BHP Mitsubishi Alliance

Appendix E

Surface Water Assessment Report

ENGENY

BM ALLIANCE COAL OPERATIONS PTY LTD

Saraji Mine Grevillea Pit Continuation Project

Surface Water Assessment

QC1000_216-REP-002-1

22 AUGUST 2025

DISCLAIMER

This Report has been prepared on behalf of and for the exclusive use of BM Alliance Coal Operations Pty Ltd and is subject to and issued in accordance with BM Alliance Coal Operations Pty Ltd instruction to Engeny Australia Pty Ltd (Engeny). The content of this Report was based on previous information and studies supplied by BM Alliance Coal Operations Pty Ltd.

Engeny accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this Report by any third party. Copying this Report without the permission of BM Alliance Coal Operations Pty Ltd or Engeny is not permitted.

Rev	Date	Description	Author	Reviewer	Project Mgr.	Approver
0	12/06/2024	Client Issue	Aaron Baldwin	Ben Kiernan	Tegan Ireland	Ryan Kinnealy
1	22/08/2025	Draft Issue	Aaron Baldwin	Ben Kiernan	Aaron Baldwin	Ben Kiernan
Signatures						

CONTENTS

Appendices

Tables

Figures

1. INTRODUCTION

1.1 Introduction

In order to continue to access additional metallurgical coal at the Saraji Mine (SRM), BM Alliance Coal Operations Pty Ltd (BMA) is seeking to continue existing mining operations at Grevillea Pit in Mining Lease (ML) 1782 through progressing the footprint to the east into ML 700021, referred to as the SRM Grevillea Pit Continuation Project (the Project).

To support the Project, BMA is seeking approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Engeny has been engaged to undertake a surface water assessment for the Project to quantify potential surface water impacts. This report details the method and results of the surface water impact assessment.

1.2 Location

The Project is located approximately 25 kilometres (km) northwest of the Dysart township, in Central Queensland, within the Northern Brigalow Belt. The designated Project area encompasses approximately 221 hectares (ha) within ML 700021 and occurs adjacent to the east of the current mining operational area at SRM.

The Project area is inclusive of areas which are currently disturbed by ancillary mining activities (e.g., roads and tracks, exploration activities, equipment laydown areas and mine water storage areas), and areas which have sustained historical land use activities, such as agriculture. Phillips Creek lies adjacent to the southern boundary of the Project area and Spring Creek lies adjacent to the northern boundary. Phillips Creek and Spring Creek drain to the Isaac River, approximately 20km downstream of the Project and is located in the Fitzroy River catchment.

Figure 1 identifies the Project area, the existing mining operations and the location of Phillips Creek and Spring Creek.

1.3 Background

The SRM is owned and operated by BMA, on behalf of the Central Queensland Coal Associates Joint Venture. The SRM is an open cut mine and has been in operation since 1974, operating using dragline and truck/shovel equipment, supplying hard coking (steel making) coal product for the export market. Currently, the SRM mines approximately 16 million tonnes per annum of Run-of-Mine (ROM) coal. Located within the Isaac Regional Local Government Area, the SRM is located approximately 20 kilometres (km) north of Dysart in the Bowen Basin, Queensland.

The SRM is located primarily within ML 1775 and ML 1782, with industrial infrastructure located primarily within ML 1784 and ML 70142. The existing Grevillea Pit at the SRM is currently being mined within ML 1782.

Existing mining operations at the SRM are undertaken in a number of pits identified in Table 1.1. Due to mine progression, the existing Grevillea Pit will reach the boundary of ML 1782 during Financial Year (FY)25.

In 2017, BMA submitted an Environmental Authority (EA) amendment application under the Qld *Environmental Protection Act 1994* (EP Act) to authorise the continuation of Grevillea Pit to access further coal resources. An application for ML 700021 was submitted in conjunction with the EA amendment application in accordance with requirements under the Qld *Mineral Resources Act 1989* and was granted in 2018. Surface Area rights (SA1) were obtained shortly after for the purpose of coal mining.

ML 700021 is positioned directly east of ML 1782 where current SRM mine operations are occurring, and is bordered by Spring Creek in the north, Phillips Creek in the south, and power easements for 132kV/66kV electrical transmission lines to the east.

As a result of mine sequencing and planning, mining activities are currently scheduled to reach the limit of approved Grevillea Pit extents during FY25. The Project seeks to enable the continuation of existing open cut mining operations into ML 700021. The Project will be confined to ML 700021 and is shown in Figure 1.1.

TABLE 1.1: SRM MINING PITS

Mine	Pit Name	Mining Lease
SRM	Acacia	ML 1775
	Bauhinia	
	Pit Name	
	Dogwood	
	Jacaranda	
	Ebony	ML 1782
	Hakea ML 1782	
	Grevillea (existing)	
	Grevillea (Continuation)	ML 700021

1.4 Project Description

The key elements of the Project are listed below:

- Continuation of vegetation clearing, the removal and stockpiling of topsoil material, drilling and blasting of overburden and interburden material.
- Continuation of open cut mining (dragline, truck, and shovel/excavation methods) of ROM coal from the coal measures to the east beyond the current ML 1782 from FY25.
- Continued use of existing SRM infrastructure (e.g., Coal Handling and Preparation Plant, ROM and product stockpiles, train load-out, water management system and other supporting infrastructure).
- Continued disposal of rejects and tailings in accordance with the EA.
- Construction and operation of new or relocated infrastructure associated with the proposed action within ML 700021 to facilitate and/or support the continuation of open cut mining (detailed further below under Mine Infrastructure).
- Continuation of overburden and interburden material removal (dragline and truck and shovel/excavator methods) to uncover coal, which is placed as back fill in the mined-out pits (in-pit spoil dumps) as mining advances.
- Ongoing exploration activities within ML 700021.
- Progressive rehabilitation of disturbed areas.

The key mine infrastructure currently within the ML 700021 includes:

- Mine access roads and borrow pits.
- Electrical infrastructure including 66kv overhead power lines and substations.
- Water management infrastructure such as dams, drains and pipelines.
- Earth-moving-equipment build pad.
- Flood protection levees.

Over the life of the SRM, the key mine infrastructure within ML 700021 will likely include:

- Haul roads (heavy vehicles), light vehicle roads and access roads including parking lots.
- Pit infrastructure such as floors, walls, benches, ramps and access roads and spoil stockpiles.
- Flood protection levees.
- Water management infrastructure such as dams, drains, and pipelines.
- Relocated earth-moving-equipment build pad and supporting infrastructure.
- Electrical infrastructure including new or realigned stub lines and substations.

During pit progression, infrastructure will be relocated as required to support the mine operations within ML 700021. A 50-100 m lead on the high wall will remain to enable positioning of this support infrastructure up to the completion of mining in the pit.

The proposed action will continue the existing Grevillea Pit up to FY2055. In accordance with Condition E3 of the EA, areas significantly disturbed by mining activities must be rehabilitated in accordance with defined requirements to ensure a safe, stable, and non-polluting landform. As per Condition E15 of the EA, infrastructure constructed by, or for the SRM, must be removed from the Project area (except where agreement is reached). The proposed action will continue to implement existing rehabilitation and landform planning activities as per current operations. These rehabilitation and closure activities will be guided by the approved Progressive Rehabilitation and Closure Plan (PRCP) for the SRM.

The final landform design is based on the mine planning information and other detail available at the time of preparation of the application for referral. The main features of the final landform will be the rehabilitated overburden dumps to the west. The design of the final landform has been developed through an understanding of the spoil type and volume, waste characterisation, mining sequence and schedules, and required postmining land use outcomes. The closure landform (excluding void and top of spoil dumps) will be free draining and will not require sediment dams or other water control structures, unless required for the mine.

The design of spoil dumps is an important part of mine rehabilitation. The spoil dumps will be constructed in lifts (or benches) which will be regraded and reshaped to PRCP-approved slopes and contour characteristic prior to soil preparation and revegetation activities to the appropriate Post Mining Land Use (as per the EA and PRCP).

R	DETAILS	DATE
1	Draft Issue	24-05-2024
2	Final Issue	10-06-2024

DRAWN	MB	CHECKED	AB
APPROVED	AB	DATE	10-06-2024

NOTES:

N
0 0.5 1 km
SCALE @ A3 - 1:50000
GDA94 / MG 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

BMA
BHP Mitsubishi Alliance

Figure 1.1
BM Alliance Coal Operations Pty Ltd
Saraji Mine
Grevillea Pit Continuation Project Surface Water Assessment
Project Context

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC SWA Figures.qgz

2. RECEIVING ENVIRONMENT

2.1 Catchment Overview

The Project is located between Spring Creek and Phillips Creek (Figure 2.1) which are tributaries of the Isaac River. The Isaac River flows southeast from the confluence with Phillips Creek for approximately 130 km to join the Mackenzie River, which flows onwards for approximately 150 km to the Fitzroy River, a major river which discharges to the Coral Sea east of Rockhampton. The Fitzroy River Basin extends from north of Nebo in the north to Injune in the south, Rockhampton in the east and Clermont in the west.

The Fitzroy River Basin catchment is regulated under the *Water Resource (Fitzroy Basin) Plan 2011*. The Fitzroy Basin has a total catchment of 142,900 square kilometres (km^2) with the main tributary rivers being the Mackenzie River, Isaac River, Dawson River, and Comet River. The Fitzroy Basin catchment and its sub-basins are presented in Figure 2.2. The Isaac River Catchment has an area of approximately 22,325 km^2.

R	DETAILS	DATE
1	Draft Issue	22-04-2024
2	Draft Issue	24-05-2024
3	Final Issue	10-06-2024

DRAWN	MB	CHECKED	AB
APPROVED	AB	DATE	10-06-2024

NOTES:

N

0 0.3 0.6 km

SCALE @ A3 - 1:30000
GDA94 / MG 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

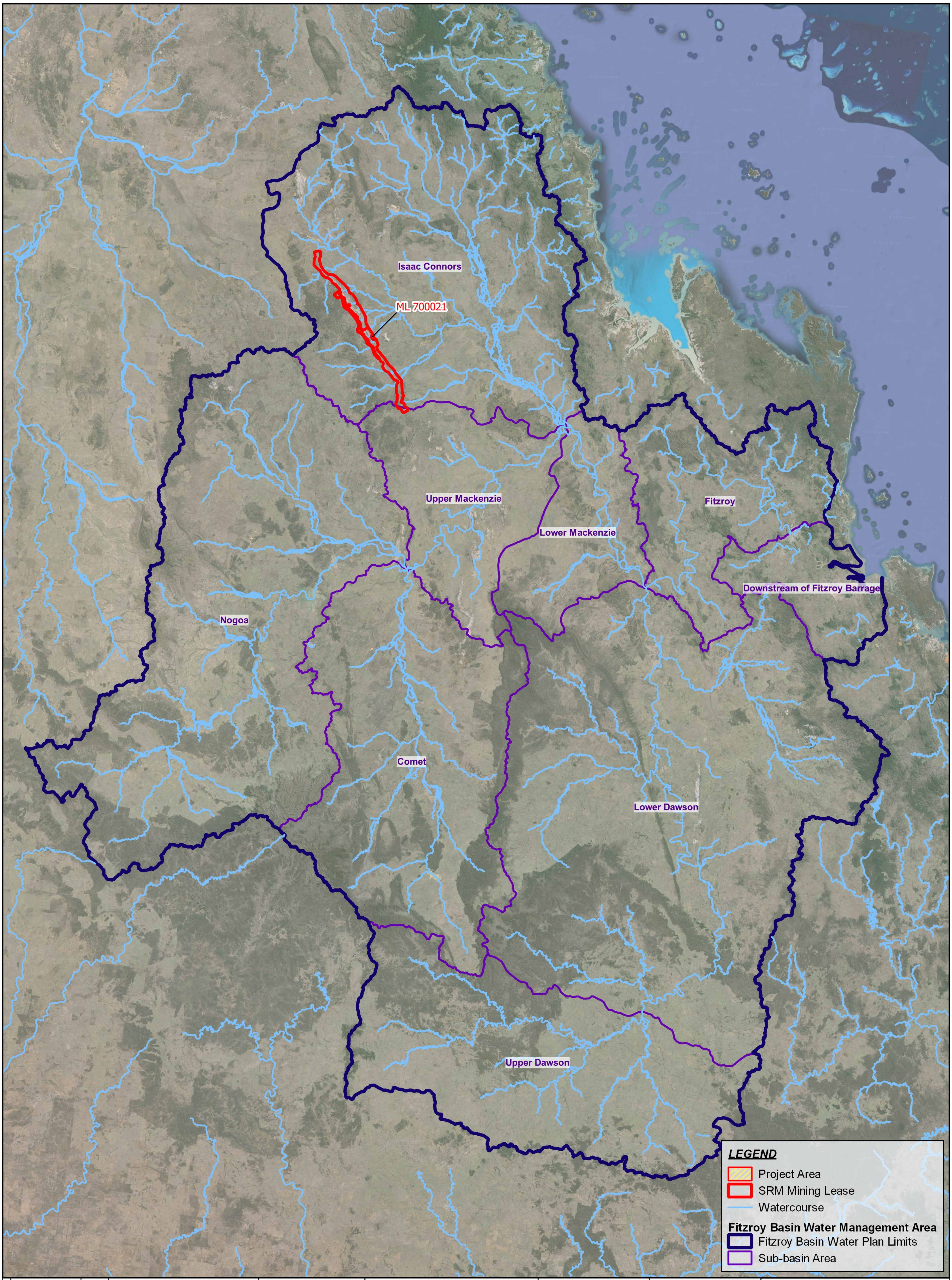
BMA
BHP Mitsubishi Alliance

Figure 2.1

BM Alliance Coal Operations Pty Ltd
Saraji Mine
Grevillea Pit Continuation Project Surface Water Assessment
Regional Context

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC SWA Figures.qgz



R	DETAILS	DATE
1	Draft Issue	22-04-2024
2	Draft Issue	24-05-2024
3	Final Issue	10-06-2024

DRAWN	MB	CHECKED	AB
APPROVED	AB	DATE	10-06-2024

NOTES:

SCALE @ A3 - 1:1750000
GDA94 / MG 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

Figure 2.2

BM Alliance Coal Operations Pty Ltd
Saraji Mine
Grevillea Pit Continuation Project Surface Water Assessment
Regional Basins

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC SWA Figures.qgz

2.2 Climate

The regional climate of the area is 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) and the Department of Regional Development, Manufacturing and Water (DRDMW) streamflow monitoring station within 30 km of the Project area are summarised in Table 2.1. Typical rainfall and evaporation rates at and proximal to the Project area are presented in Figure 2.3 to Figure 2.5. For the purposes of this report, data from the Dysart rainfall gauging station and Scientific Information for Land Owners (SILO) Data Drill (prior to 1929) 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 (DESI, 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.

