JELLINBAH COAL MINE
RECEIVING ENVIRONMENT MONITORING PROGRAM

PREPARED FOR

JELLINBAH MINING PTY LTD

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BRISBANE OFFICE
Suite 5, 1 Swann Road
Taringa, QLD 4068
P +61 7 3217 8772

CAIRNS OFFICE
PO Box 4887
Cairns, QLD 4879
P +61 7 4057 9402

E info@aarc.net.au
AARC.NET.AU

ACN. 620 818 920
ABN. 71 620 818 920

AARC Environmental Solutions Pty Ltd

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Author:	Travis Ittensohn
Project Manager:	Gareth Bramston
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LIST OF ABBREVIATIONS

%	percent
°C	degrees Celsius
AARC	AARC Environmental Solutions Pty Ltd
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
COC	Chain of Custody
CPP	coal processing plant
DO	dissolved oxygen
EA	Environmental Authority
EC	electrical conductivity
EHP	Department of Environment and Heritage Protection
EPP (Water)	*Environmental Protection Policy (Water) 2009*
EV	Environmental Value
FRP	filterable reactive phosphorus
ISQG	Interim Sediment Quality Guidelines
Jellinbah	Jellinbah Mining Pty Ltd
km	kilometre(s)
km^2	square kilometre(s)
LOR	limit of reporting
m	metre(s)
mm	millimetre(s)
ML	Mining Lease
mg/kg	milligram(s) per kilogram
mg/L	milligram(s) per litre
Mtpa	Million tonnes per annum

mV	millivolt(s)
N	nitrogen
NATA	National Association of Testing Authorities
No.	number
NTU	nephelometric turbidity units
ORP	oxidation reduction potential
PET	Plectoptera, Ephemoptera and Trichoptera
QC/QA	Quality control / quality assurance
REMP	Receiving Environment Monitoring Program
ROM	run-of-mine
RPD	Relative Performance Differences
SIGNAL	Stream Invertebrate Grade Number – Average Level
TARP	Trigger Action Response Plan
TDS	total dissolved solids
WQO	Water Quality Objective
µg/L	microgram(s) per Litre
µm	micrometre(s)
µS/cm	microSiemen(s) per centimetre

1.0 INTRODUCTION

The Jellinbah Coal Mine (the Project) is an open-cut coal operation, mining shallow, low stripping ratio coal reserves and producing approximately 4.5 – 5.0 million tonnes per annum (Mtpa) of pulverised coal injection and a minor amount of thermal coal, primarily for export. The Project is authorised by Environmental Authority (EA) EPML00516813 and operated by Jellinbah Mining Pty Ltd on behalf of the Jellinbah East Joint Venture. The participants of the Jellinbah East Joint Venture are: Jellinbah Group Pty Ltd, Tremell Pty Ltd, Marubeni Coal Pty Ltd and Sojitz Coal Resources Pty Ltd.

1.1 PURPOSE

The Project's EA requires a Receiving Environment Monitoring Program (REMP) to be developed and implemented. This REMP forms an update of the previous REMP prepared by Ison Environmental Planners in 2010.

This updated REMP has been developed in accordance with the *Receiving Environment Monitoring Program Guideline* (Department of Environment and Heritage Protection (EHP) 2014) to fulfil condition C23 of the EA:

C23 The environmental authority holder must develop and implement a Receiving Environment Monitoring Program (REMP) to monitor, identify and describe any adverse impacts to surface water environmental values, quality and flows due to the authorised mining activity. This must include monitoring the effects of the mine on the receiving environment periodically (under natural flow conditions) and while mine affected water is being discharged from the site. For the purposes of the REMP, the receiving environment is the waters of the Mackenzie River and connected or surrounding waterways within 5 kilometres (km) downstream of the release. The REMP should encompass any sensitive receiving waters or environmental values downstream of the authorised mining activity that will potentially be directly affected by an authorised release of mine affected water.

1.1.1 Aims and Objectives

This REMP aims to quantify the potential impacts of the operation of the Jellinbah Mine on the receiving environment. To achieve this, REMP monitoring is conducted on a regular basis (i.e. annually) to provide a comprehensive understanding of business-as-usual impacts. In addition, monitoring of the receiving environment is conducted during controlled and uncontrolled releases to determine the potential impacts associated with release events.

1.2 SCOPE

Condition C24 of the EA sets out the required content of the REMP. The REMP encompasses waters within 5 km downstream of each release point.

C24 The REMP must:

a) Assess the condition or state of receiving waters, including upstream conditions, spatially within the REMP area, considering background water quality characteristics based on accurate and reliable monitoring data that takes into consideration temporal variation (e.g. seasonality);

b) Be designed to facilitate assessment against water quality objectives for the relevant environmental values that need to be protected;

c) Include monitoring from background reference sites (e.g. upstream or background) and downstream sites from the release (as a minimum, the locations specified in Table C8);

d) *Specify the frequency and timing of sampling required in order to reliably assess ambient conditions and to provide sufficient data to derive site specific background reference values in accordance with the Queensland Water Quality Guidelines 2009. This should include monitoring during periods of natural flow irrespective of mine or other discharges;*

e) *Include monitoring and assessment of dissolved oxygen saturation, temperature and all water quality parameters listed in Tables C2 and C3);*

f) *Include, where appropriate, monitoring of metals/metalloids in sediments (in accordance with Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) 2000, BATLEY and/or the most recent version of AS5667.1 Guidance on Sampling of Bottom Sediments);*

g) *Include, where appropriate, monitoring of macroinvertebrates in accordance with the AusRivas methodology,*

h) *Apply procedures and/or guidelines from ANZECC & ARMCANZ 2000 and other relevant guideline documents;*

i) *Describe sampling and analysis methods and quality assurance and control; and*

j) *Incorporate stream flow and hydrological information in the interpretations of water quality and biological data.*

2.0 PROJECT DESCRIPTION

2.1 LOCATION

The Jellinbah Coal Mine is located in the Bowen Basin in central Queensland. Current operations areas are located approximately 24 km north-northeast of Blackwater and 190 km west of Rockhampton, within the Central Highlands Regional Council area. The Mackenzie North operational area, located north of the Mackenzie River, is situated within the Isaac Regional Council area.

The regional location of the Project is shown in Figure 1.

