Appendix E

Groundwater

QUEENSLAND PACIFIC METALS

EMM
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QPM Energy Project

Groundwater impact assessment

Prepared for Queensland Pacific Metals Energy

October 2022

QPM Energy Project

Groundwater impact assessment

Queensland Pacific Metals Energy

E210671 RP5

October 2022

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Abbreviations

Table 1 Abbreviations

Abbreviation	Term
AHD	Australian Height Datum
ANZG	Australian and New Zealand Guidelines for Fresh and Marine Water Quality
BoM	Bureau of Meteorology
CSG	Coal seam gas
DES	Department of Environment and Science
EA	Environmental Authority
EAR	Environmental Assessment Report
EP Act	*Environment Protection Act 1994*
EMM	EMM Consulting Limited
EPP	Environmental Protection Policy
EPP (Water and Wetland Biodiversity)	EPP (Water and Wetland Biodiversity)
ERA	Environmentally relevant activity
EV	Environmental value
GCF	Gas compression facility
GDE	Groundwater dependent ecosystem
GIA	Groundwater impact assessment
ha	hectares
L/s	Litres per second
mbgl	Metres below ground level
m	metres
mBGL	metres below ground level
National Water Commission	NWC
NQGP	North Queensland Gas Pipeline
standing water levels	SWL
TECH	Townsville Energy Chemicals Hub

Table 1 Abbreviations

Abbreviation	Term
TEG	Tri-Ethylene Glycol
TJ/d	terajoule per day
Water Act	*Water Act 2000*
WQOs	Water quality objectives

1 Introduction

1.1 Project overview

The QPM Energy Project (the Project) involves the design, construction and operation of a gas compression facility (GCF) and a high-pressure pipeline that links the proposed GCF to the nearby existing and operational North Queensland Gas Pipeline (NQGP).

The Project proposes to collect waste coal mine gas at the proposed GCF via waste gathering lines from existing adjacent mines. At the GCF, waste coal mine gas will be dehydrated and filtered, with the remaining clean gas then compressed and transported via high-pressure pipeline to the existing and operational NQGP. The NQGP will then transport the compressed gas north to Townsville, where it will be depressurised and distributed, by a third party, to industrial users, including QPM's Townsville Energy Chemicals Hub (TECH) Project.

1.2 Purpose of this report

This groundwater assessment has been prepared by EMM Consulting Limited (EMM) on behalf of QPM Energy in support of an application for a new Environmental Authority (EA) for a resource activity.

The purpose of this document is to provide sufficient detail to support an application for a site-specific EA.

The key objectives of the groundwater assessment are to:

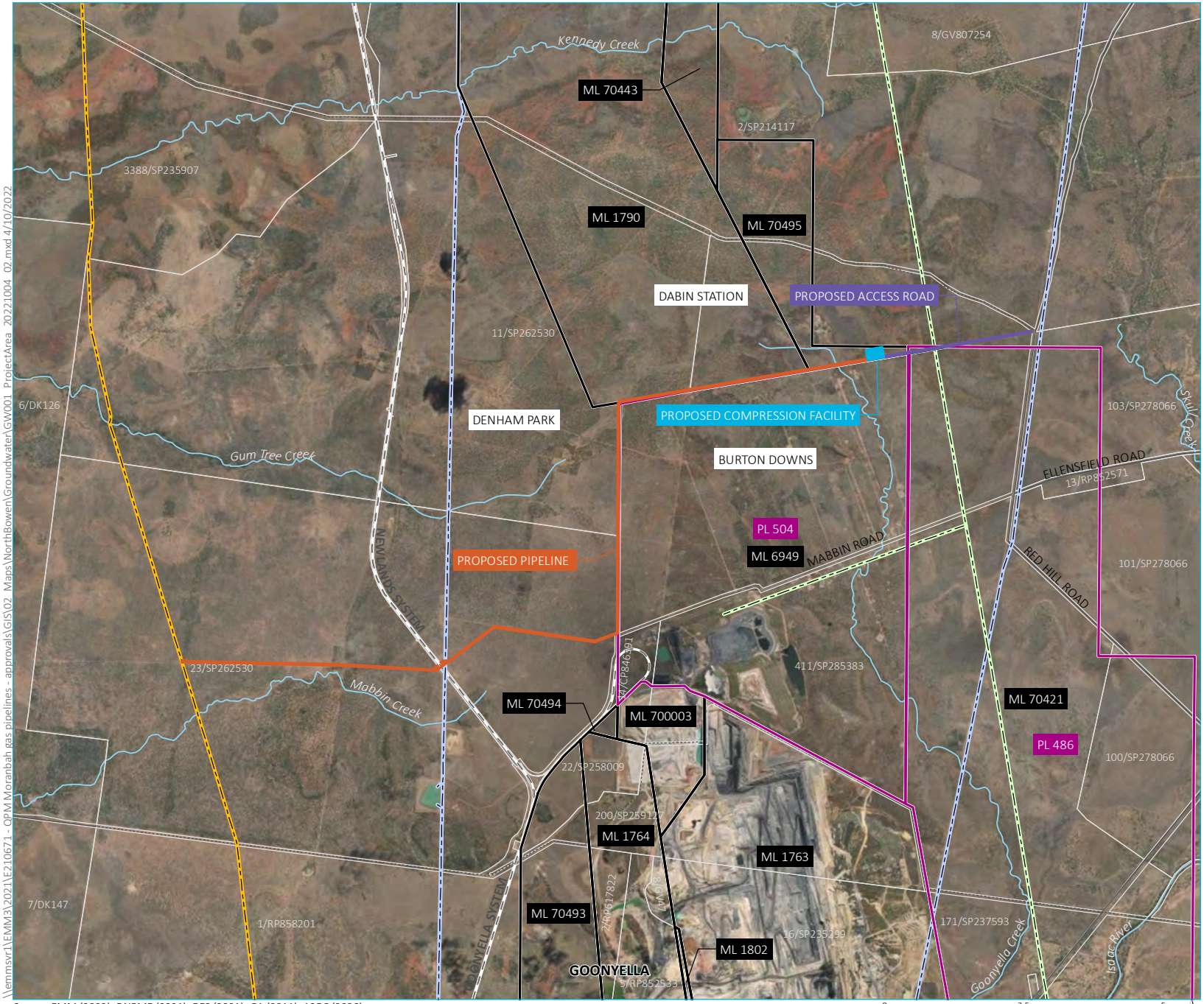
- outline the proposed site water management arrangement for the Project;
- assess the existing groundwater related environments and baseline conditions within the Project and surrounding area;
- assess the regulatory environment (with respect to groundwater resources) within which the Project will operate;
- quantify the requirements of the Project for water access to satisfy Project demands, and specify arrangements for acquiring them;
- identify and quantify the potential impacts of the Project on the current groundwater resources, and on water users both environmental and extractive (including cumulative effects);
- specific mitigation and management measures, and monitoring requirements for groundwater; and
- inform the wider community about the Project and its potential impacts on the local and regional groundwater environments.

This assessment has been made in accordance with the guideline *Application requirements for activities with impacts to water* (Department of Environment and Science, 2021).

1.3 Project footprint and study area

The Project footprint is comprised of the following components and land areas:

- GCF – 200 metres (m) by 300 m, an area of 6 hectares (ha).
- High-pressure pipeline – easement initially a 30 m wide construction right of way (an area of 51 ha) which reduces to a 15 m wide operating easement (an area of 25 ha) from 3.2 km west of the Gas Compression Facility.
- Access road – 8 ha being a 30 m wide easement from Red Hill Road to the GCF.
- Other incidental/ancillary activities, within the above footprint – a detailed project description is provided in Section 3 of the Environment Assessment Report (EAR).
- Local context shown in Figure 1.1.



KEY

- Gas compression facility
- Pipeline
- Access road
- Mining lease
- Petroleum lease
- Electrical transmission line
- North Queensland Gas Pipeline
- Water pipeline
- Rail line
- Minor road
- Vehicular track
- Named watercourse
- Cadastral boundary

INSET KEY

- Main road
- National park
- State forest

Local context

QPM Energy Project
Groundwater
Figure 1.1

Source: EMM (2022); DNRME (2021); DES (2021); GA (2011); ASGC (2006)

0 2.5 5 km

GDA 1994 MGA Zone 55

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creating opportunities

2 Project description

2.1 Overview

The Project involves the design, construction, and operation of a GCF and a high-pressure pipeline that links the proposed GCF to the nearby existing and operational NQGP.