TABLE 2.1: NEARBY RAINFALL GAUGING STATIONS

Source	Agency	Status	Latitude	Longitude	Proximity to SRM	Data Range
Keywong	BoM	Closed	-22.51	148.43	9 km	1998-2002
Dysart Post Office	BoM	Closed	-22.59	148.34	13 km	1988-2006
Dysart Station	BoM	Closed	-22.62	148.35	16 km	1956-2008
Picardy	BoM	Closed	-22.63	148.47	22 km	1953-1975
Seloh Nolem	BoM	Closed	-22.31	148.48	23 km	1973-2014
Iffley Station	BoM	Open	-22.24	148.43	27 km	1998-2024
Norwich Park	BoM	Closed	-22.70	148.42	27 km	1967-1970
Isaac River at Deverill	DRDMW	Open	-22.17	148.38	34 km	1995-2024

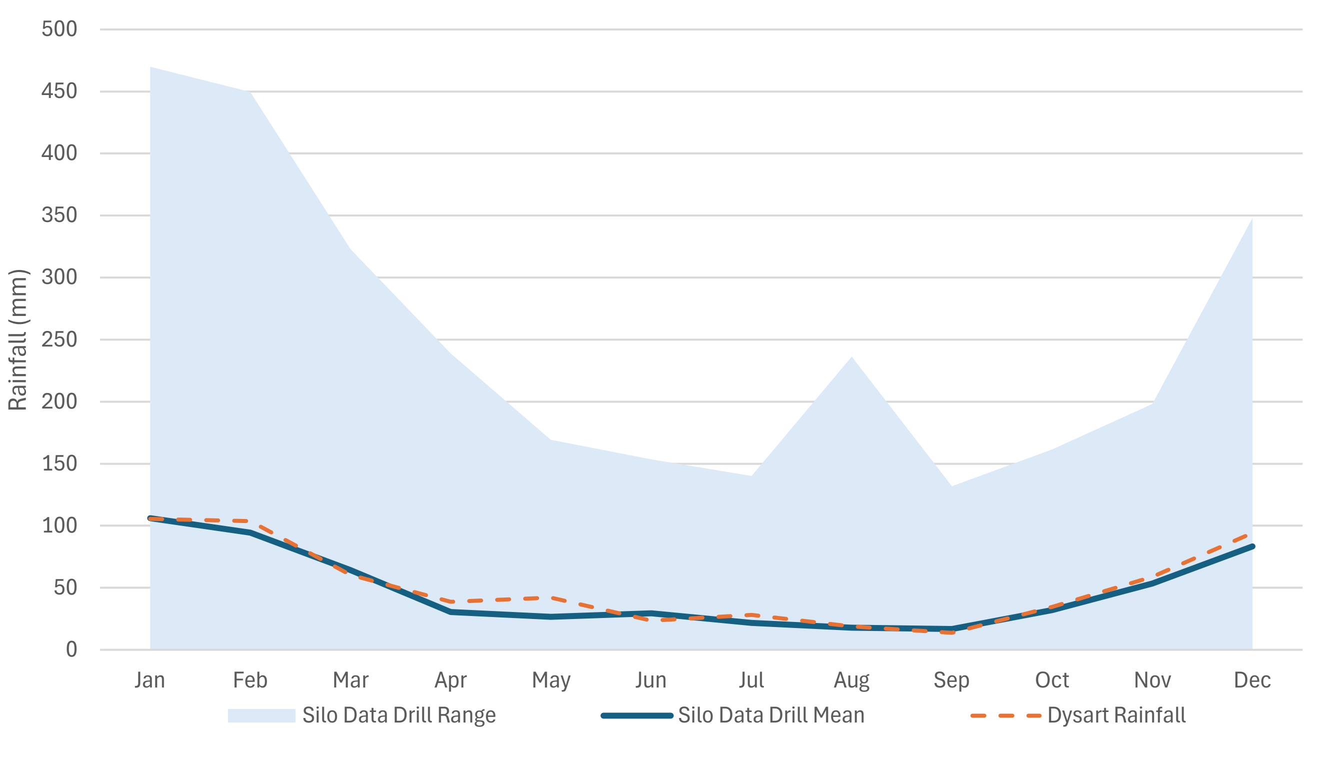


Figure 2.3: Monthly Rainfall

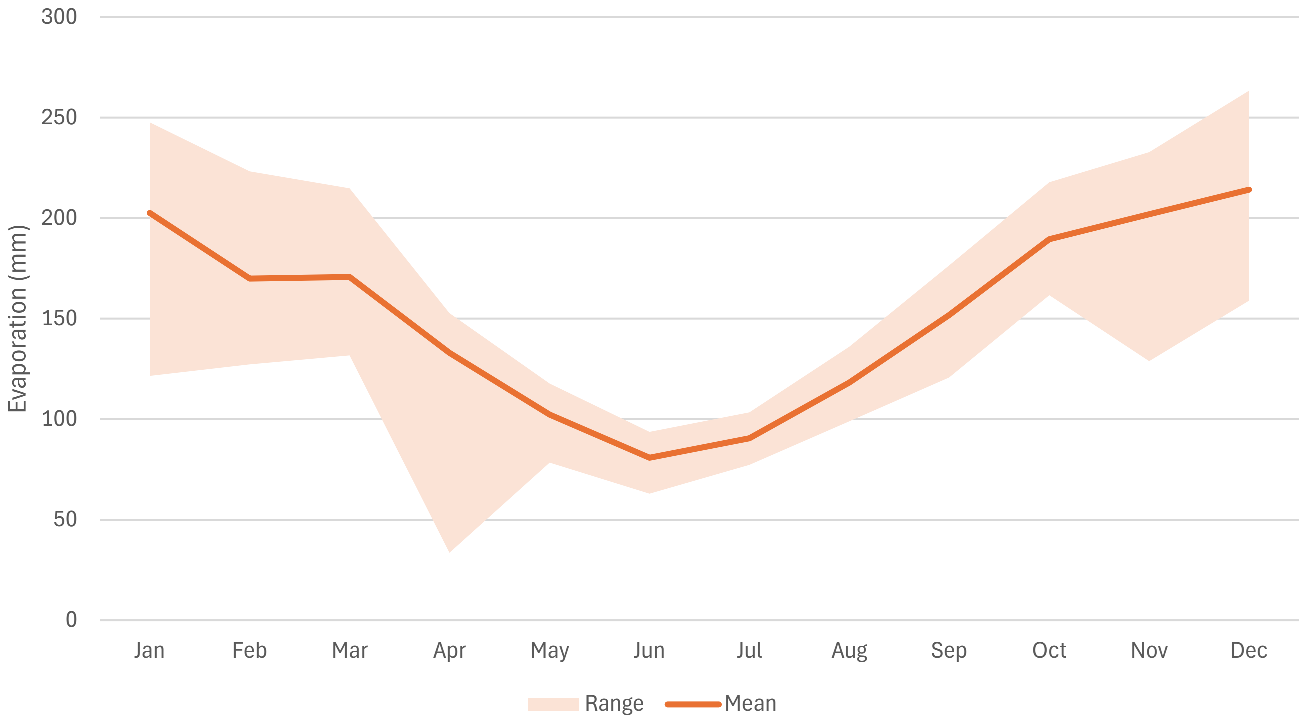


Figure 2.4: Monthly Evaporation

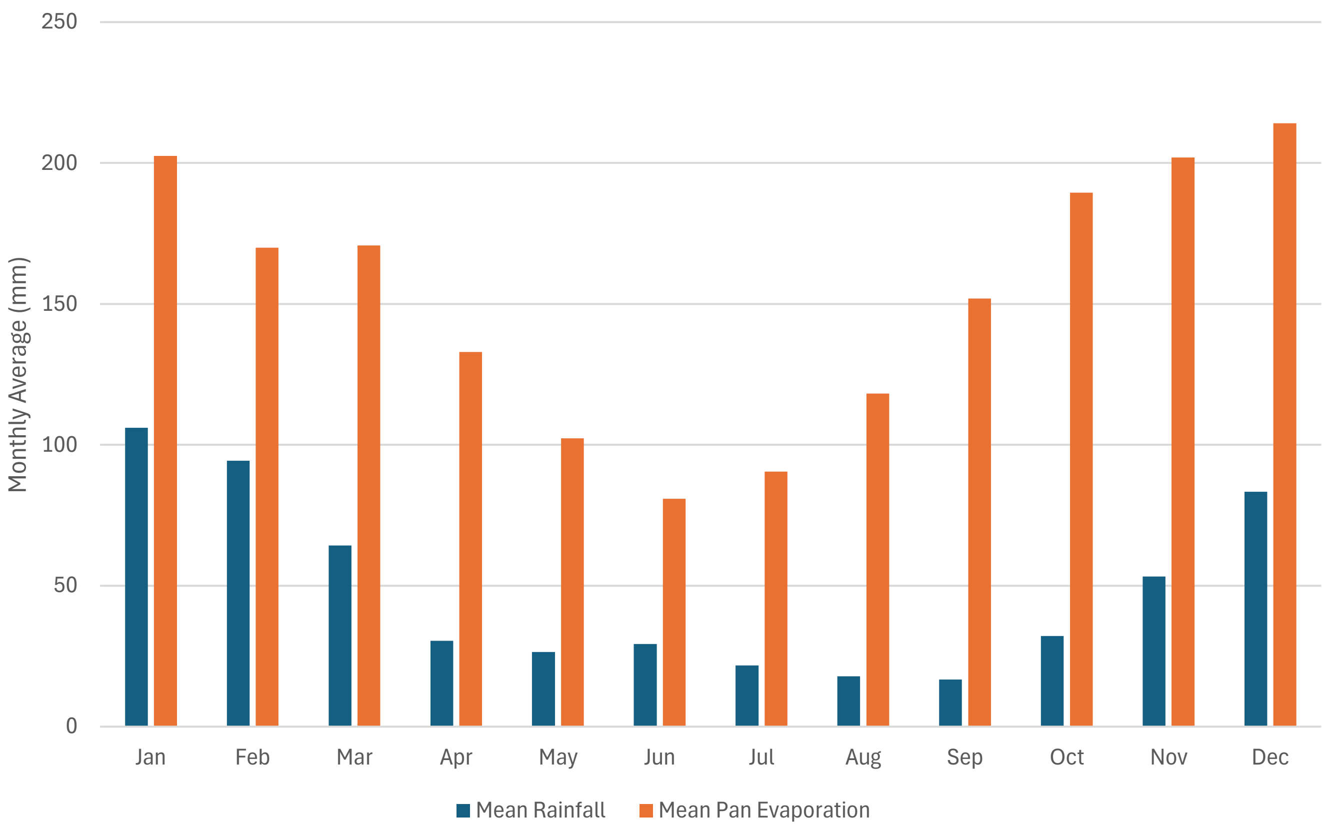


Figure 2.5: Monthly Mean Rainfall and Evaporation

2.3 Existing Waterways

SRM is located in the upper reaches of the Isaac River, which is itself located within the Fitzroy River Basin. The SRM is located to the west of the main Isaac River channel and outside of the Isaac River floodplain. The key hydrologic features at the SRM consist of a series of ephemeral creek systems originating in the range immediately to the west of SRM and flowing from west to east across the mine site. These creeks are:

- Hughes Creek (including Barrett Creek and Plum Tree Creek).
- One Mile Creek.
- Spring Creek.
- Phillips Creek (including Southern Creek).

These creek systems and their interactions with the current SRM are shown in Figure 2.6 The following sub-sections summarise key catchment information for the creek systems near the Project area; One Mile Creek, Spring Creek and Phillips/Southern Creek.

2.3.1 Phillips/Southern Creek System

Phillips Creek (including Southern Creek) intersects SRM near the southern end of the current open cut workings. Phillips Creek is the largest waterway intersecting SRM, with an upstream contributing catchment area at the Project location of approximately 382 km^2. An existing watercourse diversion (Phillips Creek Diversion) conveys Phillips Creek through the SRM mining areas, between existing Grevillea and Hakea Pits. Phillips Creek joins the Isaac River approximately 10 km downstream of SRM.

Southern Creek is a minor tributary of Phillips Creek, with an overall contributing catchment area (to the confluence with Phillips Creek) of 14 km^2. An existing diversion channel (Southern Creek Diversion) on Southern Creek diverts Southern Creek flows into Phillips Creek upstream of the SRM active pits.

