ISAAC RIVER COAL PROJECT

Underground Water Impact Report

Prepared for:

Bowen Coking Coal
Level 7 167 Eagle Street
Brisbane QLD 4000

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Bowen Coking Coal (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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DOCUMENT CONTROL

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1 Introduction

1.1 Overview

SLR has been engaged by Bowen Coking Coal Ltd (BCC) to prepare an Underground Water Impact Report (UWIR) for the Isaac River Coal Project (the Project). The Project is proposed to be developed by Coking Coal One Pty Ltd, a wholly owned subsidiary of BCC. As part of preparations for anticipated secondary approvals for the Project commencement, the UWIR is required to address Queensland regulatory requirements under Chapter 3 of the *Water Act (2000)* (Water Act). The purpose of an UWIR is to describe, make predictions and manage the impacts of groundwater extraction by resource tenure holders. The UWIR sets out the responsibilities of the resource tenure holders and ensures that effective measures and strategies are in place to respond to impacts on the identified underground water systems. This report covers the initial UWIR for the Project.

1.2 Approvals Background

In 2019, BCC submitted an Environmental Authority (EA) application to the Queensland Department of Environment and Science (DES) for the Project on ML 700062 and ML 700063. Water resources assessments supporting the application were presented in an Environmental Assessment Report prepared by CDM Smith (2021). DES issued the final EA (EA100114091) for the Project on 29 March 2022. Schedule D of the EA pertains to groundwater and is directly relevant to this UWIR.

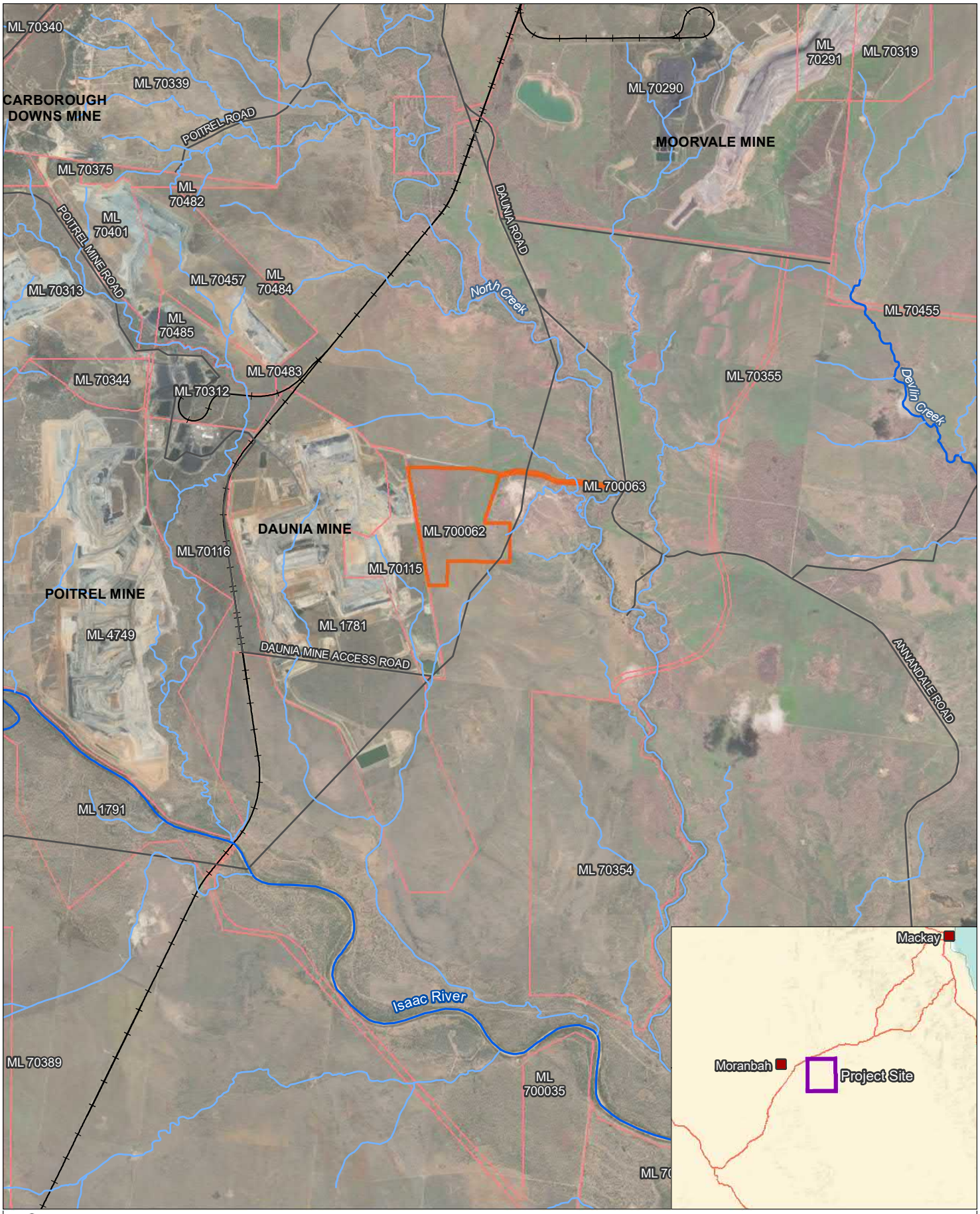
Additionally, a referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was provided to the Department of Agriculture, Water and the Environment (DAWE) now the Department of Climate Change the Environment and Water (DCCEW) in 2021 (EPBC 2021/8980). In August 2021, DAWE informed BCC that the proposed action was a controlled action, and the Project would require assessment under the EPBC Act which includes submission to the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC).

A UWIR for the Project is required to address Queensland regulatory requirements under Chapter 3 of the Water Act. This report presents the UWIR for the Project, prepared prior to the commencement of mining in accordance with Chapter 3 of the Water Act. The UWIR is based on the information contained in the groundwater assessment and associated numerical modelling (CDM Smith, 2021), and describes the potential impacts of underground water extraction by the Project and proposed management and mitigation measures, with specific reference to the requirements of Chapter 3 of the Water Act.

1.3 Project Area

The Project is a proposed open cut coal mine located approximately 28 kilometres (km) to the east of Moranbah in central Queensland. It is situated to the immediate east of the operating Daunia Coal Mine in the northern area of the Bowen Basin (**Figure 1**).

The Project is located on ML 700062 and ML 700063, and is within the Isaac Regional Council Local Government Area. The Project will consist of open cut extraction of approximately 500,000 tonnes per annum (tpa) on ML 700062 through truck and shovel methodology. These methods will target the Vermont and Leichhardt seams within the Rangal Coal Measures and mine life is expected to be approximately five years (commencing in approximately Q2 2023). The total estimated coal resource proposed to be mined over the five-year life of the Project is approximately 2.5 million tonnes (Mt).



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:100,000 at A4
Project Number:	620.30757
Date:	30-Aug-2022
Drawn by:	NT

- Major Watercourse
- Minor Watercourse
- Road
- Rail
- Mining Lease (Approved)
- Project Mining Lease (Application)

SLR

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

ISAAC RIVER PROJECT

Project Locality

FIGURE 1

H:\Projects-SLR\620-BNE\620.30757.00000 Isaac River Coal Project Groundwater\03 SLR Data\01 GIS\GIS\UWIR\SLR620307S7_F01_ProjectLocality_01.mxd

The total disturbance footprint for the Project, including the mining area, infrastructure areas, and linear infrastructure corridors is approximately 339.29 hectares (ha), and is divided into two main domains:

- ML 700062 on which mining activities and associated infrastructure will occur.
- ML 700063 over the existing access road corridor used for Daunia Quarry operations.

The Project lies in a region of particularly intensive resource extraction activity, sitting immediately adjacent to and east of BHP Billiton Mitsubishi Alliance (BMA) active Daunia Mine coal operations, immediately west of Peabody's proposed/approved Moorvale South Project, northwest of Pembroke's proposed/approved Olive Downs Project, and just north of Whitehaven's proposed Winchester South Project. This has two main implications for the Project groundwater assessment/approvals:

1. the potential for cumulative (overlapping) groundwater impacts, and
2. the availability of a significant body of groundwater data, studies and assessments of high relevance to the Project, that may be potentially drawn upon to fill any identified gaps for the UWIR.

1.4 Queensland Regulatory Framework

The obligations and underground water rights for ML 700062 and ML 700063 are regulated through:

- *Water Act (2000)* and *Mineral Resources Act (1989)*;
- *Environmental Protection Act (1994)* (EP Act) and associated Project Environmental Authority (EA) Conditions; and
- *Environmental Protection (Water and Wetland Biodiversity) Policy (2019)*.

The following sections summarise Queensland Government legislation and policy for groundwater that applies to the management of groundwater affected by open pit mining projects.

1.4.1 Water Act 2000

The statutory right of a tenure holder to take or interfere with underground water is granted as part of the Mining Lease approval under the *Mineral Resources Act 1989*, if the taking or interference with that water is necessarily and unavoidably obtained in the process of extracting the mineral resource. In developing the Project, BCC is proposing to exercise its underground water rights as part of planned mining activities. Chapter 3 of the Water Act deals with the management of water related impacts resulting from such an exercise of underground water rights.

The Water Act, supported by the subordinate *Water Regulation 2016*, is the primary legislation regulating groundwater resources in Queensland. The purpose of the Water Act is to advance sustainable management and efficient use of water resources by establishing a system for planning, allocation and use of water. The Water Act is enacted under a framework of catchment specific Water Plans (WPs). Water resources within the Project area are captured under the Water Plan Fitzroy Basin 2011. The plan covers surface water (zone WQ1301) associated with the Isaac River, and groundwater (zone WQ1310 – Fitzroy Basin groundwater). Groundwater in WQ1310 are divided into two units: Groundwater Unit 1 (containing aquifers of the Quaternary alluvium) and Groundwater Unit 2 (sub-artesian aquifers).

Chapter 3 of the Water Act provides a framework that requires the tenure holder to prepare an UWIR, the mechanism by which the potential impacts to underground water are managed under the Water Act. The main purpose of an UWIR is to describe, make predictions about and manage the impacts of underground water extraction by the tenure holder. An Initial UWIR must be submitted for approval no later than the day before the tenure holder exercises its underground water rights. Generally, the Initial UWIR must be updated with a Revised UWIR three years after the Initial UWIR took effect. A Final UWIR is also required upon tenure relinquishment.

Trigger levels are listed in Chapter 3 of the Water Act, to assist in the assessment of impacts on aquifers in the UWIR if groundwater levels are predicted to decline as a result of the exercise of underground water rights. The trigger levels are:

- A 5 m decline in water levels within a consolidated aquifer (such as coal or sandstone);
- A 2 m decline in water levels within an unconsolidated aquifer (such as alluvium); and
- A 0.2 m decline in water levels associated with active springs.

Where predicted water level declines in aquifers exceed the relevant trigger level within the first three year period of the UWIR, the areas subject to the decline are defined as Immediately Affected Areas (IAA). Declines in water levels in aquifers that exceed the trigger level at any time are defined as Long Term Affected Areas (LTAA).

The Water Act framework ensures there is sufficient monitoring, collection, and review of information to manage any impacts during the exercise of underground water rights. A summary of requirements for the UWIR under the Water Act and the relevant sections of this report in which they are addressed are shown in **Table 1**.

Table 1 UWIR requirements under the Water Act

Water Act Requirements	Sub-Requirements	UWIR Report Section
S376 (a)	An UWIR must include, for the area to which the report relates:	
	(1) the quantity of water produced or taken from the area because of the exercise of any previous relevant underground water rights; and	**2.1**
	(2) an estimate of the quantity of water to be produced or taken because of the exercise of the relevant underground water rights for a three year period starting on the consultation day for the report.	**2.2**
S376 (b)	For each aquifer affected, or likely to be affected, by the exercise of the relevant underground water rights:	
	(1) description of the aquifer;	**3.1, 3.2** and **3.6**
	(2) an analysis of the movement of underground water to and from the aquifer, including how the aquifer interacts with other aquifers;	**3.3, 3.4** and **3.5**
	(3) an analysis of the trends in water level change for the aquifer because of exercise of underground water rights;	**3.4** and **4.3**
	(4) a map showing the area of the aquifer where the water level is predicted to decline, because of the taking of the quantities of water mentioned in paragraph (a), by more than the bore trigger threshold within three years after the consultation day or the report; and	**4.4**
	(5) a map showing the area of the aquifer where the water level is predicted to decline, because of the exercise of relevant underground water rights, by more than the bore trigger threshold at any time.	**4.3**

Water Act Requirements	Sub-Requirements		UWIR Report Section
S376 (c)	A description of the methods and techniques used to obtain the information and predictions under paragraph (b).		**4.1**
S376 (d)	A summary of information about all water bores in the area shown on a map mentioned in paragraph (b)(iv), including the number of bores, and the location and authorised use or purpose of each bore.		**4.4.3.1**
S376 (da)	A description of the impacts on environmental values that have occurred, or are likely to occur, because of any previous exercise of underground water rights.		Not applicable
S376 (db)	An assessment of the likely impacts on environmental values that will occur, because of the exercise of underground water rights:		
	(1) during the period mentioned in paragraph (a)(2); and		**5.4**
	(2) over the projected life of the resource tenure.		**5.4**
S376 (e)	A program for:		
	(1) conducting an annual review of the accuracy of each map prepared under paragraph (b)(4) and (5); and		**4.5**
	(2) giving the chief executive a summary of the outcome of each review, including a statement of whether there has been a material change in the information or predictions used to prepare the maps.		**6.5.2**
S376 (f)	A water monitoring strategy:		
	S378 (1) a responsible entity's water monitoring strategy must include the following for each immediately affected area and long term affected area identified in its underground water impact report or final report:	(a) a strategy for monitoring: (1) the quantity of water produced or taken from the area because of the exercise of relevant underground water rights; and (2) changes in the water level of, and the quality of water in, aquifers in the area because of the exercise of the rights;	**6.2, 6.3** and **6.4**
		(b) the rationale for the strategy;	**6.1**
		(c) a timetable for implementing the strategy; and	**6.5.2**
		(d) a program for reporting to the commission about the implementation of the strategy.	**6.5.2**
	S378 (2) the strategy for monitoring mentioned in subsection (1)(a) must include:	(a) the parameters to be measured;	**6.3**
		(b) the locations for taking the measurements; and	**6.2**
		(c) the frequency of the measurements.	**6.2** and **6.3**
	S378 (3) if the strategy is prepared for an underground water impact report, the strategy must also include a program for the responsible tenure holder or holders under the report to undertake a baseline assessment for each water bore that is:	(a) outside the area of a resource tenure; but	**6.5.1**
		(b) within the area shown on the map prepared under section 376 (b)(5).	**6.5.1**
	S378 (4) If the strategy is prepared for a final report, the strategy must also include a statement about any matters under a previous strategy that have not yet been complied with.		Not applicable to this UWIR
S376 (g)	A spring impact management strategy:		
		(1) details of the spring, including its location;	Not applicable – no springs identified
		(2) assessment of connectivity between the spring and the aquifer over which the spring is located;	

Water Act Requirements	Sub-Requirements		UWIR Report Section
	S379 a spring impact management strategy:	(3) the predicted risk to, and likely impact on, the ecosystem and cultural and spiritual values of the spring because of the decline in water level of the aquifer over which the spring is located;	
		(4) a strategy for preventing or mitigating the predicted impacts outline above; or is a strategy for prevention or mitigating the predicted impacts is not included, the reason for not including the strategy;	
		(5) timetable for implementing the strategy; and	
		(6) program for reporting to OGIA about the implementation of the strategy.	
S376 (h)	If the responsible entity is the office:		
	(1) a proposed responsible tenure holder for each report obligation mentioned in the report; and		Not applicable to this UWIR
	(2) or each immediately affected area - the proposed responsible tenure holder or holders who must comply with any make good obligations for water bores within the immediately affected area.		
S376 (i)	Other information or matters prescribed under a regulation.		Not applicable

1.4.2 Environmental Protection Act 1994

The *Environmental Protection Act 1994* (EP Act) has the objective to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains ecological processes on which life depends i.e. ecologically sustainable development. The EP Act defines an environmental value (EV) as:

- a quality or physical characteristic of the environment that is conducive to ecological health or public amenity or safety; or
- another quality of the environment identified and declared to be an environmental value under an environmental protection policy or regulation.

Under the EP Act, mining operations are authorised through the EA process. BCC submitted an EA application to DES for the Project with the final EA (EA100114091) for the Project granted on 29 March 2022. Schedule D of the EA pertains specifically to groundwater, containing 19 conditions. This UWIR has been developed consistent with the relevant requirements of the EA where applicable, for example the development of the Project's groundwater monitoring strategy (**Section 6**).

1.4.3 Environmental Protection (Water and Wetland Biodiversity) Policy 2019

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

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

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

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

The EPP Water and Wetland Biodiversity also provides limited water quality objectives for underground aquatic ecosystem protection in Fitzroy Basin groundwaters. These WQOs provided in the EPP Water and Wetland Biodiversity are classified by groundwater depth and regional chemistry zone.

Section 5 of this UWIR discusses the Project's potential effects on EVs.

1.5 Report Structure

The main purpose of the UWIR is to describe the impacts and monitoring strategies from exercising underground water rights within the Project over a three-year period (the UWIR period). This UWIR addresses the initial three-year length of the Project form the commencement of operational activities. The planned operational activities during this UWIR period relevant to groundwater includes open cut extraction through truck and shovel down to the Vermont and Leichhardt Seams. The Project has not exercised its underground water rights to take groundwater prior to the development of this initial UWIR.

The UWIR has been prepared in accordance with Section 376 of the Water Act and the *Guideline (Water Act 2000) Underground Water Impact Reports and Final Reports* (the Guideline) (DES, 2021), where relevant.

The UWIR structure is based on the framework of the Water Act (Section 376). The structure is detailed in the Guideline. The UWIR must include the following sections:

- Part A: Information about underground water extractions resulting from the exercise of underground water rights (Section 2);
- Part B: Information about aquifers affected, or likely to be affected (Section 3);
- Part C: Maps showing the area of the affected aquifer(s) where underground water levels are expected to decline (Section 4);
- Part D: An assessment of the impacts to the environmental values from the exercise of underground water rights (Section 5); and
- Part E: A water monitoring strategy (Section 6).

A spring impact management strategy (Part F) is not required as no springs have been identified. Likewise, the Project does not lie in a Cumulative Management Area (CMA) and therefore Part G does not apply.

1.6 Summary of Methods

As noted in the UWIR guidelines, the information supplied with the EA will be utilised and built upon for the submission of this UWIR. Like the EA, this UWIR is based upon the information in the Project's Environmental Assessment Report (EAR) (CDM Smith, 2021).

The scope of work for this initial UWIR updates and re-presents the existing approved groundwater assessment from the Project's EAR (CSM Smith, 2021) to allow information specific to the UWIR period to be presented. The scope includes:

- Part A: Quantification of estimated groundwater extraction volumes for the first three years of operation, based on numerical groundwater model predictions.
- Part B: Characterisation of aquifer units and assessment of potential impacts from extraction of underground water from mining activities, including:
    - Description of each of the groundwater bearing units relevant to the Project. Based on reported details included in Section 7 of the groundwater impact assessment (CDM Smith, 2021), updated to include more recent groundwater monitoring data for the site;
    - Updated hydrographs with groundwater level readings to present; and
    - Maps showing the groundwater levels under current (pre-mining) conditions within the Permian coal measures and alluvium.
- Part C: Assessment of predicted impacts on water levels in each aquifer unit including methods and techniques used to predict these impacts. To include development of drawdown maps for the life of the Project for the initial three years of the project, and maximum drawdown over the Project life;
    - Maps showing the change in groundwater levels for each year for the first three years of operation for the Permian coal measures and alluvium, including landholder bores;
    - Maps showing the outline of the maximum predicted drawdown for the Permian coal measures and alluvium, including landholder bores; and
    - Table with landholder bores potentially impacted and the level of drawdown in each bore in years one to three, and the maximum predicted drawdown in each bore.
- Part D: Assessment of impacts to EVs in accordance with the EP Act and EPP (Water), including:
    - Reference to characterisation of groundwater units presented in Part B and summary of water values and users relevant to the Project, including landholders, surface water features (e.g. Isaac River) and groundwater dependent ecosystems (GDEs);
    - Present model predictions on the change in baseflow contributions to Isaac River as a result of the Project for each year in the first three years of operation;
    - Refer to change in groundwater levels at landholder bores as covered in Part C and discuss impact on the value/use of the bore (i.e. pumpable capacity);
    - Present the change in groundwater levels/depth to groundwater at identified vegetation communities that may be reliant on groundwater, each year for the first three years of operation;
    - Identify site activities planned in the first three years of operation that have potential to change groundwater quality (e.g. spoil dumps, mine water dams, fuel storage areas, workshops), and discuss in relation to proximity to groundwater receptors; and

    - Risk assessment based on the predicted changes in groundwater conditions in the first three years of operation, compared to the sensitivity of groundwater users to changes in groundwater level.

- Part E: Documentation of a water monitoring program, consistent with the EA conditions issued in Schedule D (Groundwater) of EA10114091 which include the requirement for a Groundwater Management and Monitoring Program (GMMP).

2 Part A: Underground Water Extractions

The following section discusses the estimated underground water extraction expected to occur during the first three years of the UWIR reporting period, following the consultation day[1]. Expected extraction is based on projected groundwater inflow estimates, and the methodology adopted to develop those estimates is discussed. This section addresses the requirements under Section 376 (a) of the Water Act (**Table 2**).

Table 2 Requirements under Section 376 (a) of the Water Act

Requirements under Section 376 (a) of the Water Act	Relevant UWIR Report Section
The quantity of underground water produced or taken from the area because of the exercise of underground water rights; and	**2.1**
An estimate of the quantity of water to be produced or taken because of the exercise of underground water rights for a three year period starting on the consultation day for the report.	**2.2**

2.1 Quantity of Water Already Produced

The taking of water from the Project will occur concurrent with mining activities. Mining activities are not scheduled to commence until the second quarter of 2023. The quantity of water already produced is therefore zero.

2.2 Quantity of Water to be Produced Over the Next Three Years

Predictive modelling was undertaken by CDM Smith (2021), which provided an estimate of groundwater inflows for the life of the Project, including the first three years of the Project. The modelling section of the EAR (CDM Smith, 2021) provides a full description of the methodology and results of the groundwater modelling.

The Project directly intercepts groundwater from Groundwater Unit 2 (sub-artesian aquifers) under the Water Plan (Fitzroy Basin) 2011, i.e. from the Permian coal measures. The predicted take of groundwater has been extracted from the model drain cells and hydrogeological budget zones. The predicted direct take over time is presented in Section 4 of the EAR Groundwater Assessment. The annual groundwater take for the first three years of the UWIR period is shown in **Table 3**.

Table 3 Estimated Volume of Groundwater Take (CDM Smith, 2021)

Year	Estimated Inflow (ML/year)
LOM Year 1	0
LOM Year 2	88
LOM Year 3	122

The increase in the estimated volume of groundwater take in Year 1 (0 ML/year) to Year 3 (122 ML/year) is a result of intersecting groundwater during operational activities in Year 2, i.e. mining does not occur below the water table in Year 1.

[1] Section 362 of the Water Act defines the consultation day as the day a notice is first published about the proposed report.

3 Part B: Aquifer Information and Underground Water Flow

This section addresses the requirements under Section 376 (b)(1) to 376 (b)(2) of the Water Act (**Table 4**). The section includes a description of aquifers within or adjacent to the Project boundaries, groundwater flow directions, hydraulic properties, groundwater quality, hydrographs, and structural geology to inform the assessment of aquifer connectivity and groundwater level trends. The information within this section is based upon and updated from the Project's EAR groundwater assessment (CDM Smith, 2021).

Table 4 Requirements under Section 376 (b)(1) to 376 (b)(2) of the Water Act

Requirements under Section 376 (b)(1) to 376 (b)(2) of the Water Act	Relevant UWIR Report Section
For each aquifer affected, or likely to be affected, by the exercise of the relevant underground water rights, an UWIR must include:	
A description of the aquifer;	**3.1, 3.2** and **3.6**
An analysis of the movement of underground water to and from the aquifer, including how the aquifer interacts with other aquifers; and	**3.3, 3.4** and **3.5**
An analysis of the trends in water level change for the aquifer because of the exercise of underground water rights.	**3.4**

3.1 Aquifer Information (Hydrogeology)

This section describes all aquifers that occur within or adjacent to the Project boundaries. The hydrogeological regime relevant to the Project comprises the following hydrogeological units:

- Cainozoic sediments:
  - Quaternary alluvium – unconfined partially saturated aquifer localised along the Isaac River and North Creek;
  - Regolith – unconfined and largely unsaturated unit bordering the alluvium;
- Triassic Rewan Group – aquitard;
- Granitoid intrusion – aquitard / lateral flow barrier;
- Permian coal measures with:
  - Hydrogeologically 'tight' interburden units; and
  - Coal sequences that exhibit secondary porosity through cracks and fissures.

This section discusses each of the hydrogeological units relevant to the Project, covering hydraulic properties, groundwater occurrence, hydraulic gradients, recharge, discharge, and groundwater quality.

3.2 Groundwater Monitoring

BCC has a Project baseline groundwater monitoring network that comprises a total of seven bores. The network was first established in 2019. The existing monitoring bores target the following hydrostratigraphic units:

- Triassic Rewan Group; and
- Permian Rangal Coal Measures - coal seams, interburden and overburden material.

The locations of the existing monitoring bores are shown in **Figure 2** and completion details are provided in **Table 5**.

Table 5 Existing Monitoring Bore Completion Details

Bore ID	Easting (GDA94/ MGA55)	Northing (GDA94/ MGA55)	Ground level (m AHD)	TOC level (m AHD)	Screen top (m bgl)	Screen base (m bgl)	Total bore depth (m bgl)	Screened hydrogeological unit and associated lithology
CB07 / PPD001A	635976	7559377	223	223.30	45.2	51.2	51.2	Rangal Coal Measures: claystone and siltstone
CB08 / PPD001B	635976	7559377	223	223.60	73	79	79	Rangal Coal Measures: coal seams, minor siltstone and tuff
PPD002B	635900	7559986	222	222.94	52.1	55.1	55.1	Rangal Coal Measures: siltstone and sandstone
PPD002C	635900	7559986	222	222.95	99	102	102	Rangal Coal Measures: sandstone
PPD003A	635611	7559923	226	226.90	45.1	51.1	51.1	Rangal Coal Measures: siltstone
PPD003B	635611	7559923	226	226.90	66	69	69	Rangal Coal Measures: siltstone and coal seams
WW04A	636619	7560695	229	229.80	42.2	54.2	54.2	Rangal Coal Measures: clayey sand, siltstone and coal seams

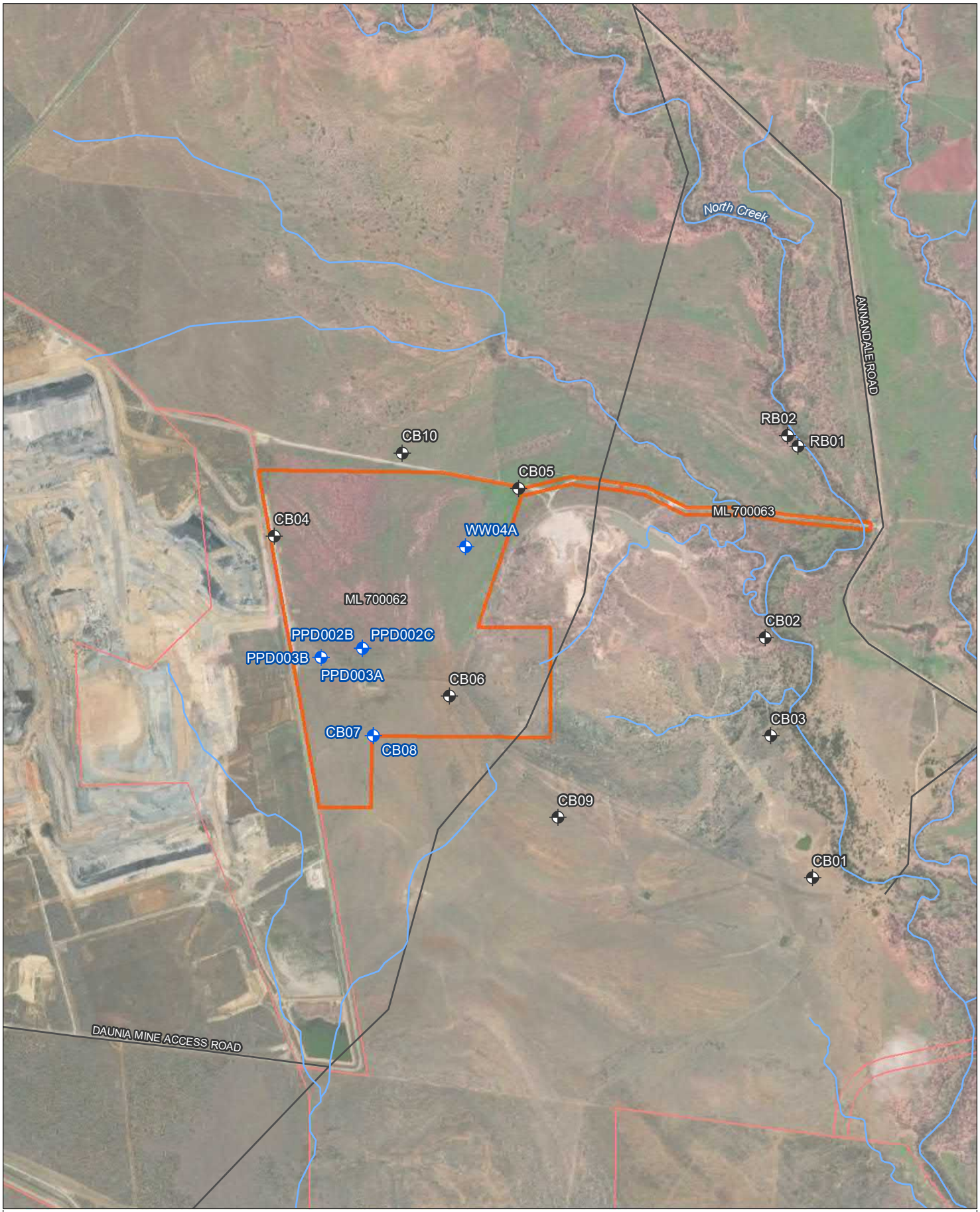
Notes: m bgl – metres below ground level m AHD – metres Australian Height Datum

Additional monitoring bores were proposed in the EAR (CDM Smith, 2021) to replace the existing bores that will be mined out in the first years of mining and are incorporated in the Project's EA and Groundwater Management and Monitoring Program (GMMP; **Appendix C**). Additional proposed bores include installation of alluvial monitoring bores adjacent to North Creek. Proposed monitoring bore details are provided in **Table 6** and locations are shown in **Figure 2**. Note that two of the EA / GMMP monitoring bores have already been installed, CB07 (also referred to as PPD001A) and CB08 (also referred to as PPD001B) (refer **Table 5**).

Table 6 EA / GMMP Proposed Monitoring Bore Details

Bore ID	Type	Easting (GDA94/ MGA55)	Northing (GDA94/ MGA55)	Proposed screen depth (m bgl)	Proposed monitored unit
RB01	Reference Bore	638937	7561395	30-70	Rangal Coal Measures
RB02	Reference Bore	638864	7561470	10-30	Alluvium
CB01	Compliance Bore	639039	7558386	10-30	Alluvium
CB02	Compliance Bore	638709	7560060	10-30	Alluvium
CB03	Compliance Bore	638748	7559377	10-30	Alluvium

Bore ID	Type	Easting (GDA94/ MGA55)	Northing (GDA94/ MGA55)	Proposed screen depth (m bgl)	Proposed monitored unit
CB04	Compliance Bore	635285	7560768	20-40	Rangal Coal Measures
CB05	Compliance Bore	636991	7561100	20-40	Rangal Coal Measures
CB06	Compliance Bore	636508	7559654	20-40	Rangal Coal Measures
CB09	Compliance Bore	637264	7558807	20-40	Rangal Coal Measures
CB10	Compliance Bore	636177	7561348	20-40	Rangal Coal Measures



0 0.5 1 km

Minor Watercourse
Road
Mining Lease (Approved)
Project Mining Lease (Application)

Groundwater Monitoring Bore
Existing
Proposed

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:35,000 at A4
Project Number:	620.30757
Date:	30-Aug-2022
Drawn by:	NT

SLR

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

ISAAC RIVER PROJECT

Existing and Proposed Groundwater Monitoring Bore Locations

FIGURE 2

H:\Projects-SLR\620-BNE\620.30757.00000 Isaac River Coal Project Groundwater\03 SLR Data\01 GIS\GIS\UWIR\SLR620307S7F_F02_GW_MonitoringNetwork.mxd

3.3 Hydraulic Properties

3.3.1 Site Specific Testing

As part of the EAR groundwater assessment (CDM Smith, 2021), slug tests were performed on the Rangal Coal Measures groundwater monitoring bores listed in **Table 7** in April-May 2019 and February-March 2021, to derive indicative values of hydraulic conductivity (permeability).

Falling and rising head tests were carried out on each bore. The average horizontal hydraulic conductivity (Kh) for the Project monitoring bores ranges from 0.002 to 0.06 m/day. These values are consistent with low hydraulic conductivity values for the Rangal Coal Measures strata for nearby coal mine developments and within the greater Bowen Basin.

Table 7 Hydraulic Conductivity Values (CDM Smith 2021)

Bore ID	Falling head test		Rising head test			Screened lithology
	Kh Hvorslev (m/day)	Kh Bouwer-Rice (m/day)	Kh Hvorslev (m/day)	Kh Bouwer-Rice (m/day)	Kh average (m/day)	
PPD001B / CB08	0.03	0.03	0.02	0.02	0.02	Coal seams, minor siltstone and tuff
PPD002B	0.06	0.068	0.05	0.06	0.06	Siltstone and sandstone
PPD002C	0.005	0.006	-	-	0.006	Sandstone
PPD003A	0.0002	0.0002	0.005	0.004	0.002	Siltstone
PPD003B	0.007	0.007	0.01	0.01	0.009	Siltstone and coal seams
WW04A	0.1	0.09	0.003	0.003	0.05	Clayey sand, siltstone and coal seams

3.3.2 Hydraulic Properties from Literature Review

Hydraulic testing of the same hydrostratigraphic units present in the Project area was carried out at the Olive Downs Project development 15 km southeast of the Project and reported in HydroSimulations (2018). This area has a similar hydrogeology to the Project study area. As part of the groundwater assessment by HydroSimulations (2018), hydraulic testing was conducted on all major geological units. This included testing of core samples for vertical and horizontal hydraulic conductivity (anisotropy), slug testing and packer testing for horizontal hydraulic conductivity, as well as assessment of documented airlift yields. Field results from the Olive Downs area for horizontal (Kh) and vertical (Kv) hydraulic conductivity are summarised in **Table 8.**

Table 8 Olive Downs Hydraulic Testing Results Summary

Formation	Kh range (m/day)	Kv range (m/day)
Alluvium	2.6×10^{-1} to 8.7	-
Regolith	1.7×10^{-1} to 6.2×10^{-1}	-
Rewan Group	1.8×10^{-6} to 5.2×10^{-3}	7.8×10^{-7} to 1.1×10^{-5}
Rangal Coal Measures – Interburden/ Overburden	6.2×10^{-7} to 6.0×10^{-3}	3.1×10^{-7} to 4.5×10^{-6}
Rangal Coal Measures – Coal	5.2×10^{-4} to 1.2×10^{-1}	-
Fort Cooper Coal Measures - Overburden	8.2×10^{-4}	-

Hydraulic testing was also conducted for the Moorvale South Project (SLR, 2019a) and Winchester South Project (SLR, 2022) Groundwater Assessments, respectively. The Winchester South Project is located approximately 10 km southwest of the Project area and hydraulic testing included slug tests on the monitoring network, core sample testing from the overburden and underburden of the coal seams, as well as downhole packer tests targeting major faults in the project area. The Moorvale South Project is located approximately 5 km southeast of the Project area and hydraulic testing included laboratory geotechnical testing of core samples for Kv and Kh, and field testing using methods such as monitoring bore slug testing, packer testing, pumping tests, as well as documenting airlift yields. In July 2019 step tests and constant rate pumping tests were conducted at two bores as part of the Moorvale South Project assessment.

Two pumping tests have been carried out near the Moorvale South Project site. The purpose of these tests was to establish characteristics of the Isaac River alluvial aquifers and the coal seam aquifers of the Rangal Coal Measures (Golder Associates, 2019). This information contributes to the understanding of the connectivity between the deep and shallow aquifers, the interaction between the shallow aquifer and the Isaac River and the flow dynamics within the aquifers.

The following section presents a summary of the available field hydraulic data and comparison to reported hydraulic properties from external sources.

The database of available field results for horizontal and vertical hydraulic conductivity is presented graphically as **Figure 3**. Tests from the Winchester South Project are provided as a separate classification on the plot. The data are also presented separately for each test method as results can vary based on the type of testing and analysis undertaken.

Figure 3 shows that the hydraulic conductivity of the alluvium is variable, ranging from 10^{-2} to almost 10^{1} m/day, which reflects the heterogeneous nature of the alluvial sediments. Pumping tests conducted in 2019 as part of the Moorvale South Project assessment reported hydraulic conductivity values in the range of 2.1 – 2.7 m/day which is in the range of values from slug testing previously conducted across the study area.

The Rewan Group sediments exhibit a low hydraulic conductivity, typically less than 10^{-4} m/day, similar to the interburden/overburden material of the Rangal Coal Measures. Two interburden slug tests conducted within the Winchester South Project area in 2012 identified two bores (R2034 and R2054) with an unusually elevated hydraulic conductivity of just under 1 m/day, which is thought to be associated with faulting and fracturing in the vicinity of these bores. Other results from this testing show an interburden hydraulic conductivity of at least an order of magnitude less than that of coal seams at similar depths. Hydraulic testing of core samples from overburden and underburden of the coal seams within the Winchester South Project area conducted in 2019 show results in the same range as those observed at Moorvale South Project, Olive Downs Project, and previous testing within the Winchester South Project area.

The coal seams of the Permian coal measures generally record higher hydraulic conductivity than the majority of the interburden/overburden tests. This is due to the dual porosity of the coal seams, with a primary matrix porosity and a secondary (dominant) porosity provided by fractures (joints and cleats) and supports the concept of the coal seams themselves forming the dominant groundwater zones of the Permian units. Moorvale South Project site pumping tests in 2019, performed on the Leichhardt and Vermont Seams, reported hydraulic conductivity ranges between 0.5 – 1.5 m/day, and 0.5 – 1.2 m/day, respectively. These values generally align with previous testing of the Permian coal measures across the study area. **Figure 3** shows that the hydraulic conductivity of the Rewan Group as well as the Permian coal measures generally declines with depth, due to increasing overburden pressure reducing the aperture of secondary porosity features.

Comparison of vertical and horizontal hydraulic conductivities indicates that within the Rewan Group the vertical hydraulic conductivity is around 10% to 40% of horizontal hydraulic conductivity. Anisotropy for the Rangal Coal Measures interburden material was more variable, with vertical hydraulic conductivity ranging between 11% and 76% of horizontal hydraulic conductivity. During the Olive Downs Project Groundwater Assessment, core samples were collected within the coal seam roof/ floor material and proximal to fault zones, where practicable (i.e. for competent samples). Results for these samples indicated a vertical hydraulic conductivity of between 50% to 160% of horizontal hydraulic conductivity.

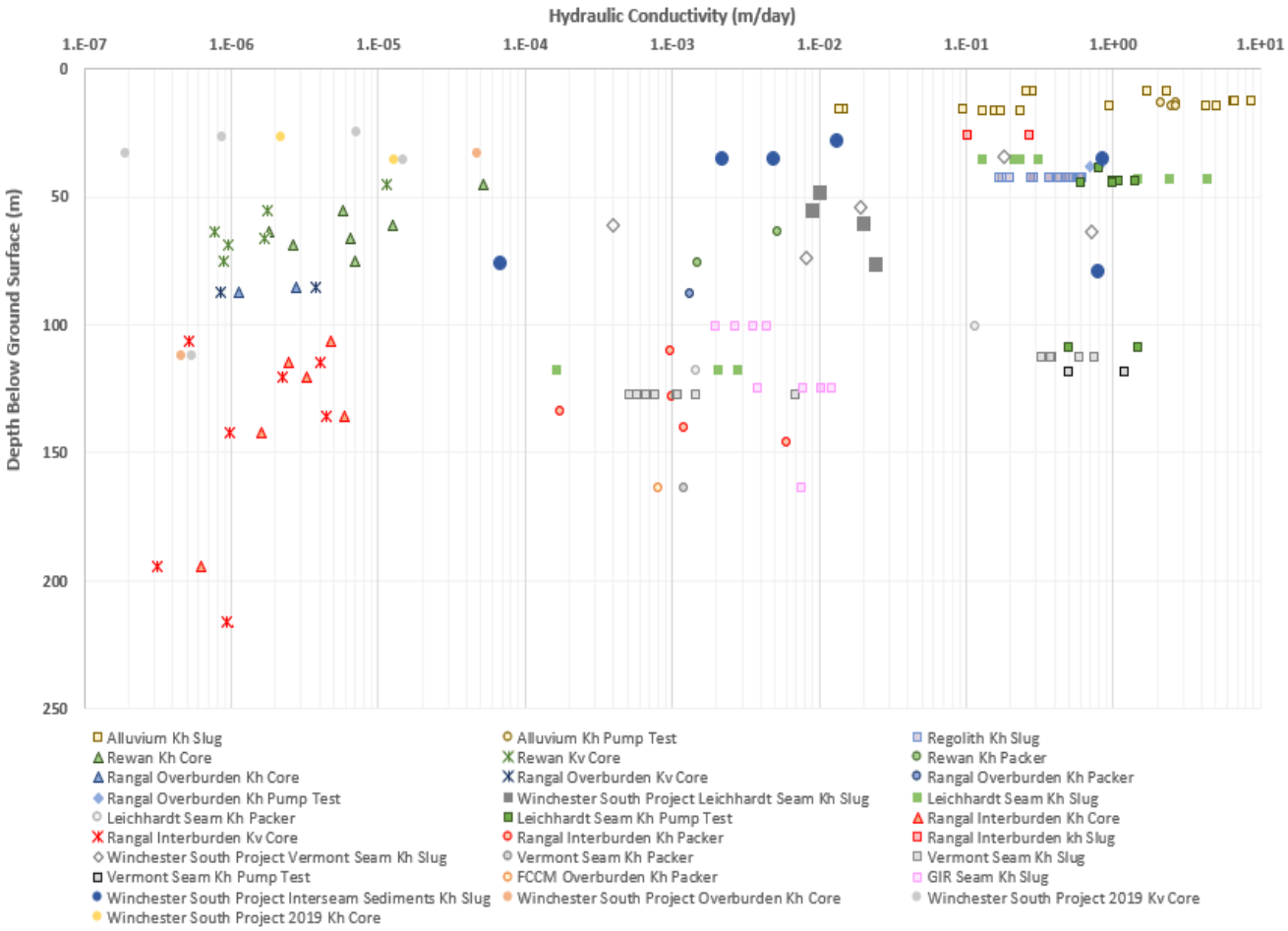
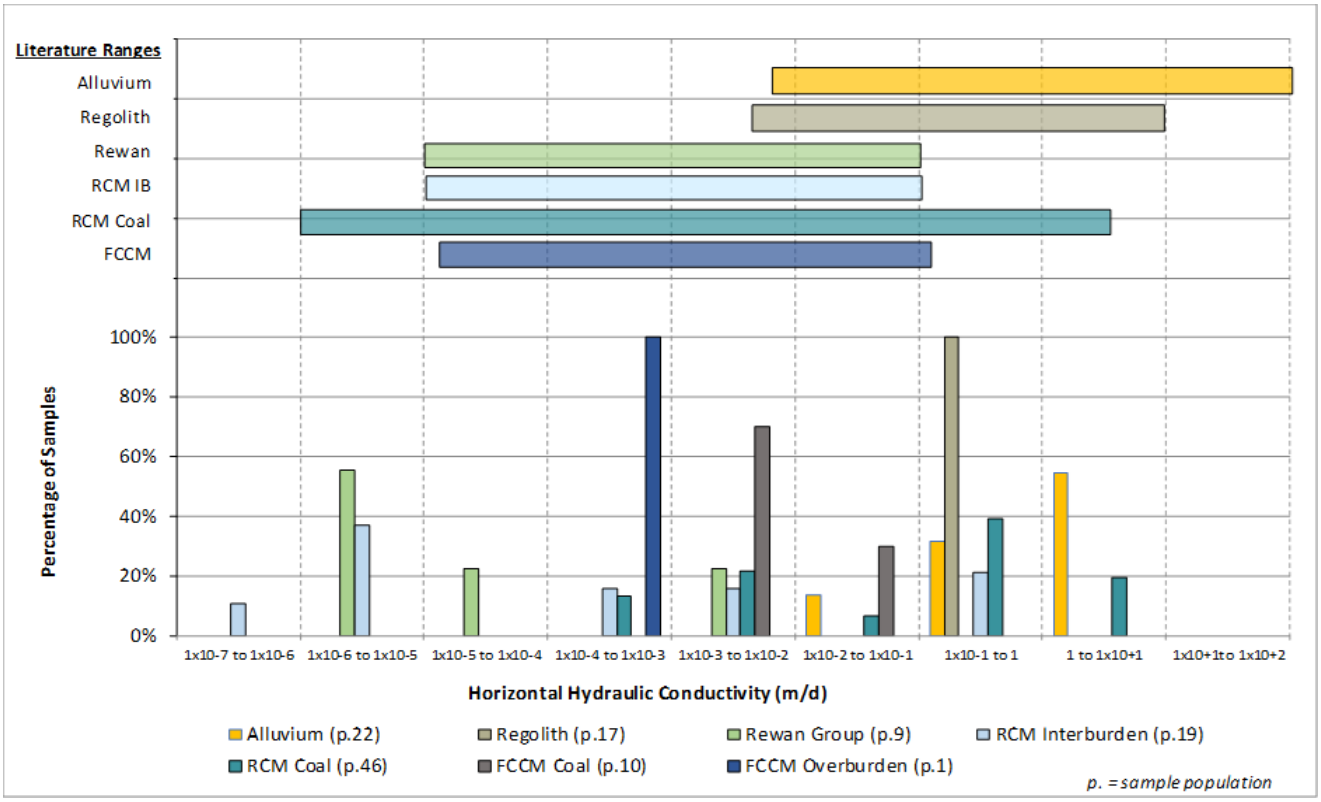


Figure 3 Summary of available Hydraulic Testing Results near to the Project

A histogram of the spread of horizontal hydraulic conductivity from the field testing at the Winchester South Project, as well as at Olive Downs Project and Moorvale South Project, is presented in **Figure 4**. The results are compared to the range of documented values for the various units in literature.

The comparison shows that the field results for alluvium, regolith, Rangal Coal Measures and Fort Cooper Coal Measures fall within the range of field data collected through other studies across the Bowen Basin. Results from the Moorvale South Project site recorded some lower readings for the Rewan Group than previously identified in literature. A broader range of hydraulic conductivity for the Rangal Coal Measures coal was also observed at the Winchester South Project, Moorvale South Project and Olive Downs Project sites than is observed in literature, with values of up to 1.5 m/day (Winchester South Project area) and 4.4 m/day (Moorvale South Project area) reported.



RCM = Rangal Coal Measures, FCCM = Fort Cooper Coal Measures, RCM IB = Rangal Coal Measures Interburden.

Figure 4 Histogram of Horizontal Hydraulic Conductivity Distribution near to the Project

3.3.3 Faults

Faulting has been mapped within the Permian coal measures at the Project, which includes the fault on the western Project boundary adjacent to the Daunia Mine, separating the Project from the Daunia operation. As identified by Jourde *et al.* (2002), faulting can result in higher permeabilities within strata parallel with the fault plane, and lower permeabilities within strata perpendicular to the fault plane. However, this can also be dependent on whether faults are currently active (Paul *et al.,* 2009). Faulting has been inactive within the Bowen Basin for over 140 million years (Clark *et al.,* 2011), indicating that the fault zones are less likely to act as conduits to flow. This relates to filling of the fractured pore spaces over time through hydrothermal alteration and mineralisation (Uysal *et al.,* 2000). Drill core logs from the Project show that where fractures and faults have been geologically logged, many fractures are "healed" with calcite and siderite. This indicates that although the system is a fractured network, many of the existing fractures are cemented. This cementation is likely to have an effect of reducing effective permeability when compared to an open fracture network.

The behaviour of faults within the greater regional area were assessed as part of the Bowen Gas Project. Kinnon (2010) assessed the movement of water and gas across a series of faults in the Bowen Basin using stable isotope and water quality analysis to assess zones of potential recharge, water mixing and flow pathways. Higher gas production rates were observed on either side of a major fault, with differences in isotopic compositions of produced water for bores north and south of the major fault line at similar depths, implying little connection across the fault boundary, and suggesting that the fault acts as a barrier to water and gas flow. The results of the study showed that compartmentalisation was evident and that this was due to the structural geology (faulting) in the basin.

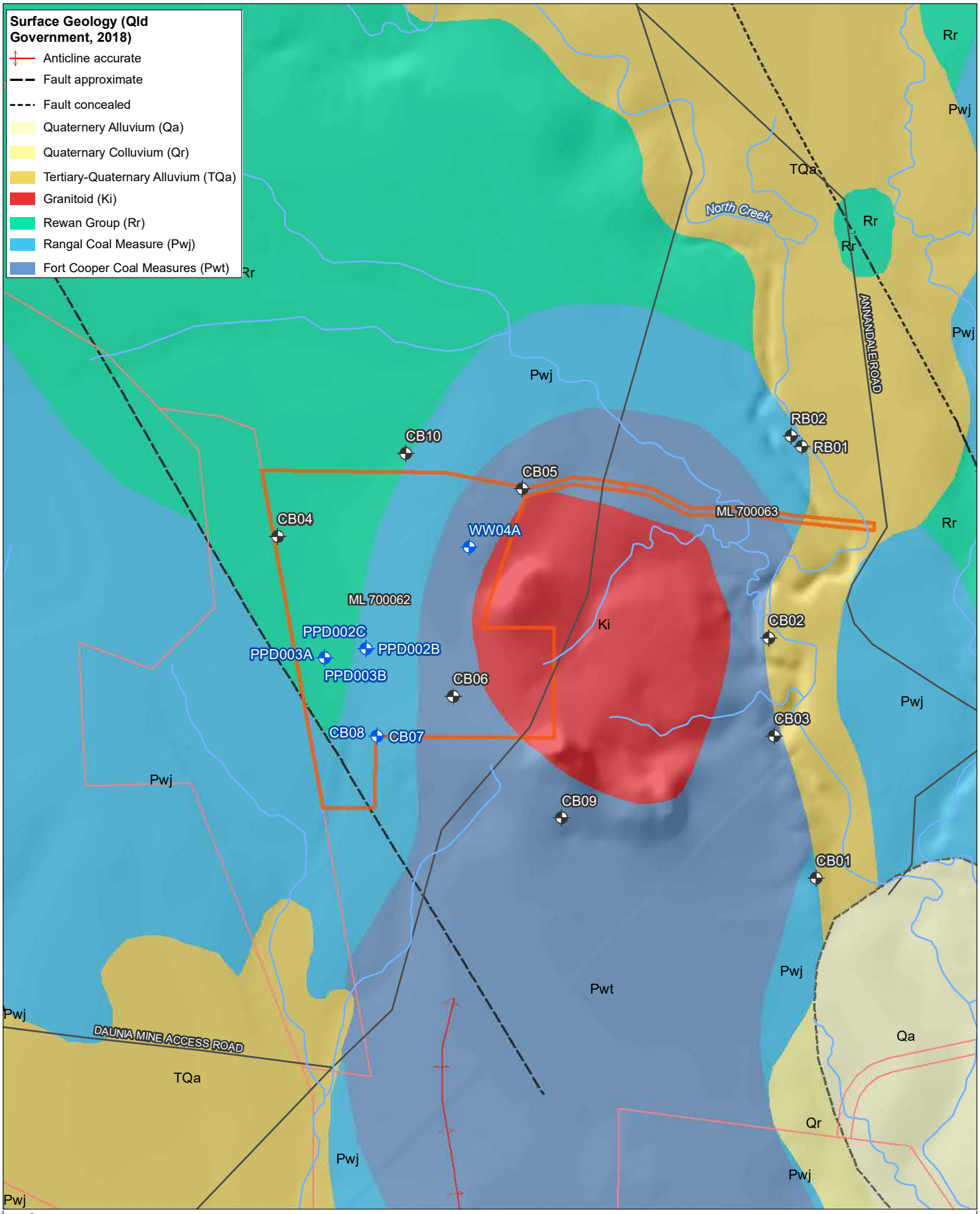
The hydraulic properties of the fault on the western Project boundary are not known. However, hydraulic testing of similar large scale faulting in the Permian coal measures was undertaken at the Winchester South Project (SLR, 2022), 10 km southwest of the Project. Fault zones were confirmed to be intersected at two drill holes due to the presence of fracturing, calcite infills, and slickensides in core obtained from the drill holes, all of which are considered an indicative marker of faulting. Packer testing hydraulic conductivity results from bore WS3182 ranged from 9.48 x 10^{-4} to 1.02 x 10^{-3} m/day. Drill hole WS3189 reported hydraulic conductivity results ranging between 6.93 x 10^{-5} and 2.07 x 10^{-3} m/day. Full details of the testing are presented in Hydrogeologist.com.au (2019). These results represent relatively low hydraulic conductivity values indicating that the faulting zones intercepted and tested within the Winchester South Project area are 'healed' and not pathways for preferential flow.

3.4 Groundwater Distribution, Flow, Recharge and Discharge

This section presents a discussion on the distribution and flow of groundwater plus the recharge and discharge processes for alluvium, regolith, Rewan Group sediments and Permian coal measures.

There is no site-specific information for the alluvium, regolith and Rewan Group, therefore these hydrostratigraphic units are discussed more generally for the regional area.

Figure 5 illustrates the surface geology in the Project area. Alluvium distribution will be refined once the proposed alluvial bores (**Section 3.2**) are installed. Note that existing bores PPD003A and PPD003B are installed below the Rewan Group formation, screened in the Permian hydrostratigraphic units.



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:35,000 at A4
Project Number:	620.30757
Date:	30-Aug-2022
Drawn by:	NT

Minor Watercourse
Road
Mining Lease (Approved)
Project Mining Lease (Application)
Refined Isaac River Alluvium Extent (SLR, 2020)

Groundwater Monitoring Bore
Existing
Proposed

ISAAC RIVER PROJECT

Surface Geology

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.
Geology: Detailed Surface Geology (Department of Natural Resources, Mines and Energy) 2018

FIGURE 5

H:\Projects-SLR\620-BNE\620.30757.00000 Isaac River Coal Project Groundwater\03 SLR Data\01 GIS\GIS\UWIR\SLR620307S7_F05_Surface Geology.mxd

3.4.1 Alluvium

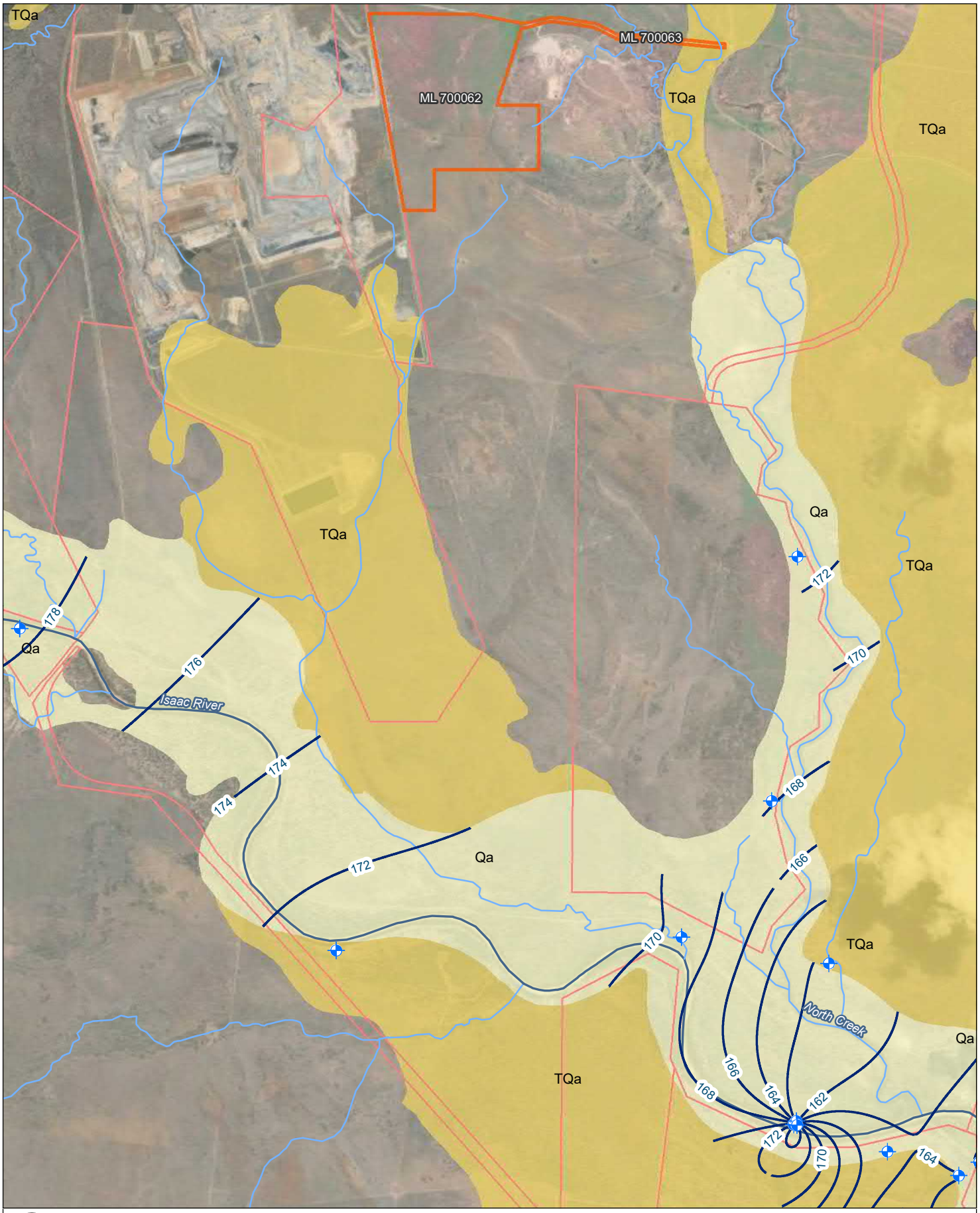
3.4.1.1 Distribution and Flow

There is no site-specific information available at the present time for groundwater levels within the alluvium to the east of the Project at North Creek and its tributaries. These watercourses are ephemeral and conceptualised to be losing systems. Groundwater data will be collected and mapped alluvium refined once proposed alluvial bores are installed as part of the Project's EA and GMMP (RB02, CB01, CB02 and CB03, refer to **Figure 2**). Given the relatively low stream order of North Creek, it is possible that the underlying alluvium is unsaturated in its northern reaches nearest to the Project. A single groundwater level record for the North Creek alluvium (RN 182167) approximately 5.5 km southeast of the Project site records a groundwater depth of approximately 17 m, which suggests groundwater does not interact with the watercourse.

Regional groundwater data within the Isaac River alluvium is presented for the Winchester South Project (SLR, 2022). Based on this data and mapped alluvium extent, interpreted hydraulic head / groundwater level contours are shown in **Figure 6**, illustrating a south-easterly groundwater flow direction following the flow direction of the Isaac River.

3.4.1.2 Recharge and Discharge

Generally, recharge to the alluvium in the regional area is mostly from stream flow or flooding (losing streams), with direct infiltration of rainfall also occurring where there are no substantial clay barriers in the shallow sub-surface. Groundwater within the alluvium is likely discharged as evapotranspiration from riparian vegetation growing along the Isaac River, as well as potential baseflow contributions after significant rainfall and flood events. Geological logs south of the Project area indicate the alluvium is underlain by low permeability stratigraphy (i.e. claystone, siltstone and sandstone), which likely restricts the rate of downward leakage to underlying formations. Localised perched watertables within the alluvium are evident where waterbodies continue to hold water throughout the dry period (e.g. pools in the Isaac River and floodplain wetlands) occurring where clay layers slow the percolation of surface water.



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:60,000 at A4
Project Number:	620.30757
Date:	18-Oct-2022
Drawn by:	NT

Alluvial Groundwater Elevation (mAHD)
Major Watercourse
Minor Watercourse
Mining Lease (Approved)
Project Mining Lease (Application)

Quaternary Alluvium
Tertiary-Quaternary Alluvium

Groundwater Monitoring Bores

Isaac River Alluvium

ISAAC RIVER PROJECT

Interpreted Hydraulic Head Contours in Alluvium

SLR

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

FIGURE 6

H:\Projects-SLR\620-BNE\620.30757.00000 Isaac River Coal Project Groundwater\03 SLR Data\01 GIS\GIS\UWR\SLR620307S7_F06_Hydraulic Head Alluvium.mxd

3.4.2 Regolith

3.4.2.1 Distribution and Flow

There is no site-specific information for groundwater levels within the regolith at the Project. Regional groundwater data within the regolith is presented in the Olive Downs UWIR (SLR, 2020). Based on this data, the regolith is considered to be largely unsaturated, with the presence of water restricted to lower elevation areas along the Isaac River and the lower reaches of its tributaries. Flow within the regolith where it is saturated is likely a reflection of topography, flowing towards nearby drainage lines.

