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Appendix T – Revegetation Management Plan

McArthur River Mine Rehabilitation Management Plan

2018 – 2020



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1 INTRODUCTION

The McArthur River Mine (the Mine) is an open pit zinc, lead and silver mining operation in the Northern Territory (NT) located approximately 700 kilometres (km) southeast of Darwin, and approximately 45 km southwest of the township of Borroloola (Figure 1).

In addition to mining activities, the operations include an on-site concentrator and processing plant, and the Bing Bong Loading Facility (BBLF) located in the Gulf of Carpentaria approximately 95 km north-northeast of the Mine (Figure 1).

McArthur River Mining Pty Ltd (MRM) is the operator of the Mine, and is a wholly owned subsidiary of Glencore. MRM is the world's largest producer of zinc in bulk concentrate form.

MRM operates in compliance with its *Sustainable Development Mining Management Plan 2013-2015* (2013 – 2015 MMP) (and associated amendments). On-site mining and processing activities are conducted within Mineral Lease (MLN) 1121, MLN 1122, MLN 1123, MLN 1124 and MLN 1125 (Figure 2). The Bing Bong Loading Facility is located within MLN 1126 (Figure 3).

A summary of key MRM operations is as follows:

- Mining of ore within the open pit using excavators, and transport by haul truck to the run-of-mine (ROM) pad for stockpiling.
- Mining of waste rock within the open pit using excavators, and transport by haul truck to the North Overburden Emplacement Facility (NOEF) or South Overburden Emplacement Facility.
- Overburden emplacement facility construction activities to manage non-benign material, including compaction and clay capping of waste rock.
- Recovery of low grade ore previously emplaced in the NOEF and transport to the ROM pad for stockpiling.
- Processing of ore via crushing, heavy/medium separation, grinding, flotation, lead oxidation, dewatering and concentrate handling and storage.
- Thickening of tailings generated by ore processing and piping of tailings for disposal at the Tailings Storage Facility (TSF).
- Construction of tailings embankment lifts at the TSF.
- Transport of product material by road train along the Carpentaria Highway to the BBLF, where the product is barged offshore for transfer to ships in the Gulf of Carpentaria, with lead concentrate being transported to Mount Isa.
- Other ancillary activities, such as dam construction, flood protection works, rehabilitation and excavation of borrow material for construction activities.

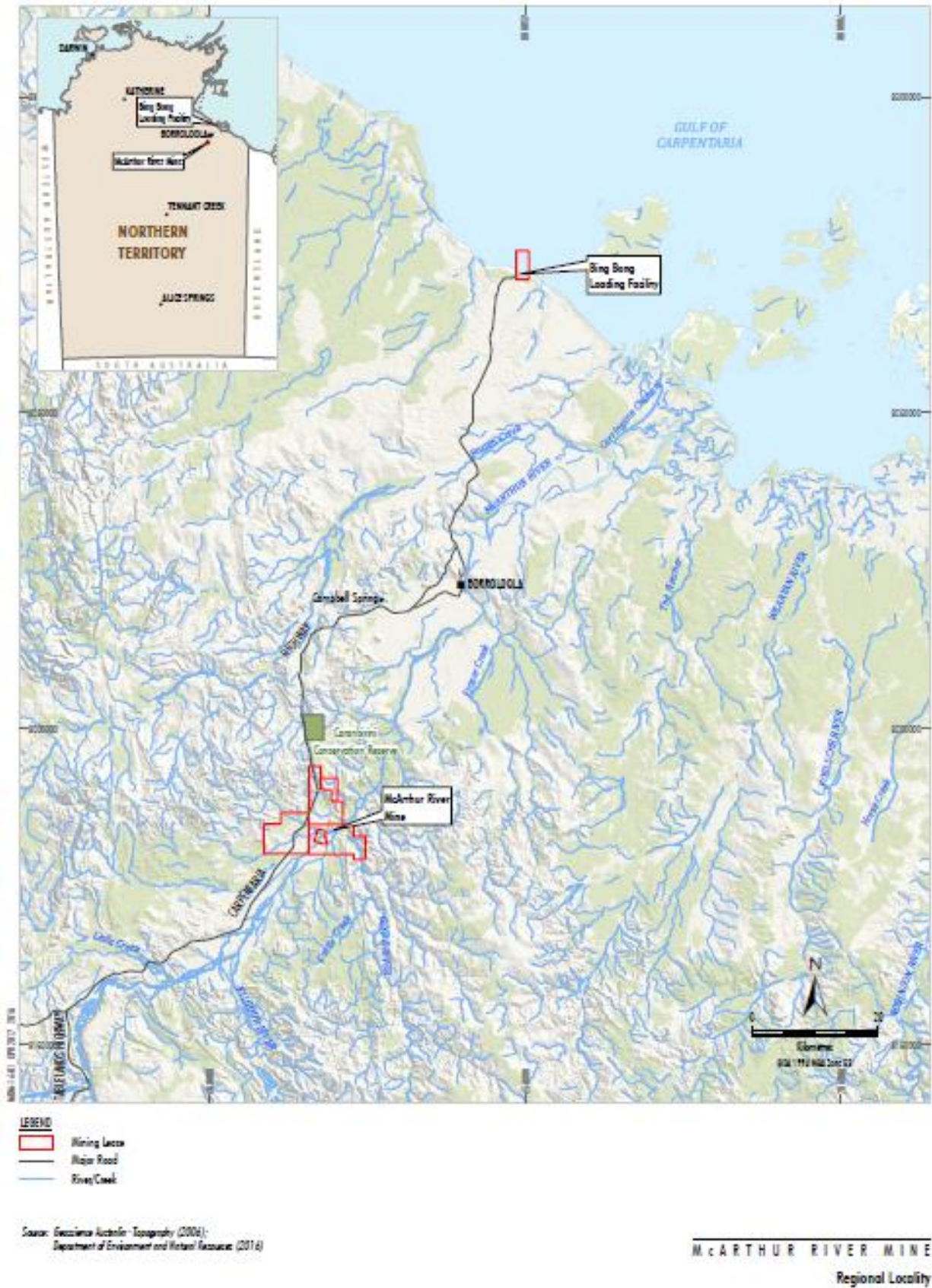


Figure 1

Figure 1 – Regional Locality



LEGEND
 Mining Lease

Source: Orthophoto AEM (2017); Department of Environment and Natural Resources (2016)

McARTHUR RIVER MINE
 Mine Site

Figure 2 – Mine Site

1 INTRODUCTION



Figure 3 – Bing Bong Loading Facility

1.1 Scope

This Rehabilitation Management Plan (RMP) has been prepared by MRM with input from experienced and qualified experts (EcoLogical Australia Pty Ltd [ELA]). The focus of this RMP is to establish a rehabilitation monitoring and management system that demonstrates MRM is progressing rehabilitation towards closure objectives.

The scope of this RMP covers revegetation of the McArthur River and Barney Creek Channels for the period 2018 to 2020, as there is no change to these existing landforms (e.g. as opposed to the NOEF, pit and TSFs, which are subject to further development). While the primary focus of this RMP is on disturbed areas of the Mine that are ready for revegetation during the period 2018 to 2020 the rehabilitation approach to be taken in the future in other mine domains is briefly discussed, but will be developed further in future versions of this RMP. This RMP is subject to periodic revision, to cover future periods that nominally align with future versions of the MMP.

This RMP:

- Provides an overview of the surrounding environment;
- Summarises rehabilitation activities undertaken at the McArthur River and Barney Creek channels to date;
- Outlines the process behind planning rehabilitation activities;
- Identifies revegetation areas and activities to be undertaken during the RMP term;
- Describes rehabilitation methods and activities;
- Provides completion criteria;
- Describes the monitoring program, including identification of suitable control sites; and
- Describes operational triggers (i.e. adaptive management) and contingency measures.

1.2 Purpose and Objectives

The purpose of this RMP is to document the rehabilitation monitoring program, management measures and completion criteria for the Mine and BBLF.

MRM's objective is to achieve a long-term stable, vegetated landscape and stable channels, having minimal impact on the surrounding terrestrial and aquatic environments. In the short-term, this objective will be achieved through the implementation of management measures and contingency measures as described in this RMP.

MRM's performance against this objective will be monitored and compared to performance indicators, completion criteria and operational trigger levels described in this RMP.

1.3 Roles and Responsibilities

Roles and responsibilities relevant to this RMP are as follows:

- **Manager – Environment, Safety & People** – implementation of RMP and mitigation/contingency measures. Provision of resources to allow the successful implementation of the plan.
- **Superintendent – Environment & Community** – implementation of RMP.
- **Senior Environmental Advisor – Rehabilitation** – implementation of RMP.
- **Environmental Engineer** – provision of specialist advice regarding geomorphology processes in the McArthur River Channel and final landform design

- **Environmental Officer – Rehabilitation** – implementation of monitoring network, review of results, trigger investigation and reporting. Collection of monitoring data and maintenance of monitoring equipment.
- **Senior Environmental Technicians** – collection of monitoring data and maintenance of monitoring equipment.
- **Mine Manager** – include mitigation measures as a component of mine planning and implementation of contingency measures. Provision of resources to allow the successful implementation of the plan.
- **Mine Operators** – implementation of mitigation/contingency measures.
- **All Staff/Contractors** – conduct work activities in a manner that avoids impacts to rehabilitated areas and report issues (e.g. as identified visually) to appropriate supervisor.

1.4 Structure

The remainder of the RMP is structured as follows:

Section 2: Outlines the requirements applicable to this RMP.

Section 3: Provides an overview of the existing environment at the Mine.

Section 4: Provides an overview of the McArthur River and Barney Creek channels.

Section 5: Describes the rehabilitation planning framework for the Mine.

Section 6: Defines the areas to be rehabilitated during the RMP term and the activities proposed.

Section 7: Provides completion criteria.

Section 8: Describes the rehabilitation monitoring program.

Section 9: Discusses adaptive management processes, continual improvement measures and mine closure planning concepts.

Section 10: Outlines the review and reporting processes relevant to this RMP.

Section 11: Lists the references cited in this RMP.

2 REQUIREMENTS AND RECOMMENDATIONS

2.1 Statutory Requirements

The Mine operates under an existing suite of regulatory obligations and commitments as defined by:

- the *Mining Management Act (NT)*, where MRM is currently operating in accordance with the approved MMP, covering the period 2015 to 2018;
- the *McArthur River Project Agreement Ratification Act (NT)* and the McArthur River Project Agreement;
- the Commonwealth's *Environmental Protection and Biodiversity Conservation Act, 1999* (EPBC Act) conditions under EPBC Approval 2003/954;
- mineral lease conditions;
- the waste discharge licence conditions issued pursuant to the *Water Act (NT)*;
- the *Mineral Royalty Act (NT)*;
- Authority Certificates issued pursuant to the *Aboriginal Sacred Sites Act (NT)*; and
- legally binding and non-legally binding commitments and promises (letters, references, records and documents).

2.2 Independent Monitor Recommendations

In accordance with Authorisation 0059, an Independent Monitor (IM) was engaged by the Northern Territory Department of Primary Industry and Resources (DPIR) to undertake an independent monitoring assessment of the environmental performance of the Mine. The IM monitors the environmental performance of the Mine by reviewing environmental assessments and monitoring activities undertaken by MRM, including those relating to rehabilitation.

This RMP has been developed to address comments and recommendations made by the IM in relation to rehabilitation.

3 OVERVIEW OF THE SITE

3.1 Climate

Long-term climate data recorded at the Mine meteorological station includes monthly mean temperatures, humidity, rainfall and wind speeds. The statistical data from the Mine meteorological station indicates that:

- mean 9.00 am relative humidity is generally higher from December to March and lower from June to October at the Mine, which coincides with seasonal patterns of the wet and dry seasons;
- mean relative humidity recorded at 3.00 pm is lower than 9.00 am recordings all year round, with mean 9.00 am recordings ranging from 46% in September to 75% in February;
- mean maximum temperatures range from 29.7–38.5 degrees Celsius (°C);
- highest temperatures have historically been recorded in November, with the average maximum temperature of 38.5°C;
- mean minimum temperatures range from 12.2–25.0°C;
- coolest temperatures occur in July, with an average minimum temperature of 12.2°C; and
- mean daily evaporation is highest in the warmest months of the year, with a mean daily rate of 9.8 millimetres (mm) in November, and lowest in the coolest months, with a mean daily rate of 5.8 mm in June.

Rainfall data indicates that conditions at the Mine are highly seasonal with distinct wet and dry seasons. The majority of rainfall occurs between December and March, with limited rainfall and drought like conditions occurring between May and September. According to the Bureau of Meteorology (BOM) data, January has the highest mean rainfall with 210.3 mm and August exhibits the lowest mean rainfall with 0.3 mm. The mean annual rainfall recorded at the Mine is 801.3 mm.

The prevailing wind direction is north-easterly throughout the year, with a pronounced south south-easterly prevailing wind during the dry season.

3.2 Landforms and Land Use

The topography and landscape character of the area is predominantly flat slopes to undulating, low hilly land. Most of the site comprises open grassy woodlands that have been used extensively for grazing over long periods. In general, the terrain units (topography and geology) across the mineral leases are consistent with, and typical of, the Gulf Region.

Immediately to the east of the Mine, the Bukalara Plateau (which is the major feature of the region) stands approximately 30 metres (m) to 100 m above the surrounding countryside.

3.3 Geology and Soils

3.3.1 Geology

The Umbolooga subgroup of the McArthur River Group is comprised of interbedded cycle dolostones, dolomitic siltstone, sandstone and shale. The Batten subgroup overlies the Umbolooga and is comprised of a succession of shallow marine deposits, chiefly dolomitic siltstone, cherty dolostone, pyritic shale, quartz sandstone and evaporites. The Middle Proterozoic McArthur River Group contains the oldest rocks in the McArthur Basin.

The youngest rocks in the McArthur Basin are found in the Roper Group and occur to the east of the Emu Fault Zone in the northeastern sector of the site. They are comprised of a Proterozoic succession of quartz arenite, quartz sandstone, siltstone and shale.

The east side of the site contains the Early Cambrian Bukalara Sandstone formation, a fine to very coarse grained, cross-bedded friable quartz to lithic sandstone with minor shale beds and basal pebbly conglomerate unconformable to the McArthur River Basin sequence.

Within the site, Quaternary sediments overlie the bedrock and consist of colluvial, alluvial, lacustrine sediment including clay, sand and silt, and gravelly residual soils. These strata are overlain by more recent alluvial material deposited on the floodplains, flood terraces, levees and channel floors of the McArthur River and the Glyde River.

3.3.2 Soils

The Mine is located in the central McArthur River catchment, a 20,000 square kilometre basin that drains from the northern Barkly Tablelands to the Gulf of Carpentaria. The topography is dominated by a broad, low relief floodplain, and floodwaters can extend up to 7 km across this area during the wet season. Elevated areas occur in the low sandstone escarpment of the Bukalara Range, ridges associated with the Favenc land system and low rises to the north and east of the mine. The topography of the mine area is characterised by cracking clay alluvial back-plains, alluvial terraces on ephemeral drainage lines, undulating plains and low stony dolomitic rises.

The soils along the water courses to the west of the Bukalara Range are generally derived from quaternary alluvial (tensols to hydrosols) or material from the dominant land system (e.g. cracking clay). There are local differences in the water courses due to variations in stream order and flow dynamics. McArthur River has a very large catchment, with high volume and velocity of flow in the wet season. Its channel has a predominantly stony substrate with deep sandy to loamy soils derived from quaternary alluvium, supporting vegetation dominated by very large tree species. This is surrounded by seasonally flooded terraces and benches with soils, likewise, derived from quaternary alluvium (gravel, sand and silt). Barney Creek is a relatively small catchment with an ephemeral stream, the soils of which are derived from quaternary alluvium or cracking clay (tensols to hydrosols), supporting shorter and denser vegetation. These are surrounded by alluvial back plains with grey and brown cracking clay soils (clay-rich kandosols to tenosols).

3.4 Terrestrial Flora

Surveys of the site and surrounds have detected 445 species of vascular plant, with a further 727 species known from the broader region (within 20 km of the Mine) (EMS, 2017). The plant species detected were not listed as threatened (endangered, vulnerable or near threatened) under the NT *Territory Parks and Wildlife Conservation Act* (TPWC Act) or Commonwealth EPBC Act (EMS, 2017).

A total of 39 plant species identified in regional databases are listed as data deficient under the TPWC Act and three of these species (Curly Mitchell Grass [*Astrebla lappacea*], Native Hibiscus [*Hibiscus setulosus*] and Sesbania [*Sesbania erubescens*]) have been recorded within the site.

A total of 31 species of non-native (i.e. exotics/weeds) plants have been recorded at the Mine.

Vegetation Mapping

The vegetation that occurs within the MRM lease area has been described and mapped in a number of projects; locally by MRM and regionally, as a part of a McArthur River catchment vegetation survey and mapping project (Cuff *et al.*, 2009). These projects have named and mapped the vegetation in different ways (EMS, 2017).

The most recent and comprehensive vegetation mapping has identified 10 vegetation mapping units (VMUs), including 25 VMU subunits (Table 1, Figure 4). VMUs and subunits were described with reference to catchment wide mapping by Cuff *et al.* (2009) to enable an assessment of the distribution of each vegetation type within the site and the McArthur River catchment. The distribution of VMUs within the site is defined by the dominant land systems, which include (EMS, 2017):

- upland sandstone and dissected plateau of the Bukalara ranges;
- steep hills and ridges with sandy to loamy lithosols and rock outcrops on the Favenc Land system;
- low stony rises and outwash areas on undulating plains with shallow, rocky rudosols on the Surprise land system;
- low hills and rises with shallow gravelly lithosols and red/yellow earths on the Emmerugga land system; and
- alluvial back plains with cracking clay black-soils on the McArthur River floodplain and deep sandy and alluvial soils on the McArthur fluvial corridor (URS, 2012).

