GEMINI PROJECT
Site-Specific EA Application

MAGNETIC SOUTH PTY LTD
December 2020

VOLUME 5:

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Appendix O Visual Amenity Assessment

GEMINI PROJECT
Visual Amenity Assessment

PREPARED FOR
MAGNETIC SOUTH PTY LTD

NOVEMBER 2020

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GEMINI PROJECT
VISUAL AMENITY ASSESSMENT

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LIST OF ABBREVIATIONS

AARC	AARC Environmental Solutions Pty Ltd
Blackwater Railway	Aurizon Blackwater Rail System
Biosecurity Act	*Biosecurity Act 2014*
CHPP	Coal Handling and Preparation Plant
DEM	Digital Elevation Model
DES	Department of Environment and Science
EA	Environmental Authority
ESD	Ecologically Sustainable Development
EIS	Environmental Impact Statement
EP Act	*Environmental Protection Act 1994*
EP Regulation	Environmental Protection Regulation 2019
EPP	Environmental Protection Policies
ERA	Environmentally Relevant Activity
Magnetic South	Magnetic South Pty Ltd
MIA	Mine Infrastructure Area
ML	Mining Lease
MLA	Mining Lease Application
PCI	Pulverised Coal Injection
ROM	Run-Of-Mine
RPI Act	*Regional Planning Interests Act 2014*
SRTM	Shuttle Radar Topography Mission
Taunton National Park	Taunton National Park (Scientific)
the Project	Gemini Project
TLO	Train Load Out
ZTV	Zone of Theoretical Visibility

UNITS OF MEASUREMENT

°	degree(s)
m	metre(s)
mAHD	metre(s) in Australian Height Datum
Mtpa	million tonne(s) per annum
km	kilometres

1.0 INTRODUCTION

AARC Environmental Solutions Pty Ltd (AARC) was commissioned by Magnetic South Pty Ltd (Magnetic South) to prepare a Visual Impact Assessment for the Gemini Project (the Project), located approximately 110 km east of Emerald and 125 km west of Rockhampton in the Bowen Basin of Central Queensland (Figure 1). The small rural townships of Bluff and Dingo are located approximately 15 km west and 3 km east of the Project, respectively. The Visual Impact Assessment will form part of the approval requirements to obtain an Environmental Authority (EA) over the Mining Lease Application (MLA) area illustrated below (Figure 1).

1.1 SCOPE OF STUDY

Visual amenity refers to the quality and appreciation of a visual landscape with respect to valued features, characteristics and attributes. Visual amenity is considered of high value to the surrounding communities and presents an important determinant of public perception and acceptance of any proposed changes that might impact on landscape character.

To assess the potential impacts the Project may impose to visual amenity, the following scope of works were undertaken:

- clearly identify existing visual landscape characteristics, features and composition expected to hold existing value to the surrounding community either from local, regional, state-wide, national or international level (e.g. major viewpoints, landmarks, watercourses, view sheds, ridgelines and other features that contribute to the existing visual amenity of the proposed site);
- identify potential sensitive receptors that are particularly vulnerable to land use change;
- determine areas with the most ability to absorb land use change without causing serious loss to existing visual amenity and landscape character (natural and cultural);
- apply a range of different visual simulations of the Project to understand the extent of visual modification likely to occur;
- determine potential impacts to the visual aesthetics with respect to sensitive receptors; and
- provide future management strategies to mitigate any identified impacts.

1.2 PROJECT OVERVIEW

The proposed Project is a greenfield, open-cut metallurgical coal mine producing pulverised coal injection (PCI) coal and coking coal within a well-established coal mining area for export to the international steel making industry. The Project will bring benefits to the local community, region, Queensland and the Commonwealth through direct employment opportunities, royalties, and taxes. Additional use of services of regional suppliers of rail, power, water, communications, contractors, service providers and local businesses is expected to occur which will have a positive economic impact beyond direct employment.

It is anticipated the Project term will be 25 years from grant of the mining lease (ML); with this term including initial construction, mine operation and rehabilitation activities. Mine construction activities are scheduled to commence in July 2021; subject to granting of the Project ML and EA. It is anticipated that it will take approximately six months to establish the necessary infrastructure to commence overburden removal and 18 months to commence coal production.

The main activities associated with the Project include:

- exploration activities continuing in order to support mine planning;
- development of a mine infrastructure area (MIA) including mine offices, bathhouse, crib rooms, warehouse/stores, workshop, fuel storage, refuelling facilities, wash bay, laydown area, sewage, effluent and liquid waste storage and a helipad;
- construction and operation of a coal handling and preparation plant (CHPP) and coal handling facilities adjacent to the MIA, including run-of-mine (ROM) coal and product coal stockpiles and rejects bin/overflow (coarse and fine rejects);
- construction and operation of a surface conveyor from the product stockpiles to a train load out (TLO) facility and rail loop connecting to the Blackwater Railway to transport product coal to coal terminals at Gladstone for export;
- construction of an accommodation facility within the bounds of the MLA;
- construction of access roads from the Capricorn Highway to the MIA, TLO facility and accommodation facility;
- installation of a raw water supply pipeline to connect to the Blackwater Pipeline network;
- construction of a 66 kV transmission line and switching/substation to connect to the existing regional network;
- other associated minor infrastructure, plant, equipment and activities;
- development of mine areas (open-cut pits) and out-of-pit waste rock emplacements;
- drilling and blasting of competent waste material;
- mine operations using conventional surface mining equipment (excavators, front end loaders, rear dump trucks, dozers);
- mining up to 1.9 million tons per annum (Mtpa) ROM coal (average of 1.8 Mtpa) for a construction/production period of approximately 20 years;
- progressive placement of waste rock in:
    - emplacements, adjacent to and near the open-cut voids; and
    - mine voids, behind the advancing open-cut mining operations.
- progressive rehabilitation of waste rock emplacement areas and mined voids;
- progressive establishment of soil stockpiles, laydown area and borrow pits (for road base and civil works (material will be sourced from local quarries where required);
- disposal of CHPP rejects (coarse and fine rejects) in out-of-pit spoil dumps, and in-pit behind the mining void;
- progressive development of internal roads and haul roads including a causeway over Charlevue Creek to enable coal haulage and pit access; and

- development of water storage dams and sediment dams, and the installation of pumps, pipelines, and other water management equipment and structures including temporary levees, diversions and drains.

A conceptual layout of the Project is illustrated below (Figure 2).

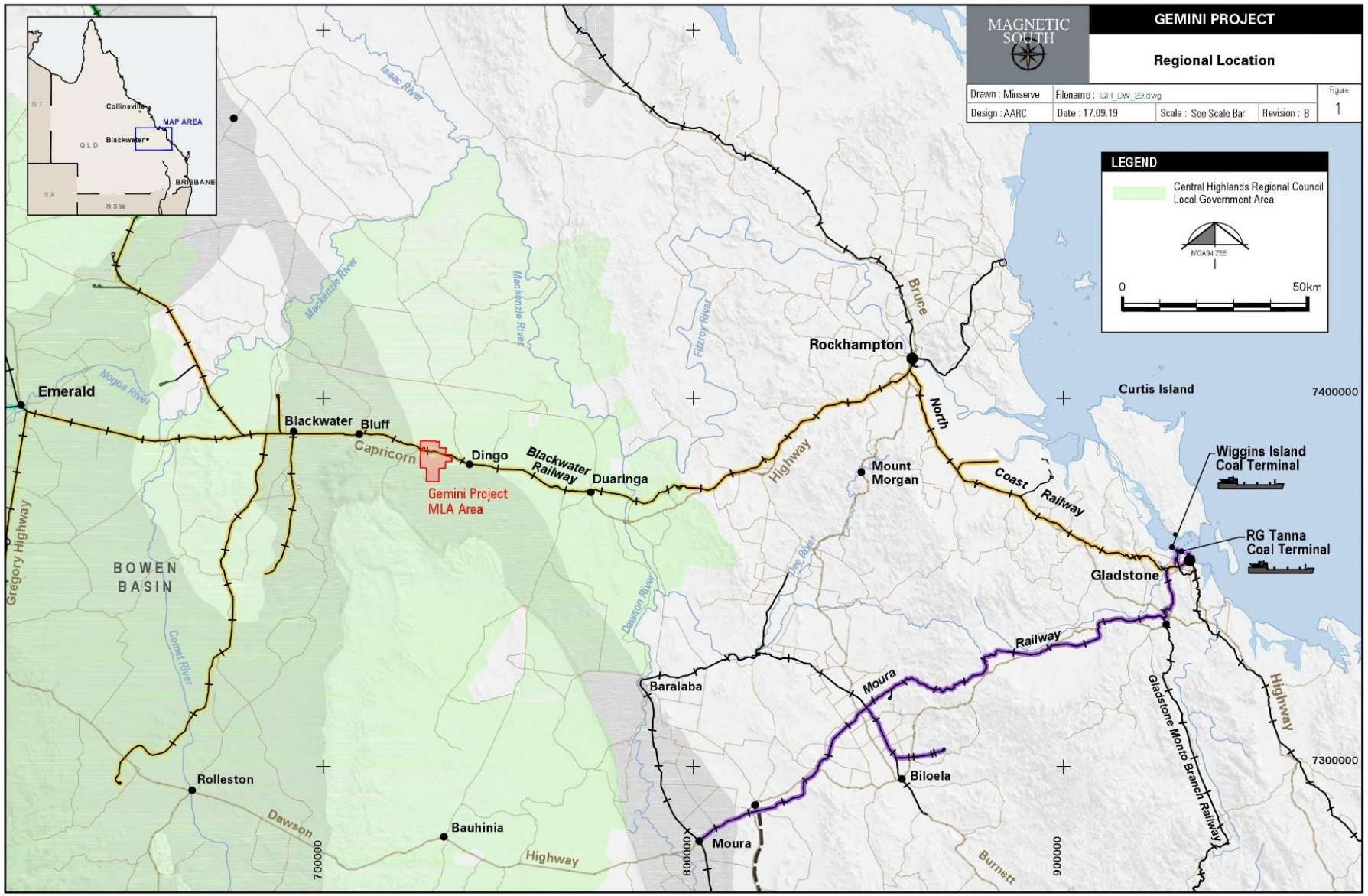

Figure 1 Regional Location

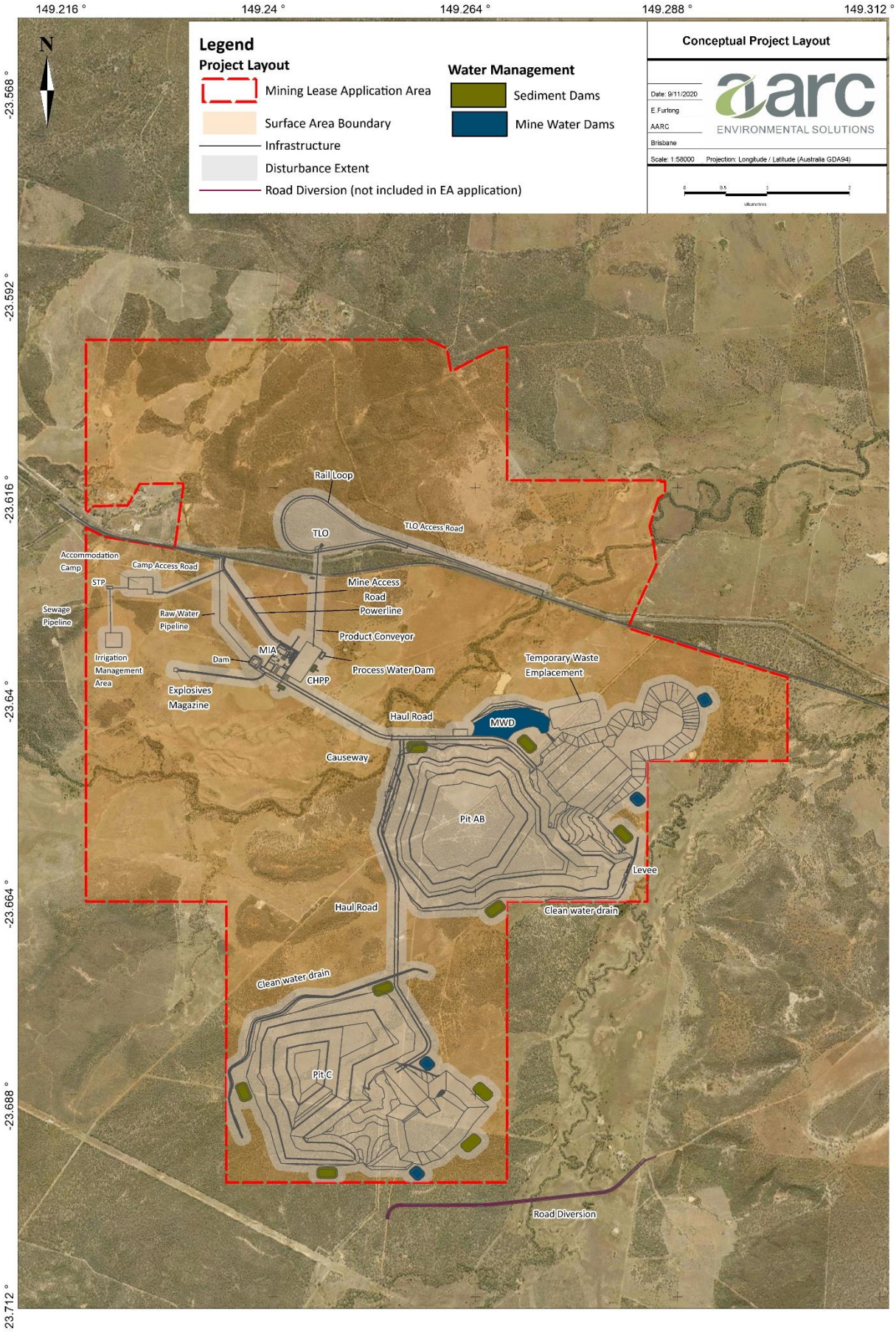

Figure 2 Conceptual Project Layout

1.3 CURRENT LAND USE

The land within the Project area is currently used for low intensity cattle grazing and resource exploration activities. The Capricorn Highway and a number of publicly gazetted roads including Charlevue, Cooinda, Red Hill, Normanby, and Ellesmere roads dissect the Project area. The Capricorn Highway, which is a state-controlled road linking Rockhampton with western Queensland (Figure 1), traverses the MLA and links the townships of Bluff and Dingo. The Aurizon Blackwater Rail System (Blackwater Railway) tracks along the northern side of the Capricorn Highway (Figure 1). A stock route (ID: 413CENT) tracks alongside the Capricorn Highway and is currently open but classified as minor and unused. Publicly gazetted roads including Sanders, Namoi, Charlevue, Cooinda, Red Hill, Normanby and Ellesmere roads provide local access.

Located directly north of the study area is the Taunton National Park (Scientific), (Taunton National Park), a scientific reserve under the *Land Act 1994 (Queensland)*, with the aim of protecting a population of Bridled nail-tail wallabies. A small section of the Taunton National Park of around 2.5 hectares (ha) occurs within the study area. Walton State Forest is approximately 6 km to the west and Blackdown Tablelands National Park is located approximately 9 km to the southwest of the Project area. These three areas are illustrated below (Figure 3).

1.4 TOPOGRAPHY

The Project area is described as gently undulating with elevations ranging between 120-150 mAHD. The physiography of the area is characterised by a dissected tableland having a general relief variation of about 80 m and slopes less than 5° within the MLA area. The highest points are located in the central and western sections of the mining lease.

The Blackdown Tableland National Park and Arthurs Bluff State Forest are situated 15-18 km to the southwest and west respectively rising to an elevation approximately 450 m above the elevation of the Project site. To the north and east of the Project, there is little relief with the land falling gently toward the Mackenzie River valley.

1.5 MAJOR WATERCOURSES

The major water bodies associated with the Project site are Charlevue Creek and Springton Creek. Charlevue Creek begins within the boundaries of Blackdown Tablelands National Park and bisects the MLA from west to east. Springton Creek flows alongside the southeast boundary of the MLA into the Fitzroy River, eventually reaching the Pacific Ocean approximately 46 km north of Gladstone. The associated floodplains of these two watercourses result in localised lower elevations within the surrounding landscape. A significantly smaller tributary, Stanley Creek, crosses the northwest corner of the MLA boundary eventually converging with Springton Creek downstream of the MLA. Minor associated tributaries, dams and drainage features also exist across the site.

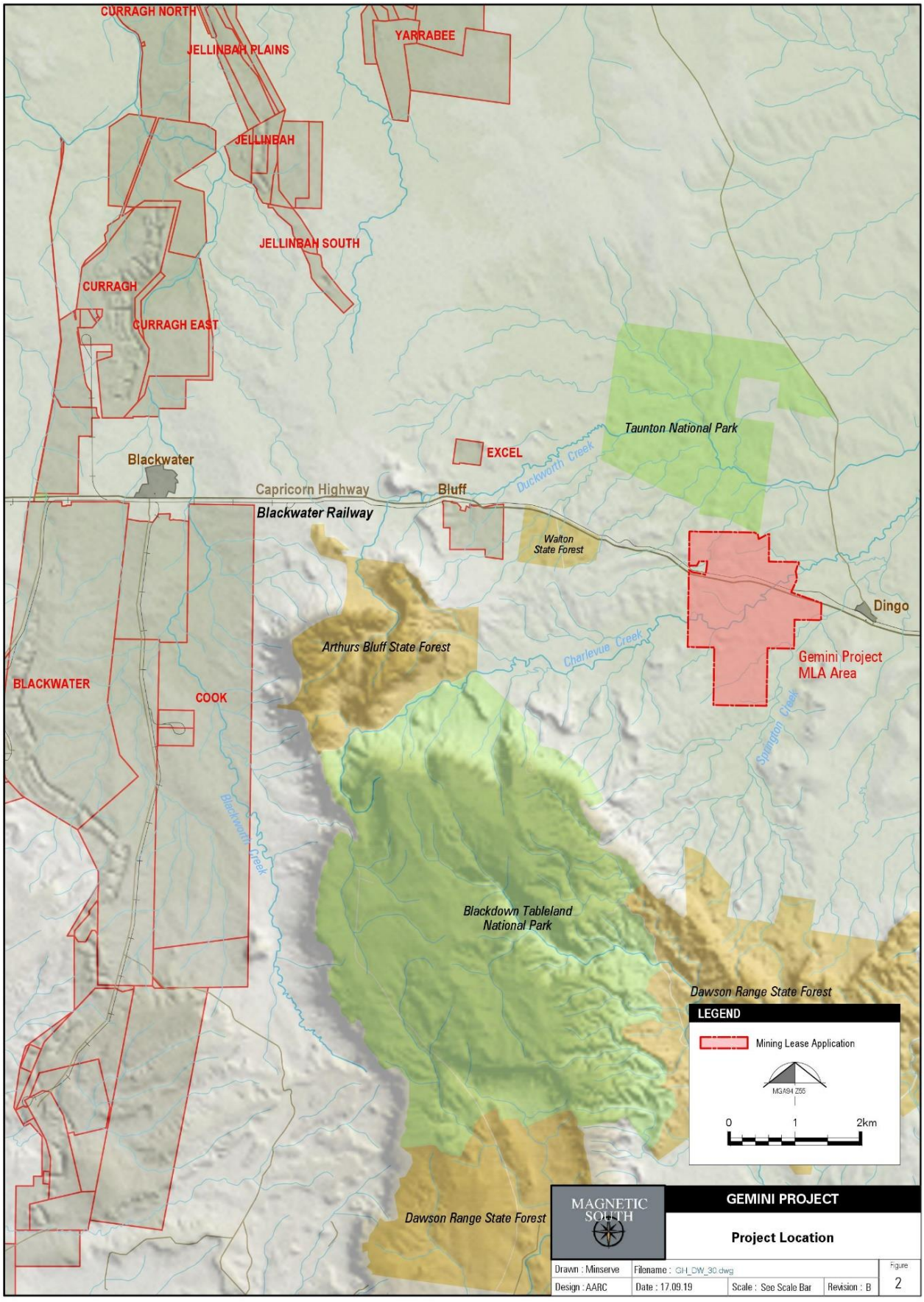

Figure 3 Project Location

2.0 RELEVANT LEGISLATION AND POLICY

2.1.1 Environmental Protection Act 1994

The objective of the *Environmental Protection Act 1994* (EP Act) is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. This is commonly referred to as ecologically sustainable development (ESD). Section 4 of the EP Act states that this objective is to be achieved through an integrated management program that is consistent with ESD. The EP Act addresses the following areas that are relevant to the Project:

- notifiable activities, that are listed in Schedule 3 of the EP Act;
- environmental protection policies (EPPs) for water and wetland biodiversity, noise and air which are intended to enhance or protect Queensland's environment and list relevant environmental outcomes and performance criteria;
- environmentally relevant activities (ERAs) defined within the EP Act and listed in schedule 2 of the Environmental Protection Regulation 2019 (EP Regulation);
- EAs which are required to carry out an ERA including a resource activity, and which will include conditions that will regulate the Project activities; and
- duties of care associated with environmental harm.

The EP Act also prescribes the environmental impact statement (EIS) process, which is managed by the Department of Environment and Science (DES), which will decide the EA application for the Project. As previously identified, the EIS for the Project is prepared for assessment pursuant to the bilateral agreement between the Commonwealth and Queensland Government. Following any grant of an EA, DES would subsequently monitor and regulate the Project's mining activities, in accordance with the EA conditions throughout the life of the Project.

2.1.2 Stock Route Management Act 2002

The *Stock Route Management Act 2002* provide for stock route network management, which is achieved mainly by:

- establishing principles of stock route network management;
- providing for stock route network management planning;
- establishing responsibilities for stock route network management;
- constructing and maintaining travelling stock facilities on the stock route network; and
- monitoring, surveying and controlling the movement of travelling stock.

2.1.3 Regional Planning Interests Act 2014

The purpose of the *Regional Planning Interests Act 2014* (RPI Act) is to identify areas of Queensland that are of regional interest, because they contribute to, or are likely to contribute to, Queensland's economic, social and environmental prosperity. The RPI Act also aims to give effect to the policies about matters of State interest, as stated in regional plans and effectively manages the impact of resource

activities and other regulated activities on areas of regional interest. In particular, the act manages the co-existence of resource activities with highly productive agricultural activities. Areas of regional interest that the RPI Act protects are as follows:

- high-quality agricultural areas from dislocation (Priority Agricultural Area);
- existing settled areas of a city, town or other community including areas for future growth and buffer areas between resource activities (Priority Living Area);
- land that is highly suitable for cropping (Strategic Cropping Land); and
- regionally important environmental areas (Strategic Environmental Areas).

3.0 METHODOLOGY

3.1.1 Desktop Assessment

A desktop assessment was undertaken to provide a preliminary assessment of the Project's impacts on visual amenity. A review of mapping data, digital aerial photography, visual simulations and elevation data has been undertaken in consideration of important social and cultural values of the study area. Based on this preliminary assessment, five vantage points were then selected to ensure that potential impacts on sensitive receptors within the local area have been appropriately considered. The assessment recognises the visual and landscape changes that are expected to occur throughout all stages (construction, operation and rehabilitated), including loss of landscape elements, attributes and values to facilitate the construction and operation of new mining infrastructure, transport, dust, light pollution and waste facilities.

A site visit to each vantage point was then undertaken by AARC personnel to ensure the subjectivity associated with human vision, attention to the duration and nature of public exposure in areas such as public roads, railways, places of work or residence and proximity to townships has been reviewed; confirming the collected imagery is representative and reflects the visual landscape present at each vantage point.

Minserve was then commissioned to develop visual simulations for each vantage point by superimposing the anticipated features from the Project onto panoramic imagery. The visual simulations undertaken represent the visual landscape during both the post-mining and rehabilitation phases of the Project, excluding any post-mining vegetation growth.

Potential visual impacts were then identified and assessed in consideration of the visual impact matrix approach developed by EDAW (2006). The impact assessment evaluates the level of visual modification associated with the Project in the context of the visual sensitivity of relevant surrounding land use areas, further details on the assessment criteria are provided below.

3.1.2 Visual Sensitivity

Visual sensitivity is used to determine how critical a change is to the existing landscape's visual features, attributes and characteristics, when viewed from various viewpoints. The criteria used to assess visual sensitivity is a function of the following:

- ***Distance*** - distance between receptor and proposed activity can substantially impact upon the experience and ability to view greater levels of detail. A greater distance will increase difficulties to distinguish changes that occur in an existing environment and surrounding background.

- ***Elevation*** - elevation of a viewpoint in relation to a proposed activity presents a greater capacity to observe changes in the line of site. If the elevation of a viewpoint is greater than the activity, this allows for better visual capacity. If the elevation sits lower, then the visual capacity is reduced.

- ***Scale*** - scale of change that occurs within the existing environment will subsequently determine the visibility from a viewing location. The larger the magnitude of change, the easier the disturbance will disrupt existing land values.

- ***Context*** - exposure and associated values placed on the existing environment can increase sensitivity to change. External features contributing to the context of exposure and associated background can influence how a disruption is perceived.

- ***Duration*** - duration of prolonged exposure from a receptor can increase the level of visual capacity to distinguish greater detail between proposed activity and its background. The greater the duration and prolonged exposure, the greater the capacity to experience adverse impacts from a visual change.

Visual receptors in the vicinity of the Project are limited to residences, rural infrastructure and passing traffic on both main and local roads. The identification of receptor sensitivity is recognised to be largely subjective and varies in response to both landscape and receiver characteristics. The level of sensitivity from the identified receptors can vary depending on a variety of conditions during which exposure occurs. The visual assessment techniques to determine visual sensitivity are classified in accordance with EDAW (2006) and detailed below (Table 1).

Table 1 Visual Sensitivity Classification

Visual Receptor	Visual Sensitivity Assessment				
	Foreground		Middle Ground		Background
	0 - 0.5 km	0.5 - 1 km	1 - 2.5 km	2.5 - 5 km	> 5 km
Residential Dwellings[1]	High	High	High	Moderate	Low
Rural Infrastructure	Low	Low	Low	Low	Low
Main Public Roads[2]	Moderate	Low	Low	Low	Low
Local Roads[2]	Low	Low	Low	Low	Low

[1] Residential dwelling classification is considered under the assumption that they will be occupied during both the construction and operational phases of the Project.

[2] Roads will be considered under the context of altered views based on their duration and extent of exposure along identified routes.

3.1.3 Visual Modification

The extent of visual modification arising from a proposed development can be measured as the level of visual contrast between the Project development and the existing visual environment. The level of visual modification generally decreases as the distance from the development to the vantage point increases. The landscape character (i.e. distinctive landscape types, unique features, landforms and characteristics) further provides an understanding of each landscape's ability to absorb changes and integrate levels of disturbance from each vantage point. The types of landscape character for this assessment have been identified based on consideration of landform, vegetation, intensity and character of land as limited to rural/grazing, mine development (infrastructure, facilities and exposed operations), remnant vegetation and regrowth, main roads/highways, residential roads (constructed and unconstructed) and residential dwellings. The descriptors used for the level of visual modification within these landscapes are as follows:

- ***Very low (or negligible)*** - the Project is not visible from viewing location and does not comprise any part of the receptor's visual environment.

- ***Low*** - the Project is partially visible from the viewpoint location, comprising only a minor part of the receptor's visual environment.

- ***Moderate*** - the Project can be recognised and is moderately visible from the viewpoint location, comprising a noticeable portion of the receptor's visual environment.

- ***High*** - the Project is clearly visible from the viewpoint location, comprising a dominant portion of the receptor's visual environment. Visibility is substantial and alters the landscape character presenting a distinctive visual impact.

3.1.4 Visual Impact Assessment

Visual impacts have been assessed as per the matrix presented below (Table 2). The assessment is undertaken by evaluating the level of visual modification associated with the Project in the context of the visual sensitivity of relevant surrounding land use areas.

Table 2 Visual Impact Matrix

		Visual Sensitivity		
		High	Moderate	Low
Visual Modification[1]	High	High	High	Moderate
	Moderate	High	Moderate	Low
	Low	Moderate	Low	Low
	Very Low	Low	Very Low	Very Low

[1] Visual modification refers to both adverse and beneficial modification to visual landscape components.

These visual impacts can be described as:

- ***Very low (or negligible)*** - very low visual impacts would be noticeable and experienced as a result of the proposed activity in the existing environment. Visual changes would be efficiently integrated into the landscape and observed by none or very few sensitive receptors that hold a neutral value on the landscape character.

- ***Low*** - low visual impacts would be noticeable and experienced as a result of the proposed activity in the existing environment. Visual changes would be moderately integrated into the landscape and observed by very few sensitive receptors that hold a low value on the landscape character.

- ***Moderate*** - moderate visual impacts would be noticeable and experienced as a result of the proposed activity in the existing environment. Visual changes would be partially integrated into the landscape and observed by various groups of sensitive receptors that hold a moderate value on the landscape character.

- ***High*** - high visual impacts would be noticeable and experienced as a result of the proposed activity in the existing environment. Visual changes would fail to be integrated into the landscape and observed by numerous sensitive receptors that hold a high value on the landscape character.

3.1.5 Photographic Vantage Points

A total of five photographic vantage points were selected as representative points to reflect the visual landscape at major sensitive receptor locations and also relatively high traffic areas within the local region.

A zone of theoretical visibility (ZTV) has been simulated for each selected vantage point location. A ZTV can be described as the viewshed or the theoretical visibility of a proposed visual modification. The visual simulations create a viewshed analysis helpful in illustrating the theoretical outline of proposed

changes or visual impact on landscape character. The bare-earth ZTV generated for this assessment presents the worst-case scenario using only existing vegetation obstructions. The ZTV is based on 1st Shuttle Radar Topography Mission (SRTM) v1.0 Digital Elevation Model (DEM) and an observer eye height of 1.8 m. Informed by the ZTV, western viewsheds of the Project from known sensitive receptors were identified as not possible due to a number of known visual obstructions (i.e. topography and existing vegetation). As a result of this assessment, no vantage points were placed in the west.

A number of visual simulations have been generated at the five vantage points described and illustrated in detail below (Table 3; Figure 4).

Table 3 Description of Vantage Points

Vantage Point	Location Description	Coordinates (Lat/Long)	Approximate Distance from MLA
VA1	Southern side of Capricorn Highway facing south west towards Pit AB between the pit and the residence of the Rubina property. This property is owned by the proponent and as the residence will be vacated prior to the commencement of operations, it is not considered to be a sensitive receptor.	-23.641, 149.292	Within MLA
VA2	Southern side of Sanders Road facing west towards Pit C at the entrance to the residence on the Namoi Hills property along the eastern boundary. This property is owned by the proponent and as the residence will be vacated prior to the commencement of operations, it is not considered to be a sensitive receptor.	-23.696, 149.281	1.3 km
VA3	Northern side of Sanders Road facing north towards Pit AB at the entrance to the residence on the Namoi Hills property along the eastern boundary. This property is owned by the proponent and as the residence will be vacated prior to the commencement of operations, it is not considered to be a sensitive receptor.	-23.694, 149.280	1.2 km
VA4	Southern side of Capricorn Highway facing south towards Pit AB. This location is closest to the northern boundary of the Namoi Hills property.	-23.629, 149.272	Within MLA
VA5	Western side of Cooinda Road facing north towards Pit C at the entrance to the residence on the Glenwood property. This property is currently under purchase by the proponent and as the residence will be vacated prior to the commencement of operations, it is not considered to be a sensitive receptor.	-23.720, 149.246	2.4 km

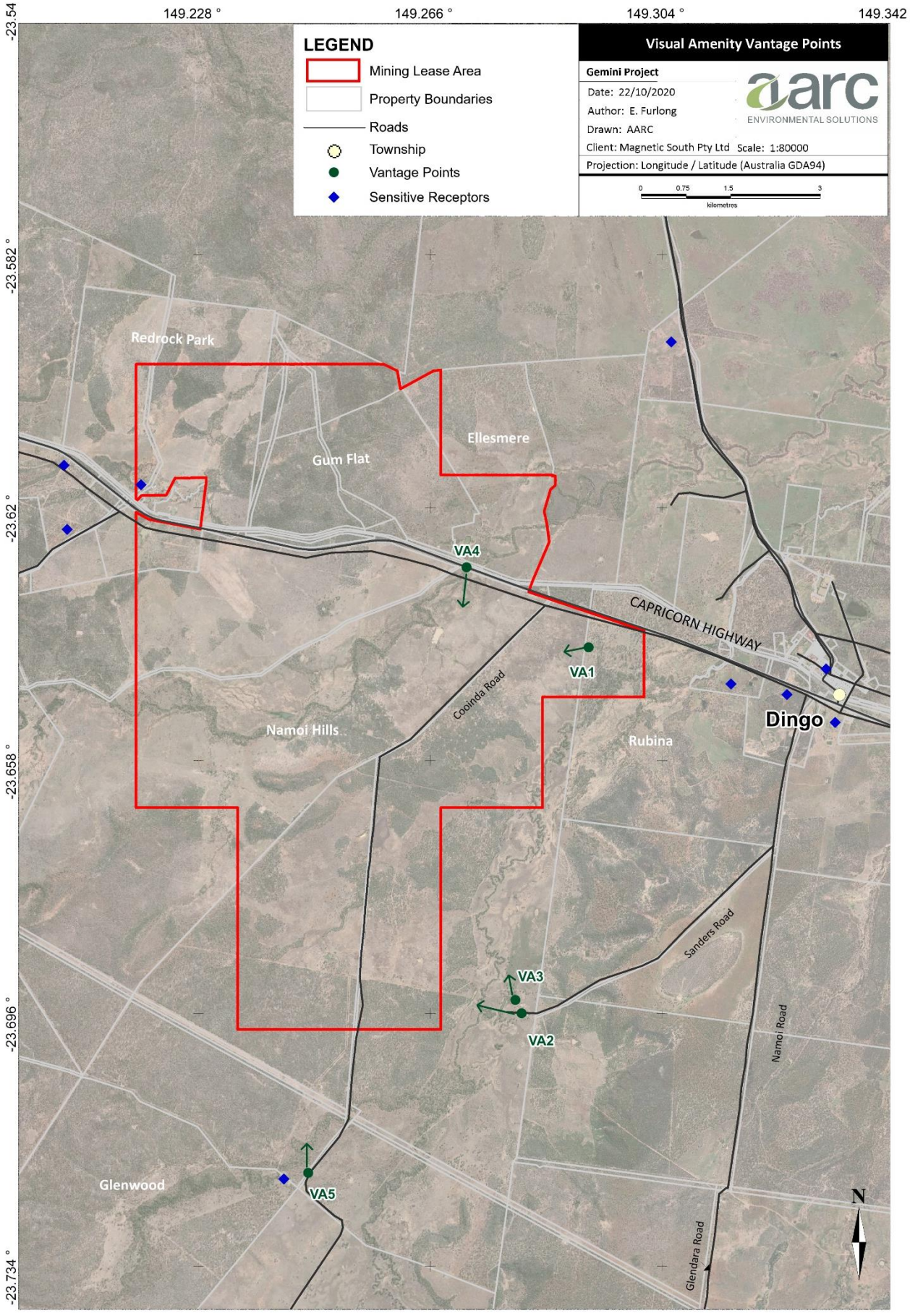

Figure 4 Vantage Point Locations

4.0 POTENTIAL IMPACTS

4.1.1 Vantage Point Visual Impact Significance

The following potential impacts were identified by the visual simulations for the proposed Project, these include:

- visual sensitivity ranged from low to high (4 low and 1 moderate);
- visual modification ranged from very low to high (1 very low, 3 low and 1 high);
- visual impacts ranged from very low to moderate (1 very low, 3 low and 1 moderate).