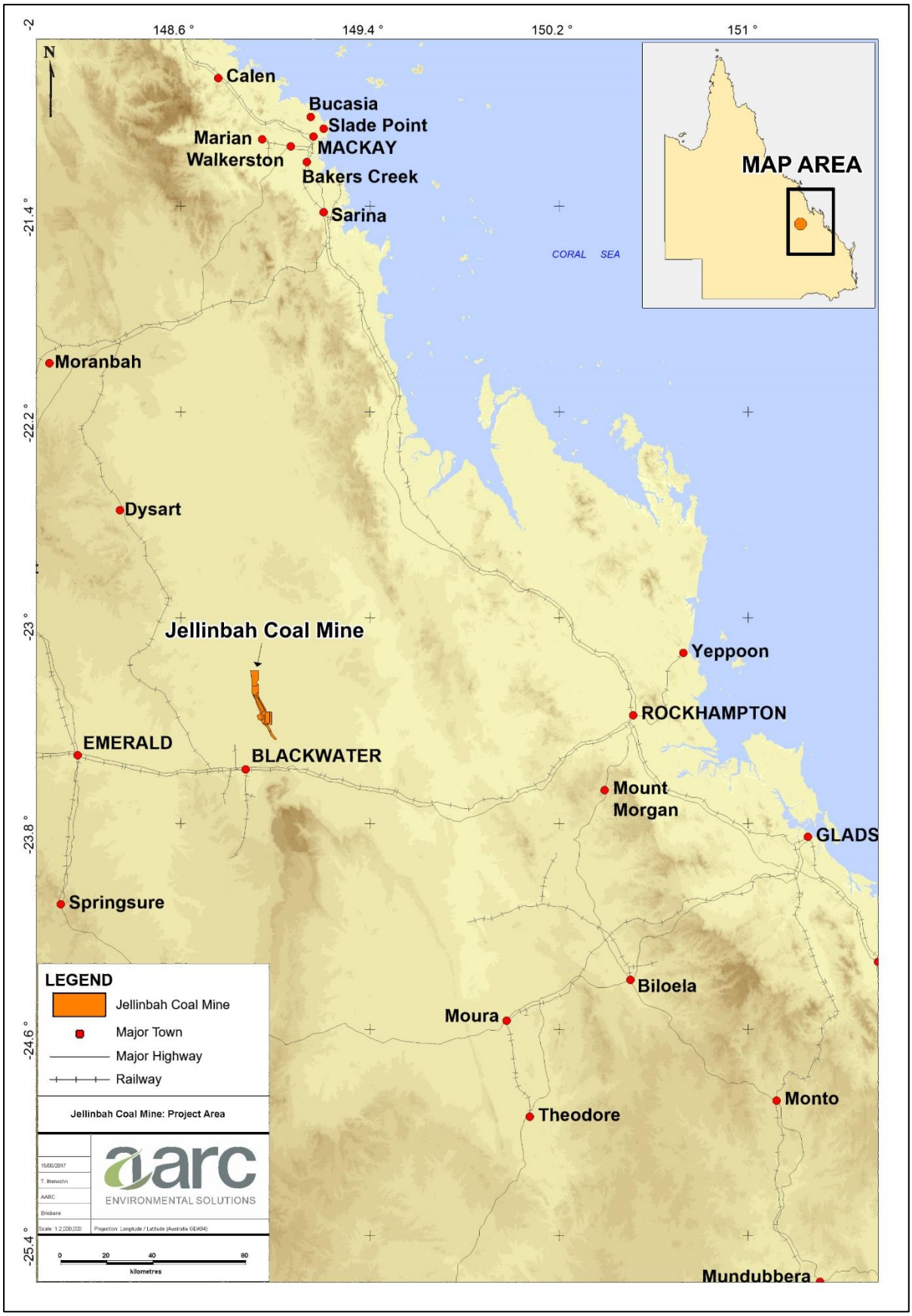

Figure 1 Regional Location of the Project

2.2 TENEMENTS

The Project encompasses 17 approved Mining Leases (MLs) comprising the following approved areas:

- Mackenzie North (operational);
- Jellinbah Plains (operational);
- Plains South (operational), Central North (operational/exploration) and Central North Extension (approved);
- Jellinbah Central (operational); and
- Jellinbah South (not currently operational).

Figure 2 illustrates the mining areas of the Jellinbah Coal Mine.

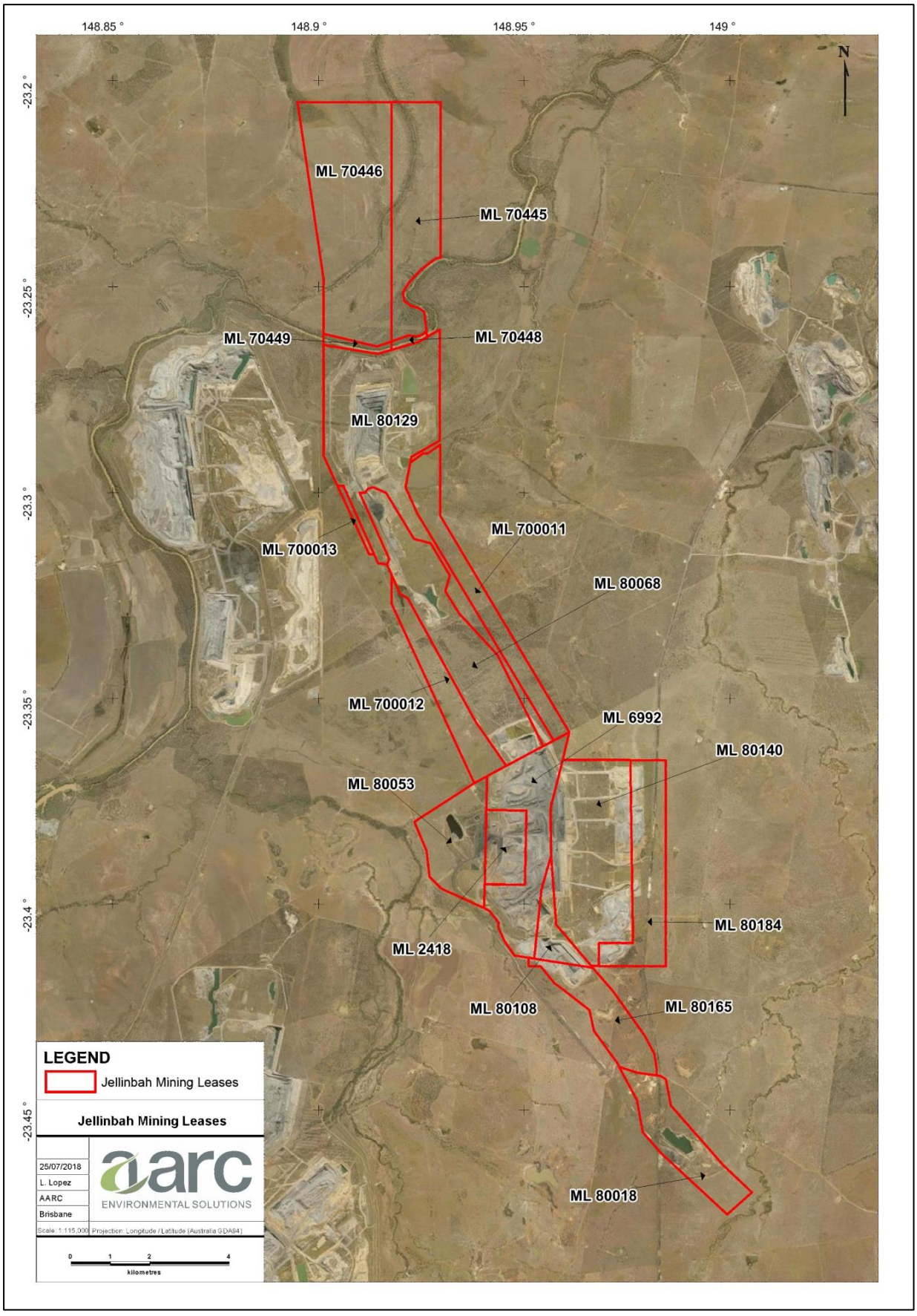

Figure 2 Jellinbah Coal Mine Tenements

2.3 ACTIVITIES

The principal activities undertaken at the Jellinbah Coal Mine are:

- Mining of a high-grade coal;
- Continuous assessment of the coal resource by exploration;
- Clearing of any remaining vegetation in advance of mining;
- Selective stripping of available topsoil under supervision to be immediately reused or stockpiled for future use in the rehabilitation program;
- Drilling and blasting of overburden to provide access to coal resources;
- Operation of a conventional open-cut truck and excavator mine to maintain production to meet market demands;
- Overburden used to form bunds, haul roads and hardstands or transported to out-of-pit spoil dumps located clear of the coal resource but within the boundary of the MLs or placed in the previous mining strip to backfill mined-out areas;
- Reshaping of spoil dumps, replacement of topsoil and revegetation of the mined out and backfilled area;
- Crushing and screening of run-of-mine (ROM) coal;
- Coal washing (if required) at the coal processing plant (CPP), located on ML 80053;
- Disposal of CPP rejects together with overburden (coarse rejects) and tailings (fine rejects) within existing mining voids;
- Transport of crushed and washed coal by private road to the existing rail loading area for rail transport to Gladstone;
- Operation of water management infrastructure such as regulated dams, sediment ponds, drains and bunds;
- Ongoing maintenance of levee banks at Jellinbah Plains and Mackenzie North to protect mining operations from flooding of the Mackenzie River;
- Utilisation of existing infrastructure facilities, including offices, power and water; and
- Continued direct and contract employment of operating workers and support personnel with flow-on employment through the provision of associated goods and services.

