SARAJI EAST MINING LEASE PROJECT

Environmental Impact Statement

Chapter 8
Surface Water Resources

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8.0 Surface Water Resources

8.1 Introduction

BM Alliance Coal Operations Pty Ltd (BMA) is seeking approval to develop the Saraji East Mining Lease Project (the Project) involving a single-seam underground mine and supporting infrastructure on Mining Lease Application (MLA) 70383 and MLA 70459 adjacent to, and accessed through, the existing open cut mine void within Mining Lease (ML) 1775.

This chapter of the Environmental Impact Statement (EIS) provides a description of the existing surface water resources in and within the vicinity of the Project Site, and the mine water management system (WMS) required to support mining operations, manage mine affected water (MAW) and protect downstream environmental values. This chapter identifies potential impacts to surface water from the Project and the required mitigation measures proposed to minimise adverse impacts.

A range of technical studies were undertaken to address specific aspects of significance to surface water resources outlined in the Project EIS Terms of Reference received May 2017, and submissions on the draft EIS received in July 2021. These include:

- **Appendix E-1 Surface Water Quality Technical Report**
- **Appendix E-2 Mine Water Balance Technical Report**
- **Appendix E-3 Hydrology, Hydraulics and Geomorphology Technical Report**
- **Appendix E-4 Conceptual Ponding Assessment**.

To obtain a complete understanding of the significance of surface water values and the possible impacts of the Project, the following chapters are also relevant:

- **Chapter 7 Aquatic Ecology**
- **Chapter 9 Groundwater**.

Appendix K-1 Rehabilitation Management Plan and **Appendix K-2 Subsidence Management Plan** present mitigation and management measures to address potential impacts with commitment to develop management and monitoring plans in **Appendix O-1 Summary of Commitments**.

8.2 Legislation and policy

8.2.1 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides for the management and protection of flora and fauna of national environmental significance, referred to as Matters of National Environmental Significance (MNES). Large coal mining developments such as the proposed Project can potentially disrupt aquatic ecosystems and therefore have adverse impacts on aquatic species, water resources and Ramsar wetland sites. Any action with the potential for a significant impact on these MNES must be referred to the Australian Government Environment Minister and may require approval under the EPBC Act.

On 18 November 2016, the Project was determined as a controlled project, with one of the controlling provisions being *a water resource, in relation to coal seam gas development and large coal mining development.* Discussion of the impacts upon MNES is provided in **Chapter 21 Matters of National Environmental Significance**.

8.2.2 Water Act 2000

The use of water for activities such as irrigation, stock water, drinking water and industrial use is regulated under the Queensland *Water Act 2000* (Water Act). The Water Act provides the basis for the planning and allocation of Queensland's water resources, which in turn must make allowances for the provision of water purely for the support of the natural processes that underpin the ecological health of natural river systems, that is, environmental flows.

The watercourses potentially affected by the Project are subject to protection under the Water Act, which regulates the extraction of water from these watercourses and works that might disturb bed and banks of each watercourse. Watercourses identified under the Water Act flow through the Project Site, including Boomerang Creek, One Mile Creek, Hughes Creek, Plumtree Creek, Spring Creek and Phillips Creek. Of these streams, only Boomerang Creek, Plumtree Creek and Hughes Creek intersect the underground mining panels and the predicted area of subsidence.

The Water Act prescribes the process for preparing Water Resource Plans (WRP) and Resource Operation Plans (ROP) which are specific for catchments within Queensland. Under this process, the WRP identifies a balance between waterway health and community needs and are applied on a catchment scale. The WRP establishes Environmental Flow Objectives that are of importance for waterway health and sets Water Allocation Security Objectives which are important to maintain water availability for community needs. The ROP provides the operational details on how this balance can be achieved. The WRP and ROP determine conditions for granting water allocation licences, permits and other authorities, as well as rules for water trading and sharing. The WRP and ROP applicable to the Project are detailed below.

Fitzroy Basin Water Resource Plan

The Project is located within the Fitzroy Basin. The Water Plan (Fitzroy Basin) 2011 was finalised in 1999 and amended in 2005 to address overland flow water management and was again updated in 2011.

Fitzroy Basin Resource Operations Plan

The Fitzroy Basin ROP came into force in January 2004 and subsequently amended in 2011, 2014 and 2015. It details how the objectives of the Water Plan (Fitzroy Basin) 2011 will be met on an operational level and defines strategies to support the WRP's overall goals for water entitlement security and ecological health.

In general, it provides the basis and rules for trading of water allocations, allows for unallocated water to be identified and allocated, and also details operating rules for the use of water management infrastructure such as weirs and dams. The Nogoa Mackenzie, Lower Fitzroy, and Fitzroy Barrage Supplemented Water Supply Schemes operate within the wider Fitzroy Basin catchment.

BMA holds allocations of raw water from the Fitzroy and Burdekin water catchments and licences to take water across BMA's mine sites via an existing BMA-operated water pipeline network servicing its mines, landholders, and towns.

BMA's current allocations are sufficient to meet the needs of the Project. BMA holds contractual rights to approximately 10,000 megalitres of water per annum from the Burdekin Pipeline (owned by SunWater) as a supply source for BMA operations in the vicinity of Moranbah. BMA also has a water allocation of 6,200 megalitres per annum from the Eungella Dam for use in BMA operations in the Moranbah vicinity. In securing its water rights, BMA has allowed for the current and potential future use of water from these sources at the Saraji Mine and for growth options associated with MLA 70383.

No additional water allocation will be sourced for this Project.

8.2.3 Environmental Protection (Water and Wetland Biodiversity) Policy 2019

The quality of Queensland waters is protected under the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (EPP (Water and Wetland Biodiversity)). The EPP (Water and Wetland Biodiversity) achieves the objectives of the *Environmental Protection Act 1994* (EP Act) to protect Queensland's waters while supporting ecologically sustainable development. Queensland waters include water in rivers, streams, wetlands, lakes, groundwater aquifers, estuaries and coastal areas.

The EPP (Water and Wetland Biodiversity) seeks to protect and enhance the suitability of Queensland's waters for various beneficial uses. The Queensland Department of Environment and Science (DES) (previously the Department of Environment and Heritage Protection (DEHP)) hold responsibility for administering the EPP (Water and Wetland Biodiversity).

The policy identifies environmental values for waters in Queensland and guides the setting of water quality objectives to protect the environmental values of any water resource. Water quality guidelines or objectives (WQOs) are the minimum levels required to protect environmental values of a waterway

(DEHP, 2009). In accordance with the EPP (Water and Wetland Biodiversity), environmental values, water quality guidelines and water quality objectives were established (DEHP, 2011).

The document that is of relevance to the Project Site's receiving environment is the EPP (Water and Wetland Biodiversity) Isaac River Sub-basin Environmental Values and Water Quality Objectives (DEHP, 2011).

To derive site specific (sub-regional) WQOs, the methods outlined in the *Queensland Water Quality Guidelines 2009* (DEHP, 2009), the *Qld Deciding aquatic ecosystem indicators and local water quality guideline values 2022* (DES, 2022*)* and the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG, 2018) were applied. This chapter considered the DES EIS Information Guideline – Water.

8.2.4 Regulated structures

The *Water Supply (Safety and Reliability) Act 2008* (WSSR Act) sets out the requirements for referable dams. Generally, these relate to dams that exceed a certain height and volume criteria which defines the scope of failure impact assessment (FIA) required to determine the population at risk in the event of dam failure.

All structures which are dams or levees associated with the operation of an environmentally relevant activity (ERA) are generally required to have their consequence category assessed in accordance with the Manual for assessing consequence categories and hydraulic performance of structures (DES, 2016) (the DES manual). Assessment is based on the potential environmental harm resulting from failure event scenarios such as seepage, overtopping and dam break. Each scenario is assessed against three assessment criteria - potential harm to humans, general environmental harm and general economic loss or property damage with the potential consequence category for each criterion being either low, significant or high. The consequence category of a structure is hence the highest consequence category determined under any of the assessment criteria for each failure scenario.

A preliminary consequence category assessment (CCA) is presented in Table 10 of **Appendix E-2 Mine Water Balance Report**. A comprehensive CCA will be completed following detailed design of the structures. Should the rating of dams change during detailed design, the associated performance and management criteria may also change.

Conditions for design, operation and auditing of regulated structures will be included in the Environmental Authority (EA) for the Project, designed according to specific hydrologic and hydraulic performance criteria set out in the DES manual, and inspected annually by a suitably qualified professional.

8.3 Methodology

Surface water resources assessment for this Project comprised:

- surface water quality assessment (AECOM, 2024c) to identify environmental values of surface waters within the Project Site and immediately downstream that may be affected by the Project and define relevant water quality objectives (WQOs) applicable to the environmental values (Section 8.3.1)
- mine water balance (AECOM, 2024b) to identify the quantity, quality, location and timing of potential and/or proposed release of contaminants (such as controlled water releases to surface water streams) from water and wastewater from the Project (Section 8.3.2)
- hydrology, hydraulics and geomorphology study to evaluate risks associated with predicted changes to land surface, surface water and geomorphic characteristics of watercourses affected by the Project (Alluvium, 2023) (Section 8.3.3)
- predictions of subsidence following successive stages of longwall panel excavation by the longwall top caving (Minserve, 2022) (Section 8.3.3).

Relevant details are presented in this chapter, with further details of the assessment of surface water resources provided in **Appendix E-1 Surface Water Resources Technical Report, Appendix E-2**

Mine Water Balance, **Appendix E-3 Hydraulics, Hydrology and Geomorphology Technical Report** and **Appendix E-4 Conceptual Ponding Assessment**.

8.3.1 Surface water quality

To identify potential impacts from the Project on the environmental values and preventative and mitigation measures to demonstrate the Project will not result in degradation of water quality related values, the assessment involved the following steps:

- identification of the environmental values of surface waters within the Project Site and immediately downstream that may be affected by the Project
- definition of relevant WQOs applicable to the environmental values
- characterisation of the quality of surface waters within the area
- identification of the quantity, quality, location and timing of all potential and/or proposed release of contaminants (such as controlled water releases to surface water streams) from water and wastewater from the Project
- assessment of the likely impact of any releases on all relevant environmental values of the surface water receiving environment
- assessment of how the WQO and performance outcomes will be achieved, monitored and audited, and how corrective actions will be managed.

Water quality datasets used in this assessment comprise monitoring data from locations monitored as part of receiving environment monitoring programs (REMP) for Saraji Mine (SRM) and Peak Downs Mine (PDM) between July 2012 and July 2022, dependent on location. Data was collected and assessed for the following purposes:

- from upstream of mining activity to develop sub-regional WQOs
- from downstream of the existing Saraji Mine to assess the existing baseline conditions of the Project Site.

Monitoring data was available for various upstream and downstream locations surrounding the Project Site (Figure 8-1). Data collected from downstream of the existing Saraji Mine was representative of the existing baseline conditions of the Project Site discussed in detail in **Appendix E-1 Surface Water Resources Technical Report**.

8.3.1.1 Existing water quality

The existing water quality of the watercourses flowing through the Project Site and the downstream receiving environment of the Project Site was assessed to characterise existing conditions. The assessment was based on a review of water quality data collected at various monitoring locations (refer to **Appendix E-1 Surface Water Quality Technical Report** for further detail).

Watercourses identified under the Water Act flow through the Project Site, including Boomerang Creek, One Mile Creek, Hughes Creek, Plumtree Creek, Spring Creek and Phillips Creek. Sampling locations for the upper reaches of Boomerang Creek, Hughes Creek, One Mile Creek and Spring Creek (Upstream sites Figure 8-1) were used to develop sub-regional WQOs. Environmental background values were derived from downstream sampling points at Phillips Creek, Isaac River and Spring Creek (Background sites Figure 8-1). WQOs were derived for the Boomerang/Hughes Creek sub-regional catchments with the potential to be impacted by mining activities. This includes Boomerang Creek, Hughes Creek, One Mile Creek and Spring Creek and is based on available data obtained when these ephemeral streams flow. As Phillips Creek passes south and outside the extent of mining activities and potential impacts, it was not used for the development of WQOs.

8.3.1.2 Water quality objectives

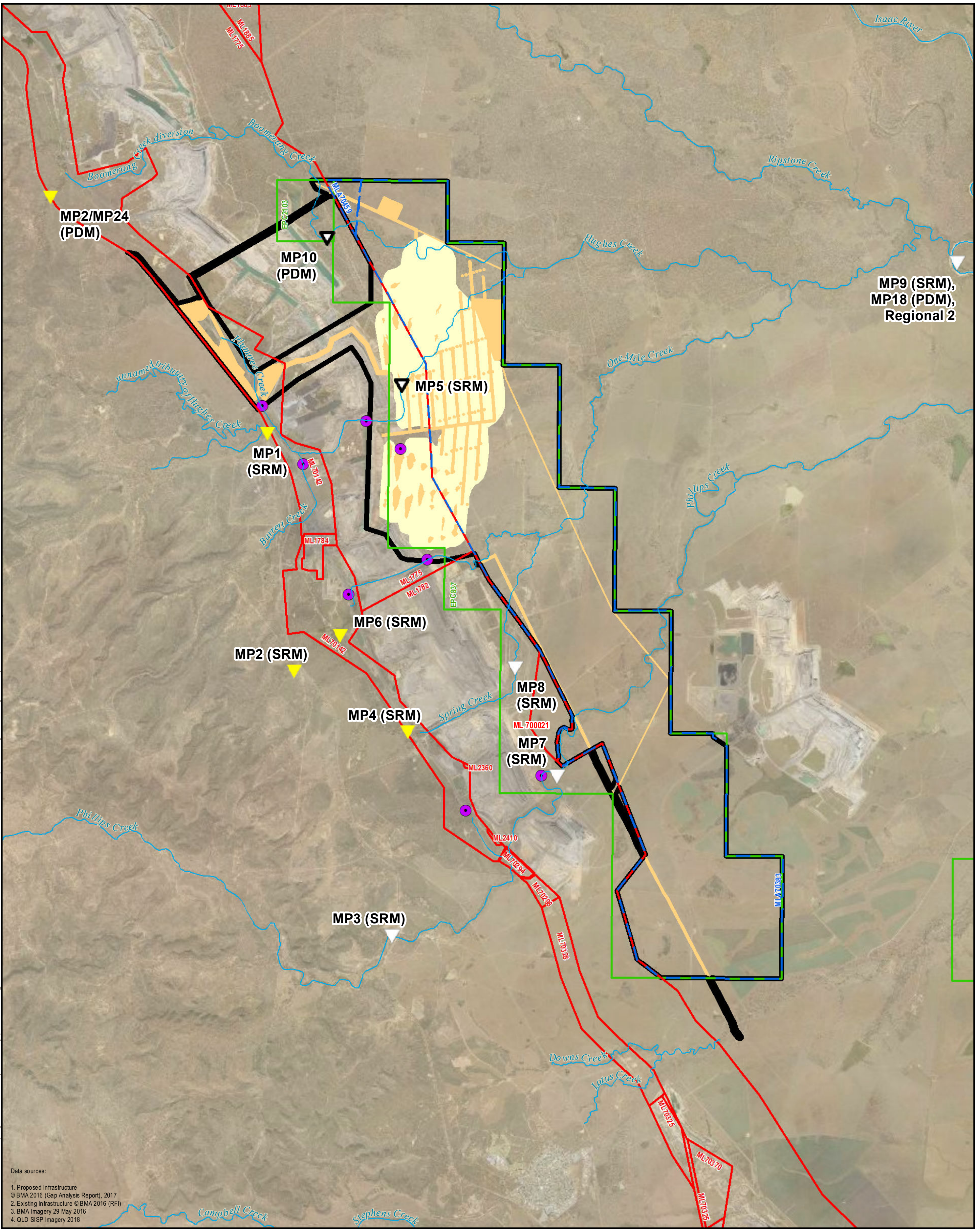
To derive WQOs for the Boomerang/Hughes Creek sub-regional catchments, parameters and monitoring locations were chosen in accordance with Deriving site-specific guideline values for physico-chemical parameters and toxicants (Huynh & Hobbs 2019), Section 4 in the Queensland Water Quality Guidelines 2009 (DEHP 2009) and the combined guidelines of Qld Deciding aquatic ecosystem indicators and local water quality guideline values 2022 and Environmental Protection Policy 2019 (DES, 2022).

The method for deriving site-specific WQOs were designed by the Queensland Government for purposes of setting targets to allow catchment managers to make improvements to the water quality of the catchment over the long-term. Because of this intent, they are a very conservative measure. Applying the 40th percentile rule for best available moderately disturbed reference sites means the designed subregional WQO will be exceeded 60 per cent of the time without influence of the proposed project.

Additionally, the Queensland Water Quality Guideline (QWQG) (DES 2022) requires wherever the 40th percentile value of a developed site-specific parameter falls within 1 standard error (SE) of the ANZG 2018 or EPP2019 WQO (2 SE if high variability between sites), the default WQO has to be applied. Hence site-specific data must vary significantly from the default WQOs for a different background value to be defensible. Therefore, it is unlikely a data set of local water quality data will comply with these sub-regional WQOs in the short term and these should be regarded as a guideline and not as trigger or threshold values.

To understand if water quality samples collected from within the Boomerang/Hughes Creek sub-regional catchments are representative of the sub-regional catchment, the data was compared to the 80th percentile of the WQO data set. The 80th percentile is criteria used for application to undisturbed reference sites for which the selected WQO sites meet the criteria: within 20 km upstream there is no intensive agriculture, major extractive industry, major urban area, significant point source wastewater and seasonal flow regime not greatly altered by regulation or abstraction, and the sites used to develop sub-regional WQOs do meet these criteria. A table presenting the combined 80th percentile values for the assessed watercourses and how these compare to developed site specific WQOs is attached in Appendix B of **Appendix E-1 Surface Water Quality Technical Report**.

For monitoring impacts of the Project on the receiving environment, a REMP will be developed. More details regarding REMP are presented in Section 8.6.5.



LEGEND

- Project Footprint - Indirect Impact
- Project Footprint - Direct Impact
- Project Site
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Watercourse
- Existing mine water release point
- Existing environment (for EIS)
- Future monitoring of mining impacts
- Background data (used for water quality objectives)

N

Figure 8-1

Waterways and existing monitoring and release points

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.75 1.5 3
Kilometres

Scale: 1:150,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

BHP Mitsubishi Alliance

DATE: 26/08/2024 VERSION: 6

8.3.2 Mine water assessment

To assess potential impacts from the Project on the environmental values and preventative and mitigation measures to demonstrate that the Project will not result in degradation of water quality related values, the assessment involved:

- identification and description of the existing environment relevant to the conceptual Project WMS
- identification of key objectives and considerations for the WMS
- development of the proposed Project WMS required to meet the key objectives and considerations
- validation of proposed Project WMS through water balance assessment
  - development of schematic for mine WMS
  - development of a water balance model to analyse the potential hydraulic performance of the WMS, subject to a range of climatic conditions, including historical climate data, climate change sequences and sensitivity analyses
  - validation of proposed Project WMS against key objectives and regulatory requirements such as containment requirements as outlined in DES (ESR/2016/1933)
  - consideration of net WMS balance including estimated water balance within WMS elements, estimated required external make up water supply, estimated salt balance, estimated transfer and dewatering volumes and potential spills via emergency spillway structures.

Conservatively, seepage losses from the proposed dam features were not modelled.

8.3.2.1 Conceptual mine water management system

The conceptual mine WMS has been progressed to a level of detail commensurate with the current Project design and data availability. Preliminary capacity estimates for all mine WMS dams and the water transfer network were determined through water balance assessment using historical climate data and climate change projections, and conceptual operational rules for minimising:

- generation of MAW by passively diverting clean runoff around the mine WMS wherever practical
- volumes of MAW stored onsite by preferencing the use of MAW where possible (e.g. for CHPP process and dust suppression)
- consumption of raw water by preferencing the use of MAW.

The conceptual mine WMS is described in detail in **Appendix E-2 Mine Water Balance Technical Report**.

8.3.2.2 Water Balance Model development

A dynamic water balance model (WBM) was developed for the Project using GoldSim probabilistic modelling software. GoldSim is a Monte Carlo simulation software package that is commonly used in the mining industry for water balance modelling. The purpose of the water balance assessment was to validate the proposed mine WMS under a range of climatic conditions and potential future climate change projections, with the aim of:

- estimating the potential quantity and quality of MAW that may be generated by the Project throughout the operation of the mine.
- estimating the storage capacity required for each of the WMS dams to meet the stated MAW containment objectives.
- Confirming that the proposed operational rules are supportive of the proposed MAW containment reuse objectives.
- identifying the required transfer capacities to move MAW around the mine WMS so that containment, productivity (CHPP operations) and reuse objectives are met.
- estimating the potential volumes of raw water required to satisfy Project consumptive demands considering:

  - process demands that cannot be satisfied through use of MAW due to water quality requirements, or
  - when stored volumes of MAW are unavailable following periods of prolonged drought.
- developing an understanding of the potential risk and impacts of controlled and uncontrolled releases to the receiving environment.

BMA is seeking authority and licence conditions to conduct the controlled release of MAW from the PWD to allow responsible flexibility and contingency management of MAW inventories. In the rare event the site experiences extreme rainfall conditions exceeding the containment volume developed for each storage, BMA may utilise licensed release as a water management strategy in preference to allowing spills from MAW dam emergency spillway structures.

Because the WMS was not modelled to spill via emergency spillway structures in the initial WMS validation, a stress test scenario was established that specifically creates an elevated water condition, such that licensed release(s) are required to prevent spills. This stress test scenario is not an expected water inventory scenario.

As a licensed release from the process water dam into Boomerang Creek has the potential to interact with the downstream receiving environment, submissions on the draft EIS requested additional analysis of managed releases. Sensitivity testing of potential release volumes and MAW water quality from the PWD has been assessed to demonstrate when and how much water could be released to the receiving environment while meeting minimum conditions as per neighbouring mines. Notwithstanding, the modelling of water quality within the WBM was simply developed, and due to available data limitations, does not model all water quality contaminants applicable to the Project.

Modelling plots exported as maximum modelled volumes per wet season year, at minimum, 5th percentile, median, 95th percentile and maximum levels, based upon the 500 climate sequences were developed for each scenario. A detailed discussion of the water balance model development and comprehensive plot outputs for the modelled scenarios is provided in **Appendix E-2 Mine Water Balance Technical Report**.

