CENTRAL NORTH EXTENSION
Preliminary Documentation Ver 2

PREPARED FOR

JELLINBAH GROUP PTY LTD

ON BEHALF OF THE JELLINBAH EAST JOINT VENTURE

November 2019

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LIST OF ABBREVIATIONS

$	dollars (in the Australian currency)
%	percent
<	less than
>	greater than
2D	two-dimensional
3D	three-dimensional
AARC	AARC Environmental Solutions Pty Ltd
AEP	Annual Exceedance Probability
ALA	Atlas of Living Australia
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZECC Guidelines	*Australian and New Zealand Guidelines for Fresh and Marine Water Quality*
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AS	Australian Standard
CHMP	Cultural Heritage Management Plan
CHPP	Coal Handling and Preparation Plant
CHRC	Central Highlands Regional Council
cm	centimetre(s)
CN	Central North
CNE	Central North Extension
CSG	coal seam gas
DES	Department of Environment and Science
DNRME	Department of Natural Resources, Mines and Energy
DoEE	Department of the Environment and Energy
EA	Environmental Authority
EC	electrical conductivity
EO Act	*Environmental Offsets Act 2014*
EP Act	*Environmental Protection Act 1994*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPP (Water)	*Environmental Protection (Water) Policy 2009*
ESD	Ecologically Sustainable Development
GBRMP	Great Barrier Reef Marine Park

GDE	Groundwater Dependent Ecosystem(s)
ha	hectare(s)
IECA	International Erosion Control Association Australasia
IESC	Independent Expert Scientific Committee
JBT	JBT Consulting Pty Ltd
Jellinbah	Jellinbah Group Pty Ltd
K	hydraulic conductivity
Kh	horizontal hydraulic conductivity
km	kilometre(s)
km^2	square kilometre(s)
kPa	kilopascal(s)
Kz	vertical hydraulic conductivity
L	litre(s)
m	metre(s)
m/s	metre(s) per second
m^2	square metre(s)
m^3	cubic metre(s)
m^3/s	cubic metres per second
MAW	mine affected water
mbgl	metre(s) below ground level
mg/L	milligram(s) per litre
ML	mining lease(s)
mm	millimetre(s)
MNES	Matter(s) of National Environmental Significance
Mt	million tonne(s)
Mtpa	million tonne(s) per annum
mv	volume compressibility
NPWS	National Parks and Wildlife Service
NSW	New South Wales
PCI	pulverised coal injection
PD	Preliminary Documentation
PMS	Protected Matters Search
QEOP	Queensland's Environmental Offset Policy
QLD	Queensland

RE	regional ecosystem(s)
REDD	Regional Ecosystems Descriptions Database
REMP	Receiving Environmental Monitoring Program
ROM	run-of-mine
RRMC	rainfall residual mass curve
SPRAT	Species Profile and Threats Database
Ss	specific storage
Sy	specific yield
TDS	total dissolved solids
TEC	Threatened Ecological Community(ies)
the Mine	Jellinbah Coal Mine
the Project	Jellinbah Central North Extension
TSSC	Threatened Species Scientific Committee
UDP	UDP Group Services Pty Ltd
WMP	Water Management Plan
WQO	Water Quality Objective(s)
µS/cm	micro Siemens per centimetre

1.0 INTRODUCTION

The following Preliminary Documentation for the Jellinbah Central North Extension (the Project) is a revision of the Preliminary Documentation submitted in March 2019. The revised Preliminary Documentation has been updated based on advice received from the Independent Expert Scientific Committee (IESC) on the 29th May 2019 and following consultation with the Department of Environment and Energy (DoEE) in July 2019.

The Preliminary Documentation addresses all of the concerns raised by the IESC and DoEE regarding Aquifer Connectivity (Section 7.5), Groundwater Dependent Ecosystems (GDEs) (Section 0), the Groundwater Model (Section 7.0), Flooding and Final Voids (Section 6.0 and Section 9.0), Catchment Analysis (Section 6.2), the Jellinbah Site Water Balance and Water Management Plan (Section 2.5 and Section 6.3), and the Jellinbah REMP (Section 11.3.1.1).

In addressing the IESC advice, the following appendix reports were added, amended, or replaced:

- The Jellinbah Mine Central North Extension Water Management Plan (Appendix C6, Engeny 2019a) replacing the Jellinbah Mine Site Water Management Plan (UDP 2016);
- The Jellinbah Coal Mine REMP Design Report (Appendix D3, AARC 2019b) – Additional Appendix;
- A Local Surface Water Quality Extended Dataset (Appendix D4) – Amended;
- The Central North Pit Final Void Hydrology Study (Appendix D5, Engeny 2019b) – Additional Document;
- The Jellinbah Central North Extension Flood Assessment (Appendix D6, WRM 2019) – Additional Document; and
- The Conceptual and Numerical Groundwater Modelling report (Appendix D7, JBT 2019) – Amended Document.
- Jellinbah Stage 3 Levee — Consequence Assessment Report (Appendix D8, Parsons Brinckerhoff 2015) – Additional Document
- IESC Cross Reference Table (Appendix E1) – Updated.

2.0 DESCRIPTION OF PROPOSED ACTION

The Jellinbah Central North Extension (the Project) proposes the addition of three mining leases (MLs) to the existing Jellinbah Coal Mine (the Mine). The purpose of the Central North Extension is to extend approved mining activities further to the east and expand the area available for spoil dumping and topsoil placement. No changes to the currently approved mining methods or production rates are proposed.

2.1 PROJECT LOCATION

The Jellinbah Coal Mine and proposed Central North Extension (CNE) are located in the Bowen Basin in central Queensland (QLD). The operational area of the current mine is located approximately 30 kilometres (km) north-east of Blackwater and 180 km west of Rockhampton, within the Central Highlands Regional Council (CHRC) area. The Mine encompasses three operating mine areas – Jellinbah Central, operated by Jellinbah Group Pty Ltd (Jellinbah), Jellinbah Plains, a contractor-run operation and Mackenzie North, operated by Jellinbah. Figure 1 shows the regional location of the Project and the new MLs.

The CNE area represents a small extension of the approved central north mining area. The CNE is located south of the Plains mining area as defined in Figure 1.

2.2 CURRENT LAND USE

The existing land use of the CNE area is low intensity cattle grazing. The topography consists of flat to gently undulating plains. Five stock watering dams, several exploration tracks, drill pads, and a powerline easement are located within the Project area. Surface water resources in the Project are currently used for livestock watering. The Project is located within the freehold lots shown in Table 1, and landholder agreements have been finalised for all proposed actions.

Table 1 Properties Underlying the Project

Real Property Description	Tenure	Land Holder
6 LR94	Freehold	Peter John Dunne
100 SP230773	Freehold	Jellinbah East Joint Venture
2 SP213140	Freehold	Peter John Dunne
3 SP213140	Freehold	Jellinbah East Joint Venture

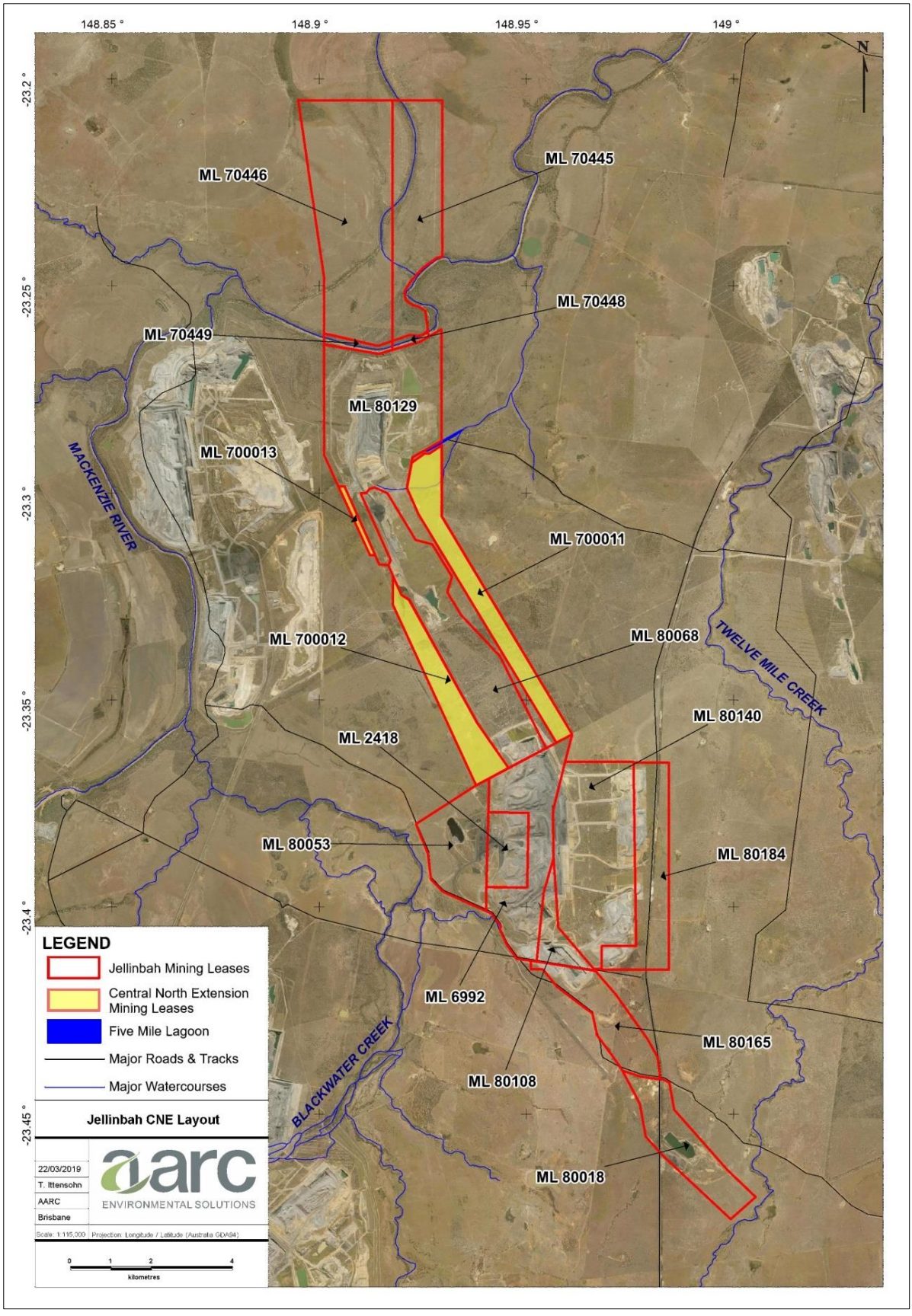

Figure 1 Jellinbah Coal Mine Site Overview

2.3 PROJECT ACTIVITIES

The main mining operations at Jellinbah occur in the Central mining precinct, which includes workshops, offices, and the coal wash plant. Runoff containment dams and a tailings dam are located at Central.

Progressive backfilling of the Plains mining void has occurred in recent years with coal production planned to cease in 2020. The Plains site has a ROM area, including a crusher, from which coal transported directly to the Boonal Loadout Facility.

Mining operations in Mackenzie North include an open cut pit that will progress to the south towards Mackenzie River and include a crusher, from which coal is transported either to Central CPP for washing or directly to Boonal Loadout Facility. The Mackenzie North Pit commenced pre-stripping in late 2019 and is expected to commence coal haulage in 2020. Mine-affected water dams and sediment dams are located in the Mackenzie North precinct.

Jellinbah Central mining area will be progressed into the authorised Central North (CN) mining area over the next few years and ultimately under this proposal, will extend the CN mining area outside the existing approved area, downdip to the east by approximately 450 metres (m). This small extension is the subject of the CNE proposal. The location of the CNE relative to the Jellinbah Central, Jellinbah Plains, and CN mining areas is shown below in Figure 1.

The purpose of the Project is to extend mining activities for current resource areas and expand the area available for dumping of spoil into three new MLs: ML 700011, ML 700012, and ML 700013. No changes to the currently approved mining methods or production rates are proposed as part of the Project.

Economically viable coal resources have been identified in a long, narrow section of ML 700011 (Figure 1). The Project consists of two primary components:

1. The extension of mining of pulverised coal injection (PCI) coal and minor amounts of thermal coal within the Rangal Coal Measures, within ML 700011; and

2. The placement of overburden, topsoil, and associated infrastructure in ML 700012 and ML 700013.

The life of the Jellinbah Central North operation, including the proposed CNE, is anticipated to be greater than 20 years based on the current economic assessment of the resource. A conceptual layout of the proposed Project area and infrastructure is shown in Figure 2. Development of the Project will involve construction and operation of the following major elements:

- Open-cut mining excavations;
- Access / haul roads;
- Sediment dams for water management;
- Water management drains; and
- Topsoil stockpiling and spoil dumping.

2.3.1 Mining and Processing

At Central North, the mine is projected to be in the order of 125 m deep. As mining progresses to the east into the CNE, the depth of mining will be approximately 145-150 m below ground level (mbgl). The depth of additional coal to mine will be determined on an economic basis prior to the commencement of mining in this area. The Project is anticipated to augment the current production of the Mine by an average of 1.0 Mt per annum (Mtpa) run-of-mine (ROM) coal in future years, thereby extending the mine's overall production life. No increase in mining or production rates is proposed for the Mine, as a result of the Project.

The Project will involve open-cut mining using truck and excavator methods. Topsoil stripped prior to mining will be stockpiled for later use in rehabilitation, whilst overburden will be relocated to in-pit dumps, and out-of-pit spoil dumps located on site.

Coal mined from the Project will continue to be transported in trucks for processing using existing Mine infrastructure. Product coal will be transported by rail to Gladstone Port along Aurizon's Blackwater rail line, where it will be exported through the RG Tanna Coal Export Terminal.

Coal mining in the Central North mining area is anticipated to commence in late 2019, based on current mine planning. Mining within the proposed CNE area (ML 700011) is expected to occur approximately five years thereafter. Overburden placement on ML 700012 is scheduled to commence soon after approval.

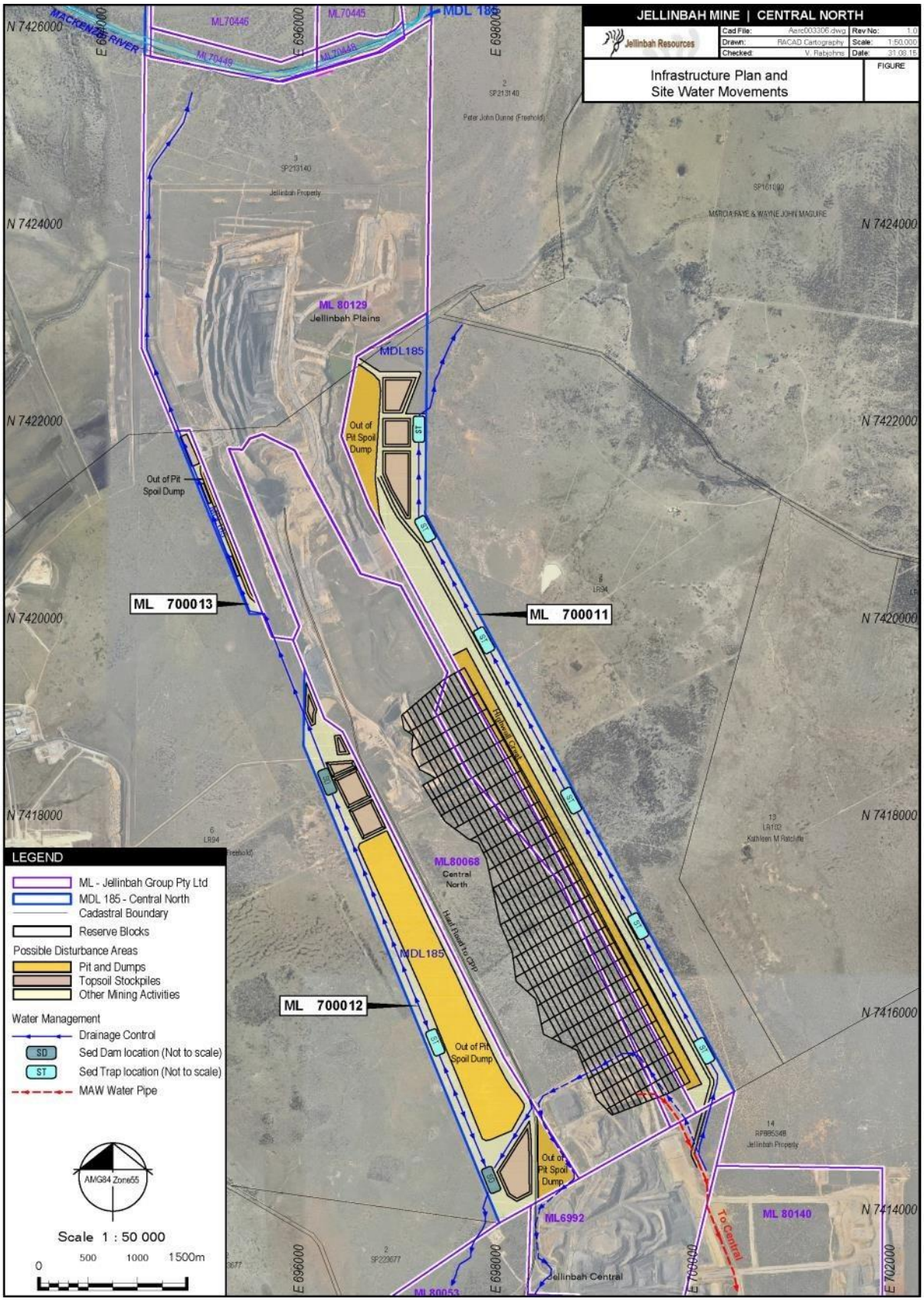

Figure 2 Conceptual Mine Layout (CNE)

2.3.2 Existing Flood Levee Design

The Mine has Blackwater Creek to the west, Mackenzie River to the North, and Twelve-Mile Creek to the East. To mitigate potential flood impacts (from the Mackenzie River), a levee was constructed around the Jellinbah Plains operations and open pit (directly south of the Mackenzie River). The levee was designed and constructed based on investigations and modelling undertaken by WRM (2015). The levee was designed and constructed to protect the mine from a 1 in 1,000 AEP peak flood level. The Jellinbah Plains Stage 3 Levee Design Flood Levels Report, (WRM 2015) provides further design detail (Appendix D6, WRM 2019).

Detailed hydrologic and hydraulic analysis included the impacts of other nearby projects, in particular, Curragh North Pit V Expansion Project and Jellinbah Resources' Mackenzie North Project (WRM 2013; WRM 2018). The model was later refined using the new TUFLOW GPU Solver. The Jellinbah model was recalibrated to historical water level and flow data, which is detailed in the WRM 2015's report (Appendix B in Appendix D6, WRM 2019).

Section 6.1.3, Section 6.5.2, and Appendix D6 (WRM 2019) have reported the existing flood conditions and assessed the flood risk in relation to the proposed CNE operations. No changes to the existing Jellinbah Plains levee design are required or proposed as part of the CNE Project. Figure 4 below shows the extent of the existing Jellinbah Plains Stage 3 levee, and the levee design details are provided in the *Jellinbah Stage 3 Levee – Consequence Assessment Report* (Appendix D8, Parsons Brinckerhoff 2015).

2.3.3 Rehabilitation and Final Landforms

Mined land will be progressively rehabilitated during the life of the operation. Within the Project mining area, spoil will be backfilled into the mined-out void as mining progresses. No additional final void is proposed by the Project. Rather the final void will remain the same size and will be similarly located to the existing approved void for Central North.

The State approved final landform for Jellinbah Mine is detailed in the Jellinbah Coal Mine Rehabilitation and Void Investigation Report (Appendix C2, AARC 2018b). The rehabilitated landform design requirements for the Mine are defined in Table 2, as approved in the Environmental Authority (EPML00516813) (EA Schedule G – Table 2). Figure 3 presents the approved final landform with the CNE, including the void location. The post-mining land uses for the Mine were developed primarily in consideration of:

- The pre-mining land use of low intensity cattle grazing;
- Stakeholder consultation during the relevant approval;
- Planning considerations, as defined in the relevant council Planning Schemes;
- Environmental considerations, specifically the need to prevent release of contaminants to the receiving surface waters or groundwater;
- Environmental values and physical considerations as they relate to the safe and stable nature of the final landform and the development of self-sustaining ecosystems required for successful rehabilitation; and
- Economic considerations relating to the cost of recreating the final land use and the likelihood of achieving rehabilitation success.

Table 2 Jellinbah Mine Approved Final Land Use (including CNE)

Disturbance Type	Projective Surface Area (ha)	Post Mining Land Description	Post Mining Land Use	Post Land Suitability Classification
Infrastructure	837	Endemic Pasture Species	Low Intensity Cattle Grazing	5
Levee Bank	86			5
Haul Roads	218			4
Topsoil Stripped	300			3
Soil Areas (<10% Slope)	2300			4
Soil Areas (>10% Slope)	2347	Endemic Pasture Species	Endemic Vegetation Community	5
Dams	50	Water Containment	Water Containment	5
	55	Pasture Species	Low Intensity 5Cattle Grazing	
Final Voids	744	Water Containment	Water Containment	5
Topsoil Stockpiles	78	Endemic Pasture Species with a native species over-storey	Corridor Conservation	5
Anabranch Diversion	140			
Three to Five Mile Lagoon Drainage Line	N/A			

Source: EA (EPML00516813) Schedule G - Table 2

2.3.3.1 Final Voids

Final voids are described as areas of the post mining landform that are below the natural ground level and will not achieve a sustainable post-mining land use. The final void proposed within the Project area has been approved by DES (as indicated in Table G5 of the EA - EPML00516813). The Project final void is the same size and will be similarly located to the existing approved void for Central North (without the extension area).

Approved final landform and void designs for the Mine (including the CNE) are described in detail in the Jellinbah Coal Mine Rehabilitation and Void Investigation Report (Appendix C2, AARC 2018b). The report concluded that:

- No voids described in the final landform are predicted to overtop or seep to groundwater;
- Each void will remain as a contaminated water sinks. Saline water will be contained within the void footprint; and
- The residual voids are not predicted to be a risk of environmental harm to surface or groundwaters.

All final voids will be made safe, stable, and non-polluting in the post mining landform. This will form a minimum requirement for certification of rehabilitation success under Queensland legislation.

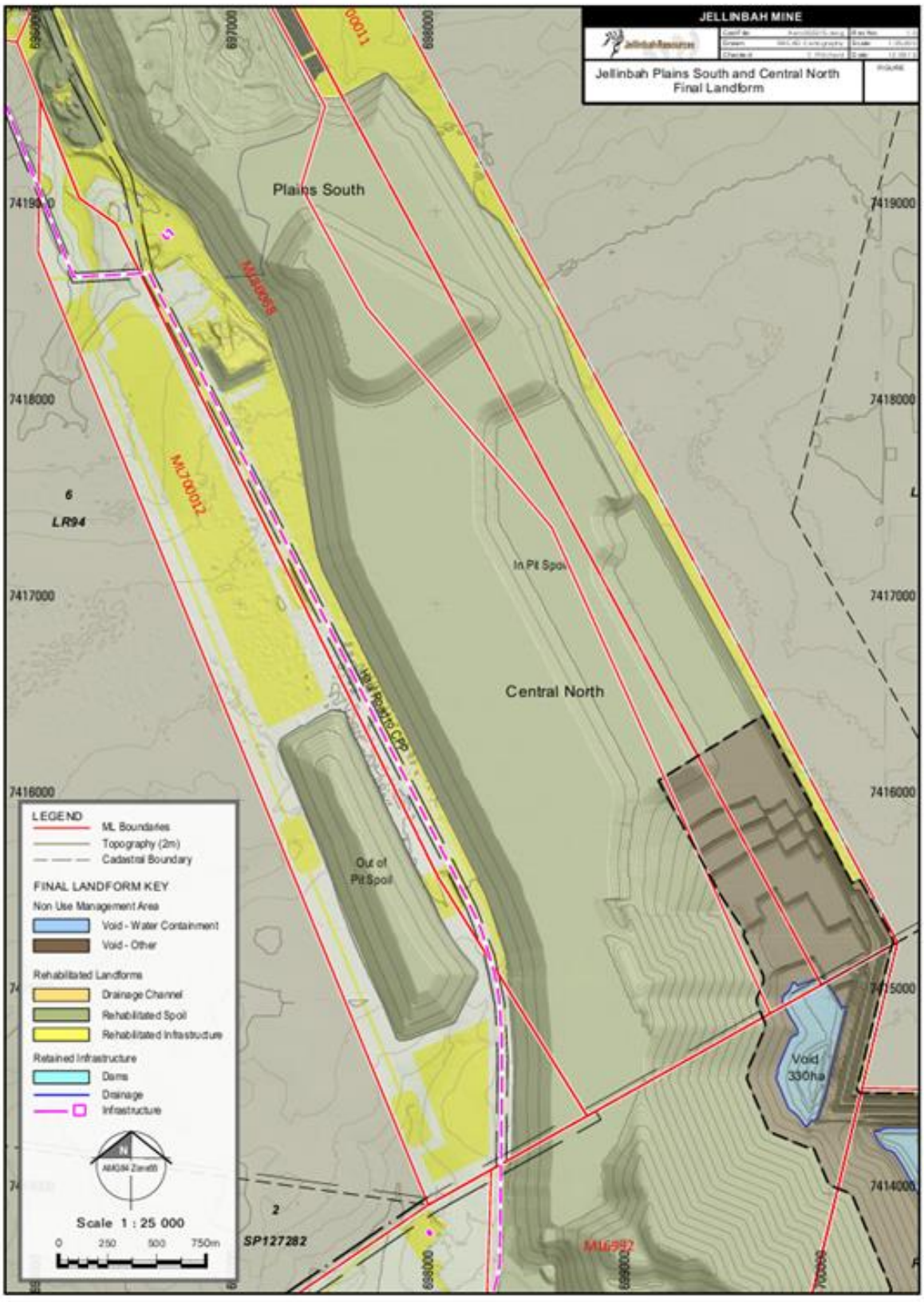

Figure 3 Final landform of the Central North Extension

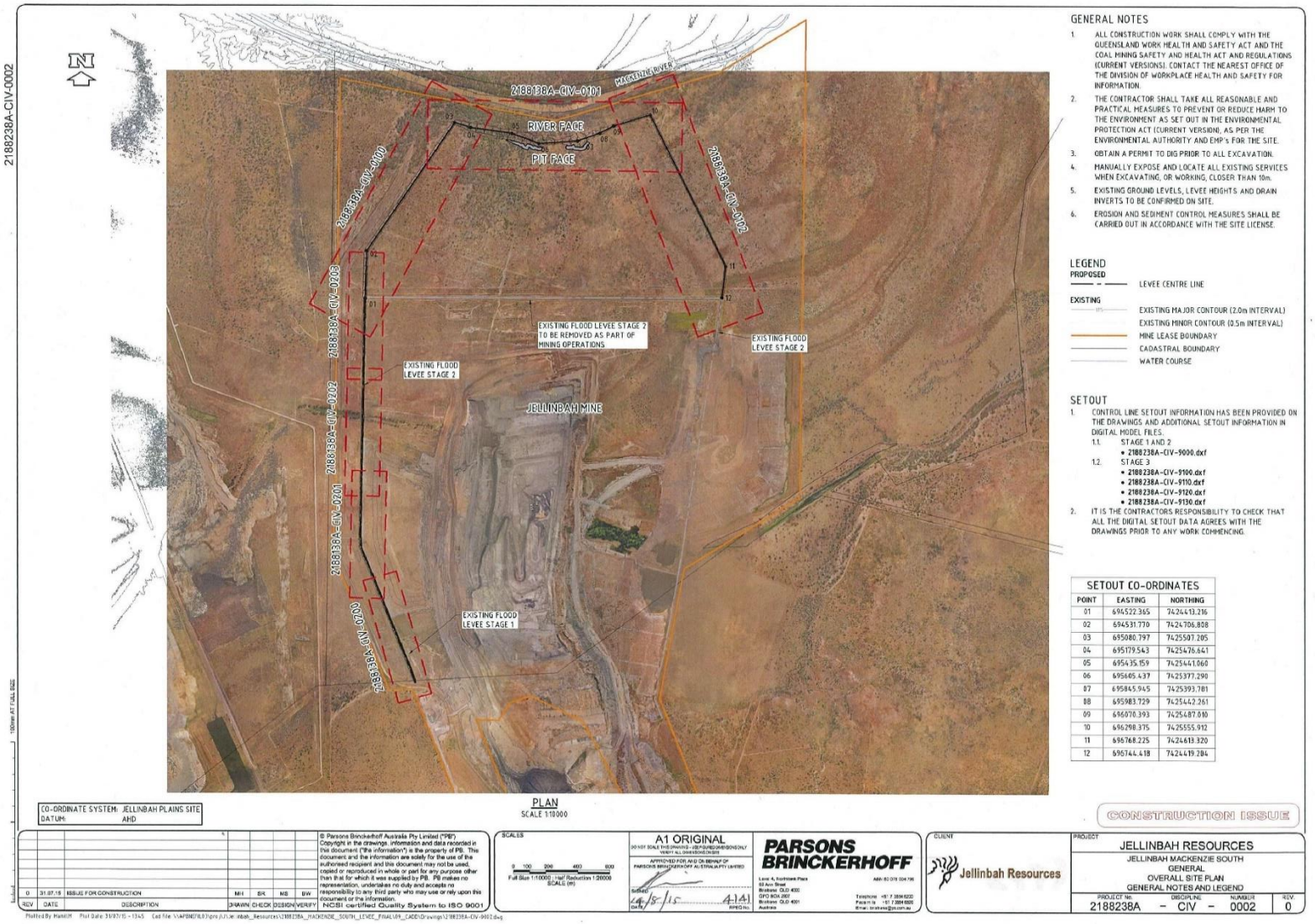

Figure 4 **Proposed Design of the Jellinbah Stage 3 Levee (source: Appendix D8, Parsons Brinckerhoff 2015)**

2.4 JELLINBAH MINE SITE WATER MANAGEMENT SYSTEM

2.4.1 Water Management Principles and Strategy

The Site Water Management System for the Project is based on the following key principles, which are consistent with the existing water management system at the Mine:

- 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 mine affected water from the 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;
- Manage water storages and transfers within site in order to:
    - Maximise onsite storage to meet reasonably anticipated periods of wet and dry weather; and
    - Minimise disruption to mining operations.

The Site Water Management Strategies employed on site for each type of water are summarised in Table 3 below.

Table 3 Overall Water Management Strategies

Type of Water	Definition	Management Strategy
Clean Runoff	Runoff from all areas that are not affected by coal or operational facilities.	Drains and dams are used to keep clean water separate and ultimately divert clean catchment runoff to receiving waterways.
Sediment Runoff	Runoff in which the only contaminants are dissolved or suspended sediments.	Runoff with a sediment load is directed through sediment dams to minimise solid content prior to exiting the site.
Mine-affected Water	Includes any water that encounters coal stockpiles, coal pads, plant areas, pit areas, and coal seam groundwater. Typically, elevated salinity.	The objective is to keep this water separate from the other water types, recycle and evaporate as much as possible and discharge if required only in accordance with release conditions.

Type of Water	Definition	Management Strategy
Raw Water	The site has a license to supplement water supply by pumping from Mackenzie River. This water is untreated and mainly used for vehicle wash down and coal processing.	Minimise consumption where possible – constrained by 300 ML/yr extraction license.
Potable Water	Water for drinking and sanitation purposes.	Water is trucked to the site as required.

Source: Engeny 2019a

2.4.2 Contaminant Source Assessment

Surface water runoff from mine landforms and disturbed areas can potentially contain a variety of contaminants, including sediment, heavy metals, hydrocarbons, and soluble salts. Potential contaminant sources, flow paths, and destinations identified across Jellinbah Mine are summarised in Table 4 below. The table also identifies the receiving waterway within which the contaminants sources are located. However, it is noted that associated water does not report directly to the receiving environment. The associated water is either contained within the mine-affected water system or directed to sediment control structures in accordance with the water management strategy for the mine.

Table 4 Contaminant Source Summary

Source	Transport Mechanisms	Site Containment	Receiving Waterway	Potential Contaminants
CHPP	Surface runoff	Water containment dams	Blackwater Creek	Sediment, heavy metals, coal fines, soluble salts, processing reagents (i.e.flocculent/magnetite), fuels, oils, and grease
Overburden Dumps	Surface runoff	Pit voids Water containment dams and sediment dams	Blackwater Creek, Mackenzie River	Low concentrations of elevated metals/metalloids, Slight alkalinity, Sediment (EGI, 2013)
ROM and Stockpile Areas	Surface runoff	Pit voids Water containment dams	Blackwater Creek, Mackenzie River	Sediment, coal fines, soluble salts, and acid forming material
Haul roads and access roads	Surface runoff	Sediment dams	Blackwater Creek, Mackenzie	Sediment, soluble salts, fuels, oils, grease (total petroleum hydrocarbons) and coal (coarse or fines)

Source	Transport Mechanisms	Site Containment	Receiving Waterway	Potential Contaminants
			River, Twelve Mile Creek	
Pit Void	Pumping of pit runoff to water containment dams	Pit voids Water containment dams	Groundwater	Alkaline or sodic soils and heavy metals, coal fines and pH altering materials
Water Containment Dams	Seepage through floor of dams Pumping within mine water system Overflows during heavy rainfall Loss of containment (failure)	Pit voids, if containment dam capacity is limited	Blackwater Creek, Mackenzie River, Twelve Mile Creek	Elevated pH, sediment, dissolved metals, coal fines, soluble salts, and hydrocarbons

Source: Engeny 2019a

2.4.3 Site Water Storage Infrastructure

The water management system at the Mine comprises storages which serve the following purposes:

- Pit dewatering;
- Containment of tailings;
- Storage of mine affected water;
- Collection of runoff from unrehabilitated and rehabilitated overburden;
- Controlled release of mine affected water;
- Water truck filling points; and
- Active and inactive mine pits.

The majority of mine-affected water at the Jellinbah Mine is stored in Plains South mining void and dedicated mine water containment dams such as Plains Environmental Dam, Max Pit Tailings Dam, and Mackenzie North Mine Water Dam. The water storages at the Mine (with the CNE) and associated details are listed in Appendix C6 (Engeny 2019a).

The water management system also includes an interconnecting pipe network with associated pumps that allow mine affected water to be transferred between water storage structures across the site.

Under the current mining operations, coal tailings from the CPP are contained in the Max Pit Tailings Dam. The tailings decant will be recycled to Russell's Dam for site water consumption at CPP. It is proposed that Russell's Dam will replace the water supply to Central CPP and Plains' crusher from Max

Pit, whilst Max Pit will continue to be used for tailings storage. A complete mine water management system schematic was developed for the Mine and is presented in Figure 5 below and discussed further in Appendix C6 (Engeny 2019a).

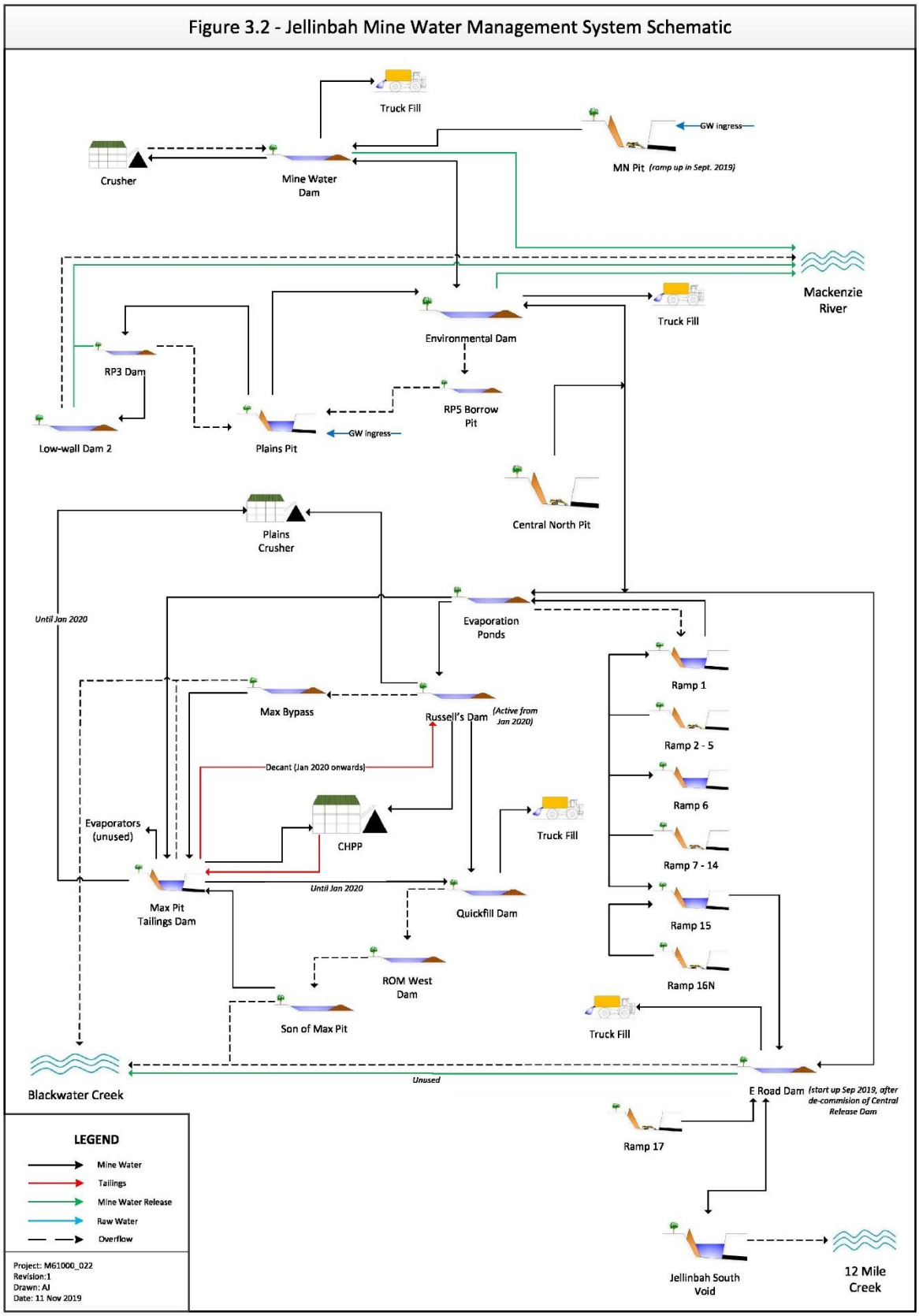

Figure 5 Water Management System Schematic (source: Engeny 2019a)

2.4.4 Jellinbah Mine Water Release Infrastructure

Jellinbah Mine has nominated mine water release points (RPs) specified within site Environmental Authority (EA) (EPML00516813) from which mine water can be discharged to either Blackwater Creek or Mackenzie River. In practice, releases to Blackwater Creek rarely occur due to the short duration of flow events.

The EA specifies monitoring points (MPs) where water quality must be monitored, and mine water can only be released during natural flow events in accordance with receiving waterway flow triggers. Receiving waterway flows in the Mackenzie River are measured at the gauging stations at MP1 (upstream) and MP3 (downstream).

The Mine is authorised to release mine-affected water only in accordance with strict release and receiving water criteria prescribed in the EA. Fixed active water release infrastructure has been constructed at the Mine and is summarised in Table 5 for the Mackenzie River. The controlled release during flow events is strictly monitored by continuous real-time water monitoring using in-stream gauges. All releases are controlled and adjusted to ensure downstream water quality is maintained for the duration of the release, within site specific water quality objectives defined in the EA. Further water quality monitoring details are discussed in Section 11.3.1.

Table 5 Controlled Mine Water Release Infrastructure Details (Mackenzie River)

Storage	Release Point	Receiving Waterway	Storage Capacity (ML)	Release Infrastructure	Release Capacity (L/s)
Environmental Dam	RP5	Mackenzie River	1,602	3 x DN450 HDPE pipes with manual valves at upstream IL of 124.22 mAHD	1,800
Mackenzie North MWD	RP4	Mackenzie River	683	Release Valve in Pipeline to Environmental Dam	200

Source: Engeny 2019a

Alternate release conditions and infrastructure exist for release to Blackwater Creek. Releases to Blackwater Creek rarely occur due to the short duration of flow events. Details of release conditions to Blackwater Creek can be found in the Project's EA (EPML00516813).

2.4.5 Existing Mine Site Water Balance Model

2.4.5.1 Operational Water Consumptions and Supply

Water consumption rates for mine operation (i.e., dust suppression, plant use, etc.) are summarised in Table 6. Operational water consumption currently accounts for a net outflow from the system of approximately 2 GL/year. Water is consumed primarily through dust suppression, at a total rate of 248 L/t of coal production. Dust suppression rates reported at other mine sites in the Bowen Basin range from 75L/t to 275L/t, with an average of 150 L/t.

Table 6 Jellinbah Mine Water Consumption Summary (FY/19/20)

Consumption	Water Source	Net Consumption (ML/yr)
CHPP	Max Pit Tailings Dam	552
Plains Crusher	Max Pit Tailings Dam	95
Dust Suppression	Quickfill Dam E Road Dam Environmental Dam Mackenzie North MWD	1,240
Washdown & other losses	Mackenzie River	180

Source: Engeny 2019a

The Mine has an annual permit for water extraction from the Mackenzie River. This water is used at both the Central and the Plains workshops, primarily for machine and vehicle wash down. The total water extraction of 180 ML over the last four quarters FY18/19 (Table 6) was primarily allocated to vehicle washdown, and no additional raw water was taken into the mine water system due to the availability of recycled water on site.

2.4.5.2 Climatic Data

The long-term climate for Jellinbah Mine was obtained from the SILO climate database facility hosted by the Department of Science, Information Technology, and Innovation (DSITI). A SILO Patched Point Data climate series was obtained for the New Caledonia Station (35132), which is located about 5 km from Jellinbah Mine. This site is considered to be representative of Jellinbah Mine site rainfall, and the data set ranges back to January 1889. The variation in annual rainfall indicates a median of 560 mm at the site.

Lake evaporation rates for the Mine have been extracted from the same SILO Patched Point Data as rainfall. Mean annual evaporation from ponded water bodies at the Mine is 2,043 mm/yr, while daily rates vary from 2.6 mm/day in June to 6.8 mm/day in December.

2.4.5.3 Groundwater Inflows

Groundwater inflows into mining voids have been adopted based on groundwater modelling predictions, anecdotal observations, and/or detailed groundwater inflow assessments (JBT 2019):

- Mackenzie North – Ranging from 0.2 ML/day to 1 ML/day.
- Plain Pit – 4.6 ML/day
- Central and Central North – 0.3 ML/day
- Jellinbah South – 0 ML/day

2.4.5.4 Overall Mine Water Balance

The GoldSim Model developed for the Mine (without the CNE) was used to assess the dynamics of the site water balance under varying rainfall and catchment conditions throughout the progression of the mining stages. Configuration of the model simulated the operation of major components of the site water management system described in Section 2.4. The water balance model operates on a daily time step and simulates the quantity and quality of water within water storages and operational pits, as well as waterways that have the potential to receive discharges of mine-impacted surface water during large rainfall events.

Detailed water balance modelling methodology is provided in Appendix C6 (Engeny 2019a).

The water balance averages (i.e., median climate scenario) produced by the site water balance model for key mine stage years are presented in Table 7 from the year 2020 to 2049.

Table 7 Existing Jellinbah Mine Central North Overall Water Balance Summary – Median Climate Scenario

Process	Year 2020	Year 2024	Year 2028	Year 2032	Year 2049
Inflows (ML)					
Rainfall Runoff	1608	1929	2266	2338	2368
Groundwater Inflows	2835	2879	3074	3001	2847
Total Inflows	4443	4808	5340	5339	5215
Outflows (ML)					
Evaporation	1571	1825	2059	2154	3198
Uncontrolled Release (not mine affected)	0	12	13	14	13
Controlled Release	998	0	0	0	106
CHPP Processing / Co Disposal Losses	763	1237	1091	1185	136
Haul Road Dust Suppression	821	1143	1101	1137	144
Total Outflows	4153	4217	4264	4490	3596
Change in Stored Inventory (ML)	290	591	1076	849	1619

Source: Engeny 2019a

The occurrence and volume of uncontrolled releases from mine water storages were assessed by simulating the site water balance model using the available historical climate data (118 years). The water balance model includes several historical extreme events, such as 2011. These releases occur from designated mine water release points at the Mine and are compliant with the release conditions and surface water quality thresholds in the Environmental Authority. The site water balance model has been updated to represent the CNE and is discussed in Section 6.2.1.2 below.

The associated uncontrolled release risks and mitigation measures are discussed in Section 6.0 and Section 11.0 later in the report.

2.5 CNE SITE WATER MANAGEMENT

Due to the proximity of the CN and CNE mining areas to the Jellinbah Central site facilities, CNE will utilise much of the same infrastructure.

Water from the pit is the only source of mine-affected water associated with the Project that has been in contact with coal / groundwater. Pit water will be pumped to the existing mine water storage located at Central and Plains mining areas.

No new mine-affected water storages are proposed as part of the Project development. The mine affected water generated from CNE is contained within the mining void (from which it originates) prior to being pumped to a dedicated mine-affected water storage located at Plains and Central mining precincts. As such, there are no out-of-pit storages associated with CNE from which mine-affected water can be released to the receiving surface waters.

Sediment and erosion control infrastructure is proposed to manage runoff from the out-of-pit overburden emplacement on the western side of the Project and the in-pit overburden emplacement. Surface water runoff from the out-of-pit emplacement will drain towards the western CNE mine lease boundary while the runoff from the in-pit emplacement will drain towards the eastern CNE mine lease boundary. Sediment dams and sediment traps are proposed to collect and treat sediment runoff prior to discharging into receiving waterways. The proposed sediment dams and traps to be constructed as part of the CNE and designed in accordance with the Jellinbah Mine ESCP (Appendix C5, AARC 2019a). It is proposed that that two sediment dams and approximately four to six sediment traps are installed to intercept runoff of overburden stockpiles. No coal contamination or mine affected water sources will be present in these areas. Additional sediment traps in the west of the Project will be established as required. These drainage systems, sediment traps, and dams will be developed as the site expands to its full size.

A clean water diversion drain will be constructed along the eastern alignment of CNE to convey runoff generated from small undisturbed catchment away from the Project mining void and towards an unnamed tributary of the Mackenzie River located immediately downstream.

2.6 HISTORICAL, CURRENT AND FORSEEABLE DEVELOPMENTS

The CNE represents a small extension to the current Jellinbah mining operation, which has been in operation since 1989. The mine is laid in an approximately linear context, on a mostly north-south axis (Figure 6). The CNE will not have any independent pits, rather it represents a lateral extension of the CN pit approximately 450 m to the east.

To the west of the Jellinbah mining complex is the open-cut Curragh Mine complex (Figure 6), which has been in operation since 1983. The Curragh Mine complex consists of two main mining areas; Curragh North and Curragh East and have a large holding of exploration tenements.

To the east of the Jellinbah mining complex is the Yarrabee open cut coal mine (Figure 6). The Yarrabee mine was historically a small privately-owned coal mine operating from 1982, and it was sold in 2004 then again in 2009. Production has steadily grown over the operating life of the mine and transitional purchases, with holdings not fully explored and further future development a possibility.

