ENGENY

BARALABA SOUTH PTY LTD

Baralaba South Project Surface Water Impact Assessment

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1. INTRODUCTION

1.1 Project Description

Baralaba South Pty Ltd proposes to develop the Baralaba South Project (the Project), the Project would be located approximately 8 kilometres (km) south of the township of Baralaba and 115 km west of Rockhampton in the lower Bowen Basin region of Central Queensland (Figure 1.2).

The Project is a greenfield, open-cut metallurgical coal mine which would extract up to 2.5 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal to produce pulverised coal injection (PCI) coal for international export to the steel production industry over a life of 23 years. Mining activities are to be undertaken within the area of Mining Lease Application (MLA) 700057, which covers a total of 2,214 ha.

Open-cut coal mining activities would target the Baralaba Coal Measures, including the basal sub-unit Kaloola Member, where the structural dip of the Permian geology brings them to or near the surface within MLA 700057. The total resource targeted comprises 48.6 Mt of ROM coal estimated to produce approximately 34.6 Mt of PCI product coal over the life of the Project. Overburden and interburden will be disposed of in out-of-pit spoil dumps located contiguous with the pit excavation, and in-pit dumps as part of ongoing progressive rehabilitation behind the advancing operations.

The Project will provide a continuation of mining operations within the local area, wherein mining operations decline at the Baralaba North Mine, mining operations will ramp up at the Project. The main activities associated with the Project include:

- A greenfield open-cut coal mine to be developed within the Mining Lease Application (MLA) 700057, including:
  - Open-cut mining operations using conventional truck and excavator methods.
  - A Coal Handling Preparation Plant (CHPP).
  - A mining infrastructure area, including workshops, administration buildings, fuel and chemical storage facilities, warehouse and hardstand areas.
  - ROM coal and product coal stockpile pads.
  - Topsoil stockpiles, laydown areas and borrow areas.
  - Haul roads and internal roads.
  - Water management infrastructure.
  - Backfilling of mine voids with waste rock behind the advancing open-cut mining operations and the placement of waste rock in out-of-pit emplacements adjacent to the pit extents.
  - Dewatering of CHPP coal rejects and disposal on-site within mine voids behind the advancing open-cut mining operation.
  - Recovery and recycling of processed wastewater through the CHPP.
  - Other associated minor infrastructure, plant, equipment, and activities; and
  - Exploration activities.
- Realignment of approximately 4.5 km of Moura Baralaba Road to the east of MLA 700057 (Realignment of Moura Baralaba Road is subject to separate approvals).
- Product coal road transport approximately 40 km via the existing Baralaba North Mine haul route on public Council-controlled roads to the existing train load-out facility located approximately 2 km east of Moura; and
- Product coal rail transport to the Port of Gladstone for export to international markets.

The Project includes development of an electricity transmission line (ETL) of approximately 8 km in length within a 20 m wide easement. The ETL will link the Project with the Baralaba Substation, located approximately 6 km east-south-east of the Baralaba township. Two ETL alignment options are being considered for the Project and the final ETL alignment will be determined at a later date in consideration of the outcomes of the assessments conducted for the EIS. The ETL will be subject to separate approvals, for which the necessary permitting will be undertaken by Ergon.

The Project would employ up to 268 construction employees and up to approximately 521 employees during peak operations. The Project layout is shown in Figure 1.1.

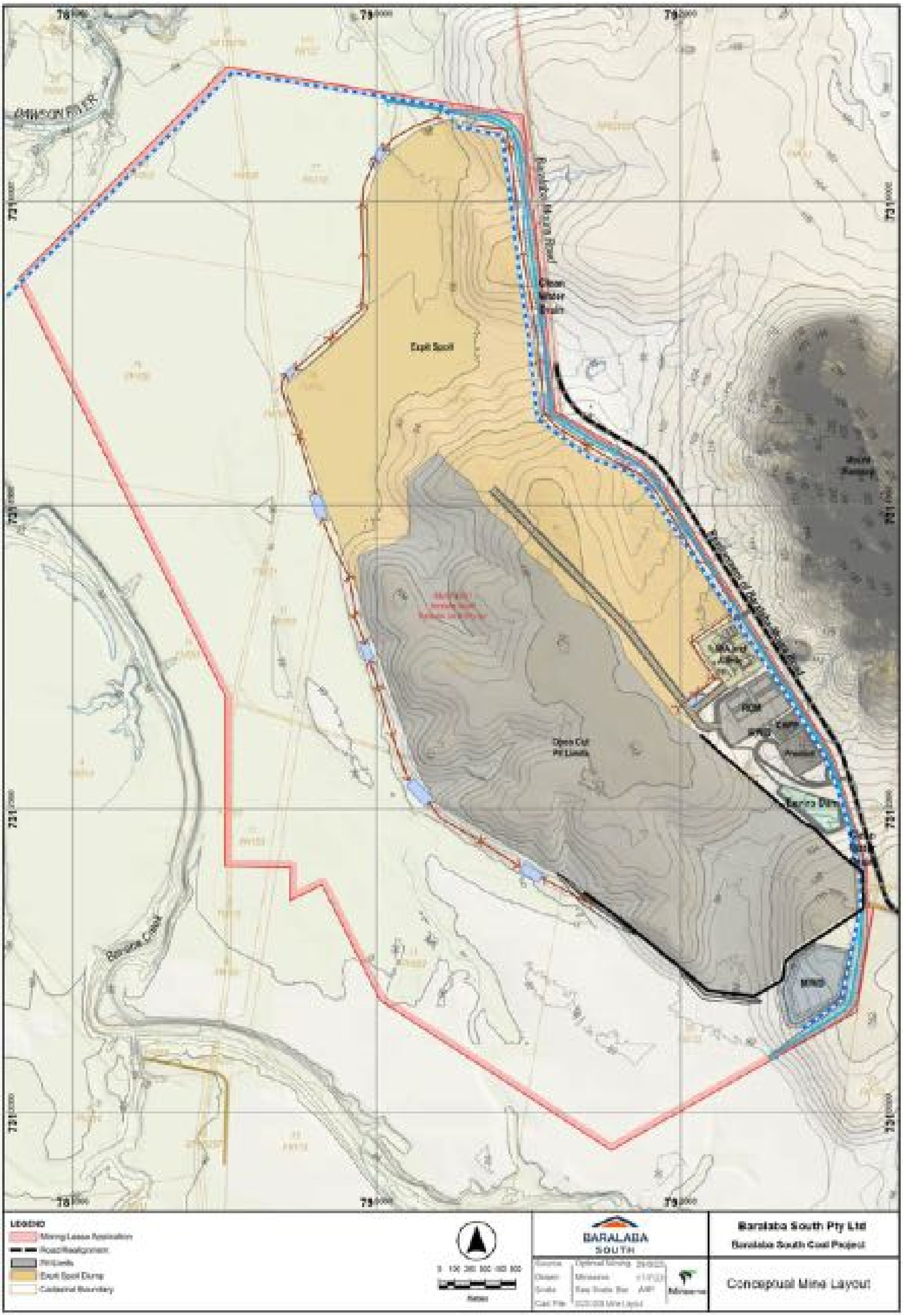

Figure 1.1: Project Layout

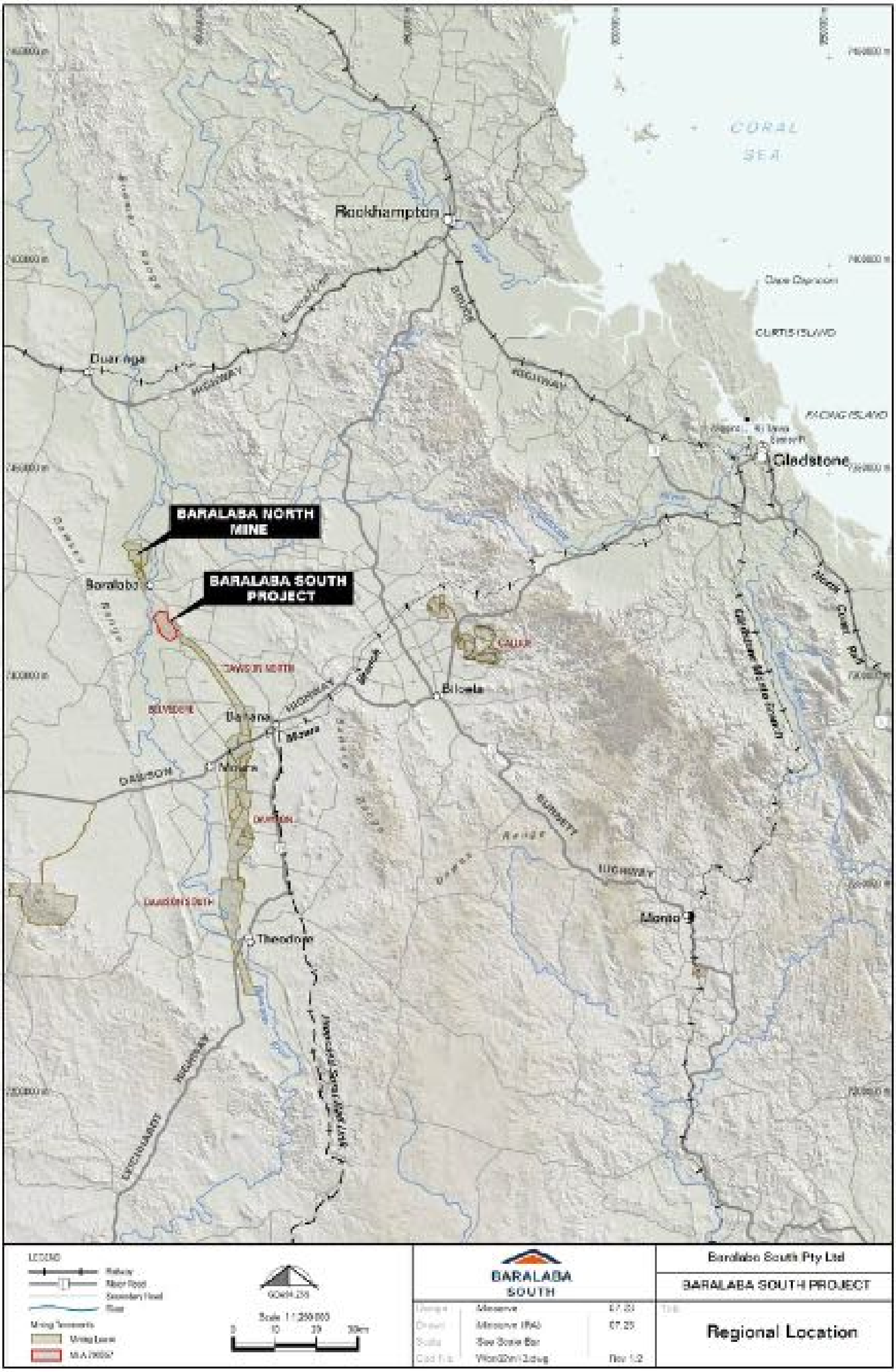

Figure 1.2: Regional Location

1.2 Terms of Reference Requirements

The Terms of Reference (TOR) for the Project Environmental Impact Statement (DEHP, 2017b) have identified three controlling provisions for the project with regard to its potential impacts on matters of national environmental significance (MNES) including:

- Listed threatened species and communities.
- Listed migratory species.
- Water resources.

The TOR for the Project Environmental Impact Statement (DEHP, 2017b) also sets the scope of critical matters that should be given detailed treatment in the EIS. Nine (9) critical matters have been identified for the Project, three (3) of which are associated with surface water (Table 1.1), including:

- Water Quality.
- Water Resources.
- Flooding and Regulated Dams.

TABLE 1.1: TERMS OF REFERENCE REQUIREMENTS

TOR Critical Matter	Information Requirement	Relevant Section of this Report or Reference to another EIS Appendix
Water Quality	8.2.1	3.2
	8.2.2	3.3, 10.2
	8.2.3	2.5 Also refer to the Project Groundwater Modelling and Assessment
	8.2.4	4.1, 6.2.2, 6.2.3, 6.2.4, 8
	8.2.5	7.1 and 7.2
	8.2.6	9
Water Resources	8.3.1	7.1, 5.3, 5.4, 5.6 Also refer to the Project Groundwater Modelling and Assessment
	8.3.2	5.3
	8.3.3	5.4, 7.1
	8.3.4	2.3, 2.6, 2.7, 2.8
	8.3.5	Refer to the Project Groundwater Modelling and Assessment
	8.3.6	
	8.3.7	2.3, 2.4, 2.5, Appendix A, B and C Refer to the Project Groundwater Modelling and Assessment
	8.3.8	6 Refer to the Project Groundwater Modelling and Assessment Refer to the Peer Review of the Surface Water Impact Assessment Refer to Peer Review of Groundwater Modelling and Assessment

TOR Critical Matter	Information Requirement	Relevant Section of this Report or Reference to another EIS Appendix
The Independent Expert Scientific Committee (IESC)	8.3.9 and Appendix 2	Refer to Table 1.2
Flooding and Regulated Dams	8.4.1-8.4.3	Refer to Flood Impact Assessment
	8.4.4	8.
	8.4.5	8.
	8.4.6	5.3
	8.4.7	8.
	8.4.8	8.1
	8.4.9	Refer to Flood Impact Assessment

1.3 Independent Expert Scientific Committee Requirements

The information requirements contained in the IESC's Information Guidelines for Proponents Preparing Coal Seam Gas and Large Coal Mining Development Proposals (IESC, 2018) and associated references to relevant sections of the report are provided in Table 1.2.

TABLE 1.2: IESC REQUIREMENTS

Information Requirement	Report Section/ Appendix or other EIS Appendix
Description of the Proposal	
Provide a regional overview of the proposed project area including a description of the geological basin, coal resource, surface water catchments; groundwater systems; water-dependent assets; and past, present and reasonably foreseeable coal mining and CSG developments.	2
Describe the statutory context, including information on the proposal's status within the regulatory assessment process and any applicable water management policies or regulations.	3.1
Describe the proposal's location, purpose, scale, duration, disturbance area, and the means by which it is likely to have a significant impact on water resources and water-dependent assets.	1.1
Describe how impacted water resources are currently being regulated under state or Commonwealth law, including whether there are any applicable standard conditions.	3.1.5
Surface Water	
Context and Conceptualisation	
Describe the hydrological regime of all watercourses, standing waters and springs across the site including: • Geomorphology, including drainage patterns, sediment regime and floodplain features. • Spatial, temporal and seasonal trends in streamflow and/or standing water levels.	2.1, 2.3 and 2.4

Information Requirement	Report Section/ Appendix or other EIS Appendix
• Spatial, temporal and seasonal trends in water quality data (such as turbidity, acidity, salinity, relevant organic chemicals, metals, metalloids and radionuclides), and, • Current stressors on watercourses, including impacts from any currently approved projects.	
Describe the existing flood regime, including flood volume, depth, duration, extent and velocity for a range of annual exceedance probabilities. Provide flood hydrographs and maps identifying peak flood extent, depth and velocity. This assessment should be informed by topographic data that has been acquired using lidar or other reliable survey methods with accuracy stated.	Flood Impact Assessment
Provide an assessment of the frequency, volume, seasonal variability and direction of interactions between water resources, including surface water/ groundwater connectivity and connectivity with sea water.	2.1, 2.3, 2.4
Analytical and Numerical Modelling	
Provide conceptual models at an appropriate scale, including water quality, stores, flows and use of water by ecosystems.	6
Use methods in accordance with the most recent publication of *Australian Rainfall and Runoff* (Ball et al. 2016).	Flood Impact Assessment
Develop and describe a program for review and update of the models as more data and information becomes available.	10.1
Describe and justify model assumptions and limitations and calibrate with appropriate surface water monitoring data.	6.1
Provide an assessment of the risks and uncertainty inherent in the data used in the modelling, particularly with respect to predicted scenarios.	6, 6.2, 6.3.4, 6.4
Provide a detailed description of any methods and evidence (e.g., expert opinion, analogue sites) employed in addition to modelling.	6.1
Impacts to Water Resources and Water-Dependant Assets	
Describe all potential impacts of the proposed project on surface waters. Include a clear description of the impact to the resource, the resultant impact to any assets dependent on the resource (including water-dependent ecosystems such as riparian zones and floodplains), and the consequence or significance of the impact. Consider: • Impacts on streamflow under the full range of flow conditions. • Impacts associated with surface water diversions. • Impacts to water quality, including consideration of mixing zones. • The quality, quantity and ecotoxicological effects of operational discharges of water (including saline water), including potential emergency discharges, and the likely impacts on water resources and water-dependent assets. • Landscape modifications such as subsidence, voids, post rehabilitation landform collapses, on-site earthworks (including disturbance of acid-forming or sodic soils, roadway and pipeline networks) and how these could affect surface water flow, surface water quality, erosion, sedimentation and habitat fragmentation of water-dependent species and communities.	6.2, 7.3, 7.4, 8.
Discuss existing water quality guidelines, environmental flow objectives and requirements for the surface water catchment(s) within which the development proposal is based.	2.8.5, 3.3
Identify processes to determine surface water quality guidelines and quantity thresholds which incorporate seasonal variation but provide early indication of potential impacts to assets.	3.3
Propose mitigation actions for each identified significant impact.	10
Describe the adequacy of proposed measures to prevent or minimise impacts on water resources and water-dependent assets.	10

Information Requirement	Report Section/ Appendix or other EIS Appendix
Describe the cumulative impact of the proposal on surface water resources and water-dependent assets when all developments (past, present and reasonably foreseeable) are considered in combination.	8.14
Provide an assessment of the risks of flooding (including channel form and stability, water level, depth, extent, velocity, shear stress and stream power), and impacts to ecosystems, project infrastructure and the final project landform.	Flood Impact Assessment
Data and Monitoring	
Identify monitoring sites representative of the diversity of potentially affected water-dependent assets and the nature and scale of potential impacts, and match with suitable replicated control and reference sites (BACI design) to enable detection and monitoring of potential impacts.	10.2
Ensure water quality monitoring complies with relevant National Water Quality Management Strategy (NWQMS) guidelines (ANZG 2018) and relevant legislated state protocols (e.g. QLD Government 2013).	10.2
Identify data sources, including streamflow data, proximity to rainfall stations, data record duration and describe data methods, including whether missing data has been patched.	2.2, 2.4, 2.5.3, 6.1.1, 6.1.8, 6.1.9
Develop and describe a surface water monitoring program that will collect sufficient data to detect and identify the cause of any changes from established baseline conditions and assess the effectiveness of mitigation and management measures. The program will: • Include baseline monitoring data for physico-chemical parameters, as well as contaminants (e.g. metals). • Comparison of physico-chemical data to national/regional guidelines or to site-specific guidelines derived from reference condition monitoring if available, and, • Identify baseline contaminant concentrations and compare these to national guidelines, allowing for local background correction if required.	2.5, 10.2, Appendix A, B, C
Describe the rationale for selected monitoring parameters, duration, frequency and methods, including the use of satellite or aerial imagery to identify and monitor large-scale impacts.	2.5, 10.2
Develop and describe a plan for ongoing ecotoxicological monitoring, including direct toxicity assessment of discharges to surface waters where appropriate	2.5, 10.2
Identify dedicated sites to monitor hydrology, water quality, and channel and floodplain geomorphology throughout the life of the proposed project and beyond.	2.5, 10.2
Water-Dependant Assets	
Context and Conceptualisation	
Identify water-dependent assets, including: • Water-dependent fauna and flora and provide surveys of habitat, flora and fauna (including stygofauna) (see Doody et al. 2019). • Public health, recreation, amenity, Indigenous, tourism or agricultural values for each water resource.	3.2
Identify GDEs in accordance with the method outlined by Eamus et al. (2006). Information from the GDE Toolbox (Richardson et al. 2011) and GDE Atlas (CoA 2017a) may assist in identification of GDEs (see Doody et al. 2019]).	Groundwater Dependent Ecosystems Assessment, Stygofauna Assessment. Groundwater Modelling and Assessment
Describe the conceptualisation and rationale for likely water-dependence, impact pathways, tolerance and resilience of water-dependent assets. Examples of ecological conceptual models can be found in Commonwealth of Australia (2015).	Groundwater Dependent Ecosystem Assessment
Estimate the ecological water requirements of identified GDEs and other water-dependent assets (see Doody et al. 2019).	Groundwater Dependent Ecosystem Assessment

Information Requirement	Report Section/ Appendix or other EIS Appendix
Identify the hydrogeological units on which any identified GDEs are dependent (see Doody et al. 2019).	Groundwater Dependent Ecosystem Assessment, Groundwater Modelling and Assessment
Provide an outline of the water-dependent assets and associated environmental objectives and the modelling approach to assess impacts to the assets.	2.6, 3.2, 3.3, 6
Describe the process employed to determine water quality and quantity triggers and impact thresholds for water-dependent assets (e.g. threshold at which a significant impact on an asset may occur).	3.3, 3.1.5, 2.8.5
Impacts, Risk Assessment and Management of Risks	
Provide an assessment of direct and indirect impacts on water-dependent assets, including ecological assets such as flora and fauna dependent on surface water and groundwater, springs and other GDEs (see Doody et al. 2019).	7.3, 8 Groundwater Dependent Ecosystem Assessment, Terrestrial Ecology Assessment, Aquatic Ecology Assessment, Stygofauna Assessment
Describe the potential range of drawdown at each affected bore, and clearly articulate of the scale of impacts to other water users.	Groundwater Modelling and Assessment
Indicate the vulnerability to contamination (e.g. from salt production and salinity) and the likely impacts of contamination on the identified water-dependent assets and ecological processes.	Groundwater Dependent Ecosystem Assessment, Terrestrial Ecology Assessment, Aquatic Ecology Assessment, Stygofauna Assessment
Identify and consider landscape modifications (e.g. voids, on-site earthworks, and roadway and pipeline networks) and their potential effects on surface water flow, erosion and habitat fragmentation of water-dependent species and communities.	8.10 Flood Impact Assessment
Provide estimates of the volume, beneficial uses and impact of operational discharges of water (particularly saline water), including potential emergency discharges due to unusual events, on water-dependent assets and ecological processes.	8.3, 8.4, 8.10, 8.14
Assess the overall level of risk to water-dependent assets through combining probability of occurrence with severity of impact.	8.14 Groundwater Dependent Ecosystem Assessment, Stygofauna Assessment
Identify the proposed acceptable level of impact for each water-dependent asset based on leading-practice science and site-specific data, and ideally developed in conjunction with stakeholders.	3.3 and Groundwater Dependent Ecosystem Assessment
Propose mitigation actions for each identified impact, including a description of the adequacy of the proposed measures and how these will be assessed.	10, 10.2
Data and Monitoring	
Identify an appropriate sampling frequency and spatial coverage of monitoring sites to establish pre-development (baseline) conditions and test potential responses to impacts of the proposal (see Doody et al. 2019).	2.5.1, 10.2
Consider concurrent baseline monitoring from unimpacted control and reference sites to distinguish impacts from background variation in the region (e.g. BACI design, see Doody et al. 2019).	2.5.1, 10.2
Develop and describe a monitoring program that identifies impacts, evaluates the effectiveness of impact prevention or mitigation strategies, measures trends in ecological responses and detects whether ecological responses are within identified thresholds of acceptable change (see Doody et al. 2019).	Groundwater Modelling and Assessment, Groundwater Dependent Ecosystem

Information Requirement	Report Section/ Appendix or other EIS Appendix
	Assessment, Terrestrial Ecology Assessment and EIS Main Text
Describe the proposed process for regular reporting, review and revisions to the monitoring program.	EIS Main Text
Ensure ecological monitoring complies with relevant state or national monitoring guidelines (e.g. the DSITI guideline for sampling stygofauna (QLD Government 2015)).	Groundwater Dependent Ecosystem Assessment, Stygofauna Assessment, Terrestrial Ecology Assessment, Aquatic Ecology Assessment
Water and Salt Balance, and Water Quality	
Provide a quantitative site water balance model describing the total water supply and demand under a range of rainfall conditions and allocation of water for mining activities (e.g. dust suppression, coal washing etc.), including all sources and uses.	5.4, 6.2
Describe the water requirements and on-site water management infrastructure, including modelling to demonstrate adequacy under a range of potential climatic conditions.	5.3, 5.4, 6.2
Provide estimates of the quality and quantity of operational discharges under dry, median and wet conditions, potential emergency discharges due to unusual events and the likely impacts on water-dependent assets.	6.2.2, 6.2.3, 6.2.4
Provide salt balance modelling that includes stores and the movement of salt between stores and takes into account seasonal and long-term variation.	6
Cumulative Impacts	
Context and Conceptualisation	
Provide cumulative impact analysis with sufficient geographic and temporal boundaries to include all potentially significant water-related impacts.	7.3, 7.4, 7.5, 8.14
Consider all past, present and reasonably foreseeable actions, including development proposals, programs and policies that are likely to impact on the water resources of concern in the cumulative impact analysis. Where a proposed project is located within the area of a bioregional assessment consider the results of the bioregional assessment.	7.3, 7.4, 7.5, 8.14
Impacts	
Provide an assessment of the condition of affected water resources which includes: • Identification of all water resources likely to be cumulatively impacted by the proposed development. • A description of the current condition and quality of water resources and information on condition trends. • Identification of ecological characteristics, processes, conditions, trends and values of water resources. • Adequate water and salt balances, and • Identification of potential thresholds for each water resource and its likely response to change and capacity to withstand adverse impacts (e.g., altered water quality, drawdown).	2.6, 2.7, 2.8, 3.2, 3.3, 3.3, 6
Assess the cumulative impacts to water resources considering: • The full extent of potential impacts from the proposed project, (including whether there are alternative options for infrastructure and mine configurations which could reduce impacts), and encompassing all linkages, including both direct and indirect links, operating upstream, downstream, vertically and laterally. • All stages of the development, including exploration, operations and post closure/decommissioning. • Appropriately robust, repeatable and transparent methods. • The likely spatial magnitude and timeframe over which impacts will occur, and significance of cumulative impacts; and opportunities to work with other water users to avoid, minimise or mitigate potential cumulative impacts.	7.3, 7.4, 7.5, 8.14

Information Requirement	Report Section/ Appendix or other EIS Appendix
Mitigation, Monitoring and Management	
Identify modifications or alternatives to avoid, minimise or mitigate potential cumulative impacts. Evidence of the likely success of these measures (e.g., case studies) should be provided.	10, Flood Impact Assessment
Identify measures to detect and monitor cumulative impacts, pre and post development, and assess the success of mitigation strategies.	2.5.1, 10.1, 10.2
Identify cumulative impact environmental objectives.	3.3, 2.8.5
Describe appropriate reporting mechanisms.	10.1, 10.2
Propose adaptive management measures and management responses.	10.1, 10.2
Final Landform and Voids – Coal Mines	
Identify and consider landscape modifications (e.g., voids, on-site earthworks, and roadway and pipeline networks) and their potential effects on surface water flow, erosion, sedimentation and habitat fragmentation of water-dependent species and communities.	Flood Impact Assessment Report
Assess the adequacy of modelling, including surface water and groundwater quantity and quality, lake behaviour, timeframes and calibration.	Surface Water Impact Assessment Peer Review
Provide an evaluation of stability of void slopes where failure during extreme events or over the long term (for example due to aquifer recovery causing geological heave and landform failure) may have implications for water quality.	Rehabilitation section in the EIS Main Text
Evaluate mitigating inflows of saline groundwater by planning for partial backfilling of final voids.	6.3.3, Groundwater Modelling and Assessment
Provide an assessment of the long-term impacts to water resources and water-dependent assets posed by various options for the final landform design, including complete or partial backfilling of mining voids. Assessment of the final landform for which approval is being sought should consider: • Groundwater behaviour - sink or lateral flow from void. • Water level recovery - rate, depth, and stabilisation point (e.g., timeframe and level in relation to existing groundwater level, surface elevation). • Seepage - geochemistry and potential impacts. • Long-term water quality, including salinity, pH, metals and toxicity. • Measures to prevent migration of void water off-site. For other final landform options considered sufficient detail of potential impacts should be provided to clearly justify the proposed option.	6.3.4 and Groundwater Modelling and Assessment
Assess the probability of overtopping of final voids with variable climate extremes, and management mitigations.	6.3.4
Acid-forming Materials and Other Contaminants of Concern	
Identify the presence and potential exposure of acid-sulphate soils (including oxidation from groundwater drawdown).	Geochemical Assessment
Identify the presence and volume of potentially acid-forming waste rock, fine-grained amorphous sulphide minerals and coal reject/tailings material and exposure pathways.	Geochemical Assessment
Identify other sources of contaminants, such as high metal concentrations in groundwater, leachate generation potential and seepage paths.	Geochemical Assessment
Describe handling and storage plans for acid-forming material (co-disposal, tailings dam, and encapsulation).	Geochemical Assessment

Information Requirement	Report Section/ Appendix or other EIS Appendix
Assess the potential impact to water-dependent assets, taking into account dilution factors, and including solute transport modelling where relevant, representative and statistically valid sampling, and appropriate analytical techniques.	Geochemical Assessment
Describe proposed measures to prevent/minimise impacts on water resources, water users and water-dependent ecosystems and species.	Geochemical Assessment

2. RECEIVING ENVIRONMENT

2.1 Catchment Overview

2.1.1 Regional Catchment

The Project is located in Central Queensland within the Fitzroy Basin (see Figure 2.1) which is a sub-basin of the greater Northeast Coast Basin. The Fitzroy Basin has a total catchment of 142,900 km2 with the main tributary rivers being the Mackenzie River, Isaac River, Dawson River and Comet River. The Fitzroy River discharges into the Coral Sea, southeast of Rockhampton. The Fitzroy Basin catchment and its sub-catchments are presented in Figure 2.2.

2.1.2 Local Catchment/s

The Project is located near the confluence of Banana Creek and the Dawson River (Figure 2.1). The Dawson River is one of the major tributaries to the Fitzroy River. The Dawson River sub-basin total catchment area is 50,800 km2 and makes up 35% of the Fitzroy Basin catchment. The Dawson River headwaters are within the Carnarvon Range and the river flows typically in a north easterly direction. Approximately 35 km downstream of the Project, the Don River flows into the Dawson River. The Don River catchment area is approximately 25% of the Dawson River catchment area at the confluence.

Banana Creek is a 5th order watercourse which flows in a north-westerly direction from south of the Banana township towards the Project. Banana Creek flows into the Dawson River to the west of the MLA. The western and northern MLA boundaries lie roughly parallel to Banana Creek and the Dawson River respectively (see Figure 2.1). At the nearest point, the MLA is within 700 m of the Dawson River channel and 500 m from the Banana Creek channel and a proportion of the site lies within the natural floodplain.

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1	Final Issue	22-09-2023

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BARALABA SOUTH

Figure 2.1

BARALABA SOUTH PTY LTD
Baralaba South Surface Water Impact Assessment
Regional Context

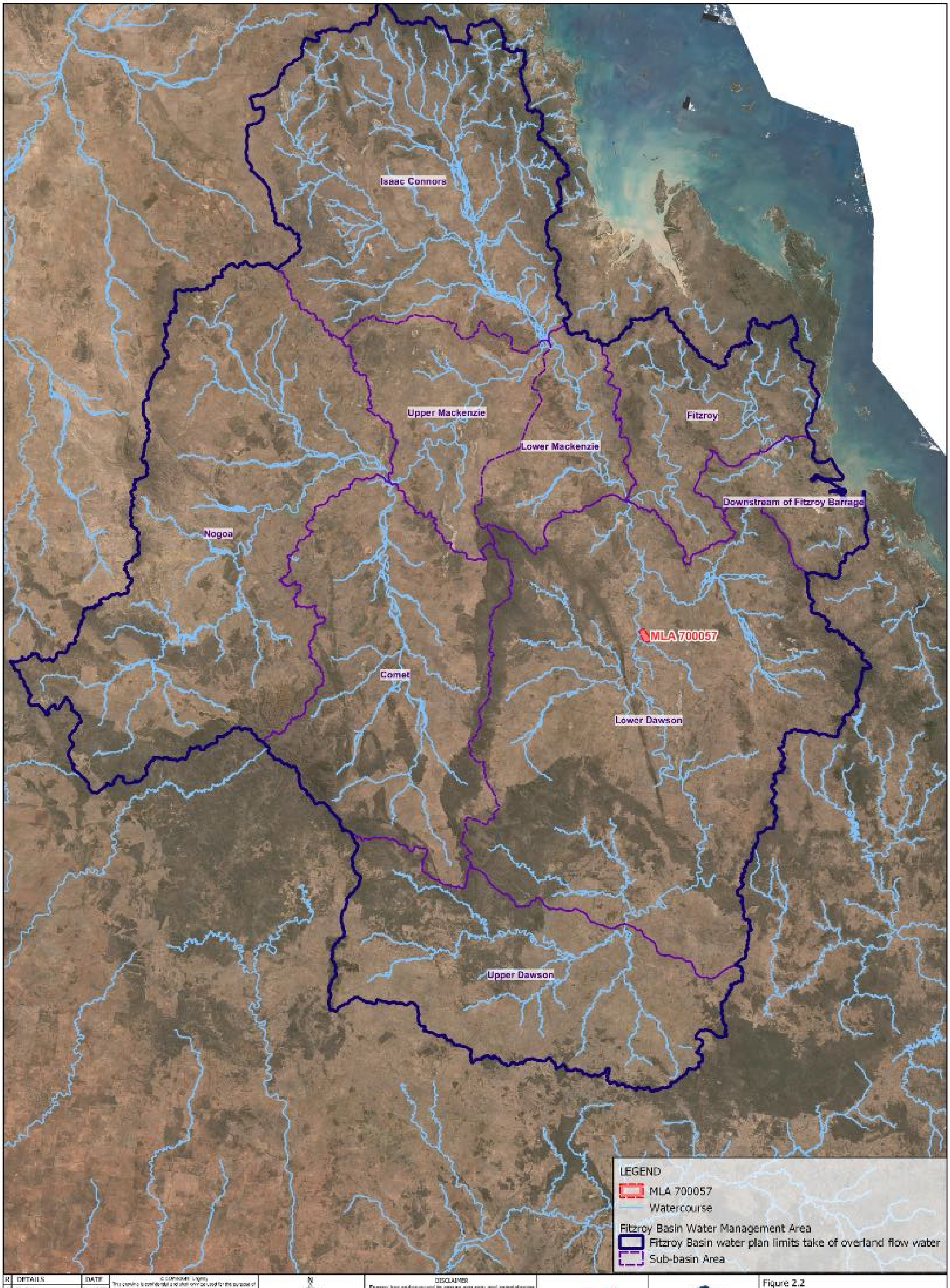

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Figure 2.2

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Baralaba South Surface Water Impact Assessment
Regional Catchments

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QC1018_004

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2.2 Climate

The regional climate of the area can be described as sub-tropical with wet season dominated rainfall and mild, dry winter months. Rainfall is highly seasonal and is typically associated with thunderstorm and cyclone weather patterns.

A summary of the rainfall gauges operated by the Bureau of Meteorology (BoM) as well as gauges associated with the Department of Resources (DoR) streamflow monitoring station within 20 km of the site and Baralaba North mine site rainfall gauge are summarised in Table 2.1. Typical rainfall and evaporation rates for Baralaba are presented in Figure 2.3 to Figure 2.5. For the purposes of this report, data from the Baralaba Post Office (1926-2013) and Belvedere (post-2013) BoM rainfall gauging stations and SILO Data Drill (prior to 1926) were used to represent the historical rainfall data set for the Project.

Monthly pan evaporation data, presented in Figure 2.4, was adopted from the SILO Data Drill at the location of the Project (DES, 2023b). The SILO Data Drill is a derived data set from a combination of interpolated recorded data between weather stations and derived long-term average values. Due to poor distribution of evaporation monitoring stations near the Project, the interpolated evaporation data at the location of the Project may be inaccurate. Therefore, the long-term pan evaporation derived from the SILO Data Drill has been compared against the average monthly recorded data from Brigalow Research Station (35149) (nearest station available) to validate the SILO data. The long-term average pan evaporation data from the SILO Data Drill matches well with the data recorded at the Brigalow Research Station from the period 1968 to 2010.

TABLE 2.1: NEARBY RAINFALL GAUGING STATIONS

Source	Proximity to Site	Data Range
Belvedere (039201)	7.9 km	1938-2019
Baralaba Post Office (039004)	9.2 km	1926-2013
Baralaba (039143)	9.3 km	1966-2010
Bindaree (039166)	14.1 km	2003
Lloyona (039332)	17.1 km	1994-2019
Baralaba North Mine	10 km	2013-2019

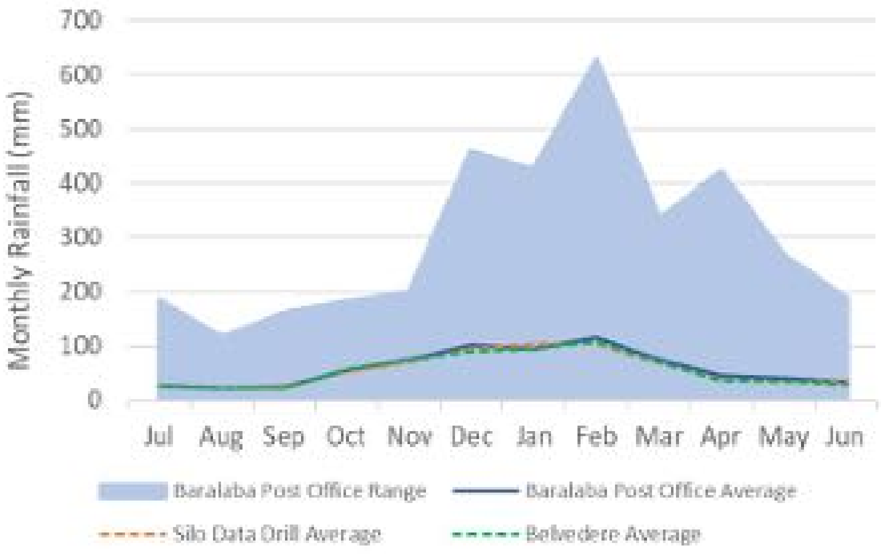

Figure 2.3: Baralaba Post Office Monthly Rainfall (Range and Mean)

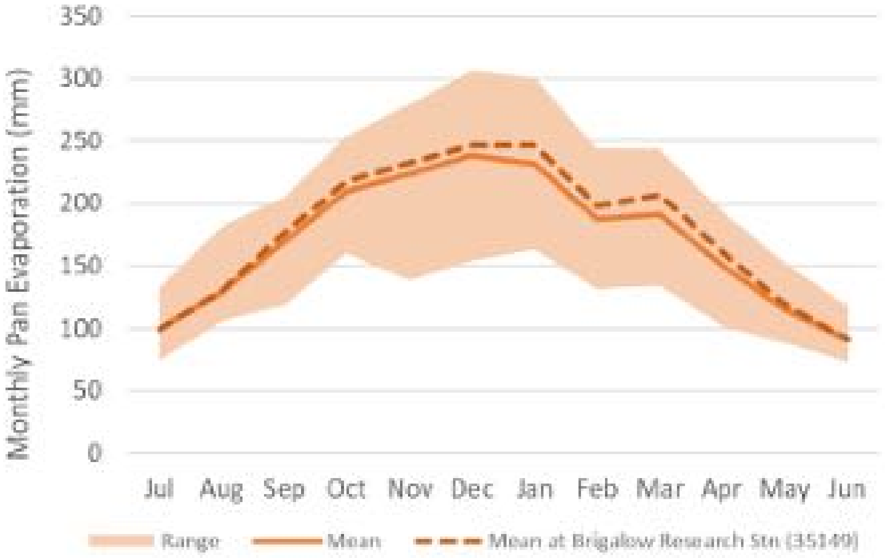

Figure 2.4: Monthly Evaporation

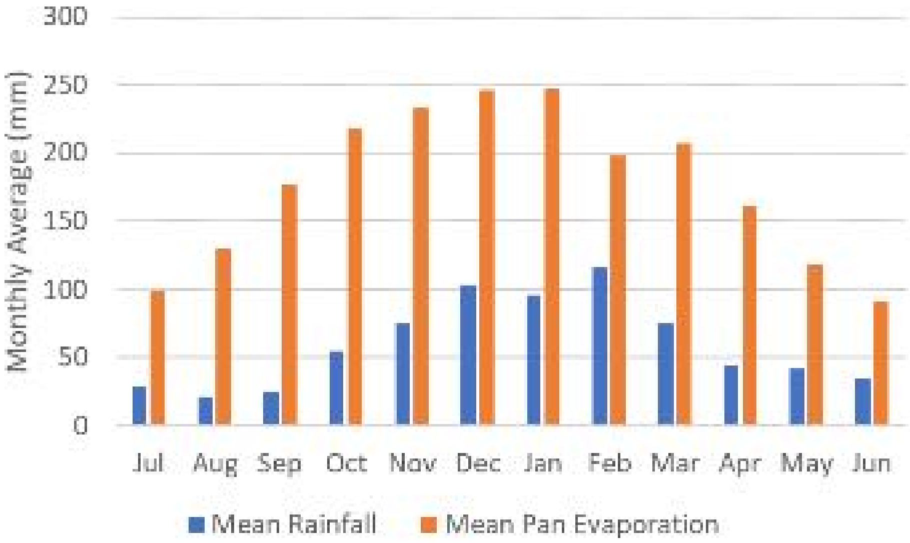

Figure 2.5: Monthly Mean Rainfall and Evaporation

2.3 Existing Waterways

The Project is partly located within the floodplain of the Dawson River, to the east of the confluence of Banana Creek and the Dawson River and the Dawson River channel. The following sections describe the existing waterways in the vicinity of the Project MLA.

2.3.1 Dawson River

The Dawson River is defined as a watercourse under the Water Act 2000 and is the largest watercourse in the vicinity of the Project with a catchment of approximately 40,500 km^2 at the Baralaba township. The Dawson River is a perennial watercourse subject to seasonal flooding. The Dawson River flows in a generally northern direction with its headwaters as far inland as Injune and joins the Don River downstream of Baralaba township and the Fitzroy River downstream of Duaringa as depicted in Figure 2.6.

At the Project location, the Dawson River main channel is approximately 150 m wide and 10 m deep and is bordered by a floodplain extending between 1.5-3 km on either side of the river channel. The Dawson River has a number of anabranch channels both upstream and downstream of the Project indicating it is reasonably laterally active (AECOM, 2016).

The Dawson River main channel lies within approximately 700 m of the MLA at its nearest point immediately downstream of the confluence with Banana Creek (refer Section 2.3.2). An anabranch of the Dawson River, to the north-west of the Project, flows within approximately 400 m of the MLA boundary. The Dawson River proximity to the Project is shown in Figure 2.6.

The Dawson River flows relatively consistently throughout the year as it receives inflow from groundwater sources along the length of the river. Mean daily and annual flow volumes in the Dawson River are approximately 2,790 ML and 1,020 GL, respectively. The Dawson River typically experiences significant seasonal variations in high flows with flooding typically occurring during the wet season (November to April).

Water resources are managed in the lower reaches of the Dawson River via a series of instream water supply storages. The nearest upstream and downstream storages are the Moura Weir (approximately 40 km upstream of the Project) and the Neville Hewitt Weir near Baralaba (approximately 8 km downstream of the Project). Entitlements for water extraction from the Dawson River are managed through the Dawson Valley Water Supply Scheme and the Water Plan (Fitzroy Basin) 2011.

Figure 2.6: Fitzroy Basin (Water Plan (Fitzroy Basin) 2011)

2.3.2 Banana Creek

Banana Creek is defined as a watercourse under the Water Act 2000 and is the second largest watercourse in the vicinity of the Project with a catchment area of approximately 1,000 km^2 at its confluence with the Dawson River. Banana Creek is an ephemeral 5th order tributary of the Dawson River. Banana Creek flows into the Dawson River approximately 1 km west of the Project MLA. The Project MLA boundary is 500m from Banana Creek at the closest point and the south-western MLA boundary is parallel to the creek alignment with an offset of generally 2 km.

Banana Creek is an ungauged watercourse. It is an ephemeral system flowing only in response to large rainfall events typically during the wet season (November to April). Banana Creek flows in a north westerly direction to its confluence with the Dawson River at Adopted Middle Threat Distance (AMTD) 97.2 km. Banana Creek in the vicinity of the Project has an approximately 120 m wide 10 m deep main channel, bordered by a floodplain extending approximately 1 km on either side of the main channel. Flooding of Banana Creek in the vicinity of the Project is heavily influenced by flooding in the Dawson River due to the magnitude of flood flows in the Dawson River and the proximity of the Project to the confluence of the two watercourses. Banana Creek is shown in Figure 2.7.

2.3.3 Unnamed Waterways

There are unnamed waterways of 1st, 2nd and 3rd stream order within the boundaries of the MLA. These waterways have not been subject to a watercourse determination under the Water Act 2000. All such waterways are tributaries to the Dawson River and combine into a 3rd order drainage feature at the northern end of the MLA before flowing into an anabranch of the Dawson River. The unnamed waterway catchments extend from Mount Ramsay to the east and to the Dawson River to the west. The 1st order drainage features flowing through the MLA area have catchment areas ranging from under 100 ha to as large as 1,300 ha. Flow paths are not well defined with no clear channel bed or bank features. The total area of the unnamed waterways where the 3rd order drainage feature intersects the MLA has a catchment area of approximately 5,000 ha and a channel width of around 30 m. All of the minor waterways in the vicinity of the MLA are ephemeral and flow only in response to rainfall for short durations. The unnamed waterways are shown in Figure 2.7.

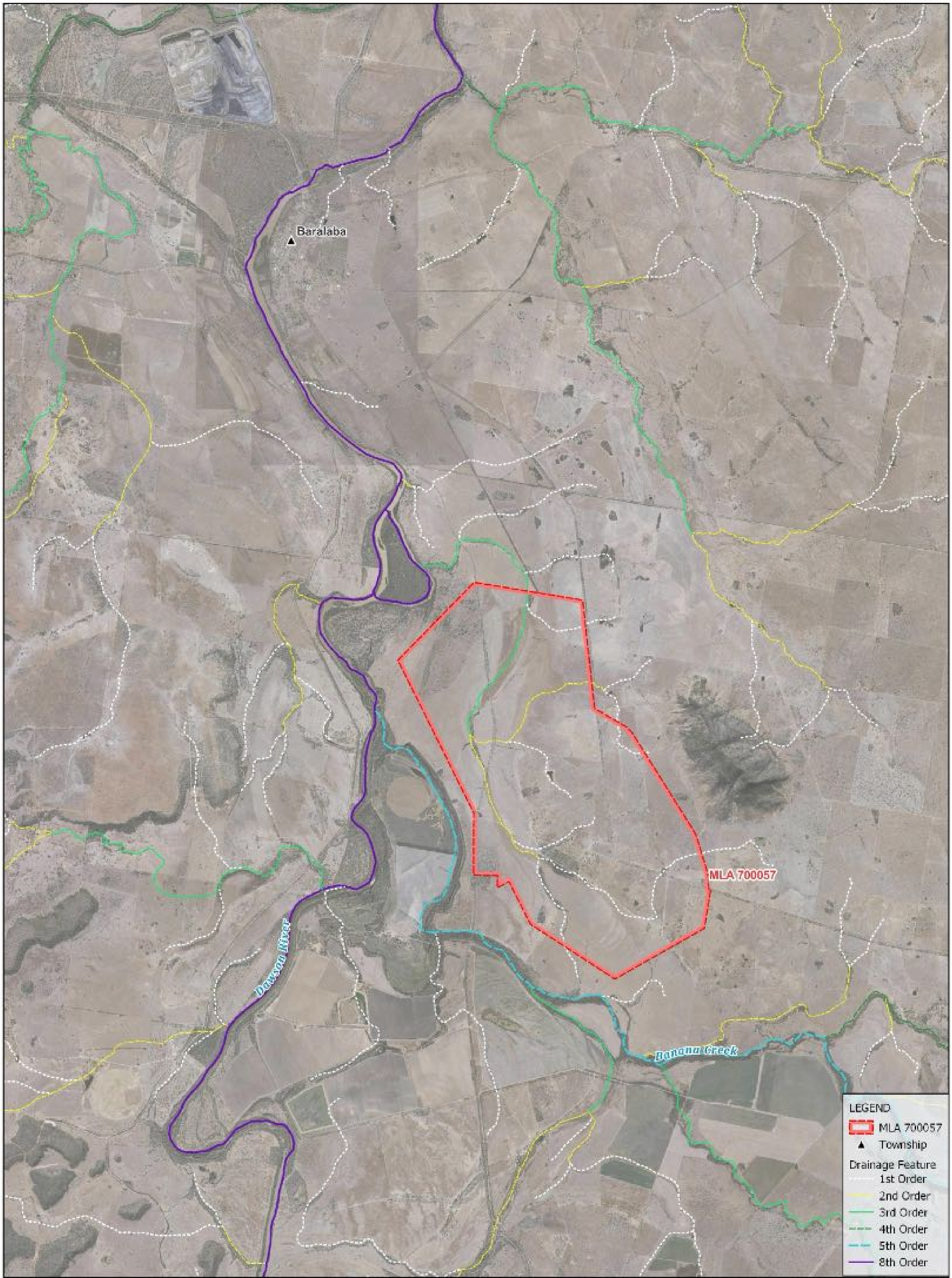

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Figure 2.7

BARALABA SOUTH PTY LTD
Baralaba South Surface Water Impact Assessment
Drainage Features

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QE2018_004

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2.4 Streamflow Monitoring

There are a number of DRDMW operated streamflow gauging stations located within 100 km of the Project on the Dawson River (DRDMW, 2025). These stations are summarised in Table 2.2 and Figure 2.9.

The nearest flow gauges are Dawson River at Bindaree (130374A) upstream of the MLA and Dawson River at Beckers (130322A) downstream of the MLA. Flow duration curves for these gauging stations are shown on Table 2.2. Streamflow duration characteristics are similar between the Bindaree gauging station and the Beckers gauging station.

TABLE 2.2: DRDMW STREAMFLOW GAUGES ON DAWSON RIVER

Station	Proximity to Site	Data Range	AMTD[1]
130374A Dawson River at Bindaree	9 km south (U/S)	2005-Present (13 years)	110.5 km
130317B Dawson River at Woodleigh	61 km south (U/S)	1985-Present (33 years)	193.6 km
130317A Dawson River at Woodleigh (Closed)	61 km south (U/S)	1957-1985 (28 years)	193.6 km
130322A Dawson River at Beckers	16 km north (D/S)	1964-Present (54 years)	71.0 km
130304A Dawson River at Baralaba (Closed)	8 km north (D/S)	1924-1961 (37 years)	84.7 km

[1] *Adopted Middle Thread Distance (AMTD).*

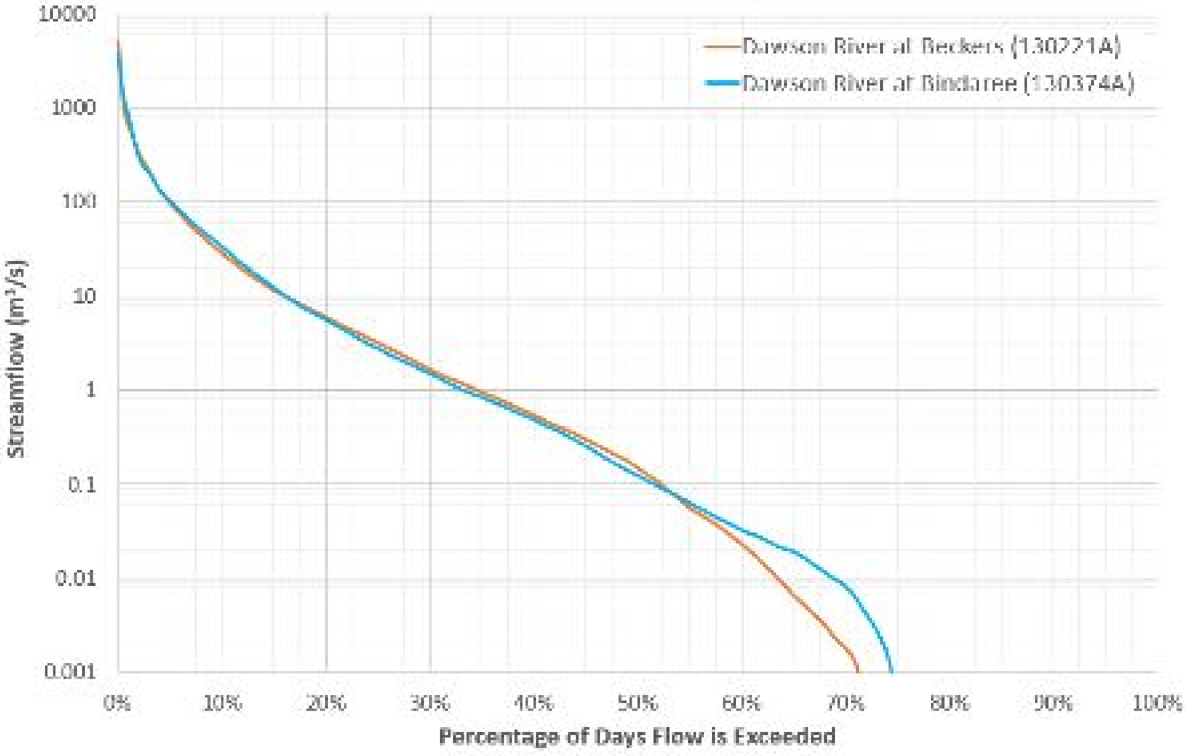
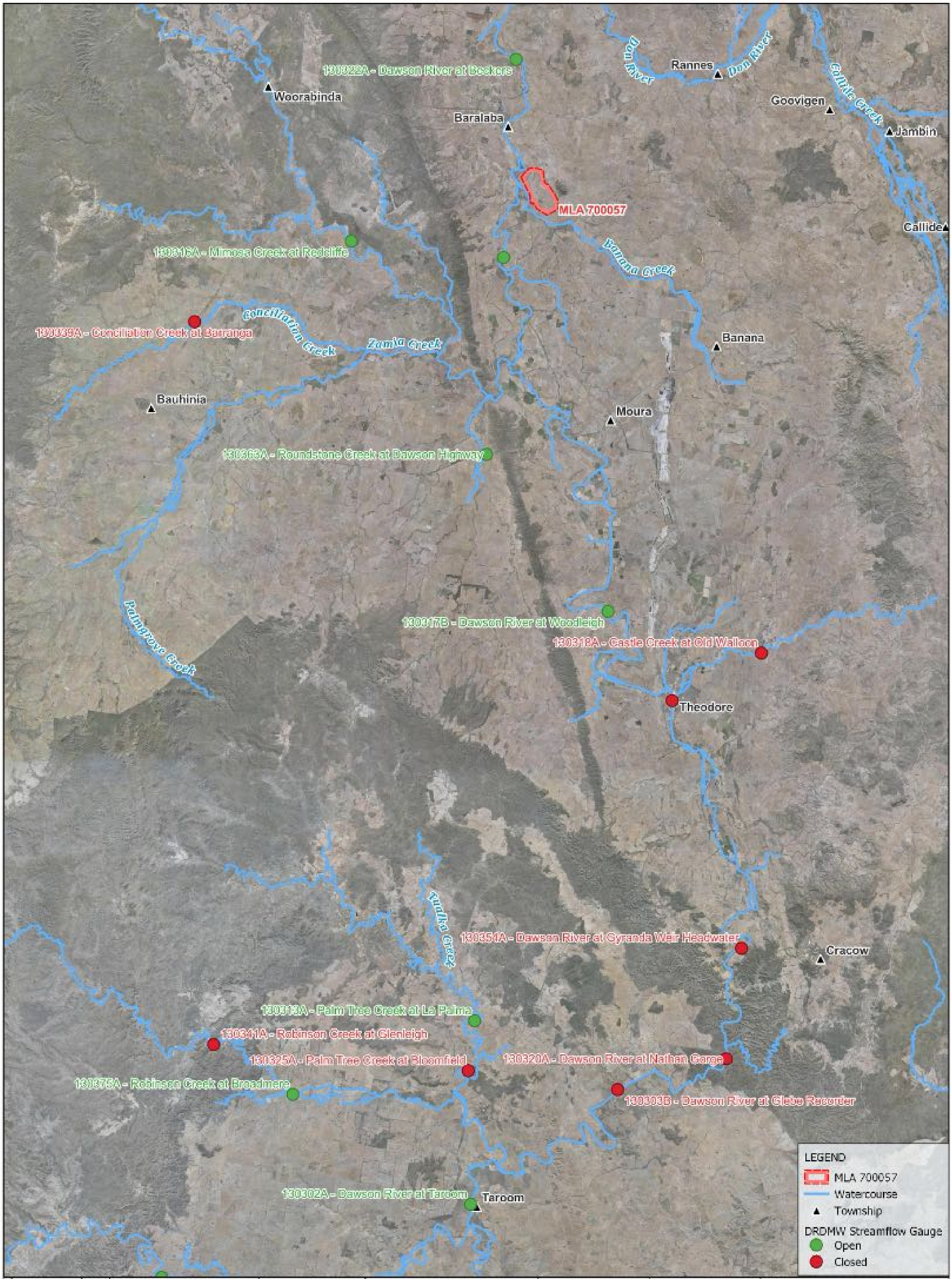


Figure 2.8: **Dawson River at Beckers (130322a) And Dawson River at Bindaree (130374a) Flow Duration Curves**



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BARALABA SOUTH

Figure 2.9

BARALABA SOUTH PTY LTD
Baralaba South Surface Water Impact Assessment
Streamflow Gauging

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2.5 Water Quality

The following sections outline the baseline surface water monitoring program and the existing water quality data available to inform the surface water assessment of the Project.

