Appendix D

Surface Water

QUEENSLAND PACIFIC METALS

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QPM Energy Project

Surface Water Technical Report

Prepared for Queensland Pacific Metals

October 2022

QPM Energy Project

Surface Water Technical Report

Queensland Pacific Metals

E210671 RP1x

October 2022

Version	Date	Prepared by	Approved by	Comments
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Abbreviations

Table 1 Abbreviations

Abbreviation	Term
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZG	Australian and New Zealand Guidelines for Fresh and Marine Water Quality
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BoM	Bureau of Meteorology
DES	Department of Environment and Science (QLD)
DoR	Department of Resources
EA	Environmental Authority
EAR	Environmental Assessment Report
ERA	Environmentally Relevant Activity
ESC	Erosion and Sediment Control
EV	environmental value
GBR	Great Barrier Reef
GCF	Gas Compression Facility
ha	hectare
IECA	International Erosion Control Association
km	kilometre
kPa	kilopascal
m	metre
mAHD	metres relative to Australian Height Datum
mm	millimetre
mbgl	meters below ground level
NQGP	North Queensland Gas Pipeline
PESCP	Progressive Erosion and Sediment Control Plan
QPM Energy	Queensland Pacific Metals Energy
RMP	Rehabilitation Management Plan
RWQIP	Regional Water Quality Improvement Plan
TEG	triethylene glycol
TJ/d	terajoules per day
WQO	water quality objective

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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 North Queensland Gas Pipeline (NQGP).

The Project proposes to collect waste coal mine gas at the proposed GCF via waste gathering lines located at Wards Well Coal Mine. 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 in turn it will be depressurised and distributed, by a third party, to industrial users, including the QPM Townsville Energy Chemicals Hub (TECH) Project.

The Project is located approximately 43 kilometres (km) north of Moranbah.

1.2 Purpose of this report

This report has been prepared by EMM Consulting Pty Limited (EMM) on behalf of QPM in support of an application for a new Environmental Authority (EA) for a resource activity, as part of the Project.

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

The key objectives of this surface water assessment are to:

- describe the Project and proposed surface water management;
- review and summarise the relevant legislative and regulatory context;
- characterise the existing surface water environment based on available data including climate, catchment context, receiving watercourses, other relevant surface water features, water quality and any sensitive downstream receptors;
- identify and assess potential impacts to the surface water environment from the Project through discharge of stormwater and modification to surface water drainage systems; and
- provide mitigation, monitoring and management measures to minimise potential impacts.

A soils assessment has also been completed for the Project (refer Appendix F of the Environmental Assessment Report (EAR)). The soils assessment closely relates to this surface water assessment in terms of assessing the potential for soil erosion and associated surface water quality impacts.

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

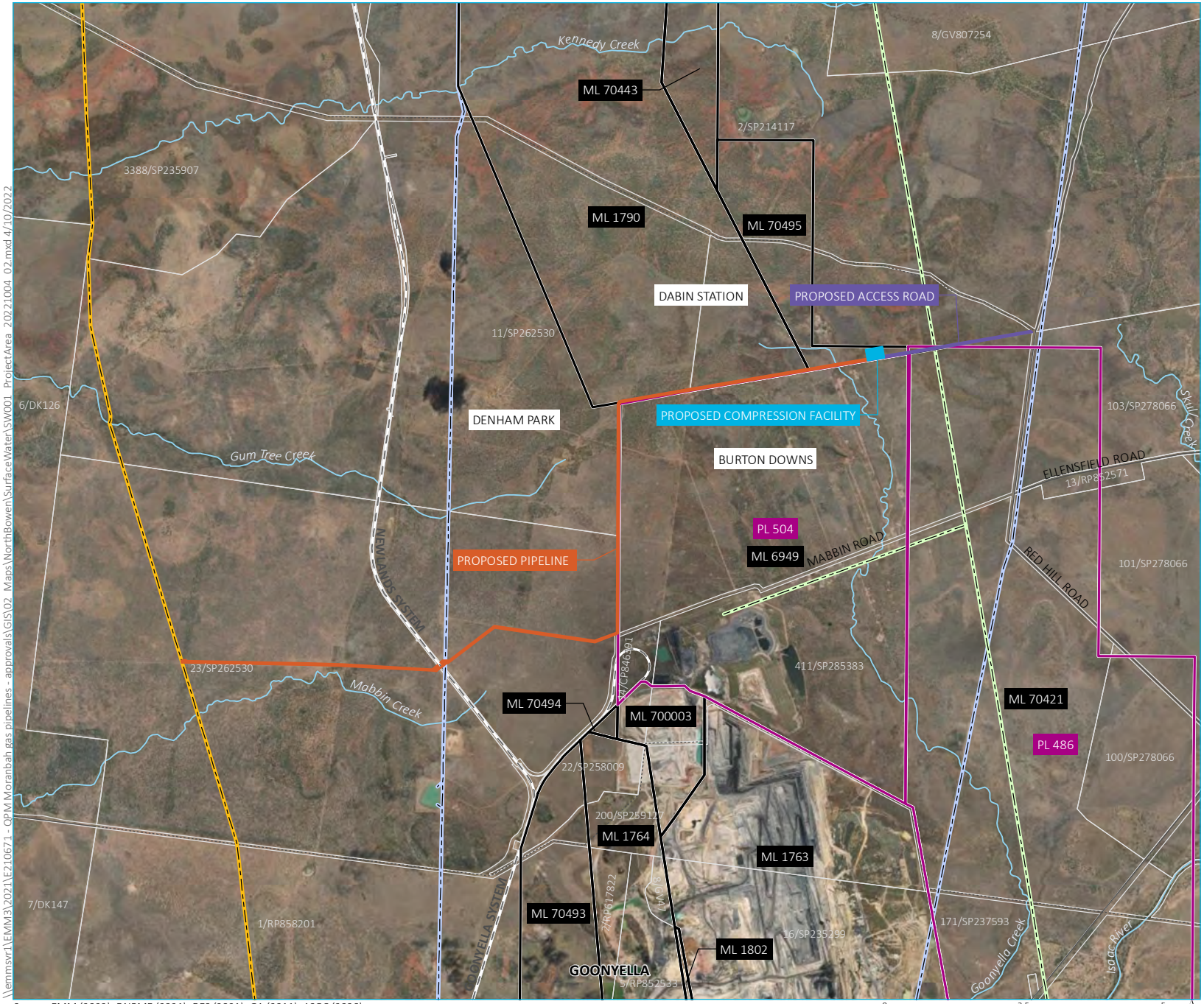
1.3 Project footprint and study area

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

- Gas Compression Facility – 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.

For the purposes of this contamination and waste assessment, the study area comprises a nominal search radius of up to 500 m radius from the high-pressure pipeline corridor and GCF.

The site locality is 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

Site locality

QPM Energy Project
Surface water
Figure 1.1

EMM creating opportunities

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

0 2.5 5 km

GDA 1994 MGA Zone 55

N

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2 Project description

2.1 Project 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 from 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 in turn 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 an 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 Environmental Assessment Report.

2.2 Key project components

Table 2.1 describes the key 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 2.8 km west of the Red Hill Road reserve. • Sited on a 200 m by 300 m pad. • 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 fence lines and 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.

2.3 Project description influencing surface water matters

Chemicals and large machinery utilised onsite will be managed in accordance with relevant Australian Standards and manufacturer specifications. Bunding will be installed for each compressor and other facilities including generators, triethylene glycol (TEG) units, fuel storage tank and TEG make-up tank to contain potential leaks and spills.

Contaminated water sourced from dehydration of feed gas as well as blowdown from the gas compressor units will be processed through an oily water separation unit supplied by a closed drain system. This may also include water generated during pipeline cleaning or 'pigging' activities. Recovered water from the oily water separation unit will be tested and returned to the relevant raw gas supplier for reuse in accordance with their approved operations. Water or waste products that are otherwise unsuitable for mining reuse will be segregated and trucked offsite for disposal at a licenced facility.

Runoff from buildings will be captured and stored in rainwater tanks for ongoing operational purposes. This will be supplemented with potable water sourced under commercial agreement and trucked to site as required.