3.0 DESCRIPTION OF THE RECEIVING ENVIRONMENT

For the purposes of the REMP, the receiving environment is defined as the waters of the Mackenzie River and connected or surrounding waterways within 5 km downstream of a release point.

3.1 SURFACE WATER

The Project is located within the catchment of Blackwater Creek and the Mackenzie River, approximately 20 km downstream from Bedford Weir and 30 km upstream of the Bingegang Weir. Blackwater Creek runs parallel to the western boundaries of the Jellinbah Central area. The Mackenzie River traverses the Jellinbah Coal Mine between the Mackenzie North area and the mining operations at Jellinbah Plains and Jellinbah Central. The Mackenzie North area is located on the northern alluvial plain of the Mackenzie River. Flow distributions on the plain are complex and vary depending on the magnitude of stream flow in the river.

The Mackenzie River is a major tributary of the Fitzroy River which flows to the Coral Sea at Rockhampton. The total catchment area of Mackenzie River to the Bingegang Weir (30 km downstream of the Jellinbah Coal Mine) is approximately 50,960 square kilometres (km^2) and incorporates the Comet and Nogoa River sub-catchments (WRM 2013).

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 Jellinbah Coal Mine.

Surface water features in the vicinity of the Project site are shown in Figure 3.

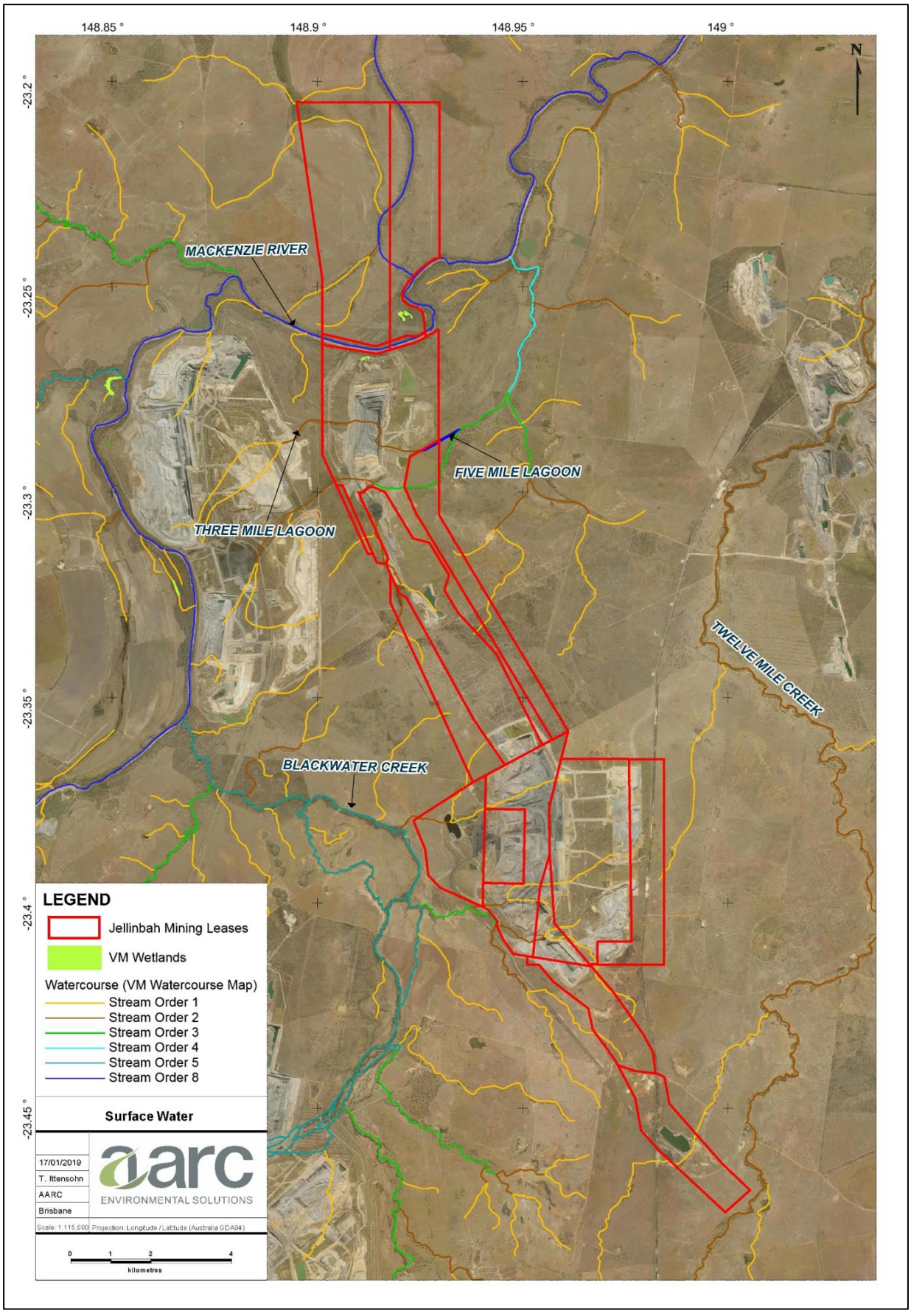

Figure 3 Surface Water Features

3.2 CURRENT LAND AND WATER USES

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. Catchment to the Mackenzie River is harvested for a range of uses, including irrigation, urban, industrial and domestic water supplies (AARC 2013).

Drinking water supplies are obtained from Fairbairn Dam, located upstream of the Project, on the Nogoa River. Immediately upstream of the Project site the Bedford Weir regulates flow of the Mackenzie River through the proposed site, as well as, providing a source of water for industrial, and agricultural uses.

Releases are made from Fairbairn Dam to deliver supplies to downstream riparian water users and to maintain supplies from Bedford and Bingegang Weirs to various towns, mines and irrigators. Water captured in the Bingegang Weir, located downstream of the Project, is used to supply the towns of Middlemount and Dysart (WRM 2013). Semi-permanent pools exist in Blackwater Creek and the Mackenzie River, as well as Three and Five Mile Lagoons, which are located adjacent to the Jellinbah Plains operation.

Land use is typically rural with substantial areas cleared for predominately low-intensity cattle grazing. Beyond the towns of Clermont, Emerald, Springsure and Blackwater, the catchment is sparsely populated. Two coal mines are located in close proximity to the Jellinbah Coal Mine: Curragh North (immediately upstream) and Yarrabee (immediately downstream).

3.3 ENVIRONMENTAL PROTECTION (WATER) POLICY 2009

The *Environmental Protection (Water) Policy 2009* (EPP (Water)) is subordinate legislation under the *Environmental Protection Act 1994*. The EPP (Water) provides a framework for:

1. Identifying environmental values (EVs) for Queensland waters, and determining water quality objectives (WQOs) to protect or enhance those EVs; and

2. Including the identified EVs and WQOs under Schedule 1 of the EPP (Water).

The EPP (Water) is relevant to the Project with regard to the protection of EVs occurring within the receiving environment of the Project site. The EVs and WQOs for waters occurring in the vicinity of the Project site are provided in the document: *Environmental Protection (Water) Policy 2009*; *Mackenzie Sub-basin Environmental Values and Water Quality Objectives*.