A summary of the visual impact significance for each vantage point is provided in Table 4; and further in-depth descriptions are detailed in the following sections.

Table 4 Visual Impact Significance Summary

Vantage Point	Visual Sensitivity	Visual Modification	Visual Impact
VA1	Low	High	Moderate
VA2	Low	Low	Low
VA3	Low	Low	Low
VA4	Moderate	Low	Low
VA5	Low	Very Low	Very Low

Photographic Vantage Point: VA1

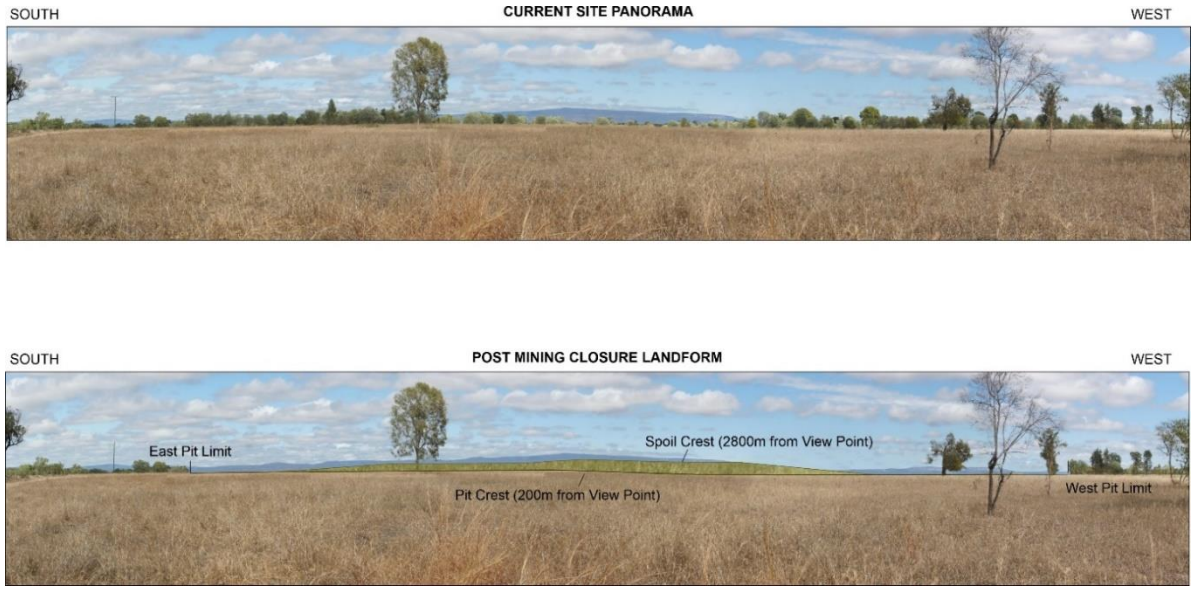

Figure 5 Vantage Point VA1 Visual Simulation

Description:

Vantage point VA1 sits within the MLA facing south west towards Pit AB along the eastern boundary of the Rubina property. Landscape character can be described as rural/grazing with a sparse shrub layer and vast open paddocks of cleared grasslands as the most predominant visual feature. The elevated range, Arthurs Bluff State Forest, can be seen in the distance beyond a vegetation community of narrow-leaved ironbark (*Eucalyptus crebra*) and Clarkson's bloodwood (*Corymbia clarksoniana*) (AARC 2019). A local residence is situated approximately 650 m east behind this vantage point on the Rubina property, however this property is owned by the proponent and will be vacated prior to the commencement of operations. In this instance, the visual sensitivity has been considered low due to dwelling vacancy, visual exposure, duration and landscape context.

Informed by the visual simulation, the visual modification is expected to be high. The unfavourable elevation and minimal vegetation present means there is little capacity for the landscape to obscure and absorb visual changes. A large portion of the spoil crest of Pit AB would be central to the visual landscape at 2.8 km in the distance facing southwest. The elevation of the spoil crest reaches a maximum height of 175 mAHD compared to a slightly undulating topography of 110mAHD at the vantage point VA1. Nonetheless, the crest of Pit AB would be obscured, and Arthurs Bluff State Forest ridgeline is still visible beyond the spoil crest.

The overall visual impact at vantage point VA1, informed by visual sensitivity and visual modification, is considered to be moderate.

Visual Sensitivity: Low **Visual Modification:** High

Visual Impact: Moderate

Photographic Vantage Point: VA2

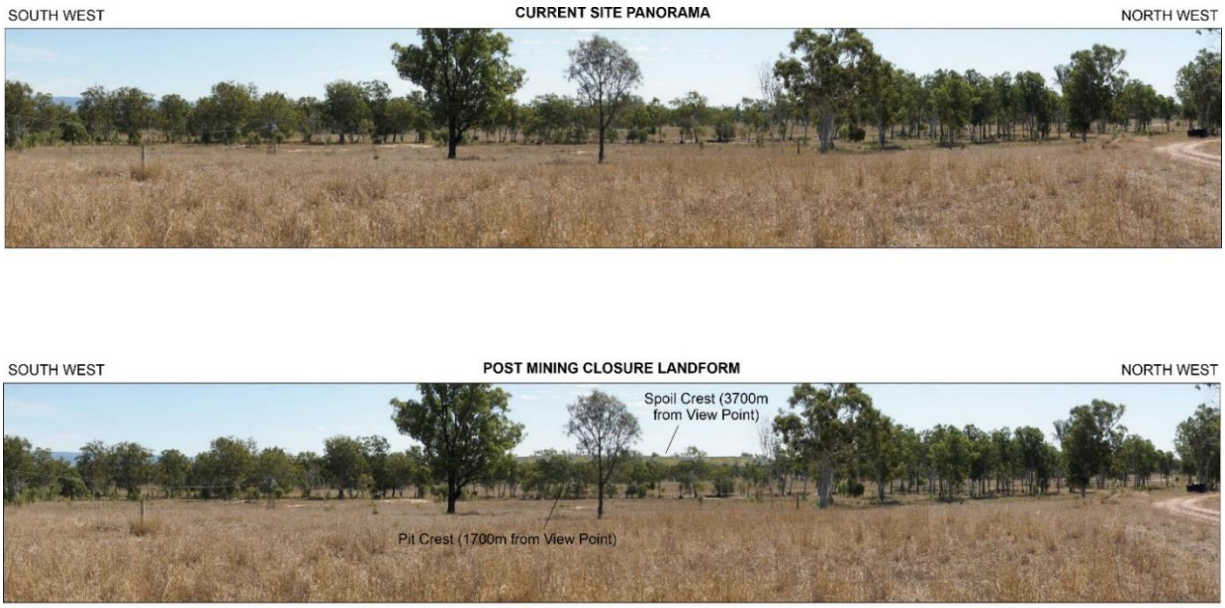

Figure 6 Vantage Point VA2 Visual Simulation

Description:

Vantage point VA2 sits approximately 1.3 km from the boundary of the MLA facing west towards Pit C at the end of Sanders Road along the eastern boundary of the Namoi Hills property. Landscape character can be described as rural/grazing in partially open non-remnant woodlands with patches of regrowth vegetation amidst cleared grass paddocks (AARC 2019). Various objects of rural infrastructure are situated in the visual landscape, including two poly rainwater tanks and an old windmill. The existing non-remnant vegetation present is likely to provide effective screening to the proposed development. A local residence is situated approximately 60 m east behind this vantage point, however this property is owned by the proponent and will be vacated prior to the commencement of operations. In this instance, the visual sensitivity is considered low due to dwelling vacancy, landscape context and expected visual exposure at this vantage point.

Informed by the visual simulation, the visual modification is expected to be low. The vegetation and slight rise in elevation from 120mAHD to 130mAHD supports a visual obstruction of the crest of Pit C. Whilst further screening of vegetation in the distance provides fortunate conditions to absorb the proposed visual changes. Only a small portion of the upper spoil crest would be central to the visual landscape at 3.7 km in the distance facing directly west. The spoil crest reaches a maximum height of 190 mAHD and comprises only a minor area of the retained visual landscape.

The overall visual impact at vantage point VA2, informed by visual sensitivity and visual modification, is considered to be low.

Visual Sensitivity: Low **Visual Modification:** Low

Visual Impact: Low

Photographic Vantage Point: VA3

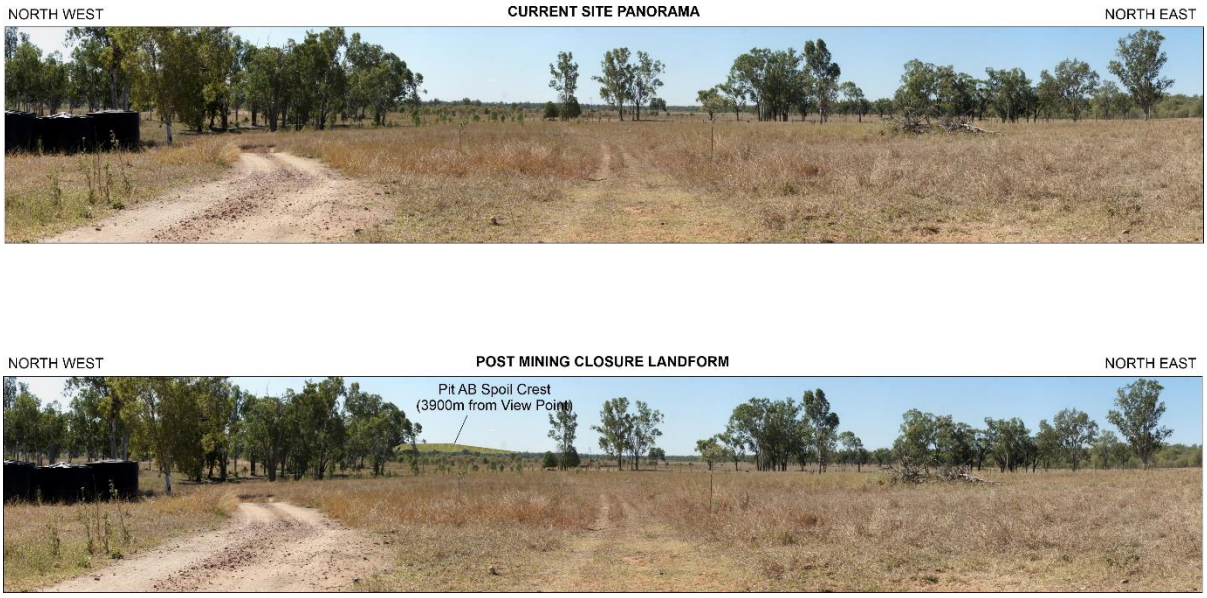

Figure 7 Vantage Point VA3 Visual Simulation

Description:

Vantage point VA3 sits approximately 1.2 km from the boundary of the MLA facing north towards Pit AB at the end of Sanders Road along the eastern boundary of the Namoi Hills property. Landscape character can be described as rural/grazing with a sparse shrub layer amongst cleared grass paddocks. Towards the west, a screening of non-remnant open woodlands is present (AARC 2019). Rural infrastructure (i.e. fencing, tracks and water tanks) are present throughout the paddocks for grazing cattle and agricultural practices. Two large poly rainwater tanks are present in the north west part of the visual landscape featuring as a prominent visual attribute.

A local residence is situated approximately 150 m south behind this vantage point, however this property is owned by the proponent and will be vacated prior to the commencement of operations. The visual sensitivity at this vantage point is considered to be low due to dwelling vacancy, landscape context and expected visual exposure.

Informed by the visual simulation, the visual modification is expected to be low. The flat topograhy of 120mAHD and lack of visual screening means that a minor portion of the proposed spoil crest of Pit AB is visible at 3.9 km in the distance. However, this visual modification does not comprise a significant majority of the visual landscape and is obscured to some degree by the vegetation screening in the west.

The overall visual impact at vantage point VA3, informed by visual sensitivity and visual modification, is considered to be low.

Visual Sensitivity: Low **Visual Modification:** Low

Visual Impact: Low

Photographic Vantage Point: VA4

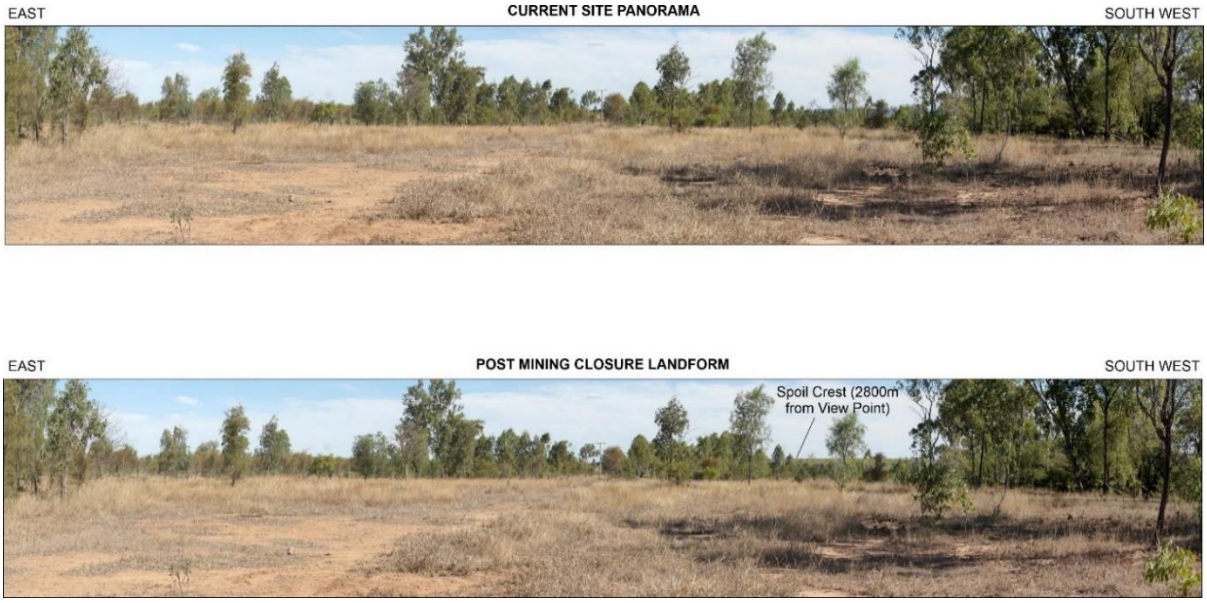

Figure 8 Vantage Point VA4 Visual Simulation

Description:

Vantage point VA4 sits within the boundaries of the MLA on the southern side of the Capricorn Highway facing south towards Pit AB. The location is at the northern most point of the Namoi Hills property. The landscape character can be described as rural/grazing with Blue Gum (*Eucalyptus tereticornis*), Bauhinia spp. and *Casuarina cunninghamiana* fringing woodlands either side of Charlevue Creek flowing south west (AARC 2019). Rural infrastructure (i.e. fencing and powerlines) can be seen beyond a cleared grass paddock lining the edge of this riparian vegetation. The Capricorn Highway runs directly parallel behind this vantage point. On this basis, the visual sensitivity has been considered moderate due to proximity to a main public road, visual exposure, duration and landscape context.

Informed by the visual simulation, the visual modification is expected to be low. The vegetation screening and continuous elevation provide favourable conditions to obscure majority of the visual modification. Only a very small portion of the spoil crest of Pit AB is visible at 2.8 km in the distance and majority of the existing visual landscape has been retained.

The overall visual impact at vantage point VA4, informed by visual sensitivity and visual modification, is considered to be low.

Visual Sensitivity: Moderate **Visual Modification:** Low

Visual Impact: Low

Photographic Vantage Point: VA5

Figure 9 Vantage Point VA5 Visual Simulation

Description:

Vantage point VA5 is approximately 2.4 km from the MLA boundaries facing north towards Pit C on the western side of Cooinda Road at the entrance to the residence on the Glenwood property. The landscape character can be described as rural/grazing with a dense screening of *Eucalyptus populnea* woodlands on alluvial plains of Springton Creek beyond a cleared grass paddock (Queensland Government 2020). A local residence is situated approximately 400 m west of this vantage point on the Glenwood property, however this property is currently under purchase by the proponent and will be vacated prior to the commencement of operations. In this instance, the visual sensitivity has been considered low due to dwelling vacancy, visual exposure, duration and landscape context.

Informed by the visual simulation, the visual modification is expected to be very low. The substantial screening of vegetation present between the vantage point and the proposed mining operations supports a favourable visual obstruction. No portion of the spoil crest is visible at 3.7 km in the distance and the entire existing visual landscape has been retained.

The overall visual impact at vantage point VA5, informed by visual sensitivity and visual modification, is considered to be very low.

Visual Sensitivity: Low **Visual Modification:** Very Low

Visual Impact: Very Low

4.1.2 Conveyor Visual Impacts

A surface overhead conveyor is proposed for construction across the Capricorn Highway and Blackwater Railway. The conveyor would be used to transport stockpiles of coal from the CHPP to the TLO facility. The conceptual design provisions and subsequent visual impact of the proposed conveyor would be similar to that of the existing conveyor across the Capricorn Highway at Boonal, approximately 28 km west. The proposed overhead conveyor for the Project will cross the Capricorn Highway at a minimum height elevation of 7m and 10m in length (refer to *Revised EA Application: Supporting Document*, *Figure 13 - Conceptual Design - Conveyor Crossing (Capricorn Highway*).

Visual simulations of the overhead conveyor was not considered necessary from the selected vantage points as the conveyor is not expected to be visible from nearby local residences, or sensitive receptors. The closest residential dwelling is located 800 m east of the TLO facility and 2.9 km east of the overhead conveyor on the Ellesmere property. However, this property is owned by the proponent and will be vacated prior to the commencement of operations. A nearby accommodation facility is also located 2.9 km to the west and would be occupied during operations. The retention of existing vegetation, outside the disturbance footprint, would provide natural screening to obscure any visual modification the conveyor might potentially impose in either direction.

As a result, the visual impact from the overhead conveyor would be limited to a short-term exposure of road users passing through the landscape periodically. Due to the close proximity of the visual modification across the transport line, the visual sensitivity of a main road is therefore considered to be moderate. The conveyor would comprise a fair portion of the viewer's visual landscape as they pass through, with the visual exposure including industrial framing, an enclosed belt crossing and light pollution during night hours. In this instance, the expected visual modification is considered moderate and consequently, the overall visual impact of the overhead conveyor would therefore be moderate.

4.1.3 Summary of Significance

The immediate surrounding sensitive receptors identified for the Project have been provided in context to the selected vantage points (Figure 4). In terms of the significance of visual impacts for these sensitive receptors, the following key points were identified:

- Magnetic South have purchased properties at most vantage points;
- The dwelling vacancy and lack of visual exposure at the remaining vantage points means the visual sensitivity is significantly reduced and the subsequent visual impact minimised in the immediate surrounds of the Project.
- Low impacts for visual amenity were predominantly identified across all assessed vantage points, except for vantage point VA1 observing a moderate impact. The residence at vantage point VA1 is owned by the proponent and will be vacated prior to commencement of mining activities.
- The anticipated short-term visual exposure of the overhead conveyor over the Capricorn Highway is likely to result in a temporary moderate visual impact for road users.

To minimise and reduce the anticipated impacts on visual amenity in the surrounding landscape, a series of management actions are summarised below.

5.0 MITIGATION AND MANAGEMENT MEASURES

A series of management actions and measures can be employed to reduce unfavourable conditions at the selected vantage points, or sensitive receptors to minimise potential impacts on visual amenity. These measures, include:

- The use of neutral tones for infrastructure cladding to reduce any stark colour contrast between the visual modification and surrounding visual landscape and environment.
- Placement of infrastructure where practical at greater distances from sensitive places (residences and transport corridors).
- Placement, configuration and direction of lighting to reduce light emissions during the operational phase of the Project, in accordance with AS 4282:1997 '*Control of the obtrusive effects of outdoor lighting*' (Standards Australia, 1997).
- Establishment of important visual buffer zones (i.e. vegetation screening) between points of high visual impact and vulnerable sensitive receptors.
- As soon as land becomes available, out-of-pit overburden dumps be rehabilitated to reduce contrast between altered landforms and the unaffected surrounding landscape.
- Overburden dumps designed to have a final landform that does not contrast significantly with the existing topography.
- Decommissioning of infrastructure in accordance with a *Rehabilitation Management Plan* to ensure the post-mine visual amenity resembles the previous landscape character as much as possible.

These mitigation and management strategies would support the retention of visual amenity during both construction, operations and decommissioning of the proposed Project.

6.0 CONCLUSION

The visual impacts arising from the Project are predominantly considered low. In terms of mining infrastructure which will be visually exposed, the changes to the visual landscape are limited to the spoil crest of Pit AB and the overhead conveyor across the Capricorn Highway connecting the TLO facility. The remaining infrastructure associated with the Project will be obscured and not likely to cause any disruption to the visual landscape.

Views of the Project's elevated landforms are not expected to be significant at vantage points VA2, VA3, VA4 and VA5 due to the presences of vegetation screening and long separation distances. Therefore, the visual impacts at these vantage points are considered low during rehabilitation and post-mine phases.

A large portion of the waste rock emplacement for Pit AB, including the mining equipment used in its construction will be visible from vantage point VA1, which has an overall moderate visual impact. However, the vantage point assessed is owned by the proponent and the dwelling will be vacant during operations. On this basis, a low-level of visual sensitivity exists and visual impacts are significantly reduced.

Still, residual short-term and intermittent visual impacts will be unavoidable for road users exposed to the overhead conveyor across the Capricorn Highway when using the main transport route. This visual modification is anticipated have moderate visual impacts to nearby road users; however, all mining infrastructure areas, including the overhead conveyor will be subject to decommissioning and rehabilitation. Therefore, these identified residual impacts of the conveyor will be limited to the operational phases of the Project.

In summary, the visual elements of the Project are not anticipated to have a significant impact for those residing in nearby properties and thereby impacts are predominantly limited to intermittent exposure when using nearby roads.

7.0 REFERENCES

AARC Environmental Solutions Pty Ltd (ARRC) 2019, *Terrestrial Ecology Assessment,* prepared for Magnetic South Pty Ltd.

EDAW 2006, Appendix H – Newcastle coal infrastructure group coal export terminal: visual assessment, prepared for Newcastle Coal Infrastructure Group, EDAW, Brisbane.

Queensland Government, 2020, *Queensland Globe Mapping*, Queensland Government, Brisbane.

Standards Australia 1997, *Control of the obtrusive effects of outdoor lighting (AS 4282 – 1997),* Standards Australia (Standards Association of Australia)

Appendix P Erosion and Sediment Control Plan

GEMINI PROJECT
EROSION AND SEDIMENT CONTROL PLAN

PREPARED FOR
MAGNETIC SOUTH

November 2020

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GEMINI PROJECT
EROSION AND SEDIMENT
CONTROL PLAN

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LIST OF ABBREVIATIONS

AARC	AARC Environmental Solutions
CHPP	Coal Handling and Preparation Plant
DES	Department of Environment and Science
EA	Environmental Authority
ESCP	Erosion and Sediment Control Plan
EPA	Environment Protection Act 1994
EPC	Exploration Permit for Coal
LOM	Life of Mine
mAHD	metres Australian Height Datum
MAW	Mine Affected Water
MIA	Mine Infrastructure Area
MLA	Mining Lease Application
Mtpa	Million tonnes per annum
PCI	Pulverised Coal Injection
ROM	Run of Mine
SAW	Sediment Affected Water
SMU	Soil Management Unit
The Project	Gemini Project
TLO	Train Loadout

1.0 INTRODUCTION

AARC Environmental Solutions (AARC) was commissioned by Magnetic South Pty Ltd (Magnetic South; the Proponent) to prepare an Erosion and Sediment Control Plan (ESCP) for the Gemini Project (the Project). This report provides the information to supplement the EA Application to the Department of Environment and Science (DES) in consideration of the information request submitted by the DES.

1.1 PURPOSE

The purpose of this document is to outline strategies to prevent and/or minimise erosion and the release of sediment into receiving waters and the contamination of stormwater runoff.

1.2 SCOPE

The Project consists of a single Mining Lease Application (MLA) which is within an exploration permit for coal (EPC) 881 in the Bowen Basin in Queensland. The ESCP specifies erosion and sediment control measures appropriate for the construction and operational stages and the closure and rehabilitation of the mine life. The process for developing the ESCP has included:

- The identification of areas of potential erosion risk arising from stormwater runoff for all Project stages;
- An assessment of the erosion risks related to the Project; and
- Nomination of appropriate erosion and sediment control measures applicable to the identified areas of erosion risk and having the objective of reducing the potential for the Project to impact the receiving environment.

2.0 GUIDELINES

The below regulatory framework and relevant guidelines are applicable to the Project site:

- *Environmental Protection Act (EPA) 1994*;
- *Water Act 2000*;
- Water Resource (Fitzroy Basin) Plan 2011;
- Environmental Protection (Water and Wetland Biodiversity) Policy 2019; and
- Environmental Protection (Water) Policy Mackenzie River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Mackenzie River Sub-basin

3.0 PROJECT DESCRIPTION

The Gemini Project is a greenfield, open-cut metallurgical coal mine producing pulverised coal injection (PCI) coal and coking coal for export to the international steel making industry.

The Project is located within the Bowen Basin, a well-established coal mining area with existing transport infrastructure. The Project will bring benefits to the local community, region, Queensland and the Commonwealth through direct employment opportunities, royalties and taxes. The Project will also utilise the services of regional suppliers of rail, power, water, communications, contractors, service providers and local businesses, which will have a positive economic impact beyond direct employment. The Project term is anticipated to be 25 years from grant of the mining lease (ML); with this term including initial construction, mine operation and rehabilitation activities.

Mine construction activities are scheduled to commence in July 2021; subject to granting of the Project ML and EA. It is anticipated that it will take approximately six months to establish the necessary infrastructure to commence overburden removal and 18 months to commence coal production.

The main activities associated with the Project include:

- Exploration activities continuing, in order to support mine planning.
- Development of a mine infrastructure area (MIA) including mine offices; bathhouse; crib rooms; warehouse/stores; workshop; fuel storage; refuelling facilities; wash bay; laydown area; sewage, effluent and liquid waste storage and a helipad.
- Construction and operation of a coal handling and preparation plant (CHPP) and coal handling facilities adjacent to the MIA; including run-of-mine (ROM) coal and product coal stockpiles and rejects bin/overflow (coarse and fine rejects).
- Construction and operation of a surface conveyor from the product stockpiles to a train load out (TLO) facility and rail loop connecting to the Blackwater Railway to transport product coal to coal terminals at Gladstone for export.
- Construction of an accommodation facility within the bounds of the MLA.
- Construction of access roads from the Capricorn Highway to the MIA and the TLO facility.
- Installation of a raw water supply pipeline to connect to the Blackwater Pipeline network.
- Construction of a 66 kV transmission line and switching/substation to connect to the existing regional network.
- Other associated minor infrastructure, plant, equipment and activities.
- Development of mine areas (open-cut pits) and out-of-pit waste rock emplacements.
- Drilling and blasting of competent waste material.
- Mine operations using conventional surface mining equipment (excavators, front end loaders, rear dump trucks, dozers).
- Mining up to 1.9 Mtpa ROM coal (average of 1.8 Mtpa) for a construction/production period of approximately 20 years.

- Progressive placement of waste rock in:
    - Emplacements, adjacent to and near the open-cut voids; and
    - Mine voids, behind the advancing open-cut mining operations.
- Progressive rehabilitation of waste rock emplacement areas and mined voids.
- Progressive establishment of soil stockpiles, laydown area and borrow pits (for road base and civil works; material will be sourced from local quarries where required).
- Disposal of CHPP rejects (coarse and fine rejects) in out-of-pit spoil dumps, and in-pit behind the mining void.
- Progressive development of internal roads and haul roads including a causeway over Charlevue Creek to enable coal haulage and pit access.
- Development of water storage dams and sediment dams, the installation of pumps, pipelines and other water management equipment and structures including temporary levees, diversions and drains.

Existing local and regional infrastructure, facilities and services would be used to support Project activities. These include the SunWater water distribution network, the Aurizon rail network, Ergon's electricity network, the Capricorn Highway and Gladstone export coal terminals.

3.1 LOCATION AND SETTING

The Project is situated within the Bowen Basin, approximately 110 km east of Emerald and 125 km southwest of Rockhampton, in central Queensland (Figure 1). Blackwater, a larger town serving mines in the region, is located approximately 34 km to the west (Figure 1). The small rural townships of Bluff and Dingo are located approximately 15 km west and 3 km east of the Project, respectively (Figure 1).

The Project is located within the Central Highlands Regional Council (CHRC) local government area (LGA), which covers approximately 60,000 km^2 and supports a population of more than 30,000 residents living in Arcadia Valley, Bauhinia, Blackwater, Bluff, Capella, Comet, Dingo, Duaringa, Emerald, Rolleston, Sapphire Gemfields, Springsure and Tieri.

Nearby mining operations include Bluff PCI Project (approximately 12 km to the west), Yarrabee Coal Mine (approximately 34 km to the northwest), Jellinbah Mine (approximately 32 km to the northwest), Curragh Coal Mine (approximately 33 km to the northwest), and the Blackwater Mine (approximately 36 km to the southwest) (Figure 2).

Taunton National Park is situated to the north of the Project's mining lease application (MLA) area, whilst Walton State Forest is approximately 6 km to the west and Blackdown Tablelands National Park is located approximately 9 km to the southwest of the MLA (Figure 2).

The Capricorn Highway, which is a state-controlled road, links Rockhampton with western Queensland (Figure 1). Capricorn Highway traverses the MLA and links the townships of Bluff and Dingo (Figure 2). The Aurizon Blackwater Rail System (Blackwater Railway) tracks along the northern side of the Capricorn Highway (Figure 1 and Figure 2). A stock route (ID: 413CENT) tracks alongside the Capricorn Highway and is currently open but classified as minor and unused. Publicly gazetted roads including Sanders, Namoi, Charlevue, Cooinda, Red Hill, Normanby and Ellesmere roads provide local access (Figure 2).

The topography of the MLA varies from flat to gently undulating, with elevations ranging between approximately 120-150 metres in Australian Height Datum (mAHD). The MLA and surrounds are currently used for low intensity cattle grazing and resource exploration activities. It is Magnetic South's intention that the land continue to be used for agricultural purposes until such time that it is required for Project construction and/or operation. Land not required for mining activities will continue to be utilised for agricultural purposes throughout the life of the Project. Reducing mining related disturbances and potential for erosion.

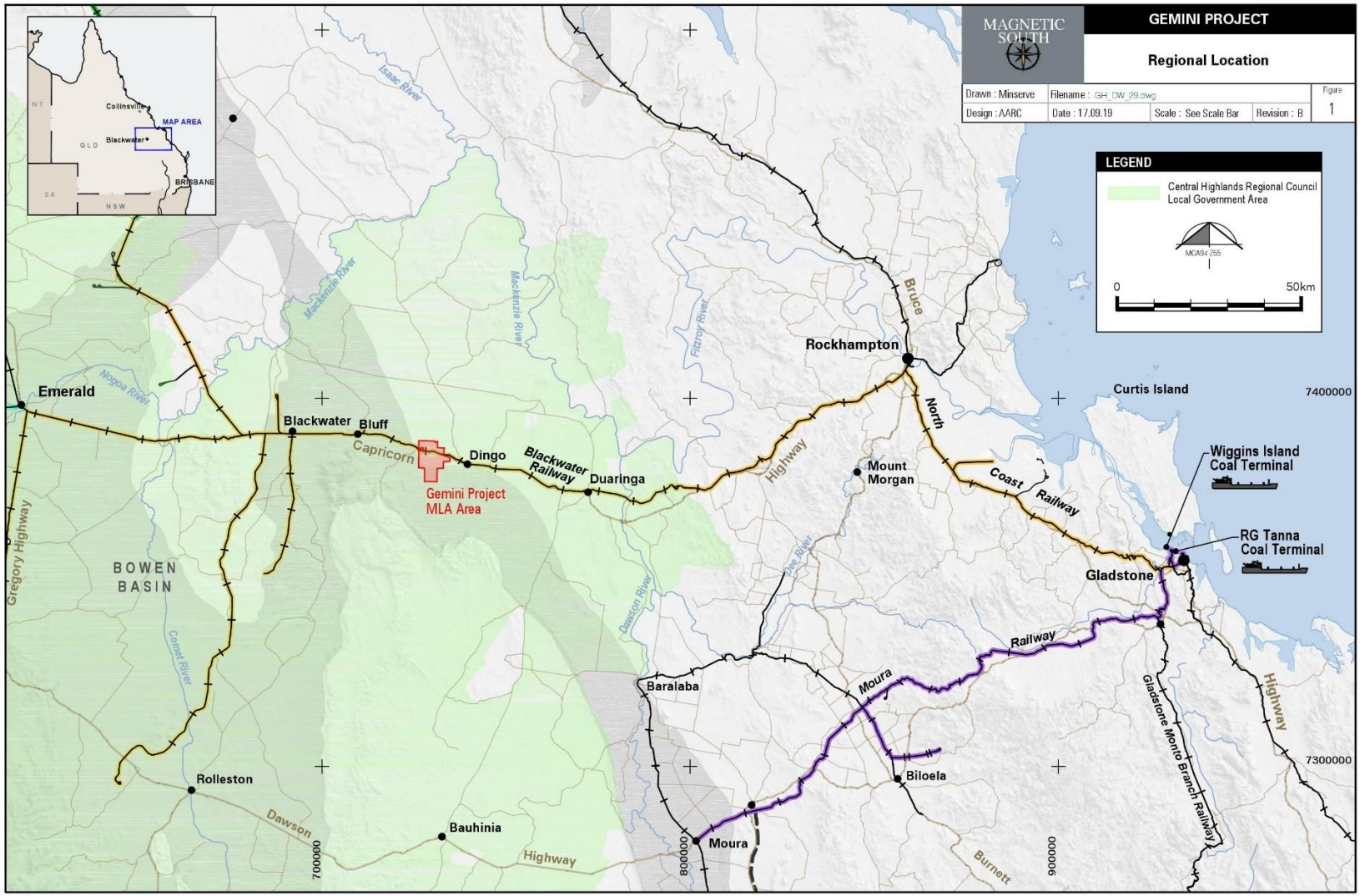

Figure 1 Regional location

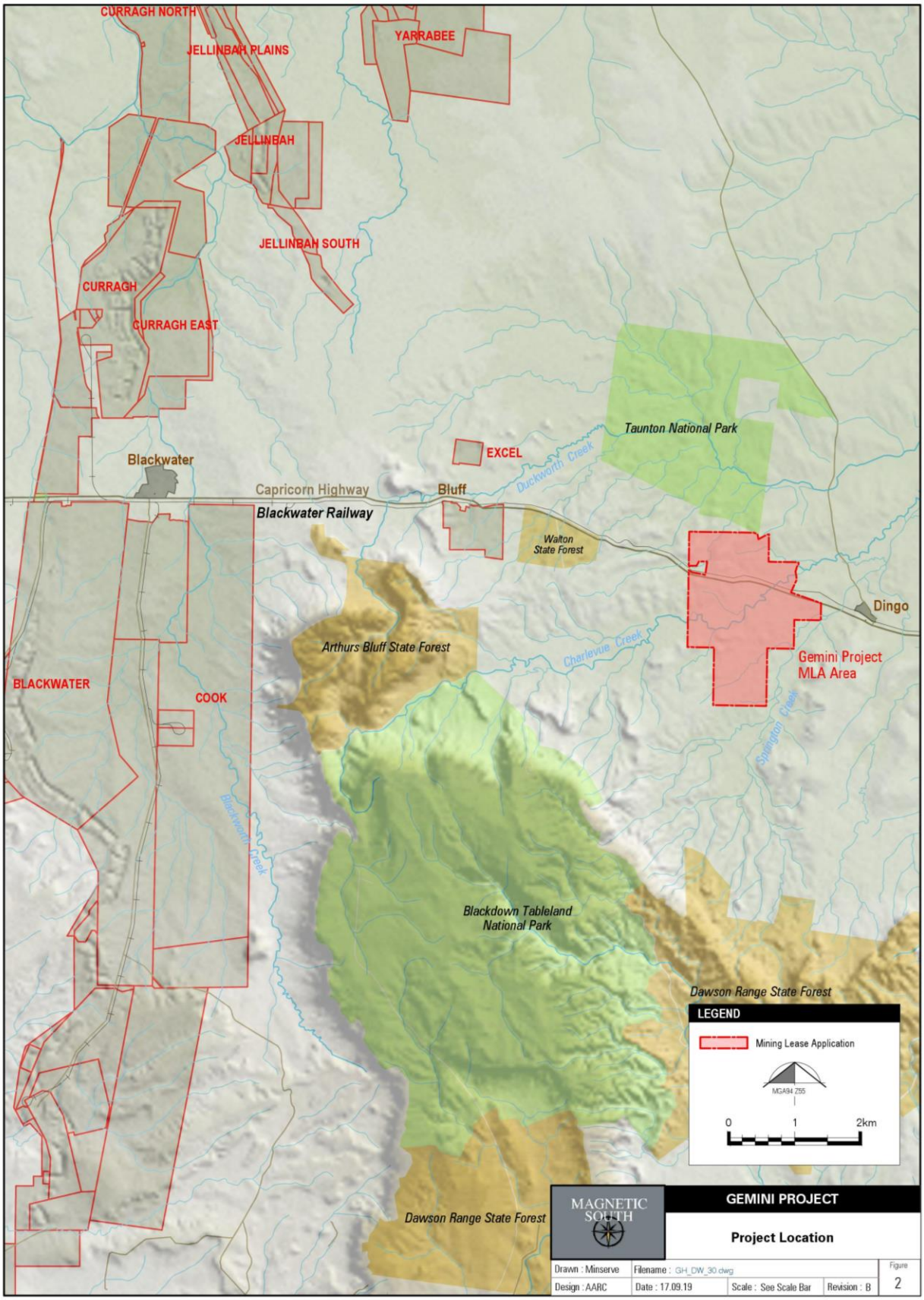

Figure 2 Project Location

3.2 LANDSCAPE

The Project lies within the Fitzroy River Basin, which encompasses an area of 142,545 square kilometres (km^2) and contains the Comet, Connors, Dawson, Don, Nogoa and Mackenzie Rivers, which make up its six sub-catchment areas (BoM 2018; DES 2018).