Further detail on the project description is provided in the Environmental Assessment Report (EMM, 2022) which is the key document supporting the EA application.

The Project incorporates a range of measures to eliminate or minimise potential impacts to surface water. The overarching water management objectives comprise:

- minimising disturbance to, and appropriate rehabilitation of, existing watercourses;
- locating infrastructure away from flood prone land near watercourses and overland flow paths where possible, and otherwise minimising offsite flooding impacts;
- minimising changes to existing downstream flow paths, flow rates and scour potential;
- eliminating water quality risks to the downstream receiving environment where possible, and otherwise minimising such risks; and
- minimising water use and demand for imported water.

The following sections provide an overview of proposed water management practices and provide a basis for assessment of potential impacts presented in Section 6.

3 Legislation, policies, standards, and guidelines

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

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

Document	Relevance to the assessment
Legislation and regulations	
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 the ecological processes on which life depends (ecologically sustainable development). The EP Act identifies and provides for the protection of environmental values (EVs) for Queensland waterways, and groundwater, within and surrounding the Project. An EV under the EP Act includes a quality and physical characteristic of the environment that is conductive to ecological or human health. Surface water management is administered under the EP Act via the following policies and regulations, which are expanded below in this table: • *Environmental Protection (Water and Wetland Biodiversity) Policy 2019*; and • Environmental Protection Regulation 2019.
*Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (*EPP (Water and Wetland Biodiversity))	The EPP (Water and Wetland Biodiversity) is the primary instrument for surface water management under the EP Act. The EPP (Water and Wetland Biodiversity) defines EVs and management goals for Queensland waters and outlines the water quality guidelines and water quality objectives (WQOs) to enhance or protect those values. The Project lies within two defined river basins: • Burdekin River Basin; and • Fitzroy River Basin. EVs and WQOs relevant to the Project are presented in Section 4.2.2.
Environmental Protection Regulation 2019 (EP Regulation)	The objective of the EP Regulation 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.
Fisheries Act 1994 (Fisheries Act)	The Fisheries Act sets out responsibilities for the economically viable, socially acceptable, and ecologically sustainable development of Queensland's fisheries resources. Waterway barrier works may inhibit the free movement of fish along waterways and onto floodplains, injure fish and affect fish health and habitat. Waterway barrier works include activities such as dams, weirs, culverts, bridges, bed level crossings, causeways and bunding. Waterway barrier works are generally considered assessable development under the Planning Act. However Schedule 6, Part 5, Item 22 of the Planning Regulation 2017 (Planning Reg) lists development that cannot be made assessable under a local government planning scheme and includes: Development for a petroleum activity as defined under the EP Act, Section 111.
Water Act 2000 (Water Act)	The Water Act provides a framework to deliver sustainable water planning, allocation, management, and supply of water resources in Queensland. The Water Act is administered by the Department of Resources (DoR). A watercourse is defined by the Water Act as a river, creek or stream in which water flows permanently or intermittently and includes the bed and banks and any other element of a river, creek or stream confining or containing water. DoR have published a 'Watercourse Identification Map' that identifies watercourses and drainage features to assist in determining what authorisations are needed to take water from a watercourse or undertake other activities as covered under the Water Act.

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

Document	Relevance to the assessment
Policies, standards, guidelines	
The Reef 2050 Long-Term Sustainability Plan	The *Reef 2050 Long-Term Sustainability Plan* (CoA 2018) (the Reef 2050 Plan) provides an overarching framework for managing the Great Barrier Reef (GBR). It focuses on actions to address key threats and build the health and resilience of the reef in the face of a changing climate. The *Reef 2050 Water Quality Improvement Plan* (SoQ 2018) (the Reef 2050 WQIP) is a sub-plan of the Reef 2050 Plan and identifies management and monitoring requirements for all land-based pollution to improve the quality of water flowing from catchments adjacent to the reef. The Reef 2050 WQIP provides an overarching framework to deliver strategic priorities across reef catchments. Regional Water Quality Improvement Plans (RWQIPs) guide the implementation of projects within regions and specific catchments. The regional plans support the Reef 2050 WQIP by providing locally relevant information and guiding local priority actions within catchments. Relevant RWQIPs comprise: • Burdekin Region Water Quality Improvement Plan 2016; and • Fitzroy Water Quality Improvement Plan 2015. The intent and objectives of these plans have been considered in this assessment. Priorities for water quality improvement generally target sediment and nutrient loads potentially mobilised into watercourses.
Australian and New Zealand Guidelines for Fresh and Marine Water Quality	The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, prepared by the Australian and New Zealand Environment and Conservation Council (ANZECC) and the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000) describe the water quality objectives for marine and freshwater environments, aquatic ecosystems, primary industries, and recreational water. The guidelines should be considered when setting water quality objectives for natural and semi-natural water resources in Australia and New Zealand sustaining current or likely future environmental values (uses). They also set out a framework for the application of water quality trigger levels. Further revisions to the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* were made in 2018 with the release of a web-based guideline (ANZG 2018). The revised default guideline values for chemical contaminants/toxicants that are relevant to the Project footprint are consistent with ANZECC/ARMCANZ (2000).
Best Practice Erosion and Sediment Control	Guidelines produced by the International Erosion Control Association (IECA) including *Best Practice Erosion and Sediment Control* (IECA 2008) and Appendix P – *Land-based pipeline construction (*IECA 2015) provides detailed guidance, strategies, and techniques to reduce the degradation of land and water from uncontrolled erosion and sedimentation. Potential erosion and sediment control risks and impacts associated with the Project, and recommended management and mitigation measures, particularly for consideration during the construction phase of the Project, are outlined in detail in the Soils Impact Assessment (EMM 2022a) EMM.
Application requirements for activities with impacts to water (ESR/2015/1837)	DES (2021a) *Application requirements for activities with impacts to water guideline* seeks to assist both regulators and operators of an ERA with the potential to impact water to identify, quantify and evaluate the impacts to the EVs of water and to ensure that these impacts are managed in a way that achieves a balance between the social benefits of development and maintaining the EVs of the receiving environment.
Stormwater and environmentally relevant activities (ESR/2015/1653)	DES (2021b) *Stormwater and environmentally relevant activities* outlines criteria to help protect receiving water EVs from potential environmental impacts arising from poor stormwater quality and altered stormwater flow. In addition, this guideline provides ways to better manage environmental impacts associated with undertaking ERAs.

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

Document	Relevance to the assessment
Reef discharge standards for industrial activities (ESR/2021/5627)	DES (2021c) *Reef discharge standards for industrial activities guideline* defines the objectives and requirements for discharges of fine sediment and/or dissolved inorganic nitrogen from industrial activities located in GBR catchments and outlines the information an applicant should include in an EA application to address Section 41AA of the EP Regulation. Whilst the Project is an industrial activity and located within GBR catchments, assessment against Section 41AA is not considered to be required per relevant exclusions nominated in DES (2021c) on the basis that industrial wastewater will not be released and that sediment is the primary pollutant of concern in stormwater proposed to be released from the Project, and this will be managed in accordance with best practice erosion and sediment control. Proposed water management for the Project will avoid the release of other potential contaminants in stormwater (eg hydrocarbons), and wastewater will not be discharged from the site.

4 Assessment methodology

This section describes the methodology used to identify and assess potential impacts to surface water.

4.1 Desktop assessment

A desktop assessment was undertaken to inform an understanding of the existing (baseline) surface water environment of the study area. The desktop assessment included a review of available spatial datasets including aerial imagery, terrain data and watercourse data. The desktop assessment also included a review of guidelines, legislation, and project design information (refer to Section 2). This information was used to:

- establish the relevant legislative and regulatory framework for the surface water aspects of the Project (refer Section 3); and
- characterise the existing environment of the study area including topography and land use, climate, hydrologic context, watercourses, soils, and hydrogeology (refer Section 5).

4.2 Impact assessment

4.2.1 Approach

A qualitative impact assessment was undertaken to identify potential impacts to surface water based on the proposed Project design and associated construction and decommissioning methods and activities. The broad approach to proposed surface water management is described in Section 2.

Additional mitigation and management measures were then identified if considered necessary to further minimise, mitigate and manage identified potential impacts. Residual impacts are then determined against baseline conditions and constraints, using a risk assessment and management framework.