The Project proposes to collect waste coal mine gas at the proposed GCF via waste gas gathering lines located at adjacent coal mines. At the GCF, waste coal mine gas will be dehydrated and filtered, with the remaining clean gas then compressed and transported via high-pressure pipeline to the existing and operational NQGP. The NQGP will then transport the compressed gas north to Townsville, where it will be depressurised and distributed, by a third party, to industrial users, including QPM's TECH Project.

Access to the GCF will be provided via the construction of a 2.8 km all-weather access road from Red Hill Road.

Ancillary activities will also occur within the defined Project footprint.

The Project is proposed 43 km north of Moranbah.

It should be noted that the Project involves capturing and converting methane in waste coal mine gas (a greenhouse gas) into carbon dioxide that would otherwise be released into the atmosphere by the relevant coal mining operator. The Project proposes to capture and convert waste coal mine gas through a process of filtration to remove water slugs and fine coal dust, compression, dehydration to remove water vapour, and flaring, in the event of a shutdown. It does not involve refining natural gas or coal seam methane gas.

For further detail on the Project description refer to Section 3 of the EAR.

2.2 Project components

Table 2.1 summarises the main components of the Project.

Table 2.1 Project components

Component	Description
Gas Compression Facility	• Captures and converts waste coal mine gas to clean gas which is then compressed to 15.3 megapascal for transport within the high-pressure gas pipeline. • Proposed to be located at Dabin Station on the southern boundary of Lot 2 SP214117 and 2.7 km west of the Red Hill Road reserve. • Sited on a 200 m by 300 m area. • 6 ha disturbance footprint.
High-pressure pipeline	• High-pressure pipeline to transport clean compressed gas from the GCF to the NQGP. • 16.8 km in length, running along cleared areas, fence lines and fire breaks along property boundaries. • During construction, a 30 m wide construction right of way (disturbance area of 51 ha). • During operations, a 15 m wide operating easement (disturbance area of 25 ha) after the first 3.2 km.
Access road	• Road to provide all-weather access to the GCF from Red Hill Road reserve. • 2.8 km long and 30 m wide. • 8 ha disturbance footprint.

A detailed project description is provided in Section 3 of the EAR.

2.3 Project description influencing groundwater matters

The GCF will receive gas at a normal pressure of 138 kilopascals (kPa) from the upstream field system and deliver a maximum pressure of 15,300 kPa. The waste coal seam methane will be dehydrated to remove water and filtered to remove particulates. The clean gas will be compressed using small 5.5 terajoule per day (TJ/d) compressor units powered by gas reciprocating engines using clean gas. The high-pressure pipeline will then transport the gas 16.8 km where it connects into the NQGP through a hot tap tee connection.

The high-pressure pipeline will cross Goonyella Creek, Denham Park Access Road, two water pipelines and a rail line before connecting with the NQGP.

A pipeline inspection gauge receival station is proposed to be installed adjacent to the connection which is used to accept a cleaning unit inserted into the high-pressure pipeline to remove pipe wall build-up and contaminants as it moves down the high-pressure pipeline under pressure from compressed gas behind it. Further ancillary facilities will also be installed such as a gas flare header, an oily water separation facility, service structures and gas blow down facilities for the operation of the high-pressure pipeline.

The below-ground, high-pressure pipeline and GCF are anticipated to utilise several chemicals within the different phases of the Project and as a result have the potential to contaminate the surrounding environment. Contaminants will be managed onsite through the implementation of management strategies including recording manifest quantities, location and bunding of chemical storage, handling methods and reporting procedures.

The key generator of contaminants will include pipe cleaning or ‘pigging’ activities, the oily water separation unit, large machinery (eg compressors, generators and the dehydration unit) and mechanical service facilities. Chemicals and large machinery utilised onsite will be managed as per manufacturer specifications and bunded (eg primary and tertiary bunds). General and regulated waste streams generated from the operation of the network will be segregated and disposed of in accordance with relevant legislative requirements.

3 Legislation, policy, standards and guidelines

The following legislation, policies, standards and guidelines discussed in Table 3.1 are relevant to this groundwater assessment.

Table 3.1 Relevant legislation, policies, standards and guidelines to the groundwater assessment

Document	Relevance to the assessment
Legislation	
Environmental Protection Act 1994 (EP Act)	The EP Act aims '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' (EP Act, Part 2). Under the EP Act, environmental protection policies are developed to cover specific aspects of the environment. The EP Act identifies EVs of Queensland waters, including those located within the impact assessment area, which are protected under the EP Act and the subordinate legislation. The EP Act defines an 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 EV under an environmental protection policy or regulation.
Water Act 2000 (Water Act)	The Water Act provides for the sustainable management of water and the management of impacts on underground water amongst other purposes. The main objective of the Water Act is to provide a framework for the: • sustainable management of Queensland's water resources by establishing a system for the planning, allocation and use of water; • sustainable and secure water supply and demand management for the south-east Queensland region and other designated regions; • management of impacts on underground water caused by the exercise of underground water rights by the resource sector; and • effective operation of water authorities. The Water Act covers water in a watercourse, lake or spring, underground water (or groundwater), overland flow water, or water that has been collected in a dam. The Project involves works which may intersect/interact with shallow groundwater units and as such the provisions of the Water Act apply.
Regulation	
Environmental Protection Regulation 2019	The objective of the Environmental Protection Regulation 2019 is to provide a framework for the effective and efficient administration and enforcement of the object and provisions of the EP Act. The regulation identifies a list of prescribed Environmentally Relevant Activities (ERA) that have the potential to cause environmental harm. The Project triggers an ERA and therefore appropriate guidelines and requirements to manage and mitigate potential impacts of these activities on the water environment are considered.

Table 3.1 Relevant legislation, policies, standards and guidelines to the groundwater assessment

Document	Relevance to the assessment
Water Regulation 2016	The Water Regulation 2016 is a subordinate legislation made under the *Water Act 2000* and details administrative and operational matters for the Act. Matters governed by the Water Regulation 2016, with relevance to the Project include, but are not limited to: • provide matters for the Minister's report on water plans; • provide the purpose and conditions for which a constructing authority may take water; • prescribes activities for which the taking of, or interfering with, water is authorised without an entitlement; • provide for matters relating to water licences; • provide for matters relating to water supply and demand management; • allow for seasonal water assignments and prescribe associated rules; • provide criteria for establishing water allocations and prescribe water allocation dealing rules; • prescribe requirements for decommissioning water bores; • provide for works that are self-assessable and assessable development for the *Planning Act 2016* and prescribe the associated codes; • make declarations about underground water taken to be water in a watercourse; and • provide rules for managing underground water that is not managed through a water plan.
Policies, standards, guidelines	
Environmental Protection (Water and Wetland Biodiversity) Policy	Under the EP Act, the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP (Water and Wetland Biodiversity)) achieves the objectives of the Act in relation to Queensland waters. The purpose of the EPP (Water and Wetland Biodiversity) is achieved by: • identifying EVs and management goals for Queensland waters; • providing state water quality guidelines and water quality objectives (WQOs) to enhance or protect relevant EVs; and • providing a framework for making consistent, equitable and informed decisions about Queensland waters. Groundwater Resources within the impact assessment area occur within two river basins with identified EVs and WQOs under the EPP (Water and Wetland Biodiversity). These basins are: • Fitzroy River Basin; and • the Burdekin River Basin.
Water Plan (Fitzroy Basin) 2011	Water plans were developed under the *Water Act 2000* to sustainably manage and allocate water resources in Queensland. The plans apply to water in watercourses and lakes, water in springs, overland flow water, and groundwater and allow for identification of availability of water options for Project uses. The Isaac Conners Groundwater Management Area (GMA) Zone 34 regulates access to groundwater resources under the *Water Plan (Fitzroy Basin), 2011* specific to the Project footprint. Groundwater units of the GMA and related to the Project footprint are classified as: • Groundwater unit 1 – containing aquifers of the Quaternary alluvium; and • Groundwater unit 2 – comprising sub-artesian aquifer.