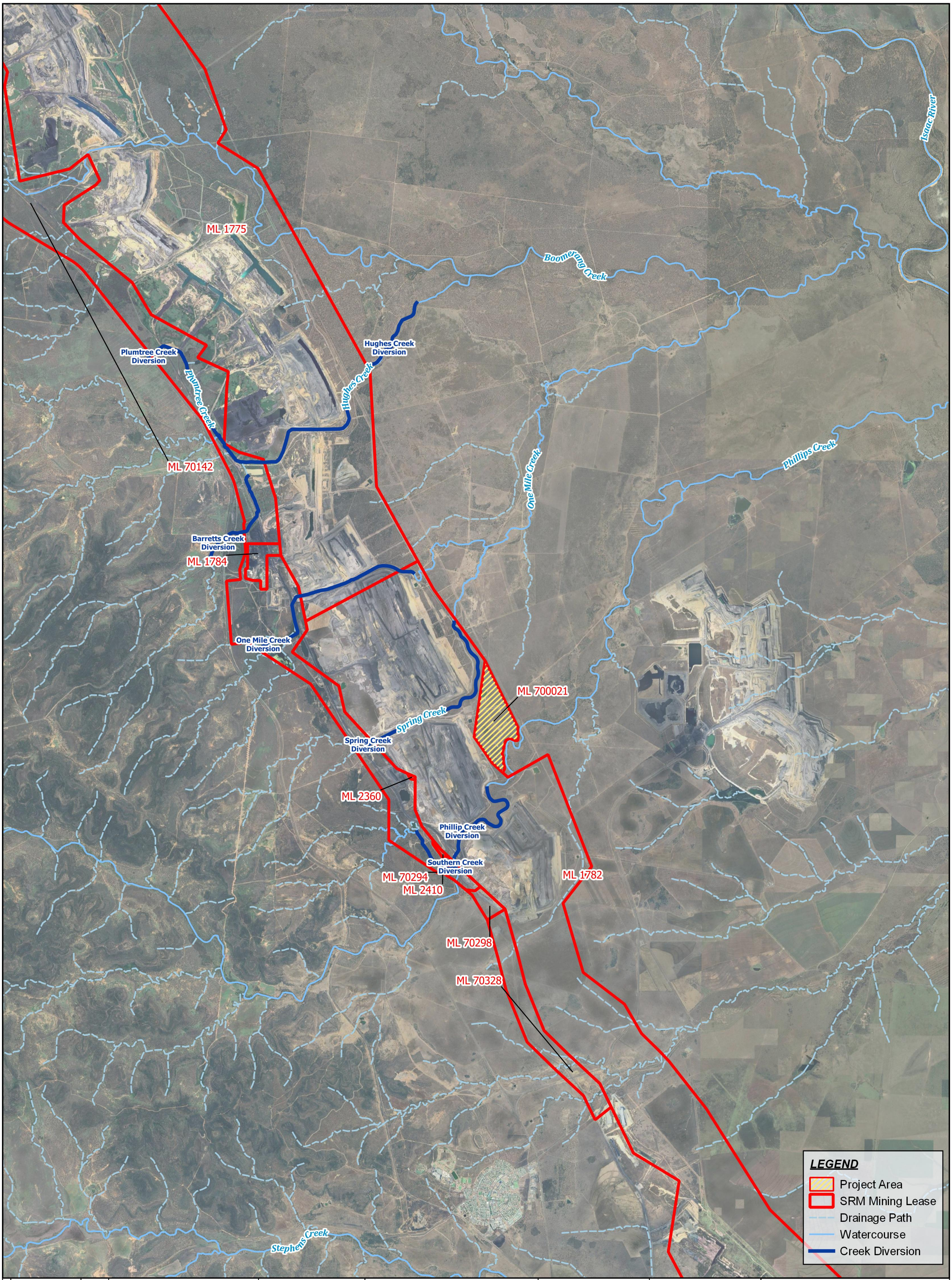
2.3.2 Spring Creek

Spring Creek is located immediately to the north of the Phillips Creek catchment. The Spring Creek catchment area upstream of SRM is approximately 20 km^2. Two existing permanent watercourse diversions convey Spring Creek flows from west to east through SRM. Spring Creek joins One Mile Creek approximately 2 km downstream of SRM, with the combined system then joining Boomerang Creek and Ripstone Creek (another 13 km and 5 km downstream, respectively) before ultimately discharging into the Isaac River.

The Project area is located immediately south of the Spring Creek diversion and drains to a tributary of One Mile Creek that reports to the main creek, 1.3 km downstream of the Spring Creek and One Mile Creek confluence.

2.3.3 One Mile Creek

One Mile Creek is located immediately to the north of the Spring Creek catchment. The One Mile Creek catchment area upstream of SRM is approximately 30 km^2. One Mile Creek is impounded by One Mile Creek Dam, located approximately 1 km upstream of SRM. One Mile Creek Dam has a full supply volume of approximately 950 ML and primarily serves a flood mitigation function. Downstream of One Mile Creek Dam, an existing permanent watercourse diversion conveys One Mile Creek flows from west to east through SRM.



R	DETAILS	DATE
1	Draft Issue	07-05-2024
2	Draft Issue	24-05-2024
3	Final Issue	10-06-2024

DRAWN	MB	CHECKED	AB
APPROVED	AB	DATE	10-06-2024

NOTES:

SCALE @ A3 - 1:100000
GDA94 / MG 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

BMA
BHP Mitsubishi Alliance

Figure 2.6
BM Alliance Coal Operations Pty Ltd
Saraji Mine
Grevillea Pit Continuation Project Surface Water Assessment
Drainage Features

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC SWA Figures.qgz

2.3.4 Streamflow Monitoring

Streamflow gauging stations operated by the Department of Regional Development, Manufacturing and Water (DRDMW), located near the Project area, are summarised in Table 2.2 shown in Figure 2.8. The closest flow gauge is the closed Tayglen station (130409A), located 4.5 km upstream of SRM on Phillips Creek. The next closest is the Isaac River at Deverill (130410A) gauging station, located upstream of the confluence of Phillips Creek and One Mile Creek with the Isaac River. Flow duration curves for these gauging stations are shown on Figure 2.8.

TABLE 2.2: NEARBY STREAMFLOW GAUGES

Station	Station Number	Station Status	Catchment Area	Proximity	Data Range
Phillips Creek at Tayglen	130409A	Closed	344 km^2	4.5 km (upstream of Project)	1968 – 1988 (19 years)
Isaac River at Deverill	130410A	Open	4,092 km^2	32 km (upstream of Project)	1968 – Present (56 years)
Scott Creek at Norwich Park	130415A	Closed	388 km^2	28 km (nearby waterway)	1972 – 1988 (16 years)
Isaac River at Yatton	130401A	Open	19,720 km^2	82 km (Downstream of Project)	1962 – Present (62 years)

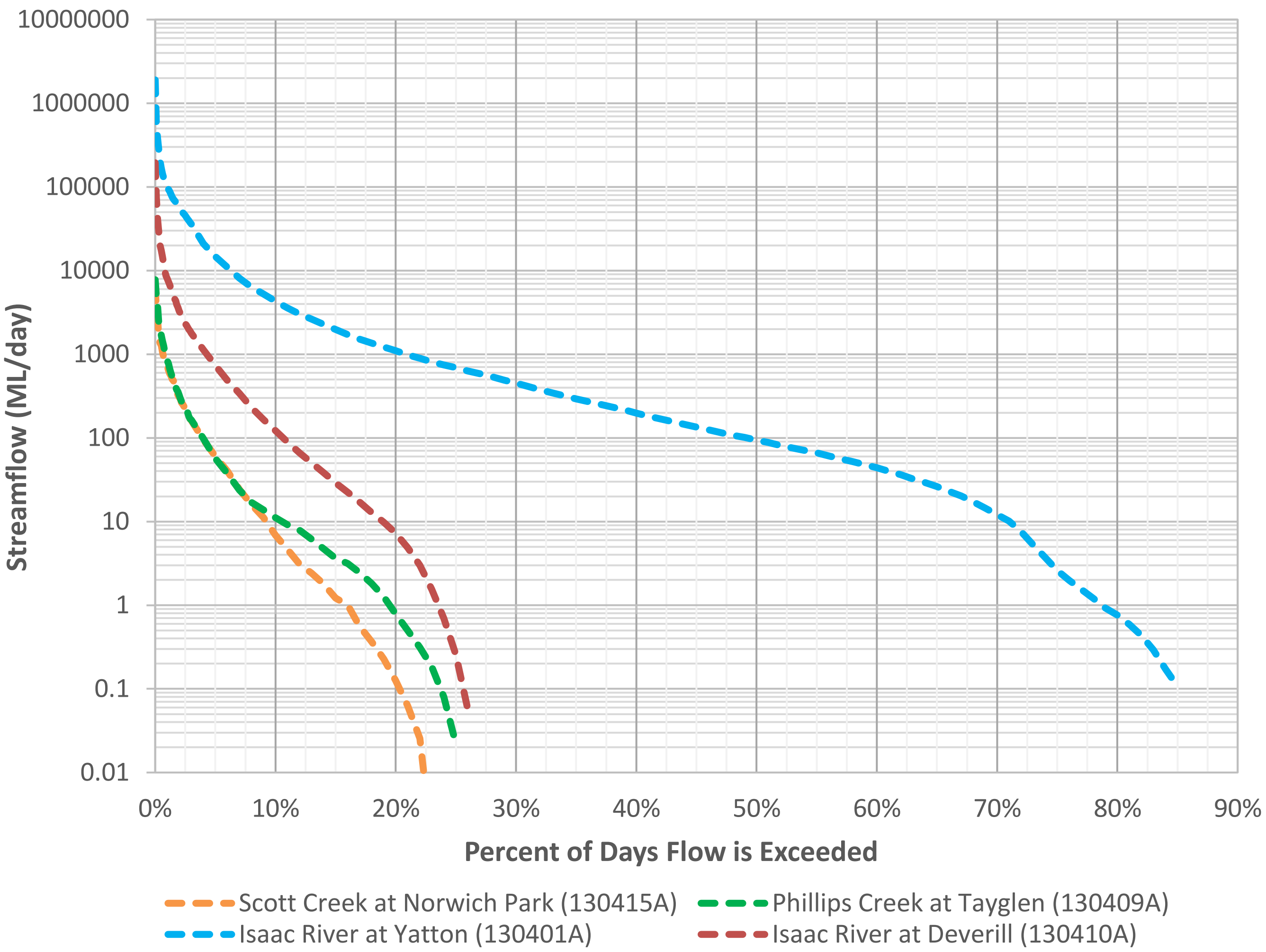
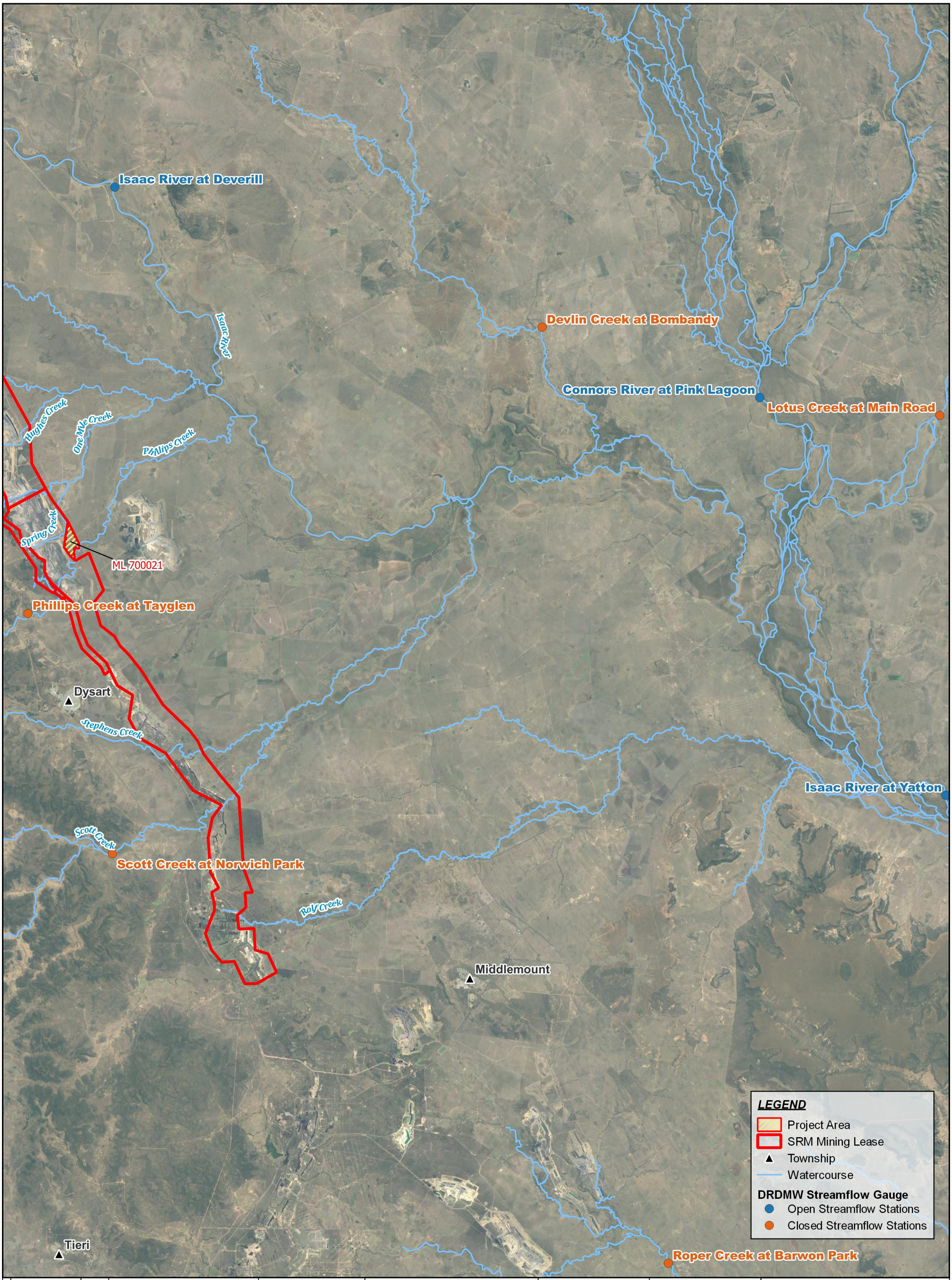


Figure 2.7: Flow Duration Curves



R	DETAILS	DATE
1	Draft Issue	07-05-2024
2	Draft Issue	24-05-2024
3	Final Issue	11-06-2024

DRAWN	MB	CHECKED	AB
APPROVED	AB	DATE	11-06-2024

NOTES:

N
0 3 6 km
SCALE @ A3 - 1:300000
GDA94 / MG 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

BMA
BHP Mitsubishi Alliance

Figure 2.8
BM Alliance Coal Operations Pty Ltd
Saraji Mine
Grevillea Pit Continuation Project Surface Water Assessment
Streamflow Gauging Stations

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC SWA Figures.qgz

2.4 Surface Water Quality

Surface water quality data for the waterways near SRM has been reviewed to inform the surface water assessment for the Project. Water quality monitoring data is available from the following two sources:

- SRM Receiving Environment Monitoring Program (REMP).
- Water quality recorded at streamflow gauging stations operated by the DRDMW.