The key steps used to assess Project related impacts are as follows:

- Review existing data of the study area to provide an understanding of existing (baseline) environmental conditions and constraints.
- Identify activities that could result in surface water impacts during construction, operation and decommissioning of the Project.
- Identify mitigation and management measures that reduce or remove potential impacts.
- Apply a risk assessment framework to assess potential Project related impacts based on residual risks assuming mitigation measures have been adopted and implemented. The assessment evaluates risk of potential impacts against baseline conditions and constraints where the level of environmental risk is based on:
    - the sensitivity of a potentially impacted EV or sensitive receptor; and
    - the magnitude in terms of the nature and extent of the potential impacts with consideration of the proposed mitigation and management measures.

Potential impacts are identified in Section 6 while surface water management and mitigation measures are described in Section 7.

4.2.2 Assessment criteria

i Environmental values

EVs define the qualities of water that make it suitable for supporting aquatic ecosystems and human water uses. EVs for waters in the Fitzroy River Basin and Burdekin River Basin are assigned according to sub-catchment and vary according to watercourse, land use and the end-use of the water. The EVs relevant to the Project are provided in Table 4.1.

Table 4.1 Environmental values relevant to the Project location

Environmental value	Fitzroy River Basin	Burdekin River Basin	
	Upper Isaac River catchment – Isaac Northern Tributaries fresh waters[1]	Suttor River Sub-basin – Upper Suttor River fresh waters[2]	Suttor River Sub-basin – Diamond Creek fresh waters[2]
Aquatic ecosystems (including habitat value)	✓	✓	✓
Irrigation (cropping, pastures, gardens etc)	✓	×	×
Farm supply/use (domestic farm water supply, other than drinking water)	✓	×	✓
Stock water (suitable for healthy livestock)	✓	✓	✓
Aquaculture (health aquatic species for human consumption)	×	×	×
Human consumer (health of humans consuming aquatic foods)	✓	✓	×
Primary recreation (direct contact where water may be ingested ie swimming)	✓	✓	✓
Secondary recreation (indirect contact with low probability of ingestion ie rowing)	✓	✓	✓
Visual recreation (amenity of waterway for recreation with no contact)	✓	✓	✓
Drinking water (suitable for raw drink water supply)	✓	✓	×
Industrial use (food, beverage, petroleum, power generation etc)	✓	✓	×
Cultural and spiritual values (waters with indigenous and non-indigenous significance)	✓	✓	✓

Notes: 1. Sourced from Table 1 of *Isaac River Sub-basin Environmental Values and Water Quality Objectives* (DEHP 2013).
2. Sourced from Table 1 of *Suttor River Sub-basin Environmental Values and Water Quality Objectives* (DES 2022).

ii Water quality objectives

Water quality objectives (WQOs) for long-term water quality management are defined under the Water Act and EPP Water. The WQOs are numerical concentration levels or narrative statements of indicators established for receiving waters to support and protect the designated environmental values for those waters. They are based on scientific criteria or water quality guidelines but may be modified by other inputs (eg social, cultural, economic).

The WQOs to protect aquatic ecosystem environmental values are generally the most conservative and are recommended as the default values applying to all waters (DEHP 2013). The management intent (level of protection) for all basins is an aquatic ecosystem that is moderately disturbed. The relevant WQOs for aquatic ecosystems in the Fitzroy River Basin relate to the Upper Isaac River catchment waters. The relevant WQOs for aquatic ecosystems in the Burdekin River Basin relate to the Diamond Creek and Upper Suttor River sub-catchment waters (draft – pending proposed *Environmental Protection (Water and Wetland Biodiversity) Amendment Policy 2022*).

Relevant WQOs are summarised in Table 4.2. It is noted only select physico-chemical parameters are presented here for brevity and on the basis that potential impacts to surface water quality as a result of the Project are primarily associated with release of sediment rather than nutrients or toxicants.

Table 4.2 Water quality objectives

Parameter	Units	Fitzroy River Basin	Burdekin River Basin
		Upper Isaac River catchment waters [1]	Diamond Creek and Upper Suttor River sub-catchment waters [2]
pH	-	6.5–8.5	6.5–8.5
Dissolved oxygen	% saturation	85–110	**85–110**
Electrical conductivity – baseflow	µS/cm	<720	**<150**
Electrical conductivity – high flow	µS/cm	<250	**<110**
Turbidity – baseflow	NTU	<50	<150
Turbidity – high flow	NTU	<50	<110
Total suspended solids – baseflow	mg/L	<55	<60
Total suspended solids – high flow	mg/L	<55	<95

Notes: 1. Sourced from Table 2 of *Isaac River Sub-basin Environmental Values and Water Quality Objectives* (DEHP 2013).
2. Sourced from Table 2 of *Suttor River Sub-basin Environmental Values and Water Quality Objectives* (DES 2022).

4.3 Data sources

Data sources used to inform an understanding of the baseline surface water environment and Project related impact assessment are summarised in Table 4.3.

Table 4.3 Data sources

Component	Available data sources
Climate	Climate data sourced from Bureau of Meteorology (BoM) climate data online available at: http://www.bom.gov.au/climate/data/
Topography and hydrology	Topographic contour datasets (10 m) and hydrology datasets available from Queensland Globe available at: https://qldglobe.information.qld.gov.au/ Watercourse spatial layers sourced from Queensland Spatial Catalogue (QSpatial) available at: https://qldspatial.information.qld.gov.au/catalogue/custom/index.page
Flooding	FloodCheck basin-level flood mapping available at: https://floodcheck.information.qld.gov.au/
Geology and soils	Queensland Globe 1;100,000 detailed geology and soil mapping available at: https://qldglobe.information.qld.gov.au/

4.4 Risk assessment method

The risk-based approach to hazard assessment and management (refer Section 8) involved the following key steps:

- Identification: This step identifies the areas of impact, potential hazards and their causes and potential consequences.
- Analysis of inherent risk: This involves developing an understanding of the risks, including the likelihood and consequences of particular events, without considering mitigation measures. The likelihood, consequence and risk scoring criteria are defined in Table 4.4, Table 4.5 and Table 4.6.
- Evaluation: Information from the risk analysis is combined to assess the overall level of risk of an event as demonstrated in Table 8.1. This helps to determine which hazards and risks need treatment or management. It also prioritises treatment.
- Mitigation: This involves identification of relevant and appropriate mitigation measures and how they will be implemented to reduce the risk.
- Analysis of residual risk: Risks are analysed again after the application of mitigation measures.

Likelihood criteria are given in Table 4.4.

Table 4.4 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%

Consequence criteria are given in Table 4.5.

Table 4.5 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.

The risk assessment matrix in Table 4.6 is used to combine the likelihood and consequence rating, to give a risk assessment score.

Table 4.6 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

5 Existing environment

5.1 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 metre 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 Goonyella Riverside and Broadmeadow Mine located immediately south of the proposed Project. Other major land uses nearby include farming, agistment and infrastructure corridors for bulk gas and water transmission.

5.2 Climate

The climate of the Project footprint is sub-tropical with generally hot, moist summers and warm, dry winters.

A review of the Bureau of Meteorology (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.

Mean monthly maximum temperatures (BoM climate station 034038) range from 24°C in June and July to 34°C in December, and mean monthly minimum temperatures range from 10°C in July to 22°C in January.

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 station 0434035 indicates that the region receives a range in annual rainfall totals of between 280 and 833 millimetres (mm) per year (Figure 5.1).