2.5.1 Baseline Surface Water Monitoring Program

A baseline surface water monitoring program has been developed for the Project in accordance with the Queensland Water Quality Guidelines (QWQG) (DEHP, 2009) and National Water Quality Management Strategy (NWQMS) Guideline (ANZG, 2018) to supplement existing surface water quality data collected at the Dawson River at Beckers monitoring station (DRDMW station) and by the Baralaba North Mine.

One objective of the baseline surface water monitoring program is to ensure collection of a suitable quantity and scope of baseline water quality data, that it is representative of the local receiving environment.

To achieve this, the QWQG recommends that a number of minimum monitoring program requirements are met before statistical analysis is undertaken to determine the representative background water quality:

- Minimum of three reference (background) sites.
- Minimum of 12 samples from each reference site.
- Minimum timeframe of 12-24 months of data collection from each reference site.

These requirements attempt to ensure that both spatial and temporal variation are captured within the water quality data sample set. The baseline surface water monitoring program has been developed such that the sample locations, frequencies and parameters align with the QWQG requirements.

Reference sites for physico-chemical indicators were selected in accordance with QWQG (DEHP, 2009). Reference sites have been selected based on analysis of aerial imagery and topography of the site and its surrounding waterways and with consideration of the:

- Practicality of access to each location; and
- QWQG definition and reference site criteria: *A reference site is a site whose condition is considered to be a suitable baseline or benchmark for assessment and management of sites in similar water bodies (DEHP, 2009).*

It should be noted that due to agricultural influences within the MLA, not all QWQG criteria for reference sites could be met, however, as the intent is to obtain data that is representative of the existing local environment, these locations are considered suitable to obtain a diverse and representative dataset. Each location was assessed to best achieve the QWQG criteria for reference sites.

Currently 16 samples have been completed over a period of 4 year for the baseline surface water quality monitoring program. The samples collected only slightly exceed the minimum sample quantity requirements of QWQG and were collected over a discontinuous period, so analysis of local water quality parameters and/or development of Water Quality Objectives (WQO) has been assessed from other sources (Refer to Section 2.5.2, 2.5.3 and 3.3). Sampling will continue to allow development of site-specific water quality objectives.

Some baseline monitoring sites will no longer be considered reference sites once disturbance from the Project commences. It is expected that these sites will then be used to assess the potential ongoing impact the Project has on the receiving waterways (Refer to Section 10.2).

The baseline water quality monitoring locations are listed in Table 2.3 and shown on Figure 2.10. A summary of water quality data captured at the baseline monitoring sites, compared to default guideline values for water quality objectives is provided in Appendix A.

TABLE 2.3: BASELINE WATER QUALITY MONITORING LOCATIONS

Monitoring Location (ID)	Easting (GDA94)	Northing (GDA94)
U/S Banana Creek	149.897	-24.3091
U/S Dawson River	149.794	-24.3254
MP1 Banana Creek	149.844	-24.2763
D/S Dawson River	149.819	-24.2081
Dawson River at Baralaba - DR1 (BNCOP SWMP)	149.805	-24.1825
Dawson River at Beckers	149.822	-24.0873

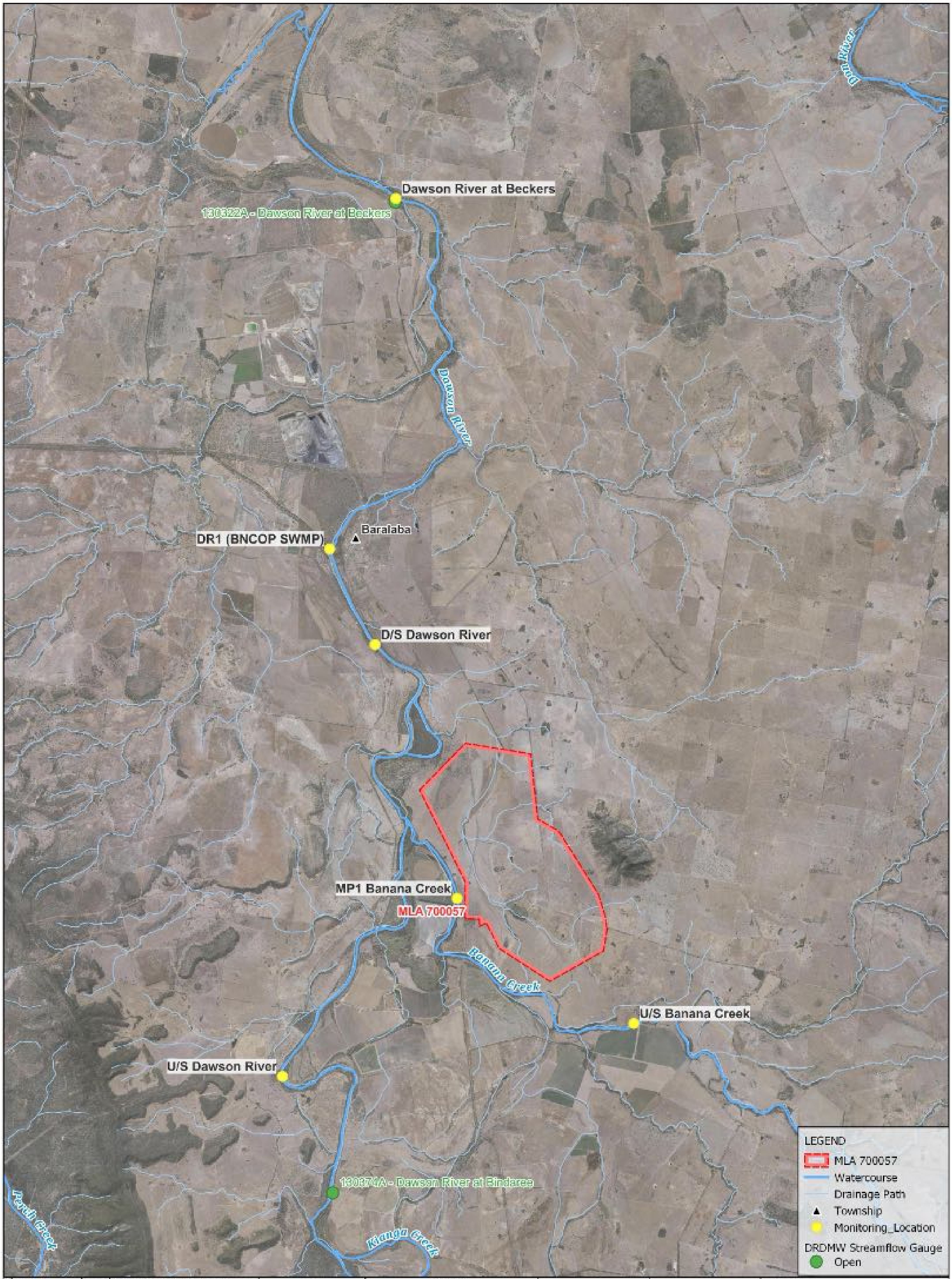

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Figure 2.10

BARALABA SOUTH PTY LTD
Baralaba South Surface Water Impact Assessment
Baseline Water Quality Monitoring Locations

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2.5.1.1 Water Quality Indicators

As part of the monitoring program development, relevant physico-chemical, biological and toxicant indicators were defined for the Project and are outlined in Table 2.4. These indicators were developed based on identified water quality objectives for the receiving waterways (Section 3.3), expected contaminants to be produced from the operation (based on Baralaba North water quality data and Environmental Authority [Refer to Section 4]) and the model mining conditions (DES, 2017).

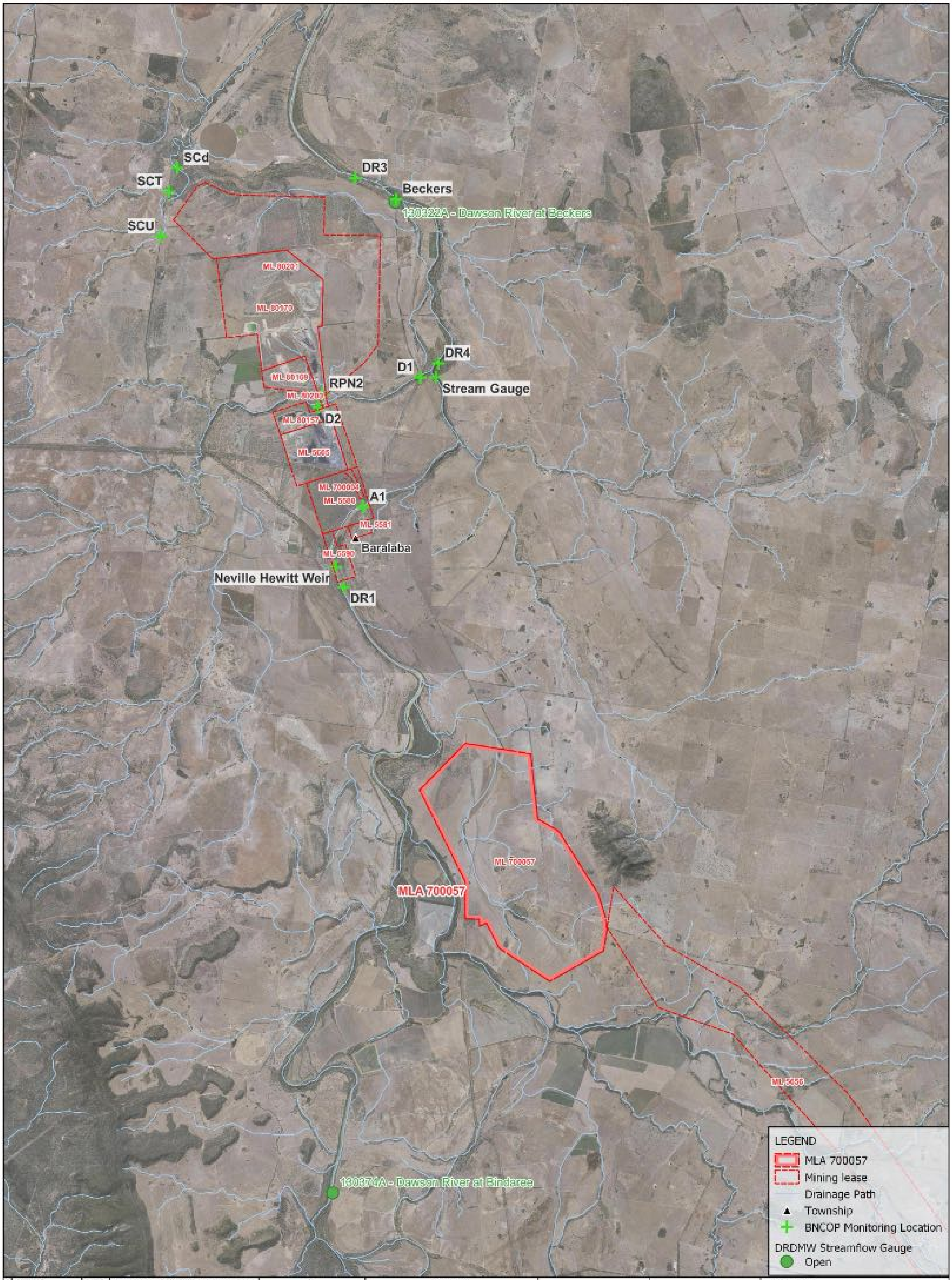
TABLE 2.4: WATER QUALITY INDICATORS

Monitoring Category	Indicator
Physico-chemical	pH Salinity (Electrical Conductivity, Total Dissolved Solids) Turbidity Sulphate Dissolved Oxygen Total Suspended Solids Colour
Biological	Chlorophyll Cryptosporidium Blue-green Algae Algal toxin
Toxicant	Metals and Metalloids (As, Al, Ag, B, Ba, Be, Cd, Co, Cr, Cu, F, Fe, Hg, Li, Mo, Mg, P, Pb, Pd, Ni, Se, U, V, Zn) Fluoride Sodium Carbonate, Hardness Nitrogen (Ammonia, Nitrate/Nitrite, Total Organic Nitrogen) Total Recoverable Hydrocarbons and Total Petroleum Hydrocarbons

2.5.2 Baralaba North Mine Water Quality Monitoring Program

A baseline water quality monitoring program was undertaken as part of the EIS process for the Baralaba North Continued Operations Project (BNCOP). The Baralaba North Mine is approximately 10 km north of the Project. Data from the Baralaba North Mine water quality monitoring program has been cross checked when defining the WQO for the Project (Refer to Section 3.3).

The locations of the Baralaba North Mine water quality monitoring points are provided in Figure 2.11. The data collected through the program is available in Appendix B. The data collected through this program was predominantly taken between 2011 and 2013 with limited sampling back to 2009 (WRM, 2014).



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ENGENY

BARALABA SOUTH

Figure 2.11

BARALABA SOUTH PTY LTD
Baralaba South Surface Water Impact Assessment
Baralaba North Water Quality Monitoring Points (WRM, 2014)

Job Number:
QL1018_004

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2.5.3 DRDMW Water Quality Monitoring

Water quality in the Dawson River has been monitored at streamflow gauging station 130322A (Dawson River at Beckers) since 1993 (DRDMW, 2025). Telemetric monitoring of electrical conductivity (EC) and streamflow produces daily readings which are presented in Figure 2.12. The data shows the streamflow EC is fairly constant during medium flows (150 µS/cm to 250 µS/cm) however increases as the Dawson River returns to baseflow following large flow events as shown in 1998, 2011 and 2013.

Section 6.1.10 provides an analysis of daily streamflow and electrical conductivity for the Dawson River at Beckers gauging station for the purpose of developing a Flow vs EC relationship for the water balance model.

Laboratory analysis of water samples collected periodically since 1964 at the gauging station location has also been completed. Water quality data of samples collected at the Dawson River at Beckers gauging station (130322A) is provided in Appendix C.

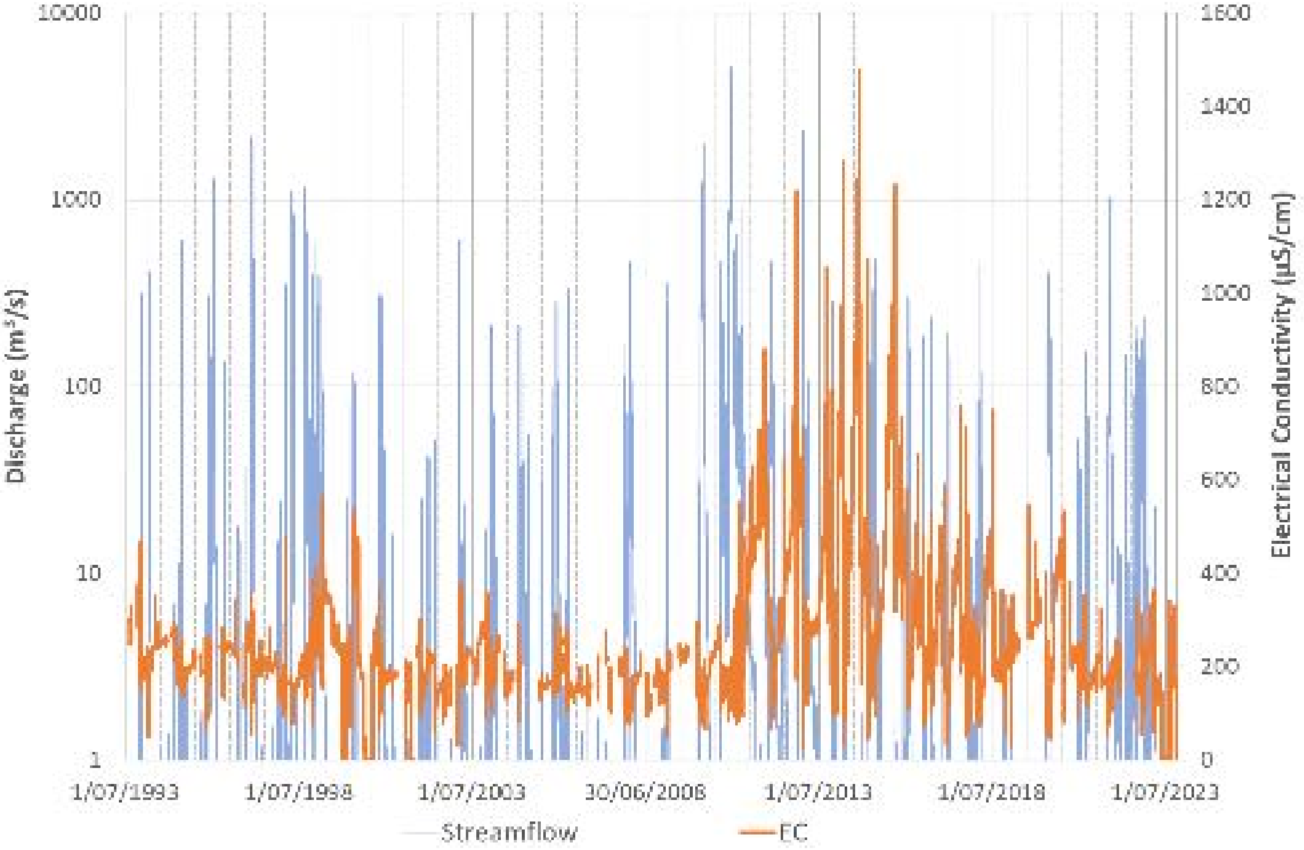

Figure 2.12: DRDMW Station 130322a (Dawson River At Beckers) Streamflow and Water Quality Timeseries

2.6 Wetlands

The Map of Queensland wetland environmental values are a state-wide statutory map under the Environmental Protection (Water and Wetland Biodiversity) Policy 2019. It identifies wetlands of high ecological significance (HES) and general ecological significance (GES) across the state.

Matters of State Environmental Significance (MSES) high ecological significance wetlands and general ecological significance wetlands and Vegetation Management Wetlands are mapped in the locality of the Project (Figure 2.13 and Figure 2.14).

A MSES high ecological significance wetland/Vegetation Management Wetland approximately 35 ha in area is located near the south-western boundary of the MLA. Two wetlands of general ecological significance (GES) were also identified within the MLA boundary, one of which is also classified as a Vegetation Management Wetland.

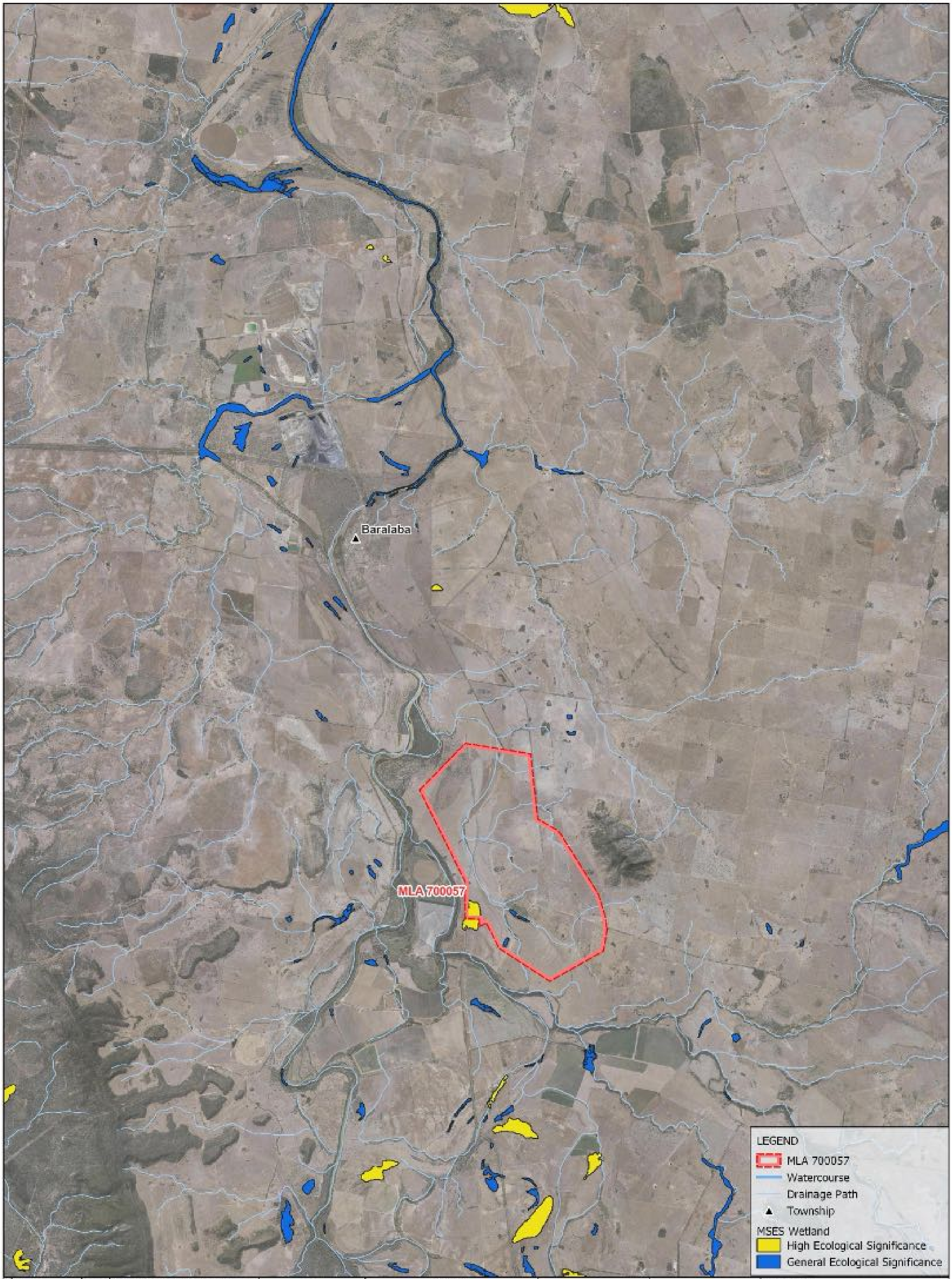

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Figure 2.13

BARALABA SOUTH PTY LTD
Baralaba South Surface Water Impact Assessment
MSES Wetlands

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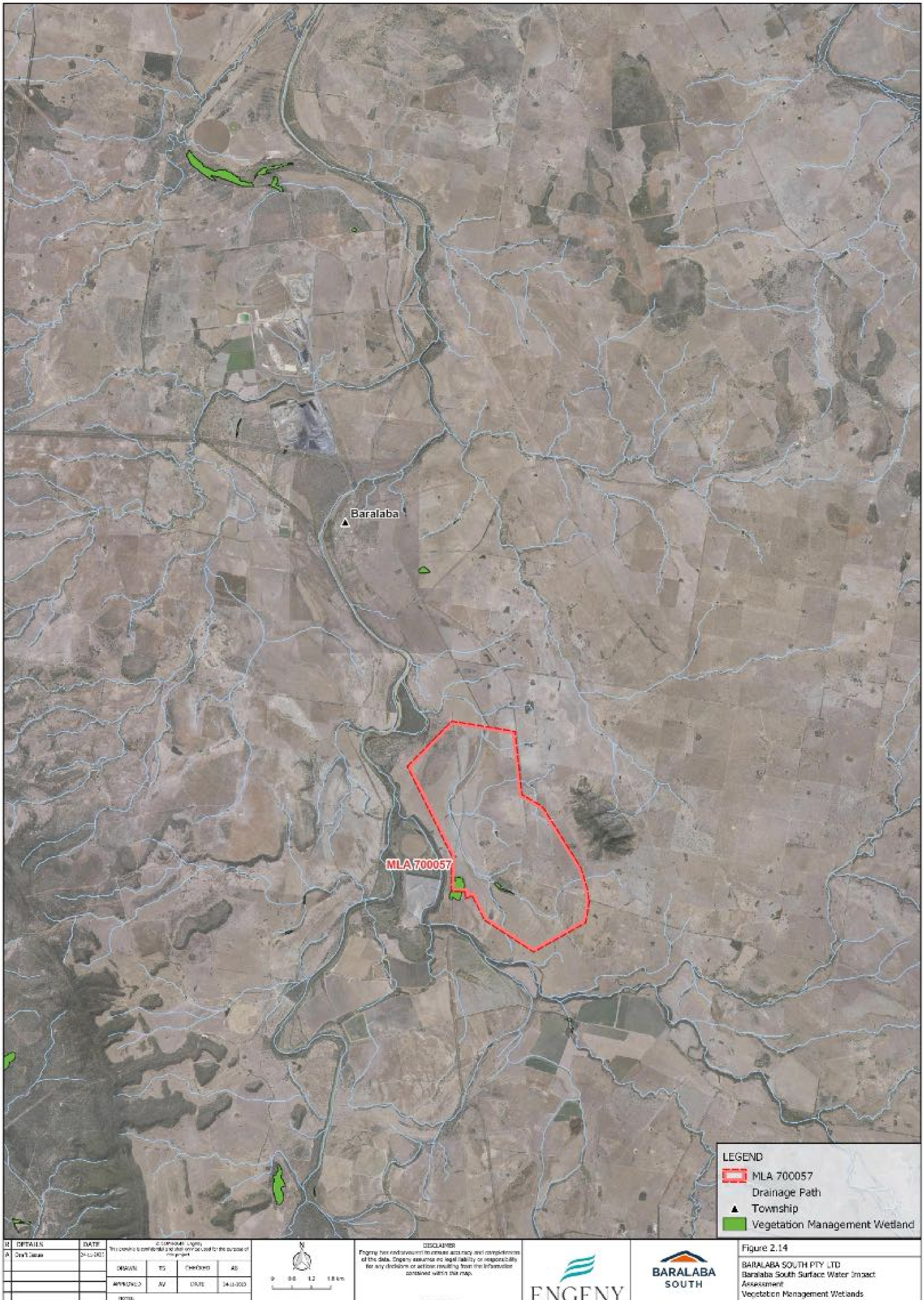

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BARALABA SOUTH

Figure 2.14

BARALABA SOUTH PTY LTD
Baralaba South Surface Water Impact Assessment
Vegetation Management Wetlands

Job Number:
Q1308_004

2.7 Land Use

The Government's indicative land use mapping (Queensland Globe) of the Project MLA maps the land use for the majority of the MLA as "grazing native vegetation". The surrounding area is also dominated by "grazing native vegetation" mapped land use. There are areas of "irrigated cropping", "managed resource protection" and "residential" land uses.

2.7.1 Agriculture

Agriculture has a significant presence in the Baralaba region. Farming of crops and grazing of livestock is present along the Dawson River both up and downstream of the Project (DES, 2019a). A large cropping operation exists on the western bank of Banana Creek at the confluence of Banana Creek and the Dawson River and to the south-west. Agricultural operations based on indicative government mapping are depicted in Figure 2.16 (DES, 2019a).

The Project is located to the east of a Priority Agricultural Area (DSDMIP, 2013) (Figure 2.15). The regional outcome for the Central Queensland Regional Plan (DSDMIP, 2013) is for "agricultural and resource industries within the Central Queensland region continue to grow with certainty and investor confidence". The regional policies to that aim to achieve this outcome are (DSDMIP, 2013):

- Protect Priority Agricultural Land Uses within Priority Agricultural Areas.
- Maximise opportunities for co-existence of resource and agricultural land uses within Priority Agricultural Areas.

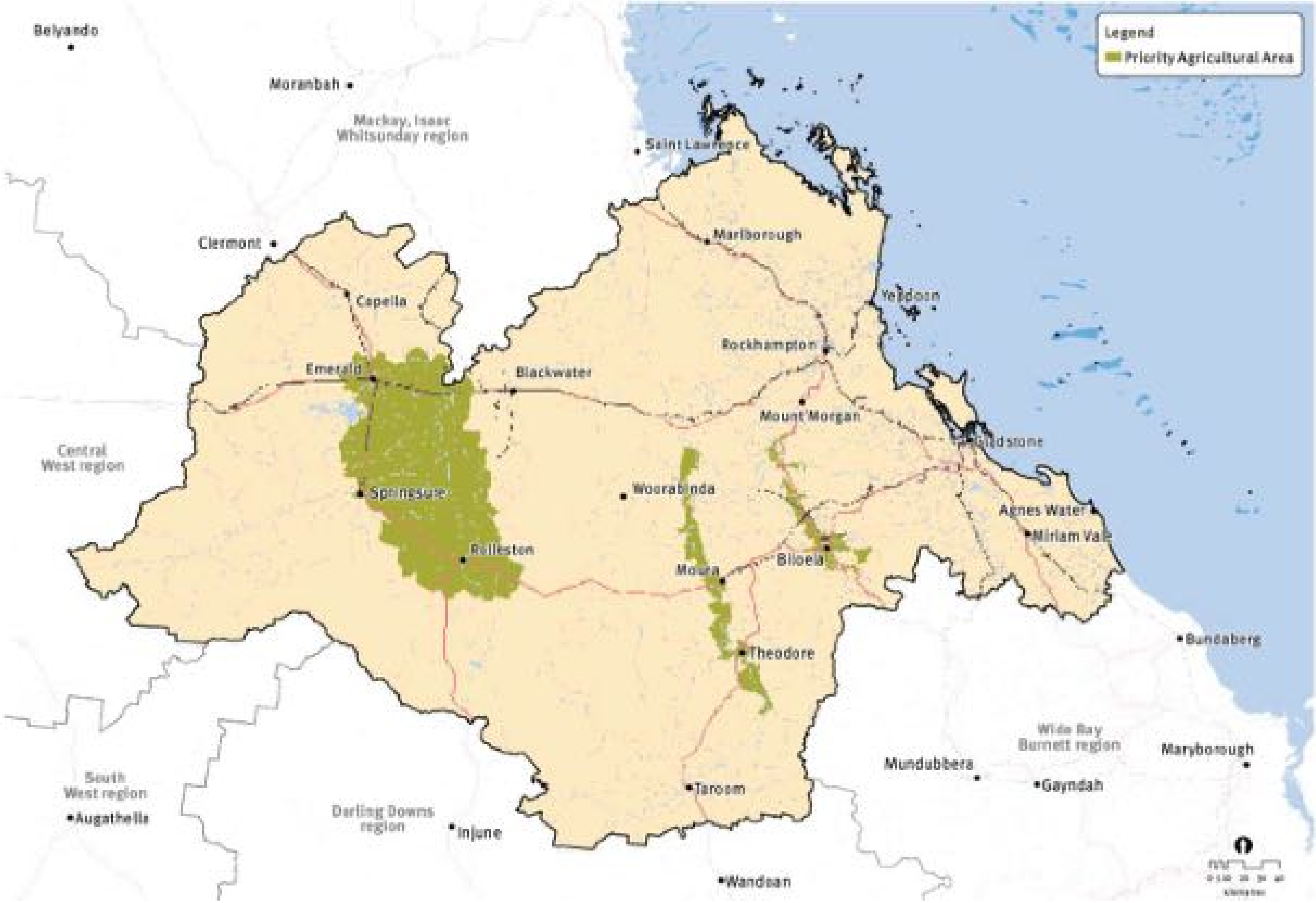
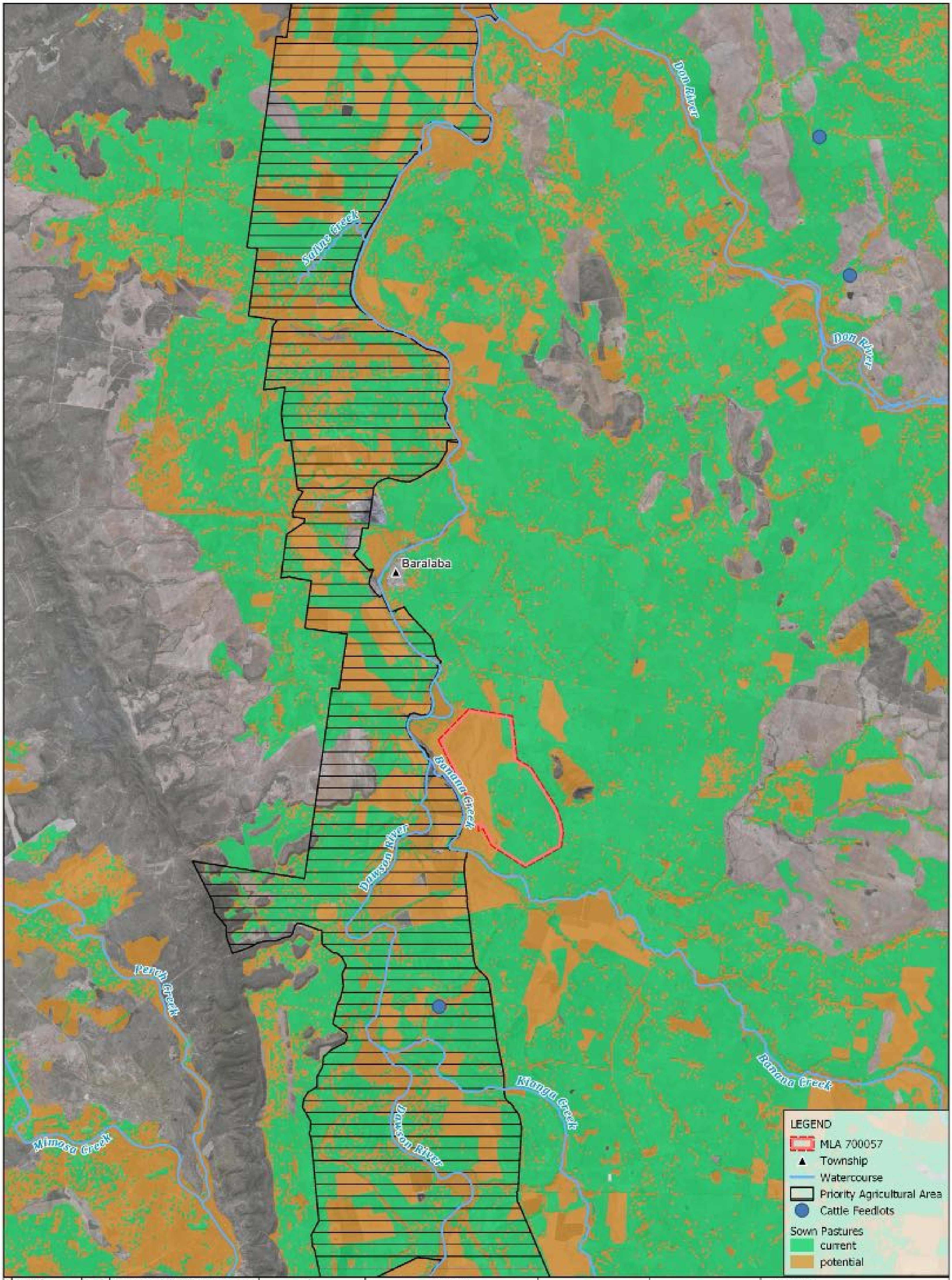


Figure 2.15: Priority Agricultural Areas Within the Central Queensland Region (DSDMIP, 2013)



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BARALABA SOUTH

Figure 2.16

BARALABA SOUTH PTY LTD
Baralaba South Surface Water Impact Assessment
Current Agriculture Operations

Job Number:
QL2018_004

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2.7.2 Nearby Mines and Industry

The Fitzroy Basin encompasses one of the most active mining regions of Queensland. There are a number of mines both north and south of the Project as well as within neighbouring catchments. A summary of coal mines and other industry within 150 km of the Project is included in Table 2.5.

Baralaba North Mine is located approximately 11 km downstream of the Project on the Dawson River western floodplain. The Dawson Mine Complex is approximately 27 km upstream of the Project.

TABLE 2.5: NEARBY MINES

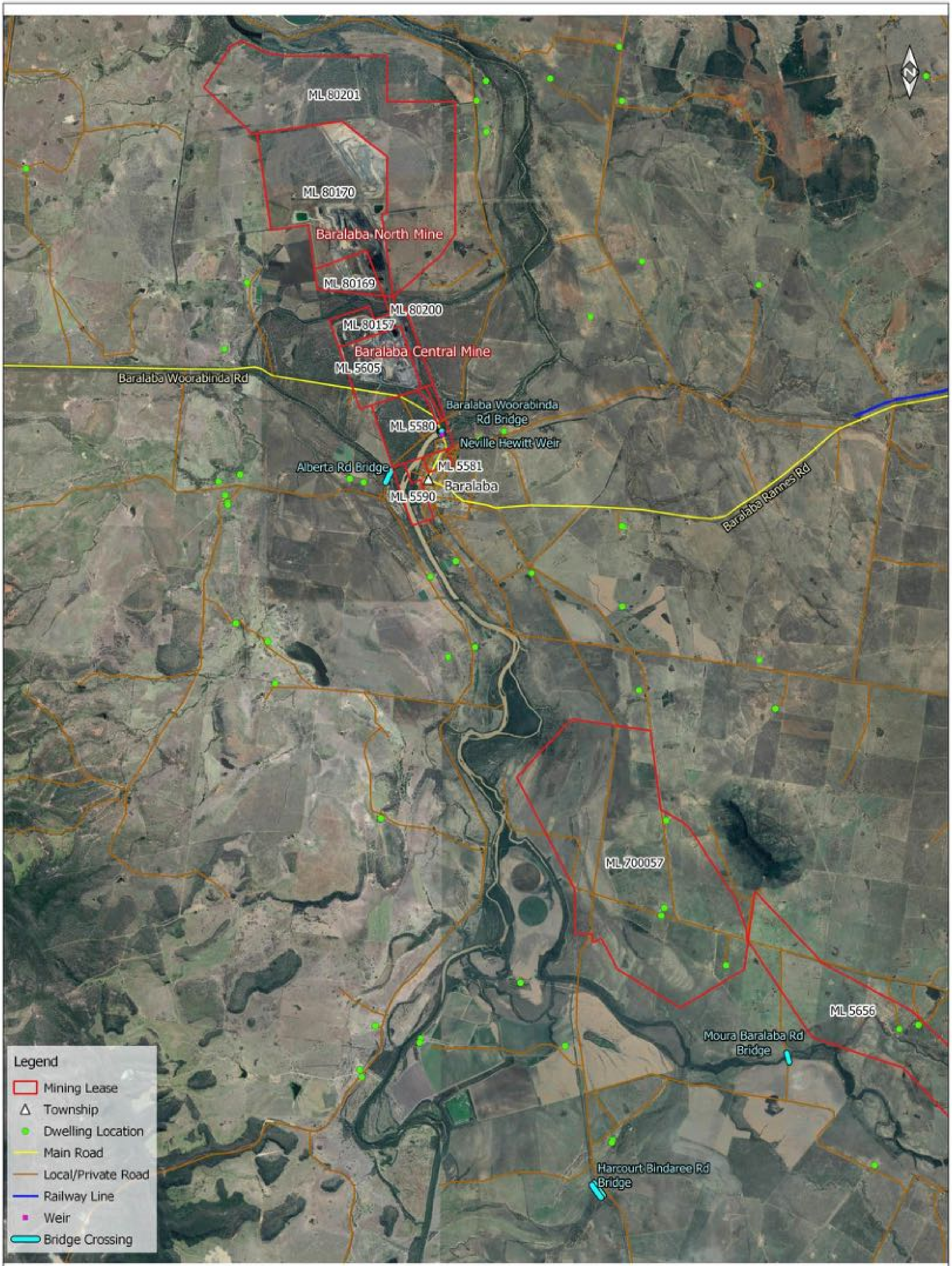
Name	Proximity	Activity
Baralaba North Mine	11 km north	Active coal mining complex
Dawson Mine Complex	27 km south	Active coal mining complex
Callide Coal Mine	82 km east (Neighbouring Catchment)	Active coal mining complex
Mt Morgan Gold Mine	86 km northeast (Neighbouring Catchment)	Inactive gold mine

2.7.3 Nearby Infrastructure, Towns and Dwellings

Infrastructure and towns near the Project are shown in Figure 2.17. Key public infrastructure near the Project:

- Baralaba Township – 8 km north (downstream) of the Project on the eastern bank of the Dawson River.
- Neville Hewitt Weir – 9 km north (downstream) of the Project on the Dawson River.
- Baralaba Woorabinda Road Bridge – 9 km north (downstream) of the Project spanning across the Dawson River Channel.
- Moura Baralaba Road Bridge – 3 km upstream of the Project spanning across the Banana Creek Channel.
- Moura Baralaba Road – Follows parallel to the Dawson River on the eastern floodplain downstream of the Project. The development of the mine will require the relocation of an approximate 4.5 km section of the existing Moura Baralaba Road from within to outside the MLA area.
- Alberta Road – Follows parallel to the Dawson River on the western floodplain.
- Baralaba Woorabinda Road – Crosses the Dawson River western floodplain 9 km downstream of the Project.

The private dwellings near the Project area are also shown on Figure 2.17.



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BARALABA SOUTH

Figure 2.17

BARALABA SOUTH PTY LTD
Baralaba South Surface Water Impact Assessment
Nearby Infrastructure and Roads

Job Number:
QC1018_004

2.8 Water Use

2.8.1 Municipal

The Banana Shire Council provides water supply services to the townships local to the Project. Banana Shire Council supplies potable water from a number of sources including Callide Dam and the Dawson River (Banana Shire Council, 2018). Baralaba township source their potable water supply from the Dawson River at Neville Hewitt Weir, approximately 8 km downstream of the Project. The Woorabinda Aboriginal Shire Council also sources water from the Neville Hewitt Weir.

2.8.2 Agricultural

As described in Section 2.7.1, agricultural users dominate the land nearby the Project. Many agricultural users have Dawson River water allocations under the Water Plan (Fitzroy Basin) 2011. A summary of the un-supplemented water licences from the Dawson River and tributaries of the Dawson River near the Project are provided in Table 2.6. Supplemented water licences from the Dawson River are administered under the Dawson Valley Water Supply Scheme (WSS) (see Section 3.1.5). The Project is located on the Zone D reach of the Dawson Valley Water Management Area and under the Dawson Valley WSS this reach has supplemented water allocations as summarised in Table 2.7.

TABLE 2.6: DAWSON RIVER WATER LICENSES IN VICINITY OF PROJECT

Authorisation Number	Authorisation Type	Authorisation Purpose	Location Lot/Plan	Attached Lot/Plan	Name of Water Entity	Nominal Entitlement per Water Year
48580S	License to Take Water	Irrigation	12/FN514	12/FN514	Unnamed Tributary of Dawson River	700 ha
621202	License to Take Water	Any	12/FN514	12/FN514 13/FN514	Dawson River	5,600 ML
48579S	License to interfere by impounding – Embankment of Wall	Impound Water	12/FN514	-	Unnamed Tributary of Dawson River	-
41219S	License to Take Water	Water harvesting	34/FN217	34/FN217	Banana Creek	-
27320S	License to interfere by impounding – Embankment of Wall	Impound Water	21/FN204	-	Back Creek	-
32491S	License to interfere by impounding – Embankment of Wall	Impound Water	22/FN204	-	Back Creek	-
48591S	License to interfere by impounding – Embankment of Wall	Impound Water	10/FN204	-	Back Creek	-
48590S	License to interfere by impounding – Embankment of Wall	Impound Water	10/FN204	-	Unnamed Tributary of Dawson River	-
48589S	License to interfere by impounding – Embankment of Wall	Impound Water	10/FN204	-	Unnamed Tributary of Dawson River	-
48475S	License to Take Water	Irrigation	10/FN204	10/FN204	Back Creek	40 ha
59721S	License to Take Water	Water harvesting	11/FN200	11/FN200	Back Creek	-
26436S	License to interfere by impounding – Embankment of Wall	Impound Water	11/FN200	-	Back Creek	-
621197	License to Take Water	Any	14/KM183	14/KM183	Dawson River	450 ML
40246S	License to interfere by impounding – Embankment of Wall	Impound Water	5/KM176	-	Dawson River (Anabranch)	-
41213S	License to Take Water	Irrigation	5/KM176	5/KM176	Dawson River (Anabranch)	320 ha
41113S	License to interfere by impounding – Embankment of Wall	Impound Water	4/KM176	-	Dawson River (Anabranch)	-

TABLE 2.7: LIMITS OF TOTAL NOMINAL VOLUME WITHIN DAWSON VALLEY WATER SUPPLY SCHEME ZONES B-D (DES, 2015)

<table>
<tr><th>Priority Group</th><th>Nominal Volume</th><th>Zone D</th><th>Zone C</th><th>Zone B</th></tr>
<tr><td>High</td><td>Maximum Volume (ML)</td><td>1200</td><td>0</td><td>350</td></tr>
<tr><td></td><td></td><td colspan="3">1200</td></tr>
<tr><td></td><td>Minimum Volume (ML)</td><td colspan="3">998</td></tr>
<tr><td>Medium A</td><td>Maximum Volume (ML)</td><td colspan="3">0</td></tr>
<tr><td>Medium</td><td>Maximum Volume (ML)</td><td>8838</td><td>1942</td><td>733</td></tr>
<tr><td></td><td></td><td colspan="3">8838</td></tr>
<tr><td>Medium A</td><td>Minimum Volume (ML)</td><td colspan="3">-</td></tr>
<tr><td>Medium</td><td>Minimum Volume (ML)</td><td colspan="3">6838</td></tr>
</table>

2.8.3 Industrial

Nearby mines to the Project are listed in Section 2.7.2. The Baralaba North Mine is located on the western side of the Dawson River channel near the Baralaba Township and has water entitlements authorised under the Water Act 2000 as administered by the Water Plan (Fitzroy Basin) 2011. Dawson Mine is located within the Dawson River catchment upstream of the project and the remaining nearby mining/industrial sites are located in different catchment areas.

2.8.4 Recreational

The Lower Dawson River main channel, and its tributaries, are used for both primary and secondary recreational purposes. These uses have been identified as environmental values (EVs) for the Dawson River, as defined in Section 3.2. The Neville Hewitt Weir impoundment includes a boat ramp and is used for recreational activities including fishing and water skiing as well as being a popular location for camping and recreational day use.

The Baralaba golf course is located on the western bank of the Dawson River 1 km upstream of the Baralaba township and the campground and picnic area is located on the eastern bank of the river upstream of the township.

2.8.5 Aquatic Ecosystems

The Dawson River flow regime and water quality is important for sustaining the natural aquatic ecosystems in the region. The Water Plan (Fitzroy Basin) 2011 (Section 3.1.5) outlines the minimum Environmental Flow Objectives (EFOs) for various flow regimes in each season for the Dawson River. EFOs which define the flow durations and mean flows for a range of conditions including seasonal base flow, medium to high flow and first post-winter flow events are developed to sustain the natural ecosystem within the watercourse. EFOs are defined for various node locations in the Fitzroy Basin. Node 2 – Dawson River at Beckers is the closest EFO node to the Project.

2.8.5.1 Seasonal Base Flow Objectives

The base flow objectives for the Dawson River at Node 2 (Dawson River at Beckers) are outlined in Table 2.8. The seasonal base flow objectives are not mandatory and are not met in the approved developed case hydrology model used for the Water Plan (Fitzroy Basin) 2011 at Node 2. The percentage of the total number of days in a water flow season in the simulation period that the base flow is equalled or exceeded should be between 0.8 and 1.2 times the percentage stated for the water flow season.

TABLE 2.8: BASEFLOW ENVIRONMENTAL FLOW OBJECTIVES (NODE 2 – DAWSON RIVER AT BECKERS)

Base Flow (ML/day)	January -April Water Flow Season	May-August Water Flow Season	September-December Water Flow Season
86	64%	27%	35%

2.8.5.2 Medium to High Flow Objectives

The annual and daily medium to high flow objectives for node 2 (Dawson River at Beckers) are outlined in Table 2.9 and Table 2.10 respectively.

TABLE 2.9: ANNUAL MEDIUM TO HIGH FLOW OBJECTIVES AT NODE 2 (DAWSON RIVER AT BECKERS)

Environmental Flow Objective	Description	Value
Mean Annual Flow	Mean annual flow as a percentage of pre-development flow	>65%
Median annual flow ratio	Median annual flow as a percentage of pre-development flow	>48%
Annual proportional flow deviation	Statistical measure of changes to flow season and volume	<3.1

TABLE 2.10: DAILY MEDIUM TO HIGH FLOW OBJECTIVE (DAWSON RIVER AT BECKERS)

Environmental Flow Objective	10% daily exceedance duration flow	4% daily exceedance duration flow	2 year daily flow volume	5 year daily flow volume	20 year daily flow volume
% of pre-development flow	>45%	>53%	>55%	>69%	>80%

2.8.5.3 First Post-Winter Flow Objectives

The first-post winter flow objectives for Node 2 (Dawson River at Beckers) are summarised in Table 2.11.

TABLE 2.11: FIRST POST-WINTER FLOW OBJECTIVES

Environmental Flow Objective	Description	Value
Number of first post-winter flows	The number of first post-winter flow events in the simulation period expressed as a percentage of the number of post-winter flow years in the period	>80%
Number of flows within 5 weeks of the pre-development	The number of 5-week lag events in the simulation period, expressed as a percentage of the number of post-winter flow years in the period	>60%
Number of flows within 2 weeks of the pre-development	The number of 2-week lag events in the simulation period, expressed as a percentage of the number of post-winter flow years in the period	>70%
Average peak flow	The average of the peak flow ratios for the post-winter flow years in the simulation period	>60%
Flow duration (2-times base flow)	The number of 2-times base flow events in the simulation period, expressed as a percentage of the number of post-winter flow years in the period	>60%
Flow duration (5-times base flow)	The number of 5-times base flow events in the simulation period, expressed as a percentage of the number of post-winter flow years in the period	>60%

3. ENVIRONMENTAL VALUES AND WATER QUALITY OBJECTIVES

3.1 Relevant Legislation

3.1.1 Environmental Protection Act 1994 (EP Act)

The EP Act defines environmental value as:

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

3.1.2 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) defines legal framework to protect and manage nationally and internationally important flora, fauna ecological places defined as Matters of National Environmental Significance (MNES). The Terms of Reference (TOR) for the Project Environmental Impact Statement (DEHP, 2017b) have identified water resources as a controlling provision for the Project with regards to its potential impacts on MNES.

3.1.3 Environmental Protection Regulation (EP Regulation) 2019

The Environmental Protection Regulation (EP Regulation) 2019 further defines specified environmental objectives and performance outcomes for key environmental aspects. The Water and Wetlands environmental objectives and performance outcomes are summarised in Section 3.3.2.

3.1.4 Environmental Protection (Water and Wetland Biodiversity) 2019

The purpose of the EPP (Water and Wetland Biodiversity) is to identify environmental values and associated water quality objectives (WQOs) for Queensland waters. The Project is located within the Dawson River Sub-basin of the greater Fitzroy Basin. Environmental Values and WQOs for the Dawson River Sub-basin are scheduled under the EPP (Water and Wetland Biodiversity) and are outlined in Sections 3.2 and 3.3.

3.1.5 Water Act 2000 (Queensland)

The Water Act 2000 is the key regulatory document in Queensland for the allocation and use of water resources. The Water Act provides a range of plans, licence and permits for surface and groundwater resources throughout the state. These include:

- Water resources plans.
- Water use plans.
- Resource operations plans.

3.1.5.1 Water Plan (Fitzroy Basin) 2011

Water resources within the Fitzroy are managed under the Water Plan (Fitzroy Basin) 2011. The purposes of the plan are defined as:

- To define availability of water in the plan area.
- To provide a framework for sustainably managing water and the taking of water.

- To identify priorities and mechanisms for dealing with future water requirements.
- To provide a framework for establishing water allocations.
- To provide a framework for reversing, where practicable, degradation of natural ecosystems.
- To regulate the taking of overland flow water.
- To regulate the taking of groundwater.

The plan defines the following surface water performance indicators and objectives:

- Environmental flow objectives (EFOs):
  - Which define the flow conditions which must be maintained at defined management nodes in the Fitzroy basin. EFOs are defined for a range of conditions including flow volume, flow duration, seasonal base flow, medium to high flow and first post-winter flow events.
- Water allocation security objectives (WASOs):
  - Which define the minimum-security requirements for both supplemented and un-supplemented water allocations for each of the water supply schemes within the basin.

The identified location nearest to the Project is the Water Plan (Fitzroy Basin) 2011 management Node 2 which is the Dawson River at Beckers monitoring station. Node 2 is located on the Dawson River 16 km downstream from the MLA. The EFOs for the Dawson River at Beckers monitoring station are provided in Section 2.8.5.

3.1.5.2 Fitzroy Basin Resource Operations Plan 2014

The Fitzroy Resource Operations Plan (ROP) 2014 is a document prepared to outline strategies for the implementation of the Water Resource (Fitzroy Basin) Plan 2011. The Fitzroy ROP regulates water allocations and licensing within the Fitzroy basin. The ROP sub-divides the Fitzroy Basin into water management zones. The Project is located within the Dawson Valley Water Management Area.

3.1.5.3 Dawson Valley Water Supply Scheme

The Dawson Valley Water Supply Scheme (WSS) is a scheme for the supply of water under a resource operation licence in accordance with the Water Plan (Fitzroy Basin) 2011. The Dawson Valley WSS is managed under the Fitzroy Basin Resource Operation Plan (DES, 2015). The scheme consists of a network of channels and weirs that extend along the Dawson River from upstream Theodore to downstream Boolburra.

Dawson Valley WSS is bulk water storages and supplemented allocations are managed by Sunwater and the irrigation channels are managed by Theodore Water. The Dawson Valley WSS supplies the following:

- Irrigation water for agriculture including cotton, fodder, cereal, and horticultural crops.
- Urban water supply for:
  - Theodore.
  - Moura.
  - Baralaba.
  - Duaringa.
  - Woorabinda.
- Industrial water supply primarily for mining.

3.2 Environmental Values

The Project is located within the Dawson River Sub-basin. Environmental Values (EVs) for this region are defined in the Dawson River Sub-basin Environmental Values and Water Quality Objective Basin No. 130 (part), including all waters of the Dawson River Sub-basin except the Callide Creek Catchment, September 2011 (DEHP, 2011). The Project is located within the Lower Dawson main channel – regulated reaches. The environmental values assigned to this region are:

- Aquatic ecosystems.
- Irrigation.
- Farm supply/use.
- Aquaculture.
- Stock water.
- Human consumer.
- Primary recreation.
- Secondary recreation.