Water quality monitoring for waterways near SRM is undertaken as part of the SRM REMP with the most recent reporting completed in 2023 (Gauge, 2023). Monitoring sites on the waterways include control or reference sites upstream of SRM and test sites downstream of SRM as required by the SRM EA. Waterways monitored as part of the REMP include the Isaac Rive, Phillips Creek, Spring Creek, One Mile Creek and Hughes Creek.

Water quality in Phillips Creek and the Isaac River has been monitored at streamflow gauging station 130409A (Phillips Creek at Tayglen) and 130410A (Isaac River at Deverill), respectively (DRDMW, 2024).

Water quality monitoring results collected as part of the REMP for the waterways near the Project area are presented in Table 2.3. Water quality data for the DRDMW streamflow monitoring stations is presented in Table 2.4.The water quality data is compared against the SRM water quality objectives (refer Section 3.3) and Contaminant Trigger Investigation Levels for SRM (Table F2 and F3 of EA EPML00862313) (DETSI, 2025).

The water quality data shows:

- Turbidity, Dissolved Oxygen and Suspended Solids consistently exceed the water quality objectives (WQOs) at all locations.
- Aluminium occurs naturally in elevated concentrations in the Isaac River, Phillips Creek, One Mile Creek, and Spring Creek with 80th percentile dissolved concentrations exceeding the WQO at all locations.
- Iron and Manganese occur naturally in elevated concentrations with most samples exceeding the WQO at all locations.
- The historical water quality data captured for Phillips Creek and the Isaac River by DRDMW show similar WQO exceedances to the SRM site data captured by the REMP.
- The REMP monitoring data does not show clear trend between upstream and downstream water quality indicating no material impact by the current mining operations.

TABLE 2.3: REMP WATER QUALITY MONITORING DATA

Analyte	Unit	Spring Creek (Upstream)			One Mile Creek (Downstream)			Phillips Creek (Upstream)			Phillips Creek (Downstream)			WQO	EA Trigger Level
		20th %ile	Median	80th %ile	20th %ile	Median	80th %ile	20th %ile	Median	80th %ile	20th %ile	Median	80th %ile		
Physical Parameters and Nutrients															
pH	pH	7.1	7.5	7.8	7.5	7.9	8.3	7.6	8.0	8.3	7.8	8.1	8.4	**6.5-8.5**	**6.5-9.0**
Turbidity	NTU	233	550	585	26.4	137	601	20.3	202	782	70.8	275	1,093	**50**	-
Dissolved Oxygen	%	42.5	72.3	88.5	52.4	65.3	104.3	45.8	68.7	84.7	58.0	66.9	88.9	**85-110**	-
Suspended Solids	mg/L	65.0	114	290	47.2	132	344	20.2	84.0	644	26.2	120	685	**55**	-
Sulphate	mg/L	8.8	19.0	78.4	24.0	52.5	147.0	5.0	11.0	19.0	12.0	21.0	35.8	**25**	-
Fluoride	µg/L	120	200	200	<100	200	400	<100	170	200	<100	140	200	**1,000**	-
Ammonia	µg/L	14.0	60.0	86.0	<10	30.0	58.0	<10	20.0	40.0	<10	30.0	50.0	**900**	-
Nitrate	µg/L	<10	40.0	186	20.0	120	930	<10	80.0	252	20.0	120	294	**700**	-
TPH C6-C9	µg/L	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	**20**	**20**
TPH C10-C36 (sum)	µg/L	<50	<50	110	<50	<50	<50	<50	<50	100	<50	<50	100	**100**	**100**
Dissolved Metals															
Aluminium	µg/L	<10	25	580	<10	30	360	<10	50	236	<10	40	236	**55**	**416**
Arsenic	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	**13**	-
Boron	µg/L	<50	<50	54	<50	53	70	<50	<50	60	<50	<50	60	**370**	-
Cadmium	µg/L	<0.1	<0.1	<0.1	0.05	0.05	<0.1	0.05	<0.1	<0.1	0.05	0.075	<0.1	**0.2**	-
Chromium	µg/L	<1	<1	<1	0.2	<1	<1	0.3	<1	<1	0.26	<1	<1	**1**	**1**
Cobalt	µg/L	<1	<1	1.4	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-
Copper	µg/L	<1	1.5	2	<1	<1	2	<1	2	2	<1	2	2.2	**2**	**2**
Iron	µg/L	<50	95	630	<50	80	670	<50	100	340	<50	145	366	-	**1,130**
Lead	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	**4**	-
Manganese	µg/L	<1	3	95	<1	2	11.2	<1	2	30	<1	2	6	-	-
Mercury	µg/L	<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**	-
Molybdenum	µg/L	<1	<1	<1	<1	<1	4	<1	<1	<1	<1	<1	2	-	-
Nickel	µg/L	2	2	3	<1	2	3	2	2	3	2	2	4	**11**	-
Selenium	µg/L	<10	<10	<10	0.44	2.4	<10	0.2	0.4	<10	0.3	0.45	<10	**10**	-
Silver	µg/L	<1	<1	<1	0.1	0.2	<1	0.1	0.1	<1	0.1	0.1	<1	**1**	-
Uranium	µg/L	<1	<1	<1	0.2	0.75	<1	0.424	<1	<1	0.34	0.94	<1	**1**	-
Vanadium	µg/L	<10	<10	<10	0.8	2.2	<10	3.08	<10	<10	2.36	5.15	<10	**10**	-
Zinc	µg/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	**8**	**8**
Total Metals															
Aluminium	µg/L	8,484	12,350	19,000	752	2,220	4,664	748	14,200	37,220	1,252	13,650	41,800	-	-
Arsenic	µg/L	2.6	4	4	<1	2	2	<1	2	4.2	<1	2	5.2	-	-
Boron	µg/L	<50	<50	54	<50	60	80	<50	<50	71.4	<50	<50	70	-	-
Cadmium	µg/L	<0.1	<0.1	<0.1	0.05	0.05	<0.1	0.05	<0.1	<0.1	0.05	0.075	<0.1	-	-
Chromium	µg/L	7.4	10.5	17.4	0.2	1.5	4	0.62	12.5	57.2	0.4	8.5	62.8	-	-
Cobalt	µg/L	3.6	6	8.4	<1	2	5	<1	5	18.6	<1	6	26.2	**50**	-
Copper	µg/L	7.6	10	14.8	2	4	8	2.6	14	36.8	3.6	13.5	42.6	-	-
Iron	µg/L	9,574	14,750	22,920	1,436	3,170	6,980	564	13,400	43,720	966	16,250	55,000	**200**	-
Lead	µg/L	9.4	13	19.6	2	3	5	<1	5.5	29	<1	7	36	-	-
Manganese	µg/L	102	158	261	23.4	54	94.6	30.8	216	546	31.6	157	860	**100**	-
Mercury	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
Molybdenum	µg/L	<1	<1	<1	<1	<1	5.8	<1	<1	<1	<1	<1	2	**10**	-
Nickel	µg/L	6.6	11	19.8	3	5	23.4	3	10.5	40.8	4	16.5	55	-	-
Selenium	µg/L	<10	<10	<10	0.56	4	<10	0.3	1	<10	0.4	0.7	<10	-	-
Silver	µg/L	<1	<1	<1	0.1	0.1	<1	0.1	0.35	<1	0.1	0.1	<1	-	-
Uranium	µg/L	<1	<1	<1	0.416	<1	<1	0.718	<1	1.548	0.788	<1	2	-	-
Vanadium	µg/L	<10	<10	20	5.04	<10	20	9.9	15.3	43.68	9.78	20.6	48.72	-	-
Zinc	µg/L	12	29	58.8	5.2	13	47.8	<5	25.5	71	8	36	77	-	-

Note: Exceedances of WQOs have been highlighted in blue.

TABLE 2.4: DRDMW WATER QUALITY MONITORING DATA

Analyte	Unit	Phillips Creek at Tayglen (130409A)			Isaac River at Deverill (130410A)			WQO	EA Trigger Level
		20th %ile	Median	80th %ile	20th %ile	Median	80th %ile		
Physical Parameters and Nutrients									
pH	*pH*	7.7	8.1	8.4	7.3	7.6	8.0	**6.5-8.5**	**6.5-9.0**
Turbidity	*NTU*	24.0	24.0	24.0	14.0	56.0	921	**50**	-
Dissolved Oxygen	*%*	-	-	-	71.1	88.2	103	**85-110**	-
Total Suspended Solids	*mg/L*	17.0	56.0	638.0	10.8	108	900	**55**	-
Sulphate	*mg/L*	4.2	11.0	20.3	7.0	10.0	15.8	**25**	-
Fluoride	*µg/L*	106	200	288	100	140	200	**1,000**	-
Ammonia	*µg/L*	-	-	-	5.0	9.2	36.8	**900**	-
Nitrate	*µg/L*	520	1,450	3,120	500	11,00	3,000	**700**	-
TPH C6-C9	*µg/L*	-	-	-	-	-	-	**20**	**20**
TPH C10-C36 (sum)	*µg/L*	-	-	-	-	-	-	**100**	**100**
Dissolved Metals									
Aluminium	*µg/L*	-	-	-	30	50	132	**55**	**416**
Arsenic	*µg/L*	-	-	-	-	-	-	**13**	-
Boron	*µg/L*	-	-	-	-	-	-	**370**	-
Cadmium	*µg/L*	-	-	-	-	-	-	**0.2**	-
Chromium	*µg/L*	-	-	-	-	-	-	**1**	**1**
Cobalt	*µg/L*	-	-	-	-	-	-	-	-
Copper	*µg/L*	-	-	-	10	30	30	**2**	**2**
Iron	*µg/L*	664	1,600	8,200	20	60	168	-	**1,130**
Lead	*µg/L*	-	-	-	-	-	-	**4**	-
Manganese	*µg/L*	-	-	-	1	10	10	-	-
Mercury	*µg/L*	-	-	-	-	-	-	**0.2**	-
Molybdenum	*µg/L*	-	-	-	-	-	-	-	-
Nickel	*µg/L*	-	-	-	-	-	-	**11**	-
Selenium	*µg/L*	-	-	-	-	-	-	**10**	-
Silver	*µg/L*	-	-	-	-	-	-	**1**	-
Uranium	*µg/L*	-	-	-	-	-	-	**1**	-
Vanadium	*µg/L*	-	-	-	-	-	-	**10**	-
Zinc	*µg/L*	-	-	-	10	10	36	**8**	**8**
Total Metals									
Aluminium	*µg/L*	-	-	-	270	270	270	-	-
Arsenic	*µg/L*	-	-	-	0.9	0.9	0.9	-	-
Boron	*µg/L*	40	40	40	40	60	90	-	-
Cadmium	*µg/L*	-	-	-	0.1	0.1	0.1	-	-
Chromium	*µg/L*	-	-	-	0.4	0.4	0.4	-	-
Cobalt	*µg/L*	-	-	-	0.7	0.7	0.7	**50**	-
Copper	*µg/L*	-	-	-	1	1	1	-	-
Iron	*µg/L*	-	-	-	620	620	620	**200**	-
Lead	*µg/L*	-	-	-	0.3	0.3	0.3	-	-
Manganese	*µg/L*	-	-	-	130	130	130	**100**	-
Mercury	*µg/L*	-	-	-	-	-	-	-	-
Molybdenum	*µg/L*	-	-	-	0.3	0.3	0.3	**10**	-
Nickel	*µg/L*	-	-	-	1.9	1.9	1.9	-	-
Selenium	*µg/L*	-	-	-	0.1	0.1	0.1	-	-
Silver	*µg/L*	-	-	-	1	1	1	-	-
Uranium	*µg/L*	-	-	-	0.1	0.1	0.1	-	-
Vanadium	*µg/L*	-	-	-	1.9	1.9	1.9	-	-
Zinc	*µg/L*	-	-	-	1	1	1	-	-

