tree species.
Groundwater modelling	Predicted Drawdown Extent	Understanding predicted impact area
	Modelled Groundwater Table impact: Horse Pit Extension Project Groundwater Assessment (SLR 2021)	<ul style="list-style-type: none"> Critical information about existing depth to groundwater and whether it is shallow enough for vegetation to access; and Critical information to predict potential impacts (including location and scale) to any potential TGDEs from drawdown.
Groundwater bore data	Site groundwater data	Important inputs into groundwater models
Remote sensing analysis	Remote Sensing of TGDEs: Using the GEM method (2rog Consulting 2021)	Method recommended by IESC that may be used for: <ul style="list-style-type: none"> Regional scale data that may be useful to supplement field assessments; Highlights vegetation areas that are relatively greener and wetter than surrounding areas; and Selection of dry (drought) images and wet images provides contrast to identify vegetation likely to be accessing groundwater sources.

4.4.4.1 Commonwealth and State Government Mapping

The National Groundwater Dependent Atlas (2016) (GDE Atlas) identified 154 ha of TGDEs mapped within the Predicted Drawdown Extent. Mapped TGDE areas were in association with watercourse and floodplain vegetation as well as areas containing underlying basalt, located within the southern extent in association with Cherwell and Caval creeks. The GDE Atlas (by the Bureau of Meteorology) mapping within the Predicted Drawdown Extent is shown in **Figure 4-7** and extent summarised in **Table 4-3**. The GDE Atlas mapped TGDEs within the Predicted Drawdown Extent are largely associated with riparian and floodplain communities (land zone 3) and intersect eight (8) RE communities (**Table 4-3** and **Table 4-4**).

Table 4-3 GDE Atlas areas within the Predicted Drawdown Extent

GDE Atlas category	Area (ha)	Associated RE Type
Low potential TGDE	88.03	11.3.2, 11.3.7, 11.3.25, 11.4.9, 11.5.3 and 11.5.9b
Moderate potential TDGE	61.76	11.3.25, 11.4.8, 11.4.9 and 11.8.5
High potential TDGE	4.54	11.3.25



Projection: GDA 1994 MGA Zone 55

Scale: 1:70,000 at A4

Project No.: 620.13593

Date: 01-Mar-2023

Drawn by: JG



- ▲ QLD Registered Groundwater Monitoring Bore
- Predicted Drawdown Extent
- Watercourses
- Project Area
- BHP Tenements

Terrestrial GDE

High potential GDE - from national assessment

Moderate potential GDE - from national assessment

Low potential GDE - from national assessment

Horse Pit Extension Project
EPBC Act Preliminary Documentation
(EPBC 2021/9031)

Bureau of Meteorology
Mapped Terrestrial GDEs

FIGURE 4-7

Table 4-4 Regional Ecosystems Associated with GDE Atlas Mapping

RE Type	RE Description
11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains.
11.3.7	<i>Corymbia</i> spp. woodland on alluvial plains.
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines.
11.4.8	<i>Eucalyptus camophageana</i> woodland to open forest with <i>Acacia harpophylla</i> or <i>A. argyrodendron</i> on Cainozoic clay plains
11.4.9	<i>Acacia harpophylla</i> shrubby woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains
11.5.3	<i>Eucalyptus populnea</i> +/- <i>E. melanophloia</i> +/- <i>Corymbia clarksoniana</i> woodland on Cainozoic sand plains and/or remnant surfaces.
11.5.9b	<i>Eucalyptus crebra</i> and other <i>Eucalyptus</i> spp. and <i>Corymbia</i> spp. woodland on Cainozoic sand plains and/or remnant surfaces.
11.8.5	<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks.

In addition, desktop mapping identified:

- There are no DNRME (now Department of Resources (DoR)) mapped GDE springs located within the Predicted Drawdown Extent or within close proximity;
- No Ramsar or important wetlands are mapped within the Predicted Drawdown Extent; and
- No wetlands of high ecological significance are mapped within the Predicted Drawdown Extent.

Due to the lack of mapped terrestrial vegetation associated with surface expression, indicator species within the groundcover (e.g., grasses and forbs) are considered unlikely to occur in the Predicted Drawdown Extent. As such, potential TGDE indicator species were restricted to canopy tree species and some subcanopy/shrub species, comprising extensive root systems that may access groundwater levels.

4.4.4.2 Indicator species and depth to groundwater diagnostic criteria

In order for vegetation to access groundwater in the subsurface, root structures need to access the capillary zone located above the groundwater level. Eamus et al. (2006) suggests that groundwater existing at depths greater than 10 m has reduced importance to vegetation. While the probability of use of groundwater by vegetation is reduced at depths of 10 to 20 m, use of groundwater is likely where DTW is 0 to 10 metres below ground level (mbgl), possible at depths of 10 to 20 mbgl and unlikely at depths greater than 20 mbgl (Eamus, Hatton, et al., 2006).

Following literature review and field survey the following likelihood of communities constituting a TGDE was determined:

- Likely interaction: Modelled groundwater table is within adequate range (<10 mbgl) to be accessed by indicator species (i.e. canopy species);
- Possible interaction: Modelled groundwater table is between 10 to 23 mbgl reducing the likelihood of access to groundwater by indicator species; and
- Unlikely interaction: Modelled groundwater table is outside of the range (>23 mbgl) to be accessed by indicator species.

Vegetation surveys of potential TGDE communities at targeted locations (i.e. mapped GDE Atlas) were conducted in accordance with the Queensland Government's Methodology for Surveying and Mapping Regional Ecosystems and Vegetation Communities in Queensland (Neldner et al., 2020)

A comprehensive literature review was then undertaken to identify potential TGDE indicator species observed during the field survey to evaluate the species' reliance of groundwater for long-term viability. Based on information identified within the desktop assessment and literature review, as well as the modelled groundwater table data, an assessment of the likelihood of vegetation and groundwater interaction could be undertaken.

Potential indicator species were only identified within two (2) riparian and floodplain communities (REs 11.3.2 and 11.3.25) and a community on sandy, depositional plains (RE 11.5.3). The literature review did not identify any potential indicator species in the remaining RE types. Only two (2) areas of the Predicted Drawdown Extent contain these RE types: in the north along Horse Creek, and in the south associated with Caval and Cherwell creeks.

Potential TGDE indicator species occurring within REs 11.3.2 and 11.3.25 consist of *Eucalyptus camaldulensis* and *E. populnea*. While the maximum rooting depths in *E. camaldulensis* and *E. populnea* are relatively unknown, a number of studies have identified critical groundwater depths that can assist determining an approximate limit to root growth for the species (Kath et al 2014). Horner et al. (2009) identified evidence of mortality of *E. camaldulensis* on floodplains of the Murray River when groundwater depths reached thresholds of 12 to 15 m deep. Similarly, modelling by Kath et al. (2014) identified correlation between decreased tree condition when groundwater depths reached thresholds of between 12 and 23 m for *E. camaldulensis* and between 13 and 27 m for *E. populnea* on the Condamine floodplain.

Naumburg et al. (2005) found groundwater decline can inhibit tree roots from accessing available moisture, contributing to water stress and impacting tree condition, particularly during extended drought conditions (Kath et al., 2014). Based on these studies, it has been assumed that the root zone of *Eucalyptus camaldulensis* and *E. populnea* is up to approximately 23 m deep. Therefore, areas of REs 11.3.2 and 11.3.25 that occur where the DTW is between 5 and 23 mbgl are considered to be possible TGDEs.

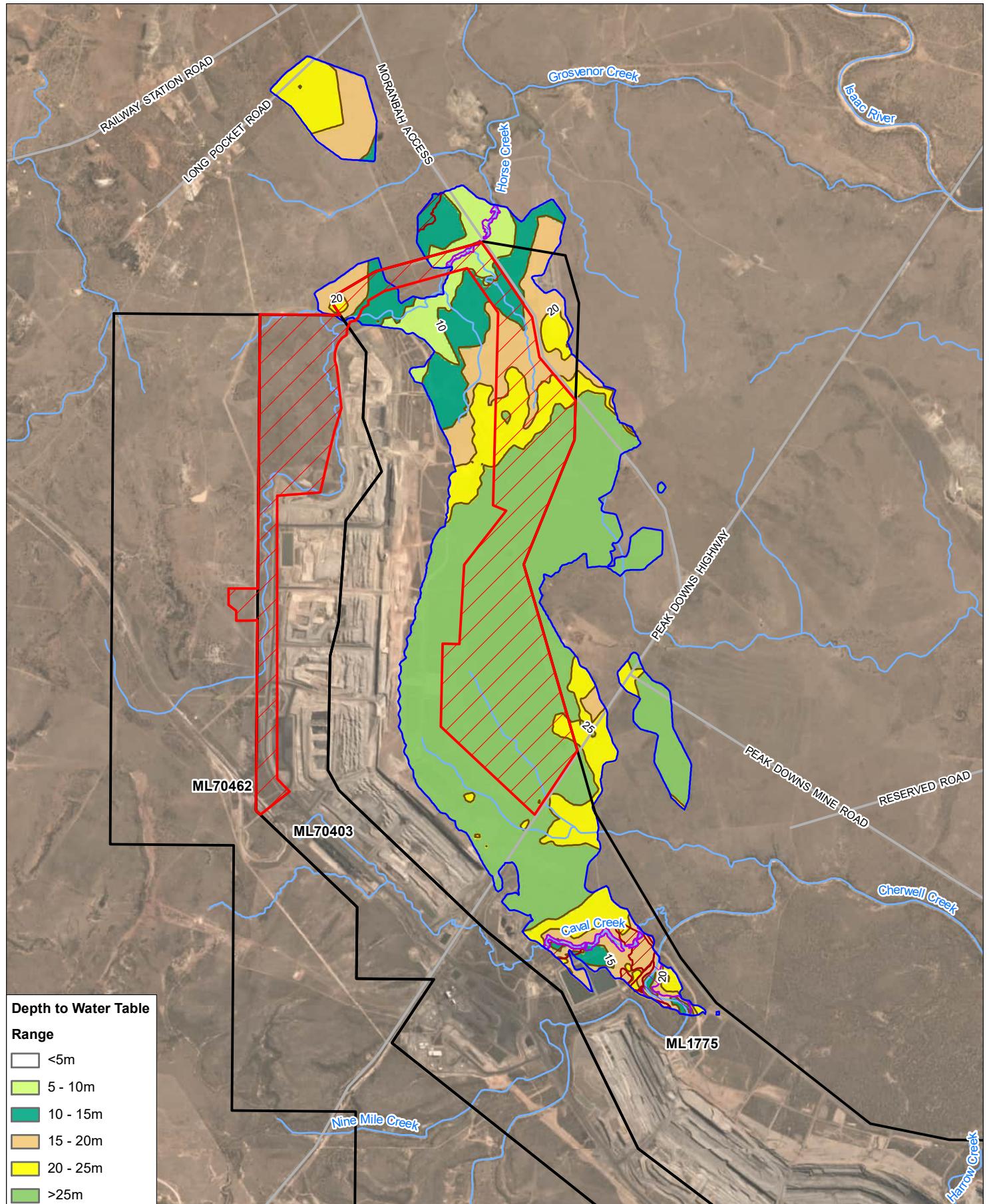
Areas of HVR and remnant RE 11.3.25 along Horse Creek are modelled with a DTW between 5 to 10 mbgl (**Figure 4-8**). Due to the proximity to the groundwater table, this community is considered likely to be a GDE. Furthermore, as the root depths associated species are within the threshold identified by previous studies, coupled with the existing modelled DTW, areas containing RE 11.3.25 are facultative, utilising groundwater when available however not dependent on access for ongoing persistence.

The modelled groundwater table for areas of RE 11.3.2 located within the floodplain of Cherwell Creek and Caval Creek were identified to be around 15 to 25 mbgl. As these areas are also within the threshold of the root depths identified by previous studies RE 11.3.2 is also considered a possible TGDE (facultative).

Rooting depths for other common tree species within floodplain vegetation was also limited. Studies undertaken by O'Grady et al. (2006) within the Daly River in the Northern Territory noted *Casuarina cunninghamiana*, was relatively opportunistic, accessing groundwater at low elevations and relying on soil water at higher elevations in the landscape. O'Grady et al. (2006) also found Melaleuca species fringing riparian corridors to be accessing groundwater, however, are likely to be facultative as opposed to obligate.

A review of modelled groundwater table identified the DTW for areas of RE 11.5.3 to range between 15 to 25 mbgl. As groundwater depths are likely to be greater than 10 mbgl, associated communities (i.e. RE 11.5.3) are considered to be possible TGDEs (facultative). Areas of RE 11.5.3 with a DTW greater than 20 m are considered unlikely to be a TGDE.

Figure 4-9 and **Figure 4-10** show the location of the vegetation communities in the context of the DTW.



Projection: GDA 1994 MGA Zone 55
 Scale: 1:70,000 at A4
 Project No.: 620.13593
 Date: 01-Mar-2023
 Drawn by: JG

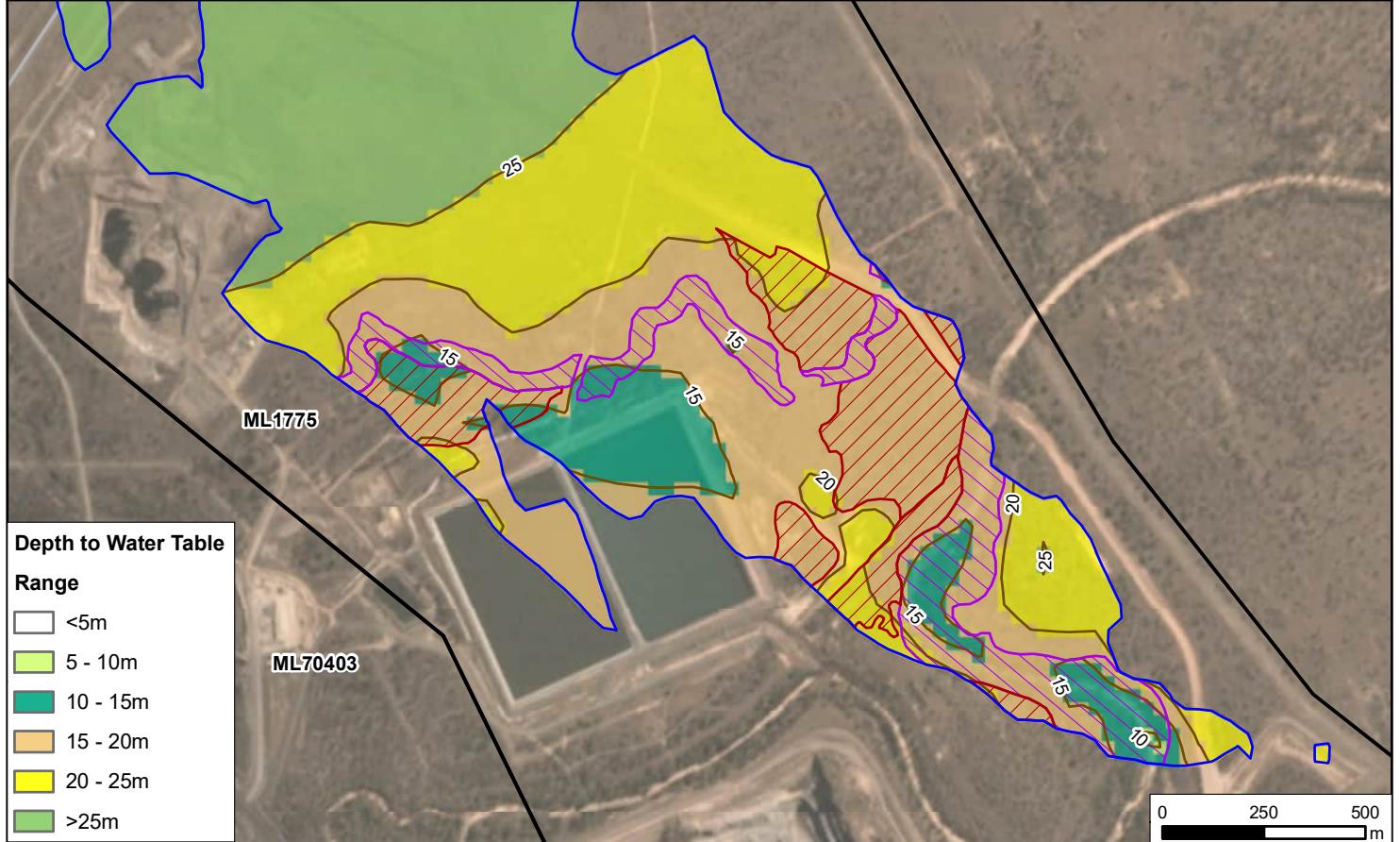
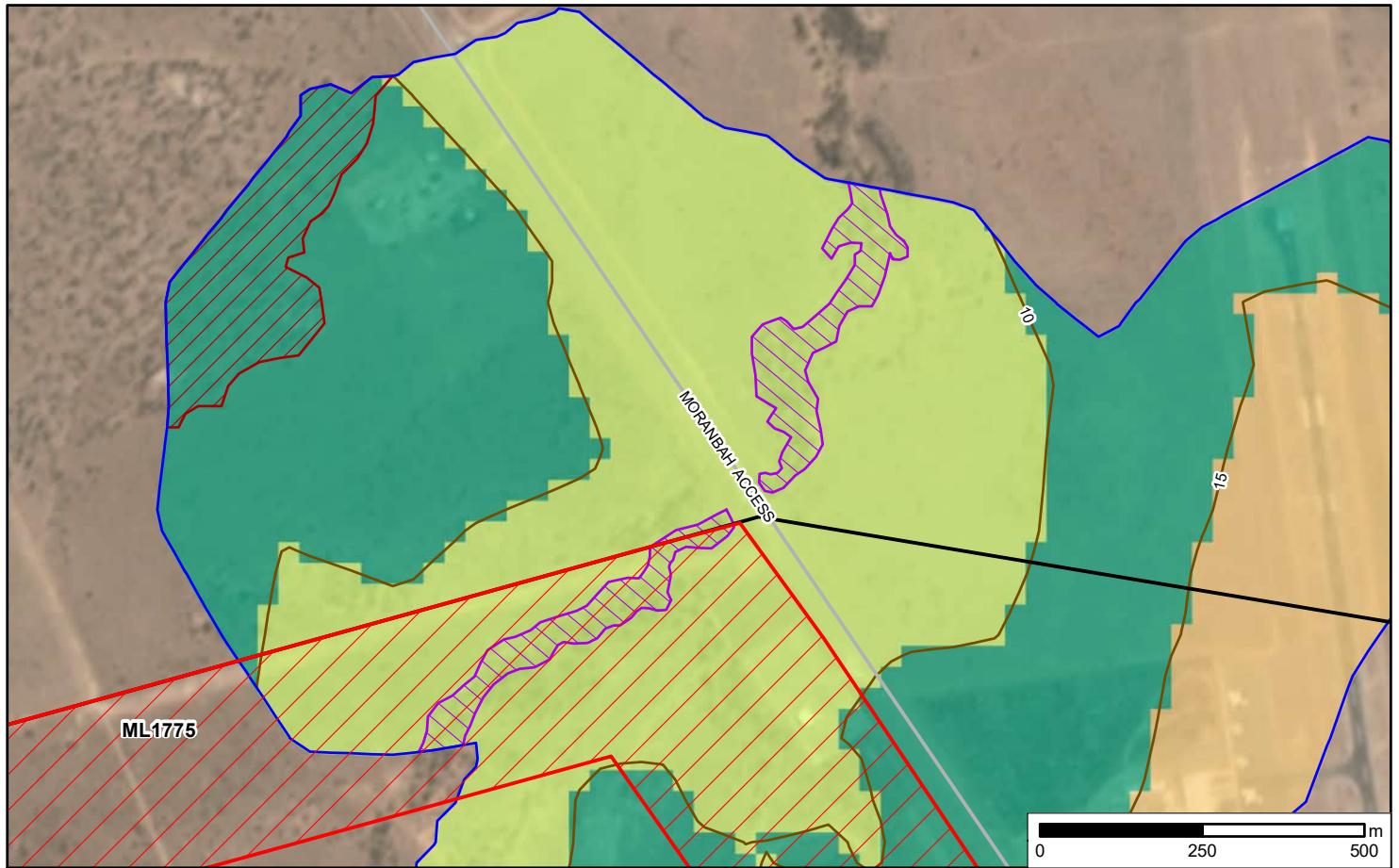
Predicted Drawdown Extent
Watercourses (Water Act 2000)
Drainage features
Project Area
BHP Tenements

Ground-truthed Terrestrial GDE
Vegetation Communities

- Communities on sandy depositional plains
- Riparian and floodplain communities

Horse Pit Extension Project
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(EPBC 2021/9031)

Overview of Depth to Water

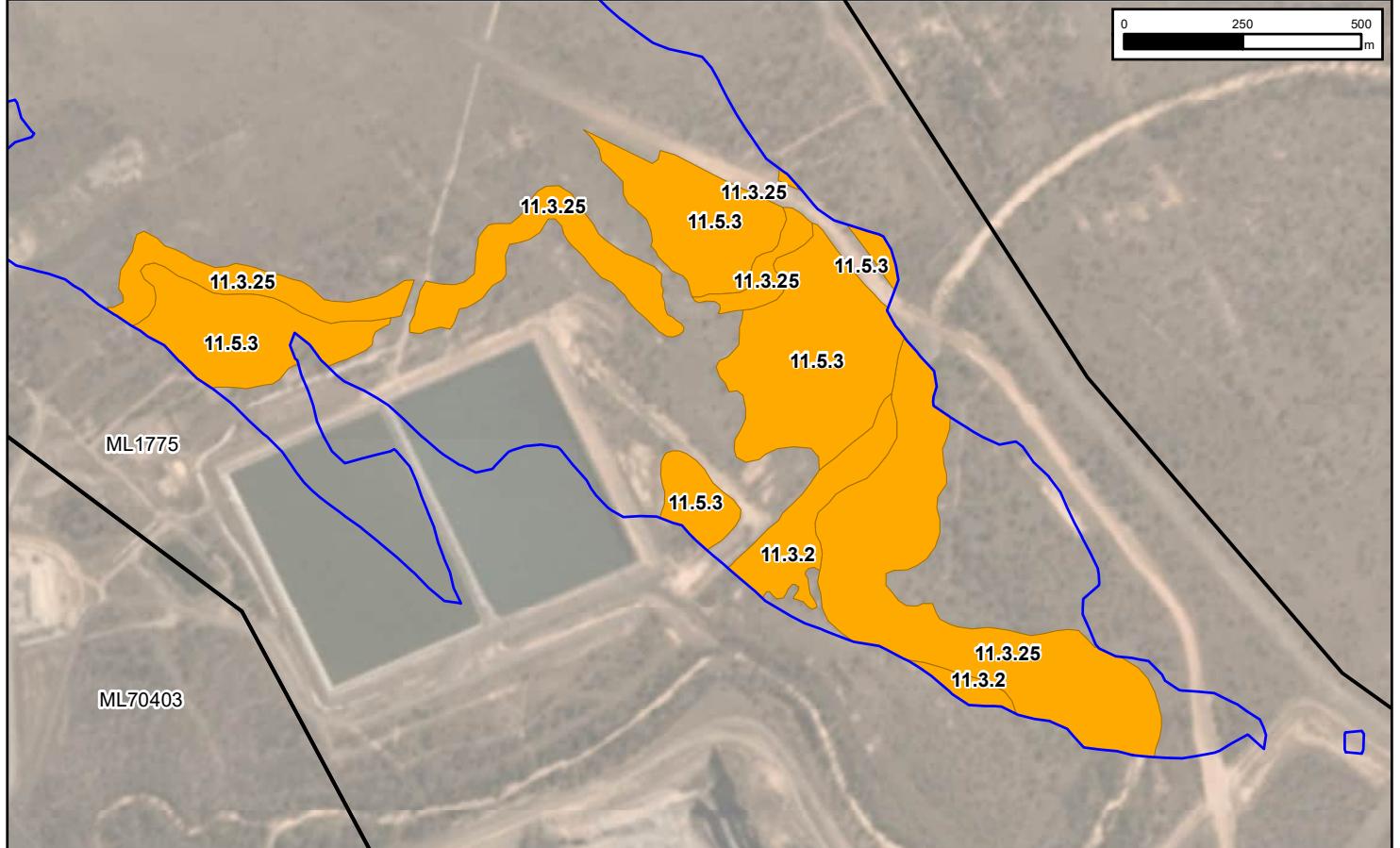
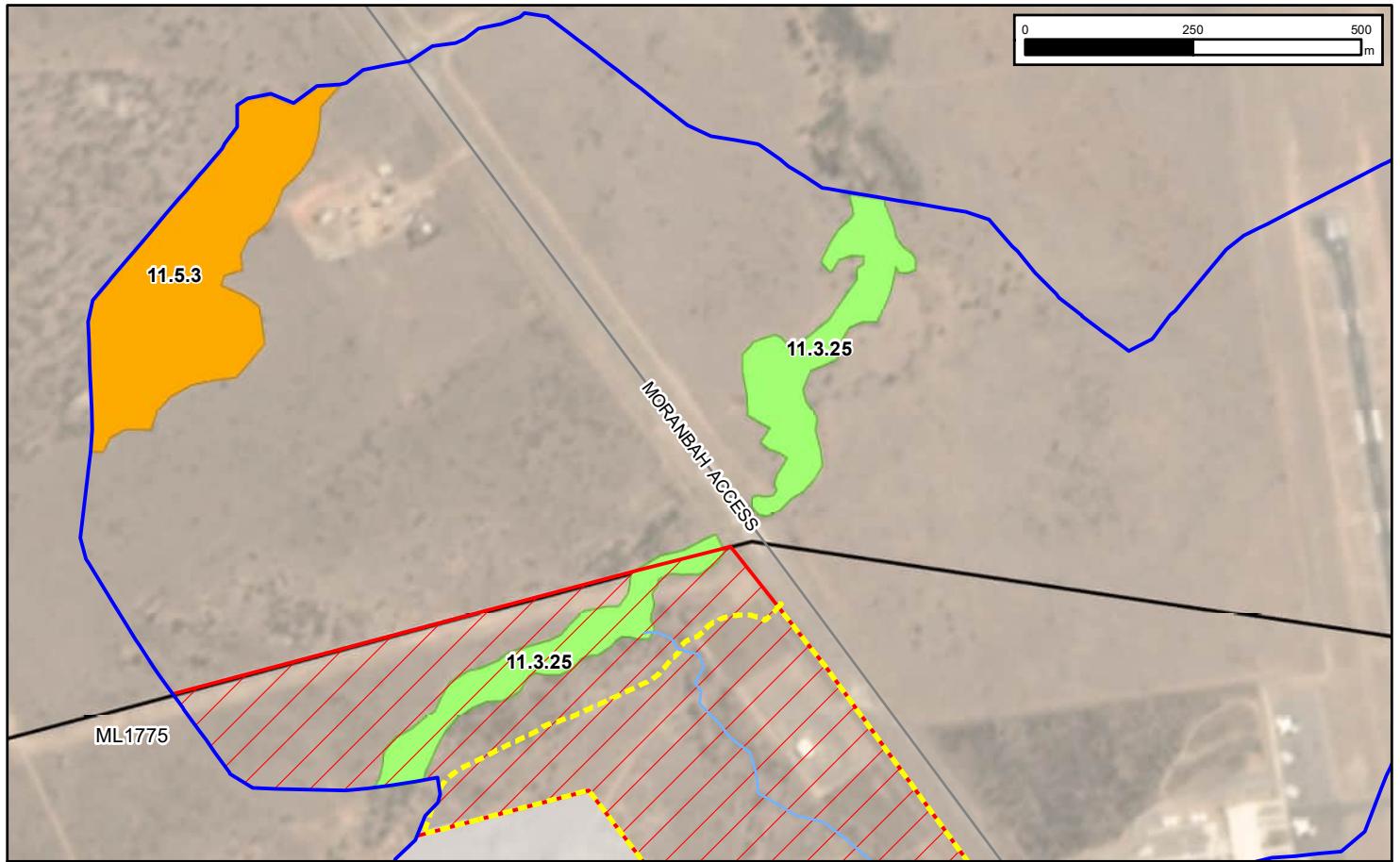


Projection: GDA 1994 MGA Zone 55
 Project No.: 620.13593
 Date: 01-Mar-2023
 Drawn by: JG

— Roads
 — Project Area
 — BHP Tenements
 — Predicted Drawdown Extent
 — Communities on sandy depositional plains
 — Riparian and floodplain communities

Horse Pit Extension Project
EPBC Act Preliminary Documentation
(EPBC 2021/9031)

Depth to Water in Relevant Potential Terrestrial GDE Areas



Projection: GDA 1994 MGA Zone 55

Scale: Various

Project No.: 620.13593

Date: 01-Mar-2023

Drawn by: JG

Road

Predicted Drawdown Extent

Project Area

Disturbance Footprint

BHP Tenements

Ground-truthed Terrestrial GDE

Likely

Possible

Horse Pit Extension Project EPBC Act Preliminary Documentation (EPBC 2021/9031)

Terrestrial GDE Likelihood based on
Depth to Water and Indicator Species

The extent of vegetation communities considered to be likely and possible TGDEs within the Predicted Drawdown Extent is depicted in **Figure 4-11**. In summary, of the vegetation communities assessed as part of the field survey, only small areas of riparian vegetation, comprising remnant and HVR RE 11.3.25 within the northern extent of the Predicted Drawdown Extent were considered likely to be a TGDE. Other remnant and HVR communities comprising RE 11.5.3, 11.3.2 and 11.3.25 within the southern extent of the Predicted Drawdown Extent were considered possible TGDEs, with DTW between 10 to 25 mbgl.

Based on available literature and current modelled groundwater table, all of the likely and possible TGDEs identified are considered to comprise facultative TGDE species, utilising groundwater when available however not dependent on access for ongoing persistence. All other vegetation within the Predicted Drawdown Extent were considered unlikely to be groundwater dependent.

A summary of vegetation communities (i.e. RE) identified as potential TGDEs, associated indicator species observed, and justification is provided in **Table 4-5**. In total, 6.21 ha of likely TGDEs and 64.88 ha of possible terrestrial were identified within the Predicted Drawdown Extent.

Table 4-5 *Summary of Potential TGDEs **

RE	Indicator Species	Area (ha)	TGDE likelihood and rationale
11.3.2	<i>Eucalyptus populnea</i>	0.78 HVR 3.85 Remnant	Possible TGDE (facultative) <ul style="list-style-type: none"> Mapped as low potential by GDE Atlas; and Modelled DTW between 15-25 mbgl.
11.3.25	<i>Eucalyptus camaldulensis</i> <i>E. populnea</i> <i>Melaleuca fluviatilis</i> <i>Casuarina cunninghamiana</i>	6.21 HVR 26.5 Remnant	Likely TGDE (facultative) <ul style="list-style-type: none"> Modelled DTW for 6.21 ha in northern area between 5-10 mbgl. Possible TGDE (facultative) <ul style="list-style-type: none"> Modelled DTW for 26.5 ha in southern area between 15-20 mbgl.
11.5.3	<i>Eucalyptus populnea</i>	9.28 HVR 28.52 Remnant	Possible TGDE (facultative) <ul style="list-style-type: none"> Modelled DTW for 34.06 ha between 15-25 mbgl; and Other areas of the community located where DTW modelled >20 m = unlikely GDE.

* Prior to further remote sensing analysis discussed in **Section 4.4.2.3**.

4.4.4.3 Remote sensing diagnostic criteria

The study reported in **Appendix E1** (and summarised above sections) considered where groundwater is available to plants for use (i.e., DTW) and if indicator species are present. The outcomes of that assessment identified three (3) vegetation communities considered to be likely or possible TGDE within the Predicted Drawdown Extent.

The remote sensing-based GEM approach has been used to identify potential TGDEs by contrasting relative 'greenness' and 'moisture status' of vegetation communities in wet and dry periods using remotely sensed data (**Appendix E1**). The approach is used to highlight particular landscape features using multi-spectral indices that relate to vegetation greenness and wetness. By considering these indices between known (using meteorological data) wet and dry periods, inferences can be made regarding those areas that appear to maintain greenness/wetness when surface runoff is unavailable (and vice versa).

The analysis can be summarised as follows:

- Selection of Landsat Enhanced Thematic Mapper (ETM) imagery from wet and dry periods using weather records and the Landsat ETM archive;
- Generate the Normalised Difference Vegetation Index (NDVI) and Normalised Difference Moisture Index (NDMI, also known as the Normalised Difference Wetness Index) for the images;
 - NDVI of vegetated areas will tend toward positive values whereas water, bare soil and built-up areas will have zero or negative values – this provides a regional image of where vegetation is located and where not;
 - NDMI provides an indication of vegetation water content;

- Combine the 'wet' image NDVI and NDMI with the 'dry' image NDVI and NDMI into a single 4 band image and reclassify to group areas of similar index values into classes/categories of likelihood. For example:
 - Where all indices for both wet and dry periods are positive the probability of TGDE presence is higher. The analyses suggests that during both wet and dry periods the vegetation maintains 'greenness' and 'wetness' so likely to have permanent or episodic access to groundwater;
 - Where the wetness indicator (NDMI) is negative during the dry period the analysis identifies that the vegetation is not maintaining wetness through the dry period and therefore unlikely to be accessing groundwater; and
 - Where GEM class data is negative, the result is less diagnostic and instead considered to be evidence contributing to the community being an unlikely TDGE.

As discussed in Section 3.1.2 of **Appendix E1**, the outcomes of the GEM analysis did not identify any TGDEs directly within the Predicted Drawdown Extent. However, it is noted that the spatial resolution is an important limitation to consider when using imagery and mapping. The Landsat data has a resolution of 30m pixels and as such the GEM class data derived following the index analyses also has a 30m pixel size. As such, narrow riparian corridors, such as those that are known to occur in the CVM region, and small wetland communities may not be identified. Recognising this limitation, the GEM analysis was explored further to consider if there are vegetation areas in the wider region that may be displaying likely TGDE values.

Figure 4-11 shows the positive GEM class data within the Predicted Drawdown Extent and surrounds.

The GEM output shows no positive GEM class areas within the Predicted Drawdown Extent, however on a regional scale there is a positive GEM class indication along the riparian areas of the Isaac River and Cherwell Creek. The regional ecosystem type in these riparian locations is 11.3.25, as a result all areas of 11.3.25 within the Predicted Drawdown Extent are categorised as likely TDGE. The remaining vegetation communities are considered unlikely TGDE as there is no indicators (using the GEM approach) to suggest there is permanent or episodic access to groundwater.

4.4.4.4 Summary of Results

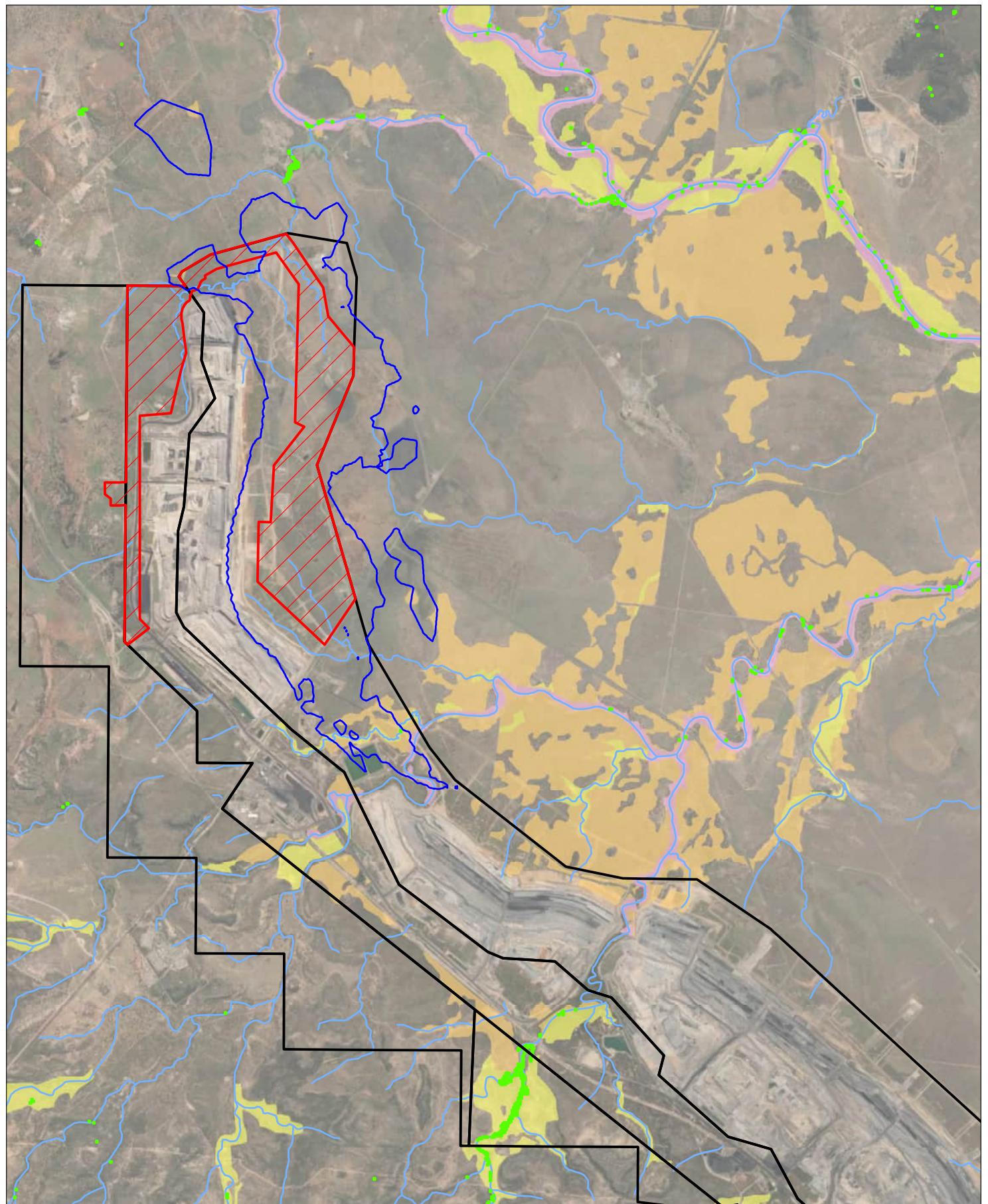
Assessment undertaken first considered the DTW and presence of TGDE indicator species within the known vegetation communities of the Predicted Drawdown Extent. The assessment highlighted three (3) communities meeting the criteria for 'likely' TGDE (areas of 11.3.25) and 'possible' GDE (areas of 11.3.2 and 11.5.3). Through additional analysis using remote sensing techniques it was determined that all areas of 11.3.25 should be considered likely TGDE with the remainder reclassified to unlikely based on the remote sensing criteria.