3.4.2.2 Recharge and Discharge

The regolith material comprises low permeability strata (i.e. clay and claystone), which likely restricts rainfall recharge. Groundwater discharge is likely to occur primarily via evapotranspiration, with some baseflow to streams from the regolith under wet climatic conditions. Vertical seepage through the regolith is likely to be limited by the underlying low permeability Rewan Group and other aquitards.

3.4.3 Rewan Group

3.4.3.1 Distribution and Flow

At the Project, the Rewan Group is present in the western area. Where it occurs at and surrounding the Project site, the Rewan Group is present beneath the alluvium and regolith. In general, the occurrence of the unit can vary regionally based on the structural setting. The Rewan Group comprises low permeability lithologies and is typically considered an aquitard.

There is no site-specific information for groundwater levels within the Rewan Group at the Project. Regional groundwater data within the Rewan Group is presented in the Olive Downs UWIR (SLR, 2020). Based on this data, a general south-easterly hydraulic gradient is observed. The low permeability strata that comprise the Rewan Group means that groundwater transmission and flow within this unit is likely limited.

3.4.3.2 Recharge and Discharge

Regional groundwater elevations within the Rewan Group are above those recorded within the deeper Permian coal measures, and below alluvial groundwater elevations where available, indicating a downward hydraulic gradient (SLR, 2020). As outlined above, due to the low permeability of the Rewan Group stratigraphy, the unit is considered an aquitard, restricting groundwater flow.

3.4.4 Permian Coal Measures

3.4.4.1 Distribution and Flow

The Permian coal measures underlie the Rewan Group and surficial cover, and outcrop within the Project area. Groundwater occurrence within the Permian coal measures is largely restricted to the more permeable coal seams that exhibit secondary porosity through fractures and cleats.

Groundwater monitoring conducted to date at the Project includes three monitoring bores targeting the coal seams (PPD001B, PPD003B and WW04A), and four bores (PPD001A, PPD002B, PPD002C and PPD003A) targeting the interburden. Groundwater level trends for the Project monitoring bores from 2019 to 2021 are presented in the EAR groundwater assessment (CDM Smith, 2021) and attached in **Appendix A**.

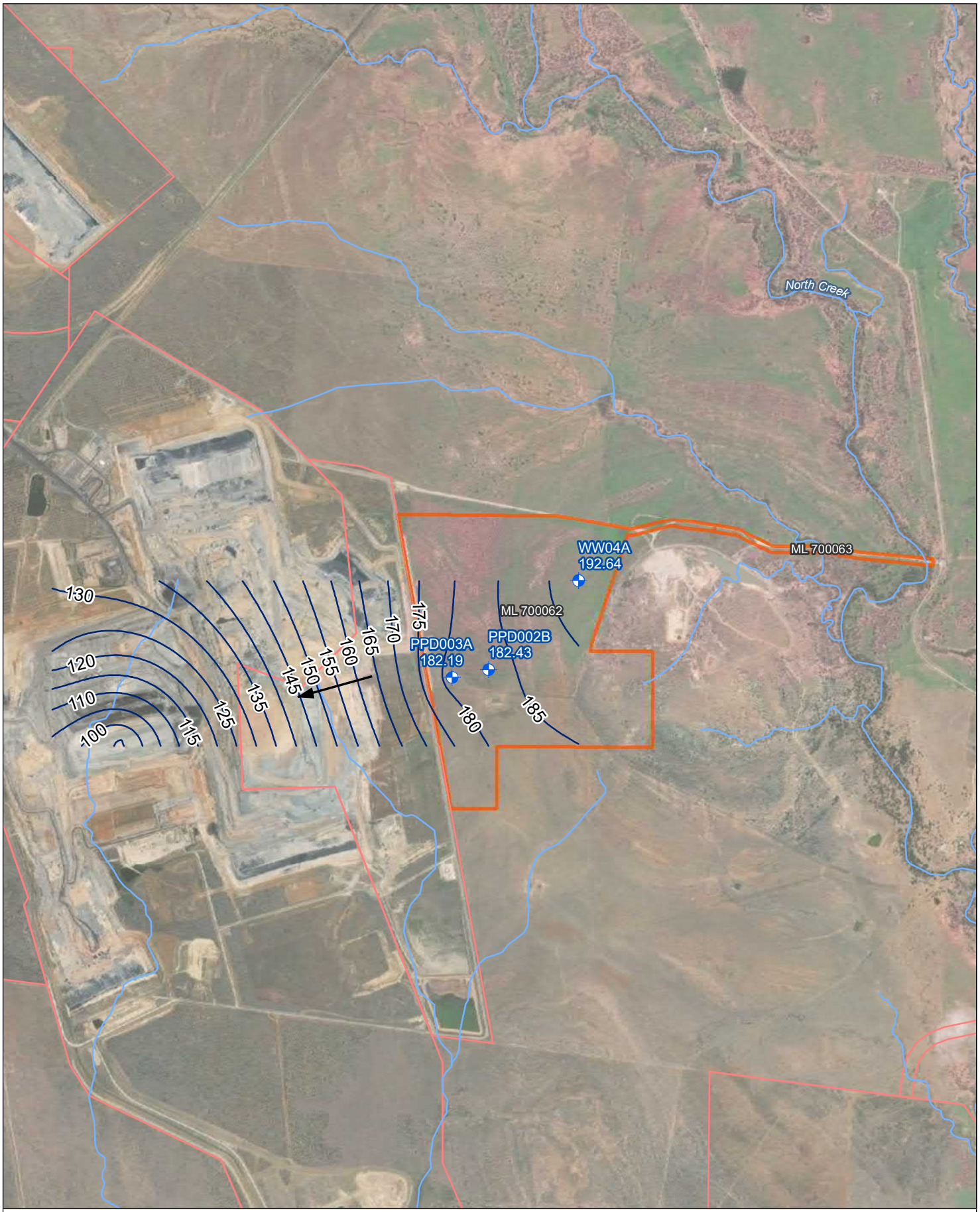
Recent groundwater levels for the Project monitoring bores are presented in **Table 9**. Groundwater depths range from 36.4 m to 43.9 m below ground level. Groundwater level elevations range from 192.6 m AHD to 181.1 m AHD. Vertical hydraulic gradients are upward at the adjacent bores PPD001A/B and PPD003A/B, while downward gradients are observed at PPD002B/C.

The groundwater flow direction of the Permian coal measures in the Project area is shown in **Figure 7**. This shows that dewatering at the Daunia mine immediately west of the Project site has led to the development of a cone of depression with local groundwater flow at the Project site in a westerly direction, towards the Daunia mine void.

Regionally groundwater within the Permian coal measures flows in a south-easterly direction, with local modification around active mine pits (SLR, 2022).

Table 9 Recent Groundwater Levels for Project Monitoring Bores

Bore ID	15 Dec 2021 Groundwater depth (m bgl)	3 Feb 2022 Groundwater depth (m bgl)	15 Dec 2021 Groundwater level (m AHD)	3 Feb 2022 Groundwater level (m AHD)
PPD001A / CB07	41.86	41.76	181.14	181.24
PPD001B / CB08	39.42	39.40	183.58	183.60
PPD002B	40.02	39.57	181.98	182.43
PPD002C	40.67	40.58	181.33	181.42
PPD003A	43.85	43.81	182.15	182.19
PPD003B	43.19	43.16	182.81	182.84
WW04A	36.41	36.36	192.59	192.64



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	620.30757
Date:	30-Aug-2022
Drawn by:	NT

- Groundwater Monitoring Bore (GWL Feb 3 2022, mAHD)
- Interpreted Hydraulic Head Contour (mAHD)
- Groundwater Flow Direction
- Minor Watercourse
- Mining Lease (Approved)
- Project Mining Lease (Application)

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

ISAAC RIVER PROJECT

Interpreted Hydraulic Head Contours in Permian Squences

FIGURE 7

H:\Projects-SLR\620-BNE\620.30757.00000 Isaac River Coal Project Groundwater\03 SLR Data\01 GIS\GIS\UWR\SLR620307S7_F07_Hydraulic Head_Permian.mxd

3.4.4.2 Recharge and Discharge

Groundwater within the deeper Permian coal measures is confined and sub-artesian. For the shallower coal measures, groundwater elevations are generally at or below groundwater elevations within the overlying unconfined sediments, indicating a downward hydraulic gradient. However, with increased depth of cover and pressure the hydraulic gradient within the Permian coal measures reverses. This coincides with a decrease in hydraulic conductivity with depth as discussed in **Section 3.3**.

Recharge to the Permian coal measures occurs where the unit occurs at subcrop. Due to the low hydraulic conductivity of the interburden material, groundwater largely flows horizontally within the coal measures, along the bedding plane of the coal seams. Groundwater discharge occurs via evaporation and abstraction from mining operations.

3.4.5 Groundwater Interaction with Watercourses

In central Queensland, highly seasonal rainfall results in intermittent stream flow, limited groundwater recharge and deep watertables. In this environment, the most appropriate way to assess surface water and groundwater interaction is by comparing stream stage elevation data to the underlying groundwater elevation in a nearby monitoring bore. The Isaac River at Deverill (130410A) stream gauge provides a long-term record of stream stage for the Isaac River south of the Project. The data indicate that at Station 130410A surface water (flowing and ponded) elevations generally remain around 170 m AHD. The gauge has recorded a maximum stream elevation of 179 mAHD, which has been recorded four times since 1970, in March 1979, March 1988, January 1991 and February 2008. The stream gauge records average flows of 460 ML/day and 167,804 ML/year based on the average of total annual flow volume.

The closest bore with long-term groundwater level monitoring in the Isaac River alluvium is registered bore RN13040180, which is approximately 40 km downstream of the stream gauge. The bore is located approximately 80 m from the Isaac River, along Carfax Road. Groundwater levels in this bore clearly follow the rainfall residual mass curve, indicating that rainfall derived recharge (including from stream flow) is a key source of water to this aquifer (**Figure 8**). From 1970 to present, groundwater levels within the alluvium at RN13040180 were recorded between 12 m to 18 m below ground surface.

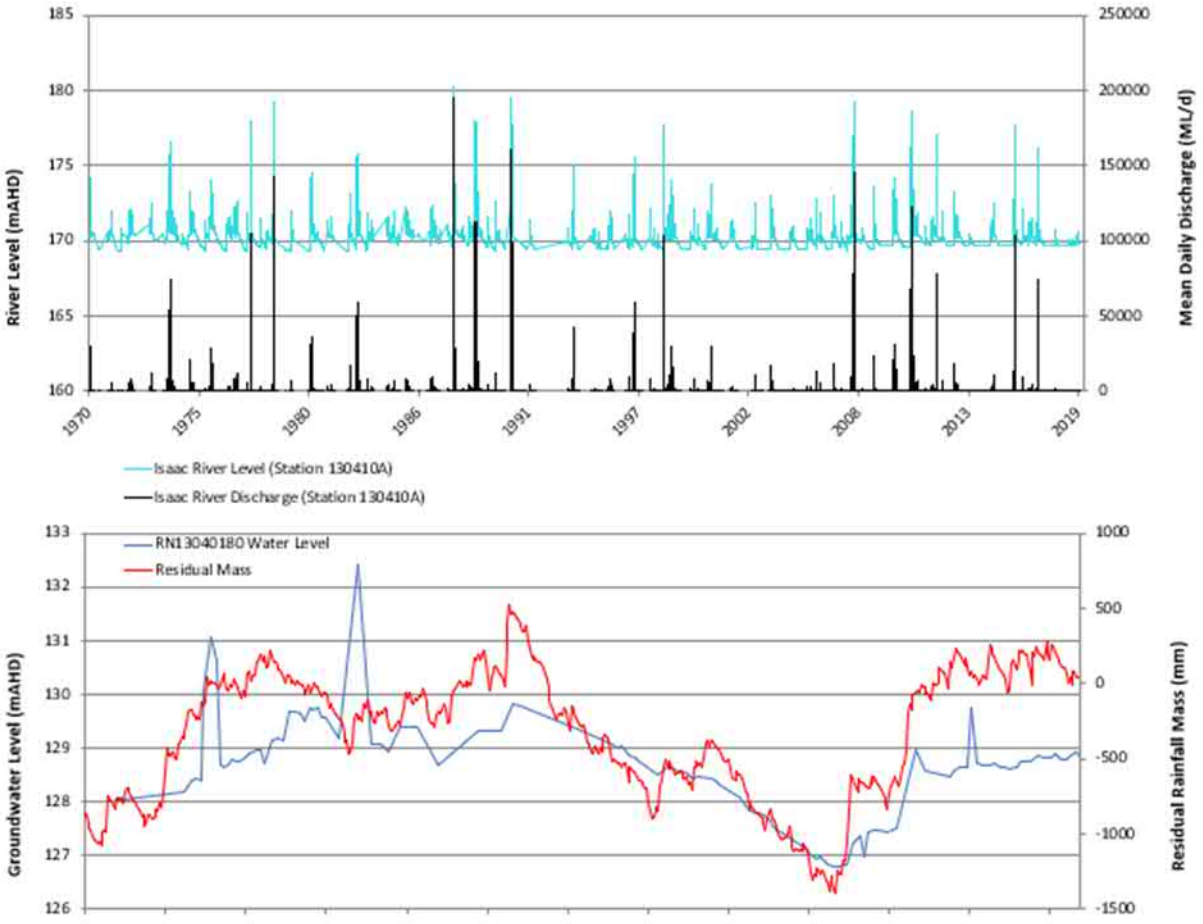


Figure 8 Groundwater Level in RN13040180 with Rainfall Residual Mass and Isaac River Levels and Discharge for Stream Gauge 130410A (SLR, 2022)

Groundwater monitoring bores were installed within the alluvium for the Olive Downs Project, including one adjacent to the Isaac River stream gauge (GW01s) and one approximately 1.6 km south-west of the river (GW02s). Comparison between stream gauge levels and monitored groundwater levels are presented in **Figure 9**. The graph shows that groundwater levels within the alluvium remained more than 2 m below river levels, with the depth to water in the alluvium increasing with distance away from the river.

The Isaac River is largely a losing system with stream-stage above that of the local groundwater levels, resulting in the water draining through the alluvial sediments to the local groundwater system. Occasional periods of baseflow to the river from the underlying alluvium may occur after prolonged rainfall events or following flood events. Under these conditions, recharged alluvial sediments will drain to the river as the hydraulic gradient reverses and sustains streamflow for a short period after the rainfall event.

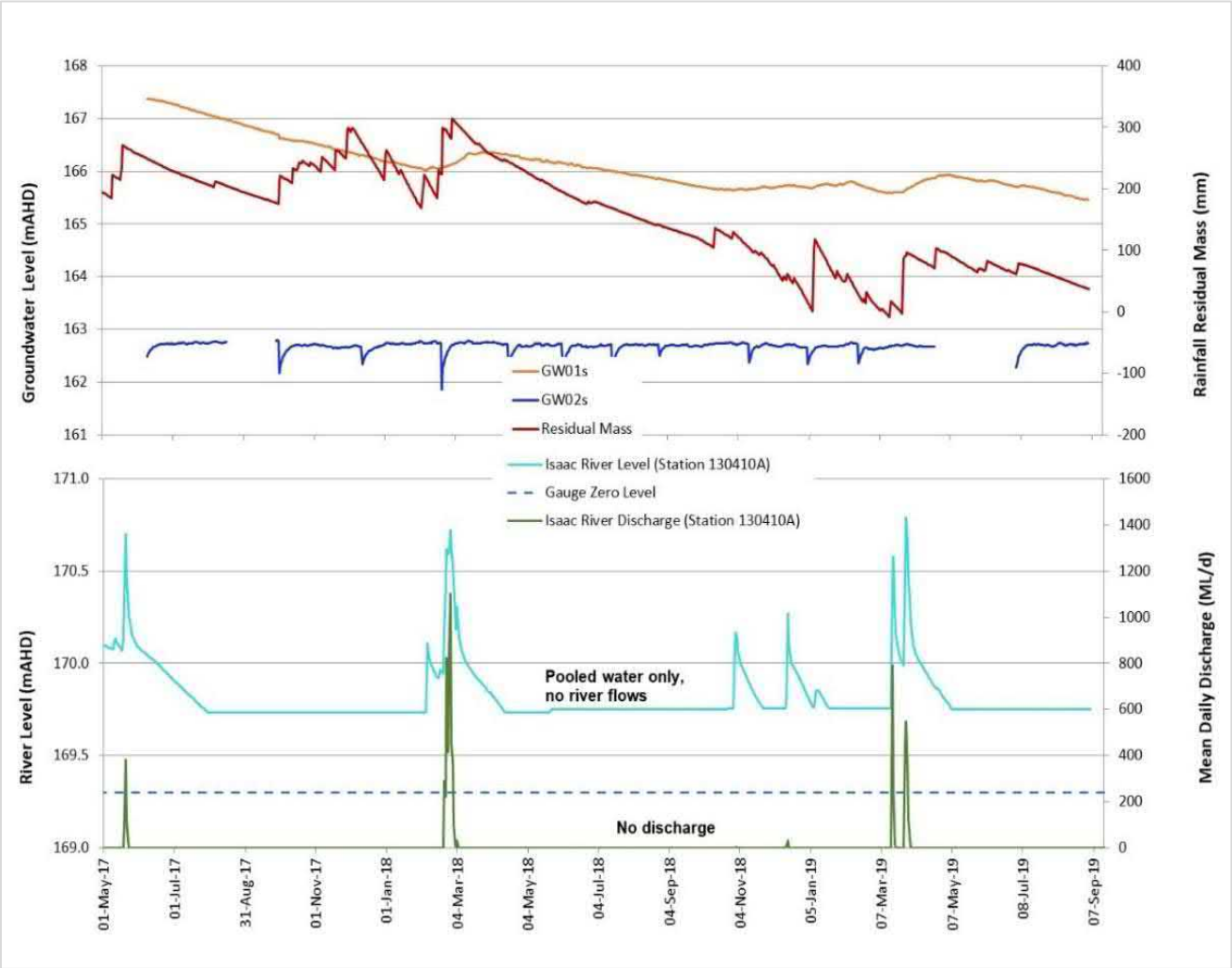


Figure 9 Groundwater Level in GW01s and GW02s with Rainfall Residual Mass and Isaac River Levels and Discharge for Stream Gauge 130410A (SLR, 2020)

3.5 Baseline Water Quality

This section reports on the characteristics and beneficial use of groundwater within the various hydrogeological units across the Project and greater regional area. The main units include alluvium, regolith, interburden (sandstone/ siltstone) and coal of the Permian aged coal measures. Water quality results for surface water (Isaac River) are also discussed below. Full groundwater quality data collected at the site, as well as other publicly available data can be found in the EAR groundwater assessment (CDM Smith, 2021).

3.5.1 Water Type

The proportions of the major anions and cations were used to determine the hydrochemical facies of sampled groundwater. The groundwater major ion results from samples collected in February 2022 from Project monitoring bores (**Table 10**) are consistent with groundwater quality reported in the EAR groundwater assessment (CDM Smith, 2021), indicating that the dominant ion chemistry is sodium and chloride (Na-Cl water type) for the Permian coal measures.

Table 10 Groundwater Quality Results – February 2022

Analyte	Sample ID:	PPD001A	PPD001B	PPD002B	PPD002C	PPD003A	PPD003B	WW04A
Physico-chemical parameters								
Field pH	pH Unit	6.8	7.35	7.11	7.04	6.98	7.32	6.57
Lab Electrical Conductivity @ 25°C	µS/cm	11100	9730	13100	12800	10200	8060	8840
Alkalinity								
Hydroxide Alkalinity as CaCO3	mg/L	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	mg/L	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	mg/L	594	220	333	409	568	179	753
Total Alkalinity as CaCO3	mg/L	594	220	333	409	568	179	753
Anions								
Chloride	mg/L	3810	3420	4740	4550	3490	2770	2620
Sulfate as SO4	mg/L	12	<1	<1	3	<1	<1	585
Cations								
Calcium	mg/L	187	99	271	243	195	94	218
Magnesium	mg/L	127	33	142	118	167	45	308
Potassium	mg/L	11	8	12	16	12	9	4
Sodium	mg/L	2030	1900	2300	2290	1750	1510	1230

Project bores have a water type that indicates end-point waters, with an influence of ancient saline groundwater, sea water or dissolution of halite, with minimal seasonal variations (CDM Smith, 2021).

The results for the Olive Downs Project monitoring bores generally indicate that although the cation compositions are similar between groundwater units, there are differences in the anion makeup of groundwater from each unit. Alluvium groundwater can be classified as Na-Ca or Na-Mg type water and are higher in bicarbonate than the other groundwater units. The proportion of chloride is higher within the regolith material, which can be classified as Na-Cl-SO_4 or Na-Cl-HCO_3 type water. The Permian coal measures generally contain Na-Cl type water, with some also recording a high proportion of magnesium but with less sulfate compared to the other groundwater units.

Major ion data collected from the Moorvale South Project and Olive Downs Project groundwater assessments, and publicly available sources, are presented in **Figure 10**, along with data for the Isaac River at Deverill (Station 130410A).

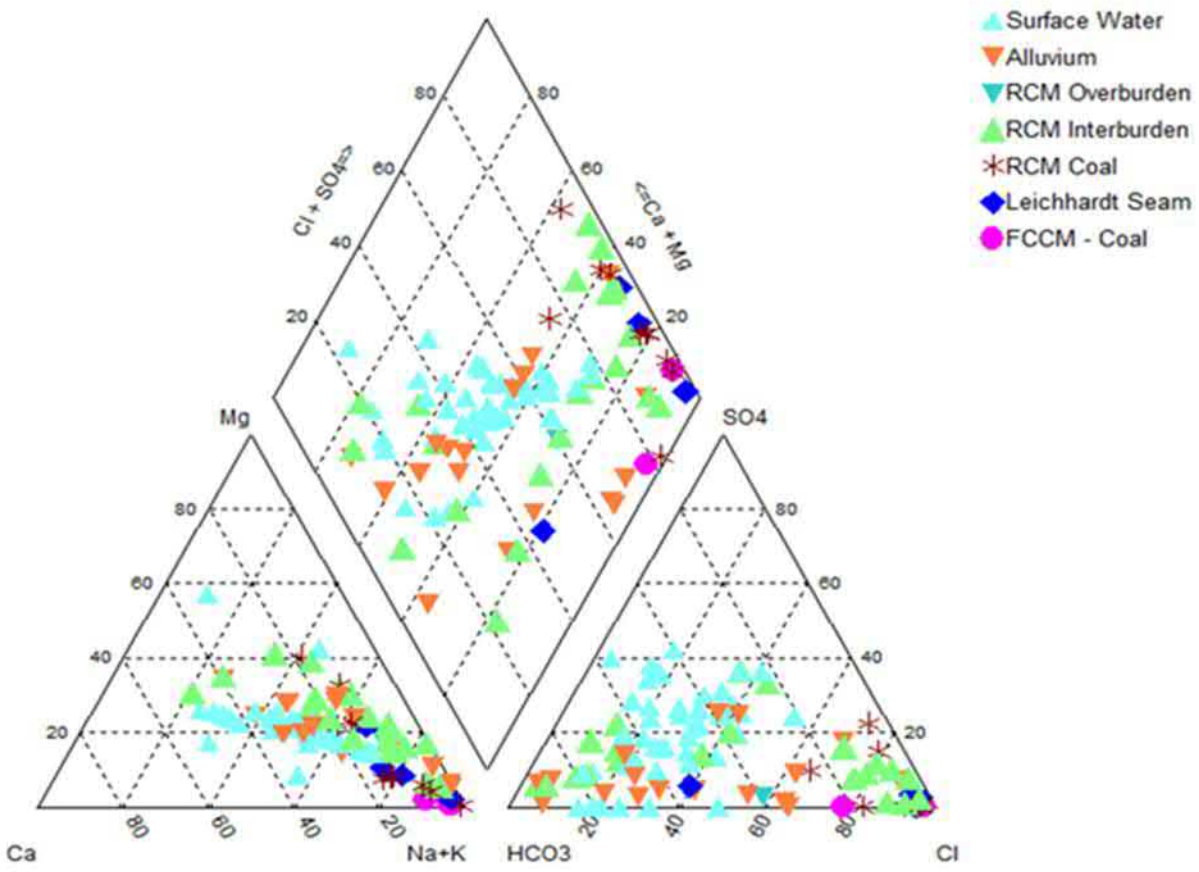


Figure 10 Piper Diagram of Regional Data from nearby Projects (SLR, 2019a)

3.5.2 Salinity

The groundwater salinity results from samples collected in February 2022 from Project monitoring bores (refer to **Table 10**) are consistent with groundwater quality reported in the EAR (CDM Smith, 2021), indicating brackish to saline conditions for the Permian coal measures. Electrical conductivity (EC) ranges from around 8,000 to 13,000 µS/cm.

Water quality data from site bores, collected as part of the landholder bore census and publicly available sources provides useful information on the beneficial use of groundwater associated with the major stratigraphic units. Salinity is a key constraint to water management and groundwater use and can be described by total dissolved solid (TDS) concentrations.

Figure 11 presents the TDS data associated with waters screened in the various hydrostratigraphic units for the Winchester South Project, Olive Downs Project, Eagle Downs Mine monitoring bores, registered bores and publicly available data. Salinity ranges represented on **Figure 11** are defined by the Food and Agriculture Organization of the United Nations (FAO, 2013).

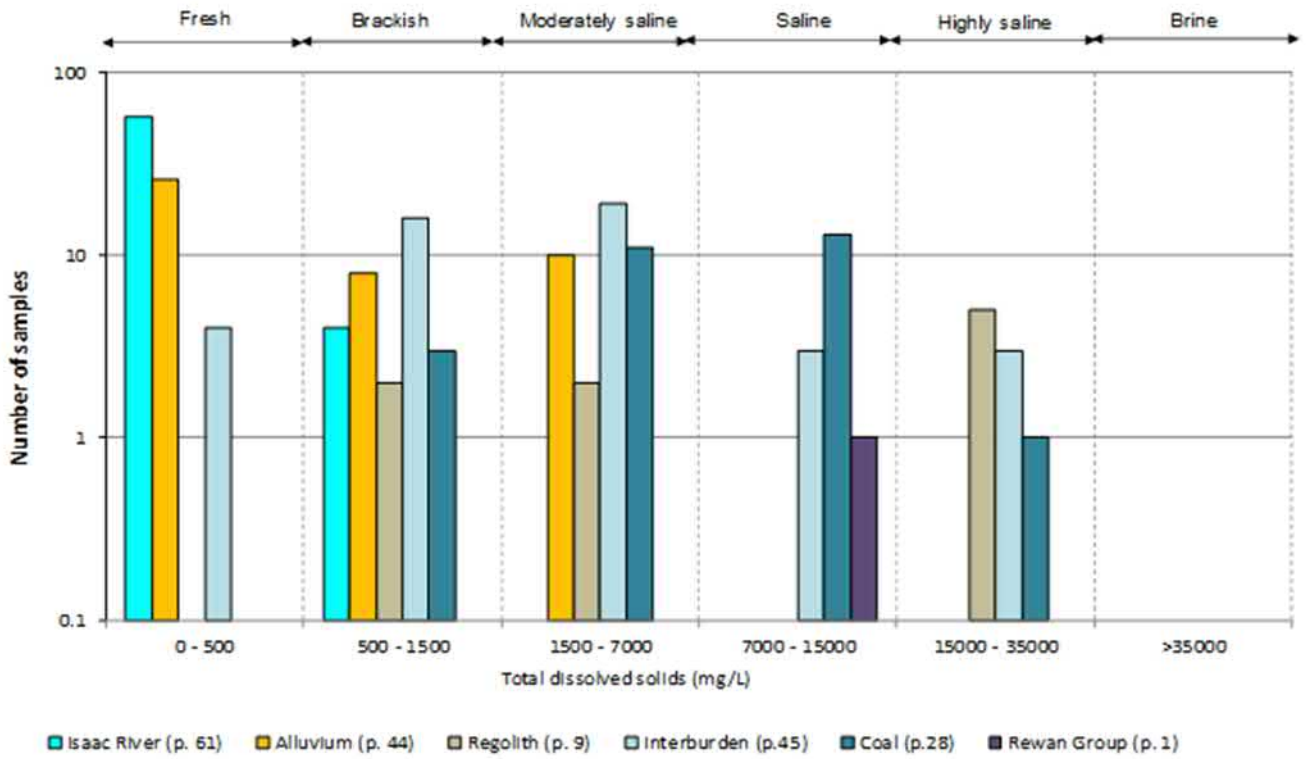


Figure 11 FAO (2013) Salinity Ranking by Unit – Central Bowen Basin (SLR, 2022)

The graph shows that water within the Isaac River is largely fresh, while water within the alluvium is fresh to moderately saline with an average TDS of 863 mg/L, ranging between 10 mg/L and 3,430 mg/L. Where water is present within the regolith material, it is generally highly saline, but can be brackish to moderately saline with an average TDS of 10,510 mg/L, ranging between 1,460 mg/L and 18,600 mg/L. Water within the Permian coal measures can range between fresh and highly saline, but is generally saline within the coal seams, and brackish to moderately saline within the interburden units. Coal seam units of the Permian coal measures record an average TDS of 6,212 mg/L, ranging between 923 mg/L and 16,400 mg/L. The interburden units of the Permian coal measures record an average TDS of 3,436 mg/L, ranging between 421 mg/L and 18,400 mg/L.

Available long-term trends in salinity within the alluvium and Isaac River within the regional area are presented in **Figure 12**. Salinity within the alluvium can be highly variable spatially. As demonstrated by **Figure 12**, salinity can also vary at one location temporally. Results for government alluvial bore RN13040180 indicates EC can range between 199 µS/cm and 7,400 µS/cm (fresh to saline). **Figure 12** also presents EC as recorded at Isaac River station 130410A since 2011, which ranges between 49 µS/cm and 1,173 µS/cm (fresh to brackish).

The water quality data for the alluvium occasionally shows an inverse correlation in EC to the rainfall residual mass curve, with rising EC recorded during periods of declining/ below average rainfall and vice versa. However, due to the lack of temporal readings, there is no clear correlation between groundwater salinity in the alluvium at RN13040180 and stream flow and salinity of the Isaac River.

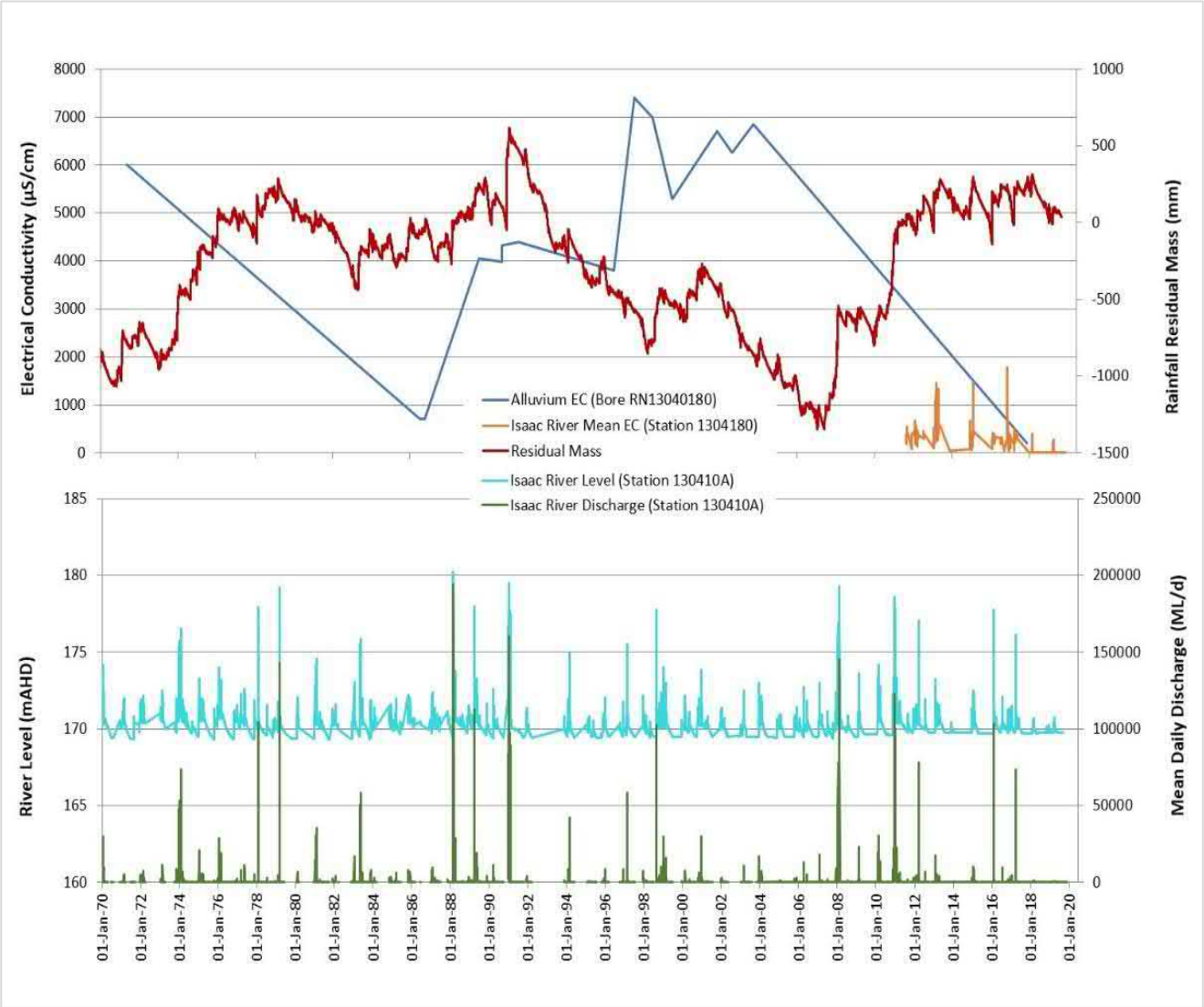
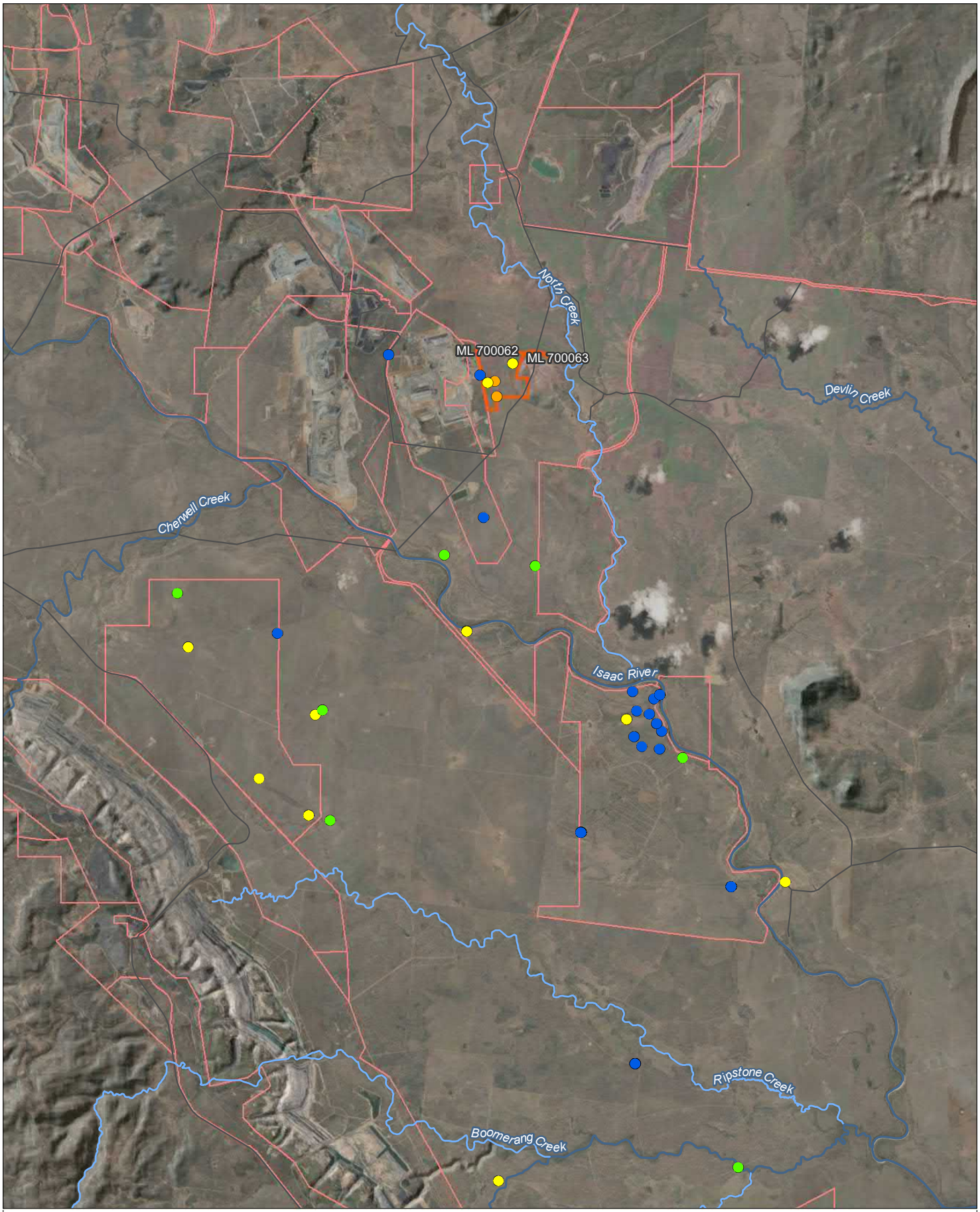


Figure 12 Isaac River and Alluvium Salinity (SLR, 2020)

Spatial distribution of TDS is shown in **Figure 13**, which is based on measured TDS and calculated[2] from available EC data in the regional area (HydroSimulations, 2018) and the Project monitoring bores. The figure depicts all freshwater quality localised along the Isaac River, with brackish to moderately saline water along the river and tributaries. The salinity within the coal measures appears to increase with depth. Bores within the coal measures near the subcrop areas generally record moderately saline water quality, which increases to saline quality where the coal measures are deepest near Isaac River. This corresponds with the coal measures being largely recharged by rainfall where they occur at subcrop.

[2] Calculated based on ANZECC (2000) approach of EC (µS/cm) x 0.67 = TDS (mg/L)



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:200,000 at A4
Project Number:	620.30757
Date:	30-Aug-2022
Drawn by:	NT

Major Watercourse
Minor Watercourse
Road
Mining Lease (Approved)
Project Mining Lease (Application)

Total Dissolved Solids (mg/L)

- 0 - 500
- 500 - 1500
- 1500 - 7000
- 7000 - 15000
- 15000 - 35000

ISAAC RIVER PROJECT

Distribution of Total Dissolved Solids in Groundwater

SLR

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

FIGURE 13

H:\Projects-SLR\620-BNE\620.30757.00000 Isaac River Coal Project Groundwater\03 SLR Data\01 GIS\GIS\SUW\R\SLR620307S7_F13_Distribution of TDS.mxd

3.6 Conceptual Hydrogeological Model

A conceptual model of the groundwater regime has been developed based on the review of the hydrogeological data for the Project and surrounds. The schematic hydrogeological conceptual model of the Project area from the EAR groundwater assessment (CDM Smith, 2021) is presented in **Figure 14**. The key components of the conceptualisation are summarised below based on CDM Smith (2021).

Alluvium

- Regional groundwater flow within the alluvium associated with Isaac River (south/southwest of the Project) is in a south-easterly direction, which is consistent with the alignment of the Isaac River. A component of local, shallow groundwater flow may occur within the localised aquifers along North Creek and they would be expected to follow the downstream flow gradient of the creek.
- A lack of alluvial aquifer recharge response to rainfall was observed by SLR (2019a,b) in an adjacent project area, which was concluded to indicate that either surficial clays restrict groundwater recharge or that the rainfall events had not sufficiently wet the unsaturated zone within the alluvium above the watertable and therefore did not result in aquifer recharge.
- Groundwater within the alluvium is unconfined and groundwater depths are generally between 10 m and 17 m (SLR, 2019a,b). This is consistent with a single groundwater level record for the North Creek alluvium (bore 182167 located approximately 5.5 km southeast of the site) which records a groundwater depth of approximately 17 m.
- There are no gauging stations on North Creek, however it has been observed to be ephemeral and only flows briefly after rainfall. The North Creek is conceptualised as a losing system in the project area when it flows, with seepage of surface water into the underlying alluvium and groundwater recharge likely occurring during flow events. It is considered to have a limited potential to receive groundwater baseflow.
- The alluvium is conceptualised to receive recharge from stream flow or flooding and direct infiltration of rainfall where there are no substantial clay barriers.
- Discharge from the alluvium will primarily be via evapotranspiration from riparian vegetation growing along the watercourses.
- Surface water and subsequent bank storage will most likely undergo evapotranspiration by vegetation around the North Creek area. Bank storage that does not undergo evapotranspiration may transmit through the weathered rock layer and eventually recharge the groundwater system. The low hydraulic conductivity of the underlying stratigraphy (i.e. claystone, siltstone and sandstone) will likely restrict the rate of downward leakage to the underlying formations.

Permian coal measures

- Regional groundwater flow for the Permian coal measures is southeast, following the flow direction of North Creek and the Isaac River. Locally at the Project site, groundwater flow contours indicate flow is west towards the Daunia mine pits due to existing local drawdown effects.
- Recharge to the Permian coal measures occurs where it outcrops or subcrops. Vertical movement of groundwater is restricted by the low permeability (confining) Rewan Group and coal measure interburden sequences. Infiltration to underlying formations is likely to be limited to areas in connection with relatively higher permeability units such as coal seams and possibly faults.
- Discharge from the Permian coal measures occurs via evaporation where it outcrops or subcrops, and extraction from active mining in the area.

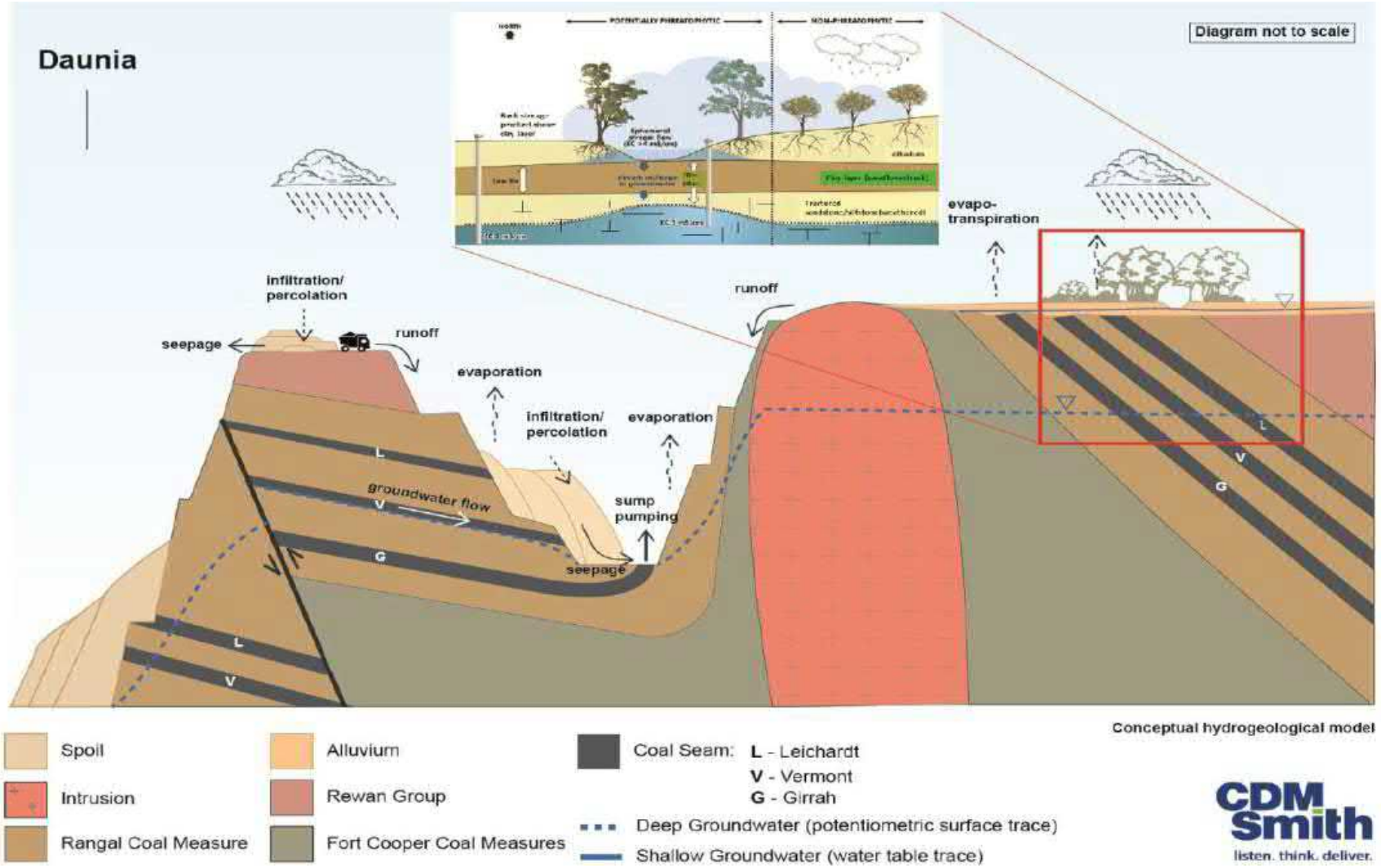


Figure 14 Project hydrogeological conceptual model (CDM Smith, 2021)

4 Part C: Predicted Water Level Declines for Affected Aquifers

This section addresses the requirements under Section 376 (b)(4) to 376 (e) of the Water Act (**Table 11**). This section considers potential impacts from water extraction on groundwater levels in aquifers. Potential impacts were assessed through the development of a numerical groundwater model by CDM Smith (2021). As defined in Section 387 of the Water Act, the model was used to identify impacts by predicting:

- Immediately Affected Area (IAA) - Water level declines, by more than the applicable bore trigger threshold, within three years following the report consultation day; and
- Long Term Affected Area (LTAA) - Water level declines, by more than the applicable bore trigger threshold, at any time.

Section 362 of the Water Act defines a bore trigger threshold for an aquifer as a decline in water levels of:

- As prescribed by regulation; or
- Five metres for consolidated aquifers; and
- Two metres for unconsolidated aquifers.

Table 11 Requirements under Section 376 (b)(4) to 376 (e) of the Water Act

Requirements under Section 376 (b)(4) to 376 (e) of the Water Act	Relevant UWIR Report Section
To meet the requirements of the Water Act, an UWIR must include the following:	-
Maps showing the LTAA and IAA - sections 376 (b)(4) and 376 (b)(5);	**4.3** and **4.4**
A description of the methods used to produce these maps - section 376 (c);	**4.1**
Information about all water bores in the IAA, including the number of bores in the area, maps showing the location of these bores and the authorised use of each bore - section 376 (d); and	**4.4**
A program for conducting an annual review of the accuracy of maps produced and giving the chief executive a summary of outcome of each review, including a statement of whether there has been a material change in the information or predictions used to prepare the maps - section 376 (e).	**4.5**

4.1 Model Details

This section provides a summary of the design and development of the Project's numerical groundwater model. Full details on the design of the numerical groundwater model are included in the EAR (CDM Smith, 2021).

4.1.1 Model Objectives

Numerical modelling was undertaken to assess the impact of the Project on the groundwater regime. The objectives of the predictive modelling were to:

- Assess the groundwater inflow to the mine workings as a function of mine position and timing;
- Simulate and predict the extent and area of influence of dewatering and the level and rate of drawdown at specific locations; and
- Identify areas of potential risk, where groundwater impact mitigation/control measures may be necessary.

4.1.2 Model Design

The Project numerical groundwater model was developed by CDM Smith (2021) based on the conceptual groundwater model, presented within **Section 3.6**. The model was developed using Geographic Information Systems (GIS) in conjunction with MODFLOW-USG, which is distributed by the United States Geological Survey (USGS). MODFLOW-USG is a relatively new version of the popular MODFLOW code (McDonald and Harbaugh, 1988) developed by the United States Geological Survey (USGS). MODFLOW is the most widely used code for groundwater modelling and has long been considered an industry standard.

To estimate the potential effect of the proposed mining development on nearby surface water features, the model domain was designed to be bounded by the Isaac River to the south, North Creek to the east and New Chum Creek to the west (**Figure 15**). The model domain covers an area of 116.8 km² and is 11.6 km in the east-west direction and 18.2 km in the north-south direction.

Voronoi cells generated by AlgoMesh (HydroAlgorithmics, 2016) were used, with cells aligned and variably sized to focus on key features such as rivers and mine areas. The maximum edge length (a proxy for cell size) is:

- 50 m for the proposed mine pit;
- 50 m for the proposed WRD;
- 50 m for the Daunia mine pits;
- 100 m along the Isaac River, North Creek, New Chum Creek and other drainage features; and
- 100 m around observation bores.

The global maximum edge length was set to 500 m. This resulted in 66,083 Voronoi cells per model layer. The same grid structure was used for all model layers. With five model layers as detailed in **Table 12**, the model has a total of 330,415 Voronoi cells.

Table 12 Model layers (CDM Smith, 2021)

Layer	Surface Geology		
	Type 1	Type 2	Type 3
1	Alluvium and colluvium	Weathered basement outcrops	Granitoid intrusion
2	Fresh Overburden (Rewan Group)		
3	Fresh Overburden (Rangal)		
4	Leichhardt and Vermont coal seams		
5	Underburden (Rangal and Fort Cooper)		

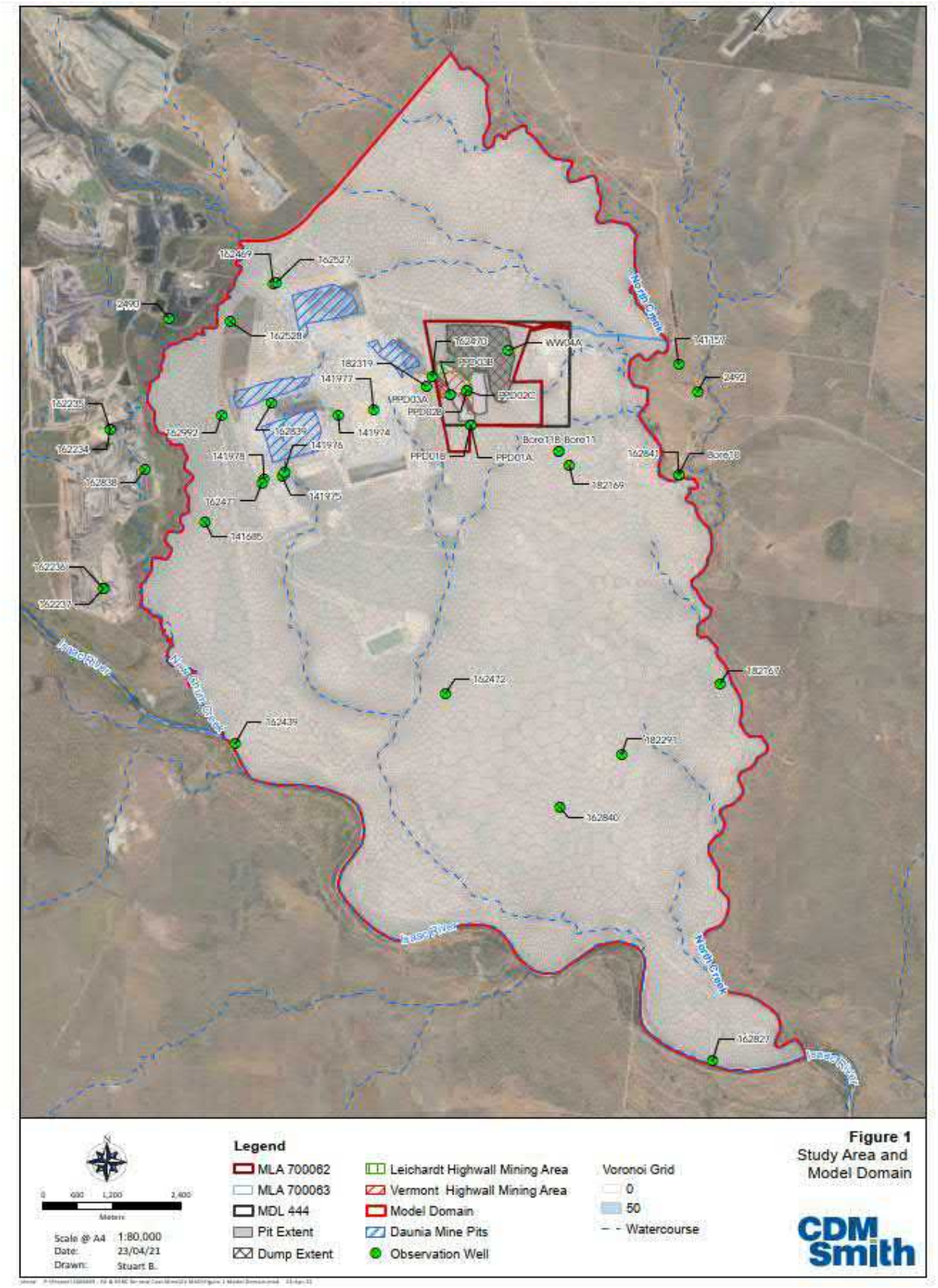


Figure 15 Model domain (CDM Smith, 2021)

4.1.3 Model Calibration

The Project numerical model included a steady-state calibration to averaged groundwater levels observed at 24 monitoring bores.

Existing mining at Daunia was represented in the model using the drain package. The objective of the calibration was to replicate the groundwater levels measured in the site monitoring network and available private bores, in accordance with Australian groundwater modelling guidelines (Barnett *et al.*, 2012).

Calibration details can be found in the EAR's groundwater modelling technical appendix (CDM Smith, 2021).

4.1.4 Model Performance and Limitations

Under the earlier MDBC 2001 modelling guideline (Middlemis *et al.,* 2001), the model is best categorised as an Impact Assessment Model of medium complexity. The earlier guide (Middlemis *et al.,* 2001) describes this model type as follows:

"Impact Assessment model - a moderate complexity model, requiring more data and a better understanding of the groundwater system dynamics, and suitable for predicting the impacts of proposed developments or management policies."

Barnett *et al.* (2012) developed a system within the modelling guidelines to classify the confidence level for groundwater models. Models are classified as Class 1, Class 2 or Class 3 in order of increasing confidence based on key indicators such as available data, calibration procedures, consistency between calibration and predictive analysis and level of stresses. Under these guidelines, this model would be classified as a Confidence Level 2 (Class 2) groundwater model, with the following key indicators (based on Table 2-1 of Barnett *et al.*, 2012):

- Groundwater head observations and bore logs are available and with a reasonable spatial coverage around the site and regionally;
- Calibration statistics are generally reasonable but may suggest significant errors in parts of the model domain; and
- Suggested model use is for prediction of impacts of proposed developments in medium value aquifers.

4.1.5 Model Predictions

Transient predictive modelling was undertaken to simulate the proposed five year mining period at the Project. Two numerical model scenarios were run:

- Calibration base case – Current conditions within the Project area including approved Daunia mine pits, excluding the proposed Project; and
- Predictive Project case – Approved Daunia mine pits and the proposed Project.

Additional model scenarios were run to test the sensitivity of the model to changes in a range of key parameters and model assumptions. This included changes to hydraulic conductivity, recharge and storage parameters. Results from the sensitivity analysis are presented in the groundwater modelling technical appendix (CDM Smith, 2021).

4.2 Predicted Groundwater Interception

The predicted total annual volumes of groundwater predicted to be intercepted as part of the Project is shown in **Figure 16**. The inflows to the open cut operations would peak in Year 4. With the adopted storage parameters, the total peak inflow due to the Project is expected to be about 0.39 ML/day (142 ML/year), whilst the average is expected to be approximately 0.2 ML/day (73 ML/year) over the five-year duration of mining (CDM Smith, 2021).

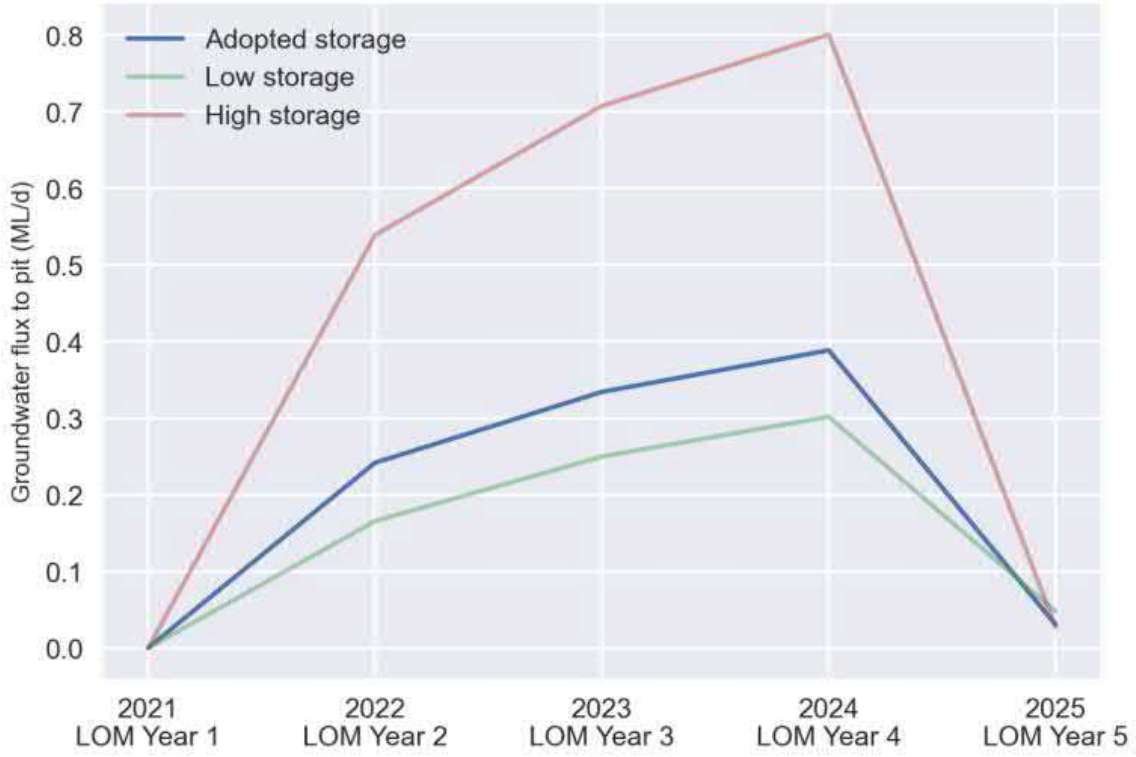


Figure 16 Predicted Groundwater Pit Inflows (CDM Smith, 2021)

4.3 Long Term Affected Area

The Long Term Affected Area (LTAA) assessed by the model showing the predicted maximum incremental drawdown extent in groundwater levels after the commencement of operational activities is shown in **Figure 17** and **Figure 18**.

This drawdown was generated by identifying the maximum drawdown predicted at all the model cells within the unconsolidated sediments and weathered rock (model layer 1) and the Leichhardt and Vermont coal seams (model layer 4). Maximum drawdown outside the proposed mine pit area was reported as Year 5 of operation (CDM Smith, 2021). The predicted maximum drawdown within the proposed mine pit area was reported as Year 3 of operation (CDM Smith, 2021), refer to **Section 4.4.1.3**.

Drawdown within the unconsolidated sediments and weathered rock (model layer 1) continues up to seven years after mining ceases and could reach 1 m of drawdown in the vicinity of North Creek (CDM Smith, 2021).

At the end of mining, Year 5 of operation, there is one impacted registered bore within the LTAA, as discussed in **Section 4.3.3.2**. One private bore (RN 162842) is predicted to intersect an area of approximately 2 m of drawdown and so may experience reduced bore function due to mining at the Project.

The predicted post-mining long-term groundwater drawdown for Layer 1 weathered rock and alluvium/colluvium (**Figure 19**) and Layer 4 coal seams (**Figure 20**) are representative of groundwater conditions once mining has ceased and groundwater levels have recovered over a recovery simulation period of 500 years. These figures show that recharge from the remnant waste rock dump will lead to the development of a groundwater mound that is localised to the site, occurring mostly within ML 700062. Mounding is not predicted to influence regional groundwater flow in the long-term as the Daunia mine pits are expected to capture most groundwater from beneath ML 700062 and the water table is predicted to be about 10 m below the ground surface (CDM Smith, 2021).