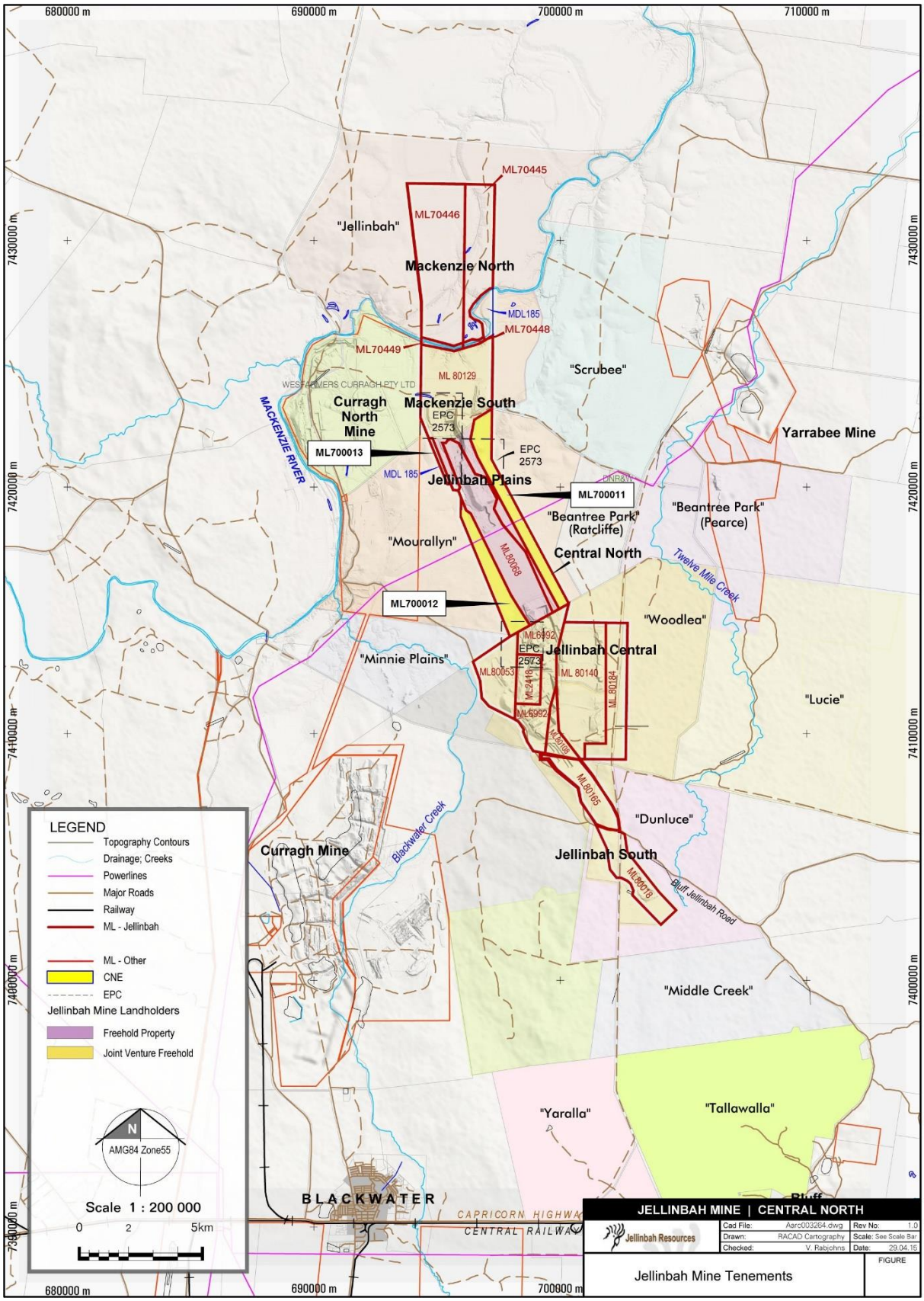

Figure 6 Jellinbah Coal Mine and Surrounding Developments

2.7 PROJECT ALTERNATIVES

The Project provides an opportunity to extend operations of the Mine to further develop coal resources in an existing mining precinct for the export of coal products.

With the local presence of equipment suitable for open cut mining, and existing open cut nature of the Mine that the proposed CNE is an extension of, no consideration has been given to the development of an underground mine on ML 70011, due to the infeasible cost of infrastructure required for underground mining. Additionally, the initial 17 Mt of resource is expected to be shallower than 150 m below the surface. Consequently, an underground mine project has not been further assessed as a feasible option.

Alternatives to the proposed CNE include not developing ML 70011, ML 70012, and ML 70013 (CNE Leases). Were the CNE Project not to be carried out, this will avoid the direct impacts on the environment within the CNE Leases. However, by developing the mine and including CNE Leases, the employment opportunities can be extended resulting in increased QLD employment stability. Additionally, the economic benefit to the Australian economy through industry flow-on effects, as well as government royalties will not be realised should the resource not be developed, and the current mine life would be reduced.

The alternative of not proceeding with the proposed CNE will result in the potential lifespan of the Mine being shortened due to the blending qualities of the coal in this area. The staging of the Project is not intended to increase production but extend total Mine life, to begin following the development of the CN mining area. Utilising ML 70012 and ML 70013 for spoil dumps is preferred due to their adjacent proximity to the CN pit and limited alternate disposal area. With the approval of the Project and preferred spoil dump points, spoil from the CN mining area will be hauled shorter distances, likely resulting in fewer impacts on environmental values such as noise quality and air quality.

2.8 ENVIRONMENTAL RECORD

Jellinbah is committed to minimising environmental impacts during all phases of the Mine life. Staff training and awareness ensures that all personnel and contractors implement best practice strategies for environmental protection and give due consideration to the environmental values of the Project.

Jellinbah has demonstrated their commitment to good environmental stewardship by thoroughly researching and assessing the environmental values of the Project before development commences.

The company currently holds multiple granted MLs for its existing operations and is currently operating under the conditions of its Environmental Authority. There have been no infringement notices or non-compliance orders issued, and Jellinbah has an open professional working relationship with local and state government authorities.

No past or present proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources have been taken against Jellinbah.

3.0 REGULATORY CONTEXT

3.1 STATE SUBMISSION PROCESS AND APPROVAL

An application to amend the Mine's EA (EPML00516813) pertaining to the new ML application by Jellinbah was submitted to the former Department of Environment and Heritage Protection (now Department of Environment and Science (DES)) for assessment and approval in August 2015. The EA Amendment Application (Major Amendment) was submitted in accordance with the requirements of the QLD *Environmental Protection Act 1994* (EP Act).

An Information Request from the former Department was received in September 2015, and a 'Response to Information Request' was submitted to the former Department in September 2016.

Following a public notice period, the EA Amendment Application was approved by the State on 10th January 2017, and ML 700011, ML 700012, and ML 700013 were granted on 21st July 2017. Site-specific conditions were included for management and mitigation of impacts on environmental values (Appendix A1).

3.2 COMMONWEALTH SUBMISSION PROCESS

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides for the protection of Matters of National Environmental Significance (MNES). Projects which have potential for a 'significant impact' on an MNES are required to be referred to the Commonwealth Minister for the Environment to determine whether they constitute a 'controlled action' and require assessment under the EPBC Act.

Part 3 of the EPBC Act prescribes nine MNES:

- World Heritage properties;
- National Heritage places;
- Wetlands of international importance (listed under the Ramsar convention);
- Listed threatened species and communities;
- Listed migratory species;
- Nuclear actions;
- Commonwealth marine environment;
- Great Barrier Reef Marine Park (GBRMP); and
- A water resource in relation to coal seam gas (CSG) development and large coal mining development.

For referred Actions, Table 8 provides an overview of the decision-making process employed by the Department of the Environment and Energy (DoEE) to determine the required assessment approach for the referred action (DoEE n.d.).

Table 8 Commonwealth Decision-Making Process for Referred Actions

Matters Considered in Determining Appropriate Assessment Approach	Assessment Approach			
	Referral Information Only	**PD**	**Public Environment Report**	**EIS**
Number of MNES affected *(i.e. number of controlling provisions)*	< 3	3	> 3	> 3
Scale and nature of impacts *(including the complexity of issues)*	Low *(Short-term impacts)*	Medium *(Short-term or recoverable)*	High *(Some complexity)*	High *(Complex analysis required)*
Degree of confidence *(with which these impacts can be predicted)*	High	High	Med – Low	Med – Low
Adequacy and completeness *(of the information provided)*	Good	Good	Variable or Low	Variable or Low
The extent to which potential impacts have already been assessed *(under State legislation)*	High	High	Low – Unknown	Low – Unknown
Degree of public concern *(associated with the proposal)*	Low	Low	Mod – High	High

Source: DoEE (n.d.).

An EPBC Act Referral (EPBC Ref. 2018/8139) for the Project (Appendix A2) was submitted to the DoEE in March 2018. The DoEE issued a Notification of Referral Decision and Designated Proponent (Appendix B1) in May 2018. The Project was determined to be a 'Controlled Action' with the following Controlling Provisions:

1. Listed threatened species and communities; and

2. A water resource in relation to CSG development and large coal mining development.

A letter accompanying the controlled action decision identified an area of Brigalow Woodland coinciding with potential habitat for the Ornamental Snake, as the specific listed threatened species and communities potentially impacted.

The assessment approach was determined to be via Preliminary Documentation.

DoEE provided a letter comprising 'Additional Information Required for Preliminary Documentation' (Appendix B3) in July 2018. A 'Response to Information Request' was submitted to the DoEE in October 2018, which was followed by a further request for information (Appendix B4) in December 2018. A response to this information request was submitted to the DoEE in March 2019.

Under the Commonwealth approvals process, as per section 131AB of the EPBC Act, the Minister for the DoEE (the Minister) must obtain advice from the IESC given that the controlled action involves a large coal mining development. The IESC published the 'Jellinbah Coal Mine – Central North Extension (EPBC 2018/8139) – Expansion' on 29th May 2019, with the DoEE allowing the proponent an opportunity to address the advice provided prior to the final assessment decision by the Minister.

3.2.1 Purpose of the Preliminary Documentation

This 'Preliminary Documentation' (PD) has been prepared for submission to the DoEE to provide further information and analysis of potential for impact on the two identified Controlling Provisions, enabling the DoEE to make a final assessment of the Project.

This PD revises and expands upon the original EPBC Act Referral and replaces previously submitted versions. The PD addresses past information requests including the advice from the IESC. The PD has been prepared in accordance with the following guidelines:

- *Information Guidelines for Independent Expert Scientific Committee (IESC) advice on coal seam gas and large coal mining development proposals* (IESC 2015);
- *MNES: Significant impact guidelines 1.1* (DoEE 2013e);
- *National Strategy for Ecologically Sustainable Development* (ESD Steering Committee 1992);
- *Outcomes-based Conditions Guidance* (DoEE 2016b);
- *Outcomes-based Conditions Policy* (DoEE 2016c);
- *Significant impact guidelines 1.3: CSG and large coal mining developments – impacts on water resources* (DoEE 2013f); and
- *Submitting a referral under the EPBC Act – A fact sheet for a person proposing to take an action* (DoEE n.d.).

Additional topic specific guidelines were utilised, and these are listed in each relevant section.

Various specialist studies and management plans form the basis of the impact assessment described in the Project – *MNES Assessment* (AARC 2017b; Appendix A2) and this PD, which include:

- *Conceptual and Numerical Groundwater Modelling – Jellinbah CNE Area* (JBT 2019; Appendix D7);
- *Environmental Offsets Strategy* (AARC 2015; Appendix A2);
- *Jellinbah Coal Mine – Chemical and Fuel Management Plan* (AARC 2018a; Appendix C4);
- *Jellinbah Coal Mine – CNE – Terrestrial Flora and Fauna Assessment* (AARC 2017a; Appendix A2);
- *Jellinbah Coal Mine – Erosion and Sediment Control Plan* (AARC 2019a; Appendix C5);
- *Jellinbah Coal Mine – Rehabilitation and Void Investigation Report* (AARC 2018b; Appendix C2);
- *Jellinbah Coal Mine – Topsoil Management Plan* (AARC 2018c; Appendix C1);
- *Jellinbah Coal Mine – Weed and Pest Management Plan* (AARC 2018d; Appendix C3);
- *Jellinbah Mine Central North Extension Water Management Plan* (Engeny 2019a; Appendix C6);
- *Central North Pit Final Void Hydrology Study* (Engeny 2019b; Appendix D5)
- *Jellinbah Central North Extension Flood Assessment* (WRM 2019; Appendix D6);
- *Microbat Call Identification Report* (Balance Environmental 2015; Appendix D1); and

- *Jellinbah Coal Mine REMP Design Report* (AARC 2019b; Appendix D3).

A 'PD Cross Reference Table' has been supplied (Appendix E1), indicating where the IESC information requests have been addressed in this PD.

A 'List of Contributing Persons' has been supplied (Appendix E2) as requested by the DoEE, outlining the people involved in the preparation of this document and their works.

A 'List of People and Agencies Consulted' has been supplied (Appendix E3) as requested by the DoEE, outlining the dates and details of the consultation.

3.3 CONTROLLING PROVISIONS

An EPBC Act Protected Matters Search (PMS) was utilised to ascertain the potential presence of MNES on and surrounding the Project, based on a 50 km buffer around a central coordinate located on the Project. Previous searches were conducted in 2015 to support the ecological field study and associated report, and in again 2017 to support the *Terrestrial Flora and Fauna Assessment* (AARC 2017a; Appendix A2).

A further updated EPBC PMS was conducted on 25th January 2019 to support this PD (Appendix F1). Table 9 below lists the number of potential threatened species and communities identified within 50 km of the Project.

Table 9 Potential Controlling Provisions within 50 km

Controlling Provision	Number
Listed Threatened Ecological Communities	5
Listed Threatened Species	36

The *Terrestrial Flora and Fauna Assessment* was used to inform the relevant components of the *MNES Assessment* (AARC 2017b; Appendix A2. Following referral, the Project was determined by DoEE to be a Controlled Action with the Controlling Provisions of:

1. Listed threatened species and communities; and

2. A water resource in relation to CSG development and large coal mining development.

Henceforth, the PD will discuss only the Controlling Provisions relevant to the proposed Action.

A letter accompanying the controlled action decision identified an area of Brigalow Woodland and potential habitat for the Ornamental Snake, as the specific listed threatened species and communities potentially impacted.

4.0 LISTED THREATENED ECOLOGICAL COMMUNITIES

The EPBC PMS (Appendix F1) identified five Threatened Ecological Communities (TECs) that have the potential to occur on or within 50 km of the Project (Table 10). Listed TECs were identified as a potential controlling provision for the Project, and field studies and impact assessments were conducted as follows.

Table 10 Desktop Potential for Listed TECs within 50 km of the Project

Community Name	Status	Presence within 50 km
Brigalow (*Acacia harpophylla* dominant and co-dominant)	Endangered	Known to occur
Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	May occur
Natural Grasslands of the QLD Central Highlands and the northern Fitzroy Basin	Endangered	Likely to occur
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	Likely to occur
Weeping Myall Woodlands	Endangered	Likely to occur

4.1 ASSESSMENT METHODOLOGY

A combination of desktop studies and a field survey were used to investigate the presence of TECs within the Project area. Database searches and an extensive literature review were conducted to characterise the Project prior to field surveys (and subsequently updated) to identify the desktop likelihood of potential for TECs to occur. The following documentation has been consulted to assist in a desktop understanding for each TEC to occur on the Project, as well as identifying the applicable conditions and thresholds that constitute eligibility for recognition as a TEC:

- *Approved Conservation Advice for Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions ecological community* (DoEE 2011a);
- *Approved Conservation Advice for Natural grasslands of the QLD Central Highlands and the northern Fitzroy Basin* (DoEE 2008h);
- *Approved Conservation Advice for the Brigalow (Acacia harpophylla dominant and co-dominant) ecological community* (DoEE 2013d);
- *Approved Conservation Advice for Weeping Myall Woodlands ecological community* (DoEE 2008l);
- *Commonwealth Listing Advice on Brigalow (Acacia harpophylla dominant and co-dominant)* (TSSC 2001a);
- *Commonwealth Listing Advice on Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions* (TSSC 2011);

- *Commonwealth Listing Advice on Natural Grasslands of the QLD Central Highlands and the northern Fitzroy Basin* (TSSC 2009a);

- *Commonwealth Listing Advice on Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions* (TSSC 2001c);

- *Commonwealth Listing Advice on Weeping Myall Woodlands* (TSSC 2009b);

- *National recovery plan for the Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions ecological community* (McDonald 2010); and

- *Regional Ecosystems Descriptions Database* (REDD) (DES 2019c).

The field survey was conducted from 16th – 20th February 2015 and involved a baseline study of the Project using accepted floristic survey methods that were in adherence with the latest guideline available at the time of survey; *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in QLD – Version 3.2* (Neldner *et al.* 2012).

The entire CNE area was vegetation mapped using the survey technique described in the guideline as 'Quaternary sites,' a rapid site assessment that notes important features relevant to vegetation community mapping and results in an intuitive classification of the RE as reflected in the REDD (DES 2019c). Condition and threshold requirements as per each TEC eligibility was also noted. The vegetation survey technique described in the guideline as 'Secondary sites' was utilised to develop a detailed description of each vegetation community ground-truthed as present on the Project.

A vegetation map of the survey area was produced following the field survey (Figure 7). The map was developed based upon survey results, satellite images, aerial photographs, and geological maps of the survey area. During ground truthing of the Project, two vegetation communities were identified:

- Community 1: Brigalow (*Acacia harpophylla*) and Dawson Gum (*Eucalyptus cambageana*) Open Forest to Woodland (RE 11.4.8 / 11.4.8a).

- Community 2: Non-remnant Pasture.

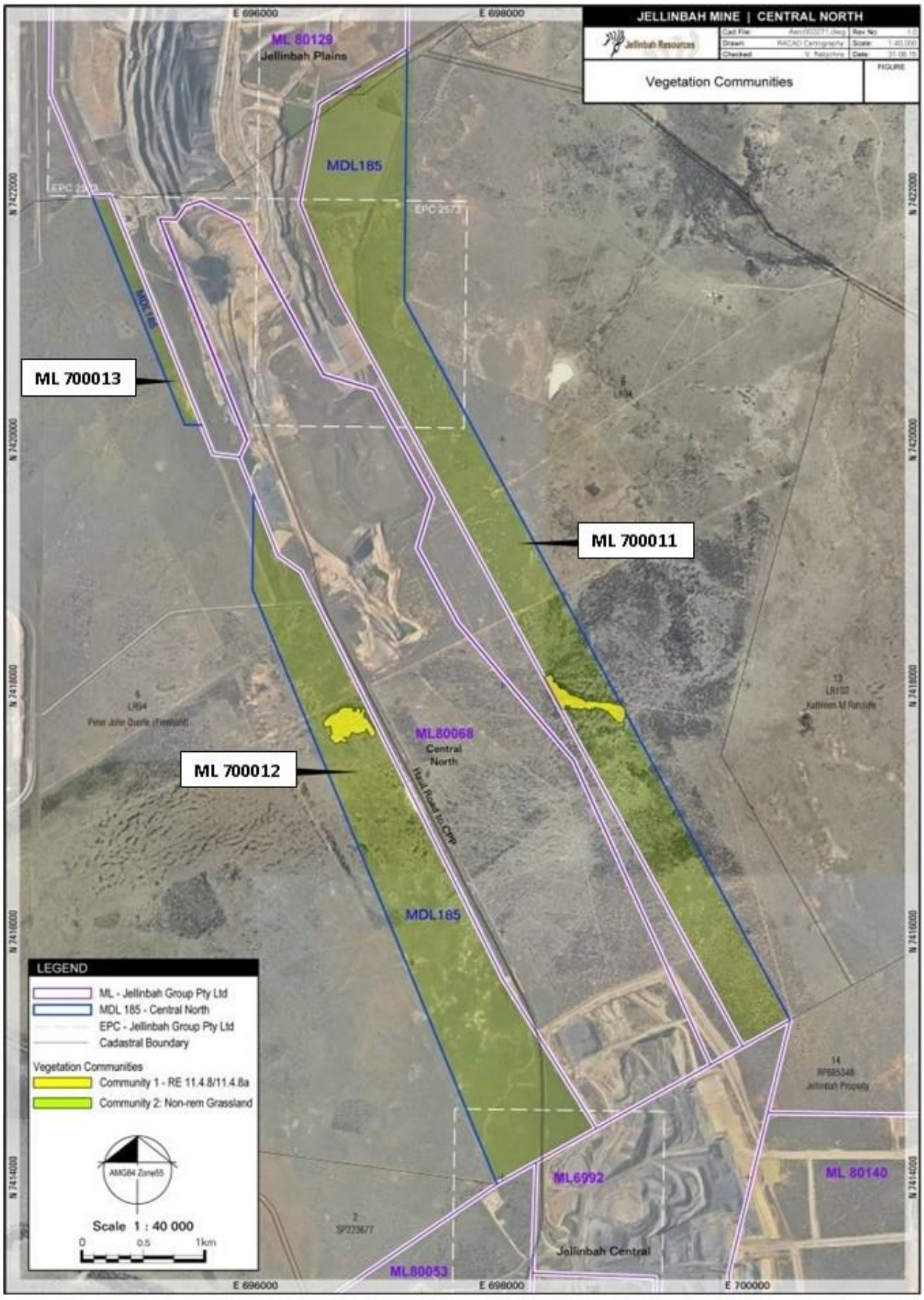

Figure 7 Vegetation Communities in the Project Area

Community 1 occurs as two small patches in the central region of the Project, totalling 14.65 ha. The REs most consistent with this community are associated with the Brigalow TEC under the EPBC Act. The State-wide remnant extent of RE 11.4.8 remaining in 2017 was 67,000 ha, approximately 9.3% of the pre-clearing extent (723,000 ha). The extent of this community in reserves is classed as low, with RE 11.4.8 having been extensively cleared for pasture (DES 2019c). This community is subject to weed invasion and low to moderate intensity cattle grazing. Buffel Grass (*Cenchrus ciliaris*) and Sabi Grass (*Urochloa mosambicensis*) invasion has modified the ground layer, and exotic cacti are scattered throughout the ground and shrub layers.

Habitat features such as exfoliating bark, logs, fallen branches, and leaf litter are present throughout this community, which support populations of common small reptiles. Scattered Gilgai's provide temporary water sources for fauna and habitat for amphibians. Emergent Dawson Gum and stags provide a small amount of isolated habitat for arboreal mammals and nocturnal birds.

Community 2 occurs throughout the majority of the survey area, covering 788.35 ha. This community includes interspersed non-remnant grassland areas, areas of regrowth, and dams with non-remnant vegetation. This community is classes as non-remnant and not consistent with any REs listed in the REDD (DES 2019c) and not associated with any TECs under the EPBC Act. The conservation value of this community is negligible due to its non-remnant status.

Vegetation in this community has been cleared to facilitate cattle grazing, and woody regrowth is generally low and sparse. The ground is heavily disturbed and dominated by exotic pasture grasses with few habitat features. Cattle dams provide habitat for aquatic birds and amphibians, whilst the dense ground layer provides a potential habitat for small mammals. A range of small granivorous and insectivorous bird species inhabit the shrubs and grasses of this community, providing a potential food resource for raptors.

Further details of field survey techniques, including site locations and detailed results, can be found in (Appendix A2):

- *MNES Assessment* (AARC 2017b); and
- *Terrestrial Flora and Fauna Assessment* (AARC 2017a).

4.2 LIKELIHOOD OF OCCURRENCE

Following desktop assessment and ground-truthing during the field study, the likelihood of occurrence for the listed TECs potentially present was assessed (Table 11).

Of the five potential TECs within the Project, Brigalow (*Acacia harpophylla* dominant and co-dominant) was the only TEC identified as present. The proposed Project will have no impacts on the remaining four TECs, and these are not discussed further.

Development of the Project proposes disturbance of approximately 798 hectares (ha) of land, including clearing of approximately 14.65 ha of identified Brigalow TEC within the Project area (1.8% of the Project).

Table 11 TEC Likelihood of Occurrence

Community Name	Database Assessment	Field Study Assessment
Brigalow (*Acacia harpophylla* dominant and co-dominant)	Known to occur	Present
Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	May occur	Not Present
Natural Grasslands of the QLD Central Highlands and the northern Fitzroy Basin	Likely to occur	Not Present
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Likely to occur	Not Present
Weeping Myall Woodlands	Likely to occur	Not Present

4.3 SIGNIFICANT IMPACT CRITERIA

The *MNES: Significant Impact Guidelines 1.1* (DoEE 2013e) define significant impact criteria for the assessment of impacts on endangered ecological communities listed under the EPBC Act. These guidelines state that an action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- *Reduce the extent of an ecological community;*
- *Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;*
- *Adversely affect habitat critical to the survival of an ecological community;*
- *Modify or destroy abiotic (non-living) factors (such as water, nutrients or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;*
- *Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;*
- *Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:*
    - *Assisting invasive species, that are harmful to the listed ecological community, to become established; or*
    - *Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or*
- *Interfere with the recovery of an ecological community.*

4.4 IMPACT ASSESSMENT

Although listed as a TEC, the integrity of the Brigalow community within the Project area is highly compromised due to small patch sizes, past and current disturbance, and the highly fragmented context of the surrounding landscape. This community is surrounded by cleared pasture lands heavily impacted by grazing. Previous clearing surrounding each patch has resulted in this community being subjected to edge effects, weed invasion, and a consequent reduction in conservation value. These isolated patches are also subject to ongoing cattle grazing, further enabling the introduction and spread of weeds. The ground layer has been modified by the invasion of Buffel Grass and Sabi Grass, while exotic cacti are present throughout the ground and shrub layers.

Brigalow patches located within ML 700011 overlie the coal resource and as a result avoidance is not possible should the Project be approved. Brigalow with ML 700012 overlies an area designated for spoil dumping and topsoil stockpiling. Jellinbah has reviewed alternate options for disposal, however the limitations of the mining tenure mean that land space for surface infrastructure including out-of-pit dump space is limited. As a result, avoidance of the stand alone patch of Brigalow within ML 700012 was not achievable in the Project design.

In order to determine whether the Project will have a significant impact on the Brigalow TEC, the ecological values of the community, as present on the Project, are summarised below:

- Consists of two small patches of Brigalow dominant vegetation totalling 14.65 ha;
- Contains a small amount of potential habitat for threatened Brigalow reptiles. The habitat in these areas was considered to be potentially suitable for the Ornamental Snake, which has previously been recorded at the neighbouring Curragh Coal Mine. However, targeted diurnal searches for the Ornamental Snake in Gilgai habitat failed to locate the species within the two isolated patches of Brigalow TEC. Potential habitat suited for the conservation of significant reptile species is isolated from other suitable habitat areas in the locality;
- Supports a variety of fauna species, but only offers fauna corridor value to larger and highly mobile species;
- Has been modified by edge effects and weed invasion resulting from cattle grazing and past intensive vegetation clearing in the surrounding landscape;
- Does not function as a buffer to important habitats as it is surrounded by cleared pasture lands;
- Occurs in a highly fragmented landscape with no connectivity to similar habitat areas; and
- Occurs within 5 km of the State and regional corridor associated with the Mackenzie River, however, connectivity between this corridor and the community patches is poor.

Table 12 examines the potential for the Project to result in a significant impact to Brigalow TEC.

Clearance of the 14.65 ha of RE 11.4.8 has been authorised by DES under Jellinbah's current EA (EPML00516813), with the impact area subject to environmental offset conditions under the Queensland *Environmental Offsets Act 2014* (EO Act). Jellinbah recognises its obligation to deliver suitable offsets prior to commencing any disturbance at the Project in a manner agreed upon with State.

When assessed against the significant impact criteria, the proposed Action is not expected to have a significant impact on Brigalow TEC (nor any TEC); however, management commitments are discussed in Section 11.1 regardless.

Table 12 Brigalow TEC Impact Assessment

Significant Impact Criteria	Impact Assessment
Reduce the extent of an ecological community.	**No** The community is small, isolated, heavily disturbed, and offers limited ecological function at the regional, state, or national level. The proposed impact represents 0.0026% of the extent of Brigalow TEC remaining in the Brigalow Belt (DES 2019c). Given the negligible extent of the impact and limited ecological value of the proposed impact area, the Project is not expected to impose a significant impact on this TEC.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines.	**No** The existing community is already fragmented, highly isolated, and offers limited ecological function due to historical clearing for pasture. It has been severely affected by grazing with invasive species being introduced into the area by livestock.
Adversely affect habitat critical to the survival of an ecological community.	**No** The importance of this community to the survival of the TEC is negligible due to its small size and historical isolation due to clearing for pasture, and ongoing impacts from grazing.
Modify or destroy abiotic (non-living) factors (such as water, nutrients or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns.	**No** Topsoil from the area will be stockpiled for rehabilitation as part of the operations of the Mine, and groundwater in the area is present only at depths far greater than accessible to the TEC. Surface water drainage patterns are not going to be dramatically altered, with only minor adjustments to normal drainage patterns to divert surface water around voids and infrastructure.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting.	**No** The existing community is heavily impacted by clearing for pasture and grazing pressure. Local species composition is already compromised through fragmentation, isolation and ongoing disturbance and introduction of invasive species, and provides only minor habitat value for fauna species. The present ecological community in its fragmented state does not offer significant protection to species unable to readily move around the surrounding area. Targeted surveys seeking to identify the Ornamental Snake in the areas did not return any positive results signifying that the vegetation is too isolated from other copses of similar vegetation for any fauna without great mobility to access it. The clearing of this community will not constitute a significant impact or substantially change the TEC.

Significant Impact Criteria	Impact Assessment
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: • Assisting invasive species, that are harmful to the listed ecological community, to become established; or • Causing regular mobilisation of fertilisers, herbicides, or other chemicals or pollutants into the ecological community, which kills or inhibits the growth of species in the ecological community.	**No** The community is already impacted by invasive pasture grasses and several cacti species. Clearing of the compromised community will likely result in the reduction of invasive species in final rehabilitated landforms. No introduction or mobilisation of fertilisers, herbicides, or other chemicals or pollutants are expected as part of the action and hold no potential to impact the TEC.
Interfere with the recovery of an ecological community.	**No** The clearing of the negligible quantity (0.0026% of the extent of Brigalow TEC remaining in the Brigalow Belt) and already impacted quality of the community within the Project will not cause a significant impact to the TEC.

5.0 LISTED THREATENED SPECIES

The EPBC PMS identified 36 threatened species that may potentially occur on or within 50 km of the Project. The DES Wildlife Online Database (Appendix F2) and WildNet Conservation Significant Species Records (Appendix F3) were also consulted for any additional Commonwealth listed species occurrences. These species are listed in Table 13. Listed threatened species were identified as a potential controlling provision for the Project, and field studies and impact assessments were conducted as follows.

Table 13 Desktop Potential for Listed Threatened Species within 50 km of the Project

Scientific Name	Common Name	EPBC Act Listing	Presence within 50 km
Plants			
Bertya opponens		V	Species or species habitat **likely** to occur within area.
Cadellia pentastylis	Ooline	V	Species or species habitat **likely** to occur within area.
Cycas ophiolitica		E	Species or species habitat **likely** to occur within area.
Daviesia discolor		V	Species or species habitat **likely** to occur within area.
Dichanthium queenslandicum	King Blue-grass	E	Species or species habitat **likely** to occur within area.
Dichanthium setosum	Bluegrass	V	Species or species habitat **likely** to occur within area.
Eucalyptus raveretiana	Black Ironbox	V	Species or species habitat **known** to occur within area.
Homoranthus decumbens		E	Species or species habitat **may** occur within area.
Logania diffusa		V	Species or species habitat **likely** to occur within area.
Macrozamia platyrhachis	Cycad	E	Species or species habitat **likely** to occur within area.
Polianthion minutiflorum		V	Species or species habitat **likely** to occur within area.
Birds			
Calidris ferruginea	Curlew Sandpiper	CE	Species or species habitat **may** occur within area.
Erythrotriorchis radiatus	Red Goshawk	V	Species or species habitat **known** to occur within area.
Geophaps scripta scripta	Squatter Pigeon (southern)	V	Species or species habitat **known** to occur within area.
Grantiella picta	Painted Honeyeater	V	Species or species habitat **may** occur within area.
Neochmia ruficauda ruficauda	Star Finch (eastern), Star Finch (southern)	E	Species or species habitat **likely** to occur within area.
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	CE	Species or species habitat **may** occur within area.

Scientific Name	Common Name	EPBC Act Listing	Presence within 50 km
Poephila cincta cincta	Southern Black-throated Finch	E	Species or species habitat **may** occur within area.
Rostratula australis	Australian Painted Snipe	E	Species or species habitat **may** occur within area.
Turnix melanogaster	Black-breasted Button-quail	V	Species or species habitat **likely** to occur within area.
Mammals			
Antechinus argentus	Silver-headed Antechinus	E	Species identified via Wildlife Online 50 km database search.
Chalinolobus dwyeri	Large-eared Pied Bat	V	Species or species habitat **likely** to occur within area.
Dasyurus hallucatus	Northern Quoll	E	Species or species habitat **likely** to occur within area.
Macroderma gigas	Ghost Bat	V	Species or species habitat **likely** to occur within area.
Nyctophilus corbeni	Corben's Long-eared Bat	V	Species or species habitat **may** occur within area.
Onychogalea fraenata	Bridled Nail-tail Wallaby	E	Species or species habitat **known** to occur within area.
Petauroides volans	Greater Glider	V	Species or species habitat **known** to occur within area.
Phascolarctos cinereus	Koala	V	Species or species habitat **known** to occur within area.
Pteropus poliocephalus	Grey-headed Flying-fox	V	Foraging, feeding or related behaviour **likely** to occur within area.
Reptiles			
Delma torquata	Collared Delma	V	Species or species habitat **likely** to occur within area.
Denisonia maculata	Ornamental Snake	V	Species or species habitat **known** to occur within area.
Egernia rugosa	Yakka Skink	V	Species or species habitat **known** to occur within area.
Elseya albagula	Southern Snapping Turtle	CE	Species or species habitat **known** to occur within area.
Furina dunmalli	Dunmall's Snake	V	Species or species habitat **may** occur within area.
Lerista allanae	Allan's Lerista	E	Species or species habitat **may** occur within area.
Rheodytes leukops	Fitzroy River Turtle	V	Species or species habitat **known** to occur within area.
Fish			
Maccullochella peelii	Murray Cod	V	Species or species habitat **may** occur within area.

Note: CE = Critically Endangered
E = Endangered
V = Vulnerable

5.1 ASSESSMENT METHODOLOGY

Thirty-seven listed flora and fauna species were identified as potentially being present within 50 km of the Project. A combination of desktop research and a field survey was used to investigate the likely presence of threatened species within the Project area.

Database searches and Literature Review were conducted to characterise the Project for potential threatened species habitat prior to field surveys and to identify the desktop likelihood of potentially threatened species to occur. The Species Profile and Threats Database (SPRAT) was consulted for each species and where available 'Conservation Advice', 'Listing Advice', and 'Recovery Plans' were consulted to assist in a desktop understanding of likelihood for each threatened species to occur on the Project, and potential impacts.

The ecological field study was undertaken on the 16th – 20th February 2015, and the *Terrestrial Flora and Fauna Assessment* (AARC 2017a; Appendix A2) was prepared for and attached to, the EPBC Act Referral which details the field study including site locations, results and a discussion of ecological values.

The field study was designed to assess for and confirm the presence or support the absence of all potentially threatened species. The methodology was developed using accepted flora and fauna survey methods that were in adherence with the latest guidelines and information available at the time of the survey:

- *Draft Referral guidelines for the nationally listed Brigalow Belt reptiles* (DoEE 2011b);
- *EPBC Act referral guidelines for the vulnerable koala* (DoEE 2014e);
- *EPBC referral guidelines for the endangered northern quoll Dasyurus hallucatus* (DoEE 2016a);
- *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland – Version 3.2* (Neldner *et al.* 2012);
- *Significant impact guidelines for the endangered black-throated finch (southern) (Poephila cincta cincta)* (DoEE 2009);
- *Survey guidelines for Australia's threatened birds* (DoEE 2010b);
- *Survey guidelines for Australia's threatened bats* (DoEE 2010a);
- *Survey guidelines for Australia's threatened mammals* (DoEE 2011c);
- *Survey guidelines for Australia's threatened reptiles* (2011d); and
- *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland – Version 2.0* (Eyre *et al.* 2014).

5.1.1 Flora Survey

The location of flora sites and a detailed description of the methodology is provided in the *Terrestrial Flora and Fauna Assessment* (AARC 2017a; Appendix A2).

The entire Project area was vegetation mapped using the survey technique 'Quaternary sites', a rapid site assessment that notes important features relevant to vegetation community mapping and results in an intuitive classification of the RE as reflected in the REDD (DES 2019c). The vegetation survey

technique ‘Secondary sites’ was utilised to develop a detailed description of each vegetation community ground-truthed as present on the Project.

‘Secondary sites’ consist of a 20 m x 50 m detailed transect, recording a complete floral assemblage (all species observed from each vegetation layer), relative abundance for individual woody species in each stratum, stem density, foliage projection cover and height of the tree and shrub layers. The percentage composition of each ground cover species was recorded in five 1 m x 1 m quadrats located at 10 m intervals along the transect line. Ancillary site data, including photos, location, habitat features, and disturbance, were also noted.

All flora encountered during the survey were identified by experienced and qualified ecologists using several field guides and other reference material where necessary. For any flora species that could not be identified in the field, a voucher specimen was collected and submitted to the QLD Herbarium for identification.

No Commonwealth survey guidelines existed for threatened flora species potentially occurring on the Project; however, the SPRAT database was consulted to gain an understanding of the species descriptions, habitats, and ecology. Targeted searches for EPBC Act listed flora species were undertaken upon identification of suitable habitat or growing conditions. The targeted survey technique for EPBC threatened flora utilised in the field study was the ‘Random Meander’ technique (Cropper 1993). This technique involves traversing areas of suitable habitat along a meandering route whilst searching for the plant species of interest. If there was any uncertainty in the identification of a species, a specimen was collected for identification by the QLD Herbarium.

5.1.2 Fauna Survey

Detailed descriptions of each survey site are presented in *Terrestrial Flora and Fauna Assessment* (AARC 2017a; Appendix A2) along with maps of the site locations and further detail of fauna survey methodology.

Comprehensive fauna surveys were undertaken within each of the vegetation communities present on the Project. Fauna trapping, habitat searches, bird surveys, and camera trapping were conducted at four survey sites (bird surveys were conducted at an additional wetland site), and microbat detectors were deployed at two survey sites. An overview of the methodologies employed to survey the fauna occurring on the Project is provided below.

Elliot Trapping

Type ‘A’ Elliot traps were used to target small ground-dwelling mammals inhabiting the survey area during the field survey period, and baited with a mixture of oats, honey, peanut butter, sesame oil, and vanilla essence. At each site, 20 Elliot traps were deployed in two parallel lines, with each trap strategically located in suitable micro-habitat, approximately 10 m apart.

Pitfall Trapping

A pitfall trap line was established at one of the survey sites to target small ground-dwelling fauna (reptiles, mammals, and amphibians) for two nights. Pitfall traps could not be established at every site due to the extremely hard ground in the survey area. The pitfall trap line consisted of a 20 centimetre (cm) tall drift fence running along the ground and crossing the middle of 20 litre (L) buckets buried flush with the soil surface. The bottom edge of the drift fence was buried to guide the target animals towards the buckets.

Funnel Trapping

Funnel traps are elongated box-shaped traps made of wire and fine mesh, with two funnel shaped entrances that allow fauna to enter with ease but make exiting difficult. Funnel traps were used to target medium and large-sized terrestrial reptiles, snakes, and some species of medium-sized skinks, dragons, and geckos, which are able to climb out of pitfall traps. Pairs of funnel traps were placed at the end of the pitfall drift fence. At fauna sites where a pitfall trap line could not be dug, six funnel traps were placed in suitable micro-habitat (such as areas of woody debris and clumps of low vegetation).

Motion Detector Camera Trapping

Motion detector cameras were deployed at four sites and utilised in favour of cage traps as it is a non-invasive technique, with the trap immediately resetting following a capture (i.e., photo), enabling sites to be surveyed continuously throughout both day and night. The camera traps consisted of a Scoutguard digital trail camera with a passive motion sensor pointed at a bait station consisting of a small, perforated plastic tube containing marsupial bait (peanut butter, oats, honey, and vanilla essence) and surrounded with sesame oil or anchovies.

Micro-bat Surveys

Micro-bats use high frequency echolocation calls, most of which are above the frequency range audible to humans (i.e., ultrasound), which provide an opportunity to unobtrusively survey and identify micro-bats through the use of a specialised ultrasonic recorder. Anabat and Songmeter bat detectors were positioned to target micro-bat at two of the fauna sites. Sound recordings were sent to Greg Ford of Balance Environmental for analysis and species identification (Appendix D1).

Bird Surveys

Bird species were targeted each morning of the survey and opportunistically throughout the survey period. Birds were identified visually and audially through call identification. A targeted bird site was established at a wetland in the north-west of the Project that is not proposed to be disturbed by current or future development. Diurnal searches were conducted at all dams encountered during the survey, as these areas are likely to support high bird diversity, and nearest possible wetland values for migratory species.

Habitat Searches

Small cryptic species were targeted through diurnal searches of likely micro-habitats at fauna sites while moving through the survey area. Searching techniques involved the examination and rolling of logs, rustling through leaf litter, and peeling back of exfoliating bark from standing trees.

Scat and Track Searches

Scats and tracks encountered during the field study were identified by ecologists where possible or collected and sent to Barbara Triggs of Dead Finish for species identification.

Incidental Recordings

All incidental observations (visual & aural) were recorded, and appropriate notes were made on the surrounding habitat.

5.1.3 Species Identified on the Project

A full list of the species observed is provided in the *Terrestrial Flora and Fauna Assessment* (AARC 2017a; Appendix A2). None of these species are listed under the EPBC Act.

A total of 143 flora species were identified on the Project during the field study. A total of 76 fauna species were identified on the Project during the field study, consisting of six amphibians, 49 birds, 10 reptiles, and 11 mammals, including four microbat species. Ambiguous call recordings of low quality meant additional microbat species might have been present; however, none of the four potentially present species are listed threatened species under the EPBC Act.

5.2 LIKELIHOOD OF OCCURRENCE & POTENTIAL FOR IMPACT

Flora and fauna species identified in the desktop assessment with the potential to be present are assessed for the likelihood of occurrence and potential for impact from the Project (Table 14).

Proposed impacts of the Project were assessed in accordance with the significant impact criteria (Section 5.3), and with consideration of relevant DoEE threatened species referral guidelines, Approved Conservation Advice, Listing Advice, and Recovery Plans.

The *Terrestrial Flora and Fauna Assessment* (AARC 2017a; Appendix A2) identified no listed threatened flora or fauna species under the EPBC Act on the Project.

Impact Assessment tables have been provided in Section 5.4 for species that were determined to have a possible occurrence. Owing to the small, disturbed, and fragmented nature of the remnant habitat within the Project, it offers limited ecological function at the regional, state or national level. Given the likelihood of occurrence for each species, the limited extent of the impact, the limited ecological values of the proposed impact area, and the availability of similar or more valuable habitat elsewhere in the locality, the Project is considered unlikely to result in a significant impact on any listed threatened species.

Table 14 Assessment of Likelihood of Occurrence and Impacts on EPBC Listed Threatened Species

Species Name **Common Name (EPBC Act Status)**	**Habitat Description**	**Likelihood of Occurrence and Assessment of Impact Significance**	**Relevant Plans & Advice Documents**
		Plants	
Bertya opponens (Vulnerable)	In QLD it is widely distributed within an area bounded by Emerald in the north and Charleville in the west, with an outlier near Charters Towers (DoEE 2019a). It has been recorded growing in a variety of community types including mixed shrubland, lancewood woodland, Mallee woodland, Eucalypt/*Acacia* open forest with shrubby understorey, *Eucalypt*/*Callitris* open woodland and semi-evergreen vine-thicket. The soils are recorded as generally shallow sandy loams or red earths associated mostly with sandstone, but also with rhyolite, shale and metasediments (TSSC 2016a).	**Unlikely Occurrence**: The Project lacks suitable geology. Targeted surveys did not identify any population or individual of the species on the Project. No Wildlife Online species records occur within 50 km of the Project. One WildNet species record from 1999 occurs within 50 km of the Project. The nearest occurrence records on Atlas of Living Australia (ALA) are at Bundoora State Forest (SF) (approximately 80 km from the Project), Expedition SF, and Dawson Range SF (both approximately 120 km from the Project). **Significant impact on this species is considered unlikely.**	*Conservation Advice: Bertya opponens* (TSSC 2016a) *Bertya sp.* Cobar-Coolabah (Cunningham & Milthorpe s.n., 2/8/73) Recovery Plan (NPWS 2002) Relevant objectives of the Adopted Recovery Plan are to: • limit grazing impacts at the Coolabah population; • survey potential habitat for further populations; • ensure there is recruitment at senescent populations; • raise awareness of the conservation significance of *Bertya sp.* Cobar-Coolabah and involve the community in the recovery program. Undertaking field surveys for the species ensured the Project supported Objective #2. Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the adopted recovery plan and Approved Conservation Advice.

Species Name **Common Name (EPBC Act Status)**	**Habitat Description**	**Likelihood of Occurrence and Assessment of Impact Significance**	**Relevant Plans & Advice Documents**
		Plants	
Cadellia pentastylis Ooline (Vulnerable)	Occurs in a range of vegetation types including semi-evergreen vine thicket, Brigalow-Belah, Poplar Box and Bendee communities. Ooline often occurs on the edges of sandstone and basalt escarpments, 200 to 500 m above sea level. Ooline grows on the moderately fertile soils preferred for agriculture and pasture development (DoEE 2019b).	**Unlikely Occurrence:** A small amount of potentially suitable habitat exists on the Project. The Project is situated north of the species natural distribution. Targeted surveys did not identify any population or individual of the species on the Project. One Wildlife Online and WildNet record occurs within 50 km of the Project. The nearest occurrence records on ALA are approximately 60 km to the south of the Project. **Significant impact on this species is considered unlikely.**	*Approved Conservation Advice for Cadellia pentastylis (Ooline)* (DoEE 2008a) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the Priority Actions outlined in the Approved Conservation Advice.
Cycas ophiolitica Marlborough Blue (Endangered)	Cycas ophiolitica inhabits eucalypt open forest and woodland communities with a grassy understorey. They occur on hill tops or steep slopes, at altitudes of 80-620m above sea level. It grows on shallow, stony, red clay loams or sandy soils (DES 2019b).	**Unlikely Occurrence:** The Project lacks suitable habitat and landforms. Targeted surveys did not identify any population or individual of the species on the Project. No Wildlife Online or WildNet species records occur within 50 km of the Project. ALA outlines a restricted distribution within approximately 150 km of the coast between approximately Rockhampton in the south and St Lawrence in the north. The Project lies 60 km further west than the westernmost ALA record. **Significant impact on this species is considered unlikely.**	*National Multi-species Recovery Plan for the cycads, Cycas megacarpa, Cycas ophiolitica, Macrozamia cranei, Macrozamia lomandroides, Macrozamia pauli-guilielmi and Macrozamia platyrhachis* (QLD Herbarium 2007) The recovery plan outlines undertaking research to determine life cycles, optimum fire regimes and protecting existing populations by securing areas and performing detailed surveys of populations. It also included translocation of threatened individual plants to suitable habitat near larger populations of the species. Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the recovery plan.

Species Name **Common Name (EPBC Act Status)**	**Habitat Description**	**Likelihood of Occurrence and Assessment of Impact Significance**	**Relevant Plans & Advice Documents**
		Plants	
Daviesia discolour (Vulnerable)	Known from the Blackdown Tableland, Mount Walsh and Carnarvon National Park in Queensland. Occurs on sandy soils in a variety of woodlands, in conjunction with species such as *Eucalyptus sphaerocarpa*, *E. nigra, E. acmenoides*, *Corymbia trachyphloia* and *Angophora* sp. (DoEE 2019e).	**Unlikely Occurrence:** Not known from the local area and little suitable habitat is available on the Project. Targeted surveys did not identify any population or individual of the species on the Project. One Wildlife Online and WildNet record occurs within 50 km of the Project. The nearest ALA occurrence records are at Blackdown Tableland National Park (NP) (over 50 km from the Project). **Significant impact on this species is considered unlikely.**	*Approved Conservation Advice for Daviesia discolour* (DoEE 2008b) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the Priority Actions outlined in the Approved Conservation Advice.
Dichanthium queenslandicum King Blue-grass (Endangered)	This species occurs on black cracking clay in tussock grasslands mainly in association with other species of Bluegrasses. It is mostly confined to the natural Bluegrass grasslands of central and southern QLD (DoEE 2019f).	**Unlikely Occurrence:** The Project lacks suitable habitat and landforms. This species occurs in natural Bluegrass grasslands which do not occur on the Project, and unlikely in grazed land. Targeted surveys did not identify any population or individual of the species on the Project. No Wildlife Online or WildNet species records occur within 50 km of the Project. ALA outlines a restricted distribution to the west of the Project. The Project lies 50 km further east than the nearest record. **Significant impact on this species is considered unlikely.**	*Approved Conservation Advice for Dichanthium queenslandicum (king blue-grass)* (DoEE 2013a) *Commonwealth Listing Advice on Dichanthium queenslandicum (king blue-grass)* (TSSC 2013a) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice and Listing Advice.