The total area of likely TGDE within the Predicted Drawdown Extent is 32.71 ha.

The likely TGDEs identified within the Project's Predicted Drawdown Extent (derived from the Project's groundwater model) are also consistent with other TGDEs identified within the Isaac River drainage sub-basin and surrounding landscape. TGDE assessments undertaken for the Olive Downs Coking Coal Project identified likely TGDEs (facultative) in association with riparian vegetation (RE 11.3.4 and RE 11.3.25) and aquatic habitats associated with the Isaac River (Pembroke Olive Downs Pty Ltd, 2019). These included terrestrial riparian vegetation (RE 11.3.25) associated with the North Creek, Cherwell Creek and the downstream reaches of Ripstone Creek (Pembroke Olive Downs Pty Ltd, 2019).

TGDE assessments undertaken for the Isaac Downs Project identified TGDEs in association with riparian communities along the Isaac River, comprising RE 11.3.25 (3D Environmental, 2019). These TGDE communities, located on the immediate fringing alluvial high bank of the River, were identified as interacting with the shallow groundwater in the alluvial aquifer (3D Environmental, 2019). Further back from the immediate River edge however, trees on the upper banks of the Isaac were considered likely to have no, or limited dependence on groundwater, and therefore have a low potential to be TGDEs (3D Environmental, 2019). Generally, the Isaac Downs Project assessment found that TGDEs are limited to deeper rooted eucalypt species along the immediately fringing riparian zone, within tens of metres of the River channel. There was no evidence of TGDEs outside this area. It is worth noting that the HPE Project's groundwater model does not predict any groundwater drawdown at the Isaac River where these TGDEs were identified.

Assessments for the Winchester South Project identified riparian vegetation associated with the Isaac River and Cherwell Creek (RE 11.3.25) had a moderate to high potential of being a TGDE, with any dependency on groundwater in the Quaternary alluvium likely to be facultative (Whitehaven Coal Pty Ltd, 2021). It was also concluded that the riparian vegetation surrounding these ephemeral wetlands (RE 11.3.27 and 11.3.3c) have a moderate potential of also being a TGDE, with any dependency on groundwater also likely to be facultative (Whitehaven Coal Pty Ltd, 2021). Some areas of vegetation associated with RE 11.5.3, but also with RE 11.3.2 and RE 11.3.4, were considered to have low potential of meeting the definition of a TGDE, due to the poor quality (high salinity) of the groundwater source (Whitehaven Coal Pty Ltd, 2021).



Projection: GDA 1994 MGA Zone 55

Scale: 1:97,248 at A4

Project No.: 620.13593

Date: 01-Mar-2023

Drawn by: JG

Predicted Drawdown Extent Positive GEM

Watercourses

Project Area

BHP Tenements

Regional Ecosystem

11.3.2

11.3.25

11.5.3

Horse Pit Extension Project
EPBC Act Preliminary Documentation
(EPBC 2021/9031)

Remote Sensing Diagnostic Output

4.4.5 Impact Assessment

Potential impacts to the likely TGDE within the Predicted Drawdown Extent as a result of the Project are related to:

- Direct disturbance – in the event vegetation clearing is required;
- Groundwater drawdown – specifically a reduced access to water at the root depth for some species within the communities present;
- Changes in groundwater quality – specifically if there is a spill event that leads to a contamination of groundwater; and
- Changes in surface water quality – noting the facultative nature of the indicator species identified, an event that leads to a deterioration of surface water quality also has potential to impact TGDE.

A formal risk assessment, detailing the likelihood of an impact occurring and the consequence associated with each impact to TGDEs has also been provided in **Appendix E2**. The risk assessment details potential impacts identified in the TGDE Report (E2M, 2021a). Based on the risk assessment outcomes, residual risk rating is ‘Low’ following application of appropriate management and mitigation measures. It should be noted that for most impact pathways, TGDE monitoring requires active management (including monitoring) from which mitigations can be adapted if impacts to TGDEs are identified which can be attributed either directly or indirectly to the Project.

4.4.5.1 Direct disturbance

No TGDEs as mapped by the National Groundwater Dependent Atlas are located within the Disturbance areas for the Project (refer to Figure 2 of **Appendix E1**). Furthermore, no likely (RE 11.3.25 along Horse Creek) or potential TGDEs (RE 11.3.2, 11.3.25 and 11.5.3) are located within the Disturbance Footprint and will require removal as a result of the Project (refer to Figure 5 of **Appendix E1**).

4.4.5.2 Potential Impact due to drawdown

The mining process reduces water levels in surrounding groundwater units due to interception of groundwater in the mined geology. To understand the potential impact the assessment has been undertaken to identify if the drawdown is likely to impact the maintenance of ecosystem function of the TGDE (i.e., impact to a supporting service, Section 5.2.1 of the *Significant impact guidelines 1.3: Coal seam gas and large coal mining developments – impacts on water resources* (DoE 2013). To determine this impact two (2) aspects have been considered:

- Are there areas of likely TGDE where predicted drawdown will result in movement of groundwater away from the vegetation root zone?
- If so, what is the context of the potential loss with regard to the functioning of the TGDE ecosystem?

A drawdown of any particular magnitude has potential to impact TGDEs differently based on the species present, the starting level of groundwater and the extent to which drawdown will move groundwater beyond the zone in which it is accessible to vegetation. The impact assessment focusses on understanding if the predicted drawdown reduces the accessibility of the water from the root zone for the applicable TGDE.

To consider the risk of impact the following criteria have been applied (**Table 4-6**).

Table 4-6 Risk of Impact Due to Drawdown

Drawdown depth	Risk of impact to GDE	Next steps
Groundwater level remains above root zone at maximum drawdown	No – TGDE unlikely to be impacted by drawdown; access to groundwater is maintained	Continue project with appropriate mitigation measures
Groundwater level remains within 1 m above root zone at max. drawdown	Potential – TGDE may be impacted by drawdown; access to groundwater may be affected	Implement adaptive monitoring over time to determine whether potential impacts arise
Groundwater level is below root zone at max. drawdown	Yes – TGDE likely to be impacted by drawdown; access to groundwater is compromised	Implement appropriate measures to address impacts. This may include further avoidance or mitigation and/or offsets

Section 4.4.4 identifies 32.71 ha of likely TGDE (RE 11.3.25) within the Predicted Drawdown Extent. The indicator species identified for 11.3.25 include *Eucalyptus camaldulensis*, *E. populnea*, *Melaleuca fluviatilis* and *Casuarina cunninghamiana*. Outcomes of the literature review led to an assumption that the root zone of *E. camaldulensis* and *E. populnea* is up to approximately 23 mbgl (for the purposes of this assessment within the 20-25 mbgl range).

The impact assessment documented in Section 6.1 of **Appendix E1** tabulated the extent to which the predicted drawdown would increase the DTW beyond the threshold of root depth for the indicator species. When considering the additional assessment described in **Section 4.4.4.3** accounting for more detailed remote sensing interpretation, a revised impact table is shown below (with reference to the criteria shown in **Table 4-7**). Of the total area of likely TGDE, only 15.91 ha is located within an area where the TGDE is considered at risk (i.e. drawdown may reduce access to the root zone of vegetation).

Table 4-7 Extent of Potential Impact to Likely TGDE due to Predicted Drawdown

Current depth to groundwater	Modelled drawdown	New maximum predicted DTW	Potential impacts to likely TGDE
5 – 10 mbgl	2 m (1-2 m)	7 – 12 mbgl	No – access to groundwater is maintained
	5 m (2-5 m)	10 – 15 mbgl	No – access to groundwater is maintained
	10 m (5-10 m)	15 – 20 mbgl	No – access to groundwater is maintained
	20 m (10-20 m)	25 – 30 mbgl	Yes - 0.63 ha of vegetation affected
	50 m (20-50 m)	55 – 60 mbgl	Yes - 1.18 ha of vegetation affected
10 – 15 mbgl	2 m (1-2 m)	12 – 17 mbgl	No – access to groundwater is maintained
	5 m (2-5 m)	15 – 20 mbgl	No – access to groundwater is maintained
	10 m (5-10 m)	20 – 25 mbgl	Potential - 1.0 ha of vegetation potentially affected
	20 m (10-20 m)	30 – 35 mbgl	Yes - 0.06 ha of vegetation affected
	50 m (20-50 m)	60 – 65 mbgl	No likely GDEs occur within this existing depth to groundwater
15 – 20 mbgl	2 m (1-2 m)	17 – 22 mbgl	No – access to groundwater is maintained
	5 m (2-5 m)	20 – 25 mbgl	Potential - 7.12 ha of vegetation potentially affected
	10 m (5-10 m)	25 – 30 mbgl	Yes - 2.68 ha of vegetation affected
	20 m (10-20 m)	35 – 40 mbgl	Yes - 2.94 ha of vegetation affected
	50 m (20-50 m)	65 – 70 mbgl	No likely GDEs occur within this existing depth to groundwater
20 – 25 mbgl	2 m	22 – 27 mbgl	Potential – 0.3 ha of vegetation potentially affected
	5 m	25 – 30 mbgl	No likely GDEs occur within this existing depth to groundwater
	10 m	20 – 35 mbgl	No likely GDEs occur within this existing depth to groundwater
	20 m	40 – 45 mbgl	No likely GDEs occur within this existing depth to groundwater
	50 m	70 – 75 mbgl	No likely GDEs occur within this existing depth to groundwater

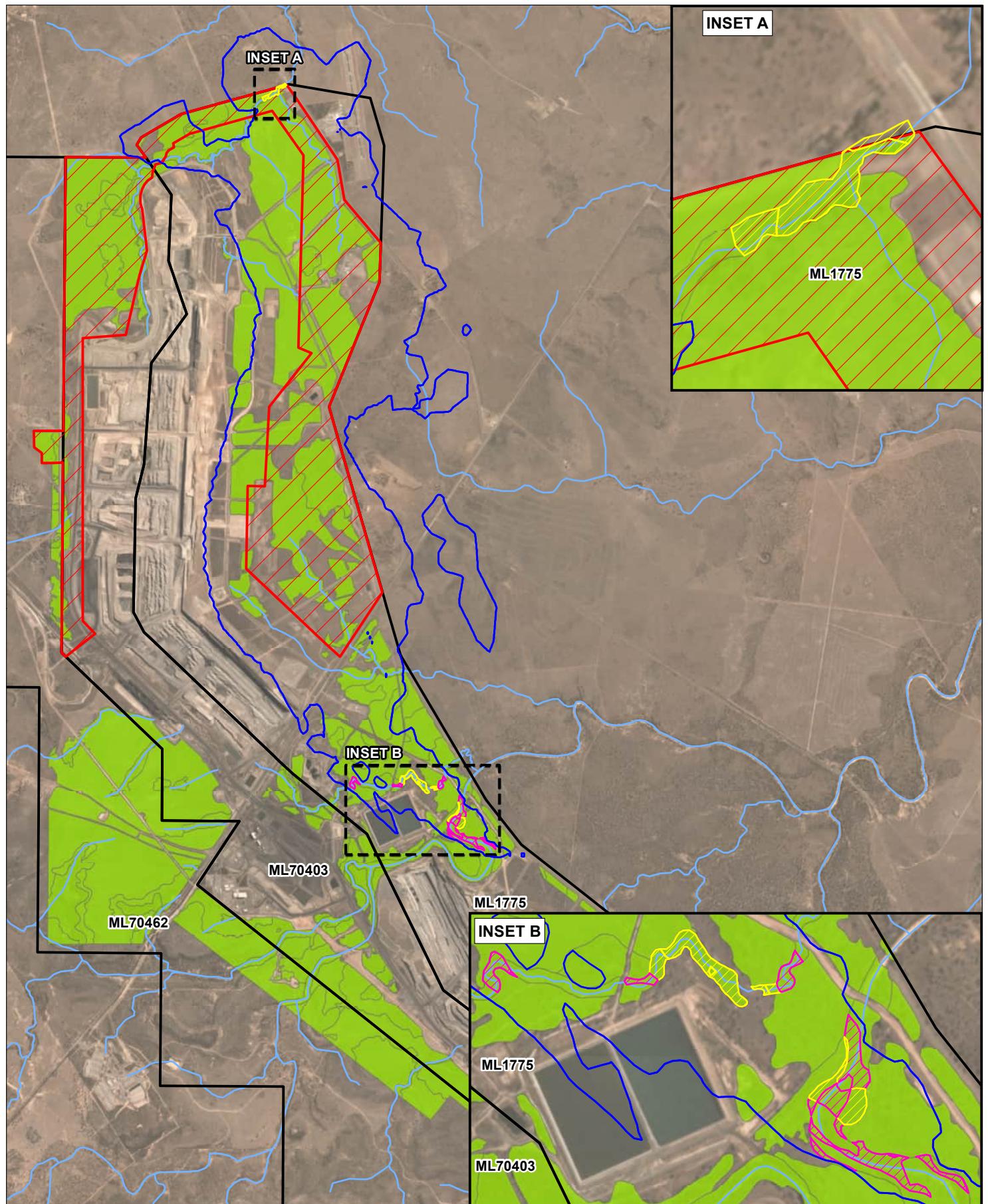
While the indicator species in this vegetation community may experience an increased depth to the groundwater as a result of the Project, it should also be acknowledged that these communities are considered facultative. The total extent of potential and likely impacts to TGDEs is:

- The total area of likely TGDE where drawdown is considered to potentially impact the community is 8.42 ha (drawdown predicted to maintain within 1 m above root zone at maximum drawdown); and
- The total area of likely TGDE where drawdown is considered likely to impact the community is 7.49 ha (drawdown predicted reduce groundwater level below the root zone at maximum drawdown).

These potential and likely impact areas are outline on **Figure 4-12**.

Ecological assessment confirmed there is no vegetation within the Predicted Drawdown Extent that meets the condition threshold for Poplar Box TEC and as such, no assessment of impact of predicted drawdown is required. Details of the assessment for potential Poplar Box TEC against the condition thresholds is provided under **Section 3.3.4**.

As identified by the IESC, while a number of potential impacts to TGDEs were discussed within the Horse Pit Extension Project Groundwater Dependent Ecosystems Report (E2M, 2021a) (TGDE Report), other potential impacts to other possible TGDEs further downstream may result from the Project (i.e. outside of the Predicted Drawdown Extent). As described in methods section (section 2) of the TGDE Report (E2M Pty Ltd (E2M), 2021a), a larger area was assessed based on the Preliminary Drawdown Area. The Preliminary Drawdown Area was derived from initial conservative coarse groundwater modelling prior to the development of the Project's groundwater assessment, as a means to identify an initial area from which to design targeted investigation programs within the Project's groundwater and ecological assessments, based on potential environmental risk. That is, identification of the Preliminary Drawdown Area early in the Project's assessments is entirely consistent with the IESC Guideline approach regarding the risk assessment process should be commenced at an early stage of the proposed project as the progressive results provide important inputs to other stages of the environmental assessment process. Following the development of the Project's groundwater assessment and groundwater modelling, a refined, higher confidence Predicted Drawdown Extent was identified and used for the final assessments. The initial area assessed as part of the field surveys (i.e. the Preliminary Drawdown Area) was then revised based on the modelled groundwater drawdown extent (i.e. the Predicted Drawdown Extent). Based on this information, riparian communities located outside of the Predicted Drawdown Extent assessed in the TGDE Project, are also likely to contain TGDEs (facultative) and have the potential to be subject to impacts resulting from the Project (e.g. reduced surface water quality).



Projection: GDA 1994 MGA Zone 55

Scale: 1:9,000 at A4

Project No.: 620.13593

Date: 01-Mar-2023

Drawn by: JG

— Predicted Drawdown

— Watercourses

■ Project

■ BHP Tenements

■ Likely Impact to

■ Potential Impact to

■ GTRE Mapping

Horse Pit Extension Project
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**Potential and Likely
Terrestrial GDE Impact Areas**



4.4.5.3 Potential impact due to changes in groundwater quality

Section 6.3 of **Appendix E1** identifies the potential impact of a change in groundwater quality to likely TGDEs.

Leaks, spills and improper disposal of wastes, including waste rock can lead to the leaching of compounds into the groundwater following rainfall events. Contamination of groundwater can impact the condition and health of TGDEs as they access this water source in the root zone.

4.4.5.4 Potential impact due to changes in surface water quality and flows

Sources of surface water potential impact to TGDEs include:

- Erosion and sedimentation;
- Reduced quality of surface water, including accidental and controlled releases from identified release points (i.e. Cherwell Creek); and
- Changes to hydrological flows affecting groundwater recharge and subsequent groundwater availability for TGDEs.

Erosion and Sedimentation

Section 6.2 of **Appendix E1** describes the potential impacts of a reduced surface water quality through erosion and sedimentation, to likely TGDEs. Where vegetation clearing occurs on floodplains and near drainage lines, erosion can lead to sedimentation of waterways, potentially degrading downstream aquatic and riparian habitats, some of which have been identified by this study as possible or likely TGDEs. This indirect impact has potential to occur during early stages of the Project when land disturbance commences.

Existing CVM ESC controls to mitigate potential surface water impacts will continue to be implemented to protect surface water quality and the downstream environments. It is a requirement of the EA that ESC structures are developed, installed and operated for all stages of mining activities on the site to minimise erosion and the release of sediment to receiving waters. As described in **Section 4.3.3** each catchment area is delineated, assessed for risk level and infrastructure designed accordingly to manage both ESC and MAW water capture and treatment.

The regional catchment has been monitored as part of the REMP with monitoring to continue for the Horse Pit Extension. The year 2021 REMP (Gauge, 2021) monitoring undertaken for the current operating site included historical analysis of flows back till 2015. Water quality data was analysed to determine if changes downstream of mining were within limits as defined by the Queensland Water Quality Guidelines 2009. The analysis found that "for analytes where the concentration increased downstream, the median was either within the upstream 80th percentile considered acceptable for slightly-to-moderately disturbed systems, or below applicable environmental protection guidelines or the current EA trigger value. The only minor exception was that turbidity was moderately higher downstream in Cherwell Creek. The increase did not extend regionally to the Isaac River and was based on only five (5) samples. There is no indication of risk to the environment and the related parameter, Total Suspended Solids was within acceptable limits.

Uncontrolled releases

Uncontrolled releases related primarily to accidental releases of contaminants (spills or leaks etc) or uncontrolled releases of ESC water from containment structures.

The accidental release of contaminants, including leaks or spills of hydrocarbon-based fluids from heavy machinery, uncontrolled spills of MAW or ESC water and spread of coal dust, has the potential to impact riparian and aquatic environments, including TGDEs. Contaminants can be introduced into waterways from surface flows during high rainfall events and uncontrolled releases, potentially impacting TGDEs and aquatic habitats further downstream (**Figure 4-13**). Multiple contamination events may lead to an accumulation of chemicals/compounds within the alluvial sediments, leaching into the alluvial aquifers and tertiary groundwater, impacting vegetation condition and habitat (Boulton et al., 2003) (**Figure 4-14**).

As detailed within the Surface Water Impact Assessment Report (**Appendix G**), existing CVM controls to mitigate potential surface water impacts will continue to be implemented to protect surface water quality and the downstream environments. This includes existing CVM surface water management measures and infrastructure

designs (e.g. water separation and bunding/storage rules) to minimise the risk of uncontrolled releases from site occurring. Based on the control measures and monitoring that occurs for the existing authorised activities and that the Project will continue to implement those approaches, the risk of adverse impacts to the water quality of Horse Creek, Cherwell Creek and the Isaac River downstream of the Project is considered negligible. These controls include:

- Appropriate ESC measures will be established (in accordance with industry standards and guidelines) as required to reduce the amount of runoff from disturbed areas, and hence accumulation of sediment in water managed onsite or redirected off-site.
- Bunding and appropriate storage of fuels and other hazardous and flammable materials will be undertaken in accordance with AS1940:2004, and where practical, will be located away from any waterbodies.
- Sediment dams, pit water storage and other water management structures (e.g. bunds and drains) will be designed and operated in accordance with BMA's standards and within the current framework specified in the existing Mine WMP – aiming to manage water levels and minimise risk of uncontrolled releases to waterways.
- The Project's water management will be based on the separation and management of clean and MAW catchments.
- Runoff from disturbed areas within the Project site will be diverted to sediment dams for treatment, and possible reuse for dust suppression and process water requirements. This reuse also allows for water levels to be managed, minimising the risk of uncontrolled releases to waterways.
- The current REMP and associated water quality monitoring program will be continued. The program is designed to ensure the CVM WMP is effective, to demonstrate compliance with the CVMs strict discharge limits, and to ensure the downstream water quality (physico-chemical parameters, at a minimum) is not being adversely impacted.
- Fuel, dangerous goods and hazardous chemicals will be managed as outlined by current standards, guidelines and in compliance with statutory requirements.
- The existing SOP for spills and emergency response procedures will continue to be utilised. Spill recovery and containment equipment will be available when working adjacent to sensitive drainage paths and within other areas, such as workshops.
- Water quality monitoring will be conducted as part of the Project's EA conditions and in accordance with the REMP providing an opportunity for adaptive management approaches to be implemented where required.

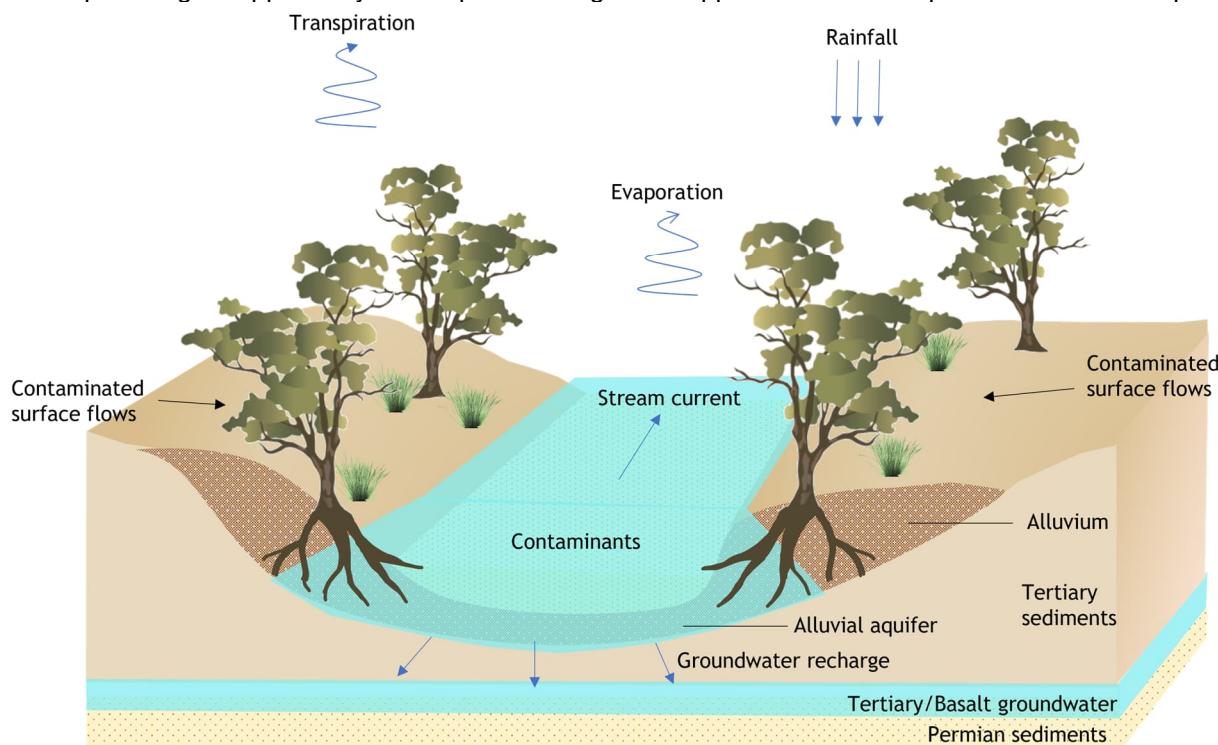


Figure 4-13 TGDEs and potential impact pathways of contaminated surface flows during 'wet season' conditions

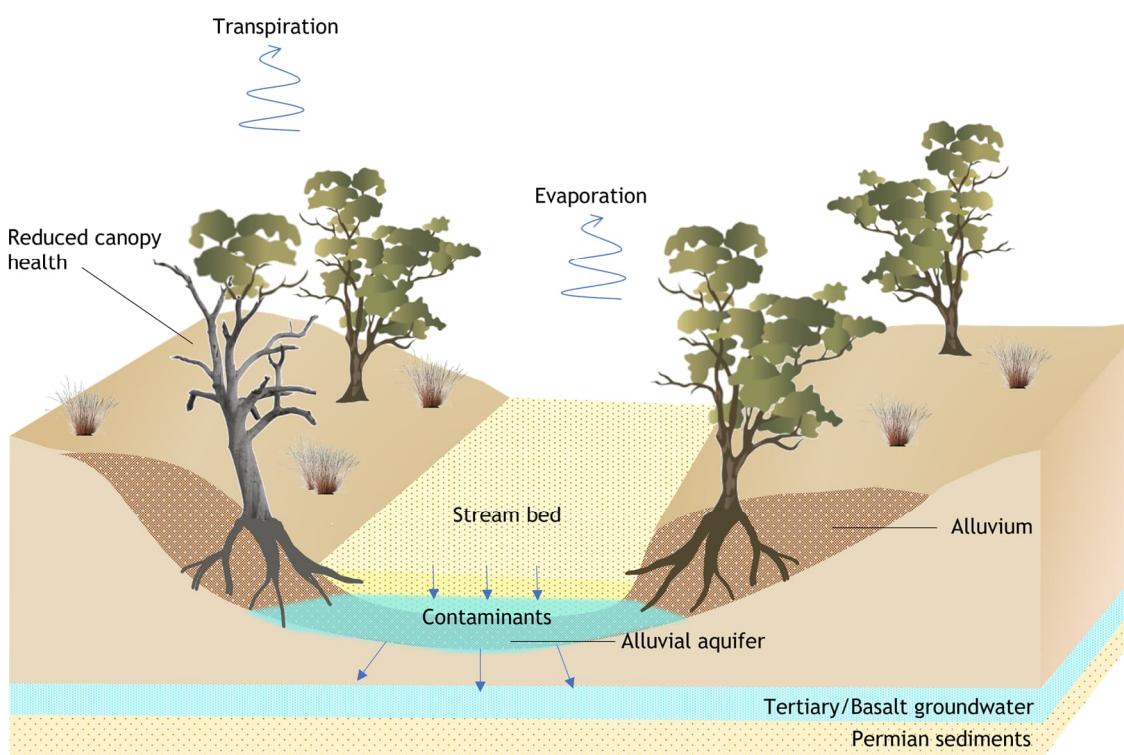


Figure 4-14 TGDEs and potential impacts from contaminated surface flows

Controlled release

Controlled releases will be made in accordance with the current EA release criteria. Criteria require that the release of MAW must only take place from a specific location, during periods of natural flow events with minimum flow requirements ($>3\text{m}^3/\text{s}$ for downstream in the Isaac River and $>0.5\text{m}^3/\text{s}$ at a specified location upstream of the authorised release point on Cherwell Creek) and when quality characteristics are appropriate (specified thresholds for electrical conductivity and pH).

Release criteria were developed as part of the CVM Environmental Impact Statement approval process when the EA was issued by the Queensland DES. The criteria are based on analysis of background data, an understanding of the local and regional catchment characteristics, and an understanding of the other activities within the catchment (in particular any release criteria of other mining activities). As detailed within the Surface Water Impact Assessment Report (**Appendix G**), the existing CVM surface water management measures are suitable to mitigate potential water quality impacts from controlled releases of water to receiving waters. As such, potential impacts to aquatic environments and TGDEs at release points are considered minimal.

Change to hydrological flows

Changes to the volume and direction of surface flows associated with the Project may impact the hydrological regimes, including groundwater recharge, associated with Cherwell, Caval and Horse creeks. While potential impacts during significant rainfall events may not be readily identified, a redirection or a reduction in surface flows may lower the recharge of alluvial aquifers within the Project Area and further downstream. A reduction in the groundwater available may result in reduced vigour and condition of TGDE indicator species (e.g. *Eucalyptus camaldulensis*, *E. populnea*), particularly during dry season conditions and prolonged drought.

Analysis of the potential impact of this reduced catchment on flow frequency and duration, was undertaken through scaling of available flow gauge data (refer to **Appendix G** Surface Water Impact Assessment Report). Results of this assessment indicated only minor changes to the occurrences of higher or medium flows, with almost no change to the spell durations. The analysis undertaken was also considered conservative and did not account for controlled releases and overflows from the Projects clean water and sediment dams. Provided normal hydrological function of the watercourses are maintained, allowing recharge of associated underlying alluvial aquifers, potential

impacts to TGDEs are likely to be minor. As such, the Project is considered unlikely to cause changes to the flow regime that would result in impacts to TGDEs within the Project area or further downstream.

4.4.5.5 Summary and Significance of Potential Impact to TGDE

The outcomes of the assessment of impacts identified:

- TGDE are the only type of GDEs identified within the Predicted Drawdown Extent.
- Areas of likely TGDE that may be impacted as a result of groundwater drawdown (associated with areas of RE 11.3.25). This included 7.49 ha of vegetation likely impacted, and 8.42 ha of vegetation categorised as potentially impacted. Only two (2) areas of the Predicted Drawdown Extent contain the potential TGDEs: in the north along Horse Creek, and in the south associated with Caval and Cherwell creeks (**Figure 4-12**).
- Within the Predicted Drawdown Extent, RE 11.3.25 is comprised of *Eucalyptus camaldulensis* woodlands occurring along riparian corridors. Associated species within the community include *E. populnea*, *Melaleuca fluviatilis*, *Casuarina cunninghamiana*, *Lysiphyllo hookeri* and *Acacia salicina*. The community is in a moderate condition across the Predicted Drawdown Extent, with some evidence of non-native plant cover, which decreases native species diversity in the ground layer. RE 11.3.25 as a community that generally provides preferred habitat for koala and squatter pigeon, although neither of the species were recorded.
- Potential impacts to groundwater and surface water quality as a result of mining activities that require management to avoid a possible indirect impact to health and condition of TGDE vegetation.

Overall, the extent of likely TGDE that is potentially impacted is small (total 15.91 ha, with only 7.49 ha likely to be impacted). The total loss of ecosystem function of this small area represents the worst-case scenario of the extent of impacts. In addition, when considering the small extent in combination with the facultative nature of the species/communities the impact to TGDE as a result of the Project is not considered significant.

The likely TGDE is facultative, and species may not necessarily be adversely impacted by a change in the depth to groundwater. In the case of facultative communities, groundwater drawdown is likely to have minimal impacts on vegetation resulting in a small decline in vegetation characteristics such as canopy cover and height during drier years, rather than total loss. Such impacts may only be visible during periods of drought when several successive years of below average rainfall occur. While the condition of vegetation may deteriorate slightly overall for some periods, a functional vegetation community remains. As a precaution, monitoring will be undertaken to identify the nature of an impact (should it be realised) and facilitate application of targeted management.

5 Avoidance, Mitigation and Management Measures

This section outlines avoidance, mitigation and management measures existing and proposed at the CVM. In addition, the following existing management plans have been attached under **Appendix O** as required by **Appendix A**:

- Land and Biodiversity Management (the CVM-PLN-0021);
- Weed and Feral Animal Management Plan (BHP-PRO-0001. 2019);
- Threatened Flora and Fauna and Ecological Communities Management Plan (the CVM-PLN-0019);
- Water Management Plan (the CVM-PLN-0009); and
- Erosion and Sediment Control Plan (the CVM-PRO-0043).

The CVM management plans are updated periodically as required, and where relevant plans would be updated to reflect requirement of the Project.

5.1 Avoidance Measures

5.1.1 Minimise Disturbance Footprint

Significant mine engineering design has been undertaken in the development of the finalised Disturbance Footprint. The Project location is defined by the nature and scale of the coal deposit. As such, it is constrained by resource, geographic, existing infrastructure and feasibility considerations. Where possible, utilisation of the existing CVM infrastructure has been incorporated into the Project design to minimise the need for additional disturbance. Existing CVM infrastructure utilised for the Project include:

- Main run-of-mine (ROM) and Horse Pit ROM coal stockpiles;
- Coal Handling and Processing Plant (CHPP) complex and product coal stockpiles;
- Conveyor that transports coal from Peak Downs Mine to the CVM CHPP;
- Train Load-out Facility, stockpiles and rail spur;
- In Pit Spoil Dumps;
- Haul roads; and
- Exploration infrastructure.

While existing infrastructure will be utilised where possible, construction and relocation of new facilities and infrastructure will be required as part of the Project. Where possible, this infrastructure has been positioned to minimise impacts to ecological values; however it is constrained by necessary proximity to existing infrastructure and the mining tenement.

The following refinements to the mine design have also been considered to minimise impacts to terrestrial ecological values over the duration of the Project:

- The spoil dumping strategy seeks to backfill the void where possible to reduce the final void area and minimise additional disturbance to the surrounding vegetation/habitat;
- Land clearing and topsoil removal will be progressive over the duration of the Project;
- Mined out areas to the west are to be progressively backfilled and rehabilitated; and
- Stockpiling topsoil from disturbed areas for storage and use in future rehabilitation of the site.

All Significant residual impacts to MNES and MSES will be offset in accordance with the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (EPBC Act EOP) (Department of Sustainability, Environment, Water, Population and Communities (SEWPaC), 2012) and the Queensland Environmental Offsets Act 2014. The suitability of potential offsets for MNES are informed by the key overarching principles outlined within Section 3 of the EPBC Act EOP. Similarly, suitability of offsets for MSES are based on seven (7) key principles under section 1.3 of the Queensland Environmental offset Policy (Department of Environment and Science (DES), 2022). The suitability of the offset areas for target MNES and MSES within the Croydon and Inderi properties are assessed against these principles within the Horse Pit Extension Project Environmental Offset Strategy (E2M, 2022).

The mining of coal is constrained by the location of the resource, so as such avoidance of all impacts resulting from the Project is not feasible. However, other Project elements have been designed to avoid areas of ecological value, including MNES. In addition, design has limited the overall footprint of the Project (to the extent that is reasonable and practicable) by utilising existing infrastructure and access roads to avoid unnecessary disturbance.

Avoidance measures achieved a significant reduction in clearing of MNES habitat. The Project will avoid a total of 8.04 ha of suitable habitat for king bluegrass and a total of 146.19 ha of habitat for squatter pigeon (comprising 19.3 ha of preferred habitat and 126.89 ha of suitable habitat).

5.2 Mitigation and Management Measures

Potential impacts have been identified relating to threatened species, groundwater, surface water and TGDEs. There are no TEC present that will be directly or indirectly impacted. To minimise the scale of impacts, a variety of mitigation measures have been developed or are already standard practice at the CVM. The following subsections provide an overview of the timing, frequency and duration of the proposed avoidance, mitigation and management and monitoring measures, and corrective actions to be implemented.

5.2.1 Threatened Species and Communities

5.2.1.1 Fauna injury and mortality

Construction and operational activities have the potential to lead to increased risk of injury or mortality to ornamental snake and squatter pigeon. Vehicles and machinery can cause injury or mortality if individuals are struck. Similarly, these species may be unable to disperse away from areas under active clearing and are particularly susceptible to injury or mortality.