3.3 Water Quality Objectives

Water Quality Objectives for the receiving environment EVs (Section 3.2) are defined in the Dawson River Sub-basin Environmental Values and Water Quality Objective Basin No. 130 (par), including all waters of the Dawson River Sub-basin except the Callide Creek Catchment, September 2011 (DEHP, 2011), under the EPP (Water and Wetland Biodiversity). The Interim Water Quality Objectives for the Project are presented in Table 3.1 with site-specific WQOs yet to be determined. Where multiple relevant EVs specify WQOs for the same parameter the most conservative value has been tabulated. The Dawson River receiving water contaminant limits approved under the Baralaba North Mine and Dawson Mine Environmental Authorities have been presented in Table 3.1.

Currently 16 samples have been completed over a period of 4 year for the baseline surface water quality monitoring program. The samples collected only slightly exceed the minimum sample quantity requirements of QWQG and were collected over a discontinuous period and therefore default guideline values for water quality objectives have been adopted. Site-specific WQOs will be able to be determined once a statistically sufficient dataset of baseline local water quality data has been obtained in accordance with QWQG and NWQMS Guideline requirements.

Table 3.1 also provides a comparison of the identified regional WQOs against local approved water quality contaminant limits which have been considered when defining mine water release conditions for the Project.

The Dawson River at Beckers (130322A) monitoring station has recorded the following exceedances of the determined WQOs (Table 3.1) for monitoring undertaken between 1964 and 2023 (DRDMW, 2025):

- Median phosphorus and nitrogen measurements were in exceedance of the WQO for aquatic ecosystems (Appendix C).
- Electrical conductivity exceeded low and high flow WQOs for aquatic ecosystems in the 95th percentile (Figure 2.11 and Appendix C).
- Turbidity and total suspended solids exceeded the aquatic ecosystems WQOs in greater than median and 20th percentiles respectively (Appendix C).

Water quality samples collected as part of the baseline water monitoring program for the Project (Appendix A) have also exhibited exceedances of WQOs for the following parameters:

- pH was marginally exceeded for a very small number of samples.
- Electrical conductivities for a small number of samples exceed the high flow WQOs for aquatic ecosystems and over 40% exceeded the low flow WQO.
- The majority of samples exceeded the WQO for Suspended Solids and turbidity.
- There were also consistent exceedances of the aquatic ecosystems WQOs for aluminium, iron and Ammonia.

Ongoing water quality sampling for the Project will allow future determination of site specific WQOs in accordance with QWQG, in place of default guideline values for WQOs suggested in the EP (Water and Wetland Biodiversity).

TABLE 3.1: WATER QUALITY OBJECTIVES

Indicator	EPP (Water) Water Quality Objectives		Approved EA Receiving Waters Contaminant Limits		EPP (Water) Water Quality Objectives for individual Environmental Values				
	WQO	Corresponding EV	Baralaba North	Dawson Mine	Aquatic Ecosystems	Drinking Water	Irrigation (Long Term)	Irrigation (Short Term)	Stock Watering
pH	6.5-8.5	Drinking Water	6.5-8.5	6.5-9	6.5-8.5	6.5-8.5	-	-	-
Electrical Conductivity (Base flow)	340 µS/cm	Aquatic Ecosystems	500 µS/cm	1,000 µS/cm	340 µS/cm	400 µS/cm	Variable based on soil type and crop. Minimum of 1,000 µS/cm.		Cattle: 2,500 µS/cm Sheep: 5,000 µS/cm
Electrical Conductivity (High flow)	210 µS/cm	Aquatic Ecosystems			210 µS/cm				
Ammonia N	20 µg/L	Aquatic Ecosystems	900 µg/L	900 µg/L	20 µg/L	-	-	-	-
Oxidised N	60 µg/L	Aquatic Ecosystems	-	-	60 µg/L	-	-	-	-
Organic N	420 µg/L	Aquatic Ecosystems	-	-	420 µg/L	-	-	-	-
Total Nitrogen	500 µg/L	Aquatic Ecosystems	-	-	500 µg/L	-	-	-	-
Reactive Phosphorus	20 µg/L	Aquatic Ecosystems	-	-	20 µg/L	-	-	-	-
Total Phosphorus	50 µg/L	Aquatic Ecosystems	-	-	50 µg/L	-	-	-	-
Chlorophyll	5 µg/L	Aquatic Ecosystems	-	-	5 µg/L	-	-	-	-
Dissolved Oxygen	85%-110% saturation	Aquatic Ecosystems	-	-	85%-110% saturation	<4mg/L at surface	-	-	-
	<4mg/L at surface	Drinking Water							
Turbidity	50 NTU	Aquatic Ecosystems	-	-	50 NTU	-	-	-	-
Suspended Solids	10 mg/L	Aquatic Ecosystem	350 mg/L	500 mg/L	10 mg/L	-	-	-	
Sulfate	25 mg/L	Aquatic Ecosystem	250 mg/L	250 mg/L	25 mg/L	-	-	-	-
Cryptosporidium	0 cysts	Drinking Water	-	-	-	0 cysts	-	-	-
Blue-green Algae	5,000 cells/mg	Drinking Water	-	-	-	5,000 cells/mg	-	-	-

Indicator	EPP (Water) Water Quality Objectives		Approved EA Receiving Waters Contaminant Limits		EPP (Water) Water Quality Objectives for individual Environmental Values				
	WQO	Corresponding EV	Baralaba North	Dawson Mine	Aquatic Ecosystems	Drinking Water	Irrigation (Long Term)	Irrigation (Short Term)	Stock Watering
Algal Toxin	Level 1: >1 µg/L	Drinking Water	-	-	-	Level 1: >1 µg/L	-	-	-
	Level 1: >10 µg/L					Level 1: >10 µg/L			
Colour	50 hazen units	Drinking Water	-	-	-	50 hazen units	-	-	-
Total Hardness	Level 1: >150 mg/L	Drinking Water	-	-		Level 1: >150 mg/L	-	-	-
	Level 1: >200 mg/L					Level 1: >200 mg/L	-	-	-
Sodium	30 mg/L	Drinking Water	-	-		30 mg/L	-	-	-
Aluminium	0.055 mg/L	Aquatic Ecosystems	0.055 mg/L	0.055 mg/L	0.055 mg/L[1]	-	5 mg/L	20 mg/L	5 mg/L
Arsenic	0.013 mg/L	Aquatic Ecosystems	0.013 mg/L	0.013 mg/L	0.013 mg/L	-	0.1 mg/L	2 mg/L	0.5-2 mg/L
Beryllium	0.5 mg/L	Irrigation	-	-	-	-	0.1 mg/L	0.5 mg/L	ND
Boron	0.94 mg/L	Aquatic Ecosystems	0.37 mg/L	0.37 mg/L	0.94 mg/L	-	0.5 mg/L	0.5 mg/L[2]	5 mg/L
Cadmium	0.2 µg/L	Aquatic Ecosystems	0.2 µg/L	0.2 µg/L	0.2 µg/L	-	10 µg/L	50 µg/L	10 µg/L
Chromium	0.1 µg/L	Aquatic Ecosystems	0.001 mg/L	0.001 mg/L	0.1 µg/L	-	0.1 mg/L	1 mg/L	1 mg/L
Cobalt	90 µg /L	Aquatic Ecosystems	1.4 µg/L	90 µg/L	90 µg/L	-	50 µg /L	100 µg /L	1,000 µg /L
Copper	2.0 µg/L	Aquatic Ecosystems	2 µg/L	2 µg/L	2.0 µg/L[1]	-	200 µg /L	5,000 µg /L	400 µg/L (sheep), 1000 µg/L (cattle)
Fluoride	1 mg/L	Irrigation	2 mg/L	2 mg/L	-	-	1 mg/L	2 mg/L	2 mg/L
Iron	0.3 mg/L	Aquatic Ecosystems	0.3 mg/L	0.3 mg/L	0.3 mg/L	-	0.2 mg/L	10 mg/L	Not sufficiently toxic
Lead	3.4 µg/L	Aquatic Ecosystems	4 µg/L	4 µg/L	3.4 µg/L	-	2,000 µg/L	5,000 µg/L	100 µg/L
Lithium	2.5 mg/L	Irrigation	-	-	-	-	2.5 mg/L	2.5 mg/L	-

Indicator	EPP (Water) Water Quality Objectives		Approved EA Receiving Waters Contaminant Limits		EPP (Water) Water Quality Objectives for individual Environmental Values				
	WQO	Corresponding EV	Baralaba North	Dawson Mine	Aquatic Ecosystems	Drinking Water	Irrigation (Long Term)	Irrigation (Short Term)	Stock Watering
Manganese	1.7 mg/L	Aquatic Ecosystems	1.9 mg/L	1.9 mg/L	1.7 mg/L	-	0.2 mg/L	10 mg/L	-
Mercury	0.06 µg/L	Aquatic Ecosystems	0.2 µg/L	0.2 µg/L	0.06 µg/L	-	2 µg/L	2 µg/L	2 µg/L
Molybdenum	0.2 µg/L	Aquatic Ecosystems	34 µg/L	34 µg/L	0.2 µg/L	-	20 µg/L	50 µg/L	-
Nickel	0.011 mg/L	Aquatic Ecosystems	0.011 mg/L	0.011 mg/L	0.011 mg/L	-	-	-	1 mg/L
Selenium	10 µg/L	Aquatic Ecosystems	10 µg/L	10 µg/L	10 µg/L[1]	-	10 µg/L	50 µg/L	20 µg/L
Uranium	1 µg/L	Aquatic Ecosystems	1 µg/L	1 µg/L	1 µg/L[1]	-	10 µg/L	100 µg/L	-
Vanadium	10 µg/L	Aquatic Ecosystems	10 µg/L	10 µg/L	10 µg/L[1]	-	100 µg/L	500 µg/L	-
Zinc	8 µg/L	Aquatic Ecosystems	8 µg/L	8 µg/L	8 µg/L	-	2000 µg/L	5000 µg/L	-

1 - Trigger Limit for aquatic ecosystem protection outlined in the model mining conditions (DES, 2017)

3.3.1 Great Barrier Reef Catchment Waters

The *Reef discharge standards for industrial activities* (ESR/2021/5627) (DES, 2023) outlines additional requirements that should be included in an application for new projects that release particular contaminants to Great Barrier Reef catchment waters under section 41AA of the EP Regulation. The Project is located in the Fitzroy Region of the Great Barrier Reef (GBR) river basins and therefore is required to address the *Reef discharge standards for industrial activities* (ESR/2021/5627).

The standards outline the requirement to quantify fine sediment and dissolved inorganic nitrogen (DIN) released via a point source to GBR waters and demonstrate there will be no residual impact associated with the Project. This requires the Project to not increase fine sediment and DIN loads to the Dawson River compared to the existing site for both operational and closure phases of mining.

If the Project cannot avoid or minimise loads from mitigation measures, a water quality offset measure can be carried out to counterbalance the residual impact of the Project.

3.3.2 Environmental Objectives and Performance Outcomes

Environmental objectives and performance outcomes for water are defined in Schedule 8, Part 3 of the EP Regulation. These align with the ToR objectives and have been used in the development of the mine water management system for the Project. These are outlined in Table 3.2.

TABLE 3.2: EP REGULATION ENVIRONMENTAL OBJECTIVES AND PERFORMANCE OUTCOMES

Category	Environmental Objective	Performance Outcomes
Water	The activity will be operated in a way that protects environmental values of waters.	There is no actual or potential discharge to waters of contaminants that may cause an adverse effect on an environmental value from the operation of the activity.
		The storage and handling of contaminants will include effective means of secondary containment to prevent or minimise releases to the environment from spillage or leaks.
		Contingency measures will prevent or minimise adverse effects on the environment due to unplanned releases or discharges of contaminants to water.
		The activity will be managed so that stormwater contaminated by the activity that may cause an adverse effect on an environmental value will not leave the site without prior treatment.
		The disturbance of any acid sulfate soil, or potential acid sulfate soil, will be managed to prevent or minimise adverse effects on environmental values.
		Acid producing rock will be managed to ensure that the production and release of acidic waste is prevented or minimised, including impacts during operation and after the environmental authority has been surrendered.
		Any discharge to water or a watercourse or wetland will be managed so that there will be no adverse effects due to the altering of existing flow regimes for water or a watercourse or wetland.
		The activity will be managed so that adverse effects on environmental values are prevented or minimised.

Category	Environmental Objective	Performance Outcomes
Wetlands	The activity will be operated in a way that protects the environmental values of wetlands.	There will be no potential or actual adverse effect on a wetland as part of carrying out the activity.
		The activity will be managed in a way that prevents or minimises adverse effects on wetlands.
Groundwater	The activity will be operated in a way that protects the environmental values of groundwater and any associated surface ecological systems.	There will be no direct or indirect release of contaminants to groundwater from the operation of the activity
		There will be no actual or potential adverse effect on groundwater from the operation of the activity
		The activity will be managed to prevent or minimise adverse effects on groundwater or any associated surface ecological systems

4. CONTAMINANT SOURCES

4.1 Potential Contaminant Sources

Potential contaminant sources associated with the Project include:

- Surface runoff from disturbed areas.
- Surface runoff from mine waste or stockpiles.
- Process waste streams and entrained water.
- Seepage, overtopping or dam failure of site water storages.
- Seepage from overburden and spoil dumps.
- Groundwater ingress to the open cut pit.

4.1.1 Surface Runoff from Disturbed Areas

Disturbance activities for the Project will include mining pits, out-of-pit dumps, ROM storage, mine infrastructure hardstand areas, access and haul roads and the processing facility (CHPP). Runoff from these areas could contain sediment and other contaminants above natural surface water runoff concentrations. The source of the runoff will influence the contaminant types and concentrations, however, generally there are two overarching categories:

- Runoff from cleared areas, overburden dumps or roads that would be expected to have elevated sediment loads.
- Runoff from processing areas and/or mine pits that may contain contaminants in addition to sediment (e.g. dissolved salts and metals, hydrocarbons, nutrients etc).

The strategies for the mitigation and management of these two categories will therefore differ to ensure they are suitably managed to protect the receiving environment and associated environmental values. Typically, erosion and sediment control strategies are implemented for runoff in which sediment is the primary contaminant of concern, whereas mine water management systems with increased controls are developed for waters containing other contaminants.

4.1.2 Processing

The proposed processing technology for the Project maximises recycling of processing water, therefore minimising raw water demands through the use of mechanical dewatering of tailings. Higher levels of water reuse within the CHPP are expected to lead to higher concentrations of contaminants within the water streams. Due to the potential contaminants within these waters, they will be managed within the mine water system.

4.1.3 Chemical and Hydrocarbon Storage

The storage of chemicals and hydrocarbons will be required as part of ongoing operations. A dedicated fuel and lube facility will be required which will be constructed to provide adequate containment and spill response in accordance with relevant Australian Standards.

4.1.4 Seepage, Overtopping and Dam Failure of Storages

Mine water is stored in dams on site and is a potential contaminant source via pathways of seepage, overtopping and dam failure. Dams will be suitably engineered to minimise the risk of occurrence. More detailed description of proposed dam design can be found in Section 5.3 and the consequence assessment for seepage, overtopping and dam failure scenarios for these dams is provided in Section 9.2.

4.1.5 Seepage and Potential Acid Mine Drainage

A geochemical assessment of potential spoil and coal reject materials was completed (Terrenus Earth Sciences, 2023), to inform the potential water contaminants generated by water contact with mine spoil and coal rejects. The outcomes of this assessment were:

- Spoil is expected to generate pH neutral to alkaline, low- to moderate-salinity surface run-off and seepage following surface exposure.
- The total sulphur concentration of potential spoil is very low, and almost all potential spoil samples are classified as Non-Acid Forming (NAF). No spoil samples were classified as Potentially Acid Forming (PAF).
- Potential coal reject material is expected to generate pH neutral to alkaline, low-salinity surface run-off and seepage following surface exposure.
- About 64% of potential coal reject samples were classified as NAF, and about 10% were classified as PAF – with a 'low' capacity to generate significant acidity. The remaining 26% were classified as Uncertain.

Spoil is expected to be NAF and have a negligible risk of developing acidic conditions (Terrenus Earth Sciences, 2023). Spoil is also expected to generate relatively low saline rainfall runoff and seepage with low metal/metalloid concentrations, however, may be susceptible to erosion due to being sodic.

Potentially Acid Forming materials which may include reject material or acid sulphate soils (unlikely to be encountered) will be managed through the placement of PAF material in out-of-pit emplacement areas, and/or placement within recently completed pit workings (within in-pit emplacement areas). The volume of PAF waste material placed in the spoil emplacement areas is expected to be small compared to the volume of the total emplacement areas. It is expected the potential for seepage from the PAF material to have an impact on the water quality of the sediment dams is low. The sediment dams will undergo water quality monitoring for the life of the project to identify potential water quality impacts from seepage (Section 10.2).

For details on spoil and rejects management and emplacement, and mitigation measures taken to reduce seepage refer to *Geochemical Assessment of Potential Spoil and Coal Reject Materials* (Terrenus Earth Sciences, 2023).

4.1.6 Groundwater

Groundwater will enter the open cut workings and be dewatered and stored in mine water storages within the MLA. Groundwater entering the mining pit is expected to have elevated salinity concentrations which is a potential contaminant source to surface waters. Water quality sampling from groundwater monitoring bores located throughout the Project area has been undertaken from 2017 to 2021. The results show significant spatial variation in water quality but limited temporal variation. Bores within 750 m of the Dawson River exhibited Electrical Conductivity (EC) in the range of 300-700 µS/cm, while those further away had EC values ranging from 15,000-38,000 µS/cm (Watershed HydroGeo, 2023).

Based on bore locations in relation to pit progression, groundwater ingress to the pit is likely to have poor water quality, consistent with bores more than 750 m from the Dawson River including:

- A-OB4
- P-OB4
- A-OB3
- A-OB10
- P-OB3

As discussed in Section 6.1.5, groundwater ingress to the pit will be dewatered to Mine Water Dam which will increase the salinity of stored water in the Dam. A summary of the recorded EC from the groundwater monitoring program is available in Table 4.1 and the locations of monitoring bores are depicted in Figure 4.1.

TABLE 4.1: GROUNDWATER MONITORING – EC (µS/CM)

Monitoring Point	Geology	Min	20th Percentile	Average	80th Percentile	Max	January 2021
A-OB1	Quaternary alluvium	466	492	586	651	700	524
A-OB2	Quaternary alluvium	565	606	686	833	911	686
A-OB3[1]	Quaternary alluvium	489	B	548	B	593	B
A-OB4[1]	Quaternary alluvium	31,759	36,292	36,920	37,614	40,022	37,415
A-OB5	-	-	-	-	-	-	-
A-OB6	Quaternary alluvium	15,681	16,775	19,061	20,587	20,717	20,508
A-OB7	Quaternary alluvium	25,754	26,260	28,100	29,668	29,951	29,553
A-OB8	Quaternary alluvium	29,887	32,347	34,406	37,462	38,786	Not Sampled
A-OB10[1]	Quaternary alluvium	335	350	397	442	481	346
A-OB11	Quaternary alluvium	306	327	388	435	526	393
P-OB2[1]	BG[2] (interburden)	16,669	18,931	19,183	19,514	21,075	19,196
P-OB3[1]	BG[2] (interburden)	28,835	32,386	33,072	34,107	37,120	33,012
P-OB4[1]	BG[2] (coal seam)	31,702	36,093	36,578	37,169	40,297	36,415
P-OB5	BG[2] (coal seam)	23,666	25,297	28,301	29,365	34,100	29,062
P-OB1	BG[2] (coal seam)	13,721	30,625	33,100	34,517	34,711	34,400
A-PB1	Quaternary alluvium	610	624	697	792	877	877
A-PB2	Quaternary alluvium	Dry	Dry	Dry	Dry	Dry	Dry
P-PB1	BG[2] (interburden)	-	-	16,900	-	-	Not Sampled

[1] *Bore located within MLA700057*

[2] *Blackwater Group*

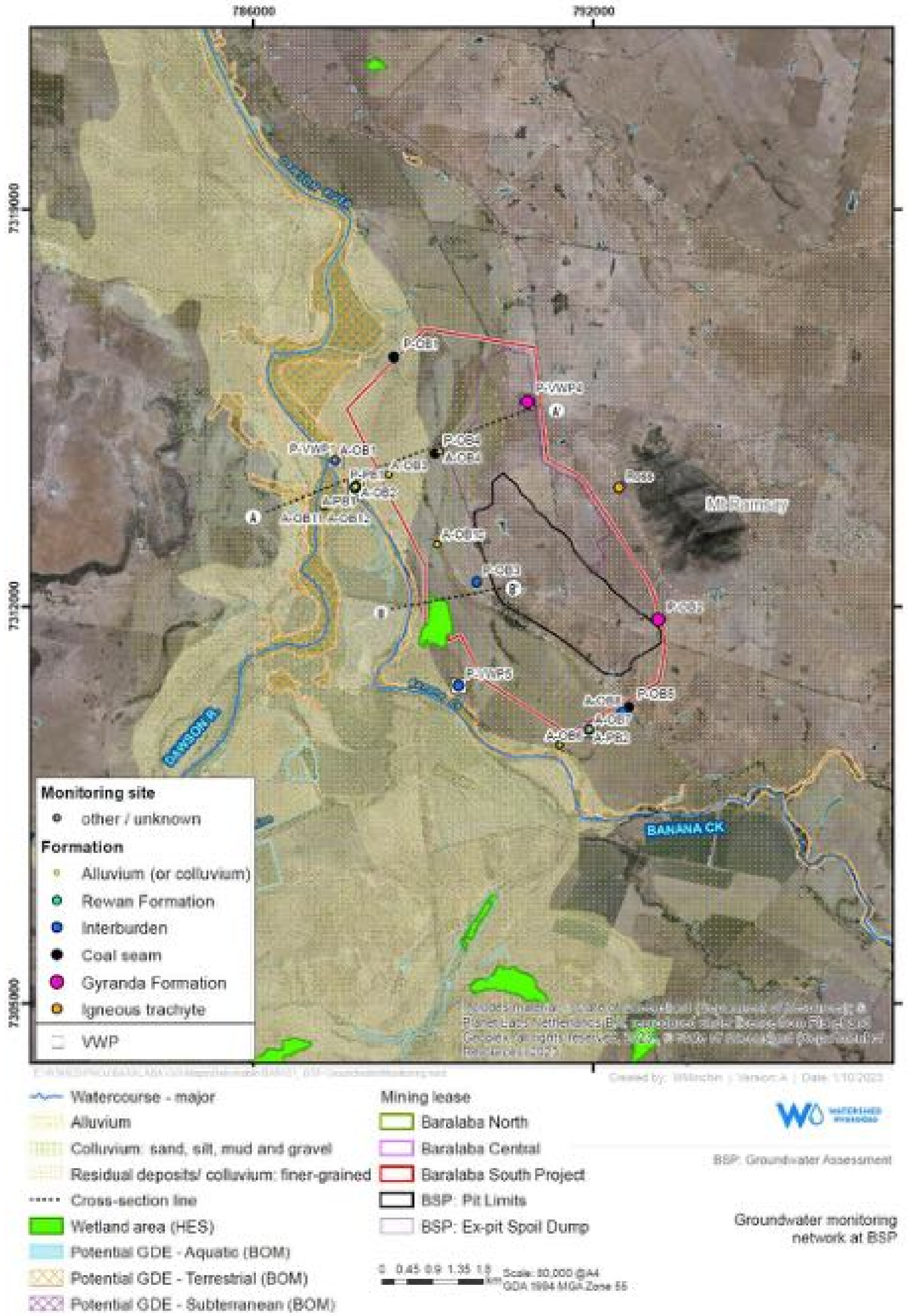


Figure 4.1: Groundwater Monitoring Bore Locations (WATERSHED HYDROGEO, 2023)

5. WATER MANAGEMENT SYSTEM

5.1 Objectives

The water management system for the Project has been developed to preserve the environmental values of the receiving environment and meet the water demands of the Project.

The objectives of the mine water management strategy include:

- Minimise capture of clean surface water from external catchments via catchment diversion.
- Maximise recycle and reuse of first mine affected water, then sediment runoff (Section 5.2), for site water demands including processing and dust suppression.
- Preferential supply of water demands from site water storages over external raw water supply and surface water harvesting.
- Minimise and manage controlled releases of water to receiving waterways.
- Minimise uncontrolled release of mine affected water to receiving waterways.

5.2 Surface Water Categories

The mine water management strategy for the Project provides separation of water types based on anticipated water quality. The proposed water management system has separation of water types by:

- Mine Affected Water - Mine affected water is defined as water which has interacted with mining activities consistent with the Mine Affected Water definition from the Queensland Model Mining Conditions (DES, 2017). This includes water runoff and groundwater collected within the mining pit, recycled water from the coal wash plant, runoff from the mine infrastructure area (MIA) and excess water in the tailings drying cells.
- Sediment Water - rainfall and runoff generated by disturbed landforms including overburden dumps, pre-cleared areas and rehabilitation that is not yet established. This water does not contain elevated contaminant concentrations other than suspended solids and must be treated through the erosion and sediment control system.
- Clean Water – runoff from undisturbed or established rehabilitation areas that has not come into contact with disturbed land or active mining or industrial areas.
- Raw Water – untreated water supplied from an external water supply.
- Potable Water – treated water suitable for human consumption.

5.3 Water Management System

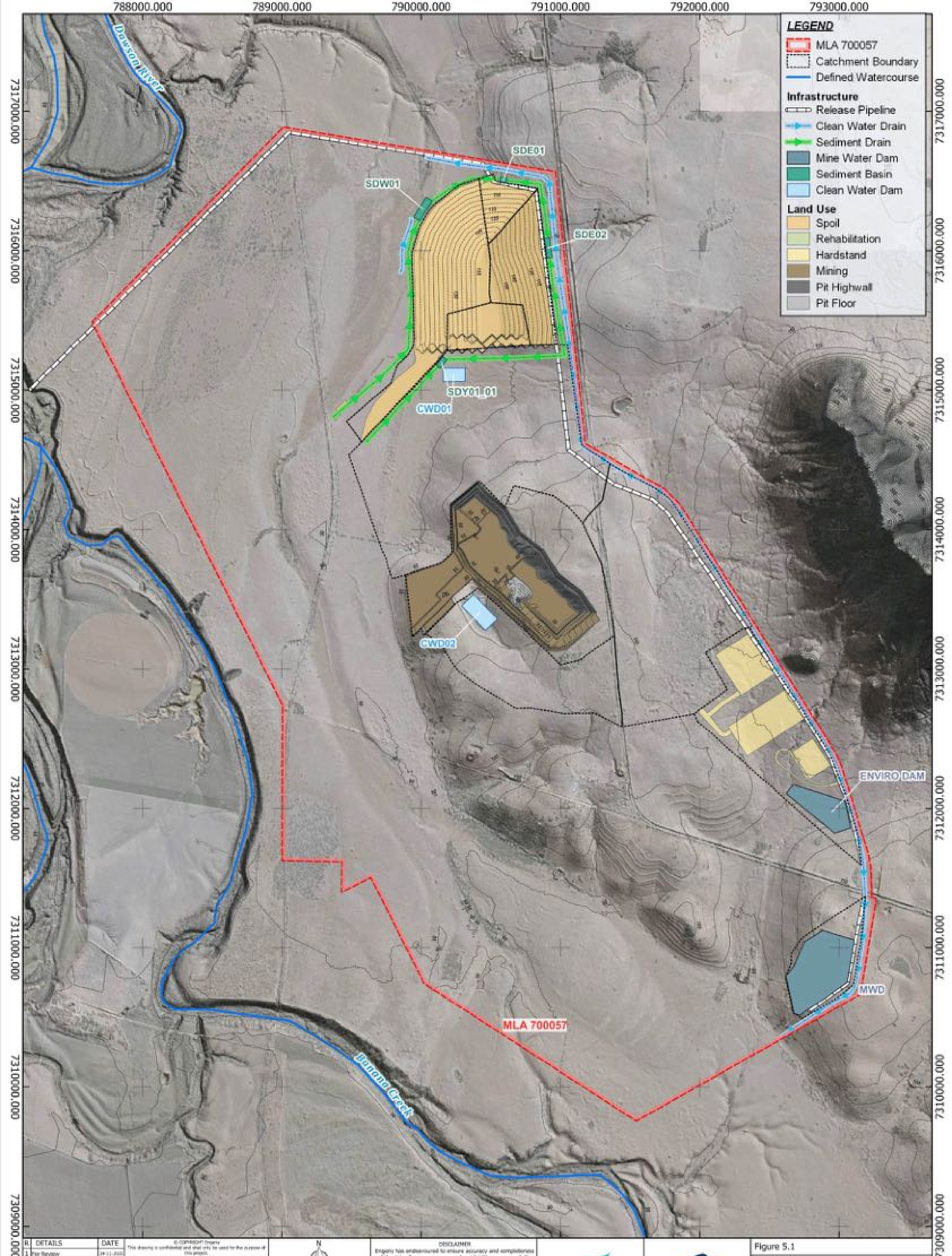
5.3.1 Proposed Water Management Strategy Overview

The proposed water management strategy can be summarised as:

- Diversions of clean catchment around mine infrastructure and disturbed land through diversion drains and pumping from upstream clean storages.
- Containment of mine affected runoff in dedicated storages for reuse in the Project.
- Capture and treatment of disturbed area runoff in sediment basins and other sediment control infrastructure.
- Minimise external catchment runoff reporting to the mining pit.
- Preferential re-use of mine affected water and sediment runoff captured by the Project to supply operational water demands (dust suppression and CHPP demands).
- Progressive rehabilitation/stabilisation of spoil dump and mine infrastructure areas to reduce the generation of sediment runoff.

The mine water management system includes mine affected water storages, sediment storages, clean water storages and drainage diversion of undisturbed catchments. The proposed water management infrastructure is summarised in the following sections and shown in

to Figure 5.7.



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BARALABA SOUTH

Figure 5.1

Baralaba South Pty Ltd
Baralaba South Project
Surface Water Impact Assessment

Year 1 Water Management Infrastructure

Drg Ref:
Q1018_004-1-SKE-001

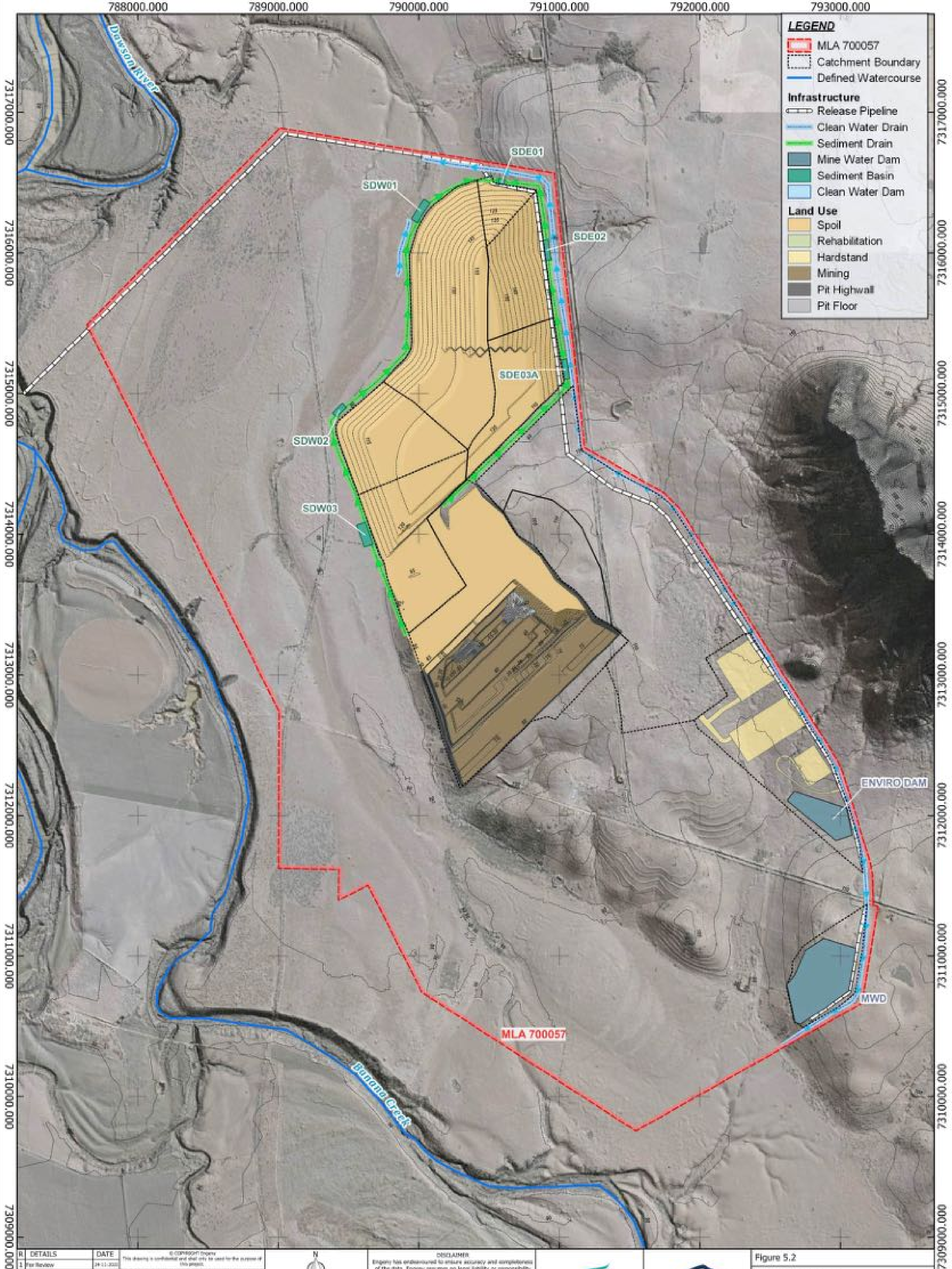

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Figure 5.2

Baralaba South Pty Ltd
Baralaba South Project
Surface Water Impact Assessment

Year 3 Water Management Infrastructure

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QC1018_004-1-SKE-002

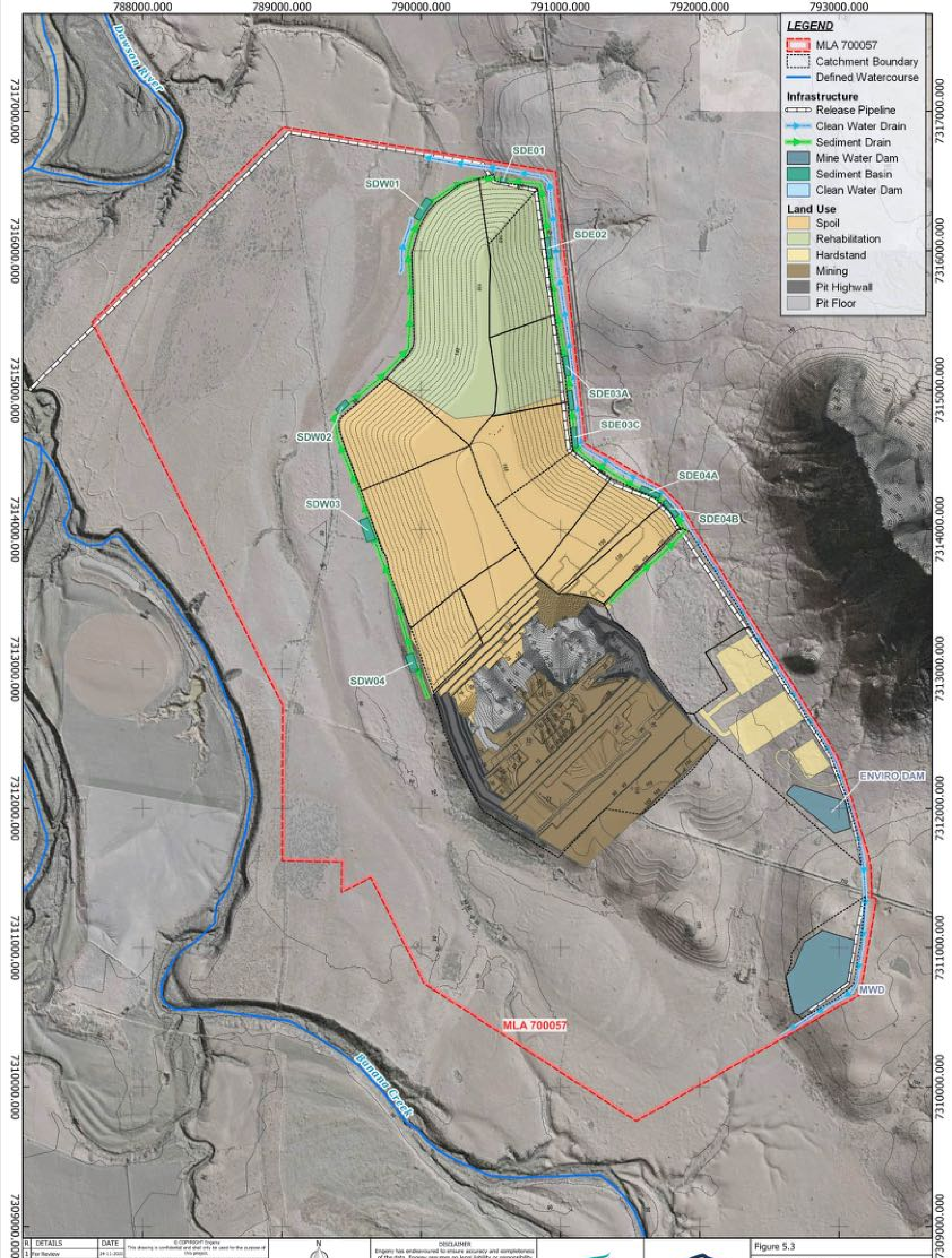

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Figure 5.3

Baralaba South Pty Ltd
Baralaba South Project
Surface Water Impact Assessment

Year 6 Water Management Infrastructure

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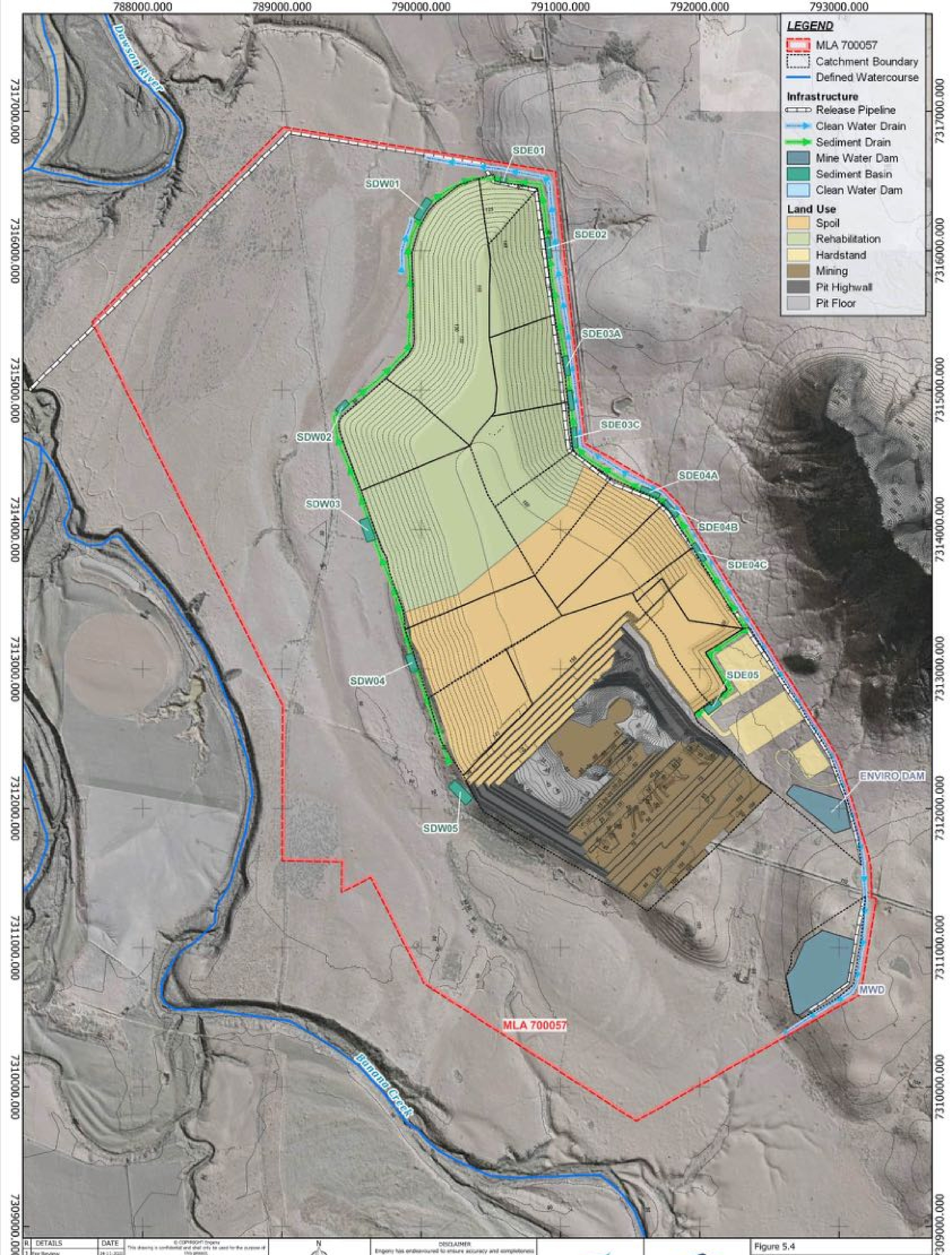

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Figure 5.4

Baralaba South Pty Ltd
Baralaba South Project
Surface Water Impact Assessment

Year 11 Water Management Infrastructure

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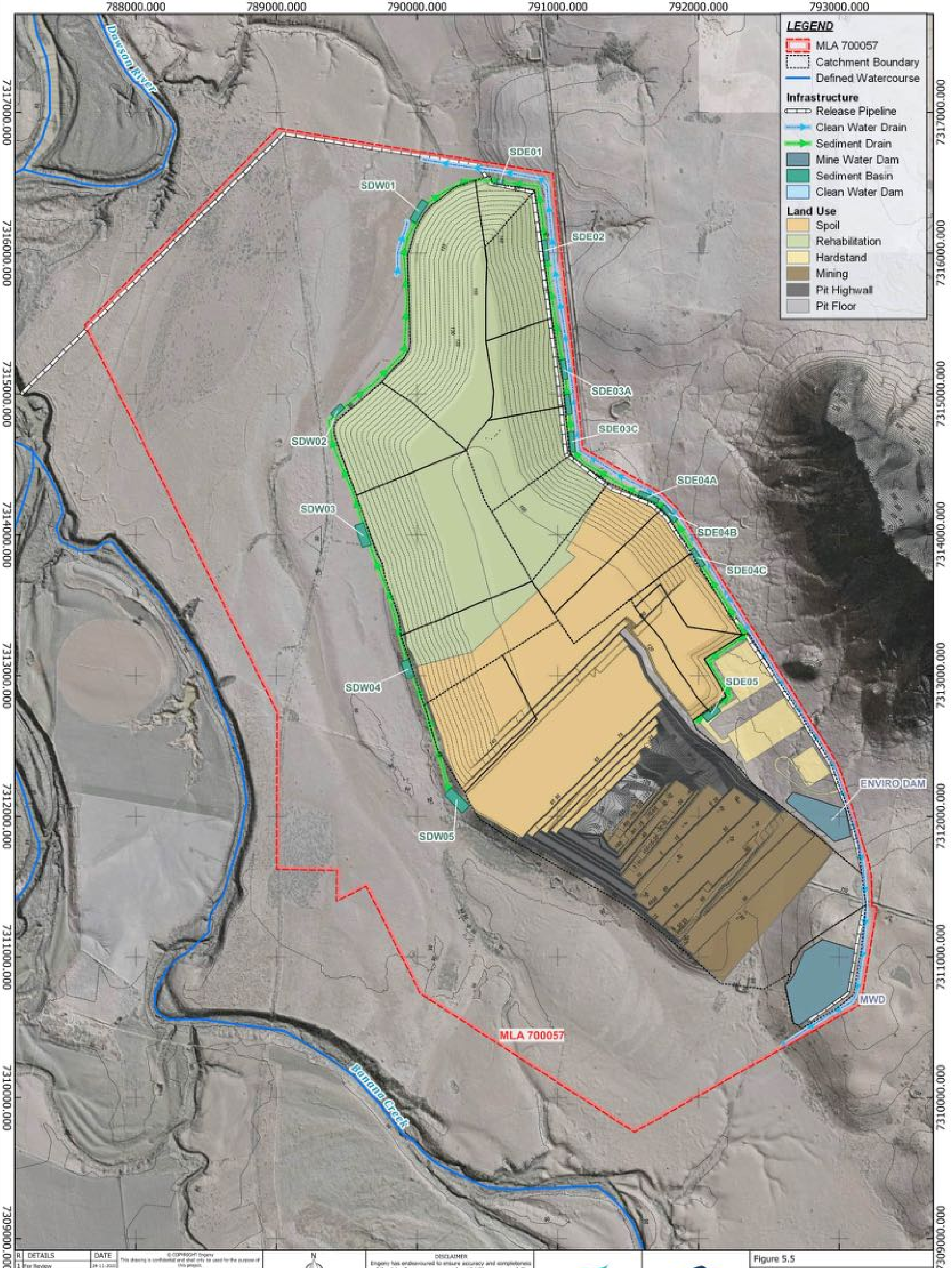

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BARALABA SOUTH

Figure 5.5

Baralaba South Pty Ltd
Baralaba South Project
Surface Water Impact Assessment

Year 14 Water Management Infrastructure

Drg Ref:
Q1018_004-1-SKE-005

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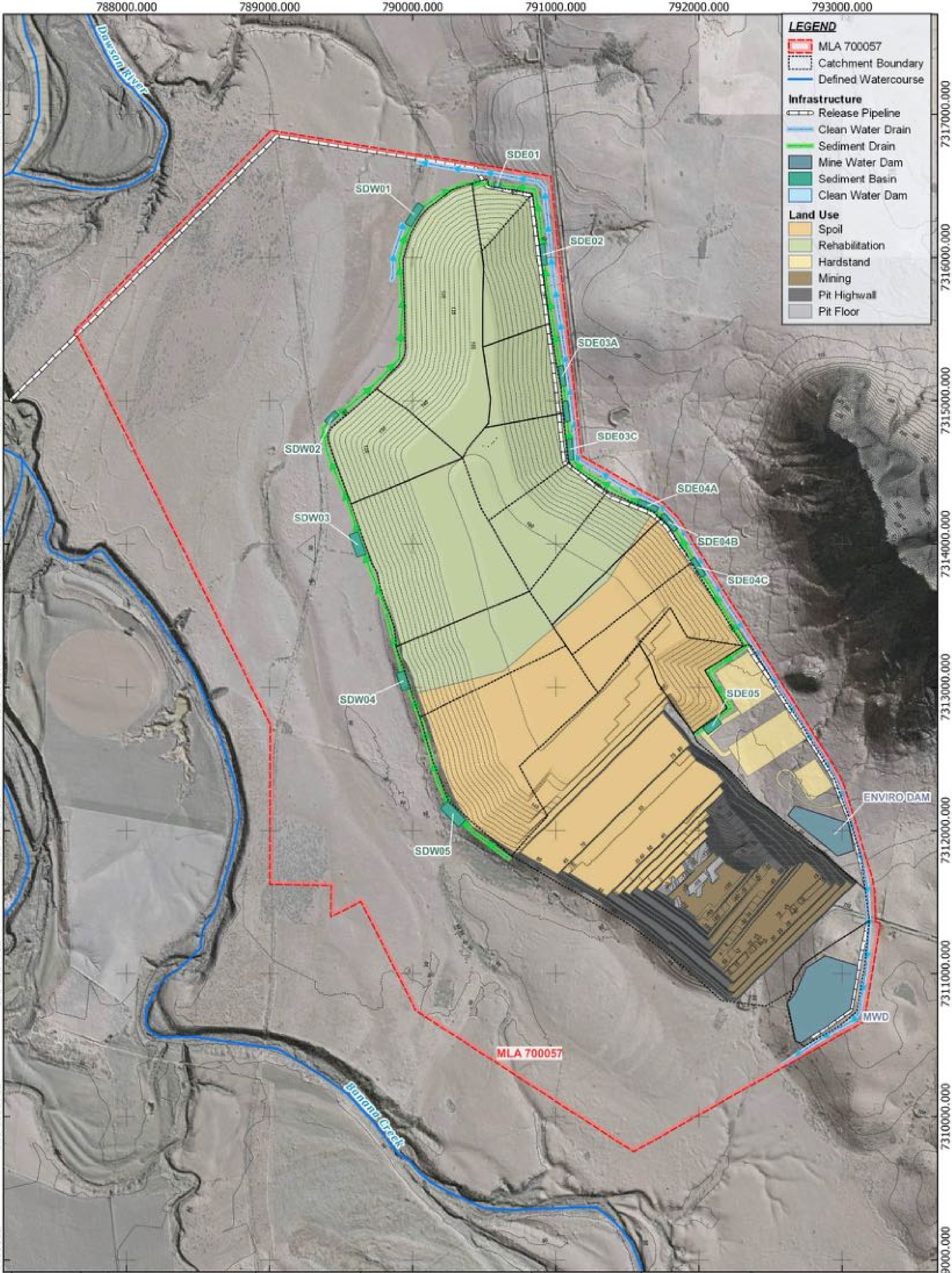

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Figure 5.6

Baralaba South Pty Ltd
Baralaba South Project
Surface Water Impact Assessment

Year 19 Water Management Infrastructure

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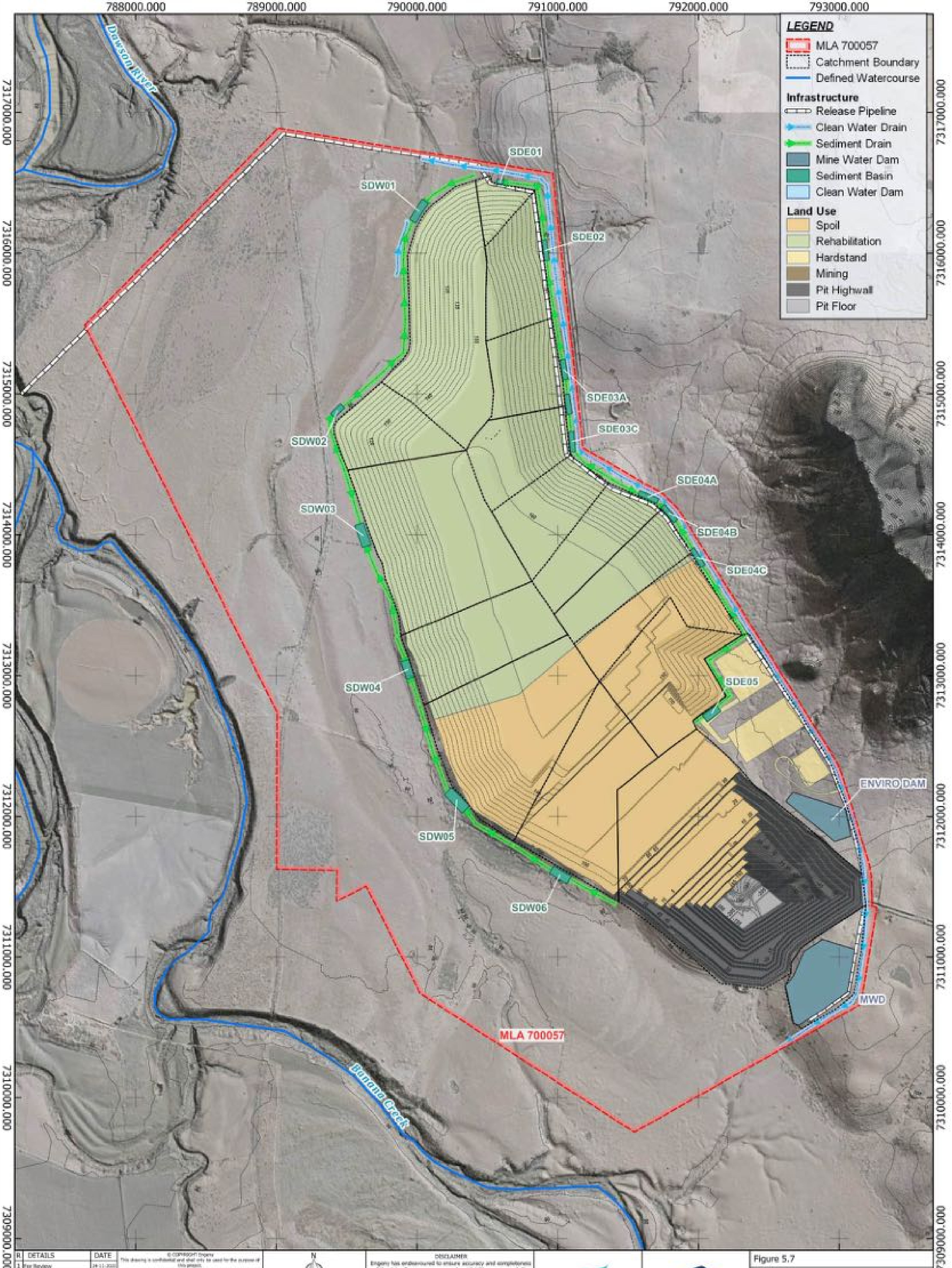

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SCALE @ A3 - 1:23,000
GDA94 / MGA zone 55

DATA SOURCE
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BARALABA
SOUTH

Figure 5.7

Baralaba South Pty Ltd
Baralaba South Project
Surface Water Impact Assessment

Year 23 Water Management Infrastructure

Drg Ref:
Q1018_004-1-SKE-007

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5.3.2 Mine Water Storages

Mine water storages will be used to contain surface water runoff and groundwater collected within the mining pit, recycled water from the coal wash plant, runoff from the MIA and excess water in the tailings drying cells. Site storages for the management of mine affected water are summarised in Table 5.1.

Water collected in the mining pit from rainfall events and groundwater ingress, will be dewatered to Mine Water Dam (MWD) and then transferred to Environmental Water Dam (Enviro Dam) to supply to CHPP and dust suppression demands.

During dry conditions MWD will be maintained empty with site inventory consolidated in Enviro Dam to reduce evaporation losses. When total site inventory is very low, Project water demands will be supplemented using existing water allocations held by Baralaba South Pty Ltd or related entities (see Section 5.4.5).

During wet conditions MWD will be used for storage of excess water to maintain pit dewatering. The site water management strategy will look to release water from MWD when total site inventory is high and streamflow conditions within the receiving waterways meet nominated thresholds in accordance with the proposed mine water release conditions (see Section 5.6).

The preliminary consequence category assessment of the dams (Section 9.2) has been assessed as a having a “low” consequence for “failure to contain – overtopping” and therefore is not required to have design storage allowance (containment standard). The mine water storages however have been conservatively sized to overtop in less than 5% of years (95th percentile containment). The containment standard of the proposed mine water storages is assessed in Section 6.2.3 which shows MWD and Enviro Dam are not expected to overtop over the Project Life. Mine water storages are located outside of the Dawson River Probable Maximum Flood extent (Engeny, 2023).

Table 5.1 also provides the estimated maximum embankment height for the storages based on the concept design. It should be noted that the embankment heights will be reviewed as part of the future detailed design for each dam.