8.3.2.3 Preliminary Consequence Category Assessment

In the Queensland regulatory context, a Consequence Category Assessment (CCA) is required for water storages meeting the definition outlined in 'Structures which are dams or levees constructed as part of environmentally relevant activities' ESR/2016/1934 (DES, 2022).

BMA acknowledge a full CCA will be required to be developed for regulated structures as part of detailed design. The final configuration of dam structures and spillways, including heights of the dam embankments, will be confirmed during the detailed design phase, preceding full CCA.

A preliminary CCA has been completed for proposed Project dams as per guidance provided by the DES (formerly DEHP) 'Manual for assessing consequence categories and hydraulic performance of structures' ('the Manual') (DES, 2016 - ESR/2016/1933). The CCAs for the described structures will be updated and confirmed during the detailed design phase of each structure.

The preliminary assessment of consequence categories has been undertaken for the following failure scenarios with consideration of populations, land use, ecological, hydrological and hydrogeological values present in the receiving environment downstream:

- Failure to Contain – Seepage: Spills or releases to ground and/or groundwater via seepage from the floor and/or sides of the structure.
- Failure to Contain – Overtopping: Spills or releases from the structure that result from loss of containment due to overtopping of the structure.
- Dam Break: Collapse of the structure due to any possible cause.

Preliminary assessment of consequence categories for the structures associated with the proposed development was completed as follows:

- A qualitative characterisation of the failure event was developed for each failure event type, and each structure.

- The potential impacts arising from the characterised failure events were assessed against Table 1 of the Manual for assessing consequence categories for dams (DES, 2016).
- A preliminary consequence category was established for each scenario (Failure to Contain – Seepage, Failure to contain – overtopping, Dam Break).

Noting assessed structures generally comprise limited water storage volume dams (less than 200 megalitres), the consideration of downstream infrastructure and assets included a potential impact distance between 10 km and 20 km exceeding the recommended distance of 5 km for dams containing less than 200 megalitres of water inventories (ANCOLD, 2012).

As per the Manual (DES, 2016), a Significant or High consequence category in any failure event category results in the application of a 'regulated structure' status to the structure being assessed. Notwithstanding, the determined consequence categories are preliminary, and based upon the expected configuration of the structures. A comprehensive CCA is required during the detailed design of the structures. Should the rating of dams change during detailed design, the associated performance and management criteria recommended may also change.

A detailed description of the approach and assumptions relevant to the preliminary CCA is provided in **Appendix E-2 Mine Water Balance Technical Report**.

8.3.3 Subsidence

Background information provided by BMA, including detailed geological logs and in situ stress measurements, informed a modelling assessment of potential subsidence over the longwall panels (Minserve, 2022). Analysis using the longwall coal mining method presents results using three-dimensional deformation models to account for overburden lithology, topography and mining extent. Further details of the modelling method and assumptions applied to identify physical effects of subsidence at 1, 2, 5, 10 and 20 years of mining are discussed in **Appendix B-1 Subsidence Modelling Technical Report.**

Subsidence-induced ponding is conceptualised and assessed using dynamic GoldSIM model to describe the catchments, flow paths, volumes stored and simulate quantity and salinity of water flowing into, stored within and overflowing from the ponding areas in **Appendix E-4 Conceptual Ponding Assessment**.

8.3.4 Hydrology, hydraulics and geomorphology

On-ground inspections, sediment sampling, previous relevant studies, aerial imagery and hydrological records provide inputs to inform modelling hydrology, hydraulic and geomorphology impacts.

Hydrologic modelling for the Project was undertaken using industry standard software programs and methods. Hydrological analysis of the Project Site was derived from a hydrologic model previously developed for a project adjacent to the Project Site, which involved the determination of flows for multiple streams including Boomerang Creek, Plumtree Creek and Hughes Creek (Alluvium 2016). The existing model was used to extract flow hydrographs and determine peak flow estimates at key locations for design flood events within the three creeks passing through the Project Site.

The rainfall runoff process occurring in a catchment is represented by conceptualisation of the catchment as a linked series of sub-catchment storages, applying excess rainfall (assuming low or no baseflow in the ephemeral streams), and calculating the resulting runoff from each sub-catchment storages and routing through the catchment system. The term Annual Exceedance Probability (AEP) is used for design events (rainfalls and floods) including rarer (less frequent) than those with a 10 per cent AEP. However, the term Annual Recurrence Interval (ARI) is used throughout the Australian Coal Association Research Program criteria for assessing hydraulic parameters of channels and is commonly understood in this context. ARI was used in the hydrology assessment for design events up to the 50 year ARI (i.e. 2 per cent AEP). Refer to Table 8-1 for a conversion between ARI and AEP.

Table 8-1 ARI to AEP conversion table

ARI (years)	AEP	AEP expressed as %
2	0.393	39
5	0.181	18
10	0.095	10
20	0.049	5
50	0.020	2
100	0.010	1
200	0.005	0.5
500	0.002	0.2
1,000	0.001	0.1
2,000	0.0005	0.05

Estimated peak flows (cubic metres per second) (m^3/s) for key locations are summarised in Table 8-2.

Table 8-2 Design discharges generated from hydrologic modelling (m^3/s)

Creek	Catchment area (km^2)	2 year ARI	50 year ARI	1% AEP	0.1% AEP
Plumtree Creek	10.1	13.4	51.5	68.3	142.0
Boomerang Creek	106.2	86.6	380.0	450.0	979.0
Hughes Creek (including Plumtree Creek)	131.5	97.8	441.0	531.0	1,132.0

Applying the predicted physical effects of subsidence through the Project Site (Minserve, 2022), hydraulic models were created for pre-subsidence (Year 0) and post-subsidence scenarios (Year 10 and Year 20) using two software packages:

- HEC-RAS (Hydrologic Engineering Centre River Analysis System), one-dimensional (1D) modelling
- TUFLOW, simulation software for waterway and flooding analysis, two-dimensional (2D) modelling.

Flow estimates applied to 1D and 2D modelling of post-subsidence conditions establish instream hydraulic and likely geomorphic response and potential changes to flooding behaviour sediment transport characteristics and characterise flooding behaviour. The potential changes in channel hydraulics, sediment transport and flooding behaviour identify risks to environmental values and inform mitigation measures to minimise impacts to the Project and the environment.

Based on results of **Appendix B-1 Subsidence Modelling**, a detailed discussion and assessment of the hydraulics, hydrology and geomorphology relevant to the Project is in **Appendix E-3 Hydraulics, Hydrology and Geomorphology Technical Report**.

8.4 Description of environmental values

8.4.1 Climate

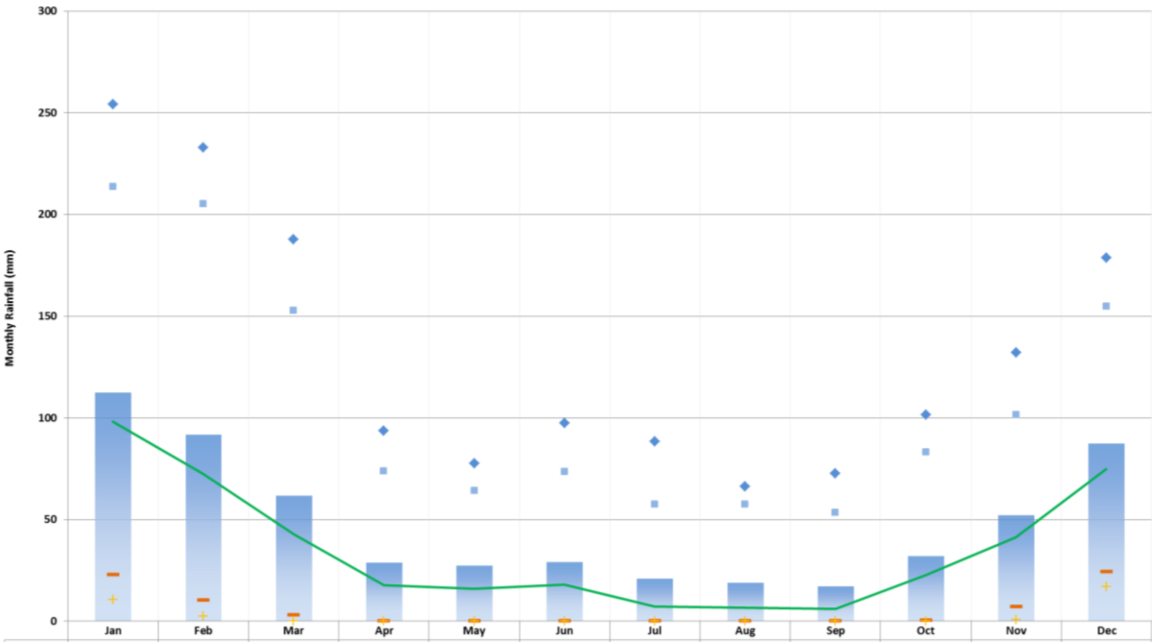
Climate at the Project Site is sub-tropical characterised by high variability in rainfall, temperature and evaporation, typical of Central Queensland; subtropical with a moderately dry winter (as per the Köppen Climate Classification). Historic climate data sourced from the Bureau of Meteorology SILO Data Drill provides 128 years of records commencing in 1889 describes existing climate at the Project Site as follows:

- Mean annual rainfall is approximately 580 millimetres (mm); however, total annual rainfall is relatively variable. The 5th and 95th percentile totals of 285 mm and 957 mm indicate there is a 5 per cent probability that total annual rainfall may be between 50 per cent and 155 per cent of the mean rainfall value.

- Monthly rainfall (Figure 8-2) shows a distinct seasonal distribution with well-defined wet season occurring from December through March. Approximately 60 per cent (320 mm) of the median annual rainfall falls during this five-month period.
- Mean monthly rainfall during the dry season months of April through October ranges from a minimum of around 17 mm per month in August, to a maximum of approximately 29 mm in April. Median rainfall for July, August and September is approximately 7 mm.
- Monthly rainfall variability during the wet season is high with the potential for both flood and drought. Variability is greatest during January where monthly total rainfall ranges from approximately 10.5 mm (5th percentile) to 254 mm (95th percentile).

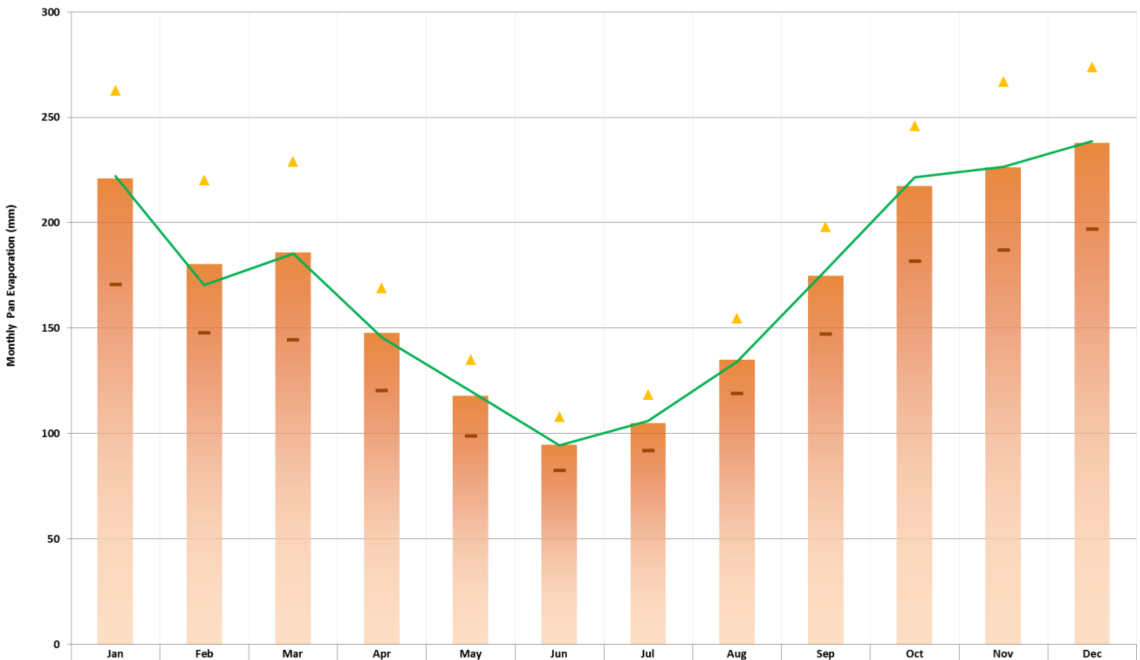
Mean monthly evaporation shown in Figure 8-3 was derived from the SILO Data Drill for the Project Site. The data can be summarised as follows:

- monthly evaporation follows a broadly similar seasonal distribution to rainfall, with rates highest from October through March, and lowest from April through September
- the maximum monthly evaporation of 238 mm occurs in December, and the minimum monthly evaporation of 95 mm occurs in June
- comparing this data with Figure 2, mean evaporation exceeds mean rainfall for all months indicating a strongly negative mean annual water balance.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	112.2	91.7	61.8	28.6	27.2	29.1	21.0	18.8	17.0	31.9	52.0	87.4
P95	254.1	232.8	187.8	93.6	77.6	97.3	88.5	66.2	72.7	101.6	132.1	178.8
P90	213.7	205.2	152.9	73.8	64.3	73.5	57.5	57.6	53.4	83.2	101.5	154.7
P50	98.1	72.6	42.8	17.6	16.1	18.1	7.3	6.8	6.0	22.8	41.2	74.9
P10	22.7	10.3	3.0	0.0	0.2	0.0	0.0	0.0	0.0	0.5	7.2	24.2
P5	10.5	2.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	17.1

Figure 8-2 Monthly rainfall (SILO Data Drill, 1889-2018)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	221.1	180.5	185.9	147.8	118.1	94.8	104.9	135.0	175.0	217.5	226.2	237.8
P90	262.7	220.1	229.0	168.9	134.9	107.9	118.2	154.6	197.8	245.8	266.7	273.6
P50	222.2	170.3	185.4	145.4	120.0	94.3	106.0	134.1	177.5	221.5	226.4	238.8
P10	170.6	147.6	144.3	120.3	98.6	82.2	91.7	118.9	146.9	181.5	186.8	196.9

Figure 8-3 Monthly pan evaporation (SILO Data Drill, 1970-2017)

8.4.2 Hydrology

Waterways defined as a watercourse under the *Water Act 2000* flow through the Project Site, including Boomerang Creek, Plumtree Creek, Hughes Creek, One Mile Creek, Spring Creek and Phillips Creek. Of these streams, only Boomerang Creek, Plumtree Creek and Hughes Creek intersect the underground mining panels and the potential area of subsidence. Watercourses are identified in Figure 8-1. Boomerang Creek and Hughes Creek commence in the Harrow Range west of Peak Downs Mine and Saraji Mine where the upper reaches are relatively confined in narrow valleys. These upper catchments are steep, containing occasional escarpments. As streams emerge from the range the valley widens, and longitudinal slope decreases as they enter a broad, gently undulating floodplain. Boomerang Creek, Hughes Creek and Plumtree Creek are previously modified by open cut mining operations west of the Project Site. Both Boomerang Creek and Hughes Creek flow through open cut Mining Leases (MLs) and contain diversion reaches. Boomerang Creek and Hughes Creek converge approximately 1 km downstream (east) of the Project Site. Plumtree Creek has no catchment upstream of the Project as the headwaters have previously been developed by the existing Saraji mine and has not been assessed further.

Typical of the ephemeral watercourses in the region, the waterways in the Project Site flow intermittently through the year in response to rainfall and runoff, with extended periods of no flow. Modelling indicates hydraulic values are higher in the larger streams and decrease from upstream to downstream for each creek, except for a local increase within the diversion reach of Hughes Creek.

8.4.3 Environmental values

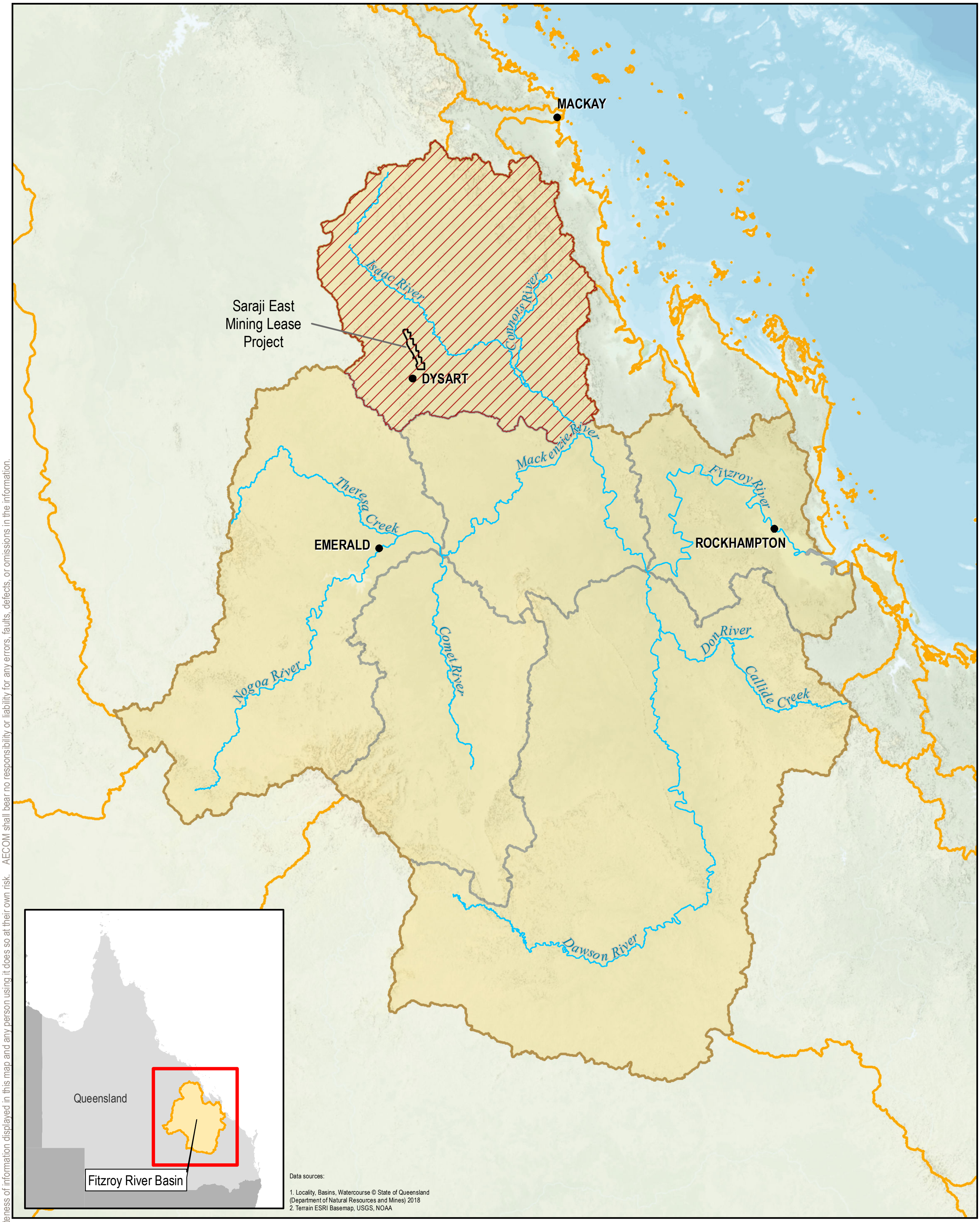
Environmental values for surface water are the qualities of water making it suitable for supporting aquatic ecosystems and human water uses to be protected from the effects of habitat alteration, waste releases, contaminated runoff and changed flows to ensure healthy aquatic ecosystems and safe waterways for community use.

The Project is located within the Isaac River sub-basin of the Fitzroy Basin, in the far upstream headwaters of the Isaac River sub-catchment. As described in Schedule 1 of the EPP (Water and Wetland Biodiversity), environmental values for waters in the Isaac River sub-basin are published by the DEHP 2011 document entitled ‘Environmental Protection (Water) Policy 2009 Isaac River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the

Isaac River Sub-basin (including Connors River)'. The environmental values identified for the Isaac Western Uplands Tributaries sub-catchment (within which the Project Site is located) include:

- aquatic ecosystems
- stock watering (high) (e.g. cattle)
- human consumer (e.g. of wild or stocked fish)
- primary recreation (e.g. swimming)
- secondary recreation (e.g. sailing, fishing)
- visual appreciation (e.g. picnic, bushwalking)
- drinking water (e.g. raw water supplies taken from river)
- cultural and spiritual values (e.g. traditional customs).

Of the water courses within the Project Site, the upstream sites exhibit typical freshwater upland stream characteristics, whereas the downstream sites have characteristics of both upland and lowland freshwater streams. Regional catchment context of the Project is shown in Figure 8-4.



LEGEND

- Locality
- Watercourse
- Isaac River Catchment
- Tenement
- Fitzroy River Basin
- Drainage Basin

N

Figure 8-4
Regional Catchment

Environmental Impact Statement
Saraji East Mining Lease Project

0 25 50 100
Kilometres

Scale: 1:3,000,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

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Filename: L:\Secure\Projects\605X\60507031\4. Tech Work Area\4.98 GIS 2021\02_MXDs\01 Environmental Impact Statement\08 Surface Water\60507031_G270_v2_A4P.mxd

8.4.4 Surface water quality

Relevant WQO for the Project Site were identified from the EPP (Water), local reference data and the Water Quality Guidelines (ANZG 2018). Water quality data for the catchment upstream of Saraji East and upstream of the existing mines was derived from data collected for REMPs or water quality trend assessments between 2012 to 2021.

Data showed a high variability of physico-chemical parameters within and between streams traversing the project site (Boomerang, Hughes, Spring and One Mile Creeks). These ephemeral watercourses represent moderately disturbed aquatic habitats as defined by the Queensland Government (2022).

Due to high variability of WQ parameters and deviations from the WQ guideline values as outlined in EPP 2019 (Water Isaac River 1301) and ANZG (2018), site specific or sub-regional WQOs were developed. Sub-regional WQOs were developed in accordance with the QWQG 2009 & 2022 and ANZG 2018 to be used as guidelines for catchment managers to set targets for long-term water quality improvements.

Sub-regional WQOs have been developed using upstream data over the period from July 2012 to March 2021. Sites unlikely to be impacted by mining were assessed and median values were derived from designated sites (thin black triangles) over the period from July 2012 to July 2021. This data was provided by BMA.