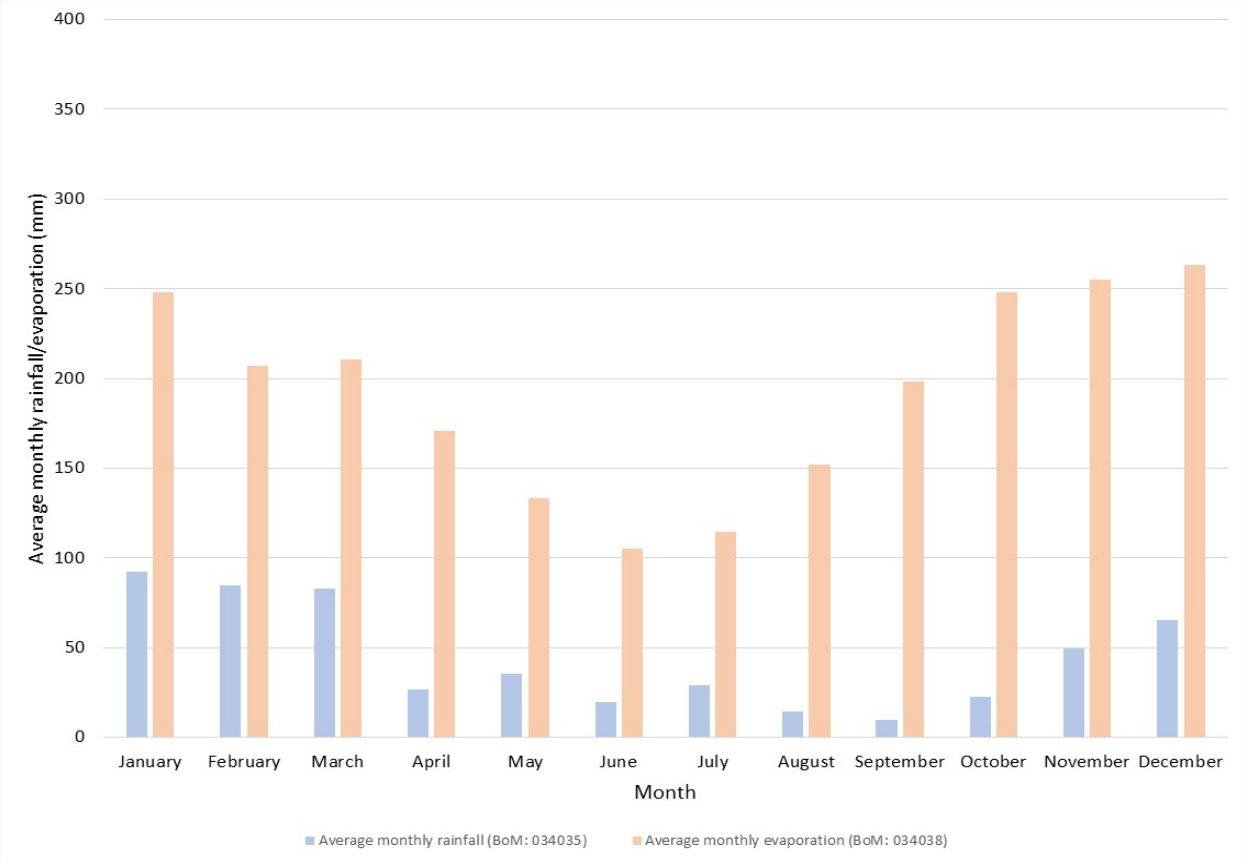


Figure 5.1 Average monthly rainfall and evaporation comparison

Evaporation data indicates a similar seasonal trend, with higher evaporation during summer and lower evaporation occurring during winter. Evaporation significantly exceeds rainfall throughout the year and results in generally low surface water availability and watercourse flow regimes of an ephemeral nature.

5.3 Hydrology

5.3.1 Regional hydrology

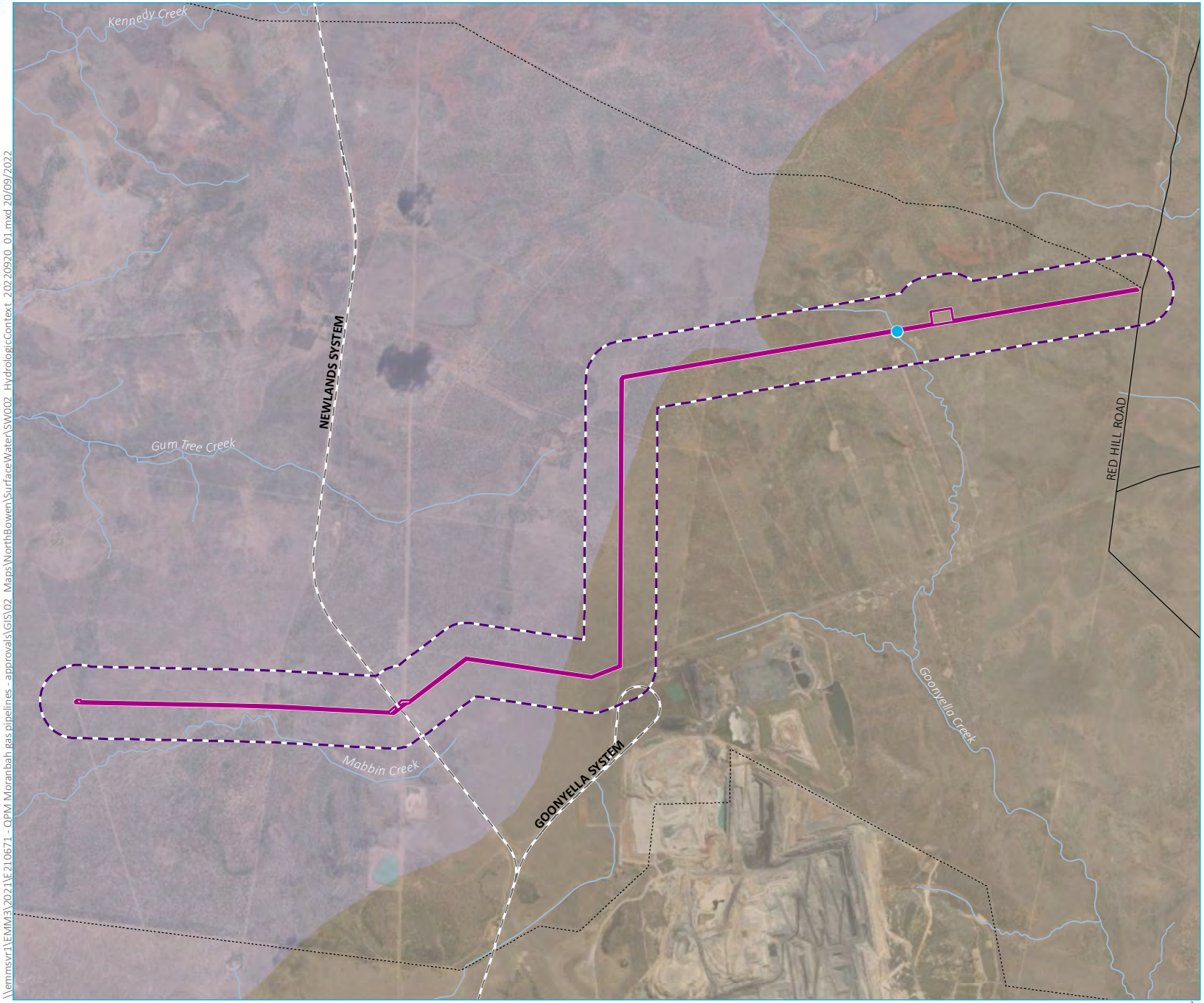
Figure 5.2 shows the hydrologic context for the Project, which lies on the catchment divide between the upper Fitzroy and Burdekin River Basins. Both basins are GBR catchments.

The eastern extent of the Project including the GCF site is in the headwaters of the upper Isaac River sub-basin. This falls generally to the south and east, draining to the Fitzroy River and ultimately to the coast near Rockhampton.

The western extent of the Project is in the headwaters of the Burdekin River Basin, within the Suttor River sub-basin. This falls generally to the west and north, draining to the Burdekin River and ultimately to the ocean near Home Hill.

5.3.2 Local hydrology and watercourses

Goonyella Creek within the upper Isaac River sub-basin is the main hydrologic feature of relevance to the Project. Goonyella Creek drains generally to the south and crosses the high-pressure pipeline alignment approximately 0.5 km to the west of the proposed GCF (refer Figure 5.2). At this location Goonyella Creek is a 1st order stream and identified as a 'drainage feature' under the Water Act. Photographs of Goonyella Creek are presented in EMM (2022a).