The Project lies within the Mackenzie River sub-catchment, which covers a total area of 12,985 km^2, and is situated in the centre of the Fitzroy River catchment. The major water body associated with the Project site is Charlevue Creek, which dissects the EPC in a north-easterly direction. This creek begins within the boundaries of Blackdown Tablelands National Park, flowing north-east before joining with Springton Creek and the Fitzroy River and eventually reaching the Pacific Ocean approximately 46 km north
of Gladstone. Two significantly smaller creeks, Stanley and Springton, cross the Project boundaries in the north-west and south-east respectively. These two creeks eventually converge with the Mackenzie River. Associated tributaries, dams and drainage features also appear across the site. Figure 2 displays the extent of the watercourses associated with the study area.

Topography of the land varies from flat to undulating hills, with elevation within the study area ranging between 120 - 150 m above sea level. The landscape is influenced by the presence of Charlevue Creek and its associated flood plains, which have relatively lower elevations than the surrounding landscape of undulating hills. The topography of the Project is representative of the surrounding region.

The majority of the Project is comprised of agricultural land used primarily for low intensity cattle grazing with the Capricorn Highway and five gazetted roads (Charlevue, Cooinda, Red Hill, Normanby and Ellesmere) crossing the Project.

3.2.1 Proposed Site Infrastructure

Proposed infrastructure and other development activities for the Project during the construction phase will include:

- Mine access road from the Capricorn Highway to the MIA, associated Capricorn Highway intersection, site access security infrastructure and car parking at the MIA;
- MIA;
- Explosives magazine;
- CHPP and associated coal handling infrastructure;
- TLO facility and access road;
- Haul road to Pit AB including a low-level causeway across Charlevue Creek; and Construction of the haul road to Pit C is anticipated to commence in Year 11 of the Project.
- Accommodation facility.

3.2.1.1 MIA and Explosives Storage

A MIA will be constructed in the northwest of the MLA (Figure 3). The MIA will include the mine offices, bathhouse, crib rooms, warehouses and storage areas, workshops, potable water storage, fuel storage and refuelling facilities, sewage, effluent and liquid waste storage, tyre bay, laydown area, Go-line, wash bay, and other associated amenities. Surface water will be controlled to ensure water is captured into the mines Surface Water Management System.

An explosives compound will be established to the west of the MIA (Figure 3). Explosives magazines will be fenced, signed and maintained in accordance with AS2187.2-2006: Explosives – Storage and use (Part 2: Use of explosives).

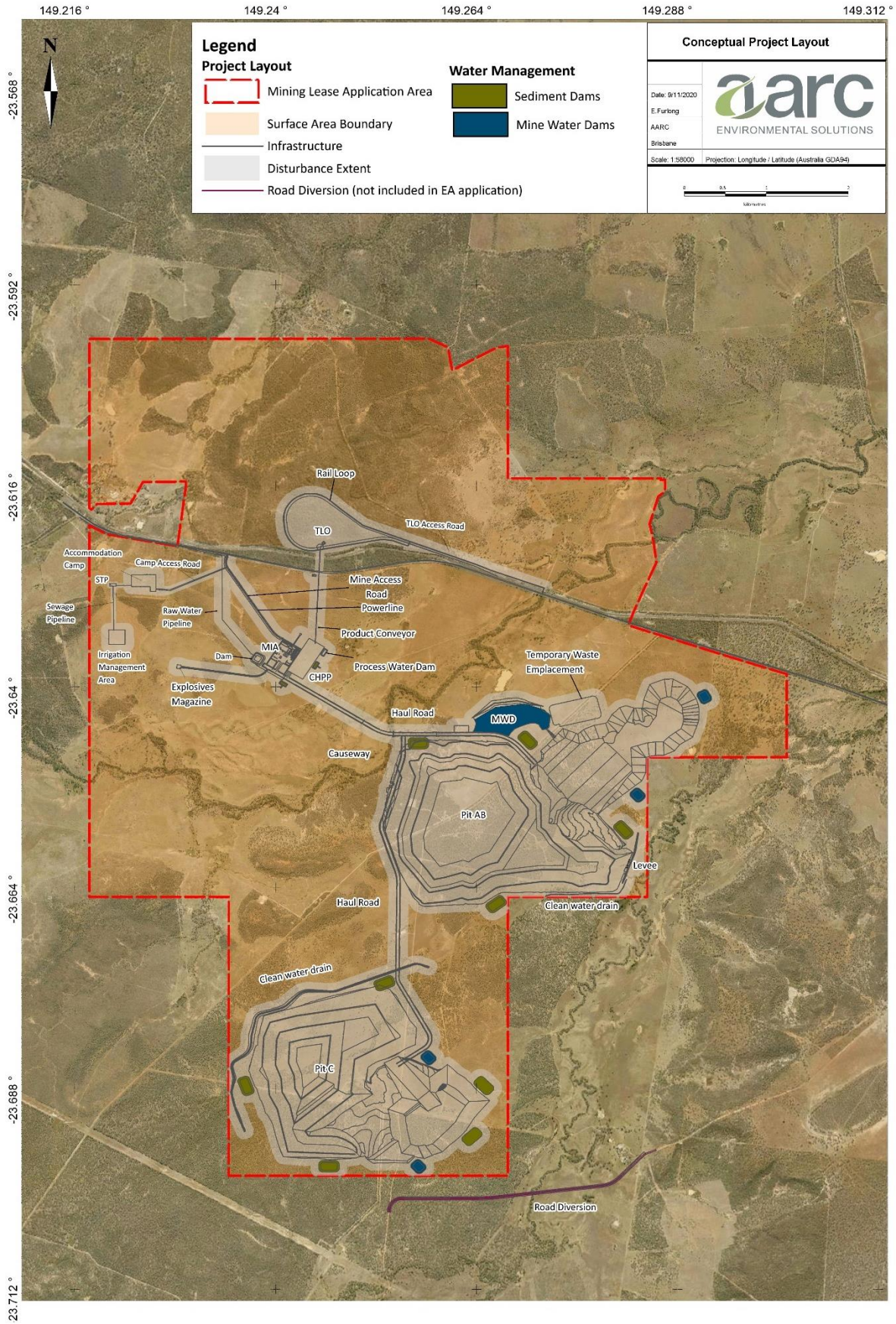

Figure 3 Project Gemini conceptual layout

3.2.1.2 CHPP, Stockpiles and Overland Conveyor

A CHPP and associated coal handling facilities will be constructed adjacent to the MIA (Figure 3) and will include:

- CHPP;
- ROM coal stockpile;
- Product stockpile;
- Rejects bin and overflow (coarse and fine rejects); and
- Coal handling facilities including an overland conveyor to transport product coal to the TLO.

It is anticipated that construction of the CHPP and associated coal handling facilities will take approximately 18 months. The CHPP will operate 24 hours per day, 7 days a week.

Product coal will be direct fed to the train loading bin by conveyor from the product coal stockpile adjacent to the CHPP.

Potential for surface water contamination from the CHPP stockpiles and associated infrastructure will require management of surface water movement across the site via bunding and drainage lines around the site. Drainage lines will direct excess water flow to sediment dams before repurposing water for dust suppression or reuse in the CHPP directly.

3.2.1.3 Train Load Out Facility and Access Road

A TLO facility comprising a rail spur, rail loop and train loading bin will be constructed adjacent to the Blackwater Railway (Figure 3). The rail spur and loop will be approximately 6 km in length and will connect to the Blackwater Railway west of the existing Charlevue Creek rail bridge.

Access to the TLO facility will be provided by an existing access track from the Capricorn Highway that runs beneath the rail bridge proximal to Charlevue Creek, however, it is suitable for light vehicles only.

The TLO facility and its access road represent a potential for product to contaminate surface water, containment of surface water flow in and around the TLO facility such as bunding and drainage lines to sediment dams will be required.

3.2.1.4 Haul Roads

The alignment of the haul roads from the MIA to Pit AB and Pit C is shown in Figure 3. Construction of the haul road to Pit C is anticipated to commence in Year 11 of the Project.

The haul road to Pit AB will include a causeway to cross Charlevue Creek. The causeway will be designed for a 1 in 2-year rainfall event, with the capacity to carry a 540 t class excavator on a float. Current modelling by WRM has the haul road inundated during 50% AEP by Charlevue Creek, controls will need to be developed to minimise the impact this causes to the creek bed and the receiving environment. Control measures for access and haul roads will include ongoing maintenance measures as well as bunding and gutters with traffic control measures to ensure that staff on site are able to contribute to the control of erosion and sediment.

3.3 LOCAL CLIMATE

The Project area has a climate classification of ‘subtropical’ (moderately dry winter) using the Bureau of Meteorology’s (BoM) modified Köppen climate classification system. The local region experiences a subtropical climate characterised by high variability seasonal rainfall subject to cyclic wet summer and dry winter seasons, with variable temperature and evaporation. Predominantly wind blows from the southeast and east in the region.

Local meteorological conditions have been compiled using data from the Scientific Information for Land Owners (SILO) Data Drill. The Data Drill accesses grids of climate data available from surrounding BoM point observations and then creates interpolated climate values for the requested location. The SILO climate data was obtained for coordinates that correspond to the approximate centre of the Project MLA. The data has been utilised to produce a climatograph for the Project (Figure 4).

The mean annual rainfall for the Project region is approximately 655 mm with average annual (pan) evaporation of 2,024 mm which exceeds rainfall for every month of the year (Table 1). Rainfall is highly seasonal, with November to March generally accepted as the ‘wet season’ and rainfall during this time accounting for approximately 68% of the region’s total yearly rainfall. The ‘dry season’ usually occurs from April through to October with monthly rainfall totals below 45 mm consistently throughout this period. The rainfall data for this region is consistent with the Köppen classification of ‘subtropical’ (moderately dry winter).

The hottest months typically occur between October and March while the coolest months occur between May and September. The highest mean maximum temperature typically occurs in January (33.8°C) and the lowest mean minimum temperature in July (7.7°C).

The presence of pronounced wet and dry seasons at the Project requires the presence of stormwater infrastructure that can contain or divert these high rainfall events. Levees are planned to divert water away from mine infrastructure and pits in the event of natural waterways overtopping during such events.

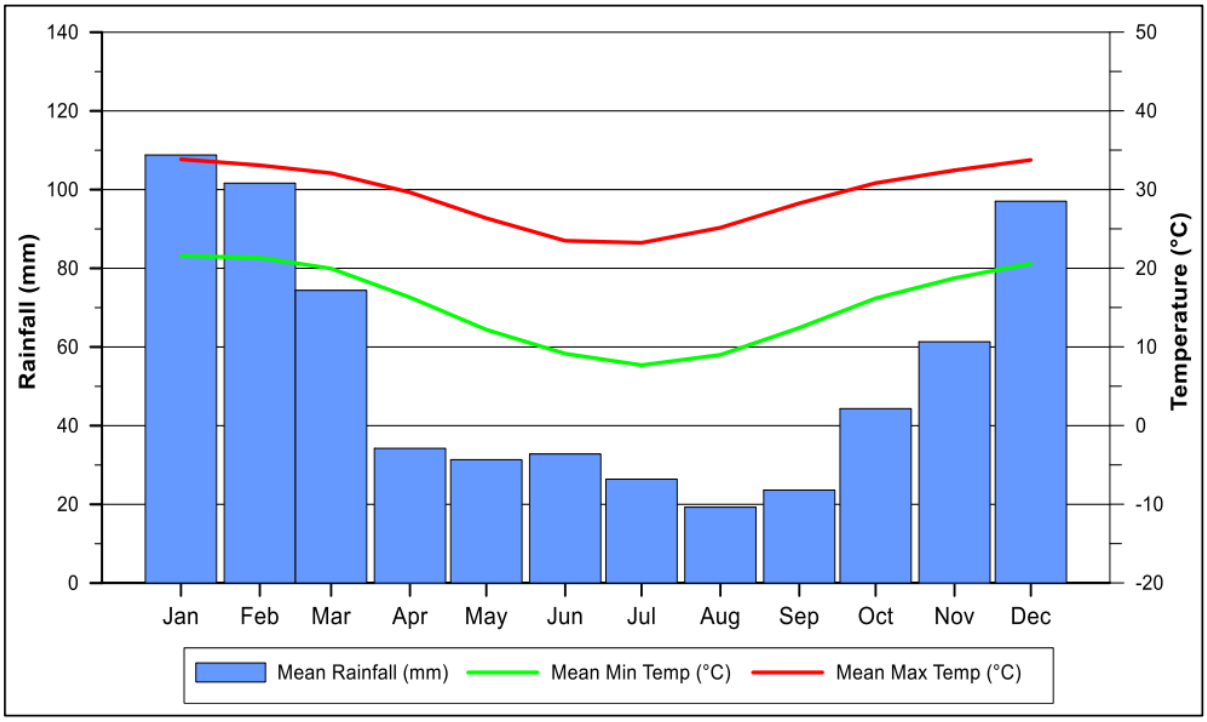

Figure 4 Climatograph

Table 1 Average monthly rainfall and evaporation

Month	Average Rainfall (mm)	Average Evaporation (mm)
January	108.8	229.6
February	101.6	186.4
March	74.4	185.1
April	34.2	150.8
May	31.3	117.7
June	32.8	93.5
July	26.4	101.2
August	19.3	129.9
September	23.6	164.2
October	44.3	207.6
November	61.3	220.2
December	97	237.8
Total	**655.2**	**2,024.1**

3.4 SOIL AND LAND SUITABILITY ASSESSMENT

The Project site is characterised by fluvial plains surrounding significant waterways. It is mostly composed of stable flood plains traversed by a branching pattern of drainage floors. The majority of deposits are weathered alluvium, with slopes of coarser or finer textured alluvium (depending on flow patterns). Channels can be up to 30 m wide and 3 m deep, with fringing riparian vegetation. Main drainage floors can then extend 800 m outwards, with deep texture contrast sandy loams over mottled clays and open spaces of *Eucalyptus tereticornis* (Blue gum) and *Eucalyptus crebra* (Narrow-leaved ironbark) with sparse shrubs. Large plains surround drainage features (up to 3 km wide) which can

contain either deep texture contrast soils with *Eucalyptus populnea* (Poplar box) woodlands, or deep layered soils on alluvium with woodlands of Blue gum and Narrow-leaved ironbark. Slopes within this land unit are usually the result of strongly gilgaied shrink-swell clays, forming depressions of finer soil textures with *Acacia harpophylla* (Brigalow) scrub.

Soil management units (SMUs) are described in Table 2, the majority of the site (66%) has a soil profile that consists of texture contrast soils with soft conditions. Where soils have been exposed due to extensive clearing and insufficient groundcover extensive washouts and large erosion gullies were observed. In the process of mine development and operation, the clearing of vegetation, topsoil stripping and stockpiling, construction of infrastructure and exposure of slopes all increase the erodibility of soils present. When considering the development of erosion control structures the dispersive tendencies of these soils require consideration. Figure 5 shows the SMUs locations throughout the Project.

Table 2 Soil Management Units & Erodibility

SMU	Description	Surface Area (ha)	Percentage of Study Area (%)	Erodibility
Anderson	Red Kurosol	37.78	0.61	Unlikely
Barry	Brown Dermosol	156.5	2.54	Unlikely
Charlevue	Red or Brown Dermosol	232.9	3.79	Likely
Cooinda	Brown Dermosol	34.94	0.57	Likely if disturbed
Ellesmere	Red Dermosol	14.59	0.24	Likely if disturbed
Geoffrey	Brown Sodosol	4061	66.0	Likely if disturbed
James	Red Dermosol	145.2	2.36	Unlikely
Kosh	Brown Dermosol	924.0	15.0	Highly likely
Namoi	Red Dermosol	177.6	2.89	Likely if disturbed
Nigel	Brown Kandosol	284.6	4.63	Unlikely
Normanby	Red Kandosol	48.5	0.79	Unlikely
Wallace	Black Vertosol	32.04	0.52	Likely if disturbed

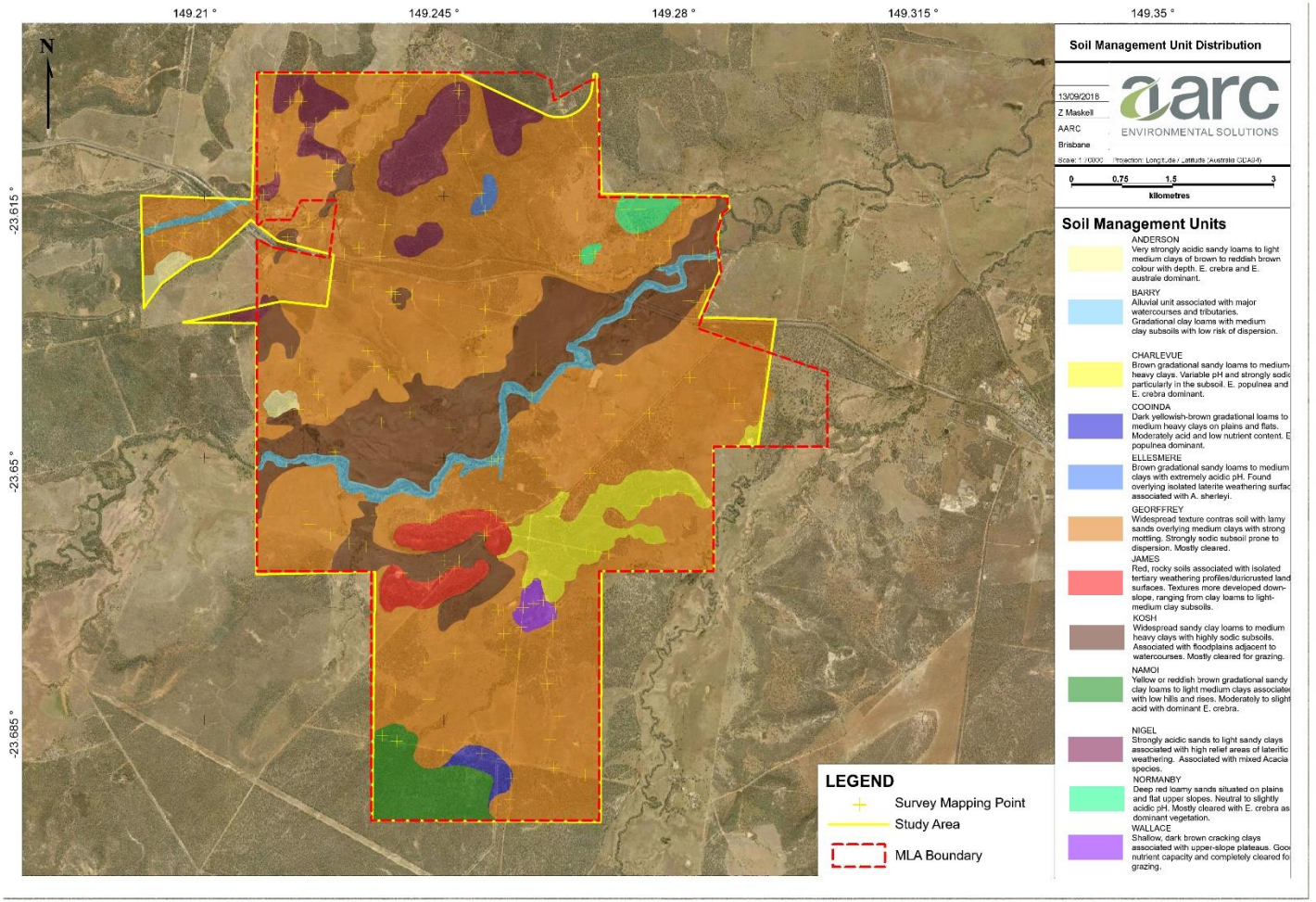

Figure 5 SMU Map of Project Site

3.5 REGIONAL GEOLOGY

The geology of the Dingo area is dominated by its position within the Bowen Basin. The Bowen Basin is one of Queensland's largest depositional zones, forming through a period of rifting and subsidence lasting from the Early Permian to Mid-Triassic. The area surrounding the Project is dominated by clastic sedimentary rocks of marine and lacustrine origin, including sandstones, conglomerates, mudstones, siltstones and coal (AARC 2019).

The surface geology within the Project area was identified below and are represented in Figure 6 :

- Qa-QLD (Qa) – Quaternary clay, silt, sand and gravel; flood-plain alluvium;
- Td-QLD (Td) – Tertiary duricrusted palaeosols at the top of deep weathering profiles, including ferricrete and silcrete; duricrusted old land surfaces;
- Duaringa Formation (Tu) – Eocene-Oligocene mudstone, sandstone, conglomerate, siltstone, oil shale, lignite and basalt; and
- Gyranda Subgroup (Pwy) – Late Permian sedimentary unit comprised of siltstone and shale with minor tuff and volcanilithic sandstone and rare coal (lower part - Banana Formation); calcareous sandstone, mudstone and siltstone (upper part - Wiseman Formation).

During the Projects construction and operation, the disturbance of the regional geology will increase the potential for sediment generation in the disturbed areas and the WRD and reject stockpiles. Increasing the erosion and sediment controls will be required to ensure capture of sediment laden surface water in the sediment dams on site. Further controls are discussed in section 5.1.3.

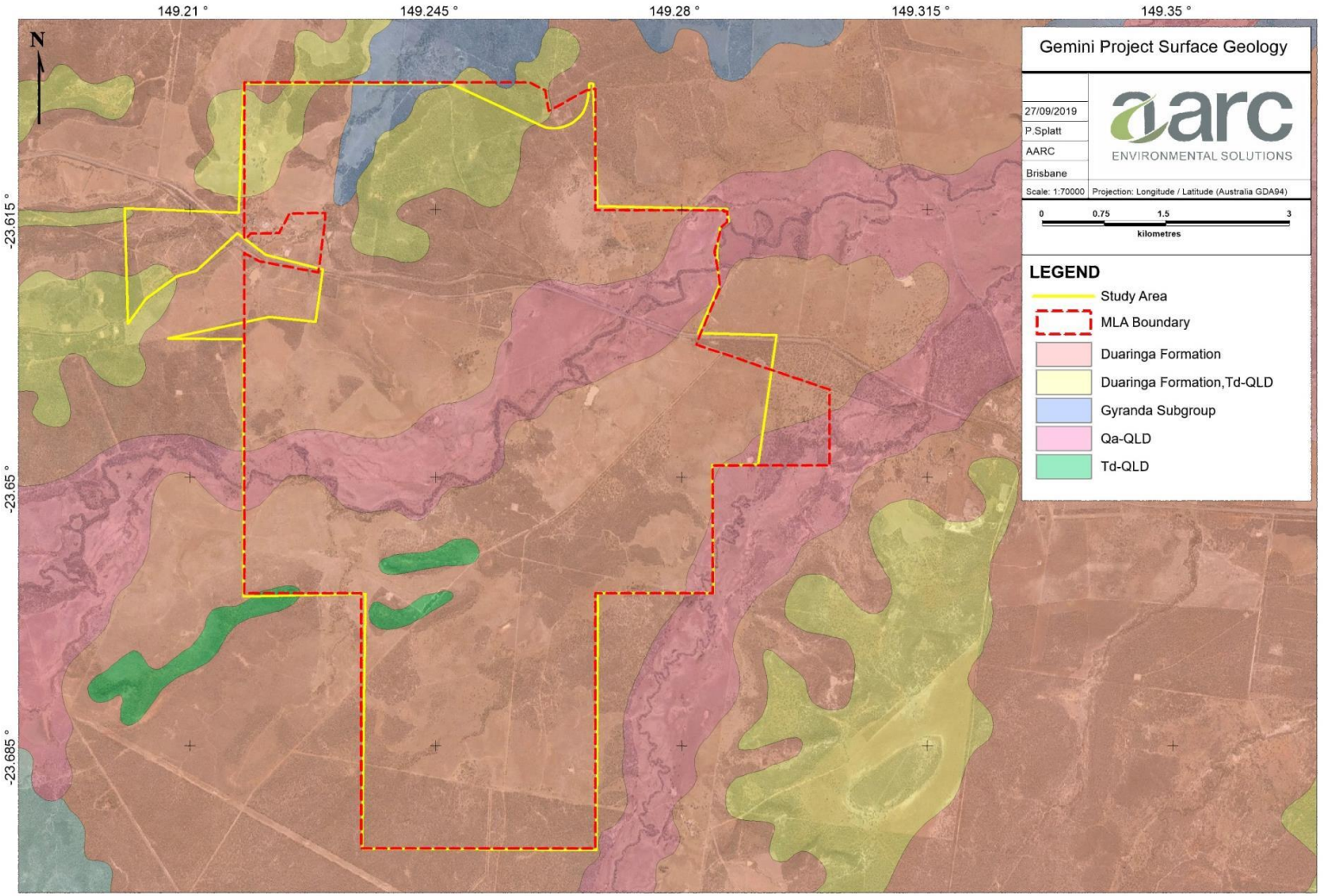

Figure 6 Surface Geology

4.0 PROJECT WATER MANAGEMENT

4.1 WATER QUALITY

From samples taken during 2019, water quality on site generally appears to be poor with no surface flow due to the ephemeral nature of the creeks present on site. Exceedances in WQOs included turbidity, hydrocarbons which were potentially due to the agriculture practises present and the Capricorn Highway nearby.

4.2 WATER MANAGEMENT PRINCIPLES

The 'Site Water Management System' (SWMS) for the Project is based on the following key principles:

- Divert clean catchment water around mining works to the extent practicable;
- Use/recycle lesser quality water in preference to higher quality water;
- Use potentially contaminated water in preference to imported raw water or uncontaminated water;
- Release water from site only in accordance with the conditions of the EA, such that the released water will not significantly impact on the values of the receiving waters or downstream properties; and
- Manage water storages and transfers within the site in order to:
    - Maximise onsite storage to meet reasonably anticipated periods of wet and dry weather; and
    - Minimise disruption to mining operations.

4.3 SITE WATER MANAGEMENT SYSTEM

For the purpose of site water management, site water has been classified into the types shown in Table 3 on the basis of likely water quality characteristics.

The proposed strategy for the management of surface water at the Project is based on the separation of water from different sources based on anticipated water quality.

A conceptual SWMS was developed for the Project by WRM Water and Environment Pty Ltd (WRM) as a part of the Surface Water Assessment (WRM 2020). Based on the expected runoff and groundwater inflow quality, the SWMS separates water into two segregated management systems:

1. Mine affected water (MAW) system: will manage runoff and seepage from the mine pits, CHPP, coal stockpiles, and MIA. This is a closed system designed to prevent releases of MAW to the environment.
2. Sediment water system: runoff from overburden dumps will be managed under this ESCP which is to be implemented throughout the Project, such that sediment generated and transported by runoff will be settled in a sediment dam. As overburden runoff quality is expected to be relatively benign, the sediment dams will potentially discharge directly into the environment (after the

settlement of suspended sediment), and as such, will not affect the mine water balance. The water balance assessment has assumed sediment dams will be pumped back to the CHPP for reuse.

Clean water flows from undisturbed areas are generally diverted around the areas of disturbance. A raw water supply pipeline is proposed to supply all site water requirements prior to dam construction and supplement site water supplies throughout the life of the Project. Raw water will be delivered to a dedicated raw water dam (located adjacent to the MIA), which will also intercept clean water from its local upstream catchment.

A site water balance model has been developed by WRM to determine the most appropriate design of the SWMS. The site water balance forms the basis of impact assessment and infrastructure design for the site. A schematic of the integrated SWMS configuration for the Project is shown in Figure 7.

Table 3 Site Water Types

Water Type	Definition
Mine Affected Water	In accordance with the DEHP Guideline Model Mining Conditions, mine affected water means the following types of water: i. pit water, tailings dam water, processing plant water; ii. water contaminated by a mining activity which would have been an environmentally relevant activity under Schedule 2 of the Environmental Protection Regulation 2008 if it had not formed part of the mining activity; iii. rainfall runoff which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated, excluding rainfall runoff discharging through release points associated with erosion and sediment control structures that have been installed in accordance with the standards and requirements of an Erosion and Sediment Control Plan to manage such runoff, provided that this water has not been mixed with pit water, tailings dam water, processing plant water or workshop water; iv. groundwater which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated; v. groundwater from the mine dewatering activities; vi. a mix of mine affected water (under any of paragraphs i to v) and other water.
Sediment Water	Surface water runoff from areas that are disturbed by mining activities but are not deemed operation areas. This runoff does not come into contact with coal or other carbonaceous material and may contain high sediment loads but does not contain elevated level of other water quality parameters (e.g. electrical conductivity, pH, metals, metalloids, non-metals). This runoff must be managed to ensure adequate sediment removal prior to release to receiving waters.
Clean Water	Surface runoff from areas unaffected by mining operations. Clean catchment water includes runoff from undisturbed areas and fully rehabilitated areas.
Raw Water	Untreated water, generally from an external water supply, that has not been contaminated by mining activities
Potable Water	Treated water suitable for human consumption

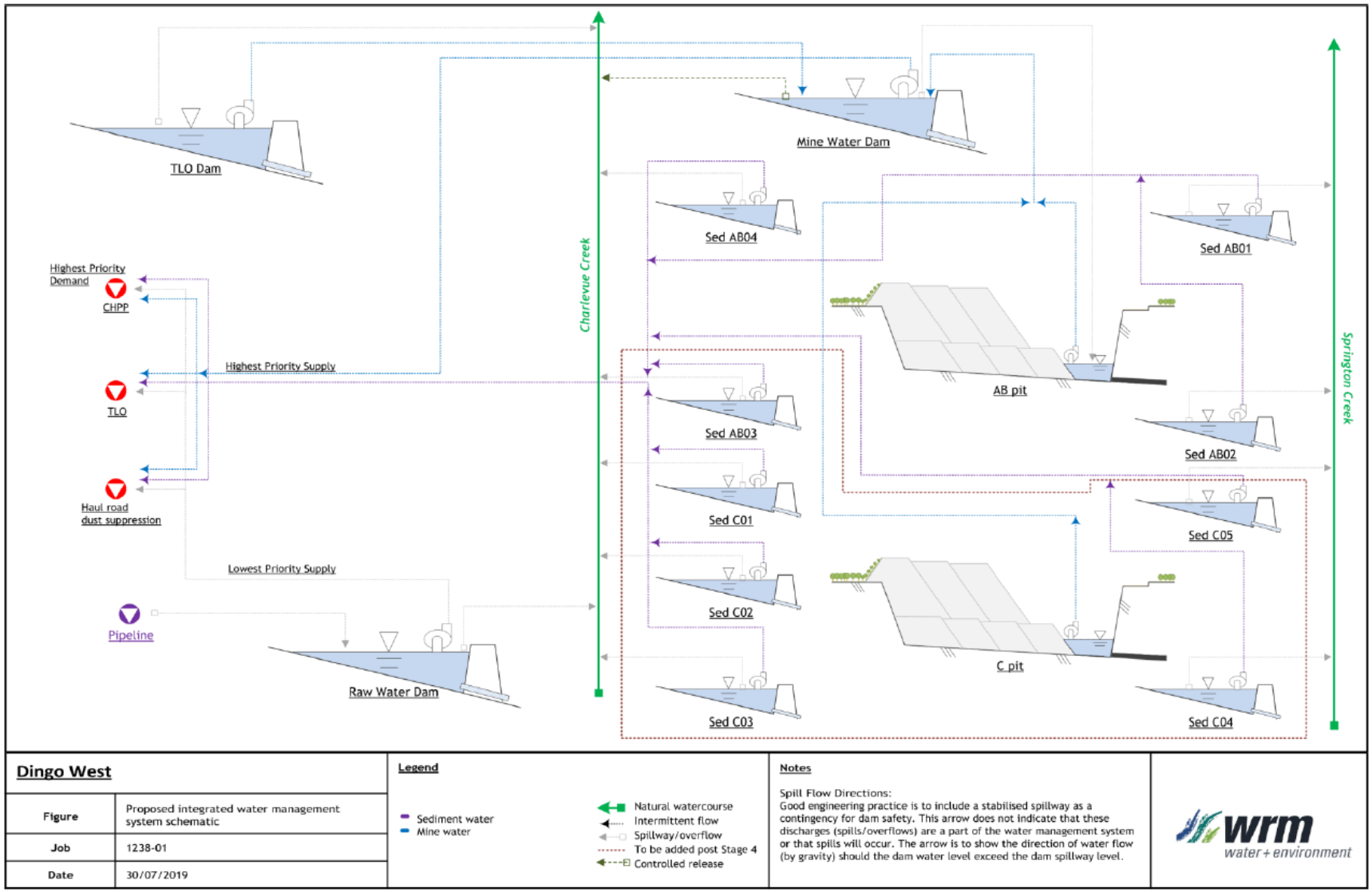

Figure 7 Proposed integrated SWMS Schematic

4.3.1 Sediment Control Infrastructure

The requirements of sediment and erosion control measures across the site which will require construction and maintenance will include:

- Bunding and drainage surrounding Haul Roads and natural areas with check dams in built to direct surface water flow to sediment dams;
- Bunding surrounding Pits, CHPP, TLO and MIA to direct water to Mine Water Dams; and
- Temporary sediment fences during construction and sediment check dams in drainage lines for long term sediment control structures.