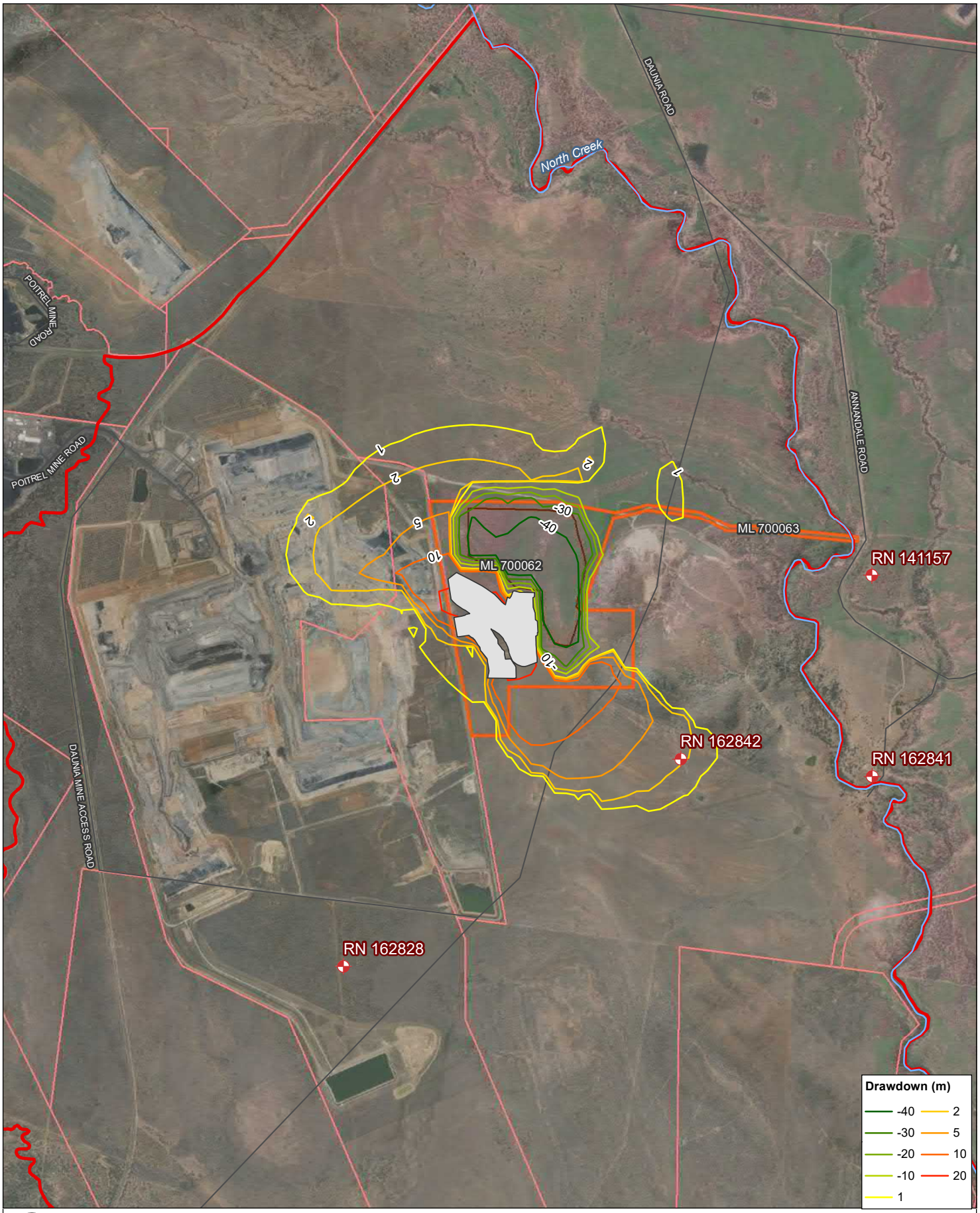
4.3.1 Predicted Maximum Drawdowns

The process of mining reduces groundwater levels in surrounding groundwater units. The extent of the zone affected is dependent on the properties of the aquifers/aquitards and is referred to as the zone of depressurisation in a confined/semi-confined aquifer and zone of drawdown within an unconfined aquifer. Depressurisation and drawdown are greatest at the working coal-face, and gradually reduce with distance from the mine.

Maximum drawdown due to the Project is obtained by comparing the difference in groundwater levels for the base case model run and the predictive Project case model run. The maximum drawdown is a combination of the maximum drawdown values recorded at each cell at any time over the duration of the predictive model.

At the end of mining, **Figure 17** shows the maximum drawdown predicted within the unconsolidated sediments and weathered rock (model layer 1) and **Figure 18** shows the maximum drawdown predicted within the Leichhardt and Vermont coal seams (model layer 4). These figures show that the mounding created by the waste rock dump is predicted to drain into the open pit void during mining and drawdown of up to 20 m adjacent to the proposed pit area is predicted. The granitoid intrusion in the eastern area of the Project forms a low permeability barrier to groundwater flow and is predicted to limit drawdown propagation to the east. At the end of mining, predicted drawdown is limited to within approximately 2 km of the mine pit.

Discussion on the maximum predicted groundwater level drawdown at private bores is included in **Section 4.3.3.2**.



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.30757
Date:	31-Aug-2022
Drawn by:	NT

SLR

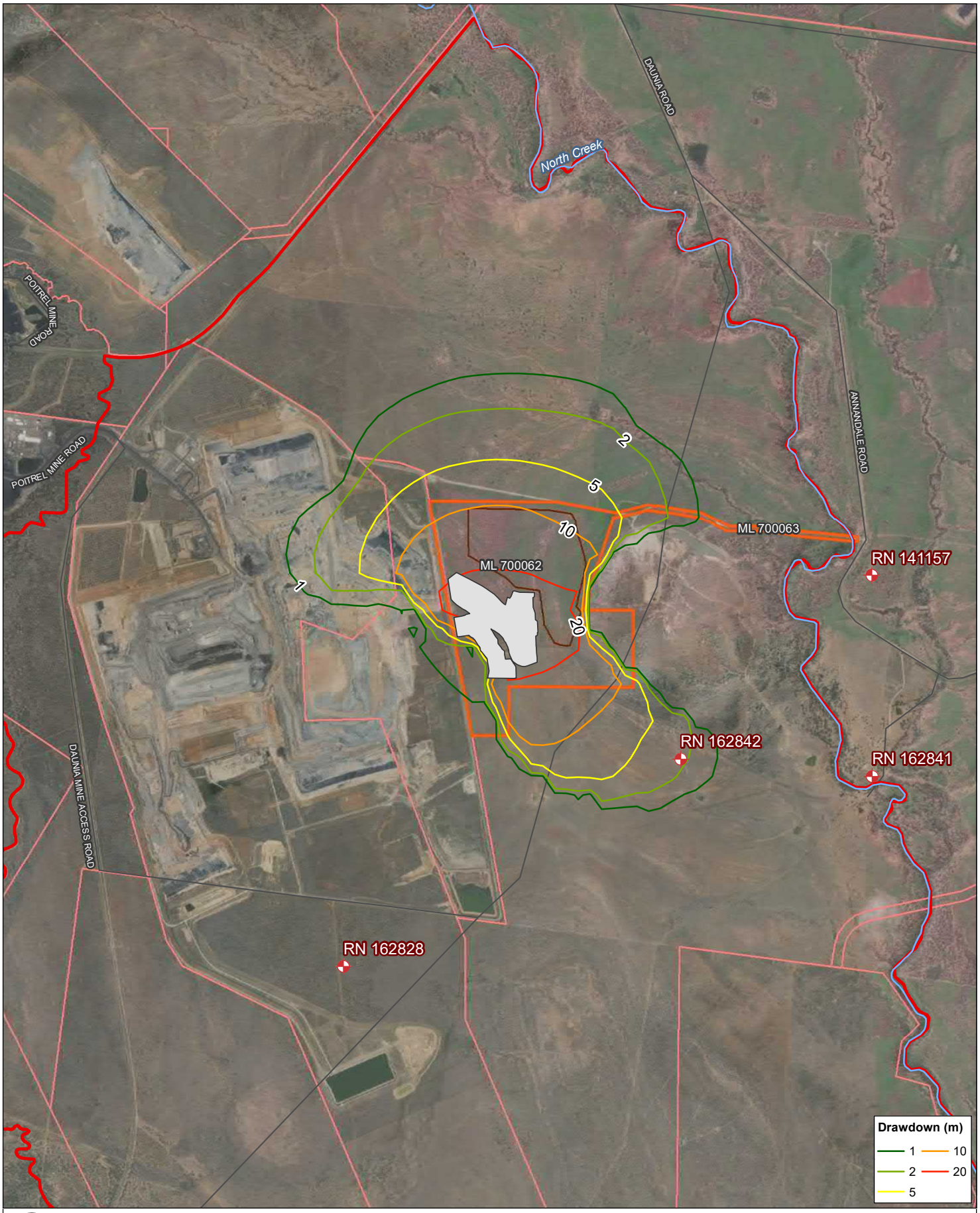
- Registered Groundwater Bore
- Minor Watercourse
- Road
- Mining Lease (Approved)
- Project Mining Lease (Application)
- Waste Rock Dump Extent
- Pit Extent
- Model Boundary

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

ISAAC RIVER PROJECT

Maximum Incremental Drawdown in Unconsolidated Sediments and Weathered Rock (Layer 1) - Year 5 of Operation

FIGURE 17



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.30757
Date:	31-Aug-2022
Drawn by:	NT

SLR

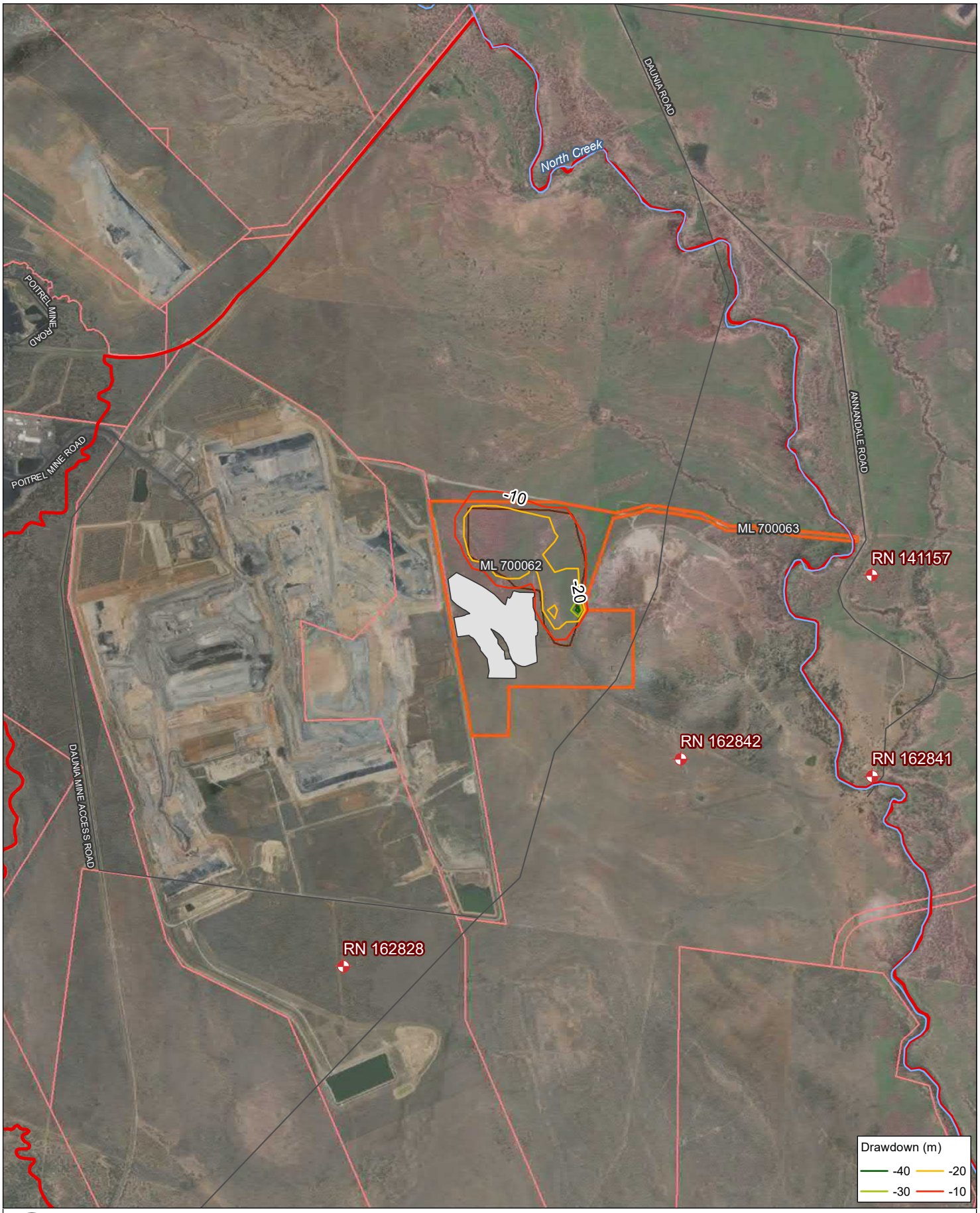
- Registered Groundwater Bore
- Minor Watercourse
- Road
- Mining Lease (Approved)
- Project Mining Lease (Application)
- Waste Rock Dump Extent
- Pit Extent
- Model Boundary

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

ISAAC RIVER PROJECT

Maximum Incremental Drawdown in Leichhardt and Vermont Coal Seams (Layer 4) - Year 5 of Operation

FIGURE 18



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.30757
Date:	31-Aug-2022
Drawn by:	NT

SLR

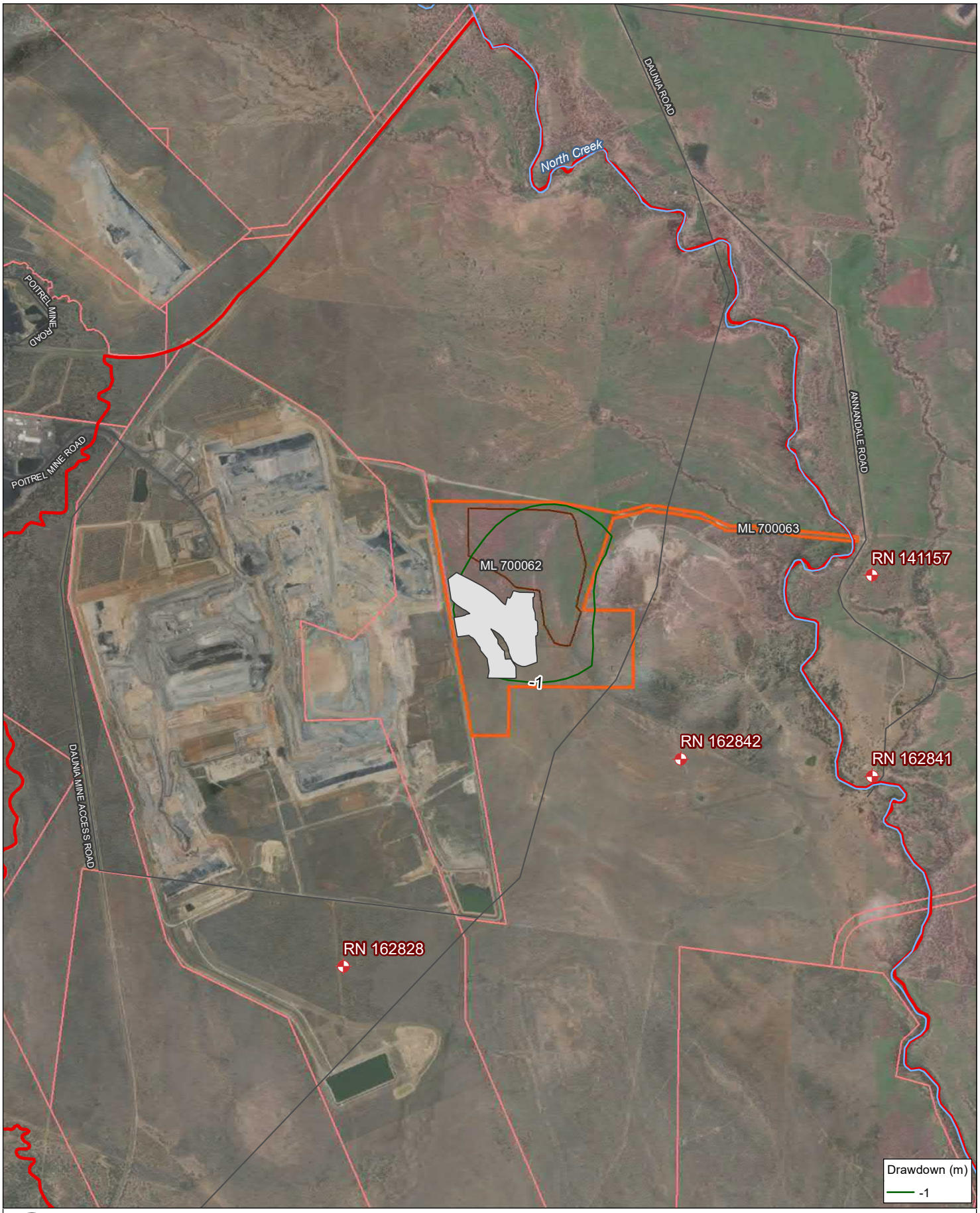
- Registered Groundwater Bore
- Minor Watercourse
- Road
- Mining Lease (Approved)
- Project Mining Lease (Application)
- Waste Rock Dump Extent
- Pit Extent
- Model Boundary

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

ISAAC RIVER PROJECT

Long-term Drawdown (Mounding) in Unconsolidated Sediments and Weathered Rock (Layer 1) - after 500 years of recovery

FIGURE 19



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.30757
Date:	31-Aug-2022
Drawn by:	NT

- Registered Groundwater Bore
- Minor Watercourse
- Road
- Mining Lease (Approved)
- Project Mining Lease (Application)
- Waste Rock Dump Extent
- Pit Extent
- Model Boundary

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

ISAAC RIVER PROJECT

Long-term Drawdown (Mounding) in Leichhardt and Vermont Coal Seams (Layer 4) – after 500 years of recovery

FIGURE 20

ntumer:H:\Projects-SLR\620-BNE\620.30757.00000 Isaac River Coal Project Groundwater\03 SLR Data\01 GIS\GIS\UWIR\SLR62030757_F20_Long-term Drawdown (Mounding) in Leichhardt and Vermont Coal Seams (Layer 4) – after 500 years of recovery.mxd

4.3.2 Incidental Water Impacts

4.3.2.1 Influence on Alluvium

No direct groundwater losses from alluvium are reported by CDM Smith (2021) as the proposed Project pit does not intersect alluvium. Interference of the alluvial groundwater would relate to indirect impacts associated with increased leakage to the underlying Permian coal measures that are depressurised due to the Project. Groundwater levels within the North Creek alluvium are not known and will be assessed by installation of the proposed alluvial bores, noting that it is possible that the North Creek alluvium is unsaturated near to the Project (**Section 3.4.1**).

4.3.2.2 Influence on Baseflow

No influence on baseflow is reported by CDM Smith (2021). The proposed pit is approximately 2.5 km from North Creek to the east, about 5 km from New Chum Creek to the west and over 7 km from Isaac River at its closest point to the southwest. These creeks and rivers are ephemeral in nature and are conceptualised as predominantly losing features, with negligible groundwater contribution. SLR (2019a,b) showed that groundwater levels in the alluvial aquifer were consistently lower than the Isaac River elevation in the Moorvale South Project area, indicating losing stream conditions during periods when the watercourse flows (i.e. the river is not baseflow fed). Whilst the same data are not available to demonstrate this for North Creek (there is no long-term stream gauge data available for North Creek or timeseries groundwater level data), a single groundwater level record for the North Creek alluvium (RN 182167 located approximately 5.5 km southeast of the site) records a groundwater depth of approximately 17 m, which also suggests groundwater does not provide baseflow to the watercourse.

4.3.3 Impacts on the Groundwater Resource

4.3.3.1 Volumetric Take

Underground water rights would be exercised for the life of the Project that result in a volumetric take of groundwater by the Project (i.e. 'associated water'). The aquifers affected by the Project's associated water take are located within the Isaac Connors Groundwater Management Area (GMA) Zone 34, as identified in the *Water Plan (Fitzroy Basin) 2011*.

The Project directly intercepts Permian strata groundwater from Groundwater Unit 2 (sub-artesian aquifers) under the Water Plan (Fitzroy Basin) 2011. The groundwater assessment for the Project (CDM Smith, 2021) describes the predicted groundwater take (inflows). The total peak groundwater inflow due to the Project is expected to be approximately 142 ML/year, while the average is expected to be approximately 73 ML/year over the five-year duration of mining.

Post-mining, modelling shows that groundwater will return to pre-mining conditions and will be approximately 10 m below the base of the rehabilitated landform. Numerical modelling indicates that the groundwater level will return to the pre-BCC mining conditions six years after the end of mining (CDM Smith, 2021). As such, the take of groundwater would cease at this time.

4.3.3.2 Potential Impacts on Groundwater Users

Based on the available registered groundwater bore data presented by CDM Smith (2021), four bores were identified as potential groundwater supply bores within 5 km of the Project. Predicted maximum groundwater drawdown at these bores due to the Project is detailed in **Table 13**.

There is a potential for approximately 2 m of drawdown at the end of mining at registered bore RN 162842 (refer **Figure 18**). Bore details including whether the bore is currently used for water supply, bore depth, screen interval and stratigraphy for RN 162842 are not known. Assessment of this bore was attempted as part of this UWIR development however land access permission was not granted at the time of the UWIR completion. Assessment of the bore in the future remains planned by BCC as part of a future bore census, pending land access approvals.

Table 13 Predicted Maximum Drawdown at Registered Bores Due to the Project (CDM Smith, 2021)

Bore ID / Registered number (RN)	Distance from Project site centre (km)	Registered Easting (GDA94/ MGA55)	Registered Northing (GDA94/ MGA55)	Use status	Bore use	Predicted Maximum Project Drawdown (m)
162842	2.1	637684	7558650	Existing	-	2 m drawdown at end of mining.
141157	3.1	639587	7560479	Existing	Water supply	Outside model domain on eastern side of North Creek. No drawdown predicted.
162841	3.6	639594	7558477	Existing	-	
162828 / Turkey nest bore	4.3	634323	7556584	Existing	-	No drawdown predicted.

4.3.3.3 Potential Impacts on Ecological Sites

The information on watercourses in **Section 4.3.2.2** suggests that Type 2 groundwater dependent ecosystems (GDEs) that are reliant on a surface expression of groundwater (such as aquatic species reliant on groundwater baseflow contributions to streams) are unlikely near to the Project area (CDM Smith, 2021).

There is a potential for Type 3 (subsurface expression of groundwater) GDEs to occur near to the Project area, associated with riparian vegetation (Forest Red Gum and River Red Gum species) accessing alluvial groundwater along the banks of the watercourses. The sensitivity of these species to changes in groundwater levels is considered to be low, based on their ability to tolerate extended drought conditions and an assessment of aerial imagery for six open-cut mines in the region, which indicate these vegetation communities have not shown signs of die-back since mines began operation in the 1980s, suggesting a tendency for being vadophytic rather than phreatophytic (CDM Smith, 2021).

Based on the CDM Smith (2021) report, there are no ecological sites that will be impacted by the Project's groundwater affects.

4.3.3.4 Potential Impacts on Surface Drainage

As discussed in **Section 4.3.2**, no influence on surface drainage baseflow is predicted by CDM Smith (2021).

4.4 Immediately Affected Area

During years one to three, this UWIR reporting period, groundwater drawdown is observed in the Permian strata. The extent of the Immediately Affected Area (IAA) is defined by drawdown exceeding 2 m in unconsolidated aquifers and 5 m in consolidated aquifers.

This section presents the predicted impacts due to mining in the three-year period, including incremental groundwater drawdown, incidental water take and impacts on groundwater users.

4.4.1 Predicted Incremental Drawdowns (Years One to Three)

The predicted drawdowns have been modelled for the unconsolidated sediments / weathered rock and the Leichhardt and Vermont coal seams. Each of the three years for the UWIR reporting period have been presented individually for each of the aquifers specified.

4.4.1.1 Year One

Figure 21 shows that for year one there is no drawdown predicted in the unconsolidated sediments and weathered rock (model layer 1) within the Project as mining has not reached the water table, however up to 10 m of groundwater mounding is predicted due to the waste rock dump. **Figure 22** shows there is no predicted drawdown in the Leichhardt and Vermont coal seams (model layer 4) in year one of the Project as mining has not reached the water table.

The figures show registered private bores within the region, no impact is predicted on these bores during year one of operation.

0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.30757
Date:	31-Aug-2022
Drawn by:	NT

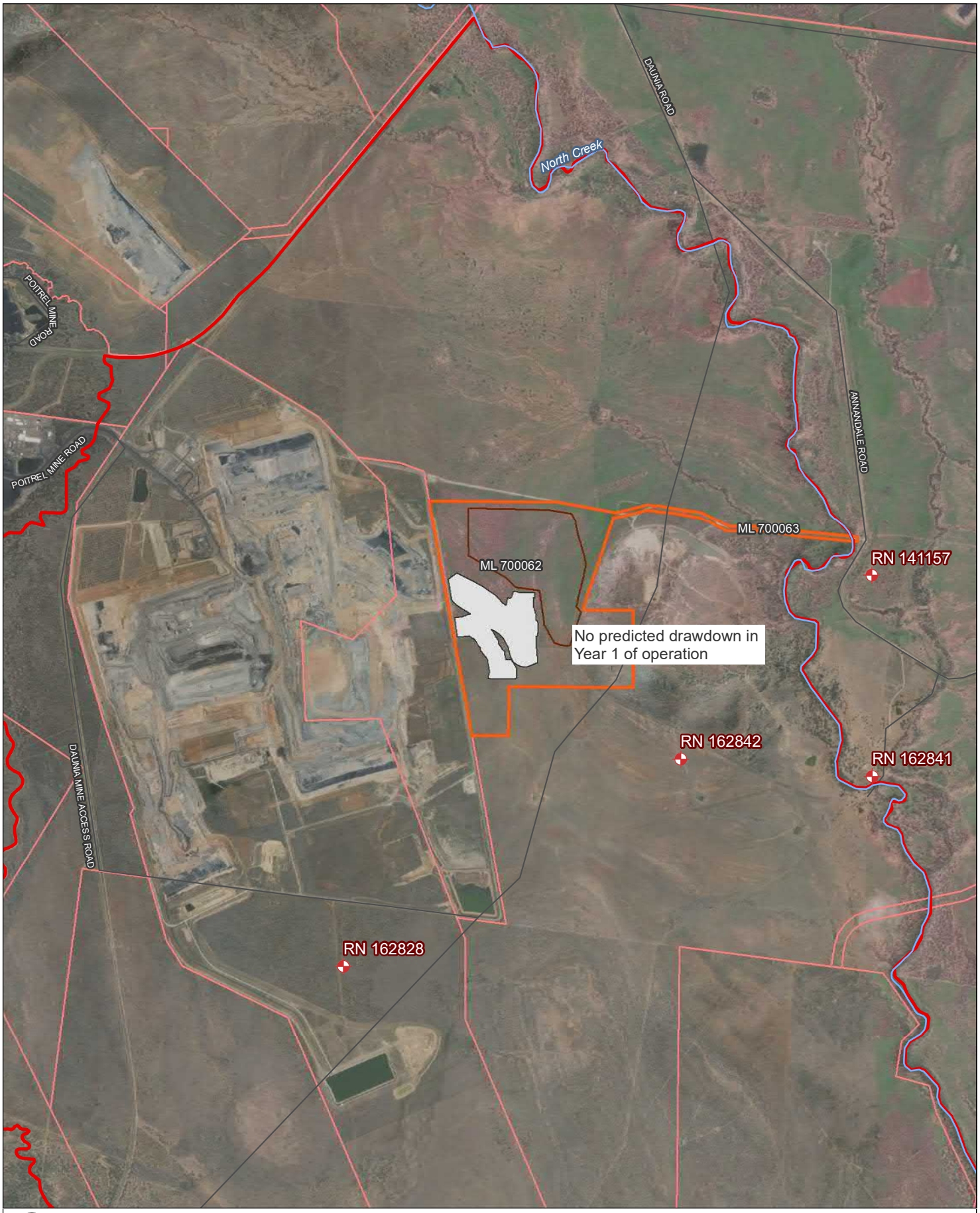
- Registered Groundwater Bore
- Minor Watercourse
- Road
- Mining Lease (Approved)
- Project Mining Lease (Application)
- Waste Rock Dump Extent
- Pit Extent
- Model Boundary

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

ISAAC RIVER PROJECT

Incremental Drawdown in Unconsolidated Sediments and Weathered Rock (Layer 1) - Year 1 of Operation

FIGURE 21



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.30757
Date:	31-Aug-2022
Drawn by:	NT

- Registered Groundwater Bore
- Minor Watercourse
- Road
- Mining Lease (Approved)
- Project Mining Lease (Application)
- Waste Rock Dump Extent
- Pit Extent
- Model Boundary

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

ISAAC RIVER PROJECT

Incremental Drawdown in Leichhardt and Vermont Coal Seams (Layer 4) - Year 1 of Operation

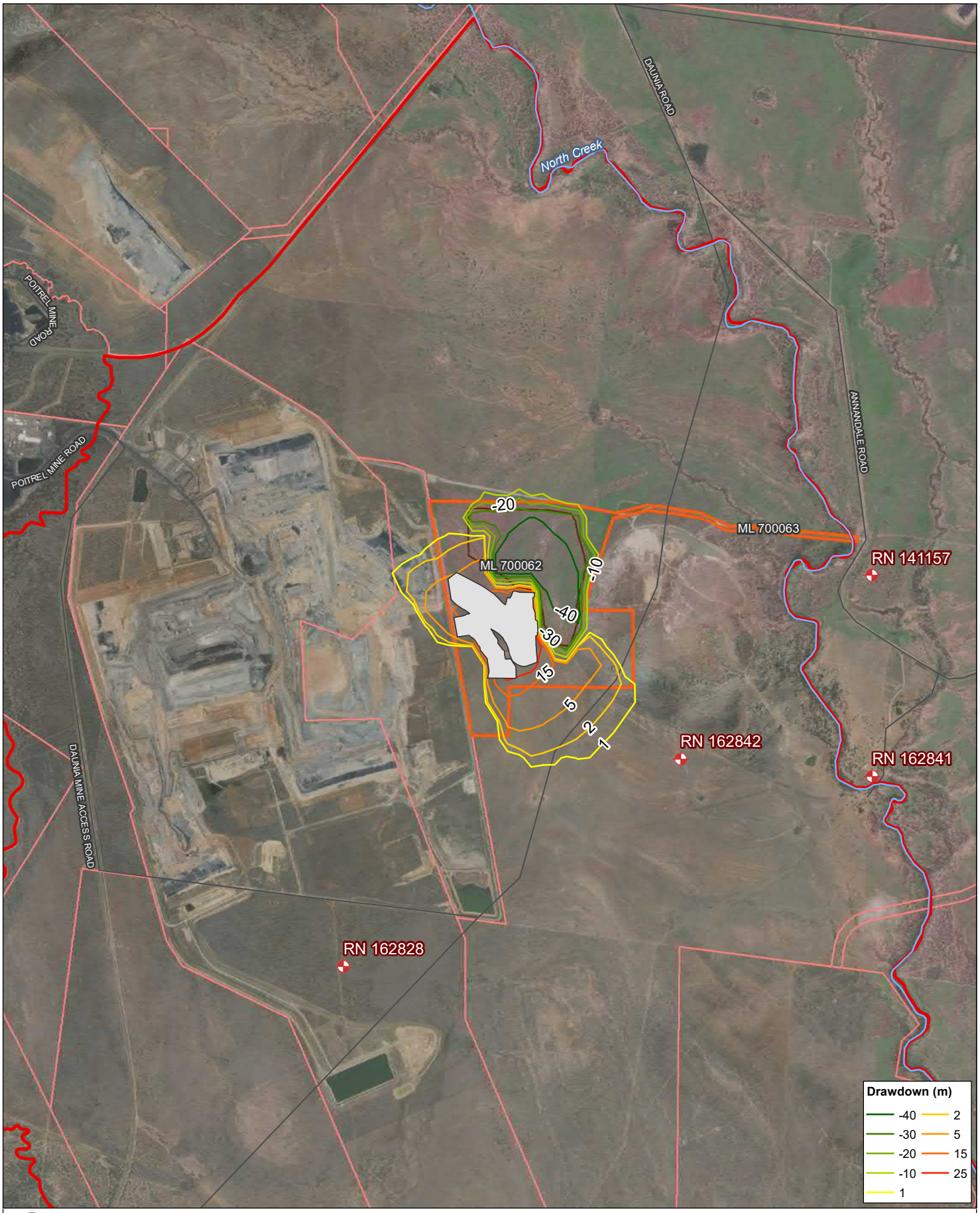
FIGURE 22

4.4.1.2 Year Two

Figure 23 shows that for year two there is up to 25 m of drawdown predicted in the unconsolidated sediments and weathered rock (model layer 1) adjacent to the Project's pit. **Figure 24** shows there is up to 25 m of drawdown in the Leichhardt and Vermont coal seams (model layer 4) in year two adjacent to the Project's pit.

The model predicts that the 1 m of groundwater drawdown extent for the coal seams will be within 1 km of the Project pit extent in year two.

The figures show registered private bores within the region, there are no impacted registered bores within the IAA in mine year two.



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.30757
Date:	31-Aug-2022
Drawn by:	NT

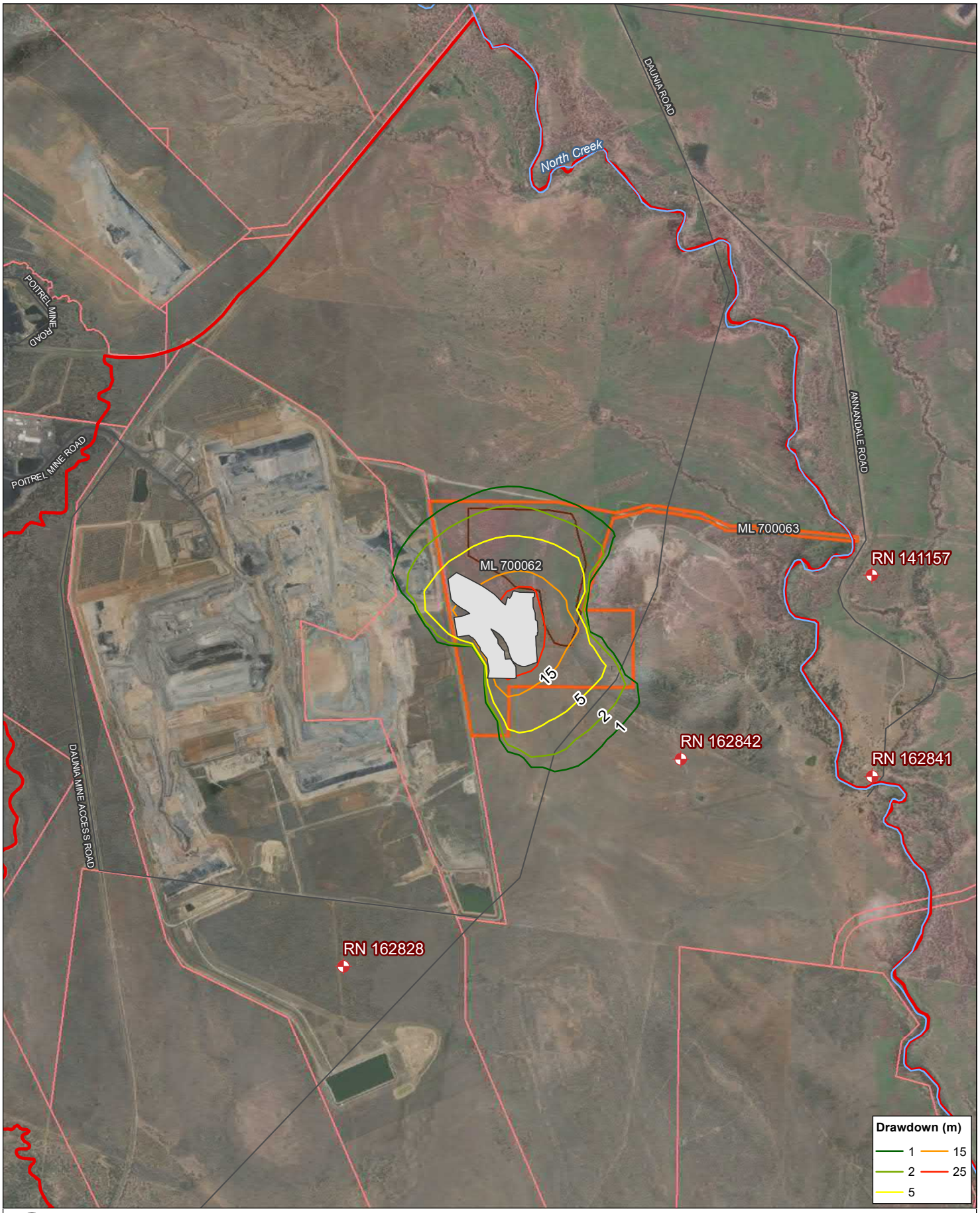
- Registered Groundwater Bore
- Minor Watercourse
- Road
- Mining Lease (Approved)
- Project Mining Lease (Application)
- Waste Rock Dump Extent
- Pit Extent
- Model Boundary

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

ISAAC RIVER PROJECT

Incremental Drawdown in Unconsolidated Sediments and Weathered Rock (Layer 1) - Year 2 of Operation

FIGURE 23



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.30757
Date:	31-Aug-2022
Drawn by:	NT

- Registered Groundwater Bore
- Minor Watercourse
- Road
- Mining Lease (Approved)
- Project Mining Lease (Application)
- Waste Rock Dump Extent
- Pit Extent
- Model Boundary

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

ISAAC RIVER PROJECT

Incremental Drawdown in Leichhardt and Vermont Coal Seams (Layer 4) - Year 2 of Operation

FIGURE 24

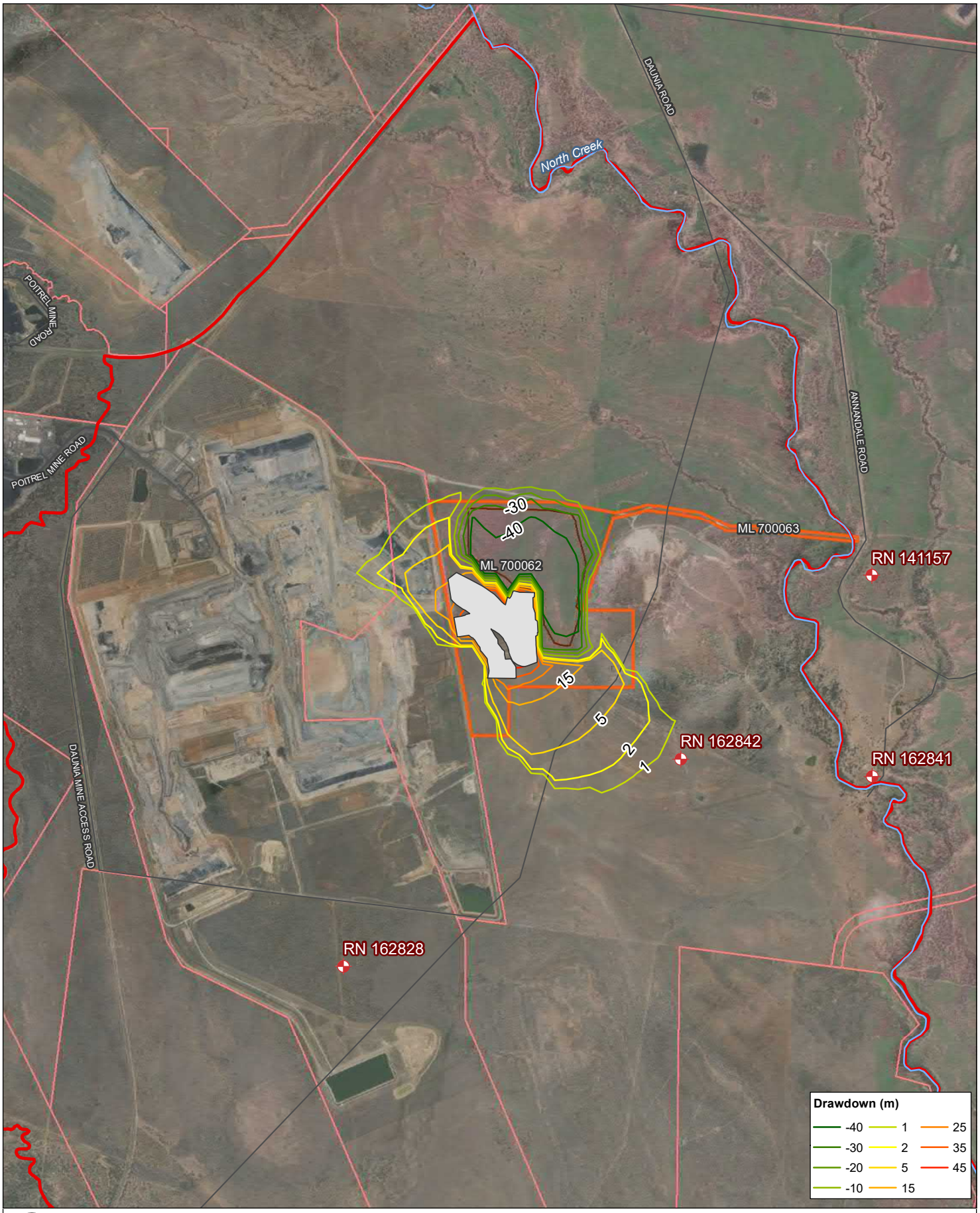
ntume:H:\Projects-SLR\620-BNE\620.30757.00000 Isaac River Coal Project Groundwater\03 SLR Data\01 GIS\GIS\UWIR\SLR620307S7_F24_Incremental Drawdown in Leichhardt and Vermont Coal Seams (Layer 4) - Year 2 of Operation.mxd

4.4.1.3 Year Three

Figure 25 shows that for year three there is up to up to 35 m of drawdown predicted in the unconsolidated sediments and weathered rock (model layer 1) adjacent to the Project's pit. **Figure 26** shows there is up to 35 m of drawdown in the Leichhardt and Vermont coal seams (model layer 4) in year three adjacent to the Project's pit.

The model predicts that the 1 m of groundwater drawdown extent for the coal seams will be within 1.6 km of the Project pit extent in year three.

The figures show registered private bores within the region, there are no impacted registered bores within the IAA in mine year three.



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.30757
Date:	31-Aug-2022
Drawn by:	NT

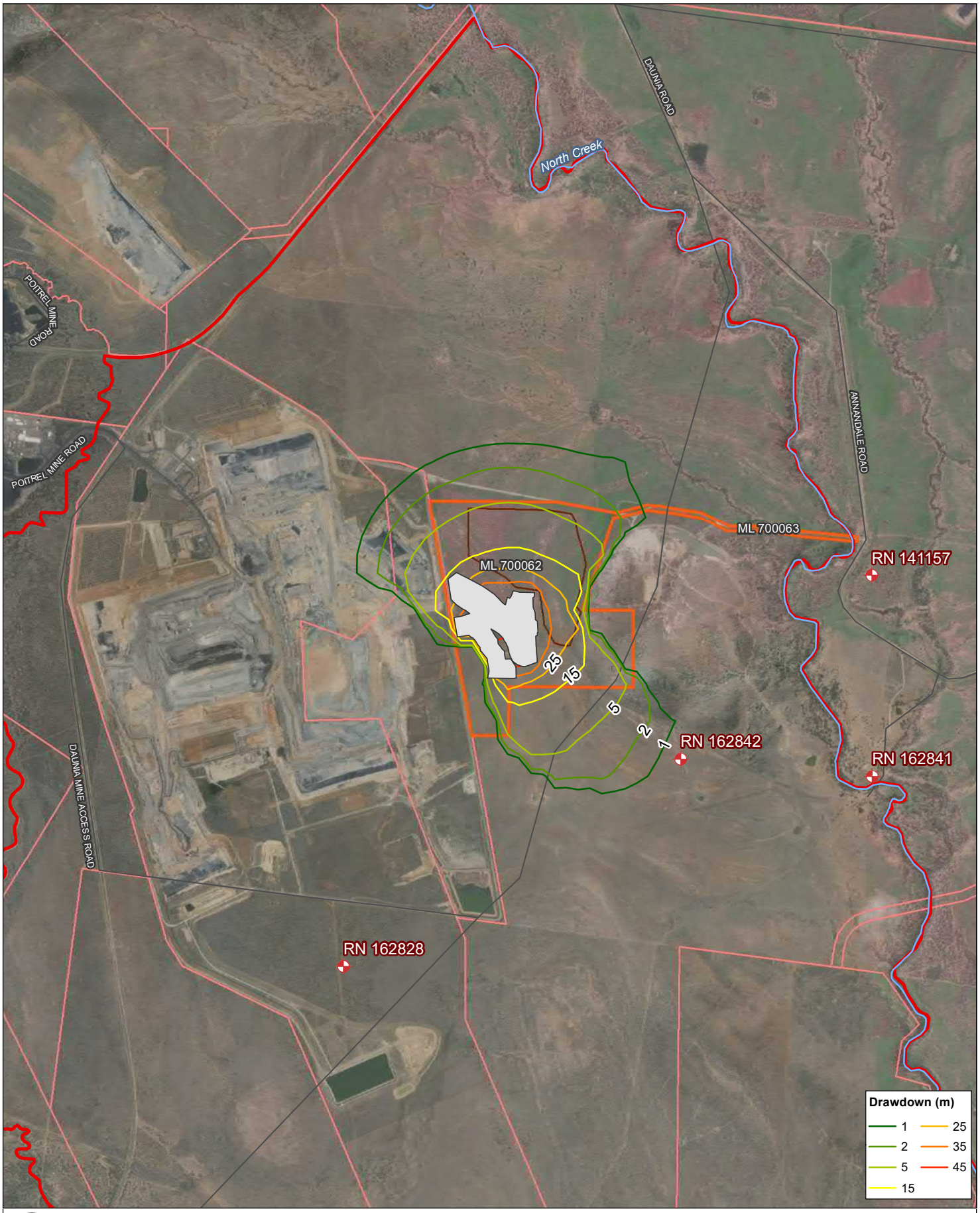
- Registered Groundwater Bore
- Minor Watercourse
- Road
- Mining Lease (Approved)
- Project Mining Lease (Application)
- Waste Rock Dump Extent
- Pit Extent
- Model Boundary

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

ISAAC RIVER PROJECT

Incremental Drawdown in Unconsolidated Sediments and Weathered Rock (Layer 1) - Year 3 of Operation

FIGURE 25



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.30757
Date:	31-Aug-2022
Drawn by:	NT

SLR

- Registered Groundwater Bore
- Minor Watercourse
- Road
- Mining Lease (Approved)
- Project Mining Lease (Application)
- Waste Rock Dump Extent
- Pit Extent
- Model Boundary

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

ISAAC RIVER PROJECT

Incremental Drawdown in Leichhardt and Vermont Coal Seams (Layer 4) - Year 3 of Operation

FIGURE 26

4.4.2 Incidental Water Impacts

4.4.2.1 Influence on Alluvium

As detailed in **Section 4.3.2.1**, no direct groundwater losses from alluvium are reported by CDM Smith (2021) as the proposed pit does not intersect alluvium. Any interference of alluvial groundwater would relate to indirect impacts through increased leakage to the underlying Permian coal measures that are depressurised due to the Project. Groundwater levels within the North Creek alluvium near to the Project are not known and will be assessed by installation of the proposed alluvial bores, noting it is possible that the North Creek alluvium is dry near to the Project.

4.4.2.2 Influence on Baseflow

As detailed in **Section 4.3.2.2**, no influence on baseflow is reported by CDM Smith (2021). The proposed pit is approximately 2.5 km from North Creek to the east, about 5 km from New Chum Creek to the west and over 7 km from Isaac River at its closest point to the southwest. These creeks and rivers are ephemeral in nature and are conceptualised as predominantly losing features, with negligible groundwater contribution. SLR (2019a,b) showed that groundwater levels in the alluvial aquifer were consistently lower than the Isaac River elevation in the Moorvale South Project area, indicating losing stream conditions during periods when the watercourse flows (i.e. the river is not baseflow fed). Whilst the same data are not available to demonstrate this for North Creek (there is no long-term stream gauge data available for North Creek or timeseries groundwater level data), a single groundwater level record for the North Creek alluvium (RN 182167 located approximately 5.5 km southeast of the Project site) records a groundwater depth of approximately 17 m, which also suggests groundwater does not provide baseflow to the watercourse.

4.4.3 Impacts on the Groundwater Resource

4.4.3.1 Potential Impacts on Groundwater Users

Based on the available registered groundwater bore data presented by CDM Smith (2021), four registered bores were identified as potential groundwater supply bores within 5 km of the Project, refer to **Table 13**.

There are no impacted registered bores within the IAA.

4.4.3.2 Potential Impacts on Ecological Sites

As detailed in **Section 4.3.3.3**, the information on watercourses suggests that Type 2 groundwater dependent ecosystems (GDEs) that are reliant on a surface expression of groundwater (such as aquatic species reliant on groundwater baseflow contributions to streams) are unlikely near to the Project area (CDM Smith, 2021).

There is a potential for Type 3 (subsurface expression of groundwater) GDEs to occur near to the Project area, associated with riparian vegetation (Forest Red Gum and River Red Gum species) accessing alluvial groundwater along the banks of the watercourses. The sensitivity of these species to changes in groundwater levels is considered to be low, based on their ability to tolerate extended drought conditions and an assessment of aerial imagery for six open-cut mines in the region, which indicate these vegetation communities have not shown signs of die-back since mines began operation in the 1980s, suggesting a tendency for being vadophytic rather than phreatophytic (CDM Smith, 2021).

Based on the CDM Smith (2021) report, there are no ecological sites that will be impacted by the Project's groundwater affects in mine years one to three.

4.4.3.3 Potential Impacts on Surface Drainage

As discussed in **Section 4.3.2**, no influence on surface drainage baseflow is predicted by CDM Smith (2021).

4.5 Review of Maps Produced

Within the first three years of the Project, there are no impacted registered bores within the IAA.

Trigger levels are listed in Chapter 3 of the Water Act, to assist in the assessment of impacts on aquifers in the UWIR if groundwater levels are predicted to decline as a result of the exercise of underground water rights. The trigger levels are:

- A 5 m decline in water levels within a consolidated aquifer (such as coal or sandstone);
- A 2 m decline in water levels within an unconsolidated aquifer (such as alluvium); and
- A 0.2 m decline in water levels associated with active springs.

Assuming a consolidated aquifer at bore RN 162842, the drawdown trigger level is 5 m. No drawdown is predicted at bore RN 162842 within the IAA, however up to 2 m of drawdown at the bore is predicted within the LTAA. Predicted drawdown at this bore in the LTAA remains less than the consolidated aquifer drawdown trigger level of 5 m.

Annual groundwater reviews will be conducted by a suitably qualified person in accordance with the Project EA and GMMP. As part of the review the groundwater prediction maps will be reviewed against observed data to compare the actual extent of groundwater drawdown to observed drawdown. Where adverse deviations are observed, further investigation into model assumptions and site activities will be undertaken and findings and planned actions to improve the model predictions reported to the regulatory authority within 20 days of the UWIR anniversary date.

5 Part D: Impacts on Environmental Values

This section addresses the requirements under Section 376 (da) and (db) of the Water Act (**Table 14**). The following section includes a description of predicted impacts on environmental values which result from the exercise of underground water rights. The UWIR ensures that there will be ongoing monitoring of impacts during the operational phase of the Project.

Table 14 Requirements under Section 376 (da) and (db) of the Water Act

Requirements under Section 376 (da) and (db) of the Water Act	Relevant UWIR Report Section
To meet the requirements of the Water Act, an UWIR must include the following:	
A description of the impacts on environmental values that have occurred, or likely to occur, because of any previous exercise of underground water rights (Section 376 (da) of the Water Act); and	**N/A** (no previous exercise of underground water rights)
An assessment of the likely impacts on environmental values that will occur, or are likely to occur, because of the exercise of underground water rights (Section 376 (db) of the Water Act) for a three year period starting on the consultation day for the report and over the projected life of the resource tenure.	**5.4** and **5.5**

5.1 Environmental Values

Section 9 of the EP Act (1994) defines an environmental value (EV) as:

- A quality or physical characteristic of the environment that is conducive to ecological health or public amenity or safety; or
- Another quality of the environment identified and declared to be an environmental value under an environmental protection policy or regulation.

The Environmental Protection (Water) Policy 2009 (EPP (Water)), specifies EVs and water quality objectives (WQOs) for groundwater in Queensland. The Project falls within Isaac Connors Groundwater Management Area (GMA – Zone 34) of the Fitzroy Basin under the Water Plan (Fitzroy Basin) 2011. Groundwater at the Project includes water within the hard rock aquifers in GMA Groundwater Unit 2 (sub-artesian aquifers). East of the project area at North Creek, alluvial groundwater under GMA Groundwater Unit 1 is present. The management objective of the Water Plan (Fitzroy Basin) 2011 is to maintain the 20th, 50th and 80th percentiles water quality results to preserve or enhance groundwater quality for its recognised uses. In the case of Isaac groundwaters, these values include:

- Aquatic ecosystems - GDEs;
- Agricultural use - irrigation;
- Agricultural use - stock water;
- Farm water supply/use;
- Primary recreation - swimming;
- Drinking water; and
- Cultural and spiritual values.

5.2 Baseline Groundwater Quality

The Isaac River Sub-basin Environmental Values and Water Quality Objectives (DEHP, 2011) provides WQOs to protect identified EVs. Relevant EVs to the Project for activities conducted over the UWIR period are discussed in relation to impacts due to changes in water availability and impacts due to changes in water quality.

Groundwater chemistry data from the Fitzroy Basin has been classified in several zones based on groundwater chemistry (DEHP, 2011). The open cut pits of the Project will be located in chemistry zone 34. A statistical summary of water chemistry data from this zone is presented in DEHP (2011). Zone 34 represents saline sodium-chloride dominant groundwater in sodic sequences. The median for EC for deep groundwater in zone 34 (more than 30 m depth) was reported as 6,100 µS/cm, and the median concentration for chloride and sodium was reported as 1,900 mg/L and 1,100 mg/L respectively.

Baseline groundwater quality monitoring data collected by CDM Smith (2021) for the site between 2019 and 2021, is presented in **Appendix B**. The water quality is compared to WQOs in the Fitzroy Basin Zone 34, the ANZG (2018) / ANZECC (2000) guidelines and the NHMRC (2011) Australian Drinking Water Guidelines (ADWG).

The groundwater major ion results from samples collected in February 2022 from Project monitoring bores (refer to **Table 10**) are consistent with groundwater quality reported in the EAR groundwater assessment (CDM Smith, 2021), indicating that the dominant ion chemistry is sodium and chloride (Na-Cl water type) for the Permian coal measures.

The groundwater salinity results from samples collected in February 2022 from Project monitoring bores (refer to **Table 10**) are consistent with groundwater quality reported in the EAR groundwater assessment (CDM Smith, 2021), indicating brackish to saline conditions for the Permian coal measures. EC ranges from around 8,000 to 13,000 µS/cm.

Dissolved metals results reported in CDM Smith (2021) included health guideline NHMRC (2011) exceedances for arsenic, chromium, manganese and nickel. Environmental WQOs exceeded the 95% species protection trigger values for chromium, copper, manganese, nickel and zinc.

5.3 Relevant Environmental Values

The EVs that are relevant to the Project are summarised in **Table 15**.

Table 15 Regional Environmental Values for Groundwater and their Applicability to the Project

Regional EV	Relevance to the Project	Applicable to the Project?[1]
Aquatic Ecosystem	Aquatic ecosystem includes all GDEs and potential groundwater – surface water interaction.	YES
Stock water	There is one private bore impacted by drawdown in the LTAA. This bore use is unknown but there is potential use for stock water supply.	YES
Irrigation	There is no known use of groundwater for irrigation purposes within the study area.	NO
Farm supply/use	There is no known use of groundwater for farm water supply/use purposes within the study area.	NO
Primary recreation	The Isaac River provides an opportunity for primary recreation (swimming).	YES
Drinking water	There is one private bore impacted by drawdown in the LTAA. Due to likely brackish to saline conditions, it is unlikely that this bore is used for drinking water supply.	NO
Industrial water	There is no industry relying on groundwater within the study area.	NO
Cultural and spiritual values	There are no known EVs in relation to cultural and spiritual values of groundwater within the study area.	NO

1. Based on review of the hydrogeologic setting, potential receptor information, and the available WQOs and Groundwater Quality Data

5.4 Nature and Extent of Impacts on Environmental Values

This report has detailed the aquifer characteristics at the Project (**Section 3**), groundwater quality (**Section 3**) and investigated the potential impacts that the mining activities may have on groundwater levels (**Section 4**). Based on the above, the potential impacts to the receiving environment due to the exercise of underground water rights have been identified and described in the section below. As discussed in **Section 4.4**, there is no predicted drawdown in year one. In years two to three, the predicted drawdown extends up to 1.6 km from the pit during the IAA.

5.4.1 Groundwater Dependent Ecosystems (GDEs)

The UWIR must consider the potential for groundwater to interact with surface water (e.g. baseflow to rivers and creeks) and groundwater dependent ecosystems (GDEs). GDEs include aquifers, caves, lakes, palustrine wetlands, lacustrine wetlands, rivers and vegetation. A GDE is one in which the plant and/or animal community is dependent on the availability of groundwater to maintain its structure and function.

Chapter 11 of the EA (CDM Smith, 2021) describes the existing aquatic flora and fauna values, including stygofauna and GDEs, within and surrounding the Project. The assessment was based on desktop literature reviews of existing background information and site-specific field assessments undertaken for the Project and the nearby Moorvale South Project (Peabody Energy) and the Olive Downs Project (Pembroke Resources).

5.4.1.1 Desktop Review

There are three types of GDEs (based on the BoM GDE Atlas, 2020):

1. Aquatic ecosystems that rely on the surface expression of groundwater such as rivers, wetlands and springs;
2. Terrestrial ecosystems that rely on the subsurface presence of groundwater such as forests and riparian vegetation; and
3. Subterranean ecosystems such as cave and aquifer ecosystems.

Within a 10 km search radius of the study area, aquatic and terrestrial GDEs are mapped in the vicinity of the Isaac River Project, (refer to CDM Smith 2021, Figure 11-5), but not the subterranean ecosystems.

Desktop mapping of potential GDEs throughout Queensland (BoM GDE Atlas, 2020) indicates that areas with possible high, moderate and low potential for groundwater interaction occur within the Project. In the study area the GDE Atlas classifies ecosystems based on the potential for dependence on groundwater based on multiple lines of scientific evidence. Ecosystems have been mapped as either:

- High potential for groundwater interaction (indicating a strong possibility the ecosystem is interacting with groundwater);
- Moderate potential for groundwater interaction; or
- Low potential for groundwater interaction (indicating it is relatively unlikely the ecosystem will be interacting with groundwater and will include ecosystems that are not interacting with groundwater).

The desktop GDE mapping (BoM GDE Atlas, 2020) indicates:

- Aquatic habitat associated with the Isaac River, North Creek and Cherwell Creek is mapped as having a high potential to be dependent on surface expression of groundwater; and
- Terrestrial vegetation associated with the Isaac River, North Creek and Cherwell Creek is mapped as having a combination of high, moderate and low potential to be dependent on subsurface expression of groundwater.

The accuracy of the desktop GDE mapping was reviewed by DPM Envirosciences (2018a, 2018b). Full details of the GDE field verification are in the Olive Downs Project Groundwater Assessment Report (HydroSimulations, 2018) and findings were summarised in the CDM Smith (2021) report.

5.4.2 Aquatic Ecosystems (GDEs)

Aquatic habitat associated with the Isaac River, North Creek and Cherwell Creek is mapped within the BoM GDE Atlas as having a high potential to be dependent on surface expression of groundwater.

5.4.2.1 Impacts from Changes in Groundwater Levels

The aquatic habitat associated with the Isaac River, North Creek and Cherwell Creek may be a facultative GDE at times for a short period after significant rainfall events (Pembroke, 2018). The Project is unlikely to result in any noticeable impacts to baseflow contributions to Isaac River or Cherwell Creek, given that these watercourses are outside the potential zone of influence of the Project. Drawdown could reach 1 m in the vicinity of North Creek (CDM Smith, 2021). Groundwater levels within the North Creek alluvium in this area are not known and will be assessed by installation of the proposed alluvial bores as part of the Project EA and GMMP. It is noted that the alluvium may be dry in this area.

Paleochannel lake, ox-bow lakes and flood channel wetlands were field verified in the Olive Downs Project EIS, as discussed in HydroSimulations (2018). The field assessment identified aquatic macroinvertebrates indicative of an area subject to complete drying and wetting cycles. The clay-rich substrates of the temporary waterbodies are likely to hold surface run-on for extended periods, creating a 'perched' system not influenced by groundwater drawdown.

No stygofauna were detected in a pilot survey conducted within and surrounding the Project area in March 2021 (CDM Smith, 2021). Groundwater drawdown predictions show there will be no impact on watercourses in the Project area, therefore if stygofauna are present in saturated alluvium, the Project drawdown would not impact stygofauna populations.

5.4.2.2 Impacts from Changes in Groundwater Quality

The comparison of the baseline groundwater quality within the study area to ANZG (2018) guidelines and the Fitzroy Basin Zone 34 WQOs (CDM Smith, 2021) shows that groundwater within the Permian strata exceeded the 95% species protection trigger values for chromium, copper, manganese, nickel and zinc.