KEY

- Waterway crossing
- Proposed disturbance footprint
- Study area (500 m buffer)
- Rail line
- Minor road
- Vehicular track
- Watercourse/draingage line

Water plan catchments

- Burdekin River Basin
- Fitzroy River Basin

\\emmsvr1\EMM3\2021\E210671 - QPM Moranbah gas pipelines - approvals\GIS\02_Maps\NorthBowen\SurfaceWater\SW002_HydrologicContext_20220920_01.mxd 20/09/2022

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

0 1 2 km

GDA 1994 MGA Zone 55

N

Hydrologic context

QPM Energy Project
Surface water
Figure 5.2

EMM
creating opportunities

Other hydrologic features within the Project footprint consist only of localised depressions in the landscape that would retain runoff only briefly following rainfall.

Mabbin Creek and Gum Tree Creek (refer Figure 5.2) are located near the western end of the Project and drain generally to the west. These ephemeral streams will receive runoff from the Project buried pipeline footprint and surrounding areas. Mabbin Creek forms a tributary of the Suttor River, whilst Gum Tree Creek forms a tributary of Diamond Creek, which in turn joins the Suttor River and then Burdekin River further downstream to the north.

There are no wetlands or other similar sensitive surface water features in proximity to the Project.

5.3.3 Water quality

Due to the ephemeral hydrology, surface water will be present for only for a short time following rainfall. No known water quality monitoring data is available for study area, nor for downstream watercourses that are likely to be representative.

5.3.4 Existing flood behaviour

Basin-level flood mapping showing broad flood risk across the State is available within the FloodCheck portal (DoR 2022).

Flooding within the Project footprint will occur generally as broad, shallow overland flow given the lack of relief and defined drainage features and relatively small upstream catchments. The exception is in the vicinity of Goonyella Creek, which comprises a defined waterway and will convey concentrated flows across the high-pressure pipeline alignment.

Other locations where concentrated flows along defined drainage paths are expected to occur in the vicinity of the Project footprint include Mabbin Creek and upstream (east) of the mapped extent of Gum Tree Creek.

5.4 Geology and soils

5.4.1 Geology

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.

5.4.2 Soils

Based on the Queensland soils atlas accessed on QLDGlobe (DNRME 2020), the main soil types in the study area include:

- grey self-mulching cracking clays in the western half of the study area;
- red massive earths through much of the central portion of the study area and immediately west of the GCF; and
- black self-mulching cracking clays in the eastern portion of the study area including in the vicinity of the GCF.

Site specific investigations of soil types were completed by QPM Energy in May and June 2022. This identified soil types consistent with the regional soils mapping, but also with specific constraints and limitations identified including sub-soils of high sodicity and salinity and which are potentially dispersive in nature. Disturbance of these soil types would require specific management measures to minimise potential impacts to downstream water quality.

5.4.3 Acid sulfate soils

There are no acid sulfate soils (ASS) mapped in the study area or otherwise known to exist, and their occurrence is considered unlikely.

5.5 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.

The shallow Quaternary sediments are an unproven groundwater system comprising a mix of alluvium and colluvium and consisting of sand, silt, clay, and gravel, presenting consistently across the Project footprint. It is assumed 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 metres below ground level (mbgl) in the nearby Tertiary-aged basalt deposits (EMM 2022d).

6 Potential impacts

6.1 Overview

Potential surface water related impacts associated with the construction, operation and decommissioning of the Project are categorised as follows:

- altered surface water quantity (streamflow, surface water availability and flood regime) and impacts to watercourse geomorphology;
- altered surface water quality (increased sediment load and turbidity, and/or other important physical and chemical water quality constituents); and
- altered surface water-groundwater interaction.

Mitigation measures to reduce the magnitude and risk of potential surface water related impacts are provided in Section 7. Residual impacts and risk to surface water after the application of proposed mitigation measures are described in Section 8.

6.2 Construction phase

Construction of the Project has the potential to impact surface water resources within and surrounding the Project footprint. Construction activities that may impact surface water resources include vegetation removal, earthworks and excavation, contamination or spills from mobile plant, construction discharges and construction water supply. This section describes potential surface water related construction phase impacts. Management measures and controls to mitigate impacts during construction are described in Section 7. Any residual impacts will only occur short-term during the construction period, which is estimated to be approximately 12 months long.

A more detailed assessment of the hazards and risks and the proposed management and application of erosion and sediment control (ESC) techniques for the Project, particularly for the construction phase, are provided in the Soils Impact Assessment (EMM 2022a).

6.2.1 Surface water quantity

i Construction water supply

Water supply for construction purposes will be sourced from the nearby Sunwater raw water pipeline under commercial agreement and trucked to site as required. Stormwater collected in temporary and permanent sedimentation basins may also be recycled for construction purposes. Water used for cleaning, pipeline hydrotesting and/or commissioning purposes during construction may also be reused to minimise demand for imported water. Hence, water required for construction purposes can be sourced without impacting (via extraction) local surface water resources.

ii Flow regimes

Runoff regimes from disturbed construction areas may be materially different from undisturbed areas due to the removal of vegetation and establishment of engineered surfaces such as roads and hardstand areas within the GCF. Generally, the frequency and volume of runoff will increase for the disturbed area. Where practical, these changes will be mitigated by application of suitable ESC measures and through minimising the duration of temporary works by progressive rehabilitation.

Management measures and controls to mitigate impacts to watercourse flow regimes during construction are described in Section 7. Impacts to flow regimes downstream of the GCF are considered minor and manageable with the proposed management measures in place. Impacts downstream of the remainder of the Project footprint are expected to be negligible.

iii Watercourse geomorphology

Potential changes to watercourse geomorphology can occur in the form of altered bed and bank conditions due to changes in streamflow characteristics, and via erosion and sediment build up which can impact instream profiles and habitat features. Soil disturbance during construction has the potential to increase sediment loads within receiving watercourses. Changes in runoff regimes from the disturbed construction areas have the potential to alter streamflow volumes and velocities. Increased flow rates and velocities can increase the risk of scour at construction area discharge locations and in the main channel of receiving watercourses.

The installation of the pipeline through Goonyella Creek will be completed during the dry-season and rehabilitated in accordance with the self-assessable code. Design of the creek crossing, and selection of suitable rehabilitation methods to be informed by local flow velocity and scour potential. The rehabilitation works will be designed to achieve a stable creek profile and minimise bed scouring and bank slumping. No changes are expected to occur to the geomorphology of the watercourse once rehabilitation has occurred.

iv Water management

Specific recommendations and proposed management measures around drainage measures, erosion and sediment control and stabilisation of disturbed surfaces during construction are contained in the Soils Impact Assessment (EMM 2022a). This will include development of overarching Progressive Erosion and Sediment Control Plans (PESCPs) for all discrete disturbance areas.

The high-pressure pipeline will cross Goonyella Creek using conventional dry-season open cut and remediation operations in accordance with the self-assessable code under the *Water Act 2000*. The Project otherwise avoids direct impacts to watercourses.

Water supply for construction purposes will be required to facilitate activities such as earthworks, dust suppression, pipeline hydrotesting, cleaning and other construction water requirements.

Construction water will be sourced from the nearby Sunwater raw water pipeline under commercial agreement and trucked to site as required. The pipeline has been used previously to source water for construction of the adjacent Aurizon rail line. Stormwater collected in temporary and permanent sedimentation basins established for the Project may also be recycled for construction purposes. Water used for cleaning, pipeline hydrotesting and/or commissioning purposes during construction may also be reused to minimise demand for imported water. Subject to landowner agreement, recycled construction water may also be used to replenish nearby dams for stock watering.

Water unsuitable for reuse during construction, as well as wastewater generated from temporary amenities, will be trucked offsite for disposal at a licenced facility.

6.2.2 Surface water quality

i Runoff from disturbed areas

Earthworks including vegetation clearing, stripping of topsoil, and stockpiling exposed soils may increase concentrations and loads of suspended solids, nutrients, and metals in runoff. Installation of the pipeline and GCF without suitable ESC measures may contribute to increased sediment loads in runoff discharged from construction areas. Impacts to receiving watercourses may occur if runoff from disturbed areas is left unmitigated.