Figure 4: Vegetation Mapping Units and Subunits at the McArthur River Mine

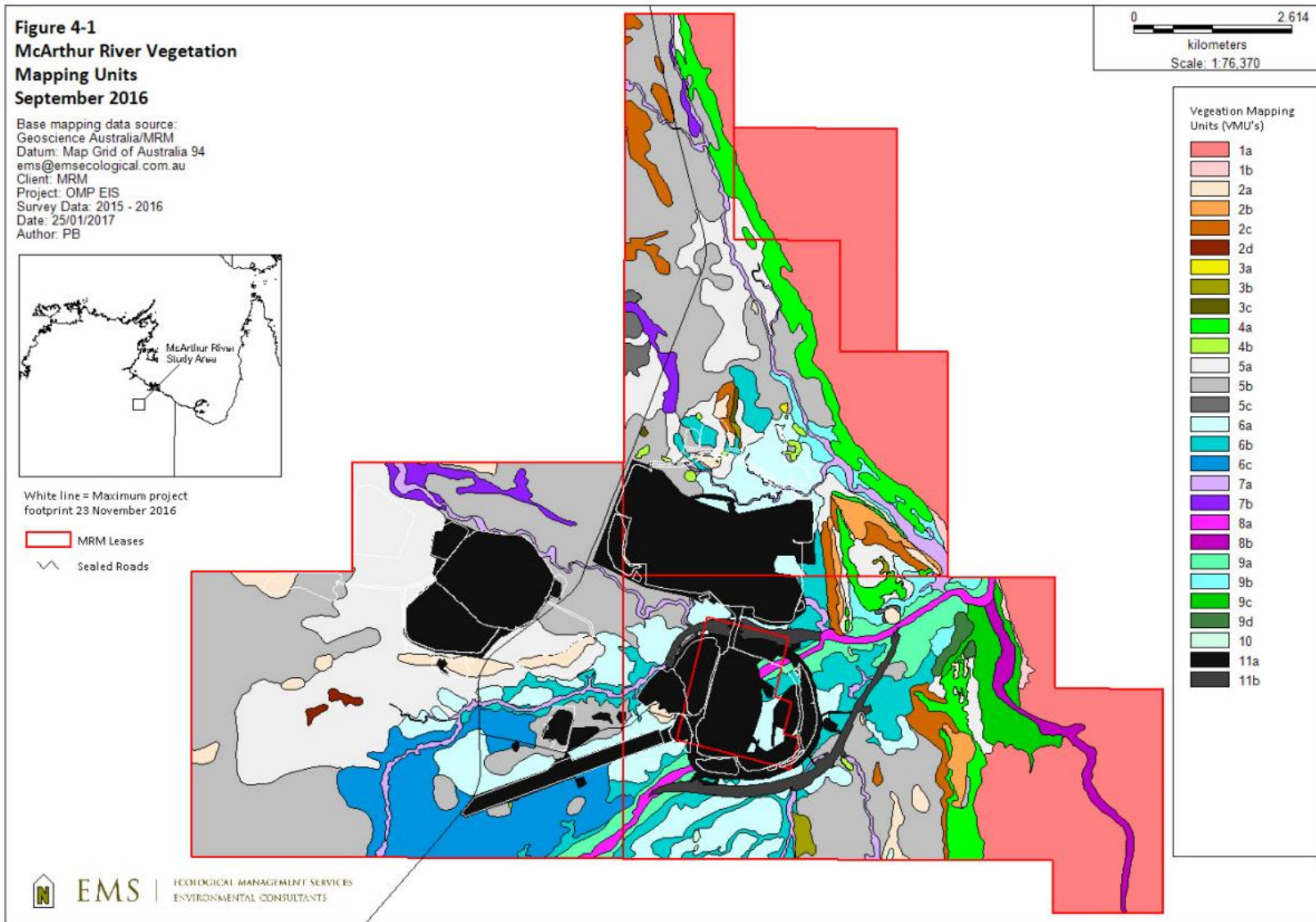


Table 1: Vegetation Mapping Units at the McArthur River Mine

VMU or VMU Sub Unit	Description	Area within MRM Lease (ha)
1 Sandstone Escarpment Low to Mid-high Woodland on the Bukalara Land System		
1	Sandstone low open woodland to mid-high woodland on sandstone escarpments associated with the Bukalara land system	2,249.3
1a	<i>Eucalyptus phoenicea</i> and <i>Corymbia dichromophloia</i> +/- <i>Eucalyptus miniata</i> , <i>Eucalyptus herbertiana</i> , <i>Corymbia setosa</i> low to mid-high open woodland on sandy soils on sandstone escarpments	2,227.3
1b	Mixed species low open woodland to mid-high woodland on sandstone escarpment terraces	22
2 Mixed species low open woodland, shrubland and grassland on stony hills and rises		
2	Mixed Species low to mid-high open woodland on stony hills and rises	537.1
2a	<i>Terminalia canescens</i> and <i>Erythrophleum chlorostachys</i> low to mid-high woodland on stony hills and rises	206.3
2b	<i>Corymbia dichromophloia</i> and <i>Eucalyptus phoenicea</i> +/- <i>Corymbia setosa</i> , <i>Erythrophleum chlorostachys</i> low to midhigh open woodland on stony hills and rises	89.4
2c	<i>Erythrophleum chlorostachys</i> and <i>Corymbia grandifolia</i> low to mid-high open woodland with mixed tussock grass ground cover on stony rises and hillslopes	228.2
2d	Low tussock grassland on low hills and rises	13.3
3 Melaleuca sp Low Woodland on Depositional and Poorly Drained Plains and Footslopes		
3	Melaleuca sp low woodland on depositional plains and poorly drained areas	31.9
3a	<i>Melaleuca viridiflora</i> low open woodland	1.6
3b	<i>Melaleuca citrolens</i> low open woodland	24.8
3c	<i>Melaleuca bracteata</i> low open woodland and closed shrubland	5.5
4 Snappy Gum Low Open Woodland and Mid-high Woodland on Undulating Plains, Low Rises, Hillslopes, Scarp-foot Slopes, Plateau and Hillcrests		
4	Eucalyptus leucophloia low to mid-high woodland on undulating plains, low rises, hillslopes, scarp-foot slopes, plateau and hillcrests	445.3
4a	<i>Eucalyptus leucophloia</i> low to mid-high open woodland on hillslopes, scarp-foot slopes, plateau and hillcrests	427.0
4b	<i>Eucalyptus leucophloia</i> low to mid-high open woodland on undulating plains and low rises	18.4
5 Mixed Inland Bloodwood and Inland Box Low to Mid-high Open Woodland on Undulating Plains, Low Rises and Hillslopes		
5	<i>Corymbia terminalis</i>, <i>Eucalyptus tectifica</i> and <i>Eucalyptus chlorophylla</i> or <i>Eucalyptus pruinosa</i> +/- <i>Corymbia grandifolia</i>, <i>Corymbia confertifolia</i>, <i>Erythrophleum chlorostachys</i> low to mid-high open woodland on plains and hillslopes	4,224.9
5a	<i>Eucalyptus tectifica</i> and <i>Eucalyptus chlorophylla</i> low to mid-high open woodland with mixed tussock grass ground cover	1,460.7
5b	<i>Corymbia terminalis</i> low to mid-high open woodland with mixed tussock grass ground cover	2,727.5
5c	<i>Eucalyptus pruinosa</i> low open woodland	36.7
6 Mixed Species Low Open Woodland, Mid-high Woodland to Open Forest on Cracking Clay Alluvial Back Plains		

VMU or VMU Sub Unit	Description	Area within MRM Lease (ha)
6	<i>Bauhinia cunninghamii</i> , <i>Eucalyptus microtheca</i> and <i>Corymbia bella</i> floodplain woodland on alluvial plains	1,881.6
6a	<i>Bauhinia cunninghamii</i> , <i>Excoecaria parvifolia</i> and <i>Atalaya hemiglauca</i> low open woodland on alluvial back plains	831.4
6b	<i>Eucalyptus microtheca</i> mid-high open woodland to open forest on alluvial back plains	501.6
6c	Mixed species low to mid-high open woodland on alluvial back plains.	548.6
7 Mixed Species Low Open Woodland, Mid-high Woodland to Open Forest on Alluvial Plains and Low Order Stream Terraces		
7	Mixed species low open woodland, mid-high woodland to open forest on alluvial plains and low order stream terraces	384.0
7a	<i>Eucalyptus camaldulensis</i> , <i>Lophostemon grandiflorus</i> , <i>Casuarina cunninghamiana</i> and <i>Terminalia platyphylla</i> riparian mid-high open woodland to open forest on low order streams	265.1
7b	<i>Corymbia bella</i> mid-high open woodland to open forest on alluvial plains and creek terraces (Surprise Land System)	118.9
8 Melaleuca Seasonally Inundated Tall Riparian Forest on Major Drainage Lines		
8	<i>Melaleuca leucadendra</i> and <i>Melaleuca argentea</i> +/- <i>Casuarina cunninghamiana</i> , <i>Nauclea orientalis</i> , <i>Terminalia sp</i> , <i>Ficus racemosa</i> , <i>Eucalyptus camaldulensis</i> tall riparian forest on major drainage channels. Sub-canopy species include <i>Barringtonia acutangula</i> , <i>Ficus coronulata</i> and <i>Pandanus aquaticus</i> .	177.4
8a	<i>Melaleuca leucadendra</i> +/- <i>Eucalyptus camaldulensis</i> , <i>Casuarina cunninghamiana</i> , <i>Nauclea orientalis</i> , <i>Ficus racemosa</i> riparian forest	81.6
8b	<i>Melaleuca argentea</i> mid-high to tall riparian forest (Bukalara land system Glyde River)	95.8
9 Mixed Species Woodland and Open Forest Seasonally Inundated River Terraces and Levees		
9	Woodland and open forest on terraces and floodplain levees.	511.3
9a	<i>Corymbia bella</i> , <i>Eucalyptus camaldulensis</i> , <i>Casuarina cunninghamiana</i> and <i>Eucalyptus microtheca</i> mid-high woodland and open forest on floodplain levees	210.3
9b	<i>Eucalyptus microtheca</i> mid-high woodland and open forest on floodplain levees	120.3
9c	<i>Eucalyptus camaldulensis</i> open forest on floodplain levees	153.0
9d	<i>Erythrophleum chlorostachys</i> mid-high open woodland on alluvial river terraces	27.7
10 Microphyll Vine Thicket on Sandstone and Dolomitic Outcrops		
10	Deciduous microphyll vine thicket on dolomitic and sandstone outcrops	3.7
11 Modified Habitats and Existing Infrastructure		
11	Modified and cleared areas, mining infrastructure, rehabilitation areas	1,706.9
11a	Existing mining infrastructure	1,569.6
11b	Restoration Areas on the McArthur and Barney Creek Channels	137.2
Total (ha)		12,153.5

Source: EMS, 2017.

3.5 Terrestrial Fauna

A review of records from surveys of fauna in the Mine site and surrounds (undertaken for the Overburden Management Project draft Environmental Impact Statement [OMP EIS]) has identified the species listed in Tables 2 and 3.

Table 2: Threatened and Migratory Terrestrial Fauna Species Recorded in the Mine Lease

Common Name	Scientific Name	Status EPBC	Status NT	Record Date	Source
Carpentarian Grasswren	<i>Amytornis dorotheae</i>	Endangered	Endangered	Pre- 1989	1, 2, 3, 4, 5
Gouldian Finch	<i>Chloebia gouldiae</i>	Endangered	Vulnerable	2016	1, 5, 7
Red Goshawk	<i>Erythroriorchis radiatus</i>	Vulnerable	Vulnerable	1992	1, 2, 5, 9
Grey Falcon	<i>Falco hypoleucos</i>	-	Vulnerable	2002	2, 5
Floodplain Monitor	<i>Varanus panoptes</i>	-	Vulnerable	2012	2, 6
Mertens' Water Monitor	<i>Varanus mertensi</i>	-	Vulnerable	2014	2, 6, 7
Mitchell's Water Monitor	<i>Varanus mitchelli</i>	-	Vulnerable	1976	8
Fork-tailed Swift	<i>Apus pacificus</i>	Migratory	-	2008	1, 6
Eastern Osprey	<i>Pandion cristatus</i>	Migratory	-	2014	1, 6
Oriental Plover	<i>Charadrius veredus</i>	Migratory	-	2002	1, 2
Little Curlew	<i>Numenius minutus</i>	Migratory	-	2016	2
Marsh Sandpiper	<i>Tringa stagnatilis</i>	Migratory	-	2015	2, 6
Common Greenshank	<i>Tringa nebularia</i>	Migratory	-	2009	2, 6
Common Sandpiper	<i>Actitis hypoleucos</i>	Migratory	-	2015	2, 3, 4, 6
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	Migratory	-	2015	2, 6
Long-toed Stint	<i>Calidris subminuta</i>	Migratory	-	2015	6
Snipe (unidentified)	<i>Gallinago sp</i>	Migratory	-	2008	6
Oriental Pratincole	<i>Glareola maldivarum</i>	Migratory	-	2002	1, 3, 5
Caspian Tern	<i>Hydroprogne caspia</i>	Migratory	-	2013	6
Glossy Ibis	<i>Plegadis falcinellus</i>	Migratory	-	2015	2, 6
Yellow Wagtail	<i>Motacilla flava (or) tschutschensis</i>	Migratory	-	2007	1, 6
Rufous (Arafura) Fantail	<i>Rhipidura rufifrons (or) dryas</i>	Migratory	-	2013	1, 6

Source: 1 – EPBC Protected Matters Report (Department of the Environment and Energy, 2016); 2 – Recent site surveys (post 2002); 3 – Atlas of Living Australia; 4 – NT Government Atlas; 5 – Historical Surveys and Collections; 6 – EMS Riparian Bird Monitoring 2006-2016; 7 – EMS Woodland bird surveys 2013-2017; 8 – CSIRO, 1976; 9 – EcoStudy, 1992.

Table 3: Threatened and Migratory Terrestrial Fauna Species Recorded in the Mine Surrounds

Common Name	Scientific Name	Status EPBC	Status NT	Record Date	Source
Partridge Pigeon	<i>Geophaps smithii smithii</i>	Vulnerable	Vulnerable	1913	5
Northern Masked Owl	<i>Tyto novaehollandiae kimberli</i>	Vulnerable	Vulnerable	1976	1, 3, 8
Painted Honeyeater	<i>Grantiella picta</i>	Vulnerable	Vulnerable	1914	5
Northern Quoll	<i>Dasyurus hallucatus</i>	Endangered	Critically Endangered	2002	1, 3, 9
Bare-rumped Sheathtailed Bat	<i>Saccolaimus saccolaimus</i>	Vulnerable	Near Threatened	-	1
Northern Crested Shrike-tit	<i>Falcunculus frontatus whitei</i>	Vulnerable	Near threatened	-	1, 4, 5
Australian Painted Snipe	<i>Rostratula australis</i>	Endangered	Vulnerable	-	1, 3
Carpentarian Antechinus	<i>Pseudantechinus mimulus</i>	Vulnerable	Near Threatened	-	1, 3
Ghost Bat	<i>Macroderma gigas</i>	Vulnerable	Near Threatened	1976	3, 8
Plain's Death Adder	<i>Acanthophis hawkei</i>	Vulnerable	Vulnerable	1976	1, 8
Northern Leaf-nosed Bat	<i>Hipposideros stenotis</i>	-	Vulnerable	-	3
Oriental Cuckoo	<i>Cuculus saturatus</i>	Migratory	-	-	1, 3, 4

Source: 1 – EPBC Protected Matters Report (Department of the Environment and Energy, 2016); 2 – Recent site surveys (post 2002); 3 – Atlas of Living Australia; 4 – NT Government Atlas; 5 – Historical Surveys and Collections; 6 – EMS Riparian Bird Monitoring 2006-2016; 7 – EMS Woodland bird surveys 2013-2017; 8 – CSIRO, 1976; 9 – EcoStudy, 1992.

3.6 Aquatic Fauna

Aquatic fauna of the McArthur River and its tributaries has been well documented through the comprehensive and continuous monitoring of the fauna present in riverine waters. Detailed ecological impact assessments have been prepared for the Phase 3 EIS and OMP EIS, including assessments of aquatic fauna.

Threatened Aquatic Fauna Species

Searches conducted using the Department of the Environment and Energy Protected Matters Search Tool and the Species Profile and Threats (SPRAT) Database indicated that four species of national conservation significance may be present in aquatic habitat in the vicinity of the Mine. These include:

- one fish species, the Freshwater Sawfish (*Pristis pristis*), listed as vulnerable; and
- three reptile species, including:
 - Gulf Snapping Turtle (*Elseya lavarackorum*), listed as endangered;
 - Freshwater Crocodile (*Crocodylus johnstoni*), listed as marine; and
 - Estuarine Crocodile (*Crocodylus porosus*), listed as marine and migratory.

In relation to species afforded protection under NT legislation only one species, the Freshwater Sawfish, is listed which is likely to occur in the vicinity of the Mine.

Extensive surveys of the aquatic fauna of the McArthur River have been conducted to date. This includes at least 300 days spent capturing and documenting aquatic fauna for monitoring purposes since 2006. Despite the significant survey effort and numerous records of Freshwater Sawfish, Freshwater Crocodiles and Estuarine Crocodiles in riverine waters of the McArthur River (including in the vicinity of the Mine), the Gulf Snapping Turtle has not been recorded.

Fish

A total of 47 species of fish have been recorded from freshwaters of the McArthur River above the Burketown Crossing. Of these, 28 are considered to be freshwater species and the 19 are estuarine vagrants.

Reptiles

Five species of aquatic reptiles have been recorded within freshwater sections of the McArthur River. Three of these, the Arafura File Snake (*Acrochordus arafurae*), Worrells' Short-necked Turtle (*Emydura subglobosa worrelli*) and Freshwater Crocodile, are regularly recorded in the McArthur River in the vicinity of the Mine. The Estuarine Crocodile is an occasional visitor to the site, but is more abundant further downstream. The Northern Snakenecked Turtle (*Chelodina oblonga*) is a scarce resident of the McArthur River catchment, including smaller tributaries such as Barney Creek.

Macroinvertebrates

Surveys of the aquatic macroinvertebrate communities within the Mine site, undertaken between 2012 and 2016, have detected 64,151 individuals from 81 families. Sludgeworms (*Naididae*), Small Square-gilled Mayflies (*Caenidae*), Mayflies (*Baetidae*), Nonbiting Midges (*Chironomidae*), Finger-net Caddisflies (*Philopotamidae*) and Net-spinning Caddisflies (*Hydropsychidae*) were the most abundant taxa collected. The macroinvertebrate communities vary widely depending on the habitat.

3.7 Sites of Cultural/Social Significance

The Mine is located on lands traditionally used by the Gurdanji and Yanyuwa people. Although areas of land are identified as belonging to particular language and family groups, other groups may have important traditional interests in that land.

Borrooloola and its immediate surrounds comprise residents from a number of Aboriginal groups and include the Garawa and Mara people. Not all of these groups are custodians of lands likely to be directly affected through mine development.

MRM holds Authority Certificates issued by the Aboriginal Area Protection Authority (AAPA). These certificates are required for all land disturbances on site in accordance with Section 22 of the NT *Aboriginal Sacred Sites Act*.

A number of Archaeological site investigation studies have been undertaken on the current mineral leases.

As a further safeguard for cultural protection in normal operations, any employee or contractor needing to undertake any ground disturbing activity must first obtain approval from both MRM Community Relations and Environmental Departments in order to ensure actions are checked against the AAPA certificates for cultural heritage sites.

Mt Stubbs (Barramundi Dreaming) is a culturally sacred site which is located directly to the east of the Mine site. The Barramundi Dreaming sacred site falls under AAPA protection, and has been protected by fencing and signage preventing access to the site.

4 MCARTHUR RIVER AND BARNEY CREEK CHANNELS

4.1 Existing Environment

The McArthur River Channel and Barney Creek Channel are in the immediate vicinity of the Mine (to the south and north of the open pit, respectively). These channels were constructed between 2006 and 2008 to divert the McArthur River and Barney Creek around the approved Mine footprint.

The McArthur River Channel is approximately 5.5 kilometres long and is the main channel to direct the natural McArthur River away from the ore body situated in the vicinity of the open pit. The Barney Creek Channel is approximately 2.5 kilometres in length and was re-channelled to enable the construction of the Mine Levee Wall. The haul road crosses the Barney Creek Channel via two bridges that are used for access to the NOEF.

The McArthur River and Barney Creek Channels diverted two different water courses that supported different ecological communities. McArthur River has a large catchment, with a high volume and velocity of water flow in the wet season. It has a predominantly stony and sandy substrate, supporting vegetation dominated by very large tree species. Barney Creek is a relatively small catchment with cracking clay soils, supporting shorter and denser vegetation (EcOz, 2015).

4.1.1 Landform and Geomorphology

In general, geomorphology characterises physical features of the broad landscape and processes that form and modify the landscape. Fluvial geomorphology is a specific aspect of river form and behaviour, including the processes that govern changes in the physical shape and form of rivers. Environmental variables such as geology, topography, soils, vegetation, hydrology and land use are relevant to the river forming processes.

The batters and slopes of the McArthur River and Barney Creek Channels vary depending on the material type they were constructed with. The sections of the McArthur River Channel developed through alluvial material were rock lined to provide stability and were covered with a 1:4 topsoil to rock ratio in preparation for rehabilitation. Rock was included to enhance stability and trap sediment whilst the topsoil aimed to provide a suitable substrate for seed germination and plant growth.

Sections of the McArthur River Channel were also excavated through bed-rock material such as sandstone. In these areas, it was expected that planting would only be possible at the base of the channel, the crest of the batter and the associated floodplain. A minimum of a 20 m wide strip each side of the crest of the channels was created to allow vehicle access during construction. These areas were reshaped to allow drainage back into the channel through drainage chutes. The topsoil from these areas was stripped and used in the construction of the batters.