Species Name **Common Name (EPBC Act Status)**	**Habitat Description**	**Likelihood of Occurrence and Assessment of Impact Significance**	**Relevant Plans & Advice Documents**
		Plants	
Dichanthium setosum Bluegrass (Vulnerable)	Occurs in grassy woodland and open forests in inland Australia. Associated with heavy basaltic black soils and stony red-brown hard-setting loam with clay subsoil and is found in moderately disturbed areas such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pasture (DoEE 2019g).	**Unlikely Occurrence:** Potentially suitable habitat for this species exists on the Project. Targeted surveys did not identify any population or individual of the species on the Project. No Wildlife Online or WildNet species records occur within 50 km of the Project. The nearest ALA occurrence records are at Springsure (over 120 km from the Project). **Significant impact on this species is considered unlikely.**	*Approved Conservation Advice for Dichanthium setosum* (DoEE 2008d) *Commonwealth Listing Advice on Dichanthium setosum (bluegrass)* (TSSC 2012b) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice and Listing Advice.
Eucalyptus raveretiana Black Ironbox (Vulnerable)	Occurs on alluvial soils, loams, light clays or cracking clays in open forests and woodlands along watercourses and occasionally on river flats (DoEE 2019k).	**Unlikely Occurrence:** The Project lacks suitable habitat on watercourses. Targeted surveys did not identify any population or individual of the species on the Project. No Wildlife Online species records occur within 50 km of the Project. One WildNet species record occurs within 50 km of the Project from 1991. The nearest ALA occurrence records are over 60 km to the east of the Project. **Significant impact on this species is considered unlikely.**	*Approved Conservation Advice for Eucalyptus raveretiana (Black Ironbox)* (DoEE 2008e) *Commonwealth Listing Advice on Eucalyptus raveretiana (Black Ironbox)* (TSSC 2012c) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice and Listing Advice.

Species Name **Common Name (EPBC Act Status)**	**Habitat Description**	**Likelihood of Occurrence and Assessment of Impact Significance**	**Relevant Plans & Advice Documents**
		Plants	
Homoranthus decumbens (Endangered)	This species is known from the Barakula Forestry area near Chinchilla and the Blackdown Tableland National Park in QLD. This species grows in shrubland on shallow sandy soils containing lateritic pebbles and on sandstone cliff edges (DoEE 2019n).	**Unlikely Occurrence:** The Project site is out of the natural distribution of the species and lacks suitable habitat. Targeted surveys did not identify any population or individual of the species on the Project. No Wildlife Online or WildNet species records occur within 50 km of the Project. ALA outlines a restricted distribution near Wandoan over 350 km to the south of the Project. **Significant impact on this species is considered unlikely.**	*Approved Conservation Advice for Homoranthus decumbens (a shrub)* (DoEE 2013b) *Commonwealth Listing Advice on Homoranthus decumbens (a shrub)* (TSSC 2013b) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice and Listing Advice.
Logania diffusa (Vulnerable)	Occurs in heathland and Eucalypt open forest. It grows in sandy or sandy clay soil with sandstone outcropping and loose surface stones on escarpments, at elevations of 600 – 780 m above sea level (Wang 1995).	**Unlikely Occurrence:** Records of this species are limited to the Blackdown Tableland NP. The Project lacks suitable habitat. Targeted surveys did not identify any population or individual of the species on the Project. Four Wildlife Online and three WildNet species records occur within 50 km of the Project. ALA outlines a restricted distribution within the Blackdown Tableland NP approximately 50 km to the south of the Project. **Significant impact on this species is considered unlikely.**	*Approved Conservation Advice for Logania diffusa* (DoEE 2008g) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice.

Species Name **Common Name (EPBC Act Status)**	**Habitat Description**	**Likelihood of Occurrence and Assessment of Impact Significance**	**Relevant Plans & Advice Documents**
		Plants	
Macrozamia platyrhachis Cycad (Endangered)	Restricted to the Blackdown Tableland / Planet Downs area of the Dawson Range in central Queensland, in Eucalypt woodland or open forest on sandy soil (QLD Herbarium 2007).	**Unlikely Occurrence:** The Project site is out of the known distribution of the species and lacks suitable habitat. Targeted surveys did not identify any population or individual of the species on the Project. One Wildlife Online and WildNet species record occurs within 50 km of the Project. The nearest ALA occurrence records are approximately 50 km to the south of the Project in the Blackdown Tableland NP. **Significant impact on this species is considered unlikely.**	*National Multi-species Recovery Plan for the cycads, Cycas megacarpa, Cycas ophiolitica, Macrozamia cranei, Macrozamia lomandroides, Macrozamia pauli-guilielmi and Macrozamia platyrhachis* (QLD Herbarium 2007) The recovery plan outlines undertaking research to determine life cycles, optimum fire regimes and protecting existing populations by securing areas and performing detailed surveys of populations. It also included translocation of threatened individual plants to suitable habitat near larger populations of the species. Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the recovery plan.
Polianthion minutiflorum (Vulnerable)	Known from five areas in east Queensland, from Redcliffe Vale, about 110 km west of Mackay, south to Kingaroy. It grows in forest and woodland on sandstone slopes and gullies with skeletal soil, or deeper soils adjacent to deeply weathered laterite (DoEE 2019w).	**Unlikely Occurrence:** The Project lacks suitable habitat. Targeted surveys did not identify any population or individual of the species on the Project. Two Wildlife Online and one WildNet species records occurs within 50 km of the Project. The nearest ALA occurrence records are approximately 50 km to the southeast of the Project in the Amaroo SF. **Significant impact on this species is considered unlikely.**	*Approved Conservation Advice for Trymalium minutiflorum* (DoEE 2008k) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice.

Species Name **Common Name (EPBC Act Status)**	**Habitat Description**	**Likelihood of Occurrence and Assessment of Impact Significance**	**Relevant Plans & Advice Documents**
Birds			
Calidris ferruginea Curlew Sandpiper (Critically Endangered)	Occur on intertidal mudflats in sheltered coastal areas, around coastal non-tidal swamps, lakes and lagoons, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters (DoEE 2019c).	**Unlikely Occurrence:** Marginally suitable habitat exists on the Project in the form of farmer dams which were targeted during bird surveys. Targeted surveys did not identify any population or individual of the species on the Project. No Wildlife Online or WildNet species records occur within 50 km of the Project. The nearest ALA records are on the coast, with the nearest inland record at Lake Maraboon near Emerald. **Significant impact on this species is considered unlikely.**	*Conservation Advice Calidris ferruginea curlew sandpiper* (DoEE 2015a) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice.
Erythrotriorchis radiatus Red Goshawk (Vulnerable)	Tall open forest, woodland, lightly treed savannah and the edge of rainforest, nesting within 1 km or permanent water (DoEE 2019j).	**Possible Occurrence:** The Project lacks suitable nesting habitat. Marginally suitable foraging habitat exists on the Project. This species was not detected during the survey despite targeted search efforts and constant incidental observation for the species. Two Wildlife Online and WildNet species records occur within 50 km of the Project. The nearest ALA record is approximately 50 km to the west. Due to its high mobility the species may uncommonly pass through the Project during foraging, however no evidence of presence was identified, and no suitable nesting habitat occurs on the Project. **Significant impact on this species is considered unlikely.**	*Conservation Advice Erythrotriorchis radiatus red goshawk* (TSSC 2015a) *National recovery plan for the red goshawk Erythrotriorchis radiatus* (DES 2012) The recovery plan outlines recommended actions to include monitoring red goshawk habitat to determine productivity, collate information on known nesting sites, protect habitat through acquisition or voluntary conservation agreements, conduct research to understand the relationship between habitat fragmentation, prey density and population persistence to inform management. Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Recovery Plan and Approved Conservation Advice.

Species Name **Common Name (EPBC Act Status)**	**Habitat Description**	**Likelihood of Occurrence and Assessment of Impact Significance**	**Relevant Plans & Advice Documents**
Birds			
Geophaps scripta scripta Squatter Pigeon (southern) (Vulnerable)	Open grassy woodlands on sandy soils interspersed with low gravelly ridges, never far from water (Morcombe 2004).	**Possible Occurrence:** Suitable habitat occurs within the Project around the Gilgai areas. Targeted surveys did not identify any population or individual of the species on the Project, however occurrence is possible. Numerous Wildlife Online and WildNet species records occur within 50 km of the Project. ALA displays records local to the Project. Due to its mobility, abundant suitable habitat immediately adjacent to the disturbance area, and no proposed disturbance to mapped essential habitat it is **unlikely the Project will have a significant impact** on the species. The possibly present population does not meet the criteria to be an 'important population' nor does it trigger any of the significant impact criteria outlined in the *MNES: Significant Impact Guidelines 1.1* (DoEE 2013e).	*Conservation Advice Geophaps scripta scripta squatter pigeon (southern)* (TSSC 2015b) The Project is unlikely to cause a significant impact on the species.

Species Name **Common Name (EPBC Act Status)**	**Habitat Description**	**Likelihood of Occurrence and Assessment of Impact Significance**	**Relevant Plans & Advice Documents**
		Birds	
Grantiella picta Painted Honeyeater (Vulnerable)	The species inhabits mistletoes in eucalypt forests/woodlands, riparian woodlands of black box and River red gum, Box-ironbark-Yellow gum woodlands, *Acacia*-dominated woodlands, Paperbarks, *Casuarinas, Callitris*, and trees on farmland or gardens. The species prefers woodlands which contain a higher number of mature trees, as these host more mistletoes. It is more common in wider blocks of remnant woodland than in narrower strips although it breeds in quite narrow roadside strips if ample mistletoe fruit is available (DoEE 2019m).	**Unlikely Occurrence:** The Project lacks suitable habitat. No mistletoe species were identified during the field study. A search of the Wildlife Online database showed one record of a mistletoe species within a 10 km range of the Project. Targeted surveys did not identify any population or individual of the species on the Project. Three Wildlife Online and two WildNet species records occur within 50 km of the Project. ALA shows the Project lies generally outside of the natural distribution of the species. Two records occur within 50 km of the Project, following these, the nearest records are in Biloela (120 km), south of Theodore (230 km) and Carnarvon NP (200 km). **Significant impact on this species is considered unlikely.**	*Conservation Advice Grantiella picta painted honeyeater* (DoEE 2015b) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice.
Neochmia ruficauda ruficauda Star Finch (Endangered)	The species inhabits tall grass and reed beds associated with swamps and watercourses in central Queensland. It may also be found in grassy woodlands, open forests, mangroves, urban and cleared areas.	**Unlikely Occurrence:** The Project lacks suitable habitat. Expert opinion suggests this taxon is extinct in the wild, with the last bird recorded in 1995 (Garnett, Szabo and Dutson 2010). Targeted surveys did not identify any population or individual of the species on the Project. No Wildlife Online or WildNet species records occur within 50 km of the Project. The nearest ALA records are south of Tierawoomba SF (120km) and Rockhampton (160 km)). **Significant impact on this species is considered unlikely.**	*Approved Conservation Advice for Neochmia ruficauda ruficauda (Star Finch (eastern))* (DoEE 2008i) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice.

Species Name **Common Name (EPBC Act Status)**	**Habitat Description**	**Likelihood of Occurrence and Assessment of Impact Significance**	**Relevant Plans & Advice Documents**
Birds			
Numenius madagascariensis Eastern Curlew (Critically Endangered)	Within Australia, has a primarily coastal distribution. During the non-breeding season, most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. Often recorded among saltmarsh and on mudflats fringed by mangroves, and sometimes within the mangroves. Also found in coastal saltworks and sewage farms (DoEE 2019r).	**Unlikely Occurrence:** The Project lacks suitable habitat and lies outside of the species natural distribution. Targeted surveys did not identify any population or individual of the species on the Project. No Wildlife Online or WildNet species records occur within 50 km of the Project. The closest ALA records are near the coastline. Distribution is heavily concentrated to coastal environs with only scattered records inland. **Significant impact on this species is considered unlikely.**	*Conservation Advice Numenius madagascariensis eastern curlew* (DoEE 2015c) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice.
Poephila cincta cincta Black-throated Finch (Endangered)	Occurs mainly in grassy, open woodlands and forests, typically dominated by *Eucalyptus*, *Corymbia* and *Melaleuca*, and occasionally in tussock grasslands or other habitats (e.g. freshwater wetlands), often along or near watercourses, or in the vicinity of water (TSSC 2005b).	**Unlikely Occurrence:** The Project has marginally suitable habitat. Targeted surveys did not identify any population or individual of the species on the Project. No Wildlife Online or WildNet species records occur within 50 km of the Project. The closest ALA records are in the Dawson Range SF (over 70 km) and east of Duaringa (over 80 km). As indicated in the *Significant impact guidelines for the endangered black-throated finch (southern) (Poephila cincta cincta)* (DoEE 2009), the black-throated finch's 'whole of range important areas' map, the nearest recorded important area lies approximately 100 km north east of the Project site. **Significant impact on this species is considered unlikely.**	*Commonwealth Listing Advice on Southern Black-throated Finch (Poephila cincta cincta)* (TSSC 2005b) *National recovery plan for the black-throated finch southern subspecies Poephila cincta cincta* (Black-throated Finch Recovery Team, Department of Environment and Climate Change & QLD Parks and Wildlife Service 2007) The plan recommends identifying and quantifying threats, investigating foraging and habitat requirements, quantifying distribution and abundance, and protecting and enhancing habitat. Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice and Recovery Plan.

Species Name **Common Name (EPBC Act Status)**	**Habitat Description**	**Likelihood of Occurrence and Assessment of Impact Significance**	**Relevant Plans & Advice Documents**
Birds			
Rostratula australis Painted Snipe (Endangered)	The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. (DoEE 2019y).	**Unlikely Occurrence:** The Project has marginally suitable habitat. Targeted surveys did not identify any population or individual of the species on the Project. No Wildlife Online or WildNet species records occur within 50 km of the Project. The closest ALA records are near Emerald (over 80 km) and north and south of Duaringa (over 60 km and 80 km, respectively). **Significant impact on this species is considered unlikely.**	*Approved Conservation Advice for Rostratula australis (Australian painted snipe)* (DoEE 2013c) *Commonwealth Listing Advice on Rostratula australis (Australian Painted Snipe)* (TSSC 2013c) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice and Listing Advice.
Turnix melanogaster Black-breasted Button-quail (Vulnerable)	Found in eastern Queensland, south of Byfield. It inhabits vine thickets, rainforests, low thickets or woodlands with dense understories, and coastal scrubs, thickets and shrublands. In QLD prior to about 1900, this species was probably fairly widespread in the Dawson and Fitzroy River catchments, but these populations have declined dramatically since then. They probably now only occur at Palm Grove in this region (DoEE 2019z).	**Unlikely Occurrence:** The Project lacks suitable habitat and lies outside of the species natural distribution, which occurs to the south and east of the Project. Targeted surveys did not identify any population or individual of the species on the Project. No Wildlife Online or WildNet species records occur within 50 km of the Project. The closest ALA records are in the Dawson Range SF (over 80 km). **Significant impact on this species is considered unlikely.**	*Conservation Advice Turnix melanogaster black-breasted button-quail* (TSSC 2015d) *National recovery plan for the black-breasted button-quail Turnix melanogaster* (Mathieson & Smith 2009) The Recovery Plan lists actions required for recovery including mapping species habitat and conducting searches for new populations in mapped habitat, involving traditional owners in research projects. Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice and Recovery Plan.

Species Name **Common Name (EPBC Act Status)**	**Habitat Description**	**Likelihood of Occurrence and Assessment of Impact Significance**	**Relevant Plans & Advice Documents**
Mammals			
Antechinus argentus Silver-headed Antechinus (Endangered)	Known from three isolated sub-populations located in central-eastern Qld; Kroombit Tops NP, Blackdown Tableland NP and Bulburin NP. Occurs on elevated plateaus with tall open-forest structure of wet sclerophyll habitat (TSSC 2018).	**Unlikely Occurrence:** The Project lacks suitable habitat or landform and lies outside of the species natural distribution. Targeted surveys did not identify any population or individual of the species on the Project. Species identified in Wildlife Online 50 km database search. Not identified in EPBC PMS but was added to the Endangered list under the EPBC Act on the 10 May 2018. No WildNet species records within 50 km of the Project. ALA outlines a restricted distribution showing only the Kroombit Tops NP population (over 230 km). **Significant impact on this species is considered unlikely.**	*Conservation Advice Antechinus argentus silver-headed antechinus* (TSSC 2018) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice.
Chalinolobus dwyeri Large-eared Pied Bat (Vulnerable)	Known from the sandstone escarpments in the Carnarvon and Expedition Ranges and Blackdown Tablelands, with additional records existing in the Scenic Rim. Appears to be reliant on cavernous rock habitat for roosting but are known to roost in abandoned mine shafts and disused Fairy Martin nests. Not known to use tree hollows (DES 2011).	**Unlikely Occurrence:** The Project lacks suitable habitat. Targeted surveys did not identify any population or individual of the species on the Project. Two Wildlife Online and WildNet species records occur within 50 km of the Project. The closest ALA records are in the Dawson Range SF (over 80 km). **Significant impact on this species is considered unlikely.**	*Commonwealth Listing Advice on Chalinolobus dwyeri (Large-eared Pied Bat)* (TSSC 2012a) *National recovery plan for the large-eared pied bat Chalinolobus dwyeri* (DES 2011) The includes recovery actions of mapping and modelling bat colonies, identifying priority colonies for management and protection of roosts and known foraging habitat. Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Listing Advice and Recovery Plan.

Species Name **Common Name (EPBC Act Status)**	**Habitat Description**	**Likelihood of Occurrence and Assessment of Impact Significance**	**Relevant Plans & Advice Documents**
Mammals			
Dasyurus hallucatus Northern Quoll (Endangered)	Occupies a diversity of habitats across its range including rocky areas, eucalypt forest and woodlands, rainforests, sandy lowlands and beaches, shrubland, grasslands and desert. Known to occupy non-rocky lowland habitats such as beach scrub communities in central Queensland. Habitat generally encompasses some form of rocky area for denning purposes with surrounding vegetated habitats used for foraging and dispersal. Eucalypt forest or woodland habitats usually have a high structural diversity containing large diameter trees, termite mounds or hollow logs for denning purposes. Appear to be most abundant in habitats within 150 km of the coast (DoEE 2019d).	**Unlikely Occurrence:** The Project lacks suitable habitat. Marginal woodland suitability exists in Community 1; however this community is small and isolated and does not provide adequate denning habitat. Targeted surveys did not identify any population or individual of the species on the Project. No Wildlife Online or WildNet species records occur within 50 km of the Project. The nearest ALA occurrence record is at Mt Zamia, Springsure (over 120 km from the Project). **Significant impact on this species is considered unlikely.**	*Commonwealth Listing Advice on Northern Quoll (Dasyurus hallucatus)* (TSSC 2005a) *National Recovery Plan For the Northern Quoll Dasyurus hallucatus* (Hill & Ward 2010) The Recovery Plan includes strategies for recovery of the species include maintaining biosecurity for offshore islands, foster the recovery of northern quoll sub-populations where species have survived in concert with cane toads, investigate causes of population declines in areas without cane toads and identify pastural land management techniques on species persistence. Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Listing Advice and Recovery Plan.
Macroderma gigas Ghost Bat (Vulnerable)	Spinifex hillsides, black soil grasslands, monsoon forest, open savannah woodland, tall open forest, deciduous vine forest and tropical rainforest. Influenced by the availability of caves and mines for roosting (Churchill 2008). QLD populations are restricted to five isolated subpopulations, the nearest of which is Mt Etna, more than 200 km away (DoEE 2019q).	**Unlikely Occurrence:** The Project lacks suitable rocky or cavernous habitat. Targeted surveys did not identify any population or individual of the species on the Project. No Wildlife Online or WildNet species records occur within 50 km of the Project. The nearest ALA occurrence records are in the Rockhampton area. **Significant impact on this species is considered unlikely.**	*Conservation Advice Macroderma gigas ghost bat* (TSSC 2016b) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice.

Species Name **Common Name (EPBC Act Status)**	**Habitat Description**	**Likelihood of Occurrence and Assessment of Impact Significance**	**Relevant Plans & Advice Documents**
Mammals			
Nyctophilus corbeni South-eastern Long-eared Bat (Vulnerable)	Wide range of inland woodland vegetation types including box / ironbark / cypress pine woodlands, Brigalow woodland, Belah woodland, smooth-barked apple woodland, river red gum forest, black box woodland, and various types of tree Mallee. In QLD and NSW is distinctly more common in box / ironbark / cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern QLD (DoEE 2019s).	**Unlikely Occurrence:** Marginally suitable and fragmented habitat occurs on the Project. Targeted surveys did not identify any population or individual of any species of the *Nyctophilus* genus on the Project. No Wildlife Online or WildNet species records occur within 50 km of the Project. ALA displays the Project as 200 km north of the natural distribution of the species, with the nearest records are in Expedition NP. over occurrence records are in the Rockhampton area. **Significant impact on this species is considered unlikely.**	*Conservation Advice Nyctophilus corbeni south-eastern long-eared bat* (TSSC 2015c) *Commonwealth Listing Advice on ten species of Bats* (TSSC 2001d) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice and Listing Advice.
Onychogalea fraenata Bridled Nail-tail Wallaby (Endangered)	Remnant population is confined to Taunton National Park near the town of Dingo with some sightings within 10 km of the park. Three reintroduced populations include Idalia NP west of Blackall, Avocet Nature Refuge near Emerald, and Scotia Sanctuary (DoEE 2019t).	**Unlikely Occurrence:** The Project lies outside of species natural range and reintroduced range. Targeted surveys did not identify any population or individual on the Project. Numerous Wildlife Online and WildNet species records occur within 50 km of the Project due to Taunton NP lying within this buffer. ALA displays several records in association with Taunton NP. One record from 1845 exists approximately 25 km to the west of the Project on Mackenzie River. Three records from 1974 exist between the Project and the western boundary of Taunton NP, the closest being approximately 20 km from the Project. **Significant impact on this species is considered unlikely.**	*Conservation Advice Onychogalea fraenata bridled nailtail wallaby* (TSSC 2016c) Recovery plan for the bridled nailtail wallaby (Onychogalea fraenata) 2005-2009 (Lundie-Jenkins & Lowry 2005) The Recovery Plan contains recovery strategies including captive breeding, translocation and sanctuaries. Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice and Recovery Plan.

Species Name **Common Name (EPBC Act Status)**	**Habitat Description**	**Likelihood of Occurrence and Assessment of Impact Significance**	**Relevant Plans & Advice Documents**
Mammals			
Petauroides volans Greater Glider (Vulnerable)	Largely restricted to eucalypt forests and woodlands. The Greater Glider favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species. Modelling suggests that the species requires native forest patches of at least 160 square km (km^2) to maintain viable populations (DoEE 2019u).	**Unlikely Occurrence:** Marginally suitable woodland composition habitat occurs on the Project; however these are small patches isolated from any habitat of viable size to support a population. Targeted surveys did not identify any population or individual on the Project. Several Wildlife Online and six WildNet species records occur within 50 km of the Project. Nearest ALA records are several records in association with Blackdown Tableland NP and one record within Taunton NP. **Significant impact on this species is considered unlikely.**	*Conservation Advice Petauroides volans greater glider* (TSSC 2016d) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice.
Phascolarctos cinereus Koala (Vulnerable)	Koalas inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by species from the genus *Eucalyptus* (DoEE 2019v).	**Unlikely Occurrence:** The Project lacks suitable habitat with primary feed trees and connectivity. Targeted surveys did not identify any population or individual on the Project. Several Wildlife Online and WildNet species records occur within 50 km of the Project. ALA shows no records within 20 km of the Project, but several records in the 20 km to 50 km range from the Project. **Significant impact on this species is considered unlikely.**	*Conservation Advice for Phascolarctos cinereus (combined populations in Queensland, New South Wales and the Australian Capital Territory)* (DoEE 2012) *Listing advice for Phascolarctos cinereus (Koala)* (TSSC 2012d) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice and Listing Advice.

Species Name **Common Name (EPBC Act Status)**	**Habitat Description**	**Likelihood of Occurrence and Assessment of Impact Significance**	**Relevant Plans & Advice Documents**
Mammals			
Pteropus poliocephalus Grey-headed Flying Fox (Vulnerable)	Roost in native vegetation near water, including mangrove, rainforest, melaleuca or casuarina (Churchill 2008). Typically commute within 15 km to feed on flowering and fruiting plants, including blossoms of various species of eucalypt, angophora, tea-tree and banksia (DES 2018).	**Unlikely Occurrence:** The Project lacks suitable habitat. No flying fox roost camps were identified from the QLD DES monitoring and location maps (DES 2019a). Targeted surveys did not identify any population, individual, or potential roosts on the Project. No Wildlife Online or WildNet species records occur within 50 km of the Project. The nearest ALA records are near Rockhampton and Biloela. **Significant impact on this species is considered unlikely.**	*Commonwealth Listing Advice on Pteropus poliocephalus (Grey-headed Flying-fox)* (TSSC 2001b) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Listing Advice.
Reptiles			
Delma torquata Collared Delma (Vulnerable)	Known mainly from south-east Queensland, with recent records from the Blackdown Tablelands and Roma. Mainly inhabits ridgelines vegetated with dry open woodland, also *Eucalyptus tereticornis* and Brigalow woodlands. Shelters under loose rocks (Curtis *et al.* 2012).	**Unlikely Occurrence:** The Project lacks suitable habitat and landforms. The Project lies further north than the natural distribution. Targeted surveys did not identify any population or individual on the Project. No Wildlife Online or WildNet species records occur within 50 km of the Project. The nearest ALA and furthest north record is south of the Project in the Blackdown Tableland NP. **Significant impact on this species is considered unlikely.**	*Approved Conservation Advice for Delma torquata (Collared Delma)* (DoEE 2008c) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice.

Species Name **Common Name (EPBC Act Status)**	**Habitat Description**	**Likelihood of Occurrence and Assessment of Impact Significance**	**Relevant Plans & Advice Documents**
		Reptiles	
Denisonia maculata Ornamental Snake (Vulnerable)	Known only from the Brigalow Belt biogeographical region, chiefly from the Fitzroy and Dawson River catchments. Prefers woodlands and open forests associated with waterways and other moist areas, particularly Gilgai (melon-hole) mounds and depressions. Also occurs on lake margins and wetlands.	**Possible Occurrence:** The Project contains potentially suitable Gilgai habitat features. This species has been previously recorded at the adjacent Curragh Mine in association with Blackwater Creek in 2003. Targeted surveys did not identify any population or individual on the Project. No Wildlife Online or WildNet species records occur within 50 km of the Project. The nearest ALA is the record on the adjacent Curragh Mine. Approximately 14.65 ha of potential habitat for this species will be impacted by the Project. However, targeted habitat searches did not locate the species and the small size of the impact area, isolated nature and availability of similar habitat in the surrounding area means a **significant impact on the species is considered unlikely.**	*Approved Conservation Advice for Denisonia maculata (Ornamental Snake)* (DoEE 2014a) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice.
Egernia rugosa Yakka Skink (Vulnerable)	Dry open forests, woodlands and rocky areas in the Brigalow Belt, where it occurs in fallen timber, wood piles, uprooted trees, deep rock crevices, deeply eroded gullies or disused rabbit warrens (DoEE 2019h).	**Unlikely Occurrence:** Marginally suitable habitat potentially exists on the Project, however better suited habitat occurs adjacent to the Project. Targeted surveys did not identify any population or individual on the Project. One Wildlife Online and WildNet species record occurs within 50 km of the Project. The nearest ALA data point is a specimen collected in the approximately area of Curragh Mine in 2000. **Significant impact on this species is considered unlikely.**	*Approved Conservation Advice for Egernia rugosa (Yakka Skink)* (DoEE 2014b) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice.

Species Name **Common Name (EPBC Act Status)**	**Habitat Description**	**Likelihood of Occurrence and Assessment of Impact Significance**	**Relevant Plans & Advice Documents**
Reptiles			
Elseya albagula Southern Snapping Turtle (Critically Endangered)	Only found in the Burnett, Fitzroy, Raglan and Mary river drainages of south-east Queensland. Prefers permanent flowing water habitats where there are suitable shelters and refuges (e.g. fallen trees) (DoEE 2019i).	**Unlikely Occurrence:** The Project lacks suitable habitat. Suitable habitat exists in the Mackenzie River to the north of the Project. Two Wildlife Online and one WildNet species records occur within 50 km of the Project. ALA displays four records collected along the Mackenzie River north of the Project. The Project is not expected to impact on the Mackenzie River and will comply with existing and approved Water Management Plan (WMP) that are in accordance with relevant water quality guidelines. **Significant impact on this species is considered unlikely.**	*Conservation Advice Elseya albagula White-throated snapping turtle* (DoEE 2014c) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice.
Furina dunmalli Dunmall's Snake (Vulnerable)	Inhabits forests and woodlands on black alluvial cracking clay and clay loams dominated by Brigalow (Acacia harpophylla). Preferred microhabitat includes fallen timber and leaf litter and possibly cracks in clay soils (DoEE 2019l).	**Unlikely Occurrence:** The Project contains potentially suitable Gilgai habitat features; however the Project does not fall within the modelled distribution boundary (DoEE 2019l). Targeted surveys did not identify any population or individual on the Project. No Wildlife Online or WildNet species records occur within 50 km of the Project. The nearest ALA records are over 150 km from the Project. Despite potentially suitable, yet isolated, habitat available on the Project, targeted searches and desktop records show the species is unlikely to occur on the Project. **Significant impact on the species is considered unlikely.**	*Approved Conservation Advice for Furina dunmalli (Dunmall's Snake)* (DoEE 2014d) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice.

Species Name **Common Name (EPBC Act Status)**	**Habitat Description**	**Likelihood of Occurrence and Assessment of Impact Significance**	**Relevant Plans & Advice Documents**
Reptiles			
Lerista allanae Allan's Lerista (Endangered)	Restricted to road verges and other small areas with friable soils, amid pastoral land dominated by heavy soils in the vicinity of Capella, Clermont and Logan Downs Station (Wilson & Swan 2017).	**Unlikely Occurrence:** The Project possibly contains potentially suitable habitat features; however the Project does not fall within the modelled distribution boundary (DoEE 2019o). Targeted surveys did not identify any population or individual on the Project. No Wildlife Online or WildNet species records occur within 50 km of the Project. The few known records are only known from Clermont and Capella area, which is reflected on the ALA. **Significant impact on the species is considered unlikely.**	*Approved Conservation Advice for Lerista allanae (Allan's Lerista)* (DoEE 2008f) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice.
Rheodytes leukops Fitzroy River Turtle (Vulnerable)	Only found in the Fitzroy River and its tributaries, around Rockhampton in eastern central QLD. The species occurs within permanent freshwater riverine reaches and large, isolated permanent waterholes (DoEE 2019x).	**Unlikely Occurrence:** The Project lacks suitable habitat. Suitable habitat exists in the Mackenzie River to the north of the Project. Six Wildlife Online and four WildNet species records occur within 50 km of the Project. ALA displays six records collected in association with the Mackenzie River west of the Project. The Project is not expected to impact on the Mackenzie River and will comply with existing and approved WMP that are in accordance with relevant water quality guidelines. **Significant impact on this species is considered unlikely.**	*Approved Conservation Advice for Rheodytes leukops (Fitzroy Tortoise)* (DoEE 2008j) Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Approved Conservation Advice.

Species Name **Common Name (EPBC Act Status)**	**Habitat Description**	**Likelihood of Occurrence and Assessment of Impact Significance**	**Relevant Plans & Advice Documents**
		Fish	
Maccullochella peelii Murray Cod (Vulnerable)	Utilises a range of habitats from clear rocky streams to slow-flowing, turbid rivers and billabongs. Frequently found in the main channels of rivers and larger tributaries. Preferred microhabitat consists of features such as large rocks, snags, overhanging banks and vegetation, tree stumps, logs, branches and other woody structures. Strongly associated with deep (>2.4 m) and slow water closer to the river bank (DoEE 2019p).	**Unlikely Occurrence:** The Project lacks suitable habitat. Potentially suitable habitat exists in the Mackenzie River to the north of the Project. No Wildlife Online or WildNet species records occur within 50 km of the Project. ALA displays no records collected in association with Mackenzie River, the only suitable habitat in the area, nor in association with any of the Fitzroy River system and tributaries. One record from 1990 occurs southwest of Emerald at Lake Maraboon. **Significant impact on this species is considered unlikely.**	*Commonwealth Listing Advice on Maccullochella peelii peelii (Murray Cod, Cod, Goodoo)* (TSSC 2003) *National Recovery Plan for the Murray Cod Maccullochella peelii peelii* (National Murray Cod Recovery Team 2010) The Recovery Plan aims to restore population levels back to 60% or better of estimated pre-European-settlement levels after 50 years of implementation. The strategy includes investigating key biological and ecological processes impacting the species. It is believed that broad scale river health programs will greatly improve the recovery ability of the species. Should the species be identified in the future, the DoEE will be notified and appropriate species management undertaken in accordance with the available Listing Advice and Recovery Plan.

5.3 SIGNIFICANT IMPACT CRITERIA

The *MNES: Significant Impact Guidelines 1.1* (DoEE 2013e) defines that an Action will require approval if the Action has, will have, or is likely to have a significant impact on a species listed in any of the following categories:

- Extinct in the wild;
- Critically endangered;
- Endangered; or
- Vulnerable.

The Guideline outlines specific significant impact criteria for each listing category. The three species that were determined to have a possible occurrence are all listed as Vulnerable under the EPBC Act. The significant impact criteria for a Vulnerable species are listed below, for any other listed threatened species category, please refer to the *MNES: Significant Impact Guidelines 1.1* (DoEE 2013e).

The Guideline states that *an action is likely to have a significant impact on a Vulnerable species if there is a real chance or possibility that it will:*

- *Lead to a long-term decrease in the size of an important population of a species;*
- *Reduce the area of occupancy of an important population;*
- *Fragment an important existing population into two or more populations;*
- *Adversely affect habitat critical to the survival of a species;*
- *Disrupt the breeding cycle of an important population;*
- *Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;*
- *Result in invasive species that are harmful to a critically endangered, endangered or vulnerable species becoming established in the critically endangered, endangered or vulnerable species' habitat;*
- *Introduce disease that may cause the species to decline; or*
- *Interfere substantially with the recovery of the species.*

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- *key source populations either for breeding or dispersal*
- *populations that are necessary for maintaining genetic diversity, and/or*
- *populations that are near the limit of the species range.*

The *Draft Referral Guidelines for the nationally listed Brigalow Belt reptiles* (DoEE 2011b) assists in the application of the significant impact guidelines to Brigalow Belt reptiles and *provides indicative*

thresholds for a number of species to determine whether there is a high, low or uncertain risk of significant impacts.

5.4 IMPACT ASSESSMENT

Section 5.2 identified three species with possible occurrence on the Project and have been preliminarily assessed as unlikely to be impacted by the Project. Regardless, an impact assessment against the significant impact criteria as set out by the *MNES: Significant Impact Guidelines 1.1* (DoEE 2013e) has been undertaken for each species to provide further support of this conclusion.

5.4.1 Red Goshawk (*Erythrotriorchis radiatus*)

The Red Goshawk was identified as possibly occurring and has been assessed against applicable significant impact criteria. It is considered unlikely that the species will be impacted as there has been no recorded occurrence of the species on the Project. Additionally, there is only marginally suitable foraging habitat available and no nesting habitat available. Due to its high mobility, the species may uncommonly pass over the Project area, but no evidence of its presence has been identified.

Table 15 assesses the possible occurrence of the Red Goshawk at the Project against the criteria for an important population of a Vulnerable species, and Table 16 assesses against the MNES significant impact criteria for a Vulnerable species.

Table 15 Red Goshawk Important Population Assessment

Important Population of a Vulnerable Species	Important Population Assessment
An 'important population' is a population that is necessary for a species' long-term survival and recovery.	
This may include populations identified as such in recovery plans, and/or that are:	**Recovery Plan**: has yet to delineate the population and define 'important population' subsets. The identification of 'important populations' is outlined as a recovery action.
• key source populations either for breeding or dispersal;	**No:** No identified population on or associated with the Project. Recovery plan outlines Cape York Peninsula and northeast QLD as 'strongholds' for the species. The Project lies outside of this area with sparse records in the greater region and no suitable breeding habitat located on the Project.
• populations that are necessary for maintaining genetic diversity, and/or	**No:** No identified population on the Project. Limited and sparse records of occurrence in the greater area surrounding the Project. No suitable breeding habitat is located on the Project and is unlikely to support the potential to contribute to or maintain the genetic diversity of the species.
• populations that are near the limit of the species range.	**No:** No identified population on the Project. Limited and sparse records of occurrence in the greater area surrounding the Project. Numerous records of occurrence to the regions north and south of the Project.

Table 16 Red Goshawk Impact Assessment

Significant Impact Criteria for a Vulnerable Species	Significant Impact Assessment
Will the action lead to a long-term decrease in the size of an important population of a species?	**No:** No identified population on the Project. Should a population be identified in association with the Project in the future, it will not constitute an important population.
Will the action reduce the area of occupancy of an important population?	**No:** No identified population on the Project. Should a population be identified in association with the Project in the future, it will not constitute an important population.
Will the action fragment an existing important population into two or more populations?	**No:** No identified population on the Project. Should a population be identified in association with the Project in the future, it will not constitute an important population.
Will the action adversely affect habitat critical to the survival of a species?	**No:** No identified population on the Project. No critical habitat identified on the Project. Critical habitat is defined in the Recovery Plan as it needs to contain sites for nesting, food resources, water, shelter, essential travel routes, dispersal, and buffer areas. The marginally suitable foraging habitat available on the Project is isolated, fragmented and not suitable for nesting.
Will the action disrupt the breeding cycle of an important population?	**No:** No identified population on the Project. Should a population be identified in association with the Project in the future, it will not constitute an important population.
Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	**No:** No identified population on the Project. Clearing of the marginally suitable habitat available and no suitable breeding habitat on the Project with no evidence of a population will not result in a species decline.
Will the action introduce disease that may cause the species to decline?	**No:** No identified population on the Project. No diseases are known for the species that could be influenced by mining activities and cause the species' population to decline, nor interfere substantially with the recovery of the species.
Will the action interfere substantially with the recovery of the species?	**No:** No identified population on the Project. The Project will not interfere with known populations of the species nor affect their recovery.

5.4.2 Squatter Pigeon (southern) (*Geophaps scripta scripta*)

The Squatter Pigeon (southern) was identified as possibly occurring and has been assessed against applicable significant impact criteria. Due to species mobility, abundant suitable habitat immediately adjacent to the disturbance area, and no identified population on the Project, it is unlikely the Project will have a significant impact on this species.

Table 17 assesses the possible occurrence of the Squatter Pigeon at the Project against the criteria for an important population of a Vulnerable species, and Table 18 assesses against the MNES significant impact criteria for a Vulnerable species.

Table 17 Squatter Pigeon (southern) Important Population Assessment

Important Population of a Vulnerable Species	Important Population Assessment
An 'important population' is a population that is necessary for a species' long-term survival and recovery.	
This may include populations identified as such in recovery plans, and/or that are:	**No Recovery Plan available.**
• key source populations either for breeding or dispersal;	**No:** No identified population on the Project. Sparse records of occurrence in the greater area surrounding the Project, with majority concentrated in the Taunton NP. The area is currently fragmented and unlikely to support a breeding population nor limit dispersal of this mobile species.
• populations that are necessary for maintaining genetic diversity, and/or	**No:** No identified population on the Project. Sparse records of occurrence in the greater area surrounding the Project. The area is currently fragmented and unlikely to be currently supporting the genetic diversity of the species.
• populations that are near the limit of the species range.	**No:** No identified population on the Project. Sparse records of occurrence in the greater area surrounding the Project. Numerous records of occurrence to the east, north and south of the Project, with scattered records to the west of the Project.

Table 18 Squatter Pigeon (southern) Impact Assessment

Significant Impact Criteria for a Vulnerable Species	Significant Impact Assessment
Will the action lead to a long-term decrease in the size of an important population of a species?	**No:** No identified population on the Project. Should a population be identified in association with the Project in the future, it will not constitute an important population.
Will the action reduce the area of occupancy of an important population?	**No:** No identified population on the Project. Should a population be identified in association with the Project in the future, it will not constitute an important population.
Will the action fragment an existing important population into two or more populations?	**No:** No identified population on the Project. Should a population be identified in association with the Project in the future, it will not constitute an important population.

Significant Impact Criteria for a Vulnerable Species	Significant Impact Assessment
Will the action adversely affect habitat critical to the survival of a species?	**No:** No identified population on the Project. No critical habitat identified on the Project. The species does not have highly specific habitat requirements, with potentially suitable habitat available on the Project widely available across the region and immediately adjacent to the Project. Clearing of potentially suitable habitat that is widely available in the region will not affect the survival of the species.
Will the action disrupt the breeding cycle of an important population?	**No:** No identified population on the Project. Should a population be identified in association with the Project in the future, it will not constitute an important population.
Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	**No:** No identified population on the Project. The species does not have highly specific habitat requirements, with potentially suitable habitat available on the Project widely available across the region and immediately adjacent to the Project. Clearing of potentially suitable habitat that is widely available in the region will not cause the species to decline.
Will the action introduce disease that may cause the species to decline?	**No:** No identified population on the Project. No diseases are known for the species that could be influenced by mining activities and cause the species' population to decline, nor interfere substantially with the recovery of the species.
Will the action interfere substantially with the recovery of the species?	**No:** No identified population on the Project. The Project will not interfere with known populations of the species nor affect their recovery.

5.4.3 Ornamental Snake (*Denisonia maculata*)

The Ornamental Snake was identified as possibly occurring and has been assessed against applicable significant impact criteria. It is unlikely that the species will be impacted as there has been no recorded occurrence of the species on the Project. Additionally, the possible habitat for the species is fragmented and has been impacted by historical clearing and grazing. The potentially suitable habitat is already isolated, and the two fragments separated by a haul road. Dispersal between the two patches or patches outside of the Project is considered unlikely. Existing potential habitat totalled 14.65 ha and mapped in Figure 8 which illustrates its small scale and heavily fragmented nature. In accordance with the proposed mine layout (Figure 2), all potential habitat will be cleared.

Table 19 assesses the possible occurrence of the Ornamental Snake at the Project against the criteria for an important population of a Vulnerable species, and Table 20 assesses against the MNES significant impact criteria for a Vulnerable species. The *Draft Referral guidelines for the nationally listed Brigalow Belt reptiles* (DoEE 2011b) outlines risk categories of significant impact on listed Brigalow Belt Reptiles and referral recommendations accordingly. Table 21 provides an assessment of the species against suitable risk categories.

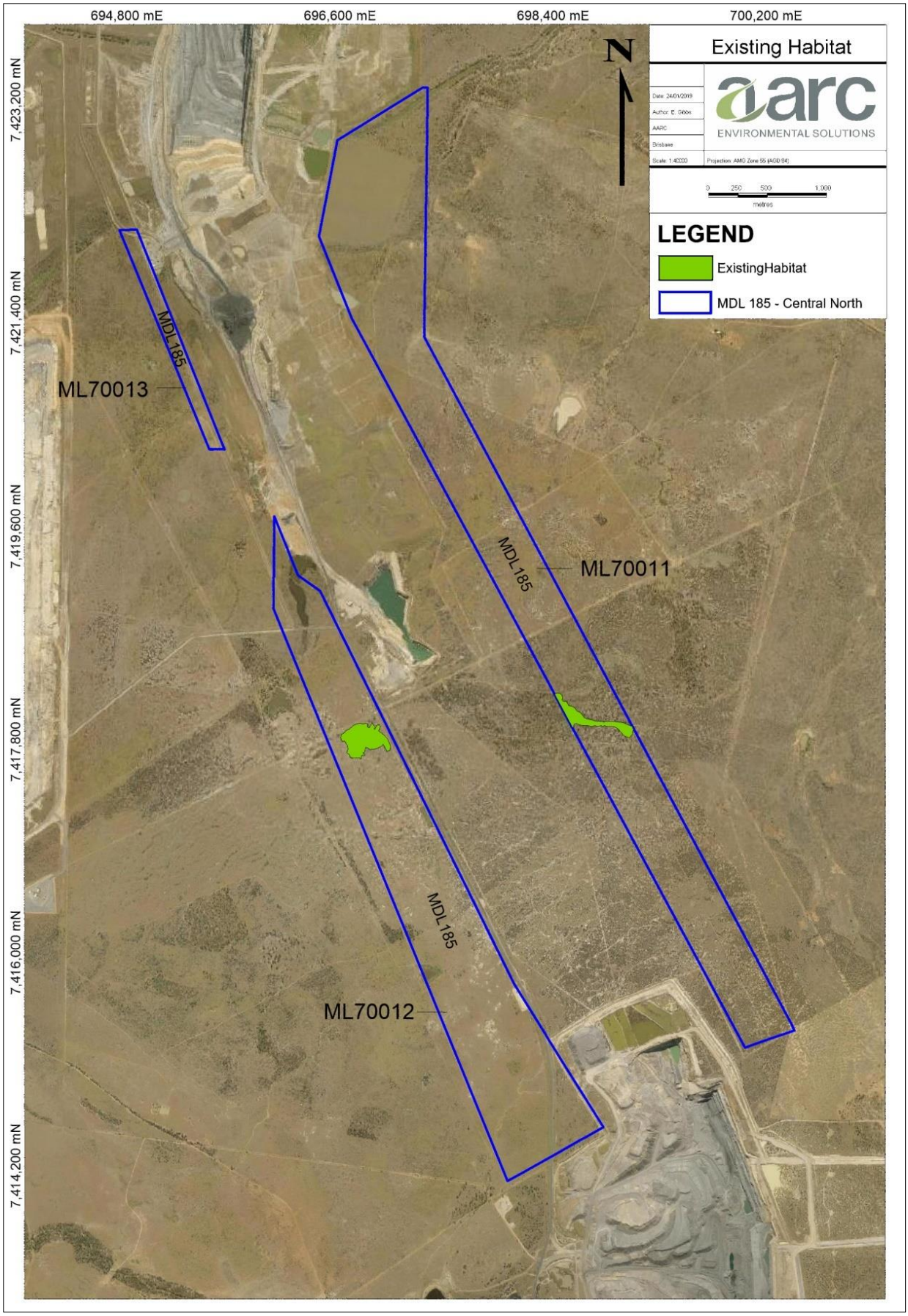

Figure 8 Potential Habitat for the Ornamental Snake

Table 19 Ornamental Snake Important Population Assessment

Important Population of a Vulnerable Species	Important Population Assessment
An 'important population' is a population that is necessary for a species' long-term survival and recovery.	
This may include populations identified as such in recovery plans, and/or that are:	**No Recovery Plan available.**
• key source populations either for breeding or dispersal;	**No:** No identified population on the Project. Limited and sparse records of occurrence in the greater area surrounding the Project. The area is currently fragmented and unlikely to support a population capable of dispersal or being a key breeding source.
• populations that are necessary for maintaining genetic diversity, and/or	**No:** No identified population on the Project. Limited and sparse records of occurrence in the greater area surrounding the Project. The area is currently fragmented and unlikely to support potential to contribute to or maintain genetic diversity of the species.
• populations that are near the limit of the species range.	**No:** No identified population on the Project. Limited and sparse records of occurrence in the greater area surrounding the Project. Numerous records of occurrence to the east, west, north and south of the Project.