4.3.1.1 Sediment Dams

Sediment dams have been developed in accordance with Best Practice Erosion and Sediment Control (IECA Australasia 2008) and the guideline for Stormwater and environmentally relevant activities [ESR/2015/1653] (EHP 2017)).

The sediment dams have therefore been sized as follows:

- Water storage capacity 1 in 10 AEP 24-hour storm event and adopted volumetric event runoff coefficient for disturbed catchments of 0.5;
- Total sediment basin volume = settling zone capacity + sediment storage volume. The sediment storage volume is the portion of the basin storage volume that progressively fills with sediment until the basin is de-silted; and;
- Solids storage volume = 25% of water storage volume.

If required, water captured in sediment dams will be pumped back into the MAW system. The required sediment dam volumes using the MAW system are shown in Table 4.

The sediment dams will be maintained until such time as vegetation within the catchment of the sediment dams successfully establishes and where runoff has similar water quality characteristics to areas that are undisturbed by mining activities. Sediment dams may be maintained during rehabilitation to augment site water requirements. The conceptual layouts for the SWMS throughout the Projects life are depicted in Figure 8 to Figure 12 for life of mine (LOM).

Table 4 Gemini Project sediment dam details

Storage	Catchment Area (ha)	10-year 24 hour water storage capacity (ML)	Solids Storage Volume (ML)	Total Storage Capacity (ML)
AB01	146.1	105.9	26.5	132
AB02	155.5	112.7	28.2	141
AB03	121.8	88.3	22.1	110
AB04	114.9	83.3	20.8	104
C01	132.7	96.2	24.1	120
C02	106.8	77.4	19.4	97
C03	32.4	23.5	5.9	29
C04	76.0	55.1	13.8	69
C05	64.8	47.0	11.7	59

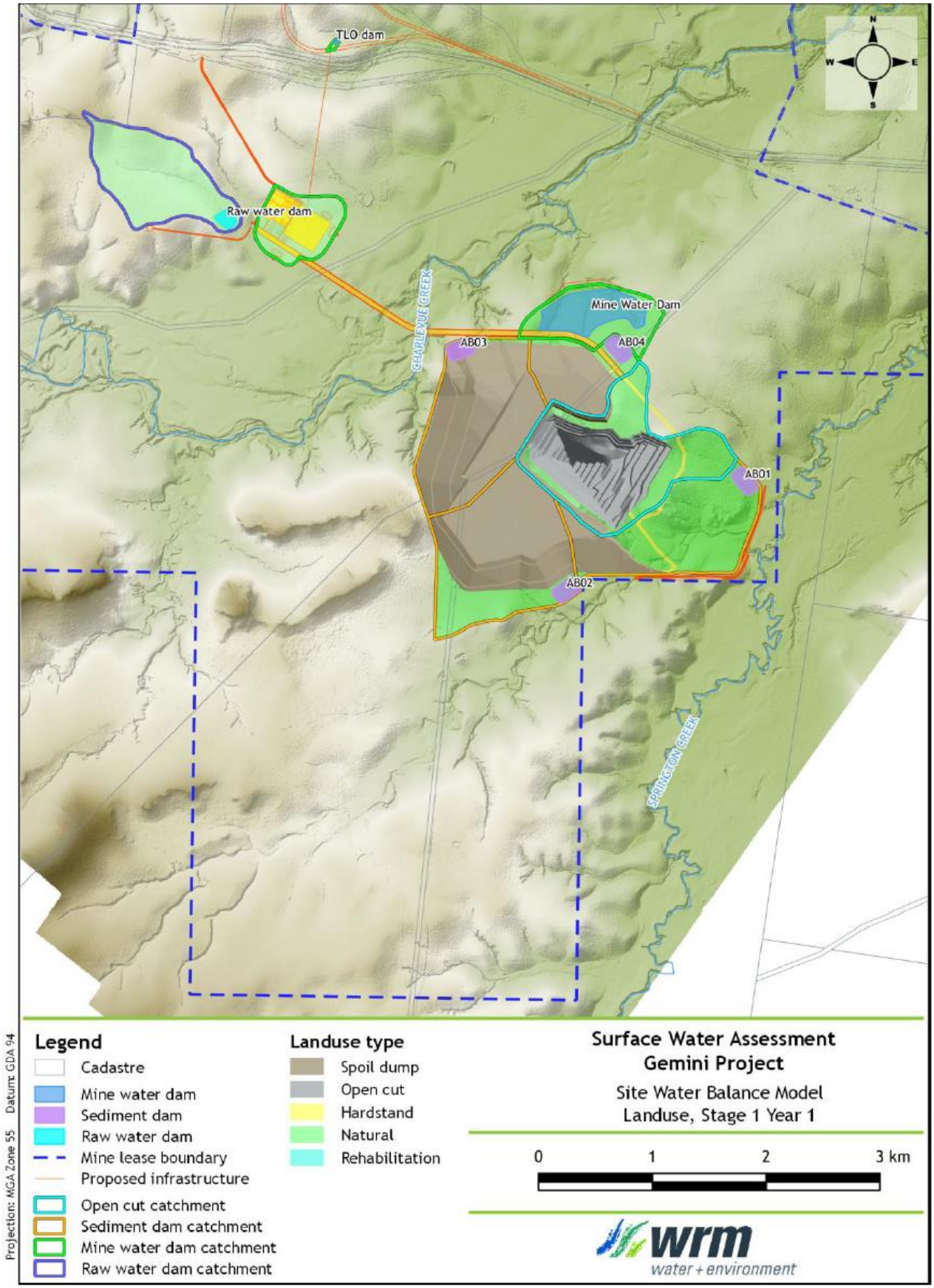

Figure 8 Proposed water management system layout Stage 1 (Year 1)

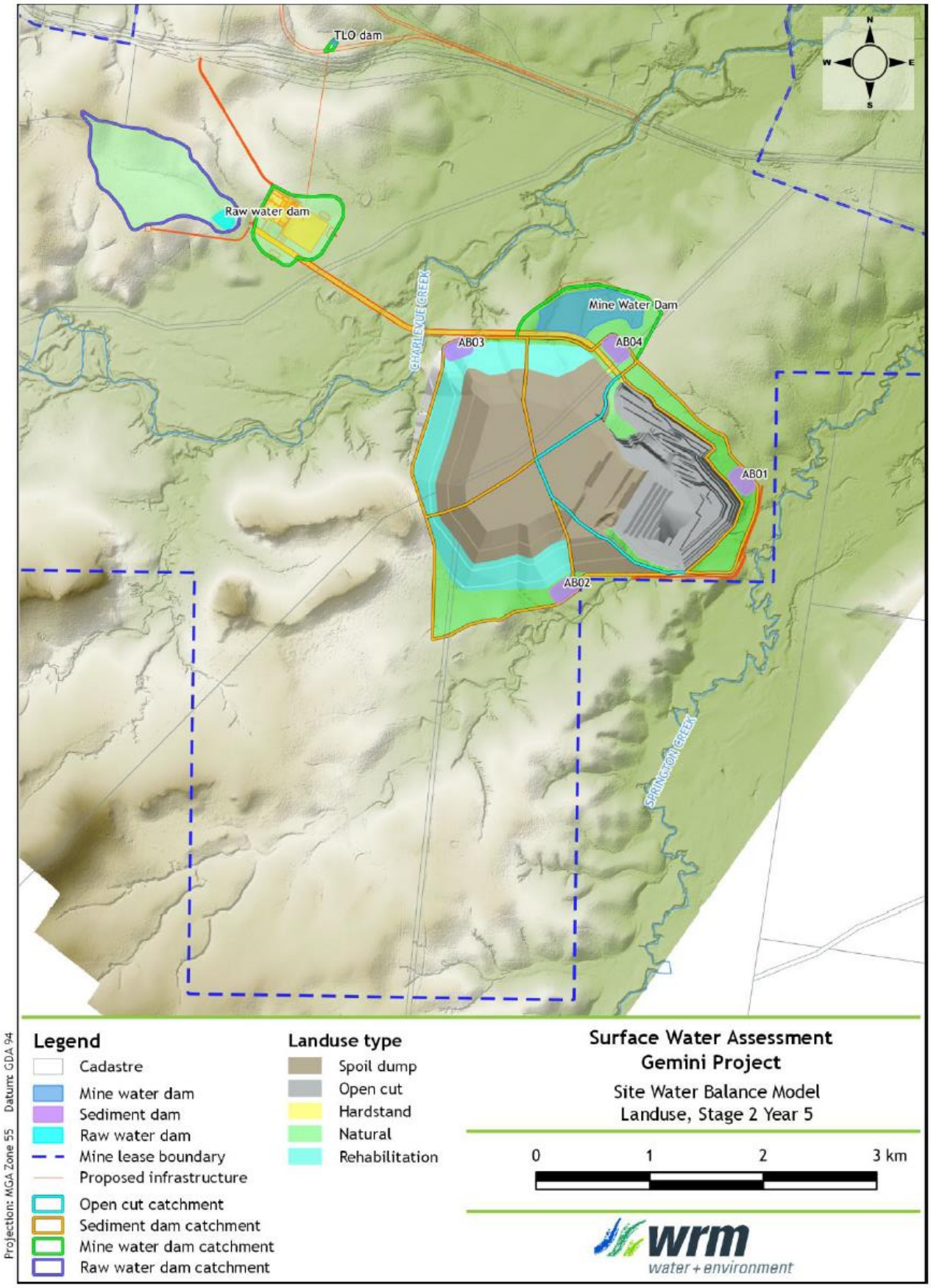

Figure 9 Proposed water management system layout Stage 2 (Year 5)

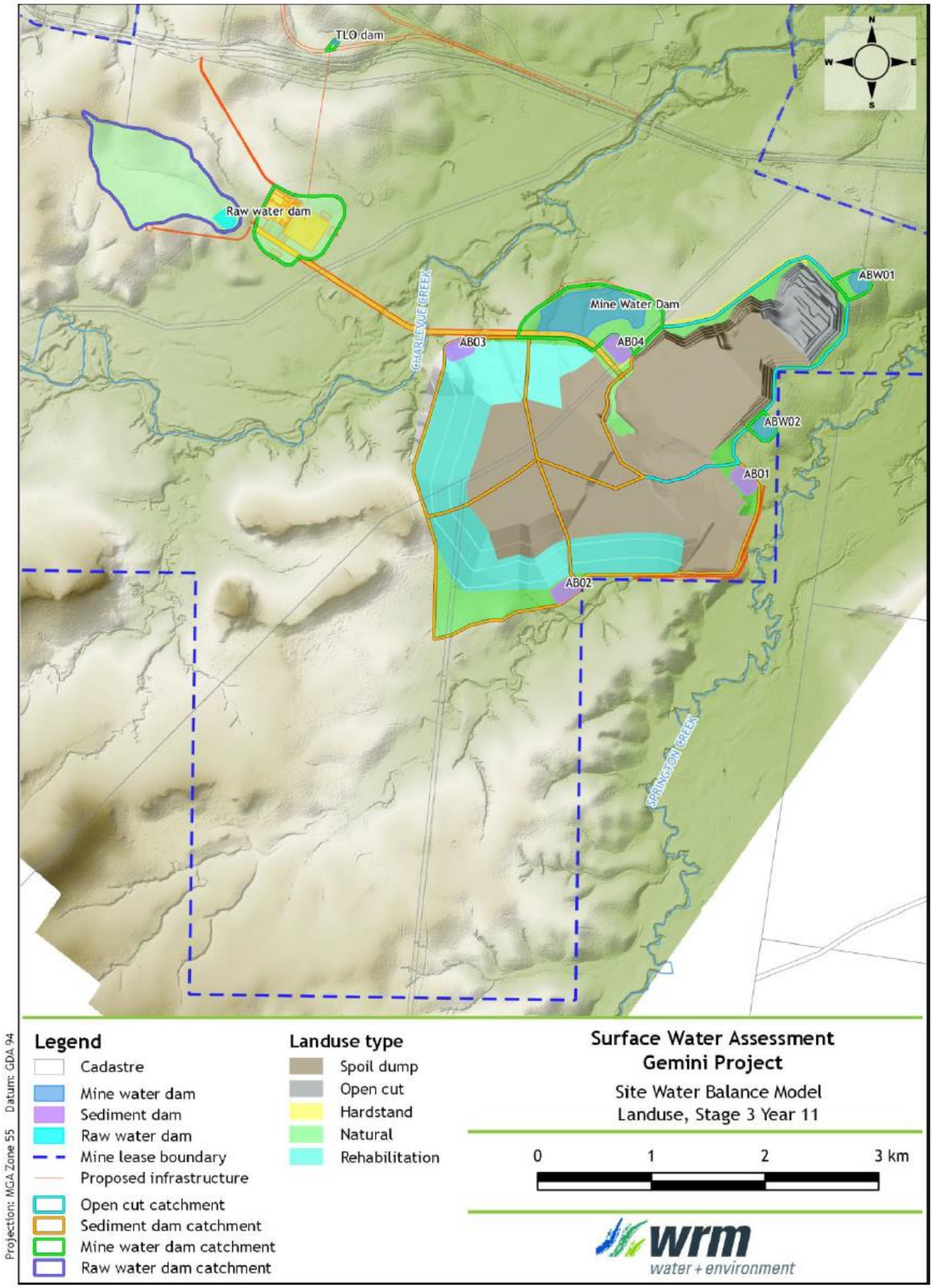

Figure 10 Proposed water management system layout Stage 3 (Year 11)

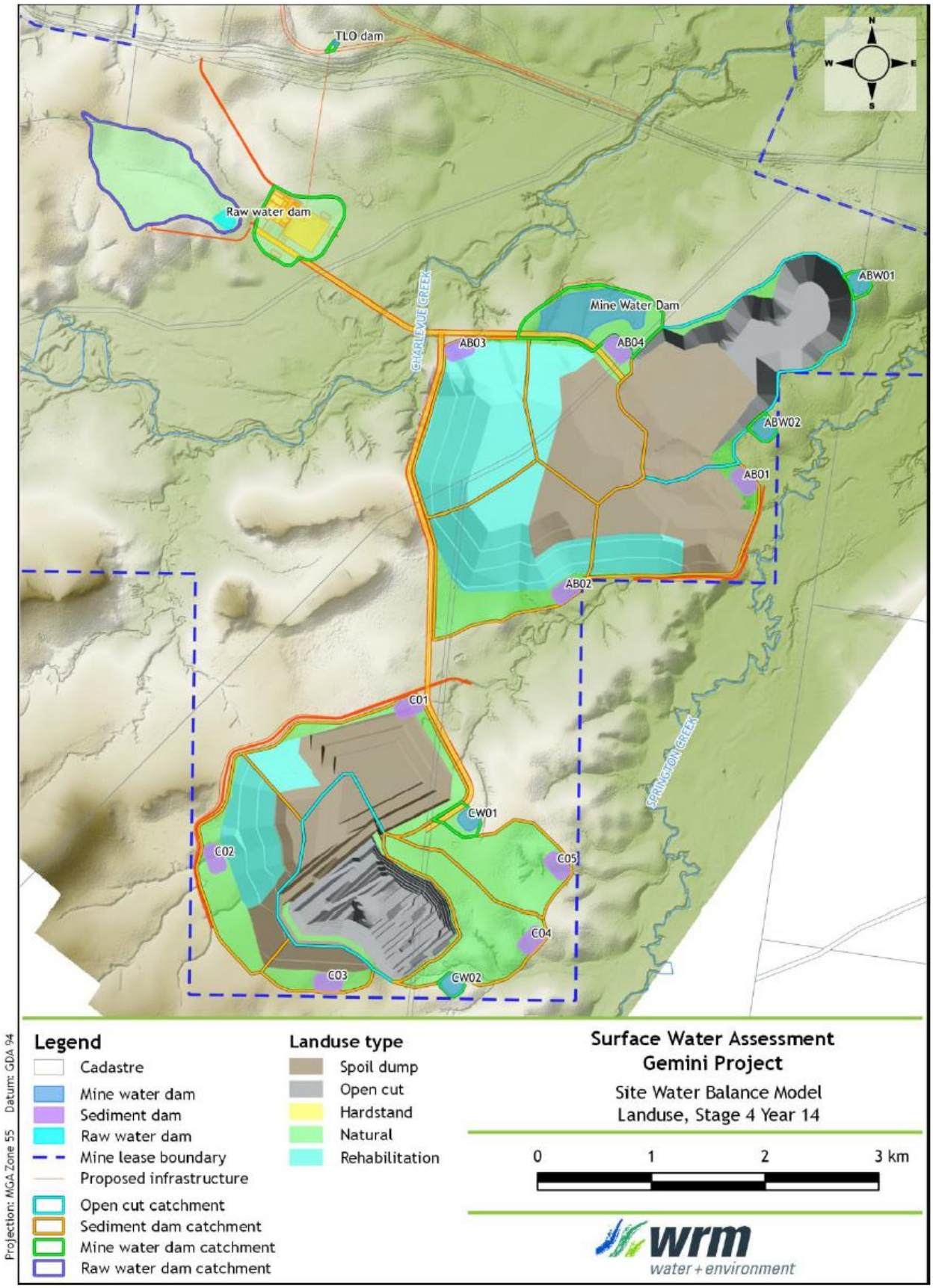

Figure 11 Proposed water management system layout Stage 4 (Year 14)

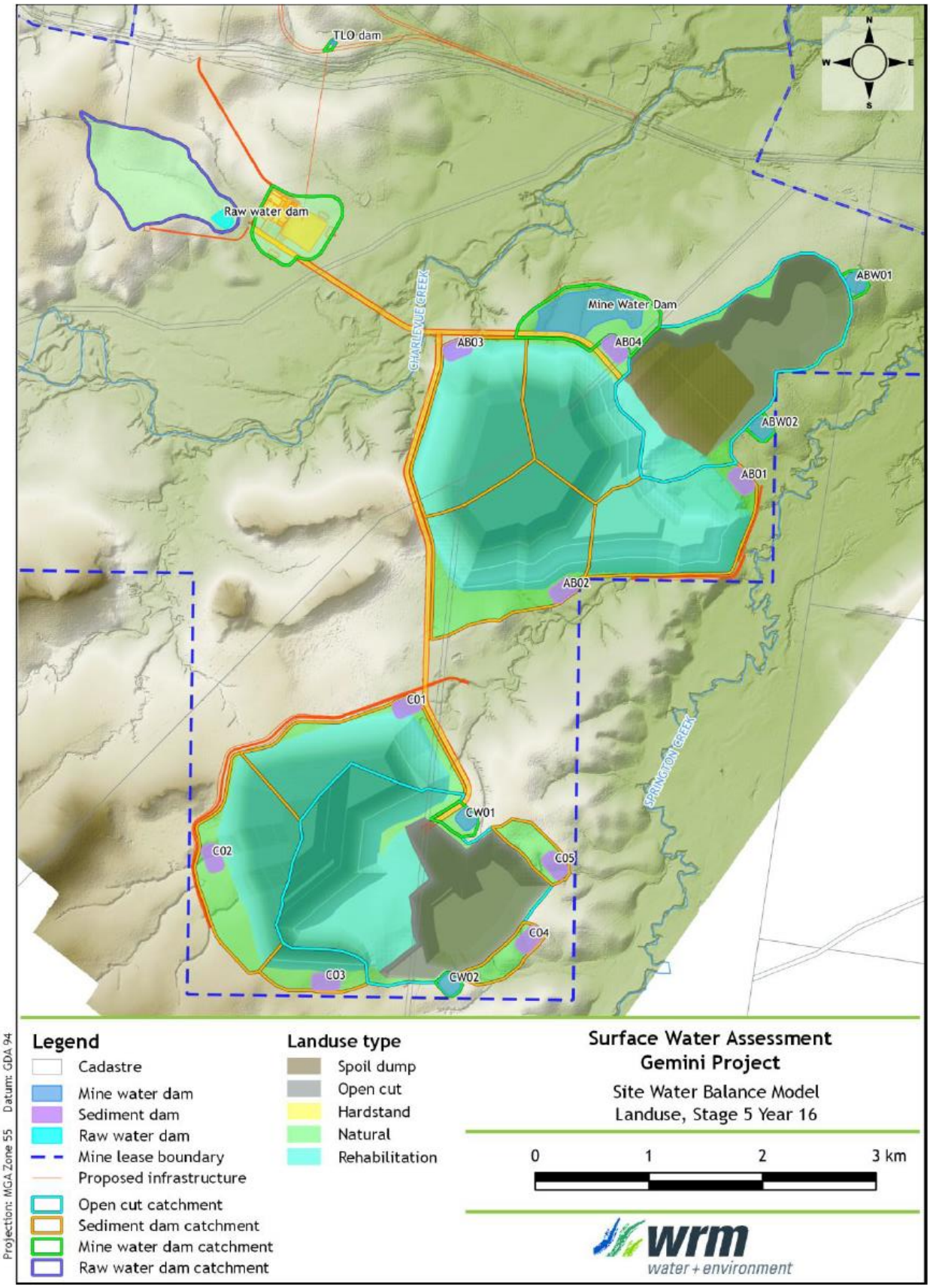

Figure 12 Proposed water management system layout Stage 5 (Year 16)

4.3.1.2 Catchment Areas and Land Use

During the life of the Project catchment areas will change as land use changes as demonstrated above, the below tables provide the proposed footprints of catchments and their land use.

Table 5 Catchment area breakdown Stage 1 – Year 1

Dam	Contributing catchment (ha)					
	Spoil dump	Open cut	Road/ Hardstand	Natural	Rehabilitation	Total
AB01	21.8	-	3.4	79.1	-	104.3
AB02	98.0	-	-	37.2	38.7	135.2
AB03	117.6	-	-	2.5	-	120.1
AB04	34.09	-	1.3	10.5	-	46.7
C01	-	-	-	-	-	-
C02	-	-	-	-	-	-
C03	-	-	-	-	-	-
C04	-	-	-	-	-	-
C05	-	-	-	-	-	-

Table 6 Catchment area breakdown Stage 2 – Year 5

Dam	Contributing catchment (ha)					
	Spoil dump	Open cut	Road/ Hardstand	Natural	Rehabilitation	Total
AB01	20.8	-	-	1.7	-	22.5
AB02	58.3	-	-	37.2	38.7	134.2
AB03	73.1	-	-	2.5	46.2	121.8
AB04	42.0	-	1.3	10.3	12.6	66.2
C01	-	-	-	-	-	-
C02	-	-	-	-	-	-
C03	-	-	-	-	-	-
C04	-	-	-	-	-	-
C05	-	-	-	-	-	-

Table 7 Catchment area breakdown Stage 3 – Year 11

Dam	Contributing catchment (ha)					
	Spoil dump	Open cut	Road/ Hardstand	Natural	Rehabilitation	Total
AB01	102.4	-	-	10.6	33.2	146.2
AB02	44.0	-	-	37.2	51.5	132.7
AB03	32.7	-	-	2.5	86.6	121.8
AB04	59.6	-	1.4	9.7	20.6	91.3
C01	-	-	-	-	-	-
C02	-	-	-	-	-	-
C03	-	-	-	-	-	-
C04	-	-	-	-	-	-
C05	-	-	-	-	-	-

Table 8 Catchment area breakdown Stage 4 – Year 14

Dam	Contributing catchment (ha)					
	Spoil dump	Open cut	Road/ Hardstand	Natural	Rehabilitation	Total
AB01	79.6	-	-	9.7	27.0	116.3
AB02	29.4	-	-	37.2	88.9	155.5
AB03	-	-	-	2.5	119.3	121.8
AB04	71.9	-	1.2	10.5	31.1	114.7
C01	91.9-	-	-	23.0	17.8	132.7
C02	26.3	-	-	37.8	48.6	112.7
C03	16.9	-	-	15.5	-	32.4
C04	-	-	-	76.0	-	76.0
C05	-	-	0.5	64.3	-	64.8

Table 9 Catchment area breakdown Stage 5 – Year 16

Dam	Contributing catchment (ha)					
	Spoil dump	Open cut	Road/ Hardstand	Natural	Rehabilitation	Total
AB01	-	-	-	9.7	106.7	116.4
AB02	-	-	-	37.2	118.3	155.4
AB03	-	-	-	2.5	119.3	121.8
AB04	-	-	1.3	10.5	103.2	115.0
C01	-	-	-	15.6	86.9	102.5
C02	-	-	-	37.8	74.9	112.7
C03	-	-	-	15.2	14.7	29.9
C04	-	-	-	15.7	-	15.7
C05	-	-	-	17.6	-	17.6

5.0 EROSION AND SEDIMENT CONTROL

5.1 SOURCES OF EROSION AND SEDIMENT

Within the Project site planned works possess the potential for altering the quality of surface water and its flow patterns through the clearing of land and construction of levees. Activities include:

- The clearing of land and construction and maintenance of haul and access roads, tracks and mine pits;
- The movement of equipment within and around the site; and
- The ROM, TLO, coal stockpiles, topsoil stockpiles and WRD.

5.1.1 Construction

During construction phases there will be significant disturbances throughout the Project site and during these works, erosion and sediment control measures need to be put in place to prevent potential erosion across the work areas. Sediment fences and bunding will be used in concert to contain the relevant work areas during construction with bunding and drainage lines to remain in place once construction has finished where required.

5.1.2 Movement of Equipment Within Site

Moving large machinery and plant equipment within the Project must only occur on the constructed haul roads and tracks to ensure minimal disturbances of natural areas. Controls for this are predominantly administrative measures to ensure personnel are aware of the restrictions of movement around site.

5.1.3 Spoil & Reject Stockpiles

The SWMS developed by WRM (2019) listed the geochemical characteristics of potential overburden on the Project site as benign. The main findings in relation to overburden, interburden and rejects are as follows:

- Initial and ongoing surface runoff and seepage from mining waste materials is expected to be moderately alkaline and have a moderate level of salinity;
- Kinetic leach column test results indicate that mining waste materials are unlikely to generate acid conditions and are more likely to generate pH neutral to alkaline conditions;
- Metal/metalloid enrichment was limited to cobalt in a single carbonaceous siltstone sample. However, the nature of a coal deposit means some metals/metalloids are expected to be slightly elevated in some materials;
- Most metals/metalloids are sparingly soluble at the neutral to alkaline pH of leachate expected from bulk mining waste materials. Dissolved metal/metalloid concentrations in surface runoff and leachate from bulk mining waste materials are therefore expected to be low and unlikely to pose a significant risk to the quality of surface and groundwater resources at relevant storage facilities; and
- Most mining materials appear susceptible to dispersion and erosion and appropriate management processes will need to be developed based on field trials for progressive rehabilitation of these materials during operations and at mine closure.

The Projects WRD sites therefore represent high potential for erosion occurrences and will be contained by bunding and drainage lines. Progressive rehabilitation and seeding of WRD will facilitate a reduction in dispersive characteristics and reduce sediment loads in surface water.

5.1.4 ROM, TLO Facility and CHPP

Work areas on site will require bunding containment to direct surface water flow to Mine Water Dams for reuse in the handling of coal and dust suppression.

5.2 CONTROL APPROACH

The control of erosion and sediment at the Project site will be developed regarding the following guidelines:

- Stormwater and environmentally relevant activities (Queensland Government 2017);
- EPA Best Practise Urban Stormwater Management – Erosion and Sediment Control (Queensland 2008);
- Best Practice Erosion and Sediment Control (IECA 2008); and
- Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (DES 2019).

ESC management will fall into three tiers with the first tier being the WMP as the basis for management of clean and mine affected water within the site. The control of erosion generating sources including rainfall and surface water runoff will form the second tier of control. Finally, the capture, treatment and reuse of MAW and SAW will limit impacts to downstream waters as defined in the EA.

5.3 OBJECTIVES AND TARGETS

The main objectives of this ESCP is to reduce the potential for erosion and sediment discharge to maintain downstream environmental values and water quality objectives.

The objectives of this ESCP are defined in Table 10.

Table 10 ESCP Objectives

Objectives	Targets	Indicators
Minimise erosion on site and in immediate surroundings	No reports of erosion incidents	Incident reports relating to instances of erosion
Minimise movement of sediment off-site	Retention of MAW and SAW on site	Incident reports of any uncontrolled releases from site
Ensure erosion and sediment controls are operating and maintained effectively	Regular checks of sediment control structures with accumulated sediment removed	Indicators for maximum allowable sediment storage and records of maintenance checks

6.0 EROSION RISK ASSESSMENT AND MANAGEMENT

This section of the report assesses the potential for soil loss on the Project site. This will assist in identifying appropriate control measures to reduce the potential for erosion and sediment loss across the site.

6.1 POTENTIAL EROSION & CONTAMINANT SOURCES AND CONTROLS

During the construction and operational stages of the Project, land clearing will be limited and progressive to ensure that disturbance areas at any point in time are minimised. Where possible, rehabilitation of disturbed areas will occur progressively to further reduce areas of disturbance.

6.1.1 Diversion of clean water

As detailed in the SWMS clean water will be diverted away from active mine sites to reduce potential contamination of surface water. These measures will take the form of pit protection levees and a diversion channel for an unnamed tributary of Springton Creek. Ensuring any access roads and tracks do not impede surface water flow in natural drainage channels.

6.1.2 Perimeter bunds

Perimeter bunding is implemented around work areas and haul roads on the Project such as TLO, WRD and ROM Pad. These bunds direct surface water flow to storages on site and will contain any spills in work areas. Perimeter bunds play an additional safety role for areas adjacent to excavation sites and traffic control. Bunding will be maintained to ensure integrity and non-impedance of natural drainage features.

6.1.3 Progressive Rehabilitation

Progressive rehabilitation during the life of the mine will contribute to lowering the risk of surface water erosion during rain and flow events. While rehabilitation can only occur on areas that will no longer be disturbed by mining activity, hydro-mulching temporary bare earth areas and seeding topsoil stockpiles will help manage short term potential topsoil loss in low activity areas.

6.1.4 Sediment fences, Sandbags & Coir logs

For short term disturbances sediment fences will be erected immediately downstream of land disturbances to capture sediment arising from storm events. Coir logs are an alternative that can be put in place downstream of worksites to capture disturbed sediment. Check dam traps constructed from sandbags can be implemented in drains to supplement the major sedimentation controls and minimise erosion in drains while reducing velocity of surface water across the site.

During operation of the Project use of sediment fences will be reduced as they will be replaced with more permanent solutions such as bunding, diversion drains and rehabilitation.

6.1.5 Sediment Dams

The sediment dams displayed in Figure 8 to Figure 12 are proposed for settlement of suspended solids. Collected runoff water will either be evaporated or reused for dust suppression or other purposes. Water will be able to be transferred between dams to balance the Projects water storage capacities and usage requirements. Maintenance of sediment dams will be required with the dams to be monitored before each wet season to ensure sufficient capacity for rainfall events.

6.1.6 Traffic

As part of the haul road between the pits and the TLO facility is susceptible to flooding construction of the causeway will need to consider minimum impact to the flow structure of Charlevue Creek while maintaining its integrity during any flood events. Other measures to minimise impacts from general vehicle movement within the Project will include the following:

- Vehicles to be restricted to access tracks and designated haul roads;
- Control measures installed on all haul roads, access tracks and roads with maintenance as required, i.e. check dam traps in gutters and diversion of overland flow away from tracks and roads;
- Bunding alongside haul roads used by heavy vehicles on site;
- Speed limits to be observed by all personnel and site visitors; and
- Cleaning and/or maintenance of vehicles or plant equipment to be undertaken within a work area that is able to capture and treat runoff.

6.2 REHABILITATION AND CLOSURE

The end goal of final landform design is the formation of stable landforms resistant to erosion. During rehabilitation works, vegetation cover, diversity and soil loss will be monitored to ensure minimal bare earth is exposed. Planning will ensure that any topsoil stockpiles will be repurposed for rehabilitation or seeded to ensure retention of topsoil for future use.

Prior to germination of rehabilitated areas, activities to ensure maximum potential for revegetation of areas are to be undertaken. These measures include:

- Timing seeding activities to ensure best germination rates are achieved;
- Sediment fences and temporary perimeter banks for short term bare earth areas;
- Sediment and erosion control structures will not be removed until disturbed areas have been stabilised;
- Mulching and/or hydro-mulching, and/or temporary seeding of stockpiles will be utilised as appropriate for rehabilitation areas including topsoil stockpiles;
- Exposed surfaces will be ripped and left with sufficient surface roughness to minimise the potential for erosion;
- Bunds and check dams will be implemented across contours in order to capture and slow runoff; and
- Disturbed areas will be contoured to ensure all runoff is directed through erosion and sediment controls and onsite water management systems.

6.3 RECOMMENDED CONTROLS

Erosion Risk	Recommended Control
Excavated waste rock/ reject material	Surface water diverted to pits and sediment dams for containment via constructed drains.
	Drains to be inspected pre and post wet season.
	Sediment and vegetation to be removed from drains as required.
	Repair of erosion bunding as required.
Stockpiled coal product (CHPP, ROM, TLO facility)	Surface water diverted to mine water dams for containment.
	Drains and spillways to be inspected pre and post wet season.
	Repair of erosion on drainage bunds as required.
Rehabilitated Areas	Surface water diverted to sediment dams.
	Sediment to be removed from drains as required.
	Rehabilitated slopes should be inspected annually and repair of significant erosion undertaken. Any disturbed areas should be revegetated as soon as possible.
Sediment dam embankments	Sediment dam embankments should be inspected pre and post wet season for rill and gully erosion to ensure stability and safety.
	Regulated structures should be inspected by a RPEQ annually before 1 November.
	Erosion of dam embankments should be repaired in line with recommendations from the dam engineer.
Pit perimeters and bunding	Earthen pit perimeter bunds should be inspected for erosion annually.
	Maintenance and repair works should be carried out as required to ensure the integrity of the perimeter bund.
	Site water flow paths into pits should be inspected pre and post wets season for gully erosion around the pit perimeter.
Drainage line diversion	To be inspected pre and post wet season.
	Ensure vegetation does not prevent drainage line diversions performance.
	Monitor and repair erosion in diversion line as required.
Sediment fences, sandbags	All sediment control structures should be checked pre wet season and following significant rainfall events.
	Sediment should be removed and repair of control structure should occur as required.
	Repairs and maintenance to sediment control structures should be carried out as required.
Bare earth areas awaiting rehabilitation or during construction	Disturbed areas will be kept to a minimum to ensure sediment runoff generation is kept to a minimum.
	Hydromulching areas subject to short term exposure to reduce potential surface water erosion during wet season.
	Sediment and erosion control infrastructure will be installed, as required, to minimise erosion of disturbed areas and prevent the contamination of any waters.
	Revegetation of disturbed areas to be conducted where no further disturbance is predicted in order to reduce sediment runoff.