A spotter-catcher will be available prior to and during all clearing activities, for the life of the Project. The spotter-catcher will be responsible for the identification, relocation and management of impacted fauna detected during clearing activity, with the authority to cease work where MNES species individual/s, such as the ornamental snake, are directly at risk of being injured or killed. Spotter-catchers are standard industry practice during clearing activities, and are highly effective at minimising harm to impacted fauna.

Other mitigation measures to avoid fauna mortality on internal roads include speed reduction measures, particularly within areas traversing or adjacent to known threatened fauna habitat. Speed reduction measures are currently implemented at CVM and will continue to be adhered to for the life of the Project. These measures are effective in reducing vehicle speed, and include the provision of fauna crossing signs to warn drivers and speed reduction measures (i.e. speed humps), where practical.

Mitigation measures for fauna injury and mortality will be detailed within the CVM Threatened Flora, Fauna and Ecological Communities Management Plan.

5.2.1.2 Habitat degradation and edge effects

Construction activities and vegetation removal have the potential to result in degradation of adjacent (edge effects) and downstream habitats. Edge effects occur where vegetation communities and habitat are subject to distinct ecotones, particularly those associated with vegetation clearing and active mine operations, resulting in changes in vegetation/habitat composition, and quality (Laurance & Yensen, 1991). Indirect influences associated with edge effects can include exposure to weeds, noise, light, dust, reduced foraging resources and species assemblages (Laurance & Yensen, 1991). Prolonged exposure to edge effects can degrade or reduce the quality of habitat.

As habitat within the Project Area and surrounds is largely fragmented and subject to indirect impacts associated with the existing mine, edge effects are likely to be currently present within the MNES habitat areas. The Project is considered unlikely to introduce any new edge effects to remaining vegetation and habitat, although relative intensities may change due to proximity to the Project disturbance footprint. The following sections provide further details relating to the mitigation of potential edge effects on avoided MNES habitat areas.

5.2.1.3 Introduction and spread of weeds and feral animals

Current weed management protocols and procedures for the CVM that will be implemented for the life of the Project are detailed within the Weed and Feral Animal Management (BHP-PRO-0001. 2019). These protocols and procedures have been highly effective in the control of both weed and feral animals. Mitigation measures detailed within the plan include:

- Vehicle hygiene:
 - all vehicles, machinery and equipment shall be cleaned at designated wash down bays/pads prior to entering vegetation communities;
 - no vehicles are to drive over topsoil stockpiles;
 - vehicles are to remain on existing access tracks and avoid driving over weed populations;
- Disturbance and topsoil management:
 - all rehabilitation amendments (e.g., seed, straw and hay) brought to site will be declared weed free and recorded in the site's document management system;
 - movement of sand, gravel, rock, soil and organic matter must be controlled to ensure that it does not result in contamination by weed seeds;
- Weed monitoring, treatment and reporting:
 - conduct quarterly weed monitoring of disturbed areas to identify new weed outbreaks as well as verify the effectiveness of ongoing weed management controls;
 - weed treatment chemical controls and herbicide application rates are conducted by an appropriately licensed person using the Department of Agriculture and Fisheries declared pest species fact sheet;
 - infestations will be recorded using GIS/mapping to ensure effective management can be achieved;
 - weed material disposed appropriately;
- Feral animals:
 - a feral animal control program will continue to be implemented when monitoring confirms there is an increasing trend in population (e.g., increase in the number of sightings), there is evidence feral animals are impacting on threatened species or neighbouring landholders raise valid concerns in regard to feral animals;
 - feral animal monitoring will reflect suitable survey locations such as water sources (pigs) or crib huts (cats), suitable time of day (e.g. diurnal/nocturnal species) and the location of indirect sign of feral animal activity (e.g., scats, diggings);
 - feral cat and pig populations will be controlled using traps in accordance with the existing BHP Weed and Feral Animal Management procedure; and
 - feral dog and pig populations will be controlled using poison baits in accordance with the existing BHP Weed and Feral Animal Management procedure.

5.2.1.4 Erosion and sediment control

Best practice ESC measures will be implemented at the commencement of land disturbance during the Project. These measures are widely used throughout the mining industry and aim to reduce the amount of sediment laden run-off entering downstream environments and potentially impacting ornamental snake and squatter pigeon habitat. ESC measures in place at the CVM and to be adhered to during the life of the Project include:

- Minimisation of the surface disturbance areas (as described in **Section 5.1**);
- Application of local temporary erosion control measures (as operations require during land disturbance activities);
- Run-off from undisturbed areas to be collected and diverted around surface disturbance areas; and
- Direct surface water run-off from surface disturbance areas to be diverted to sediment dams prior to release from the Project Area (where temporary measures are likely to be ineffective).

5.2.1.5 Proliferation of noise, light and dust

Construction and operational activities can disrupt local roosting, breeding and foraging activities of ornamental snake and squatter pigeon as a result of increased exposure to artificial lighting, noise and vibration. Artificial lighting poses risks to ornamental snake and squatter pigeon, as increased light allows predators to locate prey more easily. Additionally, noise and vibration can also lead to increased predation of some species, as it makes it harder for prey to detect approaching predators.

Excessive dust deposition on foliage can cause impacts to vegetation, including reducing photosynthetic processes, respiration, transpiration, health and growth rates. Potential dust impacts on vegetation are concentrated near dust sources such as haul roads and areas with active mine pits and stockpile as a result of construction/operation activities and vehicle and heavy machinery.

The following mitigation measures will be implemented throughout the life of the Project to minimise indirect impacts associated with dust, noise and light:

- Dust suppression on haul and light vehicle roads using water trucks;
- Restrict land disturbance to what is necessary for the construction and operation of the Project, and minimise area of land disturbed at any one time;
- Progressive rehabilitation to occur as areas become available;
- Regular maintenance of machinery and plant will be undertaken to minimise unnecessary noise;
- Where artificial lighting is required, directional lighting will be implemented in a way to:
 - focus on disturbance/work areas;
 - minimise/avoid lighting of remnant vegetation and significant fauna habitat;
 - implemented in accordance with Australian Standards; and
 - minimise lighting of remnant vegetation and significant fauna habitat (where practical).

5.2.2 Groundwater

5.2.2.1 Mine Affected Water

The mine plan for the Project includes strategies to manage MAW for the life of the Project, as per the existing CVM WMP. The WMP is subjected to an annual review, with the findings from these reviews used to continually improve the management of impacts to water quality and ensure the WMP is effective in the management of MAW.

Waste rock material will be emplaced in-pit as the space becomes available during operations and will in some areas form the walls of the final void. Groundwater within the final void is predicted to remain below pre-mining levels (Refer to Section 7.4.3 of **Appendix F**). Therefore, it is anticipated the final void will act as a groundwater sink, capturing water associated with in-pit rejects.

Where not able to be managed via passive evaporation, groundwater inflows to the open cut pits will continue to be pumped via in-pit sumps to ensure safe operating conditions. The groundwater inflows are collected and contained within the mine water management system, refer to Section 5.2.2.3 and the Surface Water Impact Assessment Report provided under **Appendix G**.

To facilitate the Project and maintain pit flood immunity at the CVM up to 0.1% AEP, two (2) additional flood levees will also be constructed. Refer to **Appendix G** for details of pit flooding immunity.

5.2.2.2 Groundwater Use

No privately-owned bores are predicted to exceed relevant bore trigger thresholds under Chapter 3 of the Water Act and therefore there are no existing privately-owned bores that would be impacted by the Project and there is no management or mitigation required. However, it remains possible that in the future, privately-owned bores may be installed within the extent of drawdown related to the Project. In accordance with Chapter 3 of the Water Act, any impacts on such bore users that exceed the magnitude of impacts predicted in the groundwater assessment (**Appendix F**) will require “make good provisions” for the additional impacts to ensure the bore user has access to a similar quantity and quality of water for the authorised purpose. This may include deepening a bore to increase its pumping capacity, constructing a new water supply bore, providing water from an alternative source or financial compensation.

5.2.2.3 Groundwater Monitoring

Monitoring is an essential part of the CVM environmental management systems. Relating to groundwater this includes monitoring in accordance with the CVM EA (Table I1 of the EA defining locations for nine compliance bores and one interpretation bore). Monitoring is conducted for comparison against locally derived water quality objectives. For the Project a proposed amendment to the CVM EA monitoring locations has been designed to

enable continued assessment of predicted impacts to all relevant hydrostratigraphic units (including the shallow groundwater system¹) and associated receptors² up and down hydraulic gradient of the Project area.

The proposed CVM EA groundwater monitoring locations is shown in **Figure 5-1** and detailed in **Table 5-1**.

The groundwater monitoring program will continue throughout the life of the Project. Ongoing recording of groundwater levels from monitoring bores will allow natural groundwater level fluctuations (such as responses to rainfall) to be distinguished from potential groundwater level impacts due to depressurisation resulting from proposed mining activities. Groundwater quality sampling will continue in order to provide longer term baseline groundwater quality at the Project, and to detect any changes in groundwater quality during and post-mining.

A summary of the rationale for each monitoring location is provided in **Table 5-1**. Key points to note regarding the rationale for the monitoring program include:

- The proposed ongoing monitoring network includes eight (8) monitoring bores and one (1) VWP sensor installed across the shallow groundwater system.
- In the north, monitoring of bore MB20CVM01A will enable the early identification of impacts to potential GDEs located at the confluence of Horse Creek and Grosvenor Creek. Monitoring of bore MB20CVM04T will act as an upstream monitoring point along Horse Creek.
- In the south, monitoring of M19CVM09A will enable the early identification of impacts to potential GDEs located downstream of Cherwell Creek, with monitoring of MB20CVM06A providing an upstream monitoring location.
- The use of monitoring bores located up and down hydraulic gradient of these identified receptors will enable adequate monitoring to groundwater levels and quality, allowing for verification of predicted modelled impacts or early identification for the deployment of mitigation and management strategies.
- Installation of one additional shallow groundwater monitoring bore in the vicinity of OOPD
- Three (3) monitoring bores and VWP sensor to be incorporated into the monitoring network located along the eastern boundary of the ML and generally co-located with bores screened within the deeper coal seams of the Permian Moranbah Coal Measures. Whilst no groundwater users have been identified in the vicinity of these locations, continued monitoring of these bores will enable model predictions to be verified and provide calibration points for future model updates. Monitoring in conjunction with the deeper bores will also enable identification of potential propagation of impacts from the deeper coal seams if they are occur.

Site specific water quality triggers will be developed for the relevant bores for comparison against the ongoing monitoring results. Development of water quality trigger levels will occur in accordance with the DES (2021) guidelines. The current EA requires an investigation into the potential for environmental harm be completed in the event that a groundwater trigger level is exceeded on three consecutive occasions. These requirements will continue to apply for the Project. The investigation will include recommendations for management (an action plan) should impacts be identified.

As the mine progresses monitoring bores will need to be replaced. In such instances bores will be relocated at least two years prior to being mined-out. Bores will be relocated outside of the proposed future mining footprint and screened within the same hydrostratigraphic unit as the replaced bore to enable monitoring of predicted impacts to continue.

Although the monitoring is defined within the CVM EA, the monitoring is also incorporated in the CVM Groundwater Monitoring and Management Plan (GMMP). The GMMP is further detailed in **Section 5.3.1**.

Note: the monitoring program shown in Figure 5-1 and described in Table 5-1 supersedes the monitoring network shown in Section 8 of Appendix F. The figure and table below represents a revised proposed monitoring network based on feedback provided during the IESC process.

¹ The shallow groundwater system is defined as Tertiary colluvium and regolith, weathered Tertiary Basalt and weathered Permian units, with alluvium (where present) unsaturated. This definition is based on the depth to water table measured across the Project Area

² Groundwater users have been primarily identified as potential terrestrial groundwater dependent ecosystems (GDEs) located downstream of the HPE Project area at the confluence of Horse Creek and Grosvenor Creek in the north and Cherwell Creek in the south. The model predicts drawdown impacts to the shallow groundwater system to be limited, with no impacts predicted for registered groundwater bores and limited drawdown (<1m) predicted at potential terrestrial GDEs locations.

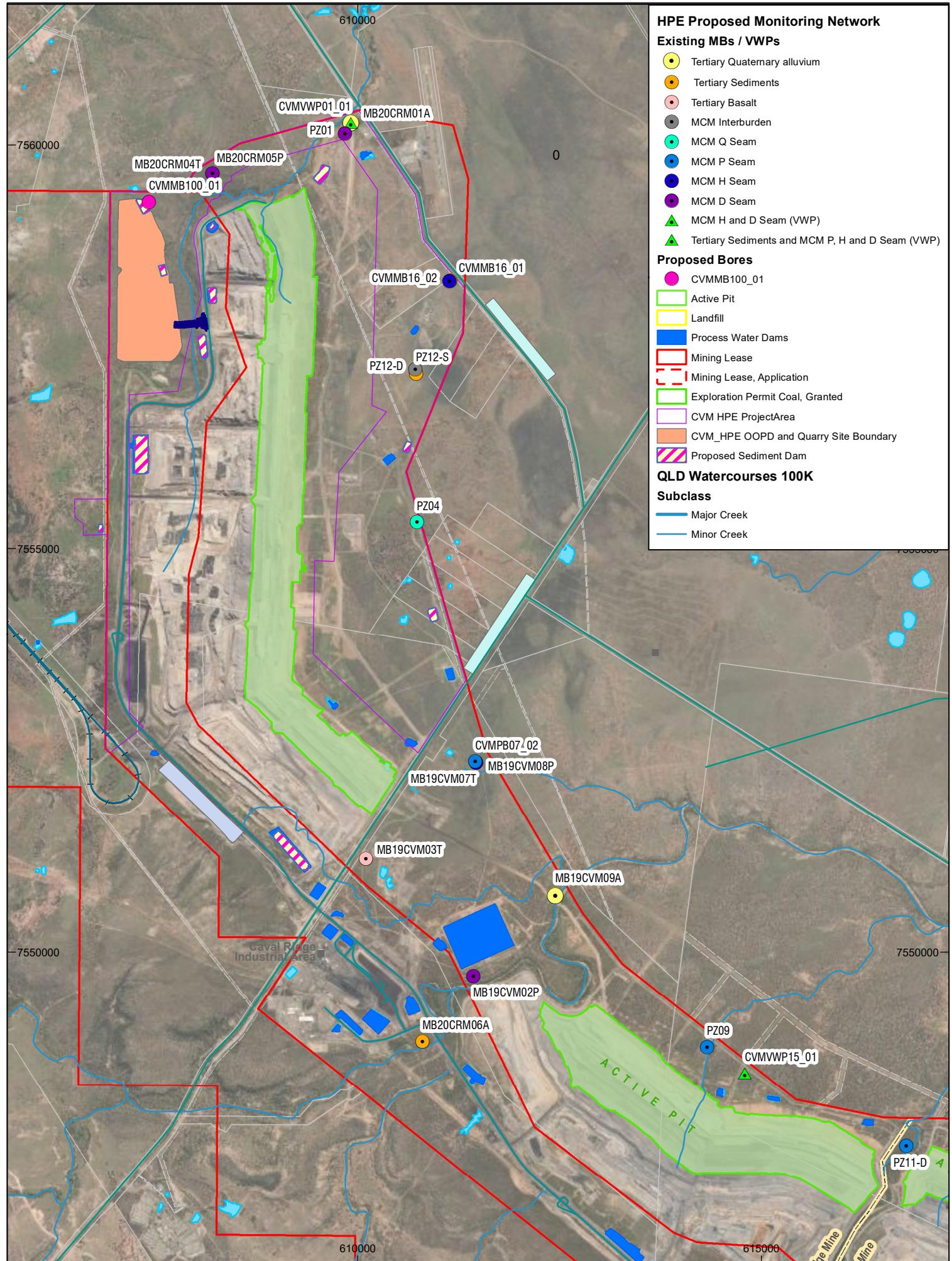


Table 5-1 Proposed Groundwater Monitoring Network Details

Bore ID	Easting (AGD66 Z55s)	Northing (AGD66 Z55s)	Target Aquifer	Monitoring Frequency	Monitoring Rationale
PZ01	609841	7560145	MCM Coal - D Seam	WQ annually WL quarterly	Existing bore. Downgradient monitoring bore to monitor predicted drawdown in economic coal seam. Located in close proximity to MB20CRM01A and CVMVWP01 enabling monitoring and assessment of interconnectivity between HSUs. Important to show if predicted drawdown propagates into shallow aquifer potentially acting as water source to terrestrial GDEs.
PZ04	610731	7555326	MCM Coal - Q Seam	WQ annually WL quarterly	Existing bore. Downgradient monitoring bore on east of ML to monitor predicted drawdown in intercepted coal seam aquifer.
PZ07-D	612465	7550704	MCM Coal - Q Seam	WQ annually WL quarterly	Existing bore. Downgradient monitoring bore on east of ML to monitor predicted drawdown in intercepted coal seam aquifer.
PZ09	614326	7548822	MCM Coal - P Seam	WQ annually WL quarterly	Existing bore. Downgradient monitoring bore located to east of Cherwell Pit / southeast HPE to monitor predicted drawdown in intercepted coal seam aquifer.
PZ11-D	616791	7547600	MCM Coal - P Seam	WQ annually WL quarterly	Existing bore. Downgradient monitoring bore on east of ML to monitor predicted drawdown in intercepted coal seam aquifer. .
PZ12-S	610721	7557164	Tertiary Sediments	WQ annually WL quarterly	Existing bore. Downgradient monitoring bore on east of ML to monitor predicted drawdown in shallow unconfined aquifer (Tertiary Sediments).
PZ12-D	610712	7557219	MCM Interburden	WQ annually WL quarterly	Existing bore. Downgradient monitoring bore on east of ML to monitor predicted drawdown in MCM interburden.
MB19CVM09A	612446	7550699	Tertiary Quaternary Alluvium	WQ quarterly. WL quarterly	Existing bore. Downgradient monitoring bore in southeast of HPE to monitor predicted drawdown shallow aquifer (TQa). Required for continued assessment of availability of water for potential GDEs identified along Cherwell Creek. To be used for early identification of impacts to GDEs to downstream reaches of Cherwell Creek.
MB19CVM02P	611424	7549705	MCM Coal - D Seam	WQ annually WL quarterly	Existing bore. Upgradient monitoring bore on west of ML/ south of Horse Pit to monitor predicted drawdown in intercepted coal seam aquifer.
MB19CVM07T	611464	7552357	Tertiary Basalt	WQ quarterly. WL quarterly	Existing bore. Downgradient monitoring bore in southeast of HPE to monitor predicted drawdown in Tertiary basalt. Co-located with MB19CVM08P and CVMPB07_02 to monitor for potential propagation of predicted impacts from intercepted coal seams to shallower HSUs.
MB19CVM08P	611465	7552346	MCM Coal - H Seam	WQ quarterly. WL quarterly	Existing bore. Downgradient monitoring bore in southeast of HPE to monitor predicted drawdown in intercepted coal seam aquifer. Co-located with MB19CVM07T and CVMPB07_02 to monitor for potential propagation of predicted impacts from intercepted coal seams to shallower HSUs

Bore ID	Easting (AGD66 Z55s)	Northing (AGD66 Z55s)	Target Aquifer	Monitoring Frequency	Monitoring Rationale
MB20CVM01A	609915	7560272	Tertiary Quaternary Alluvium	WQ quarterly. WL quarterly	Existing bore. Downgradient monitoring bore in northeast of HPE to monitor predicted drawdown shallow aquifer (TQa). Required for continued assessment of availability of water for potential GDEs identified along Horse Creek. To be used for early identification of impacts to GDEs at Grosvenor Creek / Horse Creek Confluence. Co-located with CVMVWP01 and in close proximity to PZ01, enabling monitoring of interconnectivity of HSUs.
MB20CVM04T	608193	7559651	Tertiary Basalt	WQ quarterly. WL quarterly	Existing bore. Upgradient bore monitoring shallow water table aquifer (Tertiary basalt) in northwest of Project. Co-located with MB20CRM05P to monitor interconnectivity between coal seams and shallow units. Will also provide a downgradient seepage monitoring location to the proposed OOPD.
MB20CVM05P	608198	7559646	MCM Coal - D Seam	WQ quarterly. WL quarterly	Existing bore. Upgradient bore monitoring D Seam in the northwest of Project. Co-located with MB20CRM04T to monitor interconnectivity between coal seams and shallow units.
MB20CVM06A	610802	7548890	Tertiary Sediments	WQ quarterly. WL quarterly	Existing bore. Upgradient bore monitoring located adjacent to upstream reach of Cherwell creek. TQa bore to monitor background conditions of shallow aquifer.
CVMMB16_01	611144	7558320	Tertiary Sediments	WQ quarterly. WL quarterly	Existing bore. Downgradient bore monitoring of shallow aquifer (Tertiary sediments) in the northeast of Project. Co-located with CVMMB16_02 to monitor interconnectivity between coal seams and shallow units.
CVMMB16_02	611135	7558315	MCM Coal - H Seam	WQ quarterly. WL quarterly	Existing bore. Downgradient bore monitoring H Seam in the northeast of Project. Co-located with CVMMB16_02 to monitor interconnectivity between coal seams and shallow units.
CVMPB07_02	611452	7552362	MCM Coal - P Seam	WQ quarterly. WL quarterly	Existing bore. Downgradient monitoring bore in southeast of HPE to monitor predicted drawdown in intercepted coal seam aquifer. Co-located with MB19CVM07T and MB19CVM08P to monitor for potential propagation of predicted impacts from intercepted coal seams to shallower HSUs
CVMVWP01_01	609915	7560272	MCM Coal H Seam / D Seam	WQ quarterly. WL quarterly	Existing VWP. Downgradient VWP array co-located with MB20CRM01A in northeast of the project. Monitoring of water levels in multiple coal seams to monitor predicted impacts and allow continued assessment of potential interconnectivity between impacted coal seams and shallow aquifers.
CVMVWP15_01	609915	7560272	Tertiary Sediments / MCM Coal - P Seam / H Seam / D Seam	WQ quarterly. WL quarterly	Existing VWP. Monitoring of water levels in multiple HSUs to monitor predicted impacts and allow continued assessment of potential interconnectivity between impacted coal seams and shallow aquifers.
CVMMB100_01	607640	7558446	TBC - Water Table aquifer	WQ quarterly. WL quarterly	Proposed new bore to monitor potential seepage around proposed OOPD

5.2.3 Surface Water

Details of surface water management at the CVM are provided in **Section 4.3.3**. Specific impact mitigation and management measures for the Project are summarised in the following sections.

5.2.3.1 Project Surface Water Management Plan

For the Project, the existing and new/to-be-relocated water infrastructure will be managed consistent with the existing approach at the CVM, which is informed by water balance modelling and governed by EA conditions relating to MAW releases. As water management infrastructure is moved or constructed at the CVM the WBM will be updated such that predictions are appropriately reflecting the current infrastructure.

Through a process of planning and implementation of measures, the release of contaminants to the receiving environment is minimised in order to ensure the water resource does not adversely impact the local and regional environment. Development of the CVM WMP is a condition of the existing CVM EA and BMA will update the WMP for the CVM to incorporate the Project. Management measures are described below to manage storage of MAW (as it relates to capacity), the quality of water stored and the reuse of water, such that the requirement to release water is minimised.

The EA conditions for controlled releases are based on the water quality of the release and the magnitude of flows in the receiving waterway. The conditions were derived based on flow rates of Cherwell Creek, natural Cherwell Creek flow electrical conductivity, dilution ratios and the maximum limit of the receiving water electrical conductivity downstream of the discharge.

Modelling for CVM indicates that individual releases would vary typically between 20 ML/d and 150 ML/d. For a release event with, for example a 90 ML/d (1 m³/s) release, the predicted flow in the Isaac River at that time is 20,000 ML/d or 200 m³/s. This is a 1:200 dilution ratio. Due to both the dilution ratio and the releases being required to meet the current EA water quality criteria, the scale and extent of impacts associated with the releases is expected to be minimal.

Due to the downstream receiving waterway water quality limits, the low flow release condition in the EA is only used to release good quality water which can meet the identified thresholds. The EA condition is not used frequently and typically only for a few days following the release event. The condition is mostly used where pumping infrastructure within the mine has delayed the movement of water collected from clean or relatively undisturbed areas within the mine from reaching the approved release point. Low flow releases are always done in accordance with strict water quality sampling and are considered essential. Consistent with existing water management, the following approaches to water management will apply during the life of the Project:

- Stormwater runoff from undisturbed areas will be diverted away from disturbed areas and remain within the surrounding catchments outside the CVM (i.e. redirected to Horse Creek and Cherwell Creek) – this avoids the water source becoming mine affected.
- Runoff from MAW catchments is diverted to designated MAW dams where the water may (if required) be prioritised for operational uses at the CHPP and for dust suppression or transferred (directly or staged through other MAW dams) to the MAW cell of 12N dam.
- Sediment laden runoff is captured in sediment dams and either re-used for dust suppression or transferred (directly or staged through other sediment dams) to the clean water cell of 12N dam. Sediment dams are designed to capture sediment-laden runoff from the disturbed areas and provide an area where settlement of suspended sediment in runoff can occur. Sediment can then be excavated from the dams as required to maintain the design capacity. Dams are inspected following rainfall events of 30mm or more in a 24-hour period for remaining capacity, structural integrity and effectiveness. Sediment dams are to be constructed with a spillway and appropriate drainage controls. An energy dissipator will be included downstream where required. The spillway capacity is dependent on the catchment risk rating for the location of the dam (which considers soil, catchment area, disturbance and slope) and will be a minimum of 5% AEP + 0.3m freeboard.

All dams and storages are designed in accordance with the BMAs ESC and MAW Standard which includes appropriate avoidance, maintenance, and risk minimisation activities in accordance with the nature and type of structure. The Standard references other best practice guidelines and includes risk minimisation or mitigation measures such as:

- Avoidance through separation of clean and disturbance areas;
- Progressive rehabilitation;
- Locating and or scheduling of works to minimise required controls or likelihood of runoff entering waterways;
- Permanent and temporary ESC works in accordance with risk and industry standards; and
- Performance indicators, maintenance requirements and incident reporting.

Sediment and Erosion Control

The Project will be planned and executed consistent with the existing ESC management at the CVM. Project components (for example) that have potential to lead to erosion or sedimentation impacts include unrehabilitated and partially rehabilitated spoil emplacements, disturbed pre-strip areas, civil earthworks, topsoil stockpiles, haul roads, hard stand areas and access tracks.

Location specific design and construction of ESC measures (including the installation of sediment dams as a treatment) is influenced by the scale and type of the disturbance, soil types and/or slopes, locality of the disturbance, any hydraulic/structural design requirements, and other constraints such as available space, agreed maintenance frequencies and proximity to sensitive receptors.

The objectives of ESC at the CVM can be described as follows:

- Designed to comply with the state environment approval (Conditions F26 and F27 of the EA);
 - *F26 Stormwater and water sediment controls: An Erosion and Sediment Control Plan must be developed by an appropriately qualified person and implemented for all stages of the mining activities on the site to minimise erosion and the release of sediment to receiving waters and contamination of stormwater.*
 - *F27 Stormwater, other than mine affected water, is permitted to be released to waters from: a) erosion and sediment control structures that are installed and operated in accordance with the Erosion and Sediment Control Plan required by condition F26; and b) water management infrastructure that is installed and operated, in accordance with the Water Management Plan for the purpose of ensuring water does not become mine affected water.*
- To minimise and mitigate erosion and sedimentation resulting for operations as well as erosion impacts associated with clearing of vegetation along banks of drainage lines;
- To prevent the degradation of water quality resulting from erosion and sedimentation through continued monitoring and improvement measures;
- Separation of runoff from disturbed and undisturbed areas where practicable;
- Diversion of water from disturbed catchments into mine water storages or sediment dams;
- Diversion of clean water away from areas of existing or planned disturbance;
- Rehabilitation of disturbed areas to allow vegetation propagation and regrowth; and
- Improve the integrity of areas prone to erosion through temporary and permanent erosion control techniques.

ESC is managed from three (3) key components: erosion control, drainage control and sediment control.

Erosion control relates to the measures applied to minimise the potential for soil erosion, largely including controlling the flow rate before it develops into an erosive force and protecting soil surfaces with some sort of cover. From this perspective, controls at the CVM to mitigate the risk of erosion to be applied could include revegetation, mulching, graveling, erosion control blankets and rock armouring.

Drainage (and runoff) is also controlled to reduce the risk of erosion. Options for the CVM include catch drains to intercept and convey runoff from disturbed areas into sediment control structures; diversion channels and banks to redirect concentrated flows; and chutes, level spreaders and slope drains.

Due to higher intensity rainfall and the dispersive nature of the soils in Queensland, sediment basins/dams are preferred and effective at the CVM and are implemented where long term sediment entrapment is the required treatment. Smaller scale controls such as silt fences and berms are considered where controls are required on a temporary basis.

A dam or basin acts to capture eroded or disturbed soil. Sediment dams at the CVM specifically are designed and constructed to be pumped (as opposed to a passive system such as a basin), effectively treating the runoff to reduce the sediment load. Mine operations inspect the condition of the dams to determine if maintenance activities (such as desilting of a dam) is required.

Mine Affected Water Releases

12N Dam is the only authorised mine water discharge point at the CVM, which discharges to Cherwell Creek. Criteria set in the EA provides environmental triggers under which compliant release of MAW to Cherwell Creek can occur. Since the CVM began operations, there have been three (3) releases from 12N Dam (January 2015, February 2016 and December 2021). MAW is not treated prior to release, rather it is only released when water quality parameters are recorded within the thresholds defined within the EA. The EA defined criteria were developed to avoid impacts to downstream environments.

Conditions F2 and F3 (of the EA) specifically prohibit the release of MAW to waters unless the release is from the location nominated in the EA (from 12N Dam) and if water quality characteristics are in accordance with the limits defined in the EA. The Project will be developed in accordance with these existing EA conditions.

Release limits are defined in the EA and release events are permitted only to take place during period of natural flow (Condition F8), with minimum flow requirements defined. In addition to water quality characteristics requirements, Condition F11 also requires that release events do not cause erosion of the bed and banks of receiving waters or cause a material build-up of sediment. The CVM operates streamflow gauging stations to inform decision making relating to MAW releases.

A release event must be monitored (Condition F4) and action is triggered in the event results exceed the EA defined trigger values for water quality characteristics. Action trigger commences (Condition F5) with a comparison of downstream data to data from background monitoring locations and where results are greater than background, an investigation is completed, notification to the DES is undertaken and corrective actions implemented.

As described above, the analysis of the CRWN WBM has provided opportunity to design infrastructure changes within the surface water management network such that MAW releases will remain in accordance with the EA conditions.

5.2.3.2 Proposed Water Management Infrastructure

The water management strategy for the Project includes additional water management infrastructure to manage potential impacts to surface water resources. The updated WMP will include the new disturbance areas for the Project. The WMP will be subject to an annual review for the life of the Project, and will include the following management measures:

- Where possible, stormwater runoff from undisturbed areas, both on and surrounding the mine site will be diverted away from disturbed areas and directly into adjacent waterways (i.e., Horse Creek and Cherwell Creek) (in accordance with the CVM EA Condition F27);
- Sediment laden runoff will be captured in sediment dams and used for dust suppression during operations to minimise the likelihood of offsite water discharges (in accordance with the CVM EA Condition F27);
- During operations, MAW will be prioritised for water demands at the CHPP and dust suppression, with supplementary makeup water from the Burdekin pipeline. Surplus MAW will be discharged off-site via the release dam in compliance with the CVM's EA release conditions;
- Infrastructure and mining areas will be protected from flooding from Horse Creek and Cherwell Creek using flood levees and/or bunding;
- All significant quantities of hydrocarbon and chemical products stored on site will be stored in temporary or permanent bunding;
- Sediment transport to be reduced through progressive revegetation for the life of the Project. For example, progressive rehabilitation will be applied to areas no longer required for operational use;

- Standard Operating Procedures (SOPs) are in place at the CVM and will be updated as required to accommodate the Project;
- The continued implementation of the BMA's Environmental Management System will ensure that roles and responsibilities for mining activities that may affect surface water are clearly defined and that appropriate management actions are developed and implemented for these mining activities to provide a commensurate level of environmental protection;
- All water management structures will be designed and constructed using practical hydraulic parameters based on an appropriate risk-based rainfall event, catchment size, slopes, discharge design and soil types. The design criteria and standards will be as per relevant standards and guidelines for MAW management and ESC. Design and construction will be in accordance with the existing the CVM EA conditions;
- Spill capture and retention devices will be used for refuelling and similar areas;
- Runoff from oily water areas will be treated using an oil-water separator; and
- Disturbance will be kept to an operational minimum for safe operation to reduce the area exposed.

5.2.3.3 Construction Management Measures

To manage risks to adjacent waterway water quality during the construction of the levees and the Horse Creek crossing, the following mitigation measures will be implemented by BMA:

- Appropriate ESC measures will be established as required to reduce the amount of runoff from disturbed areas in accordance with relevant standards and guidelines and in accordance with the CVM EA conditions;
- Bunding and appropriate storage of fuels and other hazardous and flammable materials will be undertaken in accordance with relevant standards and guidelines, and where practical, will be located away from any waterbodies;
- Oil spill recovery equipment will be available when working adjacent to drainage channels with the ability to discharge off site. Spill kits will be located with construction crews conducting activities with the potential for significant spills. The CVM's existing SOP for spill management will be utilised;
- Refuelling locations and handling of fuels shall be undertaken away from waterbodies;
- Construction of the Horse Creek crossing will occur during the dry season to minimise soil disturbance on adjacent waterways; and
- As soon as practical, disturbed areas will be rehabilitated.

5.2.3.4 Operations Management Measures

Water management at the CVM is based on the separation and management of clean and MAW catchments. The existing CVM controls to manage potential surface water impacts, including the CRWN, are considered appropriate to protect surface water quality and the downstream receiving environment. The following measures will be implemented by BMA for the life of the Project:

- The existing WMP will be updated to incorporate modified and new water management infrastructure following construction;
- The CRWN WBM will be updated as any water management infrastructure is modified or established such that operation of the CRWN Pipeline and the transfer agreement the relevant operations can continue to provide an approach to reducing risk associated with managing MAW volumes;
- Sediment dams, pit water storage and other water management structures (e.g., bunds and drains) will be designed and operated in accordance with relevant standards, guidelines, the CVM EA and the WMP;
- The CVM Water capture within the Project's clean catchment areas will be diverted around operational areas, and where practical, allowed to discharge off site as part of normal overland flow (in accordance with the CVM EA conditions).
- Runoff from disturbed areas within the Project Area will be diverted to sediment dams for treatment, and possible reuse for dust suppression and process water requirements. Reuse will maximise the use of the storage capacity to reduce the risk of off-site discharges;
- The current REMP and associated water quality monitoring program will be continued;
- Fuel, dangerous goods and, hazardous chemicals will be managed as outlined by current standards, guidelines and in compliance with statutory requirements and the CVM EA;
- The existing SOP for spills and emergency response procedures will continue to be utilised. Spill recovery and containment equipment will be available when working adjacent to sensitive drainage paths and within other areas, such as workshops.

Through implementing the above management strategies for surface water management, the risk of adverse impacts to the water quality of Horse Creek and the Isaac River downstream of the Project is expected to be insignificant.

5.2.3.5 Flood Levee Management Measures

The construction of the flood protection levees will be undertaken in accordance with the measures outlined above. In addition to this, the levees will be regulated structures and managed in accordance with the CVM EA conditions for regulated structures. These conditions are outlined in the Surface Water Impact Assessment Report in **Appendix G**.

5.2.3.6 Surface Water Monitoring

Monitoring is an essential part of the CVM environmental management systems and WMP. Relating to surface water, this includes monitoring through the REMP and as required by the EA. Monitoring is conducted for comparison against locally derived water quality objectives defined through sampling (refer to **Appendix H** Aquatic Ecology Impact Assessment Report).

Water quality monitoring at the CVM provides a mechanism for assessing performance against the statutory requirements and determining the effectiveness of the surface water management system. It is largely achieved through an ongoing monitoring program and regular monitoring of effectiveness of onsite controls.

Monitoring is undertaken for release and receiving waters and includes sampling of connected/surrounding waters and background sites, as outlined under Schedule F of the EA.

The monitoring currently undertaken forms part of the BMA REMP, which reports annually to DES on results and any analysis of changes detected. The REMP is a single regional monitoring program covering multiple BMA mine operations (including the CVM). The purpose of the REMP is to monitor, identify and describe any adverse impacts to surface water EVs, quality and flows due to the authorised activity. Receiving waters for the CVM are defined (by EA condition F24) as waters of the Cherwell Creek and connected or surrounding waterways within 10km downstream of the release point. As described above, the analysis of the CRWN WBM indicated that no additional release points are required due to the Project to support operational needs and meeting EA conditions. As a result, the REMP monitoring locations for the CVM are considered appropriate in order to detect any adverse impacts of the operations as they continue. In the event of adverse trends or an unacceptable change in results, an assessment against a series of criteria is undertaken to indicate if further investigation is required.