The McArthur River Channel is a relatively straight channel with a cross-section that varies between trapezoidal and composite shape with one or two small bench-like features. The channel is set within a floodplain between 150 m and 1000 m wide on the left bank and 500 m and 1500 m wide on the right bank. Several small tributaries drain into the diversion over constructed rock chutes or via steep confluences (Hydrobiology, 2016).

4 MCARTHUR RIVER AND BARNEY CREEK CHANNELS

Like McArthur River, Barney Creek diversion is a relatively straight channel with a cross-section that varies between trapezoidal and composite shape with one or two small bench-like features. Channel dimensions vary throughout, with the upper two reaches having a bed width of 15 m and the lower reach consisting of a bed width of greater than 30 m. All banks are very steep, but stable throughout. This can be partly attributable to the original boundary material and surficial rock battering (Hydrobiology, 2016).

The design of the channels included several chutes to allow water to flow into the channel without causing scouring. These areas consist of rock lined material and disturbed ground. Areas of instability have been lined with synthetic/biodegradable geofabric (MRM, 2012).

Micro-depressions on the eastern McArthur River Diversion (close to the high-flow line) were created via the use of an excavator. These depressions are a kidney-shape and occur approximately every 50 m along the channel. The primary purpose of these is to establish small clusters of cane grass that can expand over time to produce habitat for bird species (MRM, 2012).

4.1.2 Surrounding Vegetation Communities

The vegetation communities relevant to the McArthur River and Barney Creek are summarised below and in Table 4, along with the equivalent community descriptions found in previous mapping reports.

McArthur River

The vegetation that lines the water course and seasonally inundated slopes of McArthur River is relatively dense and tall compared to the surrounding woodland communities and can be described as an open forest to woodland. The upper stratum is typically 10 – 23 m and dominated by River Paperbark, *Melaleuca argentea*, with subdominants including Northern Swamp Box (*Lophostemon grandiflorus*), River She-oak (*Casuarina cunninghamiana*), Leichardt Pine (*Nauclea orientalis*) and River Red Gum (*Eucalyptus camaldulensis*).

The mid- stratum is dominated by Freshwater Mangrove (*Barringtonia acutangula*), with immature canopy species making up the subdominants along with *Syzygium eucalyptoides* and River Pandanas (*Pandanus aquaticus*), the latter often growing within the river channel. The lower stratum is often sparse, due to the dynamic nature of this environment; the most common species being the grasses Cane Grass (*Chionachne cyathopoda*), Fine Armgrass (*Urochloa reptans*), Tall Tamil Grass (*Chrysopogon elongatus*), Banyard Grass (*Echinochloa colona*), and Warrego Grass (*Paspalidium jubiflorum*).

The fringing woodland vegetation community that occurs on the levees, terraces and back plain areas surrounding the main channel of the McArthur River water course is dominated by a canopy of River She-oak (*Casuarina cunninghamiana*), Coolabah (*Eucalyptus microtheca*), River Red Gum (*Eucalyptus camaldulensis*), Weeping Paperbark (*Melaleuca leucadendra*), Ghost Gum (*Eucalyptus bella*) and *Terminalia platyphylla*, 10 – 15 m high. The mid canopy consists of a sparse mixed species shrubland including River Pandanas (*Pandanus aquaticus*), Guttapercha Tree (*Excoecaria parvifolia*), and Whitewood (*Atalaya hemiglaucula*). The ground layer consists of a mixed species low tussock grassland/forbland.

Table 4: Vegetation Communities Mapped as Occurring along McArthur River and Barney Creek

Vegetation Survey Report	McArthur River Channel and Slopes	McArthur River Batters and Surrounding Woodland	Barney Creek Channel and Slopes	Barney Creek Batters and Surrounding Woodland
McArthur River Mine Overburden Management Project: Terrestrial Ecology Technical Report (EMS, 2017)	VMU 8a: <i>Melaleuca leucadendra</i> +/- <i>Eucalyptus camaldulensis</i> , <i>Casuarina cunninghamiana</i> and <i>Nauclea orientalis</i> tall riparian forest	VMU 9a: <i>Corymbia bella</i> , <i>Eucalyptus camaldulensis</i> , <i>Casuarina cunninghamiana</i> , <i>E. microtheca</i> mid-high woodland and open forest on floodplain levees.	VMU 7a: <i>Eucalyptus camaldulensis</i> , <i>Lophostemon grandiflorus</i> , <i>Casuarina cunninghamiana</i> and <i>Terminalia platyphylla</i> riparian mid-high open woodland to open forest on low order streams	VMU 6b: <i>Eucalyptus microtheca</i> mid-high open woodland to open forest on alluvial back plains
Vegetation Survey and Mapping of the McArthur River Catchment, Northern Territory (Cuff <i>et al.</i> , 2009)	VMU 38: <i>Melaleuca leucadendra</i> and/or <i>M. argentea</i> , <i>Eucalyptus camaldulensis</i> , <i>Nauclea orientalis</i> , <i>Casuarina cunninghamiana</i> mid woodland with a lower tree stratum of species such as <i>Ficus coronulata</i> , <i>Acacia hemsleyi</i> , <i>Barringtonia acutangula</i> , <i>Pandanus spiralis</i> and <i>Lophostemon grandiflorus</i> over a mid tussock grassland of <i>Chrysopogon elongatus</i> , <i>Ectrosia leporina</i> , <i>Echinochloa colona</i> , <i>Eriachne mucronata</i> and <i>Paspalidium jubiflorum</i> .	VMU 42: <i>Casuarina cunninghamiana</i> +/- <i>Eucalyptus camaldulensis</i> , <i>Melaleuca leucadendra</i> , <i>E. microtheca</i> mid open forest with a mixed species sparse shrubland including <i>Pandanus aquaticus</i> , <i>Excoecaria parvifolia</i> , and <i>Atalaya hemiglauca</i> . The ground layer consists of a mixed species low tussock grassland / forbland.	VMU 11: <i>Lophostemon grandiflorus</i> +/- <i>Eucalyptus camaldulensis</i> , <i>Nauclea orientalis</i> mid open forest with a prominent mixed species mid stratum often including species such as <i>Ficus</i> sp. <i>carpentariensis</i> , <i>Barringtonia acutangula</i> and <i>Atalaya hemiglauca</i> generally over a low sparse tussock grassland of <i>Chrysopogon elongatus</i> .	VMU 20: <i>Eucalyptus microtheca</i> +/- <i>E. camaldulensis</i> , <i>Corymbia confertiflora</i> , <i>C. terminalis</i> , <i>C. bella</i> low open woodland with a secondary, low open tree layer of <i>Bauhinia cunninghamii</i> , <i>Hakea arborescens</i> and <i>Atalaya hemiglauca</i> . The variable ground layer is commonly composed of mixed tussock grasses or is <i>Astrebla</i> spp. and <i>Iseilema</i> spp. dominated.
MRM Phase 3 Development Project Environmental Impact Statement – Terrestrial Flora (EcoScience, 2012)	Community 4 – Riparian Corridor (Map Unit 9): tall, structurally complex open forest to woodland, typically dominated by <i>Melaleuca argentea</i> .	Community 3 – Riverine Woodland (Map Unit 8): mixed species woodland formation on creek margins dominated by <i>Lophostemon grandiflorus</i> , <i>Casuarina cunninghamii</i> , <i>Terminalia bursarina</i> and <i>Excoecaria parvifolia</i>	Community 3 – Riverine Woodland (Map Unit 8)	Community 3 – Riverine Woodland (Map Unit 8)
MRM Open Cut Project Draft Environmental Impact Statement. Appendix H, Terrestrial Flora (URS, 2006)	Map Unit No. 9 – Riverine Corridor: <i>Melaleuca argentea</i> Woodland to open woodland	Map Unit No. 8 – Riverine Woodland: <i>Casuarina cunninghamia</i> / <i>Lophostemon grandiflorus</i> Woodland	Map Unit No. 8 – Riverine Woodland	Map Unit No. 8 – Riverine Woodland

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Barney Creek

The vegetation that occurs along the channel and slopes of the ephemeral Barney Creek is a relatively narrow, linear riparian community described as a mixed species woodland dominated by Northern Swamp Box (*Lophostemon grandiflorus*), River Red Gum (*Eucalyptus camaldulensis*), *Nauclea orientalis*, Wild Plum (*Terminalia bursarina*) and Guttapercha Tree (*Excoecaria parvifolia*).

It has a prominent mixed species mid stratum, often including species such as *Ficus carpentariensis*, Freshwater Mangrove (*Barringtonia acutangula*) and Whitewood (*Atalaya hemiglauca*), generally over a low sparse tussock grassland of Tall Tamil Grass (*Chrysopogon elongatus*), Fine Armgrass (*Urochloa reptans*), Banyard Grass (*Echinochloa colona*) and Delicate Lovegrass (*Eragrostis tenellula*). Other common grasses include Golden Beard Grass (*Chrysopogon fallax*) and Warrego Grass (*Paspalidium jubiflorum*), whilst common herbs include *Ammannia multiflora*, *Phyllanthus maderaspatensis*, *Hybanthus enneaspermus*, *Melochia corchorifolia* and *Alternanthera nodiflora*.

The vegetation that occurs on the levees, terraces and back plain areas surrounding Barney Creek is described as a low open woodland of Coolabah (*Eucalyptus microtheca*), River Red Gum (*Eucalyptus camaldulensis*), Carbeen (*Corymbia confertiflora*), Northern Bloodwood (*Corymbia terminalis*) and Ghost Gum (*Corymbia bella*) with a low open mid stratum of Bean Tree (*Bauhinia cunninghamii*), Yellow Hakea (*Hakea arborescens*) and Whitewood (*Atalaya hemiglauca*). The variable ground layer is commonly composed of mixed tussock grasses, including Golden Beard Grass (*Chrysopogon fallax*), Curly Bluegrass (*Dichanthium fecundum*), Delicate Lovegrass (*Eragrostis tenellula*) and Speargrass (*Heteropogon contortus*).

4.2 Rehabilitation of McArthur River and Barney Creek Channels to Date

The environments of the McArthur River and Barney Creek Channels differ to the natural riparian environments they replaced. This is because of the different flow pattern created and the large amount of rock imported for bank stabilisation during construction of the channels. The natural water courses are generally braided and winding which slows the high volumes of water that flow along them during the wet season. The environment created in the channels is different in many aspects (e.g. geology, water flow) than that which exists along natural sections of the river (EcOz, 2016).

Rehabilitation of the McArthur River and Barney Creek channels commenced following their construction. A summary of rehabilitation undertaken to date and its relative success is provided below.

As a part of the original channel construction, a large amount of top soil was imported and used to cover the banks of the water courses. However, it was reported as early as 2012 that flood events had resulted in the erosion of much of this soil and transportation of sediment. Loss of top soil and exposure of bare rock had occurred on the McArthur River Channel across most of the middle and upper length. Topsoil loss had also occurred across the entire length of the Barney Creek Channel slopes.

The Barney Creek Channel had tubestock of several tree and grass species planted and seeds of a range of native local plant species sown in the wet season (summer) 2007/08. The McArthur River Channel had tubestock of several tree species and one grass species planted in the dry season (winter) of 2010. An assessment of vegetation establishment in 2010 (Charles Darwin University [CDU], 2010) found that tubestock contributed most of the trees regenerating at the sites initially, but in 2010, substantial establishment of a few tree species (Acacia, Bauhinia, Excoecaria) occurred from seeds. Many grasses and shrubs were also regenerating from seeds. Grass or weed competition did not appear to be affecting establishment.

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The initial planting density on the McArthur River Channel was substantially higher than for the sites along the Barney Creek Channel. In 2010, it was noted that it was too early to assess success but survival had been high (average survival of trees 95% and grasses 97%) and mortality after transplanting was similar to that when the Barney Creek tubestock were first monitored.

From 2007 to 2012, approximately 27,000 tubestock were planted at Barney Creek and a further 85,000 tubestock were planted along the McArthur River Channel. There has been some success at establishing vegetation at the beginning of both the Barney Creek and McArthur River Channels. However the lower reaches of the channels, particularly the McArthur River Channel, have issues with erosion and limited establishment of vegetation.

Revegetation monitoring has shown that the slopes of both channels have a high percentage of bare rock as cover, even following revegetation, with McArthur River sites having a greater proportion of bare ground than Barney Creek sites.

4.2.1 Geomorphological Assessment

A geomorphological assessment of the McArthur River and Barney Creek Channels was undertaken by Hydrobiology during 2016, focusing on the identification and quantification of areas and volumes of erosion and deposition and the processes causing it.

Hydrobiology (2016) made a number of recommendations to improve the geomorphic condition of the McArthur River and Barney Creek Channels, including:

- *Undertake cross-sectional surveys in conjunction with Lidar acquisition to determine submerged bed levels.*
- *Expand Lidar acquisition to include the area covered by the 2011 Lidar acquisition.*
- *Conduct further geomorphic assessments 2-yearly or immediately following a 10-year ARI event to establish a dataset that shows it is on a trajectory towards a self-sustaining system. Monitoring frequency can be reduced once performance of the channel improves.*
- *Confirm the extent of the rock bar at the downstream limit of Djirrinmini Waterhole.*
- *Investigate options to address the stability of the McArthur River channel offtake (and old McArthur River). Options to assess include:*
 - *Upstream extension and realignment of the channel offtake.*
 - *Construction of a levee on the left bank upstream of the channel.*
 - *Additional stabilisation works to the existing mine pit levee.*
 - *Post-mine high-flow diversion into the pit.*
- *Investigate options to address the McArthur River Channel instabilities discussed above. This should include:*
 - *Reprofiling and revegetation (including watering).*
 - *Stabilisation and/or reprofiling gully confluences.*
 - *Revegetation efforts throughout.*
- *Inspection of the channel reach by a rehabilitation expert to assess vegetation condition and replanting options as part of any remediation designs.*
- *Investigate the implications of adjustment of bank angles of the Barney Creek Channel for long-term relinquishment.*
- *Investigate the alignment of the confluence of Surprise Creek and the old Surprise Creek path.*
- *On site staff should monitor the flood flow paths and bank instabilities in Surprise Creek regularly.*
- *The flood flow paths and bank instabilities in Surprise Creek should be included in subsequent geomorphic surveys.*
- *Geomorphic monitoring should include a full walk through of the reach of Surprise Creek between SW01 and SW02.*

Actions to address these recommendations are currently being implemented by MRM.

4.3 Rehabilitation Trials and Programs

4.3.1 Irrigation

Plantings must be irrigated during the dry season during vegetation establishment to maximise survival and plant growth.

MRM trialled the use of a water cart for irrigation purposes however this was unsuccessful. As a result, MRM designed and implemented a sled mounted tank with a sprinkler system to water tubestock over consecutive dry seasons until they become established.

4.3.2 Large Woody Debris

Large Woody Debris (LWD) plays an important role in the ecology and geomorphology of streams and rivers. LWD provides aquatic fauna habitat, increases biodiversity and its breakdown forms the foundation of an aquatic food web. LWD can also significantly influence channel morphology, stream bank stability and create variation in flow which is vital for the migration and dispersal of fish. Furthermore, LWD promotes the establishment and success of riparian vegetation (MRM, 2017).

The installation of LWD into the channel remains the single most effective action in providing fish habitat and has additional benefits including (Indo-Pacific Environmental, 2016):

- Aiding in fish migration by effectively providing ‘stepping stones’ which provide some respite from flow and protection from predators.
- Aiding in alleviating the scouring of the channel which has resulted in large quantities of sediment being transported and deposited at sites below the channel.
- Acting as a source of carbon which is needed as basic building block in the aquatic food ecosystem.

Table 5 provides a breakdown of the LWD installed to date and scheduled for installation.

Table 5: Large Woody Debris Summary

Year	Truck Loads	Location of Placement
2010	200	Upstream & Downstream Channel
2011	18	Downstream Channel
2013	15	Mid Channel
2014	124	Downstream Channel
2016	74	Upstream Channel
2017	12	Mid Channel
2018	25	South West NOEF
Year	Truck Loads	Location of Source Material
2019	34	Inside Mine Levee
	37	North of NOEF
	67	South East of NOEF
	89	TSF WMD
	314	West of TSF
2020	0	-
2021	163	North of NOEF
	154	West of TSF

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2022-2027	126	Inside Mine Levee
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EMS (2016) noted that the LWD placement appears to have been successful in creating variation in flow and micro-habitat within the McArthur River Channel, which is beneficial for invertebrate and vertebrate fauna.

The aquatic fauna assessment undertaken by Indo-Pacific Environmental Pty Ltd in 2016 notes that “*rehabilitation works in the [McArthur River Channel], and in particular the installation of woody debris in the downstream section, have been highly successful in creating fish habitat which has increased aquatic fauna diversity and density*” (IPE, 2016).

The results of the macroinvertebrate assessment undertaken in 2016 indicated that sites in the vicinity of LWD installed in 2014 support as many species of macroinvertebrates as the McArthur River prior to the Channel construction (Indo-Pacific Environmental Pty Ltd, 2017).

LWD collected from areas to be disturbed ahead of expanding mining operations will continue to be placed in general accordance with the following specifications (MRM, 2017):

- LWD is to be placed in the bed of the channel to assist in rehabilitation, to provide localised habitat, and to encourage sediment trapping and meandering. LWD is to comprise of dead trees with a minimum Diameter Breast Height (DBH) of 300 mm, but preferably greater than 450 mm;
- LWD to be located at irregular spacing, placement, and alignment to resemble a random distribution. In channel sections with a sand/clay bed, the maximum spacing of LWD is to be approximately 100 m (minimum 30 m). In rock excavated sections, the maximum spacing of LWD is to be approximately 200 m. LWD are to be placed irregularly on alternating sides of the bed, in a random fashion. Near tributary junctions, LWD is to be placed on the bank opposite to the side where the tributary joins. About 20 to 40% of LWD is to be in groups of two or three logs placed to resemble a log jam. Log jams are to be placed closer to the banks and not obstruct more than 50% of the channel bed;
- Shallow loose sand (around 200 mm to 400 mm depth) is to be placed on the upstream and downstream side of logs to resemble sand bars. At least two thirds of LWD is to be anchored. Anchoring should be achieved by partial (>25%) burying of the log and root ball, chaining to a timber pile driven into the sand or clay bed, or chaining to a grouted steel bar in rock beds;
- Approximately 60 to 80% of LWD is to be aligned angled from the bank (about 30 to 60 degrees) in the downstream direction. The remainder to be perpendicular to the bank and some pointing upstream; and
- Shallow pools (approximately 0.5 m in depth) to be incorporated as over-excavated rock material in the base of the rock diversion section.

4.3.3 Carpentaria Highway Vegetation Enhancement

The aim of this project is to enhance visual amenity for road users of the highway (where the operational areas of the Mine are visible) and minimise potential wind generated dust from these locations.

The Carpentaria Highway Vegetation Enhancement project primarily involves the planting of tubestock through the vegetation corridor between the Carpentaria Highway and the NOEF.

4.4 Rehabilitation Success and Effectiveness

Mortality of seedlings has been reported in various years as a result of: lower rainfall in wet season (2012-2013); flooding; erosion and associated slumping and terracing of banks; and faunal impacts, predominantly grazing by cattle and donkeys. Despite this, by 2016, it was reported by EcOz (2016) that there has been some success at establishing vegetation at the beginning of both channels.

There have also been some notable recruitment events (i.e. natural propagation of plants) taking place along the low water level of the McArthur River associated with natural deposition of water dispersed seed. However, in the lower reaches of the channels, particularly the McArthur River Channel, erosion has resulted in little establishment of vegetation (EcOz, 2012-2016).

Yearly revegetation monitoring (2012 – 2016) has reported that revegetation has been most successful at the upstream end of the McArthur River Channel. The middle section of the McArthur River Channel continues to be eroded such that conditions are not conducive for the establishment or growth of vegetation (EcOz, 2012-2016).

All other revegetation monitoring sites were still determined to be “requiring remediation or intense replanting”, and therefore require active management to be on a trajectory to meet completion criteria. The batters are stable along the Barney Creek and some of the McArthur River Channel, although the substrate is generally not favourable for the establishment of new seedlings (EcOz, 2016).