Water quality data throughout the catchment shows high variability for parameters within streams and between streams. To assess for significant differences, statistical tests have been applied. Wherever differences between streams or flow regimes were significant, amendments to the WQOs according to the relevant guidelines were made. Further detail is provided in **Appendix E-1 Surface Water Technical Report**.

Table 8-3 Developed sub-regional WQOs for the Boomerang-Hughes Creek catchment

Parameter	Unit	Developed WQO	Existing Guideline Value (GLV)	Guideline Source
Water quality objectives to protect aquatic ecosystem environmental values				
Total suspended solids	mg/L	Existing GLV retained	55	EPP (Water) (2019)
Turbidity	NTU	Existing GLV retained	50	EPP (Water) (2019)
EC	µS/cm	Existing GLV retained	720	EPP (Water) (2019)
Sulfate	mg/L	Existing GLV retained	25	EPP (Water) (2019)
pH	-	6.5-8.0	6.5-8.5	EPP (Water) (2019)
Ammonia	µg/L	40	20	EPP (Water) 2019
Nitrate	µg/L	288 (High flow)	60 (low flow)	EPP (Water) (2019)
Kjeldahl nitrogen	µg/L	916 (Low flow) 1440 (High flow)	420	EPP (Water) (2019)
Total nitrogen	µg/L	1174 (Low flow) 2420 (High flow)	420	EPP (Water) (2019)
Filterable reactive phosphorus	µg/L	Existing GLV retained	20	EPP (Water) (2019)
Total phosphorus	µg/L	Existing GLV retained	50	EPP (Water) (2019)
Dissolved oxygen	%	37-86	85-110	Developed Objective EPP (Water) (2019)
Metals (Dissolved)				
Aluminium	µg/L	NA	5,000	EPP Water (2011) Stock watering**
	µg/L	Existing GLV retained	55	ANZG (2018)*
Arsenic	µg/L	NA	500	EPP Water (2011) Stock watering**

Parameter	Unit	Developed WQO	Existing Guideline Value (GLV)	Guideline Source
Water quality objectives to protect aquatic ecosystem environmental values				
		Existing GLV retained	13	ANZG (2018)*
Chromium	µg/L	NA	1,000	EPP Water (2011) Stock watering**
	µg/L	Existing GLV retained	1	ANZG (2018)*
Copper	µg/L	NA	400	EPP Water (2011) Stock watering**
	µg/L	1	1.4	(ANZG 2018)*
Iron	µg/L	214	Not provided	
Molybdenum	µg/L	NA	150	EPP (Water) (2011) Stock watering**
	µg/L	Existing GLV retained	34	ANZG (2018)*
Nickel	µg/L	NA	1,000	EPP (Water) (2011) Stock watering**
	µg/L	1.2	11	Developed Objective (ANZG 2018)
Selenium	µg/L	NA	20	EPP (Water) (2019) Stock watering
	µg/L	Existing GLV retained	5	ANZG (2018)*
Uranium	µg/L	NA	200	EPP (Water) (2019) Stock watering
	µg/L	Existing GLV retained	0.5	ANZG (2018)*
Zinc	µg/L	NA	20,000	EPP (Water) (2019) Stock watering
	µg/L	Existing GLV retained	8	ANZG (2018)*

*ANZG trigger values for toxicants applied to slightly-moderately disturbed systems

**ANZECC guideline still applicable as ANZG has not been updated for stock watering.

Data from sites unlikely to be directly impacted by mining activities was reviewed to assess the condition of streams that are within the ML (MP7, MP8, MP9/18), and for sites located in the vicinity of the actual underground mining footprint (MP5) (Figure 8-1). Data from unimpacted sites provides environmental background data for comparison of WQ before the project commences. Comparison between developed sub-regional WQOs and Environmental Background values from unimpacted sites south of proposed Saraji East Underground Mining Project is presented in Table 8-4**.** Red shading indicates exceedance of developed sub-regional adopted WQOs. Most of the median values of recorded parameters at the environmental background sites were within or below the developed sub-regional WQOs. However, median values for Turbidity, TSS, Sulfur, Ammonia, Copper and Nickel exceeded the developed sub-regional WQOs (Table 8-3). This could be due to the different geology, lithology and soil characteristics of Isaac River and Phillips creek compared to the rest of the streams. Other possible factors could be varying discharge rates and dissimilar land use upstream. Statistical analysis reinforces this difference as there was a statistically significant difference for these parameters between upstream and background sites (Table 8-4).

Fewer exceedances of WQOs were present for sites within the actual mining extent (Turbidity, Sulfur, and Nickel, Table 8-4). This more accurately represents the conditions in the Boomerang-Hughes Creek catchment. Deviations from site specific WQOs could be due to the availability of only one stream (Hughes Creek) compared to the combined data of four water courses within the sub-regional catchment utilised for WQO development.

Table 8-4 Comparison between developed sub-regional WQOs and Environmental Background values

Analyte	Developed Sub-Regional WQO	Env. Background	WQ within footprint of the extent of underground mining	Guideline adopted for Sub-Regional WQOs
pH	6.5-8.0	7.8	7.6	Developed (Sub-Catchment Specific)
EC (µS/cm)	720	490	686	EPP (Water) (2019)
Turbidity (NTU)	50	319	183	EPP (Water) (2019)
DO%	37-86	77.7	27	Developed (Sub-Catchment Specific)
TSS (mg/L)	55	271	41	EPP (Water) (2019)
SO_4 (mg/L)	25	42	84	EPP (Water) (2019)
Ammonia (µg/L)	40	50	10	Developed (Sub-Catchment Specific)
Nitrate (µg/L)	60 low flow 288 high flow	170	132	Developed (Sub-Catchment Specific)
Total Organic (Kjeldahl) Nitrogen as N (µg/L)	916 low flow 1440 high flow	600	800	Developed (Sub-Catchment Specific)
Total Nitrogen as N (µg/L)	1174 low flow 2420 high flow	1,350	1,300	Developed (Sub-Catchment Specific)
Total Phosphorus as P (µg/L)	50	50	45	EPP (Water) (2019)
Reactive Phosphorus as P (µg/L)	20	ND	ND	EPP (Water) (2019)
Al (µg/L)	55	35	16	ANZG (2018)
As (µg/L)	13	ND	ND	ANZG (2018)
Cr (µg/L)	1	ND	ND	ANZG (2018)
Cu (µg/L)	1	2	1	Developed (Sub-Catchment Specific)
Fe (µg/L)	214	80	60	Developed (Sub-Catchment Specific)
Mo (µg/L)	34	1	1	ANZG (2018)
Ni (µg/L)	1.2	2	2	Developed (Sub-Catchment Specific)
Se (µg/L)	5	ND	ND	ANZG (2018)
U (µg/L)	0.5	ND	ND	ANZG (2018)
Zn (µg/L)	8	ND	ND	ANZG (2018)

8.4.5 Existing water users

The Project Site is within the Isaac River catchment. The Lower Fitzroy and Fitzroy Barrage Water Supply Schemes are located 250 km downstream of the confluence with the Isaac River. They have 28,621 megalitres and 62,335 megalitres of allocated water, respectively. The total catchment area of these tributaries upstream and within the Project Site is about 590 km^2, this equates to less than 0.4 per cent of the total catchment area for these water supply schemes (142,665 km^2).

The ROP explanatory notes state the western tributaries of the Isaac River are significantly drier than those to the north, with annual rainfall less than 600 millimetres (mm) in the west and less than 1,600 mm in the north. This suggests creeks in the vicinity of the mine (Phillips, Boomerang, Hughes and One Mile Creeks) provide a relatively small contribution to water allocations in the Fitzroy River Basin.

The dominant land use upstream of the proposed mine site is beef cattle grazing and native bushland. Tree clearing has occurred over time to improve pastures. There is also mining activity upstream of the Project Site and the Isaac River has been dammed upstream through the construction of Burton Gorge Dam. As a result, the catchments are not in pristine condition and are susceptible to the impacts of existing land use activities.

Existing land uses downstream of the Project Site include mining, grazing (modified pastures) and dryland cropping (Alluvium, 2023). Land use further downstream of the Isaac River-Boomerang Creek confluence (up to 100 km) mainly consists of grazing and cropping with minor areas being utilised for irrigated perennial horticulture.

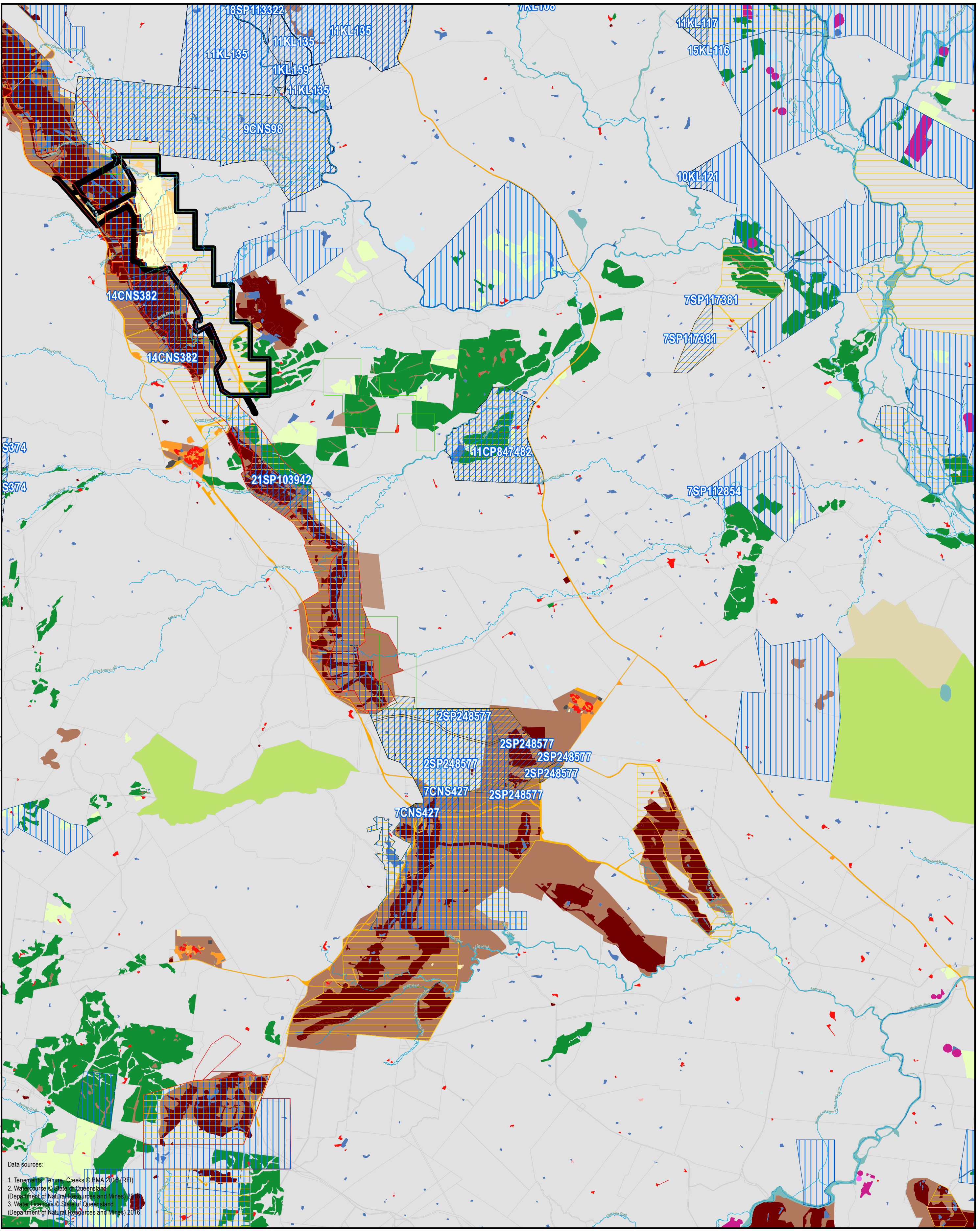
Existing surface water users identified through a search of the Department of Resources database on surface water extraction licences near the Project Site prior to the confluence with the Isaac River. The search revealed five surface water licences, consisting of two licences for stock watering purposes downstream of the site, with the remaining three licences belonging to BMA to divert a watercourse and for site water management of the existing Saraji Mine. The stock licences are all located within 8 km of the downstream extent of the Project Site. A summary of these licences is provided in Table 8-5 and illustrated in Figure 8-5.

Table 8-5 Surface water extraction licences

Lot/Plan	Creek	Purpose
9/CNS98	Ripstone Creek	Stock watering
11/KL135	Ripstone Creek	Stock watering

Lake Vermont Meadowbrook mining site, which is situated about 9,000 m south of the Saraji Mine, is owned by Bowen Basin Coal Pty Ltd (BBC) on mining leases (ML) 70331, ML 70477 and ML 70528 under the approval of the Environmental Authority Permit No. EPML00659513. An extension of the existing Lake Vermont coal mine is proposed and the EIS is being assessed. The Terms of Reference for this project (April 2020) outline the need for identification of approval or allocation for water needed under the *Water Act 2000*, hence likely water extraction permits from the site cannot be confirmed at the time of this EIS.

Of note, three unnamed gullies traversing Lake Vermont Mine drain in a north-easterly direction to the floodplain of the Isaac River, which flows south-easterly. The northern section of Lake Vermont Mine drains north to Phillips Creek, which in turn drains east to Isaac River.



LEGEND

- Project Site
- Project Footprint - Indirect Impact
- Project Footprint - Direct Impact
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Watercourse
- Cadastre
- Existing Water User

Water Licence Authorisation Type

- Licence to Take Water
- Licence to Interfere

Land Use

- Nature conservation
- Managed resource protection
- Other minimal use
- Production native forests
- Grazing modified pastures
- Cropping
- Grazing irrigated modified pastures
- Irrigated cropping
- Intensive animal production
- Manufacturing and industrial
- Residential and farm infrastructure
- Services
- Utilities
- Transport and communication
- Mining
- Waste treatment and disposal
- Lake
- Reservoir/dam
- River
- Marsh/wetland

N

Figure 8-5
Surface Water Extraction Licences

Surface Water Technical Report
Saraji East Mining Lease Project

0 3.5 7 14
Kilometres

Scale: 1:500,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

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8.4.6 Geomorphology

Boomerang Creek

Downstream of Peak Downs Mine, Boomerang Creek meanders gently south then east before joining Hughes Creek and eventually making its way to the Isaac River. It forms a continuous channel with uniform symmetrical cross-section in straights and asymmetrical on bends. The channel bed is severely aggraded with sand exceeding several metres thick smothering all bed forms and limiting habitat diversity. The system is accreting as it is in a transport limited state (it receives more sediment than it can transport). Existing conditions reflect a low energy depositional environment, limiting potential for bank erosion. A thick mud drape on the channel banks colonised by fine roots stabilises the steep banks.

Existing cattle grazing disturbs channel bed and banks limiting potential for regeneration of riparian vegetation. This has led to a dense line of *Melalueca leucadendra* and occasional *Eucalyptus tereticornis* overstorey lining the banks, with an exotic grass ground cover, the density of which is a direct result of grazing regime. Mid story (shrub) vegetation is mostly absent.

Hughes Creek

Hughes Creek is single alluvial continuous channel diverted between open cut pits in the existing Saraji Mine. The diversion has a high angle bend into the most western of the northern panels in the Project Site. This proposed panel will subside 1,300 m downstream of the diversion. The diversion reach is a deeply cut, large channel with no floodplain connectivity. It is cut through dispersive subsoils and has been subject to considerable erosion and recently, rehabilitation effort. These rehabilitation works comprise covering the long and relatively steep diversion batter slopes with pit sourced sandstone. This type of pit sourced sandstone typically completely weathers to constituent parts in two to five years. As these works are recent, there is no vegetation on the batters. Some vegetation has been left in the low flow channel.

There is existing active bank erosion where the channel capacity remains close to the diversion with decreasing erosion and increasing deposition moving downstream. Channel capacity decreases in a downstream direction. Where this occurs, flood connection with Boomerang Creek occurs.

Plumtree Creek

This tributary of Boomerang Creek is limited, commencing on the eastern edge of the existing Saraji Mine. The upstream catchment has been mined and no longer contributes flows. Plumtree Creek flows east then northeast before its confluence with Boomerang Creek on the northern edge of the underground mine plan. The watercourse is a continuous single-thread, meandering channel with a flatbed grade.

The flat bed grade and low capacity channel reflects a low energy system though the Project Site. The consequent reduced flows are reflected in a channel that is inactive and being colonised by terrestrial vegetation in part and blanketed in clay in others, leading to ephemeral wetland development in channel (Plate 4). There are no signs of instability on Plumtree Creek within the Project Site.

8.4.7 Flooding

Modelling was undertaken to determine the nature and extent of flood behaviour under existing conditions. The maximum predicted water depth across the Project Site was mapped for the 2 year ARI, 50 year ARI, 100 year ARI and 1,000 year ARI events (Figure 8-10 to Figure 8-13). The lower limit of mapping was set at 0.2 m deep to minimise capturing puddles that result from direct rainfall. Results indicate 2 year ARI event flows are contained within the channels except in the northeast corner of the Project Site, where floodplain inundation occurs near the Hughes and Boomerang Creeks confluence. The extent and depth of inundation increases for each larger flow event modelled. Overland flow paths south of Hughes Creek also become more prominent under larger flows.

8.5 Potential impacts

Construction phase (Year 1-3) will primarily involve vegetation clearing, civil earthworks and building with potential to result in surface water quality impacts from erosion and sedimentation (Section 8.5.3), and fuel and chemical spills (Section 8.5.4). During mining operations, all potential impacts to surface water resources discussed in this section will need to be managed over the 20 year mine life. The decommissioning phase will involve dewatering of WMS dams not suitable for ongoing beneficial use and earthworks associated with the removal of infrastructure on the site and commencement of rehabilitation measures in accordance with **Appendix K-1 Rehabilitation Management Plan.**

8.5.1 Mine water management

8.5.1.1 Mine water management system

The purpose of the Project mine WMS is to examine and address issues relevant to the importation (of raw water), generation, use, and management of water on the Project Site. Accordingly, the Project WMS has been designed to operate self-sufficiently with the benefits of being connected to the broader BMA network to allow water sharing.

Under normal operating conditions, most of the Project water supply will be MAW and the Project Mine WMS will operate independently of the existing Saraji Mine water system. However, should sufficient Project MAW not be available for CHPP process and dust suppression MAW or raw water may be imported from the existing Saraji Mine water system, following water quality testing to confirm that water is of an appropriate quality for the intended use. Similarly, where additional water demands at the existing Saraji Mine need to be met, water satisfying water quality testing may be exported from the Project to Saraji Mine.

The objective of the WMS is to minimise the quantity of water that is mine affected and released by Project activities. This will broadly be achieved by:

- managing the generation, storage, distribution, and reuse of all potentially MAW (including groundwater) captured and generated by the Project
- handling the conveyance of natural runoff originating from undisturbed clean catchments through the Project Site
- managing the storage and distribution of raw water.

The development of the Project conceptual mine WMS has been guided by a set of key objectives based on information provided by BMA, previous studies, best management practice for the management of MAW, and previous experience with coal mines in the Bowen Basin.

Raw water

The Project will have minor raw water demand met through BMA’s existing surface water allocations and licences. Raw water from existing BMA surface water allocations will supply potable uses (drinking, washrooms) and, when MAW is unavailable, may supplement underground mine, CHPP and dust suppression water demands. Raw water is stored in the raw water dam (RWD), which has been sized to meet all Project water demands for approximately one month. BMA’s current allocations are sufficient to meet Project needs and no additional water allocation will be sourced for this Project.

Mine affected water

Consistent with current practices for mine water management, it is intended, wherever practicable and achievable, to passively divert clean runoff around the mine WMS MAW dams (and other mine infrastructure), such that non-MAW runoff remains undisturbed. The use of catchment drains, bunding and other devices designed to contemporary standards to comply with regulatory requirements will be used wherever feasible and practicable to reduce the risk of clean water flows from entering the mine WMS.

Mine affected runoff collected from each process area dam will be transported to the process water dam. The process water dam also receives MAW from the underground mine portal sump located in the existing Saraji Mine open cut pit. MAW stored in the process water dam is the preferred source of water for the CHPP and dust suppression activities.

The CHPP will require a raw water supply of approximately 1,500 megalitres per year to process run of mine coal at a production rate of up to 800 tonnes per hour. Water will be preferentially sourced from the process water dam. Water for dust suppression (of areas that drain to MAW dams or where water will evaporate) will also be preferentially sourced from the process water dam.

By preferentially sourcing MAW to satisfy operational demands, potential volumes of MAW generated and stored onsite will be minimised wherever possible. No quality restrictions have been placed on the reuse of MAW by the CHPP or for dust suppression. Where potential quality restrictions may arise, it is expected that the blending of raw and MAW could be conducted to achieve the desired quality.

Water storages will be designed to contemporary standards to comply with regulatory requirements to support mining operations, manage MAW and protect downstream environmental values by minimising uncontrolled releases. Notwithstanding, BMA are seeking a licensed release condition for the development to allow for emergency and contingency management of MAW.

BMA is seeking authority and licence conditions to conduct the controlled release of MAW from the process water dam to allow responsible flexibility and contingency management of MAW inventories. In the rare event the site experiences extreme rainfall conditions exceeding the containment volume developed for each storage, BMA may utilise licensed release as a water management strategy in preference to allowing spills from MAW dam emergency spillway structures. Spillway release from the process water dam proposed to be directed to Boomerang Creek has potential to impact on water quality and dependent ecosystems in the receiving environment.

8.5.1.2 Mine water management system components

A schematic of the conceptual mine water management processes is shown in Figure 8-6. As outlined conceptually in Figure 8-6, the conceptual mine WMS consists of the key components:

- process water dam
- underground mine portal sump
- process area runoff storage dams for
  - mine infrastructure area (MIA)
  - coal handling and preparation plant (CHPP)
  - product coal stockpile area
  - run of mine coal stockpile area
- raw water dam.

A water transfer network of pumps and pipes will provide transfer capacity between the storages. A small potable water treatment plant (WTP) will be installed at the MIA for the treatment of raw water for potable use. A sewage treatment plant (STP) will be installed to service the MIA, the construction accommodation village, and to treat sewage generated onsite. Sewage from the stockpile/CHPP area, and from the ablutions facility at the mine portal, will be pumped back to the MIA. Treated effluent from the STP and the WTP will be captured in the process water dam.