Management measures and controls to mitigate downstream water quality impacts during construction are described in Section 7, with further details of proposed ESC measures provided in the Soils Impact Assessment (EMM 2022a). Residual impacts are considered minor and manageable with the proposed management measures in place.

ii Disturbance of acid sulfate soils

The disturbance of ASS during construction could result in acidification of surface water that contacts ASS affected areas. Acidification may also increase the risk of mobilising other contaminants such as metals due to increased solubility. Rainfall and runoff from ASS affected areas can wash acid and other contaminants into receiving watercourses.

However, the likelihood of encountering ASS is low due to the inland location, local topography and soil characteristics and generally shallow depth of construction. On this basis there is minimal risk to water quality.

iii Accidental leaks and spills

The inadequate containment of potential leaks and spills increases the risk of runoff conveying hydrocarbons and chemicals used in construction to receiving waters. Impacts to surface water quality may occur due to:

- accidental spills and leaks of hydrocarbons (oils, fuels, lubricants, and hydraulic fluids) and other contaminants associated with mobile plant, heavy equipment, and gas compression activities;
- accidental discharge of chemicals and detergents associated with washdown areas; and
- construction related contaminants mobilised via overland flow.

Management measures and controls to mitigate impacts to downstream water quality during construction are described in Section 7. Residual impacts are considered minor and manageable with the proposed management measures in place.

iv Wastewater management

Sources of wastewater or otherwise potentially contaminated water during construction that could present a risk to downstream watercourses comprise:

- excess water from cleaning, pipeline hydrotesting and/or commissioning purposes; and
- wastewater generated from temporary amenities.

Water used for cleaning, pipeline hydrotesting and/or commissioning purposes during construction will be reused to the extent practicable to minimise demand for imported water as well as minimise production of excess water. Water unsuitable for reuse during construction, as well as wastewater generated from temporary amenities, will be trucked offsite for disposal at a licenced facility. Subject to landowner agreement, recycled construction water may also be used to replenish nearby dams for stock watering or supplied to local coal washing facilities for use in accordance with their approved operations.

6.3 Operational phase

Operation of the Project has the potential to impact surface water resources within and surrounding the Project footprint. Operational activities that may impact surface water resources include development and associated increase in runoff potential of the GCF site, process water generated by gas compression activities and the use/storage of chemicals. This section describes potential surface water related operational phase impacts. Management measures and controls to mitigate impacts during operations are described in Section 7.

6.3.1 Surface water quantity

i Operational water supply

Runoff from buildings will be captured and stored in rainwater tanks for ongoing operational purposes. This will be supplemented with potable water sourced under commercial agreement and trucked to site as required. Hence, water required for operational purposes can be sourced without impacting (via extraction) local surface water resources.

ii Flow regimes

Future development of a site layout and stormwater management concept for the GCF will consider the local hydrologic context and make appropriate design provisions to manage upslope runoff by avoiding existing flow paths where possible or otherwise directing runoff through and/or around proposed infrastructure, as appropriate.

The introduction of compacted and stabilised/paved hardstand surfaces at the GCF will result in an increase in runoff potential when compared to existing conditions. However, potential increases in stormwater runoff volumes and peak flow rates leaving the site are considered minor as these areas represent only a small proportion of the total site area, and of the total catchment area draining to the downstream receiving environment. Design of the GCF drainage system will seek to minimise changes to existing flow paths and offsite impacts. Stormwater discharges offsite will be directed to existing drainage lines, or otherwise discharge as overland flow via level spreader.

Harvesting of runoff from buildings for later reuse will partially offset increases in runoff potential on the balance of the GCF site.

Management measures and controls to mitigate impacts to watercourse flow regimes during operation are described in Section 7. Impacts to flow regimes downstream of the GCF are considered minor and manageable with the proposed management measures in place. Impacts downstream of the remainder of the Project footprint are expected to be negligible.

iii Watercourse geomorphology

No changes are expected to occur to the geomorphology of Goonyella Creek or other minor drainage lines receiving runoff from the Project footprint once rehabilitation of temporary works has occurred following construction.

iv Stormwater management approach

The objectives of the stormwater management approach at the GCF are to avoid impacts to receiving waters on and off-site. The key features of the proposed stormwater management approach include measures to:

- locate the GCF to avoid disturbance to existing watercourses and overland flow paths;
- undertake grading to minimise earthworks and minimise changes to existing flow paths;
- divert upslope runoff around infrastructure;
- implement surface drainage measures to control runoff generated within the GCF;
- implement rock rip rap where flow concentrations cannot be avoided;
- stabilise disturbed and operational areas, favouring use of hardstand and equivalent impervious surfaces;

- implement sediment and erosion controls; and
- capture runoff from buildings in rainwater tanks for use on site, to minimise demand for imported water.

6.3.2 Surface water quality

i Discharges to the environment

Changes in land use and activities associated with the Project have the potential to increase concentrations and loads of various contaminants in stormwater runoff. Stormwater runoff from the Project is broadly categorised as follows:

- Low risk – relates to stormwater runoff from the pipeline corridor, as well as access roads and administration areas within the GCF that is expected to have water quality typical of conventional roads and urban/industrial areas. Sediment is the primary pollutant of concern in these low-risk areas.
- High risk – relates to processing areas, pig receival facilities and residue storage areas where potential contaminating material, waste and chemicals are stored or used, where there is a risk of stormwater contamination from hydrocarbons.

If left unmitigated, stormwater that discharges from the GCF has the potential to impact the water quality of the receiving environment, particularly stormwater generated from high-risk areas. Within the low-risk stormwater classification, DES (2021b) *Stormwater and environmentally relevant activities* guideline defines alternative stormwater management criteria for high and low erosion hazard sites. Based on the Soils Impact Assessment (EMM 2022a), the Project would be considered relatively high erosion hazard in the absence of extensive use of paving/hardstand areas.

Management measures and controls to reduce the risk of impacts resulting from stormwater discharges from the GCF during operations are described in Section 7. These include measures to minimise increases in both peak flow rates and sediment loads leaving the site, consistent with the objectives of DES (2021b) to the extent practicable. Impacts to water quality downstream of the GCF are considered minor and manageable with the proposed management measures in place.

Impacts downstream of the remainder of the Project footprint are expected to be negligible.

ii Process water management

Gas transport, dehydration, compression, and related activities (eg cleaning) will produce water streams contaminated by hydrocarbons. A designated process water management system will be implemented to collect this water and provide treatment in the form of an oily water separation unit. Recovered clean water will be tested and returned to the raw gas supplier for treatment and handling in accordance with their approved operations, which typically relies on suppling water for coal washing to reduce the demand for imported water. Separated oily water sludge and other waste products that are otherwise unsuitable for mining reuse will be segregated and trucked offsite for disposal at a licenced facility.

Management measures and controls to reduce the risk of impacts resulting from process water discharges from the GCF are described in Section 7. Impacts to water quality are considered minor and manageable with the proposed management measures in place.

iii Erosion and sediment mobilisation

Poorly located facilities and infrastructure, inadequate scour protection or improper drainage design and construction activities may lead to an increased risk of erosion and sediment mobilisation within drainage infrastructure and at stormwater discharge locations. Erosion of drainage infrastructure and at discharge outlets may result in the mobilisation of sediment directly into downstream drainage lines.

In larger storm events where the design capacity of ESC measures is exceeded, the potential for erosion and sediment mobilisation at discharge is greater. However, water quality impacts are still expected to be minimal as increased sediment loads would be expected under existing conditions and from the broader catchment in these larger storm events.

iv Uncontrolled releases and accidental leaks and spills

A range of hazardous chemicals may be stored and used on-site during the operational phase of the Project. These include:

- diesel;
- hydrocarbons (oils, lubricants, and hydraulic fluids) and other contaminants associated with mobile plant and heavy equipment; and
- TEG (for gas dehydration purposes).

If left unmitigated, accidental spills and leaks from hazardous chemical storage areas or mobile plant may be transported into the receiving environment via rainfall and runoff. If sufficient volume is spilt, hazardous materials may also discharge to the receiving environment in the absence of rainfall and runoff (ie overland flow or seepage).