4.4.1 Erosion

Rock was used in the construction of the channel banks, with topsoil applied to the rock structure to provide a substrate suitable for establishment of vegetation. Past flood events within the McArthur River and Barney Creek channels have resulted in the erosion of this soil, leaving bare exposed rock.

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Where topsoil has been lost, it was recommended by EcoScience (2012) to plant vegetation that will provide cover and encourage deposition of sand within the site (i.e. *Chrysopogon elongatus* and *Excoecaria parvifolia*). This is to attempt to reverse erosion and improve the suitability of the substrate for the ongoing recruitment of vegetation within the revegetation site.

4.4.2 Fauna Impacts

Cattle were observed at both Barney Creek and the McArthur River control sites and along the McArthur River Channel revegetation sites monitored by EcOz (2012-2013). Feral donkeys were observed at the McArthur River Channel and elsewhere within the Mine site. High levels of grazing was observed in many sites, with the highest levels of impact within revegetation sites on batter sites, as steeper slope sites are thought to be harder for cattle to navigate across.

MRM currently excludes cattle and donkeys from the channels through the implementation of a 3,391 hectare cattle exclusion area (containing 1,698 hectares of remnant vegetation, including the McArthur River and Barney Creek channels) in accordance with the MRM Cattle Management Plan (Figure 5). As described in the Cattle Management Plan, a cattle muster is undertaken approximately every six weeks during the dry season to maintain the exclusion of stock.

The MRM Cattle Management Plan is reviewed annually in consultation with DPIR.

4.4.3 Terrestrial and Aquatic Ecology

Monitoring of terrestrial and aquatic ecology along the McArthur River Channel indicates revegetation in the upper section of the McArthur River Channel and the placement of large woody debris in the channel bed is resulting in improved habitat for terrestrial and aquatic species.

This is supported by the following analysis reported in specialist monitoring reports prepared for MRM:

- Riparian bird assemblage has increased significantly at sites on upper sections of the McArthur River Channel, and is trending towards reference sites. Increased efforts to remove donkey and cattle from restoration areas are likely to have improved conditions in these areas.
- There is a high level of similarity between macroinvertebrates at riffle habitat at McArthur River Channel sites, McArthur River reference sites and other large order drainage reference sites, with MRM's program of large woody debris placement having been successful in creating variation in flow and micro-habitat within the McArthur River Channel.
- Similarly, placement of large woody debris has proven highly successful in providing fish habitat with higher numbers and an increased diversity being recorded, with no significant difference in species diversity found between the McArthur River Channel and downstream habitats.
- Three juvenile Freshwater Sawfish were found below, within and above the McArthur River Channel, indicating that the channel continues to allow fish passage as well as provide an environment conducive to the growth and survival of this species.

4.5 MRM Nursery

MRM operates a plant nursery which produces tubestock of native plant species for use as part of the Mine rehabilitation program. The nursery includes two shade houses, one used for seed propagation (75% UV shade cloth) and the other used for tubestock growth (30% UV shade cloth) and a hardening off area where plants are exposed to full environmental conditions prior to being planted. MRM are currently working towards collecting 80% of the seeds used at the nursery from within the Mine site.

4 MCARTHUR RIVER AND BARNEY CREEK CHANNELS

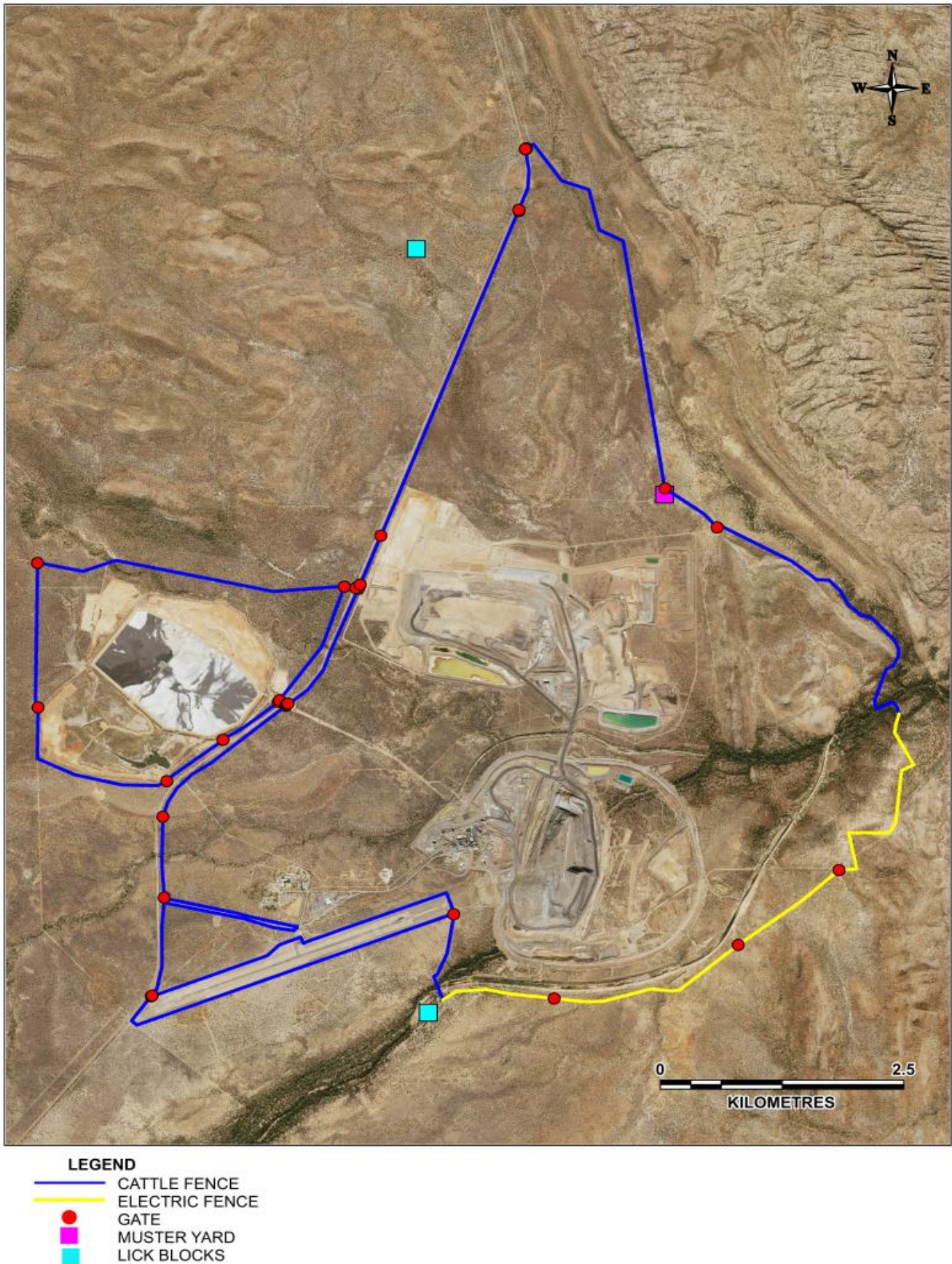


Figure 5: MRM Cattle Exclusion Area

5 REHABILITATION PLANNING

5.1 Closure Objectives

The closure objectives presented below follow the *National Strategy for Ecologically Sustainable Development*, especially in relation to intergenerational equity, the polluter pays principle, protection of biodiversity and maintenance of essential ecological processes. The following ten closure objectives are consistent with those outlined in the opening statement of the Department of Mines and Energy (DME) *Northern Territory Draft Guidelines for Mine Closure Plans* (the NT Draft MCP Guidelines) (DME, 2016):

- Post-mining landscape will be left in a condition safe and secure for humans and animals:
 - safe and secure for short term (0-100 years); and
 - safe for long term (100-1,000 years).
- Landform stability:
 - Geotechnical stability will be maintained at these standards:
 - NOEF: Long-term static drained Factor of Safety (FoS) of 1.5;
 - Maximum Design Earthquake (MDE) – 1 in 1,000 year event;
 - open cut walls: Probability of Failure (Pf) for inter-ramp slopes of <5%; and
 - TSF: as per ANCOLD (2012) guidelines.
 - Erosional stability; maintainable for these aspects:
 - cover system and landform to maintain functionality;
 - sediment release from erosion does not adversely impact on water quality;
 - erosion does not affect functionality of the landform; and
 - resulting suspended solids can be mitigated.
 - Geochemical stability will be defined, managed and monitored:
 - seepage water quality at toe/base of landforms; and
 - water quality within the mine pit lake.
- Manage surface water and groundwater such that environmental values and ecosystems are maintained downstream of the lease boundary in the short term (0-100 years), and within the McArthur River in the long term (100-1,000 years).
- Rehabilitated areas will provide appropriate habitat for fauna utilization – abundance and diversity will be appropriate.
- Metal levels for fauna comparable to background levels.
- Landform will host suitable vegetation for post-mining land use:
 - for traditional land use areas:
 - have similar environmental values as surrounding areas; and
 - for cattle grazing land use areas:
 - grasslands.
- Manage soil to meet post mining land use.

- No infrastructure left on-site unless a beneficial gain is identified and agreed with stakeholders.
- Maintain custodians' access to areas of cultural significance.
- Foster economic opportunities for custodians and local communities.

5.2 Management Domains

For the purposes of describing strategies and actions for closure in the MRM Conceptual Mine Closure Plan (from the OMP EIS), the Mine has been divided into the following nine domains (Plate 1):

- Domain 1 Open Pit and Diversions;
- Domain 2 OEFs (NOEF and WOEF);
- Domain 3 TSF;
- Domain 4 Infrastructure Areas;
- Domain 5 Borrow Pits;
- Domain 6 Water Dams;
- Domain 7 Roads;
- Domain 8 Exploration Areas; and
- Domain 9 Bing Bong Infrastructure Area.

The domains differ in final landform objectives, rehabilitation requirements and/or risks. These domains are described in the following subsections.

In developing the conceptual final landform designs and the performance indicators and completion criteria (Section 7), consideration was given to appropriate post-mining land uses, as well as the technical feasibility of the proposed conceptual designs. MRM's framework for determining post-mining land uses is presented on Figure 6.

MRM's preliminary post-mining land uses for each domain (and their associated mine features/major landforms) are presented in the following subsections.

It is noted the final land uses are subject to the approval of the OMP EIS, and will continue to be refined in consultation with relevant stakeholders (including Custodians, local communities, Environmental Protection Authority [EPA], DPIR, potential future site owner/s and Roper Gulf Regional Council).

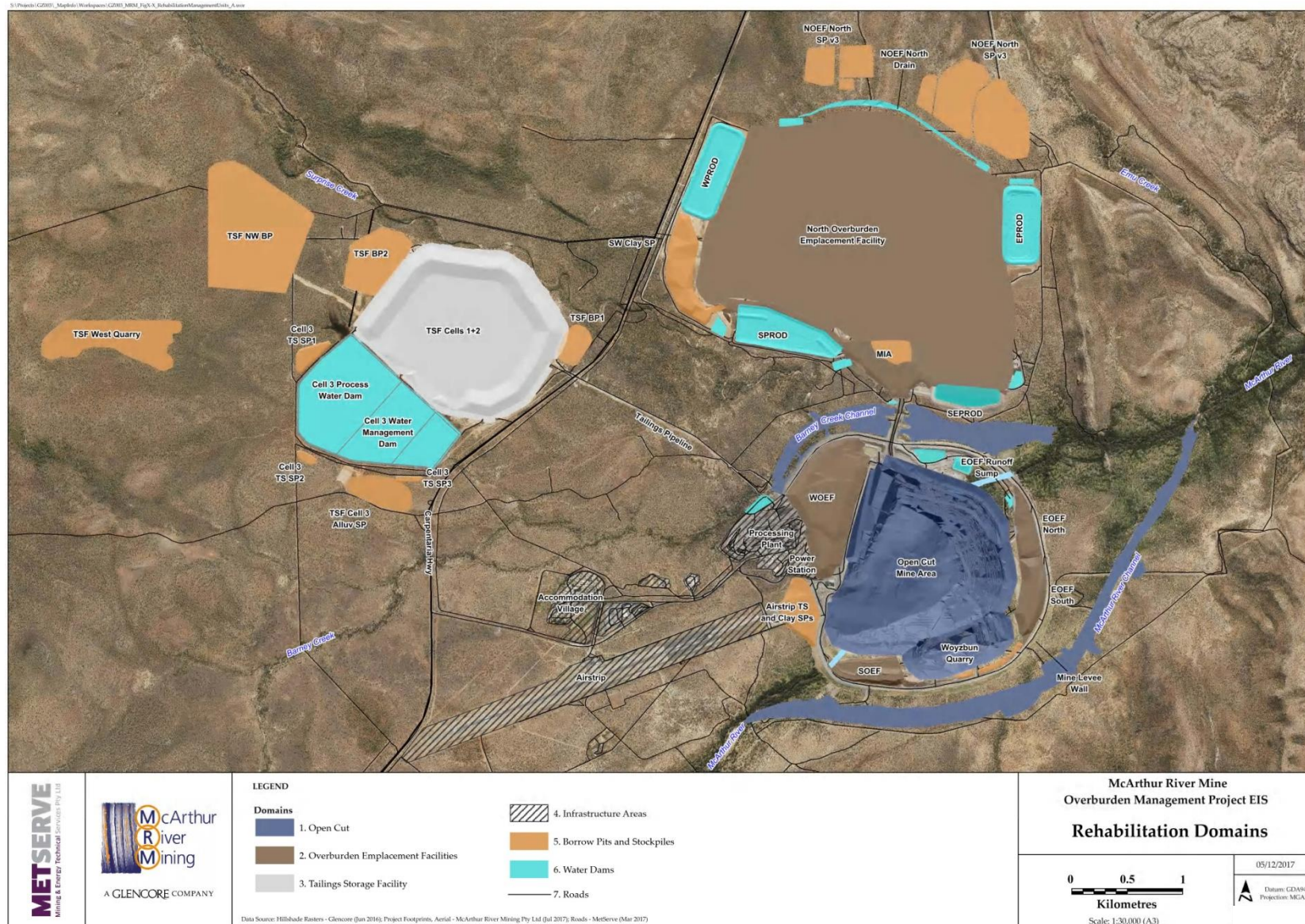


Plate 1: Rehabilitation Domains from the OMP EIS (subject to approval)

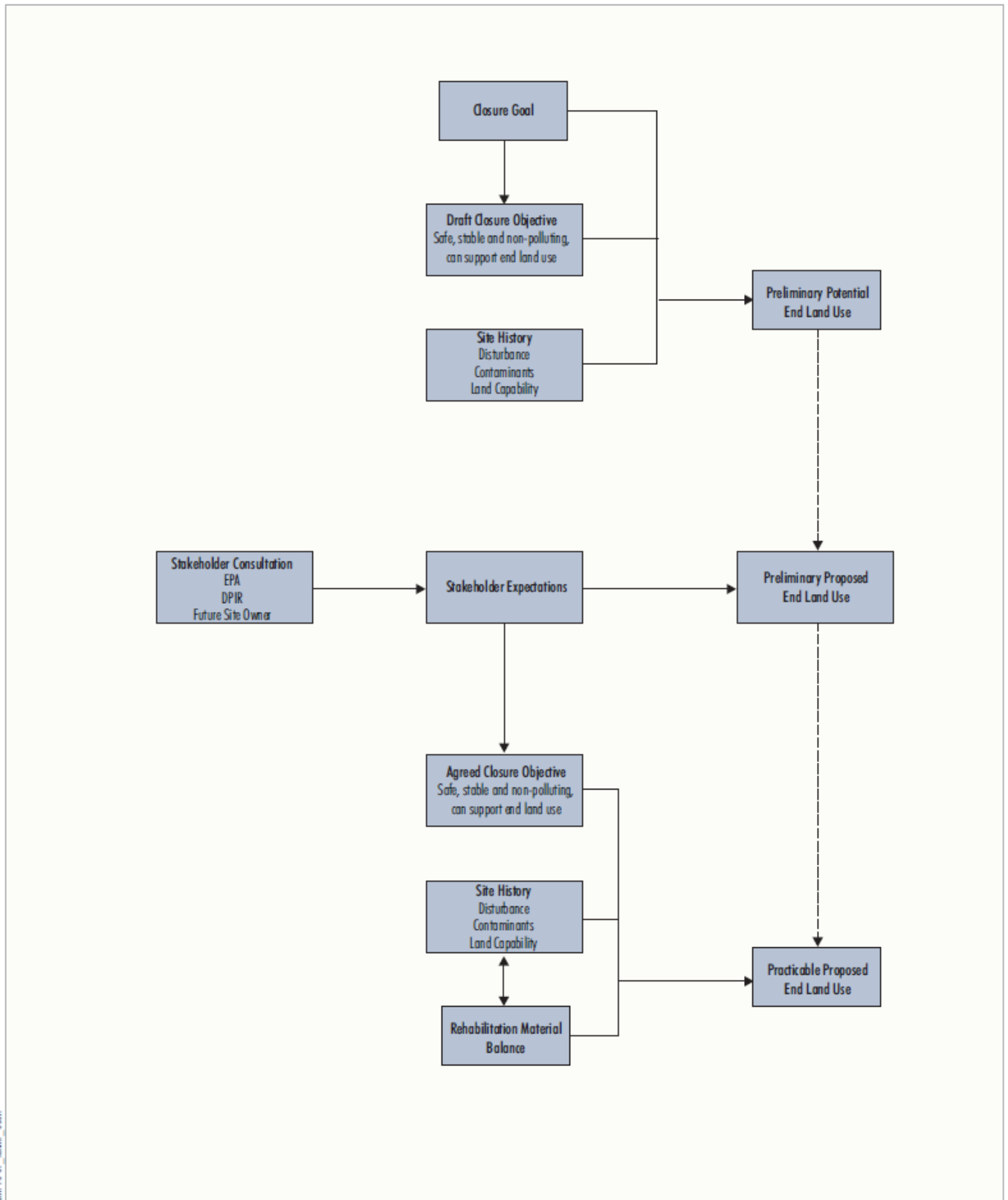


Figure 6: Framework for Determining Post-mining Land Use

5.2.1 Domain 1: Open Cut

Location

The open cut domain includes the Open Cut, Woyzbun Quarry and Mine Levee Wall (Plate 1). It also includes re-channelled sections of the McArthur River and Barney Creek, which were undertaken to accommodate the open cut.

Disturbance Area

The footprint of the mining operations within the Open Cut, including the Woyzbun Quarry, is 258 ha. Realignment of the McArthur River and Barney Creek, around the Open Cut, has created 8.5 km of channel (139.6 ha) requiring revegetation.

Disturbance Type

The Open Cut comprises a pit with a maximum depth of 420 m. The base and sides of this open cut will contain non-benign rock (potentially acid- or salt-forming material). To prevent oxidation of this material, the open cut will be filled with water and maintained as a lake. The upper rock benches of the mine pit lake sides will have batters sloped back to 18 degrees, to provide suitable stability in a mine-pit-lake setting.

The re-channelled sections of Barney Creek and the McArthur River were formed by excavating new channels into existing soil and bedrock.

The following characteristics are common to all components of the Open Cut domain:

- areas to be revegetated are the banks and batters along modified waterbodies;
- areas are to be revegetated with riparian vegetation;
- areas to be revegetated are subject to extensive seasonal variation in water level, including regular flooding;
- areas to be revegetated have been, or will be, subject to substantial modification of the original substrate, and therefore lack topsoil or soil seed banks; and
- aquatic habitats generally lack structural features such as woody debris, which is important for moderating flow rates during floods and for providing shelter for aquatic fauna.

5.2.2 Domain 2: Overburden Emplacement Facilities

Location

Domain 2 includes the NOEF, West Overburden Emplacement Facility (WOEF), and the temporary East and South Overburden Emplacement Facilities (EOEF and SOEF, respectively) (Plate 1).