TABLE 5.1: MINE AFFECTED WATER STORAGES

ID	Description	Catchment Area	Full Supply Volume	Estimated Embankment Height
Mine Water Dam (MWD)	Embankment dam sized to maximum capacity allowing storage of dewatered inventory from Pit and sediment dams. Dam used as intermediary storage for CHPP process water. Allowing to capture recycled water from coal wash plant and mechanical dewatering.	29 ha	1,220 ML	~ 14 m
Environmental Water Dam (Enviro Dam)	Storage to capture runoff from MIA area, ROM and rejects stockpile.	79 ha	410 ML	~ 8 m

5.3.3 Sediment Storages

Sediment dams are proposed as the primary mechanism to manage runoff from overburden and disturbed areas, which have elevated concentrations of suspended solids. Sediment dams form a key part of the erosion and sediment control management strategy to protect the Environmental Values of the receiving environment. The principles to be implemented for the Project in managing erosion and sediment control include:

- Minimising surface disturbance.
- Progressive rehabilitation of spoil dumps and disturbed areas to prevent sediment generation.
- Separation of runoff from disturbed and undisturbed areas through drainage controls.
- Construction of sediment dams to contain sediment laden runoff.

The principles for managing erosion and sediment control for the Project are to first prevent the generation of sediment runoff through minimising disturbance, progressive rehabilitation and separation of water types and then secondly treat sediment runoff using sediment dams when prevention is not possible or practical.

Sediment dams are required to capture runoff from disturbed areas including access roads, unrehabilitated spoil and cleared land. Sediment dams for the Project are sized in accordance with the International Erosion Control Association Guidelines methodology for "Type D" sediment basins (IECA, 2018). "Type D" sediment basins were selected as the high maintenance requirements of "Type A" and "Type B" (flow through chemical flocculation basins) are not practical in a mining operation and "Type C" basins are not suitable for dispersive or clayey soil types. The "Type D" sediment basins are designed to operate on a 5-day cycle, that being filling from a storm event and then dewatering prior to the next storm event within a 5-day period. The basins are designed to contain a nominated 5-day storm rainfall depth based on the catchment conditions (soil types) and the characteristics of the receiving environment. High flows are directed through the basins which allow the basins to treat small to medium flow events at a very high efficiency while still allowing coarse sediments to settle out in high flow events.

The sediment basin storage capacities are sized to allow for a settling zone volume to contain a 5 day, 85th percentile rainfall event and a sediment storage zone volume equal to 50% of the settling volume. The 85th percentile standard was adopted which is required for sediment basin with a design life greater than 6 months and discharging to sensitive receiving waters. Volumetric runoff coefficients adopted for the basin sizing were selected based on expected soil types encountered at the site (clay materials). The inputs used in the sizing of the sediment dams for the Project are summarised in Table 5.2. Assessment of overflows from the sediment basins (overflow frequency and volumes) are assessed in Section 6.2.4.

Sediment dams are required around the out-of-pit spoil dump to treat runoff containing sediments before discharging off site. Placement of sediment dams was determined based on topographical low points and where water would naturally accumulate and discharge from site. The sediment dams have also been placed at regular frequencies which reduces the dam sizes and allows simpler access for desilting and maintenance activities (compared to a single consolidated storage).

Sediment dams will include pumping infrastructure for dewatering of the settling zone storage volume in a maximum 5 day period to allow their continued effectiveness and availability to treat sediment-affected runoff in successive storm events. The sediment dams will dewater to the mine water system to maximise re-use of runoff within the Project area for water demands and minimise the use of raw water. This is a conservative approach for assessing impacts to streamflow and provides additional water supply for processing and dust-suppression demands, hence reducing reliance on the water allocations (refer to Section 5.4).

The design of sediment dams is based on the expected geochemistry of waste material, however, ongoing monitoring of water quality during operations will be required to confirm contained runoff does not include other contaminants and as such require alternative management strategies.

TABLE 5.2: SEDIMENT DAM SIZING INPUTS (IECA, 2018)

Parameter	Value
Y% (constant Table B28)	Y% = 85% Basins discharging to sensitive receiving waters
$I_{(1\text{ year, }120\text{ hour})}$	0.92 mm/hr (110 mm rainfall total) BOM IFD 2016 at the Project locality
K1 and K2 (constant Table B28)	23.2 and 12.6 Basins discharging to sensitive receiving waters
Y%, 5-day Rainfall ($R_{(y\%,\ 5day)}$) (Eqn B36)	K1. $I_{(1\text{ year, }120\text{ hour})}$ + K2 = 33.9 mm

Parameter	Value
Soil Hydrologic Group (Table B31)	Group D (clay)
C_v (volumetric runoff coefficient) (Table B31)	0.56

Site storages for the management and treatment of sediment runoff are summarised in Table 5.3, with the function of each dam listed in Table 5.3. Table 5.3 also lists the estimated maximum embankment height for the storages based on the concept design. The sediment dams have small embankments as the storages are proposed to be mostly excavated. It should be noted that the embankment heights will be reviewed as part of the future detailed design for each dam.

TABLE 5.3: SEDIMENT DAMS DETAILS

ID	Function	Catchment Area	Full Supply Volume	Estimated Maximum Embankment Height	Associated Mine Stages
Western Sedimentation Dam 1 (SDW01)	Manages sediment runoff generated from north western section of the northern spoil dump.	92.4 ha	26.3 ML	~1 m	Year 1 – 23
Western Sedimentation Dam 2 (SDW02)	Manages sediment runoff generated from western section of the northern spoil dump	32.8 ha	9.3 ML	~1 m	Year 3 – 23
Western Sedimentation Dam 3 (SDW03)	Manages sediment runoff generated from western section of the spoil dump	100.4 ha	28.6 ML	~1 m	Year 3 – 23
Western Sedimentation Dam 4 (SDW04)	Manages sediment runoff generated from south-western section of the spoil dump	51.6 ha	14.7 ML	~1 m	Year 6 – 23
Western Sedimentation Dam 5 (SDW05)	Manages sediment runoff generated from south-western section of the spoil dump	98.2 ha	27.9 ML	~1 m	Year 11 – 23
Western Sedimentation Dam 6 (SDW06)	Manages sediment runoff generated from southern section of the northern spoil dump.	72.6 ha	20.7 ML	~1 m	Year 23
Eastern Sedimentation Dam 1 (SDE01)	Manages sediment runoff generated from northern section of the northern spoil dump.	10.0 ha	2.8 ML	~1 m	Year 1 – 23
Eastern Sedimentation Dam 2 (SDE02)	Manages sediment runoff generated from north-eastern section of the northern spoil dump.	33.7 ha	9.6 ML	~1 m	Year 1 – 23
Eastern Sedimentation Dam 3A (SDE03A)	Manages sediment runoff generated from north-eastern section of the spoil dump.	29.8 ha	8.5 ML	~1 m	Year 3 – 23
Eastern Sedimentation Dam 3B (SDE03B)	Manages sediment runoff generated from north-eastern section of the spoil dump.	34.0 ha	9.7 ML	~1 m	Year 6 – 23
Eastern Sedimentation Dam 3C (SDE03C)	Manages sediment runoff generated from eastern section of the spoil dump.	34.4 ha	9.8 ML	~1 m	Year 6 – 23
Eastern Sedimentation Dam 4A (SDE04A)	Manages sediment runoff generated from eastern section of the spoil dump.	33.1 ha	9.4 ML	~1 m	Year 6 – 23

ID	Function	Catchment Area	Full Supply Volume	Estimated Maximum Embankment Height	Associated Mine Stages
Eastern Sedimentation Dam 4B (SDE04B)	Manages sediment runoff generated from eastern section of the spoil dump.	32.9 ha	9.4 ML	~1 m	Year 6 – 23
Eastern Sedimentation Dam 4C (SDE04C)	Manages sediment runoff generated from eastern section of the spoil dump.	34.3 ha	9.8 ML	~1 m	Year 11 – 23
Eastern Sedimentation Dam 5 (SDE05)	Manages sediment runoff generated from southern section of the spoil dump.	55.8 ha	15.9 ML	~1 m	Year 11 – 23
Year 1 Sedimentation Dam 1 (SDY01_01)	Manages sediment runoff generated from eastern section of the initial northern spoil dump.	17.1 ha	4.9 ML	~1 m	Year 1 – 3

5.3.4 Clean Water Management

Diversion of clean catchment has been maximised to reduce the harvest of clean runoff in the mine water management system. Clean water is proposed to be diverted by two mechanisms:

- Catchment diversion drains where topography allows.
- Clean water dams with pumped dewatering.

All runoff reporting to clean water dams is generated by undisturbed catchment within the MLA and therefore would be expected to be of a quality acceptable for direct release to the Dawson River. The clean water dams are used to intercept the natural catchment upstream of the mining pit highwall for the purposes of preventing unnecessary accumulation of mine affected water and are not planned for water use. Clean water dams have been designed to contain a nominal 2-year, 24 hour runoff volume with dewatering capacity to empty the maximum storage volume within 20 days.

There are two clean catchment diversions on the eastern side of the MLA which redirect runoff from Mount Ramsay around the Project. A third clean water drain involves the drainage diversion of a stream order 3 waterway (Tributary 8) around the proposed out of pit dump to ensure the drainage path is not impacted by the Project (Ecological Service Professionals, 2023).

A summary of the proposed clean water diversion infrastructure is provided in Table 5.4, with the functionality of each dam listed in Table 6.1. The clean water storages used to divert clean catchments are proposed to be mostly excavated storages without permanent water retaining embankments.

TABLE 5.4: CLEAN WATER DIVERSION INFRASTRUCTURE

Feature/Structure ID	Description	Catchment Area	Size (capacity/length)	Associated Mine Stages
Northern clean water drain	Diverts clean catchment runoff east of MLA from mining activities, diverting it south into the Dawson River	470 ha	4.3 km drainage channel	Year 1-23
Southern clean water drain	Diverts clean catchment runoff east of MLA from mining activities, diverting it south into Banana Creek.	586 ha	3.7 km drainage channel	Year 1-23
Tributary 8 diversion drain	Minor realignment of Tributary 8 around the proposed spoil dump toe and sediment collection drain at the northern extent of the MLA	3,180ha	0.39 km drainage channel	Year 1-23
Clean Water Dam 1 (CWD1)	Captures clean catchment runoff from south-of the northern spoil dump.	181 ha	88 ML	Year 1-3
Clean Water Dam 2 (CWD2)	Captures clean catchment runoff from south of mining pit.	66 ha	32 ML	Year 1-3

5.4 Water Demand and Supply

5.4.1 Process Water Demands

The CHPP will require a reliable supply of water to maintain project operation. The water demands for the CHPP have been estimated from a total moisture balance of the processing plant, based on proposed coal throughput, and expected input and output stream moisture contents. A summary of the input data used to calculate water demands is provided in Table 5.5.

The CHPP for the Project will include mechanical dewatering of coal tailings which allows the tailings water content to be significantly lower than that of conventional tailings. The major advantage of this processing methodology is that a traditional tailings dam is not required as tailings can be deposited directly into overburden and spoil dumps. The secondary advantage is that water demands for mechanical dewatering are significantly lower compared to traditional tailings dams. Annual washed coal and water demands are provided in Table 5.6.

TABLE 5.5: CHPP PARAMETERS

Parameter[1]	Value
ROM coal moisture content	5.7%
Product coal moisture content	10.6%
Wet tailings and Rejects moisture content	70%
Belt press filter tailings moisture content	30%
Product yield	71.1%

1 – Moisture content defined as the proportional weight of water entrained in the total weight of the various coal streams

TABLE 5.6: PRODUCTION SCHEDULE AND ESTIMATED WATER DEMANDS

Year	Washed Coal (tpa)	CHPP Water Demand (ML/year)	Year of Operation	Washed Coal (tpa)	CHPP Water Demand (ML/year)
Year 1	1,251,073	175	Year 13	2,250,000	340
Year 2	2,141,756	313	Year 14	2,189,267	325
Year 3	2,030,053	304	Year 15	2,416,509	362
Year 4	2,100,000	306	Year 16	2,500,000	368
Year 5	2,200,000	325	Year 17	2,500,000	363
Year 6	2,300,000	336	Year 18	2,182,084	317
Year 7	2,400,000	350	Year 19	2,100,000	313
Year 8	2,500,000	381	Year 20	2,019,095	294
Year 9	2,500,000	376	Year 21	2,142,522	313
Year 10	2,317,103	351	Year 22	1,309,976	198
Year 11	2,250,000	327	Year 23	750,948	107
Year 12	2,250,000	340			

5.4.2 Dust Suppression Demands

Dust suppression demands for the Project have been calculated based on planned water truck operating hours and water truck specification. The planned water truck operating hours were used to determine the average daily water cart loads which was then used to calculate a daily demand based on the water truck capacity.

The Project is planning on using CAT 777 water trucks which have a water carrying capacity of 75kL and an assumed fill efficiency of 90% (90% of the truck capacity is filled for each load). Historical water truck operating information for the Baralaba North Mine has been reviewed to determine an average number of loads completed per operating hour of 0.78. The calculated water truck dust suppression demand is presented in Table 5.7.

Dust suppression demands have also been calculated as part of the Air Quality and Greenhouse Gas Assessment for the Project (Trinity Consulting Australia, 2023). The dust suppression demands were calculated based on haul road length, average daytime traffic and the daily potential evaporation for the Project years 1, 3 and 11 and were assumed to linearly interpolate between Year 1 and 11 and then remain constant after Year 11 (Trinity Consulting Australia, 2023). The average demand calculated by Trinity Consulting Australia was 526 ML/year which is similar to the average demand of 488 ML/year calculated using the truck operating hours. Using the truck operating hours to calculate water demands allowed calculation of a demand for each year of the Project that closely aligns with the planned production.

TABLE 5.7: DUST SUPPRESSION WATER DEMANDS

Year	Truck Operating hours (hours)	Water Demand (ML/year)	Year of Operation	Truck Operating hours (hours)	Water Demand (ML/year)
Year 1	13,277	629	Year 13	7,915	375
Year 2	10,608	503	Year 14	10,109	479
Year 3	13,182	625	Year 15	11,821	560
Year 4	14,076	667	Year 16	12,198	578
Year 5	14,068	667	Year 17	9,050	429
Year 6	14,127	669	Year 18	11,033	523
Year 7	8,751	415	Year 19	8,808	417
Year 8	8,369	397	Year 20	10,092	478
Year 9	10,417	494	Year 21	11,479	544
Year 10	10,939	518	Year 22	4,721	224
Year 11	11,552	547	Year 23	2,339	111
Year 12	7,737	367			

5.4.3 Potable Water and Other Demands

In addition to process and dust suppression demands, the Project will also require water for vehicle wash down and potable water supply for the MIA and workshop areas. Water for wash down will be supplied from the mine water system and will have a constant demand of approximately 30 kL/day with an expected water loss rate of 30% (11ML/year). The annual potable water demands are estimated to be 70 kL/week (3.6 ML/year). Potable water will be imported to site by water trucks from the Baralaba township potable water reticulation system.

A primary sewage treatment process (STP) will be installed during construction. Septic tanks will collect liquid and sludge waste products, which will be routinely transported off-site to Biloela for further processing and disposal.

During operations, either the primary STP will continue to be utilised (for transport off-site for processing and disposal) or a package STP will be constructed within the administration area. The STP will be designed to treat 100% of the potable water (200L per person per day), assumed to become wastewater and returned to the STP for treatment.

Treated wastewater from the STP will be disposed of using low height sprays in a designated irrigation area. An effluent disposal system will incorporate a buffer of at least 50 m to comply with guideline requirements, and warning signs complying with Australian Standard AS 1319. In addition, the design of the irrigation system will take into account the need to ensure no runoff from the disposal area takes place.

Model for Effluent Disposal Using Land Irrigation (MEDLI) modelling has been undertaken as part of the Project EIS to assess the adequacy of the proposed irrigation area to the west of the Moura-Baralaba road. The STP design recommended as an outcome of the MEDLI modelling is a low maintenance system with secondary treatment capability and the ability to produce at least Class C effluent (Stantec, 2023).

Modelling results determined that an area of just over 2 ha would be sufficient for irrigation, given the soils and vegetation of the area assessed. The area nominated is suitable to ensure that drainage controls can be implemented. The waste sludge is expected to be removed every 12–18 months. Wet weather storage will be located adjacent to the plant with a capacity determined by modelling to ensure irrigation of saturated soil is avoided during wet weather periods.

5.4.4 Onsite Water Supply

Project water sources will be supplied according to the following priority (excluding potable water supplies):

- Mine water supplied from pit dewatering (including groundwater inflows).
- Recycled process water recovered from the CHPP tailings thickener and belt press filters.
- Surface runoff water captured and stored within water dams (Including sediment dams which pump into the mine water dams).
- Water supply ‘make-up’ sourced from water allocations from the Dawson Valley Water Supply Scheme. Related entities of the proponent currently hold over 1,418 ML of water allocation from the Fitzroy Basin, Dawson River Zones C/D and 315ML of water licences from the Broadmeadow properties.

The Project will capture water from both rainfall/runoff from disturbed areas and groundwater. These water supplies will interact with mining operations or overburden and spoil dumps and will therefore be considered mine affected water. The proposed water management strategy seeks to divert as much clean catchment water away from the operation as possible. Remaining catchment, and groundwater, will be captured and pumped to key water supply dams on site which will then be preferentially utilised for dust suppression and process demands.

It is proposed that the network of sediment and process water dams direct dewatering to a single mine water supply and pit dewatering dam (Mine Water Dam). This dam will be located to the east of the mining and infrastructure areas (see Figure 5.1 to Figure 5.7). It is expected that water from the pit and recycled water from the CHPP will be of appropriate quality for dust suppression and processing demands.

5.4.5 External Raw Water Supply

External supply of water to the mine is expected in median conditions where demand of the net site water balance exceeds inputs from rainfall runoff and groundwater.

Baralaba South Pty Ltd is a wholly owned subsidiary of Wonbindi Coal Pty Ltd (Wonbindi Coal). Wonbindi Coal has water allocations under the Dawson Valley Water Supply Scheme. Details of the allocations available to Wonbindi Coal are provided in Table 5.8. It has been assumed allocations will be available for use at the start of the Project. The Project also has access to 315ML of unsupplemented water licences held by the Broadmeadow properties where the Project is located.

Medium reliability water allocations within the Dawson Valley Water Supply Scheme have a monthly supplemented water sharing index of at least 82%. Water allocations can be assumed to be fully supplied in 82% of months (Water Plan (Fitzroy Basin) 2011).

The Project accessing this allocation will not impact other existing licence holders as water allocations are existing entitlements (i.e. no new water entitlements are being sought for the Project).

Water supply infrastructure will include a pump and pipe system to extract and transfer water from the Dawson River to the Environmental Water Dam. The water supply pipeline is proposed to be located within the easement of, and adjacent to the water release pipeline.

TABLE 5.8: WATER ALLOCATIONS HELD

Entitlement (#)	Volume (ML)	Issue Date	Reliability	Dawson River Zone	Crops	Mining	Property	Company
5176 CP AP6829	52	14/12/2018	Medium	Zone C	100%	-	Coominglah	Wonbindi
5175 CP AP6829	148	14/12/2018	Medium	Zone D	100%	-	Coominglah	Wonbindi
5126 CP AP6829	118	14/12/2018	Medium	Zone C	100%	-	Coominglah	Wonbindi
347 CP AP6829	150	14/12/2018	Medium	Zone C	100%	-	Coominglah	Wonbindi
5303 CP AP6829	450	14/12/2018	Medium	Zone D	100%	-	Coominglah	Wonbindi
736 CP AP6829	400	10/07/2013	Medium	Zone D	-	100%	Willeroo / Dawson Dell	Wonbindi
5569 CP AP6829	50	2/02/2018	Medium	Zone D	-	100%	Willeroo / Dawson Dell	Wonbindi
5759 CP AP6829	50	21/01/2014	High	Zone D	-	100%	Broadmeadow	Cacatua

5.5 Processing Waste Management

The CHPP will produce three major waste streams which will require active management and containment. These are summarised in Table 5.9 along with the proposed management strategy. The CHPP will utilise a belt filter press to dewater the CHPP waste material to enable disposal of the majority of the CHPP waste streams in pit mixed with the overburden spoil material.

A small portion of the CHPP waste stream which has a high ash content will not be suitable for the belt filter press or will be collected during belt filter system downtime and will be deposited in emergency drying cells within the MIA disturbance areas. Once the tailings waste material has sufficiently dried the solids will be excavated, trucked, and deposited within the overburden dumps together with the other CHPP waste material.

TABLE 5.9: PROCESS WASTE MANAGEMENT

Waste Stream	Description	Management
Dry Coal Tailings (belt filter press)	Water content <30% Conveyed via trucking	Dry coal tailings will be deposited into spoil dumps.
Wet Coal Tailings (non-belt filter press)	Water content ~70% Conveyed to drying cells via pumping Dried then conveyed via trucking	Wet coal tailings will be deposited into temporary drying cells within the MIA disturbance area until water content is reduced to enable trucking and deposition in spoil dumps.

5.6 Controlled Mine Water Release

Mine water release is proposed for the Project water management system to prevent accumulation of mine affected water on site. Controlled mine water releases are proposed to be undertaken from Mine Water Dam via a pumped transfer to the Dawson River during natural flow events to provide dilution to the release flows. Mine water release conditions for the Project have been developed in accordance with the approach presented in F11 of the *Model Mining Conditions* (DES, 2017).

The proposed mine water release conditions dictate natural flow conditions when releases can occur and the allowable maximum release rates and water quality. The release conditions have been designed to ensure release flows are significantly diluted with natural flows in the Dawson River to ensure downstream water quality will not exceed the receiving waterway water quality limits. The proposed release conditions are governed by electrical conductivity, as salinity (measured as electrical conductivity) is the key of-concern surface water quality parameter associated with the Project.

Release opportunities are governed by the following conditions:

- high flow conditions in the Dawson River adjacent the Project:
  - High flow conditions in the Dawson River occur when discharge is greater than 100 m^3/s.
- Maximum allowable release rate:
  - Maximum release rate of 0.5 m^3/s to provide a minimum 1:200 dilution with natural flows (for a natural flow condition in the Dawson River of 100 m^3/s).
- End of pipe water quality is lower than the defined end of pipe limit:
  - The end of pipe limit is defined as 10,000 µS/cm as detailed in the Model Mining Conditions (DES, 2017).
- Electrical conductivity at the downstream monitoring location is maintained at lower than 500 µS/cm and between pH 6.5 and pH 9.0.

Mine water release can occur at a maximum rate of 0.5 m^3/s when flow in the Dawson River is above the minimum flow threshold of 100 m^3/s and the release storage water quality characteristics are less than the end of pipe limits of 10,000 µS/cm. The maximum release rate and end of pipe limits provide a minimum 1:200 dilution ratio which ensures the water quality characteristics at the downstream monitoring point do not exceed the receiving waterway release limits. The proposed mine water release decision process is illustrated in Figure 5.8.

End of pipe water quality is defined as the quality of the water being released at the point of discharge. The proposed end of pipe release limit of 10,000 µS/cm has been selected based on the upper end of the end of pipe EC range recommended in the Model Mining Conditions (3,500 µS/cm to 10,000 µS/cm) for high flow stream conditions (DES, 2017). The upper EC limit of 10,000 µS/cm has been selected to provide a conservative estimate of the Project's potential impacts on Dawson River water quality for this surface water impact assessment. A range of EC and release rate values for the low, medium, and high flow conditions will be determined for the Project's site Environment Authority at a future date in accordance with the Model Mining Conditions (DES, 2017).

The receiving waterway release limits have been developed with consideration of the Baralaba North Mine Environmental Authority (Figure 8.1), the water quality objectives for the receiving waters (Section 3.3), and historical Dawson River water quality (Section 2.5).

The mine water release conditions for the Project will be further refined within the conditions of the site Environment Authority, however the release conditions adopted for the surface water assessment are considered conservative for the accumulation of mine affected water and associated impacts to streamflow.

The mine water release strategy is summarised in Table 5.10, Table 5.11 and Table 5.12. The proposed release location for the Project water management system is depicted in Figure 5.9.

TABLE 5.10: END OF PIPE MINE AFFECTED WATER RELEASE LIMITS

Quality Characteristic	End of Pipe Release Limits[1]	Monitoring Frequency
Electrical Conductivity (µS/cm)	10,000 µS/cm	Daily during release (the first sample must be taken within two hours of commencement of release)
pH	6.5 (min) 9.0 (max)	

[1] End of pipe water quality is the quality of the water being released.

TABLE 5.11: RELEASE POINT CONDITIONS

Receiving Water Description	Release Point	Gauging Station Description	Easting (GDA94)	Northing (GDA94)	Minimum Flow in Receiving Water Way for Release Event	Maximum Release Rate	Flow recording frequency
Dawson River	RP1	Dawson River Confluence	149.822	-24.0873	100 m3/s	0.5 m3/s	Daily

TABLE 5.12: RECEIVING WATERWAY RELEASE LIMITS

Quality Characteristic	Release Limits	Monitoring Frequency
Electrical Conductivity (µS/cm)	500 µS/cm	Daily during release (the first sample must be taken within two hours of commencement of release)
pH	6.5 (min) 9.0 (max)	

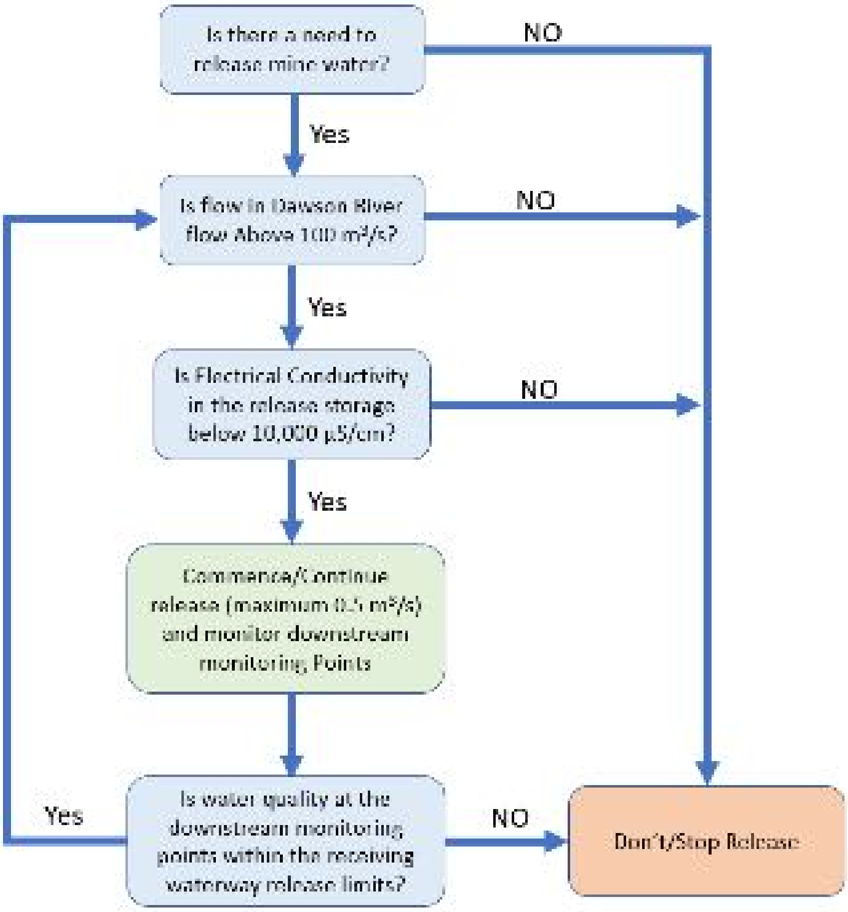


Figure 5.8: Mine Water Release Decision Tree

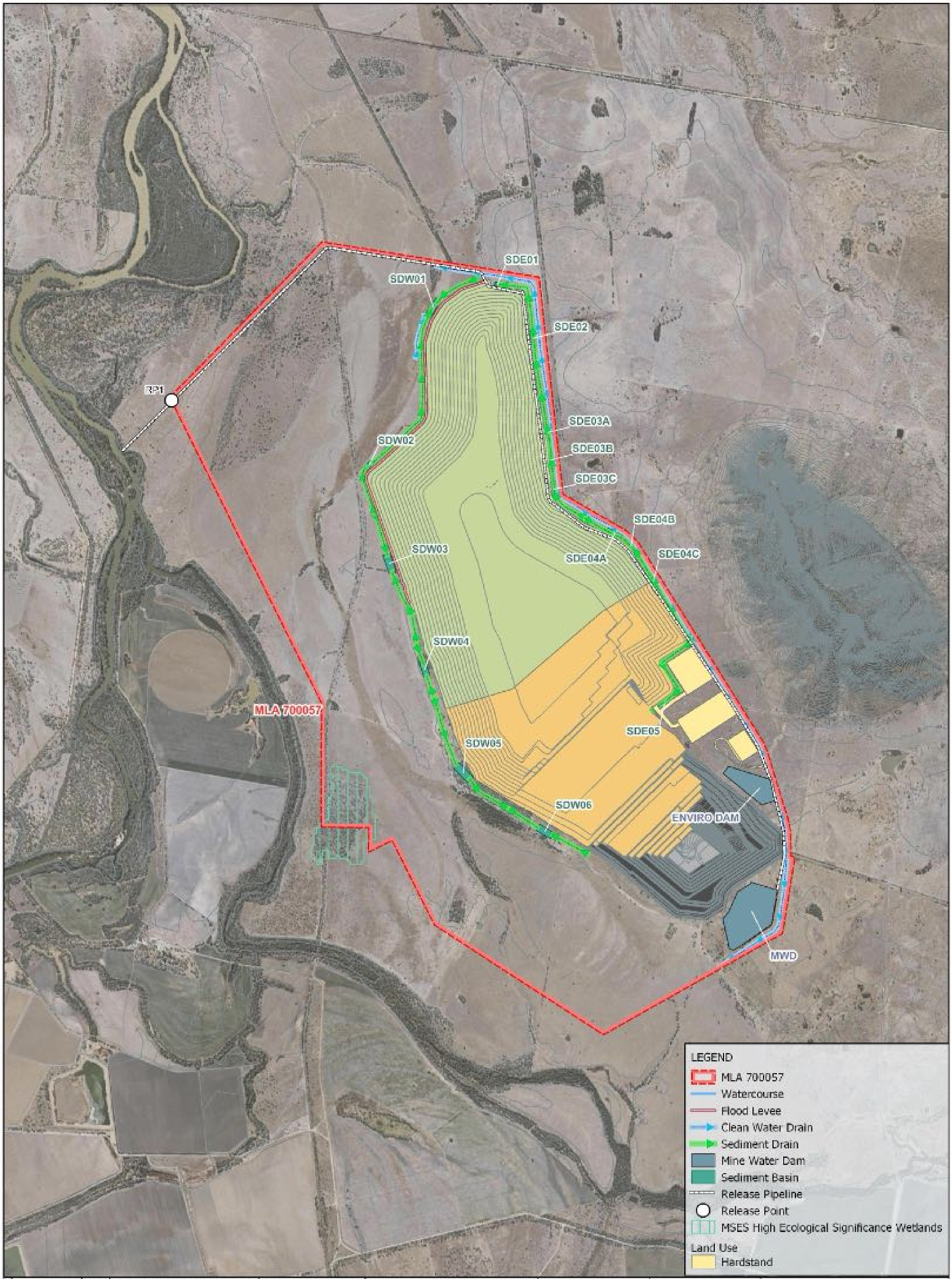
5.6.1 Mine Water Release Infrastructure

A high-capacity pump and pipe system will be used to release water from MWD directly to the Dawson River directly adjacent the Project. The pipeline will be buried beneath the access roads to the MIA and product coal stockpile, and thereafter will be above ground to the Dawson River. Ground supports will be used to raise the pipeline above the natural surface level on the floodplain so that overland flow is not obstructed. The outlet pipe will extend over and beyond the bank of the Dawson River to minimise the risk of erosion. The location of the pipeline and release point are shown on Figure 5.9 and have been located to minimise potential impacts to environmental values. The pipeline will be located within a 10 m easement that will also be used for maintenance and access.

5.6.2 Controlled Release Mixing Zone

The mixing zone can be defined as the area downstream of the release location where release waters mix rapidly with the receiving waters due to momentum, buoyancy and turbulence of the surface water (DES, 2016)). Within the initial mixing zone, dilution of release waters takes place and water quality objectives may not be met (DES, 2016). Controlled releases from the Project will be discharged directly to the Dawson River main channel from MWD via a pipeline. Controlled releases will mix directly with Dawson River flows which provide the required dilution to achieve the receiving water quality release limits. The controlled release strategy has been developed so the release rate does not exceed 0.5% of the Dawson River streamflow, providing a minimum dilution ratio of 1:200.

Small areas of elevated EC concentrations are expected in the localised vicinity of the controlled release discharge location, however the average salinity in the river immediately downstream of the discharge location will remain below the receiving waterway water quality limit of 500 µS/cm. This is due to the high dilution rate from the proposed release conditions and mixing of the release waters from high velocity and turbulence at the discharge point location as well as mixing with the natural turbulence of flow in the river.



R	DETAILS	DATE
A	Draft Issue	24-11-2023

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NOTES:

SCALE @ A3 - 1:30,000

GDA94 / MGA zone 55

DISCLAIMER

Engeny has endeavoured to ensure accuracy and completeness of the data. Engeny assumes no legal liability or responsibility for any decisions or actions resulting from the information contained within this map.

DATA SOURCE

QLD Government Open Data Source

ENGENY

BARALABA SOUTH

Figure 5.9

BARALABA SOUTH PTY LTD

Baralaba South Surface Water Impact Assessment

Baralaba South Project Release and Water Extraction Infrastructure

Job Number:

[illegible]

[illegible]

6. WATER BALANCE MODEL

6.1 Operational Water Balance Model

A site water balance model was developed using GoldSim modelling software (Version 12.1). This model has been designed to represent the water management system and surrounding waterways over the operational life of mine. The water balance model is based on local rainfall runoff modelling and does not incorporate interactions with the Dawson River during flood events as the mine water management system is outside of the Dawson River 0.1% AEP flood extent (Engeny, 2023). The site water balance model is used to calculate water volume as well as salinity using a mass balance approach. The model uses the Australian Water Balance Model (AWBM) to estimate rainfall runoff from climate data inputs.

Key model outputs used to assess the water management system include:

- Containment performance of water storages.
- Pit inundation frequency, volume, and duration.
- External supply requirements.
- Mine water releases.
- Changes to streamflow regime in surrounding waterways.

The general water management system operation is described in Table 6.1 below. A schematic of the water management system is provided in Figure 6.1. The water balance model replicates the transfer rates and destinations of the schematic. Figure 5.1 to Figure 5.7 provide conceptual site layouts of the water management system at key mine stage horizons and the final landform is presented Figure 6.20.

For detailed descriptions and design standards for the storages refer to Section 5.3.

TABLE 6.1: WATER MANAGEMENT SYSTEM OPERATION OF STORAGES

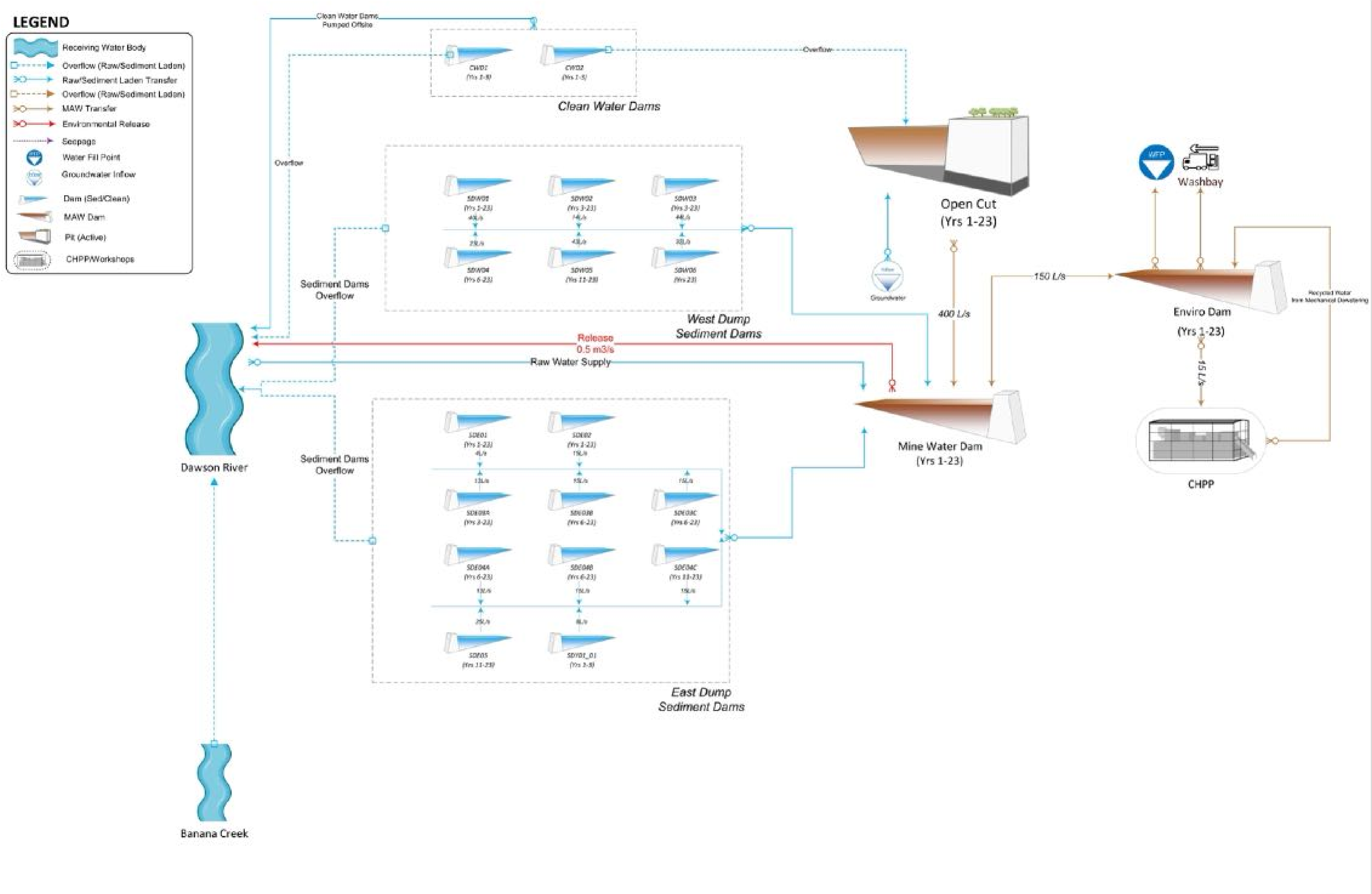
Storage	Storage ID	Full Supply Volume (ML)	Max Operating Volume (ML)	Pump Rate (L/s)	Pump Destination	Years Active
Pit	Pit	173,000[1]	-	400	Mine Water Dam	1-23
Mine Water Dam	MWD	1,220	1,000	500	Release	1-23
				150	Environmental Water Dam	
Environmental Water Dam	ENVIRO DAM	420	350	15[3]	CHPP	1-23
Sed Dam 1[2]	SDW01	26.3	25	41	Mine Water Dam	1-23
Sed Dam 2[2]	SDW02	9.3	9	14	Mine Water Dam	3-23
Sed Dam 3[2]	SDW03	28.6	27	44	Mine Water Dam	3-23
Sed Dam 4[2]	SDW04	14.7	14	23	Mine Water Dam	6-23
Sed Dam 5[2]	SDW05	27.9	27	43	Mine Water Dam	11-23
Sed Dam 6[2]	SDW06	20.7	20	32	Mine Water Dam	23

Storage	Storage ID	Full Supply Volume (ML)	Max Operating Volume (ML)	Pump Rate (L/s)	Pump Destination	Years Active
Sed Dam 7[2]	SDE01	2.8	2.7	4	Mine Water Dam	1-23
Sed Dam 8[2]	SDE02	9.6	9	15	Mine Water Dam	1-23
Sed Dam 9[2]	SDE03A	8.5	8	13	Mine Water Dam	3-23
Sed Dam 10[2]	SDE03B	9.7	9	15	Mine Water Dam	6-23
Sed Dam 11[2]	SDE03C	9.8	9	15	Mine Water Dam	6-23
Sed Dam 12[2]	SDE04A	9.4	9	15	Mine Water Dam	6-23
Sed Dam 13[2]	SDE04B	9.4	9	14	Mine Water Dam	6-23
Sed Dam 14[2]	SDE04C	9.8	9	15	Mine Water Dam	6-23
Sed Dam 15[2]	SDE05	15.9	15	24	Mine Water Dam	11-23
Sed Dam 16[2]	SDY01_01	4.9	4.6	8	Mine Water Dam	1-3
Clean Water Dam 1	CWD1	88	84	193	Dawson River	1-3
Clean Water Dam 2	CWD2	32	31	71	Dawson River	1-3

[1] *Pit storage volume varies.*

[2] *Sediment Dam volume includes sediment storage volume and settling zone volume.*

[3] *Equivalent to the maximum daily water demand (1.2 ML/day)*



BARALABA SOUTH PROJECT	SIZE A3	Project QC1018_004	Baralaba South Coal Project Water Management Schematic	REV 0	DRAWN BY TS DATE 25/08/2023	FILENAME QC1018_004-SCE-001-B-BSP WBM SCHEMATIC.VSD	ENGENY · BARALABA SOUTH
	SCALE	N/A	Status: FINAL	FIGURE 6.1			

6.1.1 Climate Inputs

Climate data inputs to the water balance model of rainfall and evaporation were sourced from both BOM rainfall stations and Silo Data Drill (DES, 2023b). A 129-year data set was used to allow continuous simulation of scenarios.

Daily rainfall data was compiled from multiple sources to capture the most representative time series to input to the model. Table 6.2 summarises the climate data sources utilised in the model and gauging station proximity to the Project.

TABLE 6.2: WATER BALANCE MODEL RAINFALL INPUT DATA SOURCES

Data Source	Proximity to Project	Years of Data Input to Model
Baralaba Post Office Rainfall Station (BOM)	9.2 km	1926-2013
Belvedere Rainfall Station (BOM)	7.9 km	2013-2019
SILO Data Drill	N/A	1889-1926

Both lake evaporation (Morton's Lake) and potential evapotranspiration (Morton's wet) were also input to the rainfall runoff model. 129-year data sets for these data types were sourced from SILO Data Drill (DES, 2023b). Monthly average rainfall, lake evaporation and potential evapotranspiration for the Project are summarised in Table 6.3.

TABLE 6.3: MONTHLY AVERAGE CLIMATE DATA

Month	Rainfall (mm)	Lake Evaporation (mm)	Evapotranspiration (mm)
January	103	204	200
February	108	171	168
March	75	168	166
April	41	131	130
May	36	98	98
June	37	76	76
July	29	85	85
August	22	113	112
September	27	146	144
October	52	184	180
November	71	197	192
December	99	212	207
Total	700	1,785	1,758

6.1.2 Catchment Runoff

Catchment runoff has been simulated using the Australian Water Balance Model (AWBM). The model represents the catchment using three surface stores to simulate partial areas of runoff. The water balance of each surface store is calculated independently of the others. The model calculates the water balance of each partial area at daily time steps. At each time step, rainfall is added to each of the three surface stores and evapotranspiration is subtracted from each store. If the value of water in the store exceeds the capacity of the store, the excess water becomes runoff. Part of this runoff becomes recharge of the base flow store if there is a base flow component to the stream flow. A schematic representation of the AWBM model is provided in Figure 6.2.

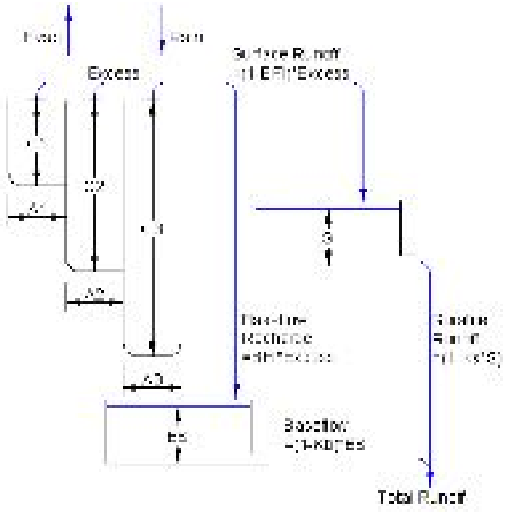


Figure 6.2: AWBM Schematic

The AWBM parameters adopted for the Project water balance model are shown in Table 6.5. The parameters were originally developed for the calibrated Baralaba Central Mine water balance model (WRM, 2013) and have been continually validated as part of the Baralaba North Mine water management plan annual updates (Engeny, 2023). The original calibration (Figure 2.5 of WRM, 2013) and recent validation (Figure 6.4 of Engeny, 2023) of the model parameters to Baralaba Coal Mine inventory is presented in Table 6.4.

These parameters have been adopted for the Project in the absence of specific information for the Project site. The AWBM parameters will continue to be validated as part of the model update and review program for the Project described in Section 10.1.

TABLE 6.4: AWBM PARAMETERS

Parameter	Natural	Roads/ Industrial/ Hardstand	Waste Dump/ Active Rehabilitation	Mining Pit	Rehabilitated Spoil
A1	0.2	0.1	0.1	0.1	0.2
A2	0.4	0.9	0.4	0.9	0.4
A3	0.4	0	0.5	0	0.4
C1 (mm)	60	12	40	12	60
C2 (mm)	90	38	140	38	90
C3 (mm)	180	0	240	0	180
BFI	0	0	0.9	0	0
Kb	0	0	0.95	0	0
Ks	0	0	0	0	0
Average annual runoff coefficient	8.6%	26.7%	5.1%	26.7%	8.6%

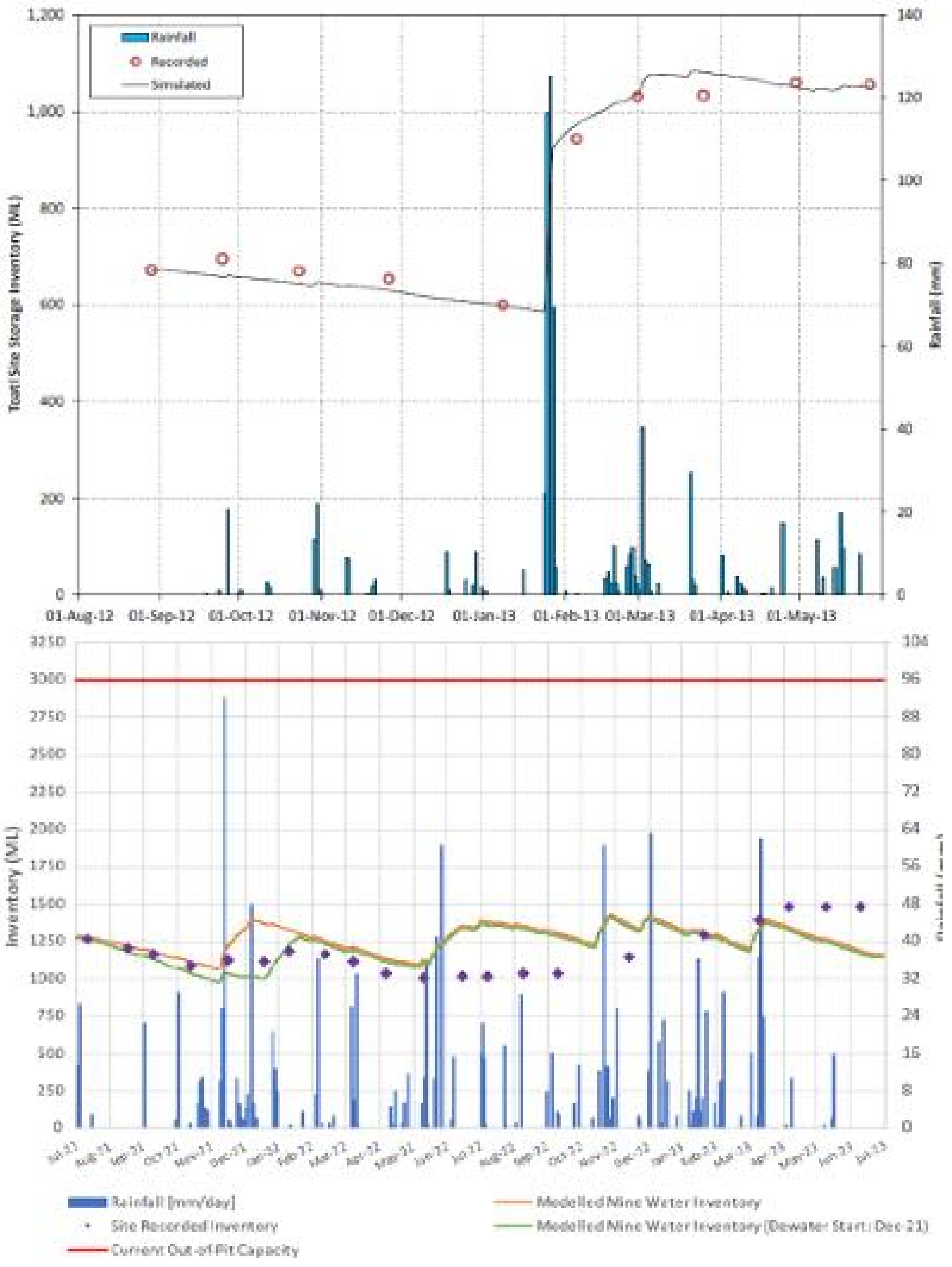


Figure 6.3: Previous AWBM parameter Calibration and Validation at Baralaba Coal Mine (WRM, 2013) (Engeny, 2023).

6.1.3 Catchment Runoff Water Quality

The Project water balance model includes a contaminant transport model to simulate water quality (salinity) for the purpose of estimating water quality in the mine water storages to allow the simulation of controlled releases of mine affected water. Salinity generation rates for the assigned land use types were adopted from modelling of the Baralaba North Mine (WRM, 2013). These rates were previously validated against recorded water quality in storages at Baralaba North Mine. Runoff salinity concentrations adopted for each land use type are presented in Table 6.5. The adopted salinity for the waste dump land use is higher than the expected salinity of 338 mg/L determined from geochemical analysis of potential spoil materials (Terrenus Earth Sciences, 2023), which provides a conservative approach to estimating mine water storage salinity and impacts from releases.

A salinity of 3 mg/L has been adopted for direct rainfall to storages (DERM, 1997). A varying streamflow and electrical conductivity relationship has been developed for the Dawson River for the purpose of estimating release opportunity as described in Section 6.1.9.

TABLE 6.5: SALINITY GENERATION RATES FOR LAND USE TYPES

Parameter	Natural	Roads/Industrial/Hardstand	Waste Dump	Mining Pit	Rehabilitated Spoil
Total Dissolved Solids (mg/L)	230	1,000	1,000	1,000	230

6.1.4 Catchments

Catchment areas were determined for all storages across the life of the mine. Catchment boundaries were defined using the proposed mine and dump design surfaces in conjunction with LiDAR survey of the existing topography flown on 25 March 2011 provided by Vekta Pty Ltd. It is assumed that spoil dumps are rehabilitated within 3 years of being completed and that rehabilitation has a 5-year establishment period before being able to be discharged from site. All rehabilitated catchment was assumed to require erosion and sediment control until established.

A summary of the site storage catchments is presented Table 6.6.

TABLE 6.6: TOTAL SITE STORAGE CATCHMENT AREA BY LANDUSE AND MINING STAGE (HECTARES)

Landuse	Year 1	Year 3	Year 6	Year 11	Year 14	Year 19	Year 23
Natural (ha)	332	94	57	68	102	85	63
Waste Dump (ha)	200	357	358	301	234	284	328
Hardstand (ha)	45	64	64	64	64	64	64
Pit (ha)	74	84	173	150	143	65	9
Rehabilitated Spoil (ha)	0	0	158	338	393	440	502
Total Area (ha)	**650**	**598**	**810**	**921**	**936**	**937**	**966**

**excludes catchment areas reporting to clean water dams*

6.1.5 Groundwater

Groundwater ingress to the open cut pit was modelled and provided as an input to the water balance model (Watershed HydroGeo, 2023). Groundwater ingress is variable based on the location and geometry of the pit and therefore has been input as a time series to align with the mine plan. Inflow rates were predicted to be variable based on climatic and geological conditions, therefore minimum, mean and maximum groundwater inflow rates were estimated for the duration of the Project by the groundwater assessment (Watershed HydroGeo, 2023).The groundwater input data is summarised in Table 6.7 and Figure 6.3. The mean groundwater ingress rates were used for the water balance assessment and reduced by 10% to account for evaporation losses over the pit walls. The average pumpable groundwater ingress for the operational period of the mine plan is predicted to be 0.37 ML/day (0.41 ML/day total ingress).

The sources contributing to the groundwater inflows has been determined from the groundwater model. The total groundwater ingress as reported in Table 6.7 is attributed to several sources (Watershed HydroGeo, 2023):

Spoil seepage	(20%)
Weathered and interburden	(45%)
Coal measures	(28%)
Alluvium (colluvium)	(8%)

TABLE 6.7: OPEN CUT PIT GROUNDWATER INGRESS*

Mine Plan Stage	Mean Groundwater Ingress (ML/day)	Mine Plan Stage	Mean Groundwater Ingress (ML/day)
Year 1	0.32	Year 13	0.30
Year 2	0.27	Year 14	0.49
Year 3	0.16	Year 15	0.38
Year 4	0.27	Year 16	0.49
Year 5	0.39	Year 17	0.67
Year 6	0.53	Year 18	0.13
Year 7	0.59	Year 19	0.31
Year 8	0.29	Year 20	0.54
Year 9	0.34	Year 21	0.26
Year 10	0.41	Year 22	0.48
Year 11	0.31	Year 23	0.75
Year 12	0.28		

** The mean predicted groundwater inflow estimates are before evaporative losses from pit floor or walls and does not account for direct rainfall or surface water ingress (Watershed HydroGeo, 2023).*

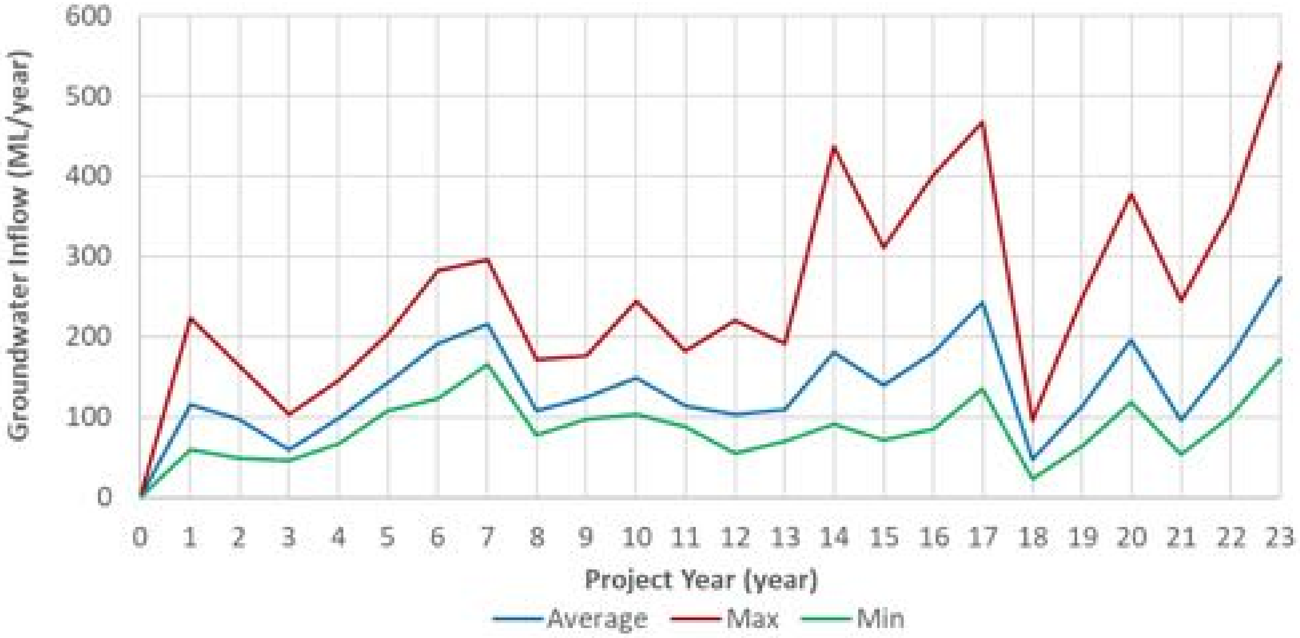


Figure 6.4: Open Cut Pit Groundwater Ingress

6.1.6 Groundwater Quality

The groundwater consultant has advised the groundwater inflow electrical conductivity (EC) for the true groundwater inflows (alluvium, coal measures and weathered and interburden) is likely to be an average of 25,000 µS/cm or a total dissolved solids (TDS) of 16,750 mg/L (assuming an EC to TDS conversion factor of 0.67). Adopting a TDS of 16,750 mg/L for the alluvium, coal measures and interburden groundwater inflows, agrees with the groundwater monitoring results presented in Section 4.1.6.