The existing program includes seven (7) sampling locations that are used to interpret changes in condition of the receiving environment. This includes two (2) sites upstream of the mining operations, one (1) site downstream of the release point on Cherwell Creek and four (4) other sites further downstream along the Isaac River (**Figure 5-2**). The surface water monitoring locations are sampled during release events at specified intervals (i.e. daily or weekly) as outlined in Schedule F of the EA.

In addition, a releases must be able to satisfy downstream receiving environment water quality as well as the release flow threshold criteria. As such there are gauging stations located upstream and downstream of the location of the release point to inform decision making relating to releases.

BMA will continue to undertake annual REMP monitoring which includes assessment of downstream water quality sampling relative to upstream water quality sampling. The REMP reviews the opportunity to develop site specific WQOs or thresholds based on the available length and quality of data.

Data collected is stored in the Environmental Data Management System (EDMS), a tool where all data can be viewed and considered by the site Environment team for reporting and analysis purposes, or in support of decision making associated with MAW release.

Other monitoring for the effectiveness of the implemented controls and EA conditions is conducted through:

- Periodic review of the management of water at the site and environmental risk assessment;
- Internal audits and site-based compliance audits; and
- Inspections of key ESC infrastructure when 24-hour rainfall totals exceed 30 mm.

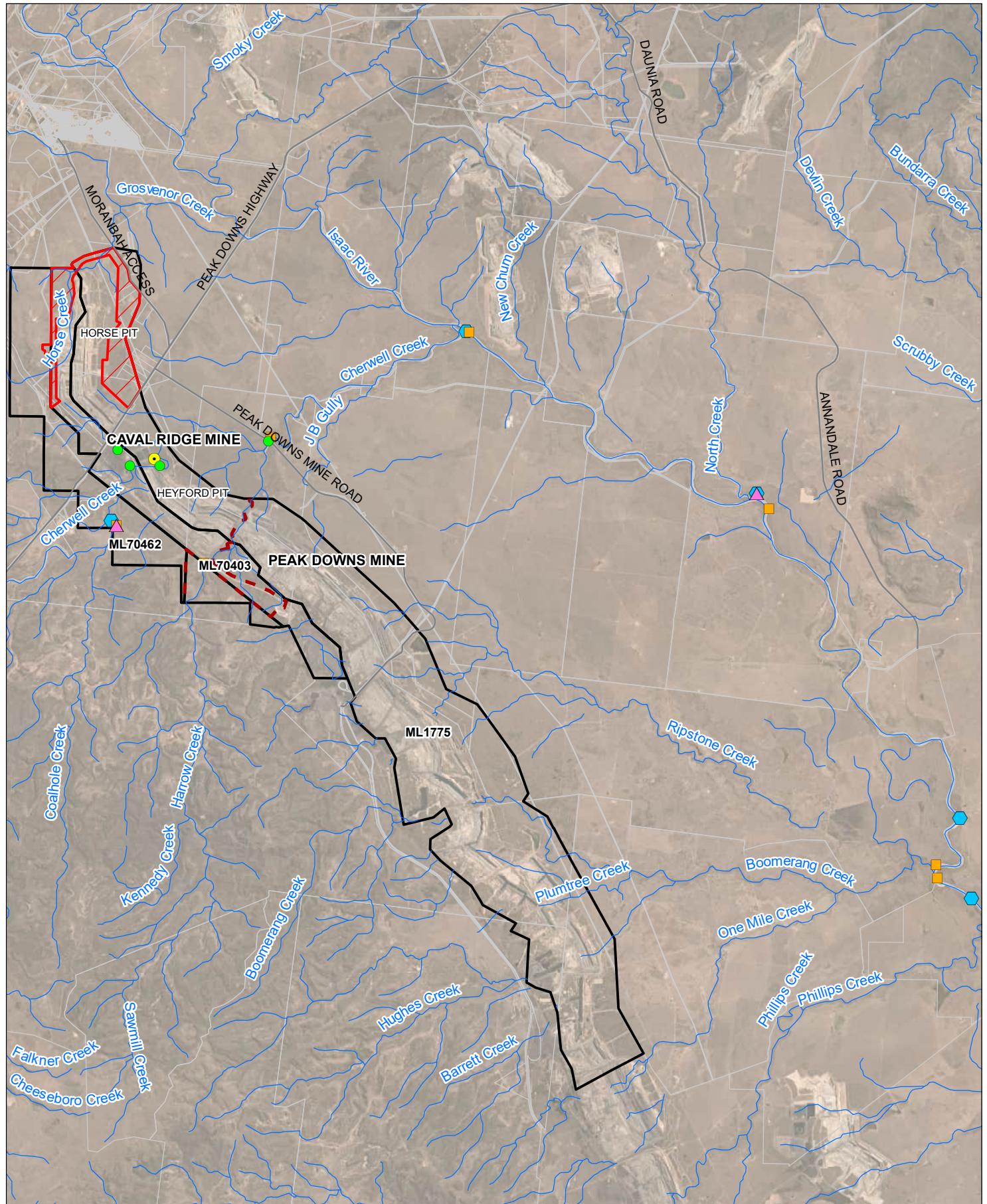
The Project will be a continuation of existing operations and the catchment monitoring and ESC monitoring protocols will continue to apply for the life of the Project. Water quality monitoring will continue to be conducted as part of current EA conditions and in accordance with the REMP for the Project. The Project will continue the controlled release regime as part of the Mine Water Management System, in accordance with the existing CVM EA conditions.

Sediment dams which are designed to a 1 in 10 AEP. These storages are therefore on average expected to only overflow twice during the twenty-year life of asset.

In addition to the monitoring undertaken as part of the EA, BMA propose that regular visual assessments of these receiving waterways are carried out on a routine basis and post any flow events, to identify potential erosion and sedimentation of the watercourses as well as any pools of water that may support opportunistic sampling (which may include sediment sampling). Mitigation actions will be developed by BMA following any adverse findings and actioned based on procedures to be outlined in the WMP.

This Project is located adjacent to Horse Creek which flows into Grosvenor and north of Caval Creek which flows into Cherwell Creek, both reporting to the Isaac River. These tributaries have relatively small catchment areas: Horse Creek 57 km², Cherwell to the Harrow Creek confluence 631 km² and Grosvenor Creek 633 km². This compares to the 1,214 km² and 4,092 km² Isaac River Catchments at Goonyella and Deverill (refer to **Figure 4-2**).

Hydrologic modelling undertaken for the Project indicates that even during extreme events, these creeks are only in flow for approximately 6 hrs. As such, monitoring on these waterways is difficult and is likely to include only limited sampling, which makes decision making in response to the sampling difficult.



Projection: GDA 1994 MGA Zone 55

Scale: 1:250,000 at A4

Project No.: 620.13593

Date: 01-Sep-2022

Drawn by: JG

Gauging Stations (MAW Release Criteria)

Monitoring Locations for Overflow Releases

Receiving Water Point

MAW Release Point

REMP Locations

Watercourses

Roads

Caval Ridge Mine and Peak Downs Mine Boundary

Project Area

BHP Tenements

Cadastre

Horse Pit Extension Project EPBC Act Preliminary Documentation (EPBC 2021/9031)

Surface Water Monitoring Locations



5.2.3.7 Final Landform

The results of the modelling indicate that the conceptual final landform will provide flood immunity for the final void in a 0.1% AEP event. The assessment of flood behaviour for the conceptual final landform was undertaken for the 0.1% AEP event, and is illustrated in Figure 7-1 of the Surface Water Impact Assessment provided under **Appendix G**.

The final landform shows the removal of the Horse Creek levees, with the final landform forming part of the Horse Creek floodplain. The final landform protects the final void from the 0.1% AEP event. The flood protection landforms are very stable, rising from 10 m to 20 m height over a length of 1 km, with top widths of approximately 50 m. These areas will be well vegetated to prevent erosion and to mitigate the potential for increased sediment load downstream.

Water balance modelling of the potential inflows and outflows to the final void was also undertaken as part of the assessment. The modelling involved an iterative process between groundwater and surface water modelling. Groundwater inflows to the GoldSim void WBM were determined from the groundwater flux curve, presented in the Groundwater Impact Assessment provided in **Appendix F**. The model was simulated for a 100-year period and the resulting water level from the GoldSim model was calculated. The groundwater model was then simulated for the resulting pit lake levels. The iterative modelling found the predicted groundwater inflow rate would be 0.18 ML/d, with a final water level of 120 mAHD, or approximately 25 m of depth in the final void.

The salinity of the final void was also modelled to examine the impacts of the effects of evaporation and groundwater inflows on final void water quality. The salinity of the final void is predicted to increase post closure. The predicted salinity values increase in excess of 35,000 $\mu\text{s}/\text{cm}$ over 100 years post closure. The CVM PRCP landform and design will implement appropriate measures to minimise the potential for the final void to cause environmental harm to the surrounding area. It is proposed to be submitted to DES in Q4 2022.

The final landform will be assessed as part of the PRCP process under the Queensland EP Act. Management of voids in the floodplain is legislated under the EP Act and the *EP Regulation 2019* (Section 41C (3)).

5.2.4 Groundwater Dependant Ecosystems

5.2.4.1 Groundwater Drawdown

Changes to groundwater quantity and interactions are not expected in the unconsolidated sediments of the Isaac River alluvium, in the lower reaches of the Isaac River and at the confluences of larger tributaries (i.e. where GDEs and stygofauna communities are likely to occur). Therefore, no impacts to potential GDE communities are expected because of the Project, and residual risk from changes to groundwater is low, as described in **Section 4.4**.

5.2.4.2 Groundwater Quality

To minimise potential impacts on groundwater quality, existing mitigation measures outlined in the EA conditions will continue to be implemented for the life of the Project, including:

- Implement annual monitoring of groundwater quality to identify trends and changes over time; and
- Fuel, dangerous goods and hazardous chemicals will be managed as outlined by current standards, guidelines and in compliance with statutory requirements.

Furthermore, ongoing groundwater quality monitoring will be conducted, as outlined in **Section 5.2.2.3**.

5.2.4.3 Surface Water Quality

To manage the potential for decreased surface water quality throughout the life of the Project, existing mitigation measures outlined in the EA conditions will continue to be implemented. These measures have been outlined under **Section 5.2.3**.

5.2.4.4 Monitoring and Management

Impact assessment determined that the impact to the likely TGDE is not significant when assessing against the *Significant impact guidelines* 1.3. A GDE Monitoring and Management Plan (GDEMMP) will be developed with the key objective of monitoring TGDE condition and functioning to verify the outcomes of the significance impact assessment and identify any unexpected impacts.

The approach to the monitoring will comprise the following broad components, with the adaptive management cycle demonstrated in the graphic below:

- **Baseline characterisation** – Vegetation condition of the likely TGDE areas will be benchmarked based on a number of monitoring events undertaken prior to any predicted impact (ie prior to drawdown nearing boundaries of the predicted extent). Data described in **Section 4.4.1** and **4.4.4** will be built upon with a minimum of four (4) additional monitoring events to collect appropriate seasonal and spatial data. Monitoring will be undertaken within the Predicted Drawdown Area, peripheral to the Predicted Drawdown Area and at chosen control sites.
- **Undertake verification monitoring** – the condition and functioning of likely TGDE vegetation will be monitored at a minimum of every 2 years during the impact phase of the Project. A summary of the monitoring structure is summarised in **Table 5-2**. The objective of the monitoring is to detect a change in vegetation condition of likely TGDE areas within the area peripheral to the Predicted Drawdown Area.
- **Analyse results** – data collected will require analysis and comparison to baseline benchmarks. Where a decline in likely TGDE vegetation condition and function is detected the significance of the decline will be assessed in accordance with significant impact guidance.
- **Investigate relationship with other environmental parameters** – where a significant decline in likely TGDE condition and function is detected, an investigation will be triggered to assess if the decline is related to the Project mining activities. This step will require drawing upon other supporting datasets (for example groundwater level and quality data, surface water flow and quality data, or other environmental datasets). Where the Project mining activities are a contributing factor in a significant impact, corrective actions will be identified and implemented.

Following the investigation, the adaptive management cycle will be completed by identifying opportunity to update the GDEMMP based on the outcomes of an investigations providing updated monitoring or mitigation approaches, or improvements as required.

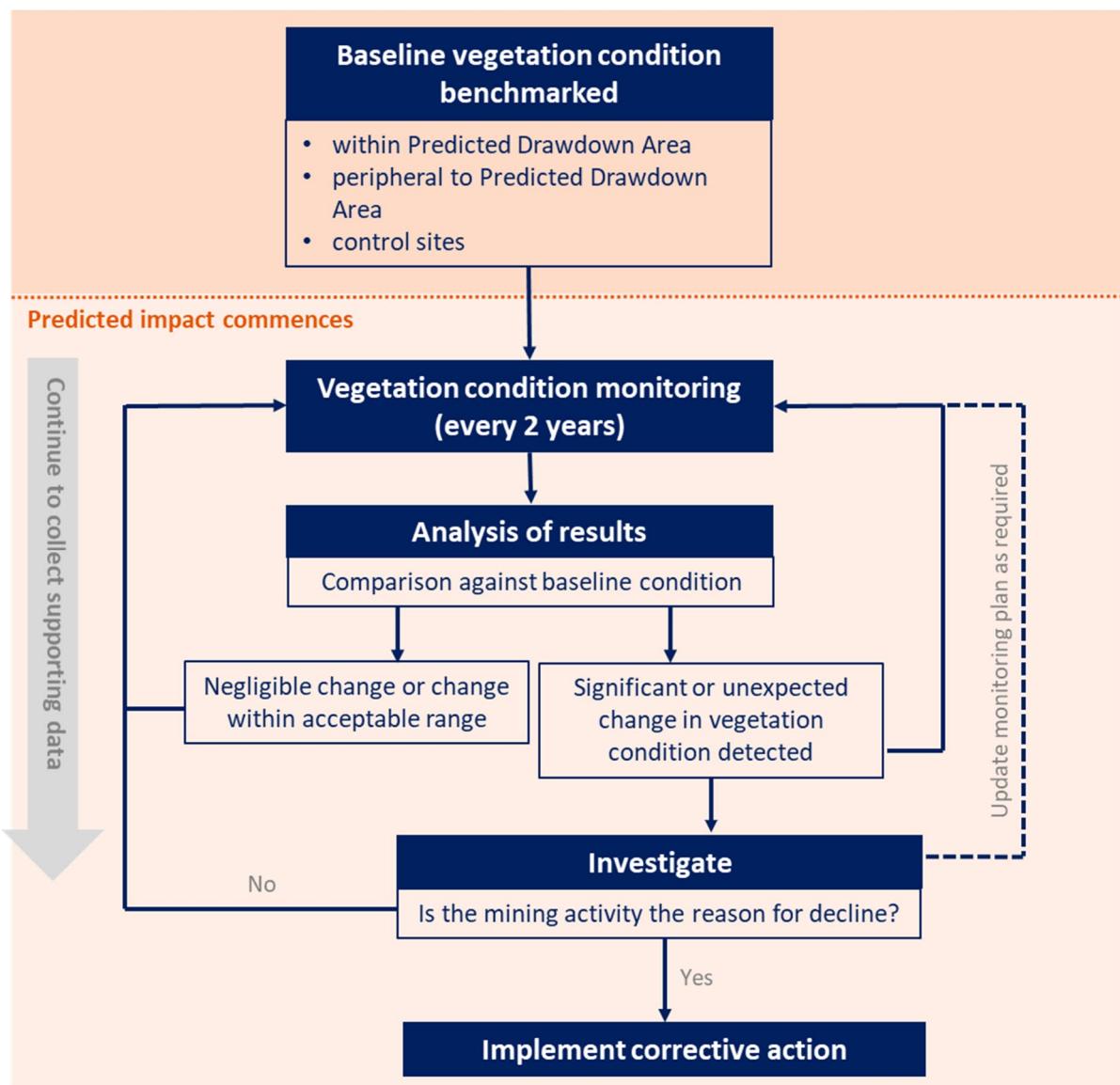


Figure 5-3 TGDE Monitoring Approach

Table 5-2 Overview of TGDE Monitoring

Aspect	Description	Responsibility
Monitoring frequency and period	<p>Prior to Predicted Impact: Minimum 4 monitoring events (2 x wet, 2 x dry season) prior to drawdown nearing boundaries of the predicted extent.</p> <p>During Impact Phase: Monitoring to commence at the first wet season following mining commencing within the Horse Pit Extension extent. Minimum once every 2 years under wet season conditions.</p>	Site Environment Team to facilitate monitoring events
Monitoring location	Impact, Peripheral and Control sites	
Monitoring parameters	<p>TGDE condition and functioning parameters:</p> <ul style="list-style-type: none"> Vegetation condition – BioCondition score Foliage cover – hemispherical camera or wide angle photographic points at each monitoring site Vegetation health – NDVI remote sensing analysis to identify relative green-ness Extent of TGDE vegetation – physical spatial extent using GPS on-ground Overall condition record – evidence of poor health such as fire damage, erosion or drought stress <p>Supporting data parameters:</p> <ul style="list-style-type: none"> Depth to groundwater and groundwater quality – monitoring of groundwater level and water quality parameters is ongoing across the CVM as part of EA requirements and data will be available for investigation as required Groundwater model – the model has been developed for the purposes of impact assessment Surface water flow and quality - monitoring of surface water flows and quality parameters as part of the Regional Environment Monitoring Plan (REMP) that is undertaken for CVM in accordance with EA requirements, and data will be available for investigation as required Climatic and other environmental data publicly available 	Suitably qualified ecologist Site Environment Team
Data analysis and investigation	Comparison of condition and functioning results against baseline conditions. Where a decline is detected at peripheral sites, an assessment must be made as to the significance of the decline in accordance with significant impact guidance. Detection of a significant impact at peripheral sites will trigger an investigation at which time supporting data will be required to determine if the Project mining activities are responsible for the decline. Corrective actions for a significant impact determined to be due to mining activities will be required, which may include compensatory measures.	Suitably qualified ecologist in collaboration with Site Environment Team and Water Planning Team. Specialists (for example hydrogeologists) to be engaged as needed where investigation determines.
Reporting requirement	Report documenting the biannual result and comparison against baseline. Where data analysis determines an investigation is required – investigation report will be documented to outline the investigation undertaken, results of the investigation, recommended corrective actions and implementation requirements.	Site Environment Team with support as required

5.3 Safeguards

5.3.1 Management Plans and Continuous Improvement

This Preliminary Documentation and supporting technical reports highlight the MNES values relevant to the Project, identify the potential impacts and corresponding mitigation/management measures and monitoring requirements. As described in **Section 2.1.1**, the CVM operates under an EA issued by the DES which regulates a variety of matters, including management of surface water values, management of groundwater values and management of biodiversity (or land) values. As a result there are a number of management plans and monitoring requirements incorporated into the EA and regulated by the DES, the authority, that are also relevant to MNES.

This document references the following plans. These CVM management plans are updated periodically and may be updated to reflect the Horse Pit Extension and any approval conditions.

- Erosion and Sediment Control Plan (see **Appendix O**)
 - Required in accordance with Condition F26 of the EA and *must be developed by an appropriately qualified person and implemented for all stages of the mining activities on the site to minimise erosion and the release of sediment to receiving waters and contamination of stormwater*
 - Applies to all activities at the CVM
 - Includes performance indicators and event investigation and reporting; and notification requirements
- Water Management Plan (see **Appendix O**)
 - Required in accordance with Condition F25 of the EA and *must be developed by an appropriately qualified person(s) and implemented for all mining activities*.
 - Applies to all activities at the CVM and applies during planning and operational phases
 - Purpose to identify potential risks to environment from operations and aims to minimise the release of contaminants to the receiving environment and ensure water resource use does not adversely impact the location environment
- Land and Biodiversity Management Plan (see **Appendix O**)
 - Applies to all activities at the CVM
 - Purpose to identify potential risks to environment from operations and aims to minimise the release of contaminants to the receiving environment and ensure water resource use does not adversely impact the location environment
 - Designed to manage the potential impacts of disturbance and contamination of land, the surrounding environment and biodiversity
- Weed and Feral Animal Management Plan
 - Applies to all activities at the CVM
 - Aligned with requirements of the Qld Biosecurity Action 2014 and Australian National Weeds Strategy (2017-2027) requiring landholder to control declared pests and WONS
 - Objective to prevent introduction of new weeds into BMA coal operations through the early detection of and rapid response to new weeds, as well as identifying and controlling spread of weeds and feral animal populations
- Threatened Flora and Fauna and Ecological Communities Management Plan (see **Appendix O**)
 - Required in accordance with Condition 4 of the Caval Ridge Mine EPBC Approval (2008/4417)
 - Applies to all operational activities at the CVM
 - Aim of the plan is to ensure that impacts to significant species and/or communities are minimised
- Offset Area Management Plans (see **Appendix M** and **Appendix N**)
 - Developed to meet the offset requirements under the EPBC Act Environmental Offsets Policy and the Queensland Environmental Offsets Policy
 - Details the management actions and monitoring requirements necessary to achieve a conservation outcome for the relevant protected matters
- Groundwater Monitoring and Management Plan (see **Section 5.3.2**)
- GDE Monitoring and Management Plan
 - Plan to be developed based on outline in **Section 5.2.4.4**
- Cultural Heritage Management Plan
 - The CVM operates in accordance with a CHMP agreement between BMA and the Barada Barna people, developed in accordance with the legislative requirements of the Queensland Aboriginal Cultural Heritage Act 2003. Further detail in **Section 9.2**)
- Regional Environmental Management Plan (REMP)

- Required in accordance with Condition F20 of the EA and *must be developed and implemented to monitor, identify and describe any adverse impacts to surface water environmental values, quality and flows due to the authorised mining activity. This must include monitoring the effects of the mine on the receiving environment periodically (under natural flow conditions) and while mine affected water is being discharged from the site.*
- Recently (June 2023) the DES established the Fitzroy Basin Receiving Environment Monitoring Program for the region in which the EA is located, of which BMA will be a participant. It will replace the BMA REMP with a basin-wide integrated program that meets the objectives of the REMP regulatory requirement under the EA (can be found at [Fitzroy Basin regional receiving environment monitoring program guideline \(des.qld.gov.au\)](https://des.qld.gov.au))
- Progressive Rehabilitation and Closure Plan (PRCP)
 - All mines with an EA must prepare a PRCP (see **Section 6.1.2**) and the CVM PRCP is under preparation to include the extended Horse Pit. DES is the administering authority and will assess the plan for approval.
 - The purpose of the PRCP is to require an EA holder to plan for how, where and when activities will occur in a way that maximises the progressive rehabilitation and provide for the condition to which an EA holder must rehabilitate land before the EA can be surrendered.
 - The PRCP schedule must include a table of milestones and conditions that are regulated through the EA and DES.

Where relevant plans incorporate requirements for adaptive management, corrective actions and continuous improvement based on monitoring data, analysis and incident investigation. In conjunction there are milestones relating to reporting to relevant regulators on specific aspects.

5.3.2 Groundwater Monitoring Program

The CVM has a Groundwater monitoring at the CVM is currently conducted as per the requirements of Schedule I of the EA and the associated GMMP. The GMMP outlines the requirements for monitoring and reporting of groundwater of the existing CVM EPBC Approval (2008/4417), existing CVM EA and any Queensland State regulator water licences. The GMMP is prepared by a suitably qualified hydrogeologist and is reviewed, at minimum, every 2 years and/or as a result of changes to conditions or the site monitoring program. For the Horse Pit Extension the groundwater monitoring program will be updated as described in **Section 5.2.2.3** and shown on **Figure 5-1**.

5.3.2.1 Triggers and Management Response

The GMMP (including proposed updates for Horse Pit Extension) has been designed to identify changes in groundwater quality, groundwater level, reduction in available drawdown/yield in landholder bores, and potential impacts to GDEs. The GMMP is supported by the groundwater modelling and impact assessment.

Once acquired, processed and uploaded to the relevant groundwater database, groundwater level and quality monitoring data is analysed against trigger levels for the various parameters, as prescribed in the CVM EA. Groundwater quality trigger levels for Alluvial and Permian bores at the CVM are defined in Table I2 of EA which includes triggers for groundwater level and contaminants.

If groundwater trigger levels are exceeded on three consecutive monitoring occasions an investigation into the potential for environmental harm is conducted. Where required an action plan to mitigate any potential environmental harm is developed by an appropriately qualified person.

5.3.3 Receiving Environment Monitoring Program

Surface water monitoring at the CVM is conducted as per the requirements of Schedule F of the EA, the REMP and the associated water quality monitoring program. Water quality sampling is undertaken at seven (7) monitoring locations within and downstream of the Project Area as part of the annual REMP and water release monitoring is completed at the discharge point of 12N Dam, overflow release points and receiving environment monitoring points. Surface water monitoring locations are outlined on **Figure 5-2**. Details of the REMP and other monitoring is outlined in Section 2.5.2 of the Surface Water Impact Assessment Report in **Appendix G**.

5.4 Commitments and Responsibilities

A summary of the commitments, responsibilities and timing for mitigation measures is presented in **Table 5-3**. The mitigation measures have been adopted to align with MNES conservation advice, recovery plans and threat abatement plans as presented in **Table 5-3**.

Table 5-3 *A Summary of the Commitments, Responsibilities and Timing*

Action	Responsibility	Timing	Alignment with MNES Conservation Advice
Minimise area of direct impact of MNES values.	BMA	Design (complete)	king bluegrass, squatter pigeon and Australian painted snipe. <i>Also relevant to TGDE</i>
Demarcate the extent of vegetation clearing and areas to be retained prior to the commencement of clearing activities with extents to remain flagged throughout construction.	BMA	Construction	king bluegrass, squatter pigeon, ornamental snake and Australian painted snipe. <i>Also relevant to TGDE</i>
Designated access tracks are utilised wherever available to prevent additional disturbance and limit the encroachment of invasive species and other edge effects.	BMA	Construction	king bluegrass, squatter pigeon and Australian painted snipe. <i>Also relevant to TGDE</i>
Sensitive clearing techniques for MNES species where safe to apply (e.g. sequential clearing).	BMA	Construction	Ornamental snake, squatter pigeon and Australian painted snipe.
Where practical, salvage fallen woody debris within proposed clearing areas and relocate to adjacent undisturbed habitats.	BMA	Construction	Ornamental snake.
Utilising a spotter-catcher prior to and during all clearing activities, with authority to cease work where species individual/s will be impacted.	BMA	Construction	Ornamental snake.
Reduce speed limits to 60 km/h along access tracks to minimise potential for collision with native fauna.	BMA		Squatter pigeon.
Protect temporary trenches and open excavation areas to avoid fauna entrapment with fauna exclusion fencing and/or covering of trenches.	BMA	Construction	Ornamental snake.
Implementing equipment and vehicle wash down procedures.	BMA	Construction	king bluegrass, ornamental snake and squatter pigeon.
Implementing ESC measures in accordance with the CVM ESCP.	BMA	Construction	Ornamental snake and Australian painted snipe. <i>Also relevant to TGDE</i>
Managing water quality and water runoff in accordance with the CVM EA conditions.	BMA	Construction	Ornamental snake and Australian painted snipe. <i>Also relevant to TGDE</i>
Manage hazardous materials in accordance with AS-1940.	BMA	Construction	Australian painted snipe. <i>Also relevant to TGDE</i>
Fuels and chemicals shall not be stored or handled within 200 m of waterbodies.	BMA	Construction	Ornamental snake and Australian painted snipe. <i>Also relevant to TGDE</i>
Appropriate dust controls to be implemented throughout construction as required to prevent and minimise dust impacts.	BMA	Construction	
Livestock are excluded from the CVM ML's, which will prevent any livestock access to the Project Area.	BMA	Operations	king bluegrass, ornamental snake and squatter pigeon.

Action	Responsibility	Timing	Alignment with MNES Conservation Advice
Implement pest and weed management controls and monitoring on the CVM ML's.	BMA	Operations	king bluegrass, squatter pigeon, ornamental snake and Australian painted snipe.
Implement REMP (undertaken annually)	BMA	Operations	<i>Also relevant to TGDE</i>

5.5 Duration, Frequency and Corrective Actions for Mitigation Measures

An overview of the duration, frequency and corrective actions for those mitigation measures specifically relating to EPBC matters are presented in **Table 5-4**.

Table 5-4 Duration, frequency and corrective actions for mitigation measures

Impact	Key mitigation measures/controls	Frequency/Duration	Performance Metric	Possible/Example Corrective Actions
Disturbance to threatened species or TEC	Pre-clearance survey ahead of clearing activities and spotter catcher will be available prior to and during all clearing activities	Prior to and during all clearing activities for the life of the Project	<ul style="list-style-type: none"> • No injured native fauna • No unauthorised clearing of threatened species habitat or TEC 	<p>An incident investigation will be conducted to identify and describe any potential environmental harm and evaluate actions that led to the incident occurring. Through the evaluation process corrective actions will be identified as well as improvement opportunities. Specific corrective actions will be dependent on the nature of an incident. Examples of corrective actions that may be relevant include:</p> <ul style="list-style-type: none"> • Review and modify boundary demarcation methods • Review and modify resources allocated to spotter catcher activities • In the event of unauthorised clearing consider if an offset is required • Increased signage • Further reduced speed limits in high risk areas • Exclusion fencing • Awareness training refreshers
	Vegetation clearing shall not occur outside the delineated boundaries	During all clearing activities for the life of the Project		
	Vegetation clearing will be confined to the smallest practicable area required for construction and operation	During all clearing activities for the life of the Project		
	Progressive rehabilitation to occur	In accordance with the PRCP rehabilitation schedule		
	Feral animals will be controlled and monitored	Life of the Project		
	During clearing, relocation of fauna habitat features (hollow logs/limbs, coarse woody debris) to undisturbed suitable habitat where possible	During all clearing activities for the life of the Project		
	Use of progressive vegetation clearing methods to provide fauna time to relocate	Life of the Project		
	Speed reduction measures will be in place on relevant roads	Life of the Project		
	Fauna crossing signs to warn drivers	Where appropriate for the life of the Project		
	Vehicle hygiene procedures for entry to areas with sensitive vegetation communities	Primarily during construction and throughout operation	<ul style="list-style-type: none"> • No spread of weeds • No unauthorised usage or storage of topsoil 	<p>An incident investigation will be conducted to identify and describe any potential environmental harm and evaluate actions that led to the incident occurring. Through the evaluation process corrective actions will be identified as well as improvement opportunities. Specific corrective actions will be dependent on the nature of an</p>
	No driving over topsoil stockpiles			
	Vehicles remain on access tracks as far as practical			

Impact	Key mitigation measures/controls	Frequency/Duration	Performance Metric	Possible/Example Corrective Actions
Wash down bays/pads for use prior to working within sensitive vegetation communities	Wash down bays/pads for use prior to working within sensitive vegetation communities			incident. Examples of corrective actions that may be relevant include: <ul style="list-style-type: none"> Additional wash-downs and inspection of machinery Weed removal or eradication (for declared pest plants) Awareness training refreshers
	Dust suppression on haul and light vehicle roads using water trucks	In response to dust monitoring results and observations for the life of the Project	<ul style="list-style-type: none"> No non-compliance with EA conditions relating to dust 	Through management of noise, light and dust to meet EA conditions it is expected that potential disturbances to threatened species and communities can be managed. Where the technical standards aren't met specific investigations will be undertaken and mitigation measures designed.
	Regular maintenance of machinery and plant will be undertaken to minimise unnecessary noise	Life of the Project	<ul style="list-style-type: none"> Vehicle fleets are maintained in accordance with maintenance schedules 	
	Minimise lighting impacts by using directional lights in accordance with Australian Standards	Life of the Project	<ul style="list-style-type: none"> Lighting design and installation in accordance with Australian Standards 	
Impacts to groundwater level and quality	Groundwater monitoring for comparison against water quality triggers	Life of the Project, with sampling to be conducted in accordance with the EA	<ul style="list-style-type: none"> EA groundwater trigger levels not exceeded on 3 different occasions Spill capture and retention devices will be used for refuelling and relevant storage areas 	An incident investigation will be conducted to identify and describe any potential environmental harm and evaluate actions that led to the incident occurring. Through the evaluation process corrective actions will be identified as well as improvement opportunities. Specific corrective actions will be dependent on the nature of an incident. The process is managed via the implementation of the GMMP.
	Fuel, dangerous goods and hazardous chemicals will be managed as outlined by current standards	Life of the Project		
Disturbance to the surface water of the local and regional environment	Update and regular review of the Mine Water Management Plan to include new disturbance areas and infrastructure requirements as mining progresses	Annually (at a minimum)	<ul style="list-style-type: none"> No unauthorised release of MAW into the surrounding environment 	An incident investigation will be conducted to identify and describe any potential environmental harm and evaluate actions that led to the incident occurring. Through the evaluation process corrective actions will be identified as well as improvement opportunities. Specific corrective actions will be dependent on the nature of an
	Fuel, dangerous goods and hazardous chemicals will be stored and managed as outlined by current standards	Life of the Project	<ul style="list-style-type: none"> No unauthorised fuel, dangerous goods and hazardous chemicals brought to site 	
	Within the CVM, separation of run-off into water types (clean, sediment and MAW)	At the commencement of		

Impact	Key mitigation measures/controls	Frequency/Duration	Performance Metric	Possible/Example Corrective Actions
	through appropriate infrastructure (containment and drainage)	land disturbance and for life of the Project		incident. Examples of corrective actions that may be relevant include: <ul style="list-style-type: none"> • All authorised fuel, dangerous goods and hazardous chemicals stored appropriately within the site • No evidence of erosion run-off entering downstream environment.
	Management of storage volumes to minimise risk of overtopping and water supply for reuse through the CRWN WBM	Life of the Project		
	Location specific design and construction of ESC measures taking account of scale, disturbance type, soil type, slopes, structural/hydraulic design requirements, access and proximity to sensitive receptors	Construction activities and where required during Operation phase		
	Defined maintenance schedules for relevant containment structures and storages	Construction activities and where required during Operation phase	<ul style="list-style-type: none"> • Water infrastructure operating as designed with suitable capacity • No unauthorised release of water to the environment 	
	Controlled releases occur only based on the water quality of the release and magnitude of flows in the receiving waters (with defined requirements in the EA)	Construction and Operation	<ul style="list-style-type: none"> • No unauthorised release of MAW into the surrounding environment 	
	Implementation of REMP monitoring and analysis requirements	In accordance with REMP frequency requirements for each parameter	<ul style="list-style-type: none"> • Completion of annual REMP reporting 	Annual REMP reporting requires interpretation of results and trends in order to assess potential impacts and recommendations for further investigation, changes or improvements to the monitoring program, and suitability of the current release limits to protect the downstream environment. The outcomes of each annual REMP report will drive any corrective actions.
Impact to TGDEs	TGDE area are clearly marked on site mapping as areas not for clearing	Life of the Project	<ul style="list-style-type: none"> • TGDE is cleared without authorisation 	An incident investigation will be conducted to identify and describe the harm and evaluate actions that led to the incident occurring. Specific corrective actions will be dependent on the nature of an incident. Examples of corrective actions that may be relevant include: <ul style="list-style-type: none"> • Remediation or rehabilitation activities • Provision of an offset
	Surface and groundwater mitigation measures and monitoring will provide controls to manage potential indirect impacts to TGDE relating to changes in water quality or flows (see measures listed above)	As above	As above	

Impact	Key mitigation measures/controls	Frequency/Duration	Performance Metric	Possible/Example Corrective Actions
	Implement GDEMMP	Baseline collection in advance of predicted impact and continue at minimum of every 2 years	No decline in TGDE condition as a result of mining activities	Where a decline in likely TGDE vegetation condition and function is detected the significance of the decline will be assessed in accordance with significant impact guidance. Where a significant decline in likely TGDE condition and function is detected, an investigation will be triggered to assess if the decline is related to the Project mining activities. This step will require drawing upon other supporting datasets (for example groundwater level and quality data, surface water flow and quality data, or other environmental datasets). Where the Project mining activities are a contributing factor in a significant impact, corrective actions will be identified and implemented. Examples of corrective actions that may be relevant include: <ul style="list-style-type: none">• Remediation or rehabilitation activities• Provision of an offset

5.6 Effectiveness of Management

5.6.1 Adaptive Management

The CVM has been operational since 2014, implementing management measures and monitoring to meet the regulatory requirements of the EA. The measures implemented have been developed and refined since commencement of mining. The effectiveness of management measures are checked and through an iterative process, improvements are applied where appropriate.

Adaptive management at the CVM is a key component of BMAs overarching Environmental Management System (EMS) framework. The PLAN-DO-CHECK-ACT cycle incorporates aspects of land and biodiversity, water, air quality, waste and noise and vibration. The cycle is mentioned further below relating to rehabilitation (**Section 6**) but applies to the wider scale of management at the CVM and compliance with the existing EA (**Figure 5-4**).