3.3.1 Environmental Values

EVs are defined as “particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety or health and that require protection from the effects of pollution, waste discharges and deposits” (EHP 2010).

The EVs and WQOs stated within this document have been developed in accordance with the EPP (Water) and the relevant supporting documents. The Project is situated within the Mackenzie River Sub-basin, and as such is subject to the EVs and WQOs outlined in the *Mackenzie River Sub-basin Environmental Values and Water Quality Objectives* document (as stipulated in Schedule 1 of the EPP (Water)).

EVs applicable to the Jellinbah Coal Mine, as defined in the *Mackenzie River Sub-basin Environmental Values and Water Quality Objectives*, include:

- Protection of aquatic ecosystems;
- Suitability for crop irrigation;
- Suitability for aquaculture (Isaac western upland tributaries only);
- Suitability for farm supply and use;
- Suitability for stock water;
- Suitability for human consumption of aquatic foods;
- Suitability for primary contact recreation;
- Suitability for secondary contact recreation;
- Suitability for visual recreation
- Suitability for drinking water supply;
- Suitability for industrial use; and
- Protection of cultural and/or spiritual values.

The *EPP (Water) Central Queensland Mapping (WQ1304 – Mackenzie River Sub-basin)* identifies several watercourses (rivers / creeks) and lakes / reservoirs on and surrounding the Project site. Of greatest significance to the Project are the Mackenzie River, Blackwater Creek, Three Mile Lagoon and Five Mile Lagoon. Associated values include aquatic ecosystems and stock water supply. The nearest downstream source of human consumption is the Bingegang Weir located 30 km downstream.

3.3.2 Water Quality Objectives

The EPP (Water) provides WQOs to support and protect the different EVs identified for waters within the Mackenzie River catchments. WQOs are provided in two main parts:

a) For the purposes of protecting the aquatic ecosystem EV; and

b) For EVs other than aquatic ecosystems ('human use EVs').

REMP monitoring data will be compared with the WQOs outlined in the EPP (Water) for the protection of the aquatic ecosystem EV, in particular the WQOs for moderately disturbed aquatic ecosystems in Mackenzie River Sub-basin waters. All WQOs relevant to the REMP are outlined in Table 1. It is important to note that the primary EVs associated with the Project site are aquatic ecosystems and stock watering suitability, and this will be reflected in the WQOs used to assess REMP monitoring results. WQOs for the protection of moderately disturbed freshwater lakes / reservoirs have been included in Table 1 due to two of the REMP monitoring sites being located within lagoons (Three and Five Mile Lagoon).

The *Australian Water Quality Guidelines for Fresh and Marine Waters* (ANZECC 2000) provide widely recognised guidelines for a range of EVs, including aquatic ecosystems, stock watering and human consumption. The ANZECC guidelines also contain Interim Sediment Quality Guidelines for assessing

metal levels in stream sediments. The ANZECC livestock drinking water guidelines are relevant for the Project area and are shown in Table 1. Table 1 also includes contaminant trigger levels and trigger investigation levels defined within the Project's EA.

The Interim Sediment Quality Guidelines (ISQG), applicable to the stream sediment monitoring carried out as part of the REMP, are provided in Table 2. EPP (Water) WQOs applicable to macro-invertebrates are provided in Table 3.

Table 1 Water Quality Objectives, Trigger Levels and Contaminant Limits – Surface Water

Quality Characteristic	EA Trigger Levels			ANZECC (2000)		EPP (Water) WQOs	
	Release Contaminant Trigger Investigation Level	Receiving Waters Contaminant Trigger Level		Livestock Drinking Water [2]	Aquatic Ecosystems	Moderately Disturbed Aquatic Ecosystems [4]	Freshwater Lakes / Reservoirs [5]
		Blackwater Ck.	Mackenzie R.				
pH	-	6.5 – 9	6.5 – 8.5	-	6 – 7.5	6.5 – 8.5	6.5 – 8
Electrical conductivity (EC)	-	1,000 µS/cm	400 µS/cm	-	20 – 250 µS/cm	Base flow: 310 µS/cm High flow: 210 µS/cm	No / base flow: 250 µS/cm
Total dissolved solids (TDS)	-	-	-	4,000 mg/L	-	-	-
Turbidity	-	Low flow: 1,885 NTU * High Flow: 2,991 NTU *	-	-	2 to 15 NTU	50 NTU	1 – 20 NTU
Suspended solids	-	690 mg/L	690 mg/L	-		110 mg/L	-
Sulphate	-	250 mg/L	250 mg/L	1,000 mg/L		10 mg/L	-
Dissolved oxygen (DO)	-	-	-	-	90 – 120%	85 – 110%	90 – 110%
Ammonia N	900 µg/L	-	-	-	900 µg/L	20 µg/L	10 µg/L
Oxidised N	-	-	-	-	30 µg/L	60 µg/L	10 µg/L
Organic N	-	-	-	-	-	420 µg/L	330 µg/L
Total N	-	-	-	-	150 µg/L	775 µg/L	350 µg/L
Filterable reactive phosphorus (FRP)	-	-	-	-	5 µg/L	20 µg/L	5 µg/L
Total P	-	-	-	-	10 µg/L	160 µg/L	10 µg/L
Chlorophyll a	-	-	-	-	-	5 µg/L	5 µg/L
Calcium	-	-	-	1,000 mg/L	-	-	-
Sodium	180,000 µg/L	180,000 µg/L	180,000 µg/L	-	-	-	-
Nitrate	1,100 µg/L	-	-	400 mg/L	-	-	-
Aluminium	55 µg/L	-	-	5 mg/L	55 µg/L	-	-
Arsenic	13 µg/L	-	-	0.5 – 5 mg/L	13 µg/L	-	-
Boron	370 µg/L	-	-	5 mg/L	370 µg/L	-	-
Cadmium	0.2 µg/L	-	-	0.01 mg/L	0.2 µg/L	-	-

Quality Characteristic	EA Trigger Levels			ANZECC (2000)		EPP (Water) WQOs	
	Release Contaminant Trigger Investigation Level	Receiving Waters Contaminant Trigger Level		Livestock Drinking Water [2]	Aquatic Ecosystems	Moderately Disturbed Aquatic Ecosystems [4]	Freshwater Lakes / Reservoirs [5]
		Blackwater Ck.	Mackenzie R.				
Chromium	1 µg/L	-	-	1 mg/L	1 µg/L	-	-
Cobalt	90 µg/L	-	-	1 mg/L	-	-	-
Copper	2 µg/L	-	-	1 mg/L (cattle)	1.4 µg/L	-	-
Iron	300 µg/L	-	-	#	-	-	-
Lead	4 µg/L	-	-	0.1 mg/L	3.4 µg/L	-	-
Manganese	1,900 µg/L	-	-	#	1,900 µg/L	-	-
Mercury	0.2 µg/L	-	-	0.002 mg/L	0.6 µg/L	-	-
Molybdenum	34 µg/L	-	-	0.15 mg/L	-	-	-
Nickel	11 µg/L	-	-	1 mg/L	11 µg/L	-	-
Selenium	10 µg/L	-	-	0.02 mg/L	-	-	-
Silver	1 µg/L	-	-	-	0.05 µg/L	-	-
Uranium	1 µg/L	-	-	0.2 mg/L	-	-	-
Vanadium	10 µg/L	-	-	-	-	-	-
Zinc	8 µg/L	-	-	20 mg/L	8 µg/L	-	-
Fluoride	2,000 µg/L	-	-	2 mg/L	-	-	-
Petroleum hydrocarbons (C6-C9)	20 µg/L	-	-	-	-	-	-
Petroleum hydrocarbons (C10-C36)	100 µg/L	-	-	-	-	-	-

Note: 1. Total (unfiltered) measurements must be taken and analysed. 2. Recommended water quality trigger values (low risk) for heavy metal and metalloids in livestock drinking water (ANZECC). 3. 95% species protection in slightly-moderately disturbed ecosystems. 4. Water quality objectives to protect moderately disturbed aquatic ecosystems in the Mackenzie River Sub-basin (EPP Water). 5. Water quality objectives to protect moderately disturbed freshwater lakes / reservoirs (EPP Water). # Not sufficiently toxic. * For the purpose of measuring turbidity in Blackwater Creek, low flow is defined as <2 m^3/s and high flow is defined as >2 m^3/s.