5.4.3 Terrestrial Ecosystems (GDEs)

Terrestrial vegetation associated with the Isaac River, North Creek and Cherwell Creek is mapped within the BoM GDE Atlas as having a combination of high, moderate and low potential to be dependent on subsurface expression of groundwater.

5.4.3.1 Impacts from Changes in Groundwater Levels

As discussed in **Section 4.3.3.3**, there is a potential for Type 3 (subsurface expression of groundwater) GDEs to occur in the Project area, associated with riparian vegetation (Forest Red Gum and River Red Gum species) accessing alluvial groundwater along the banks of the watercourses. The sensitivity of these species to changes in groundwater levels is considered to be low, based on their ability to tolerate extended drought conditions and an assessment of aerial imagery for six open-cut mines in the region, which indicate these vegetation communities have not shown signs of die-back since mines began operation in the 1980s, suggesting a tendency for being vadophytic rather than phreatophytic (CDM Smith, 2021).

Based on the CDM Smith (2021) report, there are no ecological sites that will be impacted by groundwater drawdown induced by the Project.

5.4.3.2 Impacts from Changes in Groundwater Quality

The comparison of the baseline groundwater quality within the study area to ANZG (2018) guidelines and the Fitzroy Basin Zone 34 WQOs (CDM Smith, 2021) shows that groundwater within the Permian strata exceeded the 95% species protection trigger values for chromium, copper, manganese, nickel and zinc.

5.4.4 Agricultural Use - Stock Water

5.4.4.1 Impacts from Changes in Groundwater Levels

As discussed in **Section 4.3.3.2** there is a potential for approximately 2 m of drawdown at the end of mining at private bore RN 162842. Bore details including whether the bore is currently used for water supply, bore depth, screen interval and stratigraphy for RN 162842 are not known. Field assessment of this bore will occur as part of a planned Project bore census, pending land access.

For this bore and other bores yet to be identified in the planned bore census and potentially impacted by the Project, make good measures will be put in place with affected landholders to ensure the bore owner has access

to a similar quantity and quality of water for the water bore's authorised purpose. This may include deepening a bore to increase its pumping capacity, constructing a new water supply bore, providing water from an alternative source or financial compensation.

As discussed in **Section 4.4**, there is no predicted drawdown in year one. In years two and three, drawdown is not predicted to affect known private registered bores.

5.4.4.2 Impacts from Changes in Groundwater Quality

The potential type of water use is unknown for the one bore predicted to have drawdown due to mining. It is likely the bore is screened in Permian lithology, though the bore depth and stratigraphy are not known. Water within the siltstones and sandstones of the Permian coal measures is generally suitable for stock water supply, except for some TDS concentrations exceeding guideline levels for pigs and poultry. In contrast, groundwater within the coal seams generally exhibits a higher TDS, which is on average higher than the guideline level for beef cattle but below the guideline level for sheep. Groundwater within the coal measures (coal and interburden) record concentrations of manganese and iron above the Fitzroy Plan WQO (Zone 34 –shallow).

5.4.5 Primary Recreation

5.4.5.1 Impacts from Changes in Baseflow Levels

The Isaac River is identified as having recreational and aquatic ecosystem EVs. No impact on baseflow to the Isaac River is predicted due to the Project, and therefore the Project will not impact on EVs with regards to surface water availability.

5.4.5.2 Impacts from Changes to Water Quality

Water quality sampling at the Deverill gauging station on the Isaac River indicates that the Isaac River is fresh to brackish and only has some water quality exceedances for total suspended solids (TSS), turbidity and metals including aluminum and zinc. In the study area, several mines have permits to release water to the Isaac River. Combined water releases occasionally cause water quality exceedances for EC, for short periods following significant flow events. The monitoring results within the study area record EC ranging from 49 µS/cm to 1,173 µS/cm within the Isaac River (when it flows) and is generally fresh to brackish and considered suitable for primary recreation.

5.5 Potential Impacts to Groundwater Quality

In the initial three years of operation (IAA), potential impacts to water quality relate to installation of potential sources of water that could cause a change in water quality and beneficial use along a likely flow pathway. Activities to be undertaken that are relevant to water quality include:

- Out of pit waste rock emplacement in accordance with the Waste Rock and Coal Reject Management Plan as per EA, which requires effective management of seepage;
- Development of infrastructure including workshops, water treatment/septic systems and fuel storage areas; and
- Development of mine water dams.

Each potential source is discussed below.

5.5.1.1 Out of Pit Waste Rock Emplacement

As the mine progresses, waste rock material will be placed within selected out of pit emplacement area. The out of pit waste rock emplacement area may produce seepage as a result of rainfall inundation. Runoff from disturbed areas outside the mining pit and infrastructure areas, such as the waste rock emplacement area (both active and under rehabilitation) will be captured in the sediment dams and managed under the mine water management system. The system will be designed to capture, and reuse water captured on site, with the only offsite discharge being via approved discharge points. The location of the proposed waste rock emplacement is shown in **Figure 19**.

Unconsolidated residual sediments on site generally comprise surficial soil and clays, up to 2 m in thickness. Where the low permeability surficial clays are present, they would inhibit potential seepage from the waste rock emplacement to the underlying strata. Soil testing will be conducted within the emplacement locations to verify the presence of surficial clays and the emplacements will be constructed to minimise disturbance of the surficial clays. Surface water catchment systems will be put in place to prevent any uncontrolled release of seepage from the emplacement off the mine site towards potential receptors. In addition, the geochemical assessment detailed in CDM Smith (2021) indicates that the waste rock and coal reject material is likely to be non-acid forming and generate seepage which has low sulphur, salinity and soluble metal concentrations. The presence of alkaline soils will likely buffer any localised acid, saline or metalliferous drainage.

In accordance with the EA Condition F4, a Mine Waste Management Plan (MWMP) has been developed to minimise contaminated leachate, and monitoring will be undertaken to assess performance. With these measures in place impacts to groundwater quality are unlikely in either the IAA or LTAA.

5.5.1.2 Infrastructure

Infrastructure including workshops, fuel storage areas, water treatment/septic systems are proposed to be constructed within the site infrastructure area. Each will be constructed in accordance with government regulations and industry standards to prevent the uncontrolled release of water from the sites. This includes measures such as bunding and surface water catchment systems.

With these measures in place impacts to groundwater quality are unlikely in either the IAA or LTAA.

5.5.1.3 Mine Affected Water Dams

Two mine affected water dams will be constructed (Mine Water Dam 1 (MWD1) and Sediment Dam 1 (SD1)). A pipeline will be constructed from MWD1 which will act as the controlled release point to North Creek. The release point will be monitored to ensure water management system objectives are met. The dams will be constructed in accordance with government regulations and industry standards to prevent the uncontrolled release of water from the site. This includes measures such as bunding, lining and surface water catchment systems. Releases will only occur in accordance with the conditions imposed in EA Schedule C, including water quality release limits documented therein, and development of a Water Management Plan (EA Condition C27).

With these measures in place impacts to groundwater quality are unlikely in either the IAA or LTAA.

6 Part E: Water Monitoring Strategy

The following section describes the groundwater monitoring strategy required in section 376(f) of the Water Act for the IAA and LTAA. Ongoing underground water monitoring is required to keep track of the quantity of water produced or taken because of the exercise of relevant underground water rights and to monitor changes in underground water levels and the underground water quality.

The requirements for the monitoring strategy as outlined in section 378 of the Water Act is shown in **Table 16**.

Table 16 Requirements under Section 378 of the Water Act

Requirements under Section 378 of the Water Act	Relevant section in the UWIR	Relevant EA Condition
To meet the requirements of the Water Act, an UWIR must include the following:		
A rationale for the strategy;	**6.1**	-
A timetable for the strategy;	**6.5.2**	**D5** and **Table D1**
The parameters to be measured;	**6.3**	**D6, Table D1** and **Table D2**
The locations for taking measurements;	**6.2**	**D6, Table D1** and **Appendix 3**
The frequency of the measurements;	**6.2** and **6.3**	**D6** and **Table D1**
A programme for the responsible tenure holder or holders to undertake a baseline assessment for each water bore that is outside the area of a resource tenure, but within the predicted LTAA; and	**6.5.1** and **Appendix D**	-
A program for reporting to the Office of Groundwater Impact Assessment (OGIA) about the implementation of the monitoring strategy.	**6.5.2**	**D5, D8** and **D9**

The Groundwater Management and Monitoring Program (GMMP) for the Project is attached in **Appendix C**, developed to meet the requirements of EA Schedule D. The following sections provide a summary of the GMMP as necessary to meet the requirements of the UWIR (**Table 16**).

6.1 Monitoring Rationale

The current and proposed groundwater monitoring network provides spatial and depth coverage to monitor potential groundwater impacts caused by the exercise of underground water rights. The network will track groundwater levels and groundwater quality over time and detect changes from baseline levels during operational activities of the Project. Baseline data will be used to determine trigger levels for both groundwater levels and water quality. Trends in monitoring data that exceed trigger levels will provide a warning to enable action to be taken to reduce potential impacts. If groundwater monitoring indicates continued levels outside the trigger thresholds, additional monitoring and/or the installation of additional monitoring bores may be required.

6.2 Groundwater Level Monitoring Program

The groundwater monitoring program established as part of EIS groundwater investigations, as outlined in the EAR groundwater assessment (CDM Smith, 2021), will be continued throughout the life of the Project as documented in the GMMP. Recording of groundwater levels from existing monitoring bores will continue and from proposed monitoring bores once installed will enable natural groundwater level fluctuations (such as responses to rainfall) to be distinguished from potential groundwater level impacts due to depressurisation resulting from operational activities at the Project.

Table 17 summarises the groundwater monitoring program, and **Figure 2** shows the bore locations. 10 new monitoring bores are proposed which will monitor groundwater levels and water quality. They will be located where monitoring gaps exist. The proposed bores are positioned around the pit footprint, proposed waste rock emplacement area and North Creek, and will be screened within the alluvium or Permian coal measures.

The Project's GMMP reflects the EA requirements for the groundwater monitoring program to monitor groundwater levels in the Permian coal measures and alluvium in response to operational activities at the Project. In accordance with the requirements of condition D6 of the EA, the monitoring outlined in **Table 17** will be undertaken. The EA has set groundwater level trigger thresholds for the 10 compliance monitoring bores CB01 to CB10. The trigger level threshold for these bores is 2 m drawdown from baseline groundwater levels.

Table 17 Groundwater Monitoring Program

Site	Status	Type	Easting (GDA94 / MGA55)	Northing (GDA94/ MGA55)	Screen Depth (m bgl)	Monitored Unit	SWL	WQ
RB01	Proposed*	MB	638937	7561395	30-70	RCM	Q	Q
RB02	Proposed*	MB	638864	7561470	10-30	Alluvium	Q	Q
CB01	Proposed*	MB	639039	7558386	10-30	Alluvium	Q	Q
CB02	Proposed*	MB	638709	7560060	10-30	Alluvium	Q	Q
CB03	Proposed*	MB	638748	7559377	10-30	Alluvium	Q	Q
CB04	Proposed*	MB	635285	7560768	20-40	RCM	Q	Q
CB05	Proposed*	MB	636991	7561100	20-40	RCM	Q	Q
CB06	Proposed*	MB	636508	7559654	20-40	RCM	Q	Q
CB09	Proposed*	MB	637264	7558807	20-40	RCM	Q	Q
CB10	Proposed*	MB	636177	7561348	20-40	RCM	Q	Q
CB07 / PPD001A	Existing	MB	635976	7559377	45.2-51.2	RCM	Q	Q
CB08 / PPD001B	Existing	MB	635976	7559377	73-79	RCM	Q	Q

Notes: ** Proposed bore locations / screen depths are approximate only and may change depending on access / lithology*
MB – Monitoring bore
RCM – Rangal Coal Measures
SWL – Standing water level
Q – Quarterly monitoring frequency
WQ – Water quality monitoring for analytes listed below
Field measurement of pH and EC
Laboratory analyses of TDS, major ions, dissolved metals (including aluminium, arsenic, molybdenum, selenium), total recoverable hydrocarbons (TRH)

6.3 Groundwater Quality Monitoring Program

Groundwater quality sampling of existing monitoring bores will continue to provide longer term baseline groundwater quality around the Project, and to detect any changes in groundwater quality during and post mining.

Groundwater quality monitoring will be undertaken on a quarterly basis for field parameters and laboratory analytes as outlined within **Table 17** to enhance the existing baseline data collected prior to commencement of operational activities at the Project. Trends in water quality monitoring data will be used to detect changes in groundwater quality during and post mining.

The Project's GMMP reflects the EA requirements for the groundwater monitoring program to monitor groundwater quality in the Permian coal measures and alluvium in response to operational activities at the Project. In accordance with the requirements of condition D6 of the EA, the monitoring outlined in **Table 17** will be undertaken.

Groundwater quality limits will be used to identify whether an exceedance has occurred. The groundwater quality limits are shown in **Table 18**, consistent with EA Table D2.

Groundwater quality samples will be collected by a suitably qualified person after the bore has been purged through either low flow sampling (low flow rate maintained and bore sampled once EC/pH stabilises) or high flow sampling (purging three bore volumes). Groundwater samples will be collected in accordance with the relevant guidelines specified in the *"Monitoring and Sampling Manual"* (DES, 2018b), and in compliance with AS/NZS 5667:11 1998 (Australian/New Zealand Standards, 2016).

The groundwater quality parameter suite comprises:

- Physico-chemical parameters
    - Salinity as EC (field measured) and total dissolved solids (TDS) (laboratory);
    - pH (field measured);
    - Temperature (field measured for interpretive purposes only).
- Major ions (laboratory)
    - Calcium (Ca);
    - Magnesium (Mg);
    - Potassium (K);
    - Sodium (Na);
    - Chloride (Cl);
    - Sulfate (SO_4) ;
    - Bicarbonate (HCO_3);
    - Carbonate (CO_3).
- Metals and metalloids (laboratory)
    - Aluminium (Al);
    - Arsenic (As);

  - Molybdenum (Mo);
  - Selenium (Se).
- Hydrocarbons (laboratory)
  - Total Recoverable Hydrocarbons (TRH) C6-C9;
  - Total Recoverable Hydrocarbons (TRH) C10-C36.

Table 18 Groundwater Quality Limits

Monitoring Bore	Parameter	pH	EC	Sulfate	Arsenic (dissolved)	Aluminium (dissolved)	Molybdenum (dissolved)	Selenium (dissolved)	TRH* C6-C9	TRH* C10-C36	Major Ions
	Sample	Range	Max	Max	Max	Max	Max	Max	Max	Max	
	Unit	pH units	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	
CB01											
CB02			990[B]	11[B]							
CB03											
CB04											
CB05			12,900[C]	27[C]							No Limits – Interpretation Only
CB06		6.5 – 8.5[A]			0.014[C]	0.055[E]	0.034[E]	0.005[E]	20[F]	100[F]	
CB07			11,200[C]	23[C]							
CB08			10,000[C]	62[C]							
CB09			5,500[D]	68[D]							
CB10			12,900[C]	27[C]							

* TRH: Total Recoverable Hydrocarbons

[A] Isaac River Sub-basin EVs and WQOs

[B] Isaac River Sub-basin EVs and WQOs Groundwater Unit 1 (shallow)

[C] Site specific 95%ile

[D] ANZECC stock water WQO

[E] Australian Water Quality Guidelines

[F] Model mining condition limit

6.4 Groundwater Take Monitoring

Quantifying the volume of water taken under a mining lease or mineral development licence is required under the *Mineral Resources Act 1989* and *Mineral Resources Regulation 2013* (Department of Natural Resources, Mines and Energy (DNRME), 2020).

Any water volumes captured and pumped from the open cut pit will be monitored using a calibrated flow meter. The volumes will be used as part of the site water balance and compared to predicted groundwater inflows to assist in identifying sources from groundwater versus rainfall recharge. It should be noted that the predicted groundwater inflow volumes are relatively small (**Section 4.2**) and may be naturally managed by evaporation before they can be captured and pumped.

6.5 Impact Assessment Criteria

Groundwater monitoring criteria has been established to monitor predicted impacts on both environmental values and predicted changes in groundwater quality. Impact assessment criteria is documented within the Project's GMMP, consistent with the Project's EA.

Groundwater quality trigger levels are specified in EA Table D2 (**Table 18**). Triggers were developed in consideration of the Water Plan (Fitzroy Basin) 2011 WQOs, ANZECC (2000) / ANZG (2018) criteria and site specific conditions, in consultation with the Department of Environment and Science (DES). Trigger criteria are established for each groundwater unit potentially impacted by the Project, being alluvium and the Permian coal measures.

All site monitoring bores are located within the zone of predicted groundwater level change due to the Project. Therefore, changes in groundwater levels at the site bores will be compared to predicted groundwater trends to evaluate any deviations from the predicted trends.

Baseline (pre-mining) groundwater levels for the Project monitoring bore network are yet to be defined, as detailed in the GMMP and **Table 19**. Consistent with EA Condition D10, pre-mining baseline groundwater levels for each bore will be submitted to the administering authority within 12 months of the commencement of mining activities, or when sufficient data is available. The baseline groundwater levels will replace the 'TBA' values specified in **Table 19** and EA Table D3 - Groundwater Level Trigger Thresholds. Furthermore, consistent with Condition D11 of the EA, these pre-mining baseline groundwater levels will be derived from baseline groundwater monitoring data that includes at least 12 sampling events, one month apart.

Table 19 Baseline Groundwater Levels

Bore ID	Monitored Unit	Baseline Groundwater Level (mAHD)[1]
RB01[2]	Rangal Coal Measures	TBA
RB02[2]	North Creek Alluvium	TBA
CB01	North Creek Alluvium	TBA
CB02	North Creek Alluvium	TBA
CB03	North Creek Alluvium	TBA
CB04	Rangal Coal Measures	TBA
CB05	Rangal Coal Measures	TBA
CB06	Rangal Coal Measures	TBA
CB07	Rangal Coal Measures	TBA
CB08	Rangal Coal Measures	TBA
CB09	Rangal Coal Measures	TBA
CB10	Rangal Coal Measures	TBA

[1] TBA = To Be Assessed

[2]Reference bore; baseline groundwater level for interpretation purposes only

6.5.1 Baseline Assessment Plan

Quarterly groundwater level and water quality monitoring will be undertaken on accessible landholder bores predicted to be impacted within the LTAA by the Project (registered bore RN 162842 and other bores potentially identified by the proposed bore census). Where possible, the bores should be equipped with flow meters, to enable separation of Project impacts and impacts related to private bore usage.

Further details of the proposed private bore baseline assessment program are attached in **Appendix D**.

6.5.2 Data Management and Reporting

Routine groundwater monitoring will be conducted on a quarterly basis, as outlined in **Section 6.2**. Data will be stored within a consolidated groundwater database. Quality assurance and quality control procedures will be put in place to help ensure the accuracy of data entered within the database. Groundwater quality triggers have been established as discussed in **Section 6.3**.

When coal extraction commences at site, findings from the quarterly monitoring events will be presented in a factual biannual monitoring report. The biannual review will include identification of any groundwater quality trigger exceedances. Where a trigger exceedance is identified, the regulator will be notified within 28 days. Investigation into the cause of the exceedance will also be conducted by suitably qualified personnel. The groundwater database and factual biannual reports will be available for provision to the regulator upon request.

Each year an annual review of groundwater level and water quality trends will be conducted by a suitably qualified person and submitted to the administering authority via WaTERS by 1 March each calendar year (EA condition D5). The review will assess the change in groundwater level and quality over the year, compared to historical trends and impact assessment predictions. The annual review will discuss any groundwater trigger exceedances or where trends show potential for environmental harm. If the monitoring program identifies a significant change to predictions, an investigation will be undertaken to identify the cause and manage any unexpected impacts associated with the Project. The monitoring program will also be reviewed on an annual basis to determine whether it continues to meet the requirements stated in condition D5 of the EA.

7 Part F: Spring Impact Management Strategy

A spring impact management strategy is required under Section 376 (g) of the Water Act. The contents of the spring impact management strategy are provided in Section 379 of the Water Act. This section addresses the requirements under Section 379 of the Water Act.

The requirements for the spring impact management strategy as outlined in section 379 of the Water Act is shown in **Table 20**.

Table 20 Requirements under Section 379 of the Water Act

Requirements under Section 379 of the Water Act	Relevant UWIR Report Section
To meet the requirements of the Water Act, a UWIR must include the following:	
An assessment of the connectivity between the spring and the aquifer(s) over which the springs is located.	N/A
The predicted risk to, and likely impact on, the ecosystem and cultural and spiritual values of the spring because of the decline in water levels of the aquifer over which the spring is located.	N/A
A strategy for preventing or mitigating the predicted impacts outlined above, or if a strategy for preventing or mitigating the predicted impacts is not included, the reason for not including the strategy.	N/A
A timetable for implementing the strategy.	N/A
A program for reporting to OGIA about the implementation of the strategy.	N/A

7.1 Spring Inventory

As shown in the EAR groundwater assessment (CDM Smith, 2021), there are no known springs within the Project area. The Queensland Government's Queensland Springs Database (Queensland Globe, accessed 2022) indicates that the closest known springs are approximately 160 km to the southwest of the Project.

7.2 Management of Springs

As there are no known springs within 160 km of the Project area, it is considered that there is no requirement for a spring management strategy for the Project.

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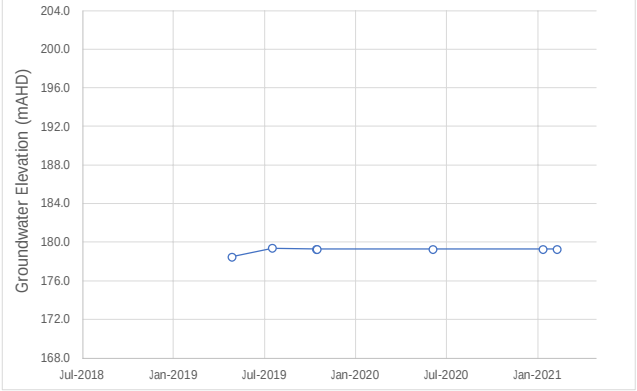
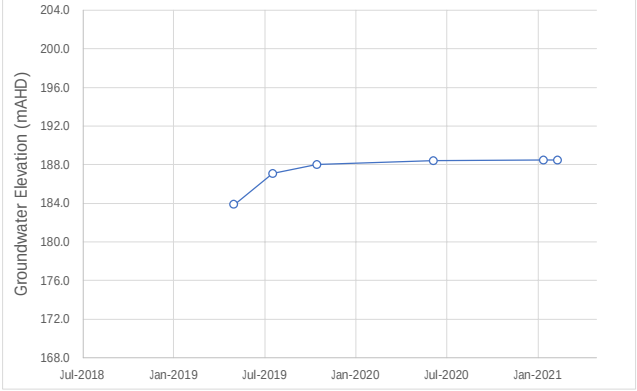
APPENDIX A

Groundwater Level Data EA Report (CDM Smith, 2021)

PPD01B



WW04A



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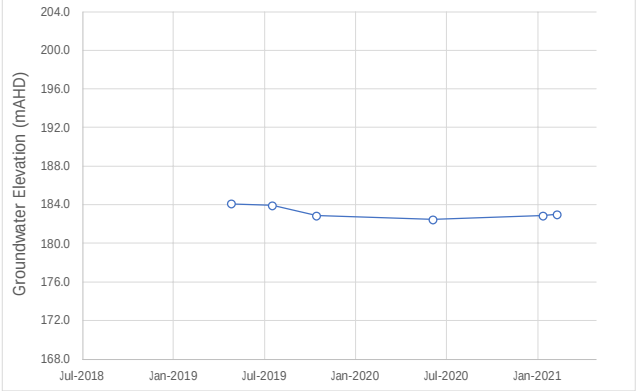

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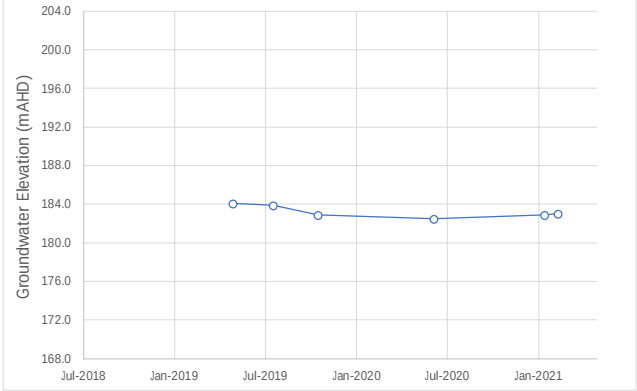

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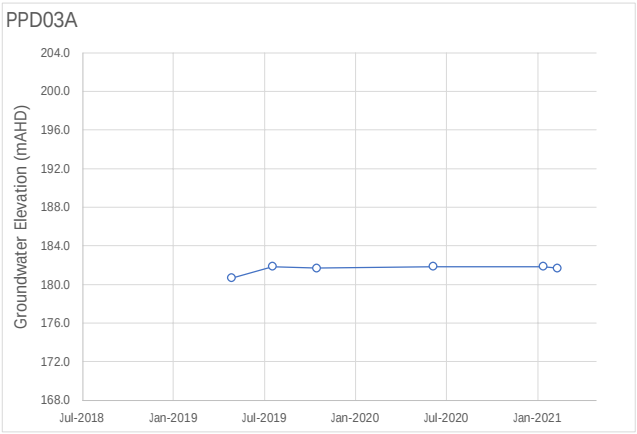

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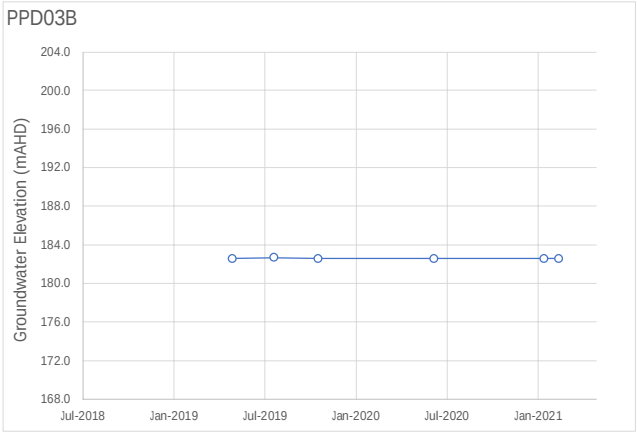

APPENDIX B

Groundwater Quality Data EA Report (CDM Smith, 2021)

7.4.10 Groundwater Chemistry

7.4.10.1 Overview

The groundwater monitoring bores within MLa 700062 and immediately south of it (PPD001A and PPD001B) were sampled in the months of July and October 2019 and analysed for major ions and metals. In May 2019, seven of the eight groundwater monitoring bores were sampled; bore PPD01A was not sampled. The hydrochemical analyses results are summarised in Table 7-9, Table 7-10 and Table 7-11. Further groundwater sampling occurred in June 2020 and January, February and March 2021 with the results summarised in Table 7-12.

Groundwater was found to be typically of a poor quality and generally not suitable for human consumption, irrigation or stock watering purposes. The quality is typically brackish ranging from 8,000 to 12,000 µS/cm. The exception to this is Bore 11, which showed potable range salinity in the 600 to 2,000 µS/cm range. Bore 11 is likely to be monitoring a local area of rapid recharge associated with the weathered zone around the granite intrusion in the east of MLa 444. Groundwater is typically neutral-alkaline with pH ranging from 6.8 to 10.2. Some elevated metals in relation to drinking water and aquatic protect guidelines were observed including zinc, chromium, copper, nickel, and manganese.

Complete groundwater analysis results are provided at Appendix O.

Table 7-9 Monitoring bores hydrochemistry May 2019

Bore / Sample Date		PPD01B 05/05/19	PPD02B 02/05/19	PPD02C 02/05/19	PPD03A 01/05/19	PPD03B 01/05/19	Bore11 01/05/19	WW04A 05/05/19	ADWG Guidelines[a] (V3.5, August 2018)		Isaac River Sub-basin Environmental Values[b]		
Determinand	Units								Health	Aesthetic	Irrigation	Stock[c]	Aquatic 95% spp
pH	-	7.67	7.95	8.01	8.23	8.37	8.20	7.24	-	6.5 to 8.5	-	-	6.5 to 8.5
EC (25° C)	µS/cm	8,750	12,300	14,100	9,110	9,250	679	8,510	-	-	-	-	-
Total alkalinity $CaCO_3$	mg/L	182	266	124	457	249	206	722	-	-	-	-	-
Bicarbonate alkalinity $CaCO_3$	mg/L	182	266	124	457	234	206	722	-	-	-	-	-
Carbonate alkalinity $CaCO_3$	mg/L	<1	<1	<1	<1	15	<1	<1	-	-	-	-	-
Hydroxide alkalinity $CaCO_3$	mg/L	<1	<1	<1	<1	<1	<1	<1	-	-	-	-	-
Aluminium[d]	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	-	0.2	-	5	0.055
Calcium	mg/L	125	338	506	271	155	46	323	-	-	-	1,000	-
Chloride	mg/L	3,090	4,140	4,900	2,980	3,080	91	2,430	-	250	-	-	-
Magnesium	mg/L	34	131	294	158	75	10	333	-	-	-	2,000	-
Manganese[d]	mg/L	0.080	0.209	0.047	0.278	0.378	0.220	0.514	0.5	0.1	10	-	1.9
Potassium	mg/L	10	12	49	16	25	5	7	-	-	-	-	-
Sodium	mg/L	1,610	2,290	2,130	1,480	1,750	66	1,200	-	180	-	-	-
Sulfate (SO_4)	mg/L	9	3	128	17	27	1	744	-	250	-	1,000	-
Zinc[d]	mg/L	0.041	0.023	0.021	0.043	0.016	<0.005	0.098	-	3	-	-	0.008
Arsenic[d]	mg/L	0.004	<0.001	<0.001	0.002	0.001	0.002	0.001	0.01	-	2	0.5	0.024
Cadmium[d]	mg/L	<0.0001	<0.0001	0.0001	<0.0001	0.0001	<0.0001	<0.0001	0.002	-	-	0.01	0.0002

Bore / Sample Date		PPD01B 05/05/19	PPD02B 02/05/19	PPD02C 02/05/19	PPD03A 01/05/19	PPD03B 01/05/19	Bore11 01/05/19	WW04A 05/05/19	ADWG Guidelines[a] (V3.5, August 2018)		Isaac River Sub-basin Environmental Values[b]		
Determinand	Units								Health	Aesthetic	Irrigation	Stock[c]	Aquatic 95% spp
Chromium[d]	mg/L	<0.001	<0.001	0.116	<0.001	0.012	<0.001	<0.001	0.05	-	-	1	0.001
Cobalt[d]	mg/L	0.001	0.003	<0.001	0.004	0.003	<0.001	0.006	-	-	0.1	1	-
Copper[d]	mg/L	0.003	<0.001	0.002	0.004	0.001	0.002	<0.001	2	1	-	1	0.0014
Lead[d]	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01	-	-	0.1	0.0034
Mercury[d]	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001	-	-	0.002	0.0006
Nickel[d]	mg/L	0.006	0.008	0.002	0.033	0.010	0.002	0.008	0.02	-	-	1	0.011
Selenium[d]	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.06	0.01	-	-	0.02	0.005[e]
Silver[d]	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.1	-	-	-	0.05

a Table 4 of Isaac River Sub-basin Environmental Values and Water Quality Objectives: Drinking water EV
b Table 2, Table 9, Table 10 and Table 11 of Isaac River Sub-basin Environmental Values and Water Quality Objectives: Aquatic ecosystem – moderately disturbed, Table 3.4.1 of Australian and New Zealand Guidelines for Fresh and Marine Water Quality: trigger values for slightly-moderately disturbed systems (95% level of protection)
c Stock water criteria are to be compared against total metals and comparison is limited in this instance by comparison with dissolved metals
d Metal data are dissolved
e The LOR for Selenium is above the assessment criteria for aquatic ecosystems and requires further assessment for this end-use scenario
Note: colour shading corresponds to the relevant exceedance criteria. Where multiple criteria are exceeded the colour representing the highest criteria is shown

Table 7-10 Monitoring bores hydrochemistry July 2019

Bore / Sample Date		PPD01A 24/07/19	PPD01B 24/07/19	PPD02B 24/07/19	PPD02C 24/07/19	PPD03A 24/07/19	PPD03B 24/07/19	Bore11 25/07/19	WW04A 25/07/19	ADWG Guidelines[a] (V3.5, August 2018)		Isaac River Sub-basin Environmental Values[b]		
Determinand	Units									Health	Aesthetic	Irrigation	Stock[c]	Aquatic 95% spp
pH	-	7.32	10.2	7.53	7.96	8.02	8.47	6.95	7.25	-	6.5 to 8.5	-	-	6.5 to 8.5
EC (25° C)	µS/cm	9,000	8,170	12,500	13,300	10,100	8,300	1,190	9,000	-	-	-	-	-
Total alkalinity $CaCO_3$	mg/L	589	48	385	205	506	256	323	840	-	-	-	-	-
Bicarbonate alkalinity $CaCO_3$	mg/L	589	<1	385	205	506	234	323	840	-	-	-	-	-
Carbonate alkalinity $CaCO_3$	mg/L	<1	33	<1	<1	<1	23	<1	<1	-	-	-	-	-
Hydroxide alkalinity $CaCO_3$	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-	-	-
Aluminium[d]	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	-	0.2	-	5	0.055
Calcium	mg/L	204	117	341	417	290	131	60	297	-	-	-	1,000	-
Chloride	mg/L	2,770	2,630	4,140	4,600	3,280	2,720	207	2,480	-	250	-	-	-
Magnesium	mg/L	95	14	118	202	161	62	15	310	-	-	-	2,000	-
Manganese[d]	mg/L	0.203	<0.001	0.096	0.401	2.07	0.311	0.422	0.168	0.5	0.1	10	-	1.9
Potassium	mg/L	13	80	11	26	12	26	7	5	-	-	-	-	-
Sodium	mg/L	1,690	1,520	2,140	2,060	1,580	1,400	116	1,220	-	180	-	-	-
Sulfate (SO_4)	mg/L	25	166	<1	53	8	28	1	729	-	250	-	1,000	-
Zinc[d]	mg/L	0.085	<0.005	0.046	0.021	0.019	0.006	<0.005	<0.005	-	3	-	-	0.008

Bore / Sample Date		PPD01A 24/07/19	PPD01B 24/07/19	PPD02B 24/07/19	PPD02C 24/07/19	PPD03A 24/07/19	PPD03B 24/07/19	Bore11 25/07/19	WW04A 25/07/19	ADWG Guidelines[a] (V3.5, August 2018)		Isaac River Sub-basin Environmental Values[b]		
Determinand	Units									Health	Aesthetic	Irrigation	Stock[c]	Aquatic 95% spp
Arsenic[d]	mg/L	0.002	<0.001	<0.001	0.001	0.006	0.001	0.001	<0.001	0.01	-	2	0.5	0.024
Cadmium[d]	mg/L	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002	-	-	0.01	0.0002
Chromium[d]	mg/L	0.002	0.279	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	0.05	-	-	1	0.001
Cobalt[d]	mg/L	0.002	<0.001	0.002	0.004	0.019	0.001	<0.001	<0.001	-	-	0.1	1	-
Copper[d]	mg/L	0.003	0.002	<0.001	0.001	0.003	<0.001	<0.001	<0.001	2	1	-	1	0.0014
Lead[d]	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01	-	-	0.1	0.0034
Mercury[d]	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001	-	-	0.002	0.0006
Nickel[d]	mg/L	0.030	<0.001	0.070	0.076	0.026	0.042	0.053	0.174	0.02	-	-	1	0.011
Selenium[d]	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	-	-	0.02	0.005[e]
Silver[d]	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.1	-	-	-	0.05

a Table 4 of Isaac River Sub-basin Environmental Values and Water Quality Objectives: Drinking water EV
b Table 2, Table 9, Table 10 and Table 11 of Isaac River Sub-basin Environmental Values and Water Quality Objectives: Aquatic ecosystem – moderately disturbed, Table 3.4.1 of Australian and New Zealand Guidelines for Fresh and Marine Water Quality: trigger values for slightly-moderately disturbed systems (95% level of protection)
c Stock water criteria are to be compared against total metals and comparison is limited in this instance by comparison with dissolved metals
d Metal data are dissolved
e The LOR for Selenium is above the assessment criteria for aquatic ecosystems and requires further assessment for this end-use scenario
Note: colour shading corresponds to the relevant exceedance criteria. Where multiple criteria are exceeded the colour representing the highest criteria is shown

Table 7-11 Monitoring bores hydrochemistry October 2019

Bore / Sample Date		PPD01A 24/10/19	PPD01B 24/10/19	PPD02B 23/10/19	PPD02C 23/10/19	PPD03A 23/10/19	PPD03B 23/10/19	Bore11 24/10/19	WW04A 22/10/19	ADWG Guidelines[a] (V3.5, August 2018)		Isaac River Sub-basin Environmental Values[b]		
Determinand	Units									Health	Aesthetic	Irrigation	Stock[c]	Aquatic 95% spp
pH	-	7.39	8.18	7.41	7.69	7.36	7.71	6.90	7.19	-	6.5 to 8.5	-	-	6.5 to 8.5
EC (25° C)	µS/cm	9,180	8,930	12,100	13,000	10,000	8,840	1,530	8,660	-	-	-	-	-
Total alkalinity $CaCO_3$	mg/L	512	180	325	232	507	235	344	724	-	-	-	-	-
Bicarbonate alkalinity $CaCO_3$	mg/L	512	180	325	232	507	235	344	724	-	-	-	-	-
Carbonate alkalinity $CaCO_3$	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-	-	-
Hydroxide alkalinity $CaCO_3$	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-	-	-
Aluminium[d]	mg/L	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	0.2	-	5	0.055
Calcium	mg/L	167	119	298	355	254	138	73	254	-	-	-	1,000	-
Chloride	mg/L	2,830	2,910	3,920	4,210	3,200	2,850	291	2,370	-	250	-	-	-
Magnesium	mg/L	93	42	126	176	162	62	21	308	-	-	-	2,000	-
Manganese[d]	mg/L	0.472	0.123	0.048	0.354	1.65	0.932	0.613	0.130	0.5	0.1	10	-	1.9
Potassium	mg/L	10	12	11	20	12	16	7	5	-	-	-	-	-
Sodium	mg/L	1,610	1,640	2,080	2,090	1,620	1,580	172	1,190	-	180	-	-	-
Sulfate (SO_4)	mg/L	9	5	<1	29	4	12	6	582	-	250	-	1,000	-
Zinc[d]	mg/L	0.244	0.103	0.084	0.012	0.157	0.023	0.025	<0.005	-	3	-	-	0.008

Bore / Sample Date		PPD01A 24/10/19	PPD01B 24/10/19	PPD02B 23/10/19	PPD02C 23/10/19	PPD03A 23/10/19	PPD03B 23/10/19	Bore11 24/10/19	WW04A 22/10/19	ADWG Guidelines[a] (V3.5, August 2018)		Isaac River Sub-basin Environmental Values[b]		
Determinand	Units									Health	Aesthetic	Irrigation	Stock[c]	Aquatic 95% spp
Arsenic[d]	mg/L	0.002	0.002	0.001	0.001	0.008	0.002	0.002	<0.001	0.01	-	2	0.5	0.024
Cadmium[d]	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002	-	-	0.01	0.0002
Chromium[d]	mg/L	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.05	-	-	1	0.001
Cobalt[d]	mg/L	0.004	0.002	0.001	0.003	0.014	0.001	<0.001	<0.001	-	-	0.1	1	-
Copper[d]	mg/L	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	2	1	-	1	0.0014
Lead[d]	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01	-	-	0.1	0.0034
Mercury[d]	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001	-	-	0.002	0.0006
Nickel[d]	mg/L	0.023	0.010	0.002	0.010	0.018	0.008	0.004	0.002	0.02	-	-	1	0.011
Selenium[d]	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	-	-	0.02	0.005[e]
Silver[d]	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.1	-	-	-	0.05

a Table 4 of Isaac River Sub-basin Environmental Values and Water Quality Objectives: Drinking water EV
b Table 2, Table 9, Table 10 and Table 11 of Isaac River Sub-basin Environmental Values and Water Quality Objectives: Aquatic ecosystem – moderately disturbed, Table 3.4.1 of Australian and New Zealand Guidelines for Fresh and Marine Water Quality: trigger values for slightly-moderately disturbed systems (95% level of protection)
c Stock water criteria are to be compared against total metals and comparison is limited in this instance by comparison with dissolved metals
d Metal data are dissolved
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Note: colour shading corresponds to the relevant exceedance criteria. Where multiple criteria are exceeded the colour representing the highest criteria is shown

Table 7-12 Monitoring bores hydrochemistry June 2020

Bore / Sample Date		PPD01A 24/10/20	PPD01B 24/10/20	PPD02B 23/10/20	PPD02C 23/10/20	PPD03A 23/10/20	PPD03B 23/10/20	Bore11 24/10/20	WW04A 22/10/20	ADWG Guidelines[a] (V3.5, August 2018)		Isaac River Sub-basin Environmental Values[b]		
Determinand	Units									Health	Aesthetic	Irrigation	Stock[c]	Aquatic 95% spp
pH	-	-	8.14	8.01	7.98	7.88	8.05	7.52	7.77	-	6.5 to 8.5	-	-	6.5 to 8.5
EC (25° C)	µS/cm	-	9,270	12,800	12,800	10,500	8,750	1,660	9,060	-	-	-	-	-
Total alkalinity $CaCO_3$	mg/L	-	179	316	222	509	225	380	698	-	-	-	-	-
Bicarbonate alkalinity $CaCO_3$	mg/L	-	179	316	222	509	225	380	698	-	-	-	-	-
Carbonate alkalinity $CaCO_3$	mg/L	-	<1	<1	<1	<1	<1	<1	<1	-	-	-	-	-
Hydroxide alkalinity $CaCO_3$	mg/L	-	<1	<1	<1	<1	<1	<1	<1	-	-	-	-	-
Aluminium[d]	mg/L	<0.01	0.01	<0.01	0.01	<0.01	<0.01	0.01	<0.01	-	0.2	-	5	0.055
Calcium	mg/L	200	145	182	289	317	170	11	312	-	-	-	1,000	-
Chloride	mg/L	-	3,030	4,270	4,270	3,380	2,820	305	2,500	-	250	-	-	-
Magnesium	mg/L	100	45	149	193	180	59	25	343	-	-	-	2,000	-
Manganese[d]	mg/L	1.19	0.152	0.060	0.341	1.68	0.912	0.734	0.115	0.5	0.1	10	-	1.9
Potassium	mg/L	12	16	12	32	12	13	6	4	-	-	-	-	-
Sodium	mg/L	1,770	1,810	2,380	2,040	1,830	1,690	214	1,330	-	180	-	-	-
Sulfate (SO_4)	mg/L	-	14	<1	57	<1	5	14	560	-	250	-	1,000	-
Zinc[d]	mg/L	0.048	0.016	0.031	0.026	0.015	0.014	0.024	0.005	-	3	-	-	0.008

Bore / Sample Date		PPD01A 24/10/20	PPD01B 24/10/20	PPD02B 23/10/20	PPD02C 23/10/20	PPD03A 23/10/20	PPD03B 23/10/20	Bore11 24/10/20	WW04A 22/10/20	ADWG Guidelines[a] (V3.5, August 2018)		Isaac River Sub-basin Environmental Values[b]		
Determinand	Units									Health	Aesthetic	Irrigation	Stock[c]	Aquatic 95% spp
Arsenic[d]	mg/L	0.003	0.003	0.001	<0.001	0.016	0.013	0.006	<0.001	0.01	-	2	0.5	0.024
Cadmium[d]	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002	-	-	0.01	0.0002
Chromium[d]	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.05	-	-	1	0.001
Cobalt[d]	mg/L	0.012	<0.001	<0.001	0.001	0.012	0.001	<0.001	<0.001	-	-	0.1	1	-
Copper[d]	mg/L	0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	2	1	-	1	0.0014
Lead[d]	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01	-	-	0.1	0.0034
Mercury[d]	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001	-	-	0.002	0.0006
Nickel[d]	mg/L	0.020	0.018	0.007	0.025	0.020	0.010	0.007	0.010	0.02	-	-	1	0.011
Selenium[d]	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	-	-	0.02	0.005[e]
Silver[d]	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.1	-	-	-	0.05

a Table 4 of Isaac River Sub-basin Environmental Values and Water Quality Objectives: Drinking water EV
b Table 2, Table 9, Table 10 and Table 11 of Isaac River Sub-basin Environmental Values and Water Quality Objectives: Aquatic ecosystem – moderately disturbed, Table 3.4.1 of Australian and New Zealand Guidelines for Fresh and Marine Water Quality: trigger values for slightly-moderately disturbed systems (95% level of protection)
c Stock water criteria are to be compared against total metals and comparison is limited in this instance by comparison with dissolved metals
d Metal data are dissolved
e The LOR for Selenium is above the assessment criteria for aquatic ecosystems and requires further assessment for this end-use scenario
Note: colour shading corresponds to the relevant exceedance criteria. Where multiple criteria are exceeded the colour representing the highest criteria is shown

Table 7-13 Monitoring bores hydrochemistry January 2021

Bore / Sample Date		PPD01A 28/01/21	PPD01B 28/01/21	PPD02B 28/01/21	PPD02C 28/01/21	PPD03A 27/01/21	PPD03B 28/01/21	Bore11 27/01/21	Bore11-B[f] 28/01/21	WW04A 27/01/21	ADWG Guidelines[a] (V3.5, August 2018)		Isaac River Sub-basin Environmental Values[b]		
Determinand	Units										Health	Aesthetic	Irrigation	Stock[c]	Aquatic 95% spp
pH	-	7.21	7.80	7.39	7.46	7.28	7.80	6.80	7.17	7.36	-	6.5 to 8.5	-	-	6.5 to 8.5
EC (25° C)	µS/cm	10,600	9,170	12,600	12,600	10,000	8,100	1,340	4,710	8,750	-	-	-	-	-
Total alkalinity $CaCO_3$	mg/L	578	271	316	314	528	196	336	1,030	712	-	-	-	-	-
Bicarbonate alkalinity $CaCO_3$	mg/L	578	271	316	314	528	196	336	1,030	712	-	-	-	-	-
Carbonate alkalinity $CaCO_3$	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-	-	-
Hydroxide alkalinity $CaCO_3$	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-	-	-
Aluminium[d]	mg/L	<0.01	0.01	<0.01	<0.01	0.01	<0.01	0.01	<0.01	<0.01	-	0.2	-	5	0.055
Calcium	mg/L	184	120	263	296	212	106	68	139	236	-	-	-	1,000	-
Chloride	mg/L	3,730	3,210	4,590	4,640	3,520	2,920	242	1,070	2,640	-	250	-	-	-
Magnesium	mg/L	126	41	140	153	179	50	20	134	329	-	-	-	2,000	-
Manganese[d]	mg/L	1.53	0.214	0.032	0.252	1.22	0.728	0.612	0.399	0.110	0.5	0.1	10	-	1.9
Potassium	mg/L	10	31	12	19	12	10	6	5	4	-	-	-	-	-
Sodium	mg/L	2,030	1,760	2,270	2,270	1,800	1,600	169	798	1,320	-	180	-	-	-
Sulfate (SO_4)	mg/L	15	62	8	15	6	12	7	94	602	-	250	-	1,000	-

Bore / Sample Date		PPD01A 28/01/21	PPD01B 28/01/21	PPD02B 28/01/21	PPD02C 28/01/21	PPD03A 27/01/21	PPD03B 28/01/21	Bore11 27/01/21	Bore11-B[f] 28/01/21	WW04A 27/01/21	ADWG Guidelines[a] (V3.5, August 2018)		Isaac River Sub-basin Environmental Values[b]		
Determinand	Units										Health	Aesthetic	Irrigation	Stock[c]	Aquatic 95% spp
Zinc[d]	mg/L	0.212	0.051	0.024	0.008	0.022	0.017	<0.005	<0.005	<0.005	-	3	-	-	0.008
Arsenic[d]	mg/L	0.006	0.002	<0.001	<0.001	0.015	0.009	0.003	0.002	<0.001	0.01	-	2	0.5	0.024
Cadmium[d]	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002	-	-	0.01	0.0002
Chromium[d]	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.05	-	-	1	0.001
Cobalt[d]	mg/L	0.013	0.001	<0.001	<0.001	0.009	0.002	0.001	<0.001	<0.001	-	-	0.1	1	-
Copper[d]	mg/L	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	2	1	-	1	0.0014
Lead[d]	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01	-	-	0.1	0.0034
Mercury[d]	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001	-	-	0.002	0.0006
Nickel[d]	mg/L	0.074	0.079	0.017	0.033	0.036	0.027	0.005	0.002	0.008	0.02	-	-	1	0.011
Selenium[d]	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	-	-	0.02	0.005[e]
Silver[d]	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.1	-	-	-	0.05

a Table 4 of Isaac River Sub-basin Environmental Values and Water Quality Objectives: Drinking water EV

b Table 2, Table 9, Table 10 and Table 11 of Isaac River Sub-basin Environmental Values and Water Quality Objectives: Aquatic ecosystem – moderately disturbed, Table 3.4.1 of Australian and New Zealand Guidelines for Fresh and Marine Water Quality: trigger values for slightly-moderately disturbed systems (95% level of protection)

c Stock water criteria are to be compared against total metals and comparison is limited in this instance by comparison with dissolved metals

d Metal data are dissolved

e The LOR for Selenium is above the assessment criteria for aquatic ecosystems and requires further assessment for this end-use scenario

Note: colour shading corresponds to the relevant exceedance criteria. Where multiple criteria are exceeded the colour representing the highest criteria is shown

F Bore 11-B. Following further investigations the bore registered as RN182169 is different to the bore sampled, hence RN182169 from the ALS report is represented in the above results as Bore 11-B

Table 7-14 Monitoring bores hydrochemistry February 2021

Bore / Sample Date		PPD01A 25/02/21	PPD01B 25/02/21	PPD02B 25/02/21	PPD02C 25/02/21	PPD03A 25/02/21	PPD03B 25/02/21	Bore11 25/02/21	Bore11-B[f] 25/02/21	WW04A 25/02/21	ADWG Guidelines[a] (V3.5, August 2018)		Isaac River Sub-basin Environmental Values[b]		
Determinand	Units										Health	Aesthetic	Irrigation	Stock[c]	Aquatic 95% spp
pH	-	7.45	7.75	7.67	7.72	7.56	7.89	7.63	6.89	7.55	-	6.5 to 8.5	-	-	6.5 to 8.5
EC (25° C)	µS/cm	11,000	9,820	13,000	13,000	10,200	8,320	8,990	2,020	4,660	-	-	-	-	-
Total alkalinity $CaCO_3$	mg/L	608	251	335	326	548	208	749	505	1040	-	-	-	-	-
Bicarbonate alkalinity $CaCO_3$	mg/L	608	251	335	326	548	208	749	505	1040	-	-	-	-	-
Carbonate alkalinity $CaCO_3$	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-	-	-
Hydroxide alkalinity $CaCO_3$	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-	-	-
Aluminium[d]	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	<0.01	-	0.2	-	5	0.055
Calcium	mg/L	154	84	220	257	166	81	208	98	136	-	-	-	1,000	-
Chloride	mg/L	3,720	3,400	4,660	4,680	3,480	2,840	2,620	424	1,030	-	250	-	-	-
Magnesium	mg/L	124	33	138	150	166	46	325	32	126	-	-	-	2,000	-
Manganese[d]	mg/L	1.28	0.340	0.031	0.250	1.05	0.639	0.100	1.06	0.534	0.5	0.1	10	-	1.9
Potassium	mg/L	10	10	11	18	11	9	4	5	6	-	-	-	-	-
Sodium	mg/L	2,130	1,970	2,360	2,320	1,770	1,570	1,340	300	762	-	180	-	-	-
Sulfate (SO_4)	mg/L	13	<1	<1	8	2	4	606	19	99	-	250	-	1,000	-
Zinc[d]	mg/L	0.041	0.006	0.023	0.026	0.187	0.006	<0.005	0.012	<0.005	-	3	-	-	0.008

Bore / Sample Date		PPD01A 25/02/21	PPD01B 25/02/21	PPD02B 25/02/21	PPD02C 25/02/21	PPD03A 25/02/21	PPD03B 25/02/21	Bore11 25/02/21	Bore11-B[f] 25/02/21	WW04A 25/02/21	ADWG Guidelines[a] (V3.5, August 2018)		Isaac River Sub-basin Environmental Values[b]		
Determinand	Units										Health	Aesthetic	Irrigation	Stock[c]	Aquatic 95% spp
Arsenic[d]	mg/L	0.008	0.009	0.001	0.001	0.014	0.013	<0.001	0.009	0.001	0.01	-	2	0.5	0.024
Cadmium[d]	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002	-	-	0.01	0.0002
Chromium[d]	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.05	-	-	1	0.001
Cobalt[d]	mg/L	0.012	<0.001	<0.001	<0.001	0.010	<0.001	<0.001	<0.001	<0.001	-	-	0.1	1	-
Copper[d]	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	2	1	-	1	0.0014
Lead[d]	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01	-	-	0.1	0.0034
Mercury[d]	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001	-	-	0.002	0.0006
Nickel[d]	mg/L	0.105	0.051	0.007	0.046	0.106	0.110	0.088	0.004	0.003	0.02	-	-	1	0.011
Selenium[d]	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	-	-	0.02	0.005[e]
Silver[d]	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.1	-	-	-	0.05

a Table 4 of Isaac River Sub-basin Environmental Values and Water Quality Objectives: Drinking water EV
b Table 2, Table 9, Table 10 and Table 11 of Isaac River Sub-basin Environmental Values and Water Quality Objectives: Aquatic ecosystem – moderately disturbed, Table 3.4.1 of Australian and New Zealand Guidelines for Fresh and Marine Water Quality: trigger values for slightly-moderately disturbed systems (95% level of protection)
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Note: colour shading corresponds to the relevant exceedance criteria. Where multiple criteria are exceeded the colour representing the highest criteria is shown
F Bore 11-B. Following further investigations the bore registered as RN182169 is different to the bore sampled, hence RN182169 from the ALS report is represented in the above results as Bore 11-B

Table 7-15 Monitoring bores hydrochemistry March 2021

Bore / Sample Date		PPD01A 30/03/2021	PPD01B 30/03/2021	PPD02B 30/03/2021	PPD02C 30/03/2021	PPD03A 29/03/2021	PPD03B 29/03/2021	Bore11 30/03/2021	Bore 11B 30/03/2021	WW04A 30/03/2021	RN141157 31/03/2021	RN162841 31/03/2021	RN182169 31/03/2021	ADWG Guidelines[a] (V3.5, August 2018)		Isaac River Sub-basin Environmental Values[b]		
Determinand	Units													Health	Aesthetic	Irrigation	Stock[c]	Aquatic 95% spp
pH	-	8.24	8.33	8.05	8.25	8.18	8.31	8.22	8.38	8.17	8.57	8.47	8.38	-	6.5 to 8.5	-	-	6.5 to 8.5
EC (25° C)	µS/cm	11,200	9,900	13,000	13,000	10,400	8,430	704	4,330	9,020	4,000	5,710	4,450	-	-	-	-	-
Total alkalinity $CaCO_3$	mg/L	513	236	266	291	465	188	172	849	636	817	715	827	-	-	-	-	-
Bicarbonate alkalinity $CaCO_3$	mg/L	513	230	266	291	465	184	172	810	636	735	663	798	-	-	-	-	-
Carbonate alkalinity $CaCO_3$	mg/L	<1	7	<1	<1	<1	4	<1	39	<1	82	52	29	-	-	-	-	-
Hydroxide alkalinity $CaCO_3$	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-	-	-
Aluminium[d]	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	-	0.2	-	5	0.055
Calcium	mg/L	172	98	257	276	183	96	37	138	196	62	82	88	-	-	-	1,000	-
Chloride	mg/L	3,680	3,330	4,550	4,540	3,440	2,810	65	942	2,560	878	1,400	1,000	-	250	-	-	-
Magnesium	mg/L	123	33	142	147	166	48	8	117	279	48	71	96	-	-	-	2,000	-
Manganese[d]	mg/L	1.23	0.364	0.056	0.264	0.939	0.656	0.207	0.758	0.087	0.022	0.018	0.015	0.5	0.1	10	-	1.9
Potassium	mg/L	10	9	12	18	11	9	10	6	4	2	3	2	-	-	-	-	-
Sodium	mg/L	2,060	1,930	2,340	2,260	1,740	1,590	49	645	1,120	788	1,040	775	-	180	-	-	-
Sulfate (SO_4)	mg/L	14	<1	<1	7	<1	<1	18	108	621	18	68	62	-	250	-	1,000	-
Zinc[d]	mg/L	0.101	0.010	0.022	0.009	0.054	0.011	0.125	<0.005	<0.005	0.014	0.020	0.041	-	3	-	-	0.008
Arsenic[d]	mg/L	0.006	0.012	<0.001	<0.001	0.014	0.014	0.006	0.004	<0.001	<0.001	<0.001	<0.001	0.01	-	2	0.5	0.024
Cadmium[d]	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002	-	-	0.01	0.0002
Chromium[d]	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.05	-	-	1	0.001
Cobalt[d]	mg/L	0.013	<0.001	<0.001	<0.001	0.010	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	0.1	1	-
Copper[d]	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.008	<0.001	<0.001	0.001	<0.001	<0.001	2	1	-	1	0.0014
Lead[d]	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01	-	-	0.1	0.0034
Mercury[d]	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001	-	-	0.002	0.0006
Nickel[d]	mg/L	0.060	0.049	0.014	0.040	0.042	0.029	0.010	0.004	0.040	<0.001	0.007	0.050	0.02	-	-	1	0.011
Selenium[d]	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	-	-	0.02	0.005[e]
Silver[d]	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.1	-	-	-	0.05

a Table 4 of Isaac River Sub-basin Environmental Values and Water Quality Objectives: Drinking water EV
b Table 2, Table 9, Table 10 and Table 11 of Isaac River Sub-basin Environmental Values and Water Quality Objectives: Aquatic ecosystem – moderately disturbed, Table 3.4.1 of Australian and New Zealand Guidelines for Fresh and Marine Water Quality: trigger values for slightly-moderately disturbed systems (95% level of protection)
c Stock water criteria are to be compared against total metals and comparison is limited in this instance by comparison with dissolved metals
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7.4.10.2 Water Quality Objectives

The Project falls within Isaac Connors Groundwater Management Area (GMA) Zone 34 of the Fitzroy Basin under the Water Plan (Fitzroy Basin) 2011. Groundwater at the Project includes alluvial groundwater under GMA Groundwater Unit 1 and water within the hard rock aquifers in GMA Groundwater Unit 2 (sub-artesian aquifers). The management is to maintain the baseline groundwater conditions. In the case of Isaac groundwaters, these values include aquatic ecosystems, irrigation, farm supply/ use, stock watering, primary recreation, drinking water as well as being of cultural and spiritual value.

In order to understand the groundwater resources within the Study Area, available water quality data has been compared to the:

- Fitzroy Basin Zone 34 groundwater quality objectives for deep and shallow water;
- Australian Drinking Water Guidelines (NHMRC and NRMMC 2011); and
- Australian and New Zealand Guidelines 2018 (95% aquatic spp. Protection), irrigation (long term and short term) and stock water supply.

Details on the data sources and the summary data (average, median, minimum, maximum and percentiles) are included at Table 7-16. This data set excludes Bore 11 and Bore 11B as these bores were determined not to be representative of typical conditions within the coal seam groundwater.