Disturbance Area

The NOEF will occupy 529.7 ha, the WOEf will occupy 57.3 ha, the EOEF will occupy 25.4 ha and the SOEF will occupy 14.4 ha.

Disturbance Type

All overburden emplacement facilities comprise stockpiles of overburden removed from the open cut. Much of this overburden contains potentially acid- or salt-forming sulphide minerals.

Overburden stored temporarily within the EOEF and SOEF will be moved to and stored within the final void of the open cut, where it will be inhibited from oxidising by a deep cover of water.

5 REHABILITATION PLANNING

The NOEF and WOEF will remain as permanent, above-ground stores of overburden. Non-benign material contained within these facilities will be inhibited from oxidising by encapsulating it within a barrier layer comprised of compacted clay and further covered by a combination of breccia, alluvial material and topsoil.

The highest point of the NOEF will be 140 m above the original ground level. The NOEF will have tri-linear concave batters, comprising:

- a lower slope section (0-55 m elevation) with a batter angle of 1V: 4.5H;
- a mid-slope section (55-100 m elevation) with an angle of 3.5H:1V; and
- an upper slope section (100-140 m elevation) with an angle of 2.5H:1V.

The WOEF will have batters with an angle of 4H:1V.

The following are characteristics common to all components of the Overburden Emplacement Facility domain:

- areas to be revegetated are highly modified from the original landscape;
- areas to be revegetated contain approximately 2 m of growth media overlying a Geosynthetic Liner or compacted clay layer above non-benign rock;
- areas to be revegetated may contain soil seed banks transported when topsoil is deposited at the site; however, the species that germinate may be poorly adapted to the new local conditions (e.g. species growing in plains may not grow on rocky slopes);
- success of revegetation is important for inhibiting erosion that may compromise the functionality of the cover system.

5.2.3 Domain 3: Tailings Storage Facility

Location

Domain 3 contains the Tailings Storage Facility (TSF), located in the west of the mining operations (Plate 1).

Disturbance Area

The TSF will have a disturbance footprint of 218.3 ha.

Disturbance Type

Domain 3 comprises the tailings ponds and surrounding embankments. No original vegetation will exist within this domain at the time revegetation will commence. All tailings and contaminated embankment and base will be removed and placed in the open cut void after reprocessing. Benign embankment materials and stockpiled topsoils and alluvia from the original development of the facilities will be used to re-profile the site.

The following are characteristics of the final landform within the TSF domain:

- areas to be revegetated are similar in profile to, but slightly lower than, the original landscape (a flat plain);
- stored topsoil, which is unlikely to contain an intact soil seed bank, will cover areas to be revegetated;
- the removal of reactive material from the domain negates the need for barrier layers beneath the growth media, allowing roots to penetrate deeply; and
- there is a small risk that inadequate removal of non-benign material could lead to acidification or salinisation of the topsoil or water runoff.

5.2.4 Domain 4: Infrastructure Areas

Location

Domain 4 comprises a range of ancillary infrastructure that supports the operation of the mine. These are primarily built structures, including the accommodation village, offices, stores, concentrate haulage depot, power station, processing plant, water treatment facilities, and airport. The locations of these structures are shown in Plate 1.

Disturbance Area

Domain 4 will have a disturbance footprint of 162.3 ha.

Disturbance Type

Unlike many of the other domains, the soil profile within Domain 4 remains relatively intact. Once buildings are removed, and the ground is ripped to reduce soil compaction, little else is required to prepare the site for revegetation. Exceptions to this include excavated areas such as the swimming pool and haulage depot work pit. Topsoil required to re-profile these areas will be sourced from the stockpile to the west of the stores.

Some areas of Domain 4 have the potential to experience minor hydrocarbon contamination, which will be removed prior to revegetation.

The following are characteristics common to all components of the Infrastructure Areas domain:

- areas to be revegetated lack a natural soil seed bank;
- areas to be revegetated are generally flat and retain a natural soil profile;
- areas to be revegetated generally have a higher than average diversity and density of weeds, due to high human traffic (a potential source of new weeds), prolonged disturbance and regular irrigation of garden beds.

5.2.5 Domain 5: Borrow Pits

Location

Domain 5 includes all stockpile areas and borrow pits used as a source of benign materials for the construction of other domains. Domain 5 occurs at widespread locations across the mine (Plate 1).

Disturbance Area

The disturbance footprint for Domain 5 is expected to be 299.1 ha.

Disturbance Type

Borrow pits and most stockpile areas experience a similar disturbance: vegetation has been cleared and part of the soil profile or underlying rock has been removed, resulting in a lowering of the soil surface.

The following are characteristics common to all components of the Borrow Pits domain:

- areas to be revegetated are free from reactive materials that could cause salinisation or acidification;
- areas to be revegetated generally have a reduced amount of topsoil, but this topsoil may contain a native soil seed bank, depending on the length of time of storage; and
- areas to be revegetated are generally flat.

One borrow pit (the site of the proposed TSF Cell 4) has a low soil surface that results in surface expression of groundwater during the wet season. This area will be revegetated as a seasonal wetland.

5.2.6 Domain 6: Water Dams

Location

Domain 6 includes the water management dam adjacent to TSF Cell 3, the Turkeys Nest Dam constructed for the storage of bore water, Emu and Donkey Dams, as well the following storage ponds for contaminated run-off and seepage: Anti-pollution Pond (APP), Concentrator Runoff Pond (CRP), Pete's Pond, Van Duncan's Dam and the NOEF perimeter run-off dams (PRODs). Domain 6 is spread across numerous locations within the mine (Plate 1).

Disturbance Area

Domain 6 has an area of 222.33 ha.

Disturbance Type

All components of Domain 6 have had vegetation removed, soil excavated and compacted, and are submerged under water for periods of time. Many of the dams collect reactive material washed from operational areas of the mine. The latter frequently have high concentrations of sulphates and some minerals, which could impede vegetation establishment.

Some dams (Emu Dam, Donkey Dam and, possibly, the water management dam) will be retained as stock watering points. The remainder will be rehabilitated by removing contaminated material and filling.

5.2.7 Domain 7: Roads

Location

Roads are scattered across the mining operations (Plate 1).

Disturbance Area

There will be approximately 5 km of sealed roads and approximately 25 km of unsealed access roads on the mine site.

Disturbance Type

Roads result in a localised disturbance, whereby the soil profile is generally kept intact, but the upper profile is heavily compacted. Roads generally occur through intact native vegetation communities, allowing widespread natural recruitment once the site has been ripped. Road verges typically experience higher than average densities of weeds, posing a risk to the vegetation communities developing on former roads.

5.2.8 Domain 8: Exploration Areas

Location

There are currently no planned locations for exploration. However, there remains a possibility that further exploration of the mineral resources present may occur in the future. Consequently, 'Exploration Areas' is retained as a hypothetical domain that would require revegetation.

Disturbance Area

There is currently no planned disturbance footprint for exploration. The potential area of disturbance, in the event that future exploration occurs, will depend on the number of exploration holes assessed.

Disturbance Type

Typical disturbance associated with exploration holes includes the clearing of a pad and excavation of a shallow sump. Exploration areas have the following characteristics:

- each disturbed exploration site is typically small (<0.5 ha);
- topsoil is not stockpiled for extended periods, and soil seed banks therefore remain intact; and
- there is minimal disturbance to the soil profile or topography.

5.2.9 Domain 9: Bing Bong Infrastructure Area

Location

The BBLF is situated on MLN1126 (Figure 3), located on the Bing Bong Pastoral Lease (PL868). Adjacent to the Bing Bong Mineral Lease is the Bing Bong Dredge Spoil Emplacement Area, located on the Non-Pastoral Land Use Approval NP033.

Disturbance Area

The area of the BBLF (including the Dredge Spoil Emplacement Area) is approximately 120 ha.

Disturbance Type

The area of the BBLF comprises surface infrastructure (e.g. sheds, offices and workers camp), dams and associated drainage infrastructure, wharf infrastructure and the Dredge Spoil Emplacement.

5.3 Target Vegetation Communities

The target post-mining land use is a combination of grazing and traditional land use (Table 6). The post-mining landforms are to support vegetation suitable for these post-mining land uses. The target vegetation is to floristically and structurally resemble local native plant communities growing on similar landforms. For most domains, the target vegetation community will be that which occurred at the site prior to disturbance. For domains that have undergone significant changes in landform (e.g. open cut and overburden emplacement facilities), the target vegetation communities are those that occur in analogous environments elsewhere within the mining leases or region.

The ten distinct vegetation communities that occur within the mineral leases for the site are provided in Table 1. Four of these are upland communities on sandstone or rocky hills, three are lowland woodland communities and the remaining three are riparian or riverine communities. The poorly drained clay soils at Bing Bong host vegetation largely dominated by open woodland communities.

Table 6: Potential End Land Uses for Each Domain

	Mine Domain	Potential End Land Use
1	Open Cut and Diversions	The mine pit lake and re-channelled sections of the McArthur River will be a conservation area with the potential for Custodian use. Re-channelled sections of Barney Creek will have restricted activities and access.
2	Overburden Emplacement Facilities	The NOEF and WOEF will have restricted access and be managed as conservation areas. They will not be used for grazing.
3	Tailings Storage Facility	The Tailings Storage Facility domain will be converted to native grassy woodlands suitable for grazing cattle.
4	Infrastructure Areas	Some infrastructure may be retained, if it conveys economic opportunities for Custodians and local communities. Areas supporting infrastructure to be dismantled will be converted to native grassy woodlands suitable for grazing cattle. Infrastructure on Barney Hill will be converted to native vegetation with grazing excluded (i.e. a conservation area).
5	Borrow Pits	Borrow pits will be converted to native pasture and woodland. The deepest pits will remain as small seasonal lakes/wetlands.
6	Water Dams	Dams retained for livestock watering will be managed for grazing. Dams associated with the overburden emplacement facilities will be converted to native vegetation and managed as a cattle-free conservation area.
7	Roads	Roads not retained for use by Custodians will be converted to native grassy woodlands suitable for grazing cattle.
8	Exploration	Exploration areas will be converted to native vegetation suitable for grazing cattle.
9	Bing Bong Infrastructure Area	Infrastructure areas that are not retained for commercial wharfing will be converted to cattle grazing area with native woodland and pasture species.

Source: OMP EIS (subject to approval).

The target vegetation communities at each domain are presented in Table 7.

Table 7: Target Vegetation Communities for Each Domain

Site Characteristics	Domain	Target Vegetation Unit
Sandy plains	3, 4, 5, 6, 7, 8	5
Clay plains	3, 4, 5, 6, 7, 8	6
Riparian areas	1, 7, 8	7, 8
Alluvial terraces and levees	1, 7, 8	9
Rocky hills	2, 7, 8	1, 2, 4

Source: OMP EIS (subject to approval).

5.4 Key Habitat Species

In addition to plant species representative of the native vegetation communities that revegetated sites are emulating, revegetation sites must also contain key habitat species. In the MRM Overburden Management Project EIS, MRM has committed to creating habitat in revegetation sites for threatened and near threatened fauna. The species of animals and the key habitat species that they depend on are listed in Table 8.

Table 8: Key Habitat Species

Threatened Species	Key Habitat Species	Use	Revegetation Objectives
Gouldian Finch, <i>Erythrura gouldiae</i>	<i>Triodia</i> spp. <i>Sorghum</i> spp. <i>Alloteroopsis semialata</i> <i>Chrysopogon fallax</i>	Grass seeds important as a food source	<i>Triodia</i> spp. are to be present in all revegetation areas emulating vegetation units 1, 2 and 4. <i>Sorghum</i> spp. are to be present in revegetation areas emulating vegetation units 5 and 6. <i>A. semialata</i> is to be present in revegetation areas emulating vegetation units 5 and 9. <i>C. fallax</i> is to be present in revegetation areas emulating vegetation units 2, 4, 5, 6, 7 and 9.
Purple-crowned Fairywren, <i>Malurus coronatus</i>	<i>Chionachne cyathopoda</i> <i>Pandanus aquaticus</i>	Important foraging and nesting habitat	<i>C. cyathopoda</i> and/or <i>P. aquaticus</i> are to dominate the understorey in revegetation areas along waterway margins (vegetation unit 8).

Key habitat species will be added to revegetation sites via seed and/or tubestock, depending on the species. In riparian areas, which experience frequent flooding, tubestock is the preferred approach for establishing *Chionachne cyathopoda* and *Pandanus aquaticus*. The successful establishment of grasses important to the Gouldian Finch using seed spread on newly prepared sites will be trialled once these areas become available for revegetation. Trials will also determine whether greater success may be achieved for some species (e.g., *Triodia* spp.) using tubestock, even in areas away from flooding.

5.5 General Rehabilitation Phases

General rehabilitation of disturbed lands will be undertaken sequentially (or in phases) to achieve the final land use. A description of these phases of rehabilitation is provided in Table 9. Completion criteria for the rehabilitation phases are provided in Section 7.

Table 9: General Rehabilitation Phases

Phase	Description
Landform Establishment	The process of shaping unformed rock or other sub-stratum material into a desired land surface profile. This includes earthworks activities such as cut and fill, rock raking, water storage and drainage construction.
Growth Medium Development	The process of establishing and enhancing the physical structure, chemical properties and biological properties of a topsoil and subsoil (or regolith) stratum suitable for plant growth. This includes placing and spreading soil and applying ameliorants.
Ecosystem and Land Use Establishment	The process of seeding, planting and transplanting plant species. Incorporates management actions such as weed and feral pest control to achieve species establishment and growth to juvenile communities, and habitat augmentation.
Ecosystem and Land Use Sustainability	The process of applying management techniques to encourage an ecosystem to grow and develop towards a desired and sustainable post-mining land use outcome. Incorporates features including species reproduction, nutrient recycling and community structure.

Source: after Department of Trade and Investment, Regional Infrastructure and Services – Division of Resources and Energy (2013).

A general overview of the rehabilitation methodology for each rehabilitation phase is provided below.

5.5.1 Landform Establishment Phase

Landform establishment is the process of shaping the final landform to a safe, stable and free draining landform that is appropriate for the desired final land use and consistent with the surrounding landscape.

Key landform establishment activities include:

- constructing and shaping completed/backfilled open cut pits and overburden emplacements in accordance with design criteria (such as desired grade, compaction and select surface layers);
- constructing surface drainage features required for water management in the final landscape consistent with best practice guidelines; and
- selective material handling to manage risks associated with PAF materials and spontaneous combustion.

5.5.2 Growth Medium Development Phase

Growth medium development includes activities to reinstate soils (including subsoil/regolith soils) with the physical, chemical and biological characteristics required for vegetation establishment and growth, including:

- topsoil application from stockpiles;
- soil amelioration: and
- soil testing to determine the suitability of growth medium to support desired vegetation type.

5.5.3 Ecosystem and Land Use Establishment Phase

Ecosystem and land use establishment includes activities to establish the desired floristic composition (species diversity and density relevant to the post-mining land use/secondary domain). Activities will include:

- seeding, tubestock planting and/or transplanting (as required);
- activities to enhance successful vegetation establishment such as weed and pest management, erosion control and bushfire mitigation; and
- installing habitat augmentation features (such as hollow bearing timber and logs salvaged during clearing activities) in native vegetation rehabilitation areas to improve habitat opportunities for native fauna.

5.5.4 Ecosystem and Land Use Sustainability Phase

The (former) Commonwealth Department of Industry, Tourism and Resources (DITR) publication *Leading Practice Sustainable Development Program for the Mining Industry - Mine Rehabilitation* (DITR, 2006) defines a functional ecosystem as one that is:

- stable (not subject to high rates of erosion);
- effective in retaining water and nutrients; and
- self-sustaining.

Ecosystem and land use sustainability is therefore considered to involve those activities necessary to develop ecosystems that are self-sustaining and assist the area to meet the nominated completion criteria. Key activities include:

- rehabilitation monitoring (Section 8);
- rehabilitation maintenance, including:
 - weed and feral animal control of rehabilitation;

- maintenance of erosion controls;
- maintenance fertilizing and re-seeding (where required);
- repair of fence lines, access tracks and other general related land management activities; and
- intervention and adaptive management (Section 9).

5.6 Progressive Rehabilitation

Rehabilitation of mined and other disturbed landforms will continue to be undertaken progressively, as infrastructure becomes redundant and is decommissioned.

Progressive remediation of mine landforms has been a consideration during the planning of the Mine. This expedites the re-establishment of vegetation at disturbed sites and reduces the duration of habitat loss for certain flora and fauna.

5.7 Rehabilitation Trials and Programs

5.7.1 Rehabilitation Methodology

During 2018, MRM will establish trial areas to test revised revegetation techniques. The trial will involve:

- Establishing a ground cover after the wet season using riparian grass species, including *Hetropogon contortus* (which has successfully colonised the upper bank of the McArthur River Channel).
- Comparing the success of seeding the banks vs mass planting of *Hetropogon contortus* tubestock (which is successfully propagating in the nursery).
- Planting tubestock after 2 months of grass growth.

The results of these trials would contribute to the rehabilitation methodology for 2019 and 2020.

5.7.2 Irrigation

During 2018, MRM is planning to trial an irrigation line along the upper bank each side of the McArthur River with smaller poly fingers running down the banks with sprinkler heads at 50 m intervals. An irrigation sled, designed to be mobile, will be used to move the planting location as rehabilitation progresses downstream.

The result of this trial will contribute to the rehabilitation methodology for 2019 and 2020.

5.7.3 Jute Matting on the McArthur River Channel

Jute matting is a robust weed and erosion control geotextile made of natural jute fibres which enhances plant establishment, while protecting topsoil from erosion. Jute matting is 100% natural and will biodegrade over time.

MRM has recently commenced a trial of jute matting on the McArthur River Channel to determine if the use of jute matting is beneficial to plant establishment on the mid-bank area of the riparian corridor.

Four trial plots were established in 2017. At each trial plot, 100 tubestock were planted within the area covered by the jute matting and 100 tubestock were planted in close proximity without jute matting.

The results of this trial will be available by mid-2018 and will contribute to the rehabilitation methodology.

5.7.4 Cane Grass Regeneration Trial

A key indicator of rehabilitation success for the McArthur River and Barney Creek diversions is the establishment of Cane Grass (*Chionachne cyathopoda*) which has been identified as the preferred habitat of the Purple Crowned Fairy Wren (listed as Vulnerable under the NT TPWC Act). As a result of the diversion construction, suitable habitat for the Purple Crowned Fairy Wren along the McArthur River has been fragmented.

During 2017, MRM planted over 3,000 Cane Grass tubestock on the McArthur River Channel focusing on the mid-bank and upper-bank areas. Survival rates of these plants will be monitored over the next three years to determine the most successful planting locations.

The results of this trial will contribute to future rehabilitation methodology.

5.7.5 MRM Nursery

In 2017, MRM undertook a nursery upgrade project including:

- Installation of new water tanks;
- Installation of new overhead irrigation in all areas;
- Potable water supply was provided (used to use raw water);
- Concrete floor was installed in the tubestock shade house; and
- Fauna proof fencing was installed to prevent predation.

In 2018, the nursery will be extended to include a third shadehouse and an extension to the hardening off area will be constructed.

The nursery is expected to produce approximately 70,000 plants in 2017 and, with the recent and planned upgrades, it is expected that the nursery will produce between 90,000 and 100,000 plants in 2018.

6 REHABILITATION IMPLEMENTATION FOR 2018 TO 2020

6.1 Areas of Revegetation

This RMP describes the revegetation of the McArthur River and Barney Creek Channels for the period 2018 to 2020. Revegetation areas will be targeted annually for planning, site establishment, planting, irrigation, management and monitoring activities.

The McArthur River and Barney Creek Channels have been delineated into areas consistent with those described in the geomorphology assessment undertaken by Hydrobiology (2016) based on morphological distinctive sub-reaches.