The CVM EA, administered under the Queensland EP Act, incorporates conditions requiring management and monitoring. Noting however that a lack of condition does not authorise environmental harm. The management measures currently being implemented at the CVM will continue to be implemented with the extension of Horse Pit.



Figure 5-4 BMA EMS Framework

5.6.2 Outcomes and Predicted Effectiveness

The CVM has been operational since 2014, implementing management measures and monitoring to meet the regulatory requirements of the EA. The measures implemented have been developed and refined since commencement of mining. Adaptive management at the CVM is a key component of BMAs overarching Environmental Management System (EMS) framework. The management measures and monitoring at the site has to date proven effective, specifically demonstrated through the presence of threatened species and threatened species habitat at the CVM, detailed under **Section 3**.

BMA is confident in the effectiveness of the avoidance of disturbance to threatened species habitat, as the CVM has been operating since 2014 and surveys have identified this habitat within close proximity to mining activities on the CVM MLs (**Section 3**). Although the mining of coal is constrained by the location of the resource, certain project elements have been designed to avoid areas of ecological value, including MNES, resulting in the avoidance of 8.04 ha of suitable habitat for king bluegrass and a total of 146.19 ha of habitat for squatter pigeon (comprising 19.3 ha of preferred habitat and 126.89 ha of suitable habitat). The effectiveness of avoidance at the CVM will continue through the mitigation and management measures already in place at the CVM and proposed to continue for this Project.

Mitigation and management measures include a collection of management plans under the EMS and the following monitoring programs:

- Groundwater monitoring program (as per the requirements of Schedule I of the EA); and
- The REMP (as per the requirements of Schedule F of the EA).

Further information on the effectiveness of these programs is provided below. Where management measures are not effective and/or exceedances are identified, these programs and the EA require further investigation and updates to the program, if necessary.

5.6.2.1 Groundwater Monitoring Program Effectiveness

Groundwater monitoring at the CVM is conducted as per the requirements of Schedule I of the EA and the associated groundwater monitoring program as described in **Section 5.3.1**. The groundwater monitoring network was established in 2008 as part of the CVM EIS and expanded further in 2019 and again in 2020 to support further environmental approvals and the Project.

Groundwater monitoring programs are utilised throughout the Australian mining industry and are an effective instrument for monitoring changes in both groundwater quality and groundwater levels. The groundwater monitoring program at CVM and for the Project will continue to follow best practice guidelines, including the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG, 2018), and the *Monitoring and Sampling Manual* (DES, 2018).

Recording of groundwater levels from existing monitoring bores will continue to be used as an effective method for distinguishing natural groundwater level fluctuations (such as responses to rainfall) from potential groundwater level impacts due to depressurisation resulting from proposed mining activities. Groundwater quality sampling of existing monitoring bores will also continue in order to provide longer term baseline groundwater quality at the Project, and to detect any changes in groundwater quality during and post-mining.

5.6.2.2 Receiving Environment Monitoring Program Effectiveness

Surface water monitoring at the CVM is conducted as per the requirements of Schedule F of the EA. The REMP and associated water quality monitoring program at CVM, as described in **Section 5.3.3**, has been an effective tool for monitoring and assessing the potential impacts of both controlled and uncontrolled releases of water and associated contaminants to the environment. The REMP provides a basis for evaluating whether the discharge limits or other conditions imposed upon the CVM have been successful in maintaining or protecting receiving environment values over time.

The REMP is a crucial 'Check' step in BMA's EMS framework as it enables BMA to confirm if water management systems are working effectively and if EVs are being adversely affected by mining activities. Results from the REMP are considered in the adaptive management cycle and allow BMA to identify areas where systems and processes can be improved. For example, recommendations from recent REMPs have included:

- Additional samples are to be taken during flow events to produce statistically robust local guideline values and confirm if manganese and cobalt are increasing significantly in Cherwell Creek.
- Further samples (another 5 – 10 preferably) be obtained from upstream Cherwell and Harrow creeks during flow events to facilitate setting of appropriate EA trigger values.

5.7 Significant Residual Impact Assessment

The significant residual impact assessments for the most relevant threatened species and TEC are summarised below. The *Significant Impact Guidelines 1.1 Matters of National Environmental Significance* (DotE 2013) were considered to determine whether significant residual impacts will occur. The Significant Residual Impact Assessment is provided under Section 7 of **Appendix C**.

5.7.1 Ornamental Snake

The significant residual impact assessment to ornamental snake is outlined under **Table 5-5**.

Table 5-5 Significant Impact Assessment Summary – Ornamental Snake

MNES Significant Impact Guideline criteria	Response
<i>Lead to a long-term decrease in the size of an important population</i>	<p>Historical vegetation clearing, land development and ongoing mining operations have increasingly fragmented and degraded ornamental snake habitat within the CVM and the wider landscape.</p> <p>Species habitat within the Project Area exists as an isolated patch disconnected from neighbouring habitats by the Peak Down Highway (south), Moranbah Access Road (east) and Horse Pit/CVM access tracks (west). The isolated habitat patch compounded by the diminished habitat quality (see Section 4.2) limits the carrying capacity of the environment to support the species thereby restricting the size of the population within the Project area.</p> <p>While the habitat is likely to be important for the limited population of ornamental snake within the Project area, the lack of connectivity or movement corridors and isolated nature of the population indicates Project impacts are expected to be localised and unlikely to be significant at a regional scale. However, with the removal of 167.84 ha of preferred habitat and the confirmed presence of the species, the Project is likely to lead to a long-term decrease in the size of an important population on a localised scale.</p>
<i>Reduce the area of occupancy of an important population</i>	The Project is expected to remove approximately 167.84 ha of ornamental snake habitat thereby reducing the area of occupancy of an important population at the local scale.
<i>Fragment an existing important population into two or more populations</i>	The non-linear shape and size of the disturbance is unlikely to fragment the existing ornamental snake population within the Project Area into two (2) or more populations.
<i>Adversely affect habitat critical to the survival of a species</i>	The ornamental snake habitat within the Project area is subject to ongoing disturbance and likely to support a relatively small population (i.e. limited environmental carrying capacity). As such, the habitat within the disturbance footprint is not considered critical to the survival of the species.
<i>Disrupt the breeding cycle of an important population</i>	Removing 167.84 ha of habitat is likely to disrupt the breeding cycle of the ornamental snake population within the disturbance footprint.
<i>Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</i>	Approximately 167.84 ha of ornamental snake habitat will be removed reducing the area of occupancy and likely resulting in species mortality and injury. This impact, however, affects a relatively small population in degraded habitat and is unlikely to trigger the species as a whole to decline in response.
<i>Result in invasive species that are harmful to an Endangered species becoming established in the Endangered species' habitat</i>	The Project is unlikely to result in novel weed and pest species becoming established within remaining ornamental snake habitat.
<i>Introduce disease that may cause the species to decline</i>	The Project is unlikely to introduce a disease that may cause the species to decline.
<i>Interfere substantially with the recovery of the species</i>	The draft Recovery Plan for the Queensland Brigalow Belt Reptiles and the Action Plan for Australian Reptiles focus on research, avoiding/mitigating habitat loss and addressing threatening processes across the species geographic distribution. Project development is expected to remove 167.84 ha of degraded habitat supporting a small population and unlikely to substantially interfere with the recovery of the species.
Assessment Outcome	The Project is likely to result in a significant residual impact on the ornamental snake

5.7.2 King Bluegrass

The significant residual impact assessment to king bluegrass is outlined under **Table 5-6**.

Table 5-6 *Significant Impact Assessment Summary – King Bluegrass*

MNES Significant Impact Guideline criteria	Response
<i>Lead to a long-term decrease in the size of a population</i>	<p>Although no individuals were recorded during the terrestrial ecology assessment undertaken by E2M (2021), the species was recorded within the CVM ML during baseline ecological studies in 2011. Native grassland habitat adjacent to the 2011 record was confirmed during 2020 field studies as suitable for king bluegrass. The Project will require the clearing of approximately 23.40 ha of suitable king bluegrass habitat.</p> <p>King bluegrass is endemic to central and southern Queensland occurring in grassland communities within three (3) disjunct populations (SEWPaC, 2013). Initial assessment by Accad et al. (2008) estimated a reduction in the extent of the occurrence from 1,100 km² to 245 km², resulting from continued expansion of agriculture, mining and infrastructure development.</p> <p>The removal of 23.40 ha of suitable habitat for king bluegrass is likely to decrease the size of a potential population. A total of 8.04 ha of suitable habitat for the species will be retained within the Project area. The implementation of mitigation measures (refer to Section 6) will assist in reducing any potential indirect impacts associated with edge effects.</p> <p>Due to the limited vegetation extent within the Study area and direct loss of 23.40 ha of suitable habitat within the disturbance footprint, the Project is considered likely to lead to a long-term decrease in the size of a local population.</p>
<i>Reduce the area of occupancy of the species</i>	<p>Although no individuals were recorded during the terrestrial ecology assessment undertaken by E2M (2021), the species was recorded within the CVM ML during baseline ecological assessments in 2011. Due to the limited vegetation extent of habitat within the Study area and direct loss of 23.40 ha of suitable habitat within the disturbance footprint, the Project is considered likely to reduce the area of occupancy for a local population of the species.</p> <p>Although the removal of suitable habitat within the Study area is likely to reduce the area of occupancy for a local population, due to the isolated nature of habitat observed, species distribution and extent of potential habitat within the sub-region (approx. 58,560 ha of remnant RE 11.4.4, 11.4.11, 11.3.21, 11.8.5 and 11.8.11 (Queensland Herbarium 2021b)), the habitat impacted by the Project is localised and not considered likely to reduce the area of occupancy of the species within the greater landscape or subregion..</p>
<i>Fragment an existing population into two (2) or more populations</i>	<p>The Project will result in the removal of 23.40 ha of suitable habitat for king bluegrass. A total of 8.04 ha of suitable habitat for the species will be retained within the Project area.</p> <p>Due to the nature of the disturbance associated with the Project, it is considered unlikely to result in the fragmentation of an existing population into two (2) or more populations.</p>
<i>Adversely affect habitat critical to the survival of a species</i>	<p>Although no individuals were recorded during the terrestrial ecology assessment undertaken by E2M (2021), the species was recorded within the CVM ML during baseline ecological assessments in 2011. Native grassland habitat adjacent to the 2011 record was confirmed as suitable for king bluegrass habitat during 2020 field studies.</p> <p>The Project will require the clearing of approximately 23.40 ha of suitable habitat for king bluegrass. At a local scale, this habitat is considered to be 'habitat critical to the survival of the species', as defined under the MNES Significant Impact Guidelines (DotE, 2013), for king bluegrass occurring within the Project area. However, this habitat is not considered to be 'habitat critical to the survival of the species' for the species as a whole.</p>
<i>Disrupt the breeding cycle of a population</i>	<p>The Project will result in the direct loss of 23.40 ha of habitat critical to the survival of the species (for king bluegrass occurring within the Project area) and potential individuals.</p> <p>Although 8.04 ha of suitable habitat ('habitat critical to the survival of the species') will be retained within the Study area, the direct loss 23.40 ha of suitable habitat is considered likely to disrupt/interfere with the breeding cycle (pollination and seed dispersal) of a potential local population.</p> <p>Due to the isolated nature of habitat observed, the Project is considered unlikely to impact on the breeding cycle of populations within the greater landscape surrounding the Project area</p>
<i>Modify, destroy, remove, isolate or decrease the availability or quality of</i>	<p>Although no individuals were recorded during the terrestrial ecology assessment undertaken by E2M (2021), the species was recorded within the CVM ML during baseline ecological assessments in 2011. Field assessments within the Study area identified 31.44 ha of habitat</p>

MNES Significant Impact Guideline criteria	Response
<i>habitat to the extent that the species is likely to decline</i>	critical to the survival of the species (for king bluegrass occurring within the Project area). The Project will result in the direct loss of 23.40 ha of habitat critical to the survival of the species. Although suitable habitat within the Study area is likely to be important to a local population present, due to the extent and relative isolation of habitat within the greater landscape context, the removal of habitat is considered unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species/populations within the greater landscape is likely to decline.
<i>Result in invasive species that are harmful to an Endangered species becoming established in the Endangered species' habitat</i>	The Project is unlikely to result in an increase in the abundance of invasive/non-native species that may be harmful to the species, above the existing levels observed or result in the introduction of new invasive species. The implementation of mitigation measures (refer to Section 4.5), including weed management and weed hygiene protocols, will assist in reducing any potential reintroduction or spread of exotic species in retained habitat within the Project area.
<i>Introduce disease that may cause the species to decline</i>	It is considered unlikely that the Project has the potential to introduce a disease to the local area, given there are no known diseases that impact king bluegrass.
<i>Interfere substantially with the recovery of the species</i>	Although there is no current recovery plan for the species, priority actions are identified within the 'Approved Conservation Advice' for the species (DSEWPaC 2013). Associated recovery and abatement strategies target reduction in habitat loss and disturbance, management of weeds, disturbance by livestock and community awareness (DSEWPaC 2013). The Project will impact 23.40 ha of suitable habitat for the species, the loss of habitat is not expected to substantially interfere with species recovery plan. The implementation of mitigation measures (refer to Section 6), including weed management and weed hygiene protocols, will assist in reducing any potential reintroduction or spread of exotic species within retained habitat within the Study area. Due to the extent and relative isolation of habitat within the greater landscape context, the Project is considered unlikely to substantially interfere with the recovery of the species.
Assessment Outcome	Project is likely to result in a significant residual impact on king bluegrass.

5.7.3 Squatter Pigeon

A summary of the significant impact assessment to squatter pigeon is outlined under **Table 5-7**.

Table 5-7 Significant Impact Assessment Summary – Squatter Pigeon

MNES Significant Impact Guideline criteria	Response
<i>Lead to a long-term decrease in the size of an important population</i>	The squatter pigeon population that utilise habitat within the disturbance footprint is not considered to be an important population. As such, the Project would not lead to a long-term decrease in the size of an important population.
<i>Reduce the area of occupancy of an important population</i>	The squatter pigeon population that utilise habitat within the disturbance footprint is not considered to be an important population. Furthermore, at a regional scale, there is approximately 162,662 ha of remnant and regrowth REs on landzones 5 and 7 that are dominated by eucalypts within the Northern Bowen Basin sub-region and therefore the loss of 83.53 ha is considered unlikely to impact the species. As such, the Project would not reduce the area of occupancy of an important population.
<i>Fragment an existing important population into two or more populations</i>	The squatter pigeon (south) population that utilise habitat within the disturbance footprint is not considered to be an important population. As such, the Project would not fragment an existing important population.
<i>Adversely affect habitat critical to the survival of a species</i>	The 54.82 ha of preferred habitat and 28.71 ha of suitable habitat within the disturbance footprint is not considered critical to the survival of the species. Squatter pigeon habitat within the Project area is degraded by fragmentation, dense non-native ground cover, lack of permanent water sources (n=1) and common feral predators. The reduced carrying capacity is likely to support a correspondingly low population size. No squatter pigeon were observed during the dry season survey (2019) or the wet season survey (2020). The most recent confirmed observation within the Project area was recorded

MNES Significant Impact Guideline criteria	Response
	<p>in 2008 during the CVM EIS (2009). Habitat utilisation within the Project area may be intermittent as the species moves between breeding/foraging resources within the CVM and neighbouring properties.</p> <p>At a regional scale, there is approximately 162,662 ha of remnant and regrowth REs on land zones 5 and 7 that are dominated by eucalypts within the Northern Bowen Basin sub-region and therefore the loss of 83.53 ha is considered unlikely to affect habitat critical to the survival of a species.</p>
<i>Disrupt the breeding cycle of an important population</i>	The squatter pigeon population that utilise habitat within the disturbance footprint is not considered to be an important population. As such, the Project would not disrupt the breeding cycle of an important population.
<i>Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</i>	Squatter pigeon habitat utilisation within the disturbance footprint is likely intermittent and to exist as part of a larger home range encompassing adjacent squatter pigeon habitat. As such, the local population, nor the species, is dependent on the degraded habitat present within the Project Area. The removal of 83.53 ha of squatter pigeon habitat is unlikely to trigger a decline in the species.
<i>Result in invasive species that are harmful to an Endangered species becoming established in the Endangered species' habitat</i>	The Project is unlikely to result in novel weed and pest species becoming established within remaining squatter pigeon habitat
<i>Introduce disease that may cause the species to decline</i>	The Project is unlikely to introduce a disease that may cause the species to decline.
<i>Interfere substantially with the recovery of the species</i>	The recovery of the subspecies depends on the protection and restoration of critical habitat, reducing mortality from feral predators and developing a deeper understanding of the species' ecology within modified landscapes (Squatter Pigeon Workshop, 2011). Regionally, the Commonwealth TSSC (2015) recommend identifying, monitoring and protecting sub-populations, managing threats to vegetation that support important sub-populations and adapting management actions to adjust effectiveness. The 83.53 ha of squatter pigeon habitat within the Project area are not deemed to be critical to the survival of the species and the proposed mitigation measures support the species recovery plan by targeting feral predators. As such, the Project's removal of 83.53 ha of squatter pigeon habitat are unlikely to substantially interfere with the subspecies' recovery.
Assessment Outcome	The Project is unlikely to result in a significant residual impact on the squatter pigeon (southern subspecies).

6 Rehabilitation Requirements

Mines are required to rehabilitate relevant areas of land disturbance caused by their activities in accordance with the EA. Conditions prescribed in EAs require coal mine operators to complete progressive and final rehabilitation over the life of the resource projects. The CVM EA issued by the Queensland DES, authorises the activities undertaken at the mine and incorporates conditions specific to rehabilitation.

The DES describe four (4) General Rehabilitation Goals, requiring areas disturbed by mining to be rehabilitated to a safe, stable and non-polluting state, able to sustain an agreed post-mining land use. The approach to rehabilitation is driven by a series of rehabilitation criteria that have been defined within the EA. This section outlines the acceptance criteria, describes how rehabilitation will be undertaken for the Project using an adaptive management approach that incorporates monitoring to encourage continuous improvement.

6.1 Rehabilitation Acceptance Criteria

6.1.1 Environmental Authority Conditioned Rehabilitation Requirements

Conditions E3 and E4 of the EA specifically relate to Rehabilitation Landform Criteria and Progressive Rehabilitation. These conditions will apply to the Project. The complete EA is provided in **Appendix K**, the relevant conditions that the activities of the Project will be required to comply with are reproduced below.

Condition E3 Rehabilitation Landform Criteria

*Unless otherwise permitted under the conditions of this environmental authority, all areas significantly disturbed by mining activities must be rehabilitated in accordance with Table E1 (Rehabilitation Requirements). Refer to **Table 6-1** below.*

Condition E4

Progressive rehabilitation must commence within two (2) years of when areas become available within the mining leases.

Mining, including rehabilitation, at the CVM is currently operated under the EA conditions. Rehabilitation objectives have been designed in accordance with the DES four (4) General Rehabilitation Goals which requires areas disturbed by mining to be rehabilitated to a safe, stable and non-polluting state, able to sustain an agreed post-mining land use. Table E1 of the EA defines the Acceptance Criteria agreed with DES that must be met to achieve the post-mining land uses.

Table 6-1 EPML00562013 Table E1 Rehabilitation Requirements

Post Mining Land Use	Goal	Objective	Indicator	Acceptance Criteria
Cattle grazing	Safe to humans and wildlife	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference
	Stable	Rehabilitation is geotechnically stable	Factor of safety	>1.5
		Rehabilitation is erosionally stable	Extent, slope gradient and groundcover	1. Groundcover >50% 2. 70% of slopes <20%
	Non-polluting	Rainfall from rehabilitation achieves relevant water quality objectives for receiving waters	pH EC Turbidity	Not significantly different to upstream values
		Deep drainage from rehabilitation achieves relevant	EC	Not significantly different to:

Post Mining Land Use	Goal	Objective	Indicator	Acceptance Criteria
	<i>Able to sustain the agreed post-mining land use</i>	water quality objectives for groundwater		(a) the EPP (Water) schedule documents water quality objectives for relevant groundwater chemistry zones; or, (b) local water quality objectives developed in accordance with the Queensland Water Quality Guidelines.
		Rehabilitation is suitable for sustainable cattle grazing	Land suitability assessment for cattle grazing	Land suitability class ≤ 3 or not different from pre-mining class if ≥ 4 . Assessment completed in accordance with LSA Framework for Open-Cut Coal Mine Rehabilitation 2018 (A rule-set for land suitability assessment of sustainable beef cattle grazing on land rehabilitated after open-cut coal mining in the Bowen Basin Queensland) unless otherwise agreed in writing between the administering authority and the environmental authority holder.
			Leucaena stem density	<250 stems >2m height (8) per ha (1 per 40m ²), mean total area
<i>Dryland cropping</i>	<i>Safe to humans and wildlife</i>	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference
	<i>Stable</i>	Rehabilitation is geotechnically stable	Factor of safety	>1.5
		Rehabilitation is erosionally stable	Percentage of cultivation at >1% slope gradient with functional contour banks	100% of rehabilitated areas
	<i>Non-polluting</i>	Rainfall from rehabilitation achieves relevant water quality objectives for receiving waters	pH EC Turbidity	Not significantly different to upstream values
		Deep drainage from rehabilitation achieves relevant water quality objectives for groundwater	EC	Not significantly different to: (a) the EPP (Water) schedule documents water quality objectives for relevant groundwater chemistry zones; or, (b) local water quality objectives developed in accordance with the Queensland Water Quality Guidelines.
	<i>Able to sustain the agreed post-mining land use</i>	Rehabilitation is suitable for sustainable cattle grazing	Land suitability assessment for cattle grazing	Land suitability class ≤ 3 or not different from pre-mining class if ≥ 4 . Assessment completed in accordance with the Regional Land Suitability Frameworks for Queensland 2013 unless otherwise agreed in writing between the administering authority and the environmental authority holder.

Post Mining Land Use	Goal	Objective	Indicator	Acceptance Criteria
Woodland habitat	Safe to humans and wildlife	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference
		Rehabilitation is geotechnically stable	Factor of safety	>1.5 unless an alternative is justified by an appropriate qualified person
	Stable	Rehabilitation is erosionally stable	Groundcover (steep slopes, >15%)	80%
			Groundcover (steep slopes, <15%)	50%
	Non-polluting	Rainfall from rehabilitation achieves relevant water quality objectives for receiving waters	pH EC Turbidity	Not significantly different to upstream values
		Deep drainage from rehabilitation achieves relevant water quality objectives for groundwater	EC	Not significantly different to: (a) the EPP (Water) schedule documents water quality objectives for relevant groundwater chemistry zones; or, (b) local water quality objectives developed in accordance with the Queensland Water Quality Guidelines.
	Able to sustain the agreed post-mining land use	Native bushland characteristics	Species richness	
			Trees Shrubs Grasses	>2 >3 >4
			Tree canopy cover	≥16%
	Water storage	Safe to humans and wildlife	Hazard assessment	No significant difference
			Factor of safety	>1.5
		Rehabilitation is erosionally stable (banks and immediate surrounds)	Groundcover	>50%
		Non-polluting	pH EC Turbidity	Not significantly different to upstream values
			EC	Not significantly different to: (a) the EPP (Water) schedule documents water quality

Post Mining Land Use	Goal	Objective	Indicator	Acceptance Criteria
	<i>Able to sustain the agreed post-mining land use</i>	<i>Rehabilitation retains water there is a potential resource for cattle grazing, with quality according to ANZECC guidelines version October 2000</i>	<i>TDS Calcium Magnesium Nitrate Nitrite Sulphate</i>	<i>objectives for relevant groundwater chemistry zones; or, (b) local water quality objectives developed in accordance with the Queensland Water Quality Guidelines.</i>
				<i><5,000mg/L <1,000mg/L <2,000mg/L <400mg/L <30mg/L <1,000mg/L</i>
Watercourse	<i>Safe to humans and wildlife</i>	<i>Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use</i>	<i>Hazard assessment</i>	<i>No significant difference</i>
	<i>Stable</i>	<i>Rehabilitation is erosionally stable</i>	<i>Geomorphic index (IDC method)</i>	<i>Greater or equal to upstream or downstream values</i>
	<i>Non-polluting</i>	<i>Rainfall from rehabilitation achieves relevant water quality objectives for receiving waters</i>	<i>pH EC Turbidity</i>	<i>Not significantly different to upstream values</i>
	<i>Able to sustain the agreed post-mining land use</i>	<i>Riparian vegetation</i>	<i>Riparian vegetation index (IDC method)</i>	<i>Greater or equal to upstream or downstream values</i>

6.1.2 Progressive Rehabilitation and Closure Plan

The *Mineral and Energy Resources (Financial Provisioning) Act 2018* (MERFP Act) amended the EP Act to introduce the requirement for each EA holder to prepare a PRCP.

The PRCP requires the EA holder to plan for how and where activities will be carried out on the land in a way that maximises the progressive rehabilitation of the land to a stable condition. It consists of two (2) parts: a rehabilitation planning component, and a schedule.

The rehabilitation planning part includes site information, rehabilitation methodologies, and justification of the post-mining land uses, non-use management areas and rehabilitation timings. The PRCP schedule includes maps that identify the post-mining land uses and rehabilitation and improvement areas, as well as rehabilitation and management milestones, milestone criteria, schedule timings, and conditions imposed by DES.

BMA is currently preparing a transitional PRCP for the CVM for submission (due December 2023) to DES for approval. The PRCP will include the Project.

Until approved and in place, operations at the CVM will continue to undertake rehabilitation to meet the existing EA conditions.

6.2 Post Mining Land Uses

The location and extent of each post mining land use (PMLU) are developed based on a variety of parameters including but not limited to:

- Post-mining landform
- Available topsoil quantity and quality
- Pre-mining land use
- Existing vegetation and ecological values
- Relevant watercourses

The PRCP (described above) will include maps and schedules identifying each of the PMLUs and the schedule for rehabilitation. The PRCP is currently under preparation however preliminary analysis identifies that the PMLU for the CVM will be dominated by woodland habitat PMLU with other areas for cattle grazing, and watercourses maintained across the landscape. The CVM will have residual voids, including one at the eastern extent of Horse Pit. Analysis undertaken estimates woodland habitat to represent in the order of 60-70% and cattle grazing to represent in the order of 20% of the total CVM however these numbers are still to be finalised and should be considered indicative only.

Areas adjoining undisturbed Endangered or Of Concern regional ecosystems, or threatened fauna species habitat, will be rehabilitated to a woodland habitat PMLU, where possible, and disturbed areas of watercourses will be rehabilitated to a watercourse PMLU. This approach will connect existing habitat values for threatened fauna species, including koala, greater glider, squatter pigeon and ornamental snake, to larger areas of woodland habitat or riparian vegetation. Maintaining waterways through landscape allows for connectivity values provided by these corridors to be upheld across the landscape from the east to the west. Outcomes relating to threatened species are discussed in Section 6.5.

6.3 Rehabilitation Procedures and Achieving Acceptance Criteria

The overarching rehabilitation process at BMA can be described as a continuous improvement process, which is in line with BMAs EMS. **Figure 6-1** summarises the continuous improvement process and framework utilised to plan for, implement rehabilitation, review rehabilitation success, assess aspects for improvement, identify contingency measures and continue towards rehabilitation objectives. It aligns with the PLAN > DO > CHECK > ACT framework, which is a key feature of the BMA EMS.

The process involves the initial execution of the rehabilitation, followed by verification of how this execution was undertaken. Based on verification outcomes, allowance is made for implementation of corrective actions and/or maintenance, as needed. The rehabilitated areas as well as corrected and/or maintenance areas then undergo further rehabilitation monitoring, and subsequent execution of the rehabilitation measures. This process allows for a repetitive execution-verification-monitoring Quality Assurance (QA) /Quality Control (QC) approach, for the objectives of achieving rehabilitation success.

The graphic in **Figure 6-1** highlights key aspects of each phase. Rehabilitation planning (PLAN) commences up to a year prior to sowing, with identifying the new soil profile requirements and testing chemical and physical fertility. The outcomes of the planning drives preparation for any required amelioration and fertiliser, appropriate seed mixes (and sourcing those) and identification of specific techniques as well as erosion planning and management.

The DO phase focuses on physical methods of land preparation (e.g., materials and geometry), vegetation establishment (e.g., germination using appropriate seed/tube stock and fit-for-purpose equipment) and maintenance (e.g., weed control, erosion management). This is effectively the execution of the rehabilitation.

Monitoring is used to CHECK progress of the rehabilitation, monitor against success criteria and importantly, inform development of annual rehabilitation maintenance plans as required. A maintenance plan outlines maintenance needs and rework activities (as required). This verification process allows for progress to be assessed on a trajectory towards achievement of acceptance criteria and eventual certification.

In the event issues in rehabilitation processes and outcomes are identified an investigation is undertaken, problems and inefficiencies or opportunities for improvement or new technologies/knowledge can feed into (ACT) maintenance plans or inform review of planning phase.

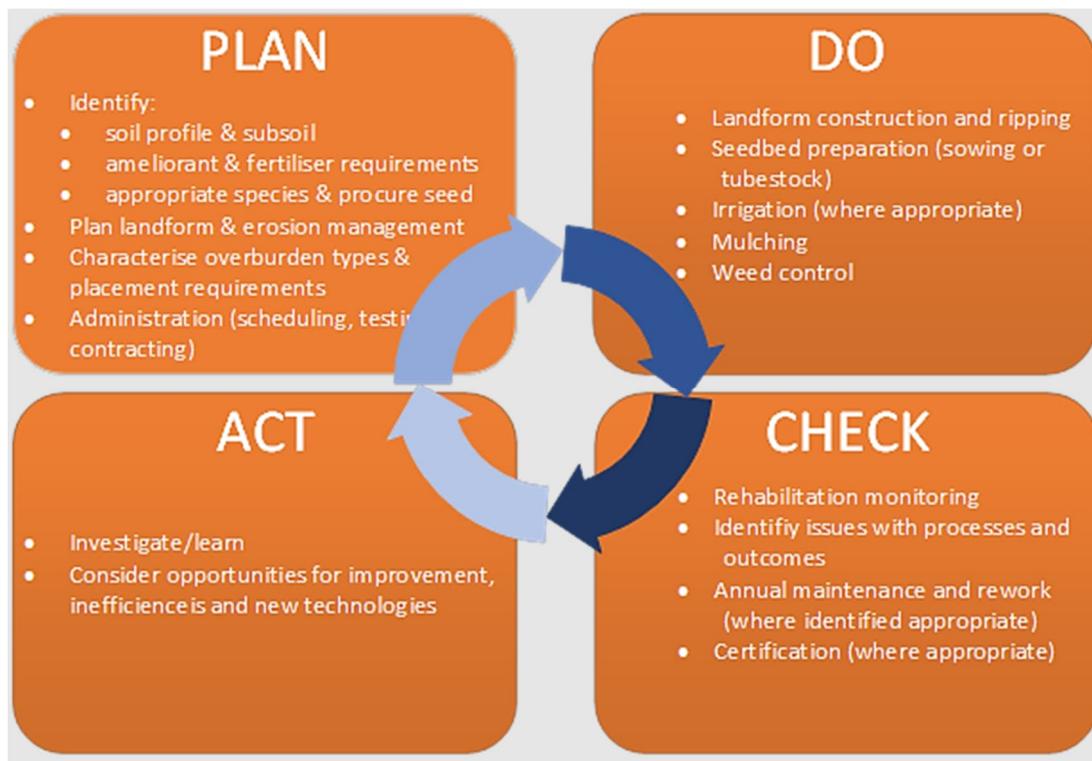


Figure 6-1 Overview of Rehabilitation Process

6.4 Rehabilitation Monitoring

Condition E7 of the EA requires BMA to conduct rehabilitation monitoring once rehabilitation has commenced at an interval of no greater than two (2) years. Monitoring must include sufficient spatial and temporal replication to enable statistically valid conclusions.

Rehabilitation monitoring at the CVM includes both rehabilitation inspections for newly rehabilitated areas and comprehensive rehabilitation monitoring, which is conducted initially for the first two (2) years and on a regular basis thereafter until performance criteria are met at which point monitoring is undertaken less frequently. All rehabilitation undertaken for Project activities will be incorporated into the existing monitoring schedule.

Current monitoring, methods, and performance criteria are summarised in **Table 6-2**, noting these may further develop as closure planning progresses (i.e. the PRCP). Once an area has commenced rehabilitation it is inspected after three (3) months or the first rain event (whichever occurs first). The purpose of the inspection is to assess vegetation establishment, topsoil/alternate growth media coverage and erosion, and drainage.

Table 6-2 Rehabilitation Monitoring Elements and Performance Criteria

Aspect of Rehabilitation	Monitoring Method	Performance Criteria
Land Use		
Land use and connectivity (i.e. habitat corridors)	Visual inspection and aerial photography to identify use and connectivity to surrounding land use	Area accomplishes and remains as a healthy working bushland ecosystem.
Soil		
Soil and spoil	Sampling	NA

Aspect of Rehabilitation	Monitoring Method	Performance Criteria
	Results are assessed to determine amelioration requirements for materials available for rehabilitation.	While there is no specific criteria to be achieved it is recognised that understanding the soil condition is a key component to determining if corrective action is required in order to achieve successful rehabilitation outcomes.
Vegetation		
Ground cover	1 x 1m plots along 50m transect measuring % ground covered by grass, forbs, shrubs, organic litter, rocks and bare ground	Minimum of 70% vegetative cover is present (or 50% if rocks, log or other features of cover are present). No bare surfaces >20m ² in area of >10m in length down slope. Vegetation develops and maintains a litter layer evidenced by a consistent mass and depth of litter over subsequent seasons.
Community structure	Large trees in 100 x 50m plots including native tree species richness, tree canopy height (8), diameter at breast height (8) (eucalypts and non-eucalypts) and plant health	Comprise a mixture of native trees, shrubs and grasses representative of regionally occurring woodland to open forest where possible. More than 75% of shrubs and/or trees are healthy when ranked healthy, sick or dead.
	Tree and shrub canopy cover along 100m transect measuring type and distance	
	Coarse woody debris in 50 x 20m plots measuring length and diameter	
	Native shrubs, grass and forbs in a 50 x 10m plot measuring species richness and plant health	
	Seedlings in 50 x 10m plot measuring species richness, numbers and height (8)s, and evidence of reproductions/regeneration (flower heads, fruits, seeds)	Species are capable of setting viable seed, flowering or otherwise reproducing. Evidence of second generation of tree-shrub species.
Habitat	Visual inspection and aerial photography to determine availability and variety of food sources and shelter, and presence of free water	Typical food, shelter and water sources required by the majority of fauna inhabitants of that ecosystem type are present, including: a variety of food plants; evidence of active use of habitat provided during rehabilitation such as nest boxes, stags and logs and signs of natural generation of shelter sources including leaf litter. Presence invertebrate species involved in different ecological processes (including termites for soil structure, Collembola for decomposition, Hemiptera for herbivory and predatory groups such as arachnids, centipedes, earwigs, cockroaches and ants as indicators of a range of other processes).
Resilience to disturbance	Visual inspection and aerial photography to determine presence of disturbance such as wildfire, grazing, non-native species and regeneration (resulting from fire)	Established species survive and/or regenerate after disturbance. Weeds do not dominate native species after disturbance or after rain. Pests do not occur in substantial numbers or visibly affect the development of native plant species.
Fauna		
Vertebrate species	Trapping, searches, surveys and inferential evidence (to commence when vegetation provides sufficient habitat cover for fauna)	Representation of a range of species characteristics (e.g. activity pattern, habitat usage, diet, dispersal character) from each faunal assemblage group (e.g. reptiles, birds, mammals), present in the ecosystem type. Presence of species of conservation significance (sightings or indicators).
Landform stability		
Slope gradient	Survey measurement of slope gradient	EA criteria, dependant on post mining land use.

Aspect of Rehabilitation	Monitoring Method	Performance Criteria
Erosion	Visual inspections and use of high-resolution aerial photographs) and GIS software	Erosion control structures are installed commensurate with slope of the landform.
Surface Water		
Water Quality	Water and soil sample collection and analysis	Receiving waters affected by surface water runoff have contaminant limits of electrical conductivity maximum of 1,000uS/cm and pH range of 6.5 to 8.5.
Surface Water Drainage	Visual inspection following rainfall	Sediment laden runoff flows into sediment dams and clean runoff flows into drainage lines/creeks.

Monitoring is a key component of the Rehabilitation Process with results providing opportunity for targeted investigations/analysis to inform action (ACT) whether it be related to maintenance or rework, certification of acceptance or allowing for informed planning. This monitoring approach is currently undertaken at the CVM and will continue to be applied for the Project activities.

6.5 Potential Environmental Outcomes for Threatened Species

Rehabilitation activities will focus on delivering a safe, stable and non-polluting state, able to sustain an agreed post-mining land use, in accordance with the CVM EA. The post-mining land use will determine the type of self-sustaining ecosystem that will be established by rehabilitation activities. Post-mining land uses conditioned in the EA (Table E1) include cattle grazing, dryland cropping, woodland habitat, water storage and watercourse.