Table 7-16 Monitoring bores hydrochemistry summary data

ANZG 2018[1]					Bore / Sample Date		General Population Statistics					Population Percentiles		
Health	Aesthetic	Irrigation	Stock	Aquatic 95% spp	Determinand	Units	Number	Average	Median	Minimum	Maximum	20th	50th	80th
-	6.5 to 8.5	-	-	6.5 to 8.5	pH	-	49	7.9	7.9	7.2	10.2	7.40	7.88	8.23
-	-	-	-	-	EC (25° C)	µS/cm	49	9,979	9,820	4,000	14,100	8,714	9,820	12,600
-	-	-	-	-	Total alkalinity $CaCO_3$	mg/L	49	423	326	48	1,030	229.2	326	619.2
-	-	-	-	-	Bicarbonate alkalinity $CaCO_3$	mg/L	49	417	326	1	1,030	228	326	619.2
-	-	-	-	-	Carbonate alkalinity $CaCO_3$	mg/L	49	6	1	1	82	1	1	1
-	-	-	-	-	Hydroxide alkalinity $CaCO_3$	mg/L	49	1	1	1	15	1	1	1
-	0.2	-	5	0.055	Aluminium	mg/L	50	0.01	0.01	0.01	0.01	0.01	0.01	0.01
-	-	-	1,000	-	Calcium	mg/L	50	210	198	62	506	119.8	198	291.2
-	250	-	-	-	Chloride	mg/L	49	3,269	3,210	878	4,900	2,636	3,210	4,234
-	-	-	2,000	-	Magnesium	mg/L	50	139	132.5	14	343	57.2	132.5	179.2
0.5	0.1	10	-	1.9	Manganese	mg/L	50	0.483	0.271	0.001	2.07	0.08	0.271	0.9334
-	-	-	-	-	Potassium	mg/L	50	14.36	12	2	80	8.2	12	18

ANZG 2018[1]					Bore / Sample Date		General Population Statistics					Population Percentiles		
Health	Aesthetic	Irrigation	Stock	Aquatic 95% spp	Determinand	Units	Number	Average	Median	Minimum	Maximum	20th	50th	80th
-	180	-	-	-	Sodium	mg/L	50	1737	1755	775	2380	1388	1,755	2,130
-	250	-	1,000	-	Sulfate (SO_4)	mg/L	49	96	13	1	729	1.6	13	64.4
-	3	-	-	0.008	Zinc	mg/L	50	0.040	0.021	0.005	0.244	0.006	0.021	0.0486
0.01	-	2	0.5	0.024	Arsenic	mg/L	50	0.004	0.001	0.001	0.016	0.001	0.001	0.0082
0.002	-	-	0.01	0.0002	Cadmium	mg/L	50	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001
0.05	-	-	1	0.001	Chromium	mg/L	50	0.009	0.001	0.001	0.279	0.001	0.001	0.001
-	-	0.1	1	-	Cobalt	mg/L	50	0.004	0.001	0.001	0.019	0.001	0.001	0.005
2	1	-	1	0.0014	Copper	mg/L	50	0.001	0.001	0.001	0.004	0.001	0.001	0.001
0.01	-	-	0.1	0.0034	Lead	mg/L	50	0.001	0.001	0.001	0.001	0.001	0.001	0.001
0.001	-	-	0.002	0.0006	Mercury	mg/L	50	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.02	-	-	1	0.011	Nickel	mg/L	50	0.036	0.026	0.001	0.174	0.008	0.026	0.053
0.01	-	-	0.02	0.005	Selenium	mg/L	50	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.1	-	-	-	0.05	Silver	mg/L	50	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia

7.4.10.3 Dissolved Metals

Dissolved metals samples within the bores monitored between May 2019 and March 2021, are within the Health based guideline values with the exception of four metals:

- Manganese in groundwater sampled from multiple bores (Bore 11, Bore 11B, PPD01A, PPD03A and PPD03B) with a maximum value of 2.07 mg/L reported for PPD03A groundwater and 80th percentile across all bores of 0.92 mg/L compared with the WQO of 0.5 mg/L;
- Arsenic in groundwater sampled from bores PPD01B, PPD03A and PPD03B reported a maximum of 0.016 mg/L and 80th percentile of 0.008 mg/L compared with the WQO of 0.01 mg/L;
- Chromium in bores PPD02C and PPD01B with a maximum of 0.279 mg/L and 80th percentile of 0.001 mg/L compared with the WQO of 0.05 mg/L; and
- Nickel in bores PPD01A, PPD01B, PPD02B, PPD02C, PPD03A, PPD03B, Bore 11, WW04A and RN182169 with a maximum of 0.174 mg/L and 80th percentile of 0.05 mg/L compared with the WQO of 0.02 mg/L.

Groundwater sampled from most of the bores exceeded the aesthetic value for:

- Manganese on at least one occasion with an 80th percentile across all bores of 0.92 mg/L compared with the WQO of 0.1 mg/L;
- Sodium with an 80th percentile of 2,084 mg/L compared to a WQO value of 180 mg/L;
- Chloride with an 80th percentile of 4,140 mg/L compared to a WQO value of 250 mg/L; and
- All other metals in groundwater were reported below ADWG guideline values. No metals exceeded the irrigation assessment criteria, or the livestock drinking water quality objectives, noting that the assessment is limited by dissolved metals data only and the guidelines are for total metals.

The 95% freshwater species aquatic protection water quality objectives were exceeded for the following metals:

- Manganese on one occasion in bore PPD03A in July 2019 with a value of 2.07 mg/L and 80th percentile of all bores of 0.92 mg/L as assessed against WQO 1.9 mg/L;
- Zinc at all bores (Figure 7-10) with over 71% of records above the WQO of 0.008 mg/L, reported a maximum of 0.244 mg/L and 80th percentile across all bores of 0.047 mg/L;
- Chromium (Figure 7-11) with 10% of records above the WQO of 0.001 mg/L, reported a maximum of 0.279 mg/L and 80th percentile across all bores of 0.001 mg/L;
- Copper (Figure 7-12) with 13% of records above the WQO of 0.0014 mg/L, reported a maximum of 0.008 mg/L and 80th percentile across all bores of 0.001 mg/L;
- Nickel (Figure 7-13) with 10% of records above the WQO of 0.011 mg/L, reported a maximum of 0.174 mg/L and 80th percentile across all bores of 0.050 mg/L; and
- Selenium was predominantly recorded below the limit of reporting of 0.01 mg/L. The WQO for aquatic protection is 0.005 mg/L which is below the LOR and the assessment for these parameters is currently limited.

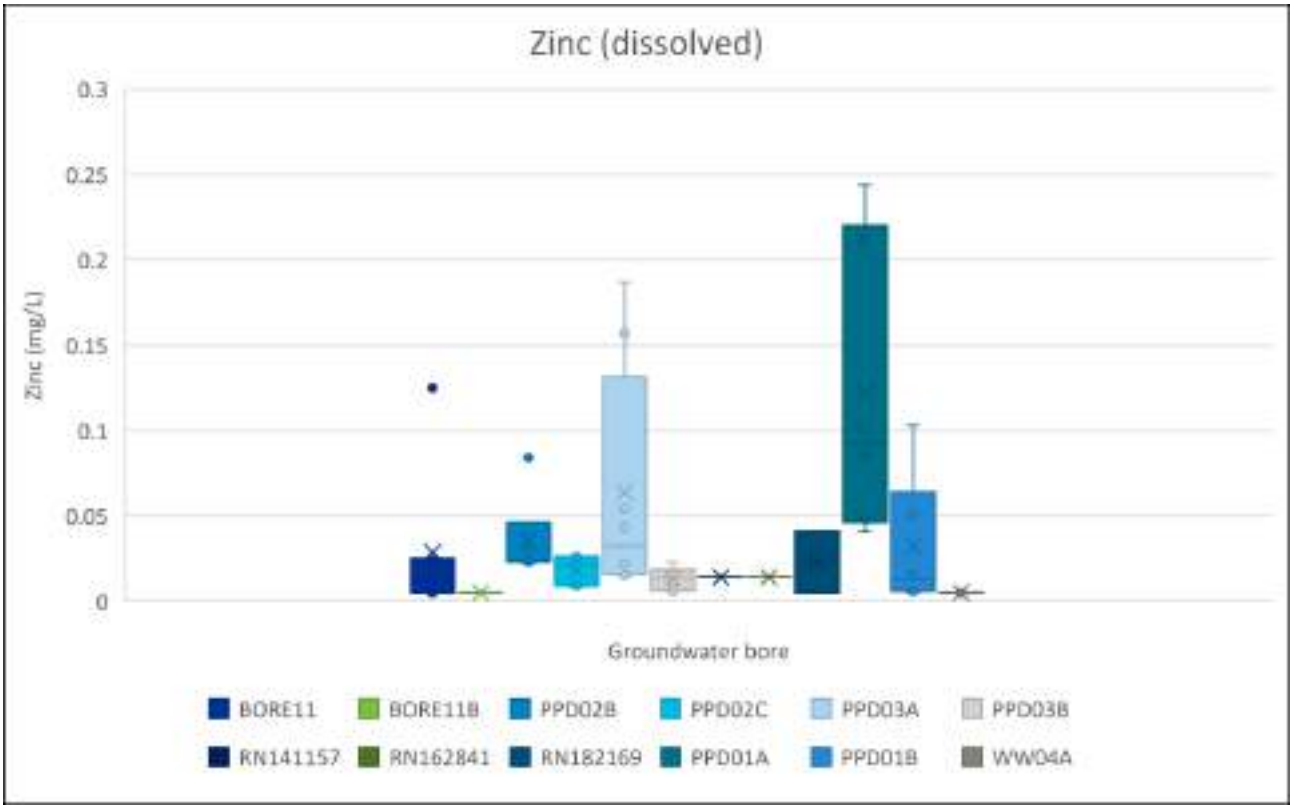

Figure 7-10 Dissolved Zinc in bores between May 2019 and March 2021

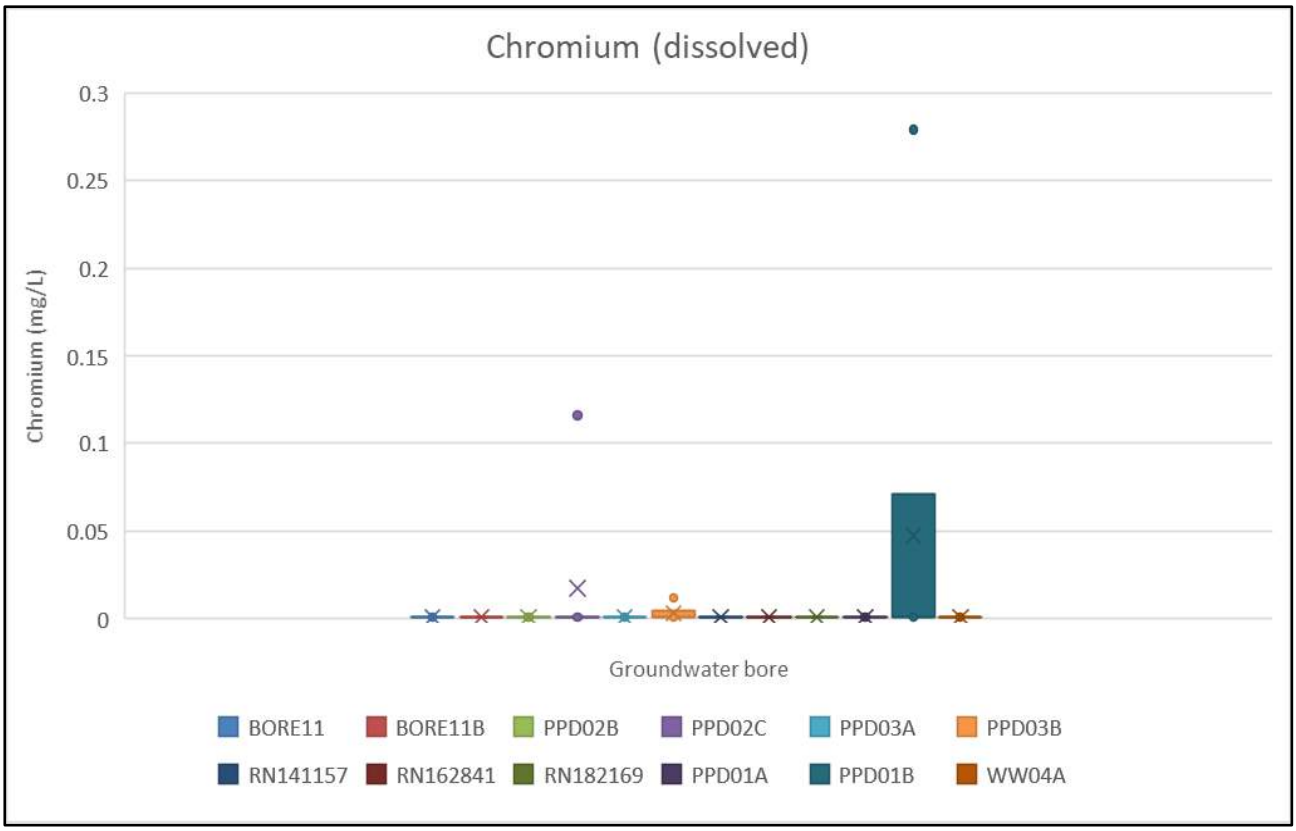

Figure 7-11 Dissolved Chromium in bores between May 2019 and March 2021

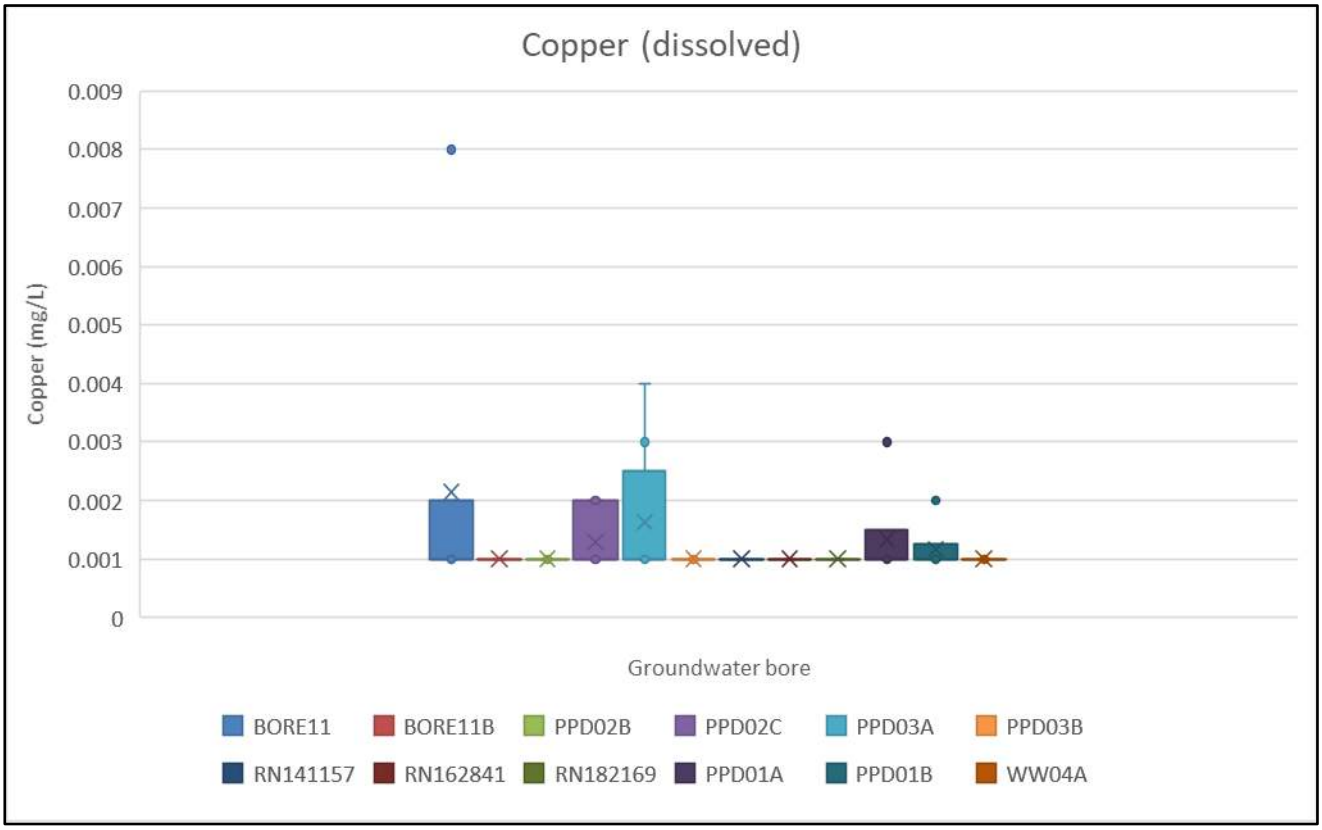

Figure 7-12 Dissolved Copper in bores between May 2019 and March 2021

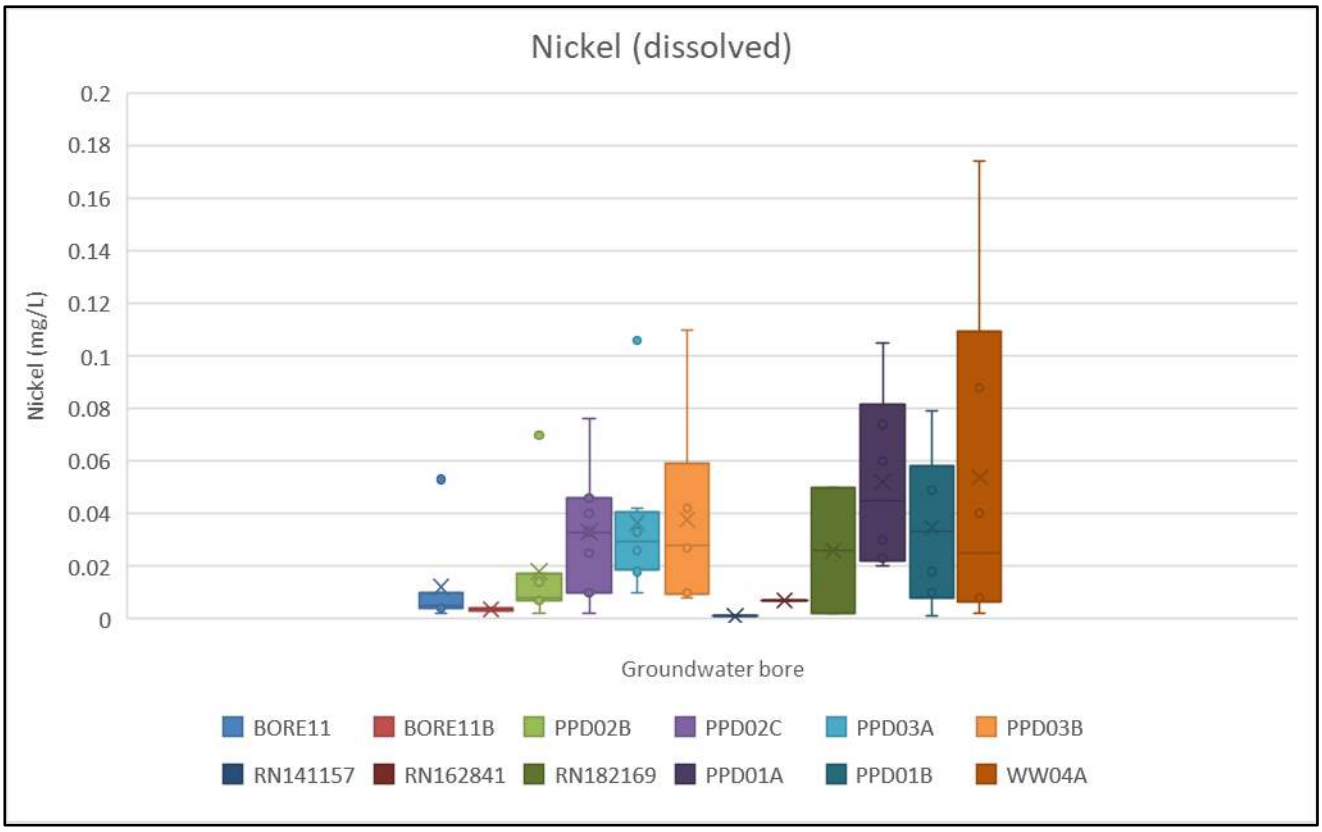

Figure 7-13 Dissolved Nickel in bores between May 2019 and March 2021

7.4.10.4 Salinity and Major Ions

The groundwater samples show brackish salinity water, with electrical conductivity (EC) generally between 8,000 to 12,000 µS/cm. The exception to this is Bore 11, which showed potable range salinity in the 600 to 2,000 µS/cm range.

Dominant ion chemistry was chloride (Cl-) and sodium (Na+) for all eight monitoring bores, but particularly for PPD01A, PPD01B, PPD02B, PPD02C, PPD03A, and PPD03B. These bores have a water type that indicates end-point waters, with an influence of ancient saline groundwaters, sea water or dissolution of halite, as shown on the expanded Durov diagrams for data between May 2019 and March 2021 (Figure 7-15 and Figure 7-21). The ion chemistry proportions are consistent between the sample dates for all bores, indicating very little seasonal variation between these dates.

Bore11 however shows some variance with the dominant ion chemistry in May 2019 (Figure 7-15) and March 2021 (Figure 7-21) indicating a bicarbonate (HCO3-) water type that suggests dilution influences from rainfall. February 2021 data from the adjacent Daunia project (Figure 7-20) illustrates that groundwaters within the area are predominantly chloride (Cl-) and sodium (Na+) dominant.

The nearby Olive Downs Project reports similar findings with the proportion of chloride in groundwater samples collected from higher within the regolith material, which can be classified as Na-Cl-SO_4 or Na-Cl-HCO_3 type water. The suggestion is that the Permian coal measures generally contain Na-Cl type water, with some also recording a high proportion of Mg but with very little sulphate compared to the other groundwater units. The results for the monitoring bores assessed generally indicate that although the cation compositions are similar between groundwater units, there are clear differences in the anion makeup of groundwater from each unit. The Olive Downs Project also notes that alluvium groundwaters can be classified as Na-Ca or Na-Mg type water, and are higher in bicarbonate than the other groundwater units.

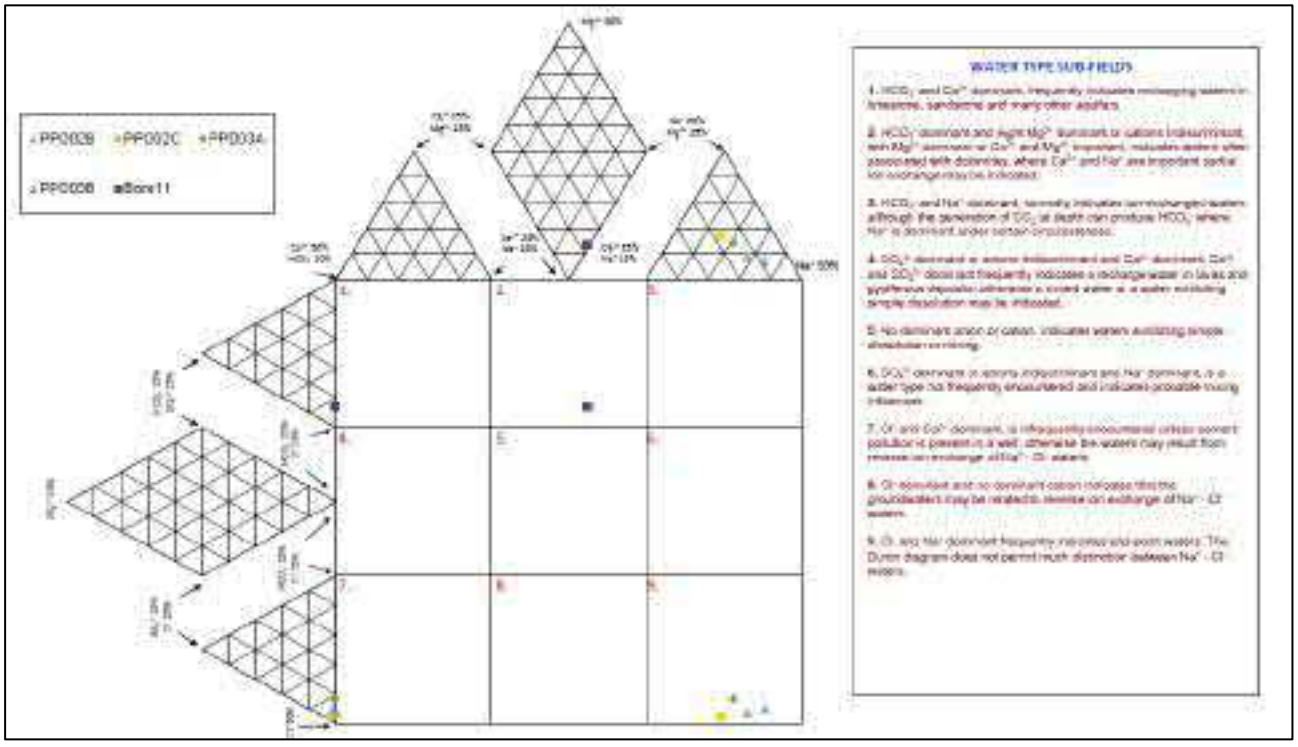

Figure 7-14 Expanded Durov plot of bores PPD01A, PPD01B, PPD02B, PPD02C, PPD03A, PPD03B, Bore11 and WW04A, May 2019 groundwater quality sampling

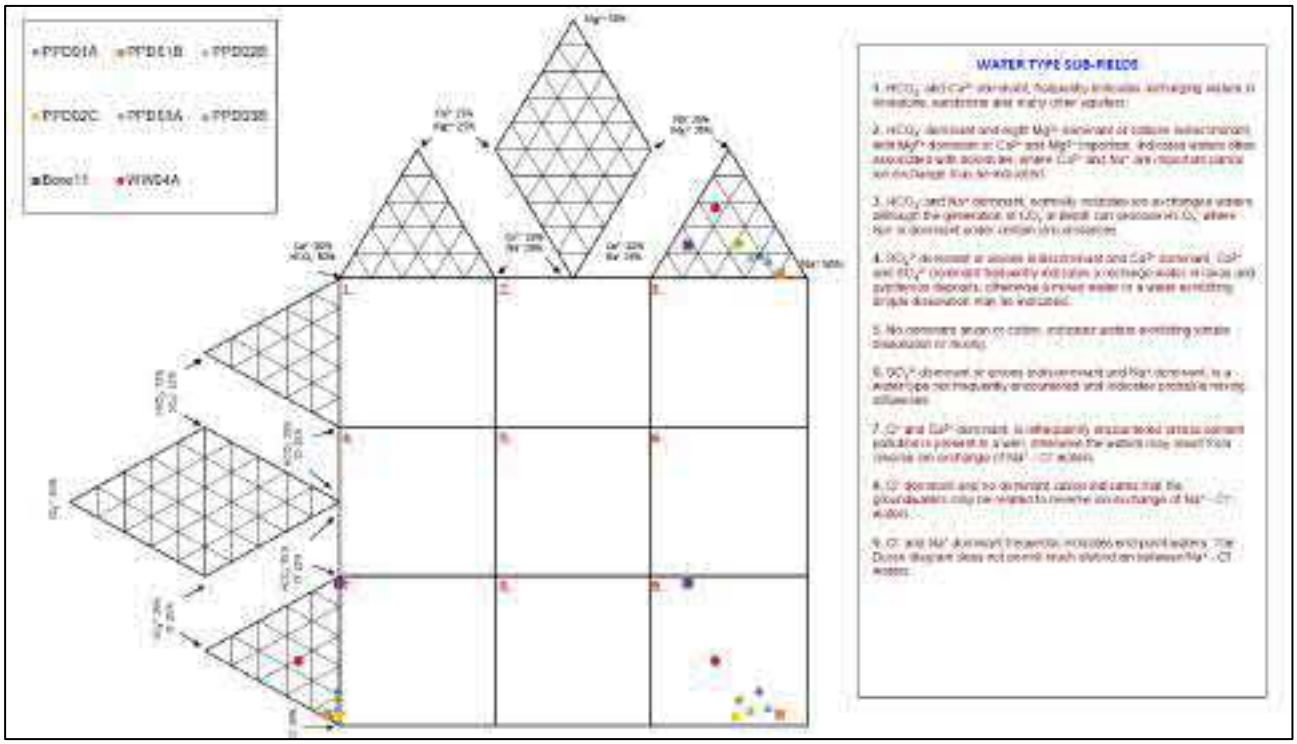

Figure 7-15 Expanded Durov plot of bores PPD01A, PPD01B, PPD02B, PPD02C, PPD03A, PPD03B, Bore11 and WW04A, July 2019 groundwater quality sampling

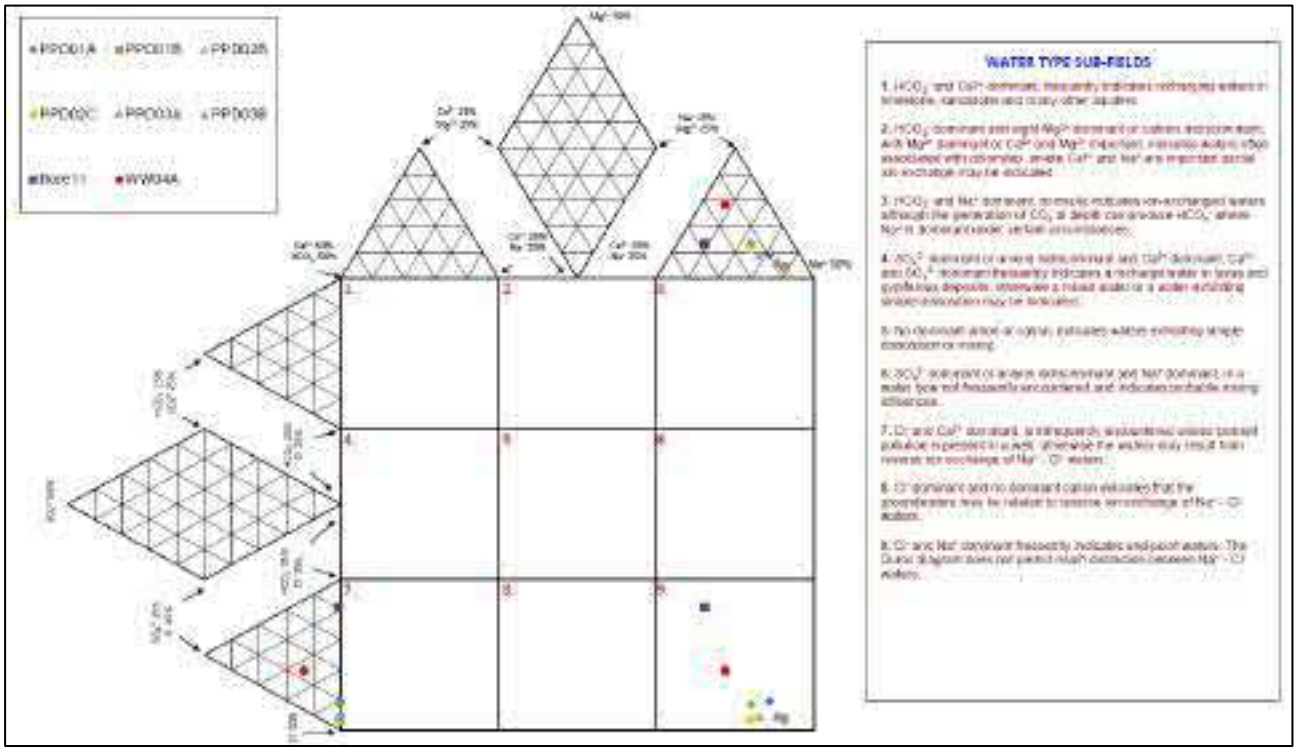

Figure 7-16 Expanded Durov plot of bores PPD01A, PPD01B, PPD02B, PPD02C, PPD03A, PPD03B, Bore11 and WW04A, October 2019 groundwater quality sampling

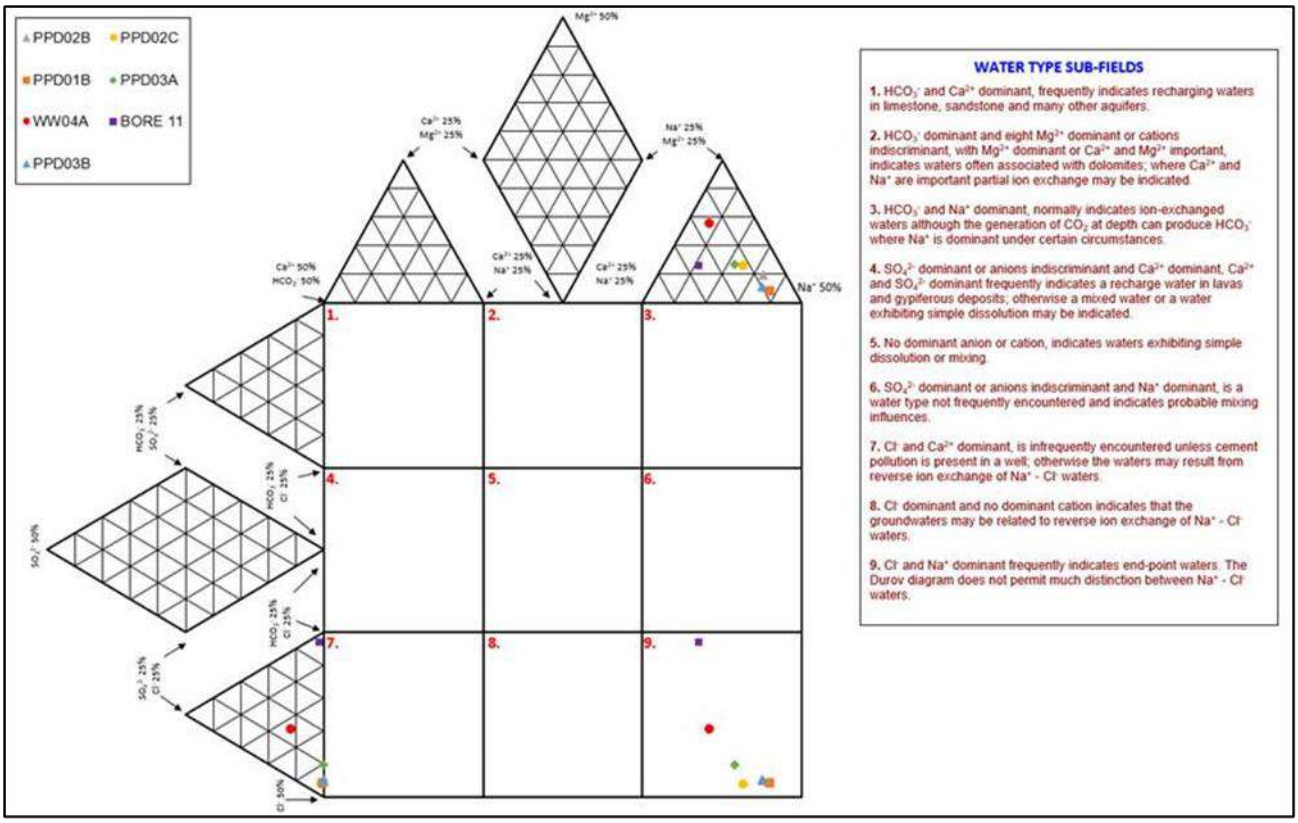

Figure 7-17 Expanded Durov plot of bores PPD01A, PPD01B, PPD02B, PPD02C, PPD03A, PPD03B, Bore11 and WW04A, June 2020 groundwater quality sampling

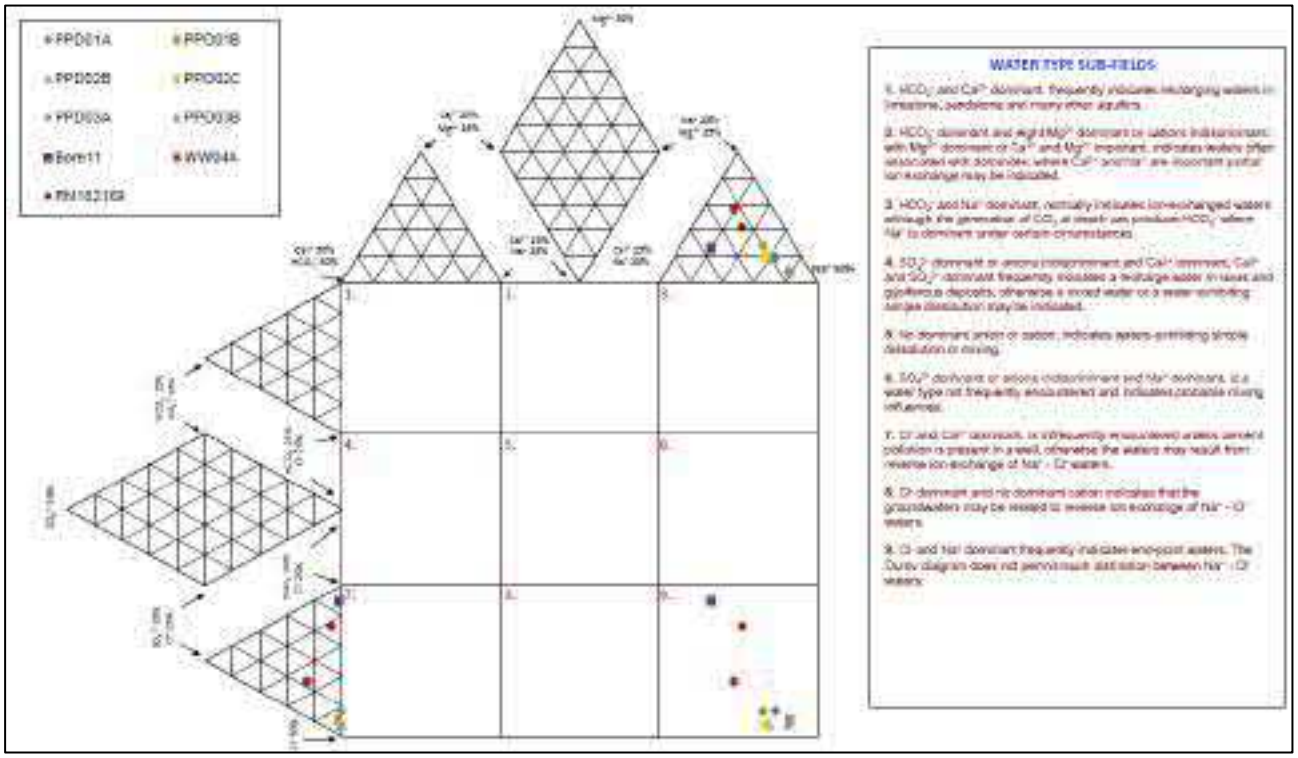

Figure 7-18 Expanded Durov plot of bores PPD01A, PPD01B, PPD02B, PPD02C, PPD03A, PPD03B, Bore11 and WW04A, January 2021 groundwater quality sampling

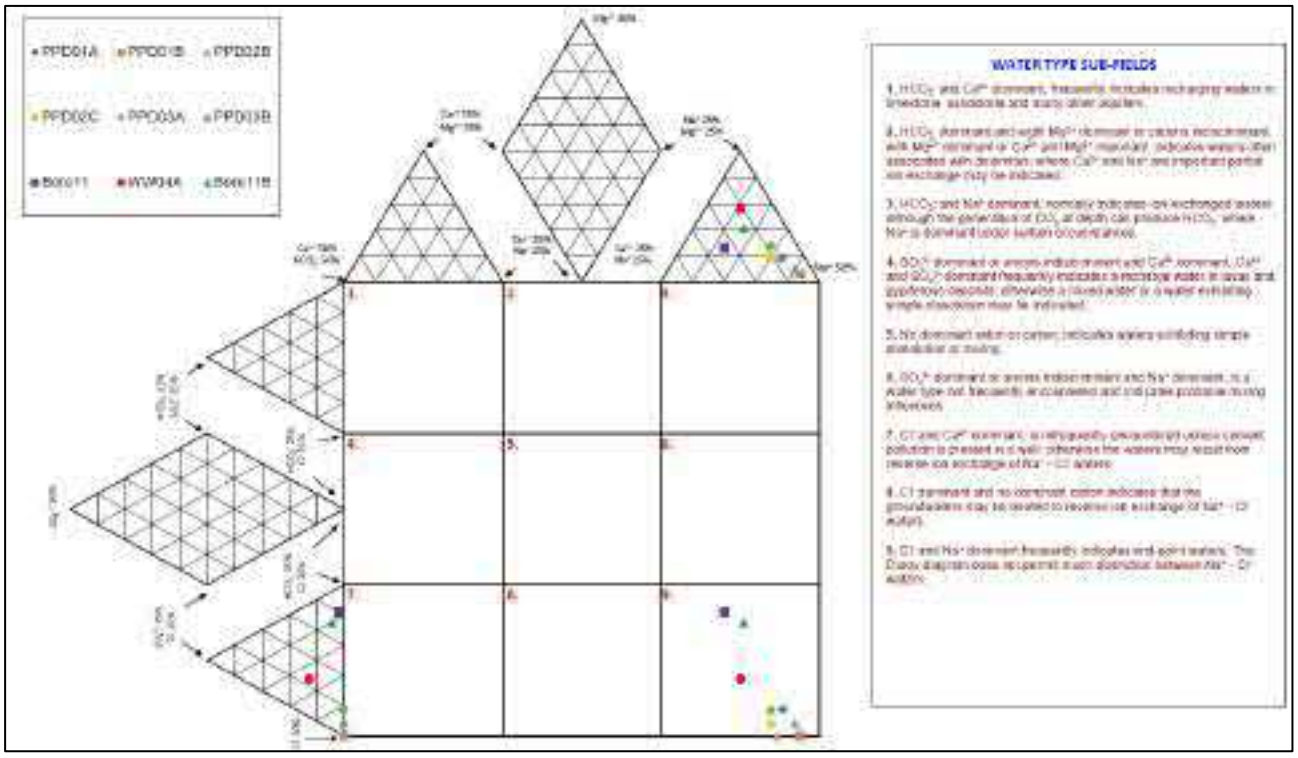

Figure 7-19 Expanded Durov plot of bores PPD01A, PPD01B, PPD02B, PPD02C, PPD03A, PPD03B, Bore11 and WW04A, February 2021 groundwater quality sampling

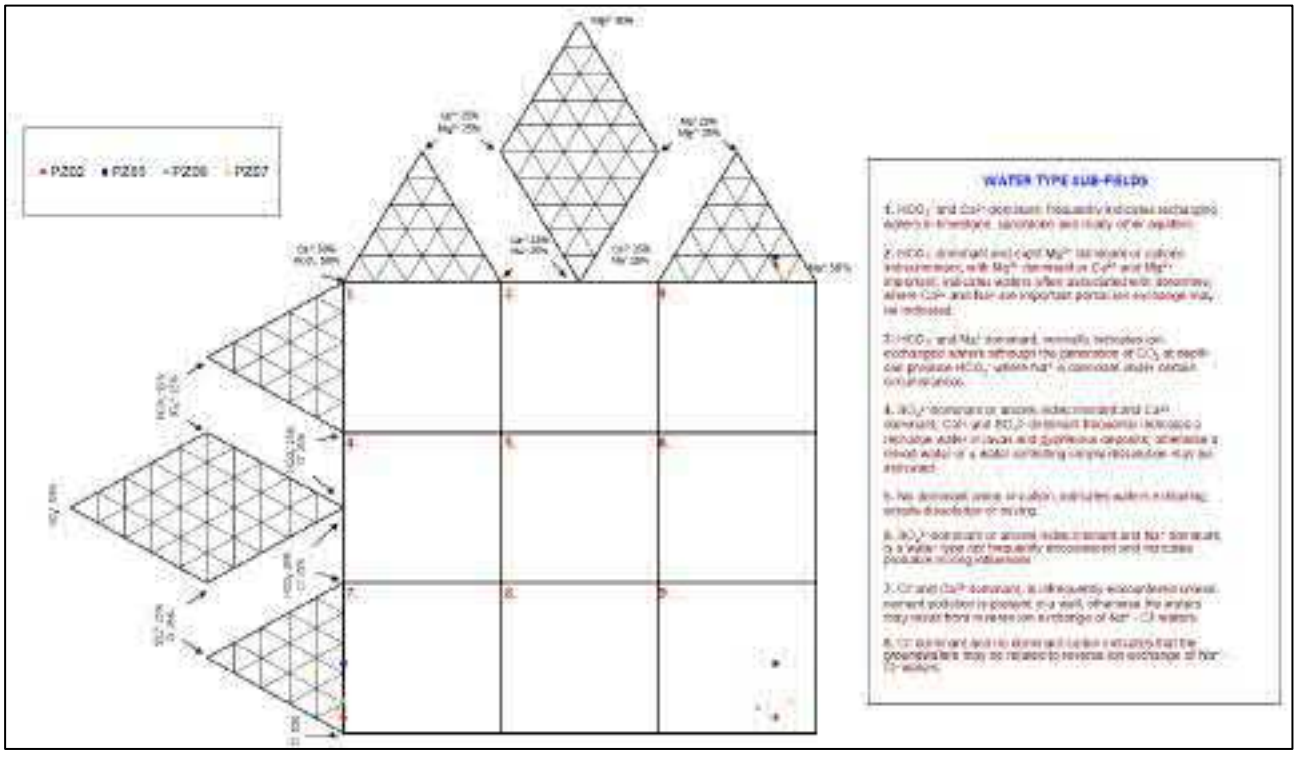

Figure 7-20 Expanded Durov plot of Daunia bores, February 2021 groundwater quality sampling

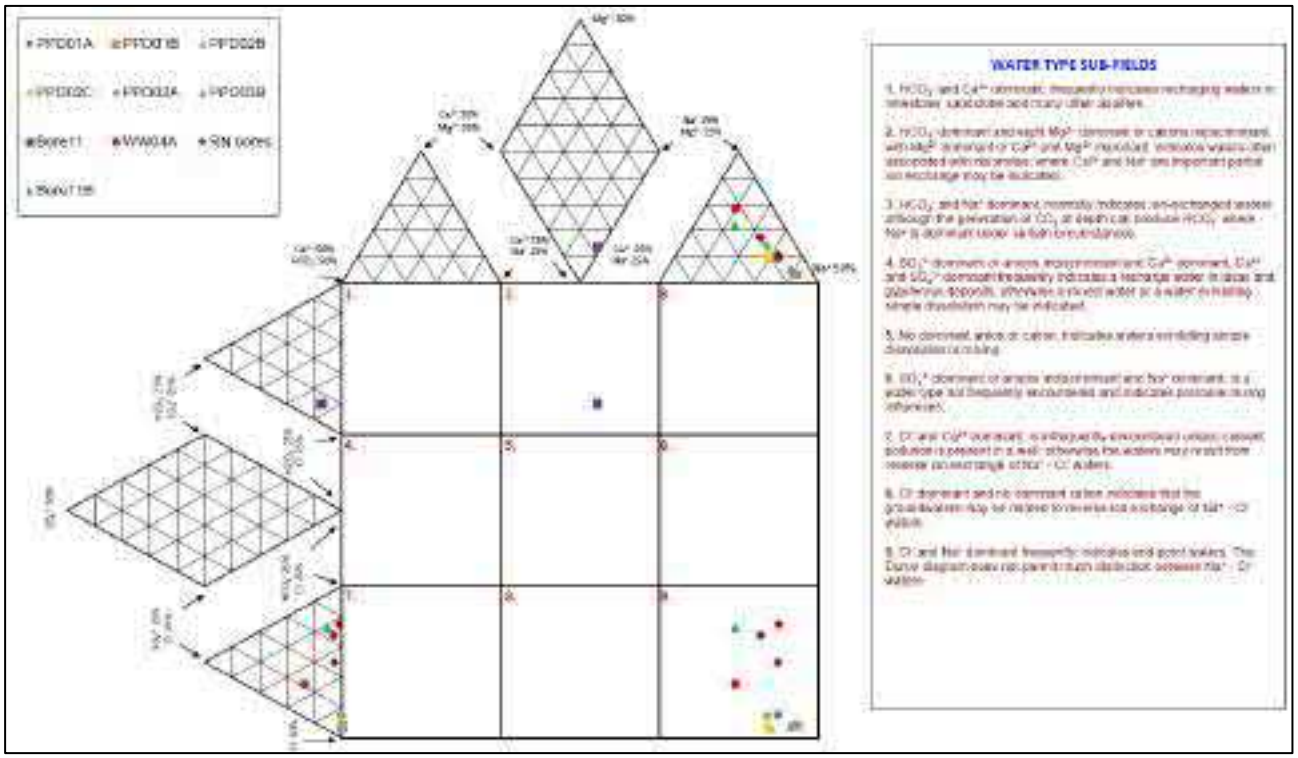

Figure 7-21 Expanded Durov plot of bores PPD01A, PPD01B, PPD02B, PPD02C, PPD03A, PPD03B, Bore11 and WW04A, March 2021 groundwater quality sampling

7.4.10.5 Seasonal Variability

The Box Plots in Section 7.4.10.3 and Durov Plots in Section 7.4.10.4 illustrate some variability between bore water quality conditions; however, overall (and excluding Bore 11) this is considered not significant.

An assessment of seasonality was undertaken to determine if variability within the data set needs to be taken into consideration. Select indicators Electrical Conductivity (Figure 7-22), Chloride (Figure 7-23), Sulfate (Figure 7-24) and dissolved Zinc (Figure 7-25) are presented in box-plots and illustrate no significant seasonal variability. Dissolved Zinc in Spring shows an elevated concentration in relation to other seasons however this is reflective of a spike recorded at bore PPD01A in October 2019.

The relatively low variability supports the use of a combined dataset in the development of interim site specific trigger values.

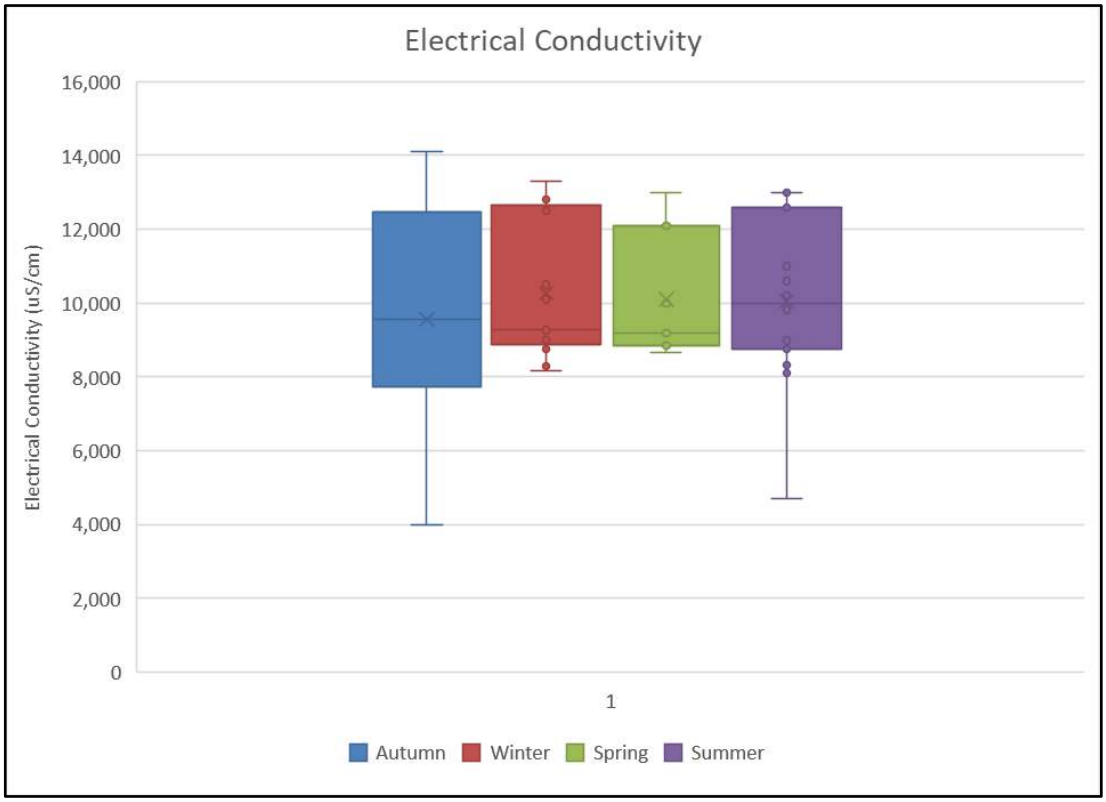

Figure 7-22 Electrical Conductivity groundwater quality seasonal variability for all bores (excluding Bore 11)

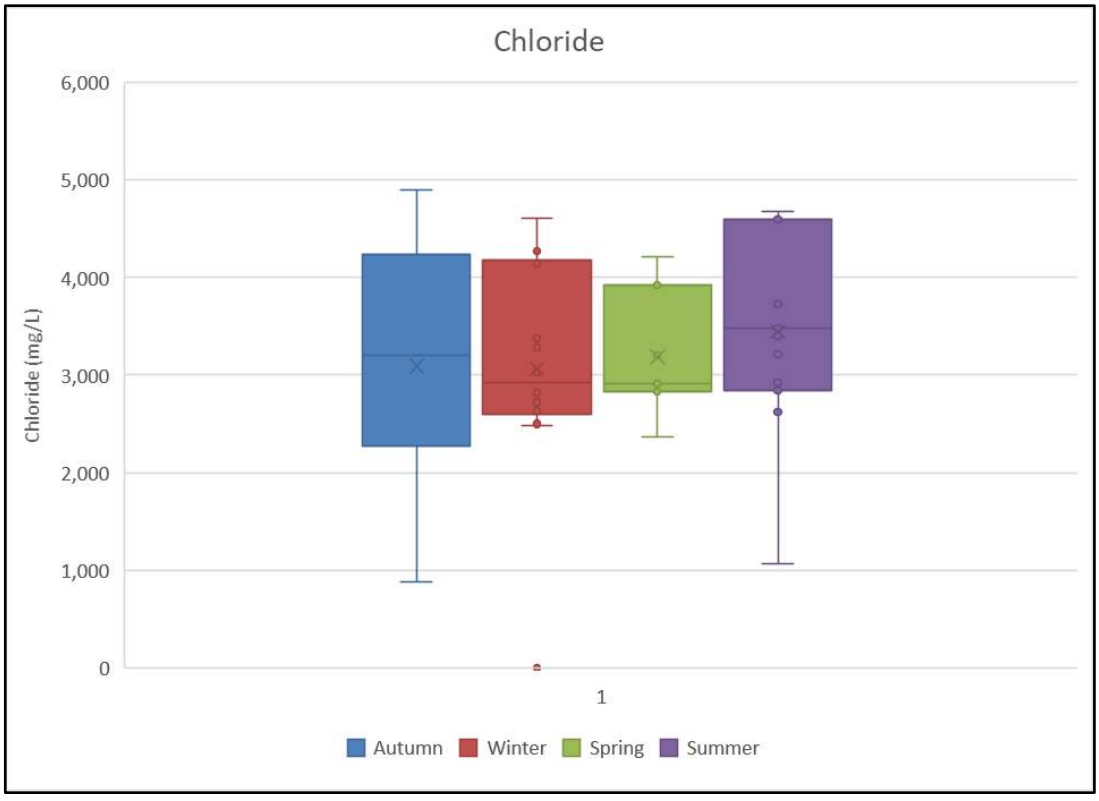

Figure 7-23 Chloride groundwater quality seasonal variability for all bores (excluding Bore 11)

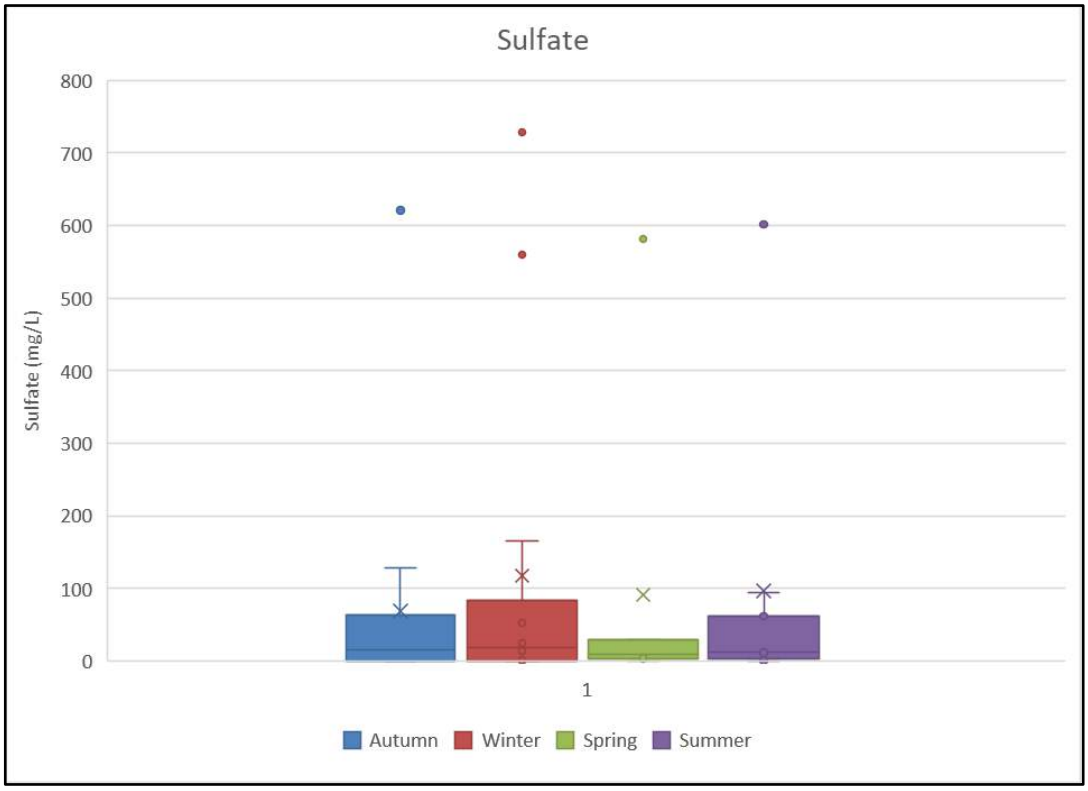

Figure 7-24 Sulfate (SO_4^-) groundwater quality seasonal variability for all bores (excluding Bore 11)

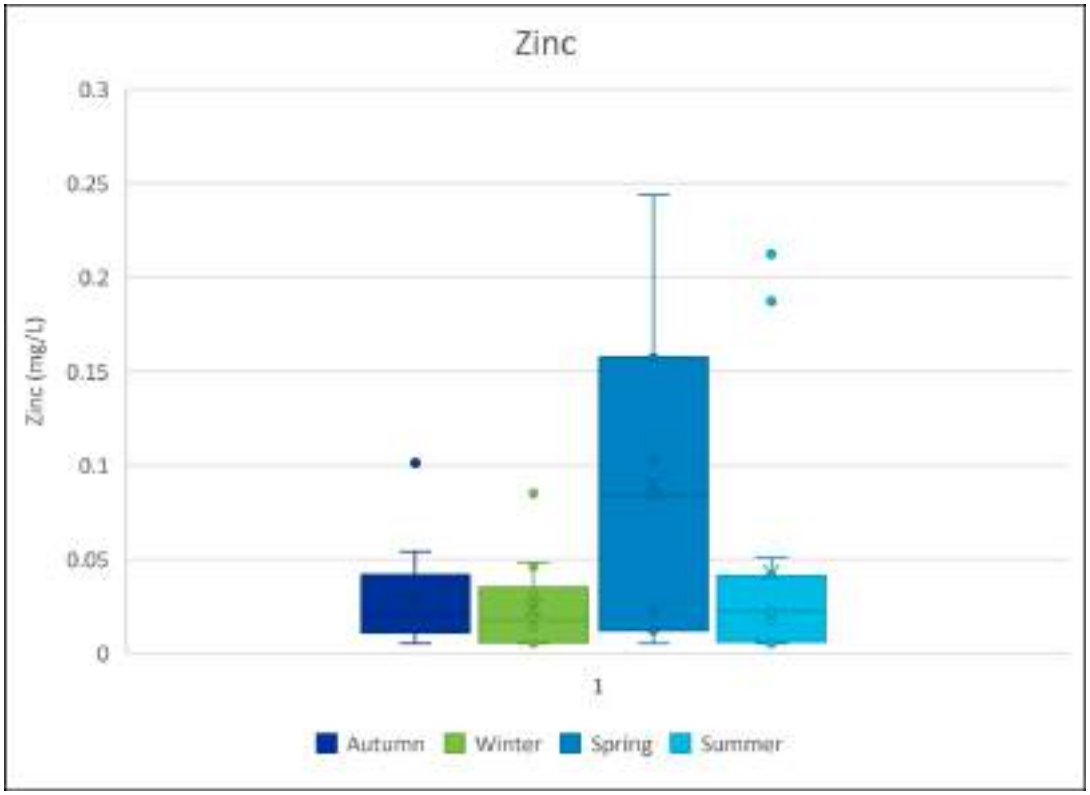

Figure 7-25 Zinc (dissolved) groundwater quality seasonal variability for all bores (excluding Bore 11)

7.4.10.6 Regional Groundwater Quality

The nearby Olive Downs Project and Daunia Project groundwater quality has been referenced to supplement site groundwater quality observations presented for this Project.

Comparing data from both Projects to relevant guideline levels, the summary results indicate that water within the Quaternary alluvium is generally suitable for stock water supply and irrigation. However, the alluvial groundwater generally exceeds guideline levels for drinking water (i.e. TDS, chloride and sodium) and freshwater aquatic systems. The alluvial groundwater also records concentrations of total and dissolved copper above the Fitzroy Plan WQOs for Zone 34 (shallow).

Water within the weathered rock exhibits poorer quality compared to the alluvium and is not considered a suitable groundwater resource for livestock, irrigation, drinking water or aquatic ecosystems. The water within weathered rock also exceeds the Fitzroy Plan WQOs (Zone 34 – shallow) for EC, chloride, calcium, sodium, hardness, magnesium, sulfate, copper and manganese.

Groundwater within the coal seams generally exhibits a higher TDS then in other HSUs, which is on average higher than the guideline level for beef cattle but below the guideline level for sheep. The range for TDS, chloride and sodium presented for both sites are similar to that found at the Isaac River project. Comparison of results to the guideline levels indicates the coal measures are not considered a suitable groundwater resource for irrigation, drinking water or aquatic ecosystems. Groundwater within the coal measures (coal and interburden) report concentrations of manganese above the Fitzroy Plan WQO (Zone 34 –deep).

7.4.10.7 Groundwater Interim Site-Specific Limits

The 80th percentile from the cumulative dataset for bores PPD02B, PPD02C, PPD03A, PPD03B, RN141157, RN162841, RN182169, PPD01A, PPD01B and WW04A between May 2019 to March 2021 are presented in Table 7-17. These bores all sit within the coal body.

Where the 80th percentile is less than the default 95% aquatic species protection guideline, the default guideline has been adopted. The interim site-specific limits will continue to be revised in respond to developing understanding of the site hydrogeology and baseline data set.