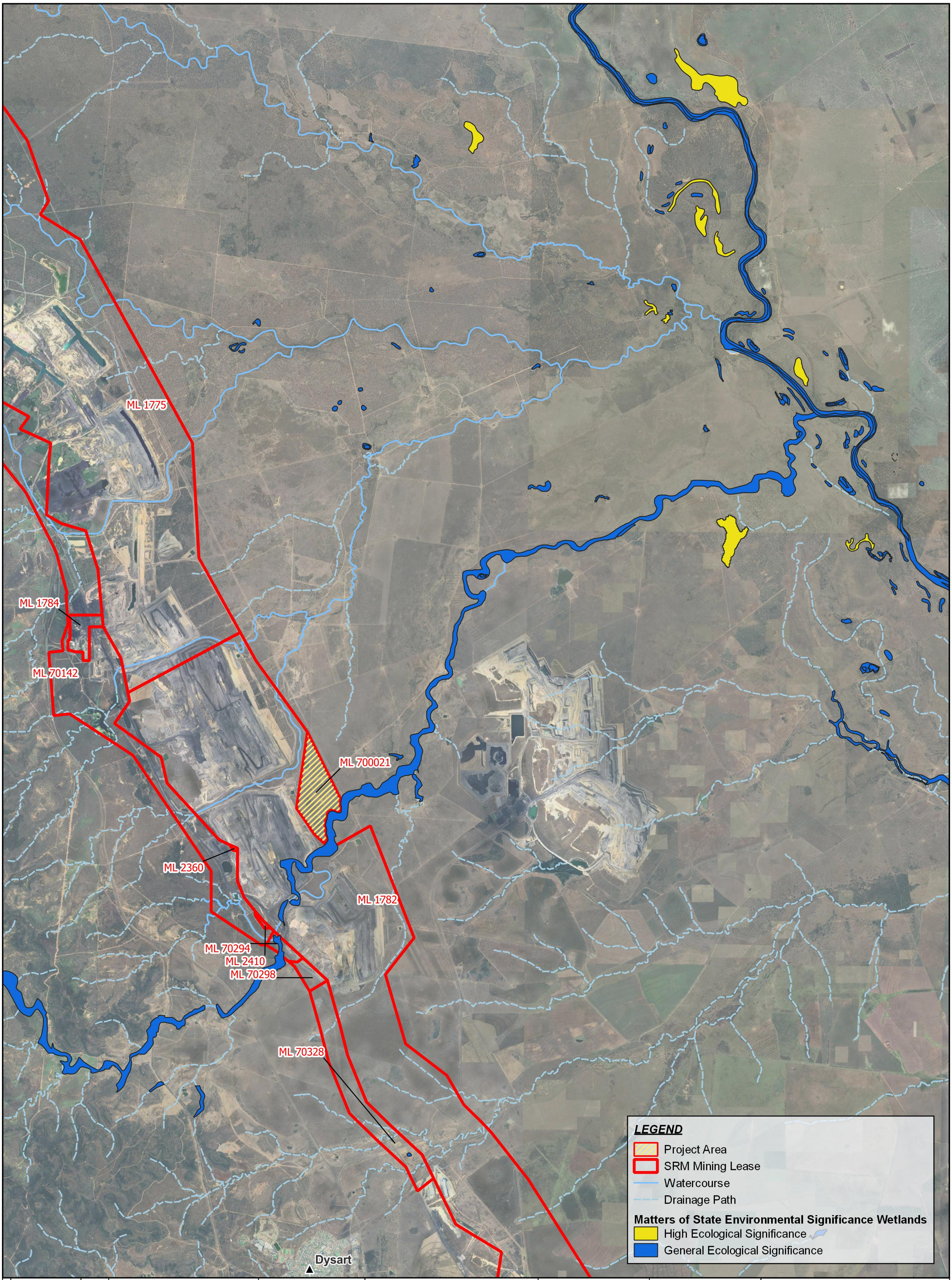
Note: Exceedances of WQOs have been highlighted in blue.

2.5 Wetlands

The Map of Queensland wetland environmental values (EVs) are a state-wide statutory map under the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP). It identifies wetlands of high ecological significance and general ecological significance across the state. The Qld *Vegetation Management Act 1999* also identifies regulated vegetation across the state, including regulated vegetation associated with wetlands (Vegetation Management Wetlands).

Matters of State Environmental Significance high ecological significance wetlands and general ecological significance wetlands, and Vegetation Management Wetlands are mapped in the locality of the Project (Figure 2.9 and Figure 2.10).

Matters of State Environmental Significance high ecological significance wetlands are located adjacent to One Mile Creek, approximately 22 km downstream of the Project, and adjacent to Phillips Creek, approximately 16 km downstream of the Project. There are several general ecological significance wetlands and Vegetation Management Wetlands also identified downstream of the Project on One Mile Creek and Phillips Creek, however all are located outside of the Project boundary area.



R	DETAILS	DATE
1	Draft Issue	07-05-2024
2	Draft Issue	24-05-2024
3	Final Issue	11-06-2024

DRAWN	MB	CHECKED	AB
APPROVED	AB	DATE	11-06-2024

NOTES:

N
0 1 2 km
SCALE @ A3 - 1:100000
GDA94 / MG 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

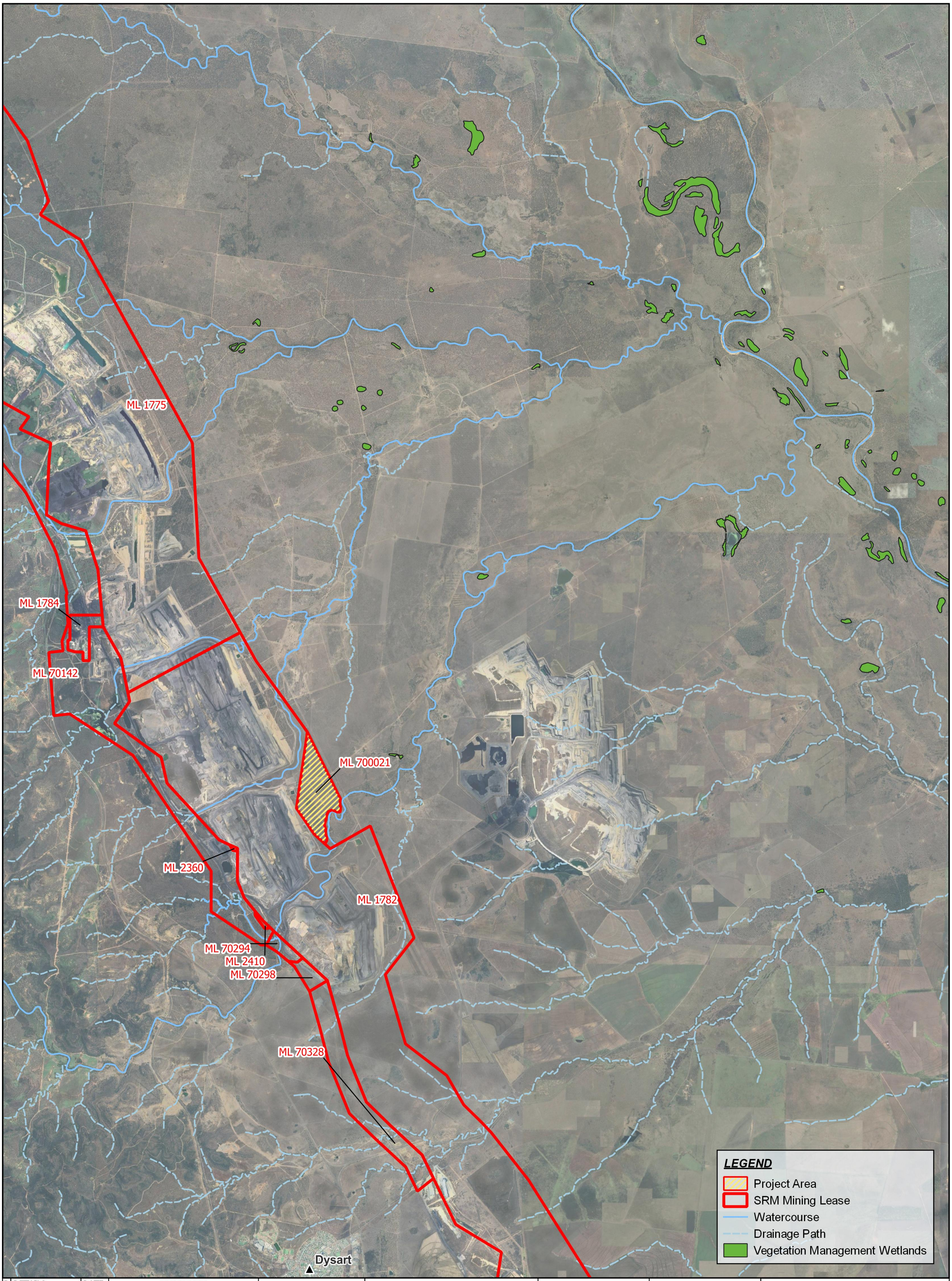
BMA
BHP Mitsubishi Alliance

Figure 2.9

BM Alliance Coal Operations Pty Ltd
Saraji Mine
Grevillea Pit Continuation Project Surface Water Assessment
Matters of State Environmental Significance Wetlands

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC SWA Figures.qgz



R	DETAILS	DATE
1	Draft Issue	07-05-2024
2	Draft Issue	24-05-2024
3	Final Issue	11-06-2024

DRAWN	MB	CHECKED	AB
APPROVED	AB	DATE	11-06-2024

NOTES:

N

0 1 2 km

SCALE @ A3 - 1:100000
GDA94 / MG 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

BMA
BHP Mitsubishi Alliance

Figure 2.10

BM Alliance Coal Operations Pty Ltd
Saraji Mine
Grevillea Pit Continuation Project Surface Water Assessment
Vegetation Management Wetlands

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC SWA Figures.qgz

2.6 Vegetation

The Project is located within the Brigalow Belt bioregion and on the boundary of the Bowen Basin and Isaac-Comet Downs sub-regions. The Project area predominantly features non-remnant vegetation, with the Phillips Creek riparian zone outside of the Project area forming a wildlife corridor providing connectivity to remnant vegetation outside of the Project area.

Using the Queensland Regional Ecosystem (RE) method for identification, the following six (6) vegetation communities were identified across the Project area (Engeny 2024):

- *Eucalyptus populnea* open forest on sand plains (RE11.5.3 – remnant);
- *Acacia harpophylla* shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains (RE11.4.9 – remnant);
- *Acacia harpophylla* and/or *Casuarina cristata* low open forest on alluvial plains (RE11.3.1 – HVR);
- *Eucalyptus populnea* low open forest on sand plains (RE11.5.3 – HVR);
- Regrowth Brigalow (non-remnant); and,
- Disturbed and impacted areas with grass and forb regrowth lacking woody vegetation (non-remnant).

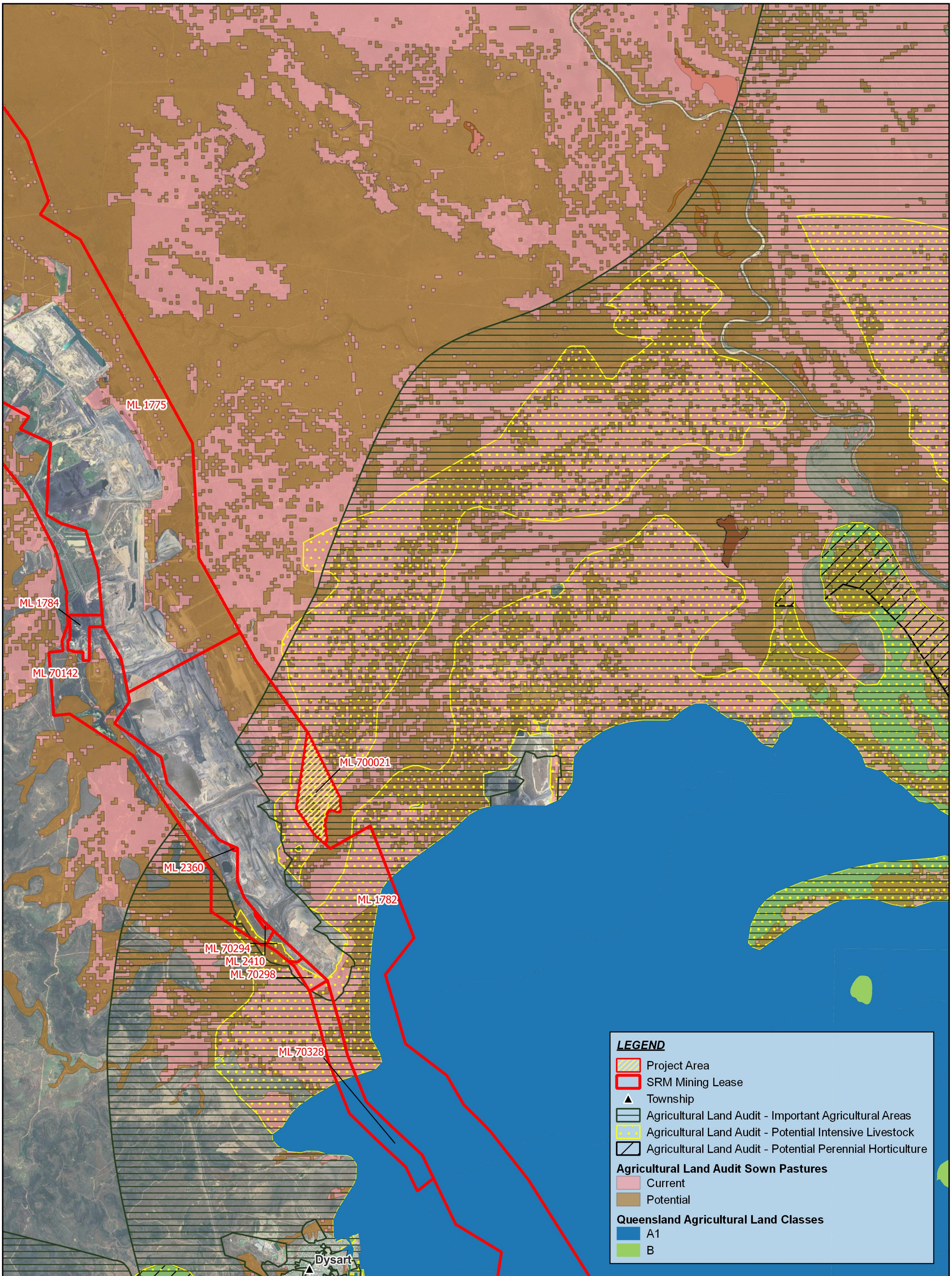
2.7 Landuse

2.7.1 Agriculture

The Queensland Government's indicative land use mapping (Queensland Globe) of the Project area shows the land use for the majority of the area as "grazing native vegetation". The surrounding area is also dominated by "grazing native vegetation" mapped land use. There are areas of "mining", "other minimal use" and "residential" land uses.

Agriculture has a significant presence in the region. Farming of crops and grazing of livestock is present along and adjacent to Phillips and Spring creeks, as well as the Isaac River both upstream and downstream of the Project. The mapping shows that the Agricultural Land Audit has classified the region surrounding the Project area boundary as an "Important Agricultural Area" and has the potential for agricultural development (Figure 2.11). Potential agricultural regions mapped in the Project area include:

- QLD Agricultural Land Classes:
  - Class A1: Crop land that is suitable for a wide range of current and potential crops, with nil to moderate limitations to production.
  - Class B: Limited crop land that is suitable for a narrow range of current or potential crops, though highly unsuitable for pastures. The land might be suitable for cropping with engineering or agronomic improvements.
- QLD Agricultural Land Audit:
  - Potential annual horticulture.
  - Potential perennial horticulture
  - Potential intensive livestock.