Given the change in landform as a result of mining, there is potentially alternative ecosystem functions and microhabitats to that currently known within the Project area to be established, hence the concept of predicting suitability for threatened species is challenging. Through assessment of the goals of the post-mining land uses planned, some features may be known as suitable habitat values for threatened species. **Table 6-3** shows potential linkages between the post-mining land use features and threatened species habitat requirements. The realisation of these features as habitat for threatened species will be dependent on a variety of factors.

Table 6-3 *Summary of Potential Environmental Outcomes for Threatened Species*

Post-mining land use	Features	Potential linkage with threatened species habitat requirements
Cattle grazing	<ul style="list-style-type: none"> Predominant pre-mining land use >50% groundcover 70% of slopes <20% <250 stems of Leucaena per ha Pasture grass seed mix 	Potential habitat values for: <ul style="list-style-type: none"> King Bluegrass; and squatter pigeon.
Dryland cropping	100% cultivation at >1% slope with functional contour banks.	None known.
Woodland habitat	<ul style="list-style-type: none"> Groundcover >80% on steep slopes, >50% on lesser slopes Bushland habitat species richness >16% tree canopy cover Proven native tree and shrub species used for seed mix Recommended seed mix includes Eucalyptus, Corymbia and Acacia species 	Potential habitat values for: <ul style="list-style-type: none"> King Bluegrass; squatter pigeon; ornamental snake; and Poplar Box Grassy Woodland on Alluvial Plains.
Water storage	Minor dams and storages for irrigation, stock and domestic supplies.	Potential habitat values for: <ul style="list-style-type: none"> squatter pigeon.

Post-mining land use	Features	Potential linkage with threatened species habitat requirements
Watercourse	Riparian vegetation not significantly different to upstream and downstream reaches.	Potential habitat values for: <ul style="list-style-type: none"> • squatter pigeon; and • ornamental snake.

Due to the changes in landform and biotic/abiotic factors (e.g. soil composition and nutrient) resulting from disturbance activities associated with mining activities, the effectiveness of rehabilitation efforts in providing habitat values for threatened species following closure of the CVM is difficult to determine. The proposed Rehabilitation Performance Criteria detailed within **Table 6-2** will assist in re-instating foraging resources (e.g. native species composition, water quality) and microhabitat features (e.g. ground cover, litter cover, coarse woody debris etc.) for local fauna and flora assemblages previously impacted from the Project. These rehabilitation efforts are also likely to be beneficial to listed species impacted by the Project. Rehabilitation and revegetation associated with woodland habitat and cattle grazing areas are likely to provide potential foraging resources for native species, including the EPBC Act-listed squatter pigeon (southern subspecies). Due to the specific microhabitat requirements for some listed species, such as ornamental snake, the return of suitable breeding habitat within areas of previous disturbance (e.g. areas adjacent to the void) may take a longer period of time to re-establish (if at all).

Rehabilitation and landform stabilisation following closure of the CVM will also improve habitat connectivity and fauna movement opportunities within the landscape. Although key movement corridors associated with major watercourses within landscape (i.e. Cherwell Creek and Harrow Creek) have been retained within the existing CVM lease and will be avoided by the Project, existing mining activities within the adjacent areas have created potential barriers to movement within the landscape. Landform stabilisation and rehabilitation of disturbance areas to post-mining land uses identified within the EA will assist in improving permeability and reduce fauna reliance on narrow 'bottlenecks' associated with these retained riparian corridors.

7 Offsets

A significant residual impact assessment (refer to **Section 5.7** and **Appendix C**) was undertaken in accordance with Commonwealth *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DotE, 2013) to determine if significant impacts will result from the Project. The assessment identified the Project was likely to have a significant residual impact on:

- King bluegrass (*Dichanthium queenslandicum*) habitat; and
- Ornamental snake (*Denisonia maculata*) preferred habitat.

No significant residual impact on the squatter pigeon (southern subspecies) (*Geophaps scripta scripta*) or Australian painted snipe (*Rostratula australis*) was considered likely to occur.

The following documents are included as part of the Preliminary Documentation:

- Project Environmental Offset Strategy (E2M, 2022a) – **Appendix L**;
- Project Offset Area Management Plan – Inderi (E2M, 2022b) – **Appendix M**; and
- Project Offset Area Management Plan – Croydon (E2M, 2022c) – **Appendix N**.

The purpose of the Environmental Offset Strategy (EOS) is to detail the offsets that will be delivered to counterbalance the significant residual impacts of the Project. The Offset Area Management Plans (OAMP) will guide the ongoing management and monitoring of the offset areas and will be implemented for the life of the offset.

7.1 Offset Areas

Two (2) suitable offsets areas have been identified to acquit significant residual impacts resulting from the Project for king bluegrass and ornamental snake. These offset areas, which will be legally secured and managed to offset the Project's offset obligations, include:

- Inderi property - an area on Lot 55 on Plan DSN318; and
- Croydon Station – an area on Lot 4 on Plan KL210.

Associated significant impacts on king bluegrass will be offset by habitat identified within the Inderi property whereas Croydon Station will compensate for Project impacts to the ornamental snake. The respective offset areas are described further below.

7.1.1 Inderi property

The Inderi property supports 1,800 to 2,000 head of cattle across 3,033.52 ha of natural grasslands, open woodlands and stands of leucaena (*Leucaena leucocephala*) on gently undulating rises. The property is located approximately 20 km northwest of the township of Rolleston and 242 km south of the CVM. The Inderi property location is provided on **Figure 7-1**.

The Inderi property is proposed as a proponent-driven, land-based offset and investigated specifically for its potential to acquit the Project impacts to:

- King bluegrass habitat (MNES); and
- A MSES (Regulated Vegetation containing 'of concern' RE 11.8.11 (BVG 30b)).

The Inderi property already supports three (3) other offset areas (two (2) in progress and one (1) established) including a 137.2 ha BMA offset secured in 2014.

7.1.1.1 Inderi Offset Area

Offset suitability assessments were completed over Inderi. Following the completion of the field surveys and identification of target offset matters, a subset of the Offset Investigation Area (OIA) (i.e. the Inderi Offset Area) was determined based on the availability of suitable habitat and vegetation to acquit offset requirements for king bluegrass and Regulated Vegetation containing 'of concern' RE 11.8.11 (BVG 30b) (MSES). The Inderi Offset Area

spans 71.43 ha and is outlined on **Figure 7-2**, along with the adjacent offset areas secured by BMA and other parties. The Inderi Offset Area will include the following:

- 33 ha required to offset EPBC Act obligations (i.e. king bluegrass habitat); and
- 34 ha required to offset the MSES under the Queensland *Environmental Offsets Act 2014* (i.e. Regulated Vegetation containing 'of concern' RE 11.8.11 (BVG 30b)).

The Inderi OAMP further details the management of the offset and is summarised in **Section 7.2.3** and attached under **Appendix L**.

7.1.1.2 Inderi Existing Environment

A summary of the existing environment at Inderi is provided below and detailed in Section 3 of **Appendix M**.

Survey Conditions

The Inderi OIA and Offset Area was surveyed by two (2) ecologists on the 10th and 11th May 2021. Survey conditions during the field survey were dry, with temperatures ranging from 11.4°C to 31.5°C2. Below average rainfall was recorded during the three (3) -month period (i.e. February, March and April) preceding the field survey, recording a total of 67.6 mm (Bureau of Meteorology (BOM) 2021). As such, conditions for identification of annual groundcover species, including grass and forb species, were not considered optimal.

Vegetation communities

A total of three (3) REs were identified within the Inderi OIA, comprising remnant, regrowth and non-remnant vegetation. The majority of the OIA was found to contain remnant and non-remnant grasslands consistent with RE 11.8.11 and eucalypt sparse open woodlands, characteristic of RE 11.8.5.

Within the Inderi Offset Area, three (3) REs were identified, comprising the following:

- Non-remnant grasslands, consistent with RE 11.8.11, were dominated by introduced species;
- Remnant RE 11.8.5 areas were observed on undulating rises and upper slopes; and
- A small area of non-remnant RE 11.3.3a was also observed in association within ephemeral drainage lines.

Flora habitat values

King bluegrass was identified during the May 2021 field survey within the OIA. Despite the dry conditions, king bluegrass was recorded at two (2) locations in a remnant grassland and open woodland communities (REs 11.8.11 and 11.8.5) within the Inderi OIA. The species has also been previously recorded within the adjacent BMA offset area. The Inderi OIA supports approximately 356 ha of king bluegrass habitat in association with remnant and non-remnant vegetation.

Although no king bluegrass individuals were observed within the Inderi Offset Area during the May 2021 field survey, approximately 67 ha of suitable habitat was present, comprising remnant RE 11.8.5 and non-remnant RE 11.8.11. Given the proximity to confirmed records of the species, coupled with active management identified within the OAMP, the suitable habitat is considered likely to support populations of the species over the duration of the offset.

The Inderi Offset Area also contains areas of DoR mapped essential habitat for king bluegrass associated with DoR mapped Remnant vegetation containing RE 11.8.5. These areas are associated with the record detected within the existing BMA offset area established in 2014.

7.1.1.3 Inderi Offset Suitability

The EPBC Act Environmental Offsets Policy (EOP) requires that offsets must deliver an overall conservation gain that compensates for the significant residual impacts associated with the Project. In addition, the EOP is accompanied by the Offsets Assessment Guide which is a practical tool using a balance sheet approach to compare impacts to offsets for threatened species and ecological communities.

The offset proposed meets the offset requirements of the EOP. Compliance of the Inderi Offset Area with the EOP and the assessment against the Offset Assessment Guide is demonstrated under Section 6 of **Appendix L**.

A summary of the target MNES for the Project and corresponding offset values within the Inderi Offset Area is provided in **Table 7-1**.

Table 7-1 *Inderi Offset Suitability*

Target Protected Matter	Impact Site			Inderi Offset	
	Significant Residual Impact (ha)	Offset Area required (ha)	Bio Condition site-attribute score (/10) ¹	Area within Offset Area (ha)	Bio Condition site-attribute score (/10) ¹
King bluegrass habitat	23.40	33 ²	3	66.61	5

¹ Rounded to whole number as per Commonwealth Offset Assessment Guide calculator format (Section 6 of **Appendix L**)

² Based on the EPBC Act Offset Assessment Guide (OAG) calculator (Section 6 of **Appendix L**)

Species presence

It is acknowledged that no king bluegrass individuals were observed within the Inderi Offset Area during the initial field surveys (May 2021). However, the species has been previously recorded in adjacent areas, including at an existing offset area on Inderi (EcoLogical Australia 2014), and additional nearby areas of suitable habitat. These records are less than 1 km south-east and approximately 3.5 km north-west of the proposed Inderi Offset Area in association with remnant RE 11.8.11. **Figure 7-3** shows the historical records of the species to the east and west in relation to the Inderi Offset Area.

The proposed Inderi Offset Area comprises non-remnant grassland consistent with RE 11.8.11 and remnant *Eucalyptus orgadophila* woodland (RE 11.8.5), both of which provide suitable king bluegrass habitat. The proposed Inderi Offset Area is located adjacent to an existing secured offset, which contains records of king bluegrass individuals (see **Appendix M** Inderi Offset Area Management Plan). The landzone and floristic characteristics within this existing secured offset are analogous to that within the proposed Inderi Offset Area (i.e. ecosystems that support natural grassland vegetation communities) and is under active management until 2034. Locating the proposed offset adjacent to another legally secured offset will enable the establishment of one contiguous habitat area and a cumulative conservation benefit for the threatened flora and vegetation communities targeted.

Bluegrass species (*Dichanthium spp.*) are known to spread by seed, through both wind dispersal as well as on animal coats and in mud on animal hoofs (Pastures Australia 2008). King bluegrass is also known to flower all year, although a peak flowering period is generally observed in March, usually after significant summer rainfall (Pastures Australian, 2008). Other bluegrasses (including *Dichanthium sericeum*, another central Queensland bluegrass species) are known to rapidly recruit new seedlings in wet warm conditions. The dispersive nature of the species, as well the contiguous nature of the proposed Inderi Offset Area with another offset containing bluegrass, provides suitable opportunities for king bluegrass to become naturally established in the Inderi Offset Area.

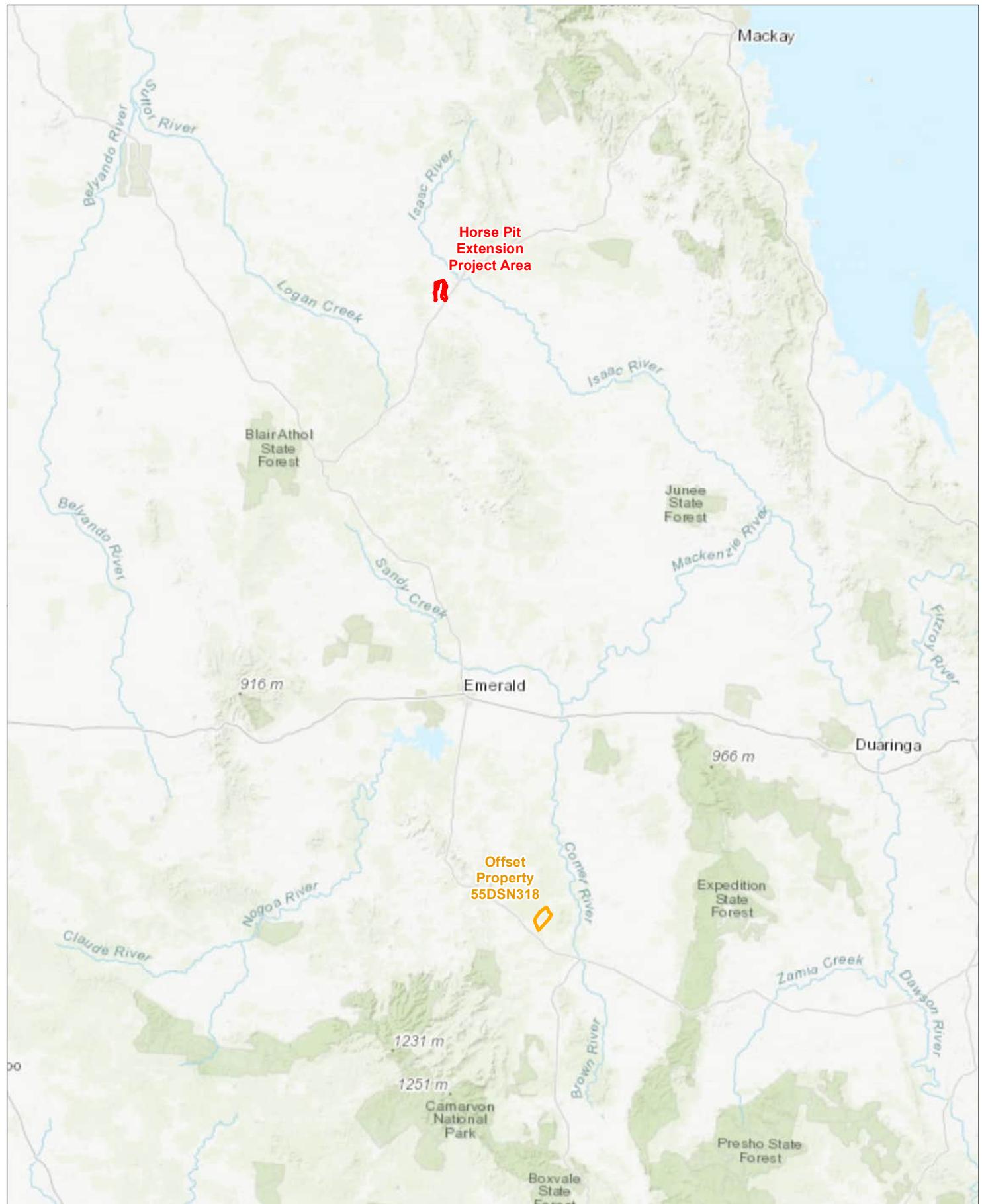
Additional work will be undertaken over the life of the offset to demonstrate presence of the species at the proposed Inderi Offset Area. Targeted king bluegrass surveys will be undertaken within the proposed offset area during optimal survey conditions (mid to late wet season, February to May) to identify species presence, stocking rate and density/population. These surveys will be undertaken annually for the first five years of the offset and then once every five years from year five to year 20. The OAMP outlines the key performance indicators (refer **Table 7-2** below) of the species being recorded within the Inderi Offset Area during optimal survey conditions and the presence of the species within the Inderi Offset Area being maintained over the duration of the offset.

The completion criteria for the offset are explicit in stating the species must be identified within the Offset Area. Corrective actions have been developed to be implemented based on the results of the target surveys. Actions may include active seeding of king bluegrass within the Offset Area. King bluegrass is able to have seed harvested and used for active seeding in species re-establishment areas as demonstrated in Bush Heritage's Carnarvon Station Reserve (Bush Heritage 2021). In addition to this example, there are good quality guidelines available for the successful re-establishment of native grasslands using seed (NSW Government 2001). It is therefore considered

very low risk that the completion criteria for species presence within the Offset Area will not be met, either via natural dispersal from neighbouring populations and/or via direct measures such as seeding.

Table 7-2 Monitoring actions for king bluegrass presence as per Inderi OAMP

Aspect	Action
Timeframe and frequency	Targeted surveys during optimal survey condition (i.e. mid to late wet season (February to May)) are to be conducted annually for first five years (Year 1 – Year 5) and then once every five years to Year 20.
Monitoring activity	Targeted king bluegrass surveys
Attribute monitored	Species presence and stocking rate: <ul style="list-style-type: none"> Presence within the Inderi Offset Area Species usage of Offset Area Density/populations
Method	Random meander technic (Cropper 1993) Population surveys in accordance with the <i>Flora Survey Guidelines Protected Plants</i> (DES 2020).
Location	Inderi Offset Area
Key performance indicators	<ul style="list-style-type: none"> The species is recorded within the Offset Area during optimal survey conditions; and The presence of the species within the Offset Area is maintained over the duration of the offset.
Possible corrective actions	Corrective actions will be determined firstly through an investigation (CHECK-ACT) to identify drivers. If the number/ extent of populations detected have reduced and is significantly different (+ standard error of the mean) to previous monitoring results, an investigation into possible causes for a decline will be undertaken. A suitably qualified flora ecologist/botanist will be consulted to inform the development of scientifically robust management actions and possible corrective actions. Corrective actions and suitable corresponding monitoring actions will be documented and incorporated into the OAMP revisions where required (ACT-PLAN). Corrective actions will be implemented as part of the DO component of the Offset Management Framework where the feedback loop allows for continuous improvement. Examples of possible corrective actions may include: <ul style="list-style-type: none"> Livestock exclusion or revision of stocking densities Additional weed removal/control Active seeding of king bluegrass



Projection: GDA 1994 MGA Zone 55

Scale: 1:1,975,000 at A4

Project No.: 620.13593

Date: 01-Sep-2022

Drawn by: JG

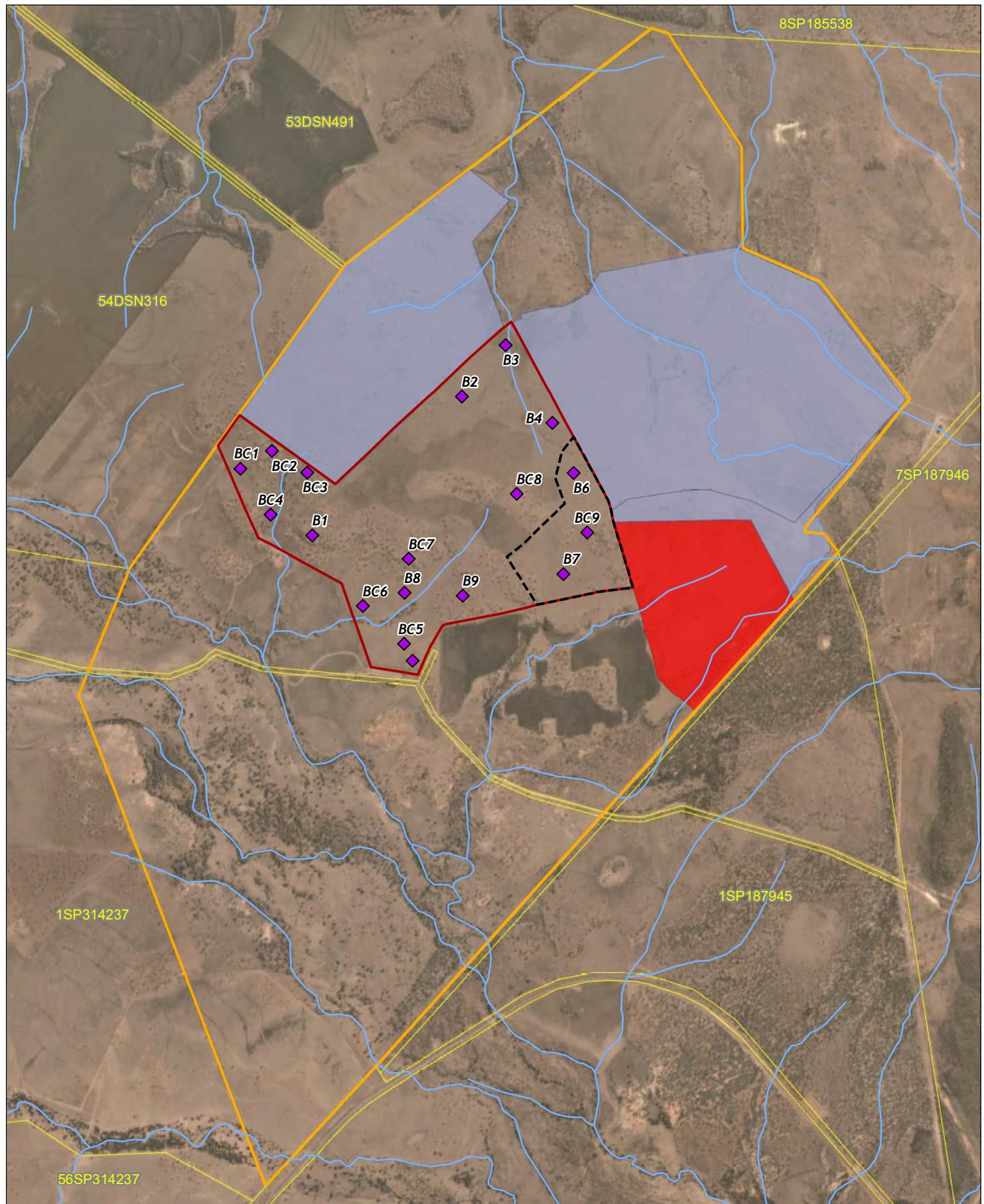
Project Area
Offset Property

**Horse Pit Extension Project
EPBC Act Preliminary
Documentation
(EPBC 2021/9031)**

Inderi Property Location



FIGURE 7-1



Projection: GDA 1994 MGA Zone 55

Scale: 1:40,000 at A4

Project No.: 620.13593

Date: 01-Sep-2022

Drawn by: JG

- ◆ Biocondition Site
- Area surveyed during initial suitability assessment (Offset Investigation Area)
- Watercourses
- Offset procurement in progress by other parties
- Cadastre
- Existing BMA Offset Category A Area
- HPE Offset Area
- Offset Property

**Horse Pit Extension Project
EPBC Act Preliminary
Documentation
(EPBC 2021/9031)**

**Inderi Property
Offset Area**



FIGURE 7-2

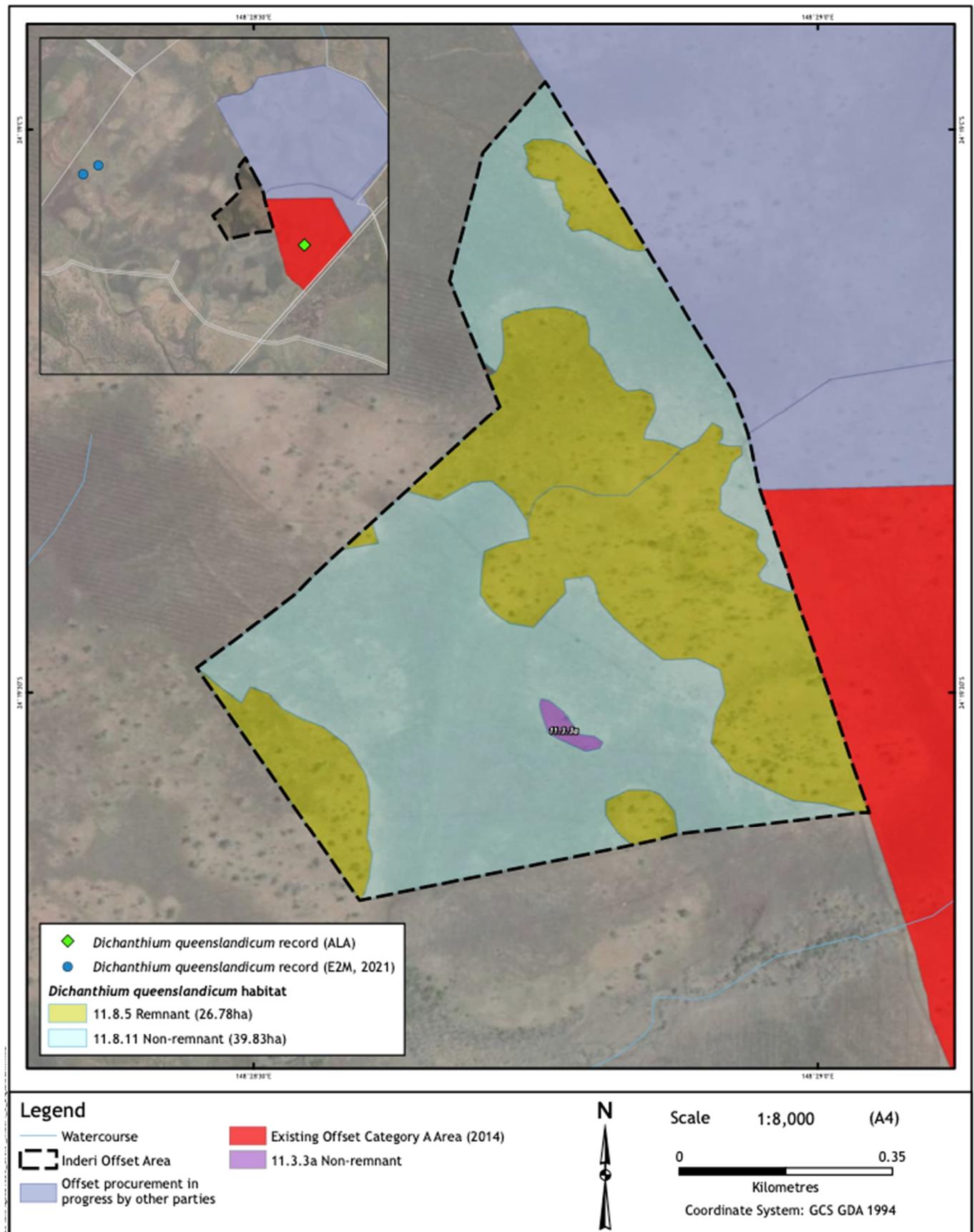


Figure 7-3 King bluegrass records to the east and west of the Inderi Offset Area

Achieving a conservation gain for king bluegrass

As per the EPBC Act Environmental Offsets Policy (DSEWPaC, 2012), a *conservation gain* is the benefit that a direct offset delivers to the protected matter, which maintains or increases its viability or reduces any threats of damage, destruction or extinction. A *conservation gain* may be achieved by:

- Improving existing habitat for the protected matter
- Creating new habitat for the protected matter
- Reducing threats to the protected matter
- Averting the loss of a protected matters or its habitat that is under threat.

The proposed Inderi Offset Area seeks to achieve a conservation gain for king bluegrass via improvement of existing habitat and reducing threats to the species. Known key threats to the species include loss of habitat through agriculture and mining activities, road construction and other infrastructure developments. An additional known threat is unsustainable grazing levels and weeds (DSEWPaC 2013). Habitat within the Inderi Offset Area is in moderate condition (quality score of 5), with initial surveys (May 2021) identifying a number of threatening processes to king bluegrass including overgrazing and environmental weeds at the proposed offset area. The OAMP has designed management actions to improve habitat and address the threatening processes present. Management actions for the offset site will aim to:

- Mitigate adverse impacts from grazing
- Control and minimise environmental weeds
- Restrict habitat loss, disturbance and modification.

Collectively these measures are designed to improve habitat for (as yet undetected) individuals that may currently be present in the offset area and to improve conditions such that recruitment of additional individuals will be supported and a local population within the offset site be enhanced or established. If necessary, this will be supplemented by active measures to establish a population, including direct seeding.

A range of conservation priorities and objectives for king bluegrass are presented in two documents:

- Approved Conservation Advice for *Dichanthium queenslandicum* (king blue-grass) (DSEWPaC 2013)
- Draft Recovery plan for the Bluegrass (*Dichanthium spp.*) dominant grassland of the Brigalow Belt Bioregions (north and south) endangered ecological community, 2007-2011 (Butler 2007).

Table 7-3 provides an assessment of each priority conservation action and how the offset meets or supports these actions, thereby delivering a conservation gain for the species.

Table 7-3 How the offset supports king bluegrass conservation objectives and priorities

Theme	Objective or priority	How the offset meets these objectives or priorities
Approved conservation advice regional priority recovery and threat abatement actions (DSEWPaC 2013)		
Habitat loss, disturbance and modification	Monitor known population to identify key threats.	<p>The known key threats to the species include loss of habitat through agriculture and mining activities, road construction and other infrastructure developments. An additional known threat is unsustainable grazing levels and weeds.</p> <p>Baseline surveys of the offset site have identified grazing and weeds as threatening processes present. Management actions for the offset site will aim to:</p> <ul style="list-style-type: none"> • Mitigate adverse impacts from grazing • Control and minimise environmental weeds • Restrict habitat loss, disturbance and modification <p>Weed and groundcover monitoring will both be implemented to identify and assess how the offset is responding to the management of the key threats present.</p>
	Monitor the progress of recovery, including the effectiveness of management	The management of the offset site will be implemented in accordance with an offset management framework centred on an adaptive management cycle. The cycle is based on the Plan – Do – Check – Act

Theme	Objective or priority	How the offset meets these objectives or priorities
	actions and the need to adapt them if necessary.	<p>cycle provide in the overarching BHP Environmental Management System.</p> <p>A key aspect of the framework is the feedback cycle facilitated by checking outcomes of monitoring, investigating contributing factors to results not considered in line with milestones or Key Performance Indicators, adapting approaches to management (informed by experts where appropriate) with the aim of improving likelihood of success and finally circling back to updating documentation and work plans to ensure improved actions are then incorporated and implemented in future.</p>
	Identify populations of high conservation priority.	<p>Surveys have identified the presence across the property (albeit not within the nominated offset area), as well as less than 1 km south-east and 3.5 km north-west of the offset area.</p> <p>Targeted surveys and habitat assessment/utilisation survey for king bluegrass will be implemented to determine presence and relative abundance within the offset area.</p>
	Ensure there is no disturbance in areas where king blue-grass occurs, excluding necessary actions to manage the conservation of the species/ecological community.	<p>The offset area will be legally secured and restrictions will be put in place to ensure there is no disturbance in king bluegrass habitat. No vegetation clearing or intentional fires will be permitted over the duration of the offset area management plan. Any new firebreaks that need to be established will be co-located within existing access tracks and fence lines where possible to further reduce disturbance.</p>
	Investigate formal conservation arrangements, management agreements and covenants on private land, and for crown and private land investigate and/or secure inclusion in reserve tenure if possible.	<p>The offset area is private land, which will be legally secured via a Voluntary Declaration under the provisions of the Queensland Vegetation Management Act 1999 where the area is secured for the life of the approval, for the purposes of an environmental offset. The OAMP will be connected to the land title under these provisions.</p>
	Manage any other known, potential or emerging threats, including mining practices, grazing, weed invasion and climate change.	<p>Management actions for the offset site will aim to:</p> <ul style="list-style-type: none"> • Mitigate adverse impacts from grazing • Control and minimise environmental weeds • Restrict habitat loss, disturbance and modification <p>Periodic monitoring of the site as part of a larger adaptive management framework will continue to identify the presence and severity of key threats, and respond accordingly.</p>
Invasive weeds	Develop and implement a management plan for king blue-grass for the control of parthenium (<i>Parthenium hysterophorus</i>) and parkinsonia (<i>Parkinsonia aculeata</i>) in the region.	<p>Environmental weed species observed within the offset area include parthenium, <i>Opuntia</i> spp and wild gooseberry (<i>Physalis aguatica</i>).</p> <p>An environmental weed baseline assessment will be undertaken prior to the commencement of management actions to determine the composition, density and map key infestation areas within offset area. Once target weed species within the offset area are identified and primary infestation areas are identified, the level for weed control measures required within the offset area can be determined.</p>
	Ensure chemicals or other mechanisms used to eradicate weeds do not have a significant adverse impact on king blue-grass.	<p>Weed control techniques to be implemented in the offset area are to comprise two broad weed control methods; mechanical removal and chemical treatment. Where practicable, weed control will be undertaken by manual removal to minimise the chance of overspray and run-off of herbicides into the adjacent environs. Chemical control will only be undertaken by a suitably trained person (i.e. Agriculture Chemical Distribution Control certified) in accordance with the Material Safety Data Sheet (MSDS). Mixing of chemicals or rinsing of equipment should never occur adjacent to water bodies.</p>
Trampling, browsing and grazing	Develop and implement a stock management plan for roadside verges and travelling stock routes.	<p>The offset area does not comprise a roadside verge or travelling stock route, however stock management will be undertaken to minimise any adverse impacts from grazing.</p> <p>To mitigate the potential effects of overgrazing, exclusion fencing will be erected around the offset area to exclude cattle during the wet season (January to May) when native grass species go to seed. Easing grazing</p>

Theme	Objective or priority	How the offset meets these objectives or priorities
		<p>pressure when native grasses flower and set seed will promote natural regeneration, replenish the soil seedbank and improve species richness and ground cover.</p> <p>Cattle grazing is permitted within the offset area during the late dry season (June to December) to reduce fuel loads and fire risk, provided the minimum live groundcover threshold (50% or in accordance with Queensland government requirements if available) is maintained.</p>
Conservation information	Raise awareness of king bluegrass within the local community, for example distribute fact sheets/information brochures or conduct field days in conjunction with known industry or community interest groups.	Not applicable to the offset area or the proponent.
	Engage with private landholders and land managers responsible for the land on which populations occur and encourage these key stakeholders to contribute to the implementation of conservation management actions.	The offset area is located on private land and a formal agreement with the landholder is in place. The OAMP details the responsibilities the landholder has regarding implementation of management actions. The OAMP will be connected to the land title via legal securement of the offset, ensure that future landholders have the same responsibilities for conservation management.
	Enable recovery of additional sites and/or populations.	Not applicable to the offset area or the proponent.
	Undertake appropriate seed collection and storage.	
	Investigate options for linking, enhancing or establishing additional populations.	
Draft recovery plan (Butler 2007)	Implement national translocation protocols (Vallee et al., 2004) if establishing additional populations is considered necessary and feasible.	
	Promote landholder awareness of sustainable management practices, especially rest from grazing, and their importance to the preservation of bluegrass grasslands' environmental and pastoral values.	
	Encourage landholders to enter into conservation agreements over bluegrass grasslands.	
	Increase the area of bluegrass grassland in the conservation estate.	
	Help graziers to reduce overall grazing pressure on bluegrass grasslands and to spell grasslands during the summer growing season.	

Theme	Objective or priority	How the offset meets these objectives or priorities
	Help graziers to fence bluegrass grasslands out from other land types and to subdivide bluegrass grasslands to facilitate sound grazing management, including rest from grazing during critical periods in the summer growing season.	

7.1.2 Croydon Station

Croydon Station is a 58,669 ha cattle station located 100 km north of Marlborough and approximately 100 km east southeast of the Project Area. Croydon Station is situated in the Isaac-Comet Downs and Nebo-Connors Ranges biogeographic subregions and is bordered by the Connors Ranges to the east. The location of Croydon Station is provided on **Figure 7-4**.

Croydon Station is proposed as a proponent-driven, land-based offset and investigated specifically for its potential to acquit the Project impacts to ornamental snake habitat. The Croydon Station includes an existing offset area which has been secured by other parties over 360.54 ha (Category A) and is immediately adjacent to the Croydon OIA.

7.1.2.1 Croydon Station Offset Area

Offset suitability assessments were completed over Croydon Station. Following the completion of the field surveys and identification of target offset matters, a subset of the Croydon Station OIA (i.e. the Croydon Station Offset Area) was determined based on the availability of suitable habitat and vegetation to acquit offset requirements for ornamental snake. The Croydon Station OIA is mapped as non-remnant, brigalow (*Acacia harpophylla*) shrublands (RE 11.4.8/11.4.9). The Connors River (stream order 4) and two (2) unnamed stream order 3 tributaries traverse the Croydon Station OIA and serve as permanent water sources. The Croydon Offset Area spans 263.68 ha and is strategically located adjacent to the existing BMC offset area. The Croydon Station Offset Area will acquit the required 259 ha offset for ornamental snake required for the Project and is outlined on **Figure 7-5**.