Table 2 Sediment Quality Guidelines

Contaminant (mg/kg dry wt)	ANZECC (2000)	
	ISQG (Low) Trigger Level	ISQG (High) Trigger Level
Antimony	2	25
Cadmium	1.5	10
Chromium	80	370
Copper	65	270
Lead	50	220
Mercury	0.15	1
Nickel	21	52
Silver	1	3.7
Zinc	200	410

Table 3 Water Quality Objectives – Macro-Invertebrates

Indicator	EPP (Water) WQOs	
	Composite	Edge Habitat
Taxa richness	12 – 21	23 – 33
PET taxa richness	2 – 5	2 – 5
SIGNAL index	3.33 – 3.85	3.31 – 4.2
% tolerant taxa	25 – 50%	44 – 56%

4.0 MINE RELEASE

Jellinbah Coal Mine currently has four operational release points, two of which release to Blackwater Creek and two of which release to the Mackenzie River. An additional release point is approved for the Mackenzie River: RP4 at Mackenzie North. Release point locations are provided in Table 4.

Mine affected water streams at the Jellinbah mine include:

- Groundwater;
- Water that accumulates in a pit;
- Water that has come into contact with coal stockpiles, processing areas, ROM pads;
- Process water; and
- Water in the tailings.

The REMP has been designed in accordance with the water release conditions whereby REMP site locations have been determined relative to the EA release and monitoring points.

Table 4 Current Release Points at the Jellinbah Coal Mine

Release Point	Location	Easting	Northing	Status
Blackwater Creek				
RP1	Jellinbah Central	697440	7413330	Existing
RP2	Jellinbah Central	697985	7410730	Existing
Mackenzie River				
RP3	Jellinbah Plains	7410730	7425570	Existing
RP4	Mackenzie North	696360	7428060	Approved
RP5	Jellinbah Plains	696387	7425862	Existing

5.0 RECEIVING ENVIRONMENT MONITORING PROGRAM

5.1 LOCATIONS

The REMP monitoring sites have been developed to incorporate all sampling procedures at each site location. The upstream background monitoring sites are used as reference sites and are not subject to the release of mine affected water from the Project. Impact sites are those located downstream of the release points and within the receiving environment. REMP monitoring at the Project site includes three upstream (background) and four downstream (impact) monitoring locations.

The locations of these receiving water monitoring sites are provided below in Table 5 and shown in Figure 4 (Mackenzie River) and Figure 5 (Blackwater Creek). The locations of release points are also depicted on Figure 4 and Figure 5.

Table 5 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	694538	7426005
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 (extra point)	Downstream Mackenzie River	696930	7425950
Five Mile Lagoon (DS5) (extra point)	Downstream Five Mile Lagoon	696694	7423071
MP5	Downstream Mackenzie River	697281	7428227

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

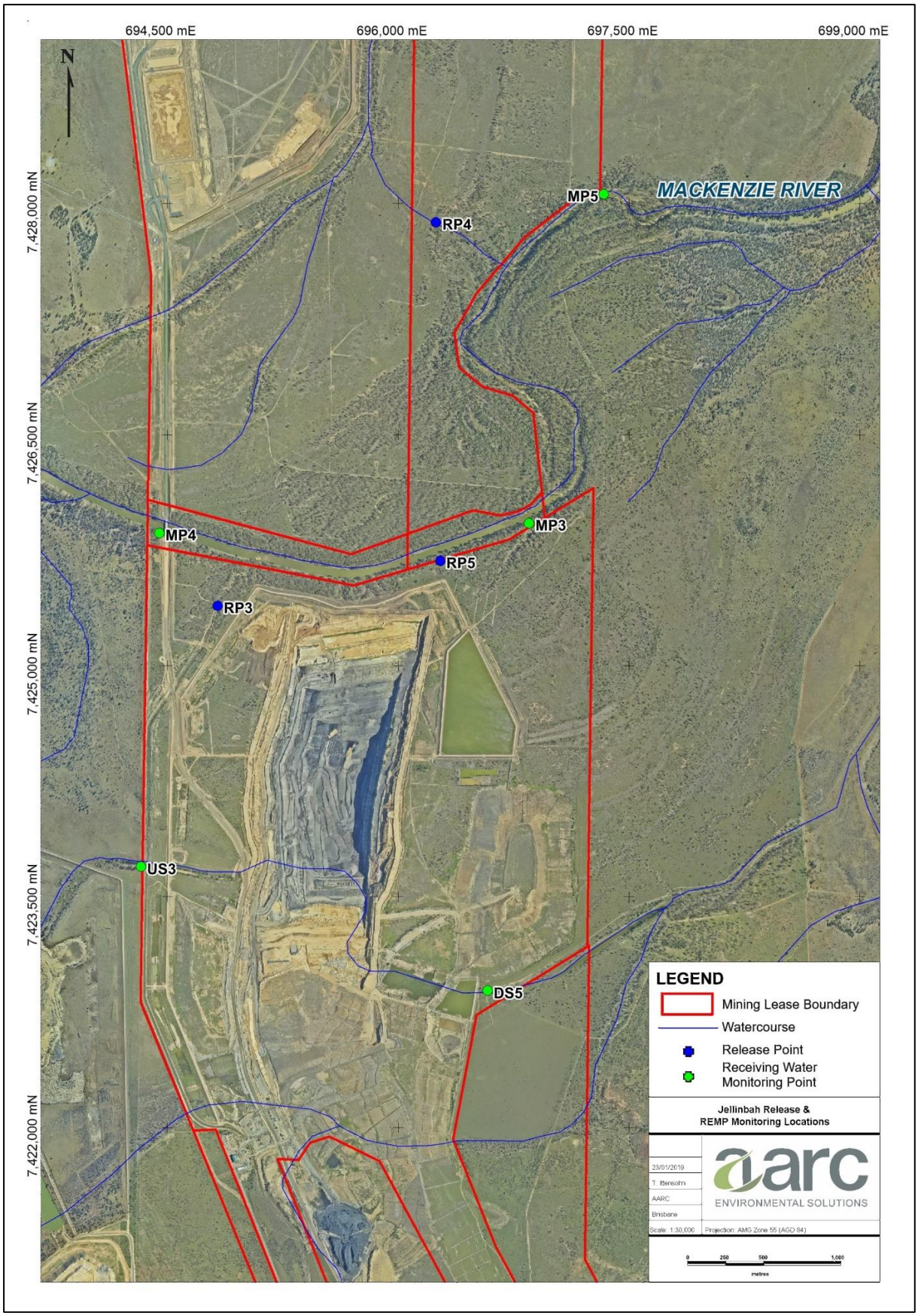

Figure 4 **Release Points and Receiving Environment Monitoring Points – Mackenzie River**