Process water dam

Process water dam is proposed to provide the storage required to contain the estimated volume of MAW generated over the production schedule. The dam design will be confirmed during detailed design; however, for assessment, the following conceptual design and operational rules were applied:

- water will be transferred to the process water dam following localised containment and collection in one of the various process area runoff dams or sumps located around the Project Site
- the process water dam will be used to preferentially supply water to various consumptive water demands for which the reuse of MAW is appropriate (CHPP process supply, dust suppression in active mining areas)
- in the event of a spillway discharge from the process water dam, water will, as far as practical, be directed via existing drainage pathways to the receiving environment.

Underground mine portal sump

Runoff and groundwater from dewatering underground mining and gas drainage bores will be pumped to the underground mine portal sump prior to transfer to the process water dam. The quality of groundwater is expected to be suitable for reuse by the Project's consumptive demands (CHPP and dust suppression).

Process areas runoff dams

Runoff from operational areas will generate MAW to be collected in storages assigned to each location via gravity inflow. For assessment, conceptual design and operational rules for the process area runoff collection system were applied:

- runoff from each process area will be conveyed by gravity flow to its respective containment dam. Pumping of runoff to the containment dams is not considered practical due to the high degree of variability in rainfall volume and intensities
- potentially clean runoff originating outside of the process areas will, as far as practical, be passively diverted around the process areas by way of catch drains as required to reduce the total volume of water requiring containment
- water will be transferred from each process area dam to the process water dam as soon as possible to ensure that capacity to contain additional inflows is maximised.

Raw water dam

To supply Project water demands for which reuse of MAW is unsuitable (potable, washdown, underground mine process), or for when MAW is unavailable, a RWD is proposed for the Project Site. The Project's raw water dam does not have a local catchment and will only receive clean water inflows from BMA's existing water allocations and delivered via BMA's existing pipeline network. The conceptual sizing of the RWD is such that it can provide approximately one month's supply of water for all Project water demands including potable, processing and operations in the absence of alternative sources such as the reuse of MAW. This will be confirmed in the detailed design stage.

Spillway release

The indicative location for controlled release of MAW is located on Boomerang Creek adjacent to the proposed process water dam. Spillway discharges (uncontrolled) from the process water dam are also proposed to be directed to Boomerang Creek. Spills via emergency spillways from process area structures will be directed to the receiving environment based on existing topographical constraints. Where dam overflow locations cannot deliver flows directly to Hughes Creek or its tributaries, conveyance channels are proposed to convey the discharge.

Monitoring of downstream flows is proposed to occur within Boomerang Creek and Hughes Creek.

The locations of the proposed WMS components are provided in Figure 8-7.

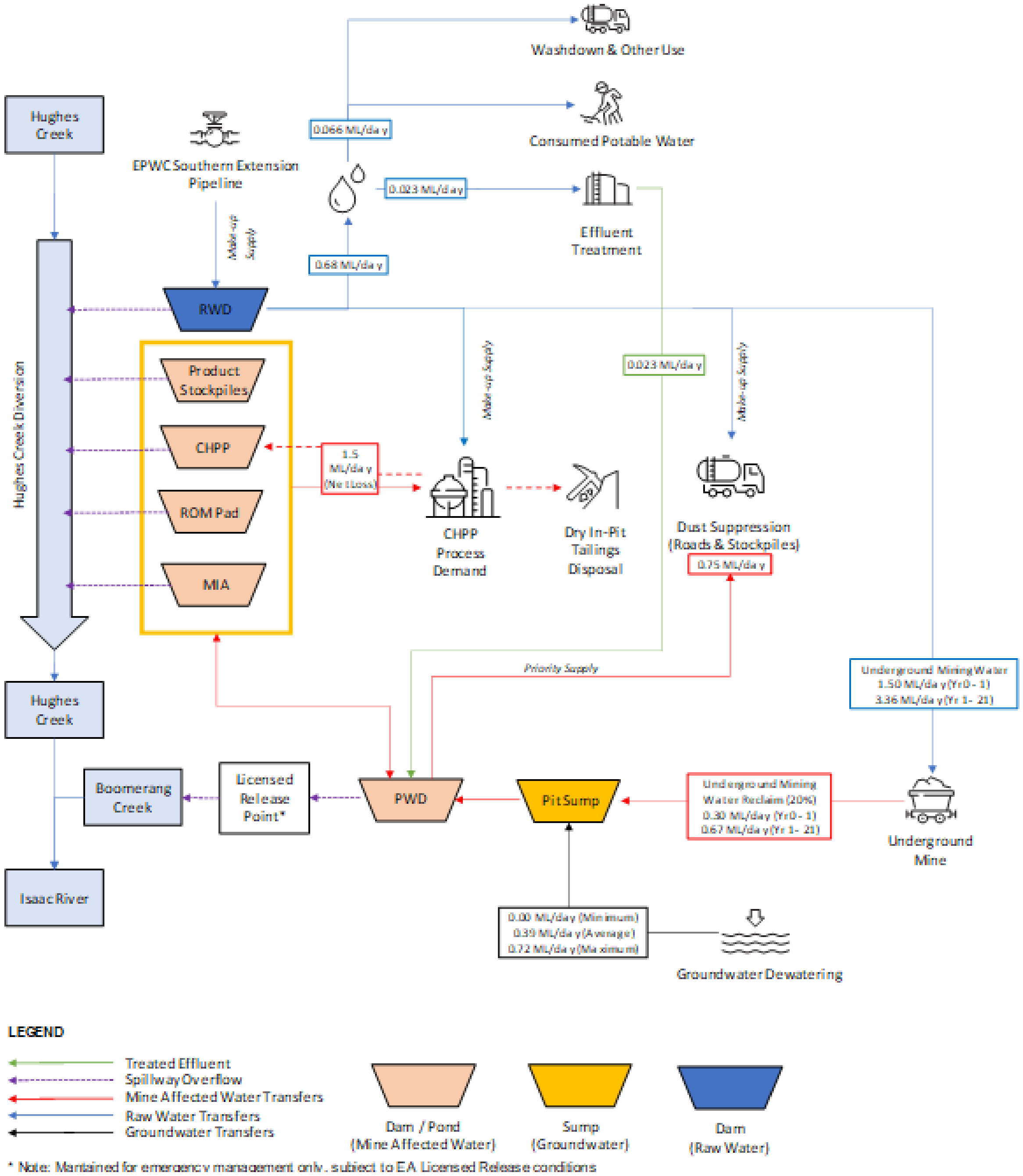
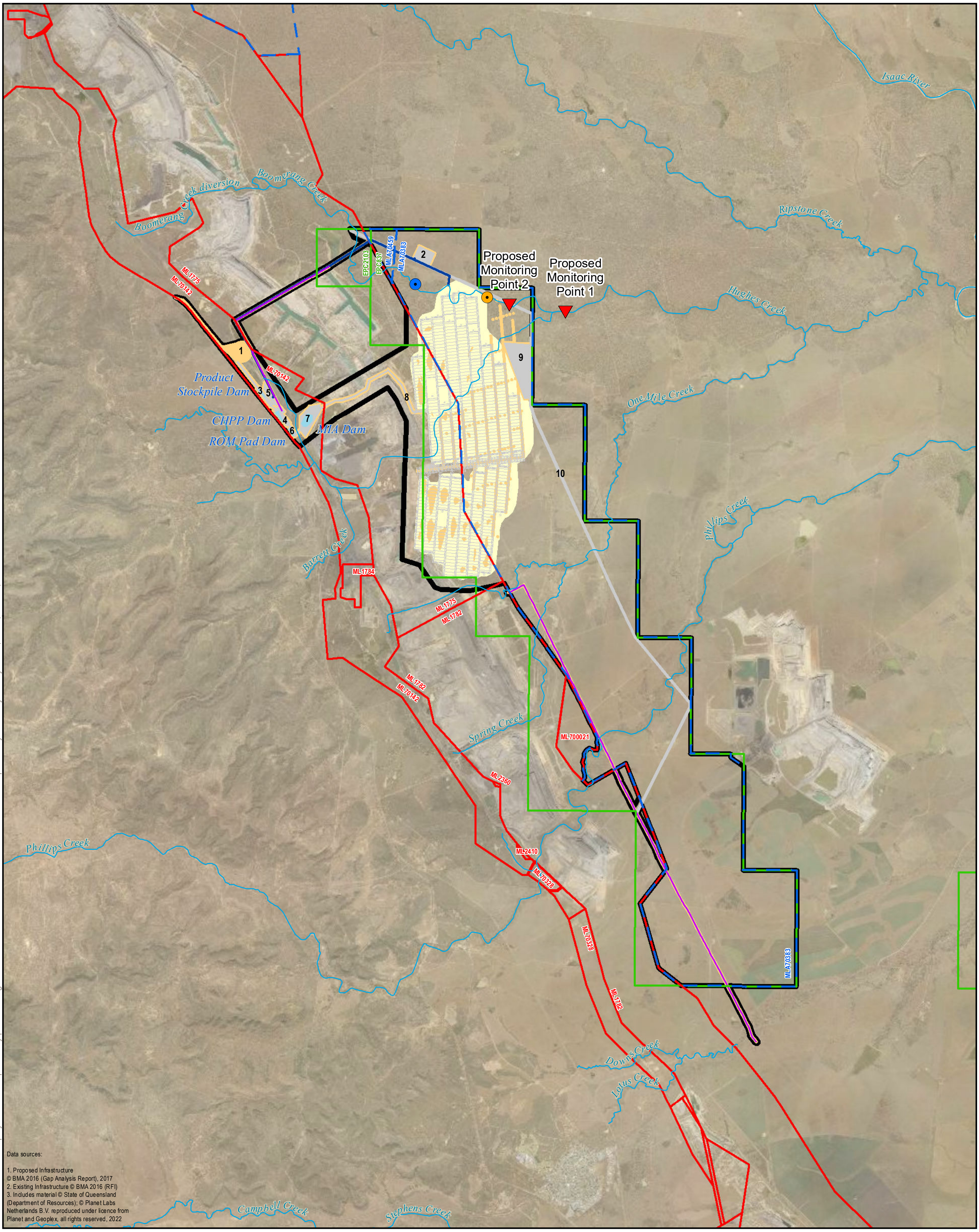


Figure 8-6 Conceptual mine WMS schematic



LEGEND

- Project Site
- Project Footprint - Indirect Impact
- Project Footprint - Direct Impact
- Surface Infrastructure
- Underground Mine Plan
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Watercourse
- 66kV Powerline
- Pipeline
- Indicative Dam Location
- Indicative Proposed Monitoring Point Location
- Indicative Proposed Mine Water Release Point
- Indicative Proposed Flow Gauging Station

Surface Infrastructure

1. Rail Loading Balloon Loop
2. Process Water Dam
3. Product Stockpiles
4. CHPP
5. Raw Water Dam
6. ROM Pad
7. Future MIA
8. Conveyor
9. Construction Village
10. Transport and Infrastructure Corridor

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Figure 8-7
Proposed Water Infrastructure

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.75 1.5 3
Kilometres

Scale: 1:158,094 (when printed at A4)
Projection: Map Grid of Australia - Zone 55 (GDA94)

BMA
BHP Mitsubishi Alliance

DATE: 28/08/2024 VERSION: 2

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8.5.1.3 Preliminary consequence category for dams

A review of the receiving environment of each proposed WMS structures was completed highlighting values of the receiving environment with potential to be impacted as described in **Appendix E-2 Mine Water Balance Technical Report** and described in detail within other chapters of this EIS. The relevant downstream receiving environment for each failure scenario includes:

- Failure to Contain – Seepage: hydrogeological regimes in proximity to each proposed structure
- Failure to Contain – Overtopping/Dam Break: adjacent areas and downstream waterways.

For each of the characterised failure events identified for WMS dam structures in Table 8-6, potential impacts were assessed against the Manual for assessing consequence categories for dams (DES, 2016) to establish a preliminary consequent category. The Underground Mine Portal Sump is not expected to comprise a structure formed by embankments, with the risk of a dam break failure considered non-credible.

Table 8-6 Characterised failure events for preliminary

Structure	Failure to contain - Seepage	Failure to contain - Overtopping	Dam break
Process water dam	Seepage plume localised to the vicinity of the structure. Potential for groundwater resource impact, however, it is noted that the water table is expected to be generally drawn down in the vicinity of structures. Potential impact to vegetation species (die-off), in the event of prolonged surface expression.	Discharge of contained water inventories, during rainfall conditions, to downstream receiving waterways, likely during periods of substantial flow.	Propagation of a moderate dam break wave through receiving waterways. Due to the overall size of the PWD anticipated being moderate, the dam break wave is expected to attenuate within 5 km. Inundation of local creeks is possible. Dependent on the degree of natural flow in downstream waterways at the time of a hypothetical dam break event, water quality impacts of Hughes Creek and Boomerang Creek are possible
CHPP Dam, Product Coal Stockpile Dam, ROM Coal Stockpile Dam, MIA Dam			Propagation of a minor Dam break wave through receiving waterways. Due to the overall size of the structures anticipated being minor to moderate, the dam break wave is expected to attenuate within 10 km.
Product Coal Stockpile Pad Dam	Seepage plume, with potential waterlogging of areas. Negligible potential for impact to ecological communities or groundwater resources due to reasonable water quality.		

Based on this assessment, preliminary consequence categories for WMS dam structures are summarised in Table 8-7. As per the Manual (DES, 2016), a Significant or High consequence category in any failure event category results in the application of a 'regulated structure' status to the structure being assessed. The process water dam having the highest volumes of MAW and most receptors in the downstream receiving environment is assessed as 'significant' and classified as a regulated structure to be managed in line with specific design and operation requirements applicable to regulated structures, as listed in Table 8-8.

Table 8-7 Preliminary CCA for Project WMS storages

Structure	Failure to contain - Seepage	Failure to contain - Overtopping	Dam break	Regulated structure?
Process Water Dam	Significant	Significant	Significant	Yes
Underground Mine Portal Sump	Low	Low	Low	No
CHPP Dam	Low	Low	Low	No
Product Coal Stockpile Pad Dam	Low	Low	Low	No
ROM Coal Stockpile Pad Dam	Low	Low	Low	No
MIA Dam	Low	Low	Low	No
Raw Water Dam	Low	Low	Low	No

The determined consequence categories are preliminary and based on the conceptual configuration of the WMS and WMS dam structures. A comprehensive CCA is required during the detailed design of the structures. Should the rating of any dams change during detailed design, the associated performance and management criteria recommended may also change.

Specific design and operation requirements apply to regulated structures as listed in Table 8-8. BMA internal policies for structures containing MAW require the process area dams to consider relevant design criteria for the failure to contain – overtopping and dam break consequence categories at the 'significant' level.

Table 8-8 Preliminary Hydrological and Hydraulic Design Criteria for Mine WMS Dams

Failure to contain - Seepage		
Consequence category	**Containment**	**Leak detection and/or monitoring**
Significant	Designed with a floor and side of material that will minimise (or reduce) seepage to avoid the environmental harm in the significant consequence category in Table 1* and ensure the environmental harm likely to occur is only as in the low consequence category of that table.	Have a system that is appropriate to demonstrate that significant harm as per Table 1* will not occur.
Failure to contain - Overtopping		
Consequence category	**Wet season containment – Design Storage Allowance (DSA)**	**Storm even containment – Extreme Storm Storage (ESS)**
Significant	1:20 wet season volume	1:10 AEP 72 hour duration
Dam Break		
Consequence category	**Flood passage – spillway event capacity**	**Flood level for embankment crest level**
Significant	1:100 AEP to 1: 1,000 AEP	Spillway design flood peak level and wave run-up allowance for 1:10 AEP wind.

* Table 1 is from the Manual for assessing consequence categories for dams (DES, 2016)

A summary of the preliminary hydrological design criteria for relevant Project mine WMS dams is provided in Table 8-9. As the CCA of the CHPP, Product coal stockpile, Run of mine coal stockpile and MIA dams is 'Low', they do not require a DSA and an ESS; however, DSA and ESS values are provided in line with BMA's internal guidelines for sizing MAW dams.

Table 8-9 Mine WMS dams - preliminary hydrologic design criteria

Structure	Process water dam	CHPP dam	Product coal stockpile dam	Run of mine coal stockpile dam	MIA dam
Catchment (ha)					
External	NA	7.3	11	4.4	8.8
Total	3.8	9.6	13.3	6.0	11.2
Preliminary consequence category	Significant	Low	Low	Low	Low
Required DSA AEP	1:20	1:20	1:20	1:20	1:20
Required ESS AEP	1:10 (72 hour storm)	1:10 (72 hour storm)	1:10 (72 hour storm)	1:10 (72 hour storm)	1:10 (72 hour storm)
Preliminary Dam Capacity (megalitres)	125	65	87	42	74
ESS	7.2	8.2	25.2	11.4	21.2
DSA	23	58	80.2	36.2	67.6
Preliminary overflow destination	Boomerang Creek, Hughes Creek	Hughes Creek via Hughes Creek diversion			

Assigned a consequence category of 'low', the Underground Mine Portal Area Sump has been nominally sized as nominally comprising a 7.5 megalitre storage to contain ten days of underground dewatering volumes at the peak extraction rate. The Underground Mine Portal Area Sump has assigned a nominal catchment area of 10 hectares (ha), representing the benches and adjacent areas upgradient of the portal, which cannot be diverted and drained elsewhere. Flood immunity of the portal has been considered by including the runoff from this 10 ha area as a potential inflow to the WMS. Additional flood immunity for the portal is to be considered during detailed design.

Spillway structures

The regulated structures are expected to include the spillway overflow structures to safely convey contained water inventories in the event of excess water accumulation. The ultimate configuration of the spillways is expected to be confirmed during the detailed design phase, proceeding the completion of a comprehensive CCA. Where required, the downstream chutes of the spillway structures are expected to include armouring to mitigate the potential of erosion of embankments or abutting natural sequences to each WMS structure. Where appropriate, spillway flows will be directed to the nearest receiving environment waterway via safe and effective hydraulic controls.

8.5.1.4 Licensed release point

The process water dam is also proposed to include a licensed release point on Boomerang Creek (refer Figure 8-7). The proposed release point has been included as a conservative management approach, consistent with BMA's approach to responsible water management. Should the site experience very rare to extreme rainfall conditions, exceeding the containment volume developed for each storage, BMA may utilise licensed release as a water management strategy in preference to uncontrolled discharge from MAW dams.

The expected water quality of MAW within the process water dam is likely to exceed WQO for downstream waterways. Accordingly, the licensed release is proposed to occur as event-based releases, whereby releases are only permissible during periods of significant flow. Dilution of released MAW will therefore occur by mixing with Boomerang Creek, Hughes Creek and Isaac River flows.

The licensed release point for process water dam, to be confirmed during detailed design, may comprise pump infrastructure, pipeline and release point structure i.e. rock armoured pad sized in accordance with the Queensland Urban Drainage Manual (Institute of Public Works Engineering Australasia, 2017). Should conveyance of licensed release flows be required between the rock pad outlet structure and Boomerang Creek, a drainage channel would be constructed including a liner barrier system overlaid with rock armouring to dissipate flows.

8.5.1.5 Release conditions

Release conditions for the process water dam licensed release point have been developed consistent with:

- Model Water Conditions for Coal Mines in the Fitzroy Basin (DES, ESR/2015/1561)
- Peak Downs Mine EA: EPML00318213.

It is proposed that the process licensed release conditions adopted follow similar criteria to neighbouring sites (i.e. Peak Downs Mine), which could be routinely complied with by the proposed Saraji East operations.

The expected receiving water flow criteria for discharge are as follows:

- Boomerang Creek ≥0.1 m^3/s
- Isaac River (Deverill Station MP19) ≥3 m^3/s.

The expected MAW release limits (end of pipe concentrations):

- Electrical Conductivity (EC) ≤10,000 µS/cm
- pH 6.5 – 9.5.

The receiving waters contaminant trigger levels during a release event:

- EC 2,000 µS/cm
- pH 6.5 – 9.0.

It is noted that the current water balance modelling, under the Stress Test Scenario (which is conservative relative to the expected process water demands) suggests these limits will be met.

8.5.1.6 Operation of releases

The licensed release point will be operated according to the conditions outlined in the EA for the site, which is expected to include:

- minimum flow threshold (licensed release permissible during flow events in Boomerang Creek)
- water quality requirements
- sampling, notification and observation and reporting
  - flow gauge (located upstream of the release point to indicate when flow conditions are sufficient for dilution of licensed release to occur)
  - release point sampling (continuous sampling at the pipeline outlet)
  - receiving environment sampling (monitoring downstream flows within Boomerang Creek and Hughes Creek (Figure 8-7).
- coordination with other releases from nearby mines may occur to age the risk of concurrent releases to result in exceedances of WQO in the downstream receiving environment.

The coordination is expected to include existing Saraji operations and Peak Downs Mine (which maintains a licensed release point on Boomerang Creek under the relevant EA: EPML00318213). Specifically, BMA are a party to the ongoing development of the ‘BHP Real-Time Forecasting System (RTFS) – Hydrologic, Hydrodynamic and Water Quality Models’ (Water Technology & Deltares, 2021) which models the potential release water quality in the receiving environment for releases originating from the central mines region, including Goonyella Riverside, Caval Ridge, Peak Downs, Saraji (existing), Saraji South (previously Norwich Park), Daunia and Poitrel mines. The Project will be considered in the next periodic update of the RTFS tool.

8.5.1.7 Mine water balance modelling

The Project WMS was assessed using water balance simulation to confirm the containment and release design objectives and criteria presented in Table 8-9 can be met. Sufficient system containment and transfer capacity has been provided to prevent the uncontrolled release (i.e. spillway overflow) of water to the receiving environment and without the requirement for controlled release of MAW. The estimated preliminary capacities for all WMS dams are given in Table 8-10.

Table 8-10 Preliminary WMS dam capacities

Dam	Preliminary capacity (megalitres)
Process water dam	125
CHPP dam	65
Product coal stockpile pad dam	87
ROM coal stockpile pad dam	42
MIA dam	74
Raw water dam	200
Underground mine portal area sump	7.5

The model results indicate that the system operates generally in deficit, whereby ongoing sourcing of MAW from the various site dams and evaporation persistently draws down runoff reporting to the WMS, and generally maintains a low overall water inventory excepting in response to very wet conditions.