Table 20 Ornamental Snake Impact Assessment

Significant Impact Criteria for a Vulnerable Species	Significant Impact Assessment
Will the action lead to a long-term decrease in the size of an important population of a species?	**No:** No identified population on the Project. Should a population be identified in association with the Project in the future, it will not constitute an important population.
Will the action reduce the area of occupancy of an important population?	**No:** No identified population on the Project. Should a population be identified in association with the Project in the future, it will not constitute an important population.
Will the action fragment an existing important population into two or more populations?	**No:** No identified population on the Project. Should a population be identified in association with the Project in the future, it will not constitute an important population.

Significant Impact Criteria for a Vulnerable Species	Significant Impact Assessment
Will the action adversely affect habitat critical to the survival of a species?	**No:** No identified population on the Project. No critical habitat identified on the Project. The potentially suitable habitat available on the Project is in association with isolated Gilgai patches. The *Draft Referral guidelines for the nationally listed Brigalow Belt reptiles* (DoEE 2011b) defines known important habitat to be "Gilgai depressions and mounds" and "Habitat connectivity between Gilgai's and other suitable habitats is important". No connectivity to other areas of potentially suitable habitat exists. Clearing 14.65 ha of potentially suitable habitat with no connectivity will not affect the survival of the species.
Will the action disrupt the breeding cycle of an important population?	**No:** No identified population on the Project. Should a population be identified in association with the Project in the future, it will not constitute an important population.
Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	**No:** No identified population on the Project. The potentially suitable habitat available on the Project is in association with isolated Gilgai patches. Clearing 14.65 ha of potentially suitable habitat with no connectivity and no evidence of a population will not result in a species decline.
Will the action introduce disease that may cause the species to decline?	**No:** No identified population on the Project. No diseases are known for the species that could be influenced by mining activities and cause the species' population to decline, nor interfere substantially with the recovery of the species.
Will the action interfere substantially with the recovery of the species?	**No:** No identified population on the Project. The Project will not interfere with known populations of the species nor affect their recovery.

Table 21 Risk Categories for Significant Impacts on Listed Brigalow Belt Reptiles

Category Eligibility	Significant Impact Assessment
High risk of significant impacts on listed Brigalow Belt reptiles *Referral Recommended*	
The loss, fragmentation or change in the ecological character or function of important habitat which is likely to adversely affect the recovery of the Ornamental Snake.	**Not Applicable:** No identified population on the Project. Potential habitat is not important habitat due to existing fragmentation and lack of connectivity. The Project is not expected to adversely affect the recovery of the Ornamental Snake.
The fragmentation of important habitat or landscape corridors through the introduction of a barrier to dispersal.	**Not Applicable:** No identified population on the Project. Potential habitat is not important habitat due to existing fragmentation and lack of connectivity.

Category Eligibility	Significant Impact Assessment
The introduction of invasive weeds, including the deliberate or accidental sowing of pasture grasses, within 30 m of important Ornamental Snake habitat without appropriate and ongoing control measures.	**Not Applicable:** No identified population on the Project. Potential habitat is not important habitat due to existing fragmentation and lack of connectivity. The potential habitat is already subject to invasive weeds, including cacti and pasture grasses. Edge effects and infiltration from adjacent pasture is already occurring. Pastoral practices, including broadscale clearing and cattle grazing, have been occurring in and adjacent to the potential habitat for an extended period. The Project is not expected to introduce any new elements nor increase the existing impacts.
Enabling the access of animal pests, including cats, pigs and cane toads, to important Ornamental Snake habitat without appropriate and ongoing control measures	**Not Applicable:** No identified population on the Project. Potential habitat is not important habitat due to existing fragmentation and lack of connectivity. The potential habitat is already subject to animal pests with cane toads and rabbits recorded during the field study. The area also supports known populations of feral pigs and cats. The Project is not expected to enable any additional access by animal pests nor increase the existing impacts.
Cattle grazing activities resulting in the degradation of microhabitat features within important habitat patches (for important Gilgai habitats, this only applies when Gilgai's contain surface water).	**Not Applicable:** No identified population on the Project. Potential habitat is not important habitat due to existing fragmentation and lack of connectivity. The potential habitat is already subject to pastoral practices including broadscale clearing and cattle grazing in and adjacent to the potential habitat for an extended period. The habitat is already in a degraded condition from the influence of pastoral practices.
Alteration of water quality or quantity affecting four or more hectares of important Gilgai or riparian habitat.	**Not Applicable:** No identified population on the Project. Potential habitat is not important habitat due to existing fragmentation and lack of connectivity. Water quality will be in accordance with water quality objectives (WQOs) and the WMP.
Clearing two or more hectares of important habitat.	**Not Applicable:** No identified population on the Project. Potential habitat is not important habitat due to existing fragmentation and lack of connectivity.
Summary: *The Project does not have a high risk of impact to the Ornamental Snake nor to important habitat for the Ornamental Snake.*	
Low risk of significant impacts on listed Brigalow Belt reptiles *Referral may not be required but may still refer for legal certainty.*	
Removal or degradation of habitat which is not considered to be important habitat for Ornamental Snake.	**Yes:** Potential habitat is not important habitat due to existing fragmentation and lack of connectivity. No identified population utilising this habitat nor on the Project.
Actions designed to retain all important habitat for listed Brigalow Belt reptiles within the affected area.	**Not Applicable:** No important habitat to be impacted. No identified population on the Project.

Category Eligibility	Significant Impact Assessment
Action plans that retain an adequate buffer zone to protect the important habitat within the affected area.	**Not Applicable:** No important habitat to be impacted. No identified population on the Project.
The loss, fragmentation or change in the ecological function of habitat which is not likely to adversely affect the recovery of the Ornamental Snake.	**Yes:** Potential habitat is not an important habitat due to existing fragmentation and lack of connectivity. No identified population is utilising this habitat nor on the Project. Loss of habitat will not adversely affect the recovery of the Ornamental Snake.
Clearing one hectare or less of important habitat (providing that important habitat connectivity is not compromised).	**Not Applicable:** No important habitat to be impacted. Potential habitat is already compromised by existing fragmentation and lack of connectivity. No identified population on the Project.
Summary: *The Project poses a low risk to impact on the Ornamental Snake due to lack of presence, no important habitat to be impacted, and the non-important habitat to be removed will not adversely affect the recovery of the species.*	

The proposed Action is not expected to have a significant impact on any listed threatened species; however management commitments are provided in Section 11.1 regardless.

6.0 SURFACE WATER & RECEIVING ENVIRONMENT

Section 528 of the EPBC Act defines a large coal mine as:

Any coal mining activity that has, or is likely to have, a significant impact on water resources (including any impacts of associated salt production and/or salinity):

- *In its own right; or*
- *When considered with other developments, whether past, present, or reasonably foreseeable developments.*

The Action was assessed as having the potential to impact on groundwater and surface water flows of the natural landscape, thereby water resources were identified as a potential controlling provision for the Project, and modelling and assessment were conducted as follows the section for surface water resources, and the following Section 7.0 for groundwater.

6.1 DESCRIPTION OF SURFACE WATER VALUES

The Mine is located within the catchment of Blackwater Creek and the Mackenzie River. Blackwater Creek runs parallel to the western boundaries of the existing Jellinbah Central area. Twelve Mile Creek is located to the east; however, its catchment extends to an area of Central and Jellinbah South only. The topography of the area consists of flat to gently undulating plains. The Project area naturally drains north to the Mackenzie River, either directly or via a small tributary. Watercourses within the region are ephemeral, with the exception of the Mackenzie River, which carries controlled releases from Fairbairn Dam, along the Nogoa River, upstream of Mine. The surface water features are depicted in Figure 9 below.

Blackwater Creek to the west is predominantly dry with temporary flows during large wet season rainfall events. The Mackenzie River supports surface flows throughout the year, including controlled releases from Fairbairn Dam, along the Nogoa River, upstream of Mine. The Mackenzie River is a major tributary of the Fitzroy River, which flows to the Coral Sea at Rockhampton.

Semi-permanent pools exist in Blackwater Creek and the Mackenzie River, as well as Three- and Five-Mile Lagoons located adjacent to the Jellinbah Plains operation on an unnamed watercourse.

The total catchment area of Mackenzie River to the Bingegang Weir (35 km downstream of the Mine) is approximately 50,960 km^2 and incorporates the Comet and Nogoa River sub-catchments. Beyond the towns of Clermont, Emerald, Springsure, and Blackwater, the catchment is sparsely populated.

Land use is typically rural, with substantial areas cleared for grazing. Surface waters in the region are of environmental value to the surrounding grazing industry, existing mining operations, the local community, and native flora and fauna. Within the vicinity of the Mine and the CNE, water resources are primarily used for stock watering purposes. Water extracted from the Mackenzie River is primarily used for agricultural purposes, however, also includes riparian, stock and domestic entitlements.

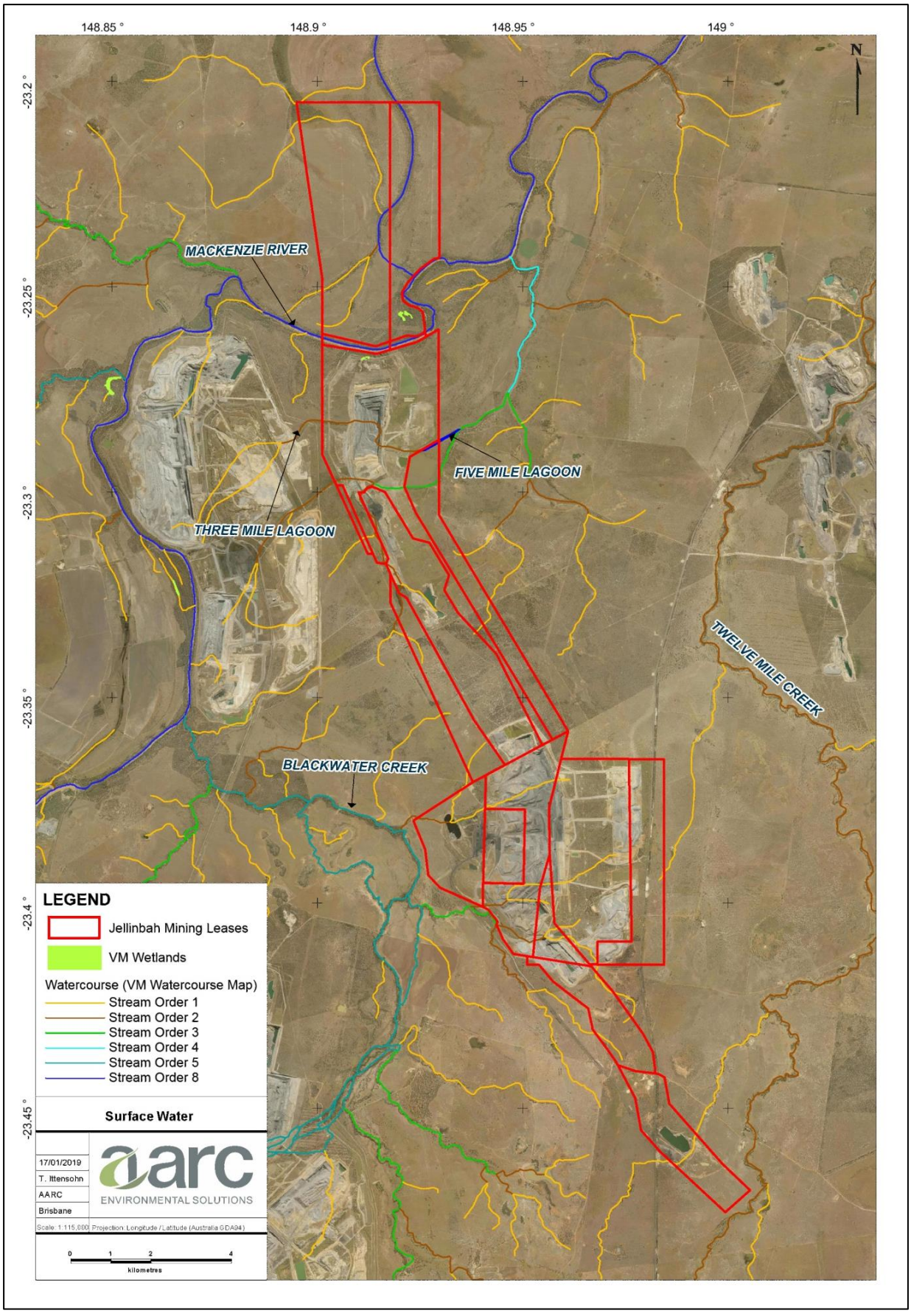

Figure 9 Surface Water Features

6.1.1 Regional Water Quality

Existing regional water quality has been summarised from the downstream of Department of Natural Resources, Mines and Energy (DNRME) streamflow gauging station located on Mackenzie River (Bingegang Weir). Water quality data (including the median and 80th percentile values) are shown in Appendix D2.

This data was compared with the following water quality guidelines with exceedances presented in Table 22:

- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC Guidelines) (ANZECC & ARMCANZ 2000) for Irrigation; Livestock Drinking Water; Aquatic Ecosystems; and

- *Environmental Protection (Water) Policy 2009* (EPP (Water)) with specific regard to the WQOs for Aquatic Ecosystems, Irrigation and Stock Water as set out in the *Fitzroy River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Fitzroy River Sub-basin)* (Environmental Policy and Planning 2013).

Table 22 Guideline Exceedances by DNRME Gauging Stations

Parameter	Units	ANZECCC (2000) Guidelines		EPP (Water) WQOs			Mackenzie River		
							Bingegang Weir		
		Stock Water	Aquatic Ecosystems	Aquatic Ecosystems	Livestock Watering	Irrigation Supply	Count	Median	80th percentile
pH		6.5 – 8.5	6.0– 8.0	6.5 – 8.5	6.5 – 8.5	6.5 – 9.0	90	7.7	8
Turbidity	NTU	n/a	15	50	n/a	n/a	39	61	100
Ammonia as N - soluble	mg/l	n/a	0.01	0.02	n/a	n/a	16	0.0085	0.013
Nitrate + nitrite as N - soluble	mg/l	n/a	n/a	n/a	n/a	n/a	16	0.033	0.24
Nitrate as NO_3	mg/l	400	0.7	n/a	400	n/a	53	1	2
Bicarbonate as HCO_3	mg/l	n/a	n/a	n/a	n/a	n/a	90	93	132.56
Hardness as $CaCO_3$	mg/l	n/a	n/a	n/a	n/a	60	90	63	91
Calcium as Ca soluble	mg/l	1000	n/a	n/a	1000	<60	90	15	20.66
Carbonate as CO_3	mg/l	n/a	n/a	n/a	n/a	n/a	69	0.3	0.84
Boron	mg/l	5.0	0.37	n/a	5.0	0.5	23	0.03	0.1
Chloride	mg/l		0.02	n/a		175	90	10.58	15.2
Conductivity	µS/cm	4000	250	<310 (baseflow) <210 (high flow)	n/a	n/a	90	189	262
Fluoride	mg/l	2	n/a	n/a	2	1	90	0.205	0.3
Iron as Fe soluble	mg/l	n/a	n/a	n/a	n/a	0.2	35	0.17	2.5
Magnesium	mg/l	n/a	n/a	n/a	n/a	n/a	90	6.45	9.62
Potassium	mg/l	n/a	n/a	n/a	n/a	n/a	75	4	5.22
Silica as Sio2 soluble	mg/l	n/a	n/a	n/a	n/a	n/a	75	14.2	16.04
Sodium	mg/l	n/a	n/a	n/a	n/a	115	90	13	18.3
Sulphate	mg/l	1000	n/a	10	1000	n/a	53	4.9	7.284
TDS	mg/l	2400	n/a	n/a	2400	n/a	79	119.42	152.4
TN	mg/l	n/a	0.3	0.775	n/a	5	3	0.5189	0.59072
TP	mg/l	n/a	0.01	0.16	n/a	0.05	25	0.09	0.17724
TSS	mg/l	n/a	n/a	110	n/a	n/a	73	46	216.4

Note: 1. ANZECC guidelines for Aquatic Ecosystems in Tropical, Lowland environments were used for the Mackenzie River at Bingegang Weir. Elevation at Bingegnag Weir ~96m above sea level.
2. No exceedances of the ANZECC Guidelines for Livestock Drinking Water occurred.

Key: XX This parameter exceeds ANZECC (2000) Aquatic Ecosystems Guidelines (upper limit, where applicable).
This parameter exceeds EPP (Water) WQOs (upper limit, where applicable).

The EPP (Water) Fitzroy River Sub-basin WQOs for Aquatic Ecosystems is generally the most stringent water quality objective for regional waterways. As can be seen in Table 22, the Mackenzie River exceeds a number of water quality objectives under median and 80th percentile scenarios. This is considered typical of a moderately disturbed waterway located in areas subject to agriculture and mining activities.

6.1.2 Local Receiving Environment

To understand background local water quality relevant to the Project, water quality samples were collected from Blackwater Creek, Mackenzie River, Three Mile Lagoon, and Five Mile Lagoon. Samples were first collected in September 2014, and every year since as part of the Receiving Environment Monitoring Program (REMP) conducted by the Mine. A brief description of the REMP methodology is provided in Section 11.3.1.1. Jellinbah's REMP Design document is also provided in Appendix D3 (AARC 2019b). The code and locations of the monitoring points are listed in Table 33 and described in Section 11.3.1.1.

The 50th (median) and 80th percentile values of all available surface water data for Blackwater Creek, Mackenzie River, Three Mile Lagoon, and Five Mile Lagoon have been presented along with the number (count) of samples assessed for each parameter. The data represents sites located immediately upstream and downstream of the Mine. Data has been summarised from sampling events between September 2014 and March 2018, and the resulting water quality data is presented in Table 23 below. The full REMP water quality dataset is included in Appendix D4. The data was compared against relevant water quality objectives (WQOs) for aquatic ecosystem protection, livestock watering, and irrigation.

With reference to the EPP (Water) WQOs (Aquatic Ecosystems), median data for pH, Turbidity, Sulphate, Suspended Solids, EC, Sodium, Aluminium, Iron, and Ammonia were found to exceed objectives at one or more of the local monitoring locations (Table 23).

As can also be seen in Table 23 below, median and/or 80th percentile values for multiple water quality parameters exceeded the relevant WQOs at both impact and reference sites for Blackwater Creek, Mackenzie River, and Three and Five Mile lagoons. This is considered typical of a moderately disturbed waterway located in an area subject to agricultural and mining activities.

Stream sediment data for Blackwater Creek, the Mackenzie River, and Three and Five Mile Lagoons collected as part of the REMP (2014 – 2018) is shown in Table 24. No stream sediment water quality objectives have been exceeded as part of the REMP monitoring to date.

Macro-invertebrates data for Blackwater Creek, the Mackenzie River, and Three and Five Lagoons collected as part of the REMP (2014 – 2018) is shown in Table 25. Table 25 shows that the macro-invertebrate results for Blackwater Creek, the Mackenzie River, and Three and Five Lagoons consistently fall below the relevant EPP WQOs. This is considered typical of a moderately disturbed waterway located in an area subject to agricultural and mining activities. The limited opportunity for sampling during flow conditions meant that habitat sampling was typically limited to stagnant ponds in Blackwater Creek and the lagoons. Results are also reflective of habitat conditions at the time of sampling.

In addition to the REMP, continuous water monitoring is conducted in accordance with the SWMP and the EA. Continuous water monitoring ensures that conditions in the receiving environment are known at all times, assisting Jellinbah to manage the site water release effectively when required. The data further allows for the analysis of relationships between flow conditions and individual water quality parameters, enabling more accurate characterisation of the receiving environment and informing the derivation of WQOs. All continuous site monitoring data (current and historical) for flow rates, pH, turbidity, and EC

recorded from the Mackenzie River gauge is presented in Figure 10 below. It is noted that during this reporting period, the continuous monitoring gauge downstream on the Mackenzie River moved from MP3 to MP5 (further downstream) (locations detailed in Table 33, Section 11.3.1.1). Likewise, the flow rating curve for the downstream Mackenzie River gauge was updated in early 2019, resulting in no flow rate data being present from February 1 to March 15, 2019. Continuous site monitoring data recorded at each gauging station can be accessed online and utilised in the interpretation of REMP monitoring data.

The peak flow rates recorded at the Mackenzie River gauging station during the monitoring period are generally correlated to the high rainfall events. The data also suggests a relatively good correlation between peak flow events and pH drops. The period in which pH levels remain low appears to be dependent on the magnitude of the rainfall/release event. Given that high flow rates are known to result in increased acidity, the lower pH levels may be naturally occurring. This is supported further by data from the upstream gauge on the Mackenzie River, as upstream pH levels also fell during rainfall and flow events throughout the monitoring period.

Due to the highly ephemeral nature of Balckwater Creek, continuous data is intermittent and vaiable in nature. No trends were able to be drawn from this data.

Table 23 REMP Surface Water Quality Data (2014 – 2018)

Parameter	Units	LOR	Water Quality Objectives			MP1 (Impact): Blackwater Creek			MP2S (Reference): Blackwater Creek			MP3 (Impact): Mackenzie River			MP4 (Reference): Mackenzie River			DS5 (Impact): 5 Mile Lagoon			US3 (Reference): 3 Mile Lagoon		
			EPP (Water) 2009, ANZECC 2000																				
			Aquatic Ecosystem Protection	Livestock Watering	Irrigation Supply	Count	Median	80th percentile	Count	Median	80th percentile	Count	Median	80th Percentile	Count	Median	80th percentile	Count	Median	80th percentile	Count	Median	80th percentile
pH	pH units	n/a	6.5 - 8.5	n/a	6.0-9.0	3	7.95	8.1	4	8.31	8.52	4	7.93	8.07	3	7.74	8.052	3	8.74	9.46	2	7.19	7.25
EC	µS/cm	1	<310 (Baseflow) <210 (Highflow)	4000	n/a	3	1178	1540	4	690	1579	4	298	343	3	338	397	3	505	859	2	749	1011
Turbidity	NTU	0.1	<50	n/a	n/a	3	519	710.4	4	82.7	117	4	198.5	247.6	4	187	274	3	84	168	2	71.65	94.66
Sulphate (SO_4^{2-})	mg/L	1	<10	1000	n/a	3	41	59.6	4	34	154	4	11.5	14.8	4	10.5	16.8	3	12	12.6	2	2.5	3.4
Suspended solids	mg/L	5	<110	n/a	n/a	3	76	115.6	4	50.5	57	4	53.5	79.6	4	55	105.2	3	50	212.6	1	21	21
Dissolved Metals/Metalloids																							
Aluminium	µg/L	10	If pH >6.5 = 55 If pH <6.5 = 0.8	n/a	5000	3	40	988	4	20	162	4	140	342	4	25	404	3	180	870	2	35	50
Arsenic	µg/L	1	As III = 24 As V = 13	n/a	100	3	2	3.2	4	1.5	2.4	4	1.5	2	4	1	1.4	3	4	11.2	2	3	3.6
Cadmium	µg/L	0.1	0.2	n/a	10	3	<0.1	<0.1	4	<0.1	<0.1	4	<0.1	<0.1	4	<0.1	<0.1	3	<0.1	<0.1	2	<0.1	<0.1
Chromium	µg/L	1	Cr VI = 1 Cr III = 3.3[L]	n/a	100	3	<1	<1	4	<1	<1	4	<1	<1	4	<1	<1	3	<1	<1	2	<1	<1
Copper	µg/L	1	1.4	n/a	200	3	4	5.2	4	2	2.4	4	2.5	3.8	4	2	2.8	3	2	3.2	2	1.5	1.8
Iron	µg/L	50	n/a	n/a	200	3	50	914	4	50	186	4	110	250	4	55	252	3	200	794	2	100	118
Lead	µg/L	1	3.4	n/a	2000	3	<1	1.6	4	<1	<1	4	<1	<1	4	<1	<1	3	<1	<1	2	<1	<1

Parameter	Units	LOR	Water Quality Objectives			MP1 (Impact): Blackwater Creek			MP2S (Reference): Blackwater Creek			MP3 (Impact): Mackenzie River			MP4 (Reference): Mackenzie River			DS5 (Impact): 5 Mile Lagoon			US3 (Reference): 3 Mile Lagoon		
			EPP (Water) 2009, ANZECC 2000																				
			Aquatic Ecosystem Protection	Livestock Watering	Irrigation Supply	Count	Median	80th percentile	Count	Median	80th percentile	Count	Median	80th Percentile	Count	Median	80th percentile	Count	Median	80th percentile	Count	Median	80th percentile
Mercury	µg/L	0.1	0.6	n/a	2	3	<0.1	<0.1	4	<0.1	<0.1	4	<0.1	<0.1	4	<0.1	<0.1	3	<0.1	<0.1	2	<0.1	<0.1
Nickel	µg/L	1	11	n/a	200	3	3	4.2	4	2	2	4	2.5	3.4	4	3	3	3	4	4.6	2	2	2.6
Zinc	µg/L	5	8	n/a	2000	3	5	17	4	6	9.4	4	7.5	11.6	4	5	10.6	3	5	5	2	5	5
Boron	µg/L	50	370[L]	n/a	500	3	160	172	4	95	104	4	50	54	4	50	50	3	100	124	2	70	82
Cobalt	µg/L	1	1.4[L]	n/a	50	3	<1	1.6	4	<1	<1	4	<1	1.4	4	<1	<1	3	<1	<1	2	<1	<1
Manganese	µg/L	1	1900	n/a	200	3	226	690.4	4	81.5	168.8	4	7.5	52	4	25.5	47	3	100	140.8	2	35.5	56.2
Molybdenum	µg/L	1	34[L]	n/a	10	3	3	3	4	2	2.4	4	1	1	4	1	1	3	1	2.2	2	1.5	1.8
Selenium	µg/L	10	11	n/a	20	3	<10	<10	4	<10	<10	4	<10	<10	4	<10	<10	3	<10	<10	2	<10	<10
Silver	µg/L	1	0.05	n/a	n/a	3	<1	<1	4	<1	<1	4	<1	<1	4	<1	<1	3	<1	<1	2	<1	<1
Uranium	µg/L	1	0.5[L]	n/a	10	3	<1	1	4	<1	<1	4	<1	<1	4	<1	<1	3	<1	<1	2	<1	<1
Vanadium	µg/L	10	6[L]	n/a	100	3	<10	10	4	<10	<10	4	<10	10	4	<10	10	3	<10	<10	2	<10	<10
Total Metals/Metalloids																							
Aluminium	µg/L	10	n/a	5000	20000	3	10400	13880	7	2820	8480	4	4070	5960	12	2815	3700	16	1675	6400	2	985	1552
Arsenic	µg/L	1	n/a	500	2000	3	9	12	7	2	3	4	2	2	12	2	2	16	6	7	2	4.5	6
Cadmium	µg/L	0.1	n/a	10	50	3	0.1	0.1	7	0.1	0.18	4	0.1	0.1	12	0.1	0.2	16	0.15	2	2	0.1	0.1
Chromium	µg/L	1	n/a	1000	1000	3	11	14.6	4	1.5	2	4	5	9.6	4	2.5	4.8	3	3	6	2	2	2.6
Copper	µg/L	1	n/a	1000	5000	3	20	22.4	7	4	9.2	4	5.5	6.4	12	4.5	6	16	3.5	8	2	2	2.6
Iron	µg/L	50	n/a	n/a	10000	3	11800	16000	4	1500	2460	4	3805	6078	4	1940	3948	3	2850	6018	2	1600	2230
Lead	µg/L	1	n/a	100	5000	3	6	10.2	7	2	2	4	1	1.4	12	1	1	16	1	3	2	1	1
Mercury	µg/L	0.1	n/a	2	2	2	0.1	0.1	3	0.1	0.1	3	0.1	0.1	3	0.1	0.1	2	0.1	0.1	2	0.1	0.1

Parameter	Units	LOR	Water Quality Objectives			MP1 (Impact): Blackwater Creek			MP2S (Reference): Blackwater Creek			MP3 (Impact): Mackenzie River			MP4 (Reference): Mackenzie River			DS5 (Impact): 5 Mile Lagoon			US3 (Reference): 3 Mile Lagoon		
			EPP (Water) 2009, ANZECC 2000																				
			Aquatic Ecosystem Protection	Livestock Watering	Irrigation Supply	Count	Median	80th percentile	Count	Median	80th percentile	Count	Median	80th Percentile	Count	Median	80th percentile	Count	Median	80th percentile	Count	Median	80th percentile
Nickel	µg/L	1	n/a	1000	2000	3	12	19.2	7	5	10	4	7.5	11.4	12	5	6.8	16	5.5	12	2	3.5	5
Zinc	µg/L	5	n/a	20000	5000	3	30	39.6	7	11	19	4	12.5	22.2	12	7.5	13.4	16	9	19	2	6.5	6.8
Boron	µg/L	50	n/a	5000	500	3	170	170	4	110	120	4	50	50	4	50	54	3	80	116	2	55	58
Cobalt	µg/L	1	n/a	1000	100	3	6	9.6	7	2	3.6	4	1.5	2	12	1	2	16	2	5	2	1.5	1.8
Manganese	µg/L	1	n/a	n/a	10000	3	630	1290	4	258	406.8	4	84	93.6	4	80	99.4	3	220	229.6	2	138	181.8
Molybdenum	µg/L	1	n/a	150	50	3	4	4	4	1	2.6	4	1	1	4	1	1	3	1	2.2	2	1.5	1.8
Selenium	µg/L	10	n/a	20	50	3	10	10	4	10	10	4	10	10	4	10	10	3	10	10	2	10	10
Silver	µg/L	1	n/a	n/a	n/a	3	1	1	4	1	1	4	1	1	4	1	1	3	1	1	2	1	1
Uranium	µg/L	1	n/a	200	100	3	1	1	4	1	1	4	1	1	4	1	1	3	1	1	2	1	1
Vanadium	µg/L	10	n/a	n/a	500	3	30	36	4	10	10	4	15	20	4	10	14	3	10	16	2	10	10
Other Parameters																							
Fluoride	mg/L	0.1	n/a	n/a	2	2	0.65	0.8	2	0.5	0.62	2	0.3	0.42	2	0.35	0.5	2	0.5	0.68	2	0.5	0.68
Sodium	mg/L	1	n/a	n/a	n/a	3	197	259.4	4	105	198.2	4	32.5	51.2	4	39.5	59	3	66	151.8	2	95.5	134.8
Petroleum hydrocarbons (C6 - C9)	µg/L	20	n/a	n/a	n/a	3	<20	<20	4	<20	<20	4	<20	<20	4	<20	<20	3	<20	<20	2	<20	<20
Petroleum hydrocarbons (C10 - C36)	µg/L	50	n/a	n/a	n/a	3	<50	<50	4	<50	<50	4	<50	<50	4	<50	<50	3	<50	254	2	<50	<50

Key:

This parameter exceeds EPP (Water) WQOs for Aquatic Ecosystem Protection (upper limit, where applicable).
This parameter exceeds EPP (Water) WQOs for Livestock Drinking Water (upper limit, where applicable).
This parameter exceeds the EPP (Water) WQOs for Irrigation (short-term value) (upper limit, where applicable).

Table 24 REMP Stream Sediment Quality Data (2014 – 2018)

Sampling site	Sampling period	Moisture Content (dried @ 103°C)	Aluminium	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Molybdenum	Nickel	Selenium	Silver	Vanadium	Zinc	Uranium	Mercury
Units		%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR		1	50	5	10	1	50	1	2	2	5	50	5	5	2	2	5	2	5	5	0.1	0.1
ANZECC Trigger value - low				20	-	-	-	1.5	80	-	65	-	50	-	-	21	-	1	-	200	-	0.15
ANZECC Trigger value - high				70	-	-	-	10	370	-	270	-	220	-	-	52	-	3.7	-	410	-	1
MP1 (Impact) Blackwater Creek	Sep-14	3.9	5420	<5	100	<1	<50	<1	16	7	10	12300	5	239	<2	11	<5	<2	28	18	0.2	<0.1
	Mar-15	27.1	9960	5	170	<1	<50	<1	21	11	18	20800	10	555	<2	18	<5	<2	46	30	0.4	<0.1
	Mar-16	33.6	8520	<5	200	<1	<50	<1	19	12	20	20600	12	517	<2	22	<5	<2	55	32	0.5	<0.1
	Mar-17	21.5	11200	<5	200	<1	<50	<1	20	12	23	20400	12	604	<2	20	<5	<2	43	37	0.5	<0.1
	Apr-18	23.1	10100	<5	150	<1	<50	<1	11	7	12	21400	6	438	<2	10	<5	<2	25	18	0.3	<0.1
MP2 (Ref) Blackwater Creek	Sep-14	1.2	4760	<5	100	<1	<50	<1	11	5	8	11900	5	232	<2	8	<5	<2	24	17	0.2	<0.1
	Mar-15	8.4	3850	<5	130	<1	<50	<1	10	5	9	17100	<5	324	<2	7	<5	<2	30	19	0.2	<0.1
	Mar-16	24.9	5650	<5	120	<1	<50	<1	11	7	11	12000	6	321	<2	14	<5	<2	28	20	0.3	<0.1
	Mar-17	17.2	1930	<5	30	<1	<50	<1	14	<2	5	5040	<5	65	<2	3	<5	<2	15	6	<0.1	<0.1
	Apr-18	8	6620	<5	130	<1	<50	<1	13	11	13	20800	9	514	<2	13	<5	<2	36	22	0.3	<0.1
MP3 (Impact) Mackenzie River	Sep-14	37.6	23300	5	190	1	<50	<1	38	18	24	31700	11	718	<2	36	<5	<2	54	51	0.5	<0.1
	Mar-15	39	20900	5	170	1	<50	<1	35	19	22	28900	10	636	<2	36	<5	<2	51	50	0.5	<0.1
	Mar-16	29.5	19200	<5	200	<1	<50	<1	35	18	19	27900	9	654	<2	40	<5	<2	54	44	0.6	<0.1
	Mar-17	20.5	14600	<5	190	<1	<50	<1	27	16	21	23500	11	608	<2	30	<5	<2	43	42	0.6	<0.1
	Apr-18	24.4	9200	<5	110	<1	<50	<1	19	11	12	17800	6	431	<2	18	<5	<2	30	25	0.4	<0.1
MP4 (Ref) Mackenzie River	Sep-14	35.5	19700	<5	170	1	<50	<1	32	18	21	27300	11	498	<2	31	<5	<2	48	46	0.4	<0.1
	Mar-15	47	22700	6	240	1	<50	<1	34	21	29	31700	14	736	<2	37	<5	<2	59	56	0.7	<0.1

Sampling site	Sampling period	Moisture Content (dried @ 103°C)	Aluminium	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Molybdenum	Nickel	Selenium	Silver	Vanadium	Zinc	Uranium	Mercury
Units		%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR		1	50	5	10	1	50	1	2	2	5	50	5	5	2	2	5	2	5	5	0.1	0.1
ANZECC Trigger value - low				20	-	-	-	1.5	80	-	65	-	50	-	-	21	-	1	-	200	-	0.15
ANZECC Trigger value - high				70	-	-	-	10	370	-	270	-	220	-	-	52	-	3.7	-	410	-	1
	Mar-16	31.7	17100	<5	200	1	<50	<1	30	18	22	26900	12	570	<2	36	<5	<2	54	46	0.6	<0.1
	Mar-17	19.8	12900	<5	160	<1	<50	<1	24	14	17	20600	9	518	<2	25	<5	<2	39	37	0.5	<0.1
	Apr-18	24.6	10000	<5	120	<1	<50	<1	19	13	15	19300	8	343	<2	19	<5	<2	32	28	0.4	<0.1
DS5 (Impact) 5 Mile Lagoon	Sep-14	19.4	22100	<5	130	1	<50	<1	37	17	27	32600	11	563	<2	35	<5	<2	51	60	0.7	<0.1
	Mar-15	38.1	20300	<5	140	1	<50	<1	31	17	25	25500	10	372	<2	35	<5	<2	48	56	0.5	<0.1
	Mar-16	36.2	20600	<5	160	1	<50	<1	32	15	24	26800	9	506	<2	38	<5	<2	54	54	0.6	<0.1
	Mar-17	27.4	17600	<5	140	1	<50	<1	33	16	41	26900	11	445	<2	33	<5	<2	49	56	0.6	<0.1
	Apr-18	27.1	11200	<5	120	<1	<50	<1	22	13	15	22200	8	493	<2	21	<5	<2	34	32	0.4	<0.1
US3 (Ref) 3 Mile Lagoon	Sep-14	3	18700	<5	200	1	<50	<1	31	22	23	27800	11	778	<2	37	<5	<2	47	52	0.6	<0.1
	Mar-15	42.5	27500	6	160	2	<50	<1	42	20	35	40400	12	475	<2	43	<5	<2	64	77	0.7	<0.1
	Mar-16	26.8	14500	<5	180	<1	<50	<1	28	22	14	22200	10	842	<2	32	<5	<2	46	36	0.4	<0.1
	Mar-17	14.3	17000	<5	150	1	<50	<1	34	17	32	31500	11	419	<2	36	<5	<2	53	74	0.7	<0.1
	Apr-18	45.3	16400	<5	130	1	<50	<1	28	14	29	32900	11	303	<2	28	<5	<2	45	65	0.6	<0.1

Table 25 REMP Macro-invertebrates Data (2014 – 2018)

Sampling Site	Sampling Period	Total Abundance	Taxa Richness	SIGNAL 2 Score	PET Taxa	% tolerant taxa	SIGNAL Count
EPP WQO (Composite)		-	12 – 21	3.33 – 3.85	2 – 5	25 - 50 %	-
MP1 (Impact) Blackwater Creek	Sep-14	n/a	n/a	n/a	n/a	n/a	n/a
	Mar-15	59	14	3.2	1	58.33	12
	Mar-16	32	11	3.12	3	11.11	9
	Mar-17	13	3	1.67	0	100	2
	Apr-18	50	14	3.13	0	50	12
MP2 (Ref) Blackwater Creek	Sep-14	8	8	2.9	1	42.86	7
	Mar-15	19	12	3.15	0	60	10
	Mar-16	9	6	2.83	0	66.67	6
	Mar-17	45	13	2.9	0	83.33	12
	Apr-18	n/a	n/a	n/a	n/a	n/a	n/a
MP3 (Impact) Mackenzie River	Sep-14	11	11	3.7	2	37.5	8
	Mar-15	15	9	2.89	0	57.14	7
	Mar-16	23	11	2.71	1	50	10
	Mar-17	27	10	1.94	0	100	8
	Apr-18	25	12	2.67	0	54.55	11
MP4 (Ref) Mackenzie River	Sep-14	10	10	2.8	1	50	8
	Mar-15	7	6	3	0	50	6
	Mar-16	21	8	3.45	1	50	8
	Mar-17	28	9	1.57	0	100	7
	Apr-18	19	11	3.45	1	40	10
DS5 (Impact) 5 Mile Lagoon	Sep-14	n/a	n/a	n/a	n/a	n/a	n/a
	Mar-15	86	12	3.09	0	66.67	9
	Mar-16	89	13	2.48	1	63.64	11
	Mar-17	n/a	n/a	n/a	n/a	n/a	n/a
	Apr-18	64	18	2.57	1	66.67	15
US3 (Ref) 3 Mile Lagoon	Sep-14	n/a	n/a	n/a	n/a	n/a	n/a
	Mar-15	137	20	2.34	0	58.82	17
	Mar-16	57	9	2.53	1	62.5	8
	Mar-17	n/a	n/a	n/a	n/a	n/a	n/a
	Apr-18	245	26	2.6	1	0	23

indicates an exceedance of the relevant EPP WQO

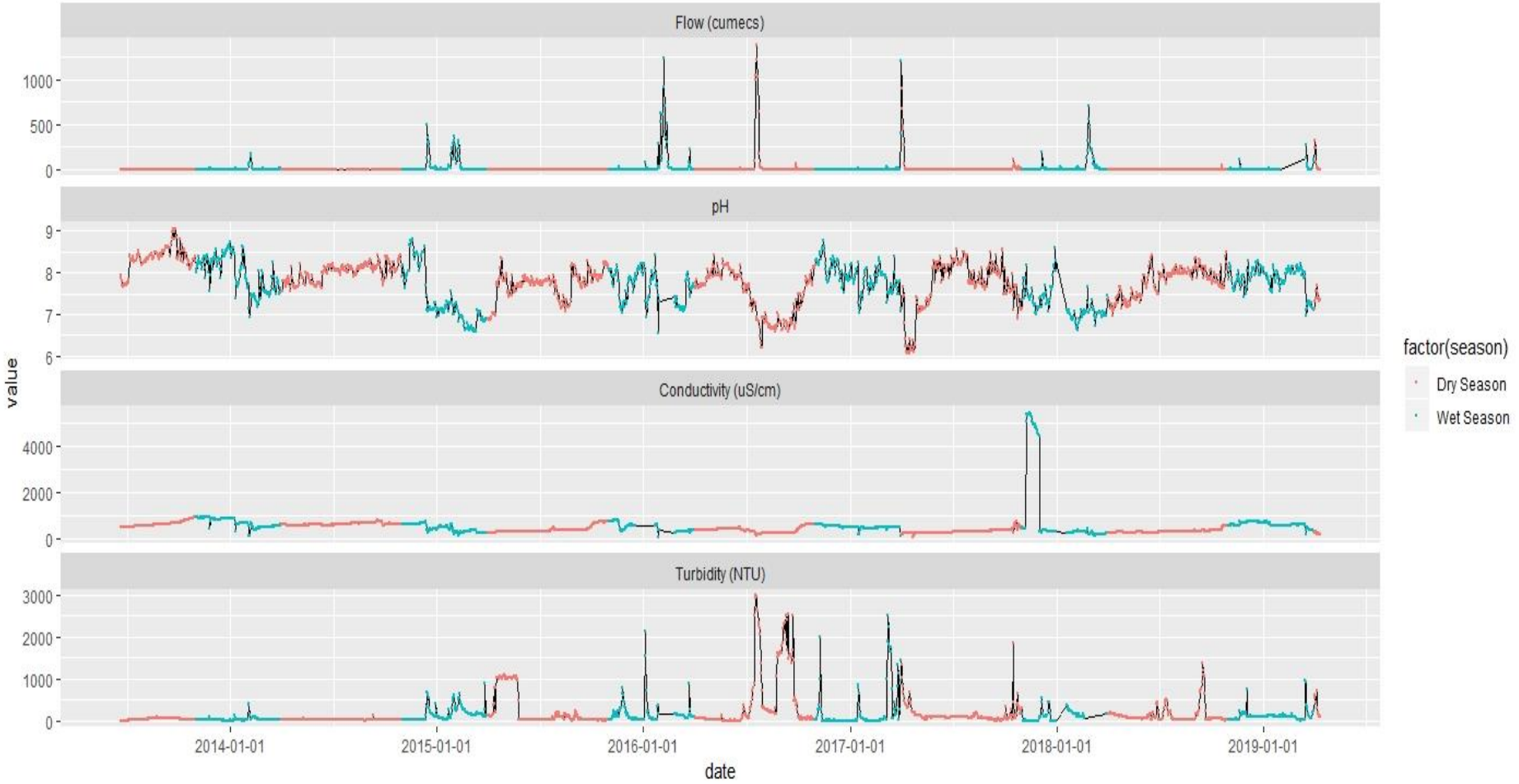

Figure 10 Mackenzie River – Historical Continuous Site Data (real-time gauging data)

6.1.3 Existing Flood Conditions

Existing flood conditions were assessed based on detailed hydrologic and hydraulic analysis of the nearby Mackenzie River using flood models previously developed by WRM for other nearby projects. For those studies, a hydrological model of the Mackenzie River and its tributaries was developed and calibrated to historical flood events.

The hydraulic model used in previous studies was subsequently revised to use the TUFLOW GPU Solver for Jellinbah Mine. This enabled the model grid size to be reduced (improving the representation of the channel and adjacent floodplain). The refined model was recalibrated to historical water level and flow data. Details of the hydraulic model calibration results are provided in the Jellinbah Plains Stage 3 Levee Design Flood Levels Report (WRM 2015), which is included in Appendix D6 (WRM 2019).

The Mackenzie North Project Flood Impact Assessment Report (WRM 2013), which outlines the hydrological modelling methodology adopted for the design of the Plains Stage 3 Levee design, is also provided in Appendix D6. The Mackenzie River hydraulic model was further revised in 2018 (using more recently obtained survey data) for the detailed design of the Mackenzie North levee (WRM 2018). That study yielded flood model results, which were consistent with the Jellinbah Plains Stage 3 levee design report. The hydraulic models for both studies included all currently approved works within the Mackenzie River and Blackwater Creek floodplains.

Historical flood and rainfall data and further information on the methodology used to develop and refine the flood models for the Mackenzie River and Blackwater Creek can be seen in Appendix D6 (WRM 2019). Appendix D6 also contains the following relevant information and figures, which have been developed by WRM as part of the extensive flood modelling process:

- Flood frequency plots (peak flow vs. AEP) developed using historical flood flow data for various locations along the Mackenzie River (Appendix B in Appendix D6);
- Maps of flood depth and flood velocity for various modelled flood intensities: 1 in 50 AEP to 1 in 1000 AEP Mackenzie River flood (Appendix A & B in Appendix D6); and
- Modelled 1 in 1000 AEP flood levels along the Plains levee (Appendix A in Appendix D6)
- The pit/final void location – which is outside the extent of the PMF for the Mackenzie River and Blackwater Creek (Appendix A in Appendix D6).

Multi-year wetting and drying cycles are not relevant to the design of the flood protection system for large floods (Appendix D6, WRM 2019).

Figure 11 shows the estimated extent of flooding in the 1 in 1,000 AEP event based on the results of the most recent flood study (WRM 2018). The results show the northern part of the Project lease areas (ML 700011) is affected by minor Mackenzie River flooding in the 1 in 1,000 AEP flood, but flooding in Blackwater Creek (which is strongly affected by Mackenzie River backwater) does not extend onto the lease area.

Likewise, modelling of the Probable Maximum Flood (PMF) in the vicinity of the project was undertaken by WRM in 2010. The results of that study were used to prepare the flood map in Figure 12, which shows that the PMF in Blackwater Creek would not impact the Project, with only the very northern part of the Project (ML 700011) affected by the PMF for the Mackenzie River.