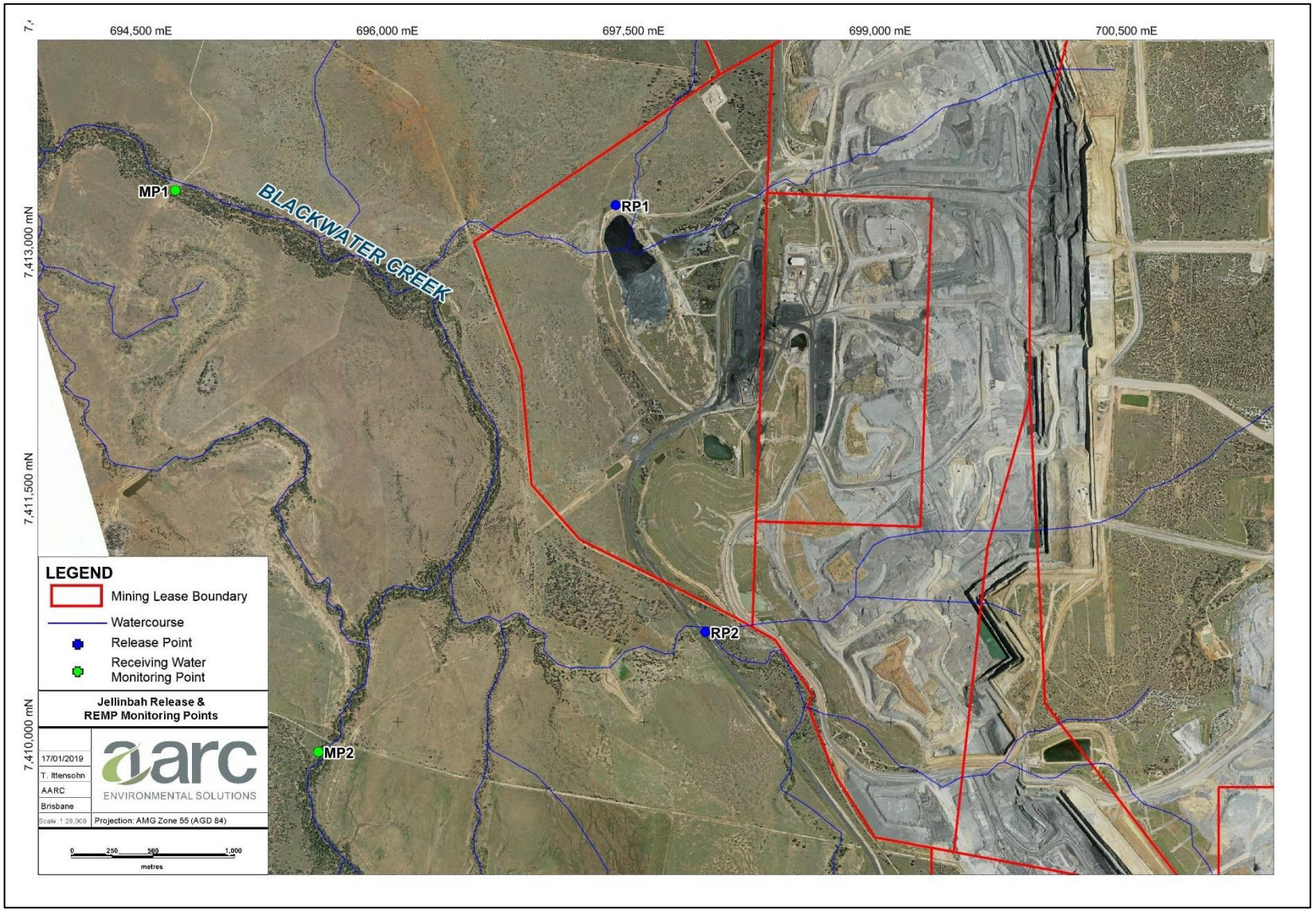

Figure 5 Release Points and Receiving Environment Monitoring Points – Blackwater Creek

5.1 TIMING AND FREQUENCY

Monitoring of the receiving environment occurs on a regular and event basis. Regular monitoring of surface water, stream sediments and macro-invertebrates is undertaken on an annual basis in March at all locations in Table 5, including Three and Five Mile Lagoons.

Additional surface water monitoring is undertaken on a daily basis during a release event only.

5.2 INDICATORS

Indicators for surface water, stream sediment and macro-invertebrates are adopted from a range of sources, including the Project's EA, ANZECC (2000) and EPP (Water) to ensure potential impacts to EVs are adequately assessed. Indicators for surface water, stream sediment and macro-invertebrates are listed in Table 6, Table 7 and Table 8, respectively.

Table 6 Surface Water Indicators

Quality Characteristics	Units	Limit of Reporting	Method
pH	pH units	-	Field
Temperature	°C	-	Field
DO	%	-	Field
EC	µS/cm	-	Field
TDS	mg/L	-	Field
Oxidation reduction potential (ORP)	mV	-	Field
Turbidity	NTU	-	Field
Suspended solids	mg/L	5	Laboratory
Calcium	mg/L	1	Laboratory
Magnesium	mg/L	1	Laboratory
Sodium	mg/L	1	Laboratory
Potassium	mg/L	1	Laboratory
Ammonia as N	mg/L	0.01	Laboratory
Nitrate as N	mg/L	0.01	Laboratory
Oxidised N	mg/L	0.01	Laboratory
Organic N	mg/L	0.1	Laboratory
Total N	mg/L	0.1	Laboratory
FRP	mg/L	0.01	Laboratory
Total P	mg/L	0.01	Laboratory
Sulphate as SO4-	mg/L	1	Laboratory
Chloride	mg/L	1	Laboratory
Fluoride	mg/L	0.1	Laboratory
Hydroxide Alkalinity (as $CaCO_3$)	mg/L	1	Laboratory
Carbonate Alkalinity (as $CaCO_3$)	mg/L	1	Laboratory

Quality Characteristics	Units	Limit of Reporting	Method
Bicarbonate Alkalinity (as $CaCO_3$)	mg/L	1	Laboratory
Total Alkalinity (as $CaCO_3$)	mg/L	1	Laboratory
Aluminium	mg/L	0.01	Laboratory – dissolved & total
Arsenic	mg/L	0.001	Laboratory – dissolved & total
Barium	mg/L	0.001	Laboratory – dissolved & total
Beryllium	mg/L	0.001	Laboratory – dissolved & total
Boron	mg/L	0.05	Laboratory – dissolved & total
Cadmium	mg/L	0.0001	Laboratory – dissolved & total
Chromium	mg/L	0.001	Laboratory – dissolved & total
Cobalt	mg/L	0.001	Laboratory – dissolved & total
Copper	mg/L	0.001	Laboratory – dissolved & total
Iron	mg/L	0.05	Laboratory – dissolved & total
Lead	mg/L	0.001	Laboratory – dissolved & total
Manganese	mg/L	0.001	Laboratory – dissolved & total
Molybdenum	mg/L	0.001	Laboratory – dissolved & total
Nickel	mg/L	0.001	Laboratory – dissolved & total
Selenium	mg/L	0.01	Laboratory – dissolved & total
Silver	mg/L	0.001	Laboratory – dissolved & total
Uranium	mg/L	0.001	Laboratory – dissolved & total
Vanadium	mg/L	0.01	Laboratory – dissolved & total
Zinc	mg/L	0.005	Laboratory – dissolved & total
Mercury	mg/L	0.0001	Laboratory – dissolved & total
Petroleum Hydrocarbon (C6 – C9)	µg/L	20	Laboratory
Petroleum Hydrocarbon (C10 – C36)	µg/L	50	Laboratory