The modelled water storage across the WMS is seasonally driven, with minimal to negligible water contained in the dry season, with short-term accumulation of water occurring over the wet season in response to wetter than average rainfall conditions. The greatest potential volume of water is modelled for the first year of the mine plan, reflecting the reduced operations and process sourcing requirements.

Additionally, the climate change scenarios analysed suggest:

- Baseline water inventories are modelled as being greater than either of the modelled climate change scenarios. Accordingly, the WMS preliminary capacities are suitable for potential future climate conditions.
- The system was modelled as being sufficiently robust in response to temporary pump failure conditions modelled, suggesting that short term pump inoperability will not significantly compromise the system.

Process water dam

The process water dam is modelled to generally contain less than 40 megalitres of MAW, accumulating to 40-100 megalitres in wetter than average rainfall conditions. The volume modelled for the process water dam is strongly influenced by transfer pumping of water from the other elements of the WMS. Accumulation above 100 megalitres is modelled to occur in rare circumstances, generally reflecting a less than 1 per cent probability. Accumulation of water above 120 megalitres, which is influenced by rainfall and dewatering from the underground mine portal area sump was modelled as being a non-typical condition (approximately 0.2 per cent annual probability of occurrence). It is noted that the process water dam receives transferred waters from many WMS elements, such that the seasonal variation of MAW volumes within the process water dam is amplified compared to other WMS elements.

Raw water dam

The raw water dam was modelled as generally containing between 146 and 155 megalitres. This level was based upon the make-up water supply rulesets implemented in the model. Seasonal variation and accumulation of the raw water dam was not generally evident in the model results.

Underground mine portal area sump

The modelled water inventory was generally modelled as being less than two megalitres. The volume of water contained in the sump is primarily influenced by runoff from the local portal area catchment (10 ha) and dewatering volumes from the underground mine. The level is effectively controlled by ongoing transfer of these waters to the process water dam. Accumulation of the sump was modelled as being a very rare occurrence, typically coincident with the process water dam MAW volume exceeding 120 megalitres, which results in transfers from the sump being ceased.

8.5.1.8 Water quality of releases

The model results provide an indication of the expected salinity and EC within the WMS. The potential water quality is particularly relevant for the process water dam where a licensed release point is proposed.

The model results indicate that the modelled water quality concentration is highly variable, and principally influenced by the volume of water stored in the process water dam. During periods of significant water storage volume (i.e. >100 megalitres), the modelled salinity is generally 600-2,000 mg/L and the modelled EC is 1,000-3,000 µS/cm. The results suggest that while the water quality analytes may be elevated during periods of low water inventories, the water quality is expected to be suitable for potential licensed release in periods of significant water inventories when licensed release would be considered (subject to appropriate testing, controls and release criteria).

Summary water and salt balance fluxes for the water balance model are presented in **Appendix E-2 Mine Water Balance Report**. WMS dams within the water balance model have been subjected to water and mass balance checks to confirm model continuity and mass balance.

- Water balance
  - raw water represents the largest single input to the mine WMS, with median values of 35,760 megalitres over the operation of the mine or 1,788 megalitres/yr
  - rainfall and runoff input is moderately variable, with the 10th and 90th percentile total annual rainfall and runoff volumes ranging from 112 megalitres/yr to 146 megalitres/yr respectively
  - site-wide water demand is 2,263 megalitres/yr (median result).
- Salt balance
  - groundwater and reclaimed underground mining water represent the largest salt input over the operation of the mine at approximately 26,580 tonnes or 1,329 t/yr.

Uncontrolled release

Analysis of the potential water quality of uncontrolled discharges from the process water dam was completed using the ‘Stress Test Scenario’, as no uncontrolled discharges (spills from MAW dams) were modelled under the Baseline (BaU) or climate change scenarios. The hypothetical ‘Stress Test Scenario’ reduced water sourcing rates (25 per cent of expected net process water demands) to force excess water inventories within the water balance model such that the potential water quality of spills can be examined.

The results show the general expected EC in the receiving waterways, subject to the developed assumptions, is generally lower than 1,000 µS/cm. In exception, the timing of elevated water inventories driven by underground mine water inflows during the middle of the mine plan duration can coincide with times of negligible or low flow within Boomerang Creek and Hughes Creek; however, this does not occur under baseline or climate change scenarios.

Managed release

The water balance model results were further analysed to understand the potential water quality within the process water dam and potential flow dilution rates that may occur during licensed releases utilising the Stress Test Scenario. Flow dilution estimates were calculated based on the volume of the relative releases and flow rates within downstream waterways modelled (Boomerang Creek and Hughes Creek). To estimate the potential receiving water quality, releases were assumed to occur for the following conditions:

- Flow Trigger Criteria: Flow in Boomerang Creek ≥ 0.1 m^3/s (consistent with other licensed release schemes authorised for Boomerang Creek)

- Licensed Release Rate: Minimum of 8 per cent of Boomerang Creek Flows, and 0.1 m^3/s (approximate to ESS containment volume to allow emergency dewatering of the process water dam)
- Assumed EC of flows within Boomerang Creek and Hughes Creek: 300 µS/cm (conservatively adopted, upstream water quality suggests median EC of 120 µS/cm)
- Assumed Minimum Volume in PWD for Licensed Releases: 75 megalitres (exceeds operational levels and represents volume likely to trigger active management of MAW).

Based upon the flow trigger (>0.1 m^3/s within Boomerang Creek) and a minimum process water dam volume of 75 megalitres for consideration of licensed release, the modelled process water dam EC during release windows indicate an expected EC of between 1,000 and 5,000 µS/cm.

Comparison of uncontrolled and managed releases

Comparison of the uncontrolled releases and managed releases suggests provision of a licensed release point, managed according to the operation described in Section 8.5.1.6, is likely to result in a reduced potential impact to downstream waterways. Principally:

- Licensed release is subject to release criteria and is likely to result in a controlled, managed and monitored release program. Active management of releases may involve water blending, or release during downstream flow events, rather than passive spills via emergency spillway structures.
- Modelling for uncontrolled and managed releases indicates that EC and pH outcomes, based on assumed mixing conditions, indicates that licensed release results in fewer occasions of significantly elevated EC in downstream waterways.

Overall, the modelling completed suggests that the licensed release of MAW from the process water dam can be feasibly achieved without exceeding trigger levels for event-based releases in downstream creeks. Additionally, inclusion of licensed releases within the water balance logic results in a reduced maximum water storage inventory within WMS dams, which has flow on benefits for:

- reduced risk to WMS dam embankment infrastructure
- reduced frequency of flows via emergency spillway structures, and therefore reduced risk of failure of emergency spillway structures
- increased operational freeboard.

Full details of the mine water balance modelling, including graphical representation of modelling results, are provided in **Appendix E-2 Mine Water Balance Report**.

8.5.2 Wastewater

During the operational phase, the Project will employ up to 500 Full Time Equivalent. However, based on the 4-week roster rotation with 12-hour shifts, an approximate 125 workers are expected to be in residence at peak times during operation. Water usage and wastewater production estimates are based on these predicted workforce numbers. The generation of wastewater has been calculated based on 180 L per equivalent population per day, in accordance with 02- 2014-3.1 Gravity Sewerage Code of Australia (Water Services Association of Australia, 2014). Effluent wastewater generated will be approximately 8.22 megalitres per year. Treatment in the STP will eliminate residual pathogen contaminants from wastewater to achieve a Class B standard considered suitable for industrial uses such as wash down water and dust suppression, as defined by the Queensland Government Public Health Regulation (2018).

The Australian Guidelines for Water Recycling (NRMMC 2006) will be used as the basis for the treatment and use of treated wastewater. Treated wastewater will be discharged to the process water dam. In this way, wastewater will be captured and preferentially reused as described by the WMS (Section 8.5.1).

Sludge and sewage from temporary construction workers accommodation village will be pumped by licensed contractor and transported to a local council sewage treatment plant.

Further details of waste management are provided in **Chapter 15 Waste**.

8.5.3 Erosion and sedimentation

Soil exposed from vegetation clearance, ground disturbance and uncovered stockpiles may generate silt and contaminant-laden runoff. Sediment mobilised during construction activities can enter surface water runoff during rainfall events and discharge to watercourses. Sediment exposed or generated during construction may also be carried by wind into surface water bodies. During construction, implications to surface water quality from erosion and sedimentation may result from:

- earthmoving
- stripping of topsoil
- stockpiling of run of mine unprocessed material and product
- vegetation removal
- trenching for pipelines
- general earth works.

During operation, vehicle movements and stormwater runoff may result in increased erosion potential and mobilisation of sediment to surface waters. The installation and operation of incidental mine gas management infrastructure poses a significant risk in terms of surface disturbance and mobilisation of sediment across the area of the underground mine footprint, access tracks and gas well pads in the vicinity of Boomerang, Hughes, One Mile, Spring and Phillips Creek.

Erosion and sediment mobilisation can lead to detrimental impacts on downstream water quality and aquatic habitats. Boomerang, Hughes, One Mile, Spring and Phillips Creek already have high turbidity concentrations upstream of the Project. Therefore, relatively small sediment inputs from mine-related activities are unlikely to cause significant changes to water quality and to the aquatic ecology.

Suspended sediments in the water column reduce light penetration, consequently affecting the primary productivity of aquatic ecosystems. Such impacts may compound effects from the already high turbidity concentrations in the receiving waterways. Concentrations of suspended solids at best available reference sites were highly variable and in the case of Hughes Creek often well above the applicable WQO for upper Isaac River catchment waters (55 mg/L). Hughes Creek and Boomerang Creek can be quite turbid in their existing condition. While a large, long-term increase in suspended solids may further degrade aquatic ecosystems, short term increases during storm events are unlikely to have a significant impact.

Deposition of suspended sediment within watercourses can lead to geomorphological changes within the streams. However, given the relatively high existing sediment loads that have already influenced the bed characteristics of these streams, short-term impacts from runoff from construction areas during storm events is unlikely to significantly change the geomorphological characteristics of these streams. Sediments mobilised by erosion may have other contaminants associated with sediment particles including heavy metals derived from the local geology. When sediment particles containing heavy metals enter water, the metals may, under certain conditions, be released into the water column and become bioavailable. This in turn can affect the health of aquatic plants and animals and potentially impact other environmental values.

The water quality results indicate most metals detected are bound to sediment particles, since total metal concentrations are typically much higher than dissolved metal concentrations. Metals released from sediments to the water column can be influenced by lower pH; however, pH results indicate that surface water pH is generally within the range of 6.5 to 9.0, thus minimising this mechanism for metal release from sediment particulates.

Controls will be installed prior to and during construction and operation in accordance with International Erosion Control Association Best Practice Erosion & Sediment Control guidelines (IECA, 2008). With design and erosion and sediment controls in place, the quantities of sediment likely to be mobilised from Project activities is likely to be low and surface water quality impacts associated with erosion and sedimentation on the downstream creeks are expected to be minimal.

8.5.4 Chemicals and contaminants

Across the Project lifecycle, chemicals will be used primarily within MIA, CHPP, warehouses and workshops. The significance of potential impacts on surface waters will depend on the quantity and nature of contaminants as well as whether the contaminants are directly released to surface waters.

Small quantities of chemicals for use in water and wastewater treatment will also be stored at the MIA, CHPP and accommodation village. Small quantities of oils and oily wastes will also be stored at the MIA and CHPP associated with vehicle and equipment maintenance. While some other chemicals will be utilised during construction (paints, resins, sealers and solvents), the quantities and natures of these chemicals suggest a low risk of significant environmental harm in the event of a spill.

Diesel fuel will be stored at the MIA and refuelling facilities will be located at fuel storages. Some mobile refuelling of equipment involved in incidental mine gas management activities may take place across the mine footprint. Accidental spills of fuel have potential to impact surface water quality from accidental spills and leaks in vicinity of drainage lines and watercourses.

All fuel and chemical storages will be designed and operated in accordance with Australian Standards (AS), including AS 1940 and AS 3780. Generally, chemical and fuel storage, refuelling activities and associated minor spills and leaks with potential to occur across the mine industrial areas will be captured by bunding. Spills are very unlikely to occur within or immediately adjacent to watercourses; however, the limited volumes may cause localised short-term water quality degradation. Accidental spills of fuel stored onsite or any other chemicals used during construction are unlikely to reach a receiving waterways or aquatic environment and hence unlikely to result in any significant water quality degradation.

Small quantities of aqueous waste will be generated from removal of stormwater and contaminants from bunded areas and sumps. Provided this is treated in accordance with the proposed management measures, surface water quality impacts are unlikely.

The release of contaminated water from a pipeline failure during decommissioning has the potential to have adverse impacts on water quality within the receiving environment and may compromise downstream environmental values. However, the likelihood of failure, and the quantities potentially involved are low and significant environmental impact is unlikely.

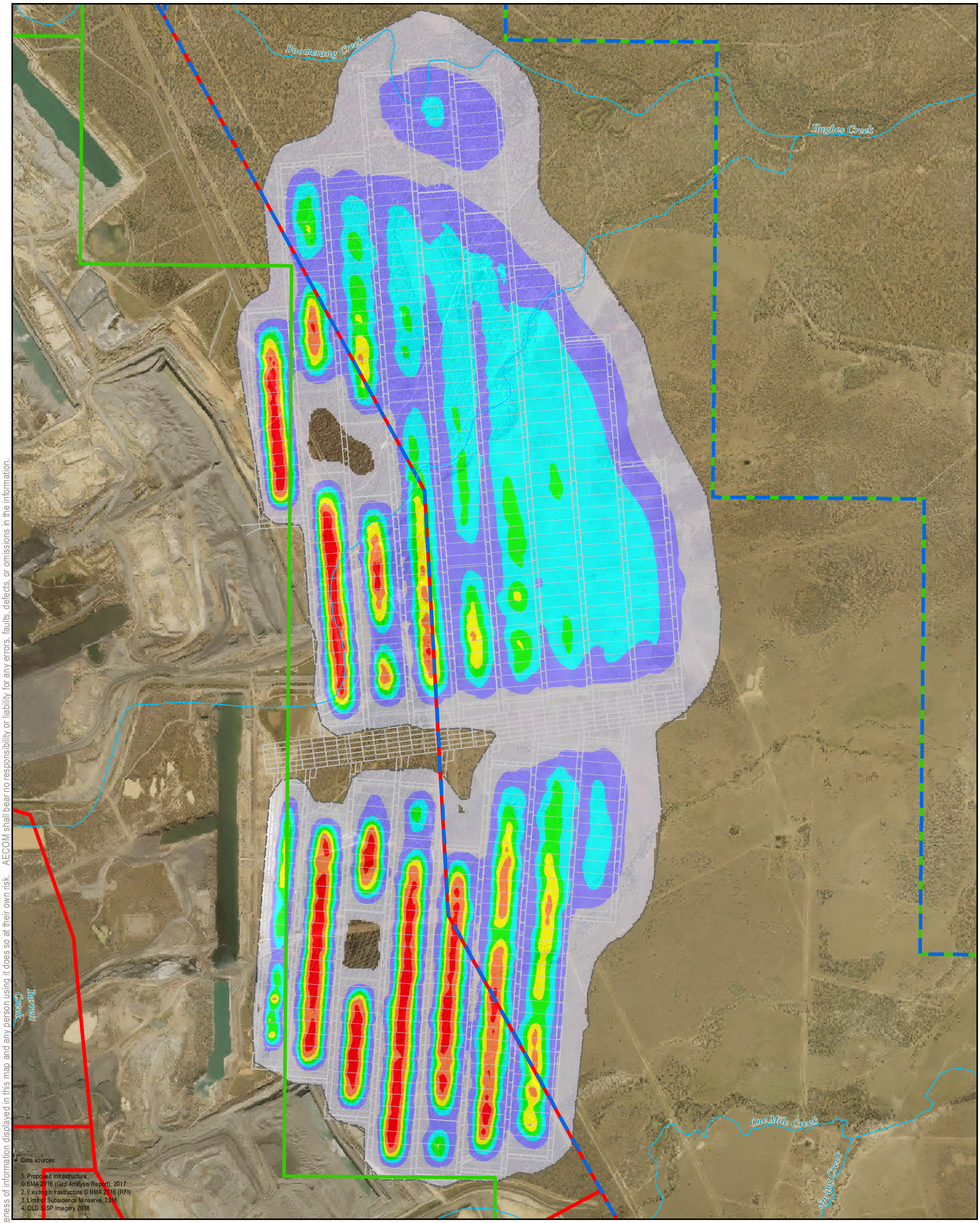
8.5.5 Overland flows and diversions

There are no new diversions planned as part of the Project; overland flow will continue to be managed through a series of existing diversion drains designed to provide conveyance of clean water flows for the existing Saraji Mine. The development of the conceptual mine WMS does not include any significant loss of catchment area reporting to Hughes Creek or its tributaries. The combined disturbed catchment area of the process area dams is 53.9 ha (0.539 km^2). Most of this disturbance area is located within the limits of the existing Saraji Mine development, which is already considered a disturbed catchment. The process water dam is located outside of the existing development; however, comprises a Turkey’s nest storage with limited extent. As such, potential loss in flow due to the development of the WMS are likely be immaterial.

8.5.6 Subsidence

Differences in pre- and post-subsidence terrain models were used to estimate and map the depth of subsidence along each longwall panel of the footprint as described in **Chapter 5 Land Resources and Appendix B-2 Subsidence Modelling** by Minserve (2022), and illustrated in Figure 8-8.

Assessment of subsidence effects on landscape, geomorphology, hydraulics and hydrology are presented in **Appendix E-3 Hydrology, Hydraulics and Geomorphology Report** prepared by Alluvium (2023). **Appendix E-4 Conceptual Ponding Assessment** outlines a conservative water balance indicating the maximum extent of ponding where overland flow reaches the subsided panels.



LEGEND

- Underground Mine Layout
- Limit Of Subsidence
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Watercourses

Modelled Subsidence Contour

- < 0.5m
- 0.5 - 1.0m
- 1.0 - 1.5m
- 1.5 - 2.0m
- 2.0 - 2.5m
- 2.5 - 3.0m
- > 3.0m

N

Figure 8-8
Subsidence Contours of the Project Site

Rehabilitation Management Plan
Saraji East Mining Lease Project

0 0.275 0.55 1.1
Kilometres

Scale: 1:40,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

BMA
BHP Mitsubishi Alliance

DATE: 23/05/2024 VERSION: 1

8.5.6.1 Geomorphic response

The modelling conducted in **Appendix E-3 Hydrology, Hydraulics and Geomorphology Report** indicated the below geomorphic responses.

Modelling indicates Hughes Creek, Boomerang Creek and Plumtree Creek will be subject to subsidence of low intensity; however, the Hughes Creek diversion experiences greater subsidence-related impacts. Subsidence impacts of the proposed underground mine plan illustrated in Figure 8-8 indicate impacts in the vicinity of Hughes Creek are localised on the two most western panels (adjacent to the open cut pit) along the stream bed, whereas the rest of the creek bed is subject to reduced levels of subsidence. When the Project goes into the detailed planning and design of the western longwall panels, changes may be proposed to reduce impacts of subsidence on Hughes Creek.

Modelling indicates that as longwall panels are installed, streambeds within watercourses may subside and gradually infill with sediments to reestablish constant sand bed grades currently present. Boomerang and Plumtree Creek systems exhibit higher bed sediment transport capacities upstream compared to downstream, which, according to modelling, will likely lead to increased sediment accumulation in the subsidised areas downstream. Hughes Creek presents contrasting conditions with higher sediment transport capacities in the sections of the creek that may be impacted by subsidence with potential to induce instabilities upstream.

Modelling indicates that watercourses will likely be subject to local incision and bank erosion over pillar zones between panels. Infilling will occur as flow events commence, but the time required for the present bed grade level to be re-established depends on number of subsidised panels and sediment transport capacity of the stream. Due to the elevated erosion rate in the upper reaches, sediment supply will be unlikely an issue and infilling of subsidence depressions will be associated with events large enough to transport bedload.

Bed load starvation will potentially impact Boomerang and Hughes Creek downstream of the mine, elevating the risk of bank erosion in these areas. Modelling indicates erosion of downstream reaches will occur until sediment loads infill the subsidised depressions upstream and the sediment supply returns to the existing load. The Hughes Creek system will likely be impacted downstream of the Project area up to the Boomerang Creek confluence for a period of years as panels subside.

Subsidence-induced surface cracks resulting in erosion responses in erodible sediments orientated downslope have the potential to cause rill erosion or gully formation. Surface cracks may develop in the area around Hughes Creek where some relief is already present and differential subsidence between pillars and longwall panels is likely to occur. These cracks have the potential to expand where lighter textured soils are present and runoff is concentrated to the crack. Over the entirety of the Project Site, areas of low relief and high sand content will unlikely display enlargement of cracks in case of their emergence. Surface waters are separated from groundwater resources due to low permeable sediments, reducing the potential of groundwater infiltrating alluvium and surface water flows.

8.5.6.2 Flow alteration

Minor alterations to flow behaviour will be expected due to subsidence; however, **Appendix E-3 Hydrology, Hydraulics and Geomorphology Report** concludes potential impacts on streamflow and geomorphology are considered temporary as channels infill and ponded areas slowly accrete.

The magnitude of the peak flow varied between -0.56 per cent and +3 per cent in Year 10 post-subsidence and -1.33 per cent to +3.05 per cent in the Year 20 post-subsidence, which are not considered material impacts for the proposed operational and post-mining land use context. During rare high rainfall events (1 per cent AEP), flooding is likely to occur between Boomerang and Hughes creeks, resulting in more frequent flow events in the lower reach of Plumtree Creek. Flooding of these areas will also likely lead to mobilisation of sediment and associated nutrients. However, these processes already occur and expected alterations through subsidence are likely to be minor outside of extreme weather events.

The reduction in flows due to the ponding within subsided areas also has the potential to impact on water quality downstream through reduced flows and hence less dilution after dry spells. However, impacts on water quality are likely to be minor and on a short temporal scale, as the predicted variation in flow between pre- and post-subsidence environment will keep decreasing over time as pools and channel beds fill in, and ephemeral wetlands slowly accrete.