Table 3.1 Relevant legislation, policies, standards and guidelines to the groundwater assessment

Document	Relevance to the assessment
Australian and New Zealand Guidelines for Fresh and Marine Water Quality	The objective of the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG) (ANZECC and ARMCANZ 2018) is to provide authoritative guidance on the management of water quality in Australia and New Zealand. The guidelines include settling water quality and sediment quality objectives designed to sustain current, or likely future, community values for natural and semi-natural water resources. The Water Quality Guidelines provide: • a platform for consistent water quality management and planning; • technical support for Australia's National Water Quality Management Strategy and New Zealand's National Policy Statement for Freshwater Management; and • sound tools for governments and the community to assess and manage ambient water and sediment quality. The ANZG have been used to assess groundwater quality in the impact assessment area.
Guideline: Application requirements for activities with impacts to water (DES 2017)	The Department of Environment and Science (DES) *Guideline: Application requirements for activities with impacts to water* (DES 2017) focuses on the types of impacts that ERAs can have on water and outlines the information to be provided to the department as part of the ERA application process. This guideline is applicable to the following ERAs: • controlled/planned releases to water; • uncontrolled/unplanned releases to water; • changes to the quantity and quality of stormwater runoff from the site of the ERA; and • indirect impacts: – disturbance to the bed or banks of waters; – turbidity due to disturbance of clearing of riparian vegetation during construction; – changes to groundwater formation characteristics; and – changes to groundwater ecology (and surface water ecology). Based on the proposed works associated with the Project, this guideline is not considered relevant to groundwater in the impact assessment area.

4 Existing environment

4.1 Topography and land use

The topography of the area is classified as flat to rolling, varying in elevation in the vicinity of the Project from approximately 295 metres Australian Height Datum (m AHD) at its western margins, adjacent to the existing NQGP, to approximately 330 m AHD in the vicinity of the proposed GCF, adjacent to the Red Hill access road.

The regional environment is dominated by underground and open cut mining activity, with BHP Mitsubishi Alliance's (BMAs) Goonyella Riverside and Broadmeadow Mine located immediately south of the proposed Project. Elsewhere, farming, agistment and the transmission of bulk gas and water dominates the landscape.

4.2 Climate

A review of the Bureau of Meteorology's (BoM) climate database was undertaken and information was sourced from two representative weather stations proximal to the site, Moranbah Airport (BoM: 0434035) and Moranbah Water Treatment Plant (BoM: 034038), both of which are located approximately 45 km south of the Project footprint.

Rainfall is seasonally distributed with a distinct wet season occurring during the summer months of December through February and an extended dry season occurring during the months of April through September. Monthly and annual rainfall data sourced from BoM 0434035 indicates that the region receives a range in annual rainfall totals of between 280 and 833 mm per year.

Conversely, evaporation data sourced from BoM 034038 indicates a similar seasonal trend, albeit monthly average totals significantly exceed monthly average rainfall totals. This is indicative of a sub-tropical climate with hot, moist summers and warm, dry winters.

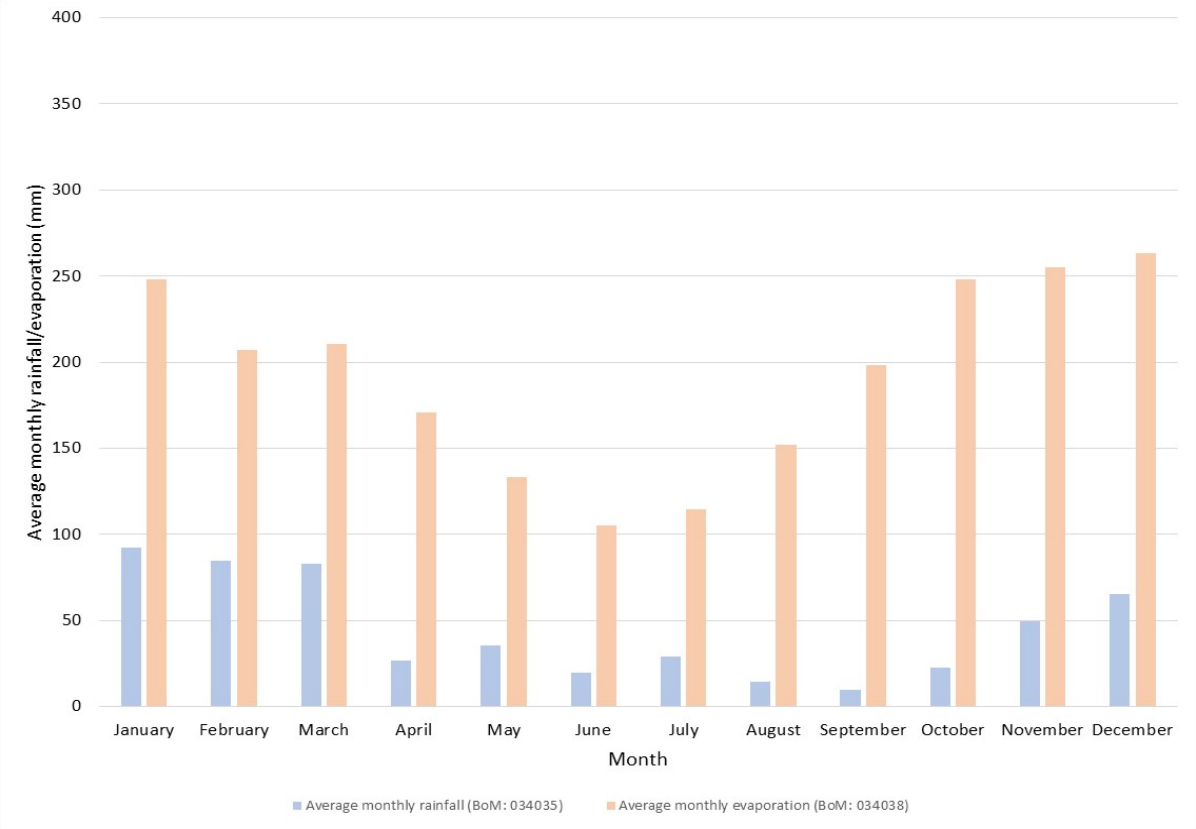


Figure 4.1 Average monthly historic rainfall and evaporation – 2012-2022 (BoM: 034035, BoM 034038)

4.3 Catchment hydrology

The Project footprint is located within the upper Isaac River sub-catchment, flanked to the south-west by the Peak Range, the Denham Ranges to the north-west, and the Broadsound and Connors Ranges to the east and north-east, respectively (refer Figure 4.2).

Drainage gradients in the Isaac River sub-catchment are generally low across the central part of the sub-catchment and high around the catchment extent, with elevations varying from over 700 m AHD in the elevated region of the Connors Range to approximately 90 m AHD at the Isaac River-Mackenzie River confluence (Pearce & Hansen 2006). The central portion of the sub-catchment, specific to the Project footprint, is flat lying with limited relief (SKM 2009).

There are two drainages of relevance to the Project footprint:

- unnamed drainage, tributary of Goonyella Creek (Isaac River sub-catchment); and
- Mabbin Creek, tributary of Diamond Creek (Suttor River sub-catchment).

4.4 Geological setting

The Project is located within the Permo-Triassic aged Bowen Basin, a geological depression occupying an area of approximately 200,000 km^2, extending from Collinsville in the north to Rolleston in the south.

The surface geology mapped across the Project footprint is varied, with approximately half the Project footprint covered by Late Tertiary and Quaternary unconsolidated sediments. The characteristics of the superficial Quaternary alluvium reflect the nature of the source rocks, weathering, transport, and depositional conditions. Poorly sorted clay, silt, sand and gravel represent floodplain alluvium: locally mottled, poorly consolidated sand, silt, clay and minor gravel, generally dissected by high-level alluvial deposits reflect present stream valleys.

The Tertiary sediment cover includes thick, clay-rich laterite, a result of the laterisation of Permian units during the Tertiary period. In addition, Tertiary aged infill includes palaeochannel deposits and basalt flows provide surficial cover across the Project footprint. The major Tertiary formations mapped in the Project footprint include the Suttor Formation. Below this unit, and of little consequence, given the scale of the Project, to this assessment, are the older Triassic and Permian aged sediments associated with the development of the mining industry across the Bowen Basin.