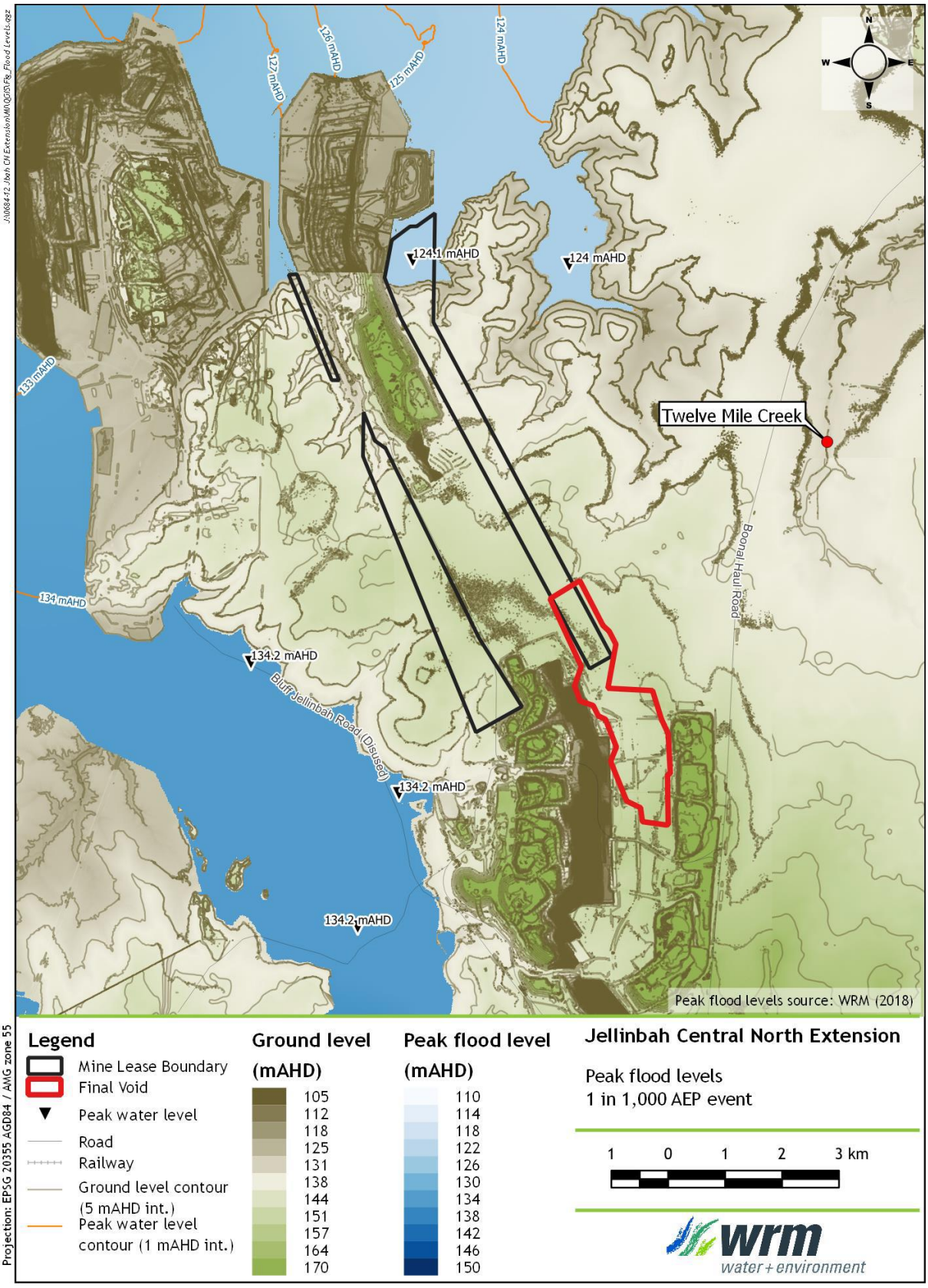

Figure 11 Extent of flooding near CNE – 1 in 1,000 AEP flood

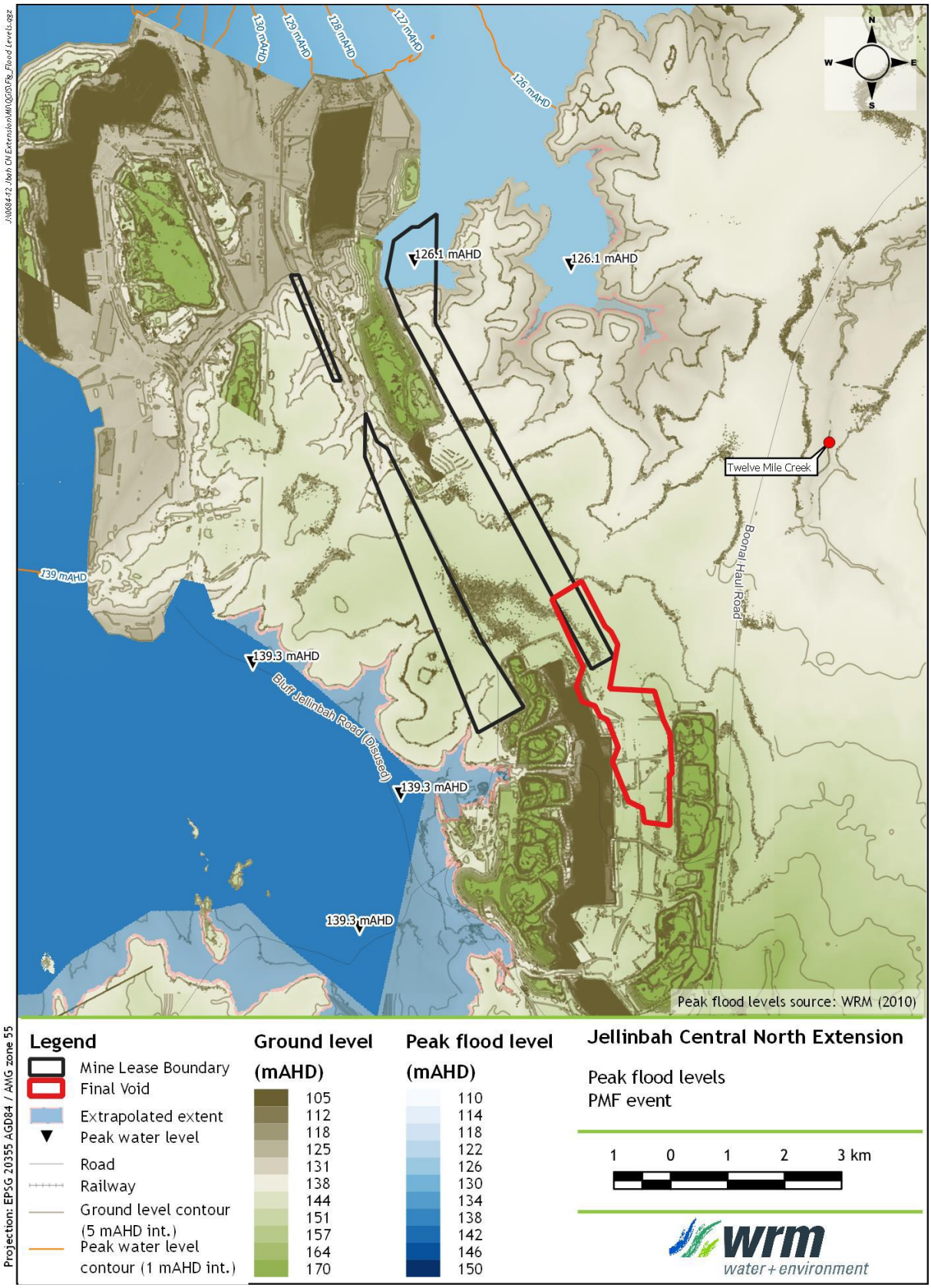

Figure 12 Extent of flooding near CNE - probable maximum flood

The additional assessment was undertaken by WRM (2019) to address the potential extent of flooding in the nearby reaches of Twelve Mile Creek for the Project. Twelve Mile Creek is located approximately 4 km to the northeast of the Project. Based on the available Light Detection and Ranging (LiDAR) data from the downstream of the location shown in Figure 13 below, the catchment area of Twelve Mile Creek is estimated to be approximately 255 km^2. A simplified assessment of the potential extent of flooding to impact the Project was carried out and summarised below:

- The catchment was estimated based on data from the Shuttle Radar Topography Mission (SRTM);
- The peak 1 in 100 AEP discharge (616 m^3/s) was estimated using the Regional Flood Frequency Estimation Model (RFFE) (Ball et al. 2019);
- The peak 1 in 100 AEP flood depth and width (approximately 1,000 m) was obtained by estimating the corresponding normal depth at the location where LiDAR data was available.
- The width and depth of flooding upstream were extrapolated, assuming the flow depth and width are similar to the above location.

The results from this assessment are presented in Figure 13 below, and it shows that the Project is located well away from the estimated extent of flooding in Twelve Mile Creek.

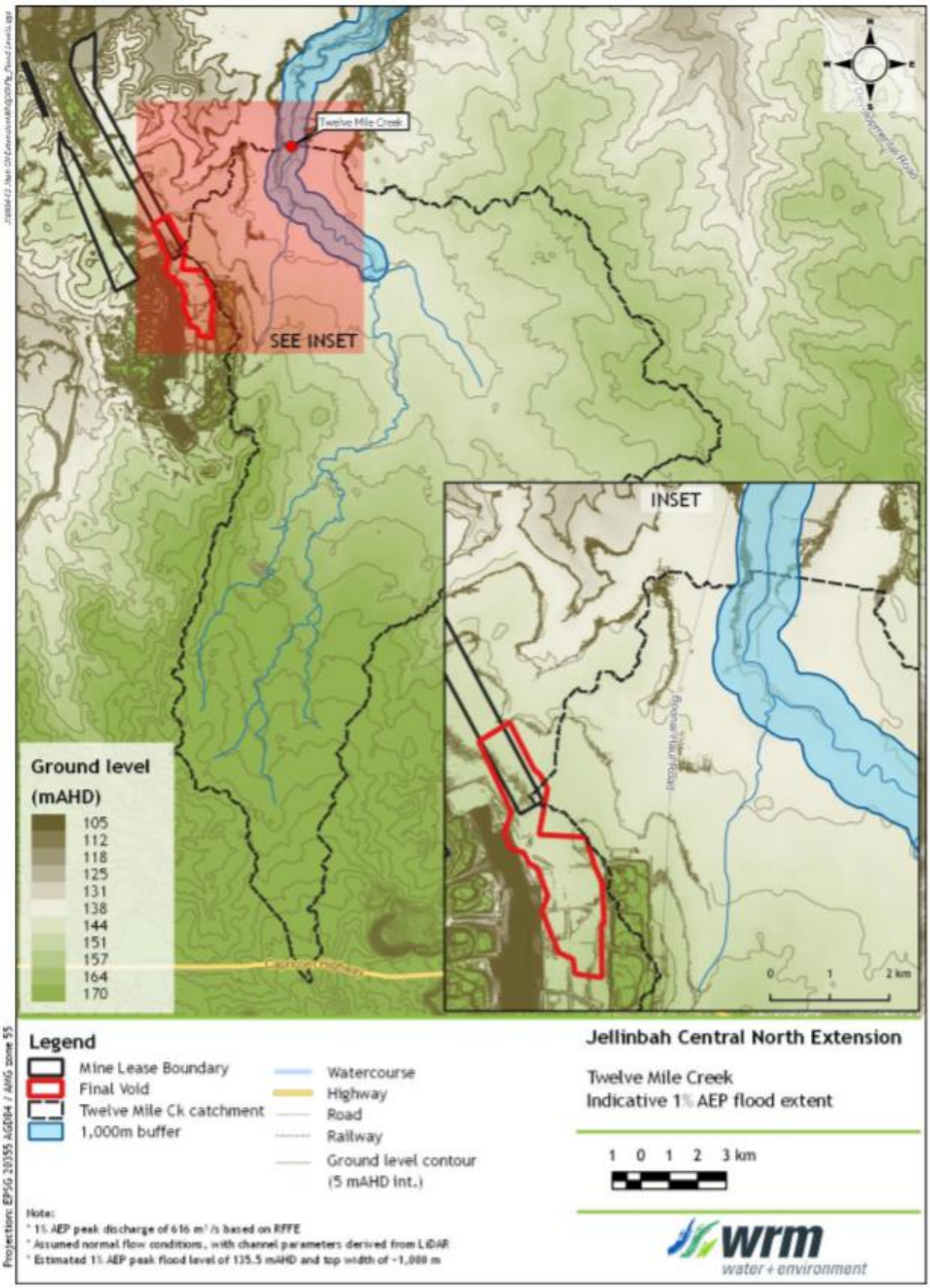

Figure 13 Extent of flooding near CNE – 1 in 100 AEP Flood (Twelve Mile Creek)

6.2 CNE CATCHMENT ANALYSIS

6.2.1 Catchment Runoff

Catchment runoff has been simulated using the Australian Water Balance Model (AWBM). The model represents the catchment using three surface stores to simulate partial areas of runoff. The water balance of each surface store is calculated independently of the others. The method of the calculations is described in Appendix C6 (Engeny 2019a).

AWBM natural land use catchment runoff parameters have been adopted from parameters calibrated to the Blackwater Streamflow Gauging Station owned by DNRM at Curragh (Station Number 130108) with data available between 1972 and 2009.

The calibration of the AWBM model involved the prediction of stream flows in Blackwater Creek for the period of adopted stream flow gauging data. The predicted stream flows were compared against the stream gauging data, and the AWBM model parameters were adjusted to provide a reasonable comparison between the gauged and modelled stream flow characteristics. The gauged and modelled flow duration curves for Blackwater Creek at Curragh are shown in Figure 14. The results indicate that Blackwater Creek has a significant baseflow component with flows exceeding 0.1 ML/d approximately 75% of the time. The calibrated parameters produce a curve that matches the gauged curve well for flows above 0.1 ML/d. The discrepancy at the tail end of the curve was unable to be corrected and is considered insignificant due to the very small volume of flow that this represents (modelled flows below 0.1 ML/day represent approximately 0.02% of the total volume over the twenty-year period of the simulation).

The modelled cumulative stream flow volume during the period 1972 to 2008 is displayed in Figure 15. The modelled and gauged stream flows appear to show similar runoff volumes for single events as well as total stream flow volume during the calibration period. Table 26 presents a summary of the amount of each land use throughout the site catchments.

Table 26 Site Land Type Breakdown

	Natural	Spoil	Hardstand and Pits	Rehabilitated Spoil	Coal Stockpile
Total Area (ha)	302.3	392	992.7	191.3	26.7
Proportion (%)	15.8%	20.6%	52.1%	10%	1.5

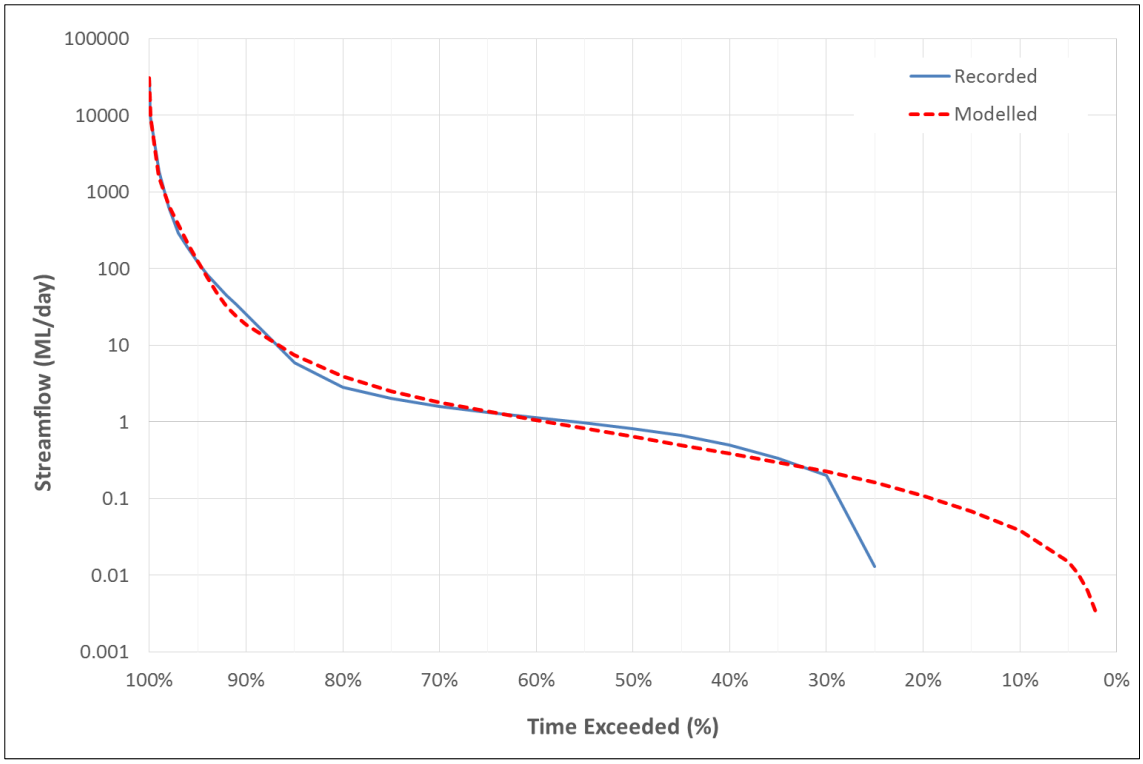

Figure 14 **Modelled Flow Duration Curve for Blackwater Creek at Curragh**

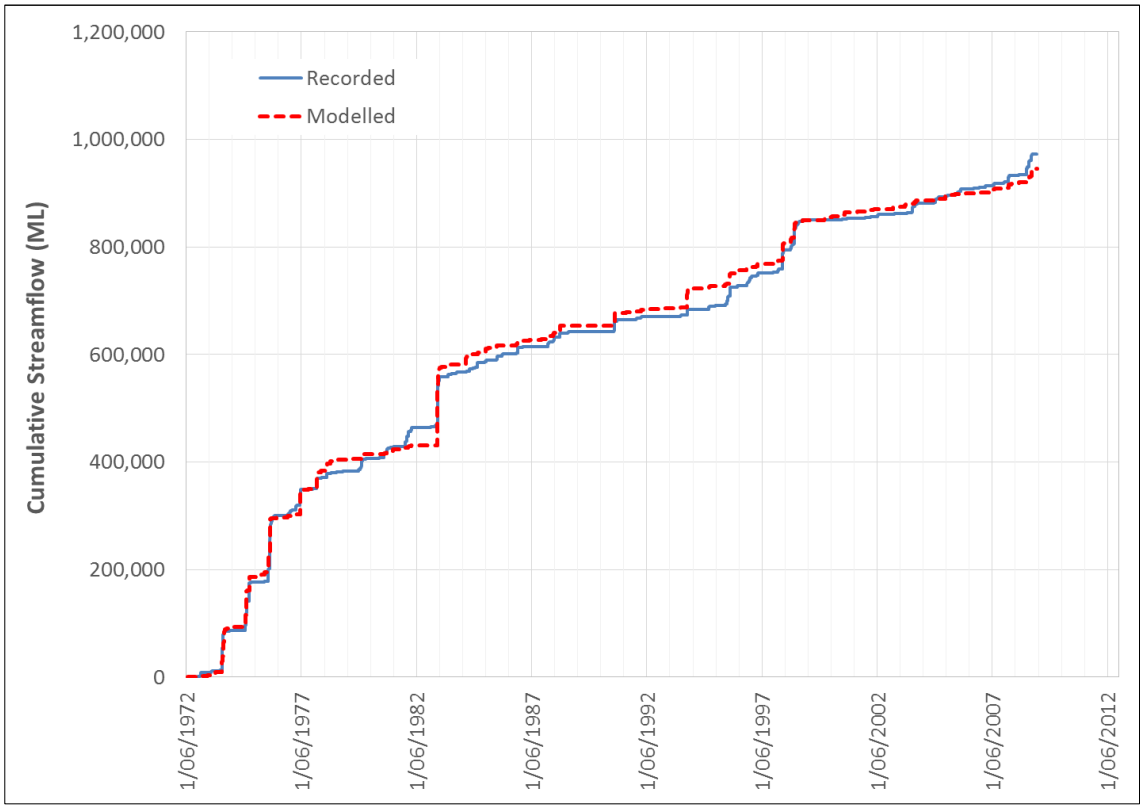

Figure 15 **Modelled Cumulative Stream Flows for Blackwater Creek at Curragh**

6.2.1.1 CNE Void Catchment Areas

Mine affected water catchment areas associated with the Project mine plan have been analysed and are shown in Figure 16.

The Project results in an increase to the CN operational mining void of up to 30% (Table 27) (Appendix C6, Engeny 2019a); however, these catchments will be reinstated to the receiving waterways through progressive backfilling and rehabilitation of the Project mining void.

Run-off from non-mine affected catchments within the Project area report to unnamed tributaries immediately downstream via sediment control devices. These unnamed tributaries flow to the Mackenzie River and do not interact with Twelve Mile Creek (Figure 16).

The increase in mine affected water catchment areas associated with CNE has been assessed as part of the Project mine water balance modelling assessment (refer to Section 6.2.1.2 below).

Table 27 Mine-affected Water Catchment Analysis Results

Date	Central North (ha)	Central North Extension (ha)	Increase in mining void catchment area (ha)
2020	151.8	151.8	0.0
2024	229.0	290.7	61.7 (+27%)
2028	357.7	422.1	64.4 (+18%)
2032	428.1	520.4	92.3 (+21%)
2049	337.4	440.0	102.6 (+30%)
2053	337.4	421.1	83.7 (+25%)

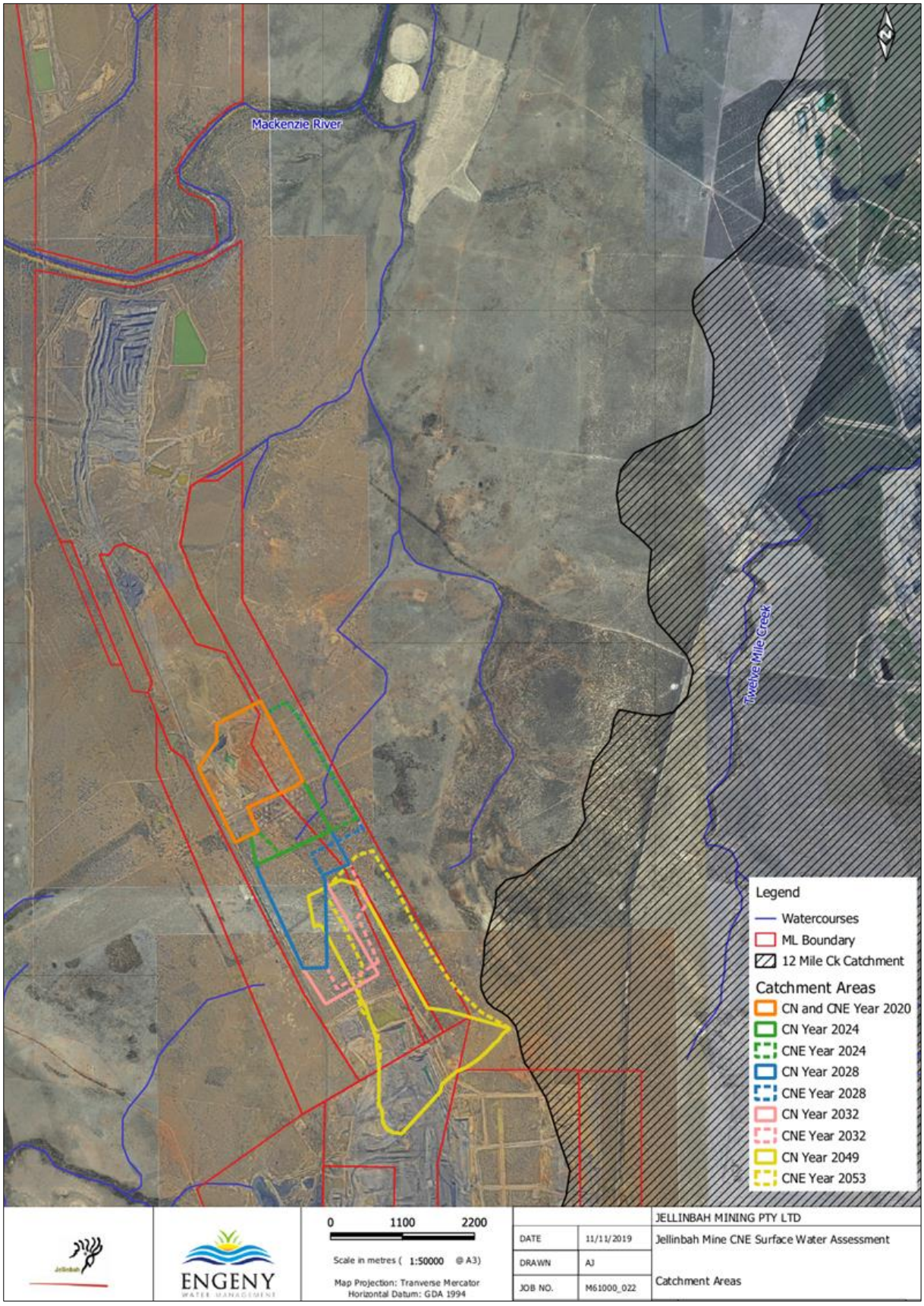

Figure 16 Jellinbah Mine CNE – Changes in Catchment Areas

6.2.1.2 CNE Receiving Environment Catchment Analysis

The runoff generated from catchments associated with the CNE mining void will be redirected to the receiving waterways through progressive backfilling and rehabilitation of overburden during the life of the mine. For this reason, there will only be a temporary reduction in the catchment area of the receiving waterways during the course CNE mine life.

A permanent reduction in the catchment area of the receiving waterways results from the proposed final void. The CNE final void catchment area is 421 ha compared to the 337 ha. The additional 84 ha will result in a reduction in annual median runoff of 0.025 ML natural catchment runoff to the receiving environment. Based on a median annual streamflow in the Mackenzie River of 1.57 million ML, the reduction in catchment area and associated runoff as a result of CNE is considered to be insignificant.

6.3 CNE WATER BALANCE ASSESSMENT

The existing Jellinbah Mine site water balance model (refer Section 2.4) has been updated to assess and compare the performance of the water management system for the proposed mine plan (i.e., with CNE). The overall water balance results with the CNE is presented in Table 28 below.

The site water balance model was updated to represent the CNE by amending the mining void catchment areas and land use, mining production schedule, and associated water consumption. System performance indicators over the life of mining activities are summarised as follows:

- Mine Water Inventory - all mine water storages were simulated in the water balance model, and the results are presented in Figure 17 to 19 below, showing the total mine water inventory forecast from 1 July 2019 to 31 June 2049 under different rainfall scenarios. The modelling results indicate there is generally no significant change to the total mine water inventory as a result of CNE. The results for the 5th percentile climate scenario (dry) show a deviation after 2040 when site water inventories are lower under the “with CNE” scenario. It should be noted that the addition of CNE allows the Mine to maintain existing production levels for the remainder of the mine life and without CNE the coal production rate will decline after 2040. The change in overall production levels between the “with CNE” and “without CNE” scenarios has a direct impact on the water consumption requirements which is reflected in the mine water inventory forecasts.

- Uncontrolled Release Risks - Modelling results indicate that uncontrolled releases from mine affected water storages occur in years equivalent to the 95th percentile and higher (Figure 19). The occurrence and volume of uncontrolled mine water releases are lower as a result of the CNE due to slightly lower stored mine water inventory volumes (Table 28).

- Controlled Release Potential - the modelling results demonstrate that there is no difference in the release potential for the two scenarios. This is due to the stored water inventories being very similar in the 50th (median) and 95th (wet) percentile climate scenarios and as such, initiating the same operational water management responses under the site water management trigger action response plan (TARP) (refer Appendix D3, AARC 2019b).

Table 28 Jellinbah Mine CNE Overall Water Balance Summary – Median Climate Scenario

Process	Year 2020	Year 2024	Year 2028	Year 2032	Year 2049
Inflows (ML)					
Rainfall Runoff	1608	1952	2287	2420	2384
Groundwater Inflows	2835	2879	3074	3001	2847
Total Inflows	4443	4831	5361	5421	5231
Outflows (ML)					
Evaporation	1571	1827	2053	2160	2990
Uncontrolled Release (not mine affected water)	0	12	13	14	13
Controlled Release	998	0	0	0	0
CHPP Processing / Co Disposal Losses	763	1237	1130	1201	370
Haul Road Dust Suppression	821	1143	1107	1140	370
Total Outflows	4154	4219	4303	4515	3742
Change in Stored Inventory (with CNE)	290	612	1058	906	1489
Change in Stored Inventory (without CNE)[1]	290	591	1076	849	1619
Difference in Stored Inventory between with and without CNE	0	21	-18	57	-202

Note: 1. The total change in Stored Inventory adapted from Table 7 in Section 2.4.5 above.

Source: Engeny 2019a

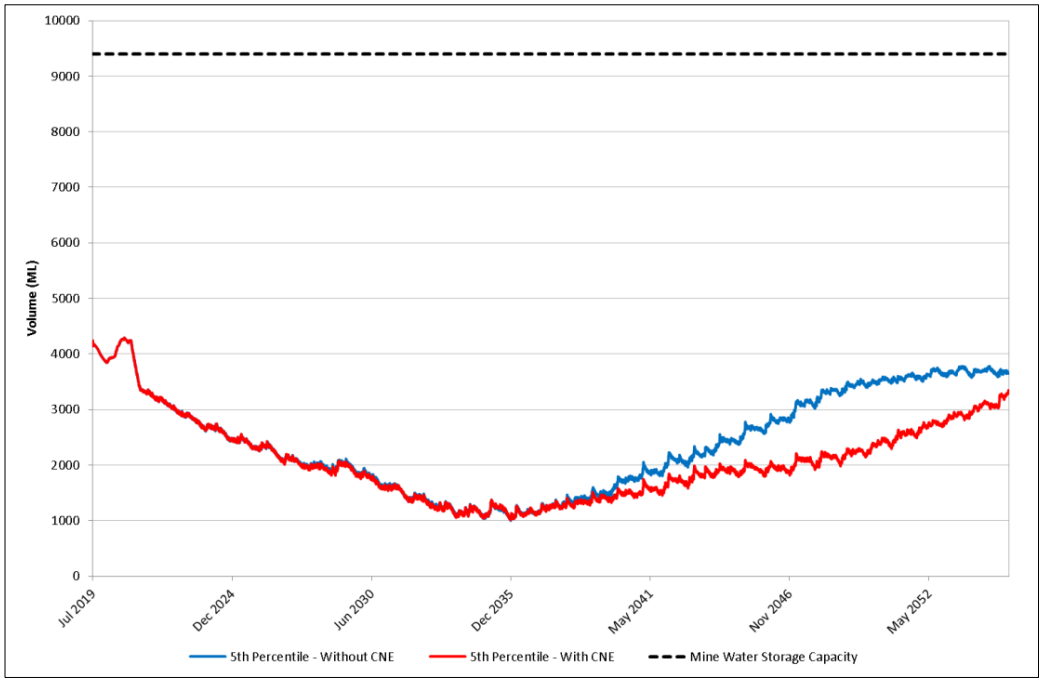

Figure 17 Mine Water Inventory Forecast - 5th Percentile

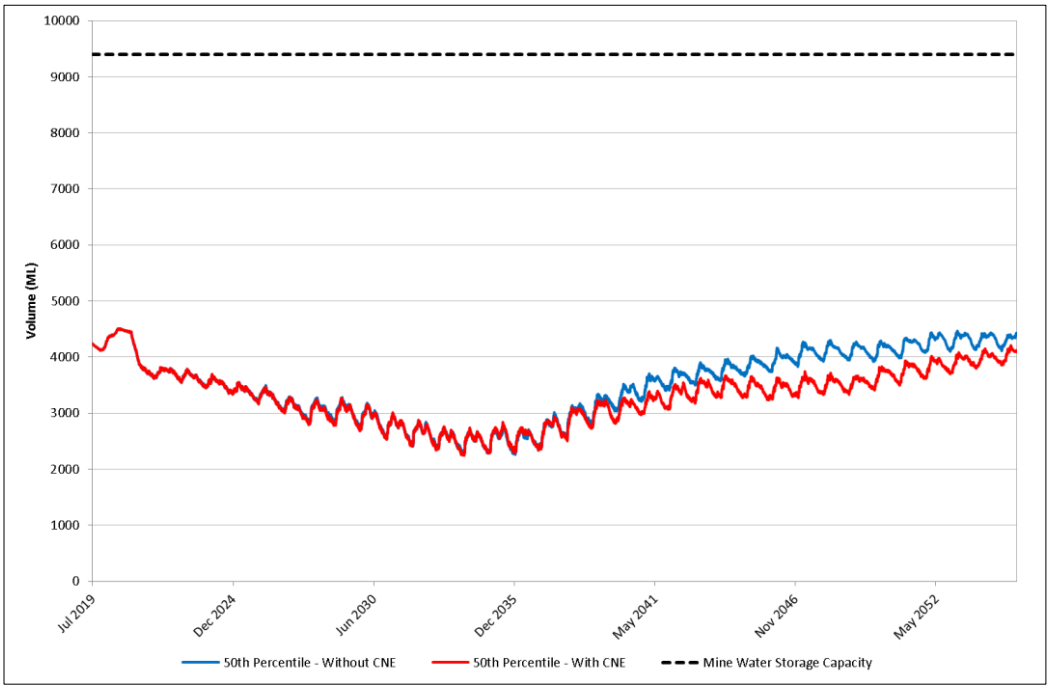

Figure 18 Mine Water Inventory Forecast - 50th Percentile

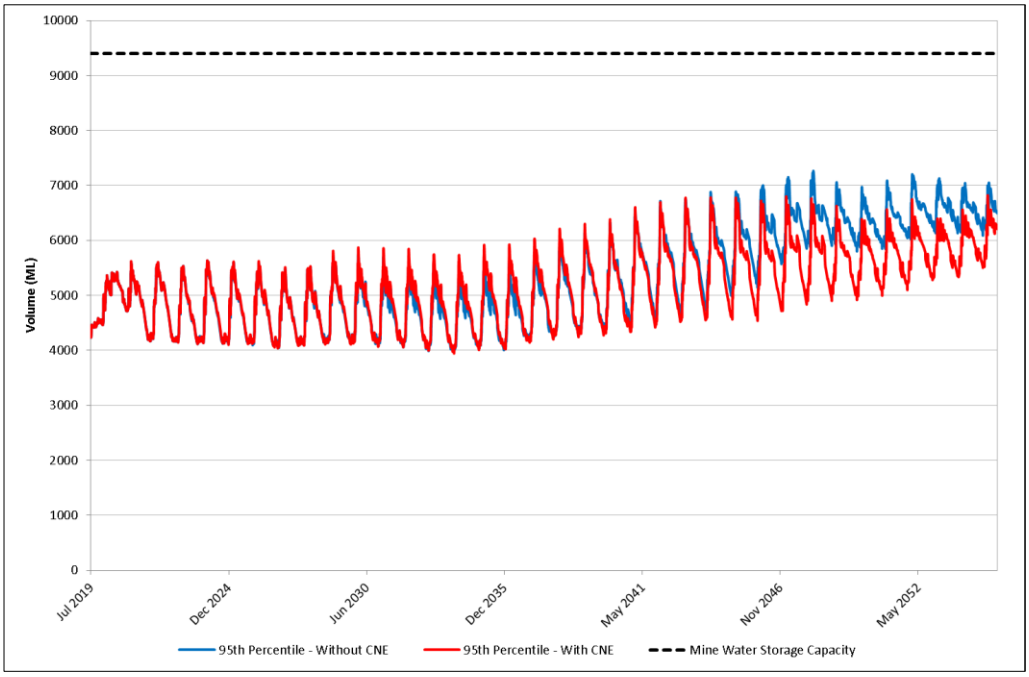

Figure 19 Mine Water Inventory Forecast - 95th Percentile

6.3.1 Climate Change Sensitivity Analysis

As suggested by the IESC, a climate change sensitivity analysis was undertaken to understand the impact of climate change on mine water management system estimates derived from the water balance model simulation. The model climate data inputs were adjusted using the methodologies outlined in "Climate Change in Australia Technical Report" (CSIRO, 2015) to undertake the sensitivity assessment. The CSIRO report provides projections of future climate variables as a result of climate response to several greenhouse gas and aerosol emission scenarios (Representative Concentration Pathways - RCPs).

Climate projections for Jellinbah Mine were obtained using the projection builder tool (Whetton et al. 2012) provided on the Climate Change Australia website, which was developed using the climate model evaluations detailed in the CSIRO report. Projections were obtained for the "Best and "Worst" case scenarios which are based on the following:

- Best Case – lower rainfall and higher evaporation, reducing void water level; and
- Worst Case – higher rainfall and lower evaporation, increasing void water level

Projections were also provided for the "Maximum Consensus," which is the climate future projected by at least 33% of the climate models and which comprises at least 10% more models than any other. The "Maximum Consensus" is considered the most representative forecast of all the climate models which is considered in the current assessment. Projected changes to annual rainfall and evapotranspiration were obtained for the following most conservative climate change scenario:

- 2090 projection year – furthest available estimated data; and
- Representative Concentration Pathway (RCP 8.5) – which represents no intervention to reducing greenhouse gas and aerosol emissions.

The climate change sensitivity parameters are provided in Appendix C6 (Engeny 2019a). Evapotranspiration increased under all climate change scenarios.

The Jellinbah Mine water management simulation model daily climate inputs were adjusted to assess the impact of the "Maximum Consensus" climate change scenario on the site water inventory, uncontrolled release, and controlled release results.

The results of the climate change sensitivity assessment on the mine water inventory forecasts are shown in Figure 20, and the sensitivity assessment was performed on the 50th Percentile rainfall scenario. The climate change sensitivity assessment indicates that the proposed CNE will not significantly impact the site mine water inventory, with the total site mine water inventory lowering as a result of the reduced rainfall intensity and increased evapotranspiration associated with climate change.

In addition, the climate change sensitivity assessment results also indicate that the Project does not significantly change the estimated risk or volume of an uncontrolled or controlled mine water release to the receiving environment. Likewise, climate change will actually reduce the risk and volume of uncontrolled and controlled releases for climate change scenarios are due to reduced rainfall intensity and increased evaporation.

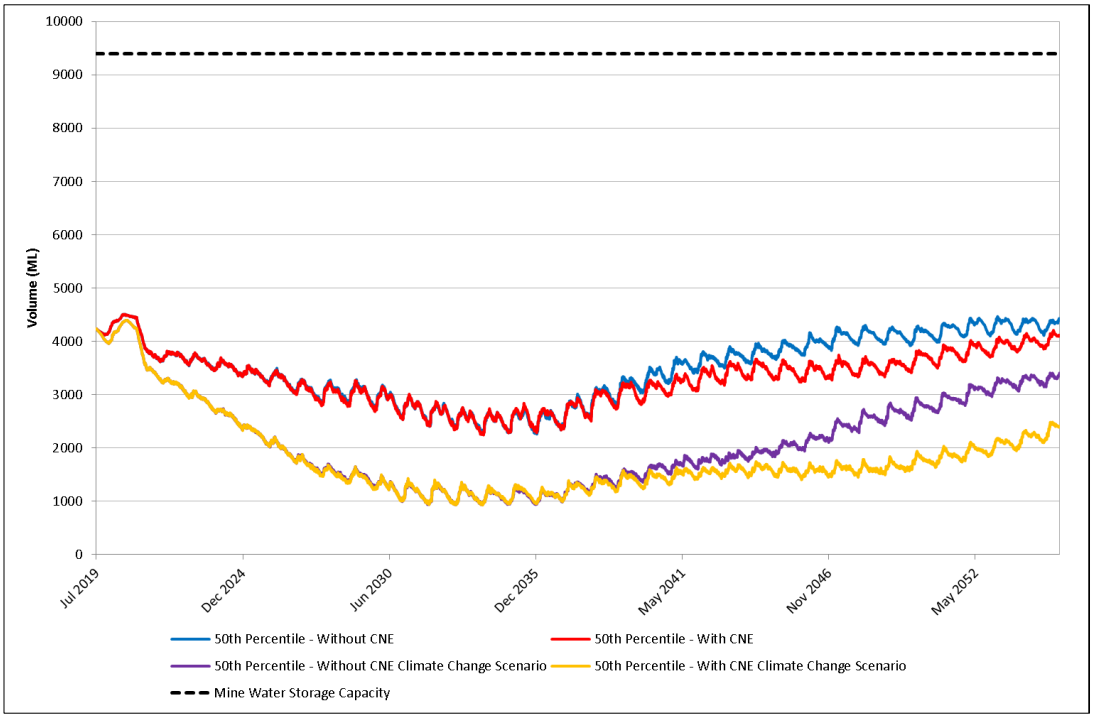

Figure 20 **Mine Water Inventory Forecast - 50th Percentile Climate Change Sensitivity Assessment**

6.3.2 Discharge Water Quality Considerations

No changes are expected to the existing discharge water quality with the CNE as demonstrated by the site water balance model results, the occurrence and volume of uncontrolled mine water releases are lower as a result of the CNE due to slightly lower stored mine water inventory volumes (Appendix C6, Engeny 2019a). The CNE will utilise much of the same infrastructure. Sediment dams and sediment traps are proposed to collect and treat sediment runoff prior to discharging into receiving waterways.

The discharge water quality has been monitored using the REMP and continuous monitoring in-stream gauges (as discussed in 11.3). The baseline data taken during the current operations are presented in Table 23 and Table 25 for both the impact and reference sites of Mackenzie River, Blackwater Creek, Three Mile Lagoon and Five Mile Lagoon, and Figure 10 for the downstream of the Mackenzie River.

6.4 SIGNIFICANT IMPACT CRITERIA

Potential impacts of the Project in relation to surface water resources were assessed with reference to the following guidelines:

- *Significant impact guidelines 1.3: CSG and large coal mining developments – impacts on water resources* (DoEE 2013f); and
- *Information Guidelines for the IESC advice on CSG and large coal mining development proposals* (IESC 2015).

The *Significant impact guidelines 1.3: CSG and large coal mining developments – impacts on water resources* (DoEE 2013f) define significant impact criteria for the assessment of impacts to water resources as a result of a large coal mining development.

The Guidelines state that: *an action is likely to have a significant impact on a water resource if there is a real or not remote chance or possibility that it will directly or indirectly result in a change to:*

a) The hydrology of a water resource; or

b) The water quality of a water resource;

that is of sufficient scale or intensity as to reduce the current or future utility of the water resource for third party users, including environmental and other public benefit outcomes, or to create a material risk of such reduction in utility occurring.

Hydrological Characteristics of a Water Resource

A significant impact on the hydrological characteristics of a water resource may occur where there are, as a result of the action:

a) Changes in the water quantity, including the timing of variations in water quantity;

b) Changes in the integrity of hydrological or hydrogeological connections, including substantial structural damage (e.g. large-scale subsidence); or

c) Changes in the area or extent of a water resource;

where these changes are of sufficient scale or intensity as to significantly reduce the current or future utility of the water resource for third party users, including environmental and other public benefit outcomes.

Hydrological characteristics include flow regimes, groundwater recharge rates, aquifer pressure, water table, surface-groundwater interactions, connectivity between river and floodplains, and connectivity between aquifers (DoEE 2013f).

Quality of a Water Resource

A significant impact on a water resource may occur where, as a result of the action:

a) There is a risk that the ability to achieve relevant local or regional WQOs would be materially compromised, and as a result the action:

a. Creates risks to human or animal health or to the condition of the natural environment as a result of the change in water quality;

b. Substantially reduces the amount of water available for human consumptive uses or for other uses, including environmental uses, which are dependent on water of the appropriate quality;

c. Causes persistent organic chemicals, heavy metals, salt or other potentially harmful substances to accumulate in the environment;

d. Seriously affects the habitat or lifecycle of a native species dependent on a water resource; or

e. Causes the establishment of an invasive species (or the spread of an existing invasive species) that is harmful to the ecosystem function of the water resource; or

b) *There is a significant worsening of local water quality (where current local water quality is superior to local or regional water quality objectives); or*

c) *High quality water is released into an ecosystem which is adapted to a lower quality of water.*

These Guidelines state that water-dependent ecosystems are likely to be significantly impacted if water quality is predicted to change to a degree greater than that required for 'moderately to slightly disturbed' systems (DoEE 2013f).

IESC Information Requirements

In addition to the *Significant impact guidelines 1.3: CSG and large coal mining developments – impacts on water resources* (DoEE 2013f), the *Information Guidelines for the IESC advice on CSG and large coal mining development proposals* (IESC 2015) were also considered. Information required by the IESC in order to fulfil their advisory role to the DoEE is detailed in Appendix E4.

6.5 IMPACT ASSESSENT

Based on the information presented below, in accordance with the criteria outlined in *Significant impact guidelines 1.3: CSG and large coal mining developments – impacts on water resources* (DoEE 2013f), **no significant impact on surface water** are anticipated to result from the development of the Project.

The potential surface water quality impacts from activities associated with the Project include:

- Surface water runoff containing elevated levels of sediment or contaminants from cleared areas, spoil dumps and stockpiles;
- Overflow of the contaminated water management system due to extreme rainfall events;
- Spills of contaminants potentially resulting in contamination of surface water; and
- Cumulative impacts, including the drawdown of ground water and subsequent flow reduction in ephemeral creeks.

Details of management and mitigation measures proposed for the Project are provided in Section 11.0.

Development of the Project is not anticipated to pose any additional risks to the downstream surface water environment beyond those already managed at the mine. The Project is a relatively small extension of the existing mine, located immediately to the north of the operational Jellinbah Central mining area, south of the Jellinbah Plains mining area, and immediately adjacent to the CN mining area and will not necessitate any substantial changes to current surface water management practices.

Overflows from the contaminated and clean water management systems are considered unlikely to occur as a result of the Project. Contaminated water storages have sufficient capacity to accommodate annual rainfall, and continual monitoring of water levels and storage capacities throughout the year is undertaken to ensure adequate storage for the wet season and onsite water use. The addition of the Project will not result in any substantial change to water quality or water management.

No additional regulated structures, mine affected water storages, or release points are proposed by the Project. Any water released to the receiving environment will be via currently authorised release points at the Mine and in accordance with current EA conditions. The proposed CNE will not significantly change the frequency, intensity or characterises of the release. Site specific WQO's are included in the existing project EA and will continue to be met.

6.5.1 Water Quality

Contaminant sources associated with the Central North Extension include sediment laden runoff from spoil dumps that will be intercepted by sediment control structures and mine affected water that will be contained within the pit and other dedicated storages.

The water quality encountered on the CNE Project is expected to be consistent with that seen at Central North and other parts of the mining operation. The CNE is not likely to significantly impact water quality stored on the Jellinbah Mine.

6.5.2 Flood Risks

The findings from the model assessments show that the northern portions of the proposed CNE lease (ML700011) areas would be impacted by Mackenzie River flooding in the 1 in 1,000 AEP flood event. However, as open cut mining is not proposed within the affected northern part of the Project lease (ML 700011) areas, an additional levee is not required in this area. Likewise, as no mine-affected water storages are proposed within this area, there is no further risk of an uncontrolled release of mine-affected water occurring as a result of flooding.

The assessment also shows flooding in Blackwater Creek (which is dominated by Mackenzie River backwater flooding) would not extend onto the Project lease area in all flood events, up to and including the PMF. In addition, the Project lease (ML 700011) area would not be impacted by flooding in Twelve Mile Creek.

6.5.3 Catchments and Water Balance

The Project results in an increase to the CN mining void catchmentof up to 30% during operations (Appendix C6, Engeny 2019a); however, these catchments will be reinstated to the receiving waterways through progressive backfilling and rehabilitation of the Project mining void.

The water balance assessment concluded no significant difference between the total mine water inventories for the ‘with CNE’ and ‘without CNE’ scenarios under all modelled rainfall conditions. Overall, as mine-affected water is recycled for use at the CHPP, the mine water inventory is actually lower for the “with CNE” scenario. It should be noted that the addition of CNE allows Jellinbah Mine to maintain existing production levels for the remainder of the mine life, and without CNE the coal production rate will decline after 2040.

6.5.4 Release Impacts

As the mine-affected water inventory is expected to decrease as a result of the inclusion of the CNE, the risk of mine-affected water release also reduces.

Continual monitoring of water levels and storage capacities is undertaken to ensure adequate storage for the wet season and onsite water use. In the event of large rain events, the pits at Central and Plains sites will be used as temporary storages. After the wet season, when there is enough storage available in other dams, the pit water will then be removed.

Given the success of the existing SWMP in managing site water runoff and releases at the Jellinbah mine to date, together with the REMP (updated with TARP incorporated) and the continuous monitoring program, it is considered that the addition of the CNE area, managed in accordance with the updated SWMP (Appendix C6, Engeny 2019a), will not result in any additional impacts on surface water values.

7.0 GROUNDWATER

JBT Consulting Pty Ltd (JBT) undertook a *Groundwater Assessment* (2016) that was attached to the EPBC Act Referral (Appendix A2) and has recently completed *Conceptual and Numerical Groundwater Modelling* (2019) report for the proposed Project (Appendix D7). These technical studies form the basis of the groundwater assessment within this PD.

7.1 REGIONAL ENVIRONMENT

7.1.1 Stratigraphy

The site and regional stratigraphy of the Project are summarised in Table 29 and include:

- Quaternary-age alluvium associated with current surface drainage features such as Blackwater Creek and the Mackenzie River;
- Tertiary deposits comprising mudstone, sandstone, siltstone, and conglomerate of the Duaringa Formation, as well as sediments that are derived from Tertiary weathering and remobilisation of older units;
- Triassic sediments of the Rewan Group, which comprise lithic sandstone and green to reddish brown mudstone and which occur in the eastern area of the Project; and
- Coal-bearing sediments of the Late Permian Blackwater Group, including the Rangal Coal Measures, which contains the target coal seam for mining within the Project (Pollux Seam).