7.0 ADMINISTRATION

7.1 MONITORING AND MAINTENANCE

Regular monitoring of construction, operation and rehabilitation areas will be undertaken. Contractors conducting construction and rehabilitation works will be responsible for maintaining surface water diversion structures and erosion control measures.

Routine inspections of all Project areas will be undertaken until rehabilitation completion criteria have been satisfied. Inspections will be completed prior to expected rainfall events to ensure the performance of control measures. Coincidental observations are encouraged to be reported by personnel to management.

Periodic inspections of site drainage systems will be undertaken, especially prior to the wet season and when any major change is implemented or planned. Amendments to the existing erosion and sediment controls and WMP will be undertaken as required.

7.1.1 Corrective Actions

Where required the following actions are to be taken:

- In the event of an environmental incident, appropriate response measures will be implemented to ensure environmental harm from the event is minimised (i.e. restoration of erosion, repairing sediment and erosion control structures);
- Any non‐conformances will be corrected as soon as possible and strategies identified, evaluated and implemented to reduce the likelihood of the incident re‐occurring;
- Any non‐conformances and corrective actions will be closed out as soon as practicable;
- Where erosion and sediment control devices are found not to be in accordance with this plan or relevant guidelines, work in the affected area will cease and corrective actions taken prior to recommencing works;
- An incident report will be filled out if any non‐conformances with this plan for construction or rehabilitation are found;
- Revision of construction, operation and rehabilitation activities as required; and
- Erosion and sediment control devices will be cleared, repaired or replaced whenever inspections show signs of non‐compliance or ineffective capability or capacity.

7.2 REPORTING

7.2.1 Internal

Incident reports will be used to inform and drive corrective actions. These reports are to be completed as soon as possible after becoming aware of an incident.

7.2.2 Regulatory Authority

The Mine Supervisor, or their delegate, will notify DES within 24 hours of becoming aware of an incident that has the potential to cause, or threaten to cause, material or serious environmental harm.

7.3 RECORDS

Inspection checklists and audits performed for erosion and sediment control will be stored within the Magnetic South Management System.

7.4 REVIEW

This document will be reviewed annually or earlier if required.

7.5 TRAINING

Relevant personnel will be trained in erosion and sediment control procedures including this document and other relevant legislation.

7.6 RESPONSIBILITIES

Roles and responsibilities are outlined in Table 11.

Table 11 Roles and Responsibilities

Role	Responsibility
Site Supervisor or Delegate	• Ensure resources are available to implement the contents of this plan • Facilitate ESCP reviews • Report incidents to DES
Site Environmental Officer	• Implement contents of this plan. • Train Staff in environmental awareness, issues and requirements of ESCP. • Facilitate monitoring of requirements in ESCP. • Report non-conformances to technical services. • Manage and ensure actions are closed out. • Advise on EA conditions. • Investigate environmental incidents and provide assistance with DES where necessary.
Employees	• Be familiar with contents of ESCP. • Undertake erosion and sediment control works. • Report visual degradation or apparent non-conformances with this ESCP within shifts as observed.
Contractors	• Undertake corrective actions as soon as practicable. • Report and non-conformance/environmental incidents within same shift as noticed. • Be familiar with contents of ESCP. • Prepare design and plan for construction.

8.0 REFERENCES

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Appendix Q Receiving Environment Monitoring Program Design Document

GEMINI PROJECT
RECEIVING ENVIRONMENT MONITORING PROGRAM DESIGN REPORT

PREPARED FOR
MAGNETIC SOUTH

NOVEMBER 2020

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GEMINI PROJECT
REMP DESIGN REPORT

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LIST OF ABBREVIATIONS

AARC	AARC Environmental Solutions Pty Ltd
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AusRivAS	Australian River Assessment System
CHRC	Central Highland Regional Council
COC	Chain of Custody
DBH	Diameter Breast Height
DES	Department of Environment and Science
DNRM	Department of Natural Resources, and Mines
DO	Dissolved Oxygen
DoE	Department of the Environment
EA	Environmental Authority
EC	Electrical Conductivity
EHP	Department of Environment and Heritage Protection
EPP (Water)	*Environmental Protection (Water) Policy 2009*
EV	Environmental Value
GDA	Geocentric Datum of Australia
LGA	Local Government Area
Magnetic South	Magnetic South Pty Ltd
mAHD	metres in Australian Height Datum
MLA	Mining Lease Application
N	Nitrogen
NATA	National Association of Testing Authorities
NTU	Nephelometric Turbidity Unit
PCI	Pulverised Coal Injection

PET	Plecoptera, Ephemeroptera and Trichoptera
QA	Quality Assurance
QC	Quality Control
QLD	Queensland
REMP	Receiving Environment Monitoring Program
RP	Release Point
RPD	relative performance differences
SMD	Slightly to Moderately Disturbed
TBA	To be announced
The Project	Gemini Project
µS	MicroSiemens
WQO	Water Quality Objectives

1.0 INTRODUCTION

1.1 BACKGROUND

AARC Environmental Solutions Pty Ltd (AARC) has been approached by Magnetic South Pty Ltd (Magnetic South) to develop a Receiving Environment Management Program (REMP) Design Report for the Gemini Project (the Project).

1.2 PROJECT DESCRIPTION

The Project consists of a single Mining Lease Application (MLA) 700056, located in the Bowen Basin in Queensland. The Project is a proposed, open-cut metallurgical coal mine producing pulverised coal injection (PCI) coal and coking coal for export to the international steel making industry. The Project term is anticipated to be 25 years from grant of the mining lease (ML); with this term including initial construction, mine operation and rehabilitation activities.

1.3 LOCATION AND SETTING

The Project is situated within the Bowen Basin, approximately 110 km east of Emerald and 125 km southwest of Rockhampton, in central Queensland (Figure 1). Blackwater, a larger town serving mines in the region, is located approximately 34 km to the west (Figure 1). The small rural townships of Bluff and Dingo are located approximately 15 km west and 3 km east of the Project, respectively (Figure 1). The Project is located within the Central Highlands Regional Council (CHRC) local government area (LGA), which covers approximately 60,000 km^2.

Nearby mining operations include Bluff PCI Project (approximately 12 km to the west), Yarrabee Coal Mine (approximately 34 km to the northwest), Jellinbah Mine (approximately 32 km to the northwest), Curragh Coal Mine (approximately 33 km to the northwest), and the Blackwater Mine (approximately 36 km to the southwest). It is noted the Bluff Mine is currently in care and maintenance with no certainty of return to operations.

The Capricorn Highway, which is a state-controlled road, links Rockhampton with western Queensland (Figure 1). Capricorn Highway traverses the MLA and links the townships of Bluff and Dingo. The Aurizon Blackwater Rail System (Blackwater Railway) is located along the northern side of the Capricorn Highway.

The topography of the MLA varies from flat to gently undulating, with elevations ranging between approximately 120-150 metres in Australian Height Datum (mAHD). The MLA and surrounds are currently used for low intensity cattle grazing and resource exploration activities. It is Magnetic South's intention that the land continue to be used for agricultural purposes until such time that it is required for Project construction and/or operation. Land not required for mining activities will continue to be utilised for agricultural purposes throughout the life of the Project, reducing mining related disturbances and potential for erosion.

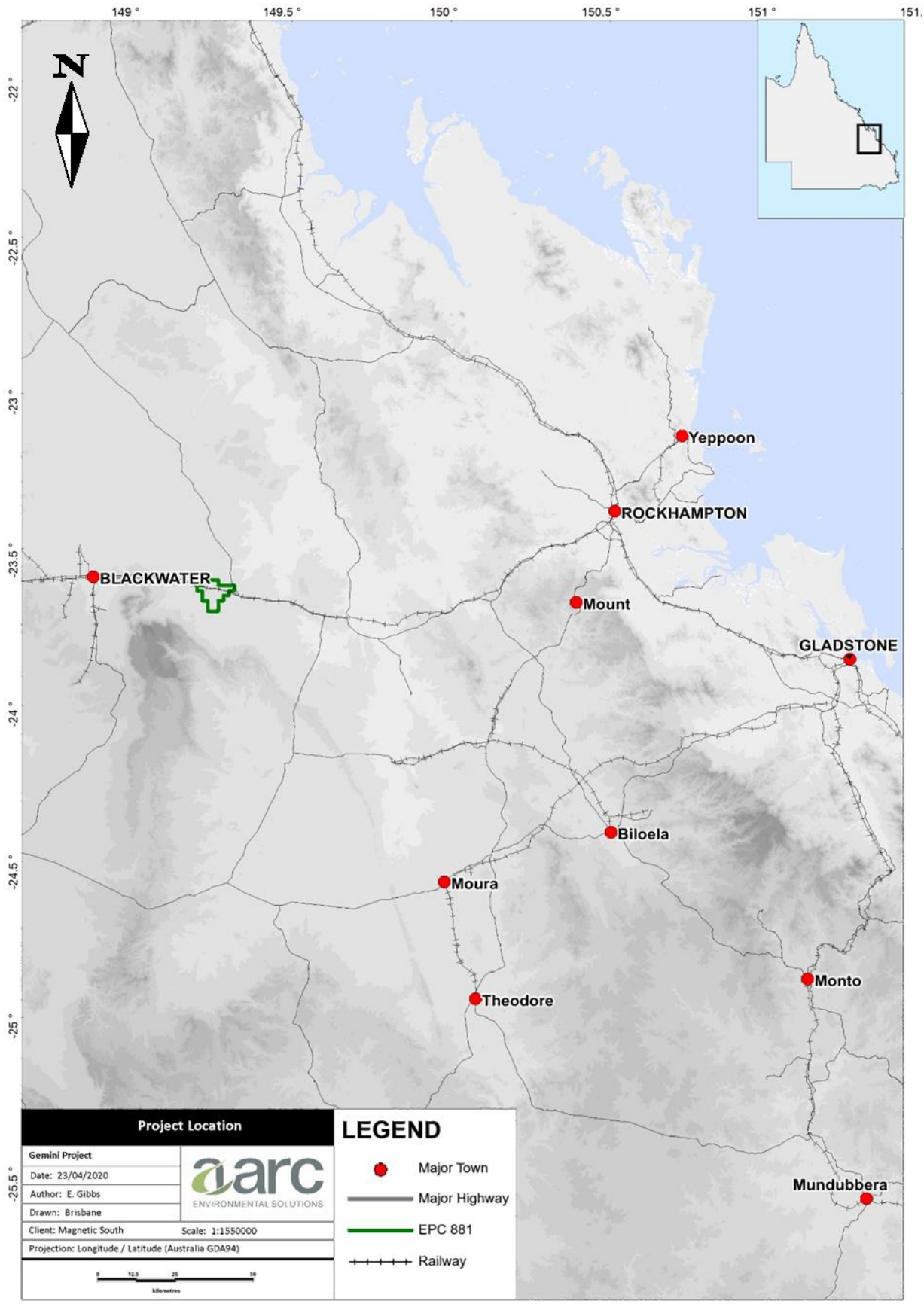

Figure 1 Regional location

1.3.1 Potential Release to the Receiving Environment

Schedule F of the Projects proposed EA outlines conditions in which the Project is permitted to release mine affected water to receiving waters from one prescribed release location.

Mine affected water includes groundwater and runoff from coal stockpiles and processing areas. It will be contained within environmental dams and released only in accordance with the criteria of the EA (based on release quality and flow conditions in the receiving environment). Mine affected water is typically higher in salt content than normal stormwater runoff. The release of mine affected water is proposed under strict release conditions.

Other stormwater runoff can contain elevated sediment loads but does not encounter other contaminant sources. This water is intercepted by sediment dams to allow suspended sediment loads to settle prior to release.

Release waters are to be monitored at the release point and at four locations upstream and downstream of the release points to ensure discharged waters do not exceed the site-specific objectives for each water quality characteristic. Monitoring at these points is to take place under natural flow conditions and while mine affected water is being discharged from the release points.

1.4 SCOPE

The purpose of this document is to monitor, identify and describe any adverse impacts to surface water environmental values, quality and flows due to the authorised mining activity. This includes monitoring the effects of the mine on the receiving environment periodically (under natural flow conditions) and while mine affected water is being discharged from the site.

2.0 GEMINI PROJECT RECEIVING ENVIRONMENT

2.1 DRAINAGE NETWORK

The Project is situated within the Fitzroy River Basin, which encompasses an area of 142,545 km^2 and contains the Comet, Connors, Dawson, Don, Nogoa and Mackenzie Rivers, which make up its six sub-catchment areas (BoM 2018; DES 2018a). The project lies within the Mackenzie River catchment, which covers a total area of 12,985 km^2, and is situated in the centre of the Fitzroy River Basin

Charlevue Creek traverses the Project area in a north-easterly direction. This watercourse begins within the boundaries of Blackdown Tablelands National Park, flowing north-east before joining with Springton Creek and the Fitzroy River, and eventually into the Pacific Ocean approximately 46 km north of Gladstone. Springton Creek also crosses the Project area in a south-easterly direction. These two creeks eventually converge with the Mackenzie River. First and second order streams associated with Charlevue Creek and Springton Creek also occur in the study area.

Stanley Creek traverses the north-west corner of the Project area and flows in a north-easterly direction to join with Duckworth Creek, which then joins with Springton Creek further downstream of the Charlevue - Springton Creek confluence.

The local receiving environment for the Project is shown in Figure 2. The regional watercourse network is displayed in Figure 3.

2.2 LOCAL STREAM MORPHOLOGY

All local waterways are ephemeral, with streamflow mostly occurring shortly after rainfall between September and April. Therefore, stream flows are highly variable, with most channels remaining dry during winter to early spring when rainfall and runoff is low, although some pools hold water for extended periods. Typical depth of channels reaches up to 0.8 m and a channel widths range between 1.2 and 3.5 m.

Within the Project area, Springton Creek and Charlevue Creek cross alluvial floodplains. The reaches of Springton Creek and Charlevue Creek in the proposed mining area have well-defined channels, typically characterised of predominant sandy beds with a mixture of silt and clay at varying proportions, and well established riparian vegetation.

The riparian vegetation varies in condition from low to moderate disturbance levels. Disturbance including clearing of remnant vegetation for agricultural purposes and direct stock access to waterways have contributed to bank instability, erosion and the occurrence of weeds.

Topography of the surrounding land varies from flat to undulating. The landscape is primarily influenced by Charlevue Creek, which has a lower elevation than the surrounding land.

2.3 WETLANDS

The only natural wetlands within the study area are riverine wetlands associated with riparian and vegetation along Charlevue Creek, Springton Creek and some larger tributaries. Outside the study area, there is a large palustrine wetland (approximately 82 ha in area) located about 4 km to the east of the boundary. This wetland, identified as High Ecological Significance (HES) under the *Environmental Protection (Water and Wetland Biodiversity) Policy* 2019, is not connected to the study area through any waterbodies or watercourses. Current Government mapping and field inspections of the mapped wetlands identified the vegetation as non-remnant.

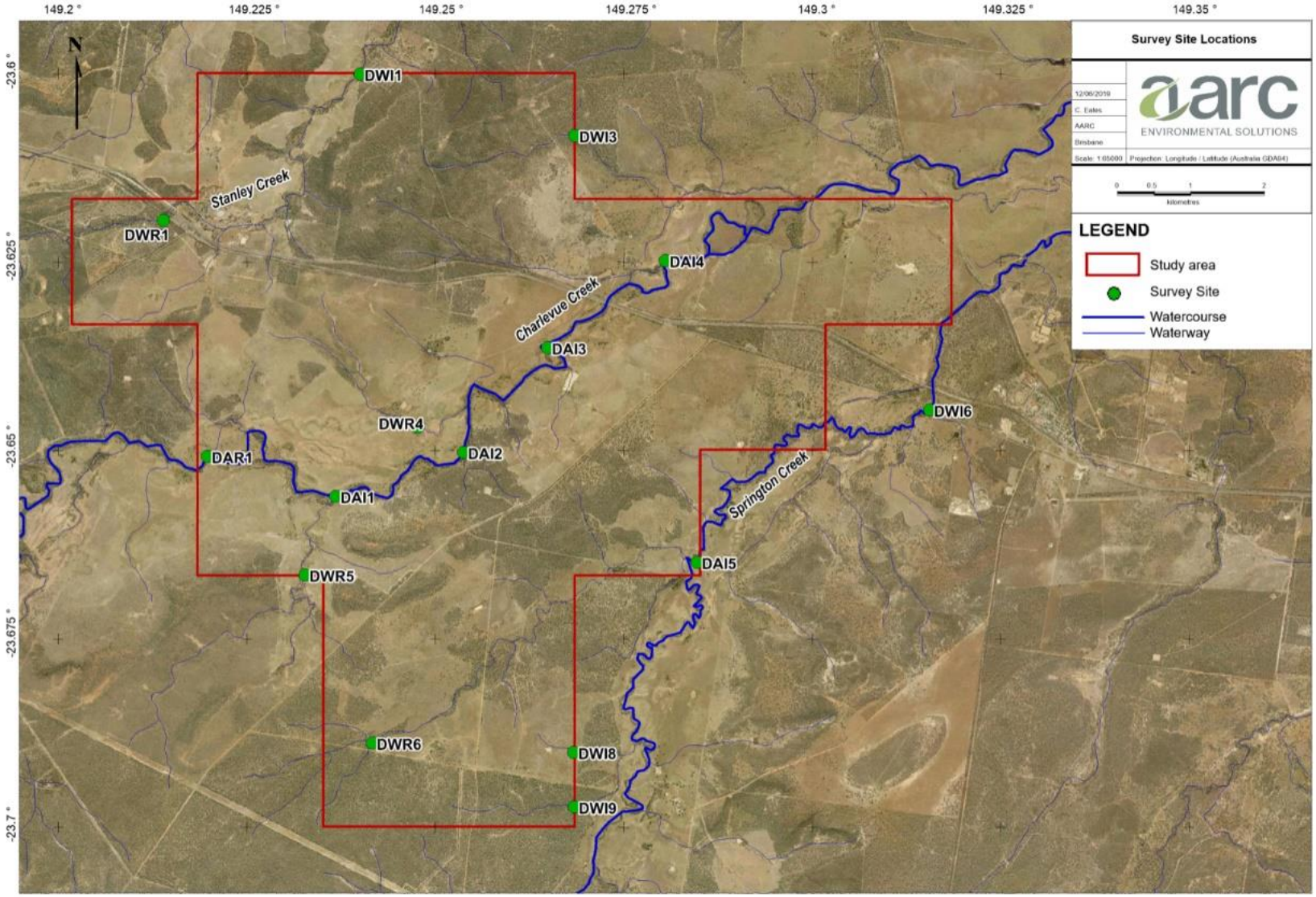

Figure 2 Local Waterways

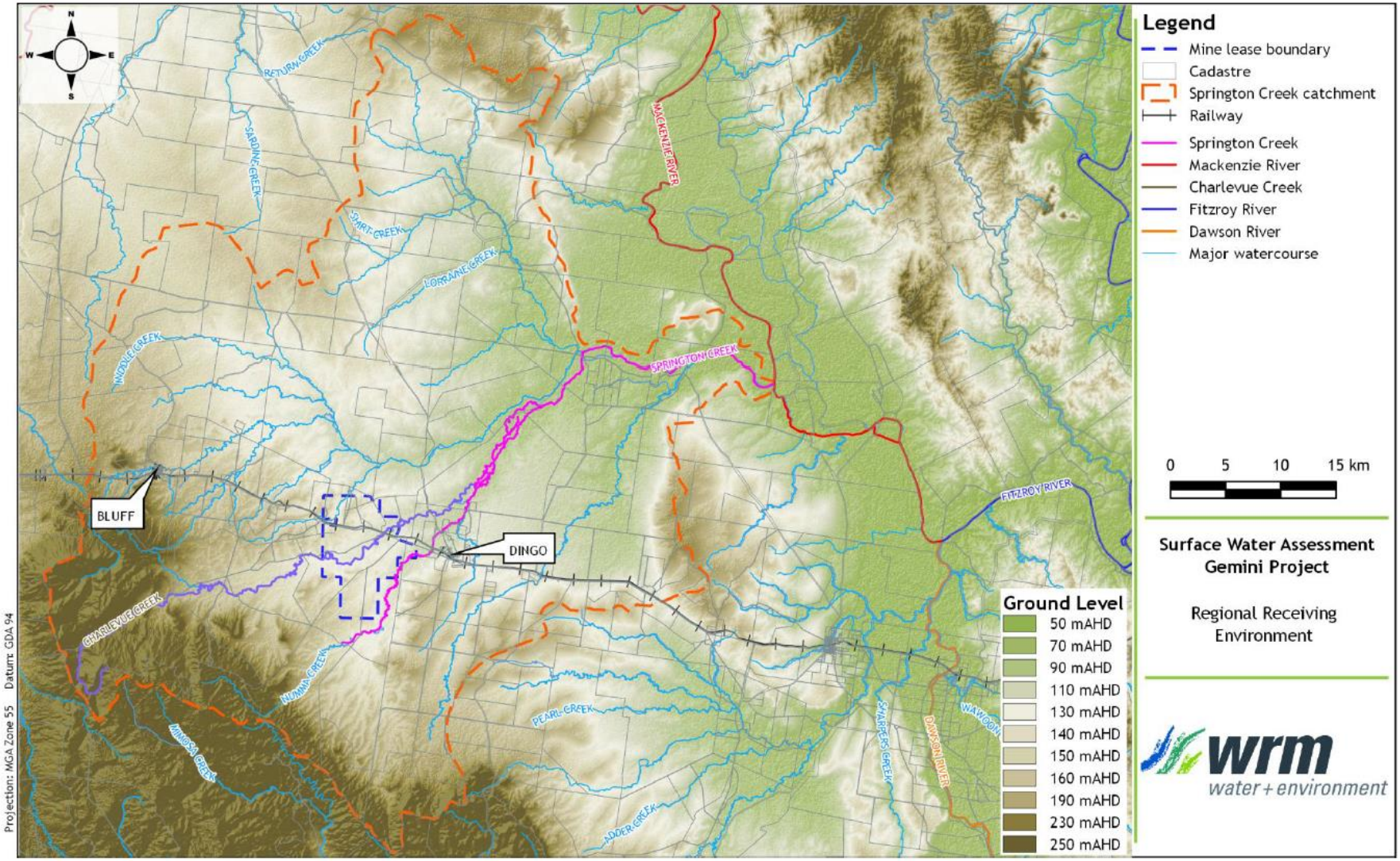

Figure 3 Regional Watercourse Network

2.4 ENVIRONMENTAL VALUES

The EVs for the region are provided by the *Environmental Protection (Water) Policy (2009) Mackenzie River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Mackenzie River Sub-basin* (EHP 2011). They are as below:

- protection of aquatic ecosystems;
- suitability for drinking water supplies;
- suitability for primary contact recreation (e.g. swimming);
- suitability for secondary contact recreation (e.g. boating);
- suitability for visual (no contact) recreation;
- suitability for human consumers of wild or stocked fish, shellfish or crustaceans;
- protection of cultural and spiritual values, including Traditional Owner values of water;
- suitability for industrial use;
- suitability for aquaculture;
- suitability for crop irrigation;
- suitability for stock watering; and
- suitability for farm supply/use.

EVs deemed to be most relevant to the Project's receiving environment are aquatic ecosystems and suitability for stock watering.

2.5 WATER QUALITY OBJECTIVES

2.5.1 EPP Water Quality Objectives and Environmental Values

The document *Environmental Protection (Water) Policy 2009 for the Mackenzie River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Mackenzie River Sub-basin* (EHP 2011) provides WQOs to support and protect the different EVs identified for waters within the Mackenzie River southern tributaries of the Mackenzie River sub-basin. Ten EVs are nominated broadly to the mapped areas of this zone, of which the following are relevant to the Project and its receiving waters:

- Aquatic ecosystems slightly to moderately disturbed; and
- Water suitable for stock watering.

The guideline WQOs for the protection of aquatic ecosystems and for stock watering are provided in Table 1.

Table 1 Water Quality Objectives Guideline Values

Table 2 Mackenzie River Sub-basin EVs and WQO Basin No. 130 (part)		
Management Intent (Level of Protection)	**WQOs to protect EV**	
	Parameter	**Water Quality Objective**
Aquatic ecosystem *(moderately disturbed)*	**Water**	
	Ammonia N	< 20 µg/L
	Oxidised N	< 60 µg/L
	Organic N	< 420 µg/L
	Total nitrogen	< 7 µg/L
	Filterable reactive phosphorus	< 20 µg/L
	Total phosphorus	< 160 µg/L
	Chlorophyll a	< 5.0 µg/L
	Dissolved oxygen	85% – 110% saturation
	Turbidity	< 50 NTU
	Suspended solids	< 110 mg/L
	pH	6.5 – 8.5
	Conductivity (EC) baseflow	< 310 µS/cm
	Conductivity (EC) high flow	< 210 µS/cm
	Sulphate	< 10 mg/L
Aquatic ecosystem *(moderately disturbed)*	**Macroinvertebrates**	
	Taxa richness (composite)	12 – 21
	Taxa richness (edge habitat)	23 – 33
	PET taxa richness (composite)	2 – 5
	PET taxa richness (edge habitat)	2–5
	SIGNAL index (composite)	3.33 – 3.85
	SIGNAL index (edge habitat)	3.31 – 4.20
	% tolerant taxa (composite)	25 – 50%
	% tolerant taxa (edge habitat)	44 – 56%
Stock watering	**Water**	
	Total Dissolved Solids	3000 mg/L
	Aluminium	5 mg/L
	Arsenic	0.5 (up to 5) mg/L
	Beryllium	ND

Table 2 Mackenzie River Sub-basin EVs and WQO Basin No. 130 (part)		
Management Intent (Level of Protection)	**WQOs to protect EV**	
	Boron	5 mg/L
	Cadmium	0.01 mg/L
	Chromium	1 mg/L
	Cobalt	1 mg/L
	Copper	0.4 (sheep), 1 (cattle), 5 (pigs), 5 (poultry)
	Fluoride	2 mg/L
	Iron	not sufficiently toxic
	Lead	0.1 mg/L
	Manganese	not sufficiently toxic
	Mercury	0.002 mg/L
	Molybdenum	0.15 mg/L
	Nickel	1 mg/L
	Selenium	0.02 mg/L
	Uranium	0.2 mg/L
	Vanadium	ND
	Zinc	20 mg/L

N nitrogen
EC electrical conductivity
ND not determined, insufficient background data to calculate
µg/L micrograms per litre
mg/L milligrams per litre
NTU Nephelometric Turbidity Units
µS/cm microSiemens per centimetre
PET Plecoptera, Ephemeroptera, Trichoptera

2.5.2 Local Surface Water Quality

As part of an ongoing surface water monitoring program implemented on the site in 2018, water quality sampling across Charlevue Creek, Springton Creek and Stanley Creek included field readings of pH, EC and temperature has occurred following two flow events. Surface water samples were also collected at each waterway that contained standing or flowing water.

Samples were analysed at a NATA accredited laboratory for various physico-chemical parameters, metals, nutrients, hydrocarbons and pesticides and assessed against ANZECC (2000) and EPP (Water) WQOs.

Exceedances of WQOs for turbidity across all sites and years were observed, which can be attributable to soil erosion, runoff, pollution and algal blooms; however, some waterways can have naturally high levels of suspended solids and turbidity (Fondriest Environmental Inc. 2014).

Low levels of dissolved oxygen (DO) were observed across most sampling sites in 2018 and 2019. The low levels of DO were recorded in stagnant pools along ephemeral waterways, which naturally experiences DO values below 50% saturation (EHP 2011). Therefore, these exceedances are not a reliable indicator of the long-term health of the system.

Petroleum hydrocarbons across sampling sites at the three waterways exceeded WQO values during the 2018 survey. Site DWR5, which is located upstream of Charlevue Creek, recorded the highest exceedance of petroleum hydrocarbons, which is mostly likely attributable to the agricultural and pastoral land uses close to or at this site. Although there were no recorded exceedances during the 2019 survey, it will continue to be closely monitored due to the existing and consistent local source of petroleum hydrocarbons.

Given the higher carbon chain fractions being reported, possible sources include; crude oil, heavy fuel oils, lubricating oils, asphalts and pitch and even waxes and other related products. Sites DWR1 (Stanley Creek) and DWI6 (Springton Creek) occur along the Capricorn Highway, which is a possible point source for the petroleum hydrocarbons observed at these locations.

Macroinvertebrate diversity, abundance and PET richness were generally low, which is reflective of the system's low waterway health at time of sampling.

2.5.3 ANZECC Sediment Objectives

Stream sediment quality objectives for the Project, adopted from the toxicant default guideline values for sediment quality values (ANZECC & ARMCANZ 2000b) are presented in Table 3.

Table 3 Site Specific Sediment Quality Objectives

Contaminant	Sediment Quality Guideline Value – Low (mg/kg)	Sediment Quality Guideline Value – High (mg/kg)
Arsenic	20	70
Cadmium	1.5	10
Chromium	80	370
Copper	65	270
Lead	50	220
Nickel	21	52
Mercury	0.15	1
Zinc	200	410

2.5.4 Local Stream Sediment Characteristics

The stream sediment samples were well below the relevant SQG low and high trigger values for all parameters except nickel, which exceeded the SQG low trigger values (21 mg/kg) at DWR6 during both years at site DWR6. This site is located along an unnamed waterway which feeds into Springton Creek at DAI5.

Particle size analysis and particle size classification demonstrated that Stanley Creek at site DWR1 the stream sediment is predominantly sand with small amounts of clay and silt. However, further downstream along Stanley Creek, sediment is characterised as sand (92% – 96%) with negligible presence of gravel, silt and clay.

Charlevue Creek stream sediment is characterised by high percentages of sand (56 – 94%) at the majority of sites with variable levels of clay (1 – 24%) and silt (1 – 17%). Though minor, the presence of gravel was recorded across the sites along Charlevue Creek. Sites DWR4, DAI2, and DAI5 presented lower levels of sand (9 – 45%) and higher percentages of clay (25 – 41%) and silt (17 – 66%). Of these sites only DWR4 had higher levels of fine particles during both the 2018 and 2019 sampling periods. This site was located along a natural depression which flows into Charlevue Creek.

Along Springton Creek stream sediment levels vary between sites but remain consistent across sample years. Springton Creek itself is characterised by predominantly sand, with consistent levels of clay and silt.

3.0 REMP MONITORING METHODOLOGY

3.1 MONITORING SITES

The REMP monitoring sites (REMP sites) have been designed to monitor the condition of the Project's receiving environment. Each of the REMP sites incorporate all sampling procedures described from section 3.3 to section 3.6 to ensure the detection of potentially negative impacts associated with the Project. These REMP sites are consistent with water monitoring sites in the proposed EA.

Reference sites are those located upstream of the mining lease and are not subject to the release of mine affected water from the Project. Impact sites are those located downstream of the Release Points (RPs).

Table 4 describes the status and location of each REMP Site and Figure 4 displays the physical locations.

Table 4 REMP Monitoring Site Locations

Site Code	Status	Latitude (decimal degree, GDA 94)	Longitude (decimal degree, GDA 94)
Springton Ck Upstream (SC1)	Reference	-23.6976	149.2738
Charlevue Ck Upstream (CC1)	Reference	-23.6305	149.2715
Springton Ck Downstream (SC2)	Impact	-23.6434	149.3145
Charlevue Ck (Downstream (CC2)	Impact	-23.6469	149.2104

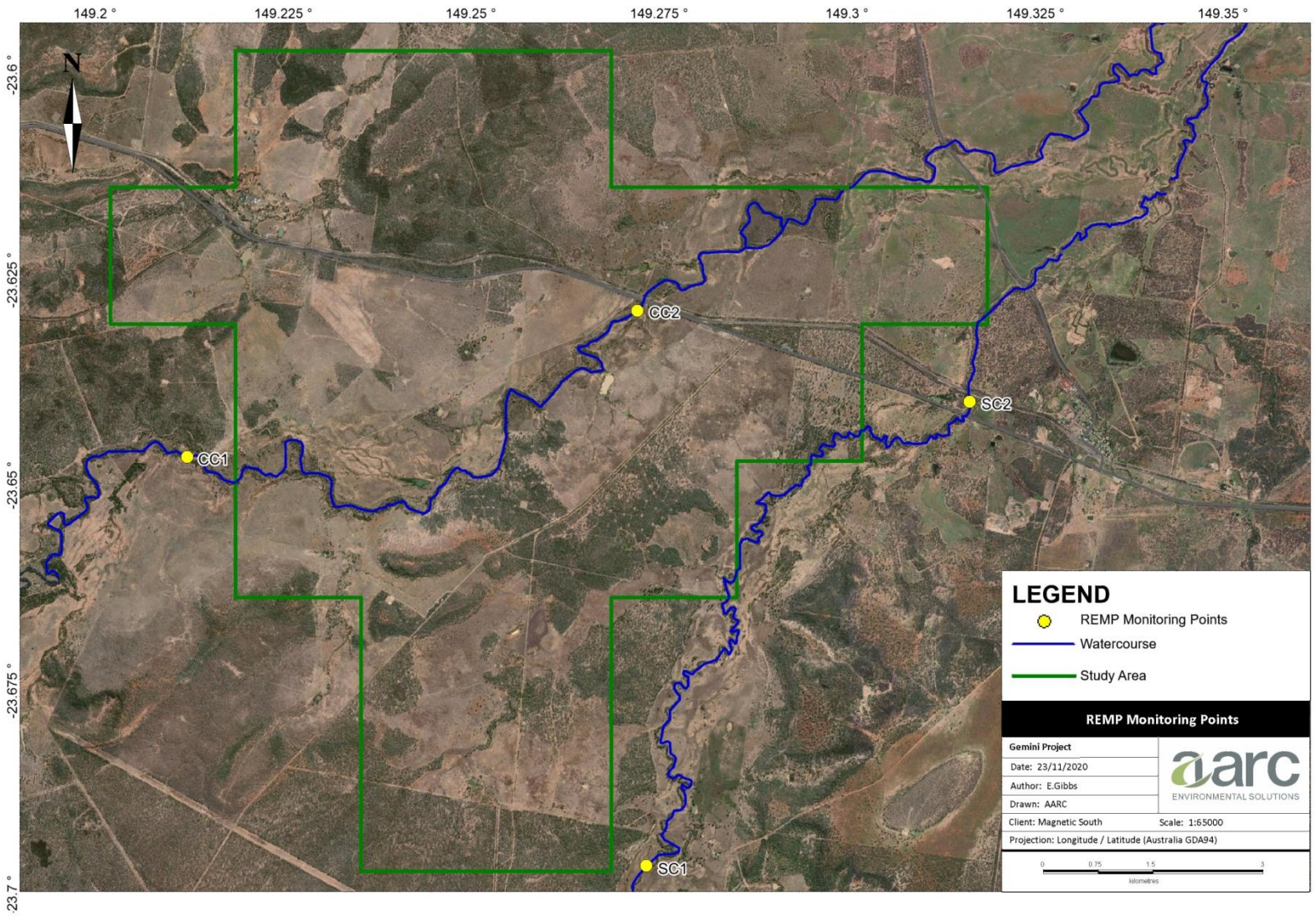

Figure 4 Monitoring Sites

3.2 MONITORING FREQUENCY AND TIMING

Routine REMP monitoring will occur annually during a flow event. The monitoring should take place during periods of stream flow, ideally toward the end of the wet season, when safe access is available. In the event of a major flow event, REMP monitoring should be scheduled to occur approximately 2 – 4 weeks later, before base flows ceases.