The Croydon Station OAMP further details the proposed roll-out and management of the offset and is summarised in **Section 7.2.3** and attached under **Appendix N**.

7.1.2.2 Croydon Station Existing Environment

A summary of the existing environment at Croydon Station is provided below and detailed in Section 3 of **Appendix K**.

Survey Conditions

The Croydon Station OIA and Offset Area was surveyed by two (2) ecologists from the 12th to 15th May 2021. Survey conditions during the field survey were dry, with temperatures ranging from 11°C to 31°C. Recent rainfall data is limited for the area. Carfax weather station (034016) (approx. 35 km west of the Croydon Station OIA) recorded 24 mm of rainfall in February 2021 and 49 mm in March 2021 (no data for April 2021). Iffley weather station (approx. 60 km west of Croydon Station OIA) recorded 41 mm of rainfall in February 2021 and 25 mm in April 2021 (no data for March 2021). Based on available data and anecdotal evidence, Croydon Station has likely received limited rainfall (~100 mm) over the three (3) months preceding the field survey. Conditions during the field survey were dry and ground cover was limited.

Vegetation communities

Two (2) REs were identified within the Croydon Station OIA. The majority of the Croydon Station Offset Area was found to contain regrowth brigalow (*Acacia harpophylla*) as the ecologically dominant layer, consistent with RE

11.4.9. Multiple other associated shrub species were observed, and ground layer cover was limited and composed of mixed native and introduced grasses and forbs.

Fauna habitat values

Suitable habitat for ornamental snake was observed during the field survey. Approximately 723.5 ha of suitable ornamental snake habitat was ground-truthed within the Croydon Station OIA. Gilgai were observed throughout remnant, regrowth and non-remnant RE 11.4.8/11.4.9 and differed in size and depth, with varying soil crack depths (shallow to deep). Coarse woody debris was limited within these areas; however, the shrub cover (~19%) was relatively low to the ground (1.5 m tall) providing potential refuge for the species.

A total of 263.68 ha of suitable habitat for the ornamental snake was identified within the Croydon Station Offset Area. While no individuals were observed during the field survey, the species has been previously recorded during ecological surveys conducted for the existing BMC offset (Eco Logical Australia, 2016). These records were located within brigalow regrowth habitat, located on the eastern boundary of the Croydon Station Offset Area and areas to the east of Connors River.

7.1.2.3 Croydon Station Offset Suitability

The offset proposed meets the offset requirements of the EOP. Compliance of the Croydon Offset Area with the EOP and the assessment against the Offset Assessment Guide is demonstrated under Section 6 of **Appendix L**.

A summary of the target MNES for the Project and corresponding offset values within the Croydon Offset Area is provided in **Table 7-4**.

Table 7-4 Croydon Station Offset Suitability

Target Protected Matter	Impact Site				Croydon Station Offset		
	Significant Residual Impact (ha)	Offset Area required (ha)	Bio Condition site-attribute score (/10) ¹	Species-habitat attribute score (/10)	Area within Offset Area (ha)	Bio Condition site-attribute score (/10) ¹	Species-habitat attribute score (/10)
Ornamental snake	167.84	259.00 ²	4	6	263.68	3	7

¹ Rounded to whole number as per Commonwealth Offset Assessment Guide calculator format (Section 6 of **Appendix L**)

² Based on the EPBC Act Offset calculator using the site-attribute scores for both the project and offset areas (Section 6 of **Appendix L**)

Species presence

No ornamental snakes were recorded within the Croydon Offset Area during surveys undertaken in May 2021. It is acknowledged that surveys were undertaken outside of optimal conditions for detecting species presence, due to the cooler, night temperatures and dry conditions which reduce the availability of prey (i.e. frogs) and nocturnal activity (and likelihood of detection) of the species. The species is known to be relatively easy to detect in suitable habitat, and under the right environmental conditions (Department of Environment 2023) and as such, there is a commitment in the OAMP to complete surveys during optimal conditions (i.e. February – April following suitable rainfall).

A number of ornamental snake individuals have been recorded during previous field surveys within the adjacent existing offset area, and on Croydon Station. Five records of the species are situated to the east of the proposed Croydon Offset Area, with one record located on the boundary of the proposed Croydon Offset Area, as shown on **Figure 7-6**. Ornamental snakes are known to disperse across landscapes, with the species having been recorded 1 km away from suitable gilgai habitat in historic surveys. Given the contiguous nature of habitat between the proposed Offset Area and the nearby records, it is considered likely the species will be able to disperse between the two areas.

The Croydon Offset Area contains suitable habitat for the species, comprised of regrowth brigalow (*Acacia harpophylla*) shrublands (RE 11.4.9) containing an abundance of gilgai, shallow in depth and variable in size. It is noted that important habitat (of which, the Croydon Offset Area contains), is also considered a surrogate for important populations as per the Draft Referral Guidelines for the nationally listed Brigalow Belt reptiles (DSEWPaC 2011). Based on the availability of important habitat, the proximity of the boundary record, and the contiguous nature of the vegetation in which the individual was recorded, it is reasonable to conclude the ornamental snake would occupy the proposed Croydon Offset Area.

Targeted ornamental snake surveys will be undertaken as part of routine monitoring, to identify species presence, stocking rate and density/population. The OAMP outlines the key performance indicators of the species being recorded within the Croydon Offset Area during optimal survey conditions and the presence of the species within the Croydon Offset Area being maintained over the duration of the offset. Further, the completion criteria for the offset are explicit in stating the species must be identified within the Offset Area.

Achieving a conservation gain

As per the EPBC Act Environmental Offsets Policy, a conservation gain is the benefit that a direct offset delivers to the protected matter, which maintains or increases its viability or reduces any threats of damage, destruction or extinction. A conservation gain may be achieved by:

- Improving existing habitat for the protected matter
- Creating new habitat for the protected matter
- Reducing threats to the protected matter
- Averting the loss of a protected matters or its habitat that is under threat

The Croydon Offset Area seeks to achieve a conservation gain for ornamental snake via the improvement of existing habitat and reducing threats to the species. The main known threat to ornamental snake is land clearing and habitat degradation, particularly via cattle and feral pigs. Habitat within the Croydon offset Area is in poor condition (quality score of 3), with baseline surveys identifying a number of threats including previous periodic clearing of the brigalow regrowth and habitat degradation (wallows, trampling) from the confirmed presence of feral pigs.

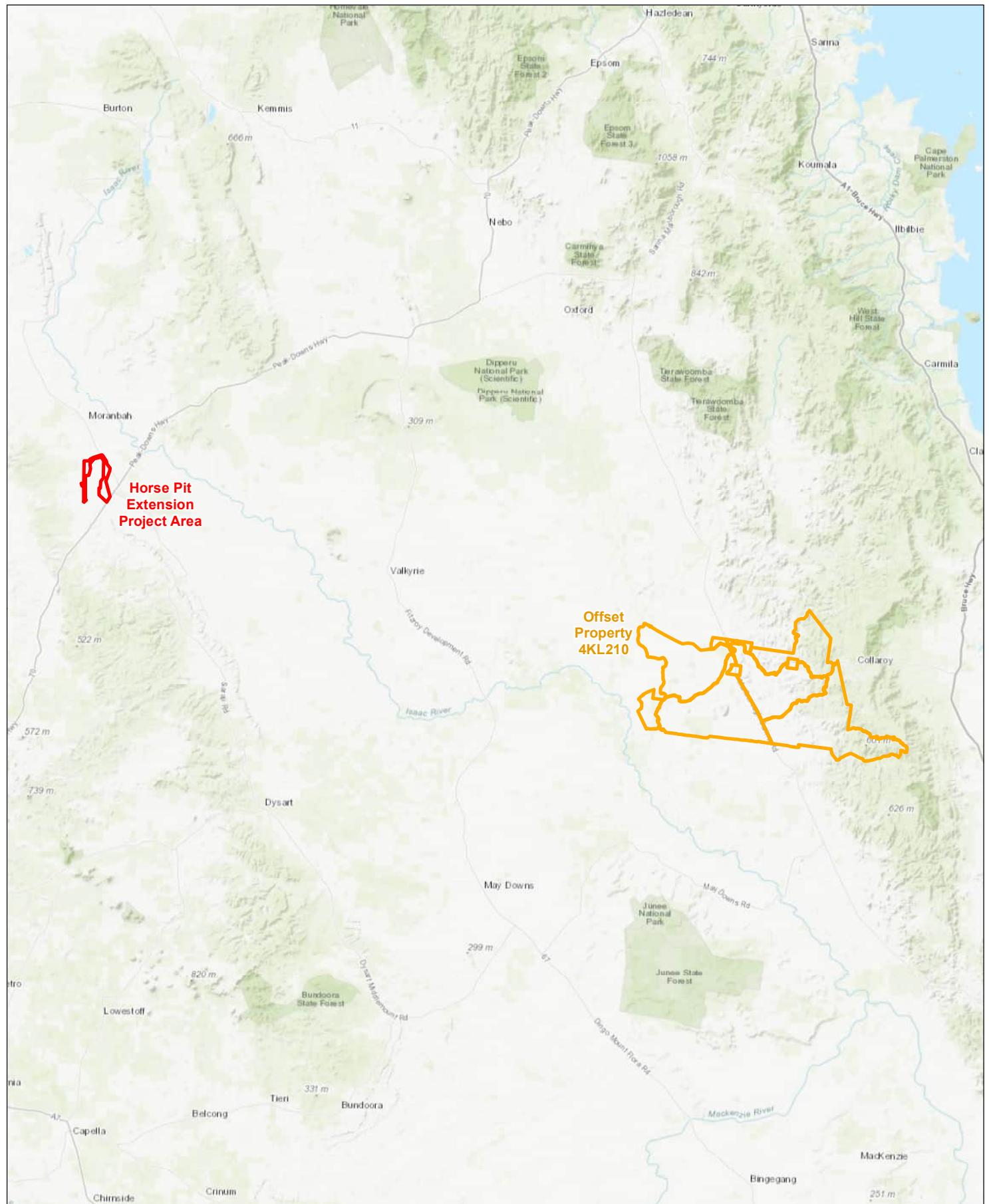
The OAMP includes targeted management actions to improve habitat and address the threatening processes present. The actions include:

- Feral pig control to reduce habitat degradation
- Controlled livestock grazing to prevent impact to microhabitat features
- Brigalow natural regeneration
- Establishment of offset area restrictions e.g. restricting vegetation clearing.

A range of conservation priorities and objectives for ornamental snake are presented in two documents:

- Approved Conservation Advice for *Denisonia maculata* (Ornamental Snake) (DotE 2014)
- Draft National Recovery Plan for the Queensland Brigalow Belt Reptiles (Richardson 2006).

Management actions within the OAMP centre on the regional and local priority actions outlined in the conservation advice. **Table 7-5** provides an assessment of each priority conservation action and how the offset meets or supports these actions, thereby delivering a conservation gain for the species.



Projection: GDA 1994 MGA Zone 55

Scale: 1:850,000 at A4

Project No.: 620.13593

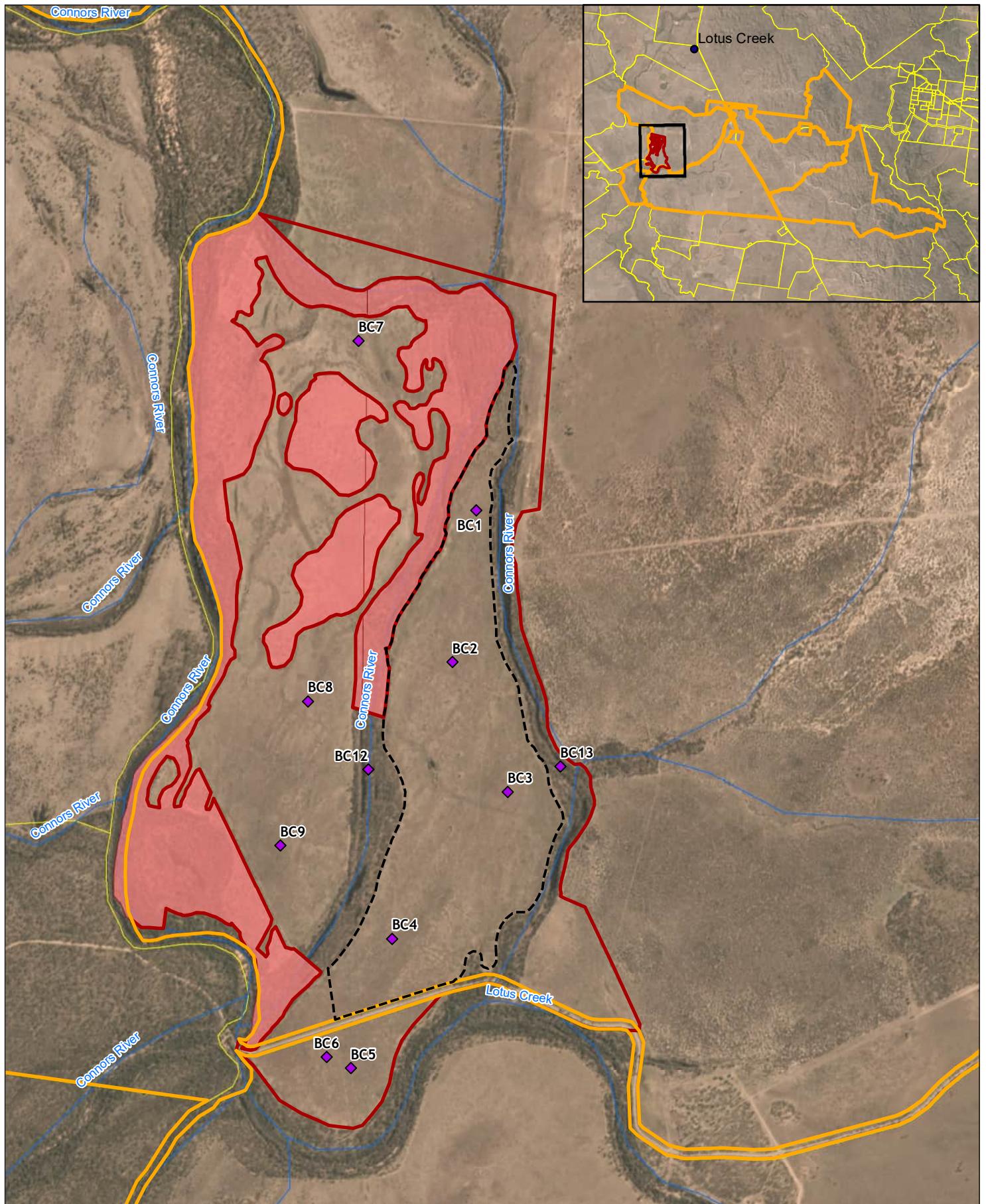
Date: 01-Sep-2022

Drawn by: JG

■ Project Area
■ Offset Property

**Horse Pit Extension Project
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Croydon Station Location



Projection: GDA 1994 MGA Zone 55

Scale: 1:32,000 at A4

Project No.: 620.13593

Date: 01-Sep-2022

Drawn by: JG



BHP Mitsubishi Alliance

- ◆ Biocondition Site
- Offset Property
- Watercourses
- Roads
- Cadastre
- Area surveyed during initial suitability assessment (Offset Investigation Area)
- HPE Offset Area
- Existing BMC Offset (Cat A Area)

**Horse Pit Extension Project
EPBC Act Preliminary
Documentation
(EPBC 2021/9031)**

**Croydon Station
Offset Area**

FIGURE 7-5

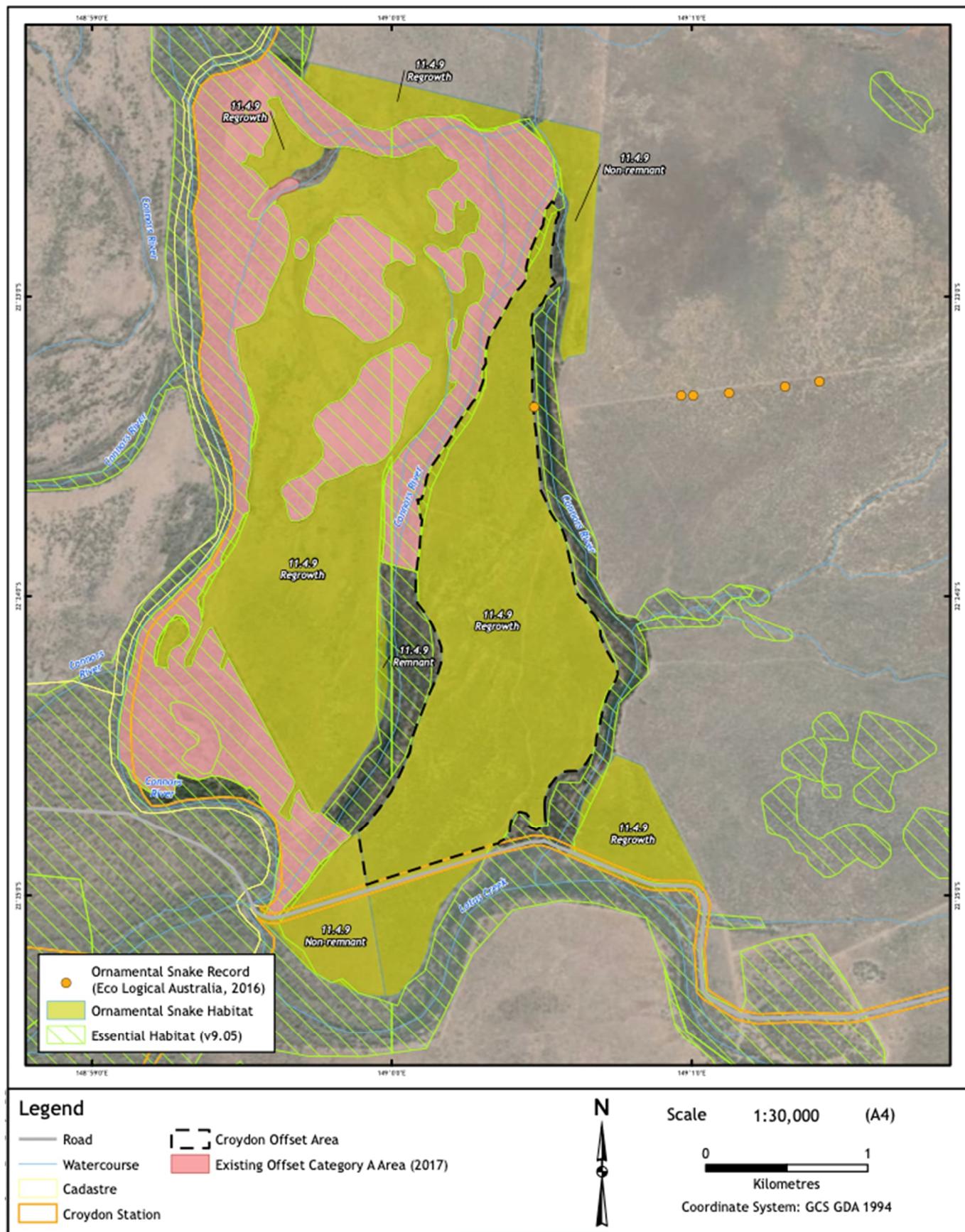


Table 7-5 *How the offset supports ornamental snake conservation objectives and priorities*

Theme	Objective or priority	How the offset meets these objectives or priorities
Conservation advice regional and local priority actions		
Habitat loss, disturbance and modification	Identify populations of high conservation priority	<p>No ornamental snake individuals were observed within the offset area, however the survey was outside the optimal survey period for the species. Previous field studies associated with the adjacent existing offset area have detected the presence of ornamental snake on Croydon Station in 2016. Five records of the species are situated to the east of the Croydon Offset Area, with one record located on the boundary of the offset area.</p> <p>Targeted ornamental snake surveys will be conducted within the offset area in accordance with Commonwealth Survey guidelines for Australia's threatened reptiles (DSEWPC, 2011) to determine the presence of ornamental snake within the offset area.</p>
	Investigate formal conservation arrangements, management agreements and covenants on private land, and for crown and private land investigate inclusion in reserve tenure if possible.	<p>The offset area is located on private land and a formal agreement with the landholder is in place. The OAMP details the responsibilities the landholder has regarding implementation of management actions. The OAMP will be connected to the land title via legal securement of the offset, ensure that future landholders have the same responsibilities for conservation management.</p>
	Minimise adverse impacts from land use at known sites.	<p>The main identified threat to the Ornamental Snake is a continued legacy of past broadscale land clearing and habitat degradation, particularly via agricultural and urban development.</p> <p>The offset area will be legally secured and restrictions will be put in place to ensure there is no disturbance to ornamental snake habitat. No vegetation clearing or intentional fires will be permitted over the duration of the offset area management plan. Livestock exclusion within the offset area is to take place during the wet season (January to May). Livestock grazing is permitted outside of these times provided the minimum live groundcover threshold (60% groundcover or 1,500kg/ha pasture biomass or in accordance with Queensland government requirements if available) is maintained.</p>
Animal impacts	Control introduced pests such as pigs to manage threats at known sites.	<p>Current control methods for feral pigs within Croydon Station and the adjacent existing offset area consist of annual baiting and periodic shooting. Poison baits is considered the most appropriate technique for achieving large-scale control. The bait material should be specific to the local diet of the pigs and therefore a grain bait is deemed appropriate for the Offset Area.</p> <p>The land manager may also remove any individuals encountered during monitoring events (i.e. periodic shooting). Where practicable, co-ordination of control measures associated with feral pig control will be undertaken in conjunction with actions implemented within the adjacent existing offset area. Similarly, an integrated control program may be developed in conjunction with Croydon Station manager or landholder and surrounding properties.</p>
	Develop and implement a management plan for the control of Cane Toads in the region.	Not applicable to the offset area or the proponent.
Conservation information	Raise awareness of the ornamental snake and other reptiles found in the Brigalow Belt Bioregion within the local community.	Not applicable to the offset area or the proponent.
Draft Recovery Plan for the Queensland Brigalow Belt Reptiles		
Recovery actions	Encourage involvement, provide incentives and adopt a collaborative approach with	Not applicable to the offset area or the proponent.

Theme	Objective or priority	How the offset meets these objectives or priorities
	<p>government agencies, NRM regional bodies, the Indigenous community, key industry stakeholders and local governments to deliver region-specific information and implement sustained, effective recovery actions.</p>	
	<p>Identify research priorities: develop and support the implementation of research projects undertaken by tertiary and research institutions.</p>	
	<p>Inspect and identify suitable habitat for conservation of the Ornamental Snake.</p>	<p>Ornamental snake habitat within the offset area is characterised by regrowth brigalow (<i>Acacia harpophylla</i>) shrublands adjacent to riparian communities. The regrowth brigalow community contains an abundance of gilgai, shallow in depth and variable in size.</p> <p>Brigalow vegetation communities often regenerate naturally after disturbance and areas within the offset area are already regenerating, in comparison to some adjacent areas. Vegetation within the offset area currently contains native species (consistent with RE 11.4.9), from each stratum (ground layer and shrub/tree layers), indicating the presence of a viable seedbank. Habitat quality assessments are to be conducted within the offset area to monitor the natural regeneration of brigalow woodland over time.</p>
	<p>Identify key threats and develop management guidelines to protect key habitat.</p>	<p>A number of existing threatening processes to the ornamental snake are present within and adjacent to the offset area including:</p> <ul style="list-style-type: none"> • Habitat degradation and fragmentation within the offset area and surrounds. • Historical and current livestock grazing. • Environmental weed species including Jerusalem thorn (<i>Parkinsonia aculeata</i>), <i>Opuntia</i> spp. and rubber vine (<i>Cryptostegia grandiflora</i>). • Feral pig presence and associated habitat degradation within gilgai and watercourses. <p>The management objectives for the offset area are:</p> <ul style="list-style-type: none"> • To protect and improve ornamental snake habitat within the offset area to a level at which: <ul style="list-style-type: none"> ◦ the habitat over time provides greater conservation value than its current form; and ◦ the habitat over time provides greater conservation than that of the current impact site. • Improve the condition and quality of regrowth vegetation providing connectivity values. <p>Management actions include:</p> <ul style="list-style-type: none"> • Pest assessment and ongoing monitoring • Feral pig control • Weed and pest animal prevention • Controlled livestock grazing • Brigalow natural regeneration • Fire management • Offset area restrictions
	<p>Maximise the establishment of appropriate reserves to protect Ornamental Snake habitat and landscape connectivity over the long term; e.g. on stock route</p>	<p>The offset area is located on private land and a formal agreement with the landholder is in place. The OAMP details the responsibilities the landholder has regarding implementation of management actions. The OAMP will be connected to the land title via legal securement of the offset, ensure that future landholders have the same responsibilities for conservation management.</p>

Theme	Objective or priority	How the offset meets these objectives or priorities
	networks, road reserves and private lands.	
	Ensure Ornamental Snake conservation is incorporated into appropriate land management decisions made by all levels of government and industry.	Not applicable to the offset area or the proponent.
	Develop and provide land-management guidelines and incentives for landowners to reduce the impact of current land use practices on the species outside reserves; e.g. restricting the use and spread of agricultural weeds, such as Buffel Grass.	The offset area is located on private land and a formal agreement with the landholder is in place. The OAMP details the responsibilities the landholder has regarding implementation of management actions. The OAMP will be connected to the land title via legal securement of the offset, ensure that future landholders have the same responsibilities for conservation management.
	Negotiate management agreements and voluntary conservation agreements with landholders, on whose land the Ornamental Snake occurs, in line with the recommended management guidelines.	
	Facilitate on-ground projects to manage and protect habitats on a range of land tenures in line with recommended management guidelines; e.g. in integrated weed and feral predator management programs.	The offset area is located on private land and a formal agreement with the landholder is in place. The OAMP details the responsibilities the landholder has regarding implementation of management actions, including: <ul style="list-style-type: none"> • Feral pig control • Controlled domestic livestock grazing • Brigalow natural regeneration via vegetation clearing prevention • Fire management The OAMP will be connected to the land title via legal securement of the offset, ensure that future landholders have the same responsibilities for conservation management.
	Develop community awareness within the species' known range through media campaigns and education material and provide incentives for wider community involvement; e.g. local governments and schools participating in reptile educational programs and adopting a local reptile species as their shire and/or school icon.	Not applicable to the offset area or the proponent.
	Implement recommended fire management guidelines in property and reserve designs.	Fire is to be, where possible, excluded from the offset area by maintaining firebreaks relative to the offset area (if applicable) and not using fire as a management tool in the offset area unless identified by a suitably qualified person in order to promote management objectives (e.g. low intensity controlled burn to reduce fuel loads or promote native species growth).
	Work with landholders and key stakeholders to undertake monitoring programs on selected sites.	The offset area is located on private land and a formal agreement with the landholder is in place. The OAMP details the responsibilities the landholder has regarding implementation of management actions. The OAMP will be connected to the land title via legal securement of the offset, ensure that future landholders have the same responsibilities for conservation management.

Theme	Objective or priority	How the offset meets these objectives or priorities
	Monitor and evaluate recovery actions applying an adaptive management approach.	<p>The management of the offset site will be implemented in accordance with an offset management framework centred on an adaptive management cycle. The cycle is based on the Plan – Do – Check – Act cycle provide in the overarching BHP Environmental Management System.</p> <p>A key aspect of the framework is the feedback cycle facilitated by checking outcomes of monitoring, investigating contributing factors to results not considered in line with milestones or Key Performance Indicators, adapting approaches to management (informed by experts where appropriate) with the aim of improving likelihood of success and finally circling back to updating documentation and work plans to ensure improved actions are then incorporated and implemented in future.</p>

7.1.3 Offset Area Summary

The Inderi and Croydon offset areas have been selected based on analysis of their habitat value and potential to meet the requirements of the offset policy. Both properties are located in landscapes subject to habitat fragmentation, largely attributed to agricultural development, where there is opportunity for improvement.

The sites show the presence of suitable habitat for the targeted MNES and MSES matters, the location of the offset areas is also in association with other existing offsets areas. The colocation of multiple offsets has potential to provide greater benefits for MNES and MSES due to larger areas of contiguous habitat which are likely to support larger populations than smaller isolated offsets, greater connectivity and reduced edge effects.

The Inderi property already supports three (3) other offset areas (two (2) in progress and one (1) established (existing BMA offset)) including an existing 137.2 ha offset secured in 2014. These offset areas are also managed for similar environmental values, including habitat for *Dichanthium queenslandicum* and the Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin Threatened Ecological Community. The positioning of the offset areas within the Inderi property will result in a larger contiguous patch of vegetation/habitat within the landscape.

The Croydon Offset Area is located adjacent to an existing 361 ha offset area, associated with anabanches of the Connors River. The improvement of non-remnant areas associated with the Croydon Offset Area will enhance the connectivity between the offset areas.

Both offset areas also comprise areas of non-remnant vegetation. By improving habitat and vegetation condition associated with non-remnant areas within the offset areas, it will assist in bolstering the connectivity corridors and habitat values associated with the remaining habitat patches and vegetative corridors within the surrounding landscapes. Habitat improvement within the Croydon Offset Area will enhance the connectivity between the anabanches of Connors River and Lotus Creek as well as increase the extent of contiguous patches of mature vegetation within the surrounding landscape.

Similarly, improvement of habitat associated with the Inderi Offset Area through the application of management measure within the OAMP will assist in enhancing the connectivity of remaining remnant patches of vegetation as well as the populations of *Dichanthium queenslandicum* recorded within the greater landscape.

7.1.4 Risk of Loss

7.1.4.1 Risk of Loss without offset

Associated risk of loss without the offset have been determined in accordance with Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act (Maseyk et al., 2017). Associated risk of loss for each of the offset areas have been calculated based on the historical land management within each of the offset properties and the calculated risk of loss over 20 years for the associated local government area (refer to Maseyk et al., 2017).

Figure 4 of the Deriving Risk of Loss guidance document (extracted below in **Figure 7-7**) provides a series of pathways (A-E) that facilitate the identification of the appropriate risk of loss (without offset).

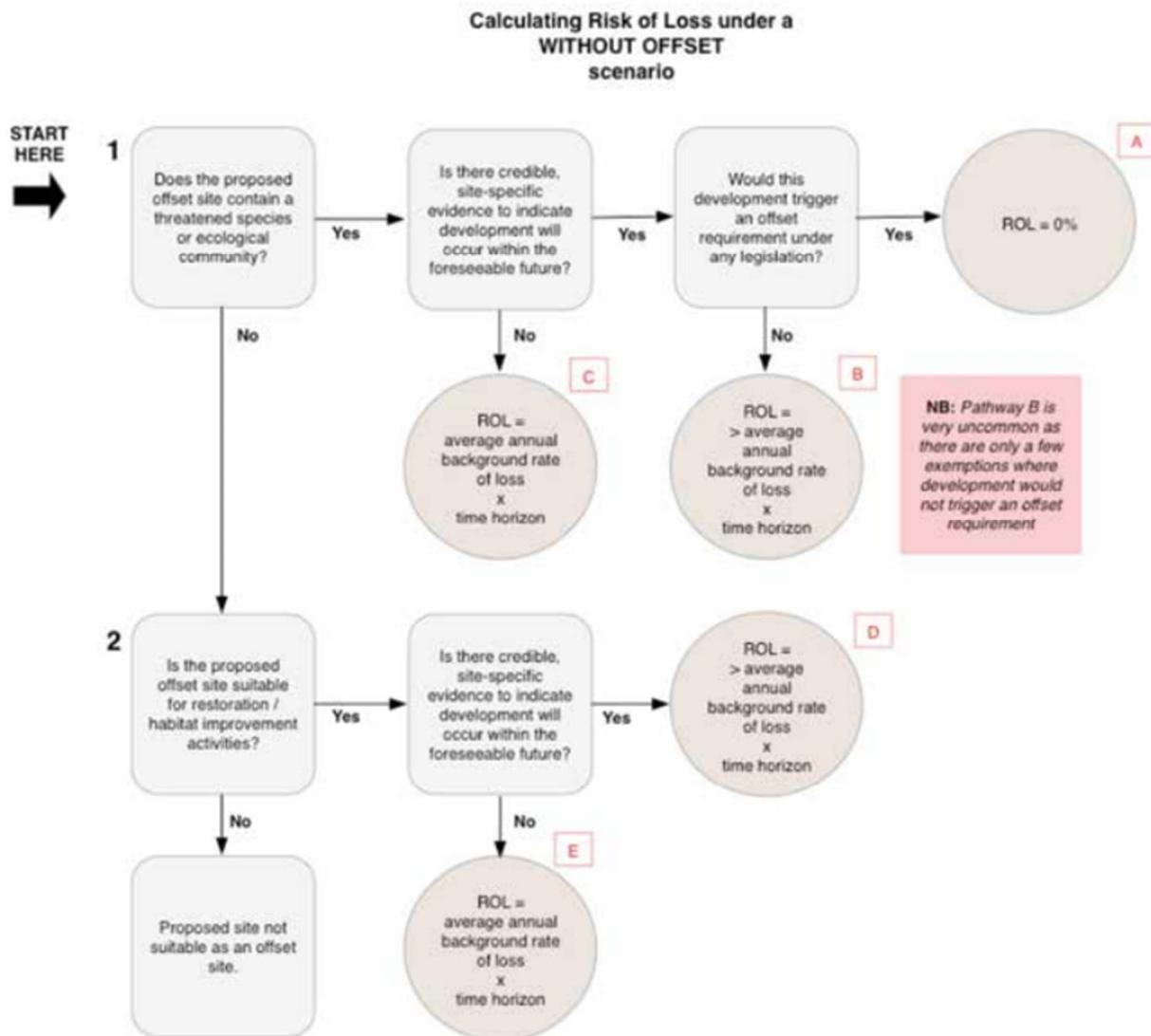


Figure 7-7 Decision tree for calculating Risk of Loss under a without offset scenario (Maseyk et al 2017)

Inderi Offset Area

1. Does the proposed offset site contain a threatened species or ecological community?

No

Dichanthium queenslandicum (king bluegrass) and Natural Grasslands TEC were confirmed to occur within the Inderi Offset Investigation Area, and while not located directly within the delineated Offset Area are situated immediately adjacent. (Further discussion of the species suitability of the site is provided in **Section 7.1.1.3**).

2. Is the proposed offset site suitable for restoration/habitat improvement activities?

Yes

The OAMP (**Appendix M**) for the site identifies that the Offset Area is suitable for restoration / habitat improvement activities.

Is there credible site-specific evidence to indicate development will occur within the foreseeable future?

Yes

The “credible, site-specific evidence indicating development will occur within the foreseeable future” (nullifying Pathway E) is based on past land management and contemporary/future land use within the Inderi Offset Area. Portions of the Inderi Offset Investigation Area are classified as Category X Regulated Vegetation (non-remnant) under State Legislation (i.e. Vegetation Management Act 999), and do not require approval to cultivate under State legislation. As such, cultivation within the delineated Offset Area has occurred over a number of years (**Figure 7-8**).