Table 29 Summary of Regional Stratigraphy

Age	Unit	Description	Thickness (m)
Quaternary	-	Unconsolidated soil, silt clay, sand and gravel associated with current surface drainage systems (e.g. Blackwater Creek and Mackenzie River).	0 to 50 m
Tertiary	Duaringa Formation and residual units	Mudstone, sandstone, conglomerate, and siltstone.	0 to 30 m
Triassic	Rewan Group	Lithic sandstone, pebbly lithic sandstone, green to reddish brown mudstone and minor volcanilithic pebble conglomerate at base.	0 to 100 m+
Late Permian Blackwater Group	Rangal Coal Measures	Feldspathic and lithic sandstone, carbonaceous mudstone, siltstone, tuff and coal seams. Includes the Pollux Coal Seam, which is the target coal seam for mining within the Project.	0 to 100 m+ Aries Seam – 0 to 1 m Castor Seam – 0 to 1 m Pollux Seam – approximately 10 m
	Burngrove Formation	Mudstone, siltstone, sandstone, coal, and tuff.	0 to 90 m
	Gyranda Formation	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).	0 to 500 m+

Source: JBT (2019).

7.1.2 Geology

The Jellinbah mining areas are developed in areas where the Rangal Coal Measures subcrop beneath the Tertiary cover (i.e., mining is undertaken in areas where the coal measures are shallowest). The dip of the coal seams is to the east or southeast so that the Project extends mining down-dip from the CN mining area. Project location in relation to 1:100,000-scale surface geology is displayed in Figure 21, and the Project location and Bowen Basin solid geology is presented in Figure 22 (JBT 2019). The Mining is situated within the Jellinbah Thrust Belt, which lies between the Jellinbah Fault to the west and the Yarrabee Fault to the east; the faults act to compartmentalise the various groundwater units in the area of the Mine (JBT 2019).

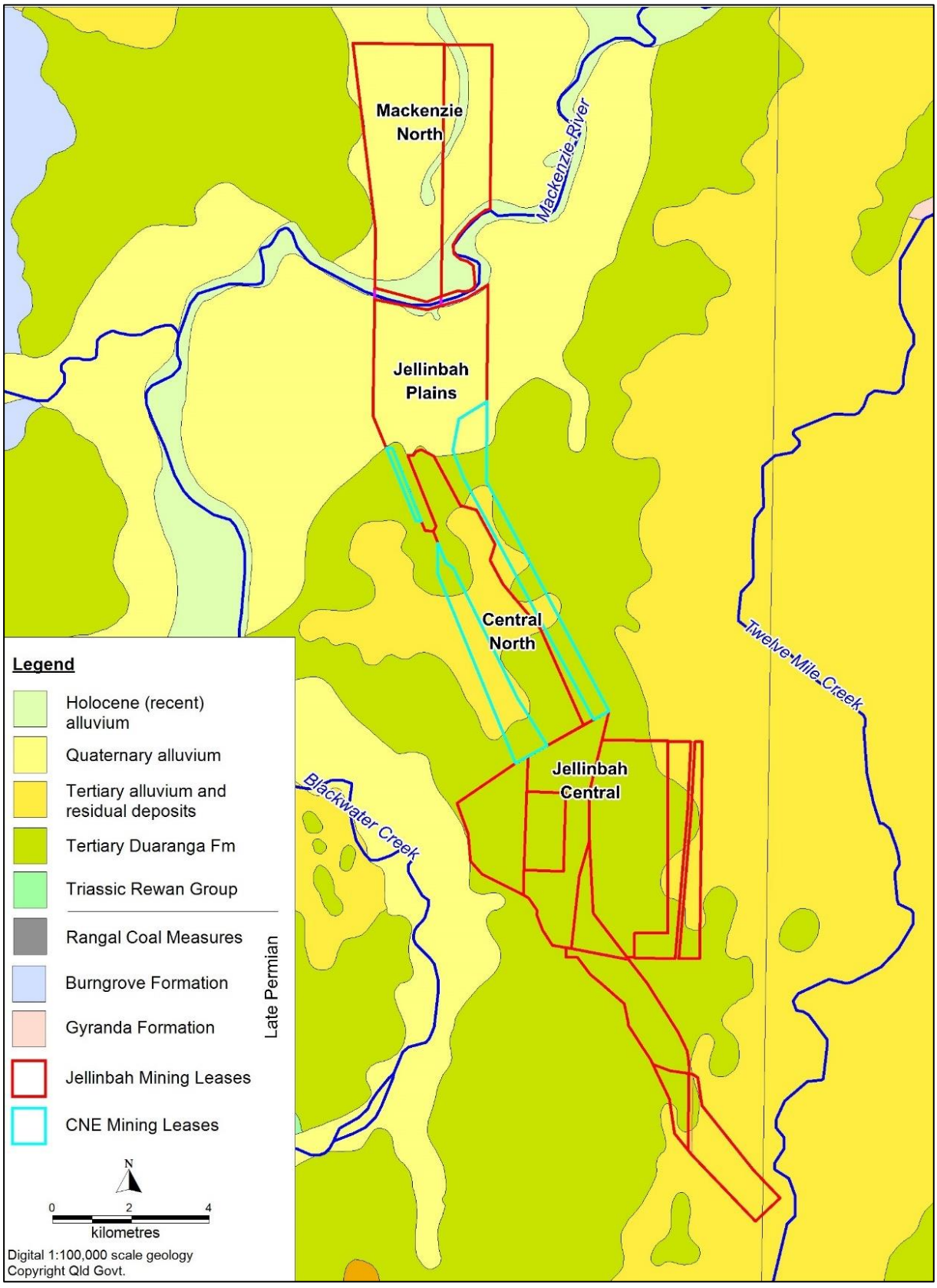

Figure 21 **Project Location and Surface Geology (1:100,000 Scale Digital Geology)**

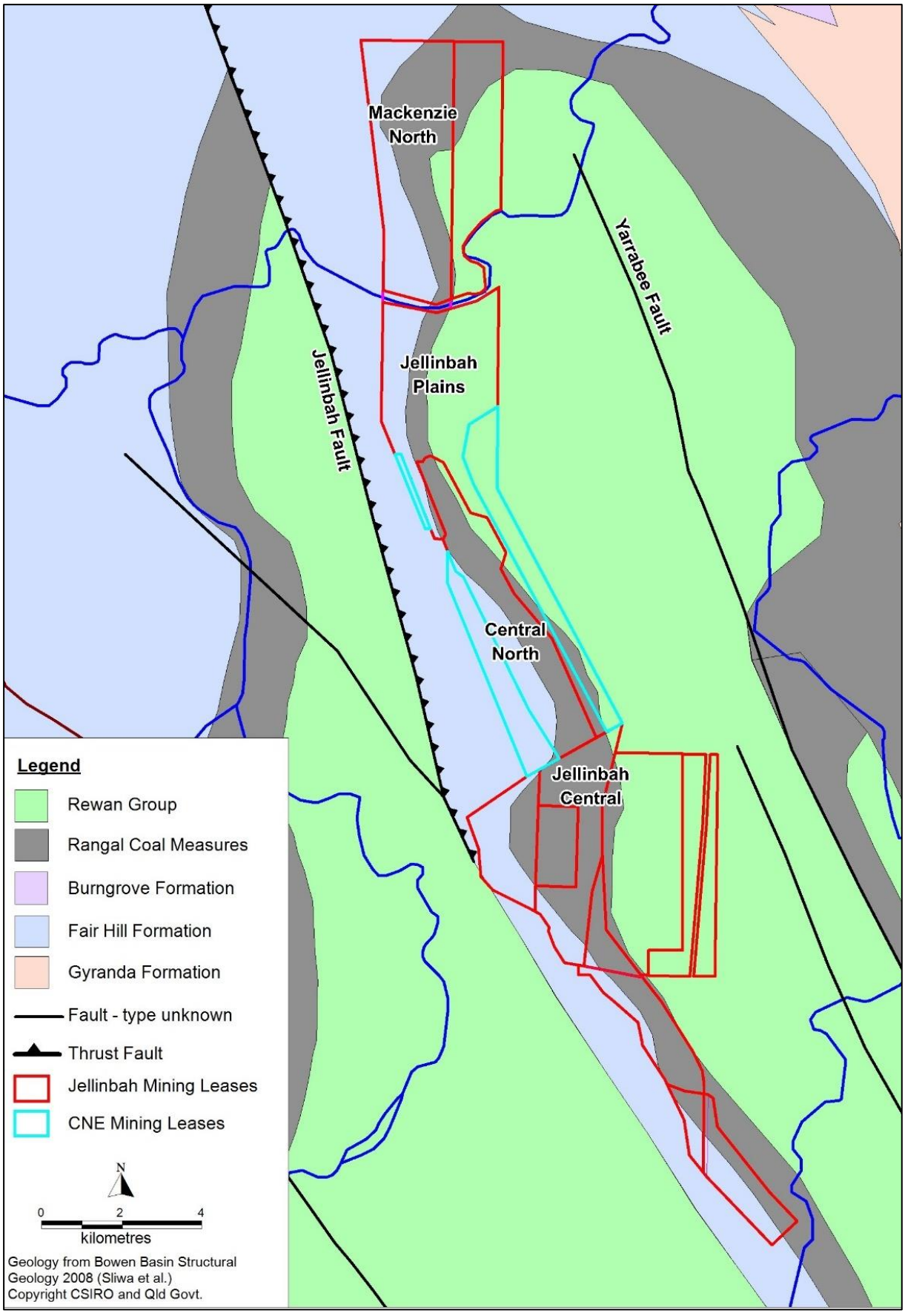

Figure 22 Project Location and Bowen Basin Solid Geology

7.1.3 Water Quality and Environmental Value

The Groundwater Assessment (JBT 2019; Appendix A2) was based on data obtained from the DNRME groundwater database (March 2019). From the review it has been determined that there are no existing registered groundwater bores in the area between the Jellinbah and Curragh/Curragh North mining lease areas (i.e. to the west of the CNE) or in the area between the Jellinbah and Yarrabee mining lease areas (i.e. to the east to the CNE). Data were obtained for private groundwater bores within approximately 25 km of the Project. Interpretation of the data is summarised below, for further details refer to (Appendix A2).

Assuming an upper limit of 4,000 milligrams per litre (mg/L) total dissolved solids (TDS) for stock use (equivalent to an electrical conductivity (EC) of approximately 6,000 micro Siemens per centimetre (µS/cm), groundwater in the region is assessed to be highly saline with little environmental value for surrounding land users (i.e., too saline for stock use). Groundwater is not used by local industries or the community. The environmental value of groundwater applicable to the Project is limited to the protection of aquatic ecosystems associated with alluvial aquifers associated with the Mackenzie River or other vegetated watercourses.

Quaternary Alluvium: is associated with larger surface drainage features such as Blackwater Creek and the Mackenzie River. 13 of 33 registered bores within the Quaternary Alluvium had water quality information with EC ranging between 456 and 5,410 µS/cm (mean: 1,620 µS/cm, median: 1,360 µS/cm). The alluvial aquifer was assessed to be the only aquifer in the region to reliably contain stock-quality water. No Quaternary Alluvium is mapped within the proposed mining area.

Tertiary Sediments: cover the majority of the Project area, including the proposed mining area. 3 of 22 registered bores within Tertiary Sediments provided water quality data. EC ranged from 900 to 16,100 µS/cm and was obtained from the shallowest depth of approximately 40 m below ground level (which is below the base of Tertiary). It is assessed that the Tertiary Sediments are likely to be dry within the Project area.

Triassic Rewan Group: occur in the eastern and northern areas of the Project and is also assessed to be a poor groundwater resource. 11 of the 17 registered bores within the Triassic Rewan Group provided water quality data with an EC range from 6,500 to 30,000 µS/cm (mean: 19,118, median: 20,000 µS/cm). Based on the salinity, groundwater within Triassic Sediments is assessed to generally not be suitable for stock use.

Permian Sediments: include the Coal-bearing sediments and target coal seam for mining within the Project. Water quality was available from 31 of the 70 bores showed that the groundwater in the area is poor. EC ranged from 1,328 to 38,400 µS/cm (mean: 9,951 µS/cm, median: 7,600 µS/cm). Only 12 out of 31 bores recorded an EC < 6,000 µS/cm, making the groundwater within the coal measures marginal to unsuitable for stock use, based on salinity criteria. The water quality in the Pollux Seam is between approximately 18,000 and 34,000 µS/cm (4 samples), which is too saline for stock use.

7.2 LOCAL ENVIRONMENT

7.2.1 Groundwater Occurrence

Two main groundwater-bearing units have been identified in the Mine area (JBT 2019), including:

1. Quaternary Alluvium: is associated with prior channels and flood deposits of the Mackenzie River (to the north). In part due to the presence of water supply structures, the Mackenzie River tends to be a perennial stream adjacent to the Mine. Quaternary alluvium is encountered in the northern section of the Jellinbah Plains operation (Figure 21), but there are no Quaternary alluvial deposits within the Project. Quaternary alluvium is also associated with Blackwater Creek (to the west of the Mine). It is noted that Twelve Mile Creek (to the east of the Jellinbah mining area) is mapped as occurring within Tertiary alluvium and residual deposits and has no mapped Quaternary alluvium at 1:100,000 scale.

2. Permian Coal Measures: comprise interbedded siltstone, sandstone, shale (interburden), and coal. The Permian interburden is hydrogeologically “tight” and hence very low yielding, with most of the groundwater storage and movement occurring within the coal seams. Faults at site are generally identified as dry. It has been observed from face mapping within the Jellinbah Central Pit that faults and joints can act as conduits for water flow; however, this is interpreted to be related to the relaxation of the strata and associated structures adjacent to the pit, with the source of the water being predominantly surface water infiltration in the zone adjacent to the pit crest.

7.2.2 Groundwater Level

Groundwater level data for the Jellinbah mining area south of the Mackenzie River is available from two sources (JBT 2019), including:

1. Long-term monitoring of bores adjacent to the Mackenzie River, which is undertaken as part of the EA conditions of the operation. Bores that are monitored are discussed further in Appendix D7; and

2. Water levels from exploration bores within the CN and CNE areas from a site visit undertaken by JBT in 2015.

From review (JBT 2019) of the bore hydrographs (Figure 23) it was interpreted that:

- The alluvium is directly recharged by rainfall, as evident from the water level increase in 2010/2011 that shows a direct correlation with the rainfall residual mass curve (RRMC);

- The Pollux Seam is directly recharged by the alluvium at this location (i.e., recharge location for the Permian Coal Measures), as the water level and water level response, is almost identical for bore MS0203 (Pollux Seam) and bore MSP0213 (overlying alluvium at the same location); and

- The waters level in the alluvium and Pollux Seam tend to follow the trend of the RRMC, which indicates a direct response to rainfall recharge. However, a downward trend in water levels is evident in data post 2016, at a time when a sharp increase in the RRMC is recorded due to above-average rainfall; this is interpreted to indicate that groundwater seepage is occurring towards the advancing Jellinbah Plains pit.

On the site visit undertaken by JBT in 2015, the only area on the Jellinbah Mine where groundwater seepage was observed was the northern portion of the Jellinbah Plains pit. This seepage was occurring from the base of the Mackenzie River alluvium at the northern end of the pit, with groundwater pooling on lower benches due to downward seepage of water from the alluvium, through the weathered zone of the Permian sediments. It was noted that groundwater occurrence was limited to the area where Quaternary alluvial deposits occur (Figure 21). There are no Quaternary alluvial deposits in the Project area where mining is proposed to occur, it is therefore anticipated that groundwater conditions in the Project will instead be similar to the Jellinbah Central pit (i.e. the pit will receive little if any visible groundwater seepage);

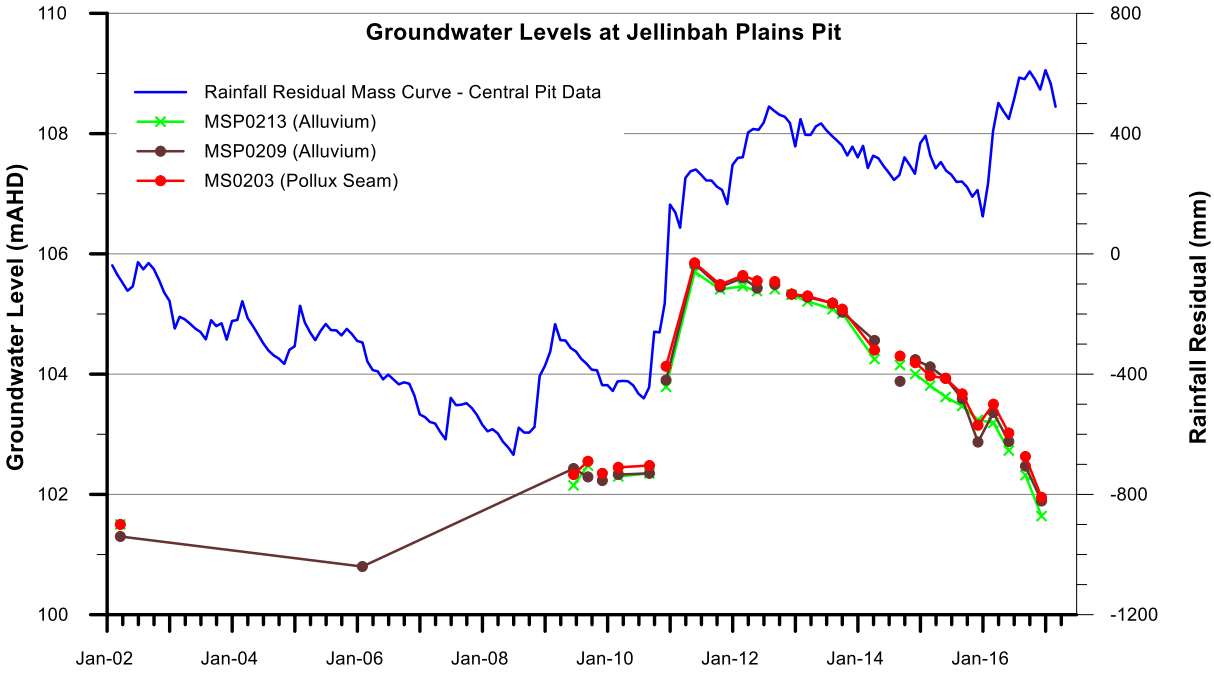

Figure 23 Hydrographs for Plains Pit Monitoring Bores (JBT 2019)

The location of exploration bores and associated water levels are presented in Figure 24. It is noted that the water levels are “bulk” water levels from the entire open sequence that has been intersected by the bores. However, the water levels are instructive in that they indicate a consistent water level at this location of approximately 40 to 50 mbgl in this area. JBT (2019) review of bore logs for bores within the Project lease area observed that:

- The base of Tertiary occurs at depths between 8 mbgl (bore JPS0001) and 25 mbgl (bore JPS0005) in the CN area; and
- The recorded water level is within the Permian coal measures in overburden just below the base of weathering, or in the case of bore JPS0003, the water level is at 49.98 mbgl, which is below the bases of the Aries Seam (43.6 mbgl). The Tertiary sediments are therefore interpreted to be dry in the CN and CNE areas.

The following observations were made (JBT 2016) with respect to groundwater levels in the Project area and adjacent to the Jellinbah Central pit:

- The observations from the site visit are that the Jellinbah Central pits are dry and do not contain groundwater seepage;

- The depth to groundwater varies from approximately 40 mbgl in bores that are located 1.5 to 2.0 km from Central Pit, to approximately 61 to 65 mbgl in bores that are adjacent to the Central Pit;

- Review of lithological logs for the exploration bores indicates that the observed groundwater level is below the base of both the Tertiary and Triassic Rewan Group sediments. It is therefore concluded that the Tertiary/Triassic strata are generally dry in the Project area and that that groundwater is likely to occur only within the Permian coal measures; and

- From review of site contour data, it is concluded that the water level in the coal measures immediately adjacent to the pit is at approximately the level of the pit floor. This indicates that groundwater seepage to the pit is occurring; however, the observation that the pits are dry (i.e., that there is no visible groundwater seepage) indicates that the rate of groundwater seepage to the pits is extremely low (i.e., the rate of evaporation is higher than the rate of groundwater seepage, resulting in dry pits).

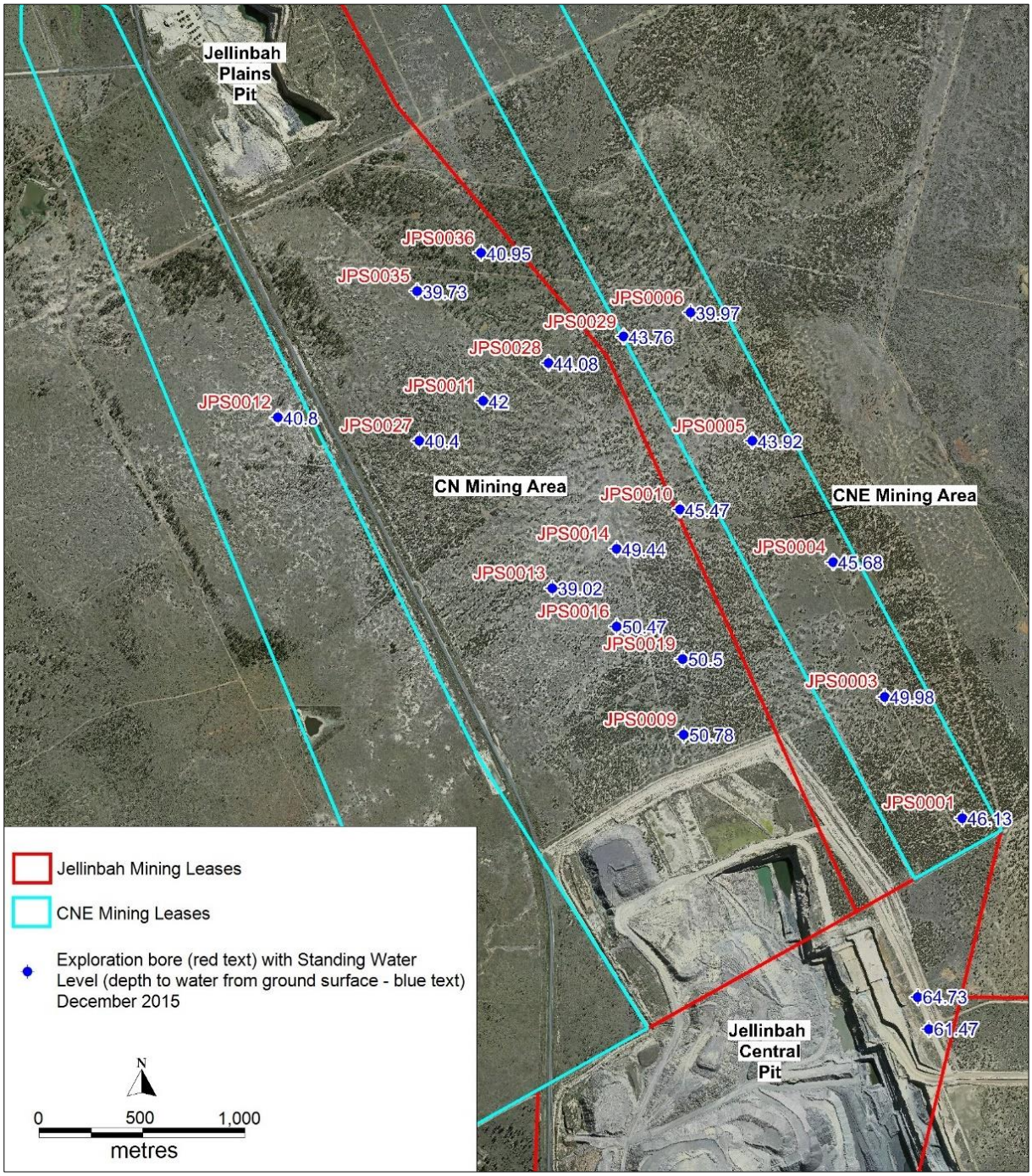

Figure 24 CN and CNE Exploration Bores and Groundwater Levels

7.3 CONCEPTUAL GROUNDWATER MODEL

7.3.1 Pre-Mining

Essential elements of the conceptual model include:

- The Tertiary deposits within the project area comprise mainly sediments of the Duaringa Formation and high-level Tertiary alluvial deposits. The thickness of the Tertiary sediments within the Project ranges from approximately 8 to 25 m. Exploration drilling and monitoring data indicate that the Tertiary sediments in the area of the Project are dry and that the water level is generally below the base of weathering but generally above the upper coal seam. Therefore, conceptually, the base of weathering is regarded as the depth below which all units at site are saturated (i.e., the phreatic surface occurs at approximately the depth of the base of weathering);

- Recharge to Tertiary sediments is via direct rainfall recharge. The porosity/permeability of the Tertiary sediments is variable; therefore rates of recharge through the sediments are also variable;

- Quaternary alluvium is associated with drainage features such as the Mackenzie River (to the north) and Blackwater Creek (to the west). There is no quaternary alluvium within the area of CN or the Project; and

- The coal seams are recharged via downward leakage from overlying Tertiary units, or in areas where the coal seams crop out at the surface. The inter-burden is less permeable that the coal seams, therefore the coal seams are preferentially recharged where the seams sub-crop beneath Tertiary or Quaternary sediments (e.g., where the coal seams sub-crop beneath the Mackenzie River alluvium).

7.3.2 Post-Mining

Essential elements of the post-mining conceptual model include:

- Mining within CN will occur to depths of approximately 125 mbgl, with mining of the Project to increase the extent of mining by approximately 360 m to the east and to an increased depth of approximately 150 mbgl;

- Mining will occur below the phreatic surface, resulting in a potential for groundwater to flow towards the pits;

- Within the Mine, evaporation rates are high (annual average of 2020 millimetres (mm) per year, compared to average annual rainfall of 600 mm). The low permeability of the overburden material will result in rates of inflow that are so low that evaporation will remove the water, creating an impression of dry pit walls. However, a cone of depression will start to develop around the pit, with the steepness of the cone, and the extent of the impact, dictated by the permeability of the sediments. Groundwater seepage modelling predicted that the cone of depression would be relatively steep, and the extent of impact relatively small;

- As mining progresses to greater depths, groundwater inflow will become more visibly apparent. Data from modelling, as well as observations from other Bowen Basin mines, suggests that inflow will manifest as:

- Visible inflow initially occurring in discrete regions where the rate of inflow is higher than the rate of evaporation (e.g., faults/ fractures, the base of transmissive coal seams, the base of Tertiary/Base of Weathering following wet season recharge events);

- A progressing incidence of damp pit walls and floor of mine at depths where the rate of inflow exceeds the rate of evaporation, eventually leading to ponding of free-standing water; and

- A potential for seasonality to inflows (e.g., certain walls/floor sections may become damper when the evaporation rate is low (i.e., when humidity is high)).

7.4 QUANTITATIVE GROUNDWATER MODELLING

7.4.1 Geological Context of Proposed Mining

The extent of mining at the CN mine and proposed extent at CNE is shown in Figure 25. At the approved CN Mine, the projected depth is approximately 125 mbgl, and as proposed mining progresses to the east into the Project, the depth of mining will be approximately 145 to 150 mbgl (JBT 2019).

Three west-east cross sections were generated from the site geological model, with the sections including delineation of the limit of mining for both the CN and CNE operations (Figure 26). Of the cross sections, Section 2 was selected as being a representative section for use in the cross-sectional groundwater model. For the purpose of groundwater modelling the geology of areas to the west and east of the site was interpreted from existing surface geology (Figure 21) and Bowen Basin solid geology (Figure 22) (JBT 2019).

A long section through the CN mining area was generated from the site geological model, with the section and section location shown below in Figure 27. For the purpose of groundwater modelling, the coal seams that occur to the north of the section were continued north to the Mackenzie River. The thickness of alluvium and coal seam depth in the area of the Mackenzie River/northern area of Jellinbah Plains pit was based on information obtained from drilling in that area (JBT 2019).

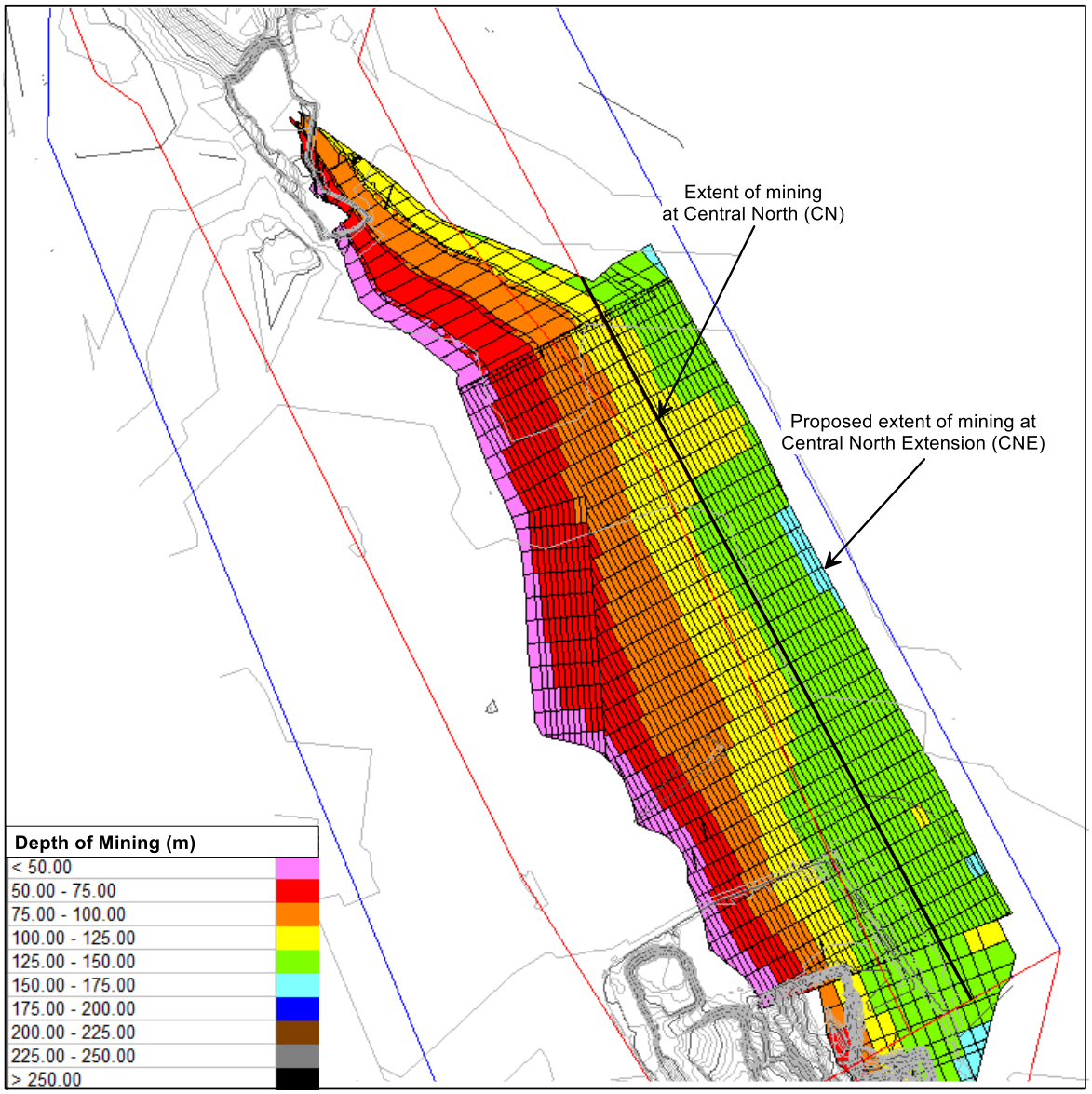

Figure 25 Extent of Proposed Mining at CNE vs Extent of Mining at CN

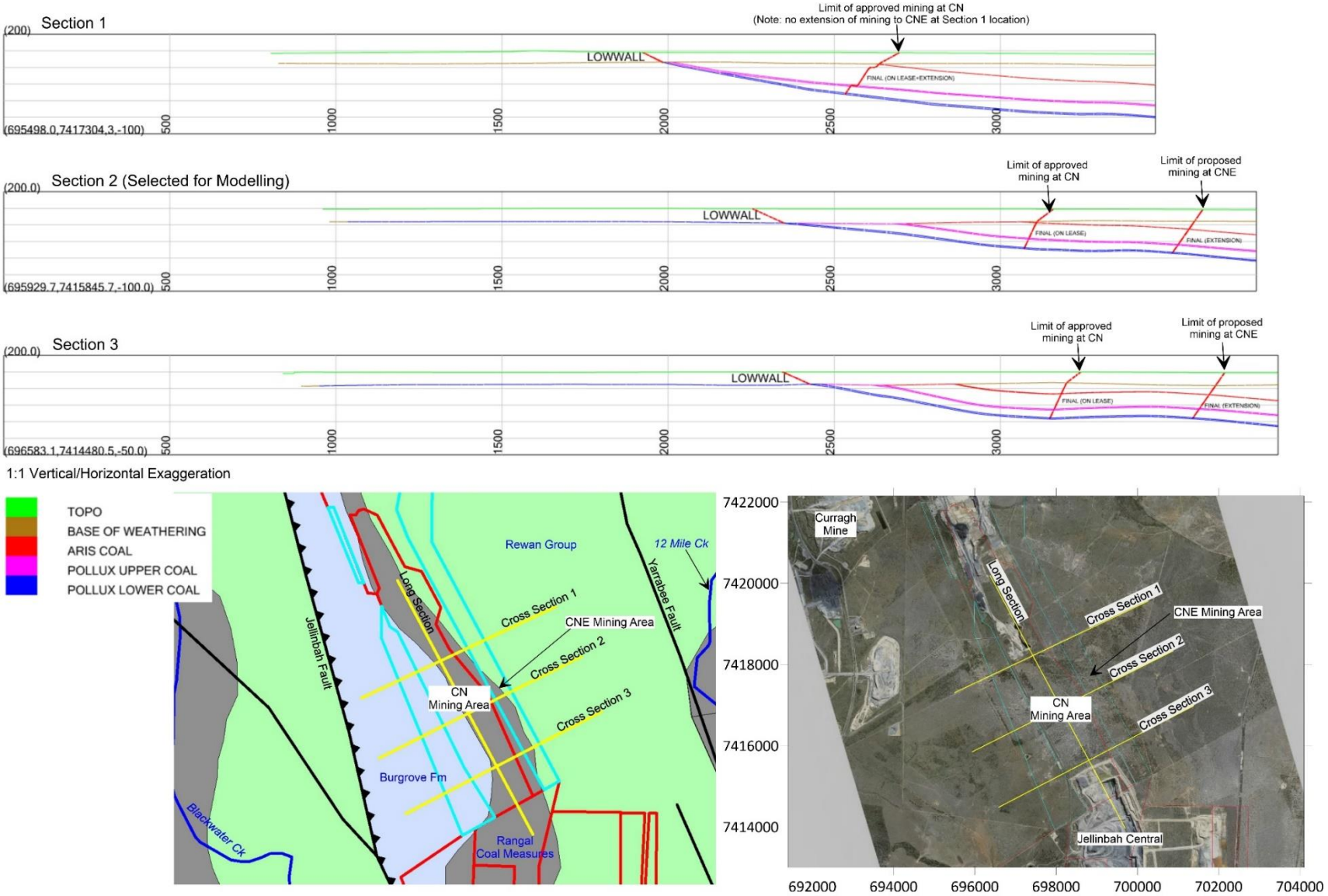

Figure 26 Cross Sections from Site Geological Model

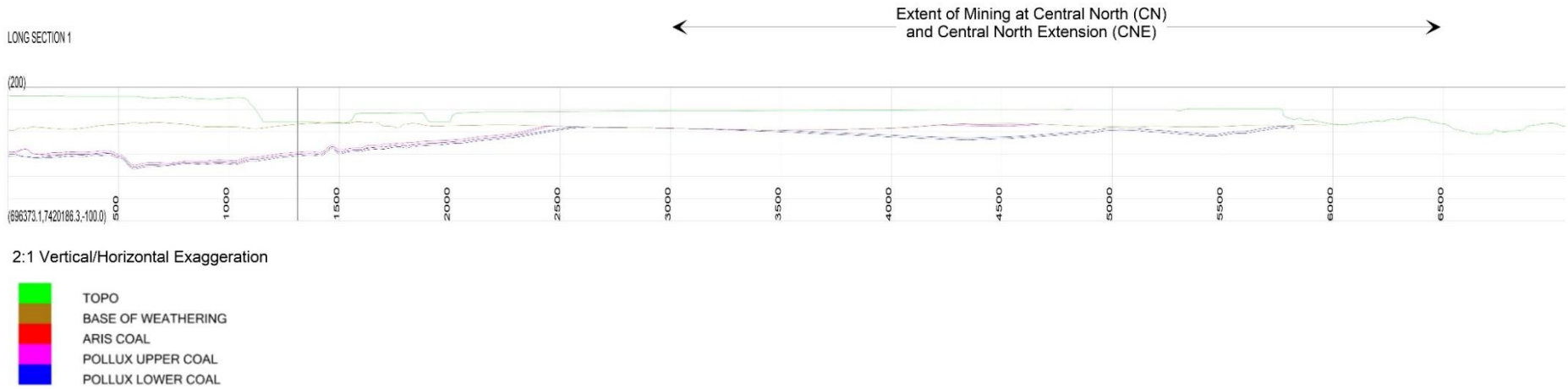

Figure 27 Long Section from Site Geological Model

7.4.2 Model Specifications

To estimate the extent of water level impact from the proposed Project, two-dimensional (2D) seepage modelling was undertaken using the numerical modelling program Seep/W (JBT 2019). The choice of model code has been based on an assessment of the model platform that was appropriate for the study requirements. The approach has been confirmed through consultation with project officers from the DoEE and a technical expert from the Office of Water Science (Appendix D7).

Factors relevant to the Project study and assessed when choosing the appropriate modelling platform included the ability of the model selected to:

(a) Represent the essential elements of the conceptual groundwater model including;

    i. accurately represent the complexity of the geology including faulting of strata, which acts to compartmentalise the geological and hydrogeological units (due to faulting having the potential to significantly impact groundwater occurrence and flow); and

(b) Adequately address the requirements of the scope of work including;

    i. assessment of the extent of groundwater level impact from mining, as well as assessment of the potential impact of groundwater level changes on any connected surface water and groundwater dependant ecosystems.

The use of a 2D Seep/W cross section model was assessed to be valid and appropriate to this investigation for the following reasons:

- The geology of the mining area is complex and includes a number of local-scale and regional-scale faults, which significantly disrupt the strata (refer Figure 22– Solid Geology). It is possible within a 2D model to reproduce complex cross-sectional geology, whereas such detail cannot be included practically within a three-dimensional (3D) model;

- Seep/W is designed to simulate flow in both the saturated zone and the unsaturated zone. When mining occurs below the phreatic surface, an unsaturated zone is induced in the pit walls as seepage to the excavation occurs. Seep/W is well suited to investigation of groundwater level impacts resulting from seepage to open pits, particularly for projects such as CNE where mine dewatering via bores does not occur, and seepage to the excavation is the only means via which the mine removes water from the groundwater system;

- In open cut mines, groundwater storage conditions transition from confined to unconfined in the zone adjacent to the pit walls. Seep/W models the rate of drainage to an excavation via a property called the volumetric water content, which is able to account for the rate of groundwater flow accurately, and the rate of change of the phreatic surface as groundwater conditions transition from confined to unconfined and gravity drainage of groundwater occurs to the excavation. Seep/W is able to model this important element of the groundwater system with considerably greater accuracy than other groundwater flow models (e.g., Modflow);

- One of the main purposes of the model is to investigate the rate and extent of groundwater level drawdown in response to mining, especially in areas of potentially connected surface water and groundwater systems. This can be readily (and potentially more accurately) achieved through the use of 2D cross section models; and

- The use of 2D models is valid in cases where the section can be oriented along a groundwater flow line so that all groundwater flow is along the section rather than across it. In open-cut mines

where mining occurs below the water table, groundwater flow towards the excavation tends to dominate over the previous regional flow patterns, making it possible to orient a section along a groundwater flow line.

The Project represents a minor expansion of an existing mine (Central Pit) and already approved operation at Central North (CN). The Project occurs to the east of the CN mining area, therefore the main area for drawdown assessment is a distinct area to the east of the Project, and it is judged that a 2D model is an appropriate tool for assessment of groundwater drawdown impacts along a west-east flow line (i.e., in the direction where assessment of potential impacts is most critical). A SEEP/W model is able to accurately represent the seepage face conditions that occur at an open pit face and to represent the transition from unconfined conditions (at and near the pit face) to confined conditions (at a distance from the pit face). In this important respect, a 2D SEEP/W model is judged to be able to more accurately represent the seepage conditions and the prediction of drawdown along a west-east flow line than a 3D model such as MODFLOW, where mining tends to be represented via more simplistic approaches, such as the use of drain cells at the pit floor.

The selected modelling platform (Seep/W) is an industry-standard finite-element model capable of modelling groundwater movement and pressure distribution within the saturated/unsaturated zone of porous materials such as soil and rock. Seep/W has been used in this study to predict the rate and extent of change to the phreatic surface in response to the ongoing mining of the CN Mine, as well as the proposed extension of the operation into the Project.

Two models were prepared for this study, including a west-east cross sectional model (cross section 2 -Figure 26) and a north-south cross-sectional model (long-section - Figure 27). The models are described in detail in Appendix D7, including model specifications such as;

1. Two model locations and two scenarios,
2. Hydraulic parameters including;
    - Hydraulic conductivity (K); and
    - Specific yield (Sy) and specific storage (Ss);
3. Representation of faulting; and
4. Boundary conditions including;
    - Recharge;
    - Starting phreatic surface; and
    - Groundwater seepage to voids.

7.4.3 Modelled Recharge Rate

The recharge rates were calculated using the chloride mass balance (CMB) method. The details of the calculation are provided in Section 6.5.1 in Appendix D7 (JBT 2019). The results of the calculated recharge rates to groundwater are shown below in Table 30 below, and recharge was applied to the model as follows:

- Recharge to areas of Mackenzie River alluvium (i.e., the northern area of the North-South Model) was applied at a rate of 1% of average annual rainfall.

- Recharge to the Tertiary sediments was applied at a rate of 0.5% of average annual rainfall, which is justified as follows:
    - The Tertiary sediments have been observed to be unsaturated in the CN and CNE mining areas; however, recharge to the Tertiary sediments will eventually report as recharge to the underlying coal measures, where recharge will preferentially occur in areas where the coal seams subcrop beneath Tertiary sediments;
    - The highest calculated recharge rates (via the CMB method) will occur in areas where the lowest salinity groundwater occurs, which is observed to be the areas where the coal seams subcrop directly beneath Tertiary sediments. In down-dip areas (e.g., to the east of the Project and towards Twelve Mile Creek), less recharge to the coal seams will occur due to the low permeability of the overlying overburden.
    - It is noted that in the area to the east of the Project, Tertiary alluvium is mapped at surface. This unit is expected to be relatively thin, and a recharge rate of 0.5% of the average annual rainfall was also applied to this unit.

Recharge was applied to transient models as a flux boundary condition applied to the upper layer of the model (representing the ground surface). Rainfall was not applied to the steady-state model as the starting phreatic surface was generated based on fixed head boundary conditions at the edges of the model.

Table 30 Calculated Groundwater Recharge Rates via CMB Method

Parameter	Description	Alluvium			Coal Seams		
		20th %	Mean	80th %	20th %	Mean	80th %
Cg	Chloride concentration in groundwater (mg/L)	64.2	485	1490.4	582.4	2417	5190
Cp	mg/L chloride in rainfall	6.2	6.2	6.2	6.2	6.2	6.2
P	Annual average rainfall (mm)	559.4	559.4	559.4	559.4	559.4	559.4
R	Annual average recharge (mm)	53.89	7.14	2.32	5.94	1.43	0.67
	Recharge as % of average annual rainfall	9.63	1.28	0.42	1.06	0.26	0.12

Source: JBT 2019

7.4.4 Model Calibration

The IESC requested calibration data for the 2D Seep/W model. The approach taken to calibrate the Seep/W model is generally to utilise realistic model parameters and to test for variability in results via uncertainty analysis. However, it is possible to assess the validity of the Project groundwater model results based on site observations.

It has been observed at the adjacent Central Pit that the mine is dry (i.e., no observable groundwater inflow) at pit depths of 100-120 m. This is not to say that no groundwater inflow from the coal measures is occurring; rather, it is interpreted to indicate that groundwater inflow occurs at a rate that is less than evaporation. This observation provides valuable information for model calibration as the predicted rate of inflow to the pit, with the mine at similar depths, should at least be less than the rate of evaporation, to be consistent with observations from mining.

During the modelling process, a check was made of the modelled rate of inflow to establish whether the inflow rate was occurring at a rate that could be removed by evaporation at equivalent depths below the surface. This is discussed further in Appendix D7.

In addition to this, The Seep/W model has also been amended to include hydraulic parameters from the calibrated Mackenzie North groundwater model, which was developed for the Mackenzie North Environmental Management Plan and which covers the area of the Project. The calibrated model parameters are consistent with observed parameters from Mackenzie North.

7.4.5 Modelled Groundwater Level Impacts

7.4.5.1 Assessment Criteria

The QLD *Water Act 2000* defines a "bore trigger threshold" (s362) as:

a decline in the water level in the aquifer that is-

1. *If a regulation prescribes the bore trigger threshold for an area in which the aquifer is situated – the prescribed threshold for the area; or*

2. *Otherwise-*

    - *For a consolidated aquifer – 5 m; or*

    - *For an unconsolidated aquifer – 2 m*

The modelled drawdown at 150 years post mining for the two modelled scenarios (CN only and CN plus CNE mining) is shown in Figure 28.

For the consolidated Permian Coal Measures, it was appropriate to represent the extent of drawdown for up to 5 m from the original water level. 2 m contours are also provided for reference. The modelled drawdown beneath surface water features of interest (Mackenzie River to the north and Twelve Mile Creek to the east) is discussed below.

The drawdown beneath Blackwater Creek (to the west) is not discussed as significant groundwater drawdown to the west does not occur. Drawdown to the south is also not discussed as drawdown from both the CN and CNE operations will only extend as far as the Jellinbah Central void, which occurs immediately to the south of both operations.

7.4.5.2 Model Results

Modelled drawdown is discussed below (JBT 2019) for each direction (north/south/east/west) from the CN and CNE mining areas. Results from modelling are shown in Figure 28 below, and predict:

- On the eastern (high wall) side of the mining area, the 5 m extent of drawdown is approximately 3,500 m from the pit crest at post-mining equilibrium (drawdown results at 150 years post-mining were utilised as post-mining equilibrium for all model results), for the CN operation only. With the Project operation included, the extent of 5 m drawdown extends to approximately 3,750 m from the pit crest at post-mining equilibrium (an increase of 250 m relative to the CN mining only case). The Project operation extends mining by approximately 360 m to the east and extends the depth of mining from approximately 125 mbgl to 150 mbgl.
- The 2 m drawdown contour extends approximately 5,250 m from the pit crest for the post-mining equilibrium, CN-only case, and approximately 5,500 m from the pit crest for the post-mining equilibrium CNE case (an increase of approximately 250 m relative to the CN-only case). The 2 m drawdown contour, therefore, extends beneath Twelve Mile Creek in some areas, as shown in Figure 28.