Additional REMP monitoring events will occur within a week following the commencement of mine affected water release.

3.3 WATER MONITORING METHODS

3.3.1 Water Quality

Water quality sampling is to be carried out in accordance with the Queensland *Monitoring and Sampling Manual* (DES 2018) methodology. Data collection sheets have been included in Appendix A.

Surface water sampling should occur during flow events, where possible. Field readings of pH, Dissolved Oxygen, Turbidity, Electrical Conductivity (EC) and Temperature are to be recorded. In-situ measurements shall be collected using a water quality meter that is calibrated to the manufacturers' specifications.

Grab samples will be collected at a depth of 10 to 20 cm where sufficient water is available. Two water samples, one total (unfiltered) and one dissolved (field filtered) will be collected at each site. Water quality samples will be analysed under laboratory conditions for the parameters listed below:

- pH
- EC
- Suspended Solids
- Total Dissolved Solids
- Turbidity
- Dissolved Oxygen
- Sulphate
- Fluoride
- Arsenic
- Beryllium
- Boron
- Cadmium
- Chromium
- Copper
- Iron
- Lead
- Manganese
- Mercury
- Nickel
- Zinc
- Selenium
- Vanadium
- Ammonia
- Petroleum hydrocarbon

Samples will be collected in suitable sample collection bottles provided by the laboratory with preservative added when appropriate. All water samples should be kept on ice or refrigerated during storage and transport to a National Association of Testing Authorities (NATA) accredited laboratory for analysis.

The results of the analysis are to be compared to upstream water quality (reference sites), and the site-specific WQOs or EA criteria.

3.3.2 Flow Monitoring

Flow will influence water quality and biological indicators and should be considered in the interpretation of REMP data. Collection of flow information allows for the analysis of the relationship between individual water quality parameters and flow conditions, enabling more accurate characterisation of the receiving environment and informs the derivation of WQOs.

Site specific stream flow gauging stations have been installed to record flow rates in Charlevue and Springton Creeks. Flow is recorded continuously during a flow event at the locations outlined in Table 5.

A QLD Government flow gauge provides continuous data for the Mackenzie River (Table 5). Flow monitoring data related to the Queensland Government gauging station (Mackenzie River) can be accessed through the following Queensland Government website and information portal (Queensland Government 2020).

Table 5 Gauging Station locations

Receiving Water	Gauging Station	Easting	Northing	Flow Recording Frequency
Charlevue Creek (site-specific)	Downstream	731813.736	7384886.933	Continuous (min. daily)
Springton Creek (site-specific)	Downstream	735352.736	7383174.769	Continuous (min. daily)
Mackenzie River (Queensland Government)	Mackenzie River at Coolmaringa (130105B)	757942.677	7418986.486	Continuous (min. daily)

3.4 STREAM SEDIMENT MONITORING

Sediment quality sampling will be undertaken in accordance with the Queensland *Monitoring and Sampling Manual* (DES 2018). Data collection sheets have been included Appendix A. Sampling is undertaken at all REMP sites when access to the channel substrate is available. Sediment sampling may not be possible at all sites during the REMP surveys, due to the likely presence of water. In such instances sampling can be undertaken at some future point in time when flow has ceased. Ideally, sediment sampling will be undertaken post-wet season.

Five sub-samples (approximately 500 g each) of the stream–bed substrate are to be taken at each REMP site at 10 m intervals along a 50 m transect in the river bed using a non-metallic shovel. The sub-samples will then be mixed in a clean plastic bucket to obtain a composite sample (approximately 500 g) to be sealed in sterilised glass jars or plastic sample bags and sent to a NATA accredited laboratory for analysis of trace metals and particle size. Sediment samples will be analysed for the following parameters:

- Arsenic;
- Cadmium;
- Chromium;

- Copper;
- Lead;
- Nickel;
- Zinc;
- Mercury; and
- Particle size distribution.

The results of the analysis of samples from the receiving environment will be compared with upstream sites and the site-specific sediment quality objectives.

3.5 BIOLOGICAL MONITORING

3.5.1 Habitat Bioassessment

A habitat assessment will be performed at all sites using a modified version of the AusRivAS protocols developed by the former Department of Natural Resources and Mines (DNRM 2001). AusRivAS is a nationally standardised method for undertaking an assessment of the biological health of inland rivers within Australia.

The assessment considers morphological characteristics of waterways only, including the broad habitat type, channel pattern, water level and flow, substrate character and cover, bed and bank stability, and riparian cover at each site. Each surveyed site will be given a score out of 135, with higher numbers indicating favourable habitats normally associated with healthy waterways. Photographs will be taken at each site, including the left and right banks, upstream and downstream and other relevant habitat features.

3.5.2 Macroinvertebrates

Macroinvertebrates will be adopted as the standard biological indicators of water quality in order to assess the condition of a waterway. These animals have been utilised worldwide as good indicators of river and stream health and are increasingly used for rapid bio-assessment (Lloyd and Cook 2002).

Macroinvertebrate sampling will be conducted in accordance with the AusRivAS sampling and assessment methodology as outlined by the Queensland *Monitoring and Sampling Manual* (DES 2018). Data collection sheets have been included in Appendix A.

3.5.2.1 Sampling Method

Along a 10 m stretch of the waterbody, a D-frame net with 250 micrometre (µm) mesh will be used to sample macroinvertebrates at each REMP site containing sufficient suitable aquatic habitat. The method employed is the kick-sampling method, where the substrate in the waterbody is disturbed and the net passed through the resulting plume to obtain benthos- and water column-dwelling macroinvertebrates. This procedure will target various micro-habitats including riffles, runs, pool beds and edge/backwaters. Due to the ephemeral nature of the creeks and rivers in the receiving environment, micro-habitats available for sampling are limited to pool beds and edge habitats.

Macroinvertebrates will be placed in a white sorting tub and ‘live-picked’ using a pipette and tweezers for a period of 60 minutes. The picking can stop after 20 min without encountering any macroinvertebrates. Macroinvertebrates are placed in a vial containing 70% methylated spirits and

sent to a designated laboratory for identification to family or sub-family level. The nets will be checked thoroughly for damage before use and washed between sites to ensure no cross contamination of samples.

Data collected during this project will be assessed using a range of indices including:

- taxa abundance
- taxa richness;
- PET richness;
- community composition;
- SIGNAL 2 biotic index; and
- percentage tolerance taxa.

3.6 EROSION ASSESSMENT

An erosion monitoring program has been developed for the REMP. Physical degradation to the banks of the receiving waterways will be described based on their specific bank characteristics (bank shape, bank slope, artificial bank stability features etc.) and erosion characteristics. Both banks are to be assessed individually and cover a section of approximately 100 m (e.g. 50 m either side of the monitoring point). This program utilises standard erosion monitoring techniques adapted from the following environmental sampling manuals:

- *AusRivAS Physical Assessment Protocol* (Parsons *et al* 2002); and
- *Australia-Wide Assessment of River Health: Northern Territory AusRivAS Sampling and Processing Manual* (Lloyd and Cook 2002).

Erosion monitoring techniques to be employed as part of the REMP are described in Table 6. Data collection sheets have been included in Appendix A.

Table 6 Erosion Assessment Methodology

Characteristic	Monitoring Methodology	Parameter
Bank Shape	Categorise the predominant shape of the left and right banks along the length of the monitoring site in accordance with the AusRivAS physical assessment categories for bank shape (i.e. concave, convex, stepped, wide lower bench or undercut).	Visual observations, as per AUSRIVAS Physical Assessment Protocol
Bank Slope	Categorise the predominant slope of the left and right banks along the length of the monitoring site in accordance with the AusRivAS physical assessment categories for bank slope (i.e. vertical, steep, moderate, low or flat).	
Factors Affecting Bank Stability	Identify disturbance factors present that may negatively influence bank stability of either the left or right bank.	
Artificial Bank Stability	Note the presence of any artificial bank protection measures.	

Characteristic	Monitoring Methodology	Parameter
Features		
Large Woody Debris	Visually estimate the percent cover of large woody debris within the lower embankment and channel area, along a length of stream that is equal to the length of the monitoring site. Large woody debris includes logs and branches greater than 10 cm in diameter.	
Turbidity, Water and Sediment Oils and Odours	Visually assess and categorise the presence of oily residues or odours in surface water and stream sediments at the aquatic sites.	
Local Catchment Erosion	Note the erosion in the surrounding catchment on the approach to the site.	
Bare Ground	Note the extent of bare ground including eroded areas or those not supporting vegetation, due to some form of disturbance that would otherwise be expected to be vegetated.	Visual observations as per *Northern Territory AusRivAS Sampling and Processing Manual*
Exposed Tree Roots	Note whether tree roots are exposed due to any disturbances.	
Gully Erosion	Record any visible gully erosion adjacent to the watercourse.	
Bank Slumping	Record any evidence of slumping banks along the watercourse.	

4.0 DATA ANALYSIS

4.1 LABORATORY ANALYSIS

All REMP samples collected (surface water and stream sediment) will be sent to a NATA certified laboratory for analysis.

4.2 INTERPRETATION AND REPORTING

Results from the annual REMP program will initially be compared to upstream reference water quality and the Project's site-specific WQOs / EA criteria to identify immediately impacts of the mine.

Data will also be analysed for trends over time and geographic location. Consideration to common variables such as stream flow, release characteristics, upstream land uses, seasonal variation and other event specific circumstances should be provided.

Where results exceed an identified WQO / EA criteria, further investigations will be undertaken to determine possible causes of the exceedance and may include further sampling to verify the results. If required, an action plan will be developed and implemented to correct any causal issues.

Analysis of biological indicators (macroinvertebrates and riparian vegetation) will assist in interpreting short and long-term impacts on the ecosystem.

A REMP Report outlining the findings of the REMP, including all monitoring results and interpretations will be prepared annually and made available to DES on request (per proposed EA Conditions). The REMP report will include an assessment of background reference water quality, the condition of downstream water quality compared against WQOs and the suitability of current discharge limits to protect downstream environmental values.

4.3 STATISTICAL ANALYSIS

Standard statistical methods will be employed unless event specific circumstances require a more detailed assessment. The following analytical methods will be employed as a minimum:

- in relation to vegetation, water and sediment quality characteristics, the mean values +/- 2 standard deviations will be calculated for comparison of reference and impact locations;
- temporal variation will be presented graphically with other variables. Statistical analysis will be undertaken only if required (where obvious trends are apparent);
- AusRivAS Predictive Modelling for macroinvertebrates community composition will be used to quantify and compare community composition in macroinvertebrates across the REMP sites Additionally, where sufficient data is available, datasets from previous monitoring events will be assessed to gain an understanding of temporal variation in macroinvertebrate community composition.

5.0 QUALITY CONTROL

To ensure the reliability of monitoring results, several quality control / quality assurance (QC/QA) procedures will be adopted during the collection and analysis of REMP samples. All field testing and sample collection will be completed using best practice techniques and in accordance with instrument manufacturer's instructions (where applicable) and the most recent applicable guidelines and procedures. All equipment will be calibrated prior to each sampling event (or more regularly if recommended by the manufacturer).

All macroinvertebrate, water and sediment samples will be sent to NATA accredited laboratories for analysis. Samples will be analysed using appropriate methods as per NATA laboratory accreditation requirements. In accordance with those requirements, the analysing laboratory will also be responsible for undertaking a range of QC/QA checks, (e.g. evaluation of sample preservation and holding times, relative performance differences (RPD) on duplicate samples, etc.). The results of these QC/QA checks will be provided with the raw quality data in the report appendices.

The following QC/QA steps will be undertaken as part of the REMP water and sediment quality sampling procedure:

- At each REMP site, water quality measurements and water samples will be collected prior to any other sampling to reduce sample contamination and bias of in-situ turbidity readings. Care shall be taken to prevent disturbance to the stream bed or banks when undertaking these tasks.
- Water quality probes will be rinsed with demineralised water between sampling sites to prevent contamination.
- Persons collecting water samples will wear clean single use powder free sterile nitrile gloves at each REMP site.
- Where required, unpreserved sample bottles are to be rinsed in local water before filling.
- Prior to the collection of field filtered samples, the sampling syringe will be rinsed twice using sampling water collected in a sample container. The entire inside surface of the syringe is to come into contact with the sample. The syringe shall then be refilled, and a filter attached. The first 2 mL of the sample shall be discarded through the filter as a filter rinse, before filling the sample bottle via the filter.
- Samples are to be stored in appropriate, laboratory allocated sample bottles and sample collection is to be conducted according to appropriate methods, as advised by the analysing laboratory.
- All label information on each sampling bottle shall be completed while at the REMP site and checked during the completion of the Chain of Custody (COC) forms prior to sample dispatch. Sampling bottles to test for dissolved elements shall be appropriately demarcated as field filtered.
- Samples collected as part of the REMP are to be stored in coolers with ice to keep them chilled and shall be sent to the NATA accredited laboratory for testing as soon as practically possible in order to comply with holding times.
- The COC's for each batch of samples are to be included in the coolers.

- Cooler lids shall be taped with the security tape to ensure that any tampering is evident.

- Data received from the laboratories shall be reviewed immediately following receipt to identify any anomalies that may require samples to be re-tested.

The following sampling control procedures will be undertaken as part of the macroinvertebrate sampling procedure, to assure sample quality and data reliability:

- Dip nets and sorting trays will be rinsed thoroughly prior to sampling at each REMP site to prevent sample contamination. and

- Each sample shall be clearly labelled with sample details to be recorded on the sample jar in permanent marker. These details will then be recorded on the COC forms prior to the samples being dispatched. This process ensures samples can be readily tracked when sent to the laboratory for processing.

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Appendix A Field Data Sheets

AEF003

WATER QUALITY SAMPLING FIELD SHEET

Queensland Government
Natural Resources and Mines

Site Number [| | | | | |] **Sample Number** [| | | | | | | | | | | |]
Site Name _____
Date [| / | / | | | |] **Project Name** _____
Time (24 hrs) [| : |]
QHSS Analysis No. [| | | | |]
Project Code [| | | | | |]
Run Code [| | | | | |] **Submitted**

A	B	C	D	E	F	G	H	I	J	K	L	M	N

Party [| |] [| |] [| |] **Received**

SAMPLING LOCATION: Latitude _____ **Longitude** _____
Reach orientation (looking downstream): N NE E SE S SW W NW Datum: _____

WATER QUALITY

Parameter	Value	Quality	Variable
Conductivity µS/cm@25^{0}C	[				]	[		]	2010.5
Water Temperature ^{0}C	[		•	]	[		]	2080.5
pH	[		•	]	[		]	2100.5
Dissolved 0_2 mg/l	[		•	]	[		]	2351.5
Turbidity NTU	[				]	[		]	2030.5
Air Temperature ^{0}C	[		•	]	[		]	2065.5
Total Alkalinity mg/l $CaCO_3$	[			•	]	[		]	2113.5
Phenol Alkalinity mg/l $CaCO_3$	[			•	]	[		]	2114.5
Transparency (secchi) m	[		•		]	[		]	2046.5
Velocity m/s	[	•		]	[		]	240.0
Gauge Height m	[			•		]	[		]	100.0
Discharge m^3/s	[				•				]	[		]	140.0

Discharge Method: measured (gauged) ☐ obtained from rating curve ☐ estimated: ☐ no flow ☐ trickle ☐ >0.01 cumecs

WEATHER: ***Rain in past week:*** Yes [ ] No [ ] Comments: . . . . . .
Today: Rain . . . . . Cloud cover . . . . . Wind . . . . . .
Comments: . . . . . .

OBSERVATIONS AT WATER SAMPLING SITE (within 2 metres of sampling point or on closest bank)

Shading: . . . . . % **Water Odour:** . . . . . .
Water Surface Condition: Normal Slick Scum Foaming Other . . . . . .
Algae: On substrate: N L S M E In water column: N L S M E
Macrophytes: Emergent: N L S M E Submerged: N L S M E
Floating: N L S M E
Impacts: Human N L S M E Pastoral animals N L S M E Non-pastoral animals N L S M E

N = none L = 1-10% (little) S = 10-50% (some) M = 50-75% (moderate) E = >75% (extensive)

PERCENT OF HABITAT TYPES IN 100 m REACH:

Riffle (R) [| |] % Run [| |] %
Pool (rocky-K) [| |] % Pool (sandy-S) [| |] %
Dry [| |] % Riffle + Run + Pool + Dry = 100%

Edge [| |] %
Edge is % of habitat available to sample from L and R banks

Macrophytes [| |] % in: R . . . . % E . . . . %
K . . . . % S . . . . % Run . . . . %
Algae [| |] % in: R . . . . % E . . . . %
K . . . . % S . . . . % Run . . . . %
Blanketing silt [| |] %

COMMENTS: . . . . . .
. . . . . .

(*Office use only*) Entered into Hydsys ___/___/___ by _____ Checked on ___/___/___ by _____
Entered into AQEIS ___/___/___ by _____ Checked on ___/___/___ by _____

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(mr17621) 2/9/2002

REACH OBSERVATIONS (of 100 m stream length)

Upstream landuse: . . . . . .

Adjacent landuse: Left bank: Score . . . . . Type . . . . . Right bank: Score . . . . . Type . . . . . .

0. Urban/semi-urban, industrial
1. Irrigated cropping, intensive forestry or heavy grazing
2. Non-irrigated cropping, moderate grazing
3. Light grazing, vegetation clearing
4. Natural

Local catchment erosion:	None	Little	Some	Moderate	Extensive
Water colour:	Clear	Green	Opaque	Tannin	Other . . . . .
Sediment deposits:	None	Sand	Silt	Other	
Algae: On substrate:	None	Little	Some	Moderate	Extensive
In water column:	None	Little	Some	Moderate	Extensive
Water odour:	No	Yes	Specify		
Substrate odour:	No	Yes	Specify		
Water surface:	Normal	Slick	Scum	Foaming	Other . . . . .
Variety of habitat: (circle all types)	Shallow	Deep	Pool	Run	Riffle
	Undercut bank		LWD	Macrophytes	Other . . . . .

Bars: (bed surface protruding from normal water level and forming a bar) . . . . . %

Flow level: (relative to 'watermark' i.e. normal inundation level shown by limit of terrestrial grasses, or by eroded area, or boundary in bank sediment types).

No flow	Low	Moderate	High	Flood
(dry/isolated)	(<watermark)	(=watermark)	(>watermark)	

RIPARIAN ZONE (to maximum 100 m width)

Width of riparian zone:		Left bank . . . . . m		Right bank . . . . . m	
*** Bare ground**	None	Little	Some	Moderate	Extensive
*** Grass**	None	Little	Some	Moderate	Extensive
*** Shrubs**	None	Little	Some	Moderate	Extensive
*** Trees <10 m high**	None	Little	Some	Moderate	Extensive
*** Trees >10 m high**	None	Little	Some	Moderate	Extensive
Presence of exotic riparian species	None	Little	Some	Moderate	Extensive
Width of continuous tree zone from bank:		Left bank . . . . . m		Right bank . . . . . m	

None = 0% Little = 1–10% Some = 10–50% Moderate = 50–75% Extensive >75% * Can add to >100%

MACROPHYTES Indicate the presence and abundance of the following common taxa in the 100 m reach:

Native

Azolla	N	L	S	M	E	Water Ribbon (*Triglochin*)	N	L	S	M	E
Duckweed	N	L	S	M	E	Water Lettuce (*Pistia stratiotes*)	N	L	S	M	E
Hornwort (*Ceratophyllum*)	N	L	S	M	E	Water Primrose (*Ludwigia*)	N	L	S	M	E
Stoneworts (*Chara* or *Nitella*)	N	L	S	M	E	Sedge (*Cyperus*)	N	L	S	M	E
Hydrilla	N	L	S	M	E	Common Rush (*Juncus*)	N	L	S	M	E
Water Milfoil (*Myriophyllum*)	N	L	S	M	E	Cumbungi (*Typha*)	N	L	S	M	E
Pondweeds (*Potamogeton*)	N	L	S	M	E	Slender Knotweed (*Persicaria*)	N	L	S	M	E
Ribbonweed (*Vallisneria*)	N	L	S	M	E	. . . . .	N	L	S	M	E
. . . . .	N	L	S	M	E	. . . . .	N	L	S	M	E

Exotic

Water Hyacinth (*Eichhornia*)	N	L	S	M	E	Alligator Weed (*Alternanthera*)	N	L	S	M	E
Salvinia	N	L	S	M	E	Elodea	N	L	S	M	E
Para Grass (*Urochloa*)	N	L	S	M	E	*Egeria*	N	L	S	M	E
. . . . .	N	L	S	M	E	. . . . .	N	L	S	M	E

Comments: . . . . . .

. . . . . .

N = none L = 1-10% (little) S = 10-50% (some) M = 50-75% (moderate) E = >75% (extensive)

STREAM SEDIMENT SAMPLING

Stream Sediment Sampling Field Sheet			
Site Number		**Date and Time**	/ / am / pm
Coordinates			
Site Description			
Project Name		**Sample Collector**	
Photo No.			

Observations (circle where appropriate)					
Sediment Odour	None	Sulfides	Sewage	Petroleum	Algal
Sediment Colour	Colourless	Green	Yellow	Red	Brown
Composition	Cobble	Gravel	Sand	Silt	Clay
Moisture	Dry	Damp	Standing Water	Flowing Water	
Comments					

Laboratory Analysis Required (circle appropriate)		
Filtering	Prior to Analysis	Sieve in field _____ Sieve in lab _____
	Post Analysis	❑ Sieve ❑ Hydrometer
Physical parameters	Moisture TOC Nutrients	
Dissolved / Total toxicants	Ag As B Ba Be Cd CN Co Cr Cu Al Fe Hg Mn Mo Ni Pb Sb Se Zn	
Other		

Stream Sediment Sampling Field Sheet			
Quality Control			
Duplicate Provided	Yes	No	Details:
Blank Provided	Yes	No	Details:
Quality Assurance			
❑	Identified safety hazards and risks before commencing sampling		
❑	Correct field equipment ie. bucket, shovel, GPS		
❑	Correct sampling bottles / bags ie. no preservative / preservative added bottles		
❑	Followed Environmental Monitoring Manual sampling procedure		
❑	Field equipment calibrated		
❑	Field Sheet completed		
❑	Sample bottle / bag label completed		
❑	Chain of Custody completed		

REMP Riparian Transect Proforma

Project:				
Date:		**Season:**		
Site:				
Site Location				
Easting:			**Northing:**	
Context:				
Notes:				
Photo No:	**Start (0m):**		**End (50):**	

Altitude (m)	Erosion Pattern	Slope (°) and Aspect	Transect Direction

Disturbance	Severity*	Notes
Storm Damage:		
Road Works:		
Fire:		
Clearing:		
Grazing:		
Weeds:	**Species list:**	
	Cover (%):	

* 1 = minor, 2 = moderate, 3 = severe

Veg Layer	E	T1	T2	T3	S1	S2	G
Height (m)*							

* measure at transect establishment, estimate during subsequent monitoring events

REMP RIPARIAN TRANSECT PROFORMA

Canopy Coverage *(length of tape under canopy)*	**Total (m)**	**%**
(example) 0 – 4, 8 – 13, 28 – 31, 45 – 48	*= 15/50*100*	*30*
Canopy:		
Shrub:		

	Distance along transect (m)	**Crown Type (%)**
Tree canopy 1:		
Tree canopy 2:		
Tree canopy 3:		
Tree canopy 4:		
Tree canopy 5:		
Tree canopy 6:		
Tree canopy 7:		
Tree canopy 8:		
Tree canopy 9:		
Tree canopy 10:		

Recruitment	**%**
Notes	

* Proportion of dominant canopy species regenerating.

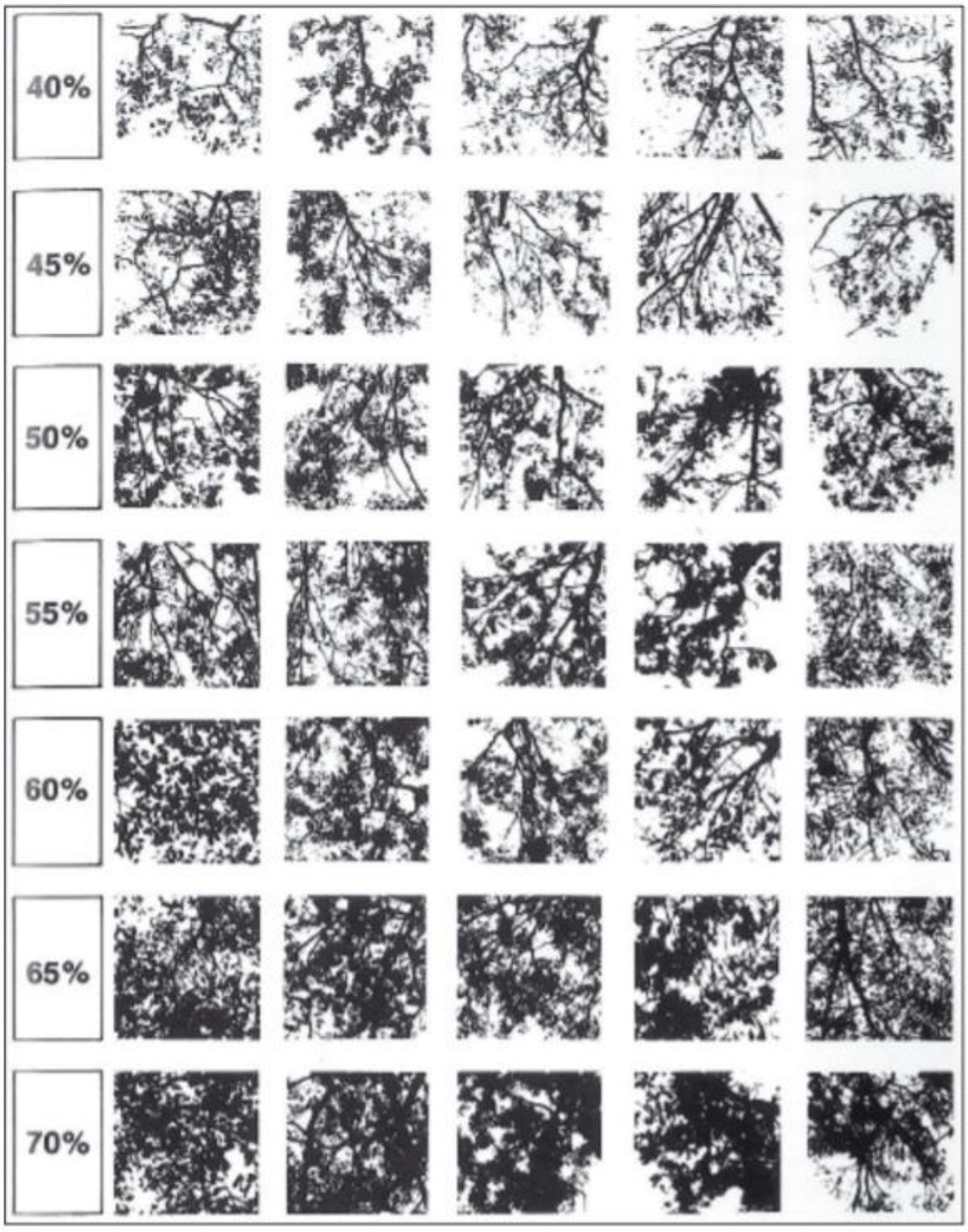
Large Woody Debris	**%**
Notes	

Dieback	**%**
Notes	

REMP RIPARIAN TRANSECT PROFORMA

Crown type cover visual reference card (DoE 2013)

Different leaf shapes shown in separate columns arranged from large to small. Most Australian vegetation is between 40 and 70% foliage cover.



REMP Riparian Transect Proforma

Dominance (D, CD, A, O or ✓)							Species*	Sample #	Photo #
E	T1	T2	T3	S1	S2	G			
							Bare		
							Litter		
							Rock		
							1.		
							2.		
							3.		
							4.		
							5.		
							6.		
							7.		
							8.		
							9.		
							10.		
							11.		
							12.		
							13.		
							14.		
							15.		
							16.		
							17.		
							18.		
							19.		
							20.		
							21.		
							22.		
							23.		
							24.		
							25.		
							26.		
							27.		
							28.		
							29.		

*Record all woody species and dominant non-woody species (50 m x 10 m plot).

AEF002

MACROINVERTEBRATE SAMPLING FIELD SHEET

Queensland Government
Natural Resources and Mines

Site Number [| | | | | |] **Sample Number** [| | | | | | | | | | | | |]
Site Name _____
Project Code [| | | | | |] **Date** [| / | / | | | |] **Time** (24 hrs) [| : |]
Run Code [| | | | | |] **Project Name** _____

EDGE/BACKWATER: Y [ ] N [ ] Collected by: [| |] Picked By: [| |] No. vials: [ ] QAQC Residue: Y [ ] N [ ]
(average over 10 m sampled)

Velocity (m/sec): max [| • | |] min [| • | |]
Mean Sample Depth: [| • | |] m
Mean Wetted Width: [| | | • |] m

Method: 10 m sweep [ ]
____ minutes random live-pick [ ]
Other _____ [ ]

Canopy Cover: [| |] % **Densiometer:** [| |] %
Shading: [| |] %

Snags and LWD:

Detritus (leaves, twigs)	N	L	S	M	E
Sticks (<2cm diam)	N	L	S	M	E
Branches (<15cm diam)	N	L	S	M	E
Logs (>15cm diam)	N	L	S	M	E

Substrate Description:

Bedrock	[		] %
Boulder (> 256 mm)	[		] %
Cobble (64 - 256 mm)	[		] %
Pebble (4 - 64 mm)	[		] %
Gravel (2 - 4 mm)	[		] %
Sand (0.05 - 2 mm)	[		] %
Silt/Clay (< 0.05 mm)	[		] %

Habitat Attributes:

Periphyton	N	L	S	M	E
Moss	N	L	S	M	E
Filamentous algae	N	L	S	M	E
Macrophytes	N	L	S	M	E
Bank overhang vegetation	N	L	S	M	E
Trailing bank vegetation (tree roots, vegetation, grasses, etc)	N	L	S	M	E
Blanketing silt	N	L	S	M	E
Substrate anoxia	N	L	S	M	E

N = none L = 1-10% (little) S = 10-50% (some) M = 50-75% (moderate) E = >75% (extensive)

BED: Y [ ] N [ ] Collected by: [| |] Picked By: [| |] No. vials: [ ] QAQC Residue: Y [ ] N [ ]
TYPE: Riffle [ ] Run [ ] Pool (rocky/gravel) [ ] Pool (sandy/silty) [ ]
(average over 10 m sampled)

Velocity (m/sec): max [| • | |] min [| • | |]
Mean Sample Depth: [| • | |] m
Mean Wetted Width: [| | | • |] m

Method: 10 m kick only [ ]
10 m kick & gleaning rocks of different sizes (5) [ ]
____ minutes random live-pick [ ]
Other _____ [ ]

Canopy Cover: [| |] % **Densiometer:** [| |] %
Shading: [| |] %

Snags and LWD:

Detritus (leaves, twigs)	N	L	S	M	E
Sticks (<2cm diam)	N	L	S	M	E
Branches (<15cm diam)	N	L	S	M	E
Logs (>15cm diam)	N	L	S	M	E

Substrate Description:

Bedrock	[		] %
Boulder (> 256 mm)	[		] %
Cobble (64 - 256 mm)	[		] %
Pebble (4 - 64 mm)	[		] %
Gravel (2 - 4 mm)	[		] %
Sand (0.05 - 2 mm)	[		] %
Silt/Clay (< 0.05 mm)	[		] %

Habitat Attributes:

Periphyton	N	L	S	M	E
Moss	N	L	S	M	E
Filamentous algae	N	L	S	M	E
Macrophytes	N	L	S	M	E
Bank overhang vegetation	N	L	S	M	E
Trailing bank vegetation (tree roots, vegetation, grasses, etc)	N	L	S	M	E
Blanketing silt	N	L	S	M	E
Substrate anoxia	N	L	S	M	E

N = none L = 1-10% (little) S = 10-50% (some) M = 50-75% (moderate) E = >75% (extensive)

Comments . . . . . .

TOTAL NO. VIALS: **OTHERS:**

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(nr17621) 2/9/2002

1. LONGITUDINAL PROFILE SKETCH OF STREAM REACH

Scale: _____

Please indicate on sketch and tick off each item when completed.

- ☐ Biological sampling sites for each habitat type.
- ☐ Water quality measurement and water sample collection sites.
- ☐ Location from where photograph(s) taken.
- ☐ Flow direction
- ☐ Location of cross-sectional profile sketch.
- ☐ Riparian vegetation (include approx. heights).
- ☐ Riparian zone width.

2. CROSS-SECTIONAL PROFILE SKETCH OF STREAM REACH

Scale: _____

Please indicate on sketch and tick off each item when completed.

- ☐ Bankfull bank height
- ☐ Bankfull stream width
- ☐ Stream wetted width
- ☐ "Normal" wetted width
- ☐ Riparian vegetation height
- ☐ Riparian zone width
- ☐ Water depth

3. COMMENTS

_____

_____

_____

_____

_____

_____

_____

(*Office use only*) Entered into AQEIS ___/___/___ by _____ Checked on ___/___/___ by _____

AEF007

River Bioassessment Program

Queensland Government
Natural Resources and Mines

HABITAT ASSESSMENT FIELD SHEET

SITE NUMBER: [| | | | | |] **SITE NAME:** _____

Date: ____/____/_____ **Time (24 hrs): [| | |]** **GPS:** _____ **Project Name:** _____

Habitat Variable	CATEGORY			
	Excellent	**Good**	**Fair**	**Poor**
1. Bottom substrate/available cover	Greater than 50% rubble, gravel, submerged logs, undercut banks or other stable habitat. 20, 19, 18, 17, 16	30-50% rubble, gravel or other stable habitat. Adequate habitat. 15, 14, 13, 12, 11	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 10, 9, 8, 7, 6	Less than 10% rubble, gravel or stable habitat. Lack of habitat is obvious. 5, 4, 3, 2, 1, 0
2. Embeddedness	Gravel, cobble and boulder particles are between 0 & 25% surrounded by fine sediment. 20, 19, 18, 17, 16	Gravel, cobble and boulder particles are between 25% & 50% surrounded by fine sediment. 15, 14, 13, 12, 11	Gravel, cobble and boulder particles are between 50 & 75% surrounded by fine sediment. 10, 9, 8, 7, 6	Gravel, cobble and boulder particles are over 75% surrounded by fine sediment. 5, 4, 3, 2, 1, 0
3. Velocity/depth category	Slow deep (<0.3 m/s & >0.5 m); slow shallow; fast deep; fast shallow; habitats all present. 20, 19, 18, 17, 16	Only 3 of the four habitat categories present (missing riffles or runs receive lower score than missing pools). 15, 14, 13, 12, 11	Only two of the four habitat categories present (missing riffles/runs receive lower score). 10, 9, 8, 7, 6	Dominating by one velocity/depth category (usually pool). 5, 4, 3, 2, 1, 0
4. Channel alteration	Little or no enlargement of islands or point bars and/or no channelisation. 15, 14, 13, 12	Some new increase in bar formation, mostly from coarse gravel; and/or some channelisation present. 11, 10, 9, 8	Moderate deposition of new gravel, coarse sand, on old and new bars; pools partly filled with silt; and/or embankments on both banks. 7, 6, 5, 4	Heavy deposits of fine materials, increased bar development; most pools filled with silt; and/or extensive channelisation. 3, 2, 1, 0
5. Bottom scouring and deposition	Less than 5% of the bottom affected by scouring and deposition. 15, 14, 13, 12	5-30% affected. Scours at constrictions and where grades steepen, some deposition in pools. 11, 10, 9, 8	30-50% affected. Deposits and scours at obstructions and bends. Some deposition in pools. 7, 6, 5, 4	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 3, 2, 1, 0

DU503400RSC.P65 (LM3883) 20/8/98

River Bioassessment Program

HABITAT ASSESSMENT FIELD SHEET cont.