The subsided landscape will develop persistent ponding areas to be addressed by minor remedial drainage works described in Section 8.6.1. Topographical survey (LiDAR) of the Project area, the underground mine plan and the predicted subsidence modelling (Minserve, 2022) has been used to identify maximum extent of future ponding areas within the Project area as detailed in **Appendix E-4 Conceptual Ponding Assessment** (Engeny, 2023). A total of 36 ponding areas have been identified, including three ponding areas within Hughes Creek. Most of the ponding areas, but particularly the ponding areas to the south of Hughes Creek, overflow into one another along existing drainage channels. Ultimately, the ponds overflow into Plumtree Creek, Hughes Creek and One Mile Creek.

As ponding areas develop gradually over the life-of-mine, minor remedial drainage works will reduce persistent ponding in the landscape. Two-thirds of the ponding areas will develop during the first decade of mining, while the remaining third will develop during the second decade of mining. Predicted subsidence-induced ponding areas at 10 years and 20 years of mining are illustrated in Figure 8-9.

Generally, this will involve a minor reduction in total flow through the site, and a flow delay due to an increased attenuation capacity of instream ponding. Without drainage works, the ponding areas are expected to reduce the annual volume of surface water generated from within the catchments flowing into Boomerang Creek, Hughes Creek and One Mile Creek. The cumulative reduction in volume is predicted to be:

- approximately 313 megalitres (50th percentile) after 10 years of mining
- approximately 445 megalitres (50th percentile) after 20 years of mining.

Alterations to stream flows will revert over time to their original states as subsidised depressions in creek beds fill otherwise ponding areas may potentially lead to an overall reduced water quantity downstream resulting in decreased dilution, increased turbidity and higher concentration of nutrients. The time this will take depends on number of subsided panels in relation to flow regimes and transport capacity of the creeks.

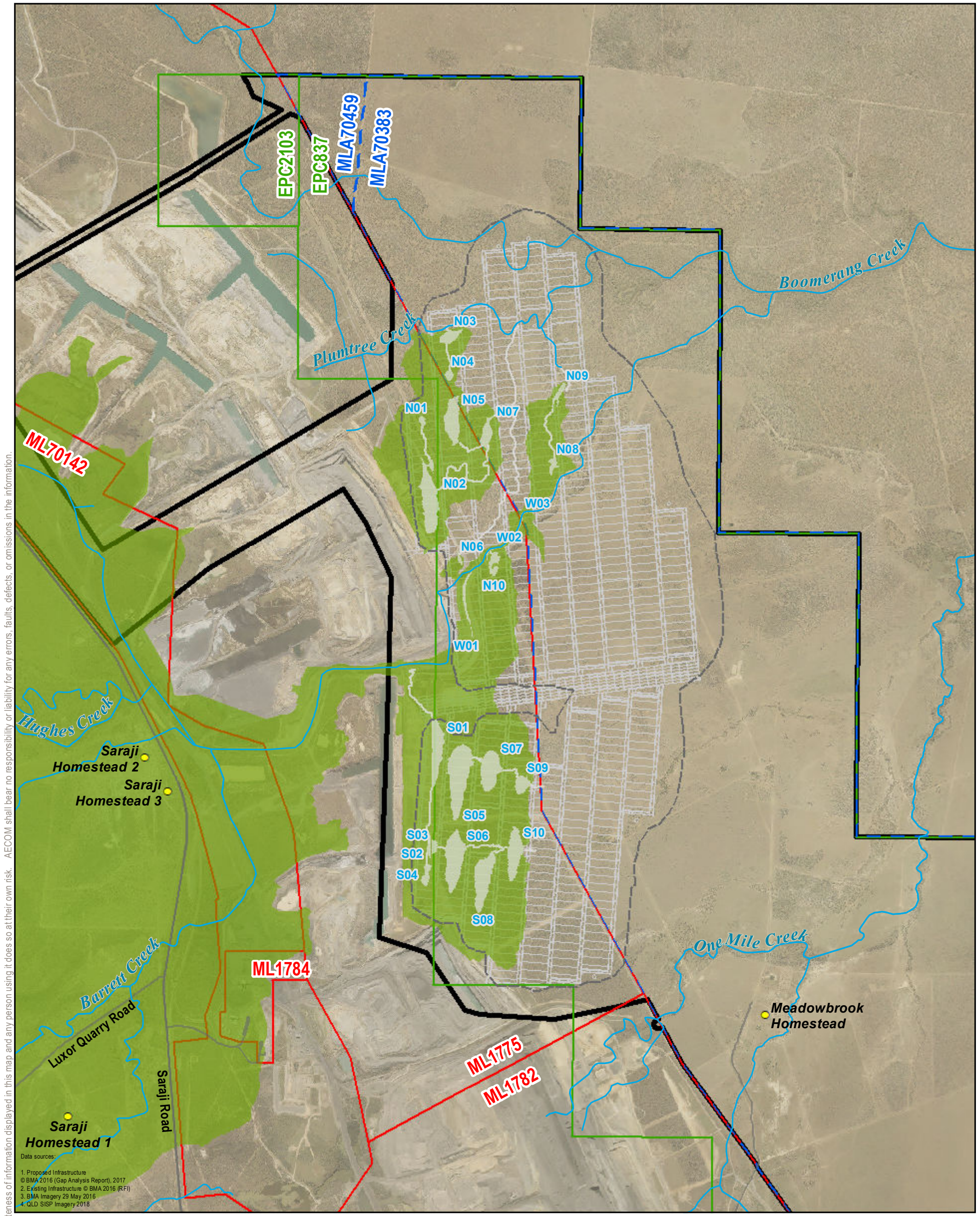
Water quality in subsidence ponds is likely to be variable over time but follow the pattern of natural pools in these landscapes. Initial inflows will be from surface water runoff and hence relatively low in salinity but potentially containing suspended solids collected from the catchment. As water is ponded in the altered (subsided) topography, it is lost through evaporation and the concentration of salts and dissolved contaminants are expected to increase over time, as is observed in ponds formed in existing waterways on the Project Site. There may also be changes to other physicochemical characteristics which, are expected to be consistent with changes in naturally ponded areas.

Subsidence monitoring will detect areas subject to persistent ponding of overland flow and remedial drainage works will ensure a free-draining landform. Subsidence ponding can be further alleviated through appropriate design and mitigation measures outlined in **Appendix K-2 Subsidence Management Plan**.

The potential impacts of mining on the geomorphology of the streams within the Project area are described in **Appendix E-3 Hydrology, Hydraulics and Geomorphology Report**) prepared by Alluvium (2023). Further detail on groundwater-surface water interactions is detailed in **Appendix F-1 Groundwater Resources Technical Report**.

The Hydrology, Hydraulics and Geomorphology Report (**Appendix E-3 Hydrology, Hydraulics and Geomorphology Report**) prepared by Alluvium (2023) and **Appendix E-4 Conceptual Ponding** Assessment indicate where overland flow may pond in the subsided panels.

Figure 8-8 present the effects of subsidence over longwall panels on surface water quality and the receiving environment. Land surface deformation is likely to occur over longwall panels resulting in surface troughs, development of surface cracks and buckling.



LEGEND

- Project Site
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Underground Mine Layout
- Limit Of Subsidence
- Watercourse
- Public Road
- Homestead
- Overland Flow Paths Year 10
- Temporary Pond Areas Year 10
- Pond Catchment Areas Year 10

Figure 8-9a
Potential Future Ponding Areas and their Catchments After 10 Years of Mining

Subsidence Management Plan
Saraji East Mining Lease Project

0 0.35 0.7 1.4 Kilometres

Scale: 1:59,840 (when printed at A4)
Projection: Map Grid of Australia - Zone 55 (GDA94)

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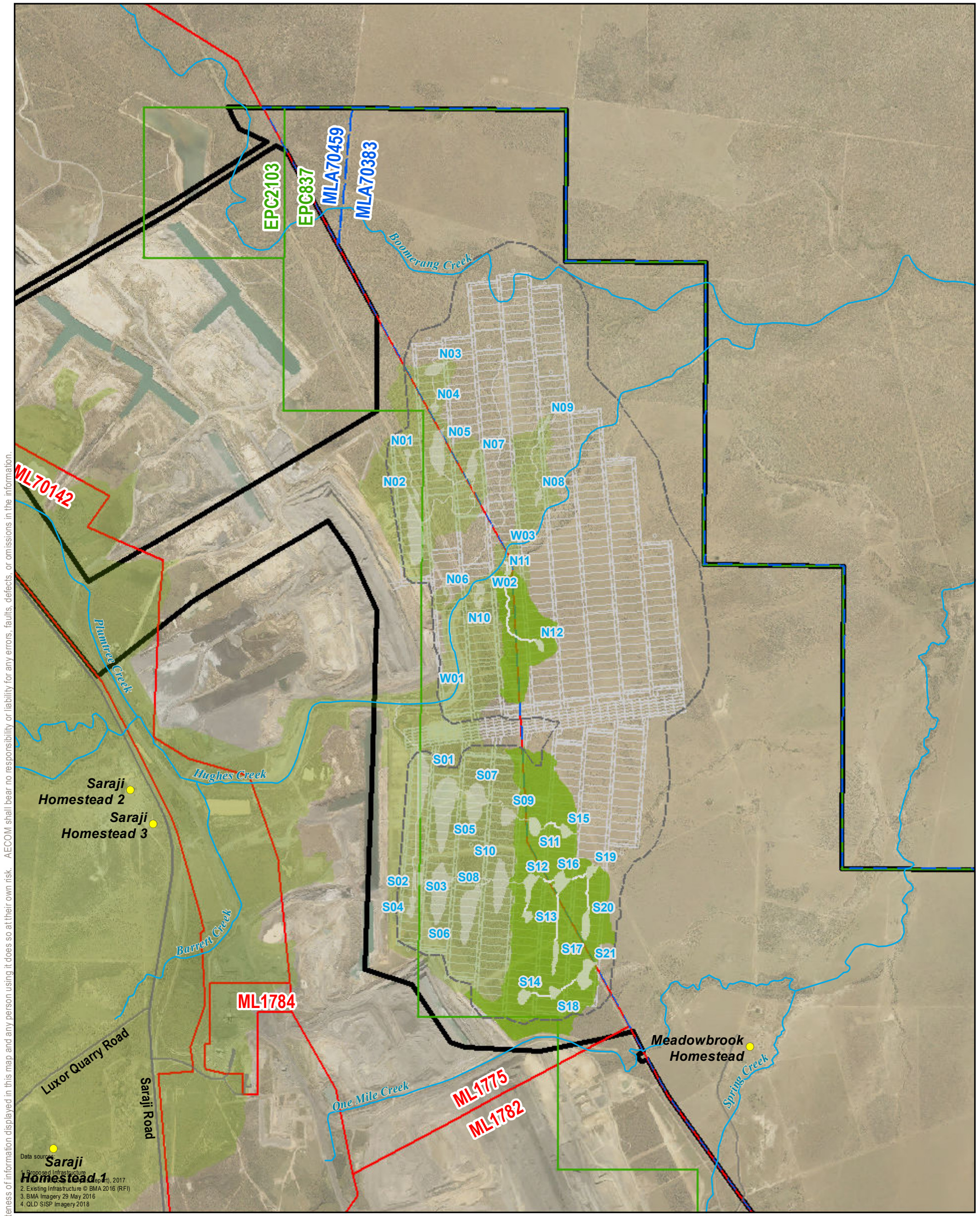

LEGEND

- Project Site
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Underground Mine Layout
- Limit Of Subsidence
- Watercourse
- Public Road
- Homestead
- Overland Flow Paths Year 10
- Temporary Pond Areas Year 10
- Pond Catchment Areas Year 10
- Overland Flow Paths Year 20
- Temporary Pond Areas Year 20
- Pond Catchment Areas Year 20

Figure 8-9b
Potential Future Ponding Areas and their Catchments After 20 Years of Mining

Subsidence Management Plan
Saraji East Mining Lease Project

0 0.35 0.7 1.4 Kilometres

Scale: 1:59,840 (when printed at A4)
Projection: Map Grid of Australia - Zone 55 (GDA94)

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8.5.7 Flooding

Flooding of mine infrastructure

The flood model was developed and was utilised to predict the influence of mine infrastructure on flooding and to assess the effectiveness of flood mitigation measures in the protection of the mining operation.

Flood inundation results for the probable maximum flood have been assessed and compared against the levels of the conveyor and underground mine entrance. Modelled peak flood levels around the mine entrance and the conveyor are within 10-35 mm water depth for the pre- and post-subsidence cases. The result is negligible flood risk to the entrance (0-15 mm flood depth). The construction village is free from flooding. Road access from the south is also likely to be affected by inundation from One Mile Creek in large flow events.

Peak flood levels are unlikely to be consequential to the operation of mine infrastructure and, where required, flood mitigation measures such as bunding and barriers will be implemented to mitigate localised flooding.

Impact on flood levels

A comparison of pre- and post-subsidence modelling of the mine layout demonstrates expected flooding response to subsidence (Figure 8-10 to Figure 8-13). Ponding will occur in all panels but there is negligible change to the flooding extents. The two most significant changes include an increased depth of water ponding upstream of the confluence of Boomerang and Hughes Creeks during large events and an increase in flow across the southern end of the southern panels following subsidence.

Water depth increases by up to one to two metres during the 1,000-year ARI event in the northeast corner of the panels within a large area of floodplain inundation that extends to the confluence of Boomerang and Hughes Creeks, though there is little change in extents resulting from subsidence.

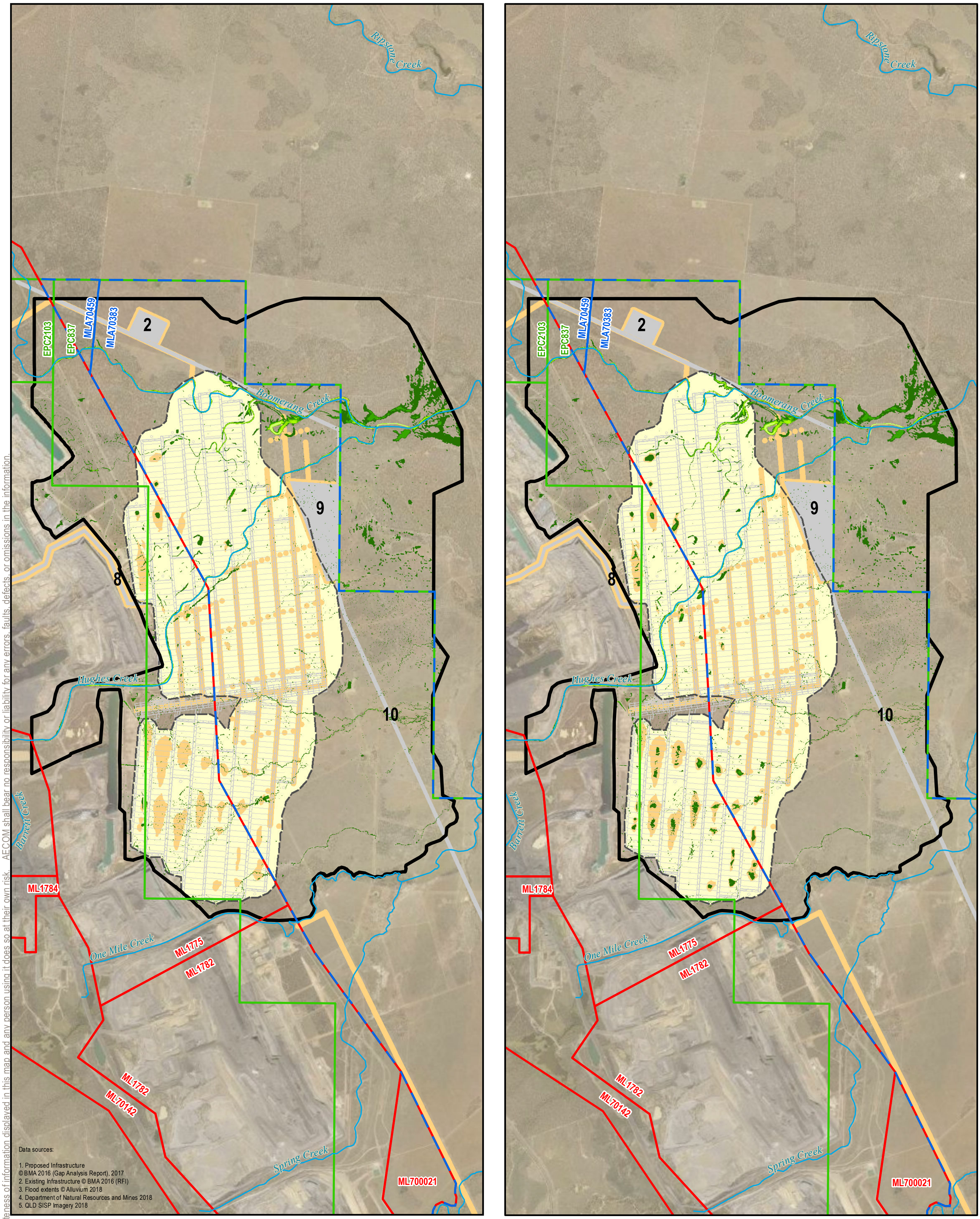
Figure 8-13 includes the Project Footprint which highlights the location of the construction village in relation to the estimated 1,000-year ARI flood extent. Road access from the south will continue to be affected by inundation from One Mile Creek in large flow events.

The subsided landscape will change flow behaviour from upstream to downstream of the Project Site. This will have different effects at different magnitude flow events.

The general effects are a reduction in total flow, more notable for the most frequent and extreme events and a delay in flow associated with the increased attenuation capacity of the subsided landscape. Residual pools will occur in parts of the landscape post-subsidence (without erosion or management intervention, which is not modelled). This will account for the reduction in flow volume leaving the Project Site. In time, with sediment movement in the system, these ponded volumes will decrease.

Residual pools in the system are generally seen as a positive environmental impact as most ephemeral wetlands or in-channel pooling has been lost to erosion and deposition. In time, subsidence pools in Boomerang and Hughes Creek will be infilled with bedload sediment.

Section 3.3 of **Appendix E-3 Hydrology, Hydraulics and Geomorphology Technical Report** concludes the magnitude of the peak flow varied between -0.56 per cent and +3 per cent in Year 10 post-subsidence and -1.33 per cent to +3.05 per cent in the Year 20 post-subsidence, which are not considered material impacts for the proposed operational and post-mining land use context, and case-by-case assessment of adaptive management such as remedial drainage works for long term ponding was proposed.



LEGEND

- Project Footprint - Indirect Impact
- Project Footprint - Direct Impact
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Surface Infrastructure
- Underground Mine Plan
- Limit Of Subsidence
- TUFLOW Model Extent
- Watercourse

Flood Depth (m)

- 0 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1 - 2
- 2 - 2.5
- 2.5 - 3
- 3 - 3.5
- 3.5 - 4
- 4 - 5
- 5 - 6
- > 6

Surface Infrastructure

2 Process Water Dam
8 Conveyor
9 Construction Village
10 Transport and Infrastructure Corridor

N

Figure 8-10
Flood depth for 50% (1 in 2 year) AEP event pre-subsidence (left) and subsided Year 20 (right)

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.325 0.65 1.3
Kilometres

Scale: 1:88,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

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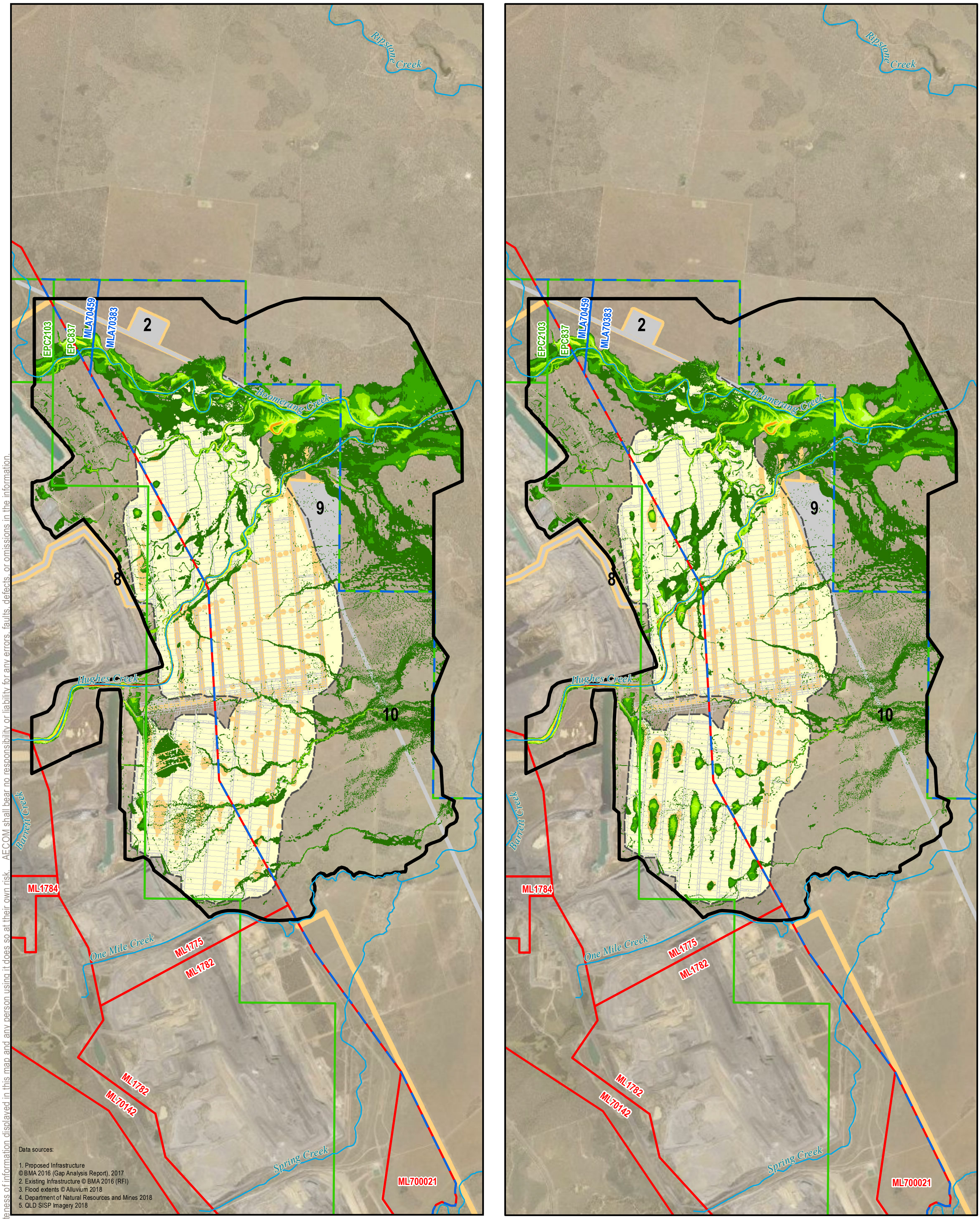