A stratigraphic summary of the geological units of consequence to this assessment is summarised in Table 4.1 and shown on Figure 4.3.

Table 4.1 Project footprint stratigraphy

Period	Stratigraphic unit			Description
Quaternary	Alluvium			Clay, silts, sand, gravel, floodplain alluvium
Tertiary	Basalt			Olivine basalt flows
	Suttor Formation			Clays, silts, sands, gravel, colluvial and residual deposits, fluvial and lacustrine deposits
Triassic	Mimosa Group	Rewan Formation		Green lithic sandstone, pebble conglomerate, red and green mudstone
Permian	Blackwater Group	Rangal Coal Measures		Sandstone, siltstone, sandstone, coal, tuff
		Fort Cooper Coal Measures	Burngrove Formation	Mudstone, siltstone, sandstone, coal, tuff
			Fair Hill Formation	Labile sandstone, quartzose sublabile sandstone, siltstone, mudstone, calcareous and tuffaceous sandstone, volcanic conglomerate, carbonaceous mudstone, coal
		Moranbah Coal Measures		Quartzose to sublabile, locally argillaceous sandstone, siltstone, mudstone, carbonaceous mudstone and coal
	Black Creek Group			Quartzose to lithic sandstone, siltstone, carbonaceous shale, minor coal and sandy coquinite

4.5 Hydrogeology

The local hydrogeological regime comprises:

- shallow, unconfined and temporary groundwater of limited extent associated with the near-surface Quaternary sediment deposits occupying valley flats and riparian corridors;
- shallow and deep, unconfined to semi-confined groundwater in Tertiary sediment deposits;
- localised fractured rock groundwater systems in Tertiary basalt deposits; and
- a regional fractured rock groundwater system associated with the underlying Permian sedimentary sequences.

4.5.1 Quaternary-aged sediments

This unproven groundwater system comprises a mix of alluvium and colluvium, consisting of sand, silt, clay and gravel, presenting consistently across the Project footprint.

The shallower deposits, comprising sand and gravel support two minor drainages; Mabbin Creek and an unnamed tributary to the Goonyella Creek (herein referred to as Watercourse A). The Mabbin Creek has its headwaters originating directly west of the Project, whilst Watercourse A is traversed by the proposed interconnected pipeline approximately four km west of Red Hill Road.

It is assumed and supported through government mapping (BoM 2022) that this shallow system is episodically recharged during flooding events, holding water in storage which is accessed by riparian vegetation opportunistically. Reported depth to groundwater across the study area varies but can be as shallow as 6.5 mbgl in the nearby Tertiary-aged basalt deposits (refer RN162631). Aquifer hydraulic properties for the Isaac River bed sands and flood plain sediments were obtained from investigations undertaken at the nearby Moranbah North mine (JBT Consulting 2010). Investigations determined that permeability of the alluvium ranged from 8.9 to 45.4 metres per day (m/day), indicative of a highly permeable system.

Groundwater residence time within the alluvium is expected to be relatively short with ongoing discharge to terrestrial riparian vegetation and through high evaporative losses.

4.5.2 Tertiary-aged sediments

The undifferentiated Tertiary sediments and differentiated Suttor Formation outcrops extensively across the Project footprint, sub-cropping in areas below the younger Quaternary-aged alluvial sediments have accumulated, such as within drainage channels. URS 2013 report a range in thickness of the unit of between 15–80 m. Groundwater is observed to be limited by the unit's high clay content, restricting recharge, groundwater flow and increasing groundwater residence times, thereby contributing to elevated salinity. This is supported by interpreted hydraulic conductivity values of 6.6×10^{-4} m/day. Indicative of a groundwater system restricted by a low porosity sediment unit (URS 2013).

4.5.3 Tertiary-aged basalt deposits

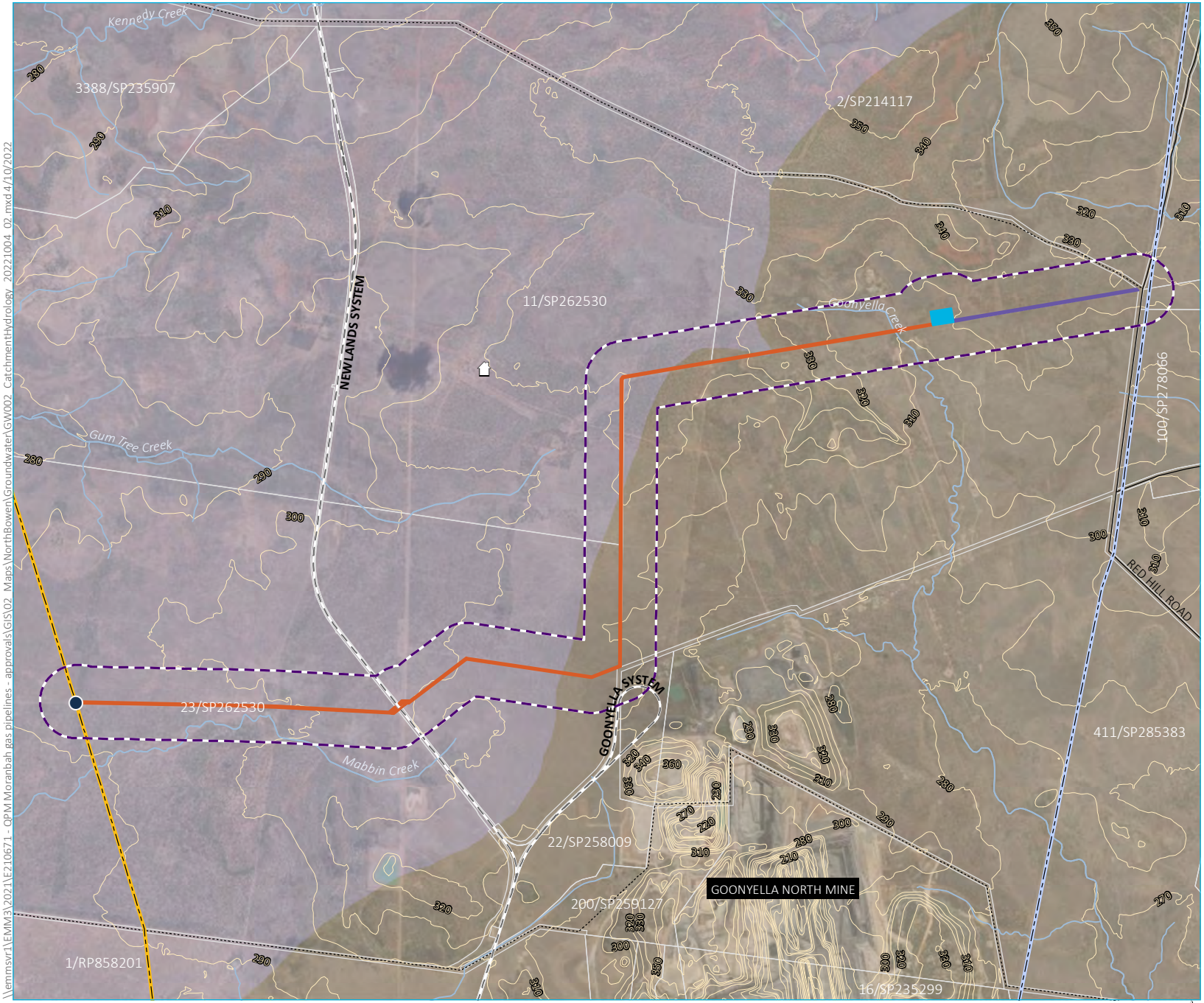
Discontinuous volcanic basaltic remnants features occur across the Project footprint, outcropping to the eastern and northern extent of the Project footprint. URS 2013 report this Tertiary-aged basalt deposits as extremely weathered, clayey and mostly dry. Groundwater flow is inferred to occur via fracture flow along fracture lineaments, bedding planes and other discontinuities in the rock matrix.