The Geochemical Assessment of Potential Spoil and Coal Reject Materials – Baralaba South Project (Terrenus Earth Sciences, 2023) report indicates that the proposed waste dump material following surface water exposure is expected to produce seepage which is pH-neutral to alkaline and low to moderate salinity. The geochemical assessment report indicates electrical conductivity of spoil samples and coal reject samples varied between 12 µS/cm and 740 µS/cm. The 90th percentile electrical conductivity for spoil material of 505 µS/cm has been adopted for the spoil seepage component of the groundwater recovery inflow. This is equivalent to a TDS concentration of 338 mg/L, assuming an EC to TDS conversion factor of 0.67 (ANZECC & ARMCANZ, 2000).

Adopting an average TDS concentration of 16,750 mg/L for the alluvium, coal measures and weathered and interburden inflows and a TDS concentration of 338 mg/L for the spoil seepage produces an average groundwater inflow TDS concentration of approximately 13,500 mg/L based on the inflow contribution breakdown presented in Section 6.1.5.

6.1.7 Starting Conditions

All storages besides Mine Water Dam are assumed to be empty at the start of the model simulation. Mine Water Dam has been modelled starting with an initial inventory of 400 ML which is assumed to be supplied from existing water allocations or water harvested in dams during the construction phase of the mine.

Water demands associated with the initial construction of the mine infrastructure and water storages is assumed to be suppled from existing water allocations which is dependent on water availability. There is the potential for this water to be supplied from runoff collected in the proposed clean water dams prior to commencement of the mine construction. The water supply strategy for the construction phase of the mine will be developed as part of the detailed construction plan for the Project.

6.1.8 Dawson River Flow

The Dawson River streamflow adopted to assess mine water release opportunity has been adopted from the Dawson Callide Sub-catchment Integrated Quantity and Quality Model (IQQM) developed for the Water Plan (Fitzroy Basin). The streamflow series from the Dawson River IQQM was available at the Dawson River at Beckers (130322A) gauging station location for the period 1889 to 2007. The streamflow series was extended to 2019 using data from the streamflow gauging station to match the adopted climate data period.

Figure 6.5 shows the flow duration curve for the IQQM streamflow series at the Beckers gauging station (130322A) for the approved WRP developed case. The cumulative streamflow volume during the modelled time period is displayed in Figure 6.6. This streamflow data was used in the water balance model to determine the mine water release opportunity in accordance with the flow conditions presented in Section 5.6.

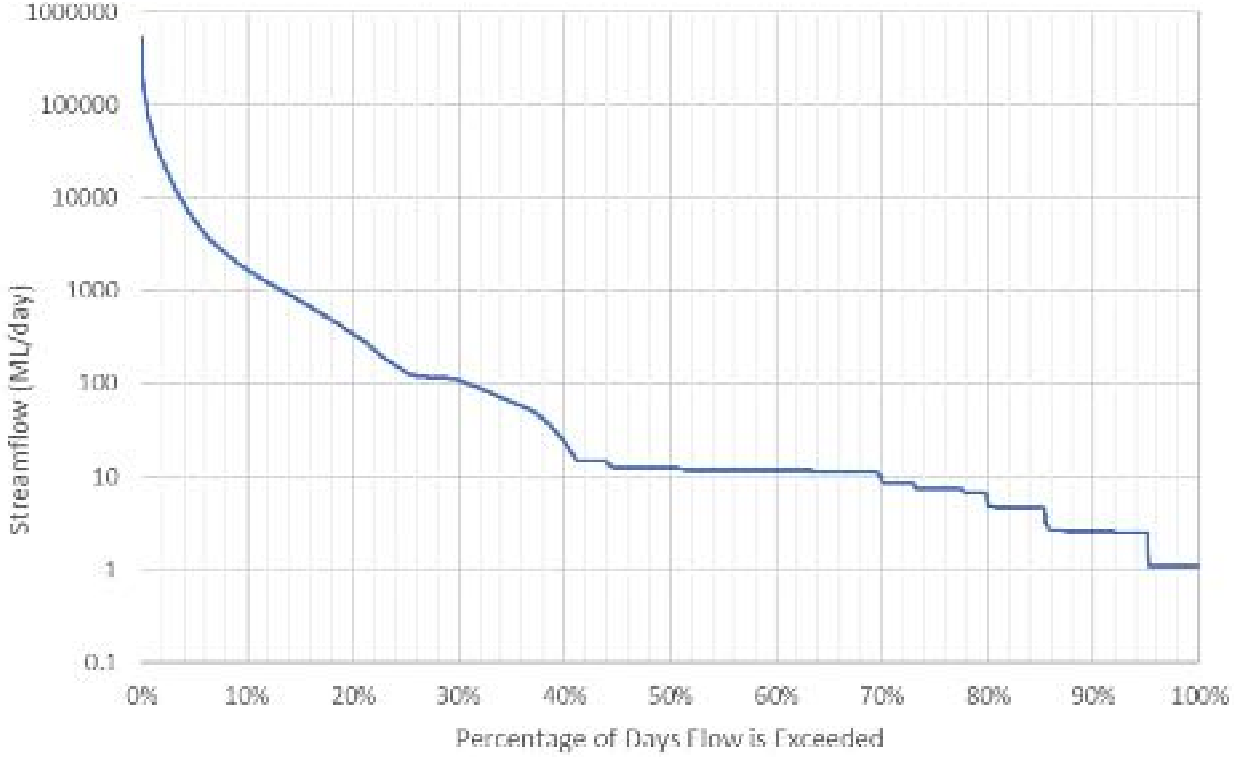


Figure 6.5: IQQM Flow Duration Curve for Dawson River at Beckers Gauging Station

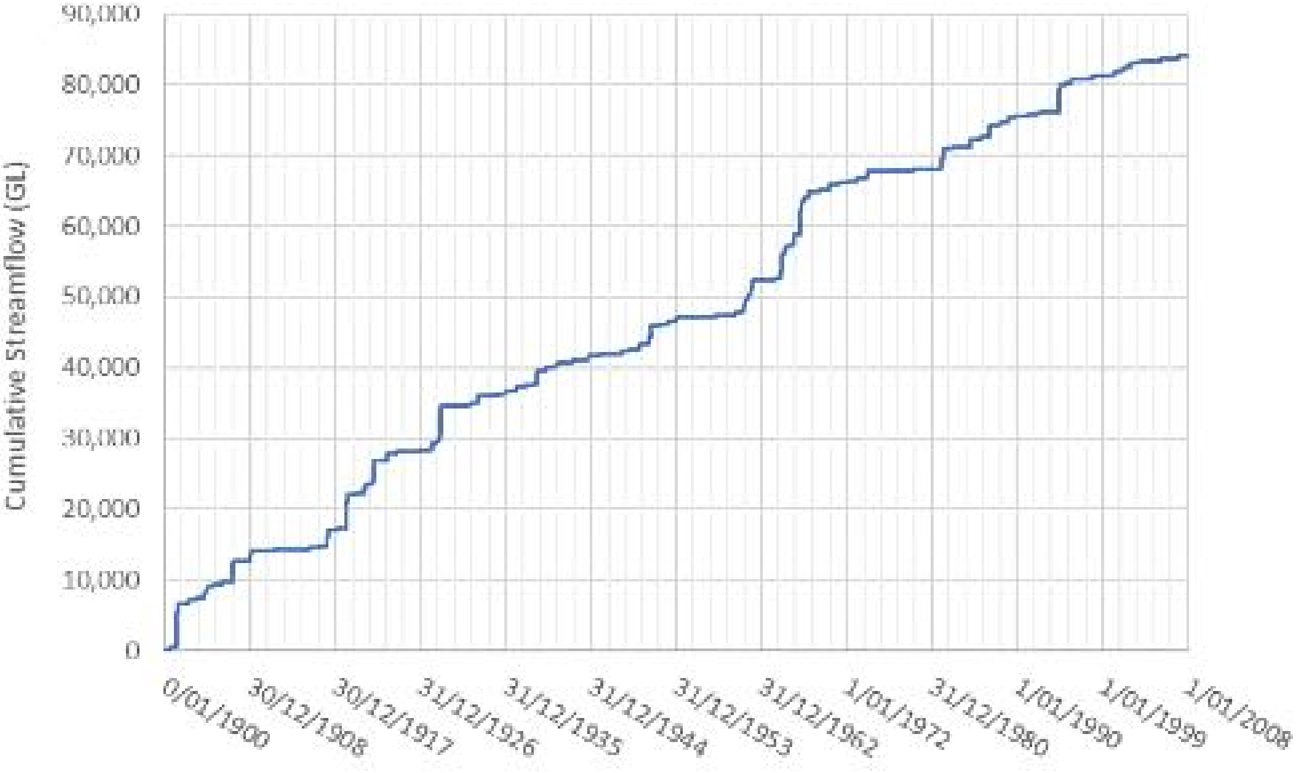


Figure 6.6: Cumulative Streamflow Volume for Dawson River at Beckers Gauging Station (IQQM)

6.1.9 Dawson River Water Quality

A varying flow and Electrical Conductivity (EC) relationship for the Dawson River was used to model mine water release opportunity in accordance with the mine water release conditions presented in Section 5.6. The flow EC relationship was developed by fitting an average relationship to the continuous monitoring data from the Dawson River at Beckers gauging station (130322A) provided in Section 2.5.3. The Dawson River flow EC relationship adopted for the water balance model is presented in Figure 6.7. The Flow EC relationship affects modelled release opportunity for flows greater than 100 m³/s.

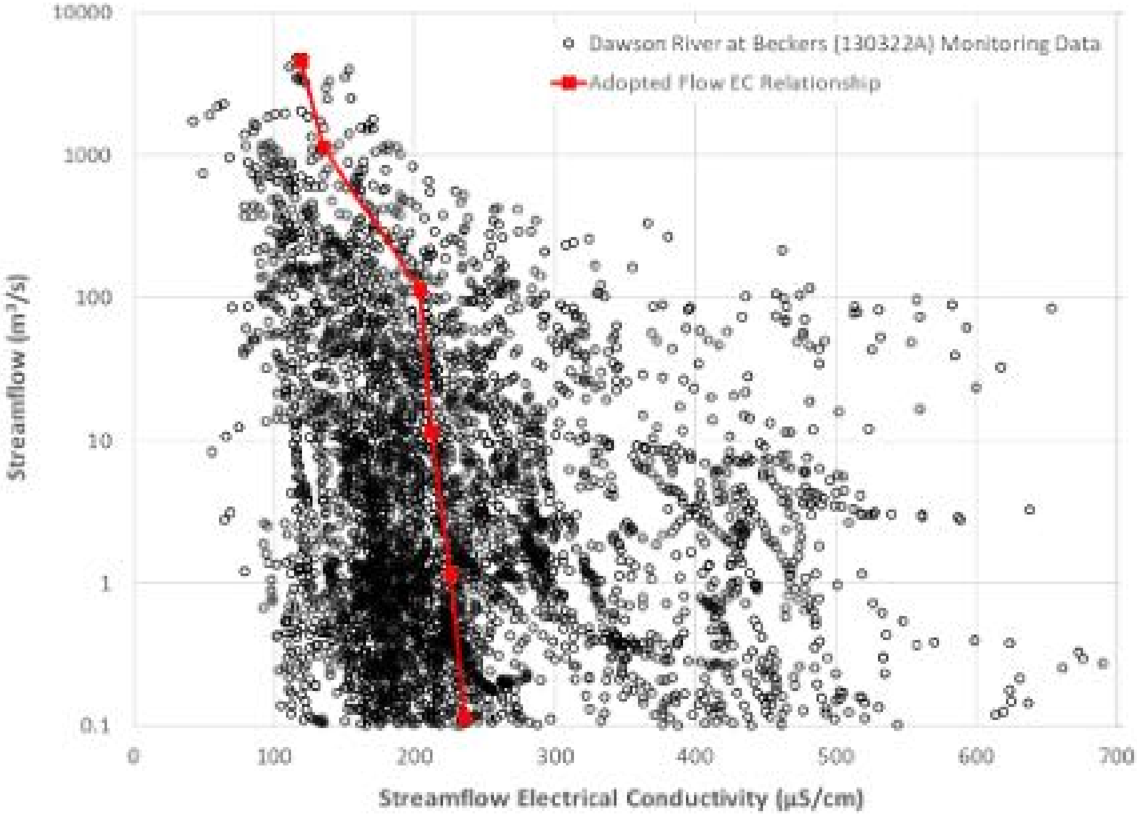


Figure 6.7: Dawson River at Beckers Flow EC Relationship

6.1.10 Mine Water Releases

Mine water is proposed to be released to prevent the accumulation of mine water on site and reduce the risk of uncontrolled mine water releases to natural waterways.

Mine water releases have been modelled to occur from the Mine Water Dam located south-east of the mine infrastructure area. Mine water will be released through a pumped transfer at a maximum rate of 500 L/s, around the northern extent of the MLA area directly to the Dawson River channel. Mine water releases were modelled in accordance with the approach outlined in condition F11 of the Model Mining Conditions (DES, 2017) (refer to Section 5.6) which is based on *Model Water Conditions for Coal Mines in the Fitzroy Basin* (DEHP, 2013).

The water balance model uses IQQM streamflow data (augmented with stream flow gauging data) for the Dawson River and water quality streamflow relationships developed from the Becker's streamflow gauge to determine the release opportunity and potential release volume (refer to Section 6.1.8 and Section 6.1.9). The predicted model water quality for the release dam is used to assess the release potential.

6.1.11 Clean Water Releases

Clean water is released into natural waterways from clean water dams to prevent overtopping into the mining pit during the early years of the Project (year 1-3). The proposed pumped release rates from the clean water dams are summarised in Table 6.1. The clean water dams capture runoff from undisturbed catchments only and therefore, the water quality is expected to be suitable for direct release into natural waterways.

6.1.12 Simulation Details

The GoldSim model was run with a daily timestep as a probabilistic simulation for a period of 23 years, for the operational life of the mine. The model was simulated for 111 realisations stepping through 23 year sequences of the 111 years of available climate data for the mine site (1889 to 2019). The first model simulation realisation uses climate data from 1889 to 1908, the second realisation uses climate data from 1890 to 1909 and so on. Climate data was not "wrapped" to allow for additional realisations because the interannual climate patterns captured by running a simulation for an extended period of time cannot be accurately modelled using non-consecutive climate years.

6.2 Water Management System Performance

The Project average annual water balance (inflows and outflows) for the key mine plan stages are summarised in Table 6.8 and shown for year 14 in Figure 6.8. The key outcomes from the average annual water balance include:

- Rainfall and runoff volumes are highest during the mid to later years of the mine plan (years 11-19) when the total site catchment is at its largest.
- Runoff and groundwater account for on average 60% and 13% respectively of total water inflows to the system.
- Mine water releases slightly increase during the later years of the Project due to lower water demands and increased groundwater inflows.
- Raw water extraction between mine years 1 to 19 account for on average 31% of the total water inflows to the system.
- Dust suppression demand is the largest outflow from the system, accounting for on average 41% of total outflows.
- Dust suppression remains constant until year 14, reaching its peak in year 6.
- Lower CHPP demands are observed in year 1 and year 23. The mine years in between remain constant over the Project duration.
- Mine water releases account for on average 14% of the total water outflows from the system. This accounts for controlled release from Mine Water Dam in accordance with the adopted release conditions described in Section 5.6.

TABLE 6.8: AVERAGE ANNUAL WATER BALANCE (ML/YEAR)

Inflow / Outflow	Year 1	Year 3	Year 6	Year 11	Year 14	Year 19	Year 23
Rainfall	66	59	82	95	112	104	131
Rainfall runoff to mine water and sediment dams	306	359	598	706	750	689	575
Groundwater inflow to mining pit	105	53	174	112	161	102	246
Clean Water Dam Overflow to Mine Water System	8	1	0	0	0	0	0
Raw Water Intake	312	559	388	282	203	247	4
Total Inflows	**797**	**1,031**	**1,243**	**1,195**	**1,226**	**1,143**	**955**
Evaporation	153	138	181	203	229	210	282
Dust Suppression	572	567	607	496	434	378	100
CHPP Water Use	186	315	347	338	336	324	118
Mine affected water release (via release structure)	20	15	60	98	135	90	122
Sediment Dam Overflow	2	2	30	77	96	118	129

Inflow / Outflow	Year 1	Year 3	Year 6	Year 11	Year 14	Year 19	Year 23
Total Outflows	**933**	**1,037**	**1,225**	**1,213**	**1,231**	**1,119**	**751**
Change	**-136**	**-6**	**17**	**-18**	**-4**	**24**	**205**

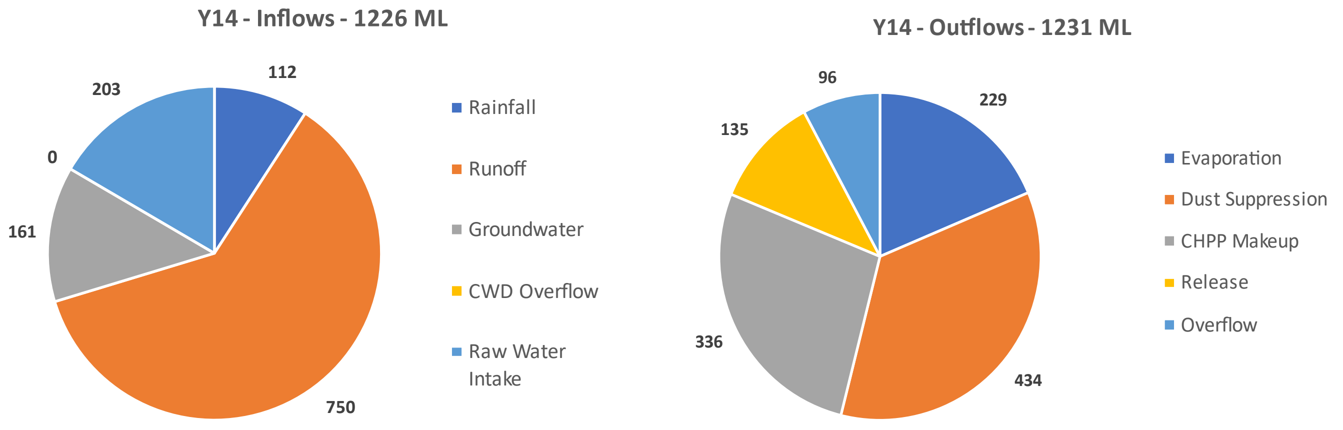


Figure 6.8: Baralaba South Project Average Annual Inflow/Outflow – Year 14

6.2.1 Site Water Inventory

Modelled total site water inventory and Mine Water Dam inventory are presented in Figure 6.9 and Figure 6.10 respectively for the project duration. The site has a modelled maximum stored inventory of approximately 1.24 GL in Year 7 in the 95th percentile. After year 7, both these inflows begin to decrease and as such the 95th percentile total inventory trend can be seen to steadily decrease.

Groundwater ingress and total catchment is low in the early years of the Project which results in lower stored inventories from years 1-6. After year 6, the total site catchment increases and groundwater inflows remain steady, resulting in fairly consistent predicted water inventories for the remaining duration of the Project.

In all Project years the 95th percentile mine water inventory does not exceed the storage capacity of Mine Water Dam and Environment Dam. Based on the total site inventory results the water management system appears to perform in accordance with its design intent (Section 5.3).

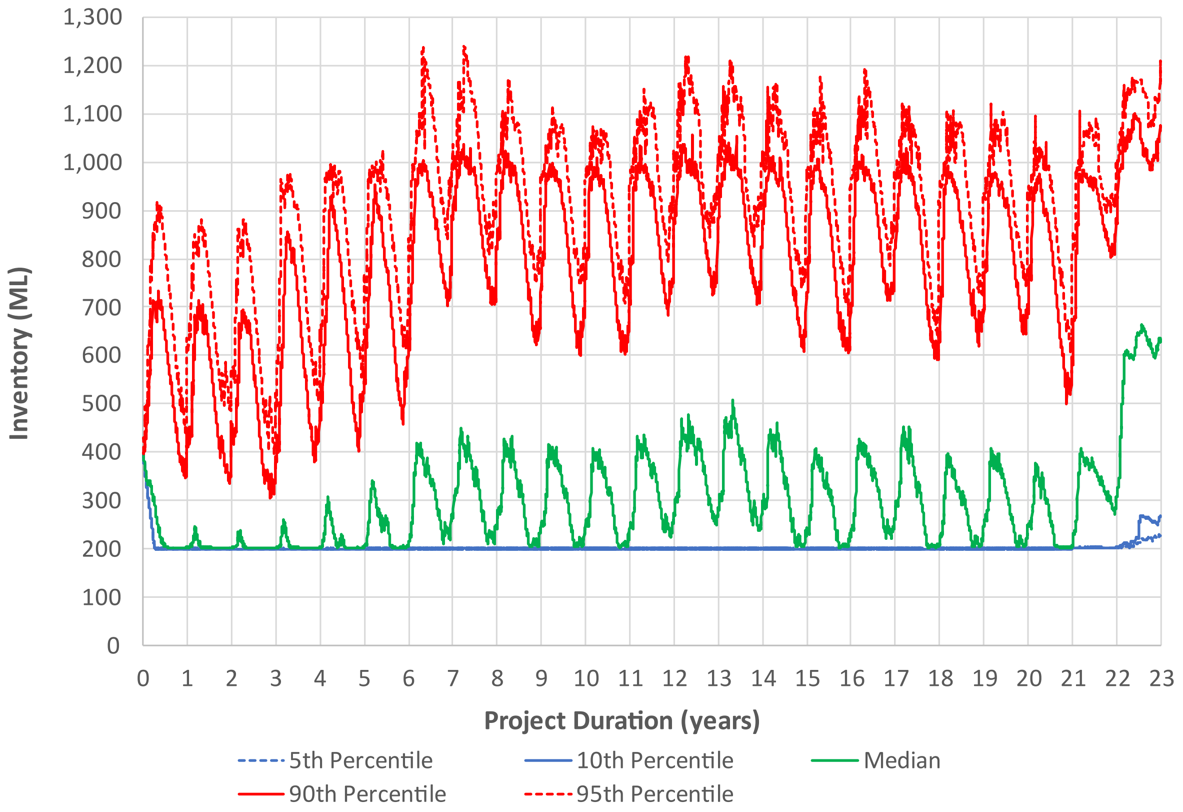


Figure 6.9: Total Site Water Inventory

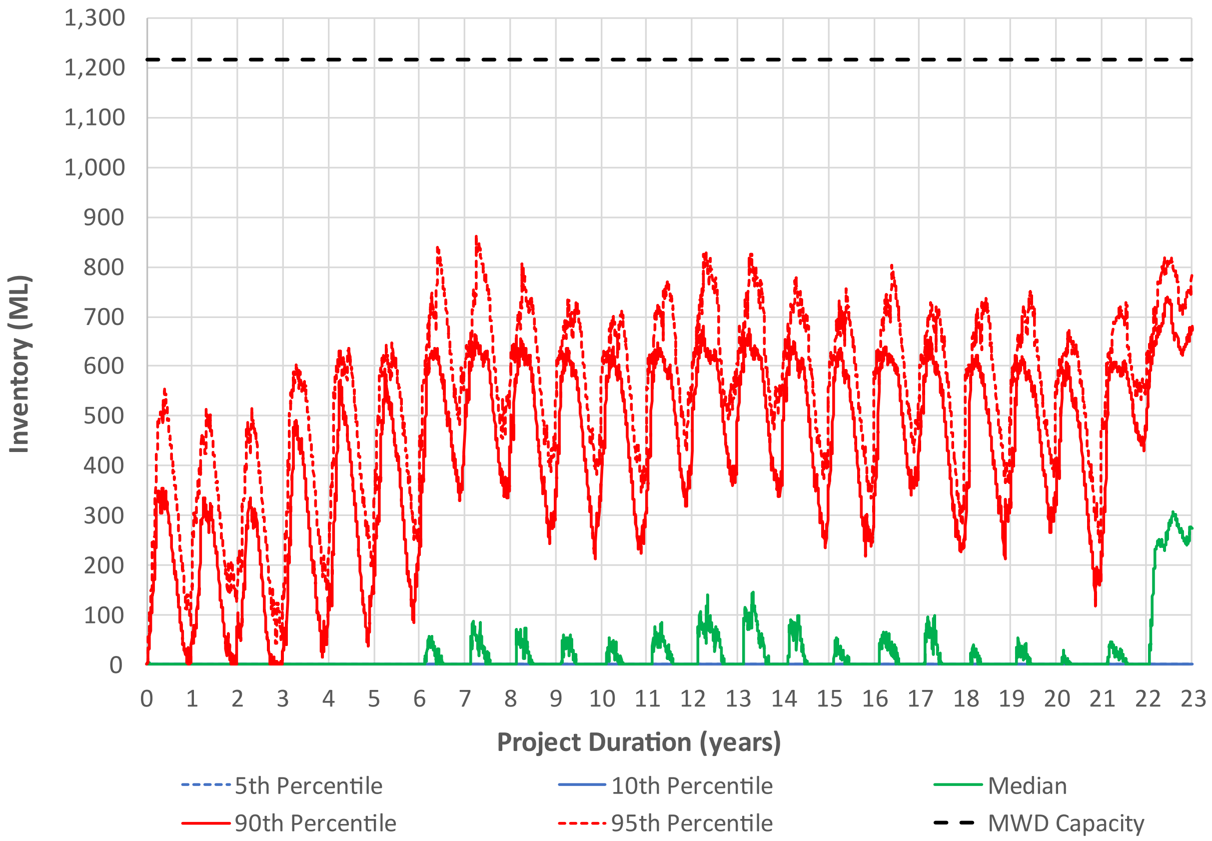


Figure 6.10: Mine Water Dam Inventory

6.2.2 Controlled Mine Water Releases

Controlled mine water releases were modelled in accordance with the mine water release strategy outlined in Section 5.6. Mine water releases occur from Mine Water Dam at a maximum rate of 43.2 ML/day (500 L/s pumping system) with a release efficiency factor of 90%. Releases only occur when the modelled flow at the Dawson River at Beckers gauging station are greater than 100 m^3/s in accordance with the release conditions in Section 5.6. Therefore, all release events coincide with medium-high streamflow conditions in the Dawson River. As shown in Figure 2.8, the Dawson River flows above 100 m^3/s for approximately 5% of the time or 18 days per year on average.

Estimated annual release volumes over the project duration for a range of probabilities are summarised in Figure 6.11. The results illustrate that releases typically occur in less than 25% of years. In a prolonged wet climate conditions (95th percentile), the annual release volume varies from 100 ML to 850 ML.

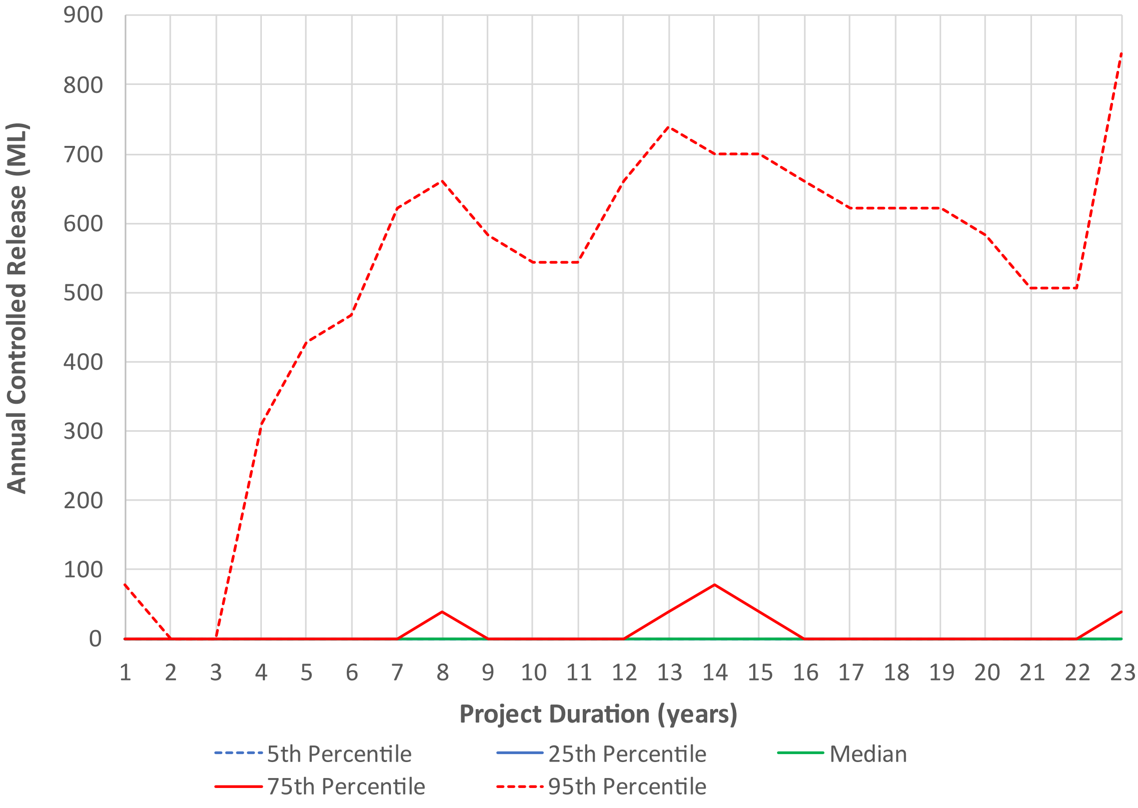


Figure 6.11: Annual Mine Affected Water Controlled Release Volume

Figure 6.12 shows an exceedance plot of annualised release event frequency and Figure 6.13 shows an exceedance plot of release event duration for all release events simulated in the model. These plots show that:

- There are no controlled releases events in 75% of years.
- The project is expected to have at least 1 controlled release event in less than 25% of years and at least 2 release events in 5% of years.
- The duration of controlled release events is expected to range from 1 to 20 days (5th percentile and 95th percentile) with the median controlled release event duration being 5 days.

Controlled releases would occur over a time period consistent with the existing duration of medium-high flows in the Dawson River and would not impact the duration of flow events.

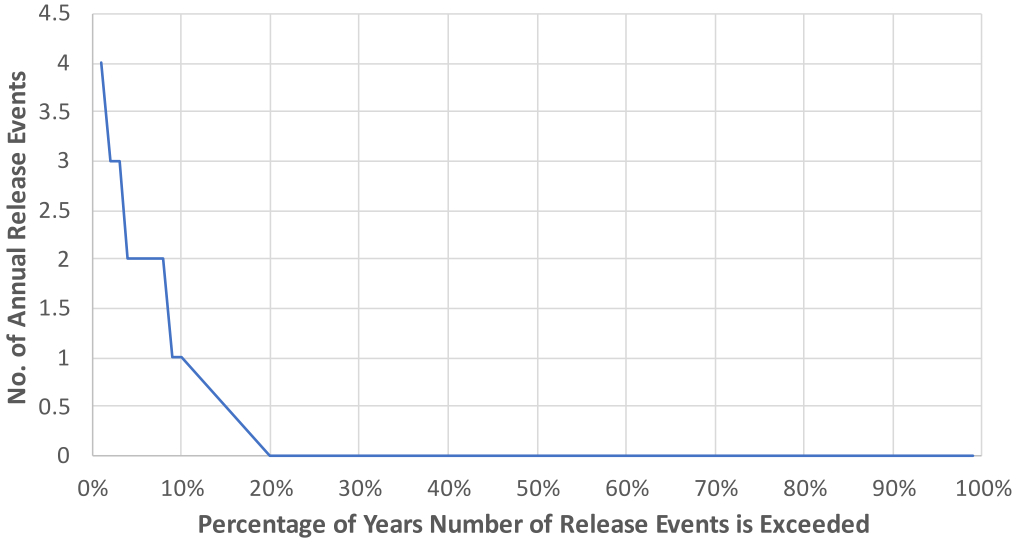


Figure 6.12: Number of Release Events Per Year

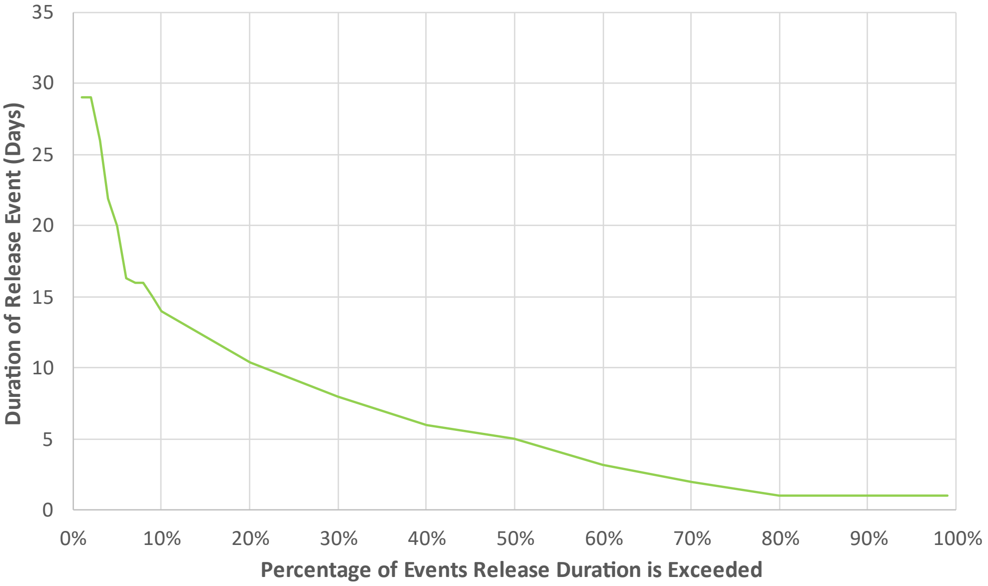


Figure 6.13: **Duration of Release Events Per Year**

6.2.3 Mine Water Dam Containment

The water balance model was used to determine the overflow frequency of the proposed mine water storages. Mine Water Dam and Enviro Dam both had no overflows during any of the model simulations, demonstrating a greater than 99th percentile annual containment performance standard.

6.2.4 Sediment Dam Overflows

Sediment dams were designed to contain an 85th percentile 5-day rainfall event based on guidance from the Best Practice Erosion and Sediment Control Guidelines (IECA, 2018) (see Section 5.3.3). The overflow frequency of the sediment dams was assessed in the operational water balance model to confirm the containment standard and determine potential overflow volumes. The annual overflow frequency of the sediment dams and the year which this occurs is provided in Table 6.9 and Figure 6.14 shows modelled overflow volumes in large wet years.

The operational water balance model results show the sediment dams overtop in 28% to 32% of years. This is a higher containment standard than the adopted design standard of 85th percentile 5-day rainfall event. The sediment dam catchment areas change over the life of the project with the establishment and rehabilitation of the out-of-pit spoil dumps. The sediment dams are designed to achieve the required containment standard for the largest reporting catchment area over the project life.

During overtopping events, coarse sediments will continue to settle out as flows attenuate through the dam reservoirs. Sediment dams will be designed such that overtopping velocities are managed so they do not cause scour on the overtopping flow paths (as depicted in Figure 6.15). Sediment dam spillway structures will be designed such that during overtopping events the velocity impacts in the receiving waterway are negligible. Spillway control structures may include or be a combination of rock chutes, rock aprons and/or level spreaders.

TABLE 6.9: SEDIMENT DAM OVERFLOW FREQUENCY

Sediment Dam	Annual Overflow Frequency (% of years)	Mine Year with Highest Overflow Frequency
Sed Dam 1	32%	16
Sed Dam 2	39%	18
Sed Dam 3	32%	16
Sed Dam 4	31%	22
Sed Dam 5	7%	23
Sed Dam 6	0%	1
Sed Dam 7	32%	16
Sed Dam 8	32%	16
Sed Dam 9	32%	16
Sed Dam 10	32%	16
Sed Dam 11	32%	16
Sed Dam 12	32%	20
Sed Dam 13	27%	23
Sed Dam 14	5%	20
Sed Dam 15	4%	23
Sed Dam 16	4%	2

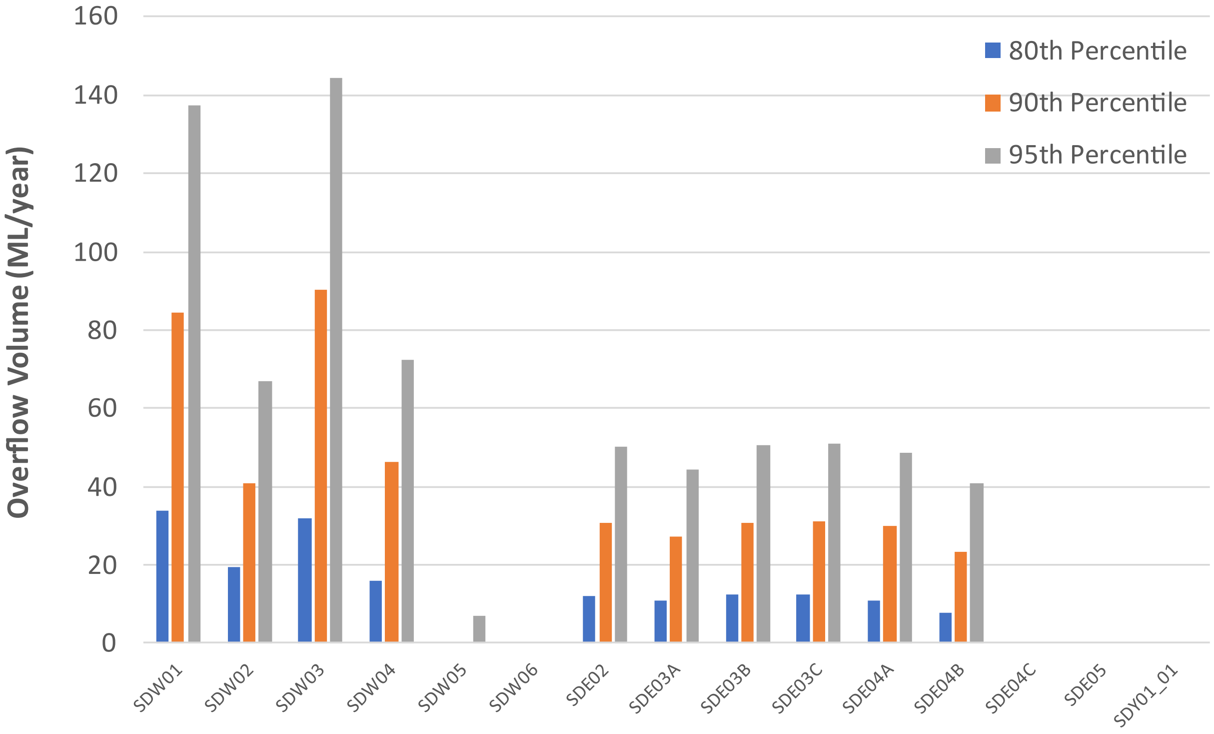
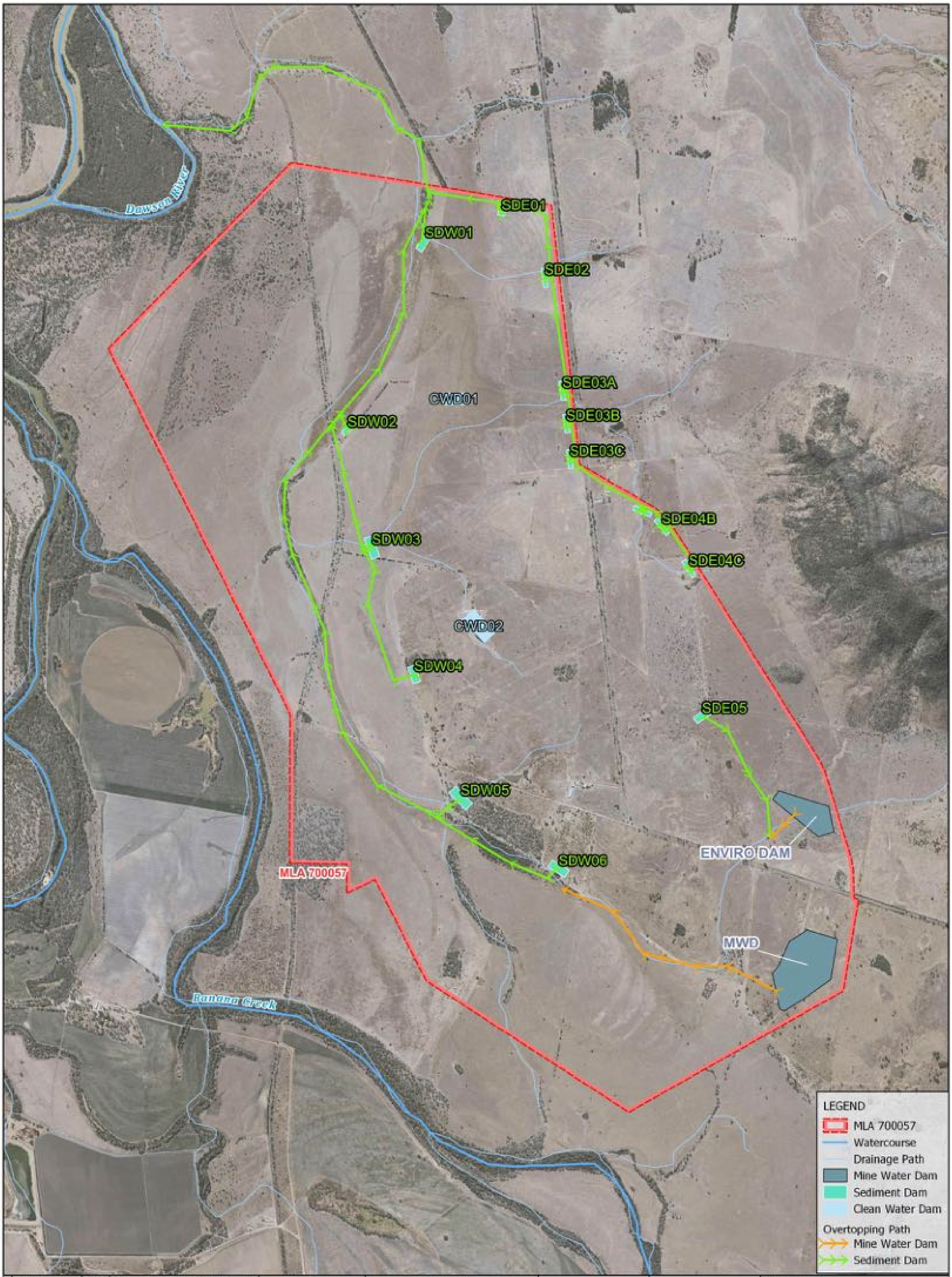


Figure 6.14: Modelled Sediment Dam Annual Overflow Volumes



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BARALABA SOUTH

Figure 6.15

BARALABA SOUTH PTY LTD
Baralaba South Surface Water Impact Assessment
Dam Overtopping Pathways

Job Number.
QC1018_004

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6.2.5 Raw Water Supply

The Project is expected to be reliant on surface water allocations from the Dawson River to maintain supply to the Project water demands. The operational water balance model includes an external raw water supply when there is insufficient water in site storages to supply the Project water demands. The modelled annual raw water supply volumes can then be used to determine the likely required surface water allocations to maintain supply to water demands for different climatic conditions.

- The raw water extraction volumes for the Project duration are presented in Figure 6.16. The results show:
- External raw water supply requirements are highest during the initial Project years and remain fairly consistent for the majority of the Project duration.
- The external raw water supply requirement to meet water demands in 95% of years is typically 600 to 700 ML/year with a peak requirement of 881 ML in Year 3.
- The maximum annual make-up water volume predicted during the mine life under median rainfall conditions is 600 ML in Year 3.
- Median annual raw water supply volumes are significantly smaller than the maximum requirement (typically less than 300 ML/year after Year 7).
- The 95th percentile peak external raw water supply requirement of 881 ML/year in Year 3 is lower than the 1733 ML of existing surface water entitlements that are available for the Project (Section 5.4.5.).

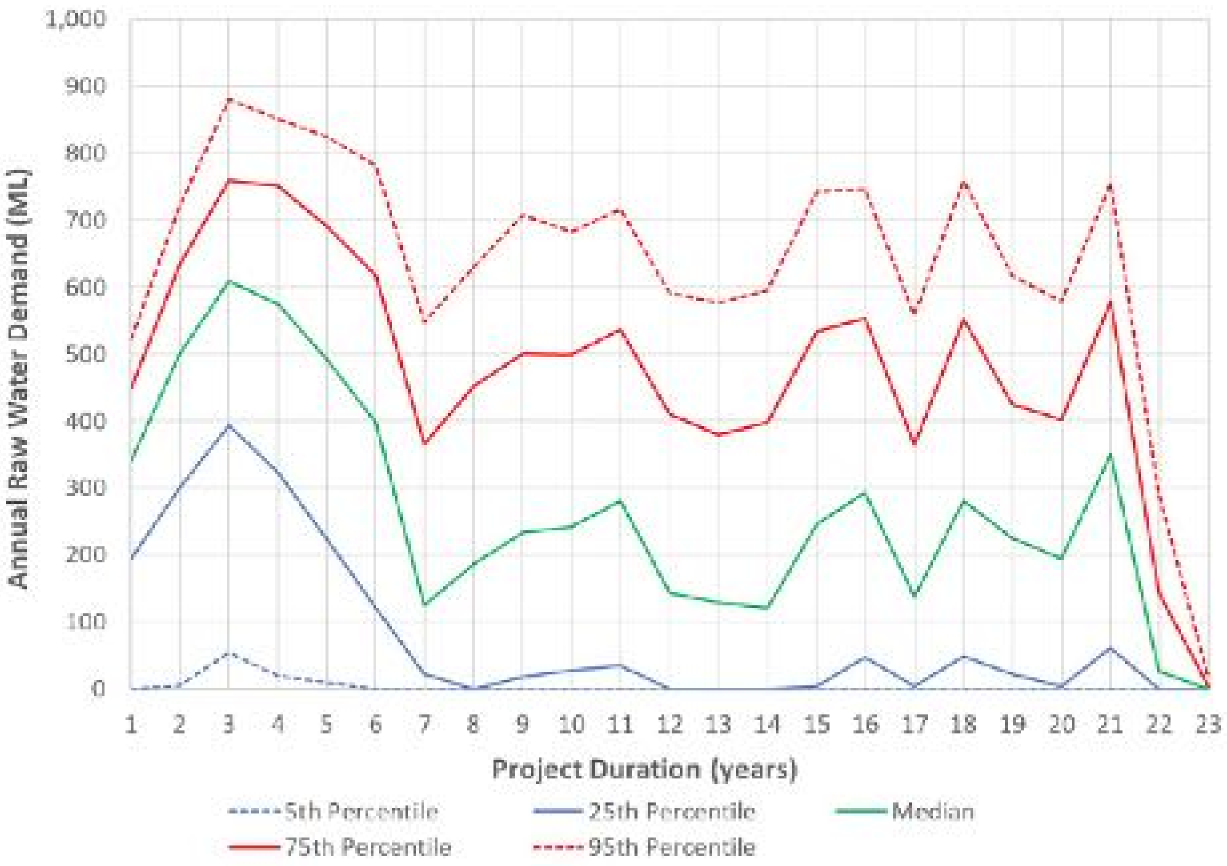


Figure 6.16: **External Raw Water Supply Volumes**

6.2.6 Groundwater Ingress Sensitivity Assessment

A groundwater sensitivity assessment was completed to review the impact of groundwater ingress on predicted mine water releases and external water supply demand from the Dawson River. The operational water balance model was simulated with the minimum and maximum groundwater inflow rates over the Project duration predicted by the groundwater assessment (refer Section 6.1.5). Figure 6.17 and Figure 6.18 shows the groundwater sensitivity results for the predicted 95th percentile-controlled release volumes and the median and 95th percentile annual raw water supply demand volumes. The results show:

- Annual release volumes under 95th percentile climate conditions are only expected to vary by 100ML to 200ML for the minimum and maximum groundwater inflows predicted for the Project.
- Similar to the release volumes, annual raw water supply demand is only expected to vary by 200ML in median and 95th percentile climate conditions for the minimum and maximum groundwater inflows predicted for the Project.
- Based on the very minor variation in predicted annual release volumes and raw water supply demand, the system performance is not expected to significantly change if the groundwater inflow rates during operations differ from the average values adopted for the water balance modelling.

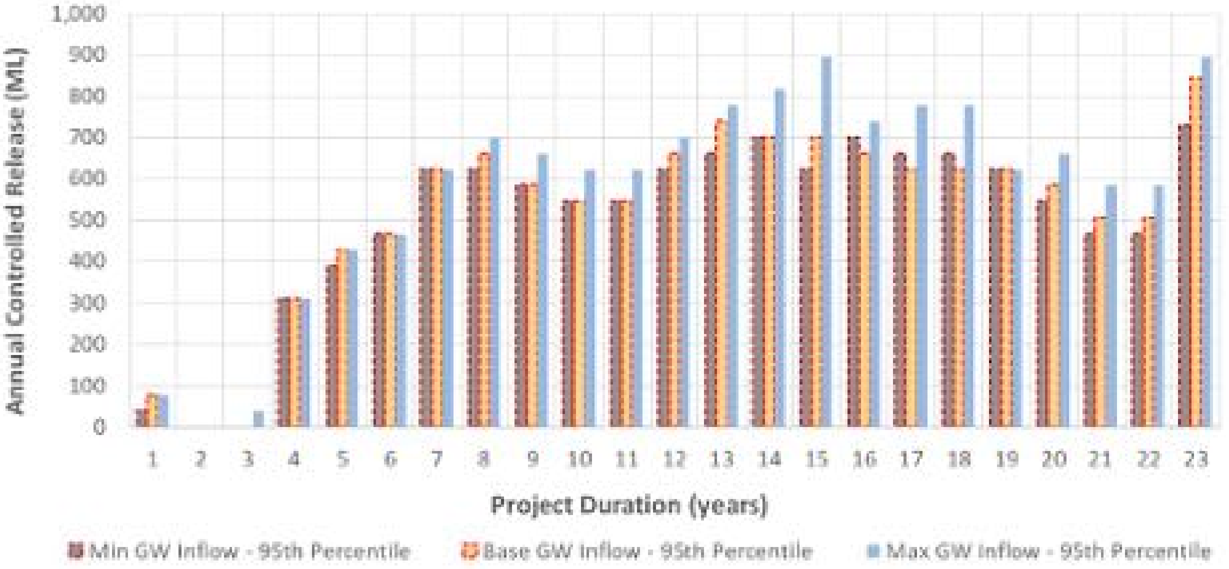


Figure 6.17: Groundwater Sensitivity – 95th Percentile Controlled Release Volumes

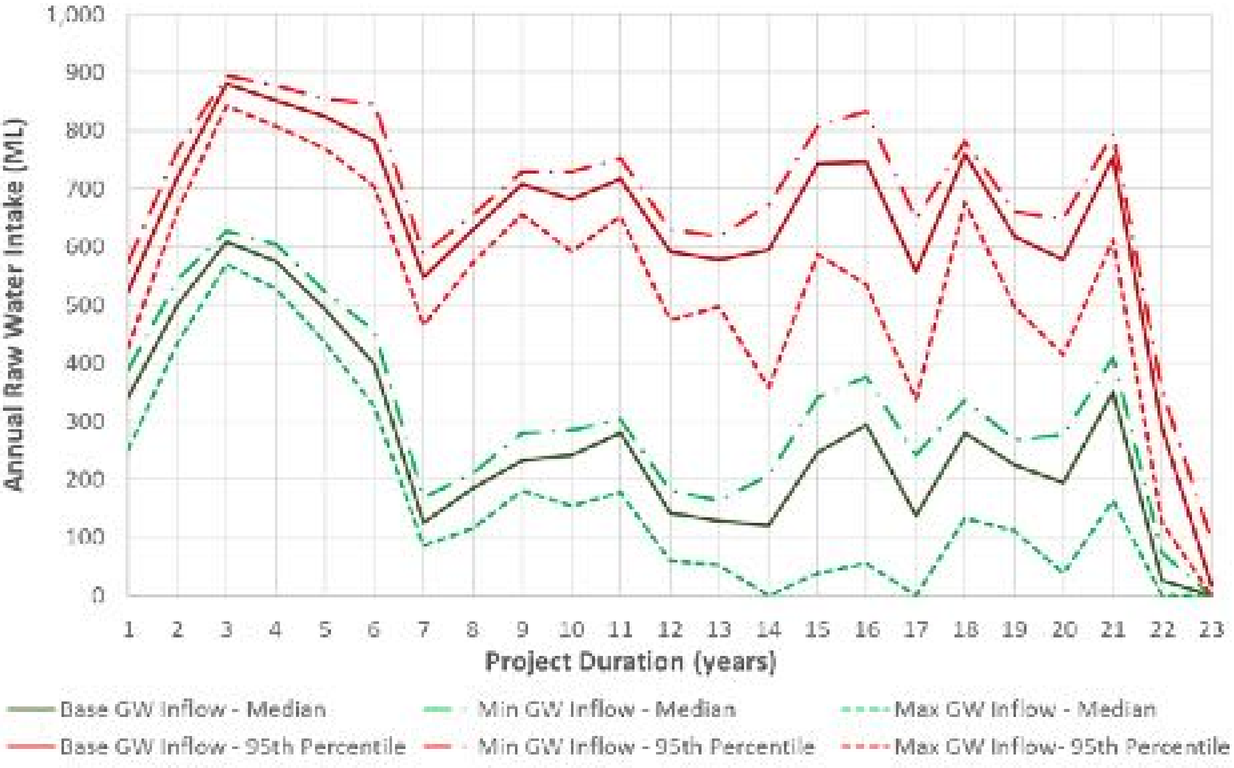


Figure 6.18: Groundwater Sensitivity – Median and 95th Percentile Raw Water Supply

6.3 Final Void Hydrology Assessment

The Project final void strategy includes an open pit residual void in the south of the Project area. The pit low wall dump will be regraded, and the upstream clean catchment will be diverted around the eastern extent of the final void. The final void is outside of the existing 0.1% AEP flood extent and includes a final landform bund around the southern extent of the pit to provide PMF protection (Engeny, 2023). The following sections outline the hydrology assessment of the final void pit lake and assessment of equilibrium lake levels and salinity of the pit lake post closure.

6.3.1 Final Void Hydrology Model Development

The operational Project water balance model (GoldSim) described in Section 6.1 was modified to assess the proposed final void lake conditions (water level and quality) post mining. The final void hydrology model development is summarised in Table 6.10. The final void arrangement is shown in Figure 6.20 and the storage characteristics are shown in Figure 6.19.