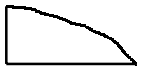
Habitat Variable	CATEGORY			
	Excellent	**Good**	**Fair**	**Poor**
6. Pool/riffle, run/bend ratio. *(Distance between riffles divided by stream width)*	0-7 Variety of habitat. Deep riffles and pools. 15, 14, 13, 12	7-15 Adequate depth in pools and riffles. Bends provide habitat. 11, 10, 9, 8	15-25 Occasional riffle or bend. Bottom contours provide some habitat. 7, 6, 5, 4	>25 Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 3, 2, 1, 0
7. Bank stability	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. Little potential for future problem. 10, 9	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods. 8, 7, 6	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme/high flows. 5, 4, 3	Unstable. Many eroded areas. Side slopes > 60% common. 'Raw' areas frequent along straight sections and bends. 2, 1, 0
8. Bank vegetative stability	Over 80% of the streambank surfaces covered by vegetation or boulders and cobble. 10, 9	50-79% of the streambank surfaces covered by vegetation, gravel or larger material. 8, 7, 6	25-49% of the streambank covered by vegetation, gravel or larger material. 5, 4, 3	Less than 25% of the streambank surfaces covered by vegetation, gravel or larger material. 2, 1, 0
9. Streamside cover	Dominant vegetation is of tree form. 10, 9	Dominant vegetation shrub. 8, 7, 6	Dominant vegetation is grass, sedge, ferns. 5, 4, 3	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 2, 1, 0

Column Totals				

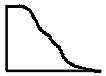
Score

○ ○ ○ ○

Bank shape
Choose one category for each bank

		Left bank	Right bank
	Concave	☐	☐
	Convex	☐	☐
	Stepped	☐	☐
	Wide lower bench	☐	☐
	Undercut	☐	☐

Bank slope
Choose one category for each bank

		Left bank	Right bank
	Vertical 80 - 90°	☐	☐
	Steep 60 - 80°	☐	☐
	Moderate 30 - 60°	☐	☐
	Low 10 - 30°	☐	☐
	Flat <10°	☐	☐

Factors affecting bank stability
Choose one or more categories

- ☐ None
- ☐ Mining
- ☐ Runoff
- ☐ Stock access
- ☐ Human access
- ☐ Ford, culvert or bridge
- ☐ Feral animals
- ☐ Other
- ☐ Cleared vegetation
- ☐ Irrigation draw-down
- ☐ Reservoir releases
- ☐ Seepage
- ☐ Flow and waves
- ☐ Drainpipes

Description _____

_____

_____

_____

Bedrock outcrops
Assess % of each bank covered by bedrock outcrops

% bedrock outcrops Left bank _____

Right Bank _____

Artificial bank protection measures
Choose one or more categories

- ☐ None
- ☐ Fence structures
- ☐ Levee banks
- ☐ Rock or wall layer
- ☐ Rip rap
- ☐ Fenced human access
- ☐ Other _____
- ☐ Fenced stock watering points
- ☐ Vegetation plantings
- ☐ Logs strapped to bank
- ☐ Concrete channel lining

_____

_____

Sediment oils
☐ absent ☐ light ☐ moderate ☐ profuse

Water oils
☐ none ☐ flecks ☐ globs ☐ sheen ☐ slick

Sediment odours
☐ normal/none ☐ sewage ☐ petroleum ☐ chemical

☐ anaerobic ☐ other _____

Water odours
☐ normal/none ☐ sewage ☐ petroleum ☐ chemical

☐ other _____

Turbidity (visual assessment)
☐ Clear ☐ Slight ☐ Turbid ☐ Opaque

Is water clarity reduced by:

☐ Suspended material (e.g mud, clay, organics) ☐ Dissolved material (e.g plant leachates)

Water level at the time of sampling
☐ Dry ☐ No flow ☐ Low ☐ Baseflow or near baseflow

☐ High ☐ Flood (don't sample)

Artificial features at the sampling site
Choose one or more categories

☐ Major ☐ Minor weir ☐ Ford ☐ Bridge ☐ Culvert ☐ Other

Description _____

_____

_____

Large woody debris
Overall % cover of logs and branches greater than 10cm in diameter

_____% Notes on visibility _____

_____

_____

REMP Erosion Observations							
Sampling Date:							
Sampling Site:							
Photo No.							
Bare Ground Note the extent of bare ground including eroded areas or those not supporting vegetation, due to some form of disturbance that would otherwise be expected to be vegetated.							
Exposed Tree Roots Note whether tree roots are exposed due to any disturbances.							
Gully Erosion Record any visible gully erosion adjacent to the watercourse.							
Bank Slumping Record any evidence of slumping banks along the watercourse.							
General Notes							

AARC AQUATIC FAUNA PROFORMA

Client/Project:	Location:	Date:

GPS Coordinates:	Weather Conditions:

Habitat Description:

Fauna Captured/Observed

Survey Method	Species Description (i.e. Spangled Perch ; unidentified gudgeon etc.)	Photo taken?	Species Abundance (tally)
Opera House Trap			
Box Trap			
Other:			
Species Observed (i.e. Birds)			

Appendix R Environmental Offsets Strategy

GEMINI PROJECT
ENVIRONMENTAL OFFSET STRATEGY

PREPARED FOR

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NOVEMBER 2020

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GEMINI PROJECT ENVIRONMENTAL OFFSET STRATEGY

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%	percent
$	dollar
AARC	AARC Environmental Solutions Pty Ltd
BVG	Broad Vegetation Group
DAF	Department of Agriculture and Fisheries
DES	Department of Environment and Science
DEHP	Department of Environment and Heritage Protection
DBMP	Direct Benefit Management Plan
EA	Environmental Authority
EHP	Environment and Heritage Protection
EP Regulation	Environmental Protection Regulation 2019
EO Act	Environmental Offsets Act 2014
EO Regulation	Environmental Offsets Regulation 2014
EP Act	Environmental Protection Act 1994
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999
EPC	Exploration Permit Coal
GDE	Groundwater Dependant Ecosystems
ha	hectares
HES	High Ecological Significance
km	kilometre
LGA	Local Government Area
Mtpa	million tonnes per annum
ML	Mining Lease
MLA	Mining Lease Application
MLES	Matters of Local Environmental Significance

MNES	Matters of National Environmental Significance
MSES	Matters of State Environmental Significance
NC Act	Nature Conservation Act 1992
PCI	Pulverised Coal Injection
Qld	Queensland
QEOP	Queensland Environmental Offsets Policy
ROM	Run of mine
RE	Regional Ecosystem
SOIC	Strategic Offset Investment Corridor
TEC	Threatened Ecological Community
VM Act	Vegetation Management Act 1999
the Project	Gemini Project
Magnetic South	Magnetic South Pty Ltd

1.0 INTRODUCTION

AARC Environmental Solutions Pty Ltd (AARC) was commissioned by Magnetic South Pty Ltd (Magnetic South) to prepare an Environmental Offset Strategy for the Gemini Project (the Project). The Project is located approximately 110 km east of Emerald and 125 km west of Rockhampton in the Bowen Basin of Central Queensland, and within the Central Highlands Regional Council Local Government Area (LGA) (Figure 1).

The Project lies within Mining Lease Application (MLA) 700056, which falls within Exploration Permit Coal (EPC) 881. The Project is a greenfield, open-cut metallurgical coal mine, producing Pulverised Coal Injection (PCI) coal and coking coal for export for steel production. Existing local and regional infrastructure, facilities and services are proposed to support Project activities. These include the SunWater water distribution network, the Aurizon rail network, Ergon's electricity network, the Capricorn Highway, and Gladstone export coal terminals.

The proponent is in the process of preparing an Environmental Authority (EA) under the *Environmental Protection Act 1994* (EP Act). This application was accepted on 23 October 2019 by the administering authority. This Offset Strategy has been developed in response to an Information Request (IR) received 31 January 2020. Prior to this, an *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) referral (2010/5775) was lodged in 2010 for the Project, which was declared 'Not a Controlled Action if undertaken in a Particular Manner' in July 2011.

An initial assessment of the terrestrial and aquatic ecological values was conducted within EPC 881 (herein referred to as the study area) by AARC in 2019. The *Terrestrial Ecology Assessment Report* and the *Aquatic Ecology Assessment Report* (AARC 2020a & 2020b) assessed the environmental values and potential impacts of the Project to ecological values including matters of state environmental significance (MSES). The findings of these studies have been used to inform this Environmental Offset Strategy; in particular:

- Vegetation mapping and community description;
- Likelihood of occurrence assessment for flora and fauna species of conservation significance;
- Habitat mapping for conservation significant species and communities;
- Detailed assessment of the ecological condition and value of waterways, wetlands and Groundwater Dependant Ecosystems (GDE);
- Impact assessments for MSES; and
- Offset requirements for impacted MSES.

1.1 PURPOSE

The purpose of this Environmental Offset Strategy is to outline the Project's environmental offset requirements under the applicable offset framework. The Environmental Offset Strategy includes:

- a summary of environmental offset requirements for the Project (Section 3.0); and
- proposed offset delivery mechanisms including staging (Section 4.0).

1.2 PROJECT DESCRIPTION

The Project involves the construction and operation of an open cut coal mine with a planned production rate of up to 1.9 million tonnes per annum (Mtpa) of ROM coal for export for steel production. The Project

term is anticipated to be 25 years from grant of the mining lease (ML); with this term including initial construction, mine operation and rehabilitation activities.

Mine construction activities are scheduled to commence in July 2021; subject to granting of the Project ML and EA. It is anticipated that it will take approximately six months to establish the necessary infrastructure to commence overburden removal and 18 months to commence coal production. A conceptual Project layout is provided in Figure 2, which represents the total area disturbed by mine operations only and does not equate to the disturbance footprint at any one point in time. The layout and mining sequence may vary from that shown in Figure 2 to account for localised geological features, detailed engineering design, mining economics and variations in market tonnages and quality requirements.

Open-cut mining areas will be developed and rehabilitated progressively. The total disturbance footprint for the Project is 1,953 ha which incorporates all mining and infrastructure components. the Project delivery has been split into two distinct stages based on the mine sequence. The total disturbance footprint for Stage 1 is approximately 1,267 ha, which includes Pit AB and associated infrastructure north west of Pit AB. Pit C and the haul road connecting Pit C and Pit AB will be developed in Stage 2, which is approximately 686 ha (refer Figure 2 and Figure 3).

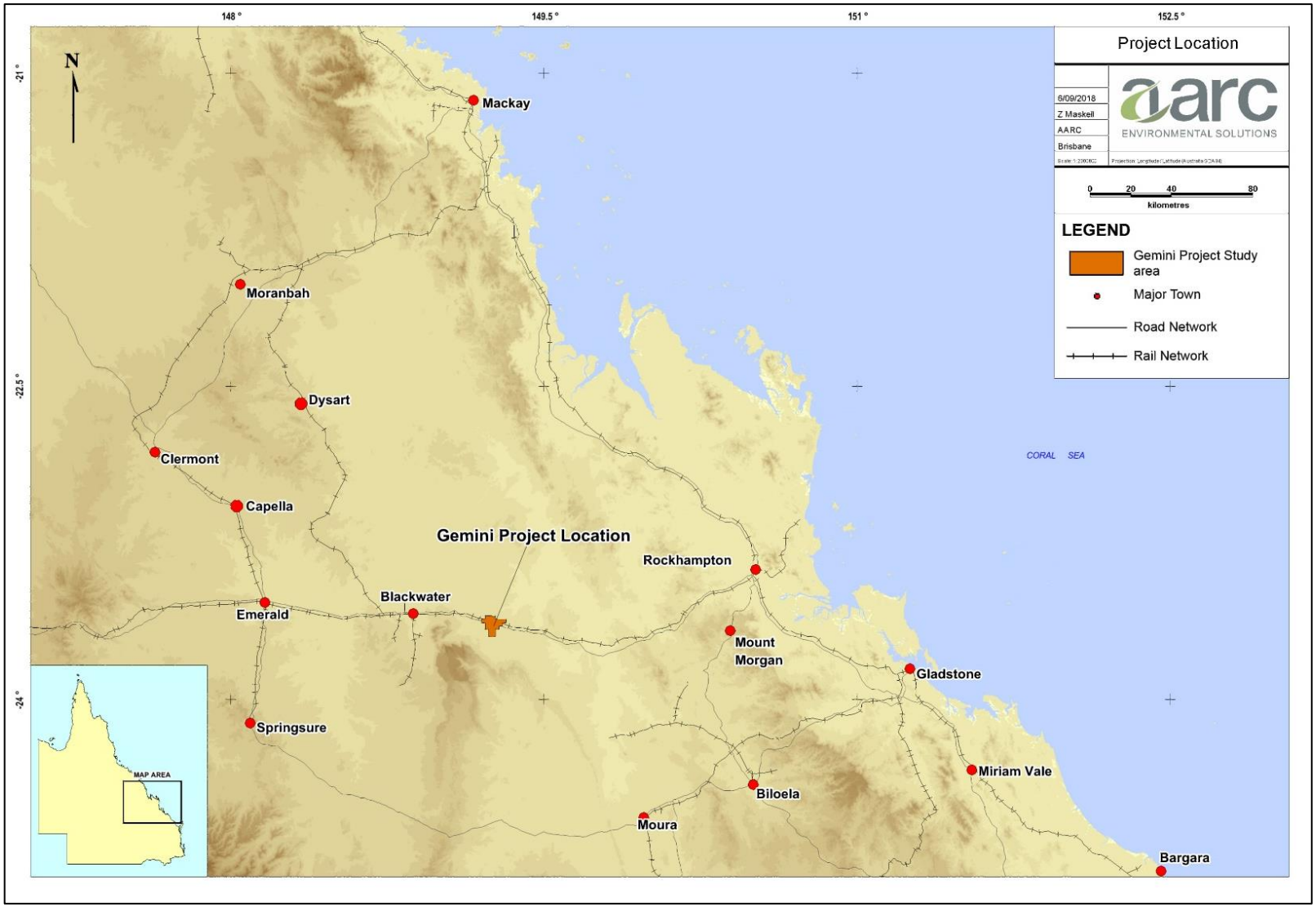

Figure 1: Project locality

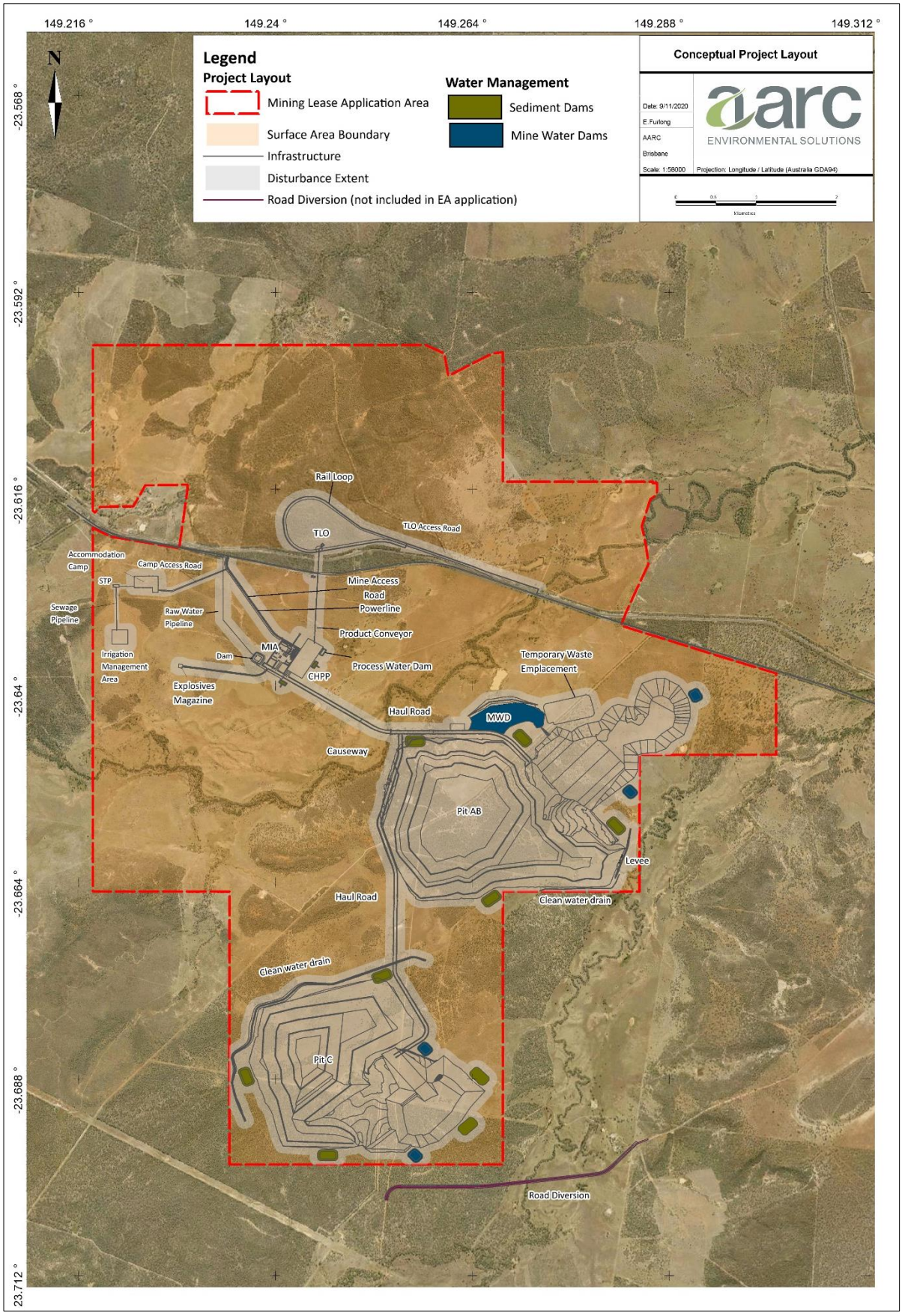

Figure 2: Project layout

2.0 LEGISLATION AND REGULATORY FRAMEWORK

Commonwealth, State and Local legislation policies and guidelines relevant to environmental offsets are discussed below.

2.1 ENVIRONMENTAL PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

Under the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), an action requires approval from the Federal Environment Minister if the action has, will have, or is likely to have a significant impact on a matters of national environmental significance (MNES). There are nine matters of national environmental significance listed under the act, which include:

- World heritage properties;
- National heritage places;
- Wetlands of international importance;
- The Great Barrier Reef Marine Park;
- Commonwealth marine areas;
- Listed threatened ecological communities;
- Listed threatened species;
- Listed threatened migratory species; and,
- A water resource, in relation to coal seam gas development and large coal mining development.

An EPBC Referral (2010/5775) was lodged in 2010 for the Gemini Project (the Project) previously known as the Dingo West Project by Dingo West Pty Ltd. The Project was declared 'Not a Controlled Action if undertaken in a Particular Manner' in July 2011.

The Particular Manner Decision conditions (EPBC 2010/5775) are as follows:

1. *To prevent downstream impacts to the Fitzroy river turtle (Rheodytes leukops) the person taking the action must appropriately bund or locate pits in a manner that prevents surface water from entering the pit during a 1:1000 year flood event (as indicated in flood modelling).*

2. *To prevent downstream impacts to the Fitzroy river turtle (Rheodytes leukops) the person taking the action must appropriately bund or locate dams in a manner that prevents surface water from entering or damaging the dams during a during a 1:1000 year flood event (as indicated in flood modelling).*

The Project requires no further assessment or provision of offsets under the EPBC Act.

2.2 QUEENSLAND ENVIRONMENTAL OFFSETS FRAMEWORK

Under Queensland law, offsets may be required for certain activities, where there is an unavoidable impact on significant environmental values. To counterbalance this loss, offsets, which can include improvement and protection of alternative sites and/or actions that improve environmental viability, can

provide a conservation outcome that is equivalent to the environmental value being lost at the impact site (DES 2020a).

The Queensland environmental offsets framework consists of:

- *Environmental Offsets Act 2014* (EO Act);
- *Environmental Offsets Regulation 2014* (EO Regulation);
- *Queensland Environmental Offsets Policy* (QEOP) (DES 2020a); and
- *QEOP Significant Residual Impact Guideline* (EHP 2014).

The offsets framework requires environmental offsets to be delivered where the Project (prescribed activity) is likely to result in a significant residual impact on a prescribed environmental matter. *The QEOP Significant Residual Impact Guideline* (EHP 2014) was used to determine if residual impacts on prescribed environmental matters were significant for the project (AARC 2020a).

2.2.1 Environmental Offsets Act 2014 and Environmental Offsets Regulation 2014

Significant impacts to MSES require environmental offsets under the EO Act. MSES are defined below and are outlined in Schedule 2 of the EO Regulation. They comprise:

- Regulated vegetation including:
  i. REs that are listed as 'Endangered' or 'Of Concern' (under the *Vegetation Management Act 1999* (VM Act));
  ii. REs that intersect areas shown as wetlands on the 'vegetation management wetlands map' (as certified under the VM Act);
  iii. REs located within the defined distance from the defining banks of a relevant watercourse or relevant drainage feature identified on the 'regulated vegetation management watercourse and drainage feature map' (as certified under the VM Act);
  iv. REs mapped as essential habitat on the 'essential habitat map' (as certified under the VM Act) for flora and fauna listed as 'endangered' or 'vulnerable' (under the *Nature Conservation Act 1992* (NC Act)); or
  v. A prescribed regional ecosystem is a matter of State environmental significance, for a prescribed activity mentioned in schedule 1, item 7(e) [1], if the ecosystem is an area of essential habitat on the essential habitat map for an animal that is near threatened wildlife or a plant that is near threatened wildlife;
- Remnant REs that contain an area of land required for ecosystem functioning (i.e. a connectivity area);
- Mapped wetlands and watercourses including:
  i. A wetland in a 'wetland protection area'; or of 'high ecological significance' as shown on the 'map of referable wetlands' (as defined under the *Environmental Protection Regulation 2019* (EP Regulation)); or

[1] Prescribed activity mentioned in schedule 1, item 7(e): development for which an environmental offset may be required under the State code 16 (Native vegetation clearing).

ii. A wetland or watercourse in 'high ecological value waters' (as defined under the *Environmental Protection (Water and Wetland Biodiversity) Policy* 2019);

- Designated precincts in a 'strategic environmental area' (under the *Regional Planning Interests Regulation 2014*);
- Protected wildlife habitat, which includes;
  i. High risk areas on the 'flora survey trigger map' that contain 'endangered' or 'vulnerable' plants (under the NC Act);
  ii. Areas (not on the 'flora survey trigger map') that contain 'endangered' or 'vulnerable' plants (under the NC Act);
  iii. Koala habitat area (as defined in the NC Act);
  iv. Habitat for 'endangered', 'vulnerable' and 'special least concern' animals (under the NC Act);
- Protected areas (under the NC Act) and highly protected zones of State marine parks (under the Marine Parks Act 2004);
- Fish habitat areas and waterways providing for fish passage (under the Fisheries Act 1994);
- Marine plants (under the Fisheries Act 1994); and
- Legally secured offset areas.

2.2.2 Queensland Environmental Offsets Policy

The QEOP is a statutory instrument that provides a single, streamlined framework for environmental offsets in Queensland. An offset may be delivered as a:

Proponent-driven offset: A proponent-driven offset may take the form of a traditional land-based offset; be undertaken through actions under a Direct Benefit Management Plan (DBMP); or a combination of both. For a proponent-driven offset, the offset delivery liability remains with the proponent and the offset must be delivered in accordance with an Offset Delivery Plan approved by the administering agency.

Financial settlement offset: For financial settlement offsets; the payment amount must be calculated in accordance with the methodology set out in in the QEOP. A web-based 'financial settlement offset calculator' is available on the Qld Government website that can assist in this process. The State is responsible for delivering a conservation outcome from the financial settlement offset payment.

A combination of a proponent-driven offset and financial settlement offset may be utilised.

2.3 MLES – CENTRAL HIGHLANDS REGIONAL COUNCIL

The project is located within the Central Highlands Regional Council LGA, which operates under the *Central Highlands Regional Council Planning Scheme 2016* (Central Highlands Regional Council 2016). As part of this Planning Scheme, matters of local environmental significance (MLES) are identified in overlay maps.

Searches of the *Central Highlands Regional Council Planning Scheme 2016* identified no MLES within the Project area.

3.0 PROJECT ENVIRONMENTAL OFFSET REQUIREMENTS

An ecological assessment comprising desktop assessments and field studies was undertaken to identify ecology values pertaining to the Project. The *Terrestrial Ecology Assessment Report* (AARC 2020a) provides details on the methods, results and impact assessments undertaken to determine if significant residual impacts to prescribed environmental matters are likely to occur as a result of the Project.

The Total Residual Impact Area has been calculated based on the remaining impact to prescribed environmental matters once all reasonable measures to avoid and minimise impacts to each matter was determined. Section 8.0 of the *Terrestrial Ecology Assessment Report* (AARC 2020a) outlines the mitigation and management strategies recommended to minimise and mitigate impacts to ecological values. Magnetic South has designed the project layout to aim to avoid areas of high ecological value, reducing impacts to prescribed environmental matters. Additional mitigation and management strategies are also recommended in the AARC (2020a) report.

3.1 PRESCRIBED MATTERS WITHIN THE STUDY AREA

Table 1 outlines the total offset requirements to be delivered under the QEOP (DES 2020a) as well as the requirements of staged offset strategy.

3.1.1 Endangered or Of Concern Regional Ecosystems

The study area consists of six vegetation communities. The remnant RE's associated with these vegetation communities include 11.5.2, 11.7.2, 11.3.25 and 11.3.2. *Eucalyptus populnea* (poplar box) woodland on alluvial plains (RE 11.3.2) is the only RE within the study area with a VM Act status Of Concern. Only small patches of this vegetation community occur within the study area, occupying 36.52 ha (0.5%) of the total area. Overall, 2.57 ha will be impacted due to Project activities that cannot be avoided or mitigated. Of this 2.57 ha, 1.83 ha will be impacted as part of Stage 1 and 0.74 ha will be impacted as part of Stage 2 (Figure 3).

3.1.2 Vegetation located the within a defined distance from the defining banks of a relevant watercourse

Several watercourses and waterways identified under the VM Act traverse the study area. The remnant vegetation located within the defined distance from the defining banks of identified VM Act watercourses, as defined in Appendix 3 of the QEOP, constitute a prescribed matter. Overall, 58.32 ha of this vegetation associated with the REs 11.5.2, 11.7.2, 11.3.25 and 11.3.2 will be impacted. Stage 1 impacts include 35.4 ha, whereas 22.39 ha will be impacted in Stage 2, due to Project activities that cannot be avoided or mitigated within these areas (Figure 3).

3.1.3 Connectivity areas

The Landscape Fragmentation and Connectivity Tool, used to determine whether a development significantly impacts Connectivity Areas as defined in Schedule 2 (DES 2018), was applied to the proposed extent of the disturbance area. The results found that significant impacts would occur to connectivity at both the local scale and to core remnant areas (Appendix B). It should be noted that the tool was run with the current regulated vegetation layer (DNRME 2020) instead of the field verified vegetation map due to technical limitations of the tool. This minor variation is highly unlikely to influence the results of analysis, being a significant impact on connectivity.

The total 710.72 ha of ground-truthed remnant vegetation within the proposed disturbance area has therefore been proposed to be offset, due to Project activities that cannot be avoided or mitigated. Specifically, 395.55 ha will require an offset in Stage 1 and 315.17 ha in Stage 2.

Table 1: MSES Offset Requirements

MSES	Regional Ecosystem	Residual Impact (ha)	Total Residual Impact Area (ha)	Residual Impact Stage 1 (ha)	Total Residual Impact Area Stage 1 (ha)	Residual Impact Stage 2 (ha)	Total Residual Impact Area Stage 2 (ha)	Habitat Description
Of Concern Regional Ecosystem	11.3.2	2.57	2.57	1.83	1.83	0.74	0.74	This vegetation community was decribed as *Eucalyptus populnea* (poplar box) woodland on alluvial plains. It was represented in several small to moderate patches within the study area and is subject to pressures from grazing and exotic species invasion.
REs located within the defined distance from the defining banks of a VM Act watercourse.	11.5.2	31.01	58.32	11.69	35.4	19.32	22.39	Several VM Act watercourses traverse the Study area. Impacts will occur to watercourse vegetation that is associated with RE 11.3.25, 11.5.2, 11.3.2 and 11.7.2.
	11.3.2	0.59		0.59		0		
	11.7.2	17.82		17.82		0		
	11.3.25	8.9		3.82		5.08		
Connectivity area	-	710.72	710.72	-	395.55	-	315.17	The Landscape Fragmentation and Connectivity Tool determined that there is significant impact to the connectivity of the remnant vegetation within the Project. Landscape Fragmentation and Connectivity Tool is based on current government mapping.
Total			**771.61**		**432.78**		**338.3**	

** The assessment of impact on connectivity using Landscape Fragmentation and Connectivity Tool is based on current government mapping; however, the total area to be offset has been proposed based on the field verified remnant vegetation within the impact area.*

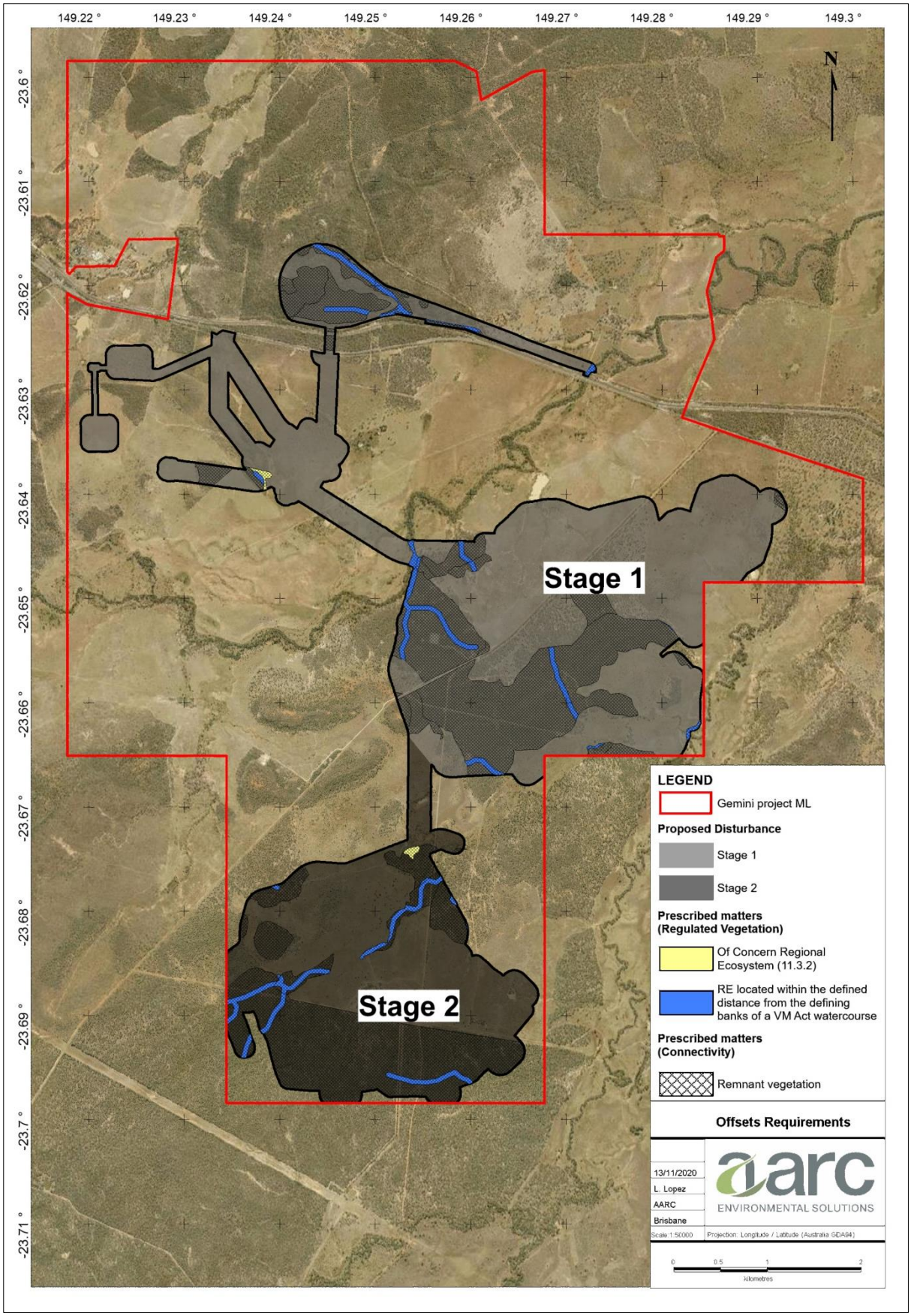

Figure 3: Distribution of prescribed environmental matters within the study area

4.0 OFFSET DELIVERY STRATEGY

The environmental offset requirements for the Project are proposed to compensate for the loss of connectivity, Regulated Vegetation (Of Concern REs), and remnant vegetation located within the defined distance from the defining banks of a VM Act watercourse, detailed in Section 3.1.2.

The Project will be developed progressively and as such, a staged offset delivery approach is proposed. This approach will enable offsets to be estimated accurately and delivered in a way that meets the obligations of the Project without over or underestimating the offset obligations. Staged offsets enable prescribed environmental matters to be accounted for as the project develops with time.

Figure 3 shows the study area and the approach to delivery of offsets.

The following sections outline the offset delivery options for the Project.

4.1 OFFSET DELIVERY ASSESSMENT

Under the QEOP there are three offset delivery options, which include:

- Proponent-driven offsets, taking the form of a land-based offset;
- Proponent-driven offsets, as part of a Direct Benefit Management Plan (DBMP) (can only be up to 10% of the offset delivery); and,
- Financial settlement offset.

A combination of offset delivery options is acceptable. However, the DBMP can only contribute up to 10% of the offset delivery.