Table 7 Stream Sediment Indicators

Quality Characteristics	Units	Limit of Reporting	Method
Moisture Content (dried @ 103°C)	%	1	Laboratory
Aluminium	mg/kg	50	Laboratory
Arsenic	mg/kg	5	Laboratory
Barium	mg/kg	10	Laboratory
Beryllium	mg/kg	1	Laboratory
Boron	mg/kg	50	Laboratory
Cadmium	mg/kg	1	Laboratory
Chromium	mg/kg	2	Laboratory
Cobalt	mg/kg	2	Laboratory

Quality Characteristics	Units	Limit of Reporting	Method
Copper	mg/kg	5	Laboratory
Iron	mg/kg	50	Laboratory
Lead	mg/kg	5	Laboratory
Manganese	mg/kg	5	Laboratory
Molybdenum	mg/kg	2	Laboratory
Nickel	mg/kg	2	Laboratory
Selenium	mg/kg	5	Laboratory
Silver	mg/kg	2	Laboratory
Vanadium	mg/kg	5	Laboratory
Zinc	mg/kg	5	Laboratory
Uranium	mg/kg	0.1	Laboratory
Mercury	mg/kg	0.1	Laboratory

Table 8 Macro-Invertebrates Indicators

Quality Characteristics	Units	Method
Total abundance	No.	Laboratory
Taxa richness	No.	Laboratory
SIGNAL 2 Score	-	Laboratory
PET taxa richness	No.	Laboratory

5.3 METHODOLOGY

5.3.1 Surface Water Monitoring

Samples are collected from each monitoring location (provided that water is present at the time) and field readings of oxygen saturation, temperature, EC, pH and TDS are recorded. Samples are immediately refrigerated and sent to a National Association of Testing Authorities (NATA) accredited laboratory for analysis. The results of the downstream water tests are compared to upstream water quality, the relevant EA trigger and trigger investigation levels, trigger levels for 95% species protection under the ANZECC aquatic ecosystems guideline, and the EPP (Water) WQOs to protect moderately disturbed aquatic ecosystems in the Mackenzie River Sub-basin.

5.3.2 Stream Sediment Monitoring

Samples are taken at each of the sites outlined in Table 5 in accordance with the most recent version of *AS5667.1 Guidance on Sampling of Bottom Sediments*. Samples are sealed in sterilised glass jars and sent to a NATA accredited laboratory for analysis of trace metals. The results of the receiving environment are compared with upstream sites and the trigger levels set out in the EA.

5.3.3 Biological Monitoring

Biological monitoring is used to assess the ecological health of any given ecosystem and has the potential to provide a more direct indication of ecosystem health than episodic sampling of water quality. Biological monitoring uses surveys and other direct measurements of organisms and/or communities that are used to provide data on biological or ecological changes that result from changes in water quality, physical habitat (such as sedimentation, hydrological changes) and biological interactions (including the introduction of exotic weed species).

Biological monitoring is generally concerned with obtaining an assessment of the current condition of a watercourse relative to its natural (or baseline) condition. The condition of a site can then be described in terms of the amount of change over time, compared to an undisturbed reference site. Wherever possible the biological indicators at the impacted site are compared with the same biological indicators at a reference site to provide an assessment of change in condition.

5.3.3.1 Macro-Invertebrate Monitoring

Macro-invertebrates are invertebrates that can be seen with the naked eye. The types and numbers of macro-invertebrates found in a river or creek can be used as biological indicators (bio-indicators) of the health of that environment for the following reasons:

1) They are generally sensitive to the cumulative impacts of a wide range of disturbances and pollutants;

2) They are abundant in freshwater systems;

3) They are relatively easy to identify; and

4) They are easy to collect (Chessman 2003).

The monitoring of macro-invertebrates is undertaken in accordance with the AusRivas methodology and samples are taken at each site where water is present.

Macro-invertebrates are collected using a D-frame pond net (350 millimetres (mm) x 250 mm with 250 micrometre (µm) mesh) and employing a kick-sampling method (the substrate in the waterbody is disturbed and the net passed through the resulting plume to obtain benthos- and water column-dwelling macro-invertebrates). At each site a representative sweep is taken across various sections of edge habitat along a 100 metres (m) length of stream (where possible).

Macro-invertebrates are placed in a white sorting tub and ‘live-picked’ using a pipette and tweezers for a period of 20 minutes. Macro-invertebrates are placed in a vial containing 70% methylated spirits and sent to a NATA accredited laboratory for identification to family or sub-family level. Data are plotted on a Stream Invertebrate Grade Number – Average Level (SIGNAL) bi-plot for interpretation of 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.

Once plotted on a bi-plot, the SIGNAL Index and the number of invertebrate families found in a stream used together can provide an indication of the types of pollution and other physical and chemical factors that affect macro-invertebrate communities (Chessman 2003), depending on their position within the graph (refer to Figure 6).

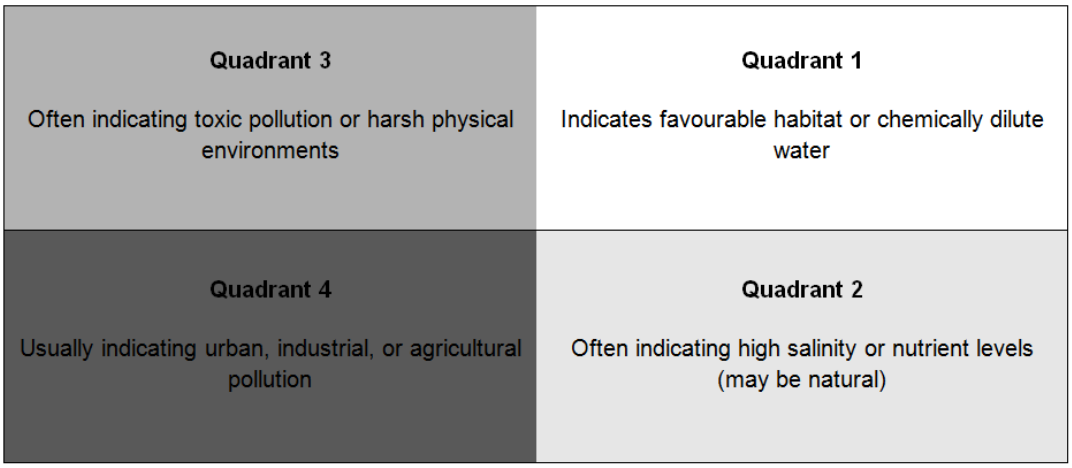

Figure 6 Bi-plot Interpretation

5.4 DATA INTERPRETATION AND REPORTING

Field and laboratory data will be entered into a central database and compared with previous years' REMP results. In accordance with condition C25 of the EA, a REMP Findings Report will be prepared on an annual basis. This report will include an assessment of:

- Background reference water quality;
- The condition of downstream water quality compared against WQOs; and
- The suitability of current discharge limits to protect downstream EVs.

Assessment of water quality, stream sediment and macro-invertebrate data will be in accordance with relevant guidelines, including the *Queensland Monitoring and Sampling Manual 2009* (EHP 2010) and ANZECC (2000).

5.4.1 Investigation Requirements

REMP

The Trigger Action Response Plan (TARP) developed for the Jellinbah 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 Table 1.

Release Event

Note that the following investigation requirement only applies to an exceedance during a release event.