TABLE 6.10: FINAL VOID HYDROLOGY MODEL DEVELOPMENT

Input	Description
	Final Void Inflows
Catchment Runoff	Catchment runoff inflows to the final void waterbody are estimated from 103 ha of rehabilitation and 118 ha of mining pit land use areas and the AWBM parameters provided in Section 6.1.2. TDS generation rates for rehabilitation and final void catchment runoff is 230 mg/L and 1,000 mg/L respectively (refer Table 6.5).
Direct Rainfall	Direct rainfall on the final void lake surface area is calculated from daily rainfall applied to the surface area of the final void which is dynamically calculated each daily timestep using the stage storage relationship shown in Figure 6.19. Salinity of direct rainfall was assumed to be 3mg/L as presented in Section 6.1.3
Groundwater Inflows	Groundwater inflows calculated based on the modelled final void lake level. Groundwater inflow relationship and salinity is discussed in Section 6.3.2.
	Final Void Outflows
Evaporation	Evaporation from the final void waterbody surface area is calculated from daily Morton's Lake Evaporation time series extracted from the SILO Data Drill at the Project location. An evaporation reduction factor of 20% was applied to account for shading and reduced windspeed of the lake surface area from the pit walls.

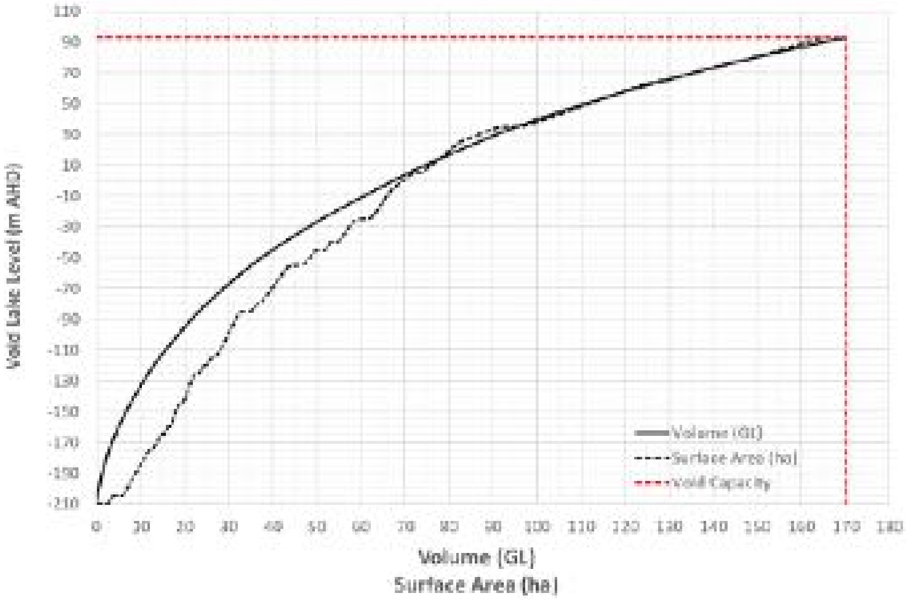
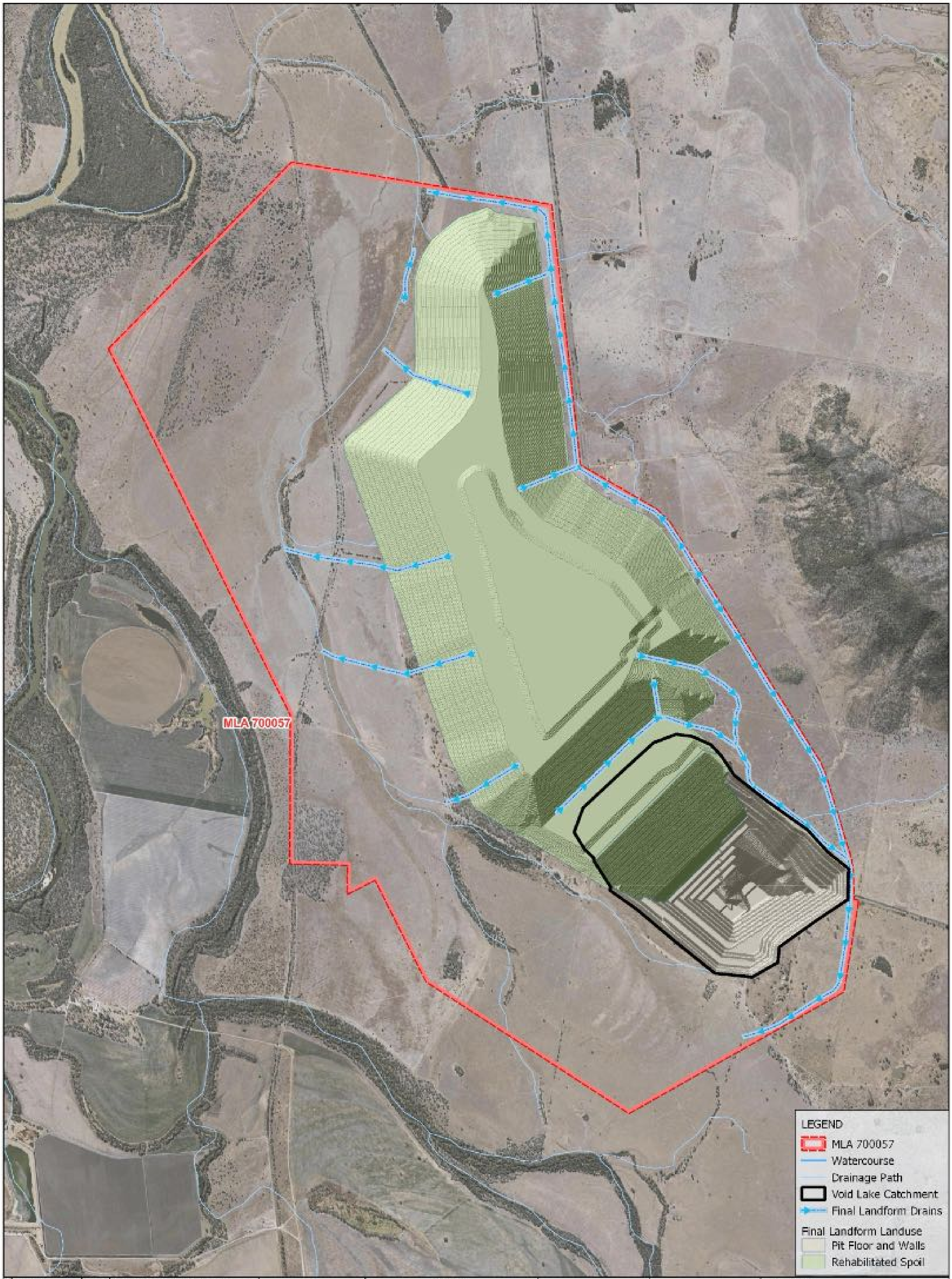


Figure 6.19: Final Void Waterbody Storage Characteristics



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BARALABA SOUTH

Figure 6.20

BARALABA SOUTH PTY LTD
Baralaba South Surface Water Impact Assessment
Final Void Arrangement

Job Number:
QLD2018_004

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6.3.2 Final Void Groundwater Ingress

A groundwater recovery curve for the Project final void has been developed by Watershed HydroGeo (2023) using a regional groundwater model. The groundwater inflow to the final void is made up of flows from the remaining coal measures, weathered and interburden material, alluvium and spoil seepage from the backfilled pit. Figure 6.21 shows the relationship between final void water level and groundwater inflow rate for the final void as well as the breakdown from the contributing inflow sources (Watershed HydroGeo, 2023).

The groundwater recovery to the final void steadily decreases as the pit lake rises in level. The groundwater inflow relationship breakdown shows that at lower lake elevations (below -150m AHD), spoil seepage makes up less than 20% of the groundwater inflow, however at higher lake elevations (above -25 m AHD) spoil seepage makes up over 70%, and the remainder is sourced from true groundwater.

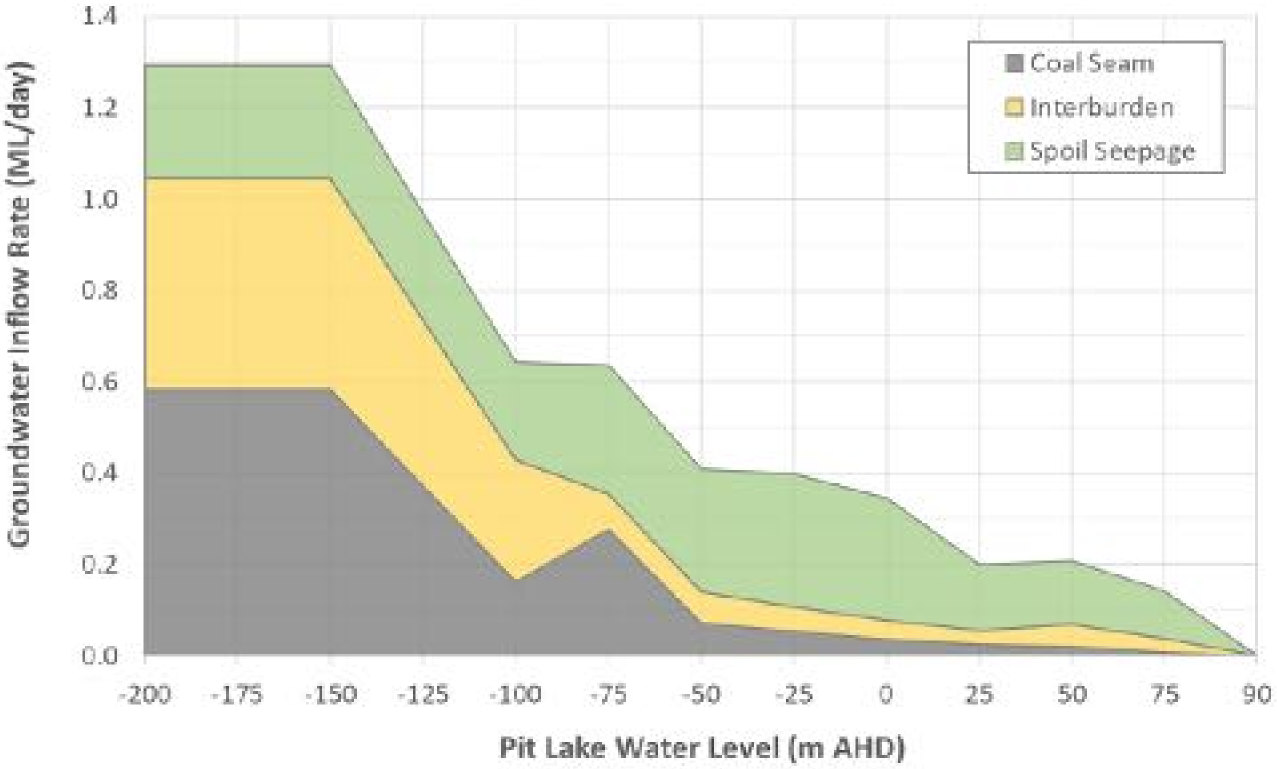


Figure 6.21: Final Void Groundwater Recovery Relationship

As discussed in Section 6.1.6 an average TDS concentration of 16,750 mg/L has been adopted for the alluvium, coal measures and weathered and interburden inflows and a TDS concentration of 338 mg/L for the spoil seepage inflows.

Table 6.11 summarises the groundwater inflows for varying final void water levels as well as the proportion contribution from the inflow sources and the assumed average groundwater inflow TDS adopted for the final void hydrology model. At lower void lake levels the groundwater inflow TDS is predicted to be high (13,000 mg/L) due to inflows being primarily sourced from the Coal Measures and interburden. At higher void lake levels (between -50 and 75 m AHD), spoil seepage is the largest source to groundwater inflows, reducing the average groundwater inflow TDS concentration to approximately 5,000 mg/L.

TABLE 6.11: FINAL VOID GROUNDWATER INFLOW SOURCES

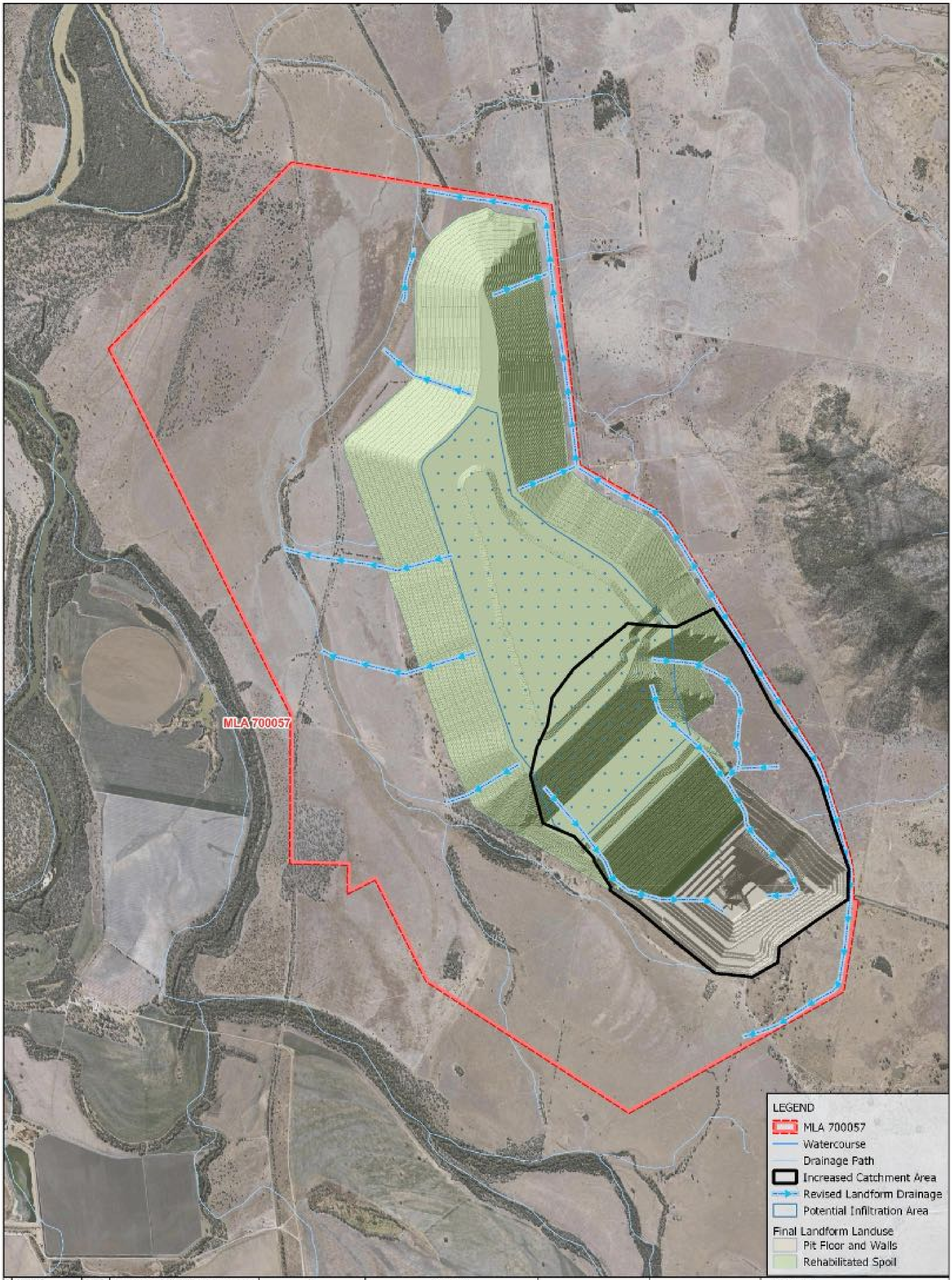
Final Void Water Level m AHD	Total Groundwater Inflow (ML/day)	Groundwater Inflow Source Contribution (%)				Average Groundwater Inflow TDS (mg/L)
		Coal Measures	Weathered and Interburden	Alluvium (colluvium)	Backfill Spoil Seepage	
-200	1.29	45%	36%	0%	19%	13,577
-175	1.29	45%	36%	0%	19%	13,577
-150	1.29	45%	36%	0%	19%	13,577
-125	0.97	38%	38%	0%	24%	12,803
-100	0.64	25%	42%	0%	34%	11,246
-75	0.64	43%	12%	0%	44%	9,471
-50	0.41	17%	16%	0%	66%	5,899
-25	0.40	14%	13%	0%	73%	4,725
0	0.35	10%	12%	0%	78%	3,992
25	0.20	12%	16%	0%	71%	5,022
50	0.21	10%	23%	0%	67%	5,702
75	0.14	4%	22%	0%	74%	4,659
90	0.00	0%	0%	0%	0%	0

6.3.3 Pit Lake Water Quality Mitigation Measures

Final void lakes are expected to deteriorate overtime due to evapo-concentration effects. Additional clean water inflows can be introduced to the void to reduce the influence of evapo-concentration and improve long-term water quality. Options of introducing clean water to the void lake have been investigated for the Project, and the following options have been considered feasible to improve the void lake water quality:

- Redirect an additional 200 ha of rehabilitation to the pit lake to increase clean runoff volumes; and
- Modification of the rehabilitated dump surface to increase rainfall infiltration and seepage through the backfilled spoil to the pit lake.

It is proposed to divert as much as practical of the rehabilitated final landform into the final void without significant concentration of flows that could result in excessive erosion or scour of the flow paths into the void. To further improve water quality, it is also proposed to modify the rehabilitated dump surface drainage, so runoff drains internally with targeted infiltration areas consisting of rock surface layer to prevent drying and maximise rainfall/runoff infiltration. Detailed analysis is required of the waste dump geotechnical properties, proposed designs of the infiltration areas and consideration of monitoring data from existing dumps at Baralaba North to determine potential rainfall infiltration seepage rates. A preliminary seepage rate of 15% has been adopted for the potential seepage inflow strategy. The proposed final void water quality arrangement for the mitigation scenario is presented in Figure 6.22.



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BARALABA SOUTH

Figure 6.22

BARALABA SOUTH PTY LTD
Baralaba South Surface Water Impact Assessment
Final Void Arrangement - Mitigation Scenario

Job Number:
QL3018_004

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6.3.4 Final Void Assessment Results

The modelled final void water level and EC for a 500-year forecast using the final void water balance model is presented in Figure 6.23 and Figure 6.24 for the base case scenario and the water quality mitigation scenario. The final void lake outcomes for the two scenarios are summarised in Table 6.12. The base case scenario includes the final landform catchment area of 221 ha and for the water quality mitigation scenario, the catchment area is increased by 200 ha and a preferential seepage area on the waste dump of 300ha, generating an additional 15% rainfall infiltration seepage to the void lake.

The base case scenario results show:

- The final void water level is expected to approach an equilibrium level of -50 m AHD (37.5 GL of storage) after approximately 200 years which is approximately 143 m below natural surface.
- After reaching equilibrium lake level conditions, the model predicts multi-annual fluctuations in water level between -59 m AHD and -48 m AHD.
- EC in the final void was not shown to reach an equilibrium over a 500-year forecast with EC predicted to reach 18,000 µS/cm at 100 years post closure and 21,000 µS/cm when the void lake level reaches equilibrium conditions.
- The Base Case final landform indicates a minimum freeboard allowance of 141 m for a pit crest level of 93 m AHD indicating there is no risk of overtopping to the receiving environment.

The Water Quality Mitigation Scenario results show.

- The final void water level is expected to approach an equilibrium level of 32 m AHD (92.5 GL of storage) after approximately 325 years which is approximately 61 m below natural surface.
- The equilibrium lake level remains approximately 40m to 50m below the pre-mining standing groundwater levels near the final void location (based on observed data this is typically 68-80 m AHD) (Watershed HydroGeo, 2023).
- At equilibrium, the model predicts multi-annual fluctuations in water level between 24.6 m AHD and 37.4 m AHD.
- EC in the final void was not shown to reach an equilibrium over a 500-year forecast with EC predicted to reach 5,650 µS/cm at 100 years post closure and 5,840 µS/cm when the void lake level reaches equilibrium conditions.
- The water quality mitigation indicates a minimum freeboard allowance of 55 m for a pit crest level of 93m AHD indicating there is no risk of overtopping to the receiving environment.

The water quality mitigation scenario results in a higher lake level however considerably better water quality due to the additional lower salinity inflows. The results also show both void scenarios are not at risk of overtopping to the receiving environment.

Continued accumulation of salt is expected to occur as a result of runoff and groundwater ingress combined with evaporative concentration. In the proposed final void arrangement, there are no salt outflows, and therefore it is expected that TDS will continue to increase until saturation at a very slow rate. The final void hydrology model assumes a constant salt load from spoil and groundwater inflows. It is more likely that the runoff water quality would improve over time as salts are leached from the landform, which indicates the model results are conservative.

TABLE 6.12: FINAL VOID WATERBODY ASSESSMENT SUMMARY

Scenario	Equilibrium Void Water Level (m AHD)	Mean Time to reach Equilibrium Water Level (years post closure)	Minimum and Maximum Void Water Level after reaching equilibrium (m AHD)	Void Water EC at 100 years post-mining (mg/L)	Void Water EC when Lake Reaches Equilibrium (mg/L)
Base Case	-52	200	-58.9 min to -47.9 max	17,920	20,830
Water Quality Mitigation Scenario (increased catchment and seepage inflows)	32	325	24.6 min to 37.4 max	5,650	5,840

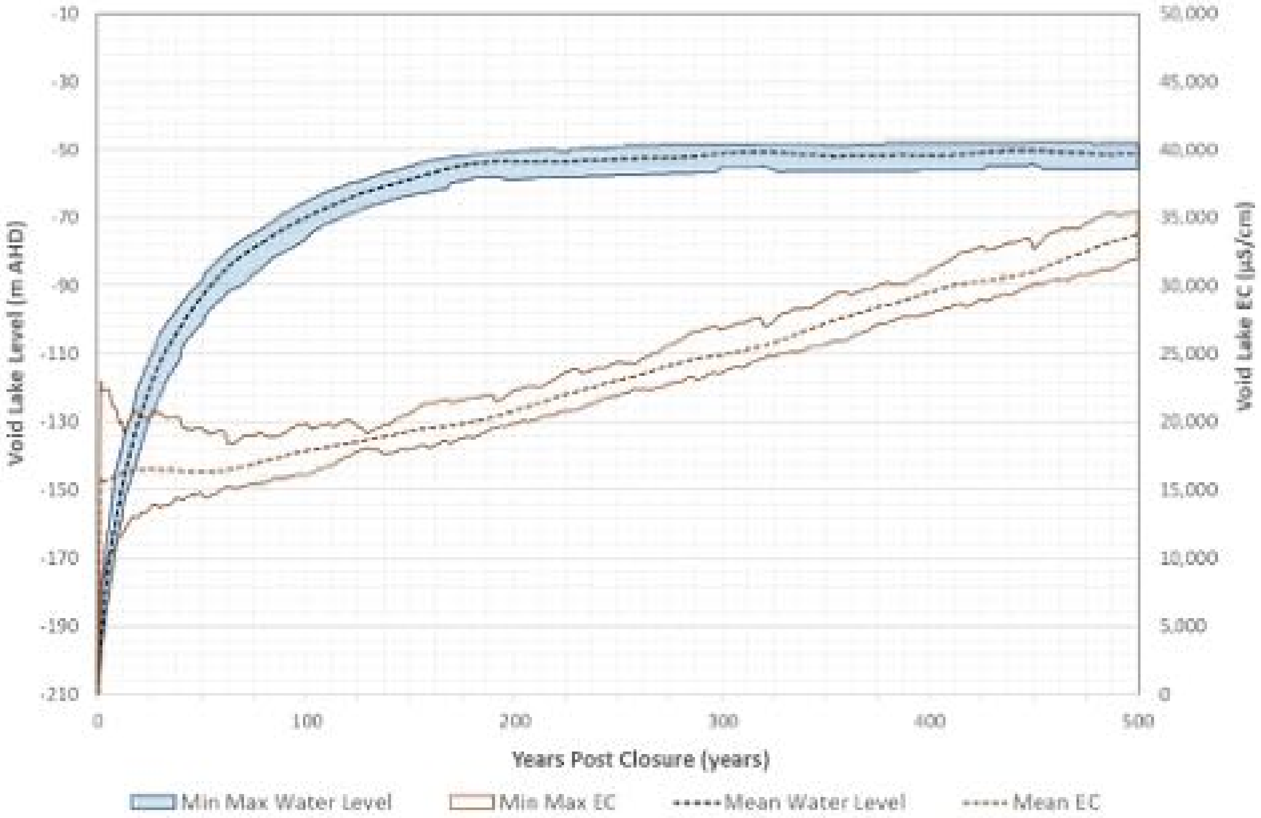


Figure 6.23: Final Void Water Balance – Base Case

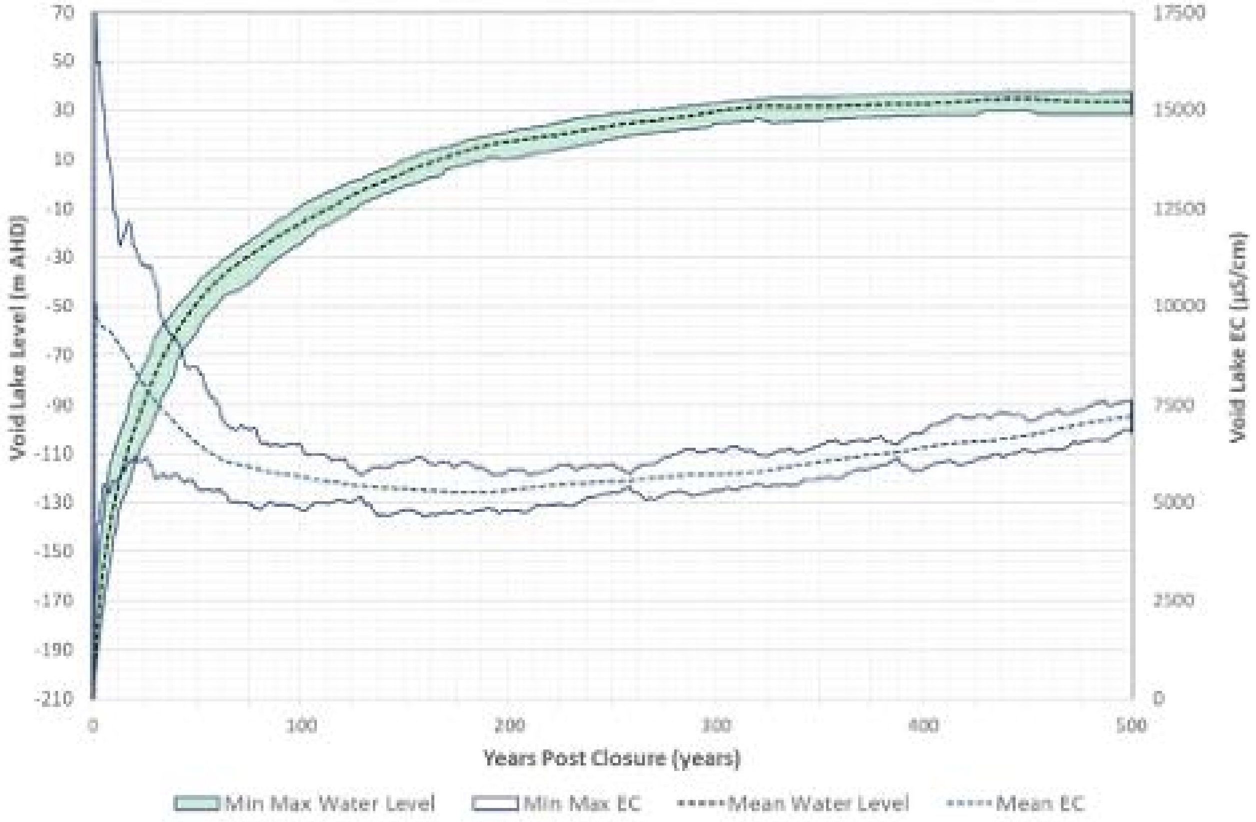


Figure 6.24: Final Void Water Balance – Water Quality Mitigation Scenario

6.4 Climate Change Sensitivity Assessment

A climate change sensitivity assessment was undertaken to understand the impact of climate change on the outcomes derived from the operational and final void water balance assessments. The model climate data inputs were adjusted using the methodologies outlined in "Climate Change in Australia Technical Report" (CSIRO, 2015) to undertake the sensitivity assessment. The CSIRO report provides projections of future climate variables for several greenhouse gas and aerosol emission scenarios (Representative Concentration Pathways).

Climate projections for the Project were obtained using the projection builder tool (Whetton P, 2012) provided on the Climate Change Australia website which was developed using the climate model evaluations detailed in the CSIRO report. Projections were obtained for the "Best" and "worst" case scenarios which are based on the following:

- Best Case – lower rainfall and higher evaporation, reducing rainfall runoff resulting in reduced spills from storages and reduced mine water release.
- Worst Case – higher rainfall and lower evaporation, increasing rainfall runoff resulting in increased spills from storages and increased mine water releases.

Projections are also provided for the "Maximum Consensus" which is the climate future projected by at least 33% of the climate models and which comprises at least 10% more models than any other. The "Maximum Consensus" is considered the most representative forecast of all the climate models.

Projected changes to annual rainfall and evapotranspiration were obtained for the Representative Concentration Pathway 8.5 (RCP8.5). RCP8.5 represents no intervention to reducing greenhouse gas and aerosol emissions.

The climate change sensitivity parameters are provided in Table 6.13 for the 2050 and 2090 projection years. The predicted change in evapotranspiration has increased for all climate change scenarios.

TABLE 6.13: CLIMATE CHANGE SENSITIVITY PARAMETERS

Projection Year	Scenario	Change in Annual Rainfall	Change in Annual Evapotranspiration	Model and Consensus
2050	Best Case	-24.4%	7.9%	GFDL-ESM2M
	Worst Case	1.4%	5.9%	NorESM1-M
	Maximum Consensus	-7.0%	4.7%	MIROC5
2090	Best Case	-34%	14.5%	GFDL-ESM2M
	Worst Case	19.1%	8.3%	NorESM1-M
	Maximum Consensus	-15.4%	15.2%	ACCESS1-0

6.4.1 Operational Water Balance Climate Change Sensitivity Assessment

The Project operational water balance model daily climate inputs were adjusted using the year 2050 climate projections in Table 6.13 to assess the impact of the "Best" case, "Worst" case and "Maximum consensus" climate change scenarios on the water balance assessment results. The year 2050 projected climate change variables reduce the total runoff reporting to storages and increases evaporation from storages in the operational water balance model. This results in a reduction in controlled and uncontrolled releases and overall reduction in impacts to the receiving environment.

6.4.2 Final Void Water Balance Climate Change Sensitivity Assessment

The final void daily climate inputs were adjusted using the year 2090 climate projections in Table 6.13 to assess the impact of the “Best” case, “Worst” case and “Maximum consensus” climate change scenarios on the final void outcomes. Climate change analysis was undertaken on the Base Case void arrangement and the proposed water quality mitigation scenario presented in Section 6.3. The final void climate change sensitivity assessment results are shown in Figure 6.25 and Figure 6.26. The climate change sensitivity assessment shows:

- For the majority of the climate change scenarios the predicted pit lake levels are lower than without climate change besides the “Best Case” climate change prediction.
- The “Best” case climate change projection results in predicted final void lake levels 130 m and 40m below the pit crest level (93 m AHD) for the Base Case and Water Quality Mitigation final void arrangement scenarios respectively.
- Concentration of salts in the final void waterbody is significantly increased in the “Best” and Maximum Consensus scenarios due to the increased evaporation and reduced annual rainfall.

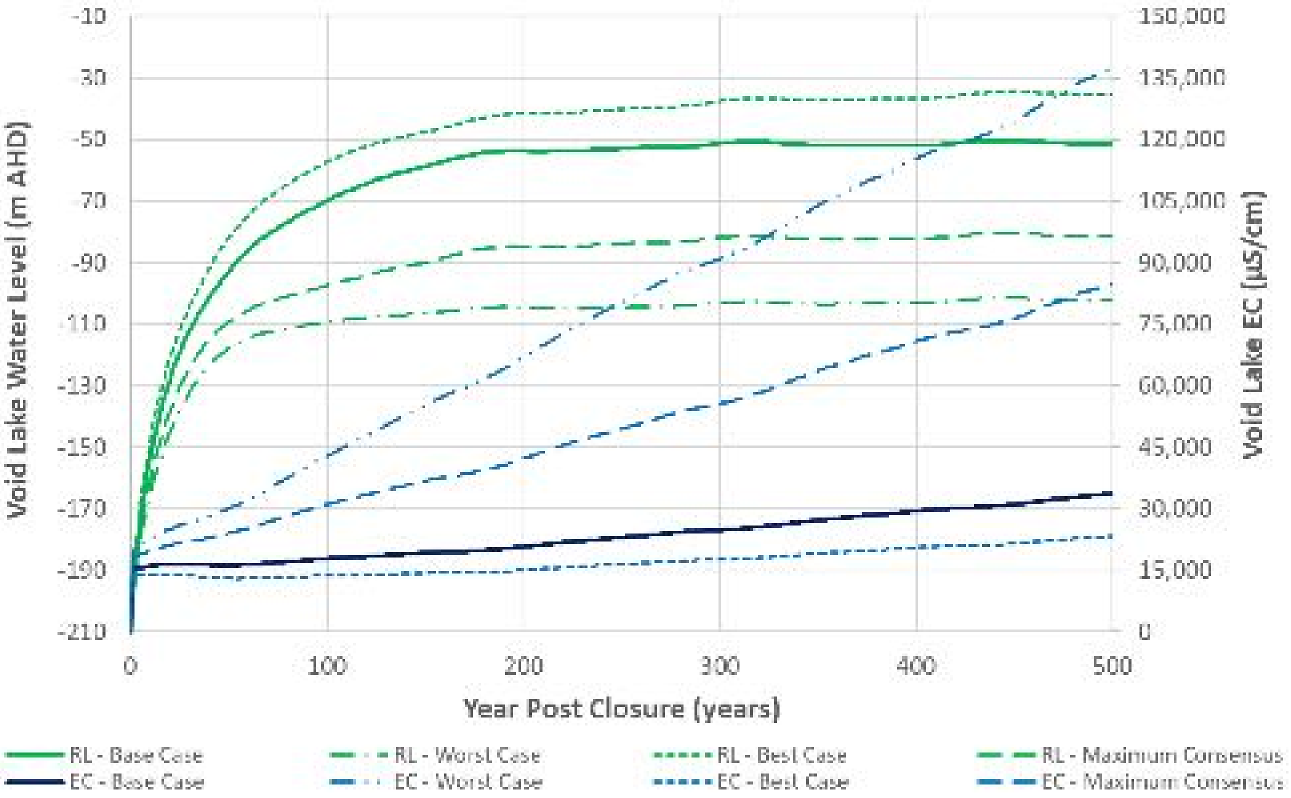


FIGURE 6.25: FINAL VOID CLIMATE CHANGE SENSITIVITY – BASE CASE FINAL VOID SCENARIO

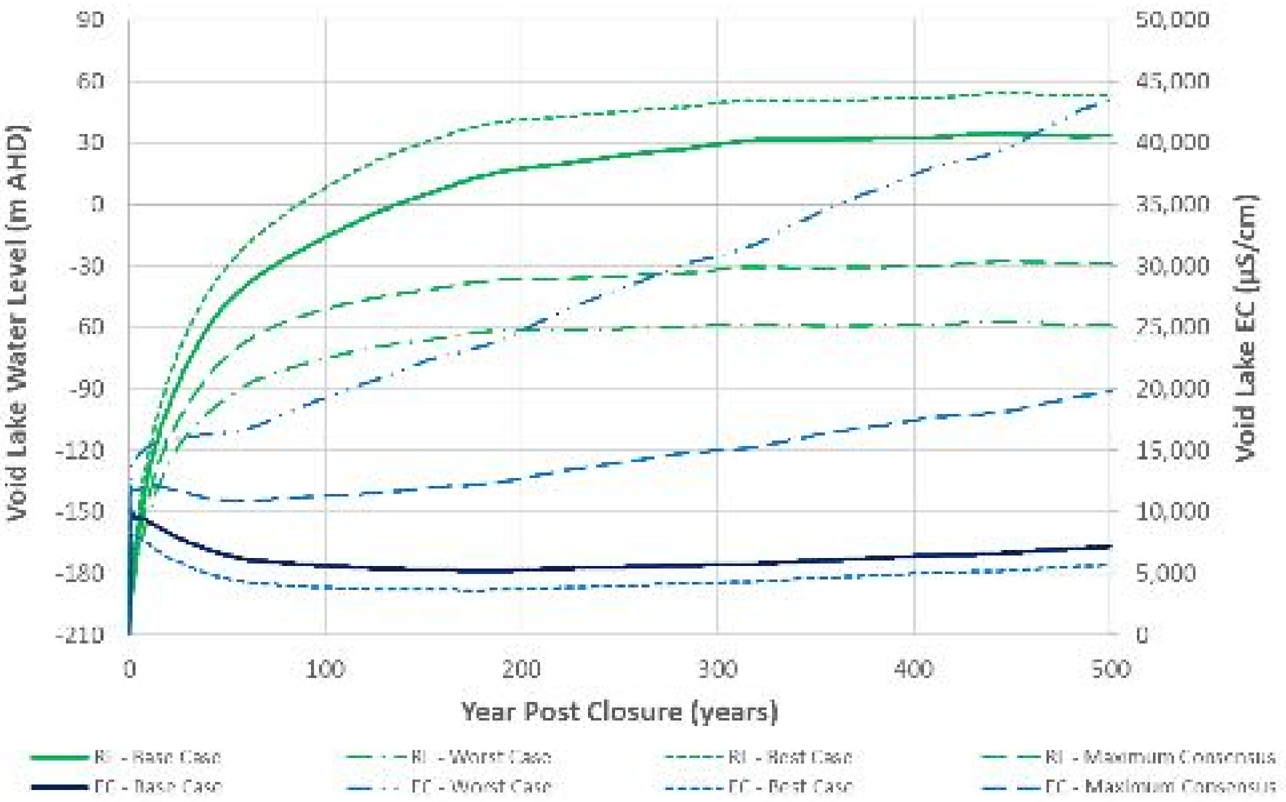


FIGURE 6.26: FINAL VOID CLIMATE CHANGE SENSITIVITY –WATER QUALITY MITIGATION FINAL VOID SCENARIO

7. STREAMFLOW ASSESSMENT

Potential sources of impact on streamflow in the Dawson River can be categorised as:

- Decreased flow due to capture of rainfall runoff within the Project disturbance area.
- Reduction in baseflow as a result of predicted groundwater drawdown from the Dawson River (Watershed HydroGeo, 2023).

The streamflow impacts on the Dawson River were assessed using the Integrated Quality and Quantity Model (IQQM) of the Dawson River catchment that was developed to inform the water resource planning aspects of the Water Plan (Fitzroy Basin) 2011. The IQQM software is designed to simulate all aspects of water resource systems to support integrated planning, operations, and governance from urban, catchment to river basin scales including human and ecological influences. IQQM accommodates diverse climatic, geographic, water policy and governance settings for both Australian and international climatic conditions.

The WRP/ROP amendment version of the Dawson Valley IQQM hydrology model developed by the Department of Environment and Science (DES) was used for the assessment. This version of the model assumes full utilisation of all surface water entitlements (including unallocated water reserves) and represents a 'maximum water use' scenario as allowed under the Fitzroy Basin Water Plan. Using the IQQM model enables assessment of the Project impacts on Dawson River streamflow' as well as assessment against the Environmental Flow Objectives (EFOs) and Water Allocation Security Objectives (WASOs) in the Water Plan (Fitzroy Basin) 2011 (Refer section 3.1.5).

The following sections outline the Dawson River streamflow impact assessment using IQQM as well as assessment against the EFOs and WASO's in Water Plan (Fitzroy Basin) 2011.

7.1 Catchment Reduction

The maximum catchment area captured by site storages over the Project life is approximately 966 ha (9.66 km^2) which accounts for approximately 0.024% of contributing catchment at the Dawson River at Beckers gauging station (40,500 km^2). Catchment reduction for other catchments of note in the Fitzroy Basin are summarised in Table 7.1. The impact of the catchment reduction on Dawson River streamflow is assessed in Section 7.3.

TABLE 7.1: CATCHMENT REDUCTION

Location	Total Catchment	Catchment Reduction %
Fitzroy River at Riverslea	131,400 km^2	0.007%
Dawson River at Boolburra	49,290 km^2	0.02%
Dawson River at Beckers (total)	40,500 km^2	0.024%

7.2 Groundwater Drawdown Impacts on Baseflow

Drawdown effects on baseflow volume for watercourses and drainage features near the Project has been assessed as part of the groundwater assessment for the Project (Watershed HydroGeo, 2023). The predicted reduction in baseflow volumes is provided in Table 7.2 and determined an increase in leakage from the Dawson River (upstream of Neville Hewitt Weir) to the surficial geology by up to approximately 0.10 ML/day. The assessment also predicted increased leakage from Banana Creek however was considered negligible volumetrically as it only flows on occasions following rainfall events (while in the model it is conservatively simulated as a fixed head or consistent source of water) (Watershed HydroGeo, 2023). Therefore, the predicted increase in leakage from Banana Creek was excluded this assessment of impacts to Dawson River streamflow.

The Groundwater Assessment concluded the predicted reduction in baseflow volumes compared to the average surface water flows in the Dawson River for the past 5 years (and recently prescribed passing flow conditions for the Dawson River) is less than 0.01% reduction in total flow volume over the 5 year period (Watershed HydroGeo, 2023). The impact of the predicted baseflow reduction on Dawson River streamflow is assessed in Section 7.3.

TABLE 7.2: PREDICTED CHANGE IN GROUNDWATER-SURFACE WATER INTERACTION AT RIVER REACHES (WATERSHED HYDROGEO, 2023)

Watercourse	Model with the BSP [ML/d]	Model without the BSP (Null) [ML/d]	Predicted Change due to the BSP (Predictive Model Run Minus 'Null' Run)	
			Effect During Mining (to Year 19) [ML/d]	
Dawson River (Upstream) [Zone E]	1.18 – 1.56 1.41 (Mean) [Leakage]	1.17 – 1.55 1.40 (Mean) [Leakage]	Negligible	-
Dawson River (Upstream of Neville Hewitt Weir) [Zone D]	1.20 – 2.63 1.94 (Mean) [Leakage]	1.26 – 2.73 2.04 (Mean) [Leakage]	0.10 (Peak) 0.09 (Mean)	Peak effect of <0.01% of average flow^
Dawson River (Downstream of Neville Hewitt Weir) [Zone C]	2.48 – 5.22 3.79 (Mean) [Leakage]	2.49 – 5.23 3.80 (Mean) [Leakage]	Negligible	-
Banana Creek *	0.01 – 0.11 0.06 (Mean) [Leakage]	0.11 – 0.22 0.16 (Mean) [Leakage]	0.1 additional loss	Negligible as Banana Creek only flows on occasions following rainfall events

^ Based on an average gauged flow in the Dawson River of 2,371 ML/d (Dawson River at Beckers 130322A)

** Note that a small section of the lower reach of Banana Creek, at the confluence of the Dawson River, is mapped as being within the 'effective upstream limit of Neville Hewitt Weir' which has likely raised the stage in part above the natural levels.*

Source: (Watershed HydroGeo, 2023)

7.3 Assessment of Dawson River Streamflow Impacts

The approved IQQM developed hydrology model for the Water Plan (Fitzroy Basin) 2011 was updated to include:

- The Project's catchment reduction of 966 ha (0.024% of catchment reporting to Beckers gauging station).
- Groundwater drawdown reduction to Dawson River baseflow of 0.1 ML/day (<0.01% of flow).

The IQQM model was then used to assess reduction in Dawson River streamflow volumes and flow duration at the Project location and at the Beckers gauging station as well as compliance against the EFOs and WASOs in the Water Plan (Fitzroy Basin) 2011. The IQQM includes the proposed Nathan Dam project, and all assessments therefore represent cumulative impacts including this project.

Figure 7.1 and Figure 7.2 show the annual and daily Dawson River flows with and without the Project at the Project Location and Figure 7.3 and Figure 7.4 show the same results at the Dawson River at Beckers gauging station (130322A).

The model results show the Project is expected to have only minor reductions to the Dawson River streamflow volume and duration. The Project is expected to have a reduction in streamflow less than 0.045% (mean annual flow) at the Project location which is not expected to impact the existing Dawson River riparian vegetation or channel morphology. Modelled changes to Dawson River stream flows at the Dawson River at Beckers gauging station are summarised in Table 7.3 with and without the Project.

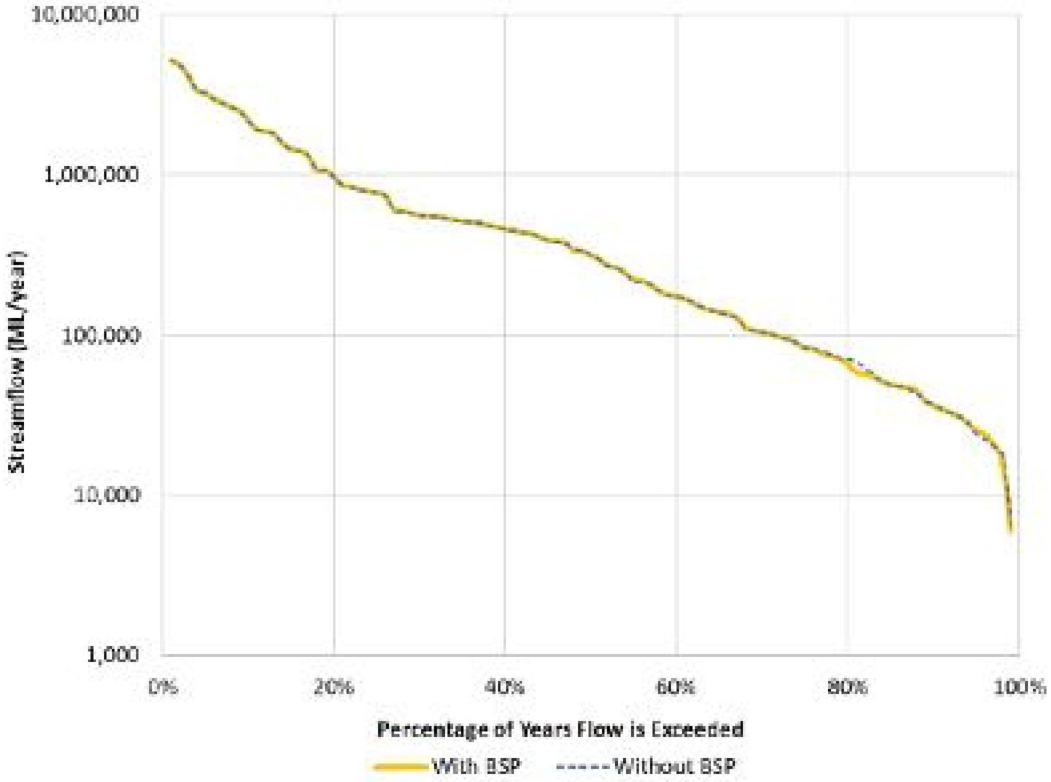


Figure 7.1: Dawson River Annual Flow Volume (with and without Project) – Project location

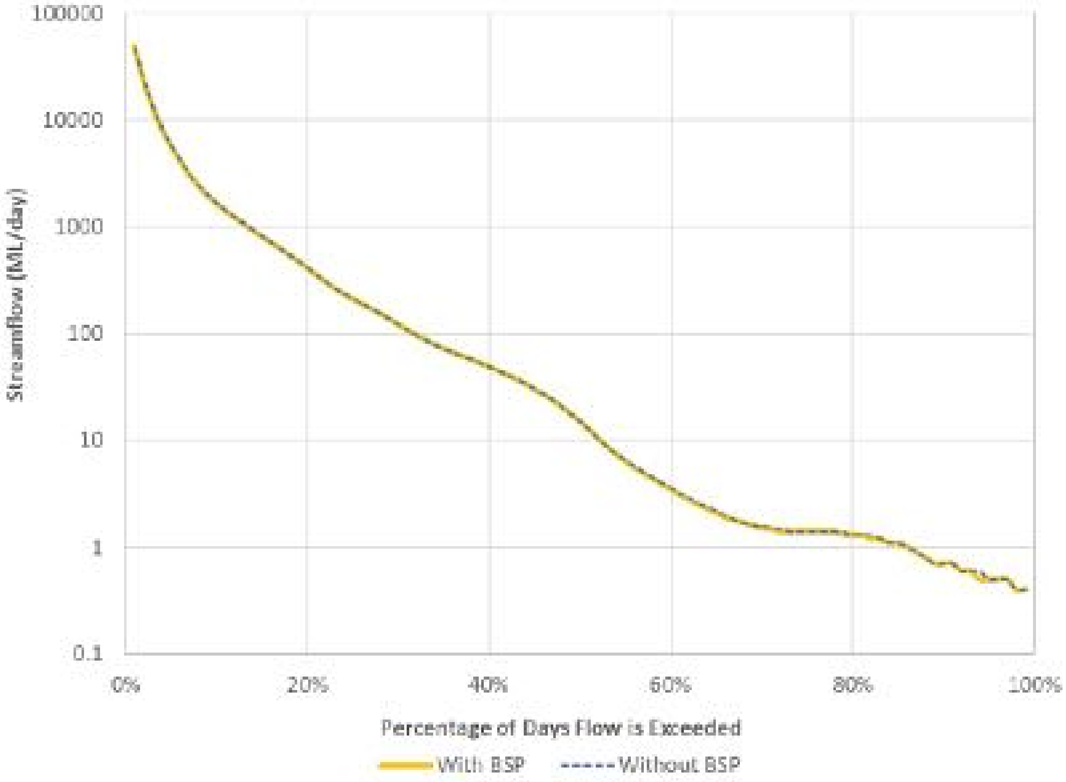


Figure 7.2: Dawson River Daily Flow Duration (with and without Project) – Project location

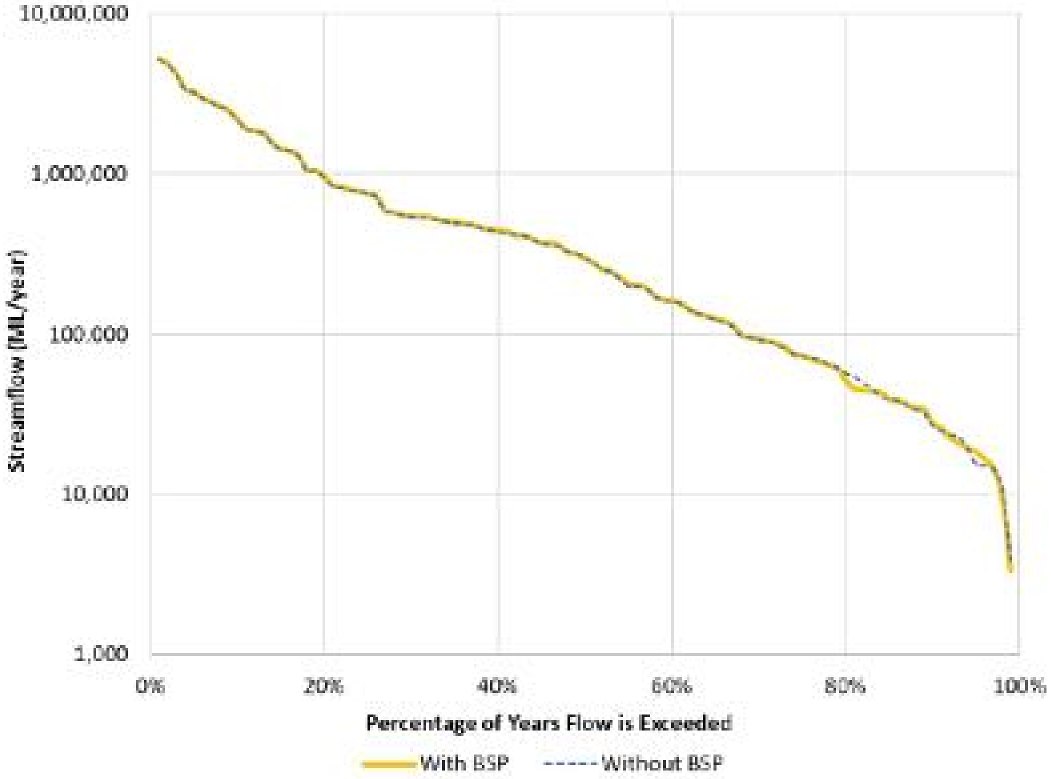


Figure 7.3: Dawson River Annual Flow Volume (with and without Project) – Dawson River at Beckers

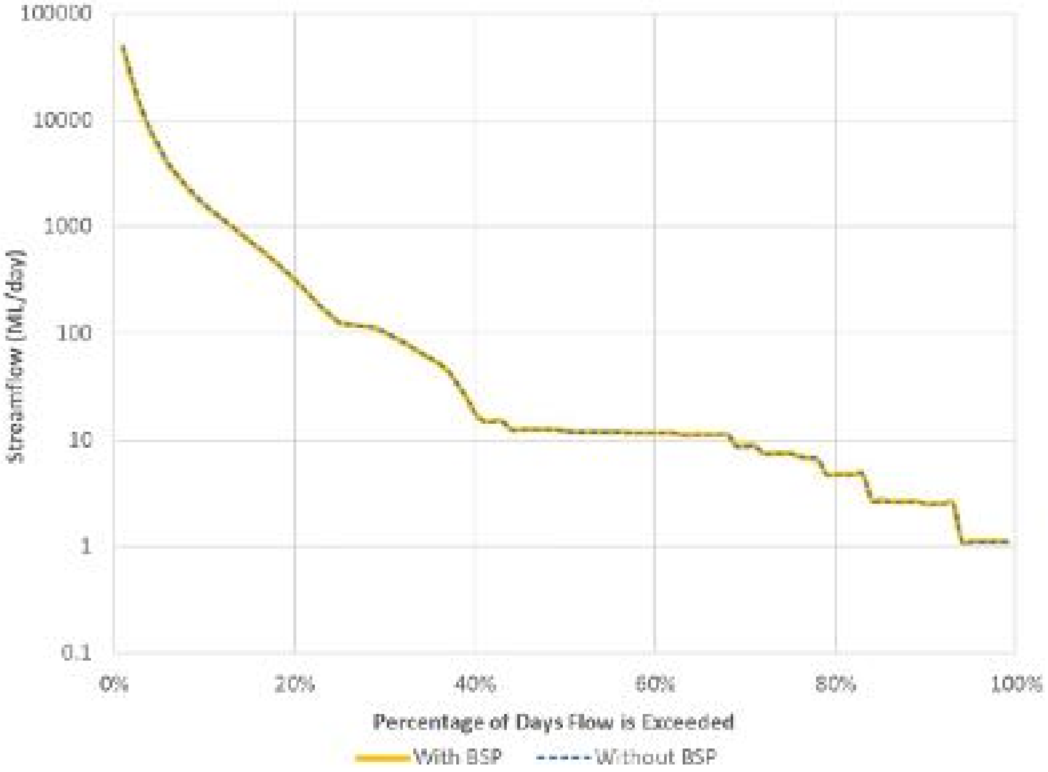


Figure 7.4: Dawson River Daily Flow Duration (with and without Project) – Dawson River at Beckers

TABLE 7.3: DAWSON RIVER STREAMFLOW IMPACT SUMMARY: –NODE 2 - DAWSON RIVER AT BECKERS.

Flow Condition		Approved WRP Case IQQM	Approved WRP Case IQQM With Project	Change
Base flows	Percentage of time Base flow is exceeded (86ML/day)	30.5%	30.3%	-0.66%
Medium Flows	Annual mean	693,050 ML/year	692,769 ML/year	-0.04%
	Median ratio of annual flows	52.4%	52.0%	-0.76%
High Flows	2 year ARI peak	26,002 ML/day	25,968 ML/day	-0.13%
	5 year ARI peak	100,026 ML/day	99,956 ML/day	-0.07%
	20 year ARI peak	209,777 ML/day	209,628 ML/day	-0.07%
	4 percentile flow	7,669 ML/day	7,664 ML/day	-0.07%
	10 percentile flow	1,524 ML/day	1,520 ML/day	-0.26%

7.4 Environmental Flow Objectives

Environmental Flow Objectives (EFOs) for the Fitzroy Basin are detailed in Schedule 6 of the Water Plan (Fitzroy Basin) 2011 and represent key performance objectives that must be achieved to meet the Water Plan outcomes for the sustainable management of surface water (refer Section 2.8.5). The closest EFO location to the Project is Node 2 – Dawson River at Beckers. Detailed descriptions of the EFO's for Dawson River at Beckers are provided in Section 2.8.5.