Groundwater recharge is considered to be limited by the high clay content of the unit and supported by the saline condition of the groundwater system. Discharge typically occurs at geological contact or where fracture lineaments extend to surface. Several groundwater dependent ecosystems are mapped as having a high potential for groundwater interaction adjacent to basalt outcrops, likely accessing intermittent spring flow.

4.5.4 Triassic-Permian-aged - fractured rock groundwater system

The Triassic to Permian aged geological units of the Blackwater Group and the Black Creek Group are the main groundwater bearing units located within the Project footprint. These sedimentary units, comprising interbedded sandstone, mudstone, siltstone and coal, have stratified confining and water bearing lenses, with groundwater typically hosted in the coal seams, confined by the relatively 'tight' interburden.

Groundwater within the Permian coal seams has low to moderate permeability and extremely saline, thought to recharge slowly via downward seepage or throughflow from overlying and adjacent Quaternary and Tertiary alluvial groundwater systems.



KEY

- Study area (500 m buffer)
- Gas compression facility
- Pipeline
- Access road
- Homesteads
- Hot tap
- North Queensland Gas Pipeline
- Water pipeline
- Rail line
- Minor road
- Vehicular track
- Watercourse/draingage line
- Topographic contour (10 m interval)
- Cadastral boundary

Water plan catchments

- Belyando Suttor (E)
- Isaac Connors

Source: EMM (2022); DES (2019); DNRME (2022); ESRI (2022)

0 1 2 km

GDA 1994 MGA Zone 55

N

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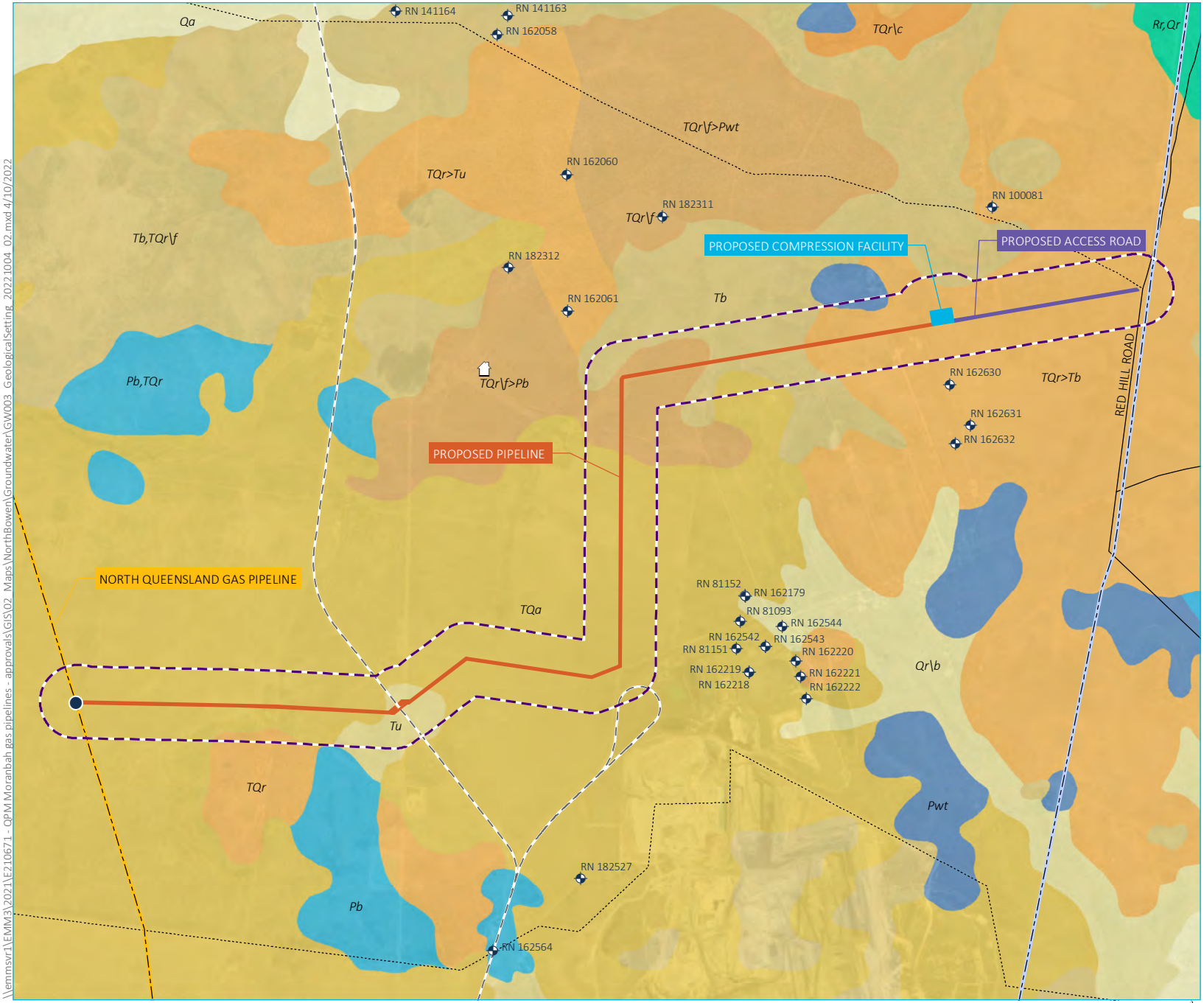
Catchment hydrology

QPM Energy Project
Groundwater
Figure 4.2

EMM
creating opportunities



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Source: EMM (2022); DNRME (2022); GA (2011); ESRI (2022); Qld Globe (2022)

GDA 1994 MGA Zone 55

Geological setting

QPM Energy Project
Groundwater
Figure 4.3

EMM creating opportunities

5 Identification of groundwater receptors

5.1 Overview

The receptors of interest are existing groundwater users and ecosystems that are potentially dependent on groundwater. Surface water users and stream environments are identified and characterised in the *Surface Water Impact Assessment* (EMM 2022).

5.2 Private landholder bores

The Queensland Globe groundwater database has been searched to identify records of private landholder bores within 10 km of the Project footprint.

The search revealed 26 groundwater bores within a 10 km search radius of the Project, consisting of:

- six private landholder bores, three of which have been abandoned/decommissioned;
- 19 monitoring bores registered for mine monitoring; and
- one bore registered for petroleum and CSG exploration.

Bore details (where available) are summarised in Table 5.1.

Reported total bore depths ranged between 6.5 and 137.5 metres Below Ground Level (m BGL) for bores registered for either private or monitoring use. A single bore registered for CSG exploration has a reported bore depth of 872.1 m BGL. Reported standing water levels (SWL) ranged in depth of between 6.5–99.99 m BGL. Most bores are located to the south of the Project footprint, proximal to the adjacent mine. Measured yields in private water bores, where reported, were generally low, ranging between 0.07–4.5 litres per second (L/s). Existing usage across operational landholder bores was not available to inform this assessment.

Table 5.1 Queensland Globe groundwater database search results

Bore ID	Registered number	Owner	Status	Total depth (m)	SWL (mBGL)[1]	Yield (L/s)[2]	Target groundwater system
1	81093	Private	Abandoned	137.5	-	-	-
2	81151	Private	Abandoned	186.0	-	-	-
3	81152	Private	Abandoned	107.0	32.65	-	Basalt Volcanic
4	100081	CSG – exploration	Existing	872.1	-	-	Moranbah Coal Measures
5	132496	Private	Existing	79.6	50.00	1.10	Black Creek Group
6	141163	Monitoring	Existing	113.0	27.55	-	Basalt Volcanic
7	141164	Monitoring	Abandoned	136.5	99.99	2.13	Basalt Volcanic
8	162058	Monitoring	Abandoned	89.0	-	-	Black Creek Group
9	162060	Monitoring	Existing	71.0	-	3.23	Basalt Volcanic