The McArthur River Channel has been delineated into eight areas (Figure 7):

- Upstream North Bank (MRUNB) (Chainage 0 to 1,490);
- Upstream South Bank (MRUSB) (Chainage 0 to 1,490);
- Mid-stream North Bank (MRMNB) (Chainage 1,490 to 2,490);
- Mid-stream South Bank (MRMSB) (Chainage 1,490 to 2,490);
- Gorge North Bank (MRGNB) (Chainage 2,490 to 3,440);
- Gorge South Bank (MRGSB) (Chainage 2,490 to 3,440);
- Downstream North Bank (MRDNB) (Chainage 3,440 to 5,420); and
- Downstream South Bank (MRDSB) (Chainage 3,440 to 5,420).

The Barney Creek Channel has been delineated into six areas (Figure 7):

- Upstream North Bank (BCUNB) (Chainage 0 to 730);
- Upstream South Bank (BCUSB) (Chainage 0 to 730);
- Mid-stream North Bank (BCMNB) (Chainage 730 to 1,500);
- Mid-stream South Bank (BCMSB) (Chainage 730 to 1,500);
- Downstream North Bank (BCDNB) (Chainage 1,500 to 2,900); and
- Downstream South Bank (BCDSB) (Chainage 1,500 to 2,900).

A summary of the revegetation activities planned to be undertaken during the RMP term is provided in Table 10 and a description of how the activities will be implemented is provided in Section 6.2.

Table 10: Revegetation Areas for the RMP Term

Year	Approximate Chainage of Works	Areas to be Revegetated
2018	South bank: 0 to 800 North bank: 800 to 1,600	<ul style="list-style-type: none"> • MRUSB. • MRUNB and MRMNB.
2019	South bank: 800 to 1,600 North bank: 1,600 to 2,400	<ul style="list-style-type: none"> • MRUSB and MRMSB. • MRMNB.
2020	South bank: 1,600 to 2,400 North bank: 2,400 to 3,200	<ul style="list-style-type: none"> • MRMSB. • MRMNB and MRGNB.

Insert Figure 7 – McArthur River and Barney Creek Channel Sub-reaches

6.2 Revegetation Activities

During the RMP term, revegetation works will target the areas outlined in Table 10. The revegetation activities would comprise:

1. Planning (Section 6.2.1).
2. Site establishment and preparation (Section 6.2.2).
3. Planting and irrigation (Section 6.2.3).
4. Management (Sections 6.2.4 and 9).
5. Monitoring (Section 8).

Figures 8 to 10 provide an overview of the rehabilitation activities that are planned to be undertaken over the course of each year during the RMP term.

6.2.1 Revegetation Planning

Revegetation planning will commence at the start of each dry season and will consider the results of the monitoring program (Section 8).

Planning will consider the success (e.g. survival rate of tubestock) of previous revegetation activities and any trials implemented based on performance indicators, and if necessary, will result in the incorporation of amendments to planned revegetation activities to reflect the most and least successful methodologies previously adopted.

6.2.2 Site Establishment and Preparation

Site establishment, includes:

- Construction of necessary access tracks.
- Rock toe protection, batter reshaping and reshaping of exposed areas.
- Surface water management via the construction of upstream drainage channels and drop structures.
- Application of soil conditioner, ameliorants and other necessary materials for treatment of disturbed soils.
- Installation of jute matting.
- Installation of large woody debris (in channel bed).
- Installation of irrigation.

6 REHABILITATION IMPLEMENTATION FOR 2018 TO 2020

6.2.3 Planting and Irrigation

The approved final landform and agreed post-mining land use will dictate the composition and structure of species to be established for rehabilitation. Species selection for native revegetation areas will be designed to promote the development of forest and woodland communities with structured understorey, mid-storey and tree canopy coverage. In order to enhance vegetation connectivity, species of the target vegetation communities will be seeded and planted adjacent or close to similar vegetation communities where possible. Species will also be chosen to improve faunal biodiversity and habitat. Species selection will take into consideration climate (e.g. water availability), landform (e.g. slopes, floodplains and creeks), soil availability, soil type and soil fertility.

The species selected for revegetation works aims to develop a plant community that will:

- return disturbed areas to an agreed post mine land use;
- maintain the biodiversity of the area;
- provide long-term and sustainable revegetation, consistent with existing vegetation communities in the area;
- stabilise stream bank erosion;
- provide micro-habitat for aquatic fauna; and
- re-establish fragmented habitat utilised by riparian habitat specialist birds as identified in the EIS. For example, Cane Grass (*Chionachne cyathopoda*) which is a favoured habitat for the Purple-crowned Fairy-wren and Freshwater Mangrove (*Barringtonia acutangula*) for the White Browed Robin.

A list of species considered to be most representative of the upper, mid and lower strata found along McArthur River and Barney Creek, has been compiled by ELA from previous vegetation surveys conducted at MRM and the wider McArthur River catchment (URS, 2006; Cuff *et al.*, 2009; EcoScience, 2012; EMS, 2017).

The lists have been separated according to the following:

- McArthur River Channel – Riparian Corridor.
- McArthur River Channel – Riverine Woodland.
- Barney Creek – Riverine Woodland.

The separate list has been compiled for the three revegetation areas due to the differences in the environments along the McArthur River and Barney Creek channels. The McArthur River Channel has been further separated into two habitats due to the difference between the flora assemblage found on the river corridor slopes and the batters and levees of seasonally inundated major drainage lines in the region (Cuff *et al.*, 2009).

The number of framework species for each revegetation area is between 24 and 27 and is split amongst the strata in proportions representative of the type of community (e.g. there is relatively greater tree [upper] and lower grass diversity in the riparian forest found along McArthur River than in the low open woodland found along Barney Creek). All framework species will be actively planted as a part of the revegetation works as tubestock and/or direct seeding.

6 REHABILITATION IMPLEMENTATION FOR 2018 TO 2020

Riparian Corridor Revegetation Species

Table 11 lists the species that will be used to revegetate the riparian corridor of the McArthur River Channel. Where necessary, these will be supplemented with other ground cover to ensure the channel beds are appropriately protected against erosion.

Table 11: Species for Revegetating the McArthur River Channel Riparian Corridor

Species	Common Name
Upper Strata	
<i>Casuarina cunninghamiana</i>	River She-Oak
<i>Corymbia bella</i>	Ghost Gum
<i>Eucalyptus camaldulensis</i>	River Red Gum
<i>Eucalyptus microtheca</i>	Coolabah
<i>Ficus racemosa</i>	Cluster Fig
<i>Lophostemon grandiflorus</i>	Northern Swamp Box
<i>Melaleuca argentea</i>	River Paperbark
<i>Melaleuca leucadendra</i>	Weeping Paperbark
<i>Nauclea orientalis</i>	Leichardt Pine
<i>Terminalia platyphylla</i>	Wild Plum, Durin
Middle Strata	
<i>Barringtonia acutangula</i>	Freshwater Mangrove
<i>Syzygium eucalyptoides</i>	Syzygium
<i>Ficus coronulata</i>	River Fig
<i>Atalaya hemiglauca</i>	Whitewood
<i>Pandanus aquaticus</i>	River Pandanus
Lower Strata	
<i>Chionachne cyathopoda</i>	River Grass
<i>Chrysopogon elongatus</i>	Tall Tamil Grass
<i>Echinochloa colona</i>	Awnless Barnyard Grass
<i>Paspalidium jubiflorum</i>	Warrego Grass
<i>Urochloa reptans</i>	Fine Armgrass
<i>Alternanthera nodiflora</i>	Common Joyweed
<i>Ammannia multiflora</i>	Jerry Jerry
<i>Hybanthus enneaspermus</i>	Lady's Slipper
<i>Phyllanthus maderaspatensis</i>	Spurge

6 REHABILITATION IMPLEMENTATION FOR 2018 TO 2020

Riverine Woodland Revegetation Species

Tables 12 and 13 list the species that will be used to revegetate the woodland areas of the McArthur River and Barney Creek Channels, respectively. Where necessary, these will be supplemented with other ground cover to ensure the channel beds are appropriately protected against erosion.

Table 12: Species for Revegetating the McArthur River Channel Riverine Woodland

Species	Common Name
Upper Strata	
<i>Casuarina cunninghamiana</i>	River She-Oak
<i>Eucalyptus camaldulensis</i>	River Red Gum
<i>Eucalyptus microtheca</i>	Coolabah
<i>Lophostemon grandiflorus</i>	Northern Swamp Box
<i>Melaleuca leucadendra</i>	Weeping Paperbark
<i>Nauclea orientalis</i>	Leichardt Pine
<i>Terminalia platyphylla</i>	Wild Plum, Durin
Middle Strata	
<i>Barringtonia acutangula</i>	Freshwater Mangrove
<i>Excoecaria parvifolia</i>	Guttapercha Tree
<i>Syzygium eucalyptoides</i>	Syzygium
<i>Ficus coronulata</i>	River Fig
<i>Atalaya hemiglauca</i>	Whitewood
<i>Terminalia bursarina</i>	Bendee
<i>Pandanus aquaticus</i>	River Pandanus
Lower Strata	
<i>Chionachne cyathopoda</i>	River Grass
<i>Chrysopogon elongatus</i>	Tall Tamil Grass
<i>Chrysopogon fallax</i>	Golden Beard Grass
<i>Echinochloa colona</i>	Awnless Barnyard Grass
<i>Eragrostis cumingii</i>	Cummings Lovegrass
<i>Eragrostis tenellula</i>	Delicate Lovegrass
<i>Paspalidium jubiflorum</i>	Warrego Grass
<i>Urochloa reptans</i>	Fine Armgrass
<i>Alternanthera nodiflora</i>	Common Joyweed
<i>Ammannia multiflora</i>	Jerry Jerry
<i>Hybanthus enneaspermus</i>	Lady's Slipper
<i>Melochia corchorifolia</i>	Melochia
<i>Phyllanthus maderaspatensis</i>	Spurge

6 REHABILITATION IMPLEMENTATION FOR 2018 TO 2020

Table 13: Species for Revegetating the Barney Creek Channel Riverine Woodland

Species	Common Name
Upper Strata	
<i>Casuarina cunninghamiana</i>	River She-Oak
<i>Corymbia bella</i>	Ghost Gum
<i>Eucalyptus camaldulensis</i>	River Red Gum
<i>Eucalyptus microtheca</i>	Coolabah
<i>Lophostemon grandiflorus</i>	Northern Swamp Box
<i>Bauhinia cunninghamii</i>	Bean Tree
<i>Terminalia platyphylla</i>	Wild Plum, Durin
Middle Strata	
<i>Barringtonia acutangula</i>	Freshwater Mangrove
<i>Excoecaria parvifolia</i>	Guttapercha Tree
<i>Atalaya hemiglauca</i>	Whitewood
<i>Terminalia volucris</i>	Rosewood
<i>Ficus carpentariensis</i>	Carpentaria Fig
<i>Terminalia bursarina</i>	Bendee
Lower Strata	
<i>Chionachne cyathopoda</i>	River Grass
<i>Chrysopogon elongatus</i>	Tall Tamil Grass
<i>Chrysopogon fallax</i>	Golden Beard Grass
<i>Echinochloa colona</i>	Awnless Barnyard Grass
<i>Eragrostis cumingii</i>	Cummings Lovegrass
<i>Eragrostis tenellula</i>	Delicate Lovegrass
<i>Heteropogon contortus</i>	Speargrass
<i>Urochloa reptans</i>	Fine Armgrass
<i>Alternanthera nodiflora</i>	Common Joyweed
<i>Ammannia multiflora</i>	Jerry Jerry
<i>Hybanthus enneaspermus</i>	Lady's Slipper
<i>Phyllanthus maderaspatensis</i>	Spurge

6 REHABILITATION IMPLEMENTATION FOR 2018 TO 2020

Revegetation Methods

Various techniques exist for seeding and planting of rehabilitation areas and these have been investigated during the early years of rehabilitation at the Mine, with the best techniques being carried through for ongoing use. Consideration is given to site conditions, including soil type and condition, landform, time of year, climate, water availability and vegetation community establishment outcomes and also the best methods of rehabilitation application.

As discussed in Section 4.2, seedlings propagated as tubestock have provided the most successful method of plant establishment and survival at the Mine to date. In particular, tubestock planting of long lived trees may be the most efficient to ensure adequate establishment of these keystone species and to control density of establishment (which can be difficult to achieve with direct seeding).

Where practical and feasible, tubestock will be propagated from locally sourced seed in an MRM nursery.

Tubestock planting will generally be undertaken in the dry season when weather conditions are optimised for vegetation establishment, however opportunistic rehabilitation will be undertaken in both the dry season and wet season if areas become available and prevailing weather conditions are favourable.

Native vegetation seed will be sown to supplement tubestock planting. Sowing will occur as soon as possible after seedbed preparation to optimise the conditions for germination prior to surface crust development.

Native vegetation restoration includes initial establishment of local pioneer species to condition the soil for successive plant regeneration. Direct seeding is typically a cost effective means of re-introducing pioneer species known to occupy disturbed environments throughout the local area.

6.2.4 Management

This section outlines the rehabilitation management measures that will be undertaken to achieve the final landform design concepts and post-mining land uses for the Mine. An overview of the Mine Rehabilitation Program is provided in Figure 11.

Seed Collection and Propagation

Native provenance species are preferred but due to the remoteness of the Mine this cannot always be achieved. Local seed collection will be carried out and entered into the MRM seed register developed to identify species location and phenology for future collection.

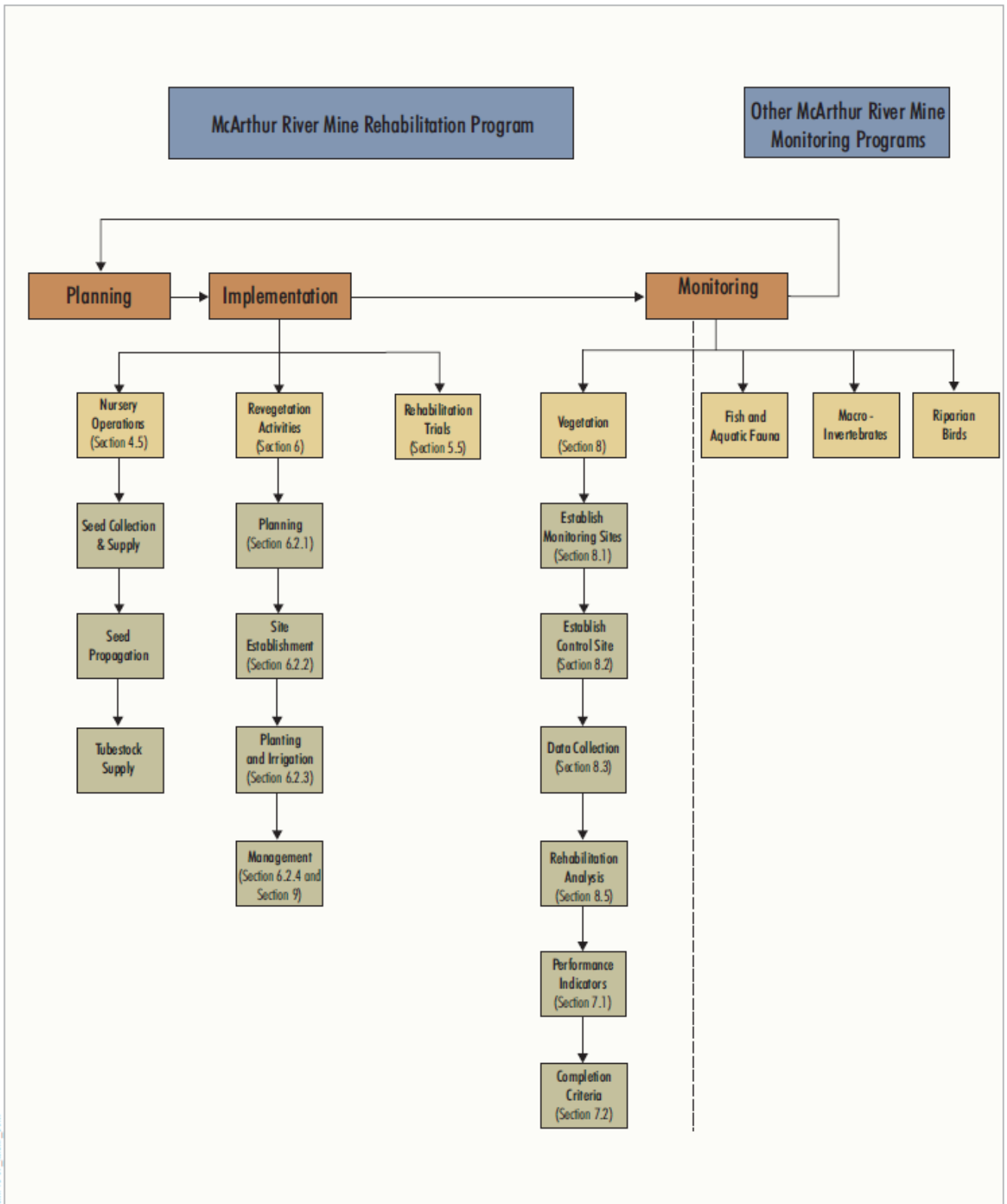
External seed supply will be sourced through regional commercial seed collectors and local community collectors where possible. The quantity of seed collected each season will ultimately determine the final species mix and will be dependent on the season.

Seedling tenders are sent to wholesale nurseries as well as local community enterprises and organisations. Several seedling species will also be grown within the onsite greenhouse by MRM staff using sexual and asexual propagation techniques.

Seed collection activities will be undertaken within relevant vegetation communities located within the Mine Mineral Leases. To avoid the spread of weeds and exotic species, seed collection will only be carried out for native species. The seedbank will be supplemented by commercially available stock from endemic native species.

Harvested seeds not used in direct sowing or production of tubestock will be stored for future use on rehabilitation areas.

6 REHABILITATION IMPLEMENTATION FOR 2018 TO 2020



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Figure 11 – Rehabilitation Program

6 REHABILITATION IMPLEMENTATION FOR 2018 TO 2020

Weed Management

Weed management will be undertaken at the Mine as described in the Weed Management Plan. Under this management plan, MRM will:

- Manage weeds on site in accordance with the NT *Weeds Management Act 2013*.
- Liaise with relevant government departments to develop integrated management practices and procedures including; the Weeds Management Branch, NT and Parks and Wildlife Commission.
- Employ an integrated weed management strategy to implement the Weed Management Plan.
- Maintain a continued workforce education and awareness program including; instructing personnel to check vehicles, and include presentations to permanent and contract staff and visitors during inductions.
- Ensure any equipment or machinery entering the site from interstate or other sectors of the NT undergo necessary quarantine measures and these goods only leave site after a 'Clean to leave site' form has been approved and signed off.
- Review the Weed Management Plan every three years, to ensure weed management practices and strategies are effective and up-to-date.

Introduced plants are of concern as they have the potential to out-compete native species, to alter habitat and affect land use (agricultural or recreational). Failure of rehabilitation due to inadequate control of weeds and pest animals is considered a high risk if not controlled. Inspections of proposed disturbance areas and adjacent land, topsoil stockpiles and rehabilitation areas will be conducted for early identification of weed infestations.

All weed control works will be completed in accordance with the *Pesticides Act, 1999*.

Pest Management

Any pest animal control program will consider:

- using a range of appropriate pest control measures to minimise collateral damage to native animals (e.g. the feral cat and goat trapping, wild dogs and wild pigs);
- follow-up inspections to assess the effectiveness of control measures implemented and the requirement for any additional control measures; and
- mandatory pest control for any declared pests (i.e. pigs and wild dogs) known to occur at the Mine.

Feral animal control will be focused on donkeys and pigs with some trials to be undertaken into feral cat control.

Cattle Management

The cattle exclusion zone encompasses the McArthur River and Barney Creek Channels as shown in Figure 5.

Livestock management will be undertaken in accordance with the MRM Cattle Management Plan.

6 REHABILITATION IMPLEMENTATION FOR 2018 TO 2020

Bushfire Management

Bushfire management at the Mine will be undertaken in accordance with MRM Management Plan and in consultation with the NT Fire and Emergency Response Group located in Borroloola.