EFOs for development scenarios are assessed by the difference in flow regime compared to the pre-development flow regime. The impact of the project on compliance against the EFOs is undertaken by updating the Approved WRP case IQQM with the Project and then re-checking compliance against the EFOs. Table 7.4 and Table 7.5 presents the Project's outcomes for all EFOs. The assessment show the Project is compliant against all EFOs for–Node 2 - Dawson River at Beckers.

TABLE 7.4: ENVIRONMENTAL FLOW OBJECTIVES: –NODE 2 - DAWSON RIVER AT BECKERS

EFO	Approved WRP Case - With Project	*Approved WRP Case - Without Project*[1]	Pre-development Case	Difference (Pre-development vs Approved WRP Case with Project)	Allowable
Annual mean	692,761	*693,050*	1,027,640	67%	>65%
Median ratio of annual flows	52.0%	*52.4%*	100%	N/A	>48%
Annual proportional flow deviation	3.05	-	-	-	<3.1
2 year ARI peak flow	25,968 ML/day	*26,002 ML/day*	46,326 ML/day	56%	>55%

EFO	Approved WRP Case - With Project	*Approved WRP Case - Without Project*[1]	Pre-development Case	Difference (Pre-development vs Approved WRP Case with Project)	Allowable
5 year ARI peak flow	99,956 ML/day	*100,026 ML/day*	143,293 ML/day	70%	>69%
20 year ARI peak flow	209,628 ML/day	*209,777 ML/day*	259,216 ML/day	81%	>80%
4 percentile flow	7,664 ML/day	*7,669 ML/day*	13,652 ML/day	56%	>53%
10 percentile flow	1,520 ML/day	*1,524 ML/day*	2,728 ML/day	56%	>45%

[1] *Presented for comparison purposes only.*

TABLE 7.5: FIRST POST WINTER FLOW STATISTICS: NODE 2 - DAWSON RIVER AT BECKERS

First Post-Winter Flow Statistics	Approved WRP Case IQQM With Project	Allowable
Number of First Post Winter Flows	83.2%	>80%
Number of flows within 2 weeks of the pre-development event	89.7%	>70%
Number of flows within 4 weeks of the pre-development event	67.3%	>60%
Average flow volume	51.7%	-
Average Peak Flow	73.5%	>60%
Flow duration (2-time base flow)	76.2%	>60%
Flow duration (5-time base flow)	67.3%	>60%

7.5 Water Allocation Security Objectives and Water Licences

Water Plan (Fitzroy Basin) 2011 specifies Water Allocation Security Objectives (WASOs) for supplemented water schemes in the Fitzroy basin. The WASOs for the Dawson Valley Supply Scheme include:

- For water allocations in the high priority group:
  - The annual supplemented water sharing index is to be at least 95%.
  - The monthly supplemented water sharing index is to be at least 98%.
- For water allocations in the medium priority group—the monthly supplemented water sharing index is to be at least 82%.
- For water allocations in the medium A priority group—the monthly supplemented water sharing index is to be at least 82%.

The IQQM results show the Project is compliant against the WASOs for the Dawson River Water Supply Scheme. The IQQM results also showed the Project had negligible impact to the mean annual diversion (MAD) of unsupplemented water licences. Based on the analysis, the Project is expected to result in a very minor reduction of Dawson River flow volume which will have negligible impacts to water availability to existing allocations and water licence holders.

8. SURFACE WATER IMPACT ASSESSMENT

The potential impacts of the Project on surface water resources include:

- Impacts on streamflow in the Dawson River and Banana Creek from loss of catchment area and groundwater drawdown.
- Impacts to streamflow in minor waterways that traverse the Project MLA.
- Impacts on Dawson River water quality due to controlled and uncontrolled releases from the mine water management system.
- Impacts on environmental values from uncontrolled overflows from sediment dams.
- Impacts on flows and the flooding regime in the Dawson River, Banana Creek and their tributaries.
- Impacts on regional water availability due to the need to source water from external sources to meet Project water requirements.
- Impacts on the quality of surface runoff draining from disturbance areas to the various receiving waters surrounding the Project, during both construction and operation phases of the Project;
- The potential for the water management system to impact on the adjacent high ecological significance wetland; and
- Cumulative surface water impacts of Projects in the region on environmental values of the receiving waters.

These potential impacts of the Project are assessed in the following sections.

8.1 Dawson River Streamflow Impacts

Potential sources of impact on streamflow in the Dawson River from the Project include:

- Decreased flow due to capture of rainfall runoff within the project disturbance area,
- Reduction in flow as a result of predicted groundwater drawdown from the Dawson River (Watershed HydroGeo, 2023).

Impacts to the Dawson River streamflow are assessed in Section 7 using the Dawson River Integrated Quality and Quantity Model (IQQM) that was developed by the State Government to inform water resource planning aspects of the Water Plan (Fitzroy Basin) 2011 (refer section). The streamflow impact assessment found:

- The Project will result in only minor reductions in the Dawson River mean annual streamflow volume (0.08% at the Project location and 0.04% at the Dawson River at Beckers gauging station).
- The Project will have only minor impacts to flow duration with negligible impacts to the Dawson River low, medium and high flow regimes.
- The Project achieves all Environmental Flow Objectives specified in the Water Plan (Fitzroy Basin) 2011.
- The Project has negligible impact on existing water licences and allocations from the Dawson River and achieves the Water Allocation Security Objectives in the Water Plan (Fitzroy Basin).

8.2 Streamflow Impacts to Minor Waterways

There are a number of small, unnamed tributaries which flow through the MLA. Details of these waterways are available in Section 2.3.3. The catchments of waterways flowing through the MLA are expected to be reduced by the open cut pit and water containment storages. As depicted in Figure 8.1, the total catchment of the main waterway draining through the MLA to the Dawson River is expected to have a maximum reduction of ~33% in year 23 of the Project. This is expected to have a moderate impact to streamflows in the waterway during operations, however at closure with the rehabilitated mine landforms draining from site, the catchment reduction is reduced to 13% (up to 420 ha draining to the final void). Where possible, undisturbed catchments have been diverted with clean water drains and dams (refer Section 5.3.4) to reduce accumulation of mine affected water and potential impacts to water resources. The minor waterways have no significant environmental values within the 2.9 km reach between the Project MLA boundary and the Dawson River that will be affected by the reduction in local catchment area.

Figure 8.1: Dawson River Tributaries Catchment Reduction

8.3 Controlled Mine Water Releases

Controlled releases of both mine affected water and clean water are used in the water management system to manage stored site inventories. Due to potential high rainfall runoff volumes in large wet seasons and sustained groundwater inflows the site proposes release of both clean and mine affected water to manage inventories for the mine life.

Mine affected water releases from the Project are defined as pumped releases through a release point from storages used to contain water which has come into contact with mining or processing activities. These storages will possibly contain water with elevated contaminant levels compared to water in the receiving waterways. Releases from mine affected water storages will only occur during medium to high flow events in the Dawson River in accordance with the proposed release conditions and strategy.

Predicted annual release volumes, release event frequency and release event durations for the proposed release conditions for the Project are presented in Section 6.2.2. The Project is predicted to release in less than 25% of years for the Project duration (typically) and release volumes greater than 850 ML in less than 5% of years. On average 2,000 ML of mine water release is expected to occur over the operational life (23 years) of the Project.

Figure 8.2 shows the change in water quality at the Beckers gauging station during controlled release from the Project. The results show the EC at Beckers increasing from 260 to 267 µS/cm in less than 50% of release days, and increasing from 277 to 309 µS/cm in in less than 10% release days. This shows the water quality at Beckers is not significantly impacted during releases due to dilution from natural flows in the Dawson River. On days when controlled release are not occurring from the Project, the water quality at Beckers is unchanged.

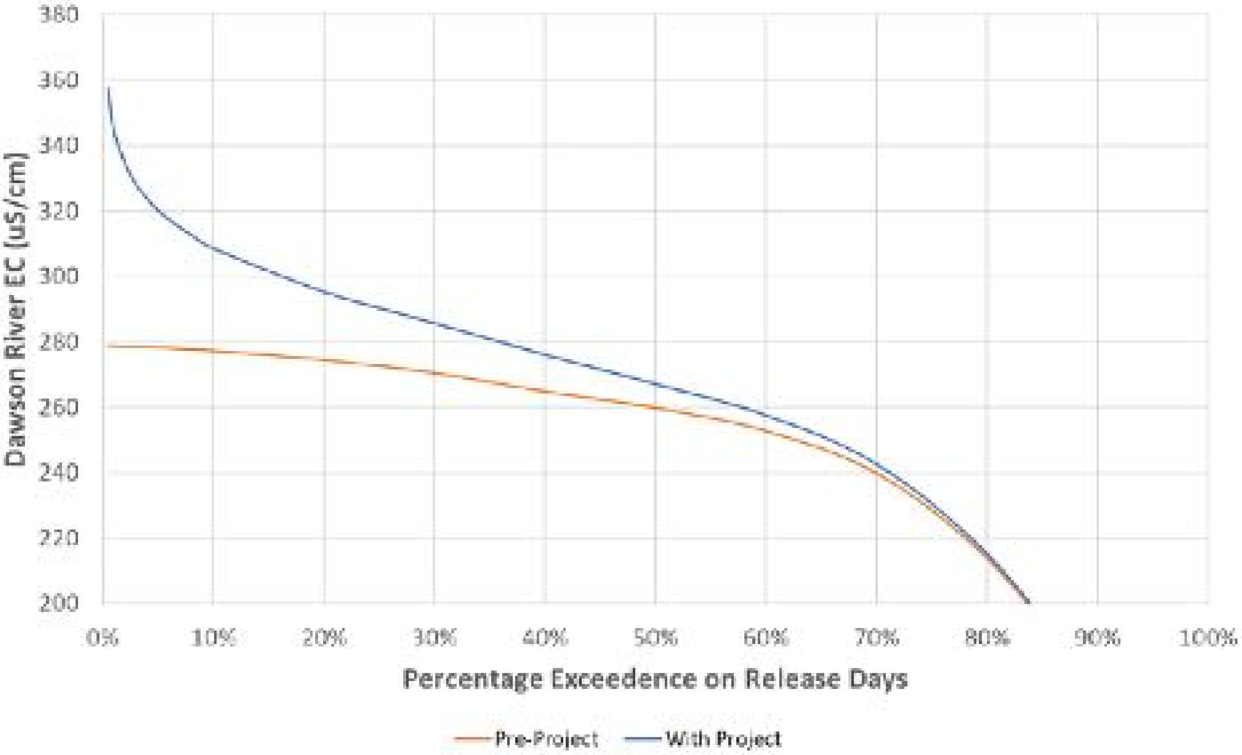


Figure 8.2: Predicted Dawson River In-Stream Water Quality During Release Events

8.4 Mine Water Dam Overflows

In an overflow event Environment Dam and Mine Water Dam would overtop to clean water tributaries of the Dawson River (see Table 5.2-Table 5.7). These dams have been designed to contain the 95th percentile wet season inflow (overflow in less than 5% of years). The water balance assessment identifies no uncontrolled overflows from the mine water system in any simulated scenarios, which demonstrates the mine water system exceeds the design containment standard.

The design containment standard for the mine water dams, and the water balance modelling results, ensure that there would be minimal actual or potential uncontrolled discharge of contaminants to waters that may or have the potential to cause an adverse effect on identified environmental values. Refer to Section 5.3.1 for further information on the design containment standards.

8.5 Sediment Dam Overflows

Sediment dams have been designed in accordance with the International Erosion Control Association Guidelines methodology for “Type D” sediment basins (IECA, 2018) (refer Section 5.3.3). The sediment dams have been designed based on the expected soil types and for protection of sensitive receiving waters. It is proposed to continually dewater the sediment dams to the mine water system to improve containment above what is required. The catchments reporting to the sediment dams are progressively rehabilitated over the project life which reduces sediment runoff generation which further improves the performance of the sediment dams. The water balance modelling shows overflows from sediment dams occur in approximately 30% of years (Table 6.9) which exceeds the design containment standards.

The sediment dams have been designed to provide sufficient storage for settlement of suspended solids so that water quality during overtopping events has negligible impact on the water quality in the receiving waterway. Settlement dams will also include overflow control structures with scour protection (rock chutes, rock aprons or level spreaders) to ensure non-erosive discharges. Monitoring of overtopping events will be undertaken to assess the performance of the sediment dams and ensure downstream environmental values are maintained and validate the design assumptions. Overtopping flows from sediment dams are not expected to have impacts on water quality affecting vegetation within the overflow pathways between the project MLA and the Dawson River (as depicted in Figure 6.15).

8.6 Clean Water Release

Clean water releases from the Project are defined as pumped releases from storages capturing only clean catchment runoff. These storages contain water which is expected to exhibit the same water quality characteristics as the receiving environment and does not collect runoff from areas disturbed by mining activities. The release of clean water from site will not impact water quality or environmental values in the receiving waterways. Clean water release is required from the proposed clean water Dams in years 1-3 of the Project where gravity diversion drain are not possible to maximise separation of clean and mine affected waters. The mine water management system has been designed to minimise the storage of clean water on site by active release to the Dawson River to preserve water resources and reduce the risk of accumulation of contaminated waters on site.

8.7 Flooding

Potential impacts of the Project on flood levels and flood velocities in Banana Creek and the Dawson River are addressed in the Baralaba South Project Flood Impact Assessment Report (Engeny, 2023).

8.8 Site Water Supply

The site will source the majority of its water demands from surface water runoff within the project disturbance area and groundwater ingress to the mining pit. When required, raw water would be sourced from existing water licences held by Wonbindi Coal and Cactua Pastoral. A graph detailing the annual requirements for external water supply is provided in Figure 6.16. The maximum annual demand on Dawson River water licences is expected to be 881 ML in the 5th percentile during year 3 of the Project. The total raw water supply demand is much lower than the volume of existing water allocations currently available to the Project.

Utilisation of existing water allocations will not result in any additional impact to other existing license holders. Water will be accessed in accordance with the existing license conditions. The licences held by Wonbindi Coal have a water allocation security objective of 82%. There is a risk to operations that the water allocations will not be available when they are required.

The base case model assumes project water demands will remain constant in both dry and wet conditions; however management actions can be implemented to increase or decrease water demands in periods of water shortage or excess to maintain site operations. The Project will develop operational procedures that include water management actions during dry conditions to improve water security and reduce reliance on surface water allocations. Water management actions that may be implemented include:

- Consolidate haul road circuits and general road traffic to reduce dust suppression water requirements.
- Temporarily reduce throughput in the CHPP by increasing ROM stockpiles to reduce processing water demands.
- Review polymer additives applied to roads for dust suppression for effectiveness and opportunities for improvement.
- Investigate options for advanced pit dewatering to gain early access to future pit groundwater ingress volumes to supply project water demands.
- Scale down mine production and processing during extreme water shortage and dry climate conditions to maintain operations.

8.9 Water Users

Catchment harvesting has been minimised through clean catchment diversions and clean water release from dams capturing clean catchment runoff. Streamflow impacts are discussed in Section 8.1. The catchment harvesting or raw water uptake from the Project is not expected to have any impact on water availability to downstream water users.

8.10 Wetlands

As discussed in Section 2.6, there is a mapped wetland classified as a MSES high ecological significance wetland situated near the south-western MLA boundary. The Project will not reduce the catchment area reporting to the wetland and not have a significant impact on flooding interactions between the Wetland and the Dawson River and Banana Creek.

Impacts to the wetland have also been assessed as part of the aquatic ecology report (Ecological Service Professionals, 2023). The aquatic ecology report concluded that the aquatic ecosystem value of this wetland was moderate rather than high, and that this wetland would provide similar value habitat as other wetlands in the region and would not support listed threatened aquatic species (Ecological Service Professionals, 2023).

8.11 Seepage

As discussed in Section 4.1.4, there is potential for seepage to surface waters to be generated in the out-of-pit spoil dump, at the northern extent of the MLA. Seepage generated from the out-of-pit dump is expected to follow the natural topography under the dump before expressing at the natural drainage point at the dump toe. This would lead to out-of-pit dump seepage draining to the sediment containment system and managed through the sediment and erosion control system. At closure the dump will be reshaped and rehabilitated to minimise rainfall infiltration and prevent significant volumes of seepage to surface. Seepage from the out of pit dump is expected to be of low salinity and neutral to alkaline pH based on geochemical testing (refer Section 6.1.6).

Seepage generated by the in-pit dump will report to the mining pit and be managed in the mine water system.

Uncontrolled release of seepage is not expected to occur from site and recovered seepage flows will be managed by the water management system. It is not expected that seepage from the spoil dumps will impact water quality in the receiving waterway.

8.12 Moura Baralaba Road Realignment

The Project includes the realignment of an approximate 4.5 km of the Moura Baralaba Road to the east of the MLA (700057) which is subject to separate approvals. The road realignment is shown in Figure 1.1. Surface water impacts for the road realignment will be managed through a separate approvals process. The road realignment is located outside of the 0.1% AEP regional flood level and will be designed so that there are negligible localised flood impacts. The new road will have a sealed surface preventing sediment runoff. A construction erosion and sediment control plan will be developed to prevent impacts during the construction of the road.

8.13 Electricity Transmission Line

The Project includes development of an electricity transmission line (ETL) of approximately 8 km in length within a 20 m easement, and associated infrastructure. The ETL will link the Project with the Baralaba Substation, located approximately 6 km east-south-east of the Baralaba township. Two ETL alignment options are being considered where the final ETL alignment will be determined at a later date in consideration of the outcomes of the assessments conducted for the EIS. The ETL will be subject to separate approvals, for which the necessary permitting will be undertaken by Ergon. The ETL will have minimal ground disturbance and the transmission line poles will be located outside of waterways to not impact overland flows or flooding. The ETL is expected to have negligible surface water impacts.

8.14 Great Barrier Reef Catchment Waters

The Project is located in the Fitzroy Region of the Great Barrier Reef (GBR) river basins and therefore is required to address the *Reef discharge standards for industrial activities* (ESR/2021/5627) (refer Section 3.3.1). The standards outline the requirement to quantify fine sediment or dissolved inorganic nitrogen (DIN) loads, released via a point source to GBR waters and demonstrate there will be no residual impact associated with the Project. The Project is expected to have discharges to GBA water from sediment dam overflows (occurs in less than 30% of years) and controlled releases of mine affected water (occurs in less than 25% of years).

Estimated sediment loads from the existing land area that comprises the Project disturbance area have been compared with expected sediment loads in water discharges during the operational phase of the mine to assess the residual impact associated with the Project. Sediment loads have been quantified as per the following:

- **Existing Case (pre-mining)** sediment loads were estimated from an average annual sediment generation rate in surface runoff of 0.125 tonnes/hectare/year, applied to the catchment area intercepted by the Project. The sediment generation rate was adopted from the calibrated sediment generation rate for the Fitzroy Natural Resource Management (NRM) region in the technical report: *"Modelling reductions of pollutant loads due to improved management practices in the Great Barrier Reef catchments – Whole of GBR"* (Waters, et al., 2014).
- **Project Case** sediment loads were calculated by applying a potential discharge TSS concentration of 350 mg/L to the average annual discharge volumes determined from the operational water balance model for sediment dam overflows and controlled mine water release (refer Section 6.2.1). The potential TSS concentration of 350 mg/L was conservatively adopted from the mine affected water release limits presented in Table C2 of the existing Baralaba North Mine Environmental Authority (EPML00223213) (DES, 2023).

The estimated Existing and Project Case sediment loads and the change in loads for the key mine plan years are presented in Figure 8.1. The results show that the Project is expected to reduce sediment loads on GBA catchment waters mostly due to the expected discharge volumes being less than the natural catchment runoff volumes. The assessment was considered conservative due to the adopted potential TSS concentration of Project Case discharges being higher than expected for the following reasons:

- Sediment dam overflows are expected to have a much lower TSS concentration than the adopted mine affected water release limits.
- The spoil dump catchment will be progressively rehabilitated which will reduce sediment loads reporting to the sediment basins.
- Recorded TSS concentrations in existing storages at Baralaba North Mine are significantly lower than the adopted concentration of 350 mg/L used to assess potential impacts to sediment loads.

Post-closure the Project landforms will be completely rehabilitated to maintain existing case sediment generation loads. The final void pit lake is not predicted to overflow (refer section 6.3) and therefore there is no expected residual increase to sediment loads post-closure. The assessment of impacts to GBA waters has been based on sediment as there was insufficient information to determine DIN concentrations of releases. However, a similar reduction in loads is expected for DIN due to the smaller discharge volumes compared to the existing catchment surface runoff volumes.

TABLE 8.1: IMPACTS TO SEDIMENT LOADS ON GREAT BARRIER REEF CATCHMENT WATERS

Project Year	Year 1	Year 3	Year 6	Year 11	Year 14	Year 19	Year 23
Existing Case (pre-mining)							
Area (ha)	650	598	810	921	936	937	966
Runoff Volume (ML)	382	352	476	542	550	551	568
Sediment Load (tonnes/year) *(generation rate of 0.125 t/ha/year)*	81	75	101	115	117	117	121
Project Case							
Average Annual Sediment Dam Overflow Volume (ML)	2	2	30	77	96	118	129
Average Annual Mine Water Controlled Release Volume (ML)	20	15	60	98	135	90	122
Total Average Annual Release Volume (ML)	22	17	90	175	231	208	251
Sediment Load (tonnes/year) ***(generation rate of 350 mg/L of discharge volume)***	**8**	6	32	61	81	73	88
Change in Annual Sediment Load (tonnes/year)	**-73**	**-69**	**-69**	**-54**	**-36**	**-44**	**-33**

8.15 Cumulative Impacts

The Project is located approximately 11 km south of the Baralaba North Mine and approximately 27 km north of the Dawson Mine. The concurrent operation of these sites has the potential to result in cumulative impacts on the surface water environmental values. Cumulative impacts on surface from the Project and existing industry in the Dawson River catchment could include:

- Impacts to water resources including existing surface water entitlements due external raw water supply demand for each operation.
- Impacts to the Dawson River streamflow regime from a cumulative reduction in the Dawson River catchment area.
- Impacts to Dawson River water quality due to concurrent controlled mine water releases occurring from each operation.

This section describes the potential cumulative impacts associated with the Baralaba North Mine and Dawson Mine.

8.15.1 Cumulative Impacts to Dawson River Streamflow

Dawson River streamflow impacts from harvesting catchment runoff are considered to be negligible as discussed in Section 7.3. The Project catchment accounts for approximately 0.024% of catchment at the Dawson River at Beckers gauging station. The Baralaba North Mine catchment is of a similar area as the Project, and therefore the cumulative impact to annual and daily Dawson River streamflow is expected to be less than twice what is presented Section 7.3. Therefore, the cumulative reduction in Dawson River streamflow volume (due to Baralaba North Mine and the Project) is expected to be approximately 0.04% (mean annual flow).

There is no expected cumulative impact to the Neville Hewitt Weir as Baralaba North Mine is located downstream of the weir.

8.15.2 Cumulative Impacts from Controlled Mine Water Releases

The Project will conduct controlled releases of mine affected water to the Dawson River in accordance with the future approved EA conditions. The Dawson River can also receive controlled release of mine affected water from both the Baralaba North Mine and the Dawson Mine as approved under their existing Environmental Authorities.

It is possible all three sites commence controlled release simultaneously, increasing the risk of water quality impacts in the Dawson River. Therefore, a cumulative impact assessment on Dawson River water quality has been undertaken for a possible simultaneous mine water release from Baralaba North Mine, Dawson Mine and the Project. The assessment was completed assuming all mines were releasing at the maximum allowable discharge rate and maximum release water quality (EC) administered by the mines' Environmental Authorities (EAs) to determine a worst-case impact on Dawson River EC over a range of flow conditions. The assessment was undertaken for impacts to streamflow EC only, as salinity (measured as electrical conductivity) is the key of-concern surface water quality parameter for open cut coal mines.

The Baralaba North Mine and Dawson Mine release conditions used to assess cumulative impacts on Dawson River water quality are summarised in Figure 8.1 and Figure 8.2 respectively.

TABLE 8.2: BARALABA NORTH MINE EA: RELEASE CONDITIONS (TABLE C4 OF EPML00223213) (DES, 2023)

Mine Affected Water Release During Flow Events			
Receiving waters	Dawson River		
Release Point (RP)	RP N1 and RP N2		
Gauging station	Gauging station 1 (Dawson River within 2,000m upstream of Anabranch confluence, and downstream of the Jerry Creek- Dawson River confluence)		
Gauging station latitude (decimal degrees GDA91)	-24.14418		
Gauging station longitude (decimal degrees GDA91)	149.80036		
Receiving water flow recording frequency	Continuous (minimum daily)		
Receiving Water Flow Criteria For Discharge (m^3/s)	**Maximum Release Rate (For All Combined RP Flows) (m^3/s)**	**Electrical Release Limits (µS/cm)**	**Sulphate Release Limits (mg/L)**
Low Flow			
<5 For a period of 28 days after natural flow events that exceed 5 m^3/s	0.5	<340	250
Medium Flow			
>5	0.5	500	250
>4	0.5	1,500	250
>53	0.5	3,000	300
>92	0.5	<5,000	300
High Flow			
>140	0.5	<7,000	300
>190	0.5	<10,000	400

TABLE 8.3: DAWSON MINE EA: RELEASE CONDITIONS (TABLE F4 OF EPML00565813) (DES, 2023)

Receiving Waters/ stream	Release Point	Gauging Station	Receiving Water Flow Recording Frequency	Receiving Water Flow Criteria for discharge (m^3/s)	Maximum Release Rate (for all combined RP flows) (m^3/s)	Electrical Conductivity (µS/cm) and Sulphate (SO_4^{2-} mg/L) Release Limits
Dawson River	RP-DN01T RP-DN02T RP-DC01T RP-DC03T RP-DC03T RP-DC07T RP-DC08T RP-DC10T RP-DS02T	Bindaree	Continuous (minimum daily)	5.4	0.288	EC <1500 Sulphate <2550
				5.4	0.112	EC <3500 Sulphate <6200
				Flow 1: 70 Flow 2: 100 Flow 3: 150 Flow 4: 200 Flow 5: 250 Flow 6: 300 Flow 7: 350	0.8 1.15 1.72 2.3 2.87 3.45 4.02	EC <2500 Sulphate <4400
				Flow 1: 70 Flow 2: 100 Flow 3: 150 Flow 4: 200 Flow 5: 250 Flow 6: 300 Flow 7: 350	0.8 1.15 1.72 2.3 2.87 3.45 4.02	EC <5000 Sulphate <9000
Kianga Creek	RP-DC01T RP-DC10T	Kianga Weir	Continuous (minimum daily)	1	0.288	EC <1500 Sulphate <2550
				1	0.112	EC <3500 Sulphate <6300

A simplified assessment of potential water quality impacts to the Dawson River was undertaken using the maximum release limits for each of the mines. The assessment was undertaken for a range of constant Dawson River flows and EC while assuming each site is releasing at the maximum allowable release rate and EC. The residual downstream EC (at Beckers Gaging station) was then determined using a dilution calculation of the receiving water and release flows. The assessment produces a conservative estimate of potential maximum impacts to downstream water quality as it is unlikely all sites can sustain a constant release at the maximum allowable release EC.

A summary of the worst case mine water release case accounting for release from the Baralaba North Mine, Dawson Mine and the Project is provided in Table 8.4 and Table 8.5 for the high flow EC WQO and 90th percentile background Dawson River streamflow EC respectively.

Based on the conservative worst-case assessment when all sites are releasing and a 90th percentile background streamflow EC (300 µS/cm), Dawson River EC could potential reach 389 µS/cm which is 22% lower than the receiving waters EC limit of 500 µS/cm in the Baralaba North EA. For the same scenario with a background streamflow equal to the high flow WQO objective of 210 µS/cm, Dawson River EC could potentially reach 300 µS/cm.

This is a highly conservative assessment as this scenario is based on the unlikely event that all mines are releasing the maximum quantity of water at the maximum allowable EC during minimum Dawson River flows. Also, in practice the timing of releases from the three mines is not likely to align due to the significant distances and additional dilution occurring from Mimosa Creek and Banana Creek between the mines.

TABLE 8.4: CUMULATIVE RELEASE WATER QUALITY (DAWSON RIVER EC HIGH FLOW WQO)

Dawson River Flow Rate (m^3/s)	Background Dawson River EC (µS/cm)[1] (Average)	Baralaba North Release		Dawson Mine Release		Baralaba South Project Release		Dawson River at Beckers EC (µS/cm)
		Rate (m^3/s)	EC (µS/cm)	Rate (m^3/s)	EC (µS/cm)	Rate (m^3/s)	EC (µS/cm)	
30	210	0.5	1500	0.288	1500	-	-	243
53	210	0.5	3000	0.288	1500	-	-	243
92	210	0.5	5000	0.38	5000	-	-	255
100	210	0.5	5000	0.38	5000	0.5	10,000	300
140	210	0.5	7000	0.55	5000	0.5	10,000	287
190	210	0.5	10000	0.82	5000	0.5	10,000	282

[1]Average Dawson River EC for streamflow greater than 30 m^3/s.

TABLE 8.5: CUMULATIVE RELEASE WATER QUALITY (90TH PERCENTILE BACKGROUND DAWSON RIVER EC)

Dawson River Flow Rate (m^3/s)	Background Dawson River EC (µS/cm)[1] (90th percentile)	Baralaba North Release		Dawson Mine Release		Baralaba South Project Release		Dawson River at Beckers EC (µS/cm)
		Rate (m^3/s)	EC (µS/cm)	Rate (m^3/s)	EC (µS/cm)	Rate (m^3/s)	EC (µS/cm)	
30	300	0.5	1,500	0.288	1,500	-	-	331
53	300	0.5	3,000	0.288	1,500	-	-	332
92	300	0.5	5,000	0.38	5,000	-	-	345
100	300	0.5	5,000	0.38	5,000	0.5	10,000	389
140	300	0.5	7,000	0.55	5,000	0.5	10,000	376
190	300	0.5	10,000	0.82	5,000	0.5	10,000	371

[1]90th percentile Dawson River EC for streamflow greater than 30 m^3/s

8.16 Climate Change Impacts

8.16.1 Operational Water Balance Climate Change Sensitivity Assessment

The Project operational water balance model daily climate inputs were adjusted using the year 2050 climate projections in Section 6.4 to assess the impact of the “Best” case, “Worst” case and “Maximum consensus” climate change scenarios on the water balance assessment results. The year 2050 projected climate change variables reduce the total runoff reporting to storages and increases evaporation from storages in the operational water balance model. This results in a reduction in controlled and uncontrolled releases from the Project and overall reduction in the identified impacts to the receiving environment.

8.16.2 Final Void Water Balance Climate Change Sensitivity Assessment

An assessment of the potential climate change scenarios on final void hydrology was completed in Section 6.4.2. Under all climate change scenarios, the pit lake level is more than 50 m below ground and will remain as a groundwater sink. The pit is not at risk of overtopping under any of the modelled climate change scenarios. The water quality in-pit lake TDS is expected to be worse for the climate change scenarios with increased evaporation and reduced rainfall. Although the TDS is higher in some of the climate change scenarios, it is not expected to have any adverse impacts to the receiving waterway as the final void is not expected to overtop.

The modelled climate change scenarios do not improve or worsen expected impacts from the Project's final void.

9. REGULATED STRUCTURES

Infrastructure proposed to manage mine affected water and sediment runoff has been assessed in accordance with the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures* – version 5.01(the Manual) (DEHP, 2016) and the Terms of Reference. The Manual specifies the procedure for consequence category assessment of regulated structures, constructed as part of environmental relevant activities under the Environmental Protection Act 1994.

Water retaining structures are assessed using the manual to determine if their consequence category is low, significant or high. Structures deemed to be of significant or high consequence category are referred to as regulated structures.

The Project water management system has been designed to minimise the requirement for regulated structures where possible and retain them where required to ensure appropriate design and management of structures assessed as possibly having significant or high consequence categories.

The manual requires the assessment of the consequences of the following failure event scenarios:

- '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.

For each failure event scenario, the Manual requires the consequences to be assessed for each of the following categories of harm.

- Harm to humans.
- General environmental harm.
- General economic loss or property damage.

The consequence category of each type of harm is assigned, based on the severity of harm as specified in Table 1 of the Manual (refer to Table 9.1).

TABLE 9.1: CONSEQUENCE CATEGORY ASSESSMENT CRITERIA (TABLE 1 OF MANUAL) (DEHP, 2016)

Environmental Harm	**Consequence Category**		
	High	**Significant**	**Low**
Harm to Humans	Location such that people are routinely present in the failure path and if present loss of life to greater than 10 people is expected[1]. Note: The requirement to consider the location of people in the failure path is only relevant to the 'dam break' scenario	Location such that people are routinely present in the failure path and if present loss of life to 1 person or greater, but less than 10 people is expected[1]. Note: The requirement to consider the location of people in the failure path is only relevant to the 'dam break' scenario	Location such that people are not routinely present in the failure path and loss of life is not expected[1]. Note: The requirement to consider the location of people in the failure path is only relevant to the 'dam break' scenario
	Location such that contamination of waters (surface and/or groundwater[2]) used for human consumption could result in the health of 20 or more people being affected[3].	Location such that contamination of waters (surface and/or groundwater[2]) used for human consumption could result in the health of 10 or more people but less than 20 people being affected.	Location such that contamination of waters (surface and/or groundwater[2]) used for human consumption could result in the health of less than 10 people being affected.

Environmental Harm	Consequence Category		
	High	Significant	Low
General Environmental Harm	Location such that: a) Contaminants may be released to areas of MNES, MSES or HEV waters that are not already authorised to be disturbed to at least the same extent under other conditions of this authority subject to any applicable offset commitment (Significant Values); and b) Adverse effects[4] on Significant Values are likely; and c) The adverse effects are likely to cause at least one of the following: i) Loss or damage or remedial costs greater than $50,000,000; or ii) Remediation of damage is likely to take 3 years or more; or iii) permanent alteration to existing ecosystems; or iv) The area of damage (including downstream effects) is likely to be at least 5 km^2.	Location such that contaminants may be released so that adverse effects (that are not already authorised to be disturbed to at least the same extent under other conditions of this authority subject to any applicable offset commitment) either: a) Would be likely to be caused to Significant Values but those adverse effects would not be likely to meet the thresholds for the High consequence category and instead would be likely to cause at least one of the following: i) Loss or damage or remedial costs greater than $10,000,000 but less than $50,000,000; or ii) Remediation of damage is likely to take more than 6 months but less than 3 years; or iii) Significant alteration to existing ecosystems; or iv) The area of damage (including downstream effects) is likely to be at least 1 km^2 but less than 5 km^2. or b) Would be likely to be caused to environmental values classed as slightly or moderately disturbed waters[5], wetland of general ecological significance[6], riverine areas, springs or lakes and associated flora and fauna (Moderate Values), and the adverse effects are likely to cause at least one of the following: i) Loss or damage or remedial costs greater than $20,000,000; or ii) Remediation of damage is likely to take more than 1 year; or iii) Significant alteration to existing ecosystems; or iv) The area of damage (including downstream effects) is likely to be at least 2 km^2	Location such that either: a) Contaminants are unlikely to be released to areas of Significant Values or Moderate Values; or b) Contaminants are likely to be released to those areas but would be unlikely to meet any of the minimum thresholds specified for the Significant Consequence Category for adverse effects.
General economic loss or property damage	Location such that harm (other than a different category of harm as specified above) to third party assets in the failure path would be expected to require $10 million or greater in rehabilitation, compensation, repair or rectification costs[7].	Location such that harm (other than a different category of harm as specified above) to third party assets in the failure path would be expected to require $1 million and greater but less than $10 million in rehabilitation, compensation, repair or rectification costs[7].	Location such that harm (other than a different category of harm as specified above) to third party assets in the failure path would be expected to require less than $1 million in rehabilitation, compensation, repair or rectification costs[7].

[1] 'People routinely present in the failure path' could be considered to be people who occupy buildings or other places of occupation that lie within the failure impact zone. For the purposes of this Manual, this should refer to people other than site personnel engaged by the resource operation and located on the tenements and tenure associated with the resource operation; for other ERAs, it would be the 'premises referred to in the authority'. It should be noted that while this is appropriate for the assessment of consequence categories in accordance with this Manual, adherence to the requirements of this Manual does not limit, amend or change in any way, any other requirements to be complied with under relevant health and safety acts or legislation that requires the safety of site personnel to be considered.

[2] When considering potential impacts on groundwater, it is not envisaged that a full hydrogeological assessment will be required in all cases. Any consideration of potential impacts on groundwater systems should consider the water quality of the potential receiving aquifer as well as the quality of fluid stored in the regulated dam. Existing groundwater drawdown in areas surrounding resource operations (e.g. drawdown as a result of mine pit or underground mine dewatering) can also be considered when assessing the consequence of dam seepage on groundwater systems.

[3] 'An adverse effect on human health means a physiological effect on human health and does not include an impact on the quality of downstream water that merely negatively affects taste and which is unlikely to cause persons to become physically ill.

[4] Adverse effects includes chronic and acute effects where an acute effect is on living organism/s which results in severe symptoms that develop rapidly, and a chronic effect is an adverse effect on a living organism/s which develops slowly. In some instances, it may be necessary to carry out or reference existing ecological/toxicological studies to assess the impacts of contaminants on living organisms.

[5] See Water EPP for definitions.

[6] Wetland of general ecological significance' means a wetland shown on a map of referable wetland as a 'general ecologically significant wetland' or 'wetland of other environmental value'.

[7] This does not include the holder's own mine or gas production, on-site industrial or commercial assets, the holder's workers' accommodation, agricultural facilities on the holder's land such as a farm shed or farm dam or infrastructure solely for servicing the holder.

9.1 Preliminary Failure Impact Assessment

9.1.1 Preliminary Dam Break Assessment

A preliminary dam break impact assessment was undertaken to determine the potential consequences associated with failure of MWD and ENVIRO. A preliminary dam break assessment of the sediment dams was not completed as they are proposed to be mostly excavated structures with low height embankments and are not expected to have any "significant" impacts associated with dam break.

Sunny day failure dam failure outflow hydrographs were calculated and applied in a localised flood model of the downstream extent of the dams to determine the potential failure impact area. Details of MWD and Enviro Dam are provided in Section 5.3.2.

Breach outflow hydrographs were calculated using the spreadsheet routing method and the concept designs of MWD and Enviro Dam. The breach dimension and development time for each dam's operating water levels was determined using the updated Froehlich's equations (Froehlich, 2008). Froehlich's equations were adopted over those documented in the Guidelines for Failure Impact Assessment of Water Dams (DNRME, 2018) as both MWD and Enviro Dam are outside the range of dam sizes (i.e. too small) from which these equations were derived.

The Froehlich equations for breach dimensions and breach development time are shown below in Equation 1 and Equation 2.

$$B_{ave} = 0.27 K_0 V_w^{0.32} h_b^{0.04} \qquad \text{Equation 1}$$

$$t_f = 63.2 \sqrt{\frac{V_w}{g h_b^2}} \qquad \text{Equation 2}$$

Where:

B_{ave} = average breach width (m)

K_0 = constant (1.0 adopted for all scenarios)

V_w = reservoir volume at time of failure (m^3)

h_b = height of final breach (m)

g = gravitational acceleration (9.81 m/s^2)

t_f = breach formation time (s)

Details of the dam breach assessment for MWD and Enviro Dam is summarised in Table 9.2.

TABLE 9.2: DAM BREACH ASSESSMENT PARAMETERS

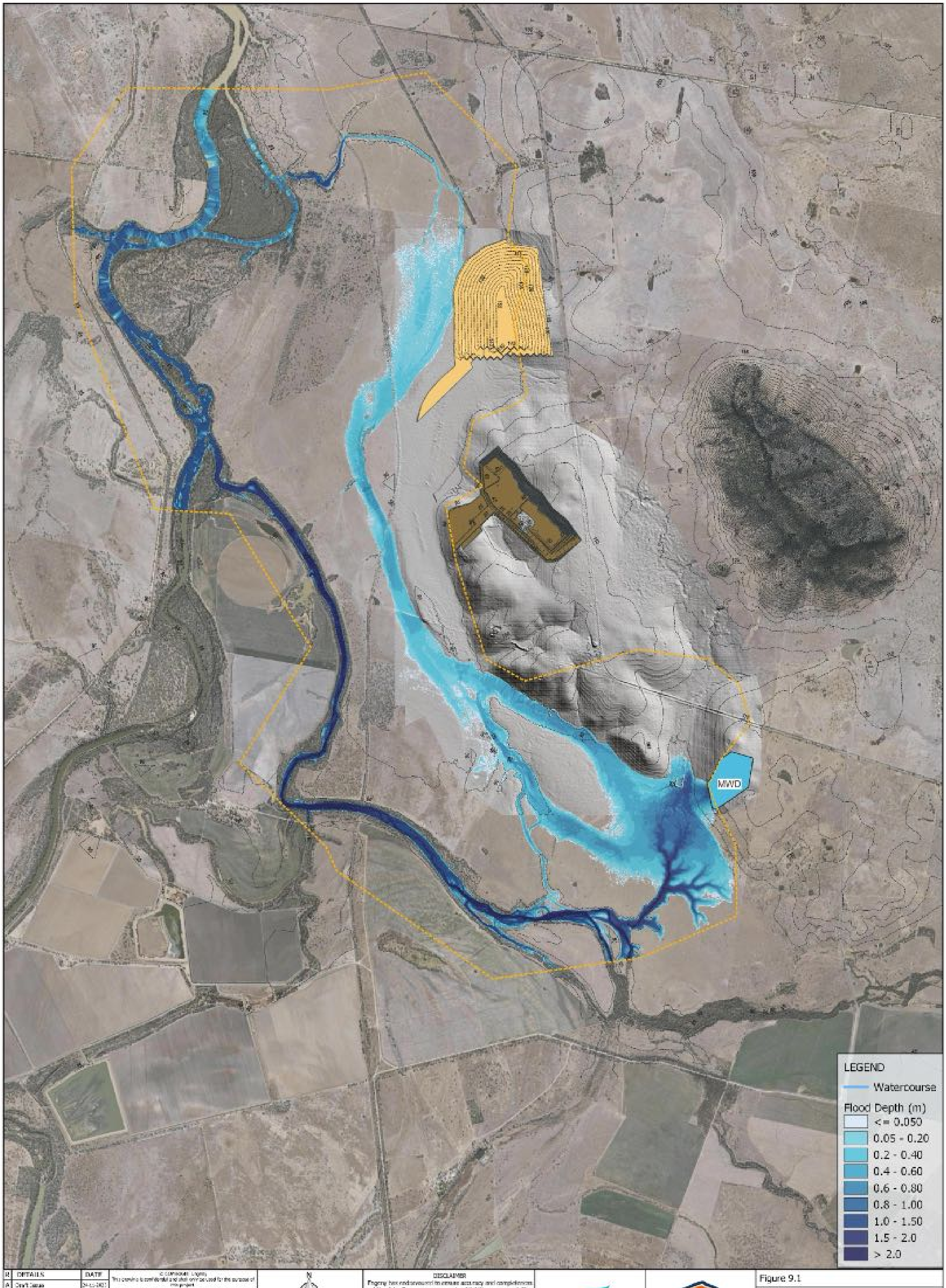
Parameter	MWD	Enviro Dam
Volume of water released (ML)	1,186 [1]	265[1]
Depth of breach (m)	8.4	4.8
Breach development time (min)	44	37
Peak breach outflow (m^3/s)	638	166

Table Note:

1 – Volume of water stored above natural ground level.

A localised two-dimensional flood model (HEC-RAS 2D) was developed for downstream dam extents to simulate the breach hydrographs and determine the failure impact extent. The model extent included the area downstream of MWD and Enviro Dam to the Dawson River where the dam breach outflows are contained within the Dawson River channel. The dam failure modelling was undertaken using the year 1 landform as it represents full impact of the potential failure of the Enviro Dam to the Dawson River. The pit progresses towards the failure pathway the Enviro Dam in the later stages of mine operations.

Figure 9.1 and Figure 9.2 show the dam failure extent for MWD and Enviro Dam respectively. The dam failure results show that once the break flows enter Banana Creek and the Dawson River the flows are contained within the main channel.



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ENGENY

BARALABA SOUTH

Figure 9.1

BARALABA SOUTH PTY LTD
Baralaba South Surface Water Impact Assessment
Preliminary Dam Break Assessment Results (MWD)

Job Number:
QC3018_004

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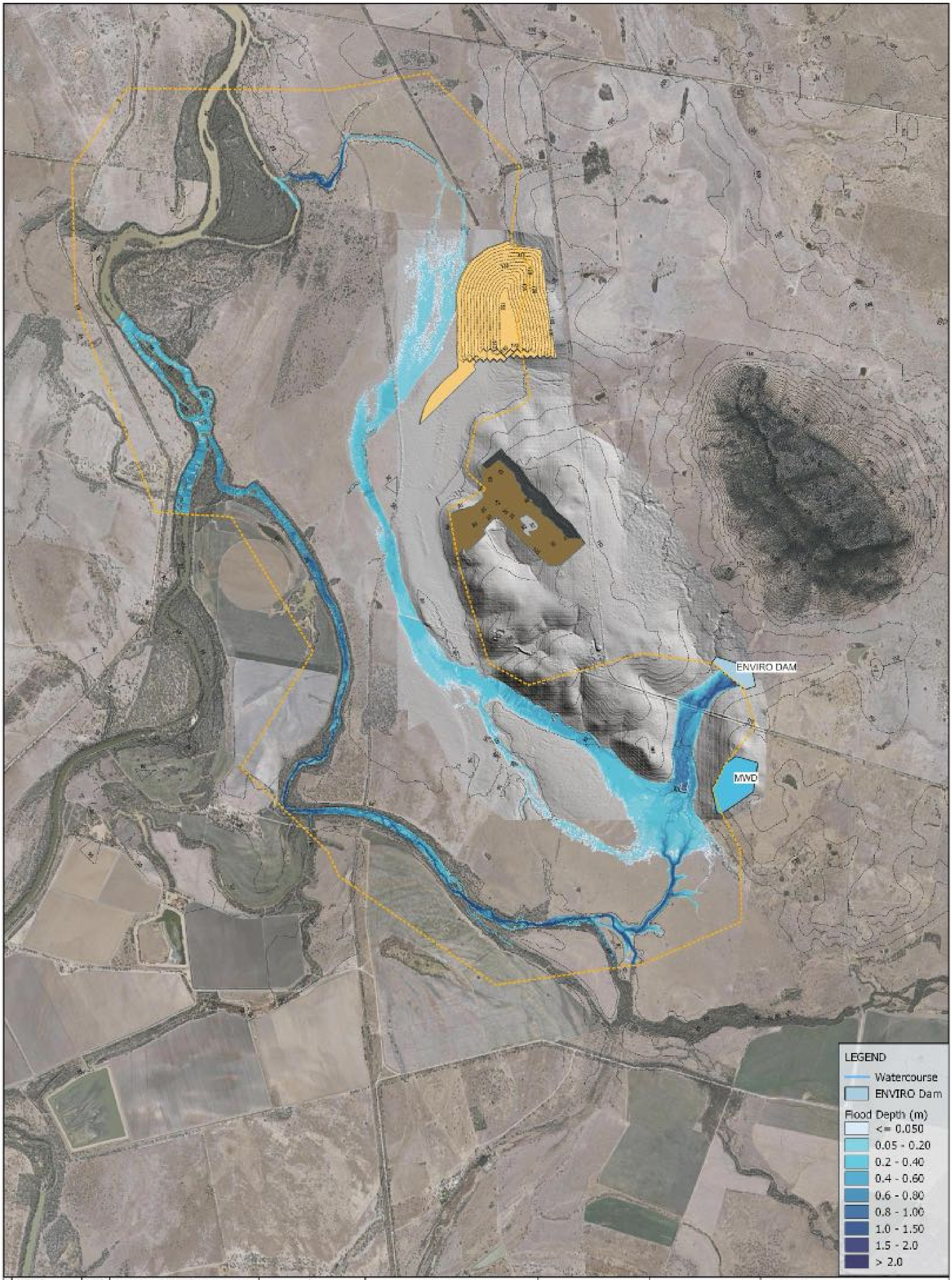

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ENGENY

BARALABA SOUTH

Figure 9.2

BARALABA SOUTH PTY LTD
Baralaba South Surface Water Impact Assessment
Preliminary Dam Break Assessment Results (Enviro Dam)

Job Number:
QC1018_004

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9.2 Preliminary Consequence Category Assessment

Table 9.3 outlines the preliminary Consequence Category Assessment (CCA) outcomes for the relevant Project water infrastructure, including the likely Regulated status and the determination for this classification. The CCA results are based on the concept design, intended operational strategy and expected salinity of stored contents for each structure.

The adopted purpose, conceptual location, and key infrastructure details for each structure are outlined in Sections 5 and 6. The mining pit does not require assessment as it is not an intended water storage for the Project and will be actively dewatered after rainfall events.

Whilst the preliminary CCAs have been completed for the purpose of the EIS, during the detailed design of the Project water infrastructure, a refined CCA is required, which will be undertaken and certified as part of this process.

TABLE 9.3: PRELIMINARY CONSEQUENCE CATEGORY ASSESSMENT OUTCOMES AND DETERMINATION

Structure	Scenario	Category of Harm	Consequence Category	Regulated	Determination
Mine Water Dam	Failure to Contain - Seepage	Harm to Humans	Low	Yes	Structure receives mine water from the pit which is considered to have greater potential for contamination (Section 4.1.1). The dam has minimal external catchment area and overflows from the dam are expected to be of low volume and occur while there are natural flows in the receiving waterways providing dilution. Therefore, the structure is likely to have a low consequence category for failure to contain. Structure is proposed to be half embankment and excavation construction and may have Significant consequence for a dam break scenario. There are however no permanent dwellings or potential Population At Risk (PAR) between the dam and the Dawson River.
		General Environmental Harm	Low		
		General Economic Loss or Property Damage	Low		
	Failure to Contain - Overtopping	Harm to Humans	Low		
		General Environmental Harm	Low		
		General Economic Loss or Property Damage	Low		
	Dam Break	Harm to Humans	Low		
		General Environmental Harm	Significant		
		General Economic Loss or Property Damage	Low		
Environmental Water Dam	Failure to Contain - Seepage	Harm to Humans	Low	Yes	Dam has reporting catchment from the MIA which is considered to have greater potential for contamination compared to other site sediment dams (Section 4.1.1). The dam has a small external catchment area and overflows from the dam are expected to be of low volume and occur while there are natural flows in the receiving waterways providing dilution. Therefore, the structure is likely to have a low consequence category for failure to contain. The structure may have Significant consequence for a dam break scenario.
		General Environmental Harm	Low		
		General Economic Loss or Property Damage	Low		
	Failure to Contain - Overtopping	Harm to Humans	Low		
		General Environmental Harm	Low		
		General Economic Loss or Property Damage	Low		
	Dam Break	Harm to Humans	Low		
		General Environmental Harm	Significant		
		General Economic Loss or Property Damage	Low		
Sediment Dams *- Eastern Dams 1-5* *- Western Dams 1-6* *- Year 1 Dam*	Failure to Contain - Seepage	Harm to Humans	Low	No	Sediment dams contain sediment runoff which is considered to have less potential for contamination. Uncontrolled overflows are only modelled as occurring during flow events in which water quality of overflows will be significantly diluted.
		General Environmental Harm	Low		
		General Economic Loss or Property Damage	Low		

Structure	Scenario	Category of Harm	Consequence Category	Regulated	Determination
	Failure to Contain - Overtopping	Harm to Humans	Low		The sediment dams are excavated below natural ground and do not pose a risk for dam failure.
		General Environmental Harm	Low		
		General Economic Loss or Property Damage	Low		
	Dam Break	Harm to Humans	Low		
		General Environmental Harm	Low		
		General Economic Loss or Property Damage	Low		
Clean Water Dams *1-2*	Failure to Contain - Seepage	Harm to Humans	Low	No	The clean water dams collect natural catchment runoff which is considered to have no potential for contamination in the scenario of a release events. The clean water dams are excavated below natural ground and do not pose a risk for dam failure.
		General Environmental Harm	Low		
		General Economic Loss or Property Damage	Low		
	Failure to Contain - Overtopping	Harm to Humans	Low		
		General Environmental Harm	Low		
		General Economic Loss or Property Damage	Low		
	Dam Break	Harm to Humans	Low		
		General Environmental Harm	Low		
		General Economic Loss or Property Damage	Low		

9.3 Preliminary Consequence Category Assessment Summary

Table 9.4 below summarises the preliminary consequence category assessment of the structures assessed to be regulated.

TABLE 9.4: PRELIMINARY CONSEQUENCE CATEGORY ASSESSMENT SUMMARY

Structure	Failure to Contain - Seepage	Failure to Contain Overtopping	Dam Break	Regulated
Mine Water Dam	Low	Low	Significant	Yes
Environmental Water Dam	Low	Low	Significant	Yes

Structures determined to be regulated for failure to contain overtopping, will require wet season containment in line with Table 9.5 and structures determined to be regulated for dam break require spillway capacity in line with Table 9.5.

TABLE 9.5: REGULATED STRUCTURE DESIGN CRITERIA REQUIREMENTS (DEHP, 2016)

Consequence Category	Design Criteria		
	Wet Season Containment (design storage allowance)	Extreme storm storage (ESS) allowance	Spillway Design Capacity
Significant	5% AEP	10% AEP 72 hour	1% - 0.1% AEP
High	1% AEP	1% AEP 72 hour	Minimum 0.1% AEP

10. MITIGATION AND MANAGEMENT MEASURES

Surface water mitigation strategies have been discussed throughout the development of the water management system and water balance model (Sections 5 to 6). The water management system has been specifically designed to minimise impacts to the surrounding environment and water resources in the region.

This section summarises how the mitigation strategies address the impacts outlined in Section 8.

The water management system infrastructure has been developed to achieve the water resource and water quality objectives of:

- Equitable, sustainable, and efficient use of water resources,
- Maintenance of environmental flows, water quality, in-stream habitat diversity and naturally occurring inputs from riparian zones (including groundwater dependent ecosystems) support the long-term maintenance of the ecology of aquatic biotic communities,
- The condition and natural function of water bodies are maintained including the stability of beds and banks of watercourses,
- Protecting the environmental values of waters,
- Protecting the environmental values of wetlands and groundwater dependent ecosystems (GDEs), and
- Protecting the environmental values of groundwater and any associated surface ecological systems.

A range of management strategies has been proposed to mitigate any negative environmental impacts on water resources and water quality, and to assist in meeting the water quality objectives and protection of identified environmental values. The proposed management strategies and contingency measures are summarised in Table 10.1 and Table 10.2 against the management hierarchy and intent of the EPP (Water).

TABLE 10.1: MANAGEMENT AND MITIGATION STRATEGIES FOR PROTECTION OF WATER RESOURCES

Mitigation/Monitoring Measure	Function
Diversion of clean catchments around disturbed areas	Minimising the catchment captured by site reduces the Project’s impact on streamflow in the receiving waterway by reducing the quantity of catchment diverted away from the Dawson River and into the mine water system. The design of clean catchment diversions throughout the Project has reduced the impact on streamflow to negligible (refer Section 8.1).
Progressive rehabilitation	Progressive rehabilitation allows the restoration of natural runoff properties to disturbed catchment which, after establishment, can be allowed to runoff into the receiving waterways. This reduces the length of impact of capture and treatment of disturbed catchments. This will reduce impacts on downstream water resources and water quality as well as reduce the water capture by the Project requiring management in the water management system.
	Water quality within sediment dams collecting runoff from rehabilitated areas will be monitored to demonstrate the success of the rehabilitation and to determine when rehabilitated catchments can begin to be directly released to the environment.
Erosion and sediment controls for treatment of sediment runoff	The erosion and sediment control strategy has been developed to prevent erosion through minimising disturbance and drainage control structures. Where minimising disturbance is not possible, sediment basins have been designed to contain sediment runoff from disturbed areas including rehabilitated areas until they are suitably established. Sediment and erosion control structures are designed in accordance with the IECA guidelines to minimise water quality impacts from disturbed land on the receiving waterways.