Table 5.1 Queensland Globe groundwater database search results

Bore ID	Registered number	Owner	Status	Total depth (m)	SWL (mBGL)[1]	Yield (L/s)[2]	Target groundwater system
10	162061	Monitoring	Existing	52.0	41.96	0.46	Basalt Volcanic
11	162542	Monitoring	Existing	11.0	-	-	Quaternary – alluvium
12	162543	Monitoring	Existing	14.0	-	-	Quaternary – alluvium
13	162544	Monitoring	Existing	11.0	-	-	Quaternary – alluvium
14	162545	Monitoring	Existing	8.0	-	-	Fort Cooper Coal Measures
15	162179	Monitoring	Existing	96.0	-	-	Basalt Volcanic
16	162218	Monitoring	Existing	6.5	-	-	Fill
17	162219	Monitoring	Existing	10.5	-	-	Fill
18	162220	Monitoring	Existing	11.0	-	-	Fill
19	162221	Monitoring	Existing	11.5	-	-	Fill
20	162222	Monitoring	Existing	16.5	-	-	Fill
21	162630	Monitoring	Existing	35.0	9.00	0.20	Basalt Volcanic
22	162631	Monitoring	Existing	26.0	9.50	0.08	Basalt Volcanic
23	162632	Monitoring	Existing	21.0	6.50	0.25	Basalt Volcanic
24	182527	Monitoring	Existing	77.0	48.20	0.07	Black Creek Group
25	182311	Private	Existing	117.1	90.66	1.90	-
26	182312	Private	Existing	118.9	34.13	4.50	-

Notes: 1. mBGL = metres Below Ground Level; and

2. L/s = litres per second.

5.3 Potential groundwater dependent ecosystems

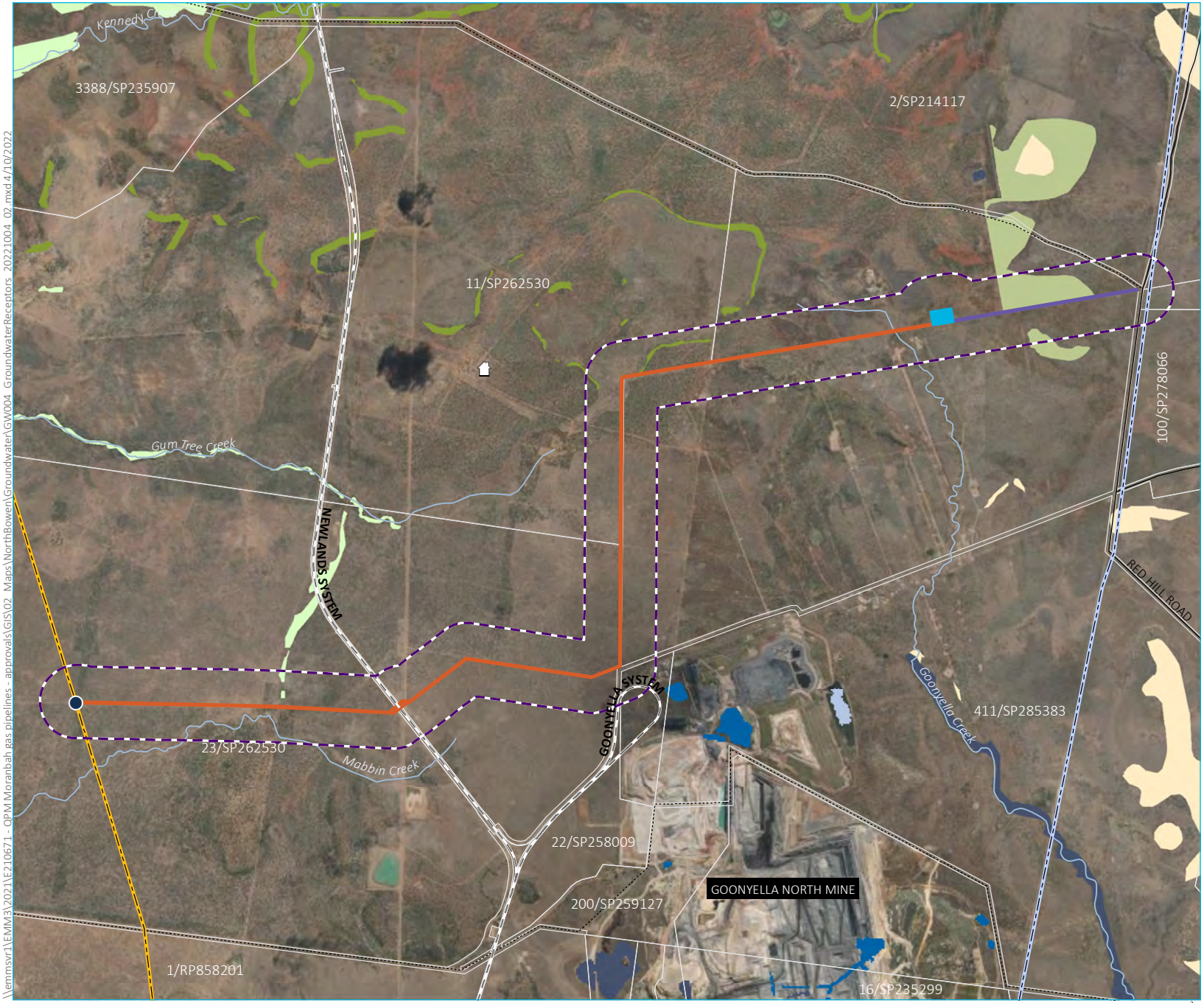
A desktop assessment was undertaken to identify potential groundwater dependent ecosystems within the vicinity of the Project footprint and surrounding area. The desktop assessment involved:

- review of the Groundwater Dependent Ecosystem (GDE) Atlas (BoM) 2022);
- collation of depth to groundwater information from the QLD Globe database; and
- a review of aerial photographs, topographic and geological maps.

A review of the BoM GDE Atlas (BoM 2022) identified eucalypt woodland, tussock grass, and rainforest and vine thicket plant communities located within the vicinity of the Mabbin Creek catchment and adjacent floodplain sediments. These features are noted in BoM (2022) as having a high potential for dependence on the surface expression of groundwater and subsurface groundwater, associated primarily with the shallow Quaternary and Tertiary alluvial sediments (refer Figure 5.1).

Ecosystem dependence associated with these plant community types are thought to have a facultative-opportunistic reliance on groundwater, accessing temporary groundwater within shallow alluvial sediments immediately following flooding events.

There are no mapped cave or aquifer ecosystems in the vicinity of the site.



KEY

- Study area (500 m buffer)
- Gas compression facility
- Pipeline
- Access road
- Homesteads
- Hot tap
- North Queensland Gas Pipeline
- Water pipeline
- Rail line
- Minor road
- Vehicular track
- Cadastral boundary

Aquatic groundwater dependent ecosytems

- High potential - regional studies
- High potential - national assessment
- Moderate potential - national assessment
- Low potential - regional studies
- Low potential - national assessment

Terrestrial groundwater dependent ecosytems

- High potential - regional studies
- Moderate potential - national assessment
- Low potential - regional studies
- Low potential - national assessment

Source: EMM (2022); BoM (2022); DES (2019); DNRME (2022); ESRI (2022)

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Groundwater receptors

QPM Energy Project
Groundwater
Figure 5.1

EMM
creating opportunities

6 Impact assessment

6.1 Overview

The location of the proposed Project is within the Isaac River sub-basin of the Fitzroy Basin as described in Schedule 1 of the EPP (Water and Wetland Biodiversity). The scheduled environmental values for groundwater to be 'enhanced or protected' in the Project footprint include the following qualities:

- biological integrity of aquatic ecosystems;
- suitability for recreational use (primary recreation);
- suitability for minimal treatment before supply as drinking water;
- suitability for use in primary industries (irrigation, farm supply, stock water); and
- cultural and spiritual values.

This chapter involves a risk assessment which will evaluate the potential direct and indirect impacts arising from the construction and operation of the Project, in-line with the relevant environmental values.

6.2 Risk assessment approach

A National Water Commission (NWC) risk framework (Moran 2010) has been adopted for the groundwater risk assessment. The framework uses a source-pathway-analysis that describes how water-affecting activities might impact on sensitive groundwater receptors. For an effect to occur to a sensitive water receptor, a pathway must exist between a water-affecting activity and a receptor. Risks are characterised by making an informed decision as to the potential for adverse effects to impact sensitive groundwater receptors because of Project-related activities, while also considering relevant groundwater environmental values (EPP (Water and Wetland Biodiversity)).