R	DETAILS	DATE
1	Draft Issue	07-05-2024
2	Draft Issue	24-05-2024
3	Final Issue	11-06-2024

DRAWN	MB	CHECKED	AB
APPROVED	AB	DATE	11-06-2024

NOTES:

N
0 1 2 km
SCALE @ A3 - 1:100000
GDA94 / MG 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

BMA
BHP Mitsubishi Alliance

Figure 2.11

BM Alliance Coal Operations Pty Ltd
Saraji Mine
Grevillea Pit Continuation Project Surface Water Assessment
Agricultural Land Audit Mapping

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC SWA Figures.qgz

2.7.2 Nearby Mines and Industry

The Fitzroy Basin encompasses one of the most active mining regions of Queensland. There are several mines located to the north, south and east of the Project. A summary of coal mines proximal to the Project that interact with waterways flowing past the Project are included in Table 2.5.

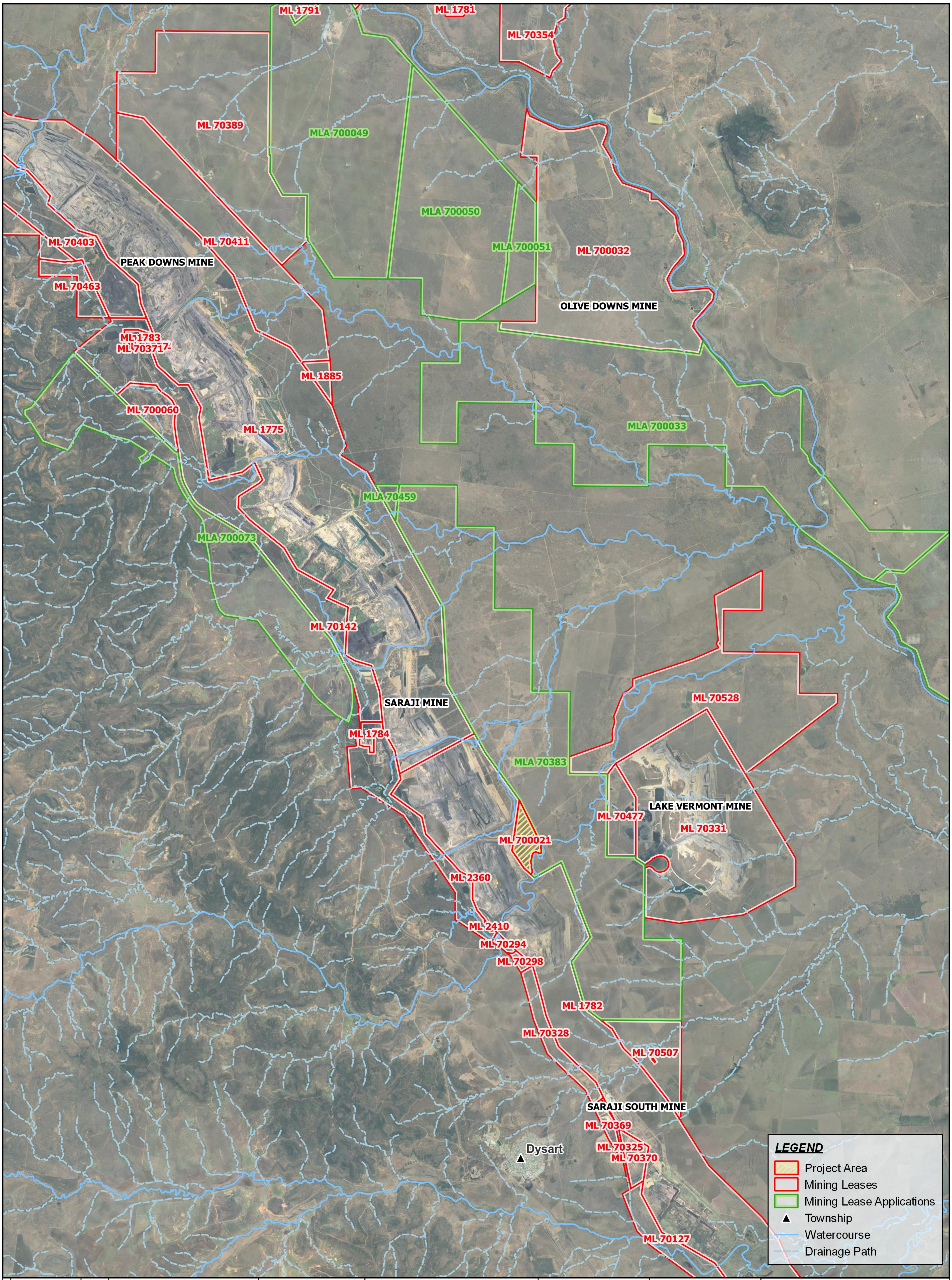
The following two mines interact with Phillips Creek and One Mile Creek downstream of the Project area, before their confluence with the Isaac River:

- Lake Vermont Mine – Located immediately east of the Project on the southern side of Phillips Creek.
- Peak Downs Mine – Located in the upper catchment of Ripstone Creek and Boomerang Creek which collects One Mile Creek before their confluence with the Isaac River.

Lake Vermont Mine is located immediately east of the Project area and is partially located in the Phillips Creek catchment. Lake Vermont Mine has infrastructure in close proximity to Phillips Creek including water storages (within 150m), Tailings Storage Facilities (within 1 km) and mining pits (within 1.5 km). Peak Downs Mine is located north of SRM and is located in the Boomerang Creek and Ripstone Creek catchment. The Lake Vermont Mine and Peak Downs Mine Environmental Authorities allow mine water releases based on receiving waterway flow and water quality conditions.

TABLE 2.5: COAL MINES NEARBY TO THE PROJECT AREA

Name	Proximity	Activity
Lake Vermont Mine	5 km east	Active coal mining complex
Peak Downs Mine	18 km north	Active coal mining complex
Olive Downs Mine	20 km northeast	Active coal mining complex
Norwich Park Mine	29 km south	Active coal mining complex



R	DETAILS	DATE
1	Draft Issue	03-05-2024
2	Draft Issue	24-05-2024
3	Final Issue	11-06-2024

DRAWN	MB	CHECKED	AB
APPROVED	AB	DATE	11-06-2024

NOTES:

N

0 1 2 km

SCALE @ A3 - 1:150000
GDA94 / MG 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

BMA
BHP Mitsubishi Alliance

Figure 2.12

BM Alliance Coal Operations Pty Ltd
Saraji Mine
Grevillea Pit Continuation Project Surface Water Assessment
Nearby Resource Operations

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC SWA Figures.qgz

2.7.3 Nearby Infrastructure, Towns and Dwellings

There are no significant population centres and there is limited infrastructure located within 200 km downstream of the Project. Key infrastructure located downstream of the Project includes:

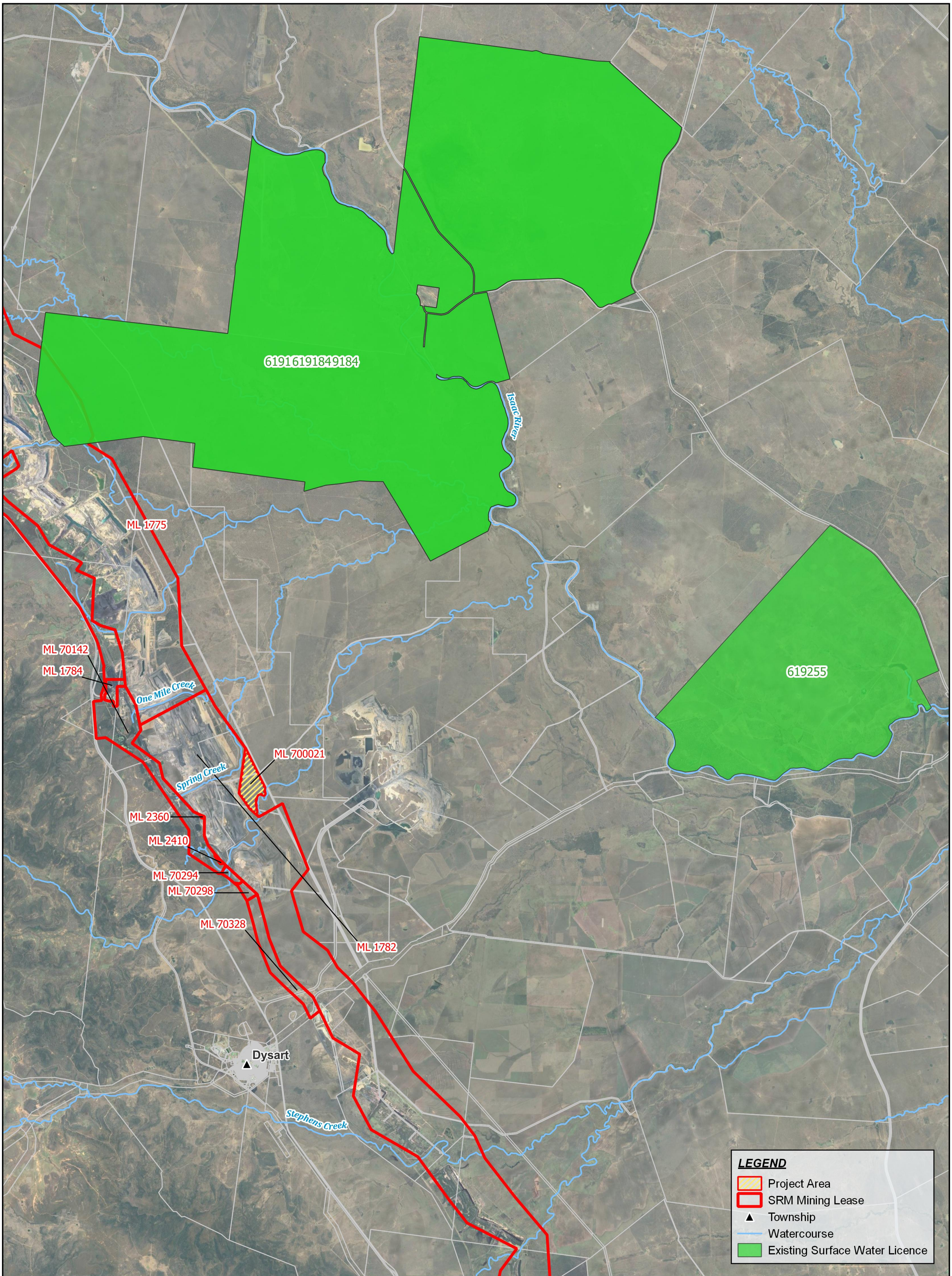
- Lake Vermont Mine – Located 5 km downstream of the Project area with water storages located within 150 m of the Phillips Creek channel.
- Fitzroy Developmental Road Isaac River bridge crossing – Located 61 km downstream of the Project area and includes 2 low level bridge crossings of the braided Isaac River channel.

2.8 Water Use

As described in Section 2.7.1, agricultural users dominate the land nearby the Project. Many agricultural users utilise small farm dams for collection of overland flow and water licences under the *Water Plan (Fitzroy* Basin) 2011. A summary of the un-supplemented water licences from the Isaac River and tributaries of the Isaac River near the Project are provided in Table 2.6. The Isaac River only has allocation of un-supplemented water licences (see Section 3.1.5.2). The existing Isaac River Water Licences are shown in Figure 2.13.

TABLE 2.6: LICENCES TO TAKE WATER DOWNSTREAM OF THE PROJECT

Authorisation Number	Authorisation Type	Authorisation Purpose	Location Lot/Plan	Attached Lot/Plan	Name of Water Entity	Nominal Entitlement per Water Year
619255	Licence to Take Water	Agriculture	9/KL97	9/KL97	Isaac River	1,250 ML
619183	Licence to Take Water	Any	11/KL135; 9/CNS98	11/KL135; 9/CNS98	Isaac River	100 ML
619184	Licence to Take Water	Any	11/KL135; 9/CNS98	11/KL135; 9/CNS98	Isaac River	15 ML



R	DETAILS	DATE
1	Draft Issue	07-05-2024
2	Draft Issue	24-05-2024
3	Final Issue	11-06-2024

DRAWN	MB	CHECKED	AB
APPROVED	AB	DATE	11-06-2024

NOTES:

N
0 1 2 km
SCALE @ A3 - 1:170000
GDA94 / MG 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

BMA
BHP Mitsubishi Alliance

Figure 2.13

BM Alliance Coal Operations Pty Ltd
Saraji Mine
Grevillea Pit Continuation Project Surface Water Assessment
Existing Licences to Take Water

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC SWA Figures.qgz

3. ENVIRONMENTAL VALUES AND WATER QUALITY OBJECTIVES

3.1 Relevant Legislation

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

The EPBC Act defines the legal framework to protect and manage nationally and internationally important ecological values and heritage places defined as Matters of National Environmental Significance (MNES).

The EPBC Act contains a process for the assessment and approval of actions that may have a significant impact on MNES. Proponents wishing to take an action that may have a significant impact on MNES must refer their project to the Commonwealth Government for consideration, and potentially for assessment and approval.

3.1.2 Qld Environmental Protection Act 1994 (EP Act)

The EP Act provides the legislative framework for environmental management and protection in Queensland. The objective of the EP Act is to protect Queensland's environment and allow for development that improves the total quality of life, both now and in the future, while maintaining ecological processes. Environmental protection is to be achieved by an integrated management program which is consistent with ecologically sustainable development. The environment, environmental values, Environmentally Relevant Activities and EAs for mining activities are defined under the 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.

3.1.3 Qld Environmental Protection Regulation 2019 (EP Regulation)

The *Environmental Protection Regulation 2019* (EP Regulation) 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 3.2 and 3.3.

3.1.4 Qld Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (EPP)

The purpose of the EPP is to identify environmental values and associated WQOs for Queensland waters. The Project is located within the Isaac River sub-basin of the greater Fitzroy Basin. Environmental Values and WQOs for the Isaac River sub-basin are scheduled under the EPP and are outlined in Sections 3.2 and 3.3.