Mitigation/Monitoring Measure	Function
Design containment standard of all mine affected water storages	Mine affected water storages have been designed such that the standard of containment for all water infrastructure containing mine water meets the environmental objectives for regulated structures containing contaminants from the DEHP Guideline for Structures which are Dams or Levees Constructed as part of Environmentally Relevant Activities (DEHP, 2017a). The design containment standard for the mine water dams and the water balance modelling results ensure that overtopping events occur in less than 5% of years. Water balance modelling shows no overflows from mine affected water storages.
Spill response and containment	Appropriate procedures, containment and spill control measures will be implemented at appropriate locations where the transportation and loading, as well as storage of materials occurs onsite. The design and management of all required fuels and hydrocarbons will ensure there are effective means of secondary containment to prevent or minimise releases to the environment from any fuel and oil storage onsite.
Controlled release strategy	The controlled release strategy ensures that an active release from site only occurs during natural flow conditions, minimising additional flow outside of natural flow conditions. The clean water release strategy enables the Project to pump runoff from clean water catchments directly to the Dawson River, further reducing the impacts of any loss of catchment on streamflow.
Reduction in stored inventory through preferential process use	Any water dewatered from the pit will be used preferentially for supply to the CHPP and for dust suppression. The water management system is designed to minimise stored inventories of mine water, reducing external raw water supply requirements.
Mechanical Dewatering	Mechanical dewatering of tailings allows for increased recycling of processing water, reducing the reliance on any external raw water supply (Dawson River water licences) to meet site water demands. The gross water demand of the plant is anticipated to be up to 50% less than that of other plants utilising conventional tailings management techniques.
Final landform design	The final landform has been designed to incorporate clean catchment diversions and drainage from the mine landforms to prevent harvesting of overland flow and risk of scour to the void walls. In addition, the final landform has been designed to provide suitable flood protection to prevent any flood inflow from the Dawson River system into the final void pit lake.

TABLE 10.2: WATER QUALITY IMPACT MITIGATION STRATEGIES

EPP (Water) Management Hierarchy	Management Strategies
Reduce use of water and/or production of wastewater or contaminants.	Progressive rehabilitation allows the restoration of natural runoff properties which, after establishment, can be allowed to runoff into the receiving waterways. This reduces the length of impact of the capture and treatment of disturbed catchments.
	Diversion of clean water catchment reduces the quantity of contaminated water generated by reducing the amount of runoff interacting with mine affected or sediment water storages.
Prevention of wastewater or contaminants into waters.	Mine affected water storages have been designed such that the standard of containment for all water infrastructure containing mine water meets the environmental objectives for regulated structures containing contaminants, from the DEHP Guideline for Structures which are Dams or Levees Constructed as part of Environmentally Relevant Activities (DEHP, 2017a).
	The design containment standard for the mine water dams and the water balance modelling results ensure that overtopping events occur in less than 5% of years. Water balance modelling indicates no uncontrolled overflows from the mine water system.
	Appropriate procedures, containment and spill control measures will be implemented at appropriate locations where the transportation and loading, as well as storage of materials, occurs onsite. Facility design, and management of all required fuels and hydrocarbons, will ensure there are effective means of secondary containment to prevent or minimise releases to the environment from any fuel and oil storage onsite.

EPP (Water) Management Hierarchy	Management Strategies
Recycle, re-use or treat waste waters or contaminants.	On-site water sources, from pit and sediment dam dewatering, will be used preferentially for water demands on site where water quality allows. The use of mine affected water for site demands significantly reduces the quantity of raw water required to supply Project water demands
	Mechanical dewatering of tailings allows for increased recycling of process water. Gross water demands for plants utilising mechanical dewatering are up to 50% less than plants utilising conventional tailings management.
	Water contained within sediment dams on site will be used wherever possible for dust suppression and other operational demands prior to drawing on any third-party supply.
Treatment and release of waters to facilities, land or waters.	Erosion and sediment controls have been designed with guidance from the IECA guidelines. The capture and treatment of sediment runoff in sediment control structures minimises release of sediment runoff to the receiving environment during rainfall events. Sediment dam water quality will be monitored regularly to validate expected water quality of runoff from disturbed areas and confirm that the proposed operating strategy achieves the desired water quality outcomes. Monitoring of the receiving environment will be undertaken during operations as well as during and after all uncontrolled releases from sediment dams. Outcomes of the monitoring data will be used to identify any potential environmental harm and provide recommendations for improvements to erosion and sediment control measures.
	The controlled release strategy ensures mine affected water is only released when conditions in the receiving waterway allow. The end of pipe limit ensures water quality at the release point is not concentrated and that the areal extent of mixing is minimised.
	Review of the water quality data for water storages will occur as part of updates to the Water Management Plan, while surface water quality data for the receiving waterways will be reviewed as part of the Receiving Environment Monitoring Program (REMP) (see Section 10.2). The reviews will identify any deviations from assumed or predicted water quality and whether the current management controls are appropriate to meet water quality objectives for environment values within the receiving environment. In an unlikely event of a non-compliant water release from the mine water management system, a review of the system operation and performance will be conducted by a suitably qualified and experienced person including recommendations for any corrective action and changes to management controls if required.

10.1 Water Balance Model Update and Review Program

The operational water balance model developed for the Project will receive continual updates and validation throughout the Project life as more data and information become available. The updated model will then be used to review the water management system and performance against what was determined for the surface water impact assessment.

The following data and information will be collected for the duration of the Project to inform the regular updating and validation of the operational water balance model:

- Water inventory of the mine water dams and sediment dams (dam water level).
- Water quality monitoring of the mine water storages and sediment dams.
- Pumped flow meter data for major transfer and water demand offtakes (pit dewatering, CHPP water transfers, fill points).
- Aerial survey of the mine topography to review catchment area and land use development.
- Site meteorological data (i.e. site weather station).

The model will be validated (or calibrated) to historical dam inventories using the recorded data listed above. The update and review of the model will be used to assess the validity of the following model parameters, inputs, and assumptions:

- Surface water runoff parameters for the various site land uses.

- Salinity generation rates for the various site land uses.
- Pumpable groundwater volumes reporting to the mining pit (using pit dewatering information).
- Truck fill demands and water loss through the CHPP.
- The classification of storages using water quality information (sediment storage or mine affected storages).

10.2 Water Quality Management and Monitoring

A water quality monitoring program is one of the key controls for the ongoing performance assessment of the site. Monitoring of upstream, downstream and site water quality and streamflow will be used to:

- Continue to collect local water quality and streamflow data,
- Detect and identify any causes in changes from baseline conditions,
- Identify any impacts and corrective actions required; and,
- Assess the performance of the water management system and the effectiveness of any mitigation and management measures.

The water quality indicators (as listed in Section 2.5.1), will be measured against the WQOs for the receiving waterway (refer to Section 3.3) throughout the construction, operation and decommissioning stages of the Project.

The Project will be required to develop site-specific plans to outline the management of surface waters during the construction, operational and decommissioning phases of the mine, for example:

- Water Management Plan (WMP),
- Receiving Environment Monitoring Program (REMP),
- Erosion and Sediment Control Plan (ESCP), and,
- Progressive Rehabilitation and Closure Plan (PRCP).

Any required changes or updates to the ongoing water quality and streamflow monitoring for the site will be assessed and documented through the development of and routine updates to these documents. These plans will also outline the routine assessment, reporting mechanisms and auditing of water quality data and WQO, as well as mitigation measures and triggers for any corrective actions.

Development of the REMP, ESCP and WMP will also assess the requirement for ongoing ecotoxicological monitoring or assessments required relating to proposed water release locations.

10.2.1 Water Quality Sampling Locations

Proposed water quality monitoring locations are summarised in Table 10.3 and shown in Figure 2.10. Dawson River at Beckers and Dawson River at Baralaba are existing points monitored by DRDMW and the Baralaba North Mine respectively. The remaining locations are proposed to be monitored by the Project. Co-ordinates for the release location RP1 will be defined once detailed design of the structure has been completed.

Monitoring locations are aligned with the baseline monitoring locations specified in Section 2.5.1 besides the addition of the Dawson River Confluence and Northern Tributary monitoring locations. Monitoring locations have been selected such that there are sampling locations both upstream (reference or control) and downstream of the site and its potential impacts. Monitoring locations upstream of the site have been selected such that they can transition into a Receiving Environment Monitoring Program (REMP) during the operational phase of the Project.

Additional or alternative monitoring locations (e.g., other water storages on site and/or surrounding environmental features) will be developed as part of site-specific plans as required. This will include dedicated sites to monitor channel and floodplain geomorphology throughout the life of the mine e.g., release point or sediment dam discharge locations.

TABLE 10.3: PROPOSED SURFACE WATER QUALITY MONITORING LOCATIONS

Monitoring Location (ID)	Easting (GDA94)	Northing (GDA94)
U/S Banana Creek	149.897	-24.3091
U/S Dawson River	149.794	-24.3254
Dawson River Confluence	149.830	-24.254
MP1 Banana Creek	149.844	-24.2763
MP2 Release Location (RP1)	TBC	TBC
Northern Tributary	149.856	-24.236
D/S Dawson River	149.819	-24.2081
Dawson River at Baralaba DR1 (BNCOP SWMP)	149.805	-24.1825
Dawson River at Beckers (130322A)	149.822	-24.0873

10.2.2 Streamflow Gauging Locations

Streamflow gauging will be required during the operational phase of the Project to inform release opportunities, assess impacts and to allow for ongoing refinement of surface water models. In addition to the flow gauging already undertaken at the DRDMW stations, it is recommended that streamflow/level monitoring be undertaken at the Dawson River Confluence monitoring point to inform natural streamflow conditions for mine water release.

10.2.3 Sampling Methods and Parameters

Water quality monitoring parameters are proposed for the baseline monitoring program in Section 2.5.1. These parameters form the basis for ongoing operational monitoring of both physico-chemical parameters, as well as potential contaminants (e.g. metals). Water quality monitoring should be undertaken using a combination of laboratory analysis and in situ/field monitoring and in accordance with the Queensland Monitoring and Sampling Manual 2018.

During the operational phase of the mine, the surface water sampling frequency will be dictated and outlined within environmental approvals and/or site-specific plans. To best meet the QWQG minimum sample quantity requirements, it is recommended the ongoing monitoring program sample frequency is monthly for all water quality parameters. Parameters such as streamflow, pH and electrical conductivity are generally monitored continuously (i.e., real time/in situ). It is recommended that monitoring be conducted for a period of at least one year prior to any statistical analysis being undertaken.

Water quality parameters will be measured against the WQOs and where they are not met, investigations will be undertaken to determine the cause and any required corrective actions.

However, WQOs associated with the water quality monitoring parameters will be able to be reviewed for the site once a statistically sufficient dataset of baseline local water quality data has been obtained in accordance with QWQG and NWQMS Guideline requirements. This review of local water quality data and any potential variation of WQO will allow development of site specific WQOs if required, which will assist the Project develop adaptive and suitable management measures and management responses.

10.3 Water Management Plan

The primary purpose of a mining project water management plan is to examine and address all issues relevant to the importation, generation, use, and management of water on a mining project in order to minimise the quantity of water that is contaminated and released by and from the project (DEHP, 2012). A water management plan detailing site water management infrastructure, maintenance requirements and containment performance standards will be prepared in accordance with EA conditions. This document will provide a structure for achieving the adequate protection of EVs by achieving WQOs (as identified in Section 3.2 and 3.3). The water management plan will document the likelihood and consequence of risks to EVs and WQOs within and around the project as well as the management controls in place to reduce risks to an acceptable level.

The water management plan is expected to address the following aspects of site water management:

- Background information and description of site activities relevant to water management including:
  - Identified environmental values and water quality objectives of the receiving waterways.
  - Description of receiving waterways.
  - Description of the local and regional groundwater aquifers.
  - Water quality monitoring of the receiving waterways and groundwater aquifers used to establish baseline conditions.
  - Description of current and historical mining and associated activities.
  - Site climate conditions.
- Description of contaminant sources for the different water sources and uses associated with the project.
- Water management system including:
  - Objectives of water management system.
  - Site storages details and locations.
  - Transfer infrastructure.
  - Identification of bulk water storages.
  - Proposed actions to maintain water infrastructure.
  - Actions required to maintain required freeboard in containment structures.
- Water release strategy including:
  - Details of release infrastructure.
  - Trigger levels for commencing and ceasing releases.
  - Release monitoring requirements.
- Site water balance details including:
  - Details of major water inflow and outflow mechanisms.
  - Water balance model development including:
    - Details of calibration of runoff parameters.
    - Key input assumptions.
  - Water balance forecast results.
- Details of water quality monitoring plan and monitoring outcomes.
- Emergency and contingency planning.
- Assignment of responsibility for water management plan actions.

The water management plan will be reviewed (and updated if required) annually prior to the wet season for the life of the Project. This will enable identification of changes to the water management system and associated impacts to the site water balance and receiving Environmental Values. The update process will identify risks associated with the water management system and feedback to infrastructure and operational management improvements.

10.4 Erosion and Sediment Control Plan

An erosion and sediment control plan detailing design and maintenance requirements will be prepared in accordance with EA requirements, to manage erosion and sediment control measures implemented in association with the Project.

Sizing of erosion and sediment control structures will be undertaken in accordance with the Best Practice Erosion and Sediment Control (BPESC) guideline (IESC, 2018), which provides guidance on sediment basin sizing and operation. Further details on sediment basin sizing is provided in Section 5.3.3. The erosion and sediment control plan will define the following aspects of the erosion sediment control requirements for the site:

- Limiting disturbance to prevent sediment runoff generation.
- Erosion control measures such as revegetation and rehabilitation, aimed to prevent soil erosion from disturbed areas.
- Documenting soil types and disturbed catchment areas on the site and their potential for sediment generation.
- Design and management of drainage control measures to prevent erosion from concentrated flows and manage the flow of both clean water and sediment runoff.
- Erosion and sediment control requirements associated with temporary disturbance and construction activities.
- Design and management of sediment dams including dewatering and desilting requirements and the use of suitable construction materials.
- Water quality testing of sediment dams to assess their performance and inform continual improvements of the erosion and sediment control system.

10.5 Receiving Environment Monitoring Program

A receiving environment monitoring program (REMP) will be developed to monitor, identify and describe any impacts to the EVs, water quality and flows within the receiving environment. This REMP will require annual monitoring and reporting and analysis of long-term trends and potential impacts. Outcomes of the monitoring programs will inform further mitigation measures and remediation of existing mitigation measures as required.

The REMP will be developed to include the following:

- Background information and descriptions of:
  - Site location and history.
  - Catchment and watercourses.
  - Regional and local land use.
  - Local climate conditions.
  - Receiving environment EVs and WQOs.
- Monitoring aspects which are expected to include stream flow, surface water and sediment quality, ecology, and habitat.
- Monitoring methodology will be developed in accordance with the Queensland Monitoring and Sampling Manual (DES, 2018).
- Monitoring locations and selection of sites including consideration of temporal variation.

11. QUALIFICATIONS

(a) In preparing this document, including all relevant calculation and modelling, Engeny Australia Pty Ltd (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

(b) Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.

(c) Engeny reserves the right to review and amend any aspect of the works performed including any opinions and recommendations from the works included or referred to in the works if:

    (i) Additional sources of information not presently available (for whatever reason) are provided or become known to Engeny; or

    (ii) Engeny considers it prudent to revise any aspect of the works in light of any information which becomes known to it after the date of submission.

(d) Engeny does not give any warranty nor accept any liability in relation to the completeness or accuracy of the works, which may be inherently reliant upon the completeness and accuracy of the input data and the agreed scope of works. All limitations of liability shall apply for the benefit of the employees, agents and representatives of Engeny to the same extent that they apply for the benefit of Engeny.

(e) This document is for the use of the party to whom it is addressed and for no other persons. No responsibility is accepted to any third party for the whole or part of the contents of this Report.

(f) If any claim or demand is made by any person against Engeny on the basis of detriment sustained or alleged to have been sustained as a result of reliance upon the Report or information therein, Engeny will rely upon this provision as a defence to any such claim or demand.

(g) This Report does not provide legal advice.

12. REFERENCES

AECOM. (2016). *Dawson River Event Release Technical Impact Assessment Report.*

ANZECC & ARMCANZ. (2000). *Australian and New Zealand Guidelines for Fresh and Marine Qater QUality.* Canberra: Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.

ANZG. (2018). *National Water Quality Management Strategy Guidelines.*

Banana Shire Council. (2018). *Drinking Water Quality Management Plan (DWQMP) report 2017-2018.*

Business Queensland. (2019, 12 4). *Current location of water allocations in the Dawson Valley Water Supply Scheme*. Retrieved from https://www.business.qld.gov.au/industries/mining-energy-water/water/water-markets/current-locations/dawson

Commonwealth of Australia. (2013). *Significant Impact Guidelines 1.3: Coal seam gas and large coal mining developments - impacts on water resources.*

CSIRO. (2015). *Climate Change in Australia Technical Report.*

DEHP. (2009). *Queensland Water Quality Guidelines.*

DEHP. (2011). *Dawson River Sub-basin Environmental Values and Water Quality Objectives Basin No.130 (part), including all waters of the Dawson River Sub-basin except the Callide Creek Catchment.*

DEHP. (2012). *Guideline: Preparation of water management plans for mining activities.*

DEHP. (2013). *Model water conditions for coal mines in the Fitzroy basin.*

DEHP. (2016). *Manual for assessing consequence categories and hydraulic performance of structures.*

DEHP. (2017a). *Guideline for Structures which are Dams or Levees Constructed as part of Environmentally Relevant Activities.*

DEHP. (2017b). *Terms of reference for the Baralaba South Project environmental impact statement.* DEHP.

DERM. (1997). *Salinity Management Handbook.*

DES. (2016). *Technical Guideline, Licensing: Wastewater release to Queensland waters, ESR/2015/1654, Version 2.02.*

DES. (2017). *Model Mining Conditions.*

DES. (2018). *Monitoring and Sampling Manual - Environmental Protection (Water) Policy 2009.*

DES. (2019a). *Land use mapping - 1999 to Current - Queensland.* Retrieved from Queensland Spatial Catalogue - QSpatial.

DES. (2019b). *SILO - Australian Climate Data*. Retrieved from https://www.longpaddock.qld.gov.au/silo/

DNRME. (2019, July). *Water Monitoring Information Portal*. Retrieved from https://water-monitoring.information.qld.gov.au/

DSDMIP. (2013). *Central Queensland Regional Plan.*

Ecological Service Professionals Pty Ltd. (2021). *Baralaba South Project EIS Aquatic Ecology Assessment Report.*

Engeny Water Management. (2021). *Baralaba South Project Flood Impact Assessment.*

Fischer et al. (1979). *Mixing in Inland and Coastal Waters, Academic Press.*

HydroSimulations. (2021, May 24). *Baralaba South Project Groundwater Modelling and Assessment.*

IECA. (2018). *Best practice Erosion and Sediment Control Guideline.*

IECA. (2018). *Best practice Erosion and Sediment Control Guideline.*

IESC. (2018). *Information Guidelines for Proposals Relating to the Development of Large Coal Mines.*

Terrenus Earth Sciences. (2019). *Geochemical Assessment of Potential Spoil and Coal Reject Materials - Baralaba South Project.*

Water Solutions. (2014). *Baralaba North Continued Operations Project Flood Study.*

Whetton P, H. K. (2012). *Use of Representative Climate Futures in impact and adaptation assessment. Climatic Change 115(3-4), 433-442.*

WRM. (2013). *Baralaba Central Water Management Investigations.*

WRM. (2014). *Baralaba North Continued Operations Project., Site Water Balance and Surface Water Assessment.*

APPENDIX A: BASELINE WATER QUALITY DATA SUMMARY

Baseline Water Quality Data Summary (16 samples collected between June 2019 and April 2023)

Parameter	Units	Min	20th %ile	Median	80th %ile	Max	Average	WQO (Default Guideline Values)
	Field							
Dissolved Oxygen	mg/L	2.28	4.12	25.00	54.56	86.40	**29.88**	**4**
Dissolved Oxygen	(%Sat)	7.8	39.8	69.4	97.7	230.6	**79.9**	**85-110% Saturation**
	Laboratory							
pH Value	pH Unit	7.17	7.63	7.80	7.99	8.60	**7.80**	**6.5-8.5**
Electrical Conductivity	µS/cm	144	162	200	257	470	**222**	**340**
Suspended Solids	mg/L	5	16	37	80	162	**49.5**	**10**
Turbidity	NTU	6	33	185	270	348	**159**	**50**
Sulfate as SO4	mg/L	1	3	4	6	10	**4**	**25**
	Dissolved major cations							
Calcium	mg/L	9	11	14	20	28	**16**	-
Magnesium	mg/L	3	4	5	8	12	**6**	-
Sodium	mg/L	11	14	18	28	61	**22**	**30**
Potassium	mg/L	5	6	6	7	9	**7**	-
	Dissolved metals							
Aluminium	mg/L	0.01	0.01	0.05	0.13	0.92	**0.09**	**0.06**
Arsenic	mg/L	<0.001	<0.001	0.002	0.003	0.008	**0.002**	**0.013**
Cadmium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	**<0.0001**	**0.0002**
Chromium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	**<0.001**	**0.0001**
Copper	mg/L	0.001	0.002	0.003	0.004	0.011	**0.003**	**0.002**
Lead	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	**<0.001**	**0.0034**
Manganese	mg/L	0.001	0.003	0.012	0.067	1.460	**0.064**	**1.700**
Molybdenum	mg/L	<0.001	<0.001	<0.001	<0.001	0.002	**0.001**	**0.0002**
Nickel	mg/L	0.001	0.002	0.003	0.004	0.027	**0.004**	**0.011**
Selenium	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	**<0.01**	**0.01**
Silver	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	**<0.001**	-
Uranium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	**<0.001**	**0.001**
Vanadium	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	**<0.01**	**0.01**
Zinc	mg/L	<0.005	<0.005	<0.005	<0.005	0.012	**0.0052**	**0.008**
Boron	mg/L	<0.05	<0.05	<0.05	0.06	0.09	**0.054**	**0.94**
Iron	mg/L	<0.05	<0.05	<0.05	0.16	1.29	**0.13**	**0.30**

Parameter	Units	Min	20th %ile	Median	80th %ile	Max	Average	WQO (Default Guideline Values)
	Other							
Mercury (dissolved)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.0004	**0.00011**	**0.00006**
Mercury (total)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.0040	**0.0002**	-
Fluoride	mg/L	0.0	0.1	0.2	0.2	0.3	**0.16**	**1.0**
Ammonia as N	mg/L	<0.01	0.02	0.06	0.15	0.44	**0.10**	**0.02**
Nitrite as N	mg/L	<0.01	<0.01	<0.01	<0.01	0.15	**0.01**	-
Nitrate as N	mg/L	<0.01	<0.01	0.03	0.26	0.46	**0.11**	-
Nitrite + Nitrate	mg/L	<0.01	<0.01	0.03	0.26	0.46	**0.12**	-

APPENDIX B: BNCOP WATER QUALITY MONITORING DATA

	Water Quality Parameter		Sampling Site																			
			Dawson River Upstream				Anabranch U/S		Anabranch D/S	Dawson River Downstream		Saline Creek				Site Dams				Release Points	
			A1	WS5	DR1	DR2	WS6	D2	D1	DR3	DR4	SCT	SCD	SCU	SCUi	Mine Dam #1	Mine Dam #2 Farm Dam	Pit	ROM Dam	RP1	RP2
	pH	N	219	10	15	2	9	13	16	28	3	2	1	1	1	12	11	12	11	201	70
	(pH units)	20%ile	6.92	7.72	7.48	6.90	7.30	7.24	7.4	7.20	7.54	5.94	7.05	6.50	6.22	7.54	8.20	7.92	8.00	7.01	6.97
		Median	7.78	8.35	8.00	7.05	7.60	7.50	7.7	7.85	7.6	6.22	7.05	6.50	6.22	7.85	8.60	8.00	8.10	7.88	7.64
		80%ile	8.10	9.52	8.34	7.20	7.64	7.72	7.9	8.16	7.6	6.50	7.05	6.50	6.22	8.10	8.90	8.10	8.30	8.28	7.86
	Conductivity	N	219	10	15	2	9	13	16	28	3	2	1	1	1	12	11	12	11	203	71
	(µS/cm)	20%ile	187	168	244	152	158	238	310	380	310	432	382	112	74	2,600	360	7,020	4,500	403	368
		Median	270	185	280	170	200	310	2,235	450	340	470	382	112	74	7,700	3,910	7,290	8,000	620	423
		80%ile	369	308	360	188	532	382	2,440	511	406	507	382	112	74	16,280	7,380	7,740	8,800	1,459	476
	Total Suspended Solids	N	237	8	17	2	5	15	21	35	3	2	1	1	1	14	13	14	11	188	72
	(mg/L)	20%ile	6	13	5	160	32	5	13	9	5	24	11	45	20	7	14	7	10	12	21
		Median	20	20	8	160	98	7	16	13	5	27	11	45	20	14	33	11	18	28	46
		80%ile	55	61	29	160	206	30	28	56	7	30	11	45	20	29	300	15	24	91	97
	Total Dissolved Solids	N	60	0	15	0	0	16	16	23	3	0	0	0	0	15	14	15	10	32	5
	(mg/L)	20%ile	150	-	183	-	-	154	134	202	208	-	-	-	-	1,650	285	4,136	5,322	42	275
		Median	207	-	211	-	-	209	277	232	213	-	-	-	-	4,290	2,095	4,990	5,775	300	290
		80%ile	248	-	227	-	-	315	1,300	267	244	-	-	-	-	9,560	3,936	5,442	5,878	502	322
	Sulphate	N	230	9	18	2	9	16	22	36	3	2	1	1	1	15	14	15	11	184	72
	(mg/L)	20%ile	5	2	4	5	1	1	2	5	4	6	11	7	5	356	5	568	540	20	15
		Median	6	3	4	5	1	1	87	5	4	8	11	7	5	810	117	640	650	65	42
		80%ile	12	10	5	5	2	2	94	5	5	9	11	7	5	1880	462	690	700	140	67
	Turbidity	N	234	9	12	0	9	12	18	32	3	2	1	1	1	11	10	11	10	189	72
	(NTU)	20%ile	17	7	6	-	15	4	11	9	8	67	39	19	34	2	9	2	4	23	150
		Median	60	14	20	-	25	5	15	15	13	67	39	19	34	4	28	4	8	65	300
		80%ile	150	154	67	-	166	13	20	47	26	68	39	19	34	13	152	7	11	304	500
	Chloride	N	32	7	3	2	8	2	4	9	0	0	0	0	0	2	2	2	2	23	6
	(mg/L)	20%ile	25	13	12	12	10	9	12	24	-	-	-	-	-	1,632	1,320	1,660	956	48	48
		Median	40	19	18	15	12	9	262	78	-	-	-	-	-	2,745	1,650	1,750	1,010	100	56
		80%ile	71	22	26	17	16	9	522	86	-	-	-	-	-	3,858	1,980	1,840	1,064	214	64
	Calcium	N	31	7	3	2	8	2	4	9	0	1	1	1	0	2	2	2	2	22	6
	(mg/L)	20%ile	12	10	12	12	13	13	17	11	-	9	9	5	-	188	76	214	130	11	9
		Median	16	13	13	13	13	13	45	16	-	9	9	5	-	305	93	220	130	19	11
		80%ile	20	17	15	14	17	13	79	23	-	9	9	5	-	422	109	226	130	43	12
	Magnesium	N	29	7	3	2	8	2	4	8	0	2	1	1	1	2	2	2	2	19	6
	(mg/L)	20%ile	4.3	5.0	4.0	4.0	4.9	4.3	6.0	3.9	-	12.1	10.6	3.6	2.5	147.2	58.0	146.0	112.0	5.6	5.3
		Median	5.9	5.3	4.8	4.9	5.8	4.4	27.7	7.9	-	13.7	10.6	3.6	2.5	249.5	77.5	155.0	115.0	8.8	5.8
		80%ile	9.7	6.6	5.8	5.7	10.8	4.5	53.0	12.2	-	15.2	10.6	3.6	2.5	351.8	97.0	164.0	118.0	16.4	6.3
	Sodium	N	27	7	2	2	8	0	2	4	0	2	1	1	1	0	0	0	1	23	6
	(mg/L)	20%ile	19	15	14	12	12	-	356	47	-	51	43	10	8	-	-	-	680	72	56
		Median	31	19	15	14	16	-	380	51	-	61	43	10	8	-	-	-	680	100	71
		80%ile	44	22	16	16	23	-	404	54	-	70	43	10	8	-	-	-	680	212	76
	Ammonia As N	N	45	2	16	1	8	15	10	19	3	2	1	1	1	14	13	14	11	26	7
	(mg/L)	20%ile	0.010	0.074	0.006	0.120	0.418	0.006	0.015	0.008	0.006	0.117	0.017	0.239	0.181	0.006	0.006	0.038	0.090	0.010	0.010
		Median	0.030	0.140	0.026	0.120	1.000	0.029	0.030	0.020	0.006	0.143	0.017	0.239	0.181	0.016	0.008	0.150	0.120	0.030	0.020
		80%ile	0.070	0.206	0.050	0.120	1.000	0.052	0.076	0.048	0.008	0.169	0.017	0.239	0.181	0.218	0.112	1.008	0.430	0.060	0.056
	Nitrate as N	N	45	5	15	0	0	15	9	17	3	2	1	1	1	14	13	14	11	26	7
	(mg/L)	20%ile	0.02	0.08	0.01	-	-	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	7.30	4.10	0.61	0.89
		Median	0.05	0.20	0.01	-	-	0.06	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	17.50	7.70	1.00	0.95
		80%ile	0.20	0.20	0.04	-	-	0.11	0.02	0.18	0.03	0.01	0.01	0.01	0.01	0.05	0.15	20.00	19.00	1.40	1.20
	Nitrite as N	N	40	3	15	1	8	15	8	18	3	2	1	1	1	14	13	14	11	23	6
	(mg/L)	20%ile	0.01	0.20	0.00	0.14	0.05	0.01	0.00	0.00	0.00	0.01	0.01	0.17	0.01	0.00	0.00	0.09	0.06	0.02	0.02
		Median	0.02	0.30	0.00	0.14	0.10	0.01	0.00	0.01	0.00	0.02	0.01	0.17	0.01	0.00	0.00	0.12	0.13	0.02	0.03
		80%ile	0.03	0.72	0.01	0.14	0.10	0.02	0.01	0.02	0.00	0.02	0.01	0.17	0.01	0.01	0.01	0.18	0.18	0.02	0.03
	Total Fluoride	N	43	1	15	1	6	13	7	16	2	2	1	1	1	12	11	12	9	26	7
	(mg/L)	20%ile	0.02	0.15	0.10	0.02	0.50	0.10	0.10	0.05	0.10	0.18	0.09	0.05	0.08	0.10	0.10	0.10	0.10	0.02	0.02
		Median	0.04	0.15	0.10	0.02	0.50	0.10	0.10	0.10	0.10	0.25	0.09	0.05	0.08	0.11	0.29	0.10	0.10	0.03	0.02
		80%ile	0.10	0.15	0.10	0.02	0.50	0.10	0.10	0.20	0.10	0.31	0.09	0.05	0.08	0.84	0.30	0.20	0.10	0.10	0.02
	Hardness	N	31	7	1	1	8	1	3	8	0	2	1	1	1	1	1	1	2	23	6
	(mg/L)	20%ile	47	47	42	42	52	50	192	41	-	68	66	28	13	600	350	1100	786	54	47
		Median	59	54	42	42	55	50	380	92	-	69	66	28	13	600	350	1100	795	93	52
		80%ile	89	69	42	42	57	50	434	100	-	70	66	28	13	600	350	1100	804	218	54
	Carbonate	N	26	1	1	0	0	2	2	9	0	0	0	0	0	2	2	2	2	21	6
	(mg/L)	20%ile	10	75	5	-	-	6	6	10	-	-	-	-	-	6	6	6	10	10	10
		Median	10	75	5	-	-	8	8	10	-	-	-	-	-	8	8	8	10	10	10
		80%ile	10	75	5	-	-	9	9	10	-	-	-	-	-	9	9	9	10	32	10
Filtered Metals	**Aluminium**	N	46	7	16	1	7	15	8	17	3	2	1	1	1	14	13	14	11	24	7
	(µg/L)	20%ile	50	67	12	490	21	2	5	5	36	101	65	87	39	2	2	2	2	50	184
		Median	100	730	38	490	110	7	10	50	83	112	65	87	39	5	9	14	3	70	510
		80%ile	480	1760	140	490	746	37	38	63	105	123	65	87	39	36	54	29	25	358	1150
	Antimony	N	29	7	2	1	8	2	2	9	0	0	0	0	0	2	2	2	2	21	6
	(µg/L)	20%ile	5	5	2	5	5	2	2	5	-	-	-	-	-	2	2	5	6	5	5
		Median	5	5	3	5	5	3	3	5	-	-	-	-	-	3	3	5	7	5	5
		80%ile	5	5	4	5	5	4	4	5	-	-	-	-	-	4	4	5	7	5	5
	Arsenic	N	46	7	16	1	1	15	10	19	3	2	1	1	1	14	13	14	11	26	7
	(µg/L)	20%ile	1	5	1	1	1	1	1	1	1	1	1	1	1	1	2	8	3	2	2
		Median	1	5	1	1	1	1	2	2	1	1	1	1	1	1	3	10	5	3	3
		80%ile	1	5	1	1	1	2	3	2	1	1	1	1	1	2	5	14	8	3	5
	Beryllium	N	29	7	2	1	8	2	2	9	0	0	0	0	0	2	2	2	2	21	6
	(µg/L)	20%ile	1	2	1	1	3	1	1	1	-	-	-	-	-	1	1	1	1	1	1
		Median	1	5	1	1	5	1	1	1	-	-	-	-	-	1	1	1	1	1	1
		80%ile	1	5	1	1	5	1	1	1	-	-	-	-	-	1	1	1	1	1	1
	Boron	N	40	7	9	1	8	9	7	13	3	2	1	1	1	8	8	8	9	25	7
	(µg/L)	20%ile	45	36	37	50	30	44	42	39	43	142	133	96	55	24	38	86	90	50	50
		Median	50	38	38	50	35	47	45	50	44	164	133	96	55	48	47	95	120	50	50
		80%ile	50	48	47	50	46	49	66	56	47	186	133	96	55	75	62	116	174	62	50

Water Quality Parameter			Sampling Site																		
			Dawson River Upstream				Anabranch U/S		Anabranch D/S	Dawson River Downstream		Saline Creek				Site Dams				Release Points	
			A1	WS5	DR1	DR2	WS6	D2	D1	DR3	DR4	SCT	SCD	SCU	SCUi	Mine Dam #1	Mine Dam #2 Farm Dam	Pit	ROM Dam	RP1	RP2
Filtered Metals	Cadmium (µg/L)	N	45	3	16	1	8	15	8	19	3	2	1	1	1	14	13	14	11	23	7
		20%ile	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2
		Median	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.2	0.2
		80%ile	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
	Chromium (µg/L)	N	46	7	16	1	8	15	8	19	3	2	1	1	1	14	13	14	11	24	7
		20%ile	1	5	2	1	5	2	1	1	2	1	1	1	1	2	2	2	1	1	1
		Median	1	5	2	1	5	2	2	2	2	1	1	1	1	3	2	3	2	1	1
		80%ile	2	5	2	1	5	2	2	2	2	1	1	1	1	6	4	5	4	1	2
	Cobalt (µg/L)	N	46	7	16	1	8	15	9	19	3	2	1	1	1	14	13	14	11	25	7
		20%ile	1	3	1	1	3	1	1	1	1	1	1	2	1	1	1	2	1	1	1
		Median	1	5	1	1	5	1	1	1	1	1	1	2	1	1	1	4	2	1	1
		80%ile	1	5	1	1	5	1	1	1	1	1	1	2	1	2	3	10	5	1	1
	Copper (µg/L)	N	49	7	16	1	1	15	10	19	3	2	1	1	1	14	13	14	11	26	7
		20%ile	1	3	1	2	3	1	1	1	1	2	2	1	1	1	1	1	1	2	3
		Median	2	5	1	2	3	1	1	1	1	2	2	1	1	2	1	2	2	3	4
		80%ile	2	5	2	2	3	1	2	2	1	2	2	1	1	5	3	3	3	3	5
	Iron (µg/L)	N	48	6	16	1	6	15	10	19	3	2	1	1	1	14	13	14	11	26	7
		20%ile	114	100	81	350	0	43	131	62	45	838	5	4030	498	10	9	12	5	120	318
		Median	220	350	145	350	300	240	210	150	88	1447	5	4030	498	580	150	970	280	275	400
		80%ile	506	1200	190	350	1000	362	312	228	125	2055	5	4030	498	2340	540	1480	1300	620	880
	Lead (µg/L)	N	46	3	16	1	8	15	8	19	3	2	1	1	1	14	13	14	11	23	7
		20%ile	1	1	1	1	3	1	1	1	1	0	0	1	0	1	1	1	1	1	1
		Median	1	1	1	1	5	1	1	1	1	1	0	1	0	1	1	1	1	1	1
		80%ile	1	3	1	1	5	1	1	1	1	1	0	1	0	1	1	1	1	1	2
	Manganese (µg/L)	N	47	7	16	1	8	15	10	18	3	2	1	1	1	14	13	14	11	25	7
		20%ile	2	5	1	5	3	1	4	1	44	228	143	292	124	3	1	11	3	5	5
		Median	5	6	2	5	21	3	55	5	96	285	143	292	124	37	1	36	22	6	5
		80%ile	5	9	3	5	112	44	144	34	98	342	143	292	124	126	143	104	120	85	6
	Mercury (µg/L)	N	44	7	15	1	8	14	7	18	3	2	1	1	1	13	12	13	11	24	7
		20%ile	0.1	0.1	0.5	0.1	0.1	0.5	0.5	0.1	0.5	0.1	0.1	0.1	0.1	0.5	0.5	0.5	0.1	0.1	0.1
		Median	0.1	0.1	0.5	0.1	0.1	0.5	0.5	0.3	0.5	0.1	0.1	0.1	0.1	0.5	0.5	0.5	0.5	0.1	0.1
		80%ile	0.5	0.1	0.5	0.1	0.1	0.5	0.5	0.5	0.5	0.1	0.1	0.1	0.1	0.5	0.5	0.5	0.5	0.1	0.1
	Molybdenum (µg/L)	N	46	7	16	1	8	15	10	19	3	2	1	1	1	14	13	14	11	26	7
		20%ile	2	5	1	5	3	1	1	2	2	0	0	0	0	9	2	43	20	6	5
		Median	5	5	2	5	5	2	2	5	2	0	0	0	0	38	12	53	29	11	6
		80%ile	5	5	2	5	5	2	6	5	2	0	0	0	0	87	22	60	54	18	7
	Nickel (µg/L)	N	47	3	16	1	2	15	10	19	3	2	1	1	1	14	13	14	11	26	7
		20%ile	1	3	1	1	3	1	2	1	1	2	2	2	1	2	2	14	6	2	2
		Median	1	4	1	1	3	1	2	1	1	2	2	2	1	7	2	24	12	3	2
		80%ile	2	5	2	1	3	2	4	2	2	3	2	2	1	26	7	32	27	4	3
	Selenium (µg/L)	N	46	7	16	1	8	15	10	17	3	2	1	1	1	14	13	14	11	26	7
		20%ile	1	5	2	1	5	2	3	1	3	1	1	1	1	6	5	15	6	3	4
		Median	1	5	5	1	5	5	5	5	5	1	1	1	1	10	5	26	16	4	4
		80%ile	5	5	5	1	5	5	5	5	5	1	1	1	1	30	27	39	43	5	5
	Uranium (µg/L)	N	46	7	16	1	8	15	8	19	3	2	1	1	1	14	13	14	11	25	7
		20%ile	1	1	1	100	2	1	1	1	1	0	0	0	0	3	1	11	11	5	100
		Median	5	5	1	100	5	1	1	1	1	0	0	0	0	6	1	14	13	5	100
		80%ile	100	5	1	100	5	1	1	5	1	1	0	0	0	8	2	16	14	100	100
	Vanadium (µg/L)	N	46	7	16	1	8	15	8	19	3	2	1	1	1	14	13	14	11	25	7
		20%ile	3	5	3	5	5	1	1	3	1	1	0	0	4	1	3	1	1	5	5
		Median	5	6	4	5	5	1	2	5	2	2	0	0	4	1	5	1	1	5	6
		80%ile	5	7	5	5	5	2	4	5	2	3	0	0	4	2	12	2	5	6	8
	Zinc (µg/L)	N	47	7	16	1	4	15	10	18	3	2	1	1	1	14	13	14	11	25	7
		20%ile	1	5	2	3	6	2	2	1	2	4	3	9	13	2	2	2	2	2	4
		Median	2	5	2	3	7	2	2	2	2	8	3	9	13	4	2	6	2	4	4
		80%ile	5	5	2	3	24	4	5	7	4	12	3	9	13	7	3	18	8	5	5
	Silver (µg/L)	N	12	0	14	0	0	13	6	9	3	2	1	1	1	12	11	12	9	0	0
		20%ile	1	-	1	-	-	1	1	1	1	0	0	0	0	1	1	1	1	-	-
		Median	1	-	1	-	-	1	1	1	1	0	0	0	0	1	1	1	1	-	-
		80%ile	1	-	1	-	-	1	1	1	1	0	0	0	0	1	1	1	1	-	-
Total Metals	Aluminium (µg/L)	N	51	6	17	1	8	16	11	19	3	2	1	1	1	15	14	15	11	26	7
		20%ile	520	330	238	8,500	198	59	170	336	366	175	170	99	58	21	272	26	28	340	2,400
		Median	1,300	845	1,300	8,500	530	95	260	790	570	212	170	99	58	57	720	37	90	675	8,400
		80%ile	2,800	6,700	3,740	8,500	1,046	160	510	3,040	1,008	248	170	99	58	238	5,580	152	150	3,200	9,260
	Antimony (µg/L)	N	30	0	3	1	0	3	3	10	0	0	1	0	0	3	3	3	2	21	6
		20%ile	5	-	1	5	-	1	1	4	-	-	1	-	-	2	3	4	5	5	5
		Median	5	-	1	5	-	1	1	5	-	-	1	-	-	3	5	5	6	5	5
		80%ile	5	-	3	5	-	3	3	5	-	-	1	-	-	4	5	6	7	5	5
	Arsenic (µg/L)	N	48	6	17	1	0	16	11	19	3	2	0	1	1	15	14	15	11	26	7
		20%ile	1	5	1	2	-	1	1	1	1	1	-	2	2	1	3	8	3	3	3
		Median	1	5	1	2	-	2	2	2	1	1	-	2	2	1	4	10	5	3	5
		80%ile	2	6	2	2	-	2	3	3	1	1	-	2	2	3	6	15	8	3	6
	Beryllium (µg/L)	N	30	6	3	1	8	3	3	10	0	0	0	0	0	3	3	3	2	21	6
		20%ile	1	1	1	1	3	1	1	1	-	-	-	-	-	1	1	1	1	1	1
		Median	1	5	1	1	5	1	1	1	-	-	-	-	-	1	1	1	1	1	1
		80%ile	1	5	1	1	5	1	1	1	-	-	-	-	-	1	3	1	1	1	1
	Boron (µg/L)	N	42	6	10	1	8	10	8	13	3	2	1	1	1	9	9	9	9	25	7
		20%ile	46	37	40	50	32	44	40	43	45	162	139	97	58	37	42	94	110	50	50
		Median	50	41	45	50	37	50	50	50	47	176	139	97	58	60	50	100	140	50	50
		80%ile	50	50	48	50	41	53	63	60	51	190	139	97	58	102	69	144	188	70	50
	Cadmium (µg/L)	N	47	2	17	1	8	16	9	19	3	0	1	0	0	15	14	15	11	23	7
		20%ile	0.1	0.3	0.1	0.2	0.2	0.1	0.1	0.1	0.1	-	0.1	-	-	0.1	0.1	0.1	0.1	0.2	0.2
		Median	0.2	0.4	0.1	0.2	0.2	0.1	0.1	0.1	0.1	-	0.1	-	-	0.1	0.1	0.2	0.2	0.2	0.2
		80%ile	0.2	0.4	0.2	0.2	0.4	0.1	0.1	0.2	0.1	-	0.1	-	-	0.3	0.2	0.3	0.5	0.2	0.2

Water Quality Parameter			Sampling Site																		
			Dawson River Upstream				Anabranch U/S		Anabranch D/S	Dawson River Downstream		Saline Creek				Site Dams				Release Points	
			A1	WS5	DR1	DR2	WS6	D2	D1	DR3	DR4	SCT	SCD	SCU	SCUi	Mine Dam #1	Mine Dam #2 Farm Dam	Pit	ROM Dam	RP1	RP2
Total Metals	Chromium (µg/L)	N	48	2	17	1	2	16	9	19	3	1	1	1	0	15	14	15	11	24	7
		20%ile	1	4	2	5	9	1	1	1	2	2	2	1	-	2	2	1	1	1	3
		Median	2	5	2	5	10	2	2	2	2	2	2	1	-	2	3	2	2	1	7
		80%ile	4	5	3	5	10	2	2	3	2	2	2	1	-	4	6	4	3	3	9
	Cobalt (µg/L)	N	48	2	17	1	0	16	10	19	3	2	1	1	1	15	14	15	11	26	7
		20%ile	1	3	1	3	-	1	1	1	1	2	1	3	1	1	1	3	1	1	1
		Median	1	4	1	3	-	1	1	1	1	2	1	3	1	1	2	4	3	1	3
		80%ile	1	4	1	3	-	1	1	2	1	3	1	3	1	3	6	9	7	2	5
	Copper (µg/L)	N	50	6	17	1	3	16	11	19	3	2	1	1	1	15	14	15	11	26	7
		20%ile	1	5	1	6	7	1	1	1	1	2	3	1	2	1	1	2	2	3	6
		Median	2	5	2	6	7	1	1	3	1	3	3	1	2	4	3	3	3	5	10
		80%ile	5	6	5	6	8	3	5	5	2	3	3	1	2	8	7	5	5	6	13
	Iron (µg/L)	N	51	6	17	1	8	16	11	19	3	2	1	1	1	15	14	15	11	26	7
		20%ile	750	100	362	7,700	202	400	360	512	556	3,000	1,700	6,180	805	144	416	69	26	720	1,800
		Median	1,700	425	1,100	7,700	800	545	580	880	880	3,420	1,700	6,180	805	970	1,090	1,000	350	1,060	3,700
		80%ile	3,300	500	3,820	7,700	1,320	1,100	1,500	3,980	1,312	3,840	1,700	6,180	805	2,300	4,600	1,960	2,000	2,000	9,600
	Lead (µg/L)	N	48	6	16	1	0	16	9	19	3	2	1	1	1	15	14	15	11	24	7
		20%ile	1	5	1	4	-	1	1	1	1	1	0	1	1	1	1	1	1	1	2
		Median	1	5	1	4	-	1	1	1	1	1	0	1	1	1	1	1	1	1	5
		80%ile	2	5	1	4	-	1	1	1	1	1	0	1	1	1	1	1	1	2	6
	Manganese (µg/L)	N	51	6	17	1	8	16	11	19	3	2	1	1	1	15	14	15	11	26	7
		20%ile	18	44	11	13	186	52	26	58	76	323	145	378	130	29	94	27	6	25	25
		Median	38	78	19	13	285	97	150	97	120	492	145	378	130	43	160	67	65	83	100
		80%ile	69	83	37	13	341	140	300	166	126	660	145	378	130	168	752	122	240	160	110
	Mercury (µg/L)	N	45	6	15	1	8	14	7	17	3	2	1	1	1	13	12	13	10	24	7
		20%ile	0.1	0.1	0.5	0.1	0.1	0.5	0.5	0.1	0.5	0.1	0.1	0.1	0.1	0.5	0.5	0.5	0.1	0.1	0.1
		Median	0.1	0.1	0.5	0.1	0.1	0.5	0.5	0.5	0.5	0.1	0.1	0.1	0.1	0.5	0.5	0.5	0.5	0.1	0.1
		80%ile	0.5	0.1	0.5	0.1	0.1	0.5	0.5	0.5	0.5	0.1	0.1	0.1	0.1	0.5	0.5	0.5	0.5	0.1	0.1
	Molybdenum (µg/L)	N	48	2	17	1	8	16	11	19	3	2	1	1	1	15	14	15	11	26	7
		20%ile	2	5	1	5	5	1	1	2	2	0	0	0	0	11	2	47	22	8	6
		Median	5	6	2	5	5	2	2	2	2	0	0	0	0	37	16	54	32	13	8
		80%ile	5	7	2	5	5	2	5	5	2	0	0	0	0	85	24	59	54	20	9
	Nickel (µg/L)	N	50	3	17	1	2	16	11	19	3	2	1	1	1	15	14	15	11	26	7
		20%ile	2	5	1	5	5	1	2	2	1	3	2	2	2	2	3	15	7	3	3
		Median	3	6	2	5	6	2	2	3	1	3	2	2	2	8	4	25	13	4	7
		80%ile	4	7	3	5	7	3	5	5	2	3	2	2	2	27	14	34	28	7	10
	Selenium (µg/L)	N	48	4	17	1	8	16	11	18	3	2	1	1	1	15	14	15	11	26	7
		20%ile	1	3	2	1	5	2	2	1	3	11	56	39	1	6	5	16	6	4	4
		Median	1	6	5	1	5	5	3	3	5	25	56	39	1	13	11	26	19	5	5
		80%ile	2	6	5	1	5	7	5	5	5	40	56	39	1	59	53	62	51	5	5
	Uranium (µg/L)	N	48	1	17	1	8	16	9	19	3	2	1	1	1	15	14	15	11	26	7
		20%ile	1	1	1	100	2	1	1	1	1	0	0	0	0	3	1	12	12	5	100
		Median	5	1	1	100	5	1	1	1	1	0	0	0	0	7	2	14	13	6	100
		80%ile	100	1	1	100	5	1	1	5	1	1	0	0	0	9	5	18	15	100	100
	Vanadium (µg/L)	N	48	6	17	1	2	16	9	19	3	2	1	1	1	15	14	15	11	26	7
		20%ile	5	5	4	16	12	1	2	5	2	1	0	0	5	1	4	1	1	5	10
		Median	6	8	5	16	15	1	2	5	3	2	0	0	5	1	8	1	1	7	21
		80%ile	10	15	10	16	17	1	4	11	4	3	0	0	5	2	21	2	5	11	27
	Zinc (µg/L)	N	50	6	17	1	8	16	11	19	3	2	1	1	1	15	14	15	11	26	7
		20%ile	3	6	2	36	11	2	2	2	2	9	6	11	15	2	2	4	2	4	19
		Median	7	17	3	36	15	5	4	9	3	13	6	11	15	6	7	7	6	14	28
		80%ile	16	49	7	36	17	10	11	21	4	17	6	11	15	18	19	25	22	24	34
	Total Silver (µg/L)	N	13	0	15	0	0	14	7	10	3	2	1	1	1	13	12	13	9	0	0
		20%ile	1	-	1	-	-	1	1	1	1	0	0	0	0	1	1	1	1	-	-
		Median	1	-	1	-	-	1	1	1	1	0	0	0	0	1	1	1	1	-	-
		80%ile	1	-	1	-	-	1	1	1	1	0	0	0	0	1	1	1	1	-	-

N=Number of samples
Note: Analytes analysed in a concentration below the detection limit were replaced with the detection limit.

APPENDIX C: DAWSON RIVER AT BECKER WATER QUALITY DATA

Dawson River at Beckers (130322A) Water Quality Monitoring Data

Parameter	Min	5th	20th	Median	80th	95th	Max	Number of Samples
Conductivity @ 25C (uS/cm)	70	114.15	150	203.5	266	412.65	790	124
Conductivity @ 25C FLD	86	120.2	158.8	210	294.2	455.2	660	85
Turbidity (NTU)	1	4.45	26.6	100	239.6	599.5	1120	84
Turbidity (NTU) FLD	6	16	32.6	121.5	322.2	808.8	1430	62
Colour True (Hazen units)	5	10	15.6	28.5	66	98.05	300	74
Air Temperature (°C) FLD	21.9	22.29	23.6	31.4	34.68	35	35	8
Water Temperature (°C) FLD	13	16.525	19	25.65	29.1	31.95	34.6	106
pH (pH units)	6.8	6.9	7.212	7.6	7.8	8	8.31	124
pH (pH units) FLD	6.5	7	7.2	7.5	7.8	8.24	8.6	73
Total Alkalinity as CaCO3 (mg/L)	24	36.75	54.6	69.5	86.4	109.55	123	124
Hydroxide as OH (mg/L)	0	0	0	0	0	0.01	0.02	93
Carbonate as CO3 (mg/L)	0	0	0.012	0.2	0.3	0.7	1.4	109
Bicarbonate as HCO3 (mg/L)	29	44.9	66	84.65	105	133.445	148	124
Hardness as CaCO3 (mg/L)	12	29	39.89	54	71.4	95.25	146	124
Hydrogen as H (mg/L)	0	0	0	0	0	0	0.1	98
Total Diss. Solids (mg/L)	0	0	91.2	120	149.4	222.3	346	119
Total Diss. Ions (mg/L)	64	84.6	113.66	156.5	191.1	276.85	491.3	124
Calcium as Ca soluble (mg/L)	3	7.215	9.86	13	18	24	32	124
Chloride as Cl (mg/L)	6.5	7.9	11	16.44	30	68	172	121
Chloride as Cl (mg/L)	10	11.3	15.2	23	24.2	24.8	25	3
Magnesium as Mg soluble (mg/L)	1	2.5	3.66	5	6.6	9.24	16	124
Nitrate as NO3(mg/L)	0	0.458	0.5	1.1	1.9	2.607	5.5	87
Kjeldahl Nitrogen (mg/L)	0.64	0.64	0.64	0.64	0.64	0.64	0.64	1
Total Nitrogen (mg/L)	0.32	0.37	0.47	0.83	1.13	1.34	1.97	50
Organic Nitrogen (mg/L)	0.60	0.69	0.87	0.95	0.99	1.36	1.59	9
Oxygen (Dissolved) (mg/L) FLD	3.1	4.1	5.32	7.2	8.64	9.9	12.5	59
Total Phosphorus as P (mg/L)	0.043	0.058	0.085	0.20	0.39	0.55	0.72	60

Parameter	Min	5th	20th	Median	80th	95th	Max	Number of Samples
Potassium as K (mg/L)	2.4	4.23	5	5.8	6.6	7.42	8.8	98
Sodium as Na (mg/L)	6.9	10	13.8	18	28	41.85	110	124
Sulphate as SO4 (mg/L)	1	1.6	2.52	3.91	6.86	15.96	37	102
Aluminium as Al soluble (mg/L)	0	0.01	0.05	0.05	0.31	1.04	1.4	67
Arsenic as As - total (Micrograms/Litre)	0	0	0	0	0	0	0	1
Boron as B (mg/L)	0	0	0.03	0.04	0.1	0.1	0.2	77
Copper as Cu soluble mg/L	0	0.01	0.03	0.03	0.03	0.05	0.06	66