In accordance with condition C22 of the EA, where a result at a downstream monitoring location (excluding Five Mile Lagoon) exceeds both the Receiving Waters Contaminant Trigger Levels and the corresponding upstream result, an investigation into environmental harm must be conducted. The

investigation must include actions taken to prevent environmental harm and be submitted with the Project's Annual Return.

C22 If quality characteristics of the receiving water at the downstream monitoring points exceed any of the trigger levels specified in Table C7 during a release event the environmental authority holder must compare the downstream results to the upstream results in the receiving waters and:

a) Where the downstream result is the same or a lower value than the upstream value for the quality characteristic then no action is to be taken; or

b) Where the downstream results exceed the upstream results complete an investigation into the potential for environmental harm and provide a written report to the administering authority in the next annual return, outlining:

i) Details of the investigations carried out; and

ii) Actions taken to prevent environmental harm.

Note: Where an exceedance of a trigger level has occurred and is being investigated, in accordance with C22 b) of this condition, no further reporting is required for subsequent trigger events for that quality characteristic.

5.5 QUALITY ASSURANCE AND QUALITY CONTROL

5.5.1 Data Collection and Sampling

Field work conducted for the purposes of this REMP will be undertaken by a suitably qualified and experienced person. Data collection will be conducted in a professional manner with the highest attention paid to quality assurance and quality control procedures.

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

At each REMP site, water quality measurements and water samples shall be collected prior to any other sampling to reduce sample contamination and bias of in-situ turbidity readings. Care shall be taken to prevent disturbance to the stream bed or banks when undertaking these tasks.

Prior to the collection of field filtered samples, the sampling syringe shall be rinsed twice using sampling water collected in a sample container. The entire inside surface of the syringe is to come in contact with the sample. The syringe shall then be refilled and a filter attached. The first 2 ml of the sample shall be discarded through the filter as a filter rinse, before filling the sample bottle via the filter.

For the macro-invertebrate monitoring, the nets and sorting tubs shall be thoroughly rinsed prior to sampling at each REMP site to prevent sample contamination.

5.5.2 Laboratory Analysis

All samples and specimens requiring laboratory analysis will be sent to a NATA laboratory. All NATA laboratories conduct analysis with the highest quality assurance procedures to ensure the accuracy of results.

In accordance with those requirements, the analysing laboratory will also be responsible for undertaking a range of QC/QA checks, (e.g. evaluation of sample preservation and holding times, relative performance differences (RPD) on duplicate samples, etc). The result of these QC/QA checks will be provided with the raw quality data in the report appendices.

All label information on each sampling bottle shall be completed while at the REMP site and checked during the completion of the Chain of Custody (COC) forms prior to sample dispatch. Sampling bottles containing dissolved water shall be appropriately demarcated as field filtered.

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

The COC's for each batch of samples are to be included in the coolers.

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

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

5.5.3 Data Interpretation

The interpretation of all results required under this REMP will be conducted in a professional manner by a suitably qualified and experienced person to ensure accuracy of interpretation and quality assurance.

6.0 REFERENCES

AARC Environmental Solutions Pty Ltd (AARC) 2013, *Mackenzie North Project: Aquatic Ecology Report*, report prepared for Jellinbah Resources Pty Ltd, July 2013.

Australian & New Zealand Environment & Conservation Council 2000, *Australian Water Quality Guidelines for Fresh and Marine Waters*, October 2000.

Chessman, B. 2003, SIGNAL 2 – *A Scoring System for Macro-invertebrate ('Water Bugs') in Australian Rivers*, Monitoring River Health Initiative Technical Report no 31, Commonwealth of Australia, Canberra.

Department of Environment and Heritage Protection (EHP) 2010, *Monitoring and Sampling Manual 2009 – Environmental Water (Protection) Policy 2009, Version 2*, State of Queensland, July 2013.

Department of Environment and Heritage Protection (EHP) 2011, *Environmental Protection (Water) Policy 2009 Mackenzie River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Mackenzie River Sub-basin*, State of Queensland, September 2011.

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Department of the Environment and Heritage 2003, *SIGNAL 2.iv – A scoring system for macroinvertebrates ('water bugs') in Australian rivers – user manual*, Australian Government.

Ison Environmental Planners 2010, *Receiving Environmental Monitoring Program – Jellinbah Coal Project*, report prepared for Jellinbah Mining Pty Ltd, October 2010.

Standards Australia 1999, *AS/NZS 5667.12:1999 Water Quality – Sampling. Part 12: Guidance on sampling of bottom sediments*, Standards Australia and Standards New Zealand, Homebush, NSW.

WRM Water & Environment 2013, *Mackenzie North Project: Surface Water Impact Assessment*, report prepared for Jellinbah Resources Pty Ltd, July 2013.

Appendix A Trigger Action Response Plan

A

<table>
<tr><td rowspan="2">Trigger Conditions</td><td>Level 1 Response</td><td>Level 2 Response</td><td>Level 3 Response</td></tr>
<tr><td>Reference Value (Upstream) > Impact Value (Downstream)</td><td>Impact Value (Downstream) > Reference Value (Upstream)</td><td>Impact Value (Downstream) > Reference Value (Upstream); and

First response determined significant or ongoing potential for environmental harm to occur</td></tr>
<tr><td colspan="4">Actions</td></tr>
<tr><td>First Response/Immediate Actions</td><td rowspan="3">No further action required</td><td colspan="2">1. Visually inspect relevant section of the waterway;
2. If applicable, identify the potential source of contaminants and stop the source (e.g. turn off pump);
3. If applicable, contain the spread of contaminants by implementing immediate mitigation measures (e.g. absorbent pads, or install sumps); and
4. Assess the potential for significant or ongoing environmental harm to occur.</td></tr>
<tr><td>Potential for Environmental Harm</td><td>No significant or ongoing potential for environmental harm to occur</td><td>Significant or ongoing potential for environmental harm to occur</td></tr>
<tr><td>Immediate Notification Requirements</td><td>No immediate notification requirements</td><td>In accordance with conditions A11 and A12 of the Jellinbah EA, administering authority must be notified of the incident by telephone or email. Details must be provided including the cause of incident, the potential for environmental harm and immediate actions taken etc. (see Jellinbah EA for further details and requirements)</td></tr>
</table>

A

Monitoring, Investigation and Reporting		If necessary, continue monitoring to ensure no significant or ongoing potential for environmental harm. Conduct a follow-up investigation/report if required.	Continue monitoring to ensure no additional potential for significant or ongoing environmental harm occurs. In accordance with condition A14 of the Jellinbah EA, results of any additional environmental monitoring conducted in response to a reported incident must be provided to the administering authority, as soon as practicable (but not more than **6 weeks** following the incident). See Jellinbah EA for further details. Conduct an investigation to identify the cause of environmental harm: ● Review historical REMP data; ● If available, review real-time monitoring gauge data; ● If required, undertake additional site inspection; ● Assess success of immediate mitigation measures; and ● If required, recommend long-term mitigation and remediation measures to prevent a recurrence of contamination. In accordance with condition A13 of the Jellinbah EA, not more than

B

			14 days following the initial notification of an incident, written advice must be provided outlining the following: ● Proposed actions to prevent a recurrence of the incident; and ● Outcomes of actions taken at the time to prevent or minimise environmental harm.
Implement Long-term Mitigation Measures		No implementation of long-term mitigation measures necessary	Implement long-term mitigation measures to prevent the recurrence of environmental harm. Examples of long-term mitigation measures include: ● Install new water management infrastructure; ● Upgrade pipelines; ● Modify or reshape drains; and/or ● Review and update Water Management Plan.

C