3.1.5 Qld Water Act 2000

The *Water Act 2000* is the key regulatory document in Queensland for the allocation and use of water resources. The *Water Act 2000* provides a range of plans, licences, 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:
  - Which define the flow conditions which must be maintained at defined management nodes in the Fitzroy basin. Environmental flow objectives 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:
  - 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 9 which is Isaac River at Yatton (AMTD 43.0 km). Node 9 is located on the Isaac River 82 km downstream of SRM.

3.1.5.2 Fitzroy Basin Resource Operations Plan 2014

The *Fitzroy Resource Operations Plan 2014* (ROP) is a document prepared to outline strategies for the implementation of the *Water Resource (Fitzroy Basin) Plan 2011*. The 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 Isaac Connors sub-basin which does not have a supplemented water supply scheme.

3.2 Environmental Values (EVs)

The Project is located within the Isaac River sub-basin. EVs for this region are defined in the Isaac River sub-basin Environmental Values and Water Quality Objective Basin No. 130 (part), including all waters of the Isaac River sub-basin including Connors River (DEHP, 2011). The Project is located within the Isaac Western Upland Tributaries region of the Isaac River sub-basin. Table 3.1 outlines the regional and local EVs associated with the Project.

TABLE 3.1: REGIONAL AND LOCAL ENVIRONMENTAL VALUES (GAUGE, 2023)

Environmental Value		Isaac River (Western Uplands)	SRM
Aquatic Ecosystems	Slightly-to-Moderately Disturbed	✓	✓
Primary Industries	Irrigation	✓	-
	Farm Use	✓	-
	Stock Water	✓	✓
	Aquaculture	✓	-
Recreation and Aesthetics	Primary Recreation	✓	-
	Secondary Recreation	✓	-
	Visual Amenity	✓	-
Human Consumption	Wild Caught	✓	-
Drinking Water	Raw Water	✓	-
Industrial Use		✓	-
Cultural and Spiritual Values		✓	-

3.3 Water Quality Objectives (WQO)

WQOs are set under the EPP. WQOs derived from the QWQG (DEHP, 2009) and national guidelines such as the Australian and New Zealand Environment Conservation Council's (ANZECC) Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ, 2000) and the Australian Drinking Water Guidelines (ADWG) (NHMRC, 2011) are listed in Table 3.2. The pertinent WQOs for SRM are highlighted (Gauge, 2023). For metals and metalloids, the dissolved fraction is applicable to slightly-to-moderately disturbed (SMD) ecosystem guidelines, whereas the total metals fraction applies to other uses (stock watering, irrigation, household use and drinking water supply). Therefore, for metals, two WQOs are applied, using the most stringent guideline for total metals.

Recent REMP reporting used data collected from reference sites to establish local guidelines for aquatic ecosystems based on 20th / 80th percentile data for slightly-to-moderately disturbed ecosystems for comparison against guideline values and trigger values in the SRM EA. The local water quality values were derived using 100 background samples collected from 2010 to 2022 and with statistical analysis relying on samples taken during flow event (Gauge, 2023) in accordance with the requirements of Queensland Water Quality Guidelines (QWQG) (DEHP, 2009).

Findings from the REMP was that the current EA trigger values mostly accommodate local reference conditions or are within one standard deviation of error from the reference stream water quality data. The only exception is aluminium, where the current value of 416 µg/L is less than the average upstream 80th percentile (678 µg/L) based on 136 samples (Gauge, 2023).

TABLE 3.2: WATER QUALITY GUIDELINES AND OBJECTIVES APPLICABLE TO THE PROJECT AREA (GAUGE, 2023)

Parameter[1,2]	Units	Aquatic Ecosystem (SMD)	Stock Water (Beef Cattle) & General Use	Irrigation (Cotton) LTV	General Use, Recreation & Raw Water Supply	Drinking Water Protection Guideline
pH	pH	6.5 – 8.5 (QWQG, EPP Upper Isaac)	6-9 (ANZECC)	NA	6.5 – 8.5 (ANZECC)	6.5 – 8.5 (ADWG)
Electrical Conductivity	µS/cm	720 (QWQG, Fitzroy N)	5,970 (ANZECC)	3,700 (ANZECC)	NA	400 (ADWG)
Temperature	^{O}C	20th and 80th percentile range of local	NA	NA	NA	NA
Turbidity	NTU	50 (QWQG, lowland)	NA	NA	NA	NA
Dissolved Oxygen	% Saturation	85-110 (QWQG, lowland)	NA	NA	>80 (ANZECC)	>85 (ADWG)
Ammonia	µg/L	900 (ANZECC, SMD)	NA	NA	10 (ANZECC)	NA
Nitrate	µg/L	700 (ANZECC) 1,100 (MWC[3])	400,000 (ANZECC)	NA	10,000 (ANZECC)	50,000 (ADWG)
Total Suspended Solids	mg/L	<30 (EPP Isaac) 3 (ANZECC)	NA	NA	50 (ANZECC)	0 (ADWG)
Sulfate	mg/L	<5 (EPP Isaac)	1000 (ANZECC)	NA	400 (ANZECC)	NA
Fluoride	µg/L	NA	2000 (ANZECC)	1000 (ANZECC)	NA	1500 (ADWG)
Aluminium	µg/L	55 (ANZECC)	5000 (ANZECC)	5000 (ANZECC)	200 (ANZECC)	NA
Arsenic	µg/L	13 (ANZECC)	500 (ANZECC)	100 (ANZECC)	50 (ANZECC)	10 (ADWG)
Boron	µg/L	370 (ANZECC)	5,000 (ANZECC)	500 (ANZECC)	1000 (ANZECC)	4000 (ANZECC)
Cadmium	µg/L	0.2 (ANZECC)	10 (ANZECC)	10 (ANZECC)	5 (ANZECC)	2 (ADWG)
Chromium (CrVI)	µg/L	1.0 (ANZECC)	1000 (ANZECC)	100 (ANZECC)	52 (ANZECC)	50 (ADWG)
Cobalt	µg/L	90 (MWC[3])	1000 (ANZECC)	50 (ANZECC)	NA	NA
Copper	µg/L	1.4 (ANZECC) 2.0 (MWC[3])	1000 (ANZECC)	200 (ANZECC)	1000 (ANZECC)	2000 (ADWG)

Parameter[1,2]	Units	Aquatic Ecosystem (SMD)	Stock Water (Beef Cattle) & General Use	Irrigation (Cotton) LTV	General Use, Recreation & Raw Water Supply	Drinking Water Protection Guideline
Iron	µg/L	300 (MWC[3])	NA	200 (ANZECC)	300 (ANZECC)	NA
Lead	µg/L	3.4 (ANZECC) 4.0 (MWC[3])	100 (ANZECC)	2000 (ANZECC)	50 (ANZECC)	10 (ADWG)
Manganese	µg/L	1900 (ANZECC)	NA	200 (ANZECC)	100 (ANZECC)	500 (ADWG)
Mercury (Inorganic)	µg/L	0.06 (ANZECC) 0.2 (MWC[3])	2 (ANZECC)	2 (ANZECC)	1 (ANZECC)	0.1 (ADWG)
Molybdenum	µg/L	34 (MWC[3])	150 (ANZECC)	10 (ANZECC)	NA	NA
Nickel	µg/L	11 (ANZECC)	1000 (ANZECC)	200 (ANZECC)	100 (ANZECC)	NA
Selenium	µg/L	5 (ANZECC) 10 (MWC[3])	20 (ANZECC)	20 (ANZECC)	10 (ANZECC)	10 (ADWG)
Silver	µg/L	0.05 (ANZECC) 1.0 (MWC[3])	NA	NA	50 (ANZECC)	100 (ADWG)
Uranium	µg/L	1.0 (MWC[3])	200 (ANZECC)	10 (ANZECC)	NA	17 (ADWG)
Vanadium	µg/L	10 (MWC[3])	NA	100 (ANZECC)	NA	NA
Zinc	µg/L	8 (ANZECC)	20,000 (ANZECC)	2000 (ANZECC)	5000 (ANZECC)	NA
Petroleum Hydrocarbons (C6-C9)	µg/L	20 (ANZECC)	NA	NA	NA	NA
Petroleum Hydrocarbons (C10 – C36)	µg/L	100 (ANZECC)	NA	NA	NA	NA

[1] Pertinent WQOs for SRM are highlighted (Gauge, 2023).

[2] Metals/metalloids are tested for Total and Dissolved. Dissolved metals apply to ecosystem guidelines. Total metals apply to others.

[3] MWC = Model Water Conditions Queensland

4. ASSESSMENT METHODOLOGY

The proposed activity and Project area have been reviewed to identify potential surface water impacts. Assessment methodology to quantify potential impacts has been developed and summarised in Table 4.1. Table 4.1 also references the relevant section of this report that presents the assessment, and a summary of the assessed impacts is provided in Section 8.

TABLE 4.1: IDENTIFIED POTENTIAL SURFACE WATER IMPACTS AND ASSESSMENT METHODOLOGY

Area	Potential Impact	Assessment Methodology	Report Section
Water Resources	Potential impacts to water users and environmental flow conditions due to reduced catchment runoff from the Project area affecting downstream streamflow characteristics.	Potential changes in streamflow behaviour downstream of the Project assessed using a streamflow model of the downstream waterways. The streamflow model was used to undertake long-term continuous simulations for the Base Case and Project Case (reduced catchment area) scenarios to quantify changes in streamflow volumes and duration at various locations downstream of the Project.	5
Flooding	Increased flood levels and velocities in Phillips and Spring Creeks from landforms constructed within the floodplain in the Project area.	Potential changes in flood behaviour in Spring Creek and Phillips Creek assessed using hydrology and hydraulic models of the areas surrounding the Project. Flooding impacts quantified from the change in peak flood height and velocity between the Base Case and Project Case scenarios.	6
Environmental Values	Impacts to surface water Environmental Values from the Projects impact on the existing SRM water management system and the containment of mine affected water.	Potential changes to the SRM water management system containment assessed using a water balance model of the sites operations. The water balance model was used to compare mine water inventory forecast results for the Base Case and Project Case scenarios.	7

5. STREAMFLOW ASSESSMENT

5.1 Overview

Potential streamflow impacts have been assessed by using hydrology models of the current SRM and the Project area to determine change in streamflow behaviour. The hydrology models were developed in the GoldSim software and simulated using the Australian Water Balance Model (AWBM) to estimate daily rainfall runoff relationships. The following sections outline the hydrology model development and assessment of potential streamflow impacts associated with the Project.

5.2 Streamflow Model Development

The Project area is located on a ridge between Spring Creek and Phillips Creek. Spring Creek flows past the northern side of the Project area and is a tributary of One Mile Creek. One Mile Creek flows northeast to its confluence with Boomerang Creek which flows into Ripstone Creek before ultimately draining to the Isaac River, 22 km downstream of SRM. The northern half of the Project area drains in a northeast direction into One Mile Creek, downstream of the Spring Creek confluence with One Mile Creek. The One Mile Creek catchment area which includes the Project area is 63.6 km^2.

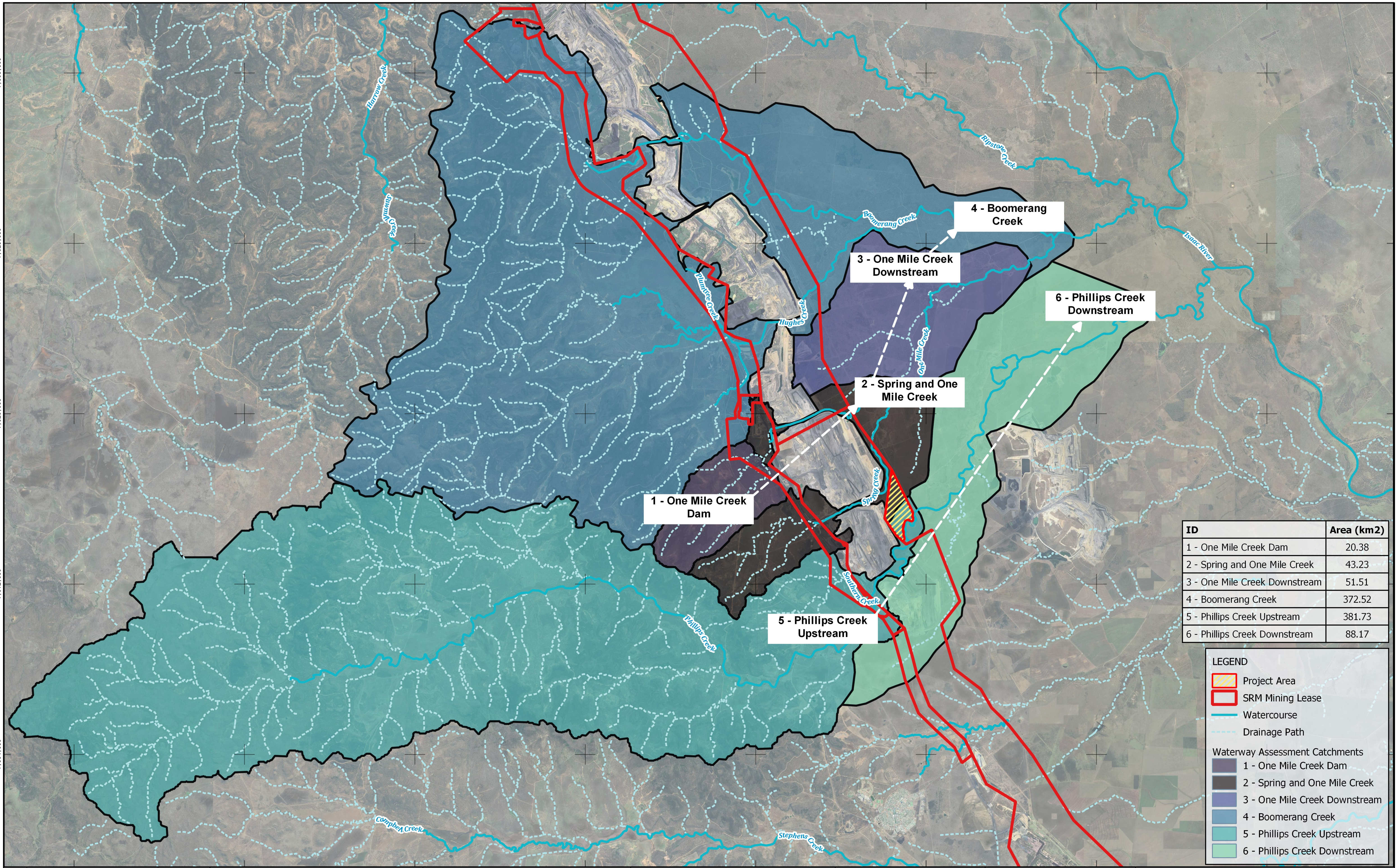
Phillips Creek flows past the southern side of the Project area and continues in a northeast direction where it collects several minor tributaries before entering the Isaac River, 21 km downstream of SRM. The southern half of the Project area drains in a southeast direction towards Phillips Creek, immediately adjacent the Project area. The Phillips Creek catchment area is 381.7 km^2. The catchment area from the Project that currently drains to One Mile Creek is 1.11 km^2 and to Phillips Creek is 1.1 km^2.