LEGEND

- Project Footprint - Indirect Impact
- Project Footprint - Direct Impact
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Surface Infrastructure
- Underground Mine Plan
- Limit Of Subsidence
- TUFLOW Model Extent
- Watercourse

Flood Depth (m)

- 0 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1 - 2
- 2 - 2.5
- 2.5 - 3
- 3 - 3.5
- 3.5 - 4
- 4 - 5
- 5 - 6
- > 6

Surface Infrastructure

2 Process Water Dam
8 Conveyor
9 Construction Village
10 Transport and Infrastructure Corridor

N

Figure 8-11
Flood depth for 2% (1 in 50 year) AEP event pre-subsidence (left) and subsided Year 20 (right)

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.325 0.65 1.3
Kilometres

Scale: 1:88,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

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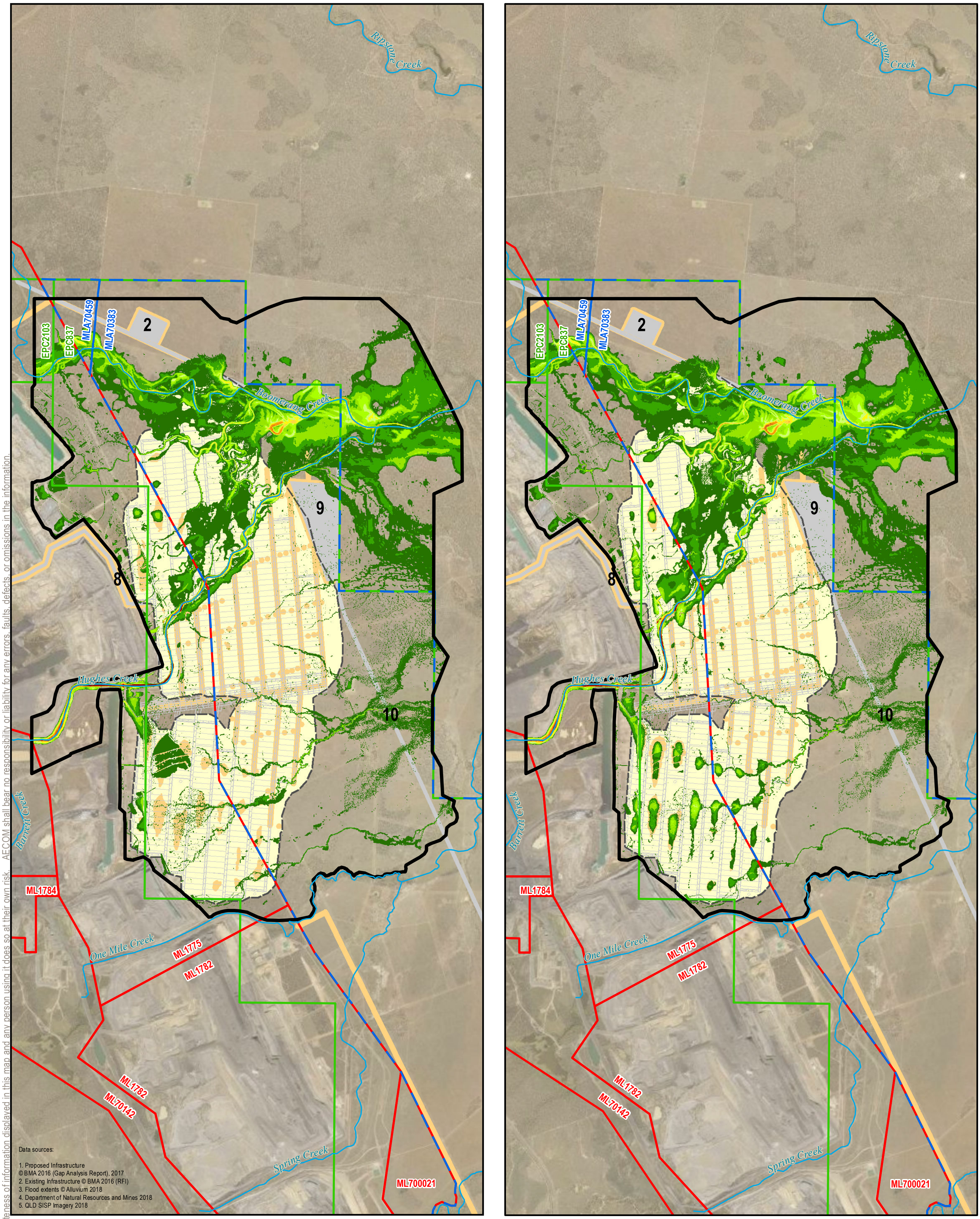

LEGEND

- Project Footprint - Indirect Impact
- Project Footprint - Direct Impact
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Surface Infrastructure
- Underground Mine Plan
- Limit Of Subsidence
- TUFLOW Model Extent
- Watercourse

Flood Depth (m)

- 0 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1 - 2
- 2 - 2.5
- 2.5 - 3
- 3 - 3.5
- 3.5 - 4
- 4 - 5
- 5 - 6
- > 6

Surface Infrastructure

2 Process Water Dam
6 ROM Pad
7 Future MIA
8 Conveyor
9 Construction Village
10 Transport and Infrastructure Corridor

N

Figure 8-12

Flood depth for 1% (1 in 100 year) AEP event pre-subsidence (left) and subsided Year 20 (right)

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.5 1 2
Kilometres

Scale: 1:88,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

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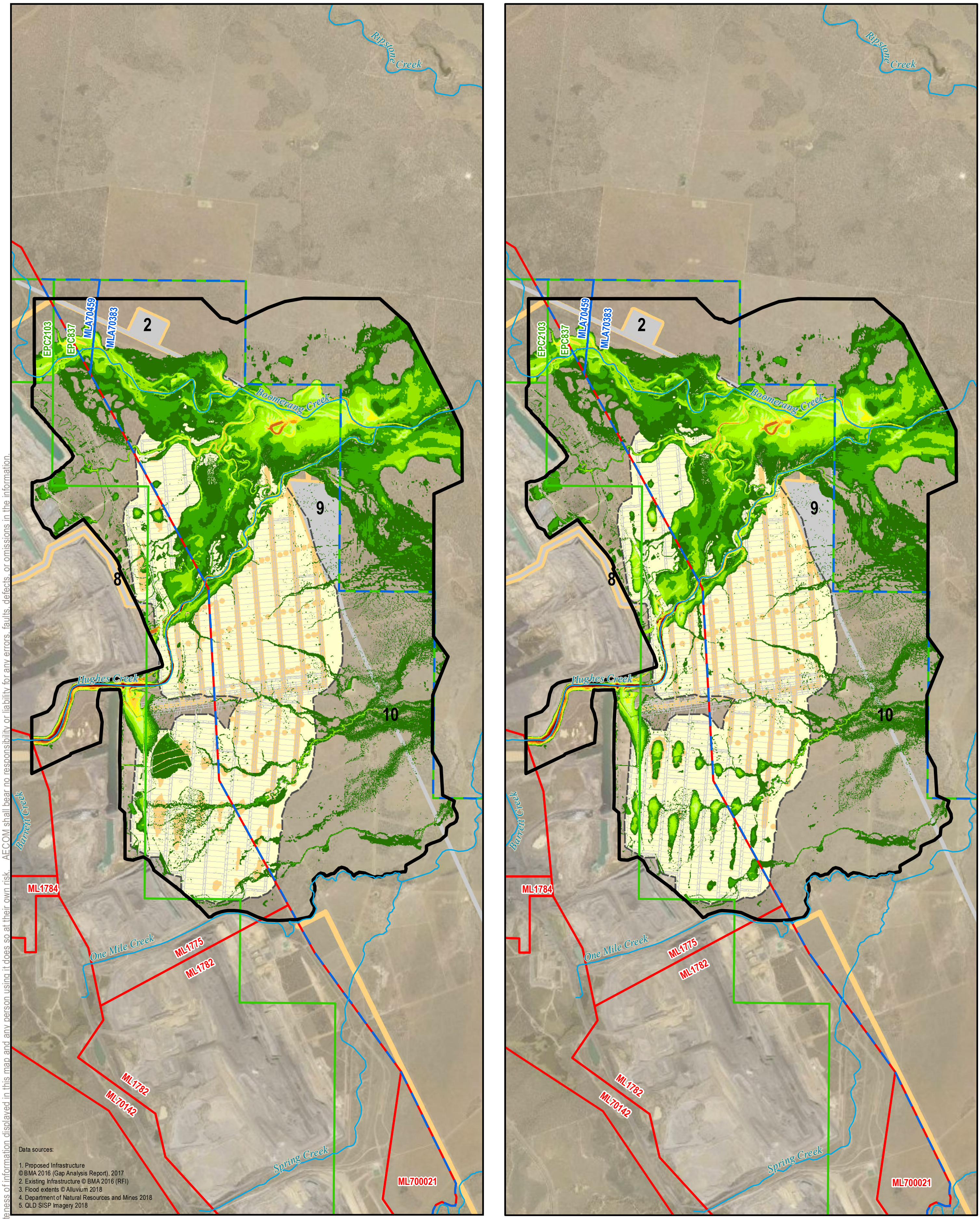

LEGEND

- Project Footprint - Indirect Impact
- Project Footprint - Direct Impact
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Surface Infrastructure
- Underground Mine Plan
- Limit Of Subsidence
- TUFLOW Model Extent
- Watercourse

Flood Depth (m)

- 0 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1 - 2
- 2 - 2.5
- 2.5 - 3
- 3 - 3.5
- 3.5 - 4
- 4 - 5
- 5 - 6
- > 6

Surface Infrastructure

2 Process Water Dam
8 Conveyor
9 Construction Village
10 Transport and Infrastructure Corridor

N

Figure 8-13

Flood depth for 0.1% (1 in 1000 year) AEP event pre-subsidence (left) and subsided Year 20 (right)

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.325 0.65 1.3
Kilometres

Scale: 1:88,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

BMA
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8.6 Mitigation measures

8.6.1 Mitigation measures

Proposed mitigation, management and monitoring measures for potential impacts on the surface water environment are summarised in Table 8-11 across construction and operation phases of the Project.

Table 8-11 Summary of mitigation measures for project phases

Project Phase	Potential Impact	Proposed management/mitigation measures	Proposed monitoring
Construction	Erosion and Sedimentation through working activities related to the construction of the project infrastructure leading through increased turbidity and nutrient concertation in receiving waters.	Management according to IECA (2008) described in Section 8.6.6 of this chapter.	To be outlined in Construction Environmental Management Plan.
Construction	Spillage of Chemicals and Contaminants used for construction leading to contamination of receiving waters with hydrocarbons, oil, hydraulic fluids and other hazardous chemicals.	Storage, operations, and handling in accordance with AS 1940, AS 3780 and as outlined in Section 8.6.7 of this chapter.	To be outlined in Construction Environmental Management Plan.
Operation	Release of MAW could increase levels of salinity and contaminants in receiving waters.	The WMS has been developed consistent with Queensland guidelines for regulated structures and preliminary consequence category of 'significant' for MAW containing structures. Accordingly, MAW structures will be managed according to the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (DES, ESR/2016/1933). The capacity of the MAW structures has been developed such that uncontrolled releases (spills) are unlikely. Licensed release(s) are proposed to allow the management of MAW in wet season or rainfall conditions exceeding licensed conditions. Licensed release(s) allows for a controlled management of excess MAW, during periods of flow in downstream waterways, to maximise dilution and minimise impact from MAW.	Regulated structures will be monitored in accordance with the Site Water Management Plan (SWMP) to be developed and the Model water conditions for coal mines in the Fitzroy Basin. The SWMP will specify: • regular inspection frequencies by site personnel, including pre wet season and post wet season inspections. • Periodic inspection by third parties (dam safety inspections) Regulated structure water volume and water quality monitoring.

Project Phase	Potential Impact	Proposed management/mitigation measures	Proposed monitoring
Operation	Water management system failure could lead to increased salinity and contaminant levels in receiving waters.	Failures can be contained within the MIA dam and the mine's WMS.	MAW monitoring will be automated and managed in accordance with the site's WMP.
Operation	Spillage of Chemicals and Contaminants used for construction leading to contamination of receiving waters with Hydrocarbons, oil, hydraulic fluids and other hazardous chemicals	Storage, operations, and handling in accordance with AS 1940, AS 3780 and as outlined in Section 8.6.7 of this report.	Incident reports.
Operation	Subsidence induced geomorphological changes leading to alterations in sediment transport, stream flow, water quantity and potentially increased turbidity.	Implementation of adaptive management framework and proposed subsidence management plan proposed in **Appendix K-2 Subsidence Management Plan.**	Ongoing subsidence monitoring and reviewing as outlined in **Appendix K-2 Subsidence Management Plan.**
Operation	Flooding of underground mine resulting in floodwaters with high salinity and contaminant concentration.	Unlikely to occur Contaminated flood waters will be treated via the Project's WMS.	Monitored and managed in accordance with the Project's WMS.
Operation	Wastewater.	Wastewater will be treated and blended with water within the process water dam.	Regular water quality sampling of treated wastewater is proposed. The basis for the treatment and use will be in accordance with Australian Guidelines for Water Recycling (NRMMC 2006).
Operation	Dewatered water volumes are expected to exceed water quality criteria for downstream waterways.	All dewatering volumes are proposed to be managed within the WMS, which is purposed as a containment system. Water transfers to be managed under a SWMP, refer Section 8.6.2).	SWMP monitoring requirements for regulated structures for pre and post regulatory wet season requirements for regulated structures. Ongoing water balance modelling for MAW containment adequacy.

8.6.2 Site water management plan

In accordance with the *Model water conditions for coal mines in the Fitzroy basin* (DES, ESR/2015/1561) and the BMA Mine Water Management Standard, BMA will prepare, update and maintain a Site Water Management Plan (SWMP) assuring a prioritisation of MAW over raw water supply. The SWMP will recognise raw water to be used for Project operations will be sourced via an offtake from the existing water pipelines developed to support BMA's current and future mining operations, along with various other purposes. The SWMP will also provide for effective management of actual and potential environmental impacts resulting from water management associated with the mining activity carried out and consist of the following:

- principles and objectives of Site Water Management across the Project
- outlines the chemicals and contaminants of concern involved in the Project

- water management system for the Site
- measures to manage and prevent saline drainage
- measures to manage and prevent acid rock drainage
- contingency procedures for emergencies
- development of an Erosion and Sediment Control Plan
- ongoing monitoring requirements of regulated structures proposed as part of the development
- ongoing water balance modelling, MAW containment adequacy
- pre and post regulatory wet season requirements for regulated structures.

Further, this Plan will recognise that water will be sourced from the Eungella Dam and/or the Burdekin Pipeline. The Project will have an internal BMA allocation to draw water from as part of the BMA-related water allocations.

The following mitigation strategies will be considered to address WMS failure risk:

- Mine water storages will be designed with consideration given to the predictions of the water balance model which considers all inputs and outputs, and which has run through a long-term period of climatic data to test storage capacities particularly in high rainfall wet season. If such discharge were to occur this would only be during rare and large events, therefore any release would be subject to dilution and would be similar to the receiving environment.
- All dams for the Project will be constructed in accordance with the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures* (DES, ESR/2016/1933). Pipes and pump systems to be designed with consideration to volume requirements predicted from water balance modelling and designed by a suitably qualified engineer.
- Regular inspections of mine water storages, pipeline, drain, bund and levees will be undertaken particularly in relation to integrity of constructed embankments.
- Mitigation solution for pump failure include standby pumps and diesel generator, additional pipeline segments in place for repairs, regular inspections.

The following mitigation and management measures apply to dewatering of water storage dams for operational requirements, such as maintenance:

- Mine dewatering is conveyed into the MAW system and the adjacent mine complex's WMS using existing water transfer systems. Water transfers to be managed under a Site Water Management Plan.
- Ensuring that pipe and pump network is operating properly before commencing dewatering.
- A post-mining monitoring program will be developed to address the recovery of groundwater drawdown impacts observed during operation.
- Potential groundwater drawdowns from mine dewatering are expected to have minor impacts on surface waters, as these mostly ephemeral in nature and are separated from the predicted impacted groundwater resources by low permeable sediments.
- Largest predicted drawdown extents are expected not to discharge into the area down gradient of the Isaac River, nor do draw down cones extend to the Isaac River.

8.6.3 Regulated structures

A comprehensive CCA is required during the detailed design of the structures. For WMS dams categorised as regulated structures as per the DES Manual for assessing consequence categories and hydraulic performance of structures (DES, 2016) as having a Significant or High consequence in any failure event category will be designed, constructed and managed to comply with the requirements of DES Guideline – Structures which are dams or levees constructed as part of environmentally relevant activities (DES, 2022). The DES Guideline identifies model conditions for design, CCA, construction, certification, operation, inspection, monitoring and reporting, and ensuring a Register of Regulated Structures is accurately maintained.

8.6.4 Licensed release of mine affected water

MAW produced during the operation phase will be stored and managed through the proposed mine WMS, which has been developed to minimise the likelihood of uncontrolled spills, as described in Section 8.5.1. The following mitigation strategies will be considered to address WMS failure risk:

- WMS storages will be designed with consideration given to the predictions of the water balance model which considers all inputs and outputs, and which has run through a long-term period of climatic data to test storage capacities particularly in high rainfall wet seasons.
- All MAW dams for the Project will be constructed in accordance with the DES Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (DES, 2016). Pipes and pump systems will be designed with consideration to volume requirements predicted from water balance modelling and designed by a suitably qualified engineer.
- regular inspections of mine water storages, pipeline, drain, bund and levees will be undertaken, particularly in relation to integrity of constructed embankments.

Consideration of licensed release has been developed according to the Model water conditions for coal mines in the Fitzroy Basin (DES, ESR/2015/1561). Licensed release subject to release criteria is likely to result in a controlled, managed and monitored release program and fewer occasions of significantly elevated EC in downstream waterways. Active management of releases may involve water blending, or release during downstream flow events, rather than passive spills via emergency spillway structures.

Under a variety of water balance modelling scenarios, no spills from WMS dams were predicted (Section 8.5.1.7); however, BMA are seeking a licensed release condition for the development to allow for emergency and contingency management of MAW.

According to the Model mining conditions (DES 2017, ESR/2016/1936), the release of MAW at release monitoring locations (Figure 8-7) must not exceed the release limits stated in Table 8-12 and Table 8-13.

Table 8-12 Mine affected water release limits (Model Mining Conditions; DES 2017)

WQ Parameter	Release limits	Monitoring frequency
EC (µS/cm)	< 10,000	Daily during release – the first sample must be taken within two hours of commencement of release or as soon as safe access permits.
pH (pH Unit)	6.5 (minimum) 9.0 (maximum)	
Turbidity (NTU)	50[1,2] Current limit or limit derived from suspended solids limit and demonstrated correlation between turbidity to suspended solids historical monitoring data for dam water.	

1 GLV EPP Water(2019) (Isaac River 1301)
2 Current limit or limit derived from suspended solids limit and demonstrated correlation between turbidity to suspended solids historical monitoring data for dam water

Table 8-13 Mine affected water release contaminant trigger investigation levels (Model mining conditions; DES 2017)

Toxicant	Trigger Levels (µg/L)	Monitoring frequency
Aluminium	55	A soon as possible after commencement of release and when safe access permits, thereafter weekly during release – one sample per week required.
Arsenic	13	
Cadmium	0.2	
Chromium	1	
Copper	2	

Toxicant	Trigger Levels (µg/L)	Monitoring frequency
Iron	300	
Lead	4	
Mercury	0.2	
Nickel	11	
Zinc	8	
Boron	370	
Cobalt	90	
Manganese	1,900	
Molybdenum	34	
Selenium	10	
Silver	1	
Uranium	1	
Vanadium	10	
Ammonia	900	
Nitrate	1,100	
Petroleum Hydrocarbons (C6-C9)	20	
Petroleum Hydrocarbons (C10-C36)	100	
Fluoride (total)	2,000	
Suspended Solids (mg/L)	55[1]	
Sulfate (SO_4^{2-}) (mg/L)	250[2]	

1 Current limit or limit derived from suspended solids limit and demonstrated correlation between turbidity to suspended solids historical monitoring data for dam water
2 Protection of drinking water Environmental Value

8.6.5 Subsidence

Managing the potential impacts of subsidence requires multiple complementary approaches, which may include adaptive management of existing issues, development of a subsidence management plan and monitoring of actual impacts as the Project progresses. An adaptive management framework is suggested as timing, duration and extent of impacts cannot be predicted accurately. This approach accommodates for the complexity involved with stream processes. The principles of an adaptive management framework are as follows:

- Risk assessment
- Design of mitigation measures
- Apply treatments
- Monitoring of key response indicators
- Evaluation of mitigation measures effectiveness
- Adaptation of policies and practices.

Appendix K-2 Subsidence Management Plan has been prepared for the Project, including:

- Ongoing subsidence monitoring, evaluation, review and improvement program
- Managing bed and bank stability

- Vegetation management
- Panel catchment management, including rehabilitation of surface cracking
- Infrastructure protection or relocation where necessary.

8.6.6 Erosion and sediment control

Erosion and sediment control practices will be applied to construction works and mining operations, in accordance with International Erosion Control Association Best Practice Erosion & Sediment Control guidelines (IECA, 2008) to mitigate the generation of sediment and its transport to waterways. Measures will be prepared by a *Suitably Qualified Person.*

Areas of disturbed or exposed soil will be managed to reduce sediment mobilisation and erosion. The following general mitigation measures are proposed:

- an erosion and sediment control plan will be prepared and executed
- erosion and sediment control protection measures will be installed prior to the commencement of land disturbance activities. Sediment control structures, such as sediment ponds, will be designed and constructed on site to trap runoff
- permanent stormwater management systems will be installed as early as possible in the construction program
- diversion bunds will be constructed to divert clean water flows around the construction site where practical
- erosion and sediment control structures will be regularly inspected and maintained
- topsoil will be stockpiled away from drainage lines to protect it from erosion by surface water runoff
- dust suppression measures will be implemented
- vehicle washdown will take place in designated areas away from flood plains and drainage lines
- water from vehicle washdown areas will be treated to remove seeds, oils and other contaminants before reuse for dust suppression or other on-site use or directed to the mine complex water management system for reuse
- road crossings of streams will be stabilised to minimise wash outs and bank erosion. Stabilisation may include placement of matting along banks
- regular inspections of road and pipeline alignments will be undertaken to ensure that disturbed surfaces are stable and not subject to concentration of flows or erosion. Repair works will be undertaken proactively to mitigate erosion from occurring or worsening.