Future monitoring of the alluvial zone groundwater will utilise Model Mining Conditions until a sufficient baseline is established to develop site specific limits for this zone.

Table 7-17 Groundwater Interim Site-Specific Limits

Determinand	Units	80th percentile (and 20th for pH)	Interim Site-Specific Limits	Health	Aesthetic	Irrigation	Stock	Aquatic 95% spp
pH	-	7.4-8.2	6.5-8.5	-	6.5 to 8.5	-	-	6.5 to 8.5
EC (25° C)	µS/cm	12,600	12,600	-	-	-	-	-
Total alkalinity $CaCO_3$	mg/L	619	619	-	-	-	-	-
Bicarbonate alkalinity $CaCO_3$	mg/L	619	619	-	-	-	-	-
Carbonate alkalinity $CaCO_3$	mg/L	1	1	-	-	-	-	-
Hydroxide alkalinity $CaCO_3$	mg/L	1	1	-	-	-	-	-
Aluminium	mg/L	0.01	0.055	-	0.2	-	5	0.055
Calcium	mg/L	291.2	291	-	-	-	1,000	-
Chloride	mg/L	4,234	4,234	-	250	-	-	-
Magnesium	mg/L	179.2	179	-	-	-	2,000	-
Manganese	mg/L	0.93	0.9	0.5	0.1	10	-	1.9
Potassium	mg/L	18	18	-	-	-	-	-
Sodium	mg/L	2,130	2,130	-	180	-	-	-
Sulfate (SO_4)	mg/L	64.4	64	-	250	-	1,000	-
Zinc	mg/L	0.0486	0.008	-	3	-	-	0.008
Arsenic	mg/L	0.0082	0.024	0.01	-	2	0.5	0.024
Cadmium	mg/L	0.0001	0.0002	0.002	-	-	0.01	0.0002
Chromium	mg/L	0.001	0.001	0.05	-	-	1	0.001
Cobalt	mg/L	0.005	0.005	-	-	0.1	1	-
Copper	mg/L	0.001	0.001	2	1	-	1	0.0014
Lead	mg/L	0.001	0.0034	0.01	-	-	0.1	0.0034

Determinand	Units	80th percentile (and 20th for pH)	Interim Site-Specific Limits	Health	Aesthetic	Irrigation	Stock	Aquatic 95% spp
Mercury	mg/L	0.0001	0.0006	0.001	-	-	0.002	0.0006
Nickel	mg/L	0.053	0.011	0.02	-	-	1	0.011
Selenium	mg/L	0.01	0.005	0.01	-	-	0.02	0.005
Silver	mg/L	0.001	0.05	0.1	-	-	-	0.05

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1911255**	Page	: 1 of 4
Client	: **CDM SMITH AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: PAUL HOWE	Contact	: Customer Services EB
Address	: LEVEL 4 51 ALFRED STREET PO BOX 359 FORTITUDE VALLEY QLD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: 1000398 Bowen Coking Coal	Date Samples Received	: 03-May-2019 09:15
Order number	:	Date Analysis Commenced	: 03-May-2019
C-O-C number	: ----	Issue Date	: 10-May-2019 09:27
Sampler	: DANIEL WHITE		
Site	: Sediment & Biota		
Quote number	: EN/222		
No. of samples received	: 5		
No. of samples analysed	: 5		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BORE 11	PPD03A	PPD03B	PPD02B	PPD02C
				Client sampling date / time	01-May-2019 00:00	01-May-2019 00:00	01-May-2019 00:00	02-May-2019 00:00	02-May-2019 00:00
Compound	CAS Number	LOR	Unit		EB1911255-001	EB1911255-002	EB1911255-003	EB1911255-004	EB1911255-005
					Result	Result	Result	Result	Result
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		8.20	8.23	8.37	7.95	8.01
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		679	9110	9250	12300	14100
EA015: Total Dissolved Solids dried at 180 ± 5 °C									
Total Dissolved Solids @180°C	----	10	mg/L		354	5460	5200	7470	8890
EA025: Total Suspended Solids dried at 104 ± 2°C									
Suspended Solids (SS)	----	5	mg/L		6	133	107	33	74
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	15	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		206	457	234	266	124
Total Alkalinity as CaCO3	----	1	mg/L		206	457	249	266	124
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		1	17	27	3	128
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		91	2980	3080	4140	4900
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		46	271	155	338	506
Magnesium	7439-95-4	1	mg/L		10	158	75	131	294
Sodium	7440-23-5	1	mg/L		66	1480	1750	2290	2130
Potassium	7440-09-7	1	mg/L		5	16	25	12	49
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		0.01	<0.01	<0.01	<0.01	<0.01
Arsenic	7440-38-2	0.001	mg/L		0.002	0.002	0.001	<0.001	<0.001
Barium	7440-39-3	0.001	mg/L		0.024	5.49	2.98	18.9	3.36
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	<0.0001	0.0001	<0.0001	0.0001
Chromium	7440-47-3	0.001	mg/L		<0.001	<0.001	0.012	<0.001	0.116
Copper	7440-50-8	0.001	mg/L		0.002	0.004	0.001	<0.001	0.002
Cobalt	7440-48-4	0.001	mg/L		<0.001	0.004	0.003	0.003	<0.001
Nickel	7440-02-0	0.001	mg/L		0.002	0.033	0.010	0.008	0.002
Lead	7439-92-1	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L		<0.005	0.043	0.016	0.023	0.021
Manganese	7439-96-5	0.001	mg/L		0.220	0.278	0.378	0.209	0.047
Molybdenum	7439-98-7	0.001	mg/L		0.001	0.007	0.059	0.003	0.172

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BORE 11	PPD03A	PPD03B	PPD02B	PPD02C
				Client sampling date / time	01-May-2019 00:00	01-May-2019 00:00	01-May-2019 00:00	02-May-2019 00:00	02-May-2019 00:00
Compound	CAS Number	LOR	Unit		EB1911255-001	EB1911255-002	EB1911255-003	EB1911255-004	EB1911255-005
					Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued									
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Silver	7440-22-4	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L		<0.001	**0.003**	**0.001**	<0.001	<0.001
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Iron	7439-89-6	0.05	mg/L		**0.13**	<0.05	<0.05	<0.05	<0.05
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.2**	**0.1**	**0.3**	<0.1	<0.1
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**12.3**	**1.81**	**2.06**	**3.31**	**1.50**
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	**0.13**	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	**1.59**	<0.01	<0.01	**0.02**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	**1.72**	<0.01	<0.01	**0.02**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**12.8**	**2.7**	**2.8**	**3.6**	**2.0**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**12.8**	**4.4**	**2.8**	**3.6**	**2.0**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**1.02**	**0.14**	**0.10**	**0.02**	**0.02**
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.95**	**0.04**	**0.02**	**0.01**	<0.01
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		**6.70**	**93.5**	**92.4**	**122**	**143**
Total Cations	----	0.01	meq/L		**6.12**	**91.3**	**90.7**	**128**	**143**
Ionic Balance	----	0.01	%		**4.58**	**1.21**	**0.96**	**2.16**	<0.01

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CERTIFICATE OF ANALYSIS

Work Order	: **EB1911503**	Page	: 1 of 6
Client	: **CDM SMITH AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: PAUL HOWE	Contact	: Customer Services EB
Address	: LEVEL 4 51 ALFRED STREET PO BOX 359 FORTITUDE VALLEY QLD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: 1000398 Bowen Coking Coal	Date Samples Received	: 08-May-2019 09:05
Order number	: ----	Date Analysis Commenced	: 08-May-2019
C-O-C number	: ----	Issue Date	: 15-May-2019 11:48
Sampler	: DANIEL WHITE		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 2		
No. of samples analysed	: 2		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Santusha Pandra	Organic Chemist	Brisbane Organics, Stafford, QLD

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When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	PPD01B	WW04A	----	----	----
			Client sampling date / time	03-May-2019 00:00	05-May-2019 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EB1911503-001	EB1911503-002	--------	--------	--------
				Result	Result	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.67**	**7.24**	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**8750**	**8510**	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**4990**	**5740**	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**15**	**122**	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**182**	**722**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**182**	**722**	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**9**	**744**	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**3090**	**2430**	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**125**	**323**	----	----	----
Magnesium	7439-95-4	1	mg/L	**34**	**333**	----	----	----
Sodium	7440-23-5	1	mg/L	**1610**	**1200**	----	----	----
Potassium	7440-09-7	1	mg/L	**10**	**7**	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.004**	**0.001**	----	----	----
Barium	7440-39-3	0.001	mg/L	**7.37**	**0.295**	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.003**	<0.001	----	----	----
Cobalt	7440-48-4	0.001	mg/L	**0.001**	**0.006**	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.006**	**0.008**	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.041**	**0.098**	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.080**	**0.514**	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.002**	**0.033**	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	PPD01B	WW04A	----	----	----
				Client sampling date / time	03-May-2019 00:00	05-May-2019 00:00	----	----	----
Compound	CAS Number	LOR	Unit		EB1911503-001	EB1911503-002	--------	--------	--------
					Result	Result	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Selenium	7782-49-2	0.01	mg/L		<0.01	**0.06**	----	----	----
Silver	7440-22-4	0.001	mg/L		<0.001	<0.001	----	----	----
Uranium	7440-61-1	0.001	mg/L		<0.001	**0.001**	----	----	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	----	----	----
Iron	7439-89-6	0.05	mg/L		<0.05	**5.10**	----	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.2**	**0.2**	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**2.35**	**0.70**	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.10**	**0.02**	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.10**	**0.02**	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**2.3**	**0.8**	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**2.4**	**0.8**	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.06**	**0.13**	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	<0.01	----	----	----
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		**91.0**	**98.5**	----	----	----
Total Cations	----	0.01	meq/L		**79.3**	**95.9**	----	----	----
Ionic Balance	----	0.01	%		**6.85**	**1.32**	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	**360**	----	----	----
C10 - C14 Fraction	----	50	µg/L		<50	<50	----	----	----
C15 - C28 Fraction	----	100	µg/L		<100	<100	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	PPD01B	WW04A	----	----	----
				Client sampling date / time	03-May-2019 00:00	05-May-2019 00:00	----	----	----
Compound	CAS Number	LOR	Unit		EB1911503-001	EB1911503-002	--------	--------	--------
					Result	Result	----	----	----
EP080/071: Total Petroleum Hydrocarbons - Continued									
C29 - C36 Fraction	----	50	µg/L		<50	<50	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L		<50	<50	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	**360**	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		<20	**360**	----	----	----
>C10 - C16 Fraction	----	100	µg/L		<100	<100	----	----	----
>C16 - C34 Fraction	----	100	µg/L		<100	<100	----	----	----
>C34 - C40 Fraction	----	100	µg/L		<100	<100	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	<100	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	<100	----	----	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	----	----	----
Toluene	108-88-3	2	µg/L		**2**	**4**	----	----	----
Ethylbenzene	100-41-4	2	µg/L		<2	<2	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	----	----	----
ortho-Xylene	95-47-6	2	µg/L		<2	<2	----	----	----
^ Total Xylenes	----	2	µg/L		<2	<2	----	----	----
^ Sum of BTEX	----	1	µg/L		**2**	**4**	----	----	----
Naphthalene	91-20-3	5	µg/L		<5	<5	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**103**	**103**	----	----	----
Toluene-D8	2037-26-5	2	%		**100**	**94.8**	----	----	----
4-Bromofluorobenzene	460-00-4	2	%		**96.8**	**96.9**	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	66	138
Toluene-D8	2037-26-5	79	120
4-Bromofluorobenzene	460-00-4	74	118

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1928348**	Page	: 1 of 9
Client	: **CDM SMITH AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MARK IMBER	Contact	: Customer Services EB
Address	: LEVEL 4 51 ALFRED STREET PO BOX 359 FORTITUDE VALLEY QLD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 7 3243 7222
Project	: 1000398 Bowen Coking Coal	Date Samples Received	: 25-Oct-2019 09:30
Order number	: ----	Date Analysis Commenced	: 25-Oct-2019
C-O-C number	: ----	Issue Date	: 01-Nov-2019 16:48
Sampler	: DANIEL WHITE		
Site	: Bowen Coking Coal		
Quote number	: BNBQ/002/18		
No. of samples received	: 8		
No. of samples analysed	: 8		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Santusha Pandra	Senior Chemist	Brisbane Inorganics, Stafford, QLD
Sarah Ashworth	Laboratory Manager - Brisbane	Brisbane Organics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- It has been noted that EK071G (Reactive Phosphorus as P) is greater than EK067G (Total Phosphorus as P) for some samples, however this difference is within the limits of experimental variation.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	PPD02B	PPD02C	PPD03A	PPD03B	WW04A
			Client sampling date / time	23-Oct-2019 00:00	23-Oct-2019 00:00	23-Oct-2019 00:00	23-Oct-2019 00:00	23-Oct-2019 00:00
Compound	CAS Number	LOR	Unit	EB1928348-001	EB1928348-002	EB1928348-003	EB1928348-004	EB1928348-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	7.41	7.69	7.36	7.71	7.19
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	12100	13000	10000	8840	8660
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	1	mg/L	7800	8360	5670	5710	5940
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	103	24	19600	17	28
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	325	232	507	235	724
Total Alkalinity as CaCO3	----	1	mg/L	325	232	507	235	724
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	29	4	12	582
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	3920	4210	3200	2850	2370
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	298	355	254	138	254
Magnesium	7439-95-4	1	mg/L	126	176	162	62	308
Sodium	7440-23-5	1	mg/L	2080	2090	1620	1580	1190
Potassium	7440-09-7	1	mg/L	11	20	12	16	5
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic	7440-38-2	0.001	mg/L	0.001	0.001	0.008	0.002	<0.001
Barium	7440-39-3	0.001	mg/L	24.3	9.09	10.1	5.49	0.196
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	0.001	0.003	0.014	0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	0.002	0.010	0.018	0.008	0.002
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	0.084	0.012	0.157	0.023	<0.005
Manganese	7439-96-5	0.001	mg/L	0.048	0.354	1.65	0.932	0.130
Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.027	0.005	0.028	0.001

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	PPD02B	PPD02C	PPD03A	PPD03B	WW04A
				Client sampling date / time	23-Oct-2019 00:00	23-Oct-2019 00:00	23-Oct-2019 00:00	23-Oct-2019 00:00	23-Oct-2019 00:00
Compound	CAS Number	LOR	Unit		EB1928348-001	EB1928348-002	EB1928348-003	EB1928348-004	EB1928348-005
					Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued									
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Silver	7440-22-4	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L		<0.001	<0.001	**0.002**	<0.001	<0.001
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Iron	7439-89-6	0.05	mg/L		**1.58**	**0.53**	**1.53**	**0.24**	**0.80**
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		<0.1	**0.1**	**0.1**	**0.3**	**0.2**
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**3.50**	**2.86**	**2.94**	**2.43**	**1.00**
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	**0.02**	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	**0.02**	<0.01	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**4.1**	**3.2**	**7.8**	**3.1**	**1.3**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**4.1**	**3.2**	**7.8**	**3.1**	**1.3**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.06**	**0.02**	**1.34**	**0.08**	**0.05**
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.07**	**0.03**	**0.04**	**0.02**	<0.01
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		**117**	**124**	**100**	**85.3**	**93.4**
ø Total Cations	----	0.01	meq/L		**116**	**124**	**96.8**	**81.1**	**89.9**
ø Ionic Balance	----	0.01	%		**0.46**	**0.15**	**1.88**	**2.53**	**1.92**
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		**30**	**40**	<20	**30**	<20
C10 - C14 Fraction	----	50	µg/L		<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L		<100	<100	<100	<100	<100

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	PPD02B	PPD02C	PPD03A	PPD03B	WW04A
				Client sampling date / time	23-Oct-2019 00:00	23-Oct-2019 00:00	23-Oct-2019 00:00	23-Oct-2019 00:00	23-Oct-2019 00:00
Compound	CAS Number	LOR	Unit		EB1928348-001	EB1928348-002	EB1928348-003	EB1928348-004	EB1928348-005
					Result	Result	Result	Result	Result
EP080/071: Total Petroleum Hydrocarbons - Continued									
C29 - C36 Fraction	----	50	µg/L		<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L		<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		**30**	**40**	<20	**30**	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	<100	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	<100	<100	<100	<100
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L		**28**	**34**	**7**	**21**	<2
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	<2	<2
^ Total Xylenes	----	2	µg/L		<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L		**28**	**34**	**7**	**21**	<1
Naphthalene	91-20-3	5	µg/L		<5	<5	<5	<5	<5
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**95.2**	**96.0**	**78.0**	**76.8**	**97.6**
Toluene-D8	2037-26-5	2	%		**97.4**	**97.0**	**95.8**	**96.8**	**94.9**
4-Bromofluorobenzene	460-00-4	2	%		**99.4**	**104**	**102**	**102**	**104**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	PPD01A	PPD01B	BORE11	----	----
			Client sampling date / time	24-Oct-2019 00:00	24-Oct-2019 00:00	24-Oct-2019 00:00	----	----
Compound	CAS Number	LOR	Unit	EB1928348-006	EB1928348-007	EB1928348-008	--------	--------
				Result	Result	Result	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.39**	**8.18**	**6.90**	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**9180**	**8930**	**1530**	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	1	mg/L	**5560**	**5460**	**804**	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**137**	**27**	**6**	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**512**	**180**	**344**	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**512**	**180**	**344**	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**9**	**5**	**6**	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**2830**	**2910**	**291**	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**167**	**119**	**73**	----	----
Magnesium	7439-95-4	1	mg/L	**93**	**42**	**21**	----	----
Sodium	7440-23-5	1	mg/L	**1610**	**1640**	**172**	----	----
Potassium	7440-09-7	1	mg/L	**10**	**12**	**7**	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	**0.01**	<0.01	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.002**	**0.002**	**0.002**	----	----
Barium	7440-39-3	0.001	mg/L	**5.41**	**7.33**	**0.042**	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	**0.002**	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Cobalt	7440-48-4	0.001	mg/L	**0.004**	**0.002**	<0.001	----	----
Nickel	7440-02-0	0.001	mg/L	**0.023**	**0.010**	**0.004**	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Zinc	7440-66-6	0.005	mg/L	**0.244**	**0.103**	**0.025**	----	----
Manganese	7439-96-5	0.001	mg/L	**0.472**	**0.123**	**0.613**	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.006**	**0.010**	<0.001	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	PPD01A	PPD01B	BORE11	----	----
				Client sampling date / time	24-Oct-2019 00:00	24-Oct-2019 00:00	24-Oct-2019 00:00	----	----
Compound	CAS Number	LOR	Unit		EB1928348-006	EB1928348-007	EB1928348-008	--------	--------
					Result	Result	Result	----	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	----	----
Silver	7440-22-4	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Uranium	7440-61-1	0.001	mg/L		**0.003**	<0.001	<0.001	----	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	----	----
Iron	7439-89-6	0.05	mg/L		<0.05	<0.05	**0.07**	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.1**	**0.2**	**0.4**	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.99**	**2.34**	**20.1**	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	<0.01	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.85**	<0.01	<0.01	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.85**	<0.01	<0.01	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**2.4**	**2.8**	**23.6**	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**3.2**	**2.8**	**23.6**	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.22**	**0.06**	**1.56**	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.05**	**0.05**	**1.31**	----	----
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		**90.2**	**85.8**	**15.2**	----	----
ø Total Cations	----	0.01	meq/L		**86.3**	**81.0**	**13.0**	----	----
ø Ionic Balance	----	0.01	%		**2.25**	**2.85**	**7.70**	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		**120**	**150**	<20	----	----
C10 - C14 Fraction	----	50	µg/L		<50	<50	<50	----	----
C15 - C28 Fraction	----	100	µg/L		<100	<100	<100	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	PPD01A	PPD01B	BORE11	----	----
				Client sampling date / time	24-Oct-2019 00:00	24-Oct-2019 00:00	24-Oct-2019 00:00	----	----
Compound	CAS Number	LOR	Unit		EB1928348-006	EB1928348-007	EB1928348-008	--------	--------
					Result	Result	Result	----	----
EP080/071: Total Petroleum Hydrocarbons - Continued									
C29 - C36 Fraction	----	50	µg/L		<50	<50	<50	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L		<50	<50	<50	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		**120**	**150**	<20	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L		**20**	**40**	<20	----	----
>C10 - C16 Fraction	----	100	µg/L		<100	<100	<100	----	----
>C16 - C34 Fraction	----	100	µg/L		<100	<100	<100	----	----
>C34 - C40 Fraction	----	100	µg/L		<100	<100	<100	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L		<100	<100	<100	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L		<100	<100	<100	----	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	<1	----	----
Toluene	108-88-3	2	µg/L		**98**	**112**	<2	----	----
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	----	----
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	----	----
^ **Total Xylenes**	----	2	µg/L		<2	<2	<2	----	----
^ **Sum of BTEX**	----	1	µg/L		**98**	**112**	<1	----	----
Naphthalene	91-20-3	5	µg/L		<5	<5	<5	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**94.0**	**73.4**	**75.8**	----	----
Toluene-D8	2037-26-5	2	%		**101**	**99.8**	**97.6**	----	----
4-Bromofluorobenzene	460-00-4	2	%		**104**	**105**	**103**	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	66	138
Toluene-D8	2037-26-5	79	120
4-Bromofluorobenzene	460-00-4	74	118

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2016343**	Page	: 1 of 9
Client	: **CDM SMITH AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: [redacted]	Contact	: Customer Services EB
Address	: LEVEL 4 51 ALFRED STREET PO BOX 359 FORTITUDE VALLEY QLD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 7 3243 7222
Project	: 1000398 Bowen Coking Coal	Date Samples Received	: 19-Jun-2020 08:45
Order number	: ----	Date Analysis Commenced	: 20-Jun-2020
C-O-C number	: ----	Issue Date	: 26-Jun-2020 14:53
Sampler	: DANIEL WHITE		
Site	: ----		
Quote number	: BNBQ/002/18		
No. of samples received	: 8		
No. of samples analysed	: 8		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dave Gitsham	Metals Instrument Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Morgan Lennox		Brisbane Organics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EK067G (Total Phosphorus as P): Sample EB2016343_005 (WW04A) was diluted due to matrix interference. LOR adjusted accordingly.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	PPD02B	PPD02C	PPD01B	PPD03A	WW04A
			Client sampling date / time	16-Jun-2020 00:00	16-Jun-2020 00:00	16-Jun-2020 00:00	16-Jun-2020 00:00	16-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EB2016343-001	EB2016343-002	EB2016343-003	EB2016343-004	EB2016343-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.01**	**7.98**	**8.14**	**7.88**	**7.77**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**12800**	**12800**	**9270**	**10500**	**9060**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	1	mg/L	**7850**	**6590**	**5110**	**6340**	**5780**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**236**	**47**	**34**	**312**	**48**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**316**	**222**	**179**	**509**	**698**
Total Alkalinity as CaCO3	----	1	mg/L	**316**	**222**	**179**	**509**	**698**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	**57**	**14**	<1	**560**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**4270**	**4270**	**3030**	**3380**	**2500**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**182**	**289**	**145**	**317**	**312**
Magnesium	7439-95-4	1	mg/L	**149**	**193**	**45**	**180**	**343**
Sodium	7440-23-5	1	mg/L	**2380**	**2040**	**1810**	**1830**	**1330**
Potassium	7440-09-7	1	mg/L	**12**	**32**	**16**	**12**	**4**
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	**0.01**	**0.01**	<0.01	<0.01
Arsenic	7440-38-2	0.001	mg/L	**0.001**	<0.001	**0.003**	**0.016**	<0.001
Barium	7440-39-3	0.001	mg/L	**24.6**	**4.71**	**6.36**	**9.12**	**0.143**
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	**0.002**	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	**0.001**	<0.001	**0.012**	<0.001
Nickel	7440-02-0	0.001	mg/L	**0.007**	**0.025**	**0.018**	**0.020**	**0.010**
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**0.031**	**0.026**	**0.016**	**0.015**	**0.005**
Manganese	7439-96-5	0.001	mg/L	**0.060**	**0.341**	**0.152**	**1.68**	**0.115**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	**0.071**	**0.036**	**0.006**	<0.001

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	PPD02B	PPD02C	PPD01B	PPD03A	WW04A
				Client sampling date / time	16-Jun-2020 00:00	16-Jun-2020 00:00	16-Jun-2020 00:00	16-Jun-2020 00:00	16-Jun-2020 00:00
Compound	CAS Number	LOR	Unit		EB2016343-001	EB2016343-002	EB2016343-003	EB2016343-004	EB2016343-005
					Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued									
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Silver	7440-22-4	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Iron	7439-89-6	0.05	mg/L		**1.85**	**0.46**	**0.27**	**4.21**	**0.62**
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		<0.1	**0.1**	**0.1**	**0.1**	**0.1**
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**3.51**	**5.15**	**2.22**	**2.79**	**0.94**
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	**0.12**	<0.01	**0.01**	<0.01
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	**0.22**	<0.01	**0.02**	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	**0.34**	<0.01	**0.03**	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**4.4**	**17.7**	**2.4**	**3.0**	**1.1**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**4.4**	**18.0**	**2.4**	**3.0**	**1.1**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.10**	**0.23**	**0.06**	**0.32**	<0.05
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.06**	<0.01	<0.01	**0.03**	<0.01
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		**127**	**126**	**89.3**	**106**	**96.1**
ø Total Cations	----	0.01	meq/L		**125**	**120**	**90.1**	**110**	**102**
ø Ionic Balance	----	0.01	%		**0.63**	**2.53**	**0.41**	**2.32**	**2.84**
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L		<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L		<100	<100	<100	<100	<100

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	PPD02B	PPD02C	PPD01B	PPD03A	WW04A
				Client sampling date / time	16-Jun-2020 00:00	16-Jun-2020 00:00	16-Jun-2020 00:00	16-Jun-2020 00:00	16-Jun-2020 00:00
Compound	CAS Number	LOR	Unit		EB2016343-001	EB2016343-002	EB2016343-003	EB2016343-004	EB2016343-005
					Result	Result	Result	Result	Result
EP080/071: Total Petroleum Hydrocarbons - Continued									
C29 - C36 Fraction	----	50	µg/L		<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L		<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	<100	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	<100	<100	<100	<100
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L		<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	<2	<2
^ Total Xylenes	----	2	µg/L		<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L		<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L		<5	<5	<5	<5	<5
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**94.1**	**95.0**	**94.4**	**93.9**	**91.7**
Toluene-D8	2037-26-5	2	%		**100.0**	**99.0**	**98.2**	**98.5**	**98.3**
4-Bromofluorobenzene	460-00-4	2	%		**104**	**100**	**101**	**99.1**	**98.3**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	BORE 11	PPD01A	PPD03B	----	----
			Client sampling date / time	16-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	----	----
Compound	CAS Number	LOR	Unit	EB2016343-006	EB2016343-007	EB2016343-008	--------	--------
				Result	Result	Result	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.52**	----	**8.05**	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**1660**	----	**8750**	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	1	mg/L	**725**	----	**4860**	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**5**	----	**26**	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**380**	----	**225**	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**380**	----	**225**	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**14**	----	**5**	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**305**	----	**2820**	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**80**	**200**	**170**	----	----
Magnesium	7439-95-4	1	mg/L	**25**	**100**	**59**	----	----
Sodium	7440-23-5	1	mg/L	**214**	**1770**	**1690**	----	----
Potassium	7440-09-7	1	mg/L	**6**	**12**	**13**	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.01**	<0.01	<0.01	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.006**	**0.003**	**0.013**	----	----
Barium	7440-39-3	0.001	mg/L	**0.029**	**6.24**	**7.49**	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	**0.001**	<0.001	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	**0.012**	**0.001**	----	----
Nickel	7440-02-0	0.001	mg/L	**0.007**	**0.020**	**0.010**	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Zinc	7440-66-6	0.005	mg/L	**0.024**	**0.048**	**0.014**	----	----
Manganese	7439-96-5	0.001	mg/L	**0.734**	**1.19**	**0.912**	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.001**	**0.022**	**0.022**	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BORE 11	PPD01A	PPD03B	----	----
				Client sampling date / time	16-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	----	----
Compound	CAS Number	LOR	Unit		EB2016343-006	EB2016343-007	EB2016343-008	--------	--------
					Result	Result	Result	----	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	----	----
Silver	7440-22-4	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Uranium	7440-61-1	0.001	mg/L		<0.001	**0.002**	<0.001	----	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	----	----
Iron	7439-89-6	0.05	mg/L		**0.28**	**0.38**	**2.12**	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.4**	----	**0.2**	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**16.1**	**1.26**	**2.35**	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	<0.01	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	<0.01	<0.01	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	<0.01	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**19.2**	**2.1**	**2.5**	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**19.2**	**2.1**	**2.5**	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**1.36**	**0.16**	**0.22**	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**1.22**	<0.01	**0.01**	----	----
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		**16.5**	----	**84.1**	----	----
ø Total Cations	----	0.01	meq/L		**15.5**	----	**87.2**	----	----
ø Ionic Balance	----	0.01	%		**3.05**	----	**1.77**	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	<20	<20	----	----
C10 - C14 Fraction	----	50	µg/L		<50	**140**	<50	----	----
C15 - C28 Fraction	----	100	µg/L		<100	**240**	<100	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BORE 11	PPD01A	PPD03B	----	----
				Client sampling date / time	16-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	----	----
Compound	CAS Number	LOR	Unit		EB2016343-006	EB2016343-007	EB2016343-008	--------	--------
					Result	Result	Result	----	----
EP080/071: Total Petroleum Hydrocarbons - Continued									
C29 - C36 Fraction	----	50	µg/L		<50	**60**	<50	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L		<50	**440**	<50	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	<20	<20	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		<20	<20	<20	----	----
>C10 - C16 Fraction	----	100	µg/L		<100	**210**	<100	----	----
>C16 - C34 Fraction	----	100	µg/L		<100	**220**	<100	----	----
>C34 - C40 Fraction	----	100	µg/L		<100	<100	<100	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	**430**	<100	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	**210**	<100	----	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	<1	----	----
Toluene	108-88-3	2	µg/L		<2	<2	<2	----	----
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	----	----
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	----	----
^ Total Xylenes	----	2	µg/L		<2	<2	<2	----	----
^ Sum of BTEX	----	1	µg/L		<1	<1	<1	----	----
Naphthalene	91-20-3	5	µg/L		<5	<5	<5	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**93.8**	**96.5**	**94.4**	----	----
Toluene-D8	2037-26-5	2	%		**101**	**98.7**	**97.9**	----	----
4-Bromofluorobenzene	460-00-4	2	%		**101**	**101**	**98.5**	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	66	138
Toluene-D8	2037-26-5	79	120
4-Bromofluorobenzene	460-00-4	74	118

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2102684**	Page	: 1 of 9
Client	: **CDM SMITH AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MARK IMBER	Contact	: John Pickering
Address	: LEVEL 4 51 ALFRED STREET PO BOX 359 FORTITUDE VALLEY QLD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 7 3552 8634
Project	: 1000859.7	Date Samples Received	: 02-Feb-2021 08:50
Order number	: ----	Date Analysis Commenced	: 02-Feb-2021
C-O-C number	: ----	Issue Date	: 05-Feb-2021 16:47
Sampler	: DANIEL WHITE		
Site	: Bowen Coking Coal		
Quote number	: BN/023/21		
No. of samples received	: 9		
No. of samples analysed	: 9		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Mark Hallas	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Thomas Donovan		Brisbane Organics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	WW04A	BORE 11	PPD03A	PPD03B	PPD01A
			Sampling date / time	27-Jan-2021 00:00	27-Jan-2021 00:00	27-Jan-2021 00:00	28-Jan-2021 00:00	28-Jan-2021 00:00
Compound	CAS Number	LOR	Unit	EB2102684-001	EB2102684-002	EB2102684-003	EB2102684-004	EB2102684-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	7.36	6.80	7.28	7.80	7.21
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	8750	1340	10000	8100	10600
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	5220	687	6710	4830	6730
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	1460	12	1740	28	319
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	712	336	528	196	578
Total Alkalinity as CaCO3	----	1	mg/L	712	336	528	196	578
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	602	7	6	12	15
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	2640	242	3520	2920	3730
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	236	68	212	106	184
Magnesium	7439-95-4	1	mg/L	329	20	179	50	126
Sodium	7440-23-5	1	mg/L	1320	169	1800	1600	2030
Potassium	7440-09-7	1	mg/L	4	6	12	10	10
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	0.01	0.01	<0.01	<0.01
Arsenic	7440-38-2	0.001	mg/L	<0.001	0.003	0.015	0.009	0.006
Barium	7440-39-3	0.001	mg/L	0.153	0.047	10.2	9.81	9.47
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.009	0.002	0.013
Nickel	7440-02-0	0.001	mg/L	0.008	0.005	0.036	0.027	0.074
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.022	0.017	0.212
Manganese	7439-96-5	0.001	mg/L	0.110	0.612	1.22	0.728	1.53
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.006	0.013	0.008

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	WW04A	BORE 11	PPD03A	PPD03B	PPD01A
				Sampling date / time	27-Jan-2021 00:00	27-Jan-2021 00:00	27-Jan-2021 00:00	28-Jan-2021 00:00	28-Jan-2021 00:00
Compound	CAS Number	LOR	Unit		EB2102684-001	EB2102684-002	EB2102684-003	EB2102684-004	EB2102684-005
					Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued									
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Silver	7440-22-4	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	**0.001**
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Iron	7439-89-6	0.05	mg/L		**0.42**	**0.35**	**3.76**	**0.74**	**1.30**
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.1**	**0.3**	**0.1**	**0.2**	**0.1**
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.79**	**18.0**	**2.64**	**2.49**	**1.96**
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	<0.01	**0.01**	<0.01	**0.08**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	**0.01**	<0.01	**0.08**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**3.3**	**18.2**	**5.6**	**3.1**	**3.2**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**3.3**	**18.2**	**5.6**	**3.1**	**3.3**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**1.52**	**1.84**	**1.17**	**0.28**	**0.29**
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	**1.43**	**0.03**	**0.04**	<0.01
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		**101**	**13.7**	**110**	**86.5**	**117**
ø Total Cations	----	0.01	meq/L		**96.4**	**12.5**	**104**	**79.2**	**108**
ø Ionic Balance	----	0.01	%		**2.46**	**4.35**	**2.83**	**4.39**	**3.98**
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L		<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L		<100	<100	**100**	<100	<100

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	WW04A	BORE 11	PPD03A	PPD03B	PPD01A
				Sampling date / time	27-Jan-2021 00:00	27-Jan-2021 00:00	27-Jan-2021 00:00	28-Jan-2021 00:00	28-Jan-2021 00:00
Compound	CAS Number	LOR	Unit		EB2102684-001	EB2102684-002	EB2102684-003	EB2102684-004	EB2102684-005
					Result	Result	Result	Result	Result
EP080/071: Total Petroleum Hydrocarbons - Continued									
C29 - C36 Fraction	----	50	µg/L		<50	<50	80	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L		<50	<50	180	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L		<100	<100	160	<100	<100
>C34 - C40 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	<100	160	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	<100	<100	<100	<100
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L		<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	<2	<2
^ Total Xylenes	----	2	µg/L		<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L		<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L		<5	<5	<5	<5	<5
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		102	97.8	97.6	100	97.9
Toluene-D8	2037-26-5	2	%		97.9	93.2	93.8	95.9	95.7
4-Bromofluorobenzene	460-00-4	2	%		85.7	98.5	98.2	97.2	97.4

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	PPD01B	PPD02B	PPD02C	RN182169	----
			Sampling date / time	28-Jan-2021 00:00	28-Jan-2021 00:00	28-Jan-2021 00:00	28-Jan-2021 00:00	----
Compound	CAS Number	LOR	Unit	EB2102684-006	EB2102684-007	EB2102684-008	EB2102684-009	--------
				Result	Result	Result	Result	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.80**	**7.39**	**7.46**	**7.17**	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**9170**	**12600**	**12600**	**4710**	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**5350**	**8540**	**8380**	**2830**	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**28**	**96**	**23**	<5	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**271**	**316**	**314**	**1030**	----
Total Alkalinity as CaCO3	----	1	mg/L	**271**	**316**	**314**	**1030**	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**62**	**8**	**15**	**94**	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**3210**	**4590**	**4640**	**1070**	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**120**	**263**	**296**	**139**	----
Magnesium	7439-95-4	1	mg/L	**41**	**140**	**153**	**134**	----
Sodium	7440-23-5	1	mg/L	**1760**	**2270**	**2270**	**798**	----
Potassium	7440-09-7	1	mg/L	**31**	**12**	**19**	**5**	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.01**	<0.01	<0.01	<0.01	----
Arsenic	7440-38-2	0.001	mg/L	**0.002**	<0.001	<0.001	**0.002**	----
Barium	7440-39-3	0.001	mg/L	**5.13**	**26.3**	**11.3**	**0.065**	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	**0.001**	<0.001	<0.001	<0.001	----
Cobalt	7440-48-4	0.001	mg/L	**0.001**	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	**0.079**	**0.017**	**0.033**	**0.002**	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Zinc	7440-66-6	0.005	mg/L	**0.051**	**0.024**	**0.008**	<0.005	----
Manganese	7439-96-5	0.001	mg/L	**0.214**	**0.032**	**0.252**	**0.399**	----
Molybdenum	7439-98-7	0.001	mg/L	**0.113**	**0.002**	**0.002**	**0.001**	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	PPD01B	PPD02B	PPD02C	RN182169	----
				Sampling date / time	28-Jan-2021 00:00	28-Jan-2021 00:00	28-Jan-2021 00:00	28-Jan-2021 00:00	----
Compound	CAS Number	LOR	Unit		EB2102684-006	EB2102684-007	EB2102684-008	EB2102684-009	--------
					Result	Result	Result	Result	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
Silver	7440-22-4	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	----
Uranium	7440-61-1	0.001	mg/L		<0.001	<0.001	<0.001	**0.005**	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
Iron	7439-89-6	0.05	mg/L		<0.05	**1.65**	**0.39**	**0.15**	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.2**	<0.1	**0.1**	**0.8**	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**27.4**	**3.57**	**12.6**	**3.12**	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		**0.03**	<0.01	<0.01	<0.01	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**4.28**	<0.01	<0.01	**0.05**	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**4.31**	<0.01	<0.01	**0.05**	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**29.8**	**4.0**	**13.5**	**3.3**	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**34.1**	**4.0**	**13.5**	**3.4**	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.53**	**0.05**	**0.68**	**0.55**	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.37**	**0.03**	**0.45**	**0.53**	----
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		**97.2**	**136**	**137**	**52.7**	----
ø Total Cations	----	0.01	meq/L		**86.7**	**124**	**126**	**52.8**	----
ø Ionic Balance	----	0.01	%		**5.73**	**4.72**	**4.12**	**0.08**	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	<20	<20	<20	----
C10 - C14 Fraction	----	50	µg/L		<50	<50	<50	<50	----
C15 - C28 Fraction	----	100	µg/L		<100	<100	<100	<100	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	PPD01B	PPD02B	PPD02C	RN182169	----
				Sampling date / time	28-Jan-2021 00:00	28-Jan-2021 00:00	28-Jan-2021 00:00	28-Jan-2021 00:00	----
Compound	CAS Number	LOR	Unit		EB2102684-006	EB2102684-007	EB2102684-008	EB2102684-009	--------
					Result	Result	Result	Result	----
EP080/071: Total Petroleum Hydrocarbons - Continued									
C29 - C36 Fraction	----	50	µg/L		<50	<50	<50	<50	----
^ C10 - C36 Fraction (sum)	----	50	µg/L		<50	<50	<50	<50	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	<20	<20	<20	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		<20	<20	<20	<20	----
>C10 - C16 Fraction	----	100	µg/L		<100	<100	<100	<100	----
>C16 - C34 Fraction	----	100	µg/L		<100	<100	<100	<100	----
>C34 - C40 Fraction	----	100	µg/L		<100	<100	<100	<100	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	<100	<100	<100	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	<100	<100	<100	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	<1	<1	----
Toluene	108-88-3	2	µg/L		<2	<2	<2	<2	----
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	<2	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	<2	----
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	<2	----
^ Total Xylenes	----	2	µg/L		<2	<2	<2	<2	----
^ Sum of BTEX	----	1	µg/L		<1	<1	<1	<1	----
Naphthalene	91-20-3	5	µg/L		<5	<5	<5	<5	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**125**	**101**	**103**	**95.9**	----
Toluene-D8	2037-26-5	2	%		**94.5**	**93.8**	**96.0**	**95.8**	----
4-Bromofluorobenzene	460-00-4	2	%		**97.8**	**96.9**	**98.9**	**98.4**	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	66	138
Toluene-D8	2037-26-5	79	120
4-Bromofluorobenzene	460-00-4	74	118

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2105686**	Page	: 1 of 9
Client	: **CDM SMITH AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: [redacted]	Contact	: John Pickering
Address	: LEVEL 4 51 ALFRED STREET PO BOX 359 FORTITUDE VALLEY QLD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 7 3552 8634
Project	: 1000859.7	Date Samples Received	: 02-Mar-2021 08:40
Order number	: ----	Date Analysis Commenced	: 02-Mar-2021
C-O-C number	: ----	Issue Date	: 08-Mar-2021 15:05
Sampler	: DANIEL WHITE		
Site	: BOWEN COKING COAL		
Quote number	: BN/023/21		
No. of samples received	: 9		
No. of samples analysed	: 9		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Diana Mesa	Senior Organic Chemist	Brisbane Organics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Minh Wills	2IC Organic Chemist	Brisbane Organics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EK067G (total Phosphorus as P): Some samples were diluted due to matrix interference. LOR adjusted accordingly.
- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	PPD01A	PPD01B	PPD02B	PPD02C	PPD03A
			Sampling date / time	25-Feb-2021 00:00	25-Feb-2021 00:00	25-Feb-2021 00:00	25-Feb-2021 00:00	25-Feb-2021 00:00
Compound	CAS Number	LOR	Unit	EB2105686-001	EB2105686-002	EB2105686-003	EB2105686-004	EB2105686-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	7.45	7.75	7.67	7.72	7.56
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	11000	9820	13000	13000	10200
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	6500	5610	8450	8510	6490
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	338	24	106	22	113
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	608	251	335	326	548
Total Alkalinity as CaCO3	----	1	mg/L	608	251	335	326	548
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	13	<1	<1	8	2
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	3720	3400	4660	4680	3480
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	154	84	220	257	166
Magnesium	7439-95-4	1	mg/L	124	33	138	150	166
Sodium	7440-23-5	1	mg/L	2130	1970	2360	2320	1770
Potassium	7440-09-7	1	mg/L	10	10	11	18	11
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic	7440-38-2	0.001	mg/L	0.008	0.009	0.001	0.001	0.014
Barium	7440-39-3	0.001	mg/L	9.14	10.8	25.1	10.6	8.69
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	0.012	<0.001	<0.001	<0.001	0.010
Nickel	7440-02-0	0.001	mg/L	0.105	0.051	0.007	0.046	0.106
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	0.041	0.006	0.023	0.026	0.187
Manganese	7439-96-5	0.001	mg/L	1.28	0.340	0.031	0.250	1.05
Molybdenum	7439-98-7	0.001	mg/L	0.006	0.005	<0.001	<0.001	0.004

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	PPD01A	PPD01B	PPD02B	PPD02C	PPD03A
				Sampling date / time	25-Feb-2021 00:00	25-Feb-2021 00:00	25-Feb-2021 00:00	25-Feb-2021 00:00	25-Feb-2021 00:00
Compound	CAS Number	LOR	Unit		EB2105686-001	EB2105686-002	EB2105686-003	EB2105686-004	EB2105686-005
					Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued									
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Silver	7440-22-4	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L		**0.001**	<0.001	<0.001	<0.001	<0.001
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Iron	7439-89-6	0.05	mg/L		**1.58**	**1.60**	**1.40**	**0.40**	**3.19**
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		<0.1	**0.1**	<0.1	**0.1**	**0.1**
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**2.05**	**10.5**	**3.62**	**12.7**	**2.46**
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	**0.02**
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	**0.39**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	**0.41**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**3.1**	**11.3**	**4.0**	**13.6**	**2.9**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**3.1**	**11.3**	**4.0**	**13.6**	**3.3**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.22**	**0.67**	**0.05**	**0.62**	**0.20**
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	**0.07**	**0.05**	**0.42**	**0.02**
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		**117**	**101**	**138**	**139**	**109**
ø Total Cations	----	0.01	meq/L		**111**	**92.8**	**125**	**126**	**99.2**
ø Ionic Balance	----	0.01	%		**2.88**	**4.16**	**4.89**	**4.58**	**4.77**
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L		<50	**280**	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L		<100	**100**	<100	<100	<100

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	PPD01A	PPD01B	PPD02B	PPD02C	PPD03A
				Sampling date / time	25-Feb-2021 00:00	25-Feb-2021 00:00	25-Feb-2021 00:00	25-Feb-2021 00:00	25-Feb-2021 00:00
					EB2105686-001	EB2105686-002	EB2105686-003	EB2105686-004	EB2105686-005
					Result	Result	Result	Result	Result
EP080/071: Total Petroleum Hydrocarbons - Continued									
C29 - C36 Fraction	----	50	µg/L		<50	<50	<50	<50	<50
^ **C10 - C36 Fraction (sum)**	----	50	µg/L		<50	**380**	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	<20	<20	<20	<20
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L		<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L		<100	**320**	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L		<100	**320**	<100	<100	<100
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L		<100	**320**	<100	<100	<100
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L		<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	<2	<2
^ **Total Xylenes**	----	2	µg/L		<2	<2	<2	<2	<2
^ **Sum of BTEX**	----	1	µg/L		<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L		<5	<5	<5	<5	<5
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**105**	**102**	**102**	**101**	**103**
Toluene-D8	2037-26-5	2	%		**97.1**	**97.3**	**98.2**	**96.5**	**99.6**
4-Bromofluorobenzene	460-00-4	2	%		**105**	**105**	**107**	**106**	**108**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	PPD03B	WW04A	Bore 11	Bore 11B	----
			Sampling date / time	25-Feb-2021 00:00	25-Feb-2021 00:00	26-Feb-2021 00:00	26-Feb-2021 00:00	----
Compound	CAS Number	LOR	Unit	EB2105686-006	EB2105686-007	EB2105686-008	EB2105686-009	--------
				Result	Result	Result	Result	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.89**	**7.63**	**6.89**	**7.55**	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**8320**	**8990**	**2020**	**4660**	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**4840**	**6120**	**1110**	**2580**	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**39**	**65**	**8**	**14**	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**208**	**749**	**505**	**1040**	----
Total Alkalinity as CaCO3	----	1	mg/L	**208**	**749**	**505**	**1040**	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**4**	**606**	**19**	**99**	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**2840**	**2620**	**424**	**1030**	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**81**	**208**	**98**	**136**	----
Magnesium	7439-95-4	1	mg/L	**46**	**325**	**32**	**126**	----
Sodium	7440-23-5	1	mg/L	**1570**	**1340**	**300**	**762**	----
Potassium	7440-09-7	1	mg/L	**9**	**4**	**5**	**6**	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	**0.03**	<0.01	----
Arsenic	7440-38-2	0.001	mg/L	**0.013**	<0.001	**0.009**	**0.001**	----
Barium	7440-39-3	0.001	mg/L	**8.95**	**0.171**	**0.045**	**0.070**	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	**0.110**	**0.088**	**0.004**	**0.003**	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Zinc	7440-66-6	0.005	mg/L	**0.006**	<0.005	**0.012**	<0.005	----
Manganese	7439-96-5	0.001	mg/L	**0.639**	**0.100**	**1.06**	**0.534**	----
Molybdenum	7439-98-7	0.001	mg/L	**0.010**	**0.001**	**0.002**	<0.001	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	PPD03B	WW04A	Bore 11	Bore 11B	----
				Sampling date / time	25-Feb-2021 00:00	25-Feb-2021 00:00	26-Feb-2021 00:00	26-Feb-2021 00:00	----
Compound	CAS Number	LOR	Unit		EB2105686-006	EB2105686-007	EB2105686-008	EB2105686-009	--------
					Result	Result	Result	Result	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
Silver	7440-22-4	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	----
Uranium	7440-61-1	0.001	mg/L		<0.001	<0.001	<0.001	**0.002**	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
Iron	7439-89-6	0.05	mg/L		**1.72**	**0.50**	**1.73**	**0.07**	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.2**	**0.1**	**0.6**	**0.8**	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**2.61**	**0.97**	**6.71**	**3.36**	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**2.8**	**1.1**	**7.0**	**3.7**	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**2.8**	**1.1**	**7.0**	**3.7**	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.23**	<0.05	**0.56**	**0.39**	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.03**	<0.01	**0.19**	**0.34**	----
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		**84.4**	**101**	**22.4**	**51.9**	----
ø Total Cations	----	0.01	meq/L		**76.3**	**95.5**	**20.7**	**50.4**	----
ø Ionic Balance	----	0.01	%		**4.98**	**3.03**	**4.04**	**1.41**	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	<20	<20	<20	----
C10 - C14 Fraction	----	50	µg/L		<50	<50	<50	<50	----
C15 - C28 Fraction	----	100	µg/L		<100	<100	<100	<100	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	PPD03B	WW04A	Bore 11	Bore 11B	----
				Sampling date / time	25-Feb-2021 00:00	25-Feb-2021 00:00	26-Feb-2021 00:00	26-Feb-2021 00:00	----
Compound	CAS Number	LOR	Unit		EB2105686-006	EB2105686-007	EB2105686-008	EB2105686-009	--------
					Result	Result	Result	Result	----
EP080/071: Total Petroleum Hydrocarbons - Continued									
C29 - C36 Fraction	----	50	µg/L		<50	<50	<50	<50	----
^ C10 - C36 Fraction (sum)	----	50	µg/L		<50	<50	<50	<50	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	<20	<20	<20	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		<20	<20	<20	<20	----
>C10 - C16 Fraction	----	100	µg/L		<100	<100	<100	<100	----
>C16 - C34 Fraction	----	100	µg/L		<100	<100	<100	<100	----
>C34 - C40 Fraction	----	100	µg/L		<100	<100	<100	<100	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	<100	<100	<100	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	<100	<100	<100	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	<1	<1	----
Toluene	108-88-3	2	µg/L		<2	<2	<2	<2	----
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	<2	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	<2	----
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	<2	----
^ Total Xylenes	----	2	µg/L		<2	<2	<2	<2	----
^ Sum of BTEX	----	1	µg/L		<1	<1	<1	<1	----
Naphthalene	91-20-3	5	µg/L		<5	<5	<5	<5	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**104**	**100**	**104**	**100**	----
Toluene-D8	2037-26-5	2	%		**100**	**98.7**	**97.1**	**95.2**	----
4-Bromofluorobenzene	460-00-4	2	%		**107**	**106**	**104**	**102**	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	66	138
Toluene-D8	2037-26-5	79	120
4-Bromofluorobenzene	460-00-4	74	118

APPENDIX C

Groundwater Management and Monitoring Program (GMMP)

ISAAC RIVER COAL PROJECT

Groundwater Management and Monitoring Program

Prepared for:

Coking Coal One Pty Ltd
Level 19, Waterfront Place
1 Eagle Street
BRISBANE QLD 4000

SLR Ref: 620.30757.00400-R01
Version No: -v1.0
July 2022

PREPARED BY

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Coking Coal One Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
620.30757.00400-R01-v1.0	15 July 2022	JH/DL	JBDL	DL

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1 Introduction

1.1 Background

This Groundwater Management and Monitoring Program (GMMP) has been prepared to monitor and manage the potential impacts on groundwater at and surrounding the Isaac River Coking Coal Project (the Project) owned by Coking Coal One Pty Ltd, a 100% owned subsidiary of Bowen Coking Coal Limited (BCC). The GMMP outlines the groundwater and groundwater dependant ecosystems (GDEs) monitoring plan for the Project and associated groundwater impact triggers that will invoke further assessment and groundwater impact management. The GMMP is designed to provide consistency across the relevant State and Commonwealth regulatory requirements as they pertain to groundwater monitoring and management at the Project.

The Project is located on Mining Lease (ML) 700062 and ML700063, 28 kilometres (km) east of Moranbah in Queensland's Bowen Basin (**Figure 1**). The Project is located immediately east of the existing Daunia Coal Mine and in close proximity to the Red Mountain Coal Handling and Processing Plant (RM CHPP).

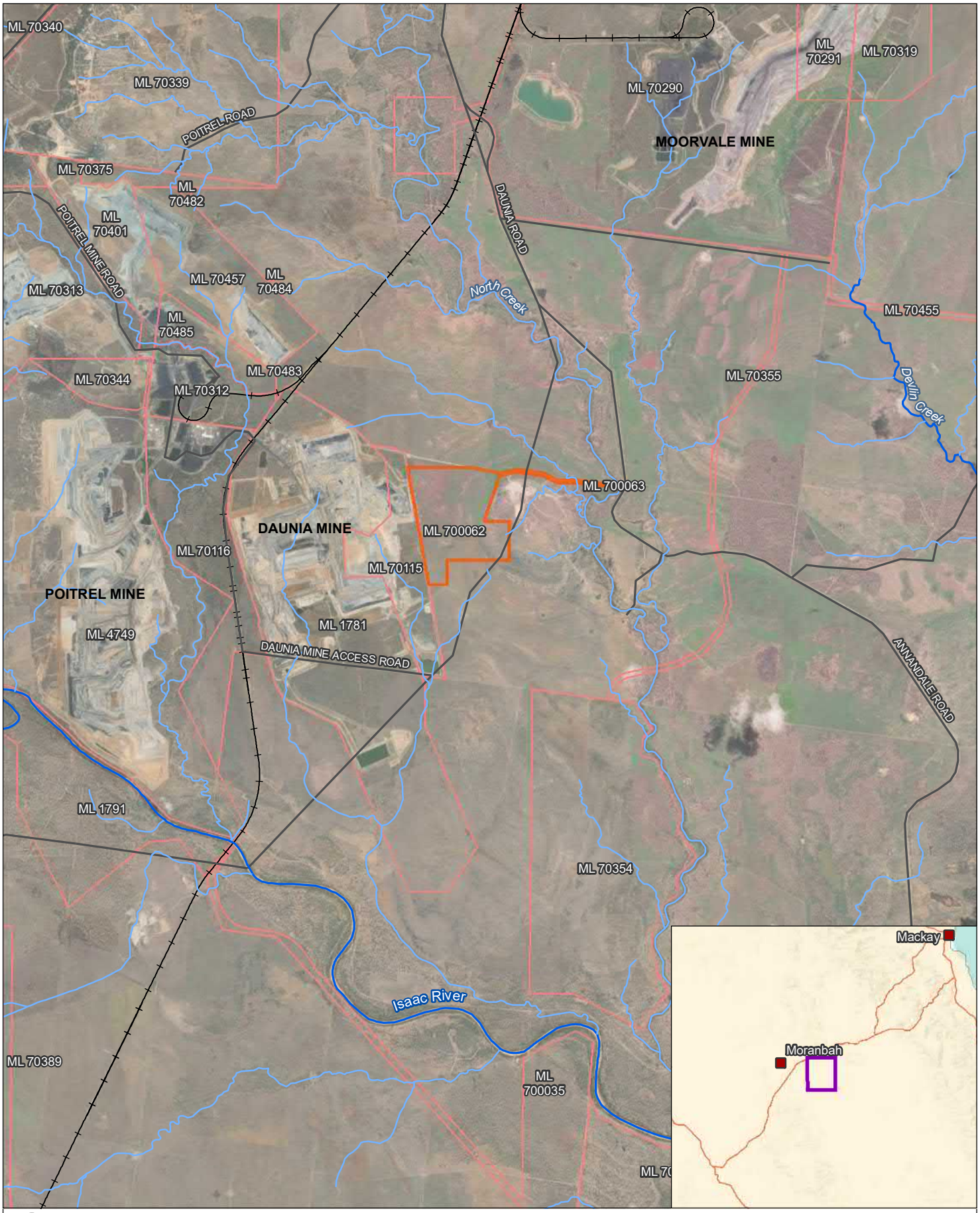
The Project will involve mining approximately 500,000 tonnes per annum (tpa) of hard coking coal, semi-hard coking coal and Pulverised Coal Injection (PCI) product over five (5) years. The run-of-mine (ROM) coal will ramp up to approximately 500,000 tpa during Year 1. This proposed scale and life of mine is relatively small in the context of other neighbouring mines and mining projects.

BCC submitted an environmental authority (EA) application to the Department of Environment and Science (Queensland) (DES) for the Project in 2019. Water resources assessments supporting the application were presented in the Project's Environmental Assessment Report (EAR) (CDM Smith, 2021). DES issued the final EA (EA100114091) for the Project on 29 March 2022. Schedule D of the EA pertains to groundwater and is directly relevant to this GMMP.

Additionally, a referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was provided to the Commonwealth Department of Agriculture, Water and the Environment (DAWE) in 2021 (EPBC 2021/8980). In August 2021, DAWE, now Department of Climate Change, Energy, the Environment and Water (DCCEEW), informed BCC that the proposed action was a controlled action, and the Project would require assessment under the EPBC Act which includes submission to the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC). DAWE also issued a request for additional information to BCC that included development of a GMMP.

1.2 Regulatory Requirements

This GMMP is based on the conditions outlined in the EA100114091 in relation to groundwater management (**Appendix A**). This GMMP is also based on addressing relevant items of an RFI issued by DAWE for EPBC 2021/8089 in August 2021 including subsequent email clarification in April 2022 (**Appendix B**).



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:100,000 at A4
Project Number:	620.30757
Date:	15-Jul-2022
Drawn by:	NT

- Major Watercourse
- Minor Watercourse
- Road
- Rail
- Mining Lease (Approved)
- Project Mining Lease (Application)

ISAAC RIVER PROJECT

Project Locality

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

FIGURE 1

H:\Projects-SLR\620-BNE\620.30757.00000 Isaac River Coal Project Groundwater\03 SLR Data\01 GIS\GIS\GMMP\SLR620.30757_F01_ProjectLocality_01.mxd

1.3 This GMMP

This GMMP has been prepared based on the groundwater system characterisation, relevant requirements from the EA (see **Appendix A**), and potential Project impacts on groundwater identified in the Project's EA application (CDM Smith, 2021). This GMMP is structured as follows:

- Section 2: describes the hydrogeologic setting of the Project including potential GDEs.
- Section 3: describes the groundwater model for the Project, potential groundwater impact and/or contamination sources, and the model's predicted impacts on groundwater and GDEs from the Project.
- Section 4: describes the groundwater and GDE monitoring programs for the Project site including monitoring locations, monitoring frequency, and the parameters to be recorded/analysed.
- Section 5: sets out the groundwater impact triggers and protocols for investigating, and if required, mitigating the impacts on groundwater and GDEs from the Project.
- Section 6: describes the quality assurance and quality control procedures that will be implemented in the GMMP.
- Section 7: describes the process of continual review and improvement of the GMMP to ensure it continues to meet its objectives.

2 Hydrogeological Setting

The Project comprises the open cut mining of late Permian aged coal measures, which strike north-northeast and on a regional scale dip to the east off the Comet-ridge. Information gathered during 2D seismic and exploration drilling programs indicate the coal measures within the Project are associated with a synclinal structure plunging to the north. The coal measures within the Project area are structurally bounded to the west by a significant thrust fault and to the east by a post-Permian intrusive granite body. The granitoid intrusion lies immediately east of ML 700062.

The Project's economic coal seams are contained in the Late Permian Rangal Coal Measures on ML 700062. The Rangal Coal Measures are approximately 100 m thick and contain the Leichardt, Vermont and Girrah coal seams. The Rangal Coal Measures are underlain by the Fort Cooper Coal Measures and overlain by the Early Triassic Rewan Group. Alluvial sediments are located along North Creek to the east of the Project. North Creek and the alluvium cover associated with it are located outside of the Project footprint and outside ML 700062.

The main hydrostratigraphic units at the Project and surrounding areas and groundwater occurrences within these units can be summarised as:

- Alluvium and colluvium (unsaturated or seasonally perched groundwater).
- Granitoid Intrusion (aquitard).
- Triassic Rewan Group (aquitard).
- Permian coal measures comprising the Rangal Coal Measures and the Fort Copper Coal Measures (minor aquifer).

2.1 Alluvium and colluvium (unsaturated or seasonally perched groundwater)

On a regional scale, the alluvium around the Project comprises heterogeneous distributions of clays, sandy clays and gravels. The alluvium is best developed immediately adjacent the Isaac River to the south of the Project, and less well developed along its tributaries such as North Creek. Due to the lithologic variability, the hydraulic properties of the alluvium vary. The base of the alluvium is likely to be clay or weathered bedrock. Regional groundwater flow within the alluvium associated with Isaac River (south of the Project) is in a south-easterly direction, consistent with the alignment of the Isaac River.

On a local scale, alluvial sediments are not located within the Project footprint. However, North Creek (a minor highly ephemeral tributary of the Isaac River) is located east and southeast of the Project and has associated alluvial sediments which are generally around 5 to 20 m thick. Groundwater is occasionally encountered at the base of this unit with groundwater levels strongly linked to seasonal rainfall. Shallow southerly groundwater flow (i.e. towards the Isaac River main channel) may occur within the alluvial sediments along North Creek. North Creek is separated from the Project area by a granitoid intrusion, discussed in **Section 2.2** below.