The objectives of bushfire management at the Mine are to:

- reduce unplanned fire ignition potential;
- prevent the spread of fire within and beyond the Mine area;
- protect flora, fauna and vegetation communities from inappropriate fire regimes and unplanned fire events; and
- utilise fire as a management tool to maintain and enhance native ecosystems, where applicable.

Planned bushfire would not be conducted in revegetation areas until the plants to become established to reduce the potential for mortality.

Access Management

Damage by vehicles can result in the compaction of soil (which can reduce the infiltration of water into the soil and restrict root growth, and consequently reduce natural regeneration), and result in the spread of weeds and disturbance to vegetation.

To reduce the degree of disturbance to the rehabilitation areas, measures will be put in place to limit access to these areas by authorised personnel only. Measures may include restricting vehicles to existing access tracks only and signage denoting rehabilitation area.

7 PERFORMANCE INDICATORS AND COMPLETION CRITERIA

7.1 Performance Indicators

Development of performance indicators and completion criteria at the Mine will be an iterative process, whereby monitoring results will be used to continuously refine the indicators and completion criteria in future revisions of this RMP. Rehabilitation performance will be considered to be satisfactory when monitoring data indicates the completion criteria have been met.

Due to the successional nature of revegetation, the monitoring conducted in the year immediately following initial revegetation activity is different to that conducted at 10 years post-revegetation as a functioning vegetation community is beginning to emerge. The early stage of monitoring, 0 – 3 years post-revegetation, is primarily concerned with the initial emergence and establishment of seedlings, particularly of key species. The focus is on assessing the range and density of species that have established, as well as early signs of factors that may hinder further development of vegetation on the site such as erosion and the presence of weed species.

Monitoring during the middle phase focuses on assessing the survival, growth and development of vegetation structure and species richness. Absence of critical species, levels of biodiversity or developing structure at this time may trigger action including re-seeding, tube-stock plantings, soil sampling and perhaps addition of soil amendments.

Final phase monitoring uses the same indicators to assess revegetation sites against the completion criteria to determine whether a self-sustaining and resilient ecosystem has been established. The actual timing of final phase monitoring will vary depending on initial site conditions and ensuing climatic variations.

To track the performance of the revegetation sites, ELA (2017) has developed a monitoring program including monitoring methods and data to be collected (Section 8 and Table 14), and completion criteria (Section 7.2). Trigger levels and adaptive management are described in Section 9.1.

Table 14: Monitoring for Revegetation Sites – Performance Indicators

Category	Monitoring Phase	Monitoring Method and Data
Planting success	Early – starting 1 year post planting	% survivorship of planted seedlings Erosion score Fauna disturbance Weed density
Native species richness, species composition and framework species	Mid – starting 3 years post planting	The overall native plant species richness and composition will be monitored using full floristic survey plots recording cover and abundance
Vegetation structure – foliage cover and heights of different strata	Mid – starting 3 years post planting	For upper (canopy) and mid (shrub) strata (where present): <ul style="list-style-type: none"> • % project foliage cover • Height • Photo monitoring For lower strata (ground cover and grasses): <ul style="list-style-type: none"> • % cover of plants – live / dead • leaf litter % cover
Stand structure	Mid – starting 3 years post planting	Measurement of Diameter at Breast Height (DBH) of all plants >2cm DBH Total Basal Area (TBA) and stem density (calculated from DBH data)
Evidence of regeneration	Mid – starting 3 years post planting	Reproductive structures (flowers, fruit) observed and viable on key species Count / cover and species identification (where possible) of naturally regenerating: <ul style="list-style-type: none"> • Seedlings • Saplings • Suckering
Ecosystem function	Mid – starting 3 years post planting	Erosion score Weed mapping Fauna disturbance
Presence of habitat suitable for fauna use	Mid – starting 3 years post planting	<ul style="list-style-type: none"> • Presence and cover of key habitat species • Mid and upper strata heights and cover • Lower strata measures (above): litter cover, coarse woody debris, rock cover

Source: after ELA (2017).

7.2 Completion Criteria

Successful revegetation will be indicated by a functioning riparian ecosystem analogous to those vegetation communities found at the control sites upstream and downstream of the channels. A further requirement for success of the revegetation is that the riparian vegetation is continuous and there is no disconnect between the upstream and downstream habitats.

Such a functioning and continuous ecosystem requires not only that the vegetation meets certain structural parameters and contains a characteristic composition of species, but also that there is evidence of a self-sustaining vegetation community. An indication of this would include the setting and germination of seed across a range of species and the growth of seedling to mature plants.

Control sites are established to serve three purposes:

- Establish baseline floristic data representative of the surrounding non-impacted environment.
- Establish completion criteria that indicate the success of revegetation activities (Table 15).
- Allow for comparison with revegetation monitoring sites to account for annual variations in environmental variables that influence plant growth and mortality.

ELA (2017) has developed completion criteria to objectively assess ecosystem conditions in consideration of reference vegetation communities (i.e. control sites) that are assumed to be the optimal state of the ecosystem being revegetated, representative of the vegetation communities along McArthur River and Barney Creek prior to the rechanneling, and analogous to the vegetation communities currently found upstream and downstream of the channels.

The completion criteria (Table 15) were developed through review of the control site monitoring data collected annually since 2012 and broadly cover the following:

- Species composition (abundance and diversity) reflects that found at control sites.
- Vegetation structure has a similar complexity as found at control sites – community structural parameters (% cover of grass and ground layer, shrub layer and canopy layer).
- There is evidence of natural recruitment of a range of species.

It is considered that once revegetation has met completion criteria then the objective of establishing “*primary drainage paths with functioning riverine ecosystems comparable to original water courses prior to diversion and potential for custodian use*” would be met.

Completion criteria will be reviewed and revised, as necessary, as the monitoring datasets from control sites increase to confirm that revegetation areas are trending towards analogous sites that are unaffected by mining activities.

Table 15: Completion Criteria for Revegetation Sites

Category	Barney Creek Channel Woodland (Channel Corridor)	Barney Creek Channel Woodland (Adjacent to Channel Corridor)	McArthur River Channel Corridor (Channel Corridor)	McArthur River Channel Woodland (Adjacent to Channel Corridor)
Native species richness	50% of control sites			
Species composition*	Revegetation plots and corresponding control plots have a similarity index <30%			
Framework species	Lower: 6 Mid: 3 Upper: 4	Lower: 6 Mid: 3 Upper: 4	Lower: 4 Mid: 3 Upper: 5	Lower: 7 Mid: 4 Upper: 4
Vegetation structure**	Foliage Cover >40% Ground Cover >10% Litter Cover >50%	Foliage Cover >30% Ground Cover >10% Litter Cover >50%	Foliage Cover >40% Ground Cover >2% Litter Cover >30%	Foliage Cover >40% Ground Cover >5% Litter Cover >40%
Stand structure	TBA >15%	TBA >10%	TBA >15%	TBA >10%
Regeneration – reproductive structures (flowers / fruit)***	Lower: 6 Mid: 3 Upper: 4	Lower: 6 Mid: 3 Upper: 4	Lower: 4 Mid: 3 Upper: 5	Lower: 7 Mid: 4 Upper: 4
Regeneration – seedlings and saplings ****	Lower: 6 Mid: 3 Upper: 4	Lower: 6 Mid: 3 Upper: 4	Lower: 4 Mid: 3 Upper: 5	Lower: 7 Mid: 4 Upper: 4
Fauna habitat	Litter cover is >50%	Litter cover is >50%	Litter cover is >30%	Litter cover is >40%
	<i>C. cyathopoda</i> and/or <i>P. aquaticus</i> > 50% of understorey			
	Coarse woody debris and some rock present			
	Minimum of 10% cover in mid and upper stratum			
Erosion	Erosion score remains <2 for at least two consecutive years			
Weeds	Cover of weed species is <5%			
Fauna disturbance	Fauna disturbance score <2			
Notes:	* Based on regional and MRM vegetation community surveys and analysis (URS, 2006; Cuff <i>et al.</i> , 2009; EcoScience, 2012; EMS, 2017). ** Figures based on control site data from revegetation monitoring reports (EcOz, 2012 – 2016).		*** Observed on minimum number of Framework species. **** Minimum number of Framework species seedling and / or saplings recorded.	

Source: after ELA (2017).

8 REHABILITATION MONITORING PROGRAM

The success of any rehabilitation works undertaken will be monitored through a number of monitoring programs, including:

- Revegetation monitoring.
- Riparian bird monitoring.
- Macroinvertebrate monitoring.
- Aquatic fauna monitoring.

Annual revegetation monitoring will be undertaken to:

- measure the progress and success of the rehabilitation program against performance indicators and completion criteria;
- inform the continuous improvement process and refine rehabilitation methodologies and completion criteria; and
- identify when rehabilitation is not trending toward completion criteria in an appropriate timeframe, triggering adaptive management.

A description of the revegetation monitoring program developed by ELA (2017) is provided in the sections below. The results of the revegetation monitoring will be reported and assessed within an annual revegetation monitoring report. A summary of the monitoring results, including any trend analysis and any proposed modifications to the monitoring program, will be reported in the Operational Performance Report annually.

8.1 Monitoring Sites

Revegetation monitoring sites have been established in areas of the channels that have been the focus of rehabilitation activity. There are five sites for the Barney Creek Channel (BCI2 only has batter plots) and eight for the McArthur River Channel (MRR7 and MRR8 only have batter plots). The locations of monitoring sites are shown in Figure 12.

At each site, monitoring is stratified across the “slope” of the channel sides and the “batter”, or top of the slope which is often a narrow bank running parallel to the channel and sloping down towards the river and towards the surrounding plain.

Three permanent monitoring plots have been established at each combination of site and subdomain. The naming convention used to distinguish each unique combination of site location, type, subdomain and plot is provided in Table 16. These are permanent plots to ensure accurate comparison of data over time (EcOz, 2013).

Table 16: Naming Convention for Monitoring Sites, Subdomains and Plots

Location		Type		Site	Subdomain		Plot
MR	McArthur River	C	Control	1, 2, 3, etc	A	Slope	1, 2, 3, etc
BC	Barney Creek	R	Revegetation	1, 2, 3, etc	B	Batter	1, 2, 3, etc

8 REHABILITATION MONITORING PROGRAM

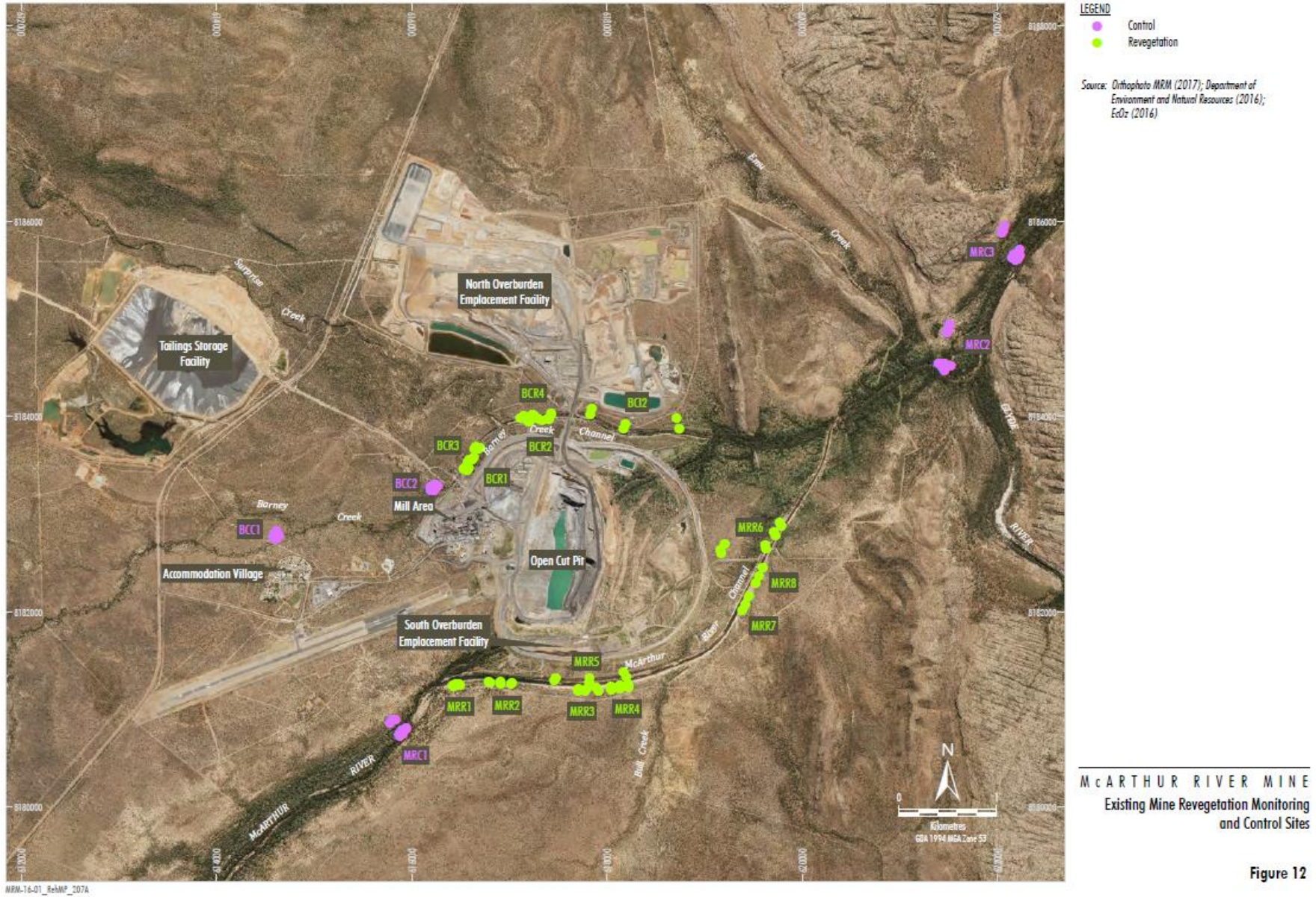


Figure 12 Revegetation Monitoring and Control Sites

8 REHABILITATION MONITORING PROGRAM

The dimensions of the monitoring plots are 5 m X 20 m and each corner has been marked with a star picket. Where the natural landform of a site places restrictions on fitting a plot of this length, the alternative dimensions of 10 m x 10 m are used. The corner post of each plot is marked with a yellow cap and labelled with an aluminium identification tag, block stamped with an individual code for site type, site number and plot number. Plots run downslope toward the river in the “slope” habitat plots, and parallel to the water course in the “batter” habitat plots (Figure 13).

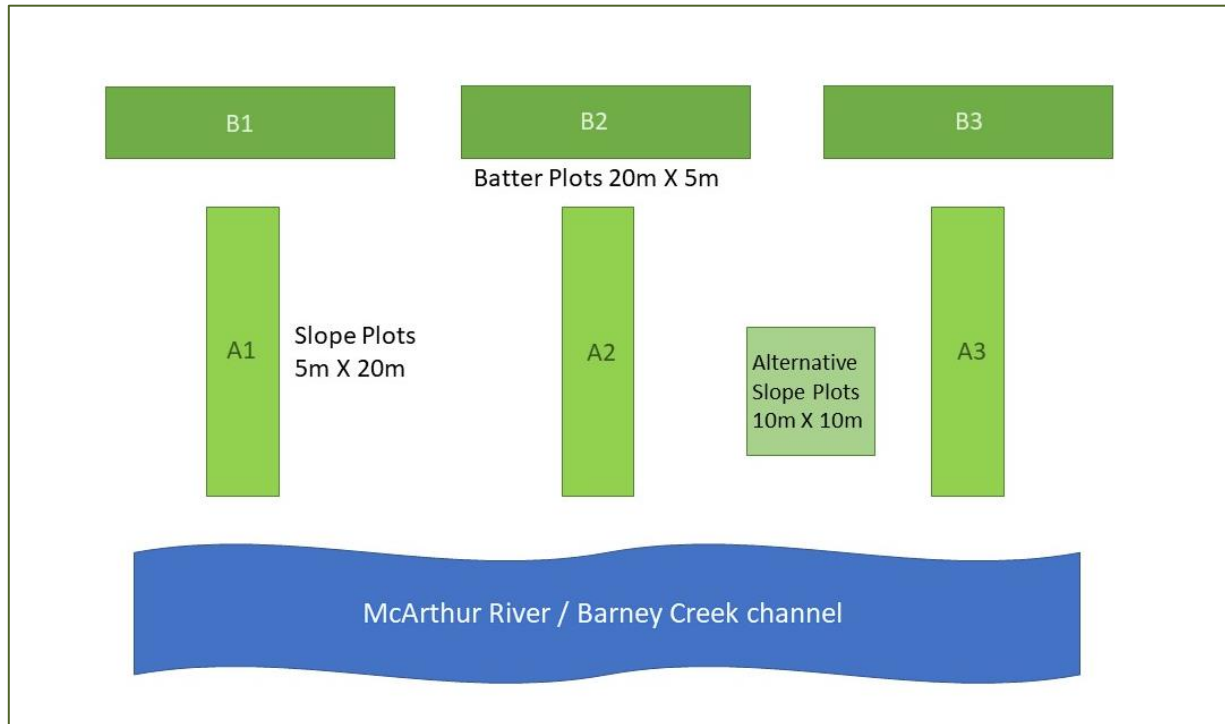


Figure 13: Plot Placement at Each Site

8.2 Control Site Selection

A minimum of three control sites within each representative native vegetation community will be established and the frequency and timing of monitoring will coincide with the monitoring of revegetation areas.

Existing control sites have been located in areas outside the influence of mine operations. Control sites were established at the beginning of the monitoring program and have been monitored every year since. There are five existing control sites (Figure 12):

- two upstream of the Barney Creek Channel;
- one upstream of the McArthur River Channel; and
- two downstream of the McArthur River Channel.

A third control site for Barney Creek will be established downstream of the Barney Creek Channel. As the revegetation works expand into the “rocky gorge” section of the McArthur River Channel, new control sites will be established.

8.3 Monitoring Program Timing

Monitoring of rehabilitation will be conducted annually and will consist of an intensive data collection period (field work), data analysis and reporting.

The data collection period for the monitoring program is constrained by the wet season (typically November to April) when access to the monitoring sites is often not possible due to flooding, and the need to monitor before the dry season in order to capture the full diversity of plant species. Rehabilitation sites will be monitored annually in April/May with necessary flexibility regarding variation in length and intensity of the wet season.

8.4 Data Collection

Annual monitoring for the first three years following tubestock planting and seeding will focus on the initial emergence and establishment of seedlings, including the range and density of key and primary species that have established. Early signs of erosion will be captured along transects at this time. During this phase the sites will be examined for the presence of weed species that may hinder further development of the site.

Monitoring of the full range of ecological attributes/floristic aspects of native vegetation will commence when the vegetation has reached a level of maturity (i.e. between 5 to 10 years after planting/seeding).

Within each plot, the height and species (where identifiable) of all seedlings (plants less than 1 m) and saplings (>1 m) will be recorded. At each 5 m point along the central transect (5 points including the 0 and 20 m points) the following will be recorded:

- Estimated foliage percent cover and maximum height for each strata (where developed).
- Estimated percentage of the ground surface covered by grass, other vegetation, organic litter, coarse woody debris (i.e. >2 cm diameter) bare ground and rock using a 1 m x 1 m quadrat.
- Erosion, fauna and weed disturbance estimates for each 5 m X 5 m block (i.e. at the 0 m point on the transect erosion is estimated for 0-5 m and 2.5 m either side of transect).

A summary of the parameters assessed at each plot and the methodology used is provided below in Sections 8.4.1 to 8.4.5. All data collected during fieldwork will be recorded onto a field survey sheet pro-forma.