A nodal link hydrology model was developed of the One Mile Creek and Phillips Creek systems to assess potential streamflow impacts associated with the Project. Two nodes were used to represent the One Mile Creek catchment that includes the Project area with one representing One Mile Creek Dam (Catchment 1) and the second representing the residual One Mile Creek and Spring Creek catchment (Catchment 2). A single node was used to represent Phillips Creek catchment immediately adjacent the Project area (Catchment 5). Several downstream nodes were used to represent the downstream waterways at various key reporting locations. The nodal link arrangement and the catchment areas of the streamflow assessment hydrology model are presented in Figure 5.1.

The Project area is located in Catchments 2 and 5 as shown in Figure 5.1 with the Project having a maximum potential to reduce the total area of these catchments by 1.11 km^2 and 1.1 km^2 respectively. A summary of the catchment areas for the Base Case and Project Case scenarios is presented in Table 5.1. As per Table 5.1, the catchment area reduction at the locations the Project area runoff enters the main waterway for One Mile Creek is 1.8% (Catchment 2) and for Phillips Creek is 0.3% (Catchment 5).

TABLE 5.1: STREAMFLOW ASSESSMENT HYDROLOGY MODEL CATCHMENT AREAS

Creek System	Catchment ID	Cumulative Catchment Area		
		Base Case (km^2)	Project Case (km^2)	Reduction (%)
One Mile Creek (including Spring Creek)	1 - One Mile Creek Dam	20.4	20.4	-
	2 - Spring and One Mile Creek	63.6	62.5	1.8%
	3 - One Mile Creek Downstream	115.1	114.0	1.0%
	4 - Boomerang Creek	487.6	486.5	0.24%
Phillips Creek	5 - Phillips Creek Upstream	381.7	380.6	0.29%
	6 - Phillips Creek Downstream	469.9	468.8	0.24%



ID	Area (km2)
1 - One Mile Creek Dam	20.38
2 - Spring and One Mile Creek	43.23
3 - One Mile Creek Downstream	51.51
4 - Boomerang Creek	372.52
5 - Phillips Creek Upstream	381.73
6 - Phillips Creek Downstream	88.17

R	DETAILS	DATE
1	Draft Issue	03-05-2024
2	Draft Issue	24-05-2024
3	Final Issue	11-06-2024

DRAWN	MB	CHECKED	AB
APPROVED	AB	DATE	11-06-2024

NOTES:

SCALE @ A3 - 1:160000
ADG66 / AMG 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

BMA
BHP Mitsubishi Alliance

Figure 5.1

BM Alliance Coal Operations Pty Ltd
Saraji Mine
Grevillea Pit Continuation Project Surface Water Assessment
Streamflow Assessment Catchments

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Streamflow Assessment.qgz

5.3 Rainfall Runoff Model

5.3.1 Catchment Runoff Model

Catchment runoff has been simulated using the 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 baseflow store if there is baseflow in the streamflow. A schematic representation of the AWBM model is provided in Figure 5.2.

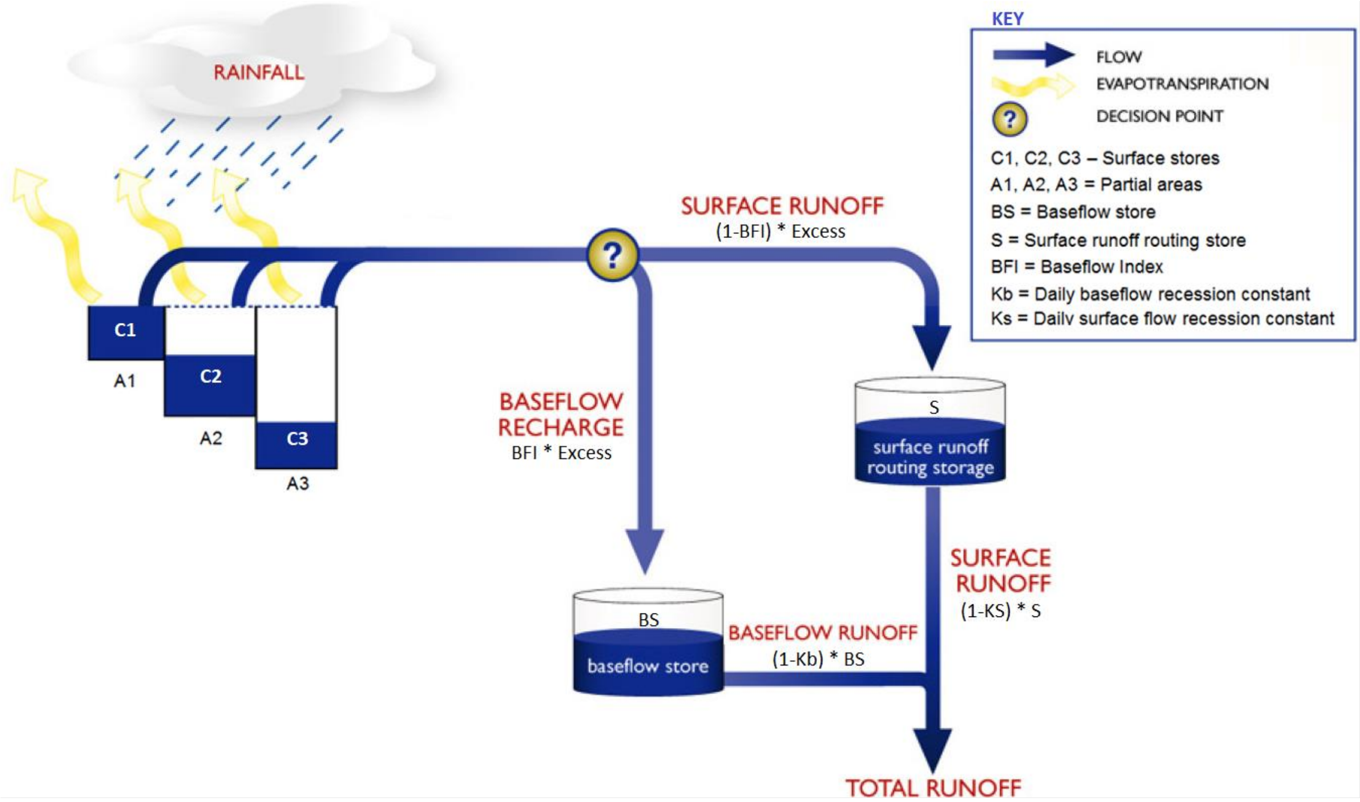


Figure 5.2: AWBM Schematic

5.3.2 Climate Data

Climate data for the system was derived from the SILO climate database at the Project location. The SILO climate data provides 126 years of data at a location on the basis of available historical climate data near the Project area. This data set was used to allow a continuous simulation of the Base Case and Project Case scenarios to determine potential impacts to streamflow at various locations downstream.

5.3.3 Model Calibration

The AWBM was calibrated to recorded streamflow on Phillips Creek at the Tayglen gauging station (130409A). Calibration of the AWBM was undertaken to ensure model predictions replicate recorded streamflow behaviour of nearby natural creeks to provide confidence in the modelled impacts for dry, average, and wet climatic conditions.

The model calibration involved simulating the AWBM for the same historical period captured by the Phillips Creek at Tayglen gauge and adjusting model parameters to improve the comparison between recorded and modelled streamflow. Given historical rainfall gauging data is not available in the Phillips Creek catchment during the calibration period, catchment daily rainfall and potential evapotranspiration data from the catchment centroid (22.55S and 148.15E) was used for the model calibration. The final calibrated AWBM model parameters are summarised in Table 5.2.

TABLE 5.2: CALIBRATED AWBM PARAMETERS FOR PHILLIPS CREEK AT TAYGLEN (130409A)

Parameters	Inputs		
Partial Area Fractions	A1 = 0.134	A2 = 0.433	A3 = 0.433
Surface Store Capacities	C1 = 20 mm	C2 = 120 mm	C3 = 280 mm
Baseflow Parameters	BFI = 0.25	Kb = 0.75	Ks = 0.05

The gauged and modelled flow duration curves for Phillips Creek at Tayglen gauge are shown in Figure 5.3. The modelled cumulative streamflow volume at Tayglen during the operational period 18th May 1968 to 29th September 1988 is displayed in Figure 5.4. The calibrated model matches the gauged flow duration curve well for flows above 1.0 ML/d. The discrepancy in daily flow duration for flows less than 1.0 ML/day was unable to be corrected, however, it is considered to be insignificant as it represents a very small volume of flow. The modelled and gauged cumulative streamflow volume results show similar runoff volumes for single events as well as total streamflow volume over the full calibration period.

The AWBM calibration parameters for the Phillips Creek catchment are considered to produce similar streamflow characteristics to the gauged streamflow data. These parameters have been adopted for the purposes of estimating long term daily runoff volumes from all creek systems considered in this assessment.

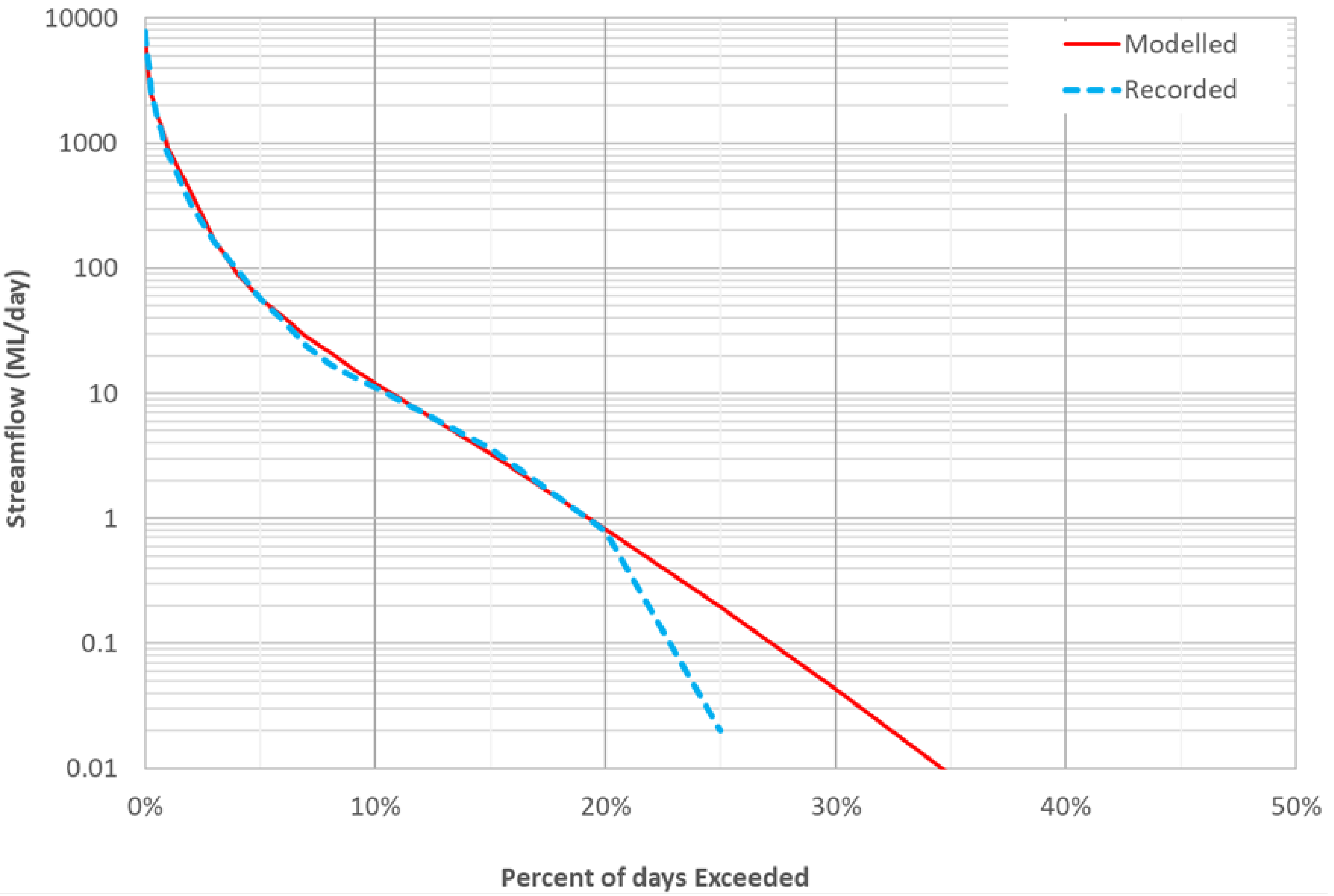


Figure 5.3: Calibration Results – Daily Flow Duration Exceedance Curve