Surface water and subsequent bank storage will most likely undergo evapotranspiration by vegetation around the North Creek area. Bank storage that does not undergo evapotranspiration may infiltrate through the weathered rock layer and eventually recharge groundwater; that is, localised groundwater recharge may occur in the vicinity of North Creek through streamflow losses when the creek occasionally flows.

2.2 Granitoid Intrusion (aquitard)

A post-Permian aged granitoid intrusion dominates the eastern portion of the Project and is reflected in the associated topographic high. In the Bowen Basin granitoid intrusions are known to be of very low yield due to insignificant water storage and very low permeability. Registered groundwater bores are not located in this rock units across the basin. The intrusion locally disconnects the Rangal Coal Measures coal seams within the Project to the west of the intrusion from those to the east of the intrusion. The intrusion is therefore interpreted to function as a local barrier to groundwater flow within the coal measures.

2.3 Triassic Rewan Group (aquitard)

The Rewan Group, comprised of low permeability lithologies including lithic sandstone, pebbly lithic sandstone and green to reddish brown mudstone, is present west of the Project. The unit is generally considered a regional scale aquitard in the Bowen Basin.

2.4 Permian Coal Measures including Rangal Coal Measured and Fort Cooper Coal Measures (minor aquifer)

In the Permian strata, low yields of groundwater are encountered in the coal seams themselves as well as the upper weathered sandstone/siltstone units. Like the rest of the Bowen Basin, the coal seams are the main water bearing units within the Permian Coal measures. Individual coal seams are generally confined by lower permeability (i.e. aquitard forming) mudstone/siltstone interburden. The coal seems are dual porosity with minor matric porosity and dominant secondary porosity in cleats and fractures. Vertical movement of groundwater is restricted by the confining interburden layers and may only locally occur along fault structures. Therefore, groundwater flow in the Permian strata is primarily sub-horizontal through the seams, with recharge typically occurring at seam outcrops or sub-crops.

Groundwater in the Permian coal measures is generally intercepted around 40 m below ground level (bgl) in the Project area, however groundwater yields are typically low. Groundwater within the Permian coal measures is generally brackish with groundwater EC generally between 8,000 to 12,000 µS/cm, with some isolated fresher pockets of groundwater. In the vicinity of the Project, groundwater flow in the Permian coal measures is dominated by the influence of the adjacent Daunia Mine, with westwards groundwater flow towards the active Daunia pits. This is superimposed on a general north to south/southeast regional groundwater flow direction in the regional groundwater system.

2.5 Environmental Values

2.5.1 Overview

The Project is wholly contained within the Isaac River Sub-basin, part of the Fitzroy Basin, Queensland. Specific EVs and WQOs for the Isaac River were released in 2011 as part of the Isaac River Sub-basin Environmental Values and Water Quality Objectives Basin No.130 (part), including all waters of the Isaac River Sub-basin (including Connors River) (EHP, 2011).

Groundwater Environmental Values (EVs) are defined by their contribution to the water requirements of ecological systems and/or anthropogenic water users. The suitability of groundwater for supporting dependant ecosystems and/or the purposes for which it is abstracted are key indicators of EVs.

To protect the aquifers of the Project and associated EVs, Water Quality Objectives (WQOs) are established for different indicators such as pH, nutrients and toxicants. The EPP Water and Wetland Biodiversity provides provisions to protect and enhance the suitability of Queensland's groundwaters for various beneficial uses. In consultation with communities (including industry and commerce sectors), regional natural resource management groups and local governments, DES has established EVs and WQOs for a number of basins including the Isaac River Sub-basin. The Project is located within the Queensland Governments Isaac Connors Groundwater Management Area. The EVs defined for this zone and therefore applicable to the Project are:

- Aquatic ecosystems – these occur where groundwater baseflow supports permanent streams and water holes to some extent (e.g. seasonally or permanently);
- Irrigation – where groundwater is used to grow crops and pastures for commercial purposes;
- Farm supply/use – where groundwater is used to provide domestic supply and support growing of domestic produce;
- Stock water – where groundwater is used to provide stock water supplies;
- Primary recreation – where supports recreational use which involves direct contact and a high probability of water being swallowed, e.g. diving, swimming, surfing, water skiing and windsurfing;
- Drinking water – where groundwater is used for potable water supply; and
- Cultural and spiritual values – where groundwater supports both indigenous and non-indigenous values, e.g. recreational fishing, heritage, ecology.

2.5.2 Comparison of Project Groundwater to Scheduled EVs and WQOs

The Project's EA application groundwater assessment found groundwater at the Project to be typically of a poor quality and generally not suitable for human consumption, irrigation or stock watering purposes. The quality is typically brackish ranging from 8,000 to 12,000 µS/cm. The exception to this is a single bore, which showed potable range salinity of 600 to 2,000 µS/cm, interpreted to be related to the bore possibly being located within a local area of rapid recharge associated with the weathered zone around the granite intrusion in the immediate east of the Project. Groundwater is typically neutral-alkaline with pH ranging from 6.8 to 10.2. Some elevated metals in relation to drinking water and aquatic protection guidelines were observed including zinc, chromium, copper, nickel, and manganese, indicating that the pre mining groundwater quality of the area may not support all the EVs defined for the Isaac Connors Groundwater Management Area.

2.5.3 Groundwater Dependant Ecosystems

Groundwater Dependant Ecosystems (GDEs) are ecosystems that rely on groundwater for some or all of their environmental water requirements. GDEs are typically classified into three groupings:

- Aquatic ecosystems that rely on the surface expression of groundwater – including surface water ecosystems which may have a groundwater component, such as rivers, wetlands and springs.
- Terrestrial ecosystems that rely on the subsurface presence of groundwater – including all vegetation ecosystems.
- Subterranean ecosystems – this includes cave and aquifer ecosystems.

Section 4.4 presents a full discussion on the potential for GDEs in the vicinity of the Project, whilst the following provides a brief summary.

Subterranean GDEs include stygofauna. Stygofauna studies undertaken for the Project's EA application did not detect stygofauna in any of the sampled bores. This is further supported by recent stygofauna sampling for other nearby projects such as the Olive Downs Project (DPM Envirosciences, 2018) and Winchester South Projects (Ecological Service Professionals, 2021), neither of which detected styogofauna in sampled bores.

The potential for aquatic GDEs at or near to the Project is very limited due to the highly ephemeral nature of the surface water systems such as North Creek that are conceptualised as 'losing' systems and lack permanent waterholes. Potential aquatic GDEs are identified in national scale mapping (i.e. GDE Atlas) associated with the Isaac River to the south of the Project, however previous studies (e.g. SLR, 2022) have found that the presence of aquatic GDEs on the Isaac River to be very unlikely given the ephemeral losing stream nature of the River.

Terrestrial GDEs, that is, terrestrial vegetation communities that may occasionally or permanent access groundwater, are identified in national scale mapping (i.e. GDE Atlas) near to the Project, particularly adjacent to the ephemeral surface water features and associated floodplains. The Project's EA application described the potential for these type of GDEs in the Project area associated with riparian vegetation (RE 11.2.35 Forest Red Gum and River Red Gum species) accessing alluvial groundwater along the banks of the water courses at times when the soil water reservoir is depleted. Previous studies (e.g. SLR, 2022) support this, however, identify such GDEs as facultative should they exist, i.e. relying on groundwater from the water table only occasionally during dry climatic periods when soil moisture is particularly depleted and where rooting depths are sufficient to access the water table. The relatively significant measured depth to groundwater in the shallow strata along these water courses, being in the order of 10 to 17 m below ground level (CDM Smith, 2021), suggests limited widespread terrestrial GDE access to the saturated water table. This significant depth to the groundwater table suggests the vegetation species present mainly only access residual soil moisture above the water table but not the water table itself, and are therefore unlikely to be GDEs even when the unsaturated soil water reservoir is depleted.

2.6 Conceptual Groundwater Model

A schematic conceptual hydrogeological model of the Project area is presented as **Figure 2**. There are two main aquifer units identified, one associated with the shallow alluvial deposits present along watercourses and particularly the Isaac River, and one associated with the coal seams of the deeper Permian coal measures. The key components of the conceptualisation are:

Alluvial aquifer

- The main alluvial aquifer is associated with the Isaac River to the distant southwest of the Project. A component of local, shallow groundwater flow may occur within the localised aquifers along tributaries such as North Creek and they would be expected to follow the downstream flow gradient of the creek.
- Groundwater within the alluvium is unconfined and water levels are generally between 10 mbgl and 17 mgbl. This is consistent with a single groundwater level record for the North Creek alluvium (RN182167) which records a groundwater depth of approximately 17 mbgl.
- In the minor tributaries such as North Creek nearer to the Project, surficial clays restrict groundwater recharge, and sufficient rainfall events are required to wet the unsaturated zone within the alluvium above the watertable to result in aquifer recharge.
- North Creek is ephemeral and only flows briefly after rainfall. North Creek is conceptualised as a losing system near to the Project Area when it flows, with seepage of surface water into the underlying alluvium and groundwater recharge likely occurring during flow events. It is considered to have a limited potential to receive any baseflow.

- Discharge from the alluvium will primarily be via evapotranspiration from riparian vegetation growing along the watercourses, and potential throughflow to the downstream alluvium.
- Surface water and subsequent bank storage will most likely undergo evapotranspiration by vegetation around the North Creek area. Bank storage that does not undergo evapotranspiration may percolate through the weathered rock layer and eventually recharge the deep groundwater. The low hydraulic conductivity of the underlying aquifer (i.e. claystone, siltstone and sandstone) will likely restrict the rate of downward leakage to the underlying formations.

Permian coal measures

- Regional groundwater flow for the Permian coal measures is southeast, following the flow direction of the Isaac River and North Creek. Locally, the groundwater flow contours are highly modified and indicate flow is west towards the Daunia mine pits (due to mine dewatering) and southeast.
- Recharge to the Permian coal measures occurs where it outcrops or sub crops. Vertical movement of groundwater is restricted by the confining interburden layers and may only locally occur along fault structures.
- Groundwater discharge occurs via evaporation and extraction from active mining in the area.

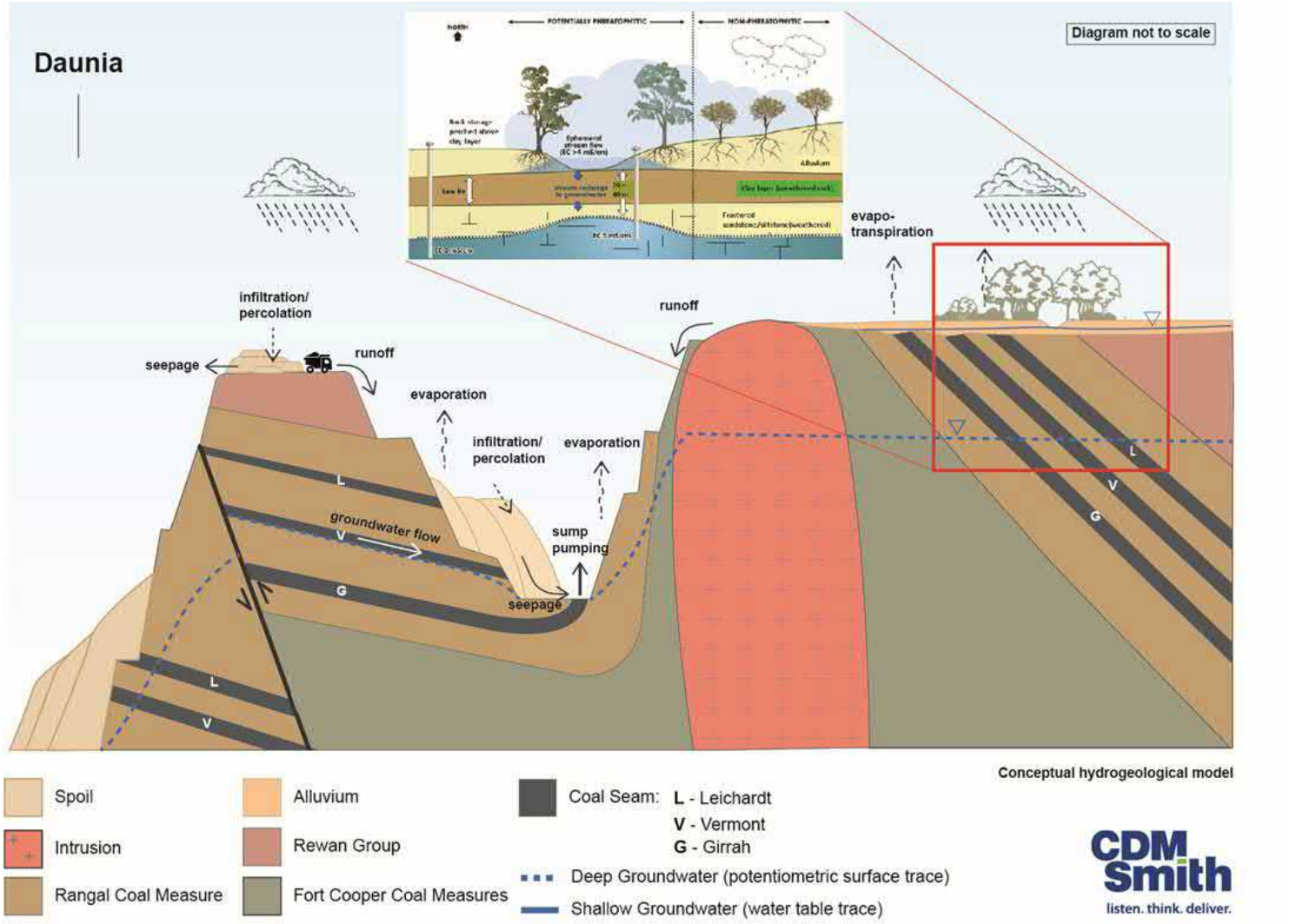


Figure 2 Conceptual Hydrogeological Model (CDM Smith, 2021)

3 Predicted Groundwater Impacts

3.1 Overview of Potential Impacts and Contamination Sources

The proposed Project activities having a potential to affect groundwater can be summarised as:

- Open pit mining and underground highwall mining; Excavation of the coal mine pit and subsequent high wall mining of coal seams down to a low point of approximately 140 mbgl and an elevation of around 89 mAHD, with the potential to disrupt local groundwater flow in the Rangal Coal Measures strata;
- Mine dewatering through sump pumping; Dewatering of the pit and highwall worked areas through sump pumping and pit base drainage systems will lead to a cone of depression being formed in the Rangal Coal Measures and underlying Fort Cooper Coal Measures strata. Groundwater levels will decline approximately 100 m below their current position immediately adjacent to the proposed pit;
- Backfilling of the mine void with waste rock; Backfilling of the pit at the end of mining to surface level will generate an area of different permeability and storage properties from the current undisturbed strata in the area above the pre-mine water table elevation;
- Waste rock storage; Construction of a waste rock dump immediately east and northeast of the proposed pit, which provides a potential source of seepage impacted recharge;
- Sediment pond construction; Construction of two sediment ponds to the northeast and northwest of the proposed pit to receive surface water drainage, which provides a potential source of seepage impacted recharge; and
- Hazardous goods and materials stores; Accidental spillage of fuels, lubricants or chemicals from fuel storage or plant and machinery operating on site.

3.2 Numerical Groundwater Model

To support the Project's EA application and evaluate the potential impacts described above, numerical groundwater modelling was undertaken by CDM Smith (2021) to:

- predict the potential drawdown effect due to the proposed mine dewatering, including the cumulative effect from the adjacent Daunia mine and the effect on nearby surface water features;
- predict potential groundwater inflows to the proposed Project mine pit;
- predict the potential effect of seepage recharge from the proposed waste rock dumps (WRD); and
- predict groundwater system recovery and potential long term changes in the groundwater system after the cessation of mining.

The 3D sub-regional scale numerical groundwater model was constructed using the MODFLOW-USG software. The model domain, also referred to as the EA application's groundwater study area, is shown on **Figure 3**. This model incorporated the latest hydrostratigraphic data available for the Project and surrounds at the time of the EA application, and captures the key physical processes based on the hydrogeological conceptualisation developed for the EA application. The model was calibrated to historical groundwater level observations using a combination of manual and automated techniques, which enables the calibration to be undertaken in a transparent and systematic manner whilst ensuring the model to be hydrogeologically and conceptually sound. The calibration was considered satisfactory, especially near the proposed mine pit, given the data availability in the study area and model simplifications.

3.3 Predicted Impacts

The impacts on groundwater from the development, operation, closure and post-closure of the Project were evaluated using the numerical groundwater model.

Mining at the Project will create a mine void up to approximately 140 m deep and with a worked seam base about 100 m below the current groundwater level. Mining will result in very local dewatering of the Permian coal measures strata immediately around the pit as groundwater inflow is captured by the pit, and a cone of depression of groundwater levels around the mine pit will develop. A peak dewatering rate of 0.39 ML/d is predicted at Mine Year 4. Dewatering will be managed through pumping from pit base sumps if inflows are substantial enough, otherwise evaporation may be sufficient to manage groundwater inflows from the highwalls and endwalls. Pit dewatering has the potential to impact the local groundwater system by creating a new groundwater sink that will combine with the cone of depression already developed around Daunia mine. The impact of dewatering will diminish after closure because backfilling of the pit will allow groundwater levels to recover.

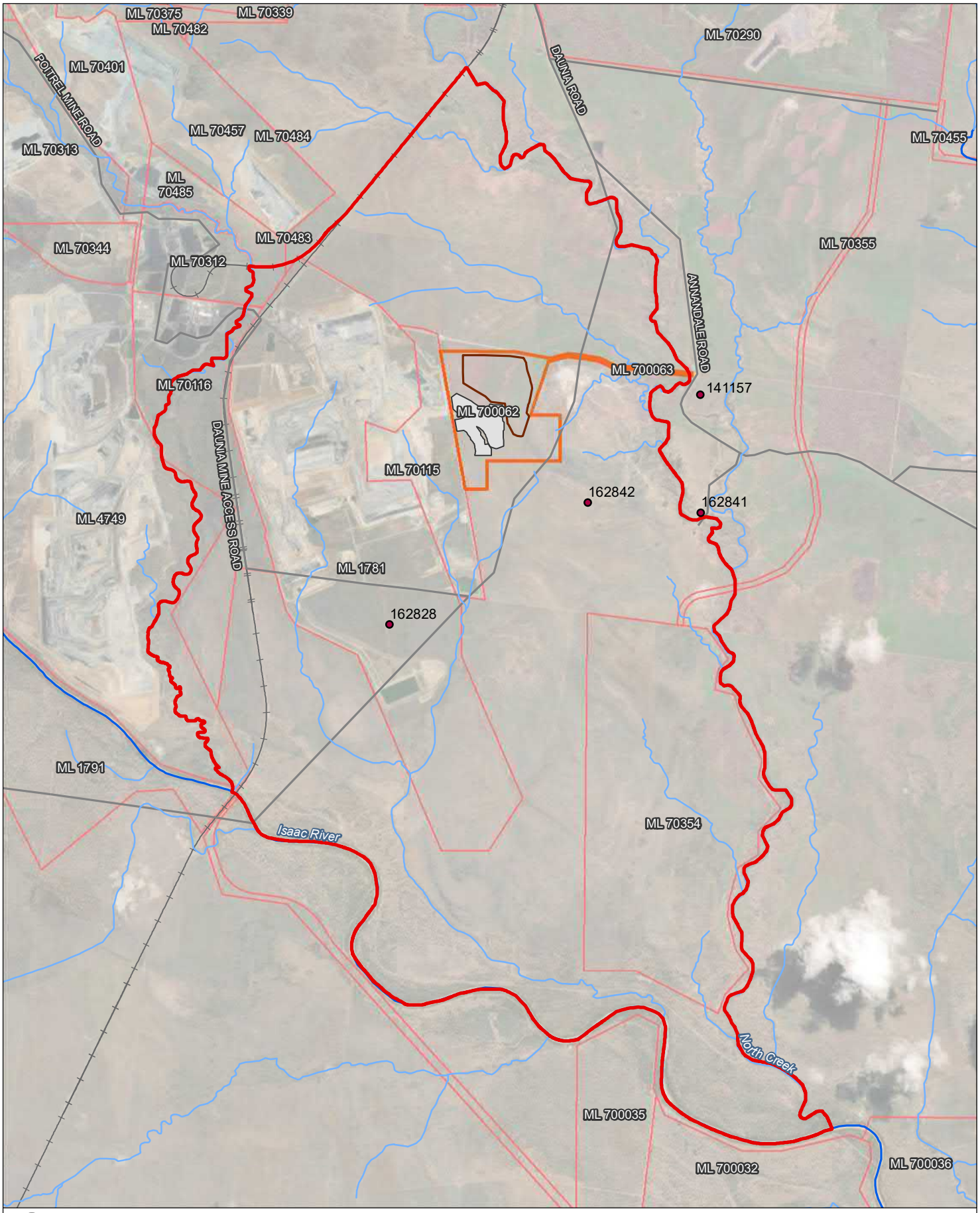
3.3.1 Impacts on Groundwater Levels

The predicted groundwater level drawdown contours after the five years of Project mining and associated mine pit dewatering are shown on **Figure 4** for the shallow weathered bedrock and alluvium/colluvium, and **Figure 5** for the Permian coal seams. These show a predicted drawdown of up to 20 m in the area of the proposed pit. The granitoid intrusion in the eastern third of the Project forms a low permeability barrier to groundwater flow and limits drawdown propagation to the east. At the end of mining (i.e. after 5 years of the Project), the drawdown impact is not predicted to reach the closest surface water feature, North Creek, and remains more than 5 km distant from the Isaac River at its nearest point.

3.3.2 Impacts to Third Party Bores

Drawdown in bores of 2 m or more in the alluvium, and 5 m or more in the Permian strata, is generally considered to have a potential material impact on supply bore yield in accordance with the relevant *Water Act 2000* (Water Act) Chapter 3 bore trigger thresholds for unconsolidated and consolidated aquifers, respectively.

Four registered groundwater bores that are potentially utilised for water supply have been identified within 5 km of the Project based on a search of the Queensland Government registered bore database (CDM Smith, 2021) (**Table 1** and **Figure 5**). They are all considered likely to draw water from the Permian coal measures based on the available information, meaning that the 5 m Water Act bore trigger threshold would be applicable to all four bores. As shown in **Table 1**, only one of the bores is likely to be subject to any Project-related drawdown impact, with approximately 2 m of predicted drawdown (i.e. less than the relevant Water Act bore trigger threshold). Given the magnitude of predicted drawdown at this bore in relation to the bore trigger threshold, it is considered unlikely that the Project would cause significant loss of water supply capacity at the bore.



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55
Scale: 1:85,000 at A4
Project Number: 620.30757
Date: 15-Jul-2022
Drawn by: NT

- Major Watercourse
- Minor Watercourse
- Road
- Rail
- Mining Lease (Approved)
- Project Mining Lease (Application)
- Waste Rock Dump Extent
- Pit Extent
- Study Area (Model Domain)
- Registered (Probable) Water Supply Bore

ISAAC RIVER PROJECT

Groundwater Study Area

SLR

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

FIGURE 3

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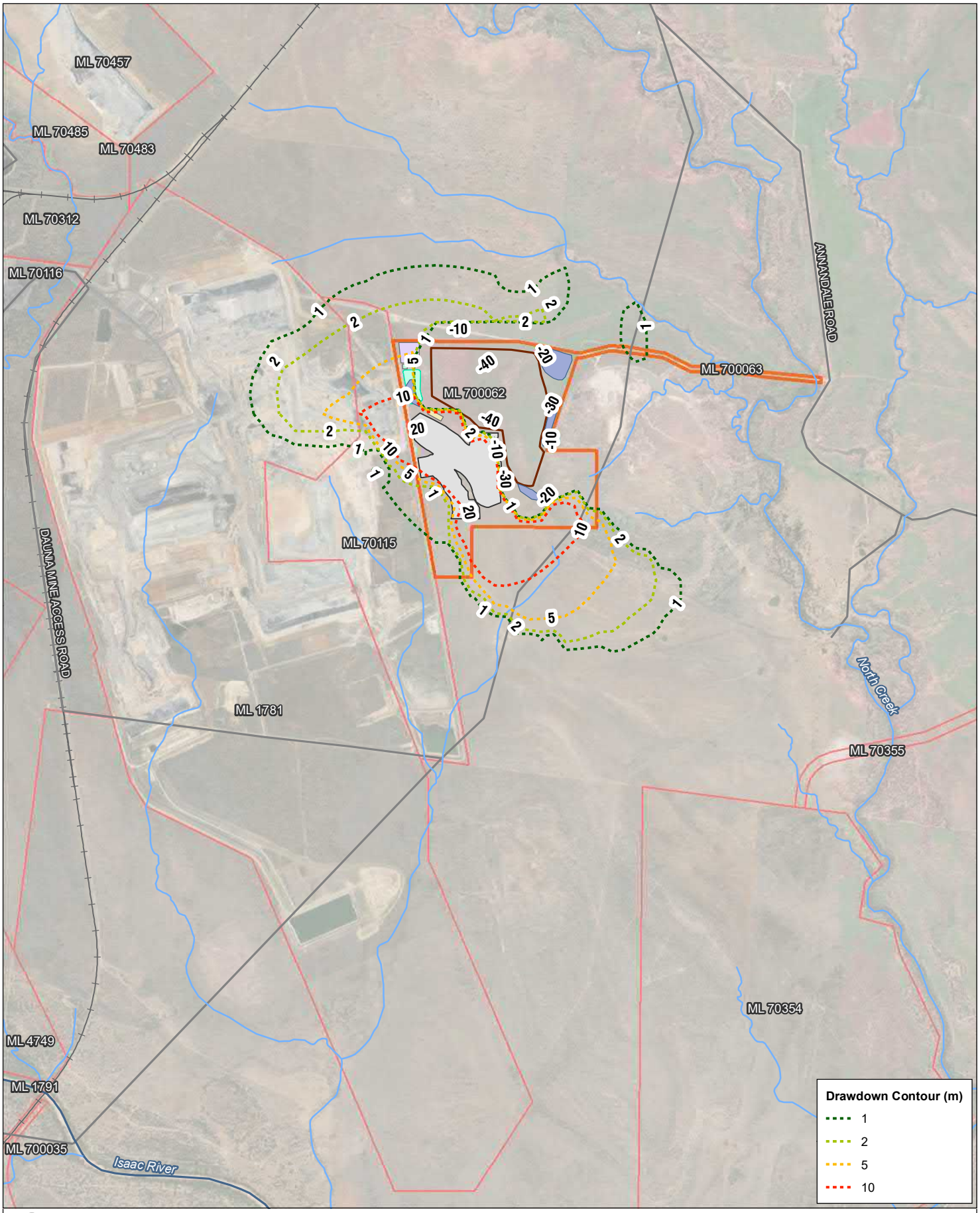
Table 1 Registered potential groundwater use bores

Registered No. (RN)	Distance from Project Centre (km)	Easting (GDA94)	Northing (GDA94)	Likely Source Aquifer	Predicted Project-related Drawdown (m)
162842	2.1	637684	7558650	Permian Coal Measures	~2.0
141157	3.1	639587	7560479	Permian Coal Measures	None
162841	3.6	639594	7558477	Permian Coal Measures	None
162828	4.3	634323	7556584	Permian Coal Measures	None



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.30757
Date:	12-Jul-2022
Drawn by:	NT

- Major Watercourse
- Minor Watercourse
- Road
- Rail
- Mining Lease (Approved)
- Project Mining Lease (Application)
- MIA Water Supply Dam
- Mine Facilities Area
- Sediment Dam
- Mine Water Dam
- ROM Pad
- Waste Rock Dump Extent
- Pit Extent

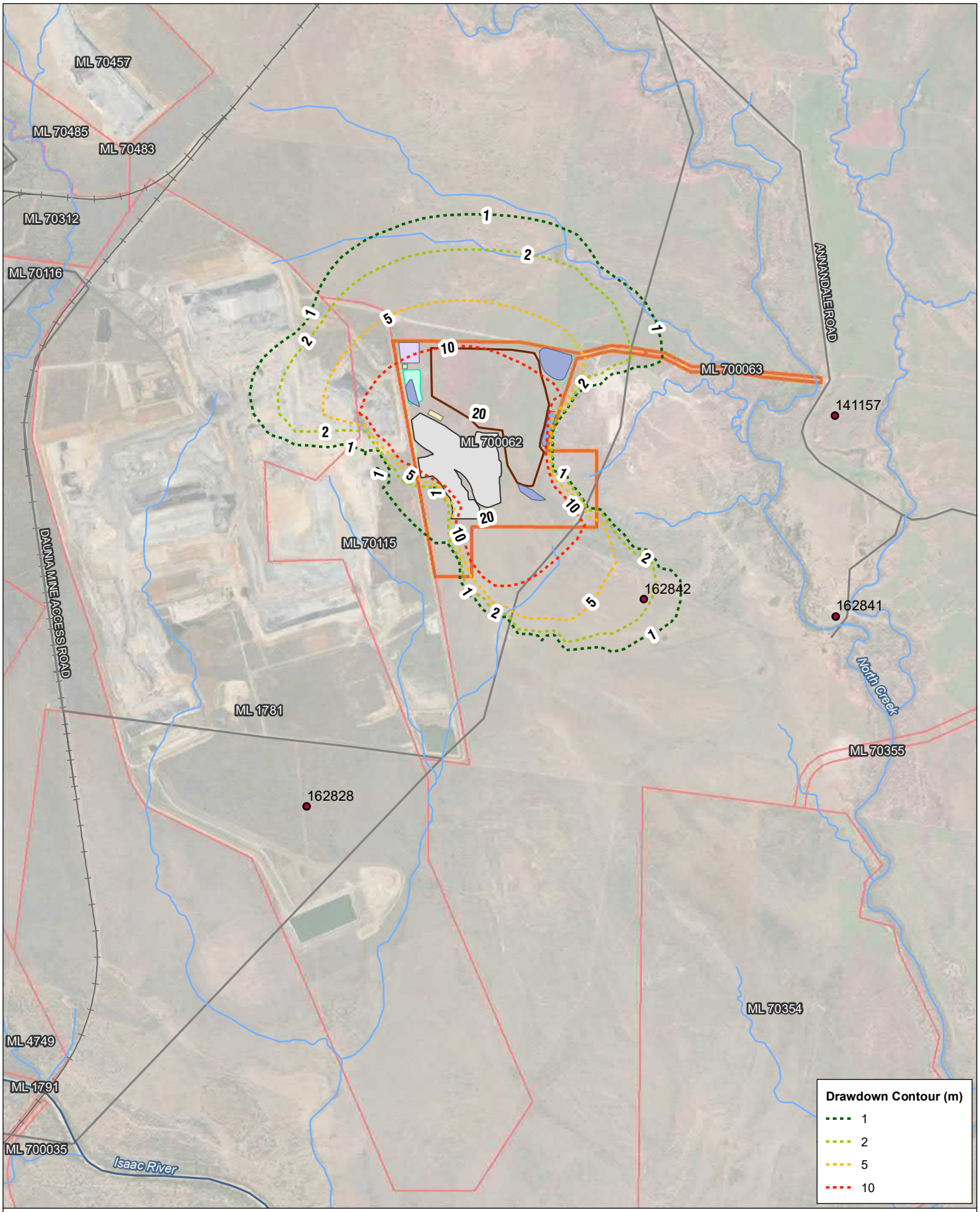
Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

ISAAC RIVER PROJECT

Predicted Groundwater Drawdown
Shallow Aquifers
Mine Year 5 (End of Mining)

FIGURE 4

H:\Projects-SLR\620-BNE\620.30757.00000 Isaac River Coal Project Groundwater\03 SLR Data\01 GIS\GIS\GMMP\SLR620307S7_F03_Drawdown_Regolith_Year5.mxd



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.30757
Date:	12-Jul-2022
Drawn by:	NT

- Major Watercourse
- Minor Watercourse
- Road
- Rail
- Mining Lease (Approved)
- Registered (Probable) Water Supply Bore
- Project Mining Lease (Application)
- MIA Water Supply Dam
- Mine Facilities Area
- Sediment Dam
- Mine Water Dam
- ROM Pad
- Waste Rock Dump Extent
- Pit Extent

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

ISAAC RIVER PROJECT

Predicted Groundwater Drawdown Permian Coal Measures Mine Year 5 (End of Mining)

FIGURE 5

H:\Projects-SLR\620-BNE\620.30757.00000 Isaac River Coal Project Groundwater\03 SLR Data\01 GIS\GIS\GMMP\SLR620307S7_F04_Drawdown_Permian_Year5.mxd

3.3.3 Impacts on Groundwater Quality

Groundwater drawdown in the Permian strata as a result of the Project mine pit is unlikely to affect groundwater quality. Furthermore, the zone of influence on groundwater levels both during and after mining will result in a hydraulic gradient towards the pit meaning that thatgroundwater will drain into the mine void, including any quality impacted groundwater.

Waste rock dumps are considered unlikely to affect groundwater quality beyond ML 700062. Model predictions of groundwater flow during mining indicate that seepage through the waste rock materials will drain back into the mine pit during mine operations and recovery after closure following backfilling of the pit and then, ultimately, towards the Daunia mine pits. Furthermore the low hydraulic conductivity of the strata in the Project area will restrict infiltration rates and any impact is likely to be low and contained to the area immediately around potential seepage sources such as waste rock dumps or surface water capture ponds.

The main threat to groundwater quality during mining was determined to be from any spills of potentially contaminating substances such as hydrocarbon fuels. This will be addressed by good housekeeping practices and containment of hydrocarbons and other hazardous materials in appropriately designed and constructed stores.

3.3.4 Impacts on Groundwater Dependant Ecosystems

The above information suggests that it is very unlikely that there are GDEs located in areas that might be impacted by the Project's effects on the groundwater system. Regardless, to understand the potential impact to any riparian vegetation GDEs along the banks of North Creek and Isaac River, the Project's numerical model was interrogated to understand how the groundwater levels at these features might change as a result of the Project.

The results indicate the change in groundwater level over time at the Isaac River is likely to be negligible (very close to zero for the entire model simulation). The change in groundwater level over time at North Creek is predicted to be less than 1 m over most of the simulation period, only reaching 1 m drawdown for approximately one year close to the end of Project mining. It is unlikely that this short-lived 1 m drawdown in shallow groundwater will impact the potential riparian vegetation GDEs associated with North Creek, given the tolerance of these tree species to prolonged drought conditions and existing mining impacts (particularly from the nearby Daunia mine).

Section 4.4 presents a full discussion on the potential for GDEs near to the Project, including the potential for impacts to those GDEs.

4 Groundwater Management and Monitoring Program

4.1 Overview

The establishment and implementation of the GMMP will evolve and respond to the various stages of the mining project, i.e. the groundwater monitoring program will be reviewed to ensure the program remains relevant for the different project phases including pre-mining, construction, operations, and post closure activities.

The GMMP for the Project includes procedures and processes required to determine and assess the hydrogeological regime and document the associated EA impact criteria (trigger levels) for contaminants and groundwater levels, which will be used to assess the mining activities potential impacts on groundwater resources.

The initial stage of the GMMP development involves:

- Preparing the GMMP;
- Obtaining approval from the relevant regulatory agencies for the GMMP;
- Including the relevant EA Conditions in the GMMP;
- Collecting representative groundwater level measurements and groundwater quality samples from each aquifer or groundwater unit identified as potentially impacted (directly and indirectly) by mining activities, at locations specified in the GMMP;
- Collecting groundwater level measurements sufficient for the determination of the pre-mining baseline groundwater levels required by EA Condition D10; and
- Identifying natural fluctuations and trends in groundwater levels and hydrochemistry.

The GMMP has been developed for the Project to detect any changes to groundwater quantity or quality due to mining activities. Data collected as part of the GMMP will:

- Be collected in accordance with the Project's approved EA;
- Be collated into annual reviews of groundwater monitoring that include an assessment of the monitoring networks suitability for ongoing monitoring, for submission to the EA's administering authority in accordance with EA Condition D5;
- Be used in the continued groundwater impact assessment for the Project;
- Enable verification and refinement of the groundwater modelling predictions from the Project's groundwater model; and
- Be collated and recorded into an environmental monitoring database and be made available to the EA's administering authority on request.

Groundwater monitoring and sampling will be conducted by a suitably qualified and experienced professional in accordance with relevant industry guidelines and practices.

Post-mining groundwater monitoring will be subject to detailed closure/relinquishment conditions in accordance with the Project's progressive rehabilitation and closure plan (PRCP). It is expected that during the operational phase of the Project, the groundwater data collected will assist towards more accurate predictions of the long term recovery of the aquifers, which can be used to assist in the development and implementation of the closure strategy and the refinement of post-mining groundwater monitoring programs.

Monitoring network details are provided in **Section 4.2**. Monitoring protocols are discussed in **Section 4.3**. Groundwater impact triggers and investigation protocols are discussed in **Section 5**.

4.2 Monitoring Network Details

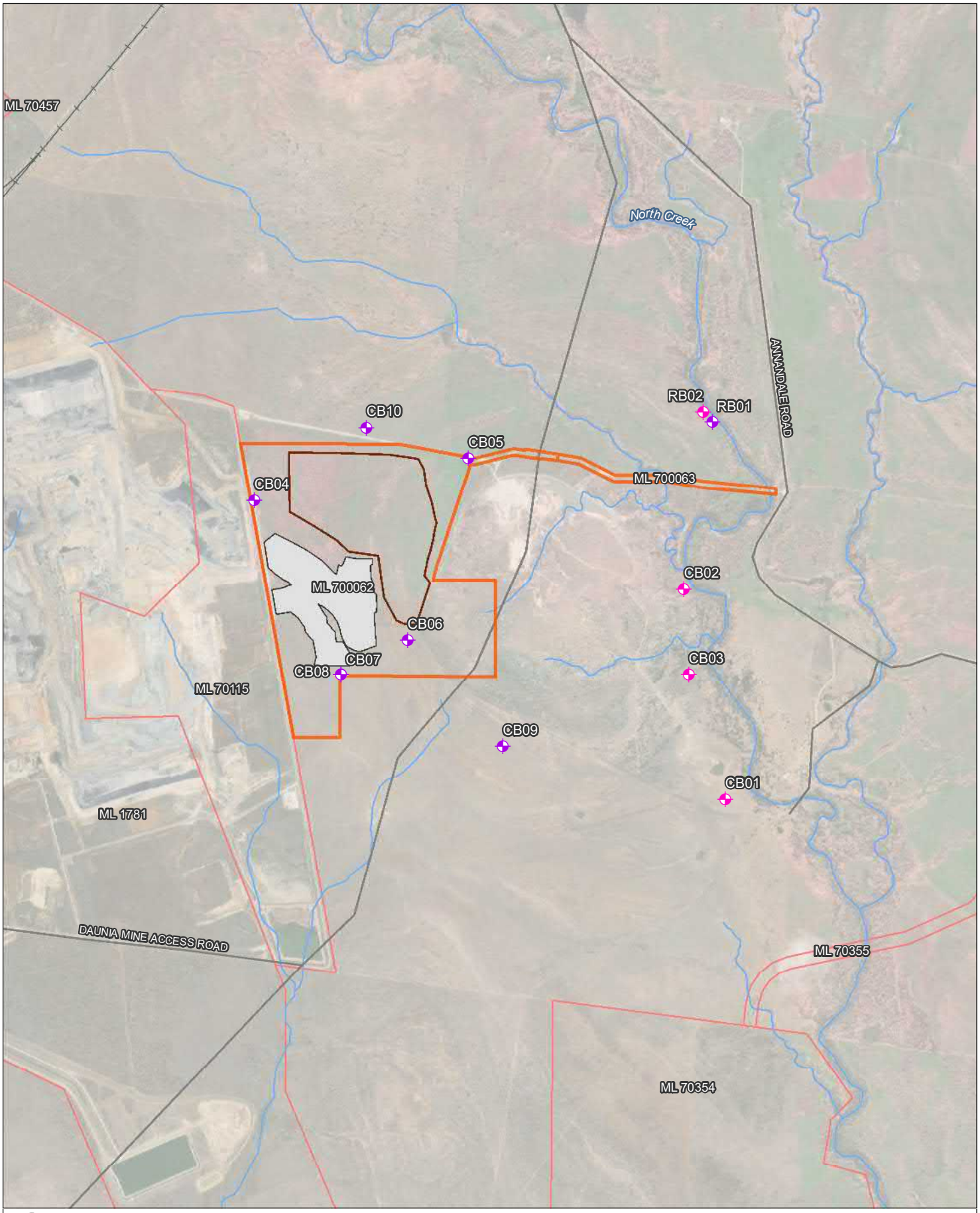
The Project groundwater monitoring network is defined in **Table 2** and the locations of the monitoring bore network are shown on **Figure 6**.

Table 2 Monitoring Bore Network Details

Bore ID	Monitored Unit	Easting (GDA94)	Northing (GDA94)	Surface RL (mAHD)	Screening Interval (mbgl)	Bore Type	Environmental Value Monitoring
RB01	Rangal Coal Measures	638937[1]	7561395[1]	218.1[1]	30-70[1]	Reference	Groundwater
RB02	North Creek Alluvium	638864[1]	7561470[1]	203.6[1]	10-30[1]	Reference	Riparian ecosystem
CB01	North Creek Alluvium	639039[1]	7558386[1]	218.1[1]	10-30[1]	Compliance	Riparian ecosystem
CB02	North Creek Alluvium	638709[1]	7560060[1]	201.6[1]	10-30[1]	Compliance	Groundwater
CB03	North Creek Alluvium	638748[1]	7559377[1]	203.6[1]	10-30[1]	Compliance	Groundwater
CB04	Rangal Coal Measures	635285[1]	7560768[1]	223.5[1]	20-40[1]	Compliance	Groundwater
CB05	Rangal Coal Measures	636991[1]	7561100[1]	216.8[1]	20-40[1]	Compliance	Groundwater
CB06	Rangal Coal Measures	636508[1]	7559654[1]	227.1[1]	20-40[1]	Compliance	Groundwater
CB07	Rangal Coal Measures	635970	7559367	217.5	45.2-51.2	Compliance	Groundwater
CB08	Rangal Coal Measures	635970	7559367	217.5	73-79	Compliance	Groundwater
CB09	Rangal Coal Measures	637264[1]	7558807[1]	221.0[1]	20-40[1]	Compliance	Potential groundwater user
CB10	Rangal Coal Measures	636177[1]	7561348[1]	218.9[1]	20-40[1]	Compliance	Groundwater

[1] To be confirmed following bore installation

The groundwater bores specified in **Table 2** will be installed within six (6) months of the commencement of mining activities in accordance with EA Condition D18.



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	620.30757
Date:	12-Jul-2022
Drawn by:	NT

- Major Watercourse
- Minor Watercourse
- Road
- Rail
- Mining Lease (Approved)
- Project Mining Lease (Application)
- Waste Rock Dump
- Mine Pit

Project Monitoring Bore

- North Creek Alluvium
- Rangal Coal Measures

SLR

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

ISAAC RIVER PROJECT

Monitoring Bore Network

FIGURE 6

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To ensure that the construction, maintenance and management of the groundwater monitoring network is undertaken in a manner that prevents or minimises impacts to the environment and ensures the integrity of the bores to obtain accurate monitoring (i.e. to ensure compliance with EA Condition D17), the groundwater monitoring network will:

- be installed and maintained under the supervision of a person appropriately qualified and experienced in the fields of hydrogeology and groundwater monitoring program design to competently make recommendations about these matters; and
- be constructed in accordance with methods prescribed in the latest edition of the 'Minimum Construction Requirements for Water Bores in Australia' by an appropriately qualified and licensed water bore driller.

The monitoring network contains sufficient monitoring points in terms of spatial distribution across all formations of interest to develop a sufficient understanding of pre-mining groundwater conditions. A process of continual review and improvement of the monitoring network via the possible expansion of the initial network during mining (i.e. where deemed necessary following the groundwater monitoring annual review, refer **Section 7.1**) will ensure the network remains appropriate for the ongoing identification and management of groundwater impacts from the Project.

Routine monitoring during the mining operation will provide early warning of any variation in response of the groundwater system to that predicted. This will enable BCC to undertake mitigation measures to minimise impact on surrounding groundwater users and the environment, such as the implementation of make-good measures.

4.3 Monitoring Protocols

4.3.1 Overview

Groundwater monitoring and sampling will be conducted in accordance with the Queensland Department of Environment and Science (DES) Monitoring and Sampling Manual (2018), or subsequent updated versions, and the Australian/New Zealand Standard (AS/NZS) 5667.11:1998 for water quality – sampling Part 11 guidance on sampling groundwater.

4.3.2 Personnel Qualifications

Groundwater monitoring and sampling will be conducted by a suitably qualified and experienced professional.

4.3.3 Groundwater Quality

4.3.3.1 General

Groundwater quality sampling will be undertaken in accordance with the protocols and QA/QC procedures outlined in:

- Australian Standard AS/NZS 5667.11:1998 Water quality – Sampling – Guidance on sampling of groundwaters;
- Groundwater Sampling and Analysis—A Field Guide (Geoscience Australia, 2009); and
- Department of Environment and Science (DES) Monitoring and Sampling Manual – Version 2 (June 2018).

Field measurement of water quality parameters will be undertaken using appropriate field equipment that is maintained and calibrated in accordance with the manufacturer's recommendations (see **Section 6.1.2**).

Groundwater sample analysis will continue to be undertaken by a laboratory accredited by the National Association of Testing Authorities (NATA) (see **Section 6.2**). The sample analysis will include duplicates and blanks consistent with industry standard QA/QC procedures (see **Section 6.1.5**).

Further detail on sampling protocol is provided in **Section 6**.

4.3.3.2 Parameter Suite

As described in **Section 3.3**, impacts on groundwater from the Project activities have been identified primarily as drawdown. Groundwater level drawdown has the potential to affect groundwater quality where changes in groundwater flow directions or velocities moves groundwaters of different quality into different areas of the hydrogeologic system. Groundwater level drawdown also has the potential to result in oxidation of the desaturated aquifer matrix, potentially resulting in acidic conditions (where acid forming rock is present) and the solution of matrix chemical constituents into groundwater. This oxidation effect may also occur within overburden spoil dumps associated with the Project. At a single monitoring bore location, these potential groundwater quality changes may manifest as one or a combination of:

- changes to groundwater salinity (measured as electrical conductivity (EC) or Total Dissolved Solids (TDS);
- changes to groundwater pH;
- modification of the ionic composition of the groundwater; and
- changes to the concentration of metal and metalloids in groundwater (particularly where reduced groundwater pH results from the oxidation of acid forming material).

Other potential groundwater quality impacts from Project activities, as identified in **Section 3.3**, include spills of potentially contaminating substances such as hydrocarbon fuels, and to a lesser extent the introduction of poorer quality water to the groundwater system from potential surface seepage sources such as waste rock dumps or surface water capture ponds.

The groundwater quality parameter suite in this GMMP has therefore been selected to detect these potential changes in groundwater, with consideration of the identified potentially relevant Environmental Values discussed in **Section 2.5**. The groundwater quality parameter suite comprises:

- Physico-chemical Parameters
    - Salinity as EC (field measured) and TDS (laboratory)
    - pH (field measured)
    - Temperature (field measured for interpretive purposes only)
- Major Ions (laboratory)
    - Sodium (Na)
    - Calcium (Ca)
    - Potassium (K)
    - Magnesium (Mg)
    - Chloride (Cl)

  - Sulphate (SO_4)
  - Bicarbonate (HCO_3)
  - Carbonate (CO_3)
- Metals and Metalloids (laboratory)
  - Aluminium (Al)
  - Arsenic (As)
  - Molybdenum (Mo)
  - Selenium (Se)
- Hydrocarbons (laboratory)
  - Total Recoverable Hydrocarbons (TRH) C6-C9
  - Total Recoverable Hydrocarbons (TRH) C10-C36

4.3.4 Groundwater Levels

Groundwater level monitoring will involve a manual water level measurement to the nearest 0.5cm at each bore using a conventional groundwater level monitoring e-tape.

Groundwater levels will be measured from the same surveyed datum point on every occasion (prior to groundwater purging / sampling), with the datum clearly recorded e.g. “XX.XX m btoc” (metres below top of PVC casing).

Any discrepancies observed between the measurements for a particular monitoring event and the prior event will be immediately investigated via a repeat measurement where necessary.

Any bore condition defects will be recorded (blockages, damaged monument / cover etc), with a view to reviewing the need to investigate or repair defects or replace bores as required.

4.3.5 Monitoring Frequency

Groundwater level and quality monitoring events will be undertaken at the frequencies specified in **Table 3**, consistent with EA Condition D1.

Table 3 Monitoring Frequency

Monitoring Parameter	Monitoring Frequency
Standing water level (SWL)	Quarterly
Groundwater Quality (all parameters)	Quarterly

4.3.6 Groundwater Data Management

The data gathered from the groundwater monitoring program will be collated into a database managed by BCC Environmental Department site personnel. The data management system will include:

- a site plan showing sample locations;
- tabulated results of the monitoring compared with applicable background/trigger levels;

- all data collected during each monitoring round;
- a record of chain of custody of the samples from sampling through to analysis;
- laboratory analysis certificates;
- groundwater monitoring program reports, and
- a description of the procedures, methods and calculations used.
    - Any other relevant notes for the monitoring event including bore defects

Further detail is provided in **Section 6.3**.

4.4 Groundwater Dependant Ecosystem Monitoring

4.4.1 Overview

Groundwater dependant ecosystems may access groundwater on a permanent (obligate) or intermittent (facultative) basis to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services (Doody *et al.*, 2019).

National scale desktop mapping of potential GDEs is available in the Bureau of Meteorology (BoM) National Atlas of GDEs (GDE Atlas). The GDE Atlas provides three classifications of land areas that have the potential to contain GDEs based on the desktop assessment used to compile the GDE Atlas:

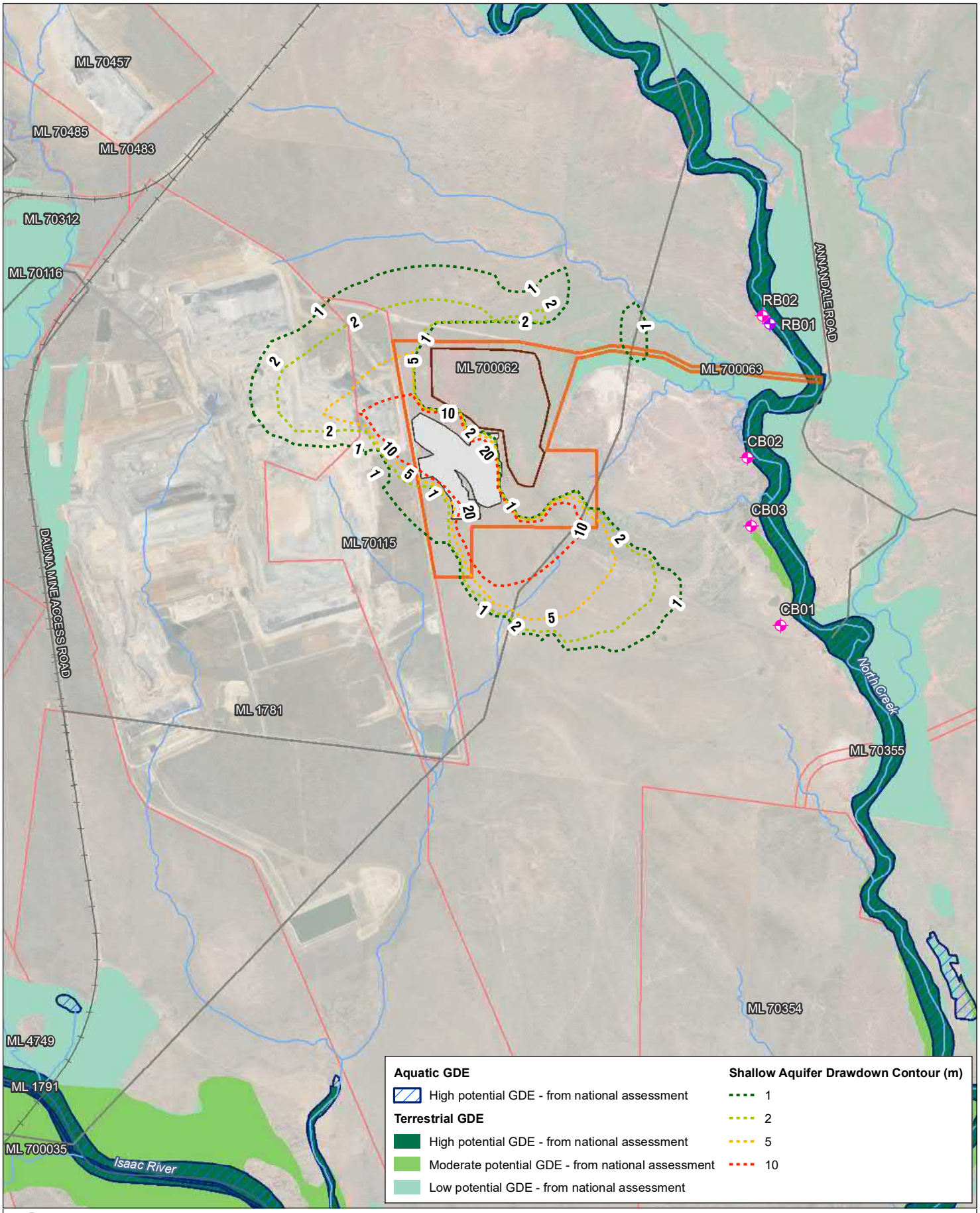
- High potential for groundwater interaction (indicating a strong possibility the ecosystem is interacting with groundwater);
- Moderate potential for groundwater interaction; or
- Low potential for groundwater interaction (indicating it is relatively unlikely, but still possible, the ecosystem will be interacting with groundwater and will include ecosystems that are not interacting with groundwater).

4.4.2 Potential GDEs adjacent the Project

Potential GDEs are mapped in the vicinity of the Project to the east, particularly associated with North Creek 2.5 km to the east of the Project's pit (**Figure 7**). The BoM GDE Atlas identifies North Creek to be associated with low, moderate and high confidence potential terrestrial GDEs, and high confidence aquatic GDEs. Additionally, the eastwards flowing minor unnamed tributary of North Creek that traverses the north-eastern extent of the Project Area is also identified as a low confidence potential terrestrial GDE.

The Project's EAR (CDM Smith, 2019) found that:

- Surface expression (aquatic) GDEs, such as wetlands or springs containing aquatic species reliant on groundwater baseflow contributions, are unlikely to be present.
- There is a potential for subsurface expression (terrestrial) GDEs to occur associated with riparian vegetation accessing alluvial groundwater along the banks of the water courses, mainly RE 11.2.35 Forest Red Gum and River Red Gum species.



0 0.5 1 km

Major Watercourse
Minor Watercourse
Road
Rail
Mining Lease (Approved)
Project Mining Lease (Application)
Waste Rock Dump
Mine Pit

GDE Monitoring Bore
North Creek Alluvium
Rangal Coal Measures

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.30757
Date:	12-Jul-2022
Drawn by:	NT

SLR

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

ISAAC RIVER PROJECT

Monitoring Bore Network GDE Bores

FIGURE 7

H:\Projects-SLR\620-BNE\620.30757.00000 Isaac River Coal Project Groundwater\03 SLR Data\01 GIS\GIS\GMMP\SLR620307S7_F06_GDEs.mxd

- The sensitivity of the RE 11.2.35 species to changes in groundwater that might arise from mining activities is considered to be low, based on their ability to tolerate extended drought conditions and an assessment of aerial imagery for six open-cut mines in the region, which indicates these vegetation communities have not shown signs of die-back since mines began operation, suggesting a tendency for being vadophytic rather than phreatophytic, noting that some of the regional mines have operated since the 1980s.

North Creek is highly ephemeral and conceptualised as a predominantly losing watercourse i.e. when it does flow it loses water via infiltration through the creek bed. Studies at nearby mines have found that groundwater levels in the alluvial aquifers associated with the ephemeral creeks and the Isaac River are consistently lower than the surface water elevations, thus demonstrating losing stream conditions during periods when the watercourses flow (i.e. the streams are not baseflow fed). Whilst the data is currently limited to demonstrate this for North Creek (CDM Smith, 2019) identified that there is no long term stream gauge data available for North Creek or timeseries groundwater level data. A single groundwater level record for the North Creek alluvium records a groundwater depth of approximately 17 mbgl, which also suggests groundwater does not interact with the watercourse. That is, the depth of groundwater suggest that groundwater does not support the potential GDEs mapped in North Creek.

Additionally, the Project's groundwater impact predictions show that groundwater drawdown of 1m or more in the shallow strata resulting from the Project mining activities does not reach North Creek or the potential GDEs mapped there (refer **Figure 7**). Only the low confidence potential terrestrial GDE associated with the minor unnamed tributary that traverses the north-eastern extent of the Project Area is predicted to be subject to shallow groundwater drawdown of approximately 1m as a result of the Project. Overall, the predictions indicate very limited potential for Project related impacts to any potential GDEs that may be present east of the Project and on North Creek.

4.4.3 GDE Monitoring Program

Regardless of the above information that suggests impacts to GDEs from the Project are unlikely, this GMMP includes a component of GDE monitoring given that potential GDEs are mapped at North Creek within 2.5 km of the Project's mining pit.

The Project groundwater monitoring network includes a subset of riparian ecosystem monitoring bores, to be installed in the alluvium associated with North Creek that might be accessed by the terrestrial vegetation, to monitor for impacts extending beyond the predicted extent of impacts towards the mapped GDEs (refer **Figure 7**). The GDE monitoring bores are also identified in **Table 4** below (a subset of the bores listed in **Table 2**).

Groundwater impact triggers and investigation protocols as set out within are discussed in **Section 5**.

Table 4 GDE Monitoring Bore Details

Bore ID	Monitored Unit	Easting (GDA94)	Northing (GDA94)	Surface RL (mAHD)	Screening Interval (mbgl)
RB01	Rangal Coal Measures	638937[1]	7561395[1]	218.1[1]	30-70[1]
RB02	North Creek Alluvium	638864[1]	7561470[1]	203.6[1]	10-30[1]
CB01	North Creek Alluvium	639039[1]	7558386[1]	218.1[1]	10-30[1]
CB02	North Creek Alluvium	638709[1]	7560060[1]	201.6[1]	10-30[1]
CB03	North Creek Alluvium	638748[1]	7559377[1]	203.6[1]	10-30[1]

[1] To be confirmed following bore installation

4.5 Surface Water Storages

The Project's mine water management strategy includes two main surface water storages, Sediment Dam 1 (SD1) and Mine Water Dam 1 (MWD) located on ML 7000062 (CDM Smith, 2021). The MWD is the primary water supply source for Project operations including dust suppression and stockpile sprays. Mine-affected water coming from the Mine Industrial Area, haul roads, ROM coal pad, rejects storage area, and pit dewatering will be collected and will report to the MWD. SD1 will capture rainfall runoff from the waste rock spoil dump areas. The primary function of SD1 is to capture sediment laden runoff for sediment removal. A pumping system will be installed dewatering SD1 to the MWD within a period of 5 days following inflows where the water will be reused.

The detailed design of SD1 and MWD will consider and make provision for the detection and management of seepage where it may result in safety and / or water quality impacts to the receiving environment, as will be documented within the Project's Water Management Plan (WMP). In general, the site water management strategy indicates that mine-impacted water will be of good to moderate quality, having been in contact with coal and / or sediment. The largest amount of seepage is likely to occur within the floor of SD1, resulting in in-detectable to minor increases in contribution to shallow aquifer groundwater. Seepage via the dam wall / embankments is also likely to be filtered and of good to moderate quality. Seepage has been considered in the consequence category of the dams. Site water management will include monitoring, including visual inspections for seepage from embankments, along with Trigger Action Response Plans (TARPs)

The significant cone of depression that will form in the Permian coal measures around the Project's mine pit will exert hydraulic control on the local groundwater system such that any seepage from the Project's surface water storages, that reached the saturated water table, would migrate towards and be captured within the pit. The potential for impacts to the broader groundwater system from seepage out of surface water storages is therefore considered negligible.

Schedule C of the EA includes requirements for the monitoring of water storage quality in SD1 and the MWD within Condition C20 and associated Tables C2, C3 and C7. The parameter suite documented in Tables C2 and C3 contains a comprehensive suite of physico-chemical parameters, metals and metalloids, nutrients and hydrocarbons. This surface water monitoring program, outside the scope of this GMMP, would ensure that the characteristics of any potential seepage to groundwater are known and could be compared to groundwater quality in the unlikely event of seepage out of the surface water storages. The surface water monitoring program is documented within the Project's Water Management Plan (WMP).

5 Groundwater Impact Triggers and Investigation Protocols

5.1 Groundwater Quality

5.1.1 Quality Limits

Groundwater quality limits will be used to identify whether an exceedance has occurred. The groundwater quality limits are shown in **Table 5**, consistent with EA Table D2. The limits were derived in consultation with DES as part of the Project's EA Application (CDM Smith, 2021), using a combination of site-specific baseline monitoring data and environmental values guideline protection criteria.

5.1.2 Investigation Protocols

5.1.2.1 Notification

If groundwater quality results exceed trigger levels set out in **Table 5** at the same monitoring bore location on three (3) consecutive occasions (consistent with EA Condition D8), then the administering authority will be notified by WaTERS with 24hrs of receiving the results for the third consecutive exceedance.