Management measures and controls to reduce the risk of impacts resulting from accidental leaks and spills at the GCF are described in Section 7. Impacts to water quality are considered minor and manageable with the proposed management measures in place.

v Wastewater management

Wastewater generated from permanent amenities at the GCF will be trucked offsite for disposal at a licenced facility. This eliminates the primary risk to water quality. Management measures and controls to mitigate risks from downstream water quality impacts during construction are described in Section 7.

6.3.3 Surface water and groundwater interaction

Impervious surfaces associated with the GCF, ancillary structures and administration buildings can increase runoff volumes and prevent infiltration of rainfall into underlying aquifers. This effectively reduces the volume of rainfall recharge that contributes to local groundwater resources, which in turn can impact groundwater availability and watercourse baseflow contributions. However, due to limited footprint of the GCF compared to the total recharge area of aquifers underlying the site, the impact to recharge rates and groundwater availability is expected to be negligible.

6.4 Decommissioning and rehabilitation

Minimal surface water risks are expected to occur during decommissioning and rehabilitation with the implementation of an appropriate rehabilitation design. A Rehabilitation Management Plan (RMP) will be developed and implemented in consultation with landholders and the regulatory agencies at the time and submitted to the relevant authority 12 months prior to decommissioning occurring.

7 Management and mitigation measures

7.1 Overview

To manage and minimise potential surface water impacts, relevant mitigation measures will be implemented during the construction and operational phases of the Project.

The following sections outline mitigation measures with respect to Project phase (construction or operation) and the potential impacts which are to be managed. A Construction Environmental Management Plan (CEMP) will be in place during construction and an Environmental Management Plan (EMP) will be in place during operations, both of which will detail relevant mitigation measures.

7.2 Construction surface water management

The following mitigation measures in Table 7.1 are recommended for implementation.

Table 7.1 Mitigation measures for construction activities

Potential Hazard	Risk	Mitigation
Vegetation clearing and landform	Site clearance, grading, construction activities and land-use changes altering runoff and flow regimes to downstream receptors.	• Development and implementation of construction stormwater management measures as part of an overarching Soil and Water Management Plan (SWMP) or similar, consistent with best practise including DES 2021b and IECA 2008, 2015. Key principles include: – Diversion of upslope runoff around worksites and infrastructure. – Avoid disturbance to existing watercourses and overland flow paths where possible. – Grading to minimise earthworks and minimise changes to existing flow paths/regimes. – Stabilise disturbed areas using hardstand and equivalent impervious surfaces and gravel or similar pervious surfaces to promote infiltration where suitable. – Maximise sheet flow and minimise concentrating flows. – Use of scour protection measures as required. – Progressive rehabilitation will be undertaken to ensure disturbance areas and temporary diversions are as small as reasonably practicable at all times. – Permit to disturb and clear to be issued prior to impact works. – Suitably trained personnel responsible for the issuing of permit to disturb and clear vegetation. – Routine and event-driven monitoring of soil and water management measures as well as condition of existing drainage lines downstream of worksites, prompt rectification as required. – Personnel to be trained through inductions and toolbox talks.
Flooding	Increased flooding risks and impact downstream and for surrounding watercourses.	• Design of the Goonyella Creek crossing and selection of suitable rehabilitation methods will be informed by local hydraulic conditions. • Construction of the GCF to incorporate measures to divert and manage local overland flows around the facility, with the objective of minimising offsite flooding impacts. • Construction of the below-ground high-pressure pipeline to consider the potential for concentrated overland flows along the length of the corridor and incorporate topographic modelling to ensure replicate prior runoff patterns from local depressions and overland flow paths.

Table 7.1 Mitigation measures for construction activities

Potential Hazard	Risk	Mitigation
Chemical storage, handling, and management	Contamination and spills (ie hazardous chemicals) potentially impacting surface water quality (affecting EVs, WQOs of receiving environment).	• Suitable controls to be incorporated into construction SWMP and implemented, including: – Hazardous materials (chemicals, fuels, lubricants, etc) will be stored and managed in accordance with relevant regulations and standards. – Spill events are to be contained, cleaned, and recorded as per emergency response procedure. – Spill kits and suitable control materials such as booms and absorbent materials will be always maintained onsite and in accessible locations, commensurate with the types and volumes of materials in use, and in place where hazardous materials are stored or used. – Refuelling and maintenance activities to be completed in designated areas and located at least 50 m away from watercourses. – Primary bunds to be installed on specific plant and equipment (eg doubled skinned where necessary). – Tertiary bunds to be installed around high-risk areas (eg concrete aprons). – Scheduled maintenance of all plant and equipment to be completed as per manufacturer specifications. – Routine and event-driven monitoring of hazardous materials storage and control measures, and prompt rectification as required.
Plant, machinery, vehicles, or equipment leak	Contamination and spills (ie hazardous chemicals) potentially impacting surface water quality (affecting EVs, WQOs of receiving environment).	
Erosion and sediment control	Water quality and watercourse impacts from construction activities (ie sediment mobilisation).	• Development and implementation of ESC measures as described in EMM 2022a and consistent with best practise including IECA 2008, 2015 and documented in PESCPs. Key principles to include: – Disturbance area to be minimised as far as reasonably practicable. – Progressive rehabilitation will be undertaken to minimise disturbance areas and temporary diversions. – Sediment basins/sumps installed where practical to capture surface water runoff and minimise sediment transport offsite. – Routine and event-driven monitoring of ESC measures to confirm effectiveness as well as condition of existing drainage lines downstream of worksites, and prompt rectification as required. – Design considers seasonal weather and completes high risk work during appropriate months (eg crossing of Goonyella Creek during dry season). – Personnel to be trained through inductions and toolbox talks.
Unauthorised discharge	Water from sediment basins is released as non-compliant water	• Discharge permits to be issued prior to the release of captured/process water. • Additional treatment to be applied to improve water quality suitable for discharge. Water unsuitable for beneficial reuse to be disposed of offsite at licensed facility. • Suitably trained personnel responsible for the testing and issuing of discharge permit. • Personnel to be trained through inductions and toolbox talks.
Re-use of contaminated water	Water treated within sediment basins does not meet specifications for suitable re-use	• Discharge/transfer permits to be issued prior to the release of captured/process water. • Suitably trained personnel responsible for the testing and issuing of discharge/transfer permit. • Additional treatment to be applied to improve water quality suitable for reuse. Water unsuitable for reuse to be disposed of offsite at licensed facility. • Personnel to be trained through inductions and toolbox talks.

Table 7.1 Mitigation measures for construction activities

Potential Hazard	Risk	Mitigation
Acid sulfate soils	Construction works result in the acidification of potential ASS (PASS) and surface water run-off impacts surrounding environments	• In the unlikely event that suspected PASS is encountered during excavations, the material will be stockpiled, lined, and covered to minimise infiltration of rainfall and subsequent leaching. • Suspected PASS will be managed in accordance with the *Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines – 2014* (DSITIA, 2014).
Effluent management	Effluent spill from ablution block enters surface water/surrounding environment	• High-level alarms to be installed on ablutions blocks. • Routine inspections to be completed to assess volume. • Ablution blocks to be appropriately sized for relevant manning numbers. • Suitably qualified contractor to be engaged to remove effluent to a licenced facility able to accept waste.
Surface water and groundwater interaction	Surface water run-off from chemical storage results in contamination of groundwater	NA

7.3 Operational surface water management

The following mitigation measures in Table 7.2 are recommended for implementation.

Table 7.2 Mitigation measures for operational activities

Potential Hazard	Risk	Mitigation
Vegetation clearing and landform	Site clearance, grading, hardstand, and land-use changes altering runoff and flow regimes to downstream receptors.	• Development and implementation of operational stormwater management measures as part of an overarching SWMP, consistent with best practise including DES 2021b and IECA 2008, 2015. Key principles generally as for construction stage, but to consider permanent drainage measures for the GCF including need for stormwater detention basin(s) to limit peak flows discharged downstream of the GCF to minimise scour potential in receiving drainage lines. • Routine and event-driven monitoring of soil and water management measures as well as condition of existing drainage lines downstream of worksites, prompt rectification as required
Flooding	Increased flooding risks and impact downstream and for surrounding watercourses.	• The GCF will incorporate measures to divert and manage local overland flows around the facility, with the objective of minimising offsite flooding impacts. • Ground levels along the high-pressure pipeline will be reinstated to match existing, with no potential to impact local flow paths and flood behaviour.