The operational areas will be inspected regularly to check that stormwater management systems are effective, and concentration of flow or scouring is not occurring.

Detailed design of the MIA and CHPP will address design of stormwater collection and retention systems to ensure that stormwater can be captured and adequately treated.

8.6.7 Chemicals and contaminants

The storage of chemicals and fuel on-site will be kept to minimum levels. Storage units will be bunded as per AS 1940 and staff will be trained in appropriate chemical handling and emergency management procedures.

The following general mitigation measures are required to manage impacts of spills and leaks of fuels, oils and other contaminants on receiving waters:

- Temporary and permanent fuel storage areas to be designed in accordance with AS 1940 *The storage and handling of flammable and combustible liquids*. This includes provision for secondary containment.
- Chemical storage areas to be designed and operated in accordance with AS 3780 *The storage and handling of corrosive substances.*

- Refuelling to occur within contained, hardstand areas in accordance with AS 1940 wherever possible. Where this is not possible, refuelling activities should be located away from streams and drainage lines and be closely supervised, with a spill kit available that is capable of containing spills of around 100 L.
- Storage and refuelling areas to be located away from areas subject to stormwater inundation.
- Storage and refuelling areas to be designed to minimise the ingress of clean stormwater either from overland flow or incidental rainfall.
- Spill clean-up kits are to be located in appropriate locations, based on the risk of a spill occurring and potential volume of material that might be spilled at the particular location.
- Instructions on spill containment and clean-up to be available at refuelling locations and in vehicles where there is a moderate risk associated with spill events.
- Spills are to be contained and cleaned up immediately to mitigate the mobilisation of pollutants in drainage lines or watercourses.
- Bunds and sumps should be emptied after each rainfall event. Water and oily water from fuel and oil storage areas removed from bunds and sumps should be treated through an oil water separator and then reused for dust suppression or other on-site use. Water and other contaminants from other chemical storage areas should be treated through on-site wastewater treatment plants and then utilised in dust suppression or irrigated in accordance with the site Environmental Authority.
- Items are not to be stored or placed within bunds or sumps.
- Contaminants and major spills will be collected by a licensed waste collection and transport contractor for disposal at an offsite licensed facility.
- Wastewater from vehicle washdown areas should be directed through oil and grease separators and effluent utilised for dust suppression or other use or directed to the mine complex water management system for reuse.

8.6.8 Monitoring

Construction Environment Management Plan

The potential for impacts during construction will be managed through development and implementation of the Construction Environmental Management Plan. This would include a Surface Water Management Sub-plan, including the establishment of baseline conditions and construction phase monitoring. During construction, surface water ponded in excavations will be tested and managed in accordance with the stormwater management system to determine whether suitable for discharge to the receiving environment or otherwise disposed of at a licenced facility. Monitoring of the receiving water during construction would be in accordance with the REMP outlined below.

Site Water Management Plan

Appropriate management of surface water resources will involve the application of the SWMP. The SWMP will provide for effective management of actual and potential environmental impacts resulting from water management associated with the mining activity carried out.

During operation, monitoring of MAW dam water levels will be automated and dam water levels will be managed in accordance with the SWMP to minimise uncontrolled releases. Where safety and access permit, the receiving water will be monitored at upstream and downstream locations during process dam release events. Monitoring will also be carried out during normal operation of the mine to in accordance with the REMP.

Subsidence Management Plan

BMA will implement a Subsidence Management Plan to manage impacts on landform, surface water, groundwater, ecology and infrastructure prior to subsidence impacts. The Plan outlines SMART controls for mitigation, monitoring and rehabilitation, including monitoring erosion and sedimentation, surface cracking across the subsidence impacted areas. Refer **Appendix K-2 Subsidence Management Plan**.

Receiving Environment Monitoring Program

A REMP will be developed and implemented prior to construction. The aim of the REMP is to monitor and assess the potential impacts of the controlled and uncontrolled releases of MAW and associated contaminants to the environment from a regulated activity. This will provide the basis for evaluating whether the discharge limits have been successful in maintaining or protecting receiving environment values over time.

According to the *Fitzroy Coal Mine Receiving Water Monitoring for Regulation Project Report* (DES, 2018a), there are three main monitoring requirements within coal mines, namely:

- Monitoring within the mine site and mine water releases, which typically compare data to limits and triggers, i.e. Release Point monitoring (Section 6.1). Under the Model Mining Conditions (DES 2017), the indicators that should be monitored at release points, and which have release limits must include EC, pH, turbidity (Table 8-12). These contaminants were determined to be the major contaminants of concern for release of mine-affected water in the Fitzroy Basin. Other indicators to be monitored end-of-pipe include contaminants presented in Table 8-13. A flow gauging station will be installed upstream of the discharge monitoring point to account for flow rates during events.
- Monitoring upstream and downstream of the mine release site during periods of mine water releases, also referred to as Receiving Environment monitoring. Triggers or limits will be applied to this monitoring for key indicators to ensure downstream water quality does not exceed levels authorised in the approval (Figure 8-1, Figure 8-7, Table 8-14).
- Monitoring of upstream, downstream and the broader receiving waters during periods of base and event flow, also referred to as REMPs. The purpose of this monitoring is to assess the overall condition of the system downstream of mining operations. Water quality is compared to water quality objectives and relevant guidelines (Figure 8-1, Figure 8-7, Table 8-14).
- Installation of continuous monitoring station for pH and EC downstream of release (downstream of mixing zone, location to be confirmed with a mixing assessment).

The proponent is committed to participation in the wider regional REMP for the Fitzroy Basin together with adjacent Saraji and Peak Downs mines as outlined in *Fitzroy Coal Mine Receiving Water Monitoring for Regulation – Efficiency Review and Gap Analysis* (2018). This includes the utilisation of existing monitoring locations, shared data management, coordination of releases between mines, as well as combined mitigation and response procedures.

Table 8-14 Proposed monitoring locations for REMP

Monitoring Point ID	Easting (GDA94)	Northing (GDA94)	Monitoring Point Name
Background data (used for water quality objectives)			
MP1 (SRM)	630293	7524061	Hughes Upstream US
MP2 (SRM)	631096	7516901	One Mile US
MP2 (PDM)	623739	7531218	Boomerang US / MP24
MP4 (SRM)	634518	7515056	Spring Downstream DS
MP6 (SRM)	632488	7517976	One Mile DS
Existing environment (for EIS)			
MP3 (SRM)	634054	7508913	Phillips US
MP5 (SRM)	634346	7525530	Hughes DS
MP7 (SRM)	639027	7513729	Phillips DS
MP8 (SRM)	634603	7515079	Spring US
MP9 (SRM)	651114	7529225	Isaac DS / MP18 (PDM) / Regional 2
MP10 (PDM)	632087	7529980	Boomerang DS

Monitoring Point ID	Easting (GDA94)	Northing (GDA94)	Monitoring Point Name
Future monitoring of mining impacts			
MP5 (SRM)	634346	7525530	Hughes DS
MP10 (PDM)	632087	7529980	Boomerang DS
Proposed			
Proposed 1	638483	7529068	Proposed location 1
Proposed 2	636701	7529300	Proposed location 2
Indicative proposed mine water release point			
Discharge Location	635984	7529559	MAW Discharge Point - Boomerang Creek

Content of the REMP will follow DES guidelines (DES, 2014), (DES, (2018a) and DES (ESR/2015/1561) to include the following sections:

- For the purposes of the REMP, the receiving environment is the waters of Boomerang Creek, Hughes Creek and Isaac River downstream of the release. The REMP encompasses sensitive receiving waters or environmental values downstream of the authorised mining activity with potential to be directly affected by an authorised release of MAW.
- Condition or state assessment of receiving waters, including upstream conditions, spatially within the REMP area, considering background water quality characteristics based on accurate and reliable monitoring data that takes into consideration temporal variation (e.g. seasonality).
- Description of the project activities, and water management system in place.
- Location of release point for controlled discharge of MAW. A mine water release point is proposed downstream of the site in Boomerang Creek (Figure 8-7).
- Location of REMP Monitoring Points (Figure 8-1, Figure 8-7, Table 8-14).
- Description of the receiving waters including suitably scaled maps, description of environmental values, developed WQOs, Land use and other MAW release points from other projects, historical and relevant data sources.
- Include baseline data on surface water flows and quality, trigger levels for investigations and a monitoring program.
- Continuous Monitoring of receiving water monitoring analytes and trigger investigation levels according to *Values adopted from Model water conditions for coal mines in the Fitzroy Basin* (DES, ESR/2015/) presented in Table 8-15.
- Frequency and timing of sampling required to reliably assess ambient conditions and to provide sufficient data to derive site specific background reference values in accordance with the Queensland Water Quality Guidelines 2006. This should include monitoring during periods of natural flow irrespective of mine or other discharges.
- Monitoring of flow rates to determine when licensed releases can be triggered without impacting the receiving water course.
- Monitoring of WQ parameters in potentially affected waterways (upstream and downstream of impact, Table 8-14) utilising established monitoring points where applicable. The comparison of upstream and downstream allows for an on-time evaluation after MAW releases as well as providing an overview of potential mining impact over time.
- Monitoring will be undertaken in accordance with the Monitoring and Sampling Manual – Environmental Protection (Water) Policy 2009 (DES, 2018b) (or guideline current at the time of construction). Field monitoring equipment, such as EC and pH meters will be calibrated. QA/QC laboratory samples will be collected. All external laboratories will be National Association of Testing Authorities (NATA) accredited for the analytical procedures they are performing.

- Further, complementary to historical/relevant datasets, REMP data will continue to be collected via the adjacent sites' REMPs (Peak Downs Mine, Saraji Mine).
- Monitoring of metals/metalloids in sediments in accordance with Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) and/or the most recent version of AS5667.1 Guidance on Sampling of Bottom Sediments.
- Monitoring of Bio-Indicators including macroinvertebrates in accordance with AUSRIVAS methodology (DNRM, 2001).
- Quality Assurance/Quality Control procedures will be developed and described for all aspects of the monitoring program, including field sampling, transport, laboratory analysis and data handling.

Development of a Trigger Action Response Plan (TARP) to identify the corrective actions and responses required in the event operations result in exceedances in surface water quality or adverse changes in stream health.

Table 8-15 Receiving water monitoring analytes and trigger investigation levels for continuous monitoring

Analyte (Physico-chemical)	Trigger investigation level	Monitoring Frequency
EC (µS/cm)	1,000	Real-time monitoring Grab samples if telemetry disabled Grab samples at commencement of MAW release and weekly thereafter (Subject to safety and accessibility concerns).
pH	6.5 – 8.5	

8.6.9 Trigger Action Response Plan

Actions that would be taken in response to an exceedance of water quality criteria are outlined in Table 8-16, including the timing, responsibilities and reporting requirements.

A TARP will be developed prior to construction, as part of the Water Management Plan, with the primary objective of providing trigger values based on the REMP framework for further investigation and outlining the corrective actions and responses required in the event:

- monitoring identifies the potential for an exceedance of water quality objectives or overtopping of water storages
- water quality monitoring identifies an exceedance of water quality objectives or an adverse change in stream health, or
- overtopping of the process water dam spillway occurs.

Under normal conditions the mine will operate as a closed system, so discharges to the downstream catchment are considered unlikely to occur. If an exceedance occurs, mine water dam overtopping or compromised stream health, the TARP will specify corrective actions and responses required in the event of exceedances.

In general, no action will be required if:

- water quality at release location (end of pipe) does not exceed trigger levels and release limits specified in Table 8-12 and Table 8-13
- water quality in the receiving environment does not exceed trigger levels and release limits specified in Table 8-13
- receiving environment water quality downstream of released MAW is below tested levels upstream, or
- water quality measured at REMP monitoring locations downstream (medians) are within upstream 80^{th} percentile values or WQOs.

The TARP will apply to the construction, operation and decommissioning stages of the Project. Site-specific water quality objectives or trigger values will be developed for the Project in line with the REMP. The TARP may also include ground condition, vegetation cover, erosion and other rehabilitation completion criteria.

Table 8-16 Preliminary response plan for exceedance of water quality objectives as part of the Water Management Plan to be developed

Trigger	Responses		Timing	Outcome / Reporting
Water quality monitoring at discharge point identifies exceedance of release limits or release trigger values	**Step 1**	If quality characteristics of a release event exceed any of the trigger levels specified in Table 8-12 of this report, downstream results in the receiving waters must be compared to all trigger values specified in the tables. ➔ If trigger values downstream are not exceeded no further action needs to be taken. ➔ If trigger values are exceeded in the downstream environment, downstream values must be compared with data from background monitoring sites upstream of the project. ➔ If downstream values are < background (upstream) site data, no action needs to be taken. ➔ If results are > than background site values, an investigation is to be initiated (Step 2).	As soon as practicable, once the exceedance is identified	Record exceedance in the REMP If downstream data > background site data, holder of EA must notify administering authority within 14 days of receiving the results
	Step 2	Review potential causes of exceedance via the following: • Visual inspection of potential diffuse sources (e.g. seepage from reject disposal areas or waste rock dumps). Where a potential source of an exceedance is identified, samples should be collected for testing where feasible and practicable. • Visual inspection of site infrastructure to identify any visible damage (e.g. a damaged pipe or broken monitoring equipment). • Visual inspection of site equipment and plant, and review of maintenance records. • Review of recent weather and rainfall data (Note that some physico chemical parameters such as conductivity and turbidity may be influenced by rainfall).	As soon as practical following step 1	Document correspondence in the site Environmental Management System Carry out incident reporting requirements in the EA Record additional water quality testing results in the REMP
	Step 3	If it is identified that the exceedance is a result of construction or operation of the Project and has resulted in the release of contaminants	If the exceedance meets reporting requirements, notify DES within 24 hours of becoming aware	Document correspondence in the site Environmental Management System

Trigger	Responses		Timing	Outcome / Reporting
		not in accordance, or reasonably expected to be not in accordance with the EA, ➔ BMA must notify DES by written notification within 24 hours of becoming aware, or in accordance with the EA conditions at the time. Actions need to be taken to prevent environmental harm		Carry out incident reporting requirements in the EA
Overtopping of process dam or uncontrolled discharge via spillway	**Step 1**	Determine impact on receiving waters: Carry out water quality testing of potentially impacted downstream water bodies to assess if water quality downstream exceeds any of the trigger levels specified in Table 8-12 and Table 8-13 of this report, ➔ If trigger values downstream are not exceeded no further action needs to be taken. ➔ If trigger values are exceeded in the downstream environment, downstream values must be compared with data from background monitoring sites upstream of the project. ➔ If downstream values are < background (upstream) site data, no action needs to be taken. ➔ If results are > than background site values, an investigation is to be initiated (Step 2).	Carry out water quality testing as soon as reasonably possible (where safety and access permits)	Record water quality testing results in the REMP
	Step 2	If it is identified that overtopping has resulted in the release of contaminants exceeding the release limits or contaminant trigger values, BMA must notify DES by written notification within 24 hours of becoming aware.	If the release of contaminants meets reporting requirements, notify DES within 24 hours of becoming aware	Document correspondence in the site Environmental Management System Carry out incident reporting requirements
Water quality monitoring at downstream location identifies exceedance of trigger values for the receiving environment	**Step 1**	To be addressed by the Receiving Environment Monitoring Plan	As per the REMP	As per the REMP

8.7 Summary and conclusions

In summary, the Project has potential to impact surface water resources particularly surface water quality and aquatic ecosystems. However, impacts can be largely mitigated by applying the developed conceptual WMS and proposed mitigation, management and monitoring measures. Full detail of the assessment of impacts to surface water resources are provided in **Appendix E-1 Surface Water Quality Technical Report, Appendix E-2 Mine Water Balance Technical Report, Appendix E-3 Hydrology, Hydraulics and Geomorphology Technical Report, Appendix E-4 Conceptual Ponding Assessment**, **Chapter 7 Aquatic Ecology** and **Chapter 9 Groundwater**.

This section summarises the key findings of the surface water technical report for the Saraji East Underground Mining lease project.

Environmental Values

The Project is in the far upstream headwaters of the Fitzroy Basin and relatively high in the headwaters of the Isaac River sub-catchment. Four upland freshwater streams have been identified within the receiving environment of the Project's mining activities, including Boomerang Creek, Hughes Creek, One Mile, Spring Creek.

The Environmental values for these watercourses have been identified with the protection of aquatic ecosystems being the category requiring the most stringent criteria for water quality objectives.

Water Quality Objectives

Located within the Fitzroy River basin, these waterways are located hydraulically up-gradient of the Isaac River, which is a scheduled river system under the Queensland Environment Protection (Water) Policy 2009. The baseline hydrological condition of the waterways within the Project Footprint comprises:

- ephemeral watercourses with nil to negligible flow expected during normal conditions
- 'moderately disturbed' catchments due to significant mining operations (located immediately upstream of the project location) and minor agricultural activity in the broader catchment
- high sediment loads during flow events and highly variable water quality.

Comparison of the regional WQOs within the Isaac River Sub-basin Environmental Values and Water Quality Objectives Basin No.130 (part) including all waters of the Isaac River Sub-basin (including Connors River) (DEHP, 2011) against reference water quality data at the Project location concluded baseline site specific water quality (within the ephemeral creeks) is significantly different to regional water quality (Isaac River), particularly: Ammonia, Kjeldahl nitrogen, Total nitrogen, Dissolved oxygen, Nickel.

A detailed analysis of water quality data developed site-specific WQOs according to guideline approaches such as DEHP (2009), ANZG (2018) and DES (2022), and were based on analysis of the best available reference data at the site location. Consistent with the intent of the Queensland Water Quality Guidelines (DES 2022) and ANZG (2018) guidelines, the site specific WQOs are proposed for long-term improvement of waterway quality.

Mine WMS

The conceptual mine WMS has been progressed to a level of detail commensurate with the current Project design and data availability. Preliminary capacity estimates for all mine WMS dams and the water transfer network were determined through water balance assessment using historical climate data and climate change projections, and conceptual operational rules for minimising:

- generation of MAW by passively diverting clean runoff around the mine WMS wherever practical
- volumes of MAW stored onsite by preferencing the use of MAW where possible (e.g. for CHPP process and dust suppression)
- consumption of raw water by preferencing the use of MAW.

While licensed releases are not expected, a licensed release point has been included for contingent management of water storages in unforeseen conditions under high flow conditions. The potential impact from licensed releases was assessed in a stress test scenario in **Appendix E-2 Mine Water Balance Technical Report** with EC as the limiting contaminant. The modelling of this scenario predicted no significant impact. Discharge criteria and trigger values for the unlikely case of a discharge, have been developed in accordance with Model water conditions for coal mines In the Fitzroy basin, existing EAs of adjacent BMA mines and 80th percentile values of background water quality where appropriate.

A REMP and TARP will be developed in accordance with DES guidelines (DES, 2014), (DES, (2018a) and DES (ESR/2015/1561) prior to construction, as part of the Water Management Plan, with the primary objective of providing trigger values based on the REMP framework for further investigation and outlining the corrective actions and responses if detrimental impacts to surface water quality and stream health are imminent.

Surface Water Risks and Mitigations

To understand the potential risks to surface water due to the project development, a review of the proposed operations was completed, with key risks identified for the construction and operational phase. Subsequently, mitigation and management measures have been developed for each risk identified.

Table 8-17 Risks and Mitigations

Aspect	Risk(s)	Mitigation(s)
Construction Phase		
Erosion and Sediment Mobilisation	Erosion and Sedimentation leading to increased turbidity and nutrient concertation in receiving waters	Management according to guidelines for erosion and sediment control (IECA 2008)
Chemicals and Contaminants of Concern	Spillage of Chemicals and Contaminants leading to contamination of receiving waters	Storage, operations, and handling as per Australian standards Construction Environmental Management Plan
Operational Phase		
Chemicals and Contaminants of Concern	Spillage of Chemicals and Contaminants leading to contamination of receiving waters	Storage, operations, and handling as per Australian standards Incident reports
Subsidence	Geomorphological changes leading to alterations in sediment transport, stream flow, water quantity and increased turbidity	Implementation of adaptive management framework and proposed subsidence management plan proposed in Alluvium (2022). Ongoing subsidence monitoring and review.
Erosion and Sediment Mobilisation	Erosion and Sedimentation leading to increased turbidity and nutrient concertation in receiving waters	Management according to guidelines for erosion and sediment control (IECA 2008)
MAW	Release of MAW could increase levels of salinity and contaminants in receiving waters	WMS Licensed Release
Mine Dewatering	Dewatering activities reduce capacity of MAW storages, resulting in unnecessary licensed releases	Mine dewatering is conveyed into the MWB MAW system and the adjacent mine complex's WMS using existing water transfer systems. Water transfers managed under a SWMP Ongoing water balance modelling for MAW containment adequacy.

Aspect	Risk(s)	Mitigation(s)
Wastewater	Wastewaters from mining or effluent streams could lead to contamination and toxicity in receiving environments.	Effluent wastewater would be treated and discharged to the PWD. Any sludge generated, and sewage from temporary workers accommodation village would be pumped by licensed contractor and transported to a local council sewage treatment plant.

Performance Monitoring, Management and Response Plans

In addition to the proposed mitigation(s) developed for the identified risks, appropriate management of surface water resources will involve the development of Plan documentation, which will be developed during the detailed design phase, including:

- SWMP to manage contaminants and containment in regulated water structures.
- REMP to identify potential impacts to surface waters during operation and licensed releases. TARP to specify corrective actions in the event of trigger exceedances.
- Subsidence Management Plan to mitigate the potential impact of subsidence on streams and infrastructure (**Appendix K-2 Subsidence Management Plan**).
- **Appendix K-1 Rehabilitation Management Plan** to manage potential impacts of decommissioning.

The REMP together with the implementation of a TARP will provide comprehensive corrective actions and responses for impacts to water quality. As such it is expected that construction and operation of the proposed underground mine will likely have little impact on surface water quality in the Boomerang-Hughes Creek catchment and the Isaac River.