8.4.1 Vegetation Surveys

Full Floristic Surveys

A floristic characterisation of the vegetation communities establishing at each rehabilitation site is developed using species richness and composition data. This is collected using full floristic surveys in which the species and abundance of all plants within the study plot are recorded. Full floristic surveys are conducted by systematically walking the plot and recording, for each plant species:

- Scientific name.
- Stratum in which it occurs (e.g. canopy, mid, ground).
- Growth form (e.g. tree, shrub, vine, grass, herb).
- Cover measure (1–5% and then to the nearest 5%; if the cover of a species is less than 1% and the species is considered important, then the estimated cover should be entered [e.g. 0.4]).
- Abundance measure (i.e. the number of individuals or shoots of a species within the plot [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100, 500, 1000 or greater than 1000 if required; numbers above 20 are estimates only]).

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Where possible, the species of dead trees is recorded. Unidentified individuals are given a code and specimens of bark, leaves, fruit, buds and flowers are collected for later identification by reference to botanical keys or against specimens held in the Northern Territory Herbarium. Photographs are also taken as reference for mine staff.

Stand Structure

Stand structure attributes will be used to determine changes in the biomass of revegetation sites over time, related to shrub and tree growth. The stand structure attributes are based upon the measurement of the heights and diameter at breast height (DBH) of all shrubs and trees (with DBH > 2cm) in a plot. Tree / shrub height will be estimated / measured using a laser range finder / height pole. DBH is measured using a forestry DBH tape.

The key attributes are:

- Mean DBH per site.
- Mean Tree Basal Area (TBA) per site, where: $TBA = (DBH/200)^2 \times \pi$ (m²).
- Mean Stand Basal Area (SBA) per site, where: $SBA (\text{plot}) = \sum TBA \times 100$ (m²/ha).
- Mean stem density (SD) per site, where: $SD (\text{plot}) = \text{no. stems} \times 100$ (stems/ ha).
- Range of tree heights across the site plotted as a histogram.

Mean site values from each year's monitoring program will be compared with the mean values from previous years to determine revegetation progress, and with control sites as an indicator of revegetation success.

Vegetation Structure

Vegetation structure describes the 3-dimensional arrangement of plants in a community and provides an indication of community development and succession as well as habitat complexity. This will be described as the average height and percent foliage cover for each strata, e.g. upper (canopy), mid (sub-canopy and / or shrub) and lower (ground layer and grasses) in a vegetation community.

Average heights of the upper and mid strata will be calculated using the height data collected:

- Canopy cover will be measured using a spherical forestry densiometer, with four measurements taken (facing N, E, S and W) at each of the five quadrat (5 m) points along the 20 m transect.
- Mid-strata cover will be estimated visually at each of the quadrat points.
- The percentage of the ground surface covered by grass, other vegetation, organic litter, coarse woody debris (i.e. >2 cm diameter) bare ground and rock will be estimated in 1 m x 1 m quadrats placed at each of the five quadrat monitoring points along the 20 m transect.

8.4.2 Erosion

Erosion will be estimated for each 5 m x 5 m block within the monitoring plot, observed from each of the 5 m vegetation structure points along each transect, using the following ratings:

- Level 1 no erosion;
- Level 2 sheet erosion;
- Level 3 rill erosion (<0.3 m deep);
- Level 4 gully erosion (>0.3 m <1 m deep); and
- Level 5 gully erosion (>1 m deep).

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However, it should be noted that there is no Australian consensus on quantitative measures for minor, major or severe erosion and this measure is a broad aggregation of multiple (gully, sheet, rill) erosion measures (CAA, 2015a).

8.4.3 Fauna Disturbance

Faunal impacts such as trampling and grazing will be recorded as an estimate of the percentage area impacted within each 5 m X 5 m block within the study plot (Table 17).

Table 17: Faunal Impact Disturbance Scores

Score	Fauna Impact (% of plot)	Description
0	0	No faunal disturbance apparent
1	1-10	Some evidence of grazing or trampling by fauna on occasional plants
2	10-25	Obvious evidence of faunal impact with moderate effects, few plant killed outright
3	25-50	Many plants impacted by grazing or trampling by fauna. Some plants killed
4	>50	Significant impacts on most plants from grazing or trampling by fauna. Many plants killed.

8.4.4 Weeds

The percentage of the ground surface covered by grass, other vegetation, organic litter, coarse woody debris (i.e. >2 cm diameter) bare ground and rock will be estimated in 1 m x 1 m quadrats placed at each of the five quadrat monitoring points along the 20 m transect.

8.4.5 Photo Monitoring

Photo-monitoring images are taken as a visual reference and a qualitative indicator of vegetation health and growth over time that compliments other quantitative floristic data. All photos will be recorded in a digital format. Photos will be taken in a portrait orientation, from a height of approximately 1.5 m with the camera focused on a labelled marker board attached to the top of the photo-point picket (generally between 1 and 1.3 m above ground level). The board will display the month and year that monitoring was conducted and the site code. The site code will indicate whether the site is a rehabilitation or control site, the site number and the plot number. At each site the following photos will be taken:

- Site photos – Two digital photos will be taken at each site to provide a general view of the site.
- Plot photos – One digital photo will be taken at each monitoring plot within each site as described below:
 - Batter plot (5 x 20 m): At a point central of the short side of the upper edge of the plot a photo will be taken downslope towards a marker board fixed on a permanent picket centrally located 4 m from the standing point.
 - Slope plot (5 x 20 m): At a point central of the short side of the upper edge of the plot a photo is taken towards a marker board fixed on a permanent picket centrally located 4 m from the standing point.

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The photos will be reviewed to assist with documenting rehabilitation progress, including (but not limited to):

- surface stability and erosion issues;
- presence of weed species;
- vegetation function/health (e.g. die-back or flowering); and
- evidence of pest animal presence/disturbance.

8.4.6 Soil Monitoring

Monitoring will be undertaken at control sites and monitoring sites to measure the soil chemical characteristics (including pH, EC and cation exchange capacity) of the soil profile and will be undertaken at any new rehabilitation areas.

Results will be analysed to assess if soils:

- have the desired chemical properties required to support the intended post-mining land use; and
- are trending toward self-sustaining soils with similar geochemical properties to those of undisturbed soils without the need for additional ameliorants.

Soil samples will be taken to a minimum depth of 300 mm and samples taken from the 100 mm, 200 mm and 300 mm intervals. The samples are taken at the rehabilitation monitoring transects and will be sampled every three years commencing in the year that the transect is established.

8.4.7 Rehabilitation Monitoring Records

MRM will maintain active records related to processes that may impact upon rehabilitation of the site. These will provide the basis for interpretation of later rehabilitation monitoring outcomes.

MRM will also record the details of each rehabilitation campaign (including mapping) to provide context for rehabilitation monitoring results and assist the continuous improvement process. The key monitoring parameters to be included in the program include:

- landform design details;
- drainage design details;
- substrate geology (i.e. geology of overburden directly below topsoil);
- site preparation techniques (e.g. topsoil and source, time of sowing, soil ameliorants used);
- revegetation methodologies (e.g. rate and type of fertiliser, cover crop species, seeding rates, native seed viability, native seed sources/location, seedling sources, revegetation contractors);
- weather conditions;
- photographic records; and
- initial follow-up care and maintenance works and any ongoing maintenance works required.

8.5 Rehabilitation Analysis

Assessing the progress of revegetation towards completion is complicated for a number of reasons. It is not simply a matter of determining what point the revegetation project is on along a linear trajectory towards the completion criteria due to revegetation following a state and transition path of succession (as described above). Performance indicators will be used to ascertain a spatial revegetation status across the monitoring area. The revegetation area will be mapped showing the spatial extent of each of the following revegetation status categories:

- **Rework** – Does not meet completion criteria. Extensive rework required that would not typically form part of a rehabilitation maintenance program (e.g. slopes do not comply with approval requirements, bare areas >0.1ha, large erosion gullies).
- **Maintenance** – Does not meet completion criteria. Routine rehabilitation maintenance works required (e.g. weed control, infill seeding/plantings, repair of minor erosion, fertiliser application).
- **Monitor** – Tracking towards completion criteria but does not meet all criteria. No intervention is required, but continue monitoring (e.g. ecologically young areas).
- **Acceptable** – Meets all completion criteria and ready for sign off by stakeholders. Continue to manage and monitor to maintain status until sign off is sought.

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Rehabilitation monitoring results will be assessed annually to identify if rehabilitation is trending towards the completion criteria. Monitoring results will also be used to refine rehabilitation completion criteria (if appropriate) in the continual improvement process.

9.1 Adaptive Management

An adaptive management approach will be implemented for revegetation of the McArthur River and Barney Creek Channels. An overview of the MRM adaptive management process is provided on Figure 14.

9.1.1 Trigger Levels

MRM has developed trigger levels for use as part of the adaptive management process (Table 18). If necessary, trigger levels will be reviewed and revised based on monitoring results and the outcomes of any actions implemented.

9.1.2 Site Investigations

Additional site investigations may be required if the contributing factors and extent of rehabilitation failure are not clearly understood using the annual rehabilitation monitoring results. The scope of any additional site investigations will be adequate to:

- define the areas where rehabilitation results are not satisfactory;
- identify specific site characteristics (such as topsoil and subsoil geochemical properties) that may be contributing to rehabilitation underperformance; and

develop recommendations for site-specific management and mitigation actions or more broad amendments to rehabilitation methodologies.

9 ADAPTIVE MANAGEMENT AND CLOSURE PLANNING

Table 18: Adaptive Management Trigger Levels and Actions

Level	Trigger	Action (If Trigger Exceeded)
Level 0	<p>Revegetation areas between 1-3 years old will be assessed against survival rates and diversity. Sites are considered to require additional work if monitoring identifies that:</p> <ul style="list-style-type: none"> • Survival rate of planted tubestock is <50% in the first year of planting. • Key species present <30% in the second and third year of planting. 	<p>Maintenance – Completion criteria not yet assessed.</p> <p>Infill planting of key species identified with low survival rates, directed by the results of monitoring.</p> <p>Additional seeding of grass species on the mid-bank and upper bank areas where bare patches may result in erosion.</p>
Level 1	<p>The monitoring site characteristics are tracking towards completion criteria but do not meet all criteria. Sites are considered to be “level one” if monitoring identifies:</p> <ul style="list-style-type: none"> • Site characteristics are greater than 60% of the completion criteria. • There is improvement in performance (by comparison to monitoring data from previous years and control sites). • Erosion is assessed as level 1 or 2 (see Section 8.4.2). 	<p>Monitor – Tracking towards completion criteria but does not meet all criteria.</p> <p>No intervention is required, but continue monitoring.</p>
Level 2	<p>The monitoring site characteristics do not meet completion criteria. Sites are considered to be “level two” if monitoring identifies:</p> <ul style="list-style-type: none"> • Site characteristics are between 30% and 60% of the completion criteria. • There is a minor reduction (1% - 40%) in performance (by comparison to monitoring data from previous years and control sites). • Erosion is assessed as level 3 (see Section 8.4.2). 	<p>Maintenance – Does not meet completion criteria.</p> <p>Routine rehabilitation maintenance works required (e.g. weed control, infill seeding/plantings, repair of minor erosion, fertiliser application).</p>
Level 3	<p>The monitoring site characteristics do not meet completion criteria. Sites are considered to be “level three” if monitoring identifies:</p> <ul style="list-style-type: none"> • Site characteristics are less than 30% of the completion criteria. • There is a significant reduction (40% - 100%) in performance (by comparison to monitoring data from previous years and control sites). • Erosion is assessed as level 4 or level 5 (see Section 8.4.2). 	<p>Rework – Does not meet completion criteria.</p> <p>Extensive rework required that would not typically form part of a rehabilitation maintenance program (e.g. slopes do not comply with approval requirements, bare within the active revegetation areas >0.1ha, large erosion gullies).</p>

9 ADAPTIVE MANAGEMENT AND CLOSURE PLANNING

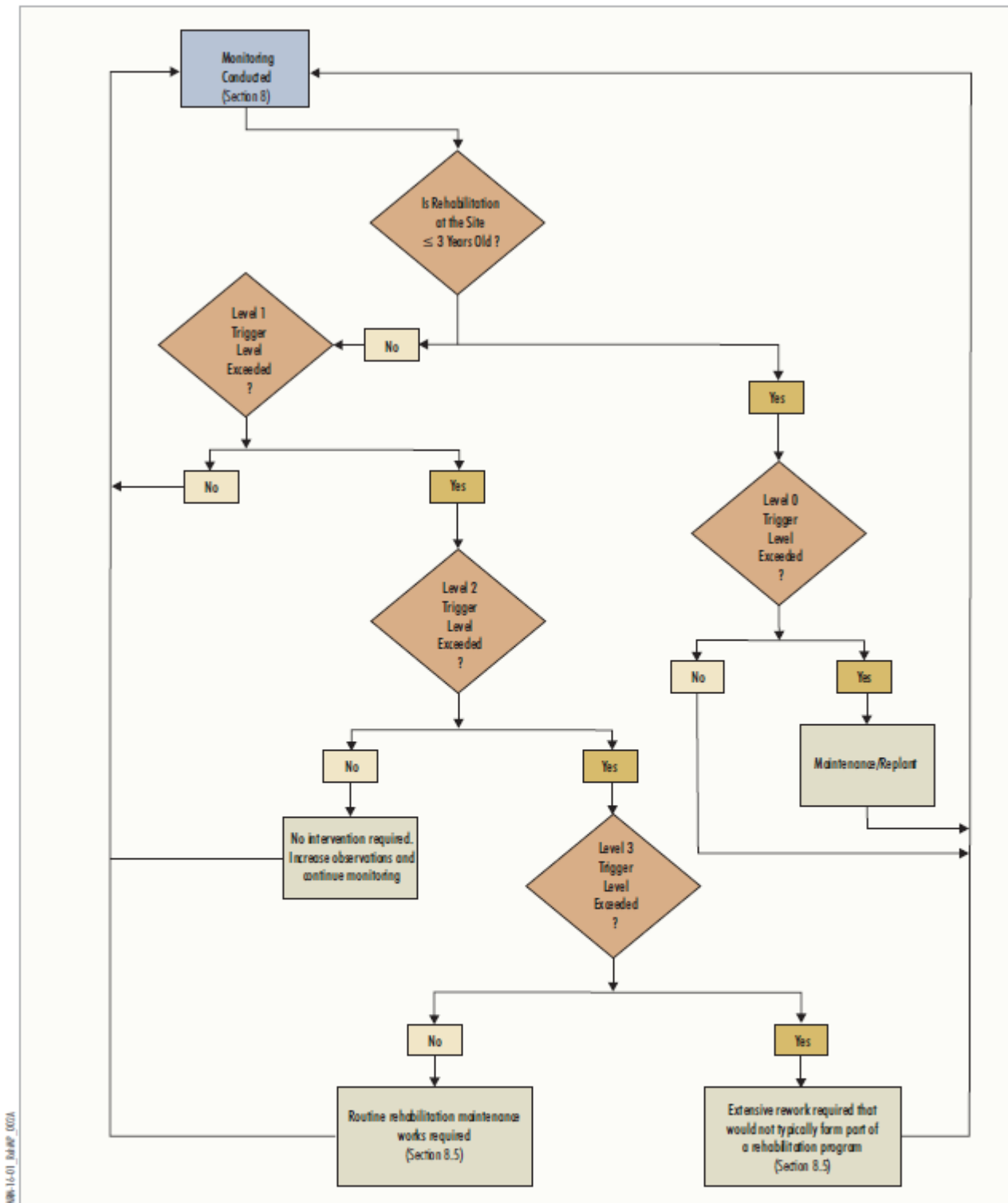


Figure 14 – MRM Adaptive Management Monitoring Program Process

9 ADAPTIVE MANAGEMENT AND CLOSURE PLANNING

9.1.3 Management and Mitigation Responses

Following site investigations, MRM will undertake appropriate management actions to mitigate the identified contributing factors. Mitigation measures may include:

- weed or feral animal control works to improve juvenile vegetation survival;
- addition tubestock planting or seeding to increase diversity or density of vegetation;
- earthworks to repair erosion channels or damage from slope instability;
- additional soil amelioration to improve seed germination rates; and
- implementing additional erosion and sediment controls to minimise erosion.

Following implementation of mitigation measures, MRM may undertake remedial works (such as remedial earthworks to regrade rills and gullies) or repeat rehabilitation works such as re-seeding/re-planting areas.

Where investigations conclude that rehabilitation methodologies or land management practices have contributed to unsatisfactory rehabilitation outcomes, MRM will use the continuous improvement feedback process to revise rehabilitation practices as outlined below.

Senior site management (including the General Manager and Manager – Environment, Safety and People) shall review the adaptive management system on an annual basis for its continuing suitability, adequacy and effectiveness. Each management review shall make decisions on changes to policy, the risk identification and assessment process, environmental aspects, objectives and targets, environmental programs/plans, resourcing and budgeting and other elements of the Mine's management system.

9.2 Continual Improvement

MRM adopts a continuous improvement feedback process to ensure that MRM maintains industry best practice rehabilitation and land management practices to achieve the post-mining land use objectives.

Where site investigations conclude that current rehabilitation methodologies are contributing to unsatisfactory rehabilitation results, MRM will revise methodologies appropriately. Periodically, MRM may engage suitably qualified professionals to review rehabilitation and land management practices to recommend opportunities to modify methodologies.

Where rehabilitation failure is the result of unpredictable or isolated events (e.g. pest attacks, extended dry seasons or >1 in 10 year rainfall events), MRM may review risks to rehabilitation and rehabilitation planning to determine if risks to rehabilitation are adequately considered.

9.3 Mine Closure Planning

9.3.1 Conceptual Mine Closure Plan

MRM has prepared a Conceptual Mine Closure Plan (CMCP) to meet the requirements for a conceptual mine closure plan outlined in the *Terms of Reference for the Preparation of an Environmental Impact Statement: McArthur River Mine – Overburden Management Project* (the EIS TOR).

9 ADAPTIVE MANAGEMENT AND CLOSURE PLANNING

The CMCP generally addresses the Western Australian *Guidelines for Preparing Mine Closure Plans* (Department of Mines and Petroleum and Environmental Protection Authority, 2015), upon which the NT Draft MCP Guideline has been based.

9.3.2 Review of the Conceptual Mine Closure Plan

The CMCP is intended to be a dynamic document that is subject to review and refinement during the life of operations and mine closure.

The CMCP will be included in the MMP and will be reviewed and updated to align with the submission of future versions of the MMP as the mine progresses. The CMCP will be reviewed and updated in accordance with new legislation, standards, guidelines and operational requirements, as required by Glencore.

10 REVIEW AND REPORTING

10.1 Review of Rehabilitation Management Plan

The performance of this RMP will be reviewed annually, along with the environmental performance of the Mine.

Any major amendments to the RMP will be undertaken in consultation with the appropriate regulatory authorities and stakeholders. Minor changes (e.g. formatting, or minor changes in monitoring locations) will be made with version control.

The RMP may also be revised due to:

- Introduction of additional mitigation measures or controls.
- Results from the monitoring and review program, including consistent exceedances of trigger levels/performance indicators.
- Changing environmental requirements.
- Changes in legislation.
- Identification of a requirement to alter the RMP following a risk assessment.
- Updates to the MMP.
- Recommendations from the Independent Monitor, NOEF Independent Review Board or regulator.

This RMP has been prepared with a focus on activities to be undertaken during the nominated RMP term (i.e. 2018 to 2020). Following the completion of the RMP term, an updated RMP will be prepared. The updated RMP will:

- Consider the outcomes of rehabilitation activities undertaken during this RMP term (i.e. 2018 to 2020).
- Provide a summary of how rehabilitation has progressed compared to the criteria outlined in this RMP.
- Define the areas to be rehabilitated during the next RMP term.
- Describe rehabilitation activities anticipated to be undertaken during the next RMP term.

MRM's CMCP was prepared as part of the OMP EIS to address the rehabilitation and closure of disturbed areas of the Mine and BBLF located within MLN 1121, MLN 1122, MLN 1123, MLN 1124, MLN 1125 and MLN 1126.

10.2 Reporting of Data

Revegetation data will be reported annually as part of the annual revegetation report and the Operational Performance Report.

Reporting will include analysis of rehabilitation performance against completion criteria.

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