5.1.2.2 Initial Investigation

Within 14 days of the notification to the administering authority, BCC will complete an initial investigation to determine of the exceedance is a result of mining activities; or

a) seasonal/natural variation; or neighbouring land use resulting in groundwater impacts; or

b) any other potential cause not related to the mining activity.

Additional event-based monitoring may be required.

The results of the investigation will be submitted to the administering authority.

5.1.2.3 Further Investigation

If the initial investigation determines that the exceedance was caused by the mining activities, then a further investigation will be completed within twenty-eight (28) days of the initial investigation. This further investigation will determine whether environmental harm has occurred or may occur, and the extent thereof.

If the further investigation determines that environmental harm has occurred, or may occur, the following actions will be completed within twenty-eight (28) days after completing the further investigation:

a) implementation of measures as soon as reasonably practicable to reduce environmental harm including potential environmental harm; and

b) development of long-term mitigation measures to address any existing groundwater contamination and prevent recurrence of groundwater contamination which is implemented in a reasonable time period; and

c) document the steps taken, and provide the documentation to the administering authority.

Table 5 Groundwater Quality Limits

Monitoring Bore	Parameter	pH	EC	Sulfate	Arsenic (dissolved)	Aluminium (dissolved)	Molybdenum (dissolved)	Selenium (dissolved)	TRH* C6-C9	TRH* C10-C36	Major Ions
	Sample	Range	Max	Max	Max	Max	Max	Max	Max	Max	
	Unit	pH units	(µS/cm)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(µg/L)	(µg/L)	
CB01		6.5 – 8.5[A]	990[B]	11[B]	0.014[C]	0.055[E]	0.034[E]	0.005[E]	20[F]	100[F]	No Limits – Interpretation Only
CB02											
CB03											
CB04			12,900[C]	27[C]							
CB05											
CB06											
CB07			11,200[C]	23[C]							
CB08			10,000[C]	62[C]							
CB09			5,500[D]	68[D]							
CB10			12,900[C]	27[C]							

* TRH: Total Recoverable Hydrocarbons

[A] Isaac River Sub-basin EVs and WQOs

[B] Isaac River Sub-basin EVs and WQOs Groundwater Unit 1 (shallow)

[C] Site specific 95%ile

[D] ANZECC stock water WQO

[E] Australian Water Quality Guidelines

[F] Model mining condition limit

5.2 Groundwater Levels

5.2.1 Baseline Groundwater Levels

Baseline (pre-mining) standing water levels for the Project monitoring bore network are yet to be defined (**Table 6**). Consistent with EA Condition D10, pre-mining baseline standing water levels for each bore will be submitted to the administering authority within 12 (twelve) months of the commencement of mining activities, or when sufficient data is available. The baseline water levels will replace the 'TBA' values specified in **Table 6** and EA Table D3 - Groundwater Level Trigger Thresholds. Furthermore, consistent with Condition D11 of the EA, these pre-mining baseline standing water levels will be derived from baseline groundwater monitoring data that includes at least twelve (12) sampling events, one (1) month apart.

Table 6 Baseline Standing Water Levels

Bore ID	Monitored Unit	Baseline Standing Water Level (mAHD)[1]
RB01[2]	Rangal Coal Measures	TBA
RB02[2]	North Creek Alluvium	TBA
CB01	North Creek Alluvium	TBA
CB02	North Creek Alluvium	TBA
CB03	North Creek Alluvium	TBA
CB04	Rangal Coal Measures	TBA
CB05	Rangal Coal Measures	TBA
CB06	Rangal Coal Measures	TBA
CB07	Rangal Coal Measures	TBA
CB08	Rangal Coal Measures	TBA
CB09	Rangal Coal Measures	TBA
CB10	Rangal Coal Measures	TBA

[1] TBA = To Be Assessed

[2]Reference bore; Baseline Standing Water Level for interpretation purposes only

5.2.2 Groundwater Level Triggers

The groundwater level trigger threshold adopted in this GMMP, consistent with EA Table D3 and associated EA Condition D9, sets the maximum groundwater level to:

- 2 m drawdown from pre-mining baseline standing water levels for Compliance bores (refer **Table 6**).

Reference bores do not have level triggers applied.

It should be noted that the EA groundwater level trigger of 2 m drawdown from baseline levels for all monitored formations is not entirely consistent with Chapter 3 of the *Water Act 2000*, which provides the framework for managing impacts on underground water that are associated with resource operations. The framework defines the groundwater level trigger threshold as:

- a 5 m decline for consolidated aquifers (being an aquifer consisting predominantly of consolidated sediment, such as the Rangal Coal Measures); or

- a 2 m decline for unconsolidated aquifers (being an aquifer other than a consolidated aquifer, such as shallow alluvial aquifers).

That is, the adopted groundwater level trigger of 2 m in the GMMP, as specified in the EA, is in terms of Chapter 3 of the *Water Act 2000* relevant only to the North Creek Alluvium in the vicinity of the Project, but not the Rangal Coal Measures. Regardless, the trigger is considered a conservative measure of potential groundwater level impact for the Rangal Coal Measures in the vicinity of the Project.

5.2.3 Investigation Protocols

5.2.3.1 Notification

If groundwater levels breach the level trigger threshold when measured against the pre-mining baseline groundwater levels, then the administering authority will be notified via WaTERS within twenty-eight (28) days of the trigger level breach being detected.

5.2.3.2 Initial Investigation

Within fourteen (14) days of the exceedance, an initial investigation will be completed to determine if the exceedance is a result of:

a) mining activities authorised under this environmental authority; or

b) seasonal/natural variation; or neighbouring land use resulting in groundwater impacts; or

c) any other potential cause not related to the mining activity.

The results of the investigation will be submitted to the administering authority.

5.2.3.3 Further Investigation

As with the groundwater quality triggers if the initial investigation determines that the exceedance was caused by the mining activities, then a further investigation will be completed within twenty-eight (28) days of the initial investigation. This further investigation will determine whether environmental harm has occurred or may occur, and the extent thereof.

If the further investigation determines that environmental harm has occurred, or may occur, the following actions will be completed within twenty-eight (28) days after completing the further investigation:

a) implementation of measures as soon as reasonably practicable to reduce environmental harm including potential environmental harm; and

b) if environmental harm has occurred as a result of groundwater drawdown exceedances,

   i) determine any actions required to reduce the potential for environmental harm; and

   ii) determine any mitigation measures required to limit the drawdown in the affected groundwater resource; and

   iii) document the steps taken and provide the documentation to the administering authority.

6 Quality Assurance / Quality Control

BCC recognises that robust QA/QC procedures are a critical component of the GMMP. QA/QC procedures adopted by BCC in the GMMP will include:

- Field based procedures for:
    - Equipment calibration;
    - Equipment decontamination;
    - Groundwater level measurement methods; and
    - Groundwater quality sampling methods.
- Groundwater quality laboratory-based procedures for:
    - Laboratory accreditation;
    - Sample analysis replication; and
    - Sample quality assurance.
- Data management and data quality assurance procedures.

6.1 Field Procedures

Field procedures have been developed to be compliant with:

- Groundwater Sampling and Analysis—A Field Guide (Geoscience Australia, 2009);
- DES (2018). Monitoring and Sampling Manual: Environmental Protection (Water) Policy. Brisbane: Department of Environment and Science, Queensland Government.
- Australian and New Zealand Standard AS/NZS 5667.1:1998 Water quality - Sampling - Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples (AS/NZS5667).

6.1.1 Qualified Personnel

Groundwater monitoring will be undertaken by appropriately qualified personnel with experience in conducting groundwater monitoring and sampling programs in accordance with the above listed guidelines.

6.1.2 Equipment Calibration

The field water quality meter (i.e. pH, EC and temperature) used during monitoring will be calibrated to the relevant calibration standard solutions daily, and prior to each day's work. Daily calibration records will be recorded in a dedicated register.

6.1.3 Equipment Decontamination

All field equipment used in the execution of the GMMP monitoring program will be thoroughly decontaminated before and after conducting any field measurements and sampling at each and every bore. This decontamination process includes the water level dip meter probe and tape, field water quality meter, and water quality sample pumps and tubing.

6.1.4 Groundwater Level Measurements

Manual groundwater level measurements will be collected prior to any disturbance of the standing water level in any bore e.g. purging for groundwater quality sample collection.

Manual groundwater level measurements will be collected using an industry standard groundwater level e-tape. The e-tape will be checked for operational readiness before each use, including a test of the probe function prior to use in the field. Measurements of the groundwater level will be taken from the top of the PVC casing at each bore, a point permanently marked at the top of the PVC casing at each bore to provide repeatability and consistency between monitoring events.

6.1.5 Groundwater Quality Sampling

6.1.5.1 Bore Purging Procedures

In accordance with the above listed guidelines, appropriate groundwater sampling procedures require that stagnant water standing in the bore casing be purged prior to collection of a groundwater sample, so that the sample is representative of the groundwater within the aquifer screened by the bore. This is due to the fact that the stagnant water in the bore column can become physically and chemically altered from that held within the aquifer. The following purge methods will be adopted during the program depending on the characteristics of each bore being sampled (e.g. bore depth, water column height, and rate of inflow to the bore):

- Three bore volumes/parameter stabilisation via a conventional submersible purge pump; or
- Low-flow sampling using specialised low-flow sampling equipment.

In conventional bore purging prior to sampling, industry standards dictate that a minimum of three bore volumes of groundwater should be purged from the bore prior to sampling. However, BCC will also monitor field water quality parameters of EC, pH, and temperature during purging, and sampling will only be undertaken once parameters have also stabilised in addition to three bore volumes being purged.

6.1.5.2 Field Measurements

Recording of field water quality parameters (i.e. EC, pH, and temperature) will be undertaken using a calibrated field water quality meter to ensure parameter stabilisation prior to sampling. The equipment will be calibrated prior to use as outlined in **Section 6.1.2**.

6.1.5.3 General Sample Collection Procedures

Following confirmation of field parameter stabilisation (EC, pH, and temperature) identifying representative aquifer water is being purged from the bore, groundwater samples will be collected as follows:

- In accordance with the relevant guidelines.
- Field filtered to 0.45 µm (where required e.g. dissolved metals).
- Placed into laboratory supplied bottles containing the appropriate preservative solutions for the analyte suite to be tested.
- Clearly labelled with the Bore ID, sampling date/time and field personnel initials.
- Placed onto ice in a cooler box with ice immediately after sampling for transfer to the analytical laboratory.

Following sampling, all equipment will be cleaned and decontaminated in preparation for moving to the next bore.

6.1.5.4 Sample Duplicates

Duplicate samples are used to check consistency in laboratory analytical processes. Duplicate samples involve the collection of a second set of samples from a bore in an identical manner to the primary samples. The duplicate samples will be tested for the same analytical suite as the primary samples (see **Section 4.3.3.2**). Additionally, duplicate samples will be collected as "blind duplicates", where an alternate naming convention is adopted for the duplicates so that the analytical laboratory cannot match a duplicate sample to its relevant primary sample. The blind duplicate sample will be clearly matched to its relevant primary sample in the field documentation (see **Section 6.1.6**).

One duplicate sample will be collected per monitoring event.

6.1.5.5 Sample Blanks

Blank samples are used to identify if any possible sample contamination has occurred during the sample collection and storage/shipping process. Blank samples will be tested for the same analytical suite as the primary samples (see **Section 4.3.3.2**). Two types of sample blanks will be adopted in the program:

- Container blank.

  Also known as a 'field blank'. Laboratory supplied ultra-pure water is placed into sample containers whilst in the field and stored/transported to the analytical laboratory in the same manner as the primary samples. The container blank testing is used to identify if any contamination of samples may have occurred as a result of the sample collection process or use of non-sterile sample containers.

  One container blank will be collected per monitoring event.

- Equipment / rinsate blank.

  Following field equipment cleaning/decontamination in the field, laboratory supplied ultra-pure water is poured over and through the field equipment and then placed into sample containers and stored/transported to the analytical laboratory in the same manner as the primary samples. The equipment blank testing is used to identify if any contamination of samples may have occurred as a result of insufficient equipment cleaning/decontamination processes.

  One equipment blank will be collected per purging pump per event.

6.1.5.6 Storage and Chain of Custody

Groundwater sample bottles will be placed onto ice in a cooler box immediately after sampling for transfer to the analytical laboratory. Sample transfer will occur under industry standard Chain of Custody (CoC) protocols/documentation and within the relevant holding times for each parameter. Copies of each CoC form will be taken prior to shipping the samples and the CoC forms will be included with the monitoring report (see **Section 6.1.7**) for record keeping purposes.

6.1.6 Field Documentation

BCC recognises that robust field documentation is a key component of field program execution. BCC will compile all field documentation at the conclusion of each monitoring event in conjunction with the monitoring report (see **Section 6.1.7**). A Field Sheet will be developed by the field team for use during the monitoring program and completed at each bore being monitored. The Field Sheet will be used to record the following information.

- Bore ID and date.
- Standing water level, time of measurement (pre-purging/sampling), and datum used.
- Time when purging commenced.
- Details of the purging method including pump/intake depth.
- Records of field water quality parameters, colour and odour, during purging at appropriate time or volume intervals.
- Purge time, purge volume and water level to be recorded when water quality parameters recorded.
- Observations of any degassing of water during purging.
- Sample collection date, time and ID, including the ID of any QA/QC (e.g. duplicate) samples taken.
- A daily Calibration Record for the field water quality meter.
- A Daily Report emailed to the BCC Environment Department project manager.
- A completed Chain of Custody (CoC) record for samples.
- A digital photographic record for each bore, containing:
    - The condition of the bore headworks and general surrounding area, and
    - The water sample at the time of sampling.

  Each photograph will contain clear identification of the bore ID that is the subject of the photograph.

6.1.7 Reporting

Following each monitoring event, a factual Monitoring Report will be prepared for record keeping purposes. The Monitoring Report will contain the following information.

- Summary details regarding the dates of the field program covered by the report.
- Identification of staff who undertook the program and their relevant qualifications.
- Details of any monitoring restrictions encountered during the program.
- A summary table of measured standing water levels.
- A summary table of final field groundwater quality measurements.
- A summary of the water quality sampling.
- Details of sample QA/QC.
- Appendices containing:
    - Laboratory analytical results sheets;
    - Field Sheets for each bore;

- The daily Calibration Record for the field water quality meter;
- Copies of the Chain of Custody (CoC) form(s); and
- The photographic record for each bore.

6.2 Laboratory Procedures

6.2.1 Accreditation

Groundwater sample analysis will be undertaken by a laboratory accredited by the National Association of Testing Authorities (NATA).

6.2.2 Sample analysis replication and Sample quality assurance

The sample analysis will include duplicates and blanks collected in the field consistent with industry standard QA/QC procedures compliant with the relevant guidelines, as described in **Sections 6.1.5.4** and **6.1.5.5**.

Additionally, the NATA accredited laboratories will employ as standard practice an internal QA/QC program (intra-lab QC) that will include laboratory control samples, method blanks, matrix spikes, laboratory duplicates and surrogates, at frequencies at or above those recommended in the NEPM (2013) guidelines.

The intra-lab QC testing regime is designed by each NATA accredited laboratory and may vary slightly between laboratories, however samples are typically analysed at the following frequencies:

- Method Blanks – one (1) analysed within each process lot of twenty (20) samples;
- 10% Laboratory Duplicates – two (2) analysed within each process lot of twenty (20) samples;
- Laboratory Control Samples – one (1) analysed within each process lot of twenty (20) samples; and
- 5% Matrix Spikes – one (1) analysed within each process lot of twenty (20) samples.

6.3 Data Management and Data Quality Assurance Procedures

6.3.1 Data Management and Storage

The data gathered from the GMMP's groundwater monitoring program will be collated into a dedicated electronic database managed by the BCC Environment Department. Data will be entered into the database no later than 24 hours after it is received by the BCC Environment Department. The database will be routinely backed up in accordance with BCC's electronic information backup procedures.

6.3.2 Data Quality Assurance

A multi-tier process for GMMP data quality assurance after data collection will be implemented as follows.

i) Within the dedicated electronic database managed by the BCC Environment Department, flags will be implemented to automatically identify data that breaches any of the groundwater level or groundwater quality triggers established in this GMMP (see **Section 7.1**) and thus automatically notify the BCC Environment Department personnel to enact the Groundwater Impact Investigation Protocols (see **Section 5**), the first step of which is to confirm the data validity.

ii) The GMMP Annual Review (see **Section 7.1**) will include a thorough review of the groundwater monitoring database that will include identification of any spurious data through comparison with baseline data and statistical trend and outlier analysis in accordance with the procedures identified in DES (2021).

iii) Any formal investigation into the potential for environmental harm enacted as a result of a trigger breach (see **Section 5**) followed by implementation of the Groundwater Impact Investigation Protocols (see **Section 5**), will include identification of any spurious data through comparison with baseline data and statistical trend and outlier analysis in accordance with the procedures identified in DES (2021).

iv) Should any of the above result in identification of spurious data, the BCC Environment Department will implement an investigation into the source of the data error, including review of the data collection procedures, and where relevant the laboratory procedures to identify the source of the error, where possible. Where the error source is conclusively identified, the procedures identified in this GMMP will be updated where necessary, to mitigate the error occurring again.

7 Review and Improvement Process

7.1 Groundwater Management and Monitoring Program Review

Consistent with EA Condition D5, this GMMP and the collected monitoring data will be subject to an annual review. The annual review will:

- Include the assessment of all groundwater levels and quality data collected under this GMMP for all groundwater bores identified in **Section 4.2** to determine long term trends.
- Include an assessment of the suitability of the GMMP monitoring network, including an assessment of whether additional or amended groundwater quality parameter limits, trigger values or compliance bores are required for all groundwater aquifers potentially impacted by the Project's authorised mining activities.
- Be presented in a report submitted to the administering authority annually via WaTERS by 1 March each calendar year.

The annual review will be completed by an appropriately qualified person, with experience in hydrogeology and mining compliance and impact assessment.

The annual review will be completed in accordance with the processes and procedures outlined in DES (2021), or any updated version of that guideline available at the time.

8 References

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APPENDIX A

EA 10114091 Schedule D: Groundwater

EA10114091 Schedule D: Groundwater

Schedule D: Groundwater		
Condition number	**Condition**	**Relevant section of this GMMP**
D1	The environmental authority holder must not release contaminants to groundwater.	n/a
D2	Groundwater monitoring and analysis must be performed by an appropriately qualified person.	Section 6 Section 7
D3	**Monitoring and reporting** A Groundwater Management and Monitoring Program must be developed, certified and implemented by an appropriately qualified person for all stages of the activities on site (including construction, mining and closure) prior to commencing mining activities.	This GMMP
D4	The Groundwater Management and Monitoring Program required by Condition D3 must: (a) Identify potential sources of contamination to groundwater from the authorised mining activity; (b) Ensure that all potential groundwater impacts due to the authorised mining activity are identified, monitored and mitigated; (c) Document sampling and monitoring methodology; and (d) Ensure that groundwater monitoring and data analysis is undertaken to achieve the following objectives: (i) detect any impacts to groundwater levels due to the authorised mining activity; (ii) detect any impacts to groundwater quality due to the authorised mining activity; (iii) determine trends in groundwater quality; (iv) include a quality assurance and quality control program; (v) include a conceptual groundwater model; and (vi) include a review process to improve the program.	 Section 3 Section 3, Section 4 Section 4 Section 4.3.4 Section 4.3.3 Section 4.3 Section 6 Section 2.6 Section 7
D5	The Groundwater Management and Monitoring Program required by Condition D3 and the data collected must be reviewed annually by an appropriately qualified person. The review must: (a) include the assessment of all groundwater levels and quality data for all groundwater bores listed within Table D1: Groundwater Monitoring Locations and Frequency to determine long term trends; (b) assess the suitability of the groundwater monitoring network, including an assessment of whether additional or amended groundwater quality parameter limits, trigger values or compliance bores are required for all groundwater aquifers potentially impacted by the authorised mining activities; and (c) be in a report submitted to the administering authority annually via WaTERS by 1 March each calendar year.	Section 7
D6	Groundwater quality and levels must be monitored at the locations and frequencies defined in Table D1 - Groundwater Monitoring Locations and Frequency and shown in Appendix 3 – Groundwater Monitoring Locations.	Section 4.2 Section 4.3

Schedule D: Groundwater		
D7	Results of monitoring of groundwater quality bores identified in Table D1 - Groundwater Monitoring Locations and Frequency must not exceed any of the contaminant limits specified in Table D2 - Groundwater Quality Limits for the same monitoring bore on three (3) consecutive sampling occasions.	Section 5.1
D8	If the contaminant limits specified in Table D2 - Groundwater Quality Limits are exceeded at the same monitoring bore on three (3) consecutive sampling occasions the holder of the environmental authority must notify the administering authority via WaTERS within twenty-four (24) hours of receiving the results.	Section 5.1.2
D9	The administering authority must be notified via WaTERS within twenty-eight (28) days following detection of drawdown fluctuations exceeding that specified at any monitoring point in Table D3 - Groundwater Level Trigger Thresholds when measured against the pre-mining baseline standing water levels.	Section 5.2.3
D10	The environmental authority holder must submit to the administering authority pre-mining baseline standing water levels for each bore identified in Table D1 – Groundwater Monitoring Locations and Frequency to replace the 'TBA' values specified in Table D3 - Groundwater Level Trigger Thresholds within 12 (twelve) months of the commencement of mining activities or when sufficient data is available when collected in accordance with Condition D11.	Section 5.2.1
D11	The pre-mining baseline standing water levels required by Condition D10 must be derived from baseline groundwater monitoring data that includes at least twelve (12) sampling events, one (1) month apart, at the locations specified in Table D1 - Groundwater Monitoring Locations and Frequency.	Section 5.2.1
D12	Within fourteen (14) days of notification given under Condition D8 or D9 an investigation must be completed to determine if the exceedance is a result of: (a) mining activities authorised under this environmental authority; or (b) seasonal/natural variation; or neighbouring land use resulting in groundwater impacts; or (c) any other potential cause not related to the mining activity.	Section 5.1.2 Section 5.2.3
D13	If the investigation under Condition D12 determines that the exceedance was caused by the mining activities authorised under this environmental authority, then a further investigation must be completed within twenty-eight (28) days of the investigation required under Condition D12 (or a timeframe agreed to with the administering authority). This investigation must determine whether environmental harm has occurred or may occur, and the extent thereof.	Section 5.1.2 Section 5.2.3

Schedule D: Groundwater		
D14	If the investigation undertaken under Condition D12 determines that environmental harm has occurred, or may occur, the following actions must be completed within twenty-eight (28) days after completing the investigation under Condition D12: (a) implementation of measures as soon as reasonably practicable to reduce environmental harm including potential environmental harm; and (b) development of long-term mitigation measures to address any existing groundwater contamination and prevent recurrence of groundwater contamination which is implemented in a reasonable time period; and (c) if environmental harm has occurred as a result of groundwater drawdown exceedances, I. determine any actions required to reduce the potential for environmental harm; and II. determine any mitigation measures required to limit the drawdown in the affected groundwater resource; and (d) document the steps taken under Condition D14(a), (b), and (c), and provide the documentation to the administering authority.	Section 5.1.2 Section 5.2.3
D15	The following information must be recorded in relation to all groundwater sampling: (a) the date on which the sample was taken; (b) the time at which the sample was taken; (c) the monitoring point at which the sample was taken; and (d) the results of all monitoring.	Section 4.3.3
D16	Monitoring and sampling of groundwater must comply with the latest edition of the administering authority's Monitoring and Sampling Manual.	Section 4.3
D17	**Bore construction and maintenance and decommissioning** The construction, maintenance and management of groundwater bores (including groundwater monitoring bores) must be undertaken in a manner that prevents or minimises impacts to the environment and ensures the integrity of the bores to obtain accurate monitoring.	Section 4.2
D18	All groundwater bores specified in Table D1 - Groundwater Level Monitoring and Frequency must be installed within six (6) months of the commencement of mining activities.	Section 4.2

Table D1 – Groundwater Level Monitoring and Frequency

Location Description	Monitoring Point	Environmental Value Monitoring	Easting (GDA94)	Northing (GDA94)	Surface RL (m)[3]	Screening Interval (mbgl)[4]	Monitoring Frequency
Reference Bores							
Rangal Coal Measure	RB01	Groundwater	638937	7561395	218.1	30-70	Quarterly measurements of SWL [1] Quarterly EC and pH Six monthly for remaining analytes[2]
North Creek Alluvium	RB02	Riparian ecosystem to the east of MDL 444	638864	7561470	203.6	10-30	
Compliance Bores							
North Creek Alluvium	CB01	Riparian ecosystem to the east of MDL 444	639039	7558386	218.1	10-30	Quarterly measurements of SWL [1] Quarterly EC and pH Six monthly for remaining analytes[2]
North Creek Alluvium	CB02	Groundwater	638709	7560060	201.6	10-30	
North Creek Alluvium	CB03		638748	7559377	203.6	10-30	
Rangal Coal Measure	CB04		635285	7560768	223.5	20-40	
Rangal Coal Measure	CB05		636991	7561100	216.8	20-40	
Rangal Coal Measure	CB06		636508	7559654	227.1	20-40	
Rangal Coal Measure	CB07		635970	7559367	217.5	45.2-51.2	
Rangal Coal Measure	CB08		635970	7559367	217.5	73-79	
Rangal Coal Measure	CB09	Potential groundwater user	637264	7558807	221.0	20-40	
Rangal Coal Measure	CB10	Groundwater	636177	7561348	218.9		

[1]SWL – Standing Water Level

[2]Quarterly or more frequently following granting of the Environmental Authority.

[3]RL – must be measured to the nearest 5cm from the top of the bore casing.

[4]mbgl – metres below ground level.

Table D2 – Groundwater Quality Limits

Monitoring Point	Parameter	pH	EC	Sulfate	Arsenic	Aluminium	Molybdenum	Selenium	*TRH C6-C9	*TRH C10-C36	Major Ions
	Sample	Range	Max	Max	Max	Max	Max	Max	Max	Max	Interpretation Only
	Unit	pH units	(µS/cm)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(µg/L)	(µg/L)	N/A
CB01		6.5 – 8.5[A]	990[B]	11[B]	0.014[C]	0.055[E]	0.034[E]	0.005[E]	20[F]	100[F]	Bicarbonate, sodium, carbonate, calcium, chloride, potassium, magnesium.
CB02											
CB03											
CB04			12900[C]	27[C]							
CB05											
CB06											
CB07			11200[C]	23[C]							
CB08			10000[C]	62[C]							
CB09			5500[D]	68[D]							
CB10			12900[C]	27[C]							

Notes:

All metals must be measured as total (unfiltered) and dissolved (filtered). Trigger levels for metal apply if dissolved results exceed trigger

*TRH: Total Recoverable Hydrocarbons

[A] Isaac River Sub-basin EVs and WQOs

[B] Isaac River Sub-basin EVs and WQOs Groundwater Unit 1 (shallow)

[C] Site specific 95%ile

[D] ANZECC stock water WQO

[E] Australian Water Quality Guidelines

[F] Model mining condition limit

Table D3 – Groundwater Level Trigger Thresholds

Monitoring Point	Groundwater Level Thresholds	Pre-mining baseline standing water level (m)	Level Trigger Threshold (Maximum)
CB01	North Creek Alluvium	TBA	2 m
CB02	North Creek Alluvium	TBA	
CB03	North Creek Alluvium	TBA	
CB04	Rangal Coal Measure	TBA	
CB05	Rangal Coal Measure	TBA	
CB06	Rangal Coal Measure	TBA	
CB07	Rangal Coal Measure	TBA	
CB08	Rangal Coal Measure	TBA	
CB09	Rangal Coal Measure	TBA	
CB10	Rangal Coal Measure	TBA	

APPENDIX B

DAWE RFI

DAWE RFI

DAWE RFI Item		Section of this GMMP
Topic	Description	
Groundwater Dependant Ecosystems (GDEs)	Discussion on the monitoring, management and mitigation strategies that will be implemented to manage the risks to GDE's.	**Section 4.4**
	Develop a Groundwater Dependent Ecosystem management and mitigation plan.	**Section 4.4**
Groundwater Monitoring	Discussion on the key management and monitoring programs described in the Groundwater Management and Monitoring Program required for the Environmental Authority	This GMMP
	Discussion on the monitoring effort to detect the extent of seepage from the sediment and mine water dams	**Section 4.5**
Groundwater Impacts	Discussion on where the drawdown is predicted, and in which geological layers.	**Section 3**
	Discussion on the cumulative impacts of the proposed action, and the subsequent impacts on aquatic ecology.	Addressed in additional preliminary documentation (outside scope of the GMMP)

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APPENDIX D

Bore Baseline Assessment Program

Memorandum

To:	[redacted]	**At:**	RPM Global
From:	[redacted]	**At:**	SLR Consulting Australia Pty Ltd
Date:	11 April 2022	**Ref:**	620.30757-M01-v1.0-Bore Baseline Assessment Program-20220411.docx
Subject:	Bore Baseline Assessment Program Isaac River Coal Project		

1 Introduction

1.1 Background

SLR is currently working with RPM Global acting on behalf of Bowen Coking Coal Limited (BCC) to undertake bore assessment fieldwork in support of an Underground Water Impact Report (UWIR) application for the Isaac River Coal Project (the Project). The following memorandum details the scope and plan for this work.

As a recommended action out of the Gap Analysis produced by SLR's in the previous scope of work related to the Isaac River Coal Project, the Bore Baseline Assessment Program (BAP) aims to address the requirement to obtain reliable knowledge of existing anthropogenic groundwater users (private bores) surrounding the Project, that would be considered potential receptors in terms of the Project's impacts on groundwater resources.

As per the findings of the Gap Analysis, the in-field characterisation of the potential anthropogenic groundwater users in the vicinity of the Project is required as part of the UWIR application in accordance with State requirements and guidelines. As such this BAP has been prepared to assist RPM Global and BCC in planning the required field work program to collect the information for private bores surrounding the Project, prior to SLR undertaking the field work component of the BAP.

1.2 Preparation of a Baseline Assessment Program

The Queensland Government Department of Environment and Science (DES) *Guideline – Baseline assessments* (DES, 2021) provides the current minimum standards expected for design and implementation of a BAP and has been authorised under section 395 of the *Water Act 2000* (Water Act). This BAP has been prepared in accordance with that Guideline.

Typically, it would be expected that the BAP is undertaken for the area subject to potential groundwater impacts arising from the Project. Using the groundwater modelling developed by CDM Smith for the Project's EA Application, SLR is able to identify the Project's relevant potential groundwater impact area, based on the area of predicted groundwater level drawdown exceeding the relevant Water Act bore trigger thresholds of 5m drawdown for consolidated aquifers (i.e. the coal seams), and 2m for unconsolidated aquifers (i.e. the alluvium and colluvium).

Cadastral mapping immediately adjacent to the Project area has been used in the planning in this BAP, overlain with the CDM Smith groundwater modelling results. Regardless of any potential revised groundwater impact predictions in future studies for the Project (i.e. the proposed IESC submission to be developed by SLR), this is considered an effective estimate of the Project's potential area of groundwater impact for the purposes of the BAP. Upon completion of any new modelling, the requirement for additional field bore census can be assessed in the event that the predicted drawdown in the revised modelling exceeds the relevant Water Act bore trigger thresholds outside of the area subject to the initial BAP.

For its current purpose, the BAP will allow BCC to characterise the private groundwater bores surrounding the Project as required as part the groundwater works supporting the UWIR. The data captured in this program will demonstrate the nature of groundwater use for potential impact assessment in the UWIR. Furthermore, since it remains possible that there exist third party water supply bores that are not identified in the GWDB, the BAP will allow identification and characterisation of those users.

2 Bore and Property Identification

2.1 Previous Bore Surveys

The area immediately south and southeast of the Project has been subject to bore census surveys in the past, most notably in surveys undertaken for the Olive Downs Project in 2017 and the Moorvale South Project in 2019. Bore identified in those surveys are shown on **Figure 1** and have been included in this BAP where those properties lie within the Project's predicted drawdown trigger threshold extents.

2.2 Registered Bores (GWDB)

In Queensland's GWDB maintained by DRDMW, each water bore is given a registration number (the bore RN). As per CDM Smith's groundwater assessment for the EA Application, GWDB-listed bores have been identified as being located within the vicinity of the Project as shown on **Figure 1**.

However, DES notes in the *Guideline – Baseline assessments* that there may be other authorised bores which may not be recorded in the GWDB and may not have a registration number. Examples of such bores may be those that were drilled prior to any legal requirement to register the bore. As such, the GWDB cannot be considered to hold a complete listing of all authorised water bores. Furthermore, many bores recorded in the GWDB are potentially non-existent (abandoned and destroyed, or simply not present).

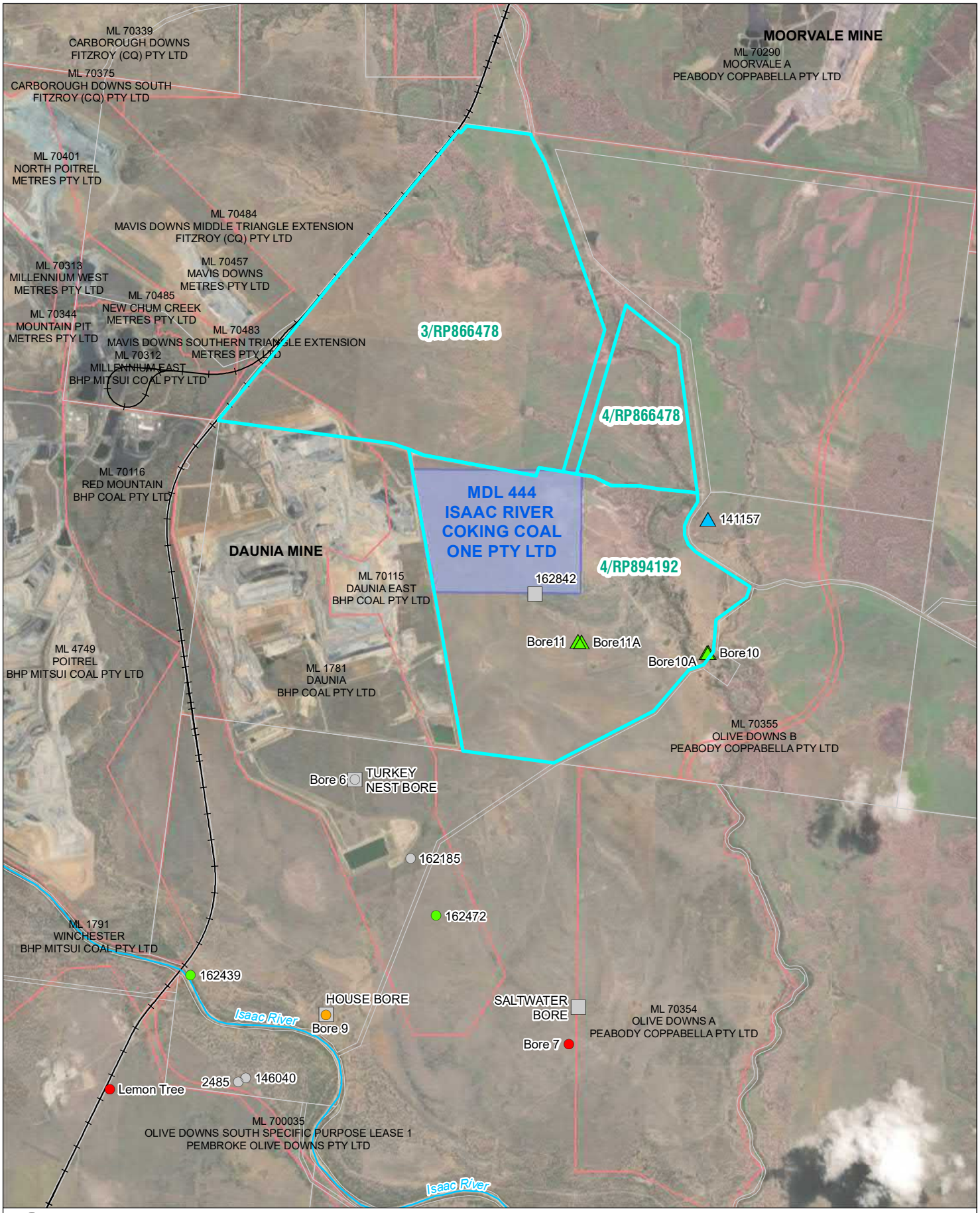
In addition, many bores listed in the GWDB do not have a known source aquifer listed, which further complicates assessment of whether or not any particular listed bore may be in an area of an aquifer subject to predicted impacts arising from the Project.

2.3 Approach for this Baseline Assessment Program

As detailed above, it is possible that:

- The locations of registered bores listed in the GWDB, including on which properties they lie, are not necessarily spatially correct.
- Many bores listed in the GWDB do not have a source aquifer listed.
- There are authorised bores in existence that are not listed in the GWDB.

As a result, SLR is unable to base this BAP on only the information held within the GWDB. Instead, the approach adopted by SLR in this BAP is to consider that all properties located within the extent of the Project's predicted Water Act drawdown trigger extents should be considered to potentially contain a water bore that is required to be assessed. This approach is considered to be consistent with that outlined in the *Guideline – Baseline assessments*.



H:\Projects-SLR\620-BNE\620.30757.00000 Isaac River Coal Project Groundwater\03 SLR Data\01 GIS\GIS\SLR62030757_GW_Existing_Census_Bores_01.mxd

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:75,000 at A4
Project Number:	620.30757
Date:	25-Mar-2022
Drawn by:	PM

SLR

Data Source: Roads, rail, mining leases, mineral development licence, watercourses from QLD Spatial Catalogue. Imagery ESRI basemaps captured 2019 - 2021.

ISAAC RIVER PROJECT

Bore Census

FIGURE 1

2.4 Property Identification

For the identification of relevant properties required to be incorporated in this BAP, SLR has relied on the following information:

- CDM Smith groundwater modelling results as presented in the Project EA Application.
- GIS shapefile of cadastral parcel mapping with property, ownership and contact details, accessed from online resources 4th April 2022.
- GWDB online database accessed 4th April 2022.

The properties identified for inclusion in this BAP are shown in **Table 1** below.

Table 1 Property Identification

Lot	Plan	Indicative number of Bores (Previous Surveys or GWDB)
4	RP894192	5
3	RP866478	0
4	RP866478	2

This first stage of the implementation of the BAP will involve BCC (or RPM Global) contacting each of representatives for the identified properties. This process should seek to identify the presence of groundwater bores on the property via consultation with the property contact persons, and then where confirmation of the existence of groundwater bores is provided, ascertain willingness to participate in the assessment program. Following acceptance of participation in the program, BCC should prepare a finalised list of properties to be surveyed and a schedule for that survey (i.e. in consideration of landholder availability) for implementation in the second stage (field execution) of the BAP (see **Section 3**).

2.5 Timing

The timing of the execution of the BAP will need to be developed in consideration of landholder availability to participate in the program. Landholders will be required to be present during program execution to assist in locating bores as well as providing the required anecdotal information on bore history and use, and any available drilling/construction records (see **Section 3.3**).

The baseline assessments should be completed in sufficient time for their outcomes to be included into the UWIR.

3 Baseline Assessment Methodology

3.1 Minimum personnel qualifications

Consistent with the DES *Guideline - Baseline assessments*, the minimum requirements for persons conducting the field assessments under this BAP are:

1. a minimum of two years prior experience in at least one of the following fields:
   a. underground water level monitoring programs, including monitoring of water levels in bores equipped with pumping infrastructure;

b. the conduct of underground water quality sampling programs; and

c. hydrogeology and/or engineering; and

2. has a practical knowledge of water bore construction and infrastructure.

3.2 Relevant Guidelines and Procedures

Consistent with the DES *Guideline - Baseline assessments*, the following guidelines and procedures will be incorporated into the field measurements undertaken under this BAP:

- EPA Guidelines: Regulatory Monitoring and Testing - Groundwater Sampling (Environment Protection Authority, 2007)
- Groundwater Sampling and Analysis—A Field Guide (Sundaram, et al., 2009)
- Quality assurance/quality control of AS/NZS 5667.11:1998 Water Quality—Sampling—Guidance on Sampling of Groundwaters (Joint Technical Committee EV/8, 2016)
- Monitoring and Sampling Manual – 2009 – Environmental Protection (Water) Policy 2009 (Department of Environment and Heritage Protection, 2013).

3.3 Recording of Field Data

A baseline assessment Field Form (**Attachment 1**) has been developed and will be used during all baseline assessments undertaken under this BAP. All information collected during the baseline assessments will be recorded onto this form in the field. The following outlines the field data that will be collected in accordance with the DES *Guideline - Baseline assessments.*

3.3.1 Bore Identification and General Site Information

Each bore assessed will be given a unique identifier (Bore ID). The unique identified will be a sequential number with a reference to the property on which sample is collected, with the general format: '*Lot Number'-'Plan Number'-'bore number in sequence*' e.g. 'RP866478-3-1'. For example, the first bore assessed on the first property visited will be known as RP866478-3-1, the second bore RP866478-3-2, etc. Under this system, bores are easily located within the properties.

The bore owner may have a bore registration number for their water bore. This information will be recorded when available as it will assist in identifying the correct bore in any future bore assessments. In many cases, it may be difficult to be confident that the bore registration number matches the bore site; in these cases commentary around the confidence level or accuracy will be recorded for the purposes of identifying the bore in future.

If the bore owner has a local name for the bore this will also be recorded, as it will assist in identifying the correct bore in any future bore assessments.

The bore location will be recorded using a hand-held GPS referenced to GDA94 in accordance with the DES guideline.

3.3.2 Bore Construction

The name of the aquifer/geological formation that is the source of supply for the bore will be recorded where available or where anecdotal information is provided by the bore owner. Where the supply source is uncertain or unknown, the reasons for the uncertainty will be analysed and reported. This information may be available on any drilling logs that are available for the bore. In many cases, it may be difficult to be confident that the bore is accessing a certain geological formation. Therefore, any commentary on the confidence level of the source aquifer (e.g. how confident is the assessor that the bore is in fact accessing a particular aquifer) is to be recorded. Other information recorded will include (where available):

- Name of drilling contractor;
- Date of construction;
- Type of casing;
- Casing diameter;
- Perforated intervals and / or screens that have been installed in the bore;
- Details of any seals and cement grouting installed in the bore annulus; and
- Bore strata log.

3.3.3 Bore Equipment and Condition

Information about the pumping equipment in the water bore including whether the bore is metered, the pump type and make and whether the bore is in operating condition or has been decommissioned will be recorded. Additional information on the power source for the bore, and details on the riser and headworks will also be recorded. This information will assist both BCC and the bore owner at the time of undertaking a future bore assessment and determining whether the bore has an impaired capacity in the future as a result of implementation of the Project.

Photographs of the bore and the bore equipment will be taken, to accurately capture the condition of the bore and equipment at the time of conducting the baseline assessment. The pictures will be representative of the bore and detail each site individually, including a shot of the site and a shot of the headworks.

The pump setting depth at the time of baseline assessment will be established as part of the baseline assessment where at all possible. This information will be useful in future bore assessment. If the bore is determined to have an impaired capacity - one possible mitigation measure may be to lower the pump where possible.

Any details that the bore owner has about any repairs or maintenance that has previously been undertaken on the bore will be recorded. These records will be useful background information to support any future bore assessment and determination of whether the bore has an impaired capacity.

3.3.4 Bore Supply

The authorised use or purpose of the bore will be established with the bore owner. Understanding the purpose of the bore at the time of baseline assessment is an important component of the assessment and any subsequent make-good agreements. Additional commentary as to how often the bore is utilised (hours pumped per day) will be recorded where available. This information will support any future bore assessment and determination of whether the bore has an impaired capacity.

Where known, the operating capacity of the bore and any associated commentary on the operating capacity of the bore that the bore owner can supply, including any seasonal variation in use will be recorded. The bore owner should supply any historical water use records that are available for the bore. These records will be valuable background information for the tenure holder and will assist BCC in understanding regional groundwater trends as part of the Project's groundwater assessment.

Peak usage information for the bore (including maximum volumes extracted and period of peak extraction) is to be obtained wherever available. If this information is not available, accurate information relating to the use of the water extracted from the bore needs to be captured and should include, as a minimum:

- Stock watering (type, head); and
- Domestic use (number of households supplied, area of gardens watered).

3.3.5 Standing Water Level

Baseline assessments are required to include the level of water in the bore. This is particularly complicated due to the presence of installed infrastructure at many bores that prohibits the direct measurement of water level using conventional 'e-tape' monitoring equipment.

3.3.5.1 Methodology

Where possible, the measurement of water levels will be undertaken using an e-tape (conventional water level "dipper") without interfering with any installed infrastructure.

The datum point of the measurement will be carefully recorded to ensure that any future measurements taken in the water bore will be referenced back to the same point. This will be achieved by photographing the bore head with the datum point clearly marked. The height of the datum above ground level is also to be measured and recorded, allowing the measurement of the water level from the datum point to be converted to a water level below ground level. The photograph will also include the unique identification number of the bore and the GWDB registered number if available, the bore owners name, the property name, and the date of the photograph.

The use of air lines will be avoided as they are not considered sufficiently accurate or reliable, and they require knowledge of the exact depth of the base of the airline in order to calculate a water level.

Where a SWL cannot be recorded, and it is not practicable for a bore owner to cease pumping, the following information will be recorded:

- Duration of pumping and rest periods; and
- Maximum pumping rates.

If a bore is pumping or has recently ceased pumping at the time of the site visit to obtain a SWL, the optimal course of action is to revisit the bore when the water level has fully recovered from the influence of pumping and has stabilised. In cases where it is not practicable for the bore owner to cease pumping for an extended period of time, best endeavours will be made to take the most representative SWL measurement possible. It is important that detailed information relating to the antecedent conditions of the bore are obtained and recorded in these circumstances.

3.3.6 Water Quality

Baseline assessments are required to include the quality of water in the bore. The parameters and minimum standards for this water quality analysis are as per DES guideline for Baseline bore assessment (DES, 2021).

3.3.6.1 Selection of Sampling Locations

Where fitted with pumping infrastructure, sampling locations will be chosen as close to the bore head as possible and before any other pipework joins the bore discharge pipework, if feasible. Manipulation of the headworks may need to be undertaken to secure a sample, this will only occur with the express permission of and with the assistance of the landholder. Potential sources of contamination will be identified and avoided wherever practicable and disturbance to the existing infrastructure will be minimised. The location of the sampling point will be documented and where the sampling point is not within 15m of the bore, it will be photographed. Its position will also be recorded using a handheld GPS referenced to GDA94. Samples of bore water will not be collected from storages such as water tanks, troughs or dams as they are subject to temporal influences that may alter the water chemistry.

Where not fitted with pumping infrastructure, a bore water sample will be obtained through the use of a temporarily installed groundwater sampling pump. When water quality samples are taken where there is no pumping equipment in place in the bore, photographs showing the bore and sampling setup will be taken to assist in demonstrating the integrity of the sampling process.

3.3.6.2 Purging

Prior to sampling a bore, wherever practicable, the volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) will be calculated. Water quality samples will only be collected:

- After three times the volume of stagnant water in the bore casing and the discharge piping (including a sufficient additional volume to account for any error in volume calculations) have been discharged; and
- When the field water quality parameters have stabilised.

Stabilisation of the water quality parameters indicates the bore is producing formation water.

Where extraction bores have been operating in the recent past prior to the assessment, purging a full three bore volumes may not be considered warranted. In these cases, sampling will be undertaken when the field water quality parameters have stabilised during purging.

In cases where full purging is not practicable, but a meaningful sample can still be collected, the pumping history of the bore, including when the bore was last used will be recorded in detail.

3.3.6.3 Field Parameters

The following water quality parameters will be collected in the field, in line with the recommendation in DES *Guideline - Baseline assessments*:

- pH
- Temperature (°C)
- Electrical Conductivity (µS/cm)

Field parameters will be recorded following the completion of the bore purging procedure using an electronic water quality meter. Furthermore, carbon dioxide and methane levels in the bore will be measured using a gas meter in line with recommendations in the Baseline assessment guideline.

3.3.6.4 Laboratory Parameters

All laboratory water samples for baseline assessments are to be analysed at National Association of Testing Authorities (NATA) accredited laboratories. The limit of detection will be sufficient for assessment against current and relevant guidelines, including but not limited to:

- ANZECC & ARMCANZ, 2000. Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy Paper No. 4, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra.
- NHMRC & NRMMC 2004, Australian Drinking Water Guidelines, National Water Quality Management Strategy Paper No. 6, National Health and Medical Research Council and Natural Resource Management Ministerial Council.

Table 2 presents the laboratory parameter list which has been developed to be consistent with DES *Guideline - Baseline assessments*. These are in line with the minimum water quality analytes to be sample for baseline assessments. The extended list of analytes for analysis relates primarily to gas extraction and fracking projects which is not considered to be relevant for this project.

Table 2 Laboratory water quality parameters

Category	Parameters	
Physical Parameter	pH (-)	
	Electrical Conductivity (µS/cm)	
	Total Dissolved Solids (mg/L)	
Alkalinity and Hardness	Alkalinity – bicarbonate hydroxide and total as $CaCO_3$	
	Total hardness as $CaCO_3$	
Major Ions	Calcium	Potassium
	Chloride	Sodium
	Fluoride	Sulphate
Metals (dissolved and total)	Aluminium	Lead
	Arsenic	Magnesium
	Barium	Manganese
	Beryllium	Mercury
	Boron	Molybdenum
	Cadmium	Nickel
	Chromium	Selenium
	Cobalt	Uranium
	Copper	Vanadium
	Iron	Zinc

Category	Parameters
Dissolved gases	Carbon dioxide (field)
	Methane
	Hydrogen Sulphide

Sample collection will occur in a controlled manner that avoids disturbance to the sample by contamination from physical, chemical or biological processes.

Sample identification, preservation and transport will adhere to best practice industry standards including:

- Samples will have a unique identification ID that can be cross-referenced to the monitoring location and time of sampling.
- Sample preservation measures are to be documented and will comply with the laboratories requirements and relevant standards (e.g. AS/NZS 5667.11:1998).
- Sample integrity will be maintained through the use of chain of custody procedures and documentation.
- Samples will be delivered to the analysing laboratory within the required sample holding times.

3.3.7 Presence of Gas

All bores visited will first be measured for the presence of carbon dioxide, methane and hydrogen sulphide using a multi-parameter gas detector and in compliance with the latest version of the Code of practice for coal seam gas well head emissions detection and reporting (Department of Natural Resources and Mines, 2011). BCC health and safety protocols will be followed in the event that gas is detected.

The pumping regime prior to assessing the presence or absence of gas will be recorded as part of the baseline assessment.

3.4 Quality Assurance Program

3.5 Laboratory QA/QC

Consistent with AS/NZS 9000 series (as required by the DES *Guideline - Baseline assessments*) QA/QC protocols for water quality samples will be established as outlined in

Table 3 Water sample quality assurance and quality control

Method	Frequency	Description
Blind duplicate	One per landholder	Duplicate samples will be collected in the same manner as the primary sample. Used to assess the precision/repeatability of the sampling procedure and laboratory analysis.
Equipment blank	One per day of sampling	Rinsate blank collected in the field under identical conditions to primary samples. Used to verify appropriate decontamination of field equipment between different bores.

Method	Frequency	Description
Field blank	One per day of sampling	Clean purified water sample collected in the field under identical conditions to primary samples. Used to verify a high standard of sampling procedure and identify if any contamination is occurring during sampling.

3.6 Third Party Certification

Consistent with the DES *Guideline - Baseline assessments*, all baseline assessments will be completed by an independent third party engaged by BCC. All baseline assessments will also be certified by an independent third party through signoff on the approved field form (**Attachment 1**). It should be noted that:

- Independent certification does not require an independent person being present in the field for all baseline assessments; and
- The entity employing the persons conducting the baseline assessments may also provide suitable persons to undertake the certification.

The certification program will include the field verification of a minimum of 10% of the baseline assessments being certified including:

- That quality assurance and quality control procedures are being implemented, inclusive of compliance with the relevant standards and manuals referenced above;
- That all aspects of the baseline assessments are undertaken in compliance with the Guideline;
- Verifies the minimum qualifications, training and experience of all persons conducting the baseline assessments.

Independent third parties conducting baseline assessments or providing certification will:

- Not be an employee of, nor have a financial interest or any involvement which would lead to a conflict of interest with BCC whose baseline assessments are being certified;
- Have a degree in a relevant science or engineering discipline;
- Have a practical knowledge of water bore construction and infrastructure; and
- Have a minimum of five years prior experience in at least one of the following fields:
  - Groundwater level monitoring programs, including monitoring of water level in bores equipped with pumping infrastructure;
  - Groundwater quality sampling programs; or
  - Groundwater hydrogeology and/or engineering;

Checked/
Authorised by:

4 References

ANZECC & ARMCANZ, 2000. Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy Paper No. 4, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra.

Department of Environment and Heritage Protection, 2013. Monitoring and Sampling Manual – 2009 – Environmental Protection (Water) Policy 2009.

Department of Natural Resources and Mines, 2011. Code of practice for coal seam gas well head emissions detection and reporting.

Department of Environment and Science, 2021. Guideline – Baseline Assessments. Version 3.03.

Environment Protection Authority, 2007. Regulatory Monitoring and Testing - Groundwater Sampling.

NHMRC & NRMMC 2004, Australian Drinking Water Guidelines, National Water Quality Management Strategy Paper No. 6, National Health and Medical Research Council and Natural Resource Management Ministerial Council.

Sundaram, B. Et al., 2009. Groundwater Sampling and Analysis – A Field Guide.

Joint Technical Committee EV/8, 2016. AS/NZS 5667.11:1998 Water Quality—Sampling—Guidance on Sampling of Groundwaters.

Approved Form

Water Act 2000

Outcome of baseline assessment

This is the approved form for a resource tenure holder to give notice of the outcome of baseline assessments for water bores to the Office of Groundwater Impact Assessment and the bore owners, under section 405 of the Water Act 2000*. Appendix 1 details the* ***mandatory*** *supporting information that must be included with this form for each bore.*

1 Resource tenure holder's information

Registered legal entity name (not a business trading name)	
Trading name(s) (if applicable)	
ABN / ACN / AN OR title and section of legislation under which corporation has legal status	
Registered business address (not a post office box)	
Postal address (write 'AS ABOVE' if same as registered business address)	
Phone	Fax
Email	Website

Principal contact within the corporation for submission of the outcome of baseline assessment form

Full name of principal contact/person in charge		Title
Position in corporation		
Postal address (write 'AS ABOVE' if same as registered business address)		
Phone	Mobile	Fax
Email		

2 Reason for conducting baseline assessments

☐ Bore/s have been identified in a priority area in a relevant baseline assessment plan (BAP).

☐ The resource tenure holder has been directed by the chief executive under section 405 of the *Water Act 2000* (Water Act) to undertake a baseline assessment.

☐ To provide details of the current bore condition as no baseline assessment was undertaken for the bore (as required by the *outcome of bore assessment form* ESR/2016/2392[1]).

3 Relevant bores

Provide details of the bores for which you are reporting the outcome of a baseline assessment and provide details of each baseline assessment in Appendix 1.

Bore ID (attach if more needed)	Date of assessment	Tenure (e.g. ATP198)

4 Collection of data and qualifications

4.1 Qualifications for persons conducting baseline assessments

The person/s conducting the field measurements required for the baseline assessments:

☐ has a minimum of two years prior experience in a relevant field (see the *baseline assessments guideline* ESR/2016/1999[1] for details); AND

☐ has a practical knowledge of water bore construction and infrastructure.

Note: Should the bore owner be concerned that the person/s conducting the baseline assessment does not possess the appropriate skills and experience, they may request the resource tenure holder to provide evidence of the person's skills and experience.

4.2 Quality assurance and quality control

☐ the baseline assessments have been undertaken in accordance with a formal quality assurance program that meets the requirements of the *baseline assessments guideline* (ESR/2016/1999[1]).

Note: the quality assurance program must be provided to the chief executive upon written request.

[1] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

4.3 Independent third party certification

☐ All aspects of the baseline assessments are undertaken in compliance with the *baseline assessments guideline* (ESR/2016/1999[2]).

Third party name	
Company	
Phone	Mobile
Email	
Signature	Date

5 Declaration

If you have not told the truth in this form, you may be liable for prosecution under the relevant legislation.

- I do solemnly and sincerely declare that the information provided is true and correct to the best of my knowledge and I make this solemn declaration conscientiously believing the same to be true.
- I am aware that under section 826 of the *Water Act 2000*, it is an offence to give the administering authority a document containing information that the person knows is false or misleading in a material particular. The maximum penalty for such action is 500 penalty units for an individual or 2,500 penalty units where the applicant is a corporation. Refer to the *Penalties and Sentences Act 1992* for the current value of a penalty unit.
- I understand that all information supplied on or with this form may be disclosed publicly in accordance with the *Right to Information Act 2009* and the *Evidence Act 1977*.

Full name	Position
Signature	Date

[2] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

6 Outcome of baseline assessments checklist

☐ Form completed and signed.

☐ Mandatory supporting information attached for each relevant bore (Appendix 1).

Please return your completed form to:

Office of Groundwater Impact Assessment
Department of Natural Resources Mines and Energy
PO Box 15216
City East, QLD 4001

Email: OGIA@dnrme.qld.gov.au

Enquiries: **13 QGOV (13 74 68)**

A copy of this form must also be provided to the bore owner/s.

If the baseline assessment is being undertaken as directed by the Department of Environment and Science (DES) under section 402 of the Water Act, **a copy of this form must also be provided to DES as detailed in the direction notice.**

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable)	ABN/ACN (if applicable)
Principal contact	
Surname	Given name(s)
Phone	Mobile
Tenure type ☐ PL ☐ ATP ☐ MDL ☐ ML	Tenure number
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number)	
Bore registration number (RN)[4]	Bore RN comments
Local bore name	
Property name	
Lot	Plan
Date of site assessment	
Bore geographic location (GDA94)	
Latitude	Longitude
Location method ☐ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☐ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments	

[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.
[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

Are construction details available?	
☐ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☐ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name)	Date of bore construction (drilled date)
Type of casing	Casing diameter (mm)
Details of perforated intervals and/or screens that have been installed	
Details of any seals and cement grouting installed in the bore annulus	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s)	
Is the source aquifer of the bore known?	
☐ Yes →	Name of source aquifer
	Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty)
☐ No →	Reasons source aquifer unknown
Is a strata log available for the bore?	
☐ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☐ No
Additional comments	

[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore	
☐ Operational	☐ Decommissioned
Is the bore equipped with a pump?	
☐ Yes	☐ No → go to Part D.
Pump type	Pump make and model
Pump setting depth (m) (depth from ground)	
Is the bore equipped with a meter?	
☐ Yes → description:	☐ No
Power source	
☐ Electric motor ☐ Generator ☐ Direct drive engine ☐ Mains supply ☐ Tractor ☐ Windmill	
Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)	
Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance	

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)	
☐ Stock ☐ Domestic supply ☐ Intensive livestock ☐ Irrigation ☐ Town water supply ☐ Other → description:	
Is the water use from this bore metered?	
☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☐ No →	Estimated volume used yearly (ML/year)
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6])
Bore utilisation	
How often is the bore utilised (estimated hours pumped per day)?	
Describe the operational capacity, including seasonal variation	
Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore.	
Are there any historical water use records available for this bore?	
☐ Yes → attach them to this form.	☐ No

[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☐ Yes →	Standing water level (m) (depth from ground)
	Current conditions relevant to the water level measurement
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing)	
Height of datum above ground level (m)	
Are water level and/or pressure records available for this bore?	
☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94)	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point)	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☐ No →	Provide details of the pumping history including when the bore was last used
Is pumping equipment in place at the bore?	
☐ Yes	
☐ No →	**Attach photo** showing the bore and sampling set up

Field parameters			
Were water quality field measurements taken?			
☐ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm_v)	H_2S (ppm_v)	CH_4 (%LEL)
☐ No →	Reason not measured		
Are historical water quality field records available for this bore?			
☐ Yes		☐ No	
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☐ No →	Reason not samples not taken		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method		
	☐ Flow through	☐ Geosciences Australia method	
	Reason method chosen		
☐ No →	Reason not measured		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☐ No →	Reason not supplied		
Are historical water quality laboratory records available for this bore?			
☐ Yes → attach them to this form.		☐ No	

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname	Given name(s)
Company	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname	Given name(s)
Company	
Phone	Alternative phone
Email	Date certified

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner?	
☐ Yes	☐ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Attachments

Provide a list of the photos and documents (i.e. digital images and scanned documents) obtained as part of the bore assessment applicable only to this bore. Ensure that all files provided are in the format and named in accordance with OGIA's Bore Baseline Assessment Database—Data File Details Format Document[8].

Documentation type		Description
Photos (i.e. JPEG, PNG)	☐ Bore and bore equipment photos (Part C)	
	☐ Water level measurement point photo (Part E)	
	☐ Water quality measurement point photo (Part F)	
	☐ Water quality sample setup photo (Part F)	
	☐ Other photo	
Documents (i.e. PDF, DOCX)	☐ Driller's log (Part B)	
	☐ Bore strata log (Part B)	
	☐ Water use log (Part D)	
	☐ Water level log (Part E)	
	☐ Water quality sample laboratory results from this baseline assessment (Part F)	
	☐ Water quality historical laboratory results (Part F)	
	☐ Water quality hitorical field results (Part F)	
	☐ Other document	

[8] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au, using "bore baseline assessment database" as a search term.

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