Magnetic South is proposing to deliver a combination of Proponent-driven land-based offsets and financial settlement offsets. At this stage of Project development Magnetic South is yet to confirm exact proportions. This detail will be provided in the Offset Delivery Plan to be prepared following project approval before impact on the prescribed environmental matter occurs.

The offset delivery options described below are proposed.

4.1.1 Land-based offset

Magnetic South is likely to provide a portion of the offset delivery on suitable land they own in the vicinity of the Project or provided by a third-party offset provider.

4.1.1.1 Condition Assessment of land-based offsets

For land-based offsets, the suitability of the offset site relative to the impact site is measured by undertaking a habitat quality assessment. This assessment will be undertaken using the *Guide to Determining Terrestrial Habitat Quality* (DES 2020b) to measure a conservation outcome.

The *Guide to Determining Terrestrial Habitat Quality* (DES 2020b) outlines two processes that can be undertaken when determining habitat quality. The Rapid Assessment process can be used to approximate a habitat quality score without undertaking a Standard Assessment. This Rapid Assessment can only be used on the impact site, providing a habitat quality score of 7 out of 10. This score represents an average score of generic remnant RE's in Queensland derived from Queensland Herbarium experts.

The Standard Assessment process can also be used to determine habitat quality for impact sites and forms a requirement for offset supply sites. To determine the habitat quality score a more rigorous field evaluation is undertaken, including the measurement of ecological condition parameters from transects established within defined assessment units.

4.1.1.2 Calculation of offset supply

Once the habitat quality scores have been determined for the offset and impact sites these numbers are entered into the Land-based Offset Multiplier Calculator. This calculator uses the inputted information to determine the required size of an offset supply land for each value.

A multiplier is defined as "*a number used to calculate the size of the offset requirement given the significant residual impact area, for a given prescribed environmental matter*". The required offset area is calculated by multiplying the area of impact by the prescribed multiplier:

Offset Area = Area of Impact x Multiplier

The prescribed multiplier is set at a maximum of four (i.e. a maximum of four times the area of the residual impact), except for impacts to connectivity and waterways providing for fish passage, for which the prescribed multiplier is set to a maximum of one.

For the purposes of this Environmental Offsets Strategy, the maximum multiplier was assumed to calculate the maximum size of the offset supply. Estimated offset supply areas required for the Project are summarised in Table 2.

4.1.1.3 Offset delivery steps

The proponent will provide a notice of election including a proposed offset delivery plan, prior to impacts occurring.

Where land-based offsets are proposed, the next stage of offset delivery will include field ecology surveys of the potential offset supply sites. Surveys will aim to validate the suitability of habitats, assess ecological condition and collect information to support preparation of offset management plans. Final offset calculators will then be prepared post field validation to confirm the extent of offset supply land required.

An outline of potential offset supply areas for the Project has been described in Section 4.2, based on the land-based offset requirements mentioned below.

Table 2: Estimated offset supply requirement

MSES	Habitat Description	Regional Ecosystem	Total Residual Impact Area (ha)	Total Residual Impact Area Stage 1 (ha)	Total Residual Impact Area Stage 2 (ha)	QEOP Multiplier	Total Required Supply Area (ha)	Stage 1 Required Supply Area (ha)	Stage 2 Required Supply Area (ha)	QEOP Offset Supply Criteria
Of Concern Regional Ecosystem	This vegetation community was characterised by *Eucalyptus populnea* (poplar box) woodland on alluvial plains. It was represented in several small to moderate patches within the study area and is subject to pressures from grazing, exotic species invasion.	11.3.2	2.57	1.83	0.74	4	10.8	7.32	2.96	In relation to endangered and of concern regional ecosystems—the offset site must be: • Of the same broad vegetation group as the impacted Regional Ecosystem; • Of the same regional ecosystem status; and • Within the same bioregion
REs located within the defined distance from the defining banks of a VM Act watercourse.	Several VM Act watercourses traverse the Study area. Impacts will occur to watercourse vegetation that is associated with RE 11.3.25, 11.5.2, 11.3.2 and 11.7.2.	11.5.2	31.01	11.69	19.32	4	233.28	135.68	97.6	For vegetation intersecting a watercourse or drainage feature the offset site must be: • Of the same broad vegetation group as the impacted Regional Ecosystem; • Within the same bioregion; and • Associated with a watercourse or drainage feature
		11.3.2	0.59	0.59	0.00					
		11.7.2	17.82	17.82	0.00					
		11.3.25	8.9	3.82	5.08					
		Total	58.32	33.92	24.4					

Connectivity area	The Landscape Fragmentation and Connectivity Tool determined that there is significant impact to the connectivity of the remnant vegetation within the Project. Landscape Fragmentation and Connectivity Tool is based on current government mapping.	-	710.72	395.55	315.17	1	710.72	395.55	315.17	• Must be a non-remnant ecosystem; and • Must be in the same subregion; however, if the subregion is intact, the offset should be in the nearest fragmented subregion.
						Total	**954.8**	**538.55**	**415.73**	

4.1.2 Financial Settlement Offset

Magnetic South expect to deliver a portion of the offset supply requirement via financial settlement. This involves payment of an amount, calculated in accordance with the Financial Settlement Offset Calculation Methodology, outlined in Appendix 4 of the QEOP. The financial settlement calculation can be based off the *Queensland Government's Financial Settlement Offset Calculator* or the formula within Appendix 4 of the QEOP. It should be noted that both methods of calculation use the same components to determine the financial offset total.

The financial settlement calculation is based on the following formula:

Financial settlement = (total offset area x on-ground cost per ha) + landholder incentive payment + administrative cost

Each component within the above calculation uses different inputs and has its own specific formula, which is also outlined in Appendix 4 of the QEOP.

Calculation of the financial settlement for 100% of the offset requirement has been provided below and can be found in detail in Appendix B:

- In total $3,786,509.52 would be required to secure an offset of 954.8 ha for the entire study area;
- $2,192,600.70 would be required to secure an offset of 538.55 ha for Stage 1 only; and,
- $1,721,708.82 would be required to secure an offset of 415.73 ha for Stage 2 only.

Magnetic South will recalculate the financial offset contribution for the specific proportion of offset requirement determined. This will be defined in the Notice of Election and Offset Delivery Plan.

4.2 POTENTIAL OFFSET SUPPLY AREAS FOR THE PROJECT

Under the QEOP; to enhance the likelihood of the environmental offset being successful and achieving a conservation outcome, the offset should be in a strategic location that provides tangible benefits for the impacted prescribed environmental matter. This will be achieved through the following approach:

- Wherever possible offsets will be located within a Strategic Offset Investment Corridor (SOIC) closest to the impacted site; and
- In order of priority:
    - Offsets will be located within the same LGA; and/or
    - Offsets will be located within the same sub-region; and/or
    - Offsets will be located within the same bioregion.

4.2.1 Offset target areas

Figure 4 displays the study area in relation to the above supply location priorities. The Southern Brigalow Belt Bioregion has SOIC's defined, which occur in the same LGA and sub-bioregion as the Project. The area in Figure 5 represented by cross hatching shows the overlap of the Central Highlands Regional Council LGA, and the Woorabinda sub-bioregion (of the Southern Brigalow Belt Bioregion). This area (further accented by a pale pink background) represents the most strategic area for the Project's offset supply to be located, referred to as the Target Offset Supply Area.

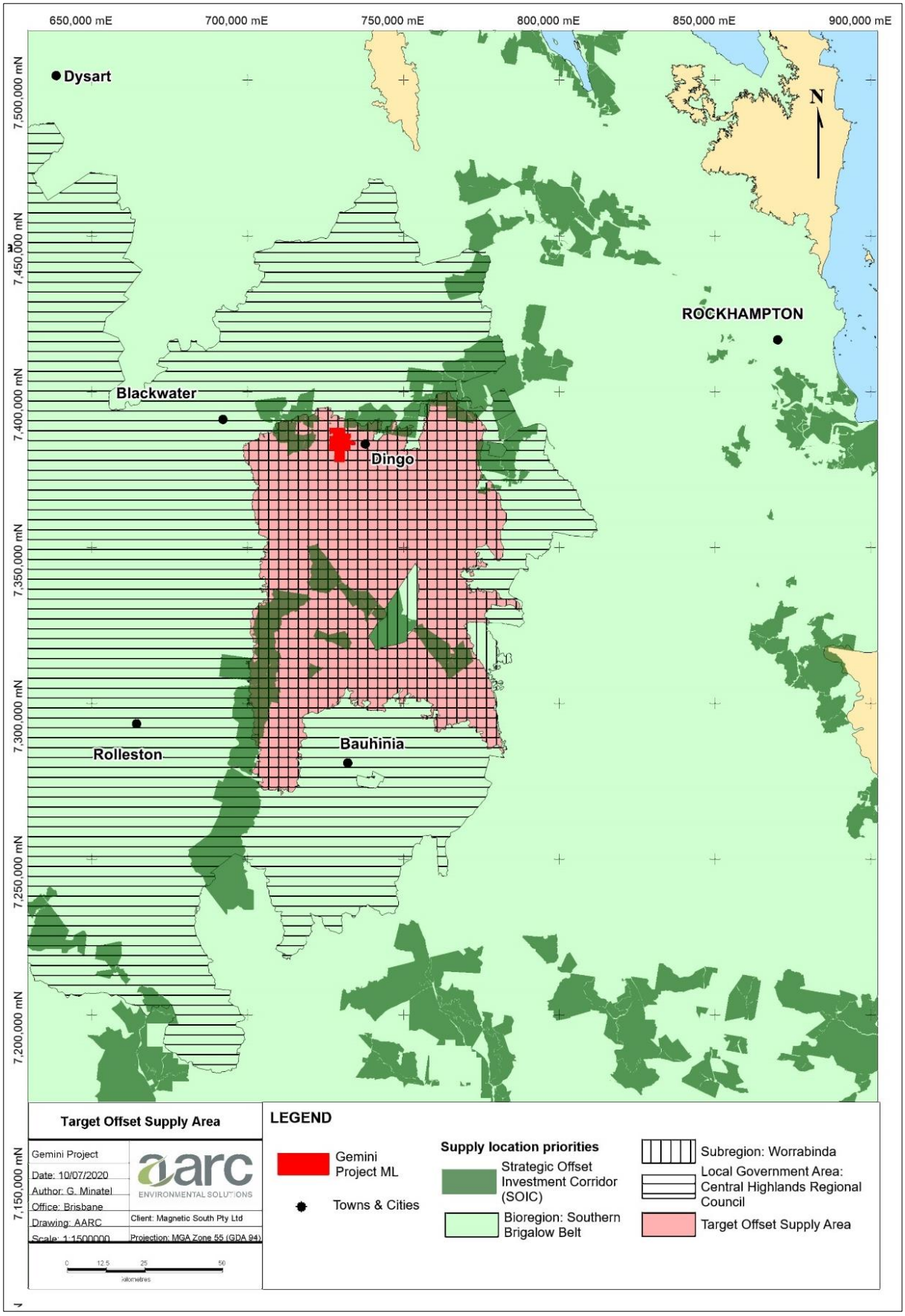

Figure 4: Target area for offset supply

Within the Target Offset Supply Area; pre-clear and remnant RE mapping was utilised to determine spatial availability of potential offset supply. Protected Areas, external Mining Leases, MSES legally secured offset areas and Category A regulated vegetation were removed from the potential offset supply areas, to give a more accurate estimation of the land that would be available for offsetting.

Table 3 outlines the potential supply area for each impacted matter, and the resulting targeted criteria for selection of potential offset supply. The available area for each impacted matter has been delineated into existing remnant vegetation, and non-remnant. Identification of suitable non-remnant sites was based on the *Vegetation management pre-clear regional ecosystem map - version 11.0* (DNRME 2019). The following calculations are based on the available area within the Target Offset Supply Area and within 35km from the study area.

Table 3: Potential offset supply area

Impacted Matter	Offset Supply Requirements	Total Supply Area Required (ha)	Stage 1 Required Supply Area (ha)	Stage 2 Required Supply Area (ha)	Supply Available: Non-remnant (ha)	Supply Available: Remnant (ha)
Of Concern Regional Ecosystem	• Of the same *broad vegetation group* as the impacted regional ecosystem; • Of the same regional ecosystem status; and • Within the same bioregion	10.8	7.32	2.96	14,137.01	2,780.61
REs located within the defined distance from the defining banks of a VM Act watercourse.	• Of the same broad vegetation group as the impacted regional ecosystem; • Within the same bioregion; and • Associated with a watercourse or drainage feature	233.28	135.68	97.6	4,454.30	2,652.00
Connectivity area	• A non-remnant ecosystem; and • In the same subregion; however, if the subregion is intact, the offset should be in the nearest fragmented subregion	710.72	395.55	315.17	157,710.89	-

Ideally, offset supply areas will be located close to the impact site. Figure 5 illustrates the potential offset supply within the Target Offset Supply Area and within 35 km of the Project. Subject to suitable land acquisition arrangements, it would be possible to satisfy 100% of required offset supply within these local areas.

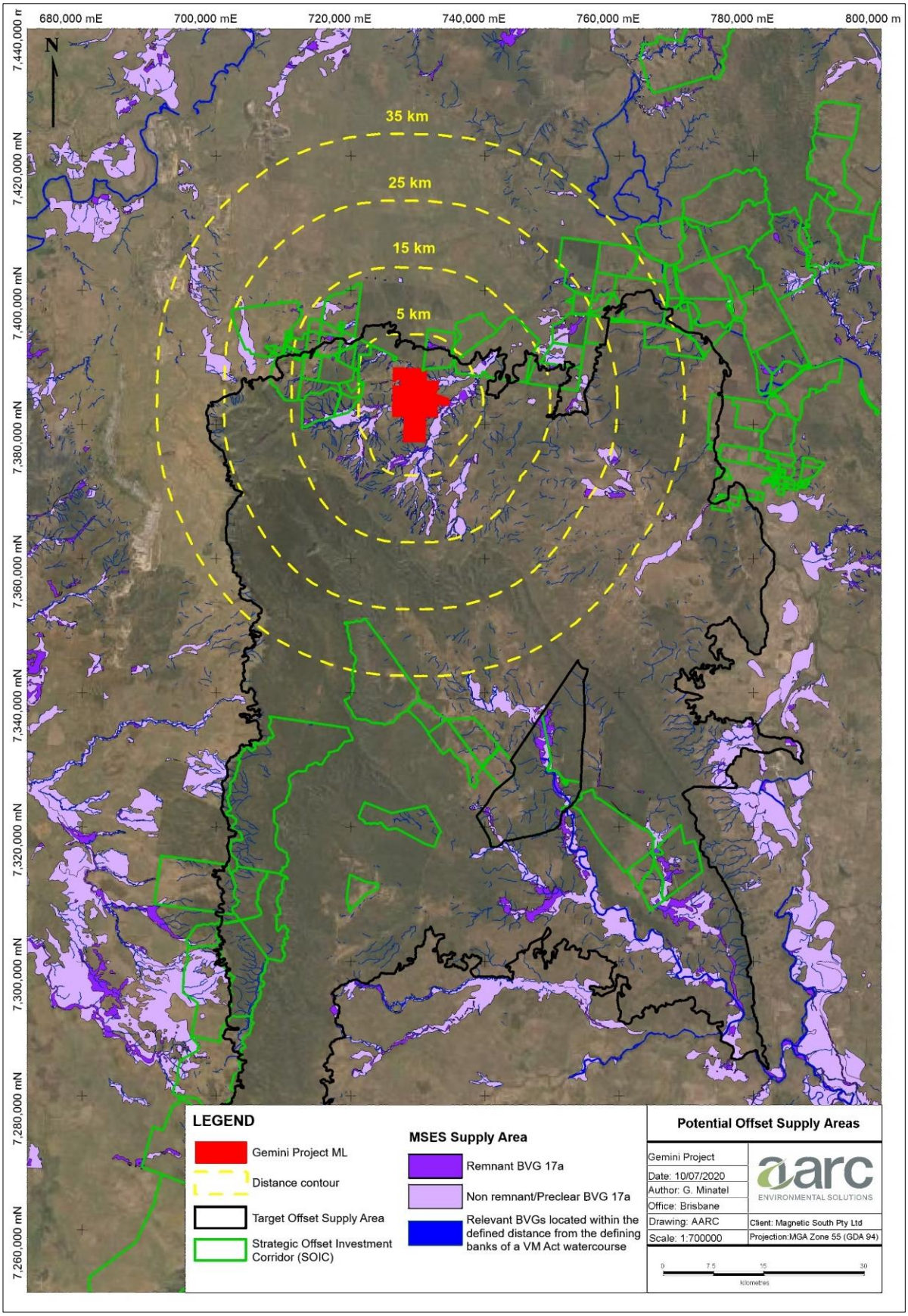

Figure 5: Potential offset supply areas within 35km

4.2.2 Offset supply on Magnetic South land

Magnetic South is the owner of land underlying the Project, along with some adjacent land parcels (Figure 6). Given the location of this land in relation to the proposed disturbance, this area is considered a suitable option for offset supply.

Although the final offset supply area will be subject to condition analysis, preliminary desktop assessment indicates the likely presence of sufficient offset supply land within Magnetic South properties to satisfy 100% of the offset requirement for the Project.

An impact area may have more than one prescribed environmental matter located on it. The Queensland Environmental Offsets Policy allows for the co-location of multiple prescribed environmental matters, except for species categorised into different functional groups.

Where possible, the offset requirements will be co-located (e.g. connectivity).

Table 4: Area of potential offset land within Magnetic South properties

Impacted Matter	Offset Supply Requirements	Total Supply Area Required (ha)	Stage 1 Required Supply Area (ha)	Stage 2 Required Supply Area (ha)	Supply Available: Non-remnant (ha)	Supply Available: Remnant (ha)
Of Concern Regional Ecosystem	• Of the same *broad vegetation group* as the impacted regional ecosystem; • Of the same regional ecosystem status; and • Within the same bioregion	10.8	7.32	2.96	1,744	426.99
REs located within the defined distance from the defining banks of a VM Act watercourse.	• Of the same broad vegetation group as the impacted regional ecosystem; • Within the same bioregion; and • Associated with a watercourse or drainage feature	233.28	135.68	97.6	355.13	355.2
Connectivity area	• A non-remnant ecosystem; and • In the same subregion; however, if the subregion is intact, the offset should be in the nearest fragmented subregion	710.72	395.55	315.17	4,763	-

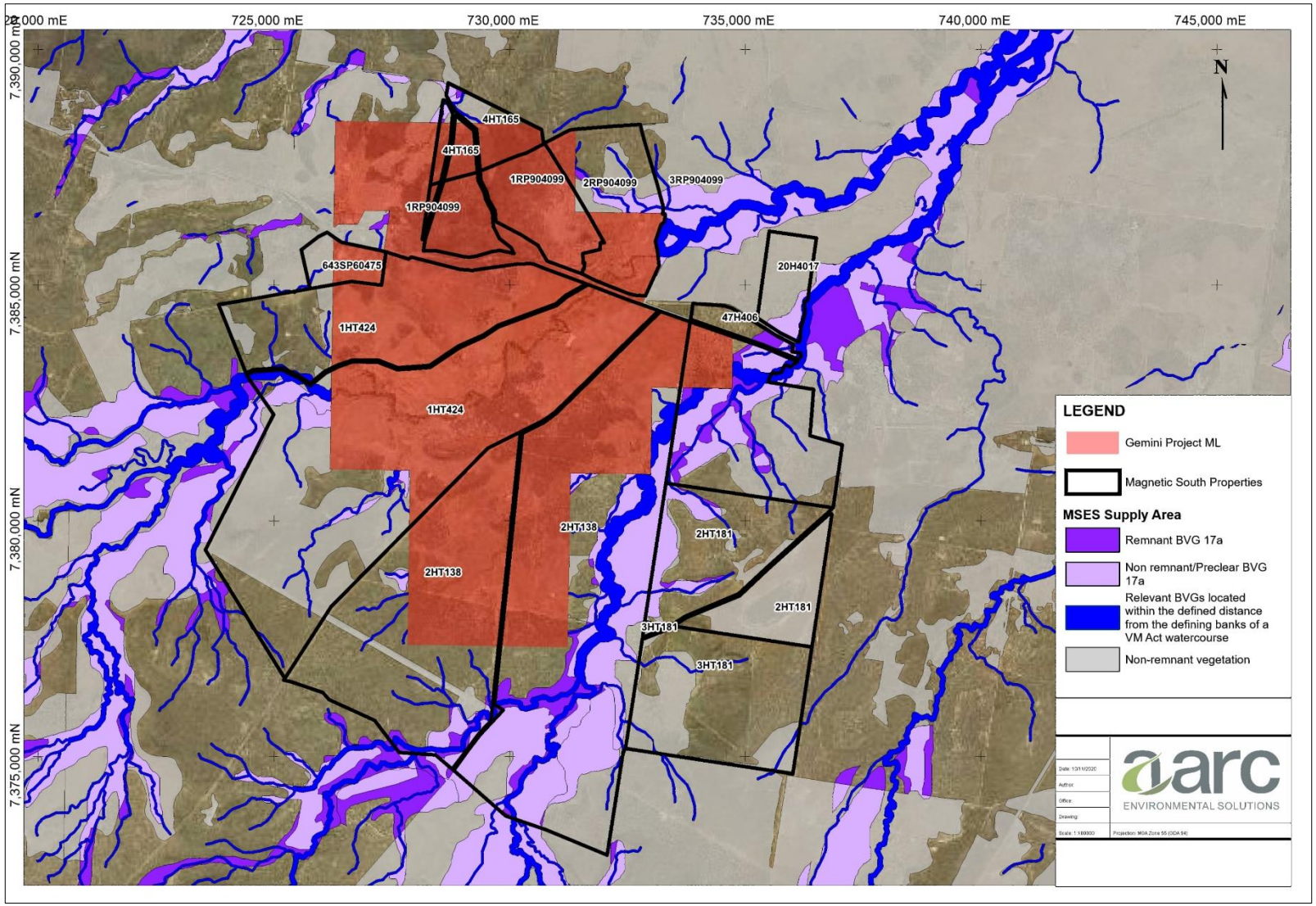

Figure 6: Potential offset supply areas within Magnetic South properties

5.0 CONCLUSION

Based on results of the significant residual impact assessment, impacts to three different MSES are proposed to be offset. Environmental offsets for the Project will include a combination of land-based offset supply and financial settlement. A two staged delivery approach is proposed.

A desktop assessment of offset supply areas was undertaken within properties owned by Magnetic South adjacent to the Project, as well as within a broader region (within 35 km of the Project). This analysis concluded that 100% of the offset requirement can likely be satisfied within the Magnetic South properties alone. However, substantial further supply opportunity exists in the surrounding landscape

Prior to project development, a condition assessment will be undertaken for both impacted land and offset supply land. A specific offset delivery plan will be prepared and submitted for approval prior to impacts occurring.

6.0 REFERENCES

AARC Environmental Solutions Pty Ltd (AARC) 2020a, Gemini Project: Terrestrial Ecology Assessment, prepared for Magnetic South Pty Ltd.

AARC Environmental Solutions Pty Ltd (AARC) 2020b, Gemini Project: Aquatic Ecology Assessment, prepared for Magnetic South Pty Ltd.

AARC Environmental Solutions Pty Ltd (AARC) 2020c, Gemini Project: Site-specific EA Application: Supporting Information, prepared for Magnetic South Pty Ltd.

Central Highlands Regional Council 2016, Central Highlands Planning Scheme 2016 (Amendment No. 4), Central Highlands Regional Council, viewed 1 July 2020 <http://www.centralhighlands.qld.gov.au/building-planning-projects/development/planning-documents/central-highlands-regional-planning-scheme/>.

Department of Environment and Heritage Protection (EHP) 2014, Queensland Environmental Offsets Policy: Significant Residual Impact Guideline, Department of Environment and Science, State of Queensland, Brisbane, viewed 2 July 2020 <https://environment.des.qld.gov.au/__data/assets/pdf_file/0017/90404/significant-residual-impact-guide.pdf >.

Department of Environment and Science (DES) 2020a, Queensland Environmental Offsets Policy (Version 1.8), Department of Environment and Science, State of Queensland, Brisbane, viewed 1 July 2020 < https://environment.des.qld.gov.au/__data/assets/pdf_file/0018/102834/offsets-policyv1-8.pdf>

Department of Environment and Science (DES) 2020b, Guide to determining terrestrial habitat quality: Methods for assessing habitat quality under the Queensland Environmental Offsets Policy (Version 1.3), Department of Environment and Science, State of Queensland, Brisbane, viewed 1 July 2020 < https://environment.des.qld.gov.au/__data/assets/pdf_file/0017/102833/habitat-quality-assessment-guide-v1-3.pdf>

Department of Natural Resources Mines and Energy (DNRME) 2019, *Vegetation management pre-clear regional ecosystem map - version 11.0*, Department of Natural Resources Mines and Energy, State of Queensland, Brisbane, viewed July to November 2020.

Appendix A Land Fragmentation Connectivity Tool Results

Department of Environment and Heritage Protection (DEHP)
Landscape Fragmentation and Connectivity (LFC) Tool version 1.4 LOGFILE
Process started at 11-11-2020 07:13:08 PM
Python version: 2.7.14 (v2.7.14:84471935ed, Sep 16 2017, 20:19:30) [MSC v.1500 32 bit (Intel)]
Arcpy version: 10.6
Username: carte

INPUT PARAMETERS
Output Workspace: W:\RACAD\AARC LFC TOOL - DINGO WEST\LFC OUTPUT
Threshold lookup table: W:\RACAD\12 - QLD DATA - LFC TOOL\LFC_data.gdb\tbl_Regional_frag_local_threshold
Remnant cover layer: W:\RACAD\AARC LFC TOOL - DINGO WEST\RVM MAPPING EXTRACT\Regulated_vegetation_management_export.shp
Remnant cover layer edited: False
Regional buffer extent: 20 kilometres
Local buffer extent: 5 kilometres
Impact layer: W:\RACAD\AARC LFC TOOL - DINGO WEST\DISTURBANCE AREAS\20201109 Infrastructure_Buffer100m AREA.shp
layer projection: GDA_1994_MGA_Zone_55
Raster cell resolution for analysis: 10 metres
Edge Width: 50 metres
(The distance from non-remnant landscapes through to the core ecosystem - the edge of remnant ecosystems)
Default projection: W:\RACAD\12 - QLD DATA - LFC TOOL\scripts\QLD Albers Equal Area Conic.prj

19:13:08 Checking out the spatial analyst tool - required for LFC

19:13:08 BEGINNING LANDSCAPE FRAGMENTATION AND CONNECTIVITY ANALYSIS

19:13:08 This tool will categorise the landscape into:
{0: 'non-rem', 1: 'patch', 2: 'edge', 3: 'perforated', 4: 'core (< 100 hectares)', 5: 'core (100-500 hectares)', 6: 'core (> 500 hectares)', 7: 'water'}

19:13:29 W:\RACAD\AARC LFC TOOL - DINGO WEST\LFC OUTPUT\lyr_file does not exist, creating it now.
19:13:29 Copying across impact site feature(s) and calculating area in hectares (AreaHA)
19:13:32 Making a local copy of the impact site
19:13:34 Preparing remnant cover layer for analysis
19:13:37 Created regional scale buffer of 20 kilometres
19:13:39 Created local scale buffer of 5 kilometres
19:13:47 Clipped the remnant cover to the regional buffer extent
19:13:49 Unioned the pre impact remnant layer with the impact site
19:13:53 Attributed the impact area as not RVM Cat B
19:13:53 Area of RVM Cat B clearing is 783.38 hectares
19:13:53 SQL selection used is "RVM_CAT" = 'B' and "Cover" = 'Not RVM Cat B' on shapefile W:\RACAD\AARC LFC TOOL - DINGO WEST\LFC OUTPUT\main_output\clip_remcover_post.shp

19:13:55 Categorised the cover attributes in clip_remcover_pre.shp ready for raster conversion
19:15:00 Converted clip_remcover_pre.shp to raster

19:15:03 Categorised the cover attributes in clip_remcover_post.shp ready for raster conversion
19:16:11 Converted clip_remcover_post.shp to raster

19:16:11 Run Landscape fragmentation analysis on the pre impact regional landscape

REGULATED VEGETATION TYPES BEING EXTRACTED FROM LAND COVER
IDENTIFICATION OF CORE, PATCH, EDGE AND PERFORATIONS
COMBINING FRAGMENTATION CLASSES

CLASSIFYING CORE FOREST PATCHES BY AREA
COMPOSING FINAL FRAGMENTATION MAP
COMPOSING FINAL FRAGMENTATION MAP
(FRAGMENTATION CALCULATION TIME WAS 21.2 MINUTES)

19:37:25 Run Landscape fragmentation analysis on the post impact regional landscape

REGULATED VEGETATION TYPES BEING EXTRACTED FROM LAND COVER
IDENTIFICATION OF CORE, PATCH, EDGE AND PERFORATIONS
COMBINING FRAGMENTATION CLASSES
CLASSIFYING CORE FOREST PATCHES BY AREA
COMPOSING FINAL FRAGMENTATION MAP
COMPOSING FINAL FRAGMENTATION MAP
(FRAGMENTATION CALCULATION TIME WAS 21.3 MINUTES)

Extracting a local subset of lfc_regional_pre_impact
Extracting a local subset of lfc_regional_post_impact

Collating pre and post impact statistics and trigger assessment
20:01:17 Summarising area statistics for: lfc_localmsk_pre_impact
20:01:19 Summarising area statistics for: lfc_localmsk_post_impact
20:01:20 Summarising area statistics for: lfc_regional_pre_impact
20:01:29 Summarising patch count for lfc_localmsk_pre_impact
20:02:43 Summarising patch count for lfc_localmsk_post_impact

Analysing impact on Connectivity Areas

SIGNIFICANCE TEST ONE

The regional total area is 182159.98
The regional extent of core remnant is 85580.99
The regional extent of core remnant is 46.98 percent
This level of regional fragmentation sets a local impact threshold of: 10.0 percent

The table below lists the local impact thresholds for categories of regional core remnant extent:

REGIONAL CORE CATEGORY	LOCAL IMPACT THRESHOLD
< 10	2.0
10 - 30	5.0
30 - 50	10.0
50 - 70	20.0
70 - 90	30.0
>90	50.0

Area of core at the local scale (pre impact): 8941.33
Area of core at the local scale (post impact): 8264.93
Percent change of core at the local scale (post impact): 7.56 percent

SIGNIFICANCE TEST TWO

The number of core remnant areas occurring on the site: 10
The number of core remnant areas remaining on the site post impact: 7
(Only core polygons greater than or equal to 1 hectare are included)

RESULT

20:04:55 This analysis has determined a SIGNIFICANT impact on connectivity areas
(A significant reduction in core remnant at the local scale is False OR a change from core to non-core remnant at the site scale is True)

(Total area of RVM Cat B clearing is 783.38 hectares)

The significance table has been written to: ..\main_output\lfc_significance_assessment.csv
The local scale summary table has been written to: ..\main_output\lfc_local_scale_summary.csv
The site scale summary table has been written to: ..\main_output\lfc_site_scale_summary.csv
GIS layer files copied into folder \lyr_file within the project folder.
View layers in ArcMAP using..\W:\RACAD\AARC LFC TOOL - DINGO WEST\LFC OUTPUT\lyr_file\lyr_file\Connectivity Area Impact Assessment.lyr

Please scrutinise the output tables and spatial layers to confirm the desktop modelling of connectivity area impact

This analysis used an unedited copy of the Regulated Vegetation layer.

20:43:31 COMPLETED LANDSCAPE FRAGMENTATION AND CONNECTIVITY ANALYSIS

Appendix B Financial Settlement Offset Calculator Results

Environmental offsets calculator results - Financial settlement offset calculator

Payment details

Non-protected area cost

On ground cost	$2,962,840.00
Landholder incentive payment	$82,959.52
Administrative cost	$740,710.00
Total non-protected area cost	$3,786,509.52

Protected area cost

Total protected area cost	$0.00

Total cost

Grand total	$3,786,509.52

Total offset area: 954.28 ha

Section 1

LGA
Central Highlands Regional Council
Bioregion
Brigalow Belt
Subregion
Woorabinda
Impact area
771.61 ha
Notional offset area
954.28 ha
Distinct matter area 1.1

Impact area: 2.57 ha
Notional offset area: 10.28 ha

Matter groups:

- 1.1.1: Regional ecosystem - 11.3.2 (Eucalyptus populnea woodland on alluvial plains)

Distinct matter area 1.2

Impact area: 31.01 ha
Notional offset area: 124.04 ha

Matter groups:

- 1.2.1: Regional ecosystem - 11.5.2 (Eucalyptus crebra, Corymbia spp., with E. moluccana woodland on lower slopes of Cainozoic sand plains and/or remnant surfaces)

Distinct matter area 1.3

Impact area: 0.59 ha
Notional offset area: 2.36 ha

Matter groups:

- 1.3.1: Regional ecosystem - 11.3.2 (Eucalyptus populnea woodland on alluvial plains)

Distinct matter area 1.4

Impact area: 17.82 ha
Notional offset area: 71.28 ha

Matter groups:

- 1.4.1: Regional ecosystem - 11.7.2 (Acacia spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone)

Distinct matter area 1.5

Impact area: 8.9 ha
Notional offset area: 35.6 ha

Matter groups:

- 1.5.1: Regional ecosystem - 11.3.25 (Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines)

Distinct matter area 1.6

Impact area: 710.72 ha
Notional offset area: 710.72 ha

Matter groups:

- 1.6.1: Connectivity

Sections, areas and matter groups used in calculations

Section	Bioregion / Marine (and waterways) zone	Subregion / Marine bioregion	Local government area (LGA)	Distinct matter area (DMA)	DMA impact area (ha)	DMA notional offset area (ha)	Matter group
1	Brigalow Belt	Woorabinda	Central Highlands Regional Council	1.1	2.57	10.28	1.1.1 Regional ecosystem - 11.3.2 (Eucalyptus populnea woodland on alluvial plains)

Sections, areas and matter groups used in calculations

Section	Bioregion / Marine (and waterways) zone	Subregion / Marine bioregion	Local government area (LGA)	Distinct matter area (DMA)	DMA impact area (ha)	DMA notional offset area (ha)	Matter group
1	Brigalow Belt	Woorabinda	Central Highlands Regional Council	1.2	31.01	124.04	1.2.1 Regional ecosystem - 11.5.2 (Eucalyptus crebra, Corymbia spp., with E. moluccana woodland on lower slopes of Cainozoic sand plains and/or remnant surfaces)
1	Brigalow Belt	Woorabinda	Central Highlands Regional Council	1.3	0.59	2.36	1.3.1 Regional ecosystem - 11.3.2 (Eucalyptus populnea woodland on alluvial plains)
1	Brigalow Belt	Woorabinda	Central Highlands Regional Council	1.4	17.82	71.28	1.4.1 Regional ecosystem - 11.7.2 (Acacia spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone)
1	Brigalow Belt	Woorabinda	Central Highlands Regional Council	1.5	8.9	35.6	1.5.1 Regional ecosystem - 11.3.25 (Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines)
1	Brigalow Belt	Woorabinda	Central Highlands Regional Council	1.6	710.72	710.72	1.6.1 Connectivity