The impact assessment qualifies the risk from water-affecting activities and involves assessing the potential consequences arising from the water-affecting activities in terms of direct effects (ie altered water resource condition, Section 6.2.2) and of possible indirect effects at identified receptors (Section 6.2.3). The risk assessment also provides a basis for communicating risks and consequences and identifying the management approach that may be necessary to eliminate or reduce risk. Results of both existing and new monitoring data will be used to review the effectiveness of management measures over the construction and operation of the Project.

6.2.1 Risk assessment criteria

The likelihood, consequence and risk scoring criteria used to characterise unmitigated and mitigated residual risk are defined in Table 6.1, Table 6.2 and Table 6.3, respectively.

Table 6.1 Likelihood criteria

Likelihood	Description	Frequency
A) Almost certain	Can be expected to occur in most circumstances.	>85%
B) Likely	Will probably occur in most circumstances.	40–85%
C) Possible	Might occur at some time.	20–40%
D) Unlikely	Could occur at some time.	5–20%
E) Rare	May only occur in exceptional circumstances.	<5%

Table 6.2 Consequence criteria

Rating	Description
5. Severe: Widespread serious permanent effect	Incident is reportable to the regulator, serious permanent/persistent and irreversible damage is caused, significant public interest and media coverage and/or uncontained impacts.
4. Major: Widespread, moderate to long-term effect	Incident is reportable to the regulator and notable damage is caused to an area or asset from which it will take more than 10 years to recover with long-term evidence of the incident resulting, or incident is reportable to the regulator and public concern raised.
3. Moderate: Localised, short-term to moderate effect	Moderate but repairable damage that will take up to 10 years to recover, or incident is reportable to the regulator.
2. Minor: Localised short-term effect	Minor damage to the environment or heritage asset or area that is immediately contained on-site. It will take less than two years for the resource or asset to fully recover or it will only require minor repair, or disturbance to scarce or sensitive environmental or heritage resources.
1. Insignificant: No impact or no lasting effect	Negligible damage that is contained on-site, or the damage is fully recoverable with no permanent effects, taking less than three months to fully recover

Table 6.3 Risk assessment matrix

Likelihood	Consequence				
	1) Insignificant	2) Minor	3) Moderate	4) Major	5) Severe
A) Almost certain	Medium A1	Medium A2	High A3	Extreme A4	Extreme A5
B) Likely	Low B1	Medium B2	High B3	Extreme B4	Extreme B5
C) Possible	Low C1	Low C2	Medium C3	High C4	High C5
D) Unlikely	Low D1	Low D2	Low D3	Medium D4	Medium D5
E) Rare	Low E1	Low E2	Low E3	Low E4	Medium E5

6.2.2 Direct effects on groundwater

Direct effects encompass changes to the water resource, extending to both water quality or 'physical' (ie storage, groundwater flow paths, levels and pressure) as a result of an activity or change to the existing environment. Direct effects arising through the construction and operation of the Project are summarised in Table 6.4.

Direct effects encompass the changes to physical and/or quality aspects of groundwater due to water affecting activities, or the changes to the physical characteristics of aquifers affected by these activities.

6.2.3 Indirect effects on groundwater

Indirect effects typically occur as a response to direct effects, commonly impacting a sensitive receptor (ie GDE, third party bore). The assessment of potential receptor exposure to adverse changes in the groundwater regime (quantity, quality, groundwater and surface water interactions, and physical disruption of aquifers) requires:

- knowledge of the location of sensitive receptors within the landscape, particularly in relation to the location and area of influence of water affecting activities;
- an understanding of the receptor's reliance on groundwater (eg depth to water table, groundwater flux to baseflow-fed streams, groundwater quality to meet beneficial purposes); and
- an understanding of the spatial and temporal scale of direct groundwater effects at the location of sensitive receptors.

The indirect effects arising through the construction and operation of the Project are summarised in Table 6.5.

Table 6.4 Direct effects of water affecting activities and potential effects

Water affecting activity	Potential risk/effect	Project Phase	Likelihood	Consequence	Risk
Groundwater quantity					
Construction of Gas Compression Facility	Minor excavation works required to construct footings have the potential to interact with groundwater, temporarily inducing groundwater inflow and thereby locally depressurising the shallow Tertiary groundwater system. Nearby mine monitoring bores indicate that historic standing groundwater levels exceed 6.5 mBGL (URS 2013) and are therefore unlikely to be intercepted through the construction of the GCF.	Construction	Unlikely (D)	Insignificant (1)	Low (D1)
High pressure pipeline – trenching	Minor trenching excavation works required to lay the gas pipeline have the potential to cause temporary localised depressurisation of the shallow Quaternary and Tertiary alluvial groundwater system, specifically at the intersection with the Sunwater pipeline and the Newlands Rail Line. Trenching works below both the Sunwater pipeline and Newlands Rail Line will be undertaken via directional drilling to a maximum depth of 4 mBGL. Trenching is therefore unlikely to intercept the shallow watertable at either location.	Construction	Unlikely (D)	Insignificant (1)	Low (D1)
High pressure gas pipeline – open cut excavation	The high-pressure gas pipeline trenching works at the Goonyella Creek crossing will be completed as an open cut excavation during the dry season. There is the potential for the works to intercept shallow groundwater within the Goonyella Creek alluvial sediments, although depth to groundwater is unknown. Regardless, if groundwater is encountered, given the temporary nature of the works and the shallow cut, groundwater inflow volumes are likely to be negligible, generating little to no groundwater drawdown and indirect impact to downstream sensitive receptors.	Construction	Possible (C)	Minor (2)	Low (C2)

Table 6.4 Direct effects of water affecting activities and potential effects

Water affecting activity	Potential risk/effect	Project Phase	Likelihood	Consequence	Risk
Groundwater quality					
Temporary storage and transfer of contaminated wastewater	Oily water from the operation of the compressors will be collected in a closed drain system which is predominantly supplied from the blowdown from the GCF's compressor units. Other sources of water include slug catcher water from incoming low-pressure gas and oily water from the pig cleaning operation returned to site. The closed drain system will collect and de-gas the liquids discharged from the process equipment. A set of oily water transfer pumps are provided that will manage the liquid level in the closed drain drum. Oily water is transferred to the Oily Water Feed Tank for further processing. An oily water separation unit will screen the oil content of the water down to an acceptable level (<10 parts per million (ppm)) so that the treated (clean) water can be returned to the coal mine operator. The closed-loop arrangement of this activity does not present opportunity for contaminants to interact with the groundwater environment within the Project footprint. In the event that the closed loop design was compromised, with contaminated water exceeding storage capacity resulting in an uncontrolled release to the environment, there is the potential for wastewater contaminants to interact with shallow groundwater impacting the beneficial use of the system.	Operations	Rare (E)	Moderate (3)	Low (E3)

Table 6.4 Direct effects of water affecting activities and potential effects

Water affecting activity	Potential risk/effect	Project Phase	Likelihood	Consequence	Risk
Pipeline hydrostatic pressure testing	Following construction of the high-pressure gas pipeline, the Project will enter a commissioning phase involving various tests to ensure the structural integrity of key plant, equipment and infrastructure meet industry standards. As part of this exercise the high-pressure gas pipeline will undergo hydrostatic pressure testing. This activity involves pumping water at high pressure from one end of the pipeline to the other at a pressure which exceeds the performance criteria of the pipeline, thereby inducing stress to identify potential structural weaknesses. Once testing has concluded, wastewater will be evacuated using compressed air and directed to above ground tanks for offsite disposal. There is the potential for the uncontrolled release of water during both hydrostatic pressure testing and the evacuation of the line. Uncontrolled releases have the potential to interact with shallow groundwater, impacting the beneficial use of the system.	Construction (commissioning)	Possible (C)	Minor (2)	Low (C2)
Chemical and fuel spills during construction Hazardous goods storage	Fuels and chemicals used on site include lubricants, triethylene glycol (TEG) and diesel. These listed contaminants of concern are stored on site throughout construction and operation and regularly replenished to maintain plant and equipment functioning. There is the potential for contaminants to enter the environment via a failure in storage and/or replenishment processes.	Construction, operations	Possible (C)	Moderate (3)	Medium (C3)