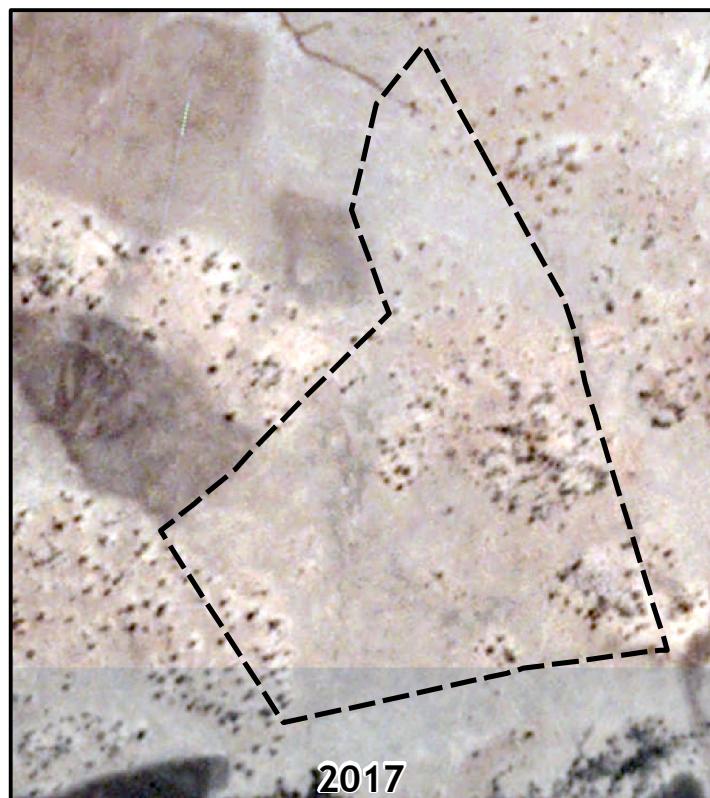
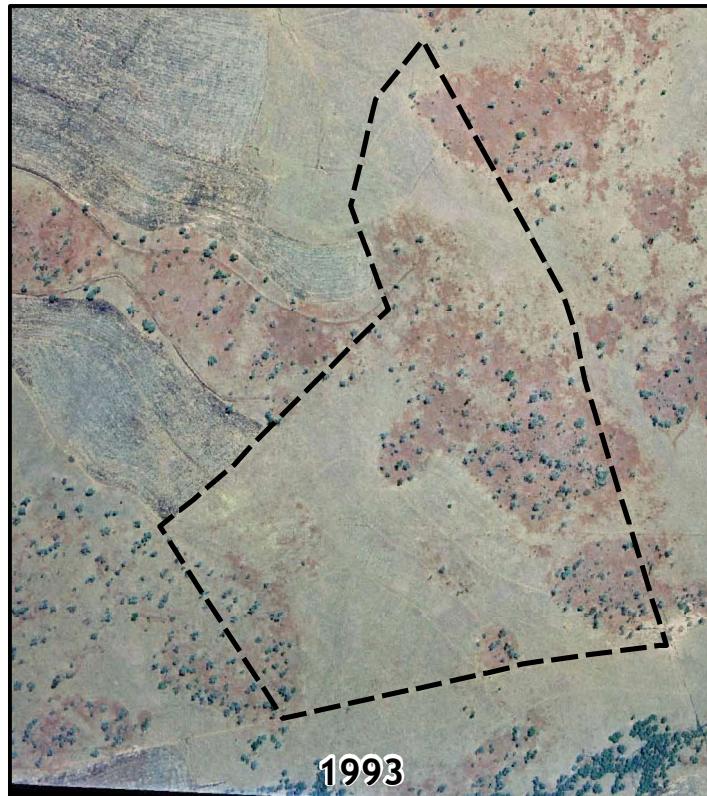
While it is uncertain whether past cultivation events indicate future cultivation, the previous impact to the community paired with the current and ongoing land use, namely cattle grazing, is anticipated to gradually deteriorate the grassland habitat via the threatening processes described in the Offset Strategy without the protection and management afforded by an offset.

Pathway D Risk of Loss = \rightarrow average background rate of loss x time horizon

Under Pathway D, the risk of loss (without offset), in accordance with the guidance document, must be greater than the product of the average annual background rate of loss and the time horizon of the proposed offset. The average annual background rate of loss for the Central Highlands Regional Council LGA over the life of the offset (20 years) is 1.81% (Maseyk et al., 2017).

Based on the historical land management involving cultivation and current land use of cattle grazing, which is expected to exacerbate the documented threatening processes impacting native grasslands at Inderi), the ROL (without offset) is slightly higher than the average annual background rate of loss (i.e. 1.81%). As such, the ROL (without the offset) for the Inderi Offset Area is calculated to be 5%.

Furthermore, it is also worth noting that non-woody communities (e.g. grasslands) are not captured within the method employed to calculate risk of loss (Maseyk et al., 2017). As such, the estimated risk of loss for the Central Highlands Regional Council may not be entirely accurate for grasslands within the Inderi Offset Area.



Legend

Inderi Offset Area



Scale

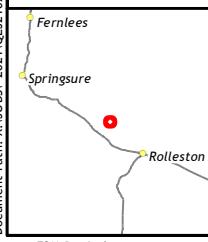
1:16,500

(A4)

0 100 200 300 400 500

Metres

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
Projection: Mercator Auxiliary Sphere



Notes:
Aerial Imagery: © DoR 2023

A	Issued for Review	CD	PW	16/06/2023
Rev	Description	Drawn	Approved	Date



BMA Caval Ridge Mine
Map Number 1 of 1

Job Number QEJ21025

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FIGURE 7-8: HISTORICAL DISTURBANCE WITHIN INDERI OFFSET

Croydon Offset Area**1. Does the proposed offset site contain a threatened species or ecological community?**

Yes

A number of ornamental snake individuals have been recorded during previous field surveys within the adjacent existing offset area, and on Croydon Station. Five records of the species are situated to the east of the proposed Croydon Offset Area, with one record located on the boundary of the proposed Croydon Offset Area, as shown on **Figure 7-6**. (Further discussion of the species suitability of the site is provided in **Section 7.1.2.3**).

Is there credible site-specific evidence to indicate development will occur within the foreseeable future?

Yes

The “credible, site-specific evidence indicating development will occur within the foreseeable future” (nullifying Pathway C) is based on past land management and contemporary/future land use within the Croydon Offset Area. Suitable ornamental snake habitat within the Croydon Offset Area is situated in an area classified as Category X Regulated Vegetation (non-remnant) which is not protected under State legislation (i.e. Vegetation Management Act 1999).

The species habitat is characterised by the presence of gilgai formations on cracking clay soils interspersed amidst regrowth brigalow vegetation. Brigalow was first pulled and burnt on Croydon Station in the early 1970s and seeded to buffel grass for cattle grazing. The area was pulled again in 1988 and subjected to controlled burning in 1989. This cycle of clearing and burning regrowth brigalow was repeated every 5-7 years, guided by seasonal conditions and market commodity prices. Evidence of past brigalow pulling and burning was observed within ornamental snake habitat during survey of the Croydon Offset Investigation Area.

While it is uncertain whether past events indicate future activities, the previous impact to the community paired with the current and ongoing land use, namely cattle grazing, is anticipated to gradually deteriorate the habitat via the threatening processes described in the Offset Strategy without the protection and management afforded by an offset.

Would this development trigger an offset requirement under any legislation?

No

Suitable habitat within the Offset Area comprises non-remnant vegetation not protected under State legislation (e.g. Vegetation Management Act 1999). Without the securement of the offset, clearing of regrowth brigalow can continue without approval under State vegetation clearing legislation (Vegetation Management Act 1999) thereby continuing to incrementally degrade ornamental snake habitat over time. Without the securement and protection of an offset, recurrent pulling and burning of regrowth brigalow is permissible without approval under State vegetation clearing legislation consequently incrementally degrading ornamental snake habitat over time.

As the recurrent agricultural practice does not trigger an offset requirement under legislation, the risk of loss (without offset) pathway depicted in the guidance document deviates from Pathway A and aligns with Pathway B.

Pathway B Risk of Loss => average annual background rate of loss x horizon

Under Pathway B the risk of loss (without offset), in accordance with the guidance document, must be greater than the product of the average annual background rate of loss and the time horizon of the proposed offset. The average annual background rate of loss for the Isaac Regional Council LGA over the life of the offset (20 years) is 8.42% (Maseyk et al., 2017). Based on the historical land management of Croydon Station, the risk of loss (without offset) is slightly higher than the average annual background rate of loss (i.e. 8.42%). As such, the risk of loss (without the offset) is estimated at 9%.

7.1.4.2 Risk of Loss with offset

The associated risk of loss with the Inderi and Croydon Offset Areas has been calculated to be 0%.

7.1.4.3 Time until ecological benefit

The associated time until ecological benefit for the Inderi and Croydon Offset Areas is 20 years.

7.2 Offset Delivery

This Preliminary Documentation includes two (2) OAMP's for the Inderi Property and Croydon Station for consideration by the DCCEEW. The OAMP's detail the delivery of offsets to acquit the impacts of the Project, namely:

- Project Offset Area Management Plan – Inderi (E2M, 2022b) – **Appendix M**; and
- Project Offset Area Management Plan – Croydon (E2M, 2022c) – **Appendix N**.

Key details of offset delivery are summarised in the following sections.

7.2.1 Timeframes for Offset Delivery

BMA anticipates that implementation of the OAMPs will be a condition of the Project's EPBC Act approval. As such, the Project Environmental Offset Strategy (**Appendix L**) and the OAMPs (**Appendix M** and **Appendix N**) will be implemented as required, post approval of the Project.

The offset sites will be legally secured as per the requirements of the EPBC Act approval conditions. This allows adequate time for administrative arrangements to be implemented post-Project approval.

The offsets will be in place for at least 20 years.

7.2.2 Legal Security

The offset areas will be secured via a Voluntary Declaration under the Queensland VM Act, where they are secured for the life of the approval, for the purposes of an environmental offset.

7.2.3 Offset Area Management Plan

A OAMPs for the Inderi Property and Croydon Station (attached under **Appendix M** and **Appendix N**) have been developed as part of the Environmental Offset Strategy (**Appendix L**). The OAMPs will guide the management and monitoring of the offset areas and will be finalised through the assessment process, in consultation with DCCEEW.

The inclusion of the squatter pigeon within the Offset Strategy or Croydon OAMP has not been undertaken as no significant impact to the species, as described under the EPBC Act Significant Impact Guidelines 1.1 - Matters of National Environmental Significance (Department of the Environment, 2013), is considered likely to result from the Project.

The OAMP's include:

- A description of the offset area/s, including location, size, condition, EVs present and surrounding land uses;
- Details of how the offset area/s will provide connectivity with other habitats and biodiversity corridors and/or will contribute to a larger strategic offset for the relevant listed threatened species and communities;
- Maps and shapefiles to clearly define the location and boundaries of the offset area/s, accompanied by the offset attributes (e.g. physical address of the offset area/s, coordinates of the boundary points in decimal degrees, the listed threatened species and communities that the environmental offset/s compensates for, and the size of the environmental offset/s in hectares);
- Specific offset completion criteria derived from the site habitat quality to demonstrate the improvement in the quality of habitat in the offset area/s over a 20-year period;
- Details of the management actions, and timeframes for implementation, to be carried out to meet the offset completion criteria;
- Interim milestones that set targets at 5-yearly intervals for progress towards achieving the offset completion criteria;
- Details of the nature, timing and frequency of monitoring to inform progress against achieving the 5-yearly interim milestones (the frequency of monitoring must be sufficient to track progress towards each set of milestones, and sufficient to determine whether the offset area/s are likely to achieve those milestones in adequate time to implement all necessary corrective actions);

- Proposed timing for the submission of monitoring reports which provide evidence demonstrating whether the interim milestones have been achieved;
- Timing for the implementation of corrective actions if monitoring activities indicate the interim milestones have not been achieved;
- Risk analysis and a risk management and mitigation strategy for all risks to the successful implementation of the OAMP and timely achievement of the offset completion criteria, including a rating of all initial and post-mitigation residual risks in accordance with a risk assessment matrix;
- Evidence of how the management actions and corrective actions take into account relevant approved conservation advices and are consistent with relevant recovery plans and threat abatement plans; and
- Details of the legal mechanism for legally securing the proposed offset area/s, such that legal security remains in force over the offset area/s for at least 20 years to provide enduring protection for the offset area/s against development incompatible with conservation.

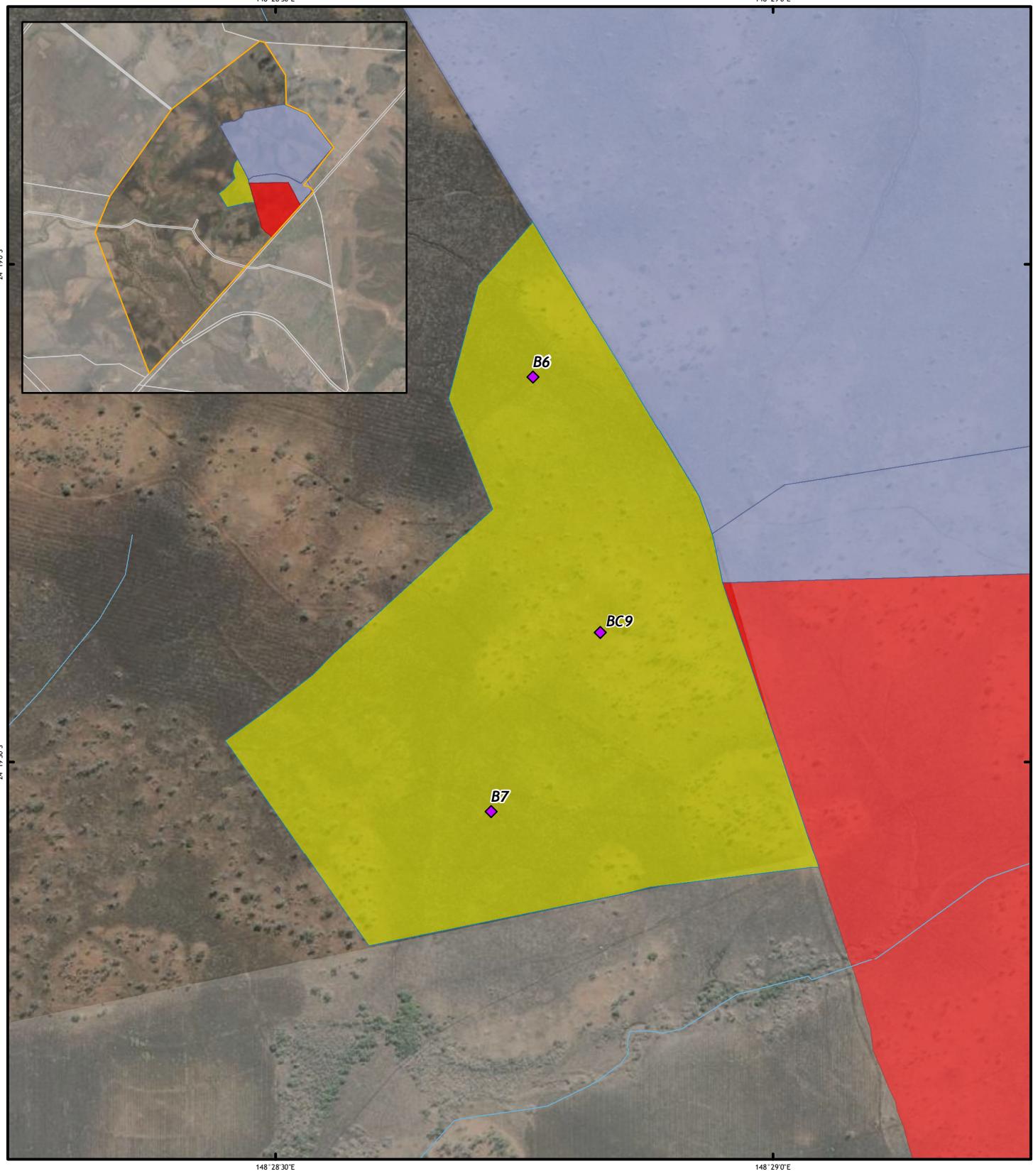
7.2.3.1 Monitoring

Ongoing monitoring will be undertaken to gauge the effectiveness of and, if necessary, adapt the management actions, as well as record the progress towards completion criteria. Monitoring is outlined in the OAMPs in **Appendix M** and **Appendix N**. Monitoring will include:

- Habitat Quality Assessments (i.e. site-based attribute BioCondition surveys) to monitor vegetation regeneration;
- Weed surveys to monitor the cover and abundance of non-native/environmental pest flora species
- Targeted surveys and habitat assessment/utilisation survey for relevant threatened species to determine presence and relative abundance; and
- Feral pig monitoring to assess pest control and livestock impact monitoring to assess gilgai degradation (at Croydon).
- Routine maintenance to ensure security of the Offset Area.

Monitoring will be undertaken in the Offset Areas for the duration of the environmental offset or until completion criteria are met, which-ever is longer. In the event completion criteria are met prior to end of the life of asset, monitoring will continue, to ensure the completion criteria are maintained for life of the offset.

The location of Habitat Quality monitoring sites will be based on the sites assessed as part of the initial offset investigations (i.e. BioCondition) and used as baseline habitat quality. Specific to the Croydon Offset Area, as the initial assessments were based on a larger Investigation Area, additional monitoring sites will be established within the offset area to ensure suitable replication (i.e. SP3 to SP7). The location of monitoring sites within the Inderi and Croydon offset areas are depicted in **Figure 7-9** and **Figure 7-10** respectively with locations to be first implementation of the OAMPs.



Legend

- ♦ Monitoring Site
- Watercourse
- Inderi Property
- HPE Offset Area (71.43 ha)
- Offset procurement in progress by other parties
- Existing Offset Category A Area (2014)

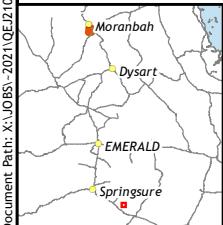


Scale

1:10,000 (A4)

Kilometres

Coordinate System: GCS GDA 1994



Notes:
 Aerial Imagery: © ESRI 2021
 Cadastre: © DNRME 2021
 Watercourse: © DNRME 2020
 Road: © DNRME 2020

A	Issued for Review	DL	PW	09/06/2023
Rev	Description	Drawn	Approved	Date



FIGURE 7-9: INDERI OFFSET AREA MONITORING SITES

Map Number

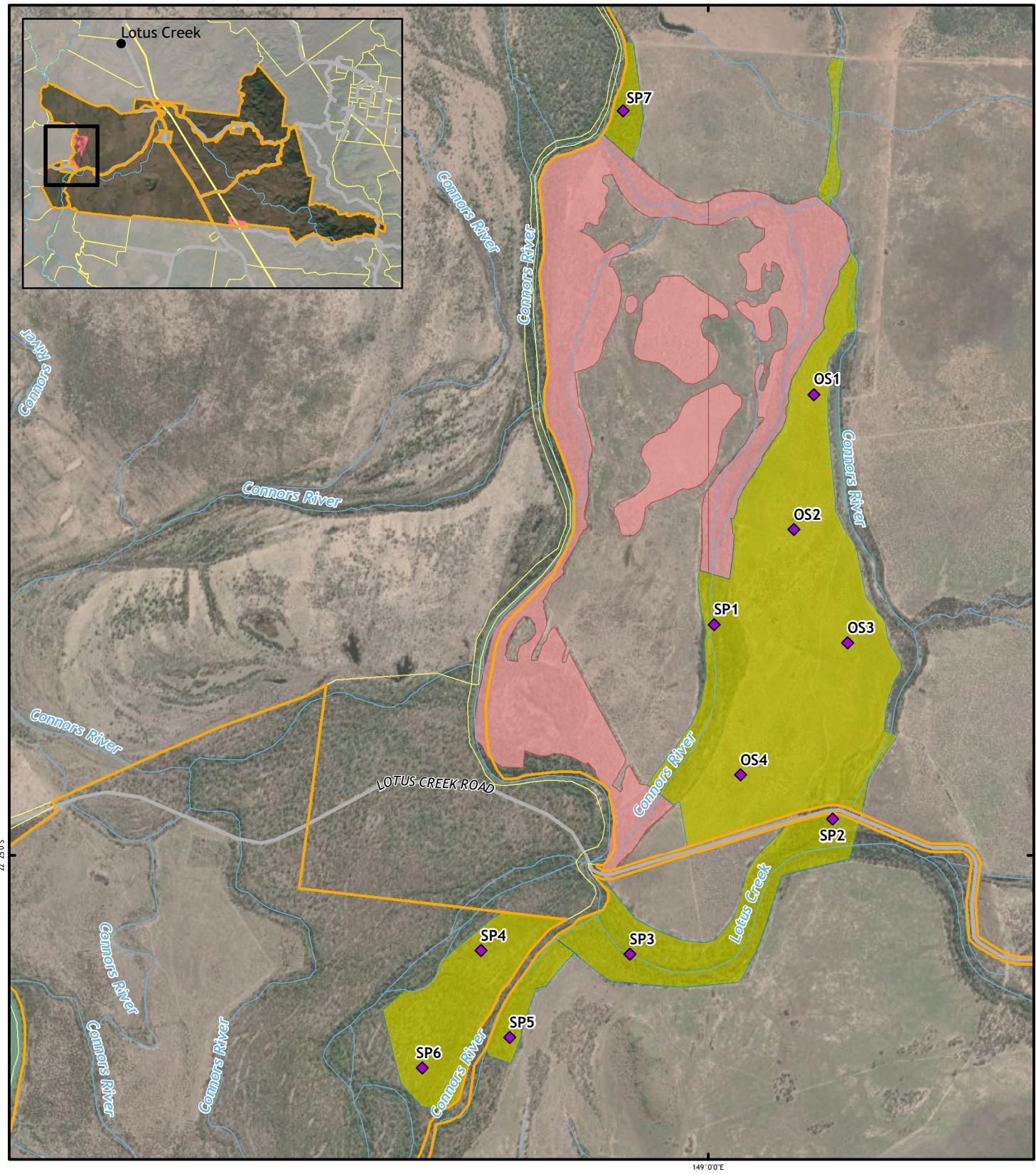
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Legend

- ◆ Monitoring Sites
- Road
- Watercourse
- Cadastre
- Orange Box: Croydon Station
- Pink Box: Existing Offset (Cat A Area)
- Green Box: Croydon Offset Area (to offset HPE Project impacts) (263.68ha)



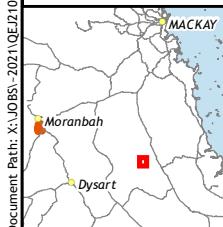
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0 1 2 Kilometres

Coordinate System: GCS GDA 1994



Notes:
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A	Issued for Review	CD	PW	16/06/2023
Rev	Description	Drawn	Approved	Date



FIGURE 7-10: CROYDON OFFSET AREA MONITORING SITES

Map Number

1 of 1

Job Number

QEJ21025

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8 Ecologically Sustainable Development (ESD)

This section outlines the Project's compatibility with the principles defined in Section 3A of the EPBC Act. An outline of the Project against the ESD requirements of Section 3A of the EPBC Act is provided in **Table 8-1**.

Table 8-1 Principles of Ecologically Sustainable Development

Section 3A, EPBC Act	Project Compatibility
<i>The following principles are principles of ecologically sustainable development:</i>	<p>BMA is committed to the principles of sustainable development, including the wellbeing of its employees and communities. BMA is also committed to developing, implementing and maintaining management systems for health, safety, environment and the community that are consistent with best practices. This commitment is given practical effect by BHP's Health, Safety, Environment and Community (HSEC) Management Standards, and the systems, procedures and operational protocols through which these standards are applied at a site level. Through these standards, BMA seeks to achieve its stated company goal of "zero harm to people and the environment". The BMA Environmental Management System (EMS) is aligned to ISO14001.</p>
<i>(a) Decision making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations.</i>	<p>The Project will provide immediate and long-term benefits to the economic and social fabric of Queensland and in particular the Isaac Regional Council (IRC). The Project will contribute to the local, state and Commonwealth economies, including economic growth through sustained employment at the local and regional levels (primarily through local employment and business opportunities). BMA intends to invest subject to approvals, approximately \$100 million (estimated) per annum on average over the life of the mine. In addition, the Project will provide sustained employment and wealth for the region. Issues of community interest and concern will be addressed through the EA Amendment process and through BMA's ongoing engagement with key stakeholders throughout the life of the Project as an extension of its existing key stakeholder program.</p> <p>The management of the Project will align with the current approach of the CVM and the BMA EMS. The Project will achieve an ongoing minimisation of the activity's environmental harm through the existing environmental management plans, monitoring programs and emissions control measures in place at the CVM. Refer to Section 4.5 for details.</p> <p>In addition, BMA is committed to providing a safe, inclusive and diverse workplace, as outlined in the BMA Charter. BMA's strategy to achieve a more equitable workplace is focused on four (4) areas:</p> <ol style="list-style-type: none"> 1. Embedding flexibility in the way we work; 2. Encouraging and working with our partners; 3. Uncovering and taking steps to mitigate potential bias; and 4. Making our brand attractive to everyone.

Section 3A, EPBC Act	Project Compatibility
<p>(b) <i>If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.</i></p>	<p>The 'precautionary principle' is defined in Section 391 (2) of the EPBC Act, that being:</p> <p><i>The precautionary principle is that lack of full scientific certainty should not be used as a reason for postponing a measure to prevent degradation of the environment where there are threats of serious or irreversible environmental damage.</i></p> <p>To address this principle, BMA has undertaken an assessment of the risk of unacceptable environmental harm consistent with the precautionary principle. These findings have been incorporated into the development of appropriate environmental control strategies/mitigation strategies as outlined in Section 4.5. In addition, BMA also commissioned an independent peer review of the Groundwater Impact Assessment (Appendix J), completed by Dr. Noel Merrick (HydroAlgorithmics Pty Ltd). Further, BMA has the technical and financial support and resources to establish and maintain the proposed environmental protection controls/mitigation measures proposed for the Project.</p>
<p>(c) <i>The principle of inter-generational equity – that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.</i></p>	<p>The Project addresses the welfare of future generations while realising economic benefits. The welfare of future generations has been considered through minimising disturbance, building beneficial infrastructure and planning a post-mining landform. The Project aims to preserve, where possible, the ecological value areas and has designed the project footprint to minimise impacts as reasonably practicable. The use of existing infrastructure will improve the overall project efficiency and resource utilisation.</p> <p>Building intergenerational equity requires that the Project consider the long-term use of the land and community impacts. The Project seeks to safeguard the welfare of future generations and achieve intergenerational equity by achieving a post-mining landform consistent with the former landscape recognising that mining has been undertaken in and around Moranbah since the early 1980's. This will be achieved through project design, operational management (including sound rehabilitation techniques) and environmental monitoring and reporting. The coarse rejects and tailings from the CHPP will be co-disposed with overburden to In-Pit Spoil Dumps, as per ongoing operations at the CVM. This is designed to minimise erosion and is in line with current practice progressive rehabilitation techniques. BMA may also seek progressive "sign-off" on successfully rehabilitated landforms once they have met the requirements of the final land use success criteria. A PRCP is under preparation for the CVM incorporating the Project.</p> <p>Water management practices on site will ensure that water quality in Horse, Grosvenor, Cherwell and/or Caval Creeks is not adversely affected by the Project. There will be some clearing of vegetation; however, the clearing will not threaten the existence of individual species or ecosystems as significant residual impacts (Section 4.6) will be offset via land-based offsets (Section 6). Rehabilitation and monitoring programs on site performed by BMA (or its contractors) will ensure that biodiversity is not compromised or significantly impacted as a result of the Project.</p> <p>In summary, through the continued use of sound management practices (currently in practice) and monitoring of the impacts of the Project on the local environment, the Project will not significantly reduce, or fail to maintain, the health, diversity and productivity of the regional environment or affect future generations.</p>
<p>(d) <i>The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making.</i></p>	<p>Key decisions for the Project support the protection of biological diversity. Specifically, limiting the overall footprint of the Project (to the extent that is reasonable and practicable) by utilising existing infrastructure to avoid further clearing has protected ecological processes. The LoA plan has been prepared to incorporate the progressive rehabilitation of disturbed areas and to prevent or minimise environmental harm. The rehabilitation strategy will allow BMA to proactively measure the success of the rehabilitation in line with the post mine land use strategy to be incorporated into the PRCP.</p> <p>In addition, the Project Area has historically been subject to habitat degradation caused by agricultural activities, erosion and mining operations. The vegetation within the Project Area is largely regrowth brigalow and eucalypt woodland communities. Much of the regrowth</p>

Section 3A, EPBC Act	Project Compatibility
	<p>brigalow community occurs on soils with a heavy clay content and has a capacity to hold water creating local depressions.</p> <p>A desktop assessment and two (2) field surveys targeting threatened/protected wildlife and wildlife habitat, regulated vegetation, ecosystem function and other MNES and Matters of State Environmental Significant (MSES) was conducted. Despite the Project Area being highly modified, it was found to support a diversity of wildlife, habitat features and vegetation communities.</p> <p>The following conservation-significant ecological values were recorded within the Project Area:</p> <ul style="list-style-type: none"> • two (2) ornamental snake observations and preferred habitat within brigalow regrowth habitat; • suitable habitat for threatened fauna species: <ul style="list-style-type: none"> ◦ squatter pigeon; ◦ Australian painted snipe; and ◦ suitable habitat for king bluegrass. • Various MSES (including 'of concern' prescribed RE 11.8.11 and ecological connectivity value). <p>Despite this, avoidance and mitigation measures will be implemented during the life of the Project as a demonstration of sound environmental practice. Specifically, these include, but not limited to:</p> <ul style="list-style-type: none"> • Clearing of vegetation to be avoided or minimised where practical; • Weed management practices to continue to be implemented to prevent spread of weeds; • Manage existing weeds, particularly around Horse Creek and drainage lines; and • Rehabilitate mined land to reinstate native species where practical. <p>The Project will result in significant residual impacts (Section 4.6) to ornamental snake and king bluegrass. These impacts will be offset via land-based offsets (Section 6).</p>
(e) <i>Improved valuation, pricing and incentive mechanisms should be promoted.</i>	<p>The Project will be managed in accordance with relevant Queensland and Commonwealth Government policies and standards.</p>

9 Economic and Social Matters

9.1 Economic and Social Impacts

BMA's operations provide significant benefits to the local communities in which it operates, the broader Central Queensland region and to the Queensland economy as a whole. BMA is the largest employer in the Central Queensland region and plays a key role in its economic development. The substantial economic contribution in FY 2021 is demonstrated by the following:

- A\$3,391M spent by BMA on equipment, goods and services from other Queensland business;
- A\$1,379M spent by BMA on equipment, goods and services from interstate and New Zealand businesses;
- US\$617M in total payments to Governments (including corporate income taxes and royalties) related to BHP's coal operations in Queensland which includes a 50% share of BMA plus the BMC South Walker Creek and Poitrel mines; and
- Over A\$111M spent in local townships and communities via the CRES Local Buying Program (note: this includes payments related to the South Walker Creek and Poitrel mines as well as BMA's operations).

In addition, BMA employs approximately 6,800 people directly (including contractors) in Central Queensland.

The CVM represents about 13% of BMA's operations measured on a saleable coal basis. Given the Project, if approved, will extend the life of the CVM and play an important role in extending the positive economic benefits outlined above.

BMA is working closely with traditional owners on all its sites including the CVM, providing employment opportunities as well as ensuring the respect and sound treatment of Cultural Heritage. Cultural Heritage survey work has been undertaken and the salvage of significant items identified (if any) will take place as part of pre-clearing activities. BMA is also committed to working with our near neighbours on an ongoing basis to understand and mitigate any resulting impacts that they may be concerned about.

Overall the Project creates economic and social value by:

- Minimising operational costs through mining the targeted reserves (i.e. alternatives in the BMA portfolio would involve higher costs);
- Enabling operational efficiency through maintained annual mine production and extending the life of the CVM;
- Providing continuation of royalty provision;
- Delivering metallurgical coal to markets in accordance with product specifications that are in demand from customers;
- Providing opportunities for local procurement participation; and
- Enabling continuation of employment opportunities and social programs through the extension of the CVM operations.

The Project will make a considerable positive economic impact in terms of the ongoing challenge involved in delivering supplies to meet growing world demand for metallurgical coal. Forecasting organisations such as Wood MacKenzie (2021) expect considerable growth in Australian seaborne metallurgical exports in coming decades. Wood MacKenzie analysis in 2021 led the organisation to conclude that "We expect Australian seaborne metallurgical exports to grow from 170 Mt in 2021 to 271 Mt by 2050. The 52% growth in total trade is substantial and is principally attributable to India's persistent expansion through the period". Given the characteristics of Australian metallurgical coal reserves including those associated with the CVM, Wood MacKenzie (2021) expects "the country's dominance within the metallurgical coal sector will continue, despite the near-term effect of the November 2020 import ban imposed by China. Australia is in prime position to benefit once the ban is lifted given its high quality and competitive delivered costs." According to Wood MacKenzie (2021), in addition to growing demand as outlined above, projected ongoing reserve exhaustion for hard coking coals, particularly after 2030, will drive the need for new projects. The CVM is an established mine producing high quality export hard coking coal that is required to stay in operations until the 2050s to meet the demand indicated above in conjunction with other existing and new projects.

Potential negative social and economic impacts associated with ongoing the CVM operations were identified in Environmental Impact Statement (EIS) leading up to the commencement of operations in 2014. The social issues

addressed included impacts on living amenity matters such as dust, noise, vibration and traffic. The published EIS related material (www.statedevelopment.qld.gov.au/coordinator-general/assessments-and-approvals/coordinated-projects/completed-projects/caval-ridge-mine) includes extensive impact mitigation measures that have been put in place to ensure negative impacts are mitigated and positive impacts maximised. BMA implemented substantive investments in accommodation, road, community and other infrastructure and community programs to address the identified issues and BMA continues to implement relevant impact mitigation measures in accordance with its commitments and the project approval conditions thereby ensuring overall positive outcomes. The Queensland Coordinator General concluded that any negative social impacts of the CVM can be acceptably managed by the implementation of the measures described in the EIS and the Coordinator-General's report (source: page 10 of *Bowen Basin Coal Growth Project: Caval Ridge Mine Coordinator-General's Evaluation Report* for an EIS August 2010). The Project involves the life extension of the CVM and its economic and social benefits along with the measures adopted to ensure the acceptable management of any negative social impacts.

9.1.1 Consultation

In the lead up to the lodgement of the HPE EPBC Act referral, BMA held discussions with neighbours and traditional owners and has provided information to the Caval Ridge workforce about the project. In addition, a project fact sheet has been published on the BHP website. These activities build on the extensive ongoing consultation activities established and implemented for the CVM in the lead up to the start of operations in 2014 and beyond. These activities have been focused on identifying, exploring and progressively addressing issues and requirements raised by BMA's stakeholders. This includes bi-annual meetings between BMA and the Isaac Regional Council to discuss issues relevant to all of BMA operations within the Isaac Regional Council including those at the CVM. At the State level, the Project will trigger the need for additional public notification in relation to the application for additional Mining Lease surface area required by the *Minerals Resources Act 1989* and the EA Amendment application that is in progress as required by the EP Act. Field checks, consultation and related documentation has been completed as per the Cultural Heritage Management Plan established and agreed by BMA and the Barada Barna people. These arrangements address the duty of care requirements of the *Aboriginal Cultural Heritage Act 2003*.

9.1.2 Economic Costs and Benefits

Substantial economic assessments were undertaken and published as part of the EIS process leading up to the commencement of operations at the CVM in 2014. However, BMA conducts annual commercial in confidence analysis of its forward operational and development options as part of BMA business planning activities. The Project has been assessed as economically attractive through BMA's business planning processes, and the development of coal resources within the Project area has been identified as a priority within BMA's large portfolio of options; noting that BMA owns and manages seven (7) coal mines within Central Queensland.

Independent analysts, for example Wood MacKenzie, produce financial and economic analysis of mines such as the CVM. In May 2021, Wood MacKenzie completed an analysis indicating that its estimated present value of projected production at the CVM in the period between 2021 and 2050 (including production from the Project area) would be in excess of A\$16,000 million. Projected total asset cash flows in present value terms was estimated to be in excess of A\$3,000 million. Estimating cash flows involves subtracting estimates for the following from estimated revenues:

- operating cash costs;
- capital costs; and
- royalties, taxes and carbon emission related fees.

The Wood MacKenzie analysis was developed without input from BMA subject matter expert personnel and does not reflect BMA's commercial in confidence pricing assumptions, forecasts, projections or analysis.

9.2 Indigenous Engagement

Native Title has been extinguished across ML1775, and the Project Area. The Barada Barna people are the determined native title holders for the CVM regional area.

The CVM operates in accordance with a Cultural Heritage Management Plan (CHMP) agreement between BMA and the Barada Barna people, developed in accordance with the legislative requirements of the Queensland *Aboriginal Cultural Heritage Act 2003*. The CHMP Area (to which the agreement applies) already includes all areas within the Project Area and disturbance footprint. Implementation of the agreement aims to avoid or where appropriate minimise harm to Aboriginal Cultural Heritage within the CHMP Area.

All areas within the disturbance footprint have been assessed by a Barada Barna field team for items of heritage significance. Any items that were located have been salvaged. Any areas requiring monitoring during a disturbance activity have been identified spatially and appropriate measures will be implemented by the Barada Barna field team when required.

BMA engages with Barada Barna during initial stages of a project and prior to any ground disturbance. Heritage work is organised and conducted through Winnaa Pty Ltd, the cultural heritage body set up to manage heritage through the Barada Barna Aboriginal Corporation.

10 Environmental Record of the Person Proposing to take the Action

BMA has an excellent record of responsible environmental management and a strong commitment to continual improvement of environmental performance.

BMA has not been subject to any environmental related proceedings in any of the following Courts - High Court, Federal Court, Supreme Court, District Court, and Planning and Environment Court.

BMA has been the subject of environmental related proceedings in the Queensland Magistrates Court, for matters related to State legislation. A fine was imposed and paid by BMA. No conviction was recorded.

BMA has a strong commitment to continual improvement of environmental performance. BMA has environmental procedures and plans in place to avoid breaches and where required incorporate corrective actions. Where breaches have occurred, BMA has followed the relevant regulatory notification requirements and has responded immediately to apply the appropriate corrective actions to rectify the relevant breaches and to avoid environmental harm.

BHP's approach to environmental management is incorporated in the Charter, which outlines 'an overriding commitment to health, safety, environmental responsibility and sustainable development'. BHP strives to achieve the efficient use of resources, including reducing and preventing pollution, and enhancing biodiversity protection by assessing ecological values and land use in our activities. Our stewardship approach is designed to ensure that the lifecycle health, safety, environment and community impacts associated with resources, materials, processes and products related to our businesses are minimised and managed.

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