- On the western (low wall) side of the mining area, the 5 m and 2 m extent of drawdown contours do not extend appreciably (by less than 100m) due to mining. This is interpreted to be related to the lack of coal measures to the west of the mining area (due to the dip of the strata) and the relatively low permeability of the Burngrove Formation, which is the dominant unit to the west of the mining area;
- On the northern side of the mining area, the 5 m extent of drawdown is approximately 2,300 m from the pit crest at post-mining equilibrium for the CN-only case and approximately 2,400 m from the pit crest for the Project case. The difference in drawdown to the north, relative to the modelled drawdown to the east, is interpreted to be related to the variability of the geology to the north, relative to the east.
- The 2 m drawdown contour extends approximately 2,400 m from the pit crest at post-mining equilibrium for the CN-only case and approximately 2,800 m from the pit crest for the Project case. It is noted that no mining was assumed for the area to the north of the CN/CNE mining areas. The intent of the model was to establish any additional drawdown that may be due to mining in the Project area. However, it is judged that, in reality, any significant drawdown to the north is unlikely due to the existing impacts of mining in the Jellinbah Plains area.
- No drawdown was considered to the south as the model terminates in the south at the Jellinbah Central mined void. The groundwater elevation is held constant at the southern boundary of the model at the floor elevation of the Jellinbah void.

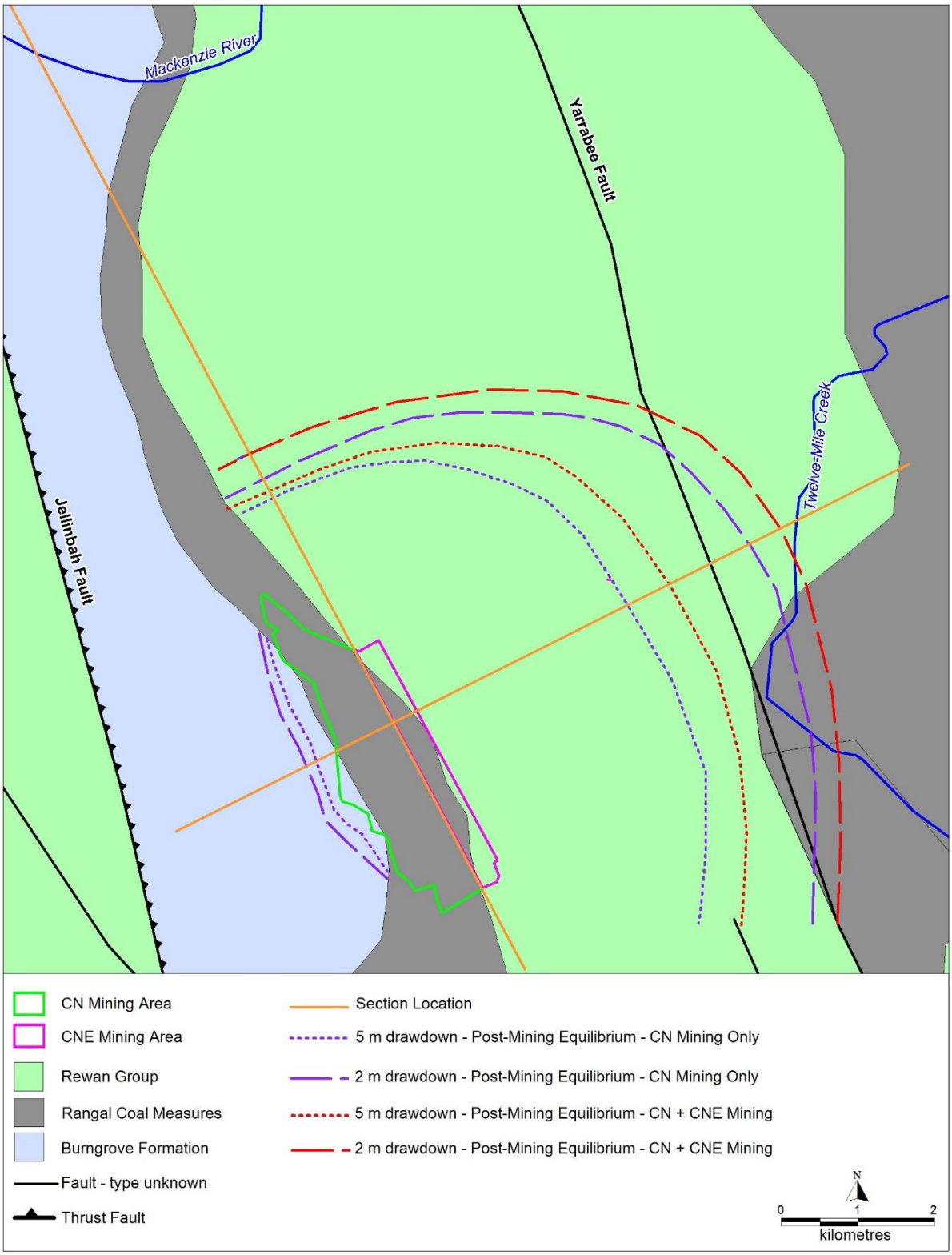

Figure 28 **Water Level Drawdown for CN and CNE Mining Cases - Post-Mining Equilibrium**

7.4.5.3 Uncertainty Analysis

A sensitivity analysis of the groundwater model developed for the Project was undertaken with reference to the following documents:

- *Australian Groundwater Modelling Guidelines* (Barnett *et al.* 2012);
- *Explanatory Note, Uncertainty Analysis in Groundwater Modelling* (Middlemis & Peeters 2018); and
- *Guidelines for Evaluation of Groundwater Flow Models* (Reilly & Harbaugh 2004).

The groundwater model sensitivity analysis involves the evaluation of model input parameters to see how much they affect model outputs, which are heads and flows. The process can be conducted manually or automatically; in the manual approach, multiple model simulations are made in which ideally a single parameter is adjusted by an arbitrary amount (Reilly & Harbaugh 2004). The emphasis of sensitivity modelling is on determining how sensitive the model is to each parameter tested, using a non-technical interpretation of "sensitive" (Barnett *et al.* 2012).

Further details on the sensitivity analysis, including scenarios and parameters, are further discussed in Appendix D7 (JBT 2019).

The results of the sensitivity analysis are summarised in Table 31 and presented in Figure 29 below, which shows the extent of 5 m drawdown contours for each modelled scenario at the end of mine life, over a background of the solid geology (JBT 2019).

- Scenario 1 - An increase in the Kh of the Triassic and Permian non-coal units by a factor of 10 results in an increase in the extent of the 5 m drawdown contour at the post-mining equilibrium of between 1,250 m (to the east) and 340 m (to the north). The variability in the extent of the 5 m drawdown contour is related to dominant rock type in each direction;
- Scenario 2 - An increase in the Kz of the Triassic and Permian non-coal units by a factor of 10 results in an increase in the extent of the 5 m drawdown contour at the post-mining equilibrium of between 2,300 m (to the east) and 1,600 m (to the north). The model is more sensitive to changes in Kz than Kh;
- Scenario 3 - An increase in the specific yield (Sy) of the coal seams by a factor of 2 and an increase in the coefficient of volume compressibility (mv) by a factor of 10 results in a decrease in the extent of the 5 m drawdown at post-mining equilibrium (-860 m to the east and -560 m to the north) relative to the base case;
- Scenario 4 - An increase in the specific yield (Sy) of the non-coal Triassic and Permian sediments by a factor of 2 and an increase in the coefficient of volume compressibility (mv) by a factor of 10 results in a decrease in the extent of the 5 m drawdown at post-mining equilibrium (-1490 m to the east and -780 m to the north) relative to the base case;

  A lower value for mv (and Ss) indicates a geotechnically stiffer (less compressible) aquifer. An increase in the aquifer mv (and hence Ss) will result in a more compressible aquifer, which will act to decrease the extent of drawdown.
- Scenario 5 – An increase (doubling) in the rate of recharge results in a decrease in the extent of the 5 m drawdown contour at post-mining equilibrium of -1,150 m to the east and -740 m to the north of the Project.

The results highlight the sensitivity of the model to changes in key parameters and the need to utilise realistic model inputs (hydraulic parameters, recharge) for the base-case model.

It is noted that the Tertiary sediments at the site are dry and that the regional groundwater system is developed within the Permian coal measures and is assessed to be disconnected from the surface water systems and alluvium (refer Section 7.5.2 below). Therefore it is concluded that variability in model input parameters from those used in the base-case model will only affect groundwater levels within Permian sediments and is unlikely to have practical impacts on water levels within the shallow groundwater systems in the area (i.e., alluvial aquifers).

Table 31 Change in the location of the 5 m Drawdown Contour, Relative to the Base-Case

Modelled Scenario		Base Case	Sensitivity Model	Change (m) in extent of 5 m drawdown contour*
East-West Section				
1	Increase horizontal hydraulic conductivity (Kh) x 10			
	Rewan Group	9.4 x 10^{-4} m/d	9.4 x 10^{-3} m/d	1250
	Interburden 1	9.4 x 10^{-4} m/d	9.4 x 10^{-3} m/d	
	Interburden 2	3.4 x 10^{-4} m/d	3.4 x 10^{-3} m/d	
	Burngrove Formation	4.0 x 10^{-5} m/d	4.0 x 10^{-4} m/d	
2	Increase horizontal hydraulic conductivity (Kh) x 10			
	Rewan Group	6.9 x 10^{-5} m/d	6.9 x 10^{-4} m/d	2300
	Interburden 1	6.9 x 10^{-5} m/d	6.9 x 10^{-4} m/d	
	Interburden 2	1.0 x 10^{-4} m/d	3.4 x 10^{-4} m/d**	
	Burngrove Formation	4.0 x 10^{-5} m/d	4.0 x 10^{-4} m/d	
3	Increase specific yield (*Sy*) of coal seams x 2	2%	4%	-860
	Increase compressibility (*mv*) of coal seams x 10	1 x 10^{-5}/kPa	1 x 10^{-4}/kPa	
4	Increase specific yield (*Sy*) of Rewan Group, Interburden 1&2, Burngrove Formation x 2	1%	2%	-1490
	Increase compressibility (*mv*) of above units x 10	1 x 10^{-5}/kPa	1 x 10^{-4}/kPa	
5	Increase Recharge x 2			
	Alluvium	1%	2%	-1150
	Tertiary Sediments	0.5%	1%	
North-South Section				
1	As above			340
2	As above			1600
3	As above			-560
4	As above			-780
5	As above			-740

* Change in the extent of the 5 m drawdown contour for the Project mining case at post-mining equilibrium. A positive value indicates an increase in the extent of drawdown, a negative value indicates a decrease in the extent of drawdown.

** Value changed by less than 10x original value, to the value of the Kh of this unit

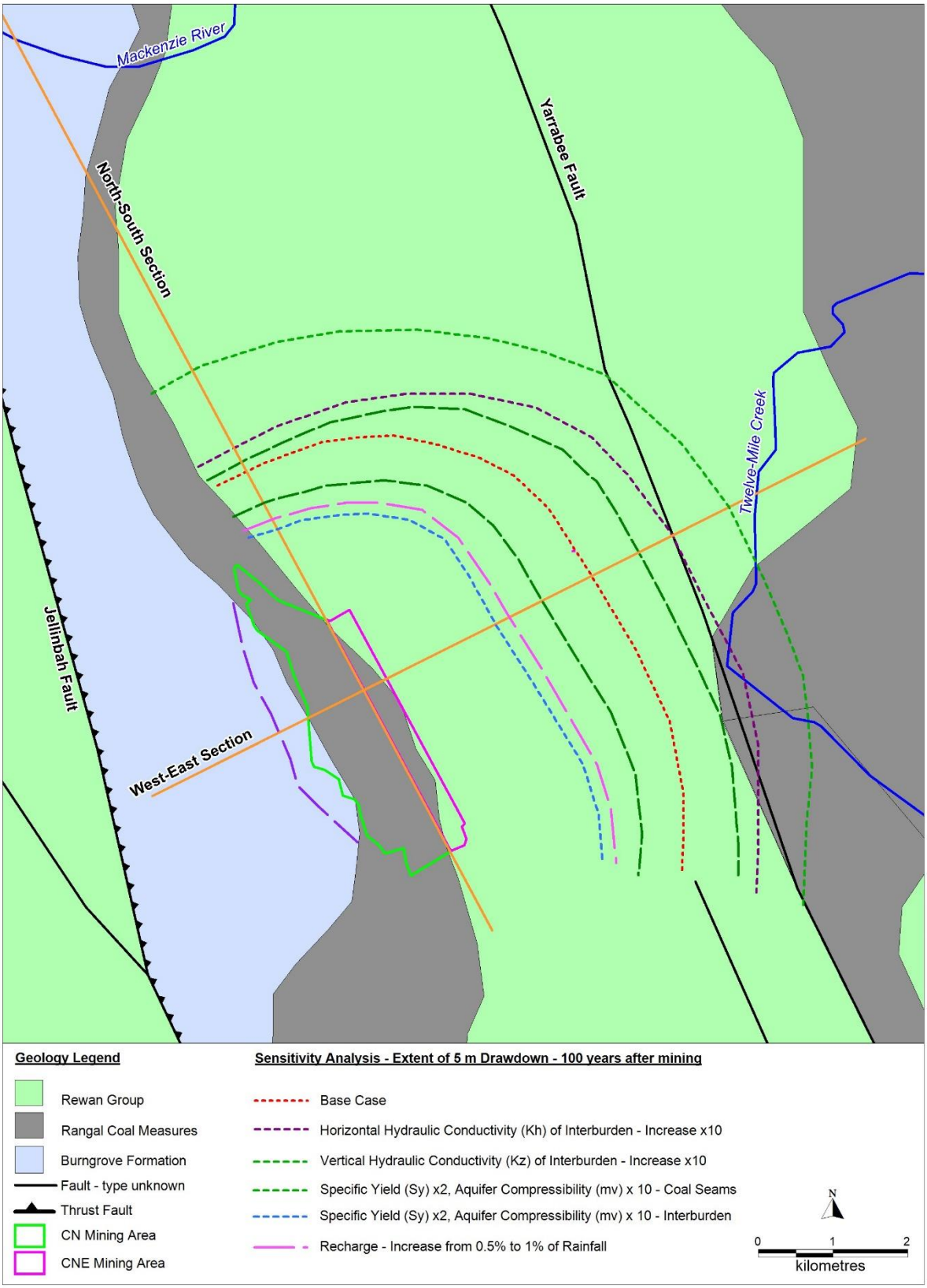

Figure 29 Results of Groundwater Model Sensitivity Analysis

7.5 IMPACT ASSESSMENT

The Significant Impact Criteria for the assessment of impacts to Groundwater are the same for surface water, as defined in *Significant impact guidelines 1.3: Coal seam gas and large coal mining developments – impacts on water resources* (DoE 2013b), which has been presented with detail in Section 6.4 above.

Potential impacts on groundwater resources are primarily associated with the risk of drawdown from existing aquifers and the associated impacts on dependant users such as bores supplying stock water or dependant vegetation.

Potential for groundwater quality impacts may include infiltration of process water, mine water or leachate to the groundwater from areas such as:

- Voids containing pit water or tailings;
- Spoil dumps and stockpiles; and
- Dams and ponds.

The potential for the Project to result in significant impact groundwater or dependant users is discussed in the following sections.

7.5.1 Impacts on Existing Agricultural Users

The most current version of the DNRME Groundwater Database (downloaded March 2019) was reviewed for the location of registered private groundwater bores. From the review, it has been determined that there are no existing registered groundwater bores in the area between the Jellinbah and Curragh/Curragh North mining lease areas (i.e., to the west of the Project) or in the area between the Jellinbah and Yarrabee mining lease areas (i.e., to the east to the Project). Therefore, it is concluded that there are no registered groundwater bores that will be impacted by the Project operation.

7.5.2 Impacts on Groundwater Level and Groundwater Quality

The IESC suggests installing new monitoring bores in case future groundwater level rebound occurs. Even though proposed mining at the Project extends to the eastern edge of the lease - it is not possible to drill monitoring bores to the east of the Project due to land ownership and access constraints. Likewise, the installation of monitoring bores to the north or south of the Project (i.e., within the Jellinbah lease boundaries) is not regarded as necessary as the bores could only be located within Permian sediments that are close to the mining operation, where drawdown from mining is a given.

Groundwater modelling predicts that a permanent cone of depression will develop that will direct groundwater flow towards the final void. End of mine closure studies for the Mine predict that post mining, voids will remain a groundwater sink. However, the Project could impact groundwater quality if the water within the final void were able to exit the void via unconsolidated sediments (i.e., the base of Tertiary) and flow via the groundwater system towards sensitive environmental receptors such as Twelve Mile Creek. An assessment of the potential for water within the final voids to exit the void via the base of Tertiary sediments was undertaken and is summarised as follows:

- The post-mining final void lake equilibrium level is assessed to be a maximum of 45.3 mAHD (Engeny 2019).
- In the area of the CNE the base of Tertiary is interpreted to be in the order of 120 mAHD, i.e., approximately 70-75 m higher than the final void water level.

It is therefore concluded that there is no possibility of outflow from the final void via the base of Tertiary and that there is a very low risk of the Project impacting the water quality of the surrounding groundwater system.

The proposed extension to the Central North final void will cause a minor increase in void equilibrium water level (~0.14m) and negligible change in water quality (i.e., salinity). Therefore, the risk of the project impacting on water quality (via the groundwater system) is judged to be very low.

7.5.3 Potential Environmental Impacts

Creeks to the west and east of the project area (Blackwater Creek and Twelve Mile Creek, respectively) are ephemeral, and available groundwater level data indicates that the regional water table is generally at or below the base of Tertiary. Therefore, it is judged that there is a low risk that the project will impact on baseflow contribution (i.e., groundwater contribution) to surface water resources, with a correspondingly low risk of impact on groundwater dependent ecosystems.

Quaternary alluvium exists to the north of the Project, associated with the Mackenzie River main channel and flood plains. Groundwater dependent ecosystems (GDEs) in association with the Mackenzie River to the north of the proposed Project are not considered to be at risk from any potential groundwater related impacts corresponding to the Project as the modelled drawdown contour is well south of the GDEs.

GDES are discussed further in Section 0.

8.0 GROUNDWATER DEPENDENT ECOSYSTEMS

Groundwater Dependent Ecosystems (GDEs) are ecosystems that rely on groundwater for some or all of their water requirements. Not all GDEs draw on groundwater directly, and not all are solely reliant on groundwater. However, in many cases, groundwater commonly provides an important and reliable source of water to many ecosystems. Australia has typically unreliable rainfall across much of the country, including central QLD, and the possibility of ecosystems to rely on groundwater is not remote.

Creeks within the project area (Blackwater Creek and Twelve Mile Creek, respectively) are highly ephemeral, and groundwater level data indicates that the regional water table is generally at or below the base of Tertiary. Groundwater modelling predicts very limited drawdown to the west as the coal seams crop out in this direction, and drawdown is limited by the low permeability of the interburden (non-coal) sediments. In addition, the Project is developed to the east of the already-approved CN operation. Therefore any additional drawdown will be to the east rather than to the west in the direction of the CN mine void. It is judged that there is a low risk that the project will impact on baseflow contribution (i.e., groundwater contribution) to surface water resources, with a correspondingly low risk of impact on groundwater dependent ecosystems (JBT 2019).

The GDE Atlas (BOM 2019) maps for the surrounding Project area show very few other potential GDEs. Potential GDEs in the vicinity of the Project are discussed below.

Remnant Vegetation on / adjacent to the Project (low potential terrestrial GDE)

The groundwater assessment of CNE (Section 7.0; Appendix D7) has established that groundwater levels are approximately 40 mbgl at shallowest (Figure 31 below) compared to a Tertiary thickness of approximately 15 mbgl. The vegetation within the project area is predominantly grassland. However, a small amount of wooded remnant vegetation exists and has been mapped as a low potential GDE. The dominant woody species within these communities capable of sending roots to depth are *Eucalyptus spp.* and *Corymbia spp.*, however, research on rooting depths has revealed that whilst several species are likely to root deeper than 10 m, this is limited up to approximately 20 m (Cannadell *et al.* 1996; O'Grady, Carter & Holland 2010; Hulme 2008). It is considered unlikely that any of these communities are currently accessing groundwater at minimum depths of 40 mbgl, nor be affected by any potential drawdown.

Twelve Mile Creek to the east of the Project (moderate potential aquatic GDE)

An assessment has been undertaken of the potential depth of groundwater beneath Twelve Mile Creek, which occurs to the east of the Project and which may contain GDE in accordance with the IESC advice. Figure 30 below shows available water level data in the CN and CNE area as well as interpreted water level elevation contours. Figure 31 shows the depth to groundwater data and interpretive contours, which were developed based on Figure 30. The depth to groundwater contours (Figure 31) shows an increase in depth to groundwater from approximately 40 mbgl in the CN/CNE area to approximately 60 mbgl in the area of Twelve Mile Creek. Therefore it can be interpreted that the groundwater below Twelve Mile Creek is disconnected from the base of the shallow alluvium and that at 60 mbgl it is beyond the depth that is accessible by vegetation.

Twelve Mile Creek also lies outside of the modelled 150 year – 5 m draw down contours (Figure 28), while Figure 32 below shows the location of potential aquatic and terrestrial GDEs from the BOM groundwater dependent ecosystem atlas, relative to the 5 m and 2 m drawdown predictions at post-mining equilibrium, for the CNE.

Based on the information presented, it is concluded that:

- Any remaining vegetation along Twelve Mile Creek is likely to be dependent on surface water flows and on water that may be periodically stored within the alluvium following recharge events;

- Mining at the Project will have no impact on groundwater levels within the alluvium as mining will only impact on water levels within the Permian sediments and the water level within Permian sediments at the location of Twelve Mile Creek is interpreted to significantly below ground level and below the base of alluvium (as any Quaternary alluvium within Twelve Mile Creek is interpreted to be thin and of limited extent).

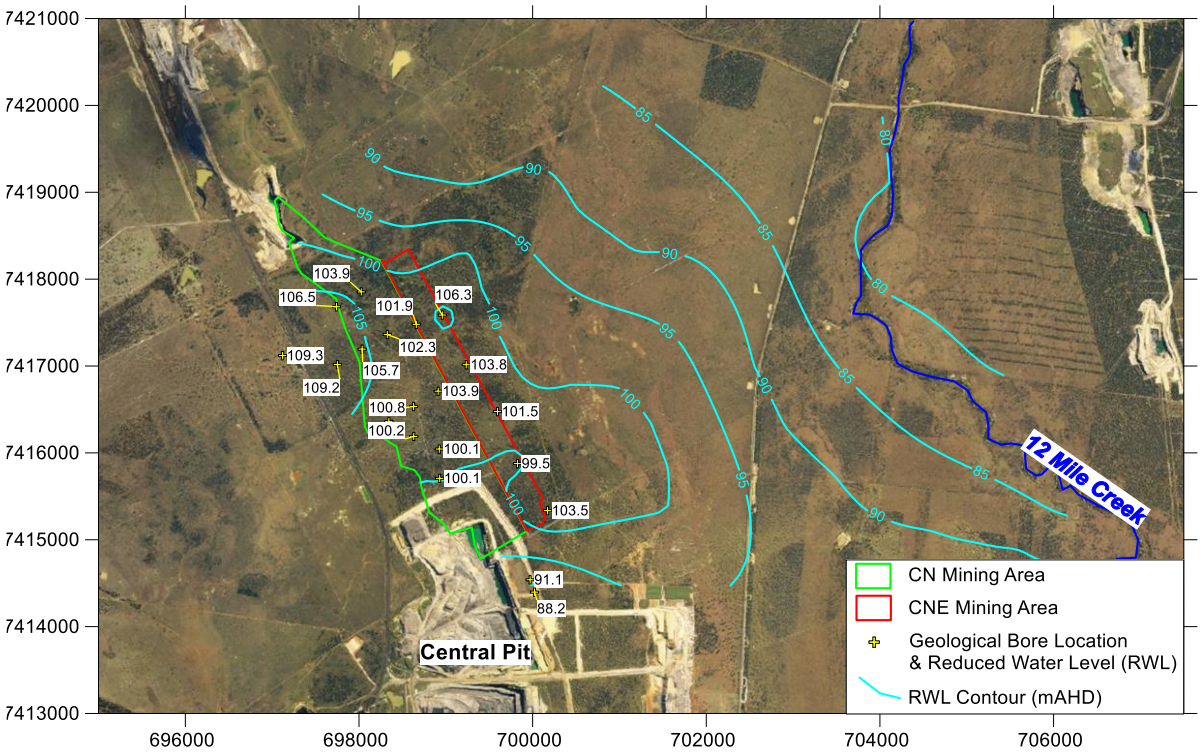

Figure 30 Groundwater Elevation Data and Interpretive Contours

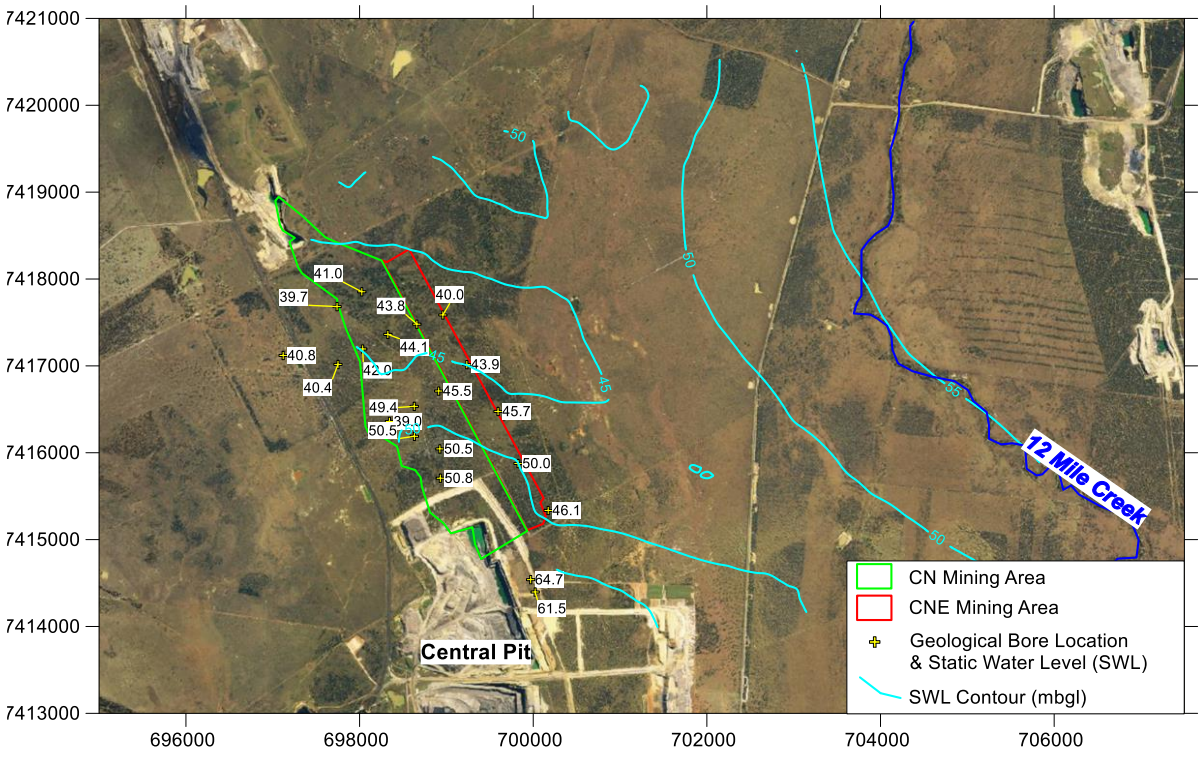

Figure 31 Depth to Groundwater Data and Interpretive Contours

Mackenzie River to the north of the Project

Quaternary alluvium exists to the north of the Project, associated with the Mackenzie River main channel and flood plains. It is noted that the 2 m drawdown contour from CNE operations at post-mining equilibrium is more than 4.5 km from the Mackenzie River and does not extend to the area of mapped Mackenzie River alluvium (Figure 32); therefore, any GDEs that are associated with the Mackenzie River to the north of the Project are not considered to be at risk from any potential groundwater related impacts corresponding to the Project.

Five Mile Lagoon located on the boundary of Jellinbah Plains / CNE MLs (moderate potential aquatic and high potential terrestrial GDE)

Five Mile Lagoon lies outside of the modelled 150 year – 5 m & 2 m draw down contours (Figure 32), and it is unlikely that the Project will impact any potential GDEs associated with Five Mile Lagoon. Adjacent to the Lagoon in the top north eastern corner of ML 700011 a small patch of vegetation mapped as a high potential terrestrial GDE. The field study assessed this area and was consequently mapped as non-remnant regrowth vegetation in the *Terrestrial Flora and Fauna Assessment* (Appendix A2). This patch also lies outside of the 150 year – 5 m & 2 m drawn down contours (Figure 32), and it is considered highly unlikely that the Project will impact potential GDEs associated with this non-remnant vegetation.

The narrow southward extension of Quaternary Alluvium located to the east of the Jellinbah Plains

The surface geology displayed in Figure 21 shows a small narrow southward extension of the Quaternary Alluvium into the Duaringa Formation to the east of Jellinbah Plains. Queensland Government vegetation mapping identifies no remnant vegetation in this area. This area also falls outside the predicted 5 m & 2 m drawdown contours (Figure 32). There is no known GDE in this area and the risk of impact from the Project is considered to be insignificant or nil.

In summary, it is not expected that the Project will impact on any GDEs within the vicinity of the Project.

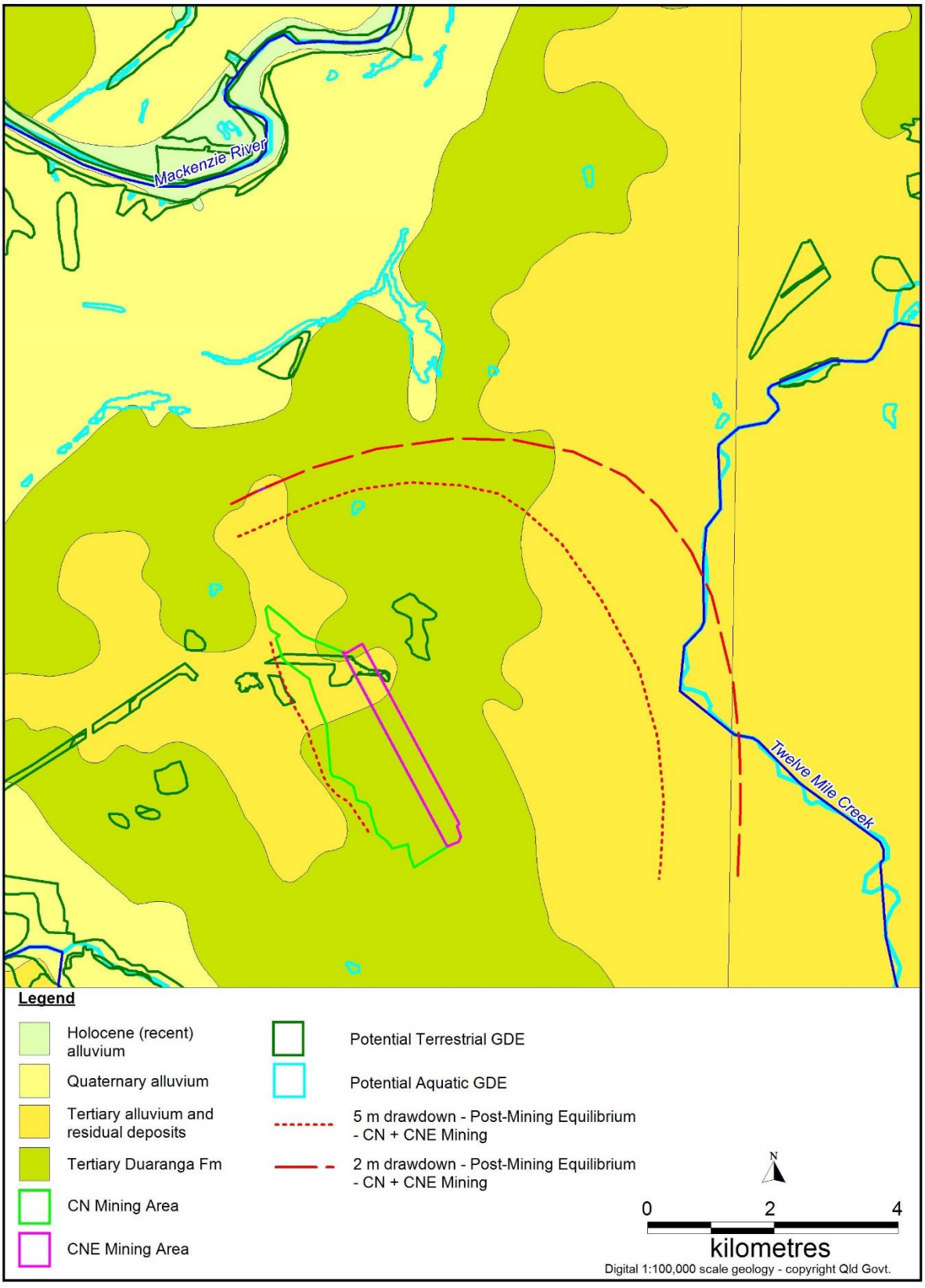

Figure 32 Location of Drawdown Contours with Respect to Potential GDE

9.0 CNE FINAL VOID HYDROLOGY STUDY

As described in Section 2.3.2 and the Jellinbah Rehabilitation and Void Investigation Report (Appendix C2, AARC 2018b), the final voids and landforms within the Mine, which include the Project were adequately assessed and approved previously by the DES. In addition, a Central North Pit Final Void Hydrology study was undertaken by Engeny (Appendix D5, Engeny 2019b) to further address the comments by the IESC relevant to the Project final voids.

9.1 WATER BALANCE MODELLING

Long-term water balance models were developed for Central and Central North void with and without the proposed extension using 129 years of historical climate data and final void surfaces provided. The post-closure water and salt balance of the Mine was simulated using the GoldSim software. The water balance model of the final voids utilises a daily time step and simulates rainfall, runoff, evaporation, groundwater ingress, overflows (where applicable), and the long-term void lake water quality changes as a result of these flows. Further details of the model input data, specifications and assumptions are presented in Appendix D5 (Engeny 2019b).

9.2 SURFACE WATER HYDROLOGY ASSESSMENT RESULTS

The forecast void lake levels and salinities for final voids with the Project are presented in Figure 33 and Figure 34 respectively. Table 32 below summarises the Central North and the Central final void water balance results. The overall findings suggest that no final voids pose an overtopping risk; all final void equilibrium volumes are under 25% total void capacity. All the final voids are expected to act as 'sinks' and will not contribute to sustained baseflow recharge.

Table 32 Final Void Lake Modelling Results Summary

Final Void	Catchment Scenario	Bottom of Pit (m AHD)	Void Spill Elevation (m AHD)	Time to Equilibrium (years)	Void Equilibrium Water Level (m AHD)	Max Level post-equilibrium (m AHD)	Void Equilibrium Lake Area (ha)	Equilibrium Volume (GL, % of total volume)	Void EC after 100 years	Void EC after 400 years
Central-North[1]	Without CNE	-7.1	140[3]	30	45.3[3]	45.3	16.0	3.2	18,280	25,430
	With CNE			30	45.3[3]	45.3	21.3	4.1	19,900	28,730
Central[2]	Without CNE	-60.2	140	90	2.68	10.09	69.5	22.3	26,690	106,790
	With CNE			90	2.68	10.15	69.6	22.4	26,410	106,920

Note: 1. No seepage to Central assumed (results in largest area and volume).
2. Seepage from Central-North included (results in largest area and volume).
3. Spills to Central first at 45.3 m AHD. Both voids would then overflow to the environment at 140 m AHD.

The results indicate that the proposed extension to the Central North final void will cause a small increase in void equilibrium water level (~0.14m) and negligible change in water quality (i.e., salinity). However, the salinity of the final voids will continue to slowly increase over time due to the ongoing concentration from evaporation without significant freshwater inflows flushing from rainfall runoff. Void lake quality is expected to worsen over time for all scenarios as a result of evapo-concentration as there are no solute outflows from the voids. All final voids become hypersaline salt lakes within the first 100 years. Further closure advice that considers final void water quality under future climatic conditions is discussed in Section 9.2.1 below.

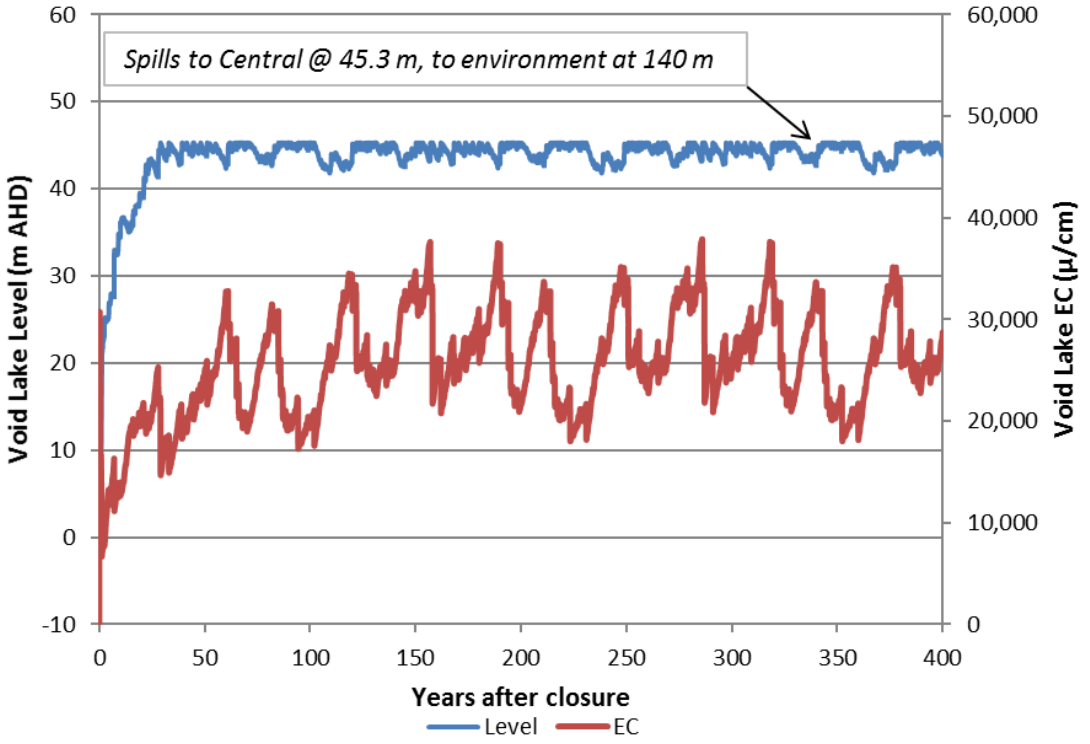

Figure 33 **Model predicted void lake level and EC - Central North Final Void with Extension**

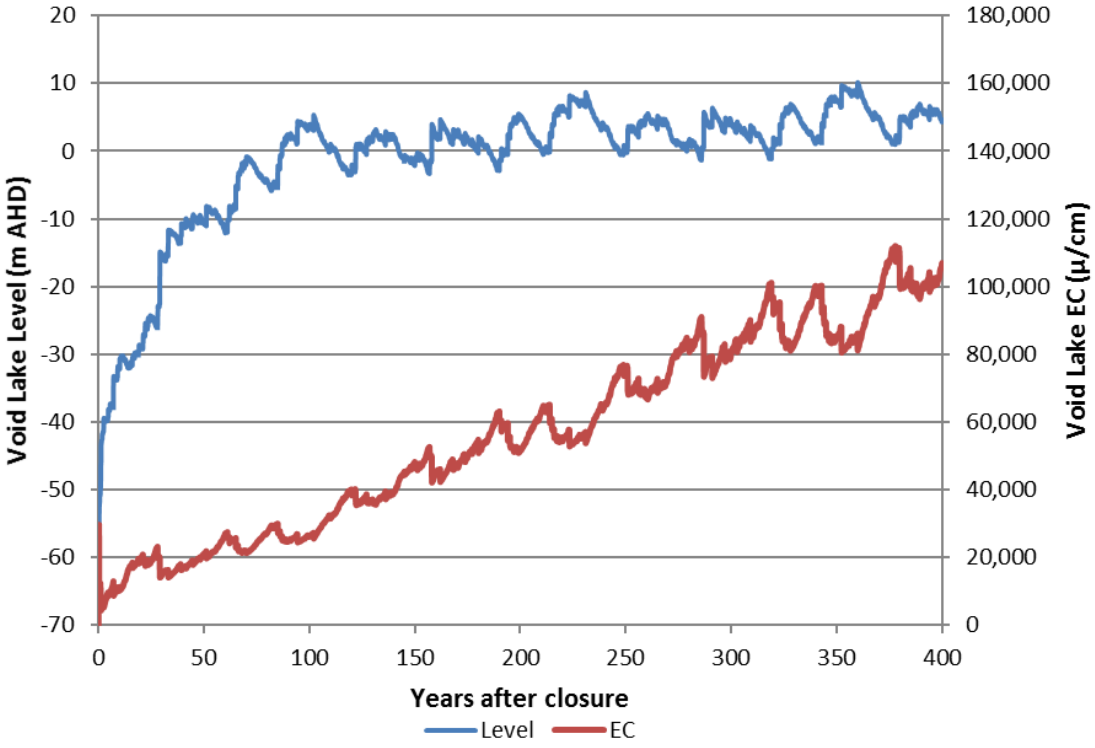

Figure 34 **Model predicted void lake level and EC - Central Final Void with Extension**

9.2.1 Climate Change Sensitivity Analysis

The final voids water level and salinity change were also assessed under future climate change scenario (2090 project year) as suggested by the IESC (refer Appendix D5 for more details). The climate change sensitivity assessment results are shown in Figure 35 (for water level) and Figure 36 (for salinity, i.e. EC). The climate change sensitivity assessment indicates that in all scenarios, the final void water level was significantly below the spill level to the environment (i.e., 140 m AHD). The “Maximum Consensus” climate projection shows a reduction in the final void water level from 10 m AHD to -16 mAHD. This shows the majority of the climate model projections of future climate variables will produce a reduction to the estimated final void water level.

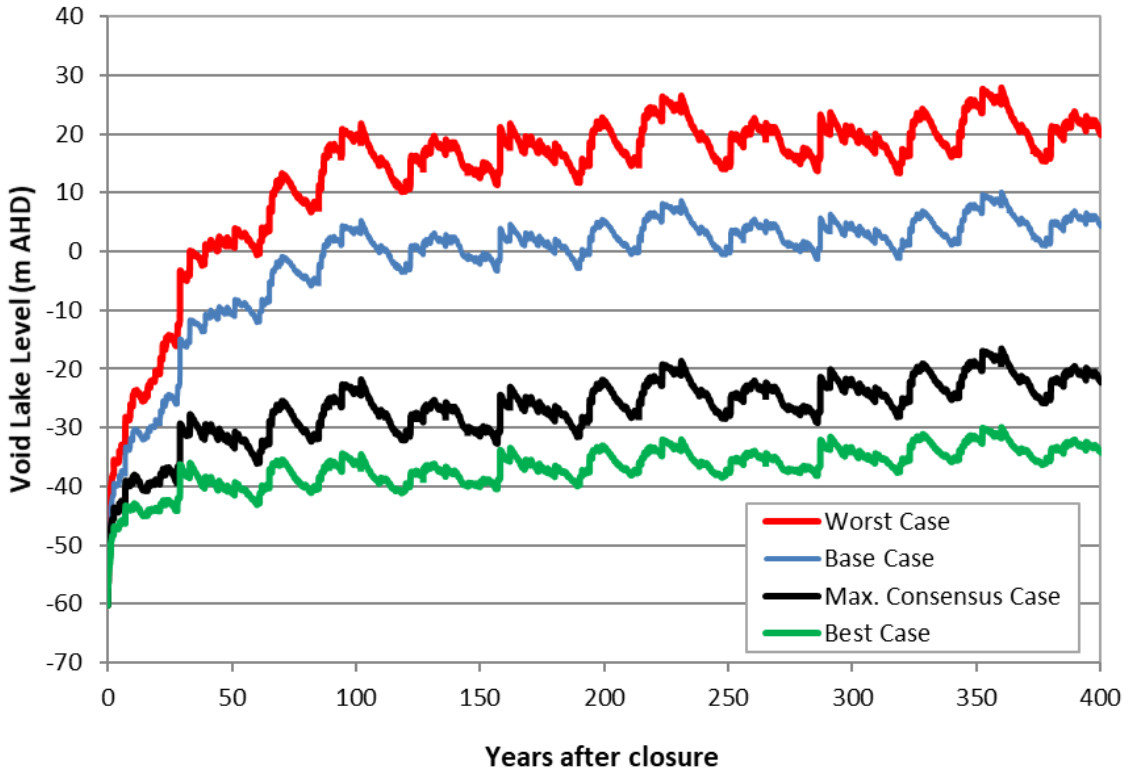

Figure 35 Final Void Level Climate Change Sensitivity Assessment Results

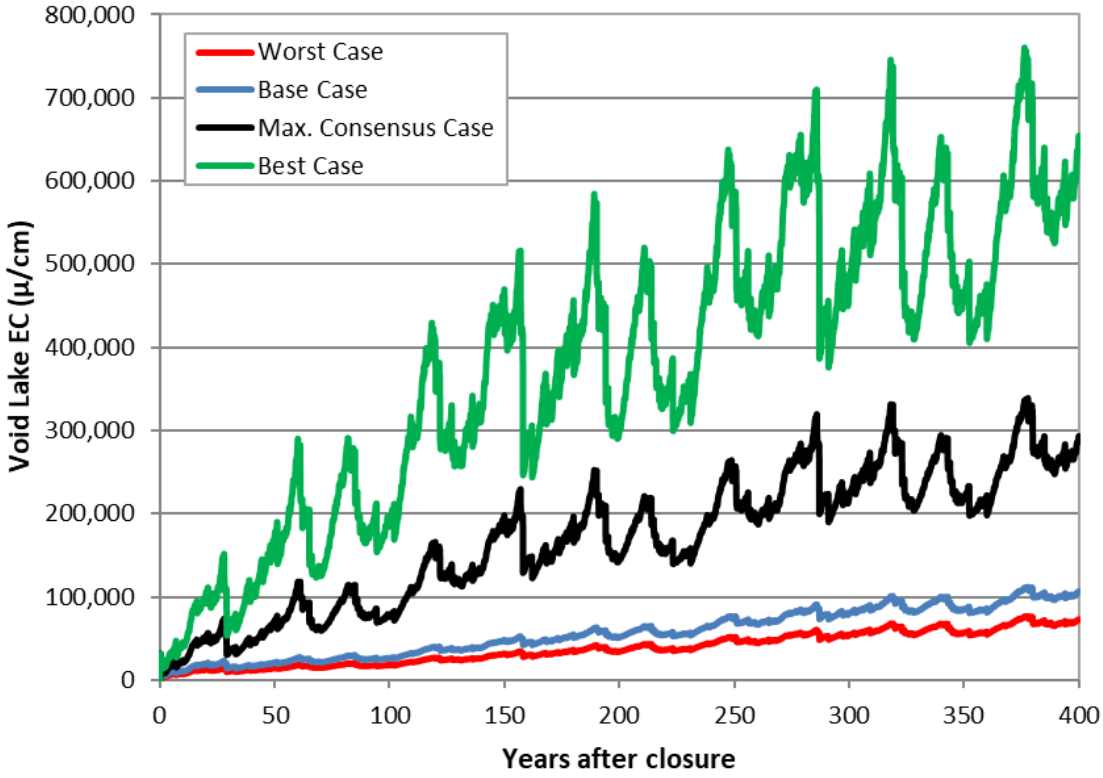

Figure 36 Final Void Salinity (EC) Climate Change Sensitivity Assessment

9.3 POTENTIAL IMPACTS

Groundwater modelling (Section 7.0) predicts that a permanent cone of depression will develop that will direct groundwater flow towards the final void. End of mine closure studies for the Jellinbah Coal Mine predict that post mining, voids will remain a groundwater sink. However, the Project could impact groundwater quality if the water within the final void were able to exit the void via unconsolidated sediments (i.e., the base of Tertiary) and flow via the groundwater system towards sensitive environmental receptors.