Table 6.5 Indirect effects of water affecting activities and potential effects

Impacted environmental value	Potential risk/effect (source-pathway-receptor)
Groundwater quantity	
Aquatic ecosystems	There are no listed aquatic ecosystems within the study area.
Terrestrial ecosystems with potential groundwater dependence	Localised and temporary groundwater depressurisation has a low potential of occurring across the Project footprint, associated with the excavation and construction of the GCF and the high-pressure gas pipeline. Project activities have the greatest potential of intercepting shallow groundwater at the Sunwater pipeline crossing and at the Goonyella Creek crossing. Eucalypt woodland, tussock grass, and rainforest and vine thicket plant communities (PCT) are each mapped as having a high dependence on groundwater (BoM 2022), however each PCT are characterised as having a facultative-opportunistic dependence on groundwater and as such, are unlikely to be adversely impacted if access is restricted through the temporary depressurisation of groundwater.
Third party bores	Third party bores, listed in Table 5.1, are unlikely to be impacted by the Project given the temporary and minor nature of subsurface workings and their proximity to these activities.
Groundwater quality	
Aquatic ecosystems	There are no listed aquatic ecosystems within the study area.
Terrestrial ecosystems with potential groundwater dependence	Eucalypt woodland, tussock grass, and rainforest and vine thicket plant communities (PCT) are each mapped as having a high dependence on groundwater (BoM 2022), however each PCT are characterised as having a facultative-opportunistic dependence on groundwater. Uncontrolled releases of potentially contaminated wastewater or contaminants of concern, such as lubricants, TEG or diesel have the potential to interact with groundwater and indirectly impacting these communities.
Third party bores	Third party bores, listed in Table 5.1, are unlikely to be impacted by the Project given the temporary and minor nature of subsurface workings and their proximity to these activities.
Surface water-groundwater connectivity	
Aquatic ecosystems	There are no listed aquatic ecosystems within the study area.

7 Mitigation measures

The following summary tables, detailed in Table 7.1 (direct impacts) and Table 7.2 (indirect impacts) considers management and mitigation measures for each of the direct and indirect water affecting activities characterised in Table 6.4 and Table 6.5.

A qualitative residual risk to groundwater following the implementation of relevant management and mitigation measures id discussed in both tables with consideration to key legislation, regulation, policies and guidelines (refer Table 3.1).

Table 7.1 Direct groundwater effects residual risk assessment

Water affecting activity	Project phase	Assessment with mitigation actions/controls	Residual risk
Groundwater quantity			
Construction of Gas Compression Facility	Construction	The following environmental management controls are proposed to mitigate risk: • excavation and construction of footings will be limited to 4 mbgl and is therefore unlikely to intersect groundwater; and • if works do intercept groundwater, inflows are expected to be temporary and will be contained on-site in sumps. The risk associated with impacting groundwater quantity through depressurisation of shallow groundwater associated with this activity, given the proposed controls, is considered low.	Low (E1)
High pressure pipeline - trenching	Construction	The following environmental management controls are proposed to mitigate risk: • trenching works will typically be completed at 2 mbgl and above the water table; • deeper trenching, occurring below the Sunwater pipeline at a depth of 4 mbgl, is not expected to intercept shallow groundwater; and • if works do intercept groundwater, inflows are expected to be temporary and will be contained on-site in sumps. The risk associated with impacting groundwater quantity through depressurisation of shallow groundwater associated with this activity, given the proposed controls, is considered low.	Low (E1)
High pressure pipeline – open cut excavation	Construction	The following environmental management controls are proposed to mitigate risk: • open cut works across Goonyella Creek will take place during the dry season; • the works are expected to remove alluvial sediments within the creek to a maximum depth of 2 mbgl and are not expected to interact with groundwater; and • if works do intercept groundwater, inflows are expected to be temporary and will be contained on-site in sumps. The risk associated with impacting groundwater quantity through depressurisation of shallow groundwater associated with this activity, given the proposed controls, is considered low.	Low (D2)

Table 7.1 Direct groundwater effects residual risk assessment

Water affecting activity	Project phase	Assessment with mitigation actions/controls	Residual risk
Groundwater quality			
Temporary storage and transfer of contaminated wastewater	Operations	The following environmental management controls are proposed to mitigate risk: • "Wet" gas will be dehydrated and compressed at the proposed GCF. The wastewater stream separated from this activity will enter a closed loop stream. The oily water separation facility separates the oil content of water removed from the gas product which will be temporarily stored in an oil loadout tank to be removed by truck via a licenced waste disposal operator. • If the Project encounters an uncontrolled release of contaminated wastewater from the GCF, QPM Energy will contain the spill and remediate as required following a detailed site investigation. The risk associated with impacting groundwater quality through contaminant release associated with this activity, given the proposed controls, is considered low.	Low (E2)
Pipeline hydrostatic pressure testing	Construction (commissioning)	The following environmental management controls are proposed to mitigate risk: • potable water will be transferred to site and stored in above ground tanks for use during hydrostatic pressure testing of the high-pressure gas pipeline; • wastewater that is generated by this activity will be returned back to the above ground tanks and transferred offsite for disposal at an appropriate facility; and • uncontrolled releases of pressurised water which may exit at various points along the pipeline will be monitored and if possible, contained. This is however, considered highly unlikely. The risk associated with impacting groundwater quality through contaminant release associated with this activity, given the proposed controls, is considered low.	Low (D2)
Chemical and fuel spills during construction Hazardous goods storage	Construction, operations	The following environmental management controls are proposed to mitigate risk: • chemicals and fuels will be appropriately stored in bunded designated areas of the GCF as per the supplier recommendations detailed in the material Safety Data Sheets (SDS); • refuelling of diesel will again take place in a controlled and bunded area, limiting interaction with the environment; • QPM Energy will monitor the performance of engineered bunds to ensure the migration of chemicals and diesels does not interact with the environment; and • plant and equipment will be audited on a weekly basis to limit the potential for oil and fuel leaks when operating across the Project footprint, and specifically adjacent to Goonyella Creek. The risk associated with impacting groundwater quality through contaminant release associated with this activity, given the proposed controls, is considered low.	Low (D2)

Table 7.2 Indirect groundwater effects residual risk assessment

Impacted environmental value	Assessment with mitigation actions/controls
Groundwater quantity	
Aquatic ecosystems	Environmental values are not anticipated to be impacted by the Project, with respect to maintaining access to groundwater.
Terrestrial ecosystems with potential groundwater dependency	
Third party bores	
Groundwater quality	
Aquatic ecosystems	Environmental values are not anticipated to be impacted by the Project, with respect to maintaining access to consistent groundwater quality.
Terrestrial ecosystems with potential groundwater dependency	
Third party bores	
Surface water-groundwater interaction	
Aquatic ecosystems	Environmental values are not anticipated to be impacted by the Project, with respect to maintaining access to intermittent groundwater baseflow contributions.

8 Conclusions

This GIA forms part of the environmental risk assessment for the QPM Energy Project. The assessment has been informed by the concept design for the Project. The following aspects have been addressed by the GIA:

- assessment of environmental and human users dependent on groundwater, including:
  - GDEs; and
  - landholder water supplies;
- management of groundwater during construction of the Project, including:
  - consideration of excavation sequencing and its influence on groundwater inflow and environmental impacts; and
  - changes to water quality due to construction associated with the storage and replenishment of potential contaminants of concern;
- impacts to groundwater during the operation of the Project including potential changes to groundwater quality associated with the uncontrolled release of wastewater generated by both the GCF and as a by-product of hydrostatic pressure testing; and
- assessment of the Project against listed environmental values for the Fitzroy Basin, including:
  - biological integrity of aquatic ecosystems;
  - suitability for recreational use (primary recreation);
  - suitability for minimal treatment before supply as drinking water;
  - suitability for use in primary industries (irrigation, farm supply, stock water); and
  - cultural and spiritual values.

The Project is not expected to interact with groundwater through the construction, operational or decommissioning phases and as such, impacts to groundwater quantity, groundwater quality and surface water-groundwater interactions are expected to be negligible. Indirectly, identified sensitive environmental receptors and the Fitzroy Basin EVs are not anticipated to be impacted by the Project.

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