Table 7.2 Mitigation measures for operational activities

Potential Hazard	Risk	Mitigation
Chemical storage, handling, and management	Contamination and spills (ie hazardous chemicals) potentially impacting surface water quality (affecting EVs, WQOs of receiving environment).	• Suitable controls to be incorporated into SWMP and implemented, including: – Hazardous materials (chemicals, fuels, lubricants, etc) will be stored and managed in accordance with relevant regulations and standards. – Spill events are to be contained, cleaned, and recorded as per emergency response procedure. – Spill kits and suitable control materials such as booms and absorbent materials will be always maintained onsite and in accessible locations, commensurate with the types and volumes of materials in use, and in place where hazardous materials are stored or used. – Refuelling and maintenance activities to be completed in designated areas and located at least 50 m away from watercourses. – Primary bunds to be installed on specific plant and equipment (eg doubled skinned where necessary). – Tertiary bunds to be installed around high-risk areas (eg concrete aprons). – Scheduled maintenance of all plant and equipment to be completed as per manufacturer specifications. – Routine monitoring of hazardous materials storage and control measures, and prompt rectification as required.
Plant, machinery, vehicles, or equipment leak	Contamination and spills (ie hazardous chemicals) potentially impacting surface water quality (affecting EVs, WQOs of receiving environment).	
Erosion and sediment control	Water quality and watercourse impacts from operational activities (ie sediment mobilisation).	• Development and implementation of ESC measures as described in EMM 2022a and consistent with best practise including IECA 2008, 2015 and documented in PESCPs. Key principles generally as for construction stage, but to consider permanent drainage measures for the GCF including need for sediment control measures to minimise sediment discharged downstream of the GCF. • Routine and event-driven monitoring of water quality control measures to confirm effectiveness as well as condition of existing drainage lines downstream of worksites, and prompt rectification as required.
Re-use of contaminated water	Clean water treated within the oily water treatment unit does not meet specifications for suitable re-use.	• Discharge / transfer permits to be issued prior to the release of captured/process water. • Additional treatment to be applied to improve water quality suitable for return to mine users. Water unsuitable for transfer to be disposed of offsite at licensed facility. • Suitably trained personnel responsible for the testing and issuing of discharge/transfer permit. • Personnel to be trained through inductions and toolbox talks.
Acid sulfate soils	N/A	N/A
Effluent management	Effluent spill from ablution block enters surface water/surrounding environment.	• High-level alarms to be installed on ablutions blocks. • Routine inspections to be completed to assess volume. • Ablution blocks to be appropriately sized for relevant manning numbers. • Suitably qualified contractor to be engaged to remove effluent to a licenced facility able to accept waste.
Surface water and groundwater interaction	Surface water run-off from chemical storage or oily water treatment plant results in contamination of groundwater.	N/A

Table 7.2 Mitigation measures for operational activities

Potential Hazard	Risk	Mitigation
Groundwater recharge	Groundwater recharge impacted by from impervious surfaces and structures.	N/A

8 Risk assessment

A preliminary risk assessment has been undertaken in accordance with the likelihood, consequence and risk matrices in Section 4.4. Mitigation measures presented in Table 7.1 and Table 7.2 have been incorporated into the residual risk assessment, demonstrating the risk level to be as low as is reasonably practicable.

Table 8.1 Surface water risk assessment

Risk	Description	Phase	Before mitigation measures are applied			After mitigation measures are applied (refer to Section 9)		
			L	C	R	L	C	R
Vegetation clearing and landform	Site clearance, grading, construction activities and land-use changes altering runoff and flow regimes to downstream receptors.	Construction	Likely	Moderate	High	Possible	Minor	Low
	Site clearance, grading, construction activities and land-use changes altering runoff and flow regimes to downstream receptors.	Operation	Likely	Moderate	High	Possible	Minor	Low
Flooding	Increased flooding risks and impact downstream and for surrounding watercourses.	Construction	Unlikely	Major	Medium	Unlikely	Moderate	Low
	Increased flooding risks and impact downstream and for surrounding watercourses.	Operation	Unlikely	Major	Medium	Unlikely	Moderate	Low
Chemical storage, handling, and management	Contamination and spills (ie hazardous chemicals) potentially impacting surface water quality (affecting EVs, WQOs of receiving environment).	Construction	Almost Certain	Moderate	High	Possible	Minor	Low
	Contamination and spills (ie hazardous chemicals) potentially impacting surface water quality (affecting EVs, WQOs of receiving environment).	Operation	Almost Certain	Moderate	High	Possible	Minor	Low

Table 8.1 Surface water risk assessment

Risk	Description	Phase	Before mitigation measures are applied			After mitigation measures are applied (refer to Section 9)		
			L	C	R	L	C	R
Plant, machinery, vehicles, or equipment leak	Contamination and spills (ie hazardous chemicals) potentially impacting surface water quality (affecting EVs, WQOs of receiving environment).	Construction	Likely	Moderate	High	Possible	Minor	Low
	Contamination and spills (ie hazardous chemicals) potentially impacting surface water quality (affecting EVs, WQOs of receiving environment).	Operation	Likely	Moderate	High	Possible	Minor	Low
Erosion and sediment control	Water quality impacts from construction activities (ie sediment mobilisation).	Construction	Likely	Moderate	High	Unlikely	Moderate	Low
	Water quality impacts from construction activities (ie sediment mobilisation).	Operation	Likely	Moderate	High	Unlikely	Moderate	Low
Unauthorised discharge	Water from sediment basin is released as non-compliant water.	Construction	Likely	Moderate	High	Unlikely	Moderate	Low
	N/A	Operation	N/A	N/A	N/A	N/A	N/A	N/A
Re-use of contaminated water	Water treated within the sediment basin does not meet specifications for suitable re-use.	Construction	Almost certain	Moderate	High	Unlikely	Moderate	Low
	Water treated within the sediment basin and/or oily water treatment unit does not meet specifications for suitable re-use.	Operation	Almost Certain	Moderate	High	Unlikely	Moderate	Low
Acid sulfate soils	Construction works result in the acidification of ASS and surface water run-off impacts surrounding environments.	Construction	Unlikely	Moderate	Low	Rare	Moderate	Low
	N/A	Operation	N/A	N/A	N/A	N/A	N/A	N/A

Table 8.1 Surface water risk assessment

Risk	Description	Phase	Before mitigation measures are applied			After mitigation measures are applied (refer to Section 9)		
			L	C	R	L	C	R
Effluent management	Effluent spill from ablution block enters surface water/surrounding environment.	Construction	Likely	Moderate	High	Unlikely	Moderate	Low
	Effluent spill from ablution block enters surface water/surrounding environment.	Operation	Likely	Moderate	High	Unlikely	Moderate	Low
Surface water and groundwater interaction	Surface water run-off from chemical storage results in contamination of groundwater.	Construction	Likely	Moderate	High	Unlikely	Moderate	Low
	Surface water run-off from chemical storage or oily water treatment plant results in contamination of groundwater.	Operation	Likely	Moderate	High	Unlikely	Moderate	Low
Groundwater recharge	N/A	Construction	N/A	N/A	N/A	N/A	N/A	N/A
	Groundwater recharge impacted by from impervious surfaces and structures.	Operation	Unlikely	Minor	Low	Rare	Minor	Low

9 Conclusions

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

- establish the relevant legislative and regulatory framework for the surface water aspects of the Project;
- characterisation of the existing surface water environment relevant to the Project, including:
  - topography and land use;
  - climate;
  - regional and local hydrology and surface water features;
  - geology and soils; and
  - hydrogeology;
- describe the Project and proposed water management approaches during construction and operation;
- assessment of potential surface water impacts during construction and operation of the Project; and
- development of mitigation and management measures to reduce and manage potential residual impacts.

Potential surface water impacts were considered in terms of changes to water quality and quantity, flooding and impacts to watercourses. Overall, potential impacts to surface water resources and associated EVs during both construction and operation are considered minor and manageable with proposed mitigation measures in place, which are summarised in Section 7.

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