Final void modelling predicts that there is no possibility of overflow or outflow from the final void via the base of Tertiary. As a result, there is a very low risk of the Project impacting the water quality of the surrounding groundwater system.

10.0 CUMULATIVE IMPACTS

10.1 SURFACE WATER & RECEIVING ENVIRONMENT

The assessment of the surface water impacts in Section 6.0 outlines that surface water impacts likely to occur as a result of CNE development will be insignificant. In fact the water inventory is expected to reduce as a result of the CNE Project. On this basis the need to release mine affected water will also reduce.

Surface water from the Project will be managed through a WMP (Engeny 2019a; Appendix C6), and the Project is not expected to contribute to additional cumulative surface water impacts significantly. The existing management strategies will continue to apply for the Project. Cumulative impacts to surface water values will continue to be assessed and managed via the Jellinah REMP and associated TARP.

During a release event, cumulative impacts on the receiving environment will be managed using the real-time monitoring gauges installed on the Mackenzie River upstream and downstream of the Jellinbah Mine and in Blackwater Creek. These gauges enable the mine to identify when stream water quality or flow rates are nearing compliance limits within the receiving environment, at which point the release can be immediately ceased before they are exceeded. Protection of water values in the receiving environment will inherently provide protection of aquatic and riparian ecological values.

Jellinbah's release conditions also provide DES with authority to issue a cease release order at any time during a release event based on water quality at downstream gauging stations. This provides a failsafe strategy to ensure cumulative impacts in the receiving environment are managed appropriately, and no environmental harm will occur as a result.

10.2 GROUNDWATER

Cumulative impact assessments are highly specific to the impact under analysis and may consider, for example, the following (Franks et al. 2010):

- Multiple areas of groundwater abstraction (e.g., adjacent mining operations);
- Overlapping cones of drawdown;
- Dewatering discharge locations;
- Distribution of ecosystems around the Project area; and,
- Catchment-scale groundwater levels.

Existing projects that may combine with the Central North Extension to impact groundwater resources have been identified from the following sources:

- The Queensland Coordinated Projects Map (DSDIP 2014);
- Queensland's Mineral, Petroleum and Energy Operations and Resources map (State of Queensland 2012); and
- Publicly available documentation (e.g., EIS documents that exist within the public domain).

Based on the review of the above documentation, it is concluded that the projects with the potential to contribute to cumulative groundwater impacts include:

- The existing Jellinbah Central operation that occurs immediately to the south of the Project;
- The approved but as-yet unmined Central North (CN) operation, of which the Project will be an extension;
- The existing Jellinbah Plains operation, which occurs to the north of the CN and CNE operations;
- The existing Curragh Central and Curragh North projects, which occur approximately 5 km west of the Project; and
- The existing Yarrabee Coal Mine, which is located approximately 6 km to the east of the Project.

As the Project is to be developed in the middle of existing Jellinbah mine operations, it is taken as a given that the drawdown from the Project will coalesce with the drawdown from existing Jellinbah operations to the north and south. The Project area is located between the existing Jellinbah Central and Jellinbah Plains pits, which are approximately 4 km apart at the closest points. Additionally, mining activities in the CN will extend to the boundary with CNE (and continue into ML700011 if approved). Groundwater drawdown due to mining extends for a distance of 1.5 to 2.0 km from the pits, so it is likely that groundwater levels in the region of the Project have already been impacted to some degree by cumulative impacts from both the Jellinbah Central pit and Jellinbah Plains pit and may be further impacted by mining in CN. Mining of the Project area will, therefore, occur within a region where groundwater levels are assessed to be impacted by existing mining operations.

On the eastern (high wall) side of the mining area, the 5 m extent of drawdown is approximately 3,500 m from the pit crest at 150 years post-mining for the CN operation only. With the Project operation included, the extent of 5 m drawdown extends to approximately 3,750 m from the pit crest (at 150 years post-mining), representing an increase of 250 m relative to the CN mining only case. The Project operation extends mining by approximately 360 m to the east and extends the depth of mining from approximately 125 mbgl to 150 mbgl. The combined drawdown extent is expected to reach approximately halfway across the distance between the Jellinbah complex and the Yarrabee Mine to the east. On the western (low wall) side of the mining area, the 5 m extent of drawdown does not extend appreciably (by less than 100m) due to mining.

Based on searches undertaken for this study, it is concluded that there is no information in the public domain on the extent of groundwater level drawdown due to the adjacent Curragh/Curragh North and Yarrabee operations; therefore, it is only possible to discuss the potential for cumulative impacts in general terms.

In Section 7.4 (model results) it is noted that the predicted extent of the 5 m drawdown contour at the end of mining extends approximately 3,750 m to the east of the Project at 150 years post-mining and by less than 100 m to the west (for base-case hydraulic parameters). The depth of mining at operations to the west of the project (Curragh/Curragh North) and east of the project (Yarrabee) is unknown; however, given the distance of these existing mining projects from the Project it is concluded that:

- Cumulative impacts to the west of the Project are judged to be unlikely due to the relatively limited drawdown that is predicted to the west of the Project (less than 100 m) and the fact that the Curragh/Curragh North operation is located approximately 5 km away. In any case, drawdown to the west from the Project will be limited by the presence of the CN operation immediately to the west; and

- There is potential for cumulative impacts between the Project and the Yarrabee mining area to the east. This is based on the observation that the extent of 5 m drawdown from the Project is approximately 3,750 m and that the Yarrabee operation occurs approximately 6 km to the east. Therefore, there is potential for the cones of depression from these two operations to coalesce.

It is also noted that there are no existing registered groundwater bores or impacted GDE's (see Section 0) in the area between the Project and Yarrabee operations; therefore, the potential for negative environmental impacts is assessed to be low.

11.0 MITIGATION AND MANAGEMENT COMMITMENTS

11.1 LISTED THREATENED SPECIES

No listed threated species were identified on the Project and the significant impact assessment resulted in no significant impacts identified. The Project is considered unlikely to have significant impacts on any listed threated species as per the criteria set out in the *MNES: Significant Impact Guidelines 1.1* (DoEE 2013e). However, Jellinbah commits to implement the following strategies as part of a commitment to best practice management:

- The clearing footprint will be minimised by limiting disturbance to only those areas required for mining and associated activities;
- Clearing will be conducted in a staged manner to enable fauna to safely move out of the disturbance area to adjacent habitat;
- Disturbed areas will be progressively rehabilitated to minimise the area of land subject to a disturbance at any one time;
- Vehicle speeds will be restricted to minimise the risk of collisions with fauna;
- The staff training and awareness program will incorporate a segment for the identification of key environmental values of the site and provide procedures for environmental protection and incident response;
- Pest species will be monitored and actively controlled in an appropriate manner to protect ecological values; and
- Weed species will also be monitored to determine abundance and identify the presence of any new species and weed controls will be implemented as required to protect ecological values.

Environmental outcomes associated with these mitigation strategies include:

- Minimisation of incidental fauna fatalities;
- Control of erosion processes to ensure landform stability;
- Minimisation of impact to fauna and flora habitat; and
- Control of pest species, reducing competition for native species and impact to their habitat.

11.1.1 Staff Training

Mine site staff inductions will include training and awareness to ensure vehicle speeds are limited to minimise collisions with fauna. Further education will incorporate the identification of key environmental values of the site and provide procedures for environmental protection and appropriate incident responses.

11.1.2 Pest & Weed Monitoring

The presence of pest and weed species will be monitored in a monthly schedule and incidental sightings with appropriate procedures in place for the control of the invasive species in accordance with the *Weed*

and Pest Management Plan (AARC 2018d). This plan will be updated following approval to include the Project and applied in concert with the threat abatement plans listed below.

11.1.3 Threat Abatement Plans

Threat Abatement Plans provide the structure for the reduction of impacts from a list of invasive species. The management of the Project will take into consideration the relevant plans to reduce potential impacts that pests will cause or exacerbate for the life of the mine and its rehabilitation. The plans to be considered for the Project include:

- *Threat abatement plan for competition and land degradation by rabbits* (DoEE 2016d);
- *Threat abatement plan for predation by European red fox* (DoEE 2008m);
- *Threat abatement plan for predation by feral cats* (DoEE 2015d);
- *Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs (Sus scrofa)* (DoEE 2017); and
- *Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads* (DoEE 2011e).

The Department of Agriculture and Fisheries profiles were consulted for pest species identified on site in developing the *Weed and Pest Management Plan* (AARC 2018d). The relevant Threat Abatement Plans will be included as a post approval, pre-development update to the *Weed and Pest Management Plan* to ensure that control procedures are in line with Commonwealth specifications. The Project will be managed within this plan in addition to the existing Mine already managed under this Management Plan.

11.2 LISTED THREATENED ECOLOGICAL COMMUNITIES

Brigalow dominant woodland is present on the Project, covering an area of 14.65 ha. Listed as a TEC, the integrity of this community within the Project area is highly compromised and presents little ecological value due to small patch sizes, historical and ongoing disturbance, and the highly fragmented context of the surrounding landscape. This community is surrounded by cleared pasture lands, and the previous clearing in the immediate vicinity of each patch has resulted in this community being subjected to edge effects and weed invasion. This community is also subject to low to moderate intensity cattle grazing, further enabling the introduction and spread of invasive species. The ground layer has been modified by the invasion of Buffel Grass and Sabi Grass, while exotic cacti are present throughout the ground and shrub layers.

Owing to the small, disturbed, and fragmented nature of the community, it offers limited ecological function at the regional, state, or national level. Ongoing protection of the two sites, therefore, provides little conservation value to the recovery of Brigalow TEC, as without active management, the sites will continue to degrade due to ongoing impacts related to edge effects and cattle access.

The community present on the Project represents 0.02% of the 2017 remnant extent of RE 11.4.8. There is 12 REs in the QLD Brigalow Belt that are associated as Brigalow TEC, totalling a 2017 remnant extent of 565,300 ha. The compromised 14.65 ha of RE 11.4.8 on the site, represents 0.0026% of the 2017 remnant extent of Brigalow TEC in the QLD Brigalow Belt Bioregion.

Given the extent of the impact and the ecological values of the proposed impact area, the Project is not expected to impose a significant impact on this TEC. Furthermore, the proponent has been conditioned

to provide environmental offsets for this vegetation under the state policy, as described in the following section.

11.2.1 State Offsets

Clearance of the 14.65 ha of RE 11.4.8 has been authorised by DES under Jellinbah's current EA (EPML00516813), with the area subject to environmental offset conditions under the EO Act for an endangered RE (Vegetation Management Class). Jellinbah recognises its obligation to deliver suitable offsets prior to commencing any disturbance at the Project, in a manner agreed upon with State administrative authorities. The State relevant *Environmental Offsets Strategy* (AARC 2015) is provided in Appendix A2.

Jellinbah are committed to providing suitable offset commitments that provide tangible *conservation outcomes* in accordance with the *QLD Environmental Offsets Policy* (QEOP). The QEOP outlines offset delivery options of:

- Land-based Offset;
- Direct Benefit Management Plan (up to 10% of the offset delivery); and
- Financial Settlement Offset.

For land-based offsets, the QEOP sets multipliers for prescribed environmental matters, with a maximum multiplier of four. 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 offset area is calculated by multiplying the area of impact by the prescribed multiplier:

Offset Area = Area of Impact x Multiplier

For the purposes of the *Environmental Offsets Strategy* (AARC 2015), the maximum multiplier of four was used, resulting in 58.6 ha of total offset supply area protected to offset the impact to 14.65 ha of RE 11.4.8 (i.e., Brigalow TEC).

Even with the maximum multiplier applied, the offset supply area required under the QEOP is of a size that will constitute a minimal beneficial *conservation outcome*. Under the QEOP and the EO Act; *conservation outcome* is defined as:

A conservation outcome is achieved by an environmental offset for a prescribed activity for a prescribed environmental matter if the offset is selected, designed and managed to maintain the viability of the matter.

A land-based offset supply area of 58.6 ha is considered unlikely to maintain the viability of RE 11.4.8 (i.e., Brigalow TEC), and consequently, a financial settlement offset is considered by Jellinbah to represent an offset delivery of a greater benefit to the prescribed environmental matter.

The *QEOP Financial Settlement Offset Calculator* was utilised to generate an alternative offset delivery option of $332,262 (Appendix G1). This offset delivery option is expected to provide a superior *conservation outcome* than a stand-alone land-based offset of 58.6 ha. A financial settlement can be utilised by the State to target critical areas of conservation value, combined with other offset supply areas that might provide strategic functional outcomes such as improved habitat connectivity.

11.2.2 Commonwealth Offsets

Where impacts to listed species and communities under the EPBC Act have been assessed and found to be significant, an offset is normally provided under the *EPBC Act Environmental Offsets Policy*. The assessment of impacts for the Project determined that the Project was not likely to result in a significant impact on any threatened species or communities (Section 5.0).

Furthermore, the commitment in place under the State offset policy includes an offset for impacts to the same 14.65 ha area of Brigalow vegetation that was identified as a controlling provision for the Project. Any additional offset imposed for this area of land will be overlapping and unwarranted.

11.2.2.1 EPBC Act Environmental Offsets Policy

The *EPBC Act Environmental Offsets Policy* provides for offsets that improve or maintain the viability of the aspect of the environment that is protected by national environment law affected by the proposed action. The policy utilises an *Offsets Assessment Guide* (i.e., calculator/balance sheet) to give effect to the requirements of the *EPBC Act Environmental Offsets Policy.*

The offset principles for the *EPBC Act Environmental Offsets Policy* require that suitable offsets must:

- Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action;
- Be built around direct offsets but may include other compensatory measures;
- Be in proportion to the level of statutory protection that applies to the protected matter;
- Effectively account for and manage the risks of the offset not succeeding;
- Be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of State or Territory offsets that may be suitable as offsets under the EPBC Act for the same action;
- Be efficient, effective, timely, transparent, scientifically robust and reasonable;
- Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced;
- Be informed by scientifically robust information and incorporate the precautionary principle in the absence of scientific certainty; and
- Be conducted in a consistent and transparent manner.

The principles of the *EPBC Act Environmental Offsets Policy* are consistent with those of the State offset policy. However, the State offset policy provides an additional mechanism for payment to a government fund for the purpose of coordinating strategic offsets managed by the State. For the purpose of the Project impacts, this outcome is expected to provide a greater benefit to the environment and an improved conservation gain than an alternate offset delivered under the EPBC Act.

For the purposes of comparison only, the Commonwealth *Offsets Assessment Guide* (for determining offsets under the EPBC Act) was completed for the Project using data from the *Terrestrial Flora and Fauna Assessment* (AARC 2017a). Based on the ecological assessment completed for the Project, the Brigalow TEC was located on site in two patches totalling 14.65 ha. The habitat quality of the TEC was

determined based on field survey site assessment (detailed in Appendix G2) and entered into the *Offsets Assessment Guide* along with expected timelines and land quality improvements of offset areas. The calculated offset required for 100% of the impact was 18.57 ha (Appendix G2). This represents a supply ratio significantly less than the 4:1 ratio provided for under the State offset policy. As such, it was concluded that provision of environmental offsets under the EPBC Act does not represent the best environmental outcome and that the existing commitment to offset under State more than satisfies the required outcomes.

11.3 WATER RESOURCES

11.3.1 Surface Water

Surface water impacts and the potential for downstream contamination are managed through the Mine WMP (Engeny 2019a; Appendix C6). Catchments of differing water quality are separated to prevent uncontrolled discharge of potentially contaminated water into the receiving environment. Based on current site experience and monitoring data, the implementation of the WMP is considered adequate to mitigate the potential for adverse impacts to downstream water quality. The WMP will ensure the Project maintains compliance with EA conditions pertaining to release and receiving water quality, which will support regional WQOs. No significant impact on surface water quality is anticipated.

The site water monitoring, release monitoring and receiving environment monitoring programs for water quality and other environmental values associated with surface water, where applicable, will be undertaken for the Mine (including CNE) in accordance with the WMP and EA conditions outlined in Schedule C (Appendix A1). Jellinbah currently monitors water quality in storages on a quarterly basis (section 6.1.3). Additionally, Jellinbah also undertakes dedicated monitoring (upstream and downstream) during release events to ensure compliance with limits and trigger levels listed in the EA and to assess the potential for impacts to downstream environmental values. Receiving environment water quality is also monitored annually as part of Jellinbah's Receiving Environment Monitoring Program (REMP) (See Section 11.3.1.1 below).

Through the ongoing implementation of the SWMP, Jellinbah will ensure that water quality, water access, and the physical, chemical, and biological characteristics of the adjacent streams are not degraded by operations at the Project.

In addition, the Mine operates in accordance with a number of management plans which assist in preventing environmental harm. These management plans include:

- The *Chemical and Fuel Management Plan* (AARC 2018a; Appendix C4), which documents the procedures for preventing and cleaning up spills of contaminants. Control strategies assisting in the protection of downstream environmental values include:
    - Bunding of chemical and fuel storage areas in accordance with *Australian Standard (AS) 1940 The Storage and Handling of Flammable and Combustible Liquids* (Standards Australia 2017); and
    - Implementation of spill containment and notification procedures;
- The *Erosion and Sediment Control* Plan (AARC 2019; Appendix C5), which provides for the prevention and control of potential erosion at the Mine, preventing sedimentation of surface water. Control strategies and structures in place which assist in the protection of downstream environmental values include:

- Diversion drains and banks to divert clean runoff into sediment detention basins before release to natural streams in the receiving environment;
- Sediment fences to slow the flow of water and catch sediments in erosion susceptible locations; and
- Sediment control dams to intercept runoff and allow sediments in runoff to settle out before release to the receiving environment or recycling.

These management plans will be updated to reflect the addition of the approved CNE prior to development in this area.

11.3.1.1 Receiving Environment Monitoring Program (REMP)

A REMP is currently implemented at Jellinbah and includes annual monitoring of surface water, stream sediments, and macro-invertebrates, at both upstream (reference) and downstream (impact) sites. The locations of these receiving water monitoring sites are provided below in Table 33 and shown in Figure 37 (Mackenzie River) and Figure 38 (Blackwater Creek). The REMP aims to quantify the potential impacts of the Jellinbah Mine on the receiving environment. The locations of the currently authorised release points are also depicted in Figure 37 and Figure 38.

There will be no new release points as part of the Project, and the Project will not result in any substantial change to water quality or management, and no significant change to the release risk profile is proposed. Therefore, no additional monitoring points and baseline data are required, and no changes will be made to the current REMP design, meaning the existing WQOs and EA conditions are suitable for the Project.

A brief overview of the current Jellinbah REMP methodology is outlined below:

For surface water, all samples are collected from each monitoring location (provided that water is present at the time) and are analysed by a National Association of Testing Authorities (NATA) accredited laboratory. Macro-invertebrates are invertebrates that can be seen with the naked eye. The monitoring of macro-invertebrates at the Project is undertaken in accordance with the AusRivas methodology, and samples are taken at each site where water is present.

The macro-invertebrate samples are analysed by a NATA accredited laboratory for identification to family or sub-family level. Data are interpreted based on a Stream Invertebrate Grade Number – Average Level (SIGNAL) to indicate the health of the waterbody. The SIGNAL Index was developed by the National River Health Program as a tool for the bio-assessment of water pollution and considers the taxonomic composition of the invertebrate assemblage to determine river health. Each macro-invertebrate is given a grade number between one and ten based on their sensitivity to various pollutants (Chessman 2003), with a lower number indicating a higher tolerance to a range of conditions. The SIGNAL Index value is calculated by averaging the pollution sensitivity grade numbers of the families present at each site. Refer to Chessman (2003) for families excluded from SIGNAL scoring results. Macro-invertebrate data is analysed to determine total abundance, taxonomic richness, SIGNAL index, the proportion of tolerant taxa, and the richness of *Plecoptera*, *Ephemoptera,* and *Trichoptera* (PET) taxa.

For stream sediment monitoring, samples are taken at each of the sites outlined in Table 33 in accordance with the most recent version of *AS5667.1 Guidance on Sampling of Bottom Sediments*. Samples are sent to a NATA accredited laboratory for analysis of trace metals. The results from the downstream sites are compared with the results from the upstream sites along with the trigger levels set out in the EA (Table 34 and Table 35).

In accordance with condition C23 of the EA, a REMP Findings Report is prepared on an annual basis. Assessment of water quality, stream sediment, and macro-invertebrate data are prepared in accordance with relevant guidelines, including the *Queensland Monitoring and Sampling Manual 2009* (EHP 2010) and ANZECC (2000).

Results from the REMP (2014 – 2018), including Blackwater Creek, Mackenzie River, Five Mile Lagoon, and Three Mile Lagoon, are shown in Section 6.1.2 and Appendix D4, and these results provide a snapshot of the local receiving environment.

Table 33 Receiving Water Monitoring Locations

Monitoring Points*	Receiving Waters Location Description*	Easting (MGA GDA94 Zone 55)	Northing (MGA GDA94, Zone 55)
Upstream Background Monitoring Points			
MP2	Blackwater Creek 1360 m upstream of RP2	695630	7410000
MP4	Upstream Mackenzie River	694535	7426000
Three Mile Lagoon (US3) (extra point)	Upstream Three Mile Lagoon	694443	7423876
Downstream Monitoring Points			
MP1	Blackwater Creek 1500 m downstream of RP1	694760	7413420
MP3	Downstream Mackenzie River	696930	7425950
Five Mile Lagoon (DS5) (extra point)	Downstream Five Mile Lagoon	696694	7423071
MP5	Downstream Mackenzie River (as required when operations commence)	697450	7428244

*MP = Monitoring Point, US = Upstream, DS – Downstream, RP = Release Point

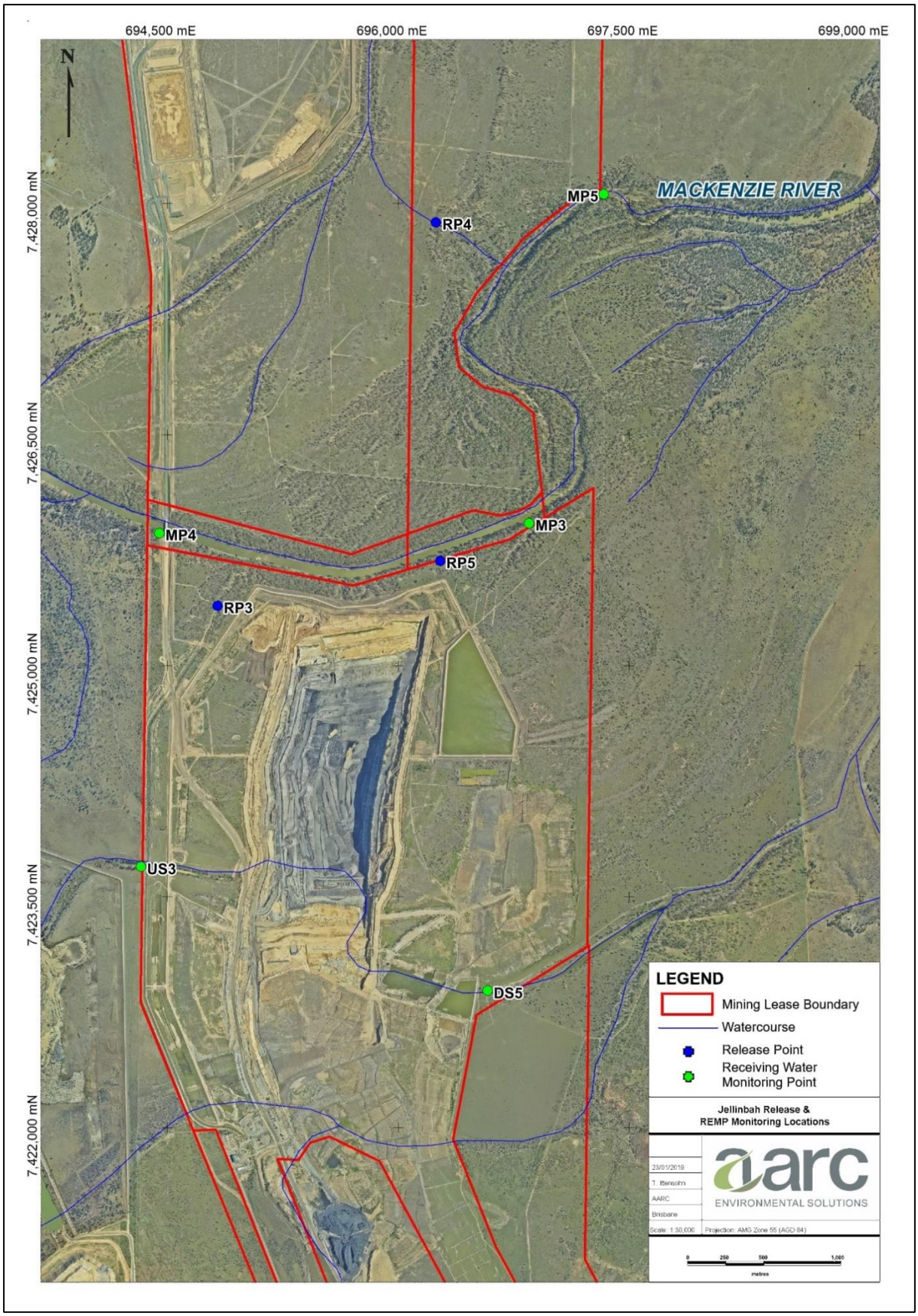

Figure 37 **Release Points and Receiving Environment Monitoring Points – Mackenzie River**

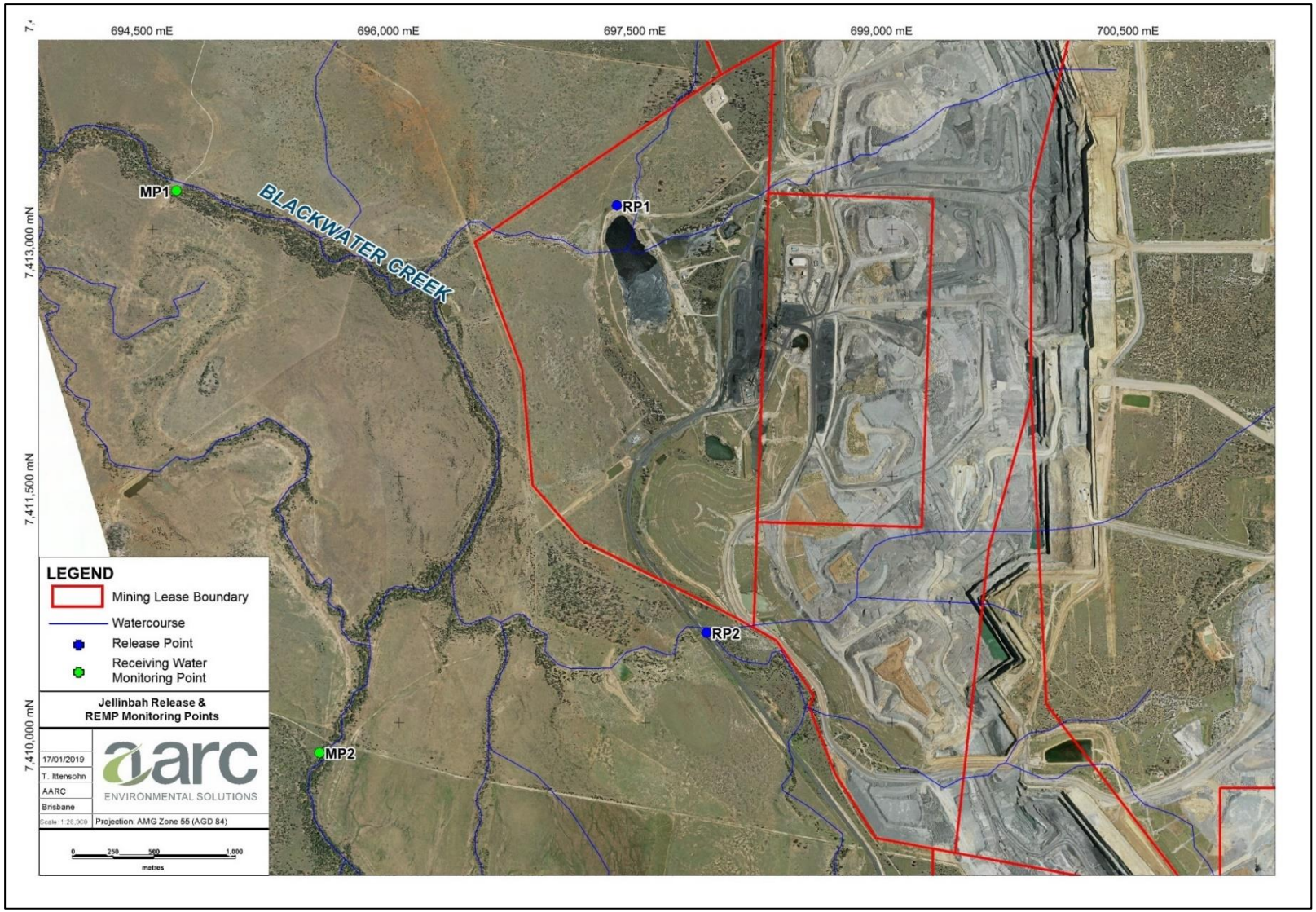

Figure 38 Release Points and Receiving Environment Monitoring Points – Blackwater Creek

The Trigger Action Response Plans (TARPs) developed for the REMP outlines actions and measures to take in the event that downstream (impact site) water quality results collected as part of the REMP exceed any of the EA trigger levels outlined in the Jellinbah Coal Mine REMP Design Report (AARC 2019b; Appendix D3).

11.3.1.2 Release Controls

Water Release Procedure for Jellinbah Mine Site has been implemented (AARC 2019b). The same procedure and relevant TARPs also apply to the Project. The procedure refers to the release of water from Jellinbah's mine-affected water system, and include the following events which should be managed in accordance with the release procedure:

- Pumping from any water storage on the Jellinbah Mine to a designated release point for release to Blackwater Creek or the Mackenzie River; and
- Runoff from the mine-affected system leaving the site through Max Dam Bypass, South Dam Bypass, or Plains Bypass

All releases of mine affected water are strictly controlled under the conditions of the Mine's EA. Continuous monitoring gauging stations are located upstream and downstream in the Mackenzie River. The gauges provide real-time water quality data, including pH, EC, turbidity, temperature, and flow. Real time data in the receiving environment ensure that's any release form the mine can be monitored and managed in real time to ensure the protection of Environmental Values.

Since no additional release or monitoring, points are proposed in the Project, and all modelling results from surface and groundwater show that the Project is unlikely to result in a significant change to current water quality, existing EA conditions for receiving/release water contaminant trigger levels list in Table 34 and Table 35 will apply.

In addition, the Project site water management plan (SWMP) (Section 6.1.3) and the REMP (Section 11.3.1.1) are integrated, ensuring adequate management and mitigation measures are in place to protect downstream environmental values and to continue meeting the existing EA conditions.

Table 34 EA Release Water Contaminant Trigger Investigation Levels

Quality Characteristic	Trigger Levels (µg/L)	Comment on Trigger Level
Aluminium	55	*For aquatic ecosystem protection, based on SMD guideline*
Arsenic	13	*For aquatic ecosystem protection, based on SMD guideline*
Cadmium	0.2	*For aquatic ecosystem protection, based on SMD guideline*
Chromium	1	*For aquatic ecosystem protection, based on SMD guideline*
Copper	2	*For aquatic ecosystem protection, based on LOR for ICPMS*
Iron	300	*For aquatic ecosystem protection, based on low reliability guideline*
Lead	4	*For aquatic ecosystem protection, based on SMD guideline*
Mercury	0.2	*For aquatic ecosystem protection, based on LOR for CV FIMS*
Nickel	11	*For aquatic ecosystem protection, based on SMD guideline*
Zinc	8	*For aquatic ecosystem protection, based on SMD guideline*
Boron	370	*For aquatic ecosystem protection, based on SMD guideline*

Quality Characteristic	Trigger Levels (µg/L)	Comment on Trigger Level
Cobalt	90	*For aquatic ecosystem protection, based on low reliability guideline*
Manganese	1900	*For aquatic ecosystem protection, based on SMD guideline*
Molybdenum	34	*For aquatic ecosystem protection, based on low reliability guideline*
Selenium	10	*For aquatic ecosystem protection, based on LOR for ICPMS*
Silver	1	*For aquatic ecosystem protection, based on LOR for ICPMS*
Uranium	1	*For aquatic ecosystem protection, based on LOR for ICPMS*
Vanadium	10	*For aquatic ecosystem protection, based on LOR for ICPMS*
Ammonia	900	*For aquatic ecosystem protection, based on SMD guideline*
Nitrate	1100	*For aquatic ecosystem protection, based on ambient QLD Water Quality Guidelines (2006) for TN*
Petroleum hydrocarbons (C6-C9)	20	
Petroleum hydrocarbons (C10-C36)	100	
Fluoride (total)	2000	*Protection of livestock and short term irrigation guideline*
Sodium	180000	*Australian Drinking Water Guidelines (2004)*

Note: 1. All metals and metalloids must be measured as total (unfiltered) and dissolved (filtered). Trigger levels for metal/metalloids apply if dissolved results exceed trigger. 2. SMD – slightly moderately disturbed level of protection guideline refers ANZECC & ARMCANZ (2000). 3. Limit of Reporting (LOR) – typical reporting for method stated. 4. ICPMS/CV FIMS – analytical method required to achieve LOR.

Table 35 EA receiving Waters Contaminant Triggers Levels

Quality Characteristics	Trigger Level
pH	Blackwater Creek > 6.5 or < 9
	Mackenzie River > 6.5 or < 8.5
Electrical Conductivity	Blackwater Creek < 1000 µS/cm
	Mackenzie River < 400 µS/cm
Turbidity (NTU)	Blackwater Creek: Low flow (<2 m^3/s): 1,885 High flow (>2 m^3/s): 2,991
	Mackenzie River: NA
Suspended solids (mg/L)	690
Sulphate (SO_4^{2-}) (mg/L)	250
Sodium (mg/L)	180 (Australian Drinking Water Guidelines, 2004)

Note: Daily during releases

11.3.1.3 Emergency Contingency Planning

Emergency Contingency Planning has also been undertaken as part of the WMP to minimise any impacts of a water emergency on the receiving environment. As a primary means of minimising the impacts of unplanned releases, poorer quality water is to be retained in internal structures from which there is negligible potential for unplanned off-site releases. Another key mine water release contingency measure adopted at Jellinbah Mine is the pumping of high-risk storages to available mine water storages, Jellinbah South Void, or open pits (in preferential order).

The contingency planning and wet weather preparedness strategy also include:

- Maintaining water management infrastructure, including insuring dams, drains, pipes, pumps, monitoring equipment, and other water management infrastructure to ensure it is serviceable in advance of each wet season;
- Reviewing the water management plan and associated water management procedures annually and after each wet season to capture lessons learnt from that wet season; and
- Ensuring relevant personnel are trained in the water management plan and associated procedures.

11.3.2 Groundwater

The impact assessment predicts no significant impact on groundwater dependant assets associated with the Project. Additional mitigation and management measures are limited to ongoing monitoring. Groundwater monitoring will continue to be carried out in accordance with the requirements of the EA.

The following commitments will be undertaken for the Mine and CNE:

- Ensure there continues to be no connectivity between the Mackenzie River and the mining operations by conducting groundwater monitoring at the locations and frequency defined in Table C10 of the EA;
- Three additional groundwater monitoring bores will be installed within ML 700011 in accordance with recommendations of the Queensland Department of Natural Resources, Mines and Energy. The bores will provide information on the presence/absence of water and the rate of water level decline as a result of mining activity occurring at Central North. Any bore located within the mining footprint will be decommissioned as the mine progresses.
- All mine affected water storages will be monitored for level and quality to identify potential contaminant sources within the operation; and
- Ongoing Receiving Environment Monitoring Programs will continue to identify potential impacts on GDEs in the vicinity of the Jellinbah Mine.

11.3.3 Assessment of Risk to Water Resources

The *Information Guidelines for the IESC advice on CSG and large coal mining development proposals* (IESC 2015) were considered in assessing the potential impacts on water resources. A key information requirement for the IESC to fulfil its advisory role to the DoEE is the proponent's assessment of risk.

A qualitative risk assessment was conducted to determine the degree of risk associated with various potential impacts on water resources and the effectiveness of proposed management and mitigation strategies. The aim of the assessment was to:

- Assess the likelihood and consequence, and assign an overall risk level to each identified impact;

- Document management and/or mitigation strategies that are proposed to address potential impacts; and

- Reduce the level of risk associated with regional assets to an acceptable level.

11.3.3.1 Methodology

The qualitative risk analysis was conducted in accordance with *AS ISO 31000 Risk Management Guidelines* (Standards Australia 2018) and *AS HB 203 Managing Environmental-related Risk* (Standards Australia 2012).

The risk analysis framework utilised for the assessment is detailed in Table 36 (Measure of Consequence), Table 37 (Measure of Likelihood), and Table 38 (Risk Analysis Matrix).

Table 36 Measure of Consequence

Level	Descriptor	Environmental Impacts	Legal	Public / Media Attention	Financial Impact
1	Catastrophic	Significant extensive detrimental long term impacts on the environment, community or public health. Catastrophic and/or extensive chronic discharge or persistent hazardous pollutant. Damage to an extensive portion of aquatic ecosystem. Long term impact on water resource.	Licence to operate likely to be revoked or not granted.	Probable public or media outcry with national / international coverage. Significant green NGO campaign.	>$1 million
2	Major	Off-site release contained with outside assistance. Short to medium term detrimental environmental impact off-site or long term environmental damage on-site.	May involve significant litigation and fines. Specific focus from regulator.	May attract attention of local and state media and local community groups.	$500,000 – $1 million
3	Moderate	Onsite release contained with outside assistance. Significant discharge of pollutant, a possible source of community annoyance. Non persistent, but possible widespread damage to land. Damage that can be remediated without long term loss or very localised long persistent damage.	Probably serious breach of regulation. Possible prosecution and/or fine. Significant difficulties or delays experienced in gaining future approvals.	May attract attention from local media, heightened concern by local community.	$50,000 – $500,000
4	Minor	On site release immediately contained without outside assistance. Ongoing or repeat exceedances of odour, dust or noise / vibration limits.	Minor on the spot fines or formal written correspondence from regulator.	Local community attention or repeated complaints.	$5,000 – $50,000
5	Insignificant	Negligible environmental impact. Minor transient release of pollutant including odour, dust and noise / vibration.	No serious breach of regulation. Minor licence non-compliances.	Local landholder verbal discussion / complaint.	Less than $5,000

Source: *AS HB 203 Managing Environmental-related Risk* (Standards Australia 2012).

Table 37 Measure of Likelihood

Level	Descriptor	Example	Frequency
A	Almost certain	Is expected to occur in most circumstances	> Once per year
B	Likely	Will probably occur in most circumstances	Once per year
C	Possible	Could occur	Once every 5 years
D	Unlikely	Could occur but not expected	May happen within Project life
E	Rare	Occurs in only exceptional circumstances	Not likely to happen within Project life

Source: *AS HB 203 Managing Environmental-related Risk* (Standards Australia 2012).

Table 38 Risk Analysis Matrix

Likelihood	Consequences				
	1 Catastrophic	2 Major	3 Moderate	4 Minor	5 Insignificant
A - Almost Certain	E	E	E	H	H
B - Likely	E	E	H	H	M
C - Possibly	E	E	H	M	L
D - Unlikely	E	H	M	L	L
E - Rare	H	H	M	L	L

Source: *AS HB 203 Managing Environmental-related Risk* (Standards Australia 2012).
Key: E = Extreme risk; immediate action required.
H = High risk; senior management attention needed.
M = Moderate risk; management responsibility must be specified.
L = Low risk; manage by routine procedures.

11.3.3.2 Risk Assessment

The likelihood and associated consequence value were determined for each hazard associated with the Project to qualify the level of risk associated with each event.

Prior to the application of control strategies, four hazards were assigned a medium risk rating, and five were assigned a low risk rating. Following the application of control strategies, all risk categories were reduced. No high or medium risks remain for the Project following implementation of control strategies.

Table 39 indicates the hazards assessed, control measures applied to reduce the initial level of risk associated with each hazard, and the residual risk rating following application if control measures.

Table 39 Risk Assessment Water Resources - CNE

Source of Risk / Environmental Aspect	Incident / Event	Potential Impact	No Control Strategies In Place			Control Strategies	Control Strategies In Place		
			Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
Groundwater	Seepage from water storages	Contamination of groundwater	4	D	L	✓ Continuation of existing groundwater monitoring program for the Mine ✓ Water storage monitoring program	4	E	L
	Groundwater Drawdown	Diminished water supply for ecosystems dependent on groundwater	4	E	L		4	E	L
		Diminished water supply for other groundwater users	4	D	L		4	E	L
		Increased cumulative impact from existing mine sites and the expansion.	4	D	L		4	D	L
		Cumulative impact of drawdown upon ephemeral creeks in the surrounding areas	4	D	L		4	D	L
Surface Water	Surface water inflow to final void during flood events	Release of contaminated / saline water to waterways	4	E	L	✓ WMP in place ✓ REMP for Mine in place ✓ CNE Pit is located outside 1:1000-year flood extent	4	E	L

Source of Risk / Environmental Aspect	Incident / Event	Potential Impact	No Control Strategies In Place			Control Strategies	Control Strategies In Place		
			Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
	Increased sediment load in runoff entering creek	Degradation of water quality in Blackwater Creek, Mackenzie River and 5 Mile Lagoon	4	D	L	✓ Minimise the area of disturbance ✓ Local temporary erosion control measures ✓ Intercept runoff from undisturbed areas and divert around disturbed areas ✓ Where temporary measures are likely to be ineffective, divert runoff from disturbed areas to sedimentation basins prior to release from the site ✓ WMP in place to control capture of potentially contaminated water ✓ Erosion and Sediment Control Plan in place, as per EA requirements ✓ Implementation of the REMP	4	E	L
	Loss of catchment area draining to local drainage lines and wetlands	Impacts to ecological values	5	B	M	✓ Rehabilitation of Project site will minimise the capture of runoff into the final void ✓ REMP for Mine in place	5	C	L
	Uncontrolled release from mine-affected water system	Contamination of receiving surface waters, including Mackenzie River	3	D	M	✓ WMP in place ✓ Operation of storages at safe water levels and	4	E	L

Source of Risk / Environmental Aspect	Incident / Event	Potential Impact	No Control Strategies In Place			Control Strategies	Control Strategies In Place		
			Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
	Release from sediment dams		5	C	L	with capability to transfer water between storages ✓ Water storage monitoring program ✓ Implementation and compliance with operational plans for regulated structures, as required by the EA	5	D	L
	Seepage from water storages	Contamination to surface water	4	D	L	✓ WMP in place ✓ Water storage monitoring program ✓ Hazard Consequence Assessment of Water Storages ✓ Appropriate storage design (UDP 2016)	4	E	L

12.0 ECOLOGICALLY SUSTAINABLE DEVELOPMENT

Ecologically Sustainable Development (ESD) has no universally accepted definition; however, in 1990, the Commonwealth Government suggested the following definition for ESD in Australia:

'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased'.

The *National Strategy for ESD* was developed in 1992 (ESD Steering Committee), of which the primary goal is:

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.

The Core Objectives are:

- *To enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations;*
- *To provide for equity within and between generations; and*
- *To protect biological diversity and maintain essential ecological processes and life-support systems.*

The Guiding Principles are:

- *Decision making processes should effectively integrate both long and short-term economic, environmental, social and equity considerations;*
- *Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;*
- *The global dimension of environmental impacts of actions and policies should be recognised and considered;*
- *The need to develop a strong, growing and diversified economy which can enhance the capacity for environmental protection should be recognised;*
- *The need to maintain and enhance international competitiveness in an environmentally sound manner should be recognised;*
- *Cost effective and flexible policy instruments should be adopted, such as improved valuation, pricing and incentive mechanisms;*
- *Decisions and actions should provide for broad community involvement on issues which affect them.*

The Project conforms to the principals of ESD in the following manner:

- Decision making processes, including planning and management measures, integrate both long and short-term economic, environmental, social and equity considerations;

- Where there are threats of environmental harm, lack of full scientific certainty is not used as a reason for postponing the implementation of avoidance, mitigation and management measures;

- Ongoing monitoring programs implemented at Jellinbah aim to further understanding of potential impacts and to mitigate them as necessary;

- Decisions and actions provide for broad community involvement on issues which affect them, through Jellinbah's ongoing liaison with surrounding landholders and the community;

- Approval of the Project will result in short and long term economic, social and equity benefits for the larger community, including employees, businesses in the town of Blackwater and the central QLD hubs of Emerald and Rockhampton through flow on-effects; and

- The Project poses only a negligible impact to the clearing of the 14.65 ha of already compromised ecological values, which will be offset financially in manner to best enhance the capacity for environmental protection.

13.0 ECONOMIC AND SOCIAL MATTERS

The proposed project has a direct economic impact on the State of QLD through the development of the mine to make the best use of the existing resource. The consequences of not proceeding with the Project are associated with a significant coal resource remaining undeveloped and economic proceeds through taxation and royalties not being realised for the State of Queensland.

There is a significant opportunity cost to both State and Commonwealth revenues without the development of the Project. The availability of existing process facilities and product transport infrastructure at the Mine is limited to the economic life of the operating Mine. Should the Project development not go ahead, or be deferred to a later date, the use of existing coal processing and transport infrastructure is not guaranteed. The feasibility of a deferred Project, without transport and processing facilities, is highly uncertain.

The Blackwater area has a rich history in mining spanning forty years, the extension of the Mine's life through the addition of the resources in the Project mining area will contribute to continued direct and contract employment of operating workers and support personnel, with flow-on employment through the provision of associated goods and services at the local, regional, and State and National levels.

Public consultation specific to the Project Project has been undertaken with Project stakeholders, including the underlying landholders, the CHRC, and relevant QLD and Commonwealth Government departments. Affected persons were notified of the application during the Certificate of Public Notice process. All property owners of land underlying the Project have been consulted and have entered into compensation agreements where applicable.

Jellinbah has conducted extensive consultation with the registered Native Title groups and will continue to do so as part of a proactive community consultation program and ongoing development of Cultural Heritage Management Plans (CHMPs) for the existing Mine. Consultation has been planned between the registered Native Title groups and Jellinbah for the purpose of developing a CHMP for the CN MLs.

Following public consultation, one submission was received from the CHRC for consideration prior to the QLD Government's EA Amendment approval. The submission raised concerns regarding communication infrastructure, road transport, and associated impacts to Five Mile Lagoon, fire and flood potential, noise mitigation, waste management, pest management, water management, rehabilitation, accommodation, Community liaison and benefits, and local opportunities. The letter from CHRC was included as a supporting document to the referral, along with a presentation from Mine's General Manager given to the CHRC addressing the Council's concerns (Appendix A2).

14.0 CONCLUSION

The Project has been developed with regard to the principles of the EPBC Act and aims to provide for the protection of the environment and Australia's biodiversity. Decision making processes, including planning and management measures, integrate both long and short-term economic, environmental, social and equity considerations. Through detailed technical studies and the implementation of successful management plans and commitment to ongoing monitoring of environmental values, the Project (the proposed action) was determined to have a minimal impact on water resources and no significant impact on any threatened species or communities.

The Project was determined to have no significant impact on listed threatened species and communities; however management commitments will still be enacted to ensure suitable mitigation of potential impacts to all environmental values, not just those protected by the EPBC Act. Environmental Offsets under the QEOP have been committed to as a part of the QLD approval process. Such offsets would provide an equivalent or improved environmental outcome when compared to an offset provided under the EPBC Act, should a significant impact have been determined.

As CNE represents only a small pit extension at an operating mine site, it is infeasible to propose development in an alternative manner. The design process has maximised the functionality of the area and minimised the impact. The outcome of the approval will be an extension of mine life of an existing operation with a significant social and economic benefit. Any potential environmental impacts have been appropriately mitigated with management commitments throughout the development, operational and rehabilitative phases of the Project. Commitments for ongoing monitoring, including surface water, groundwater, and receiving environment monitoring for the life of the operation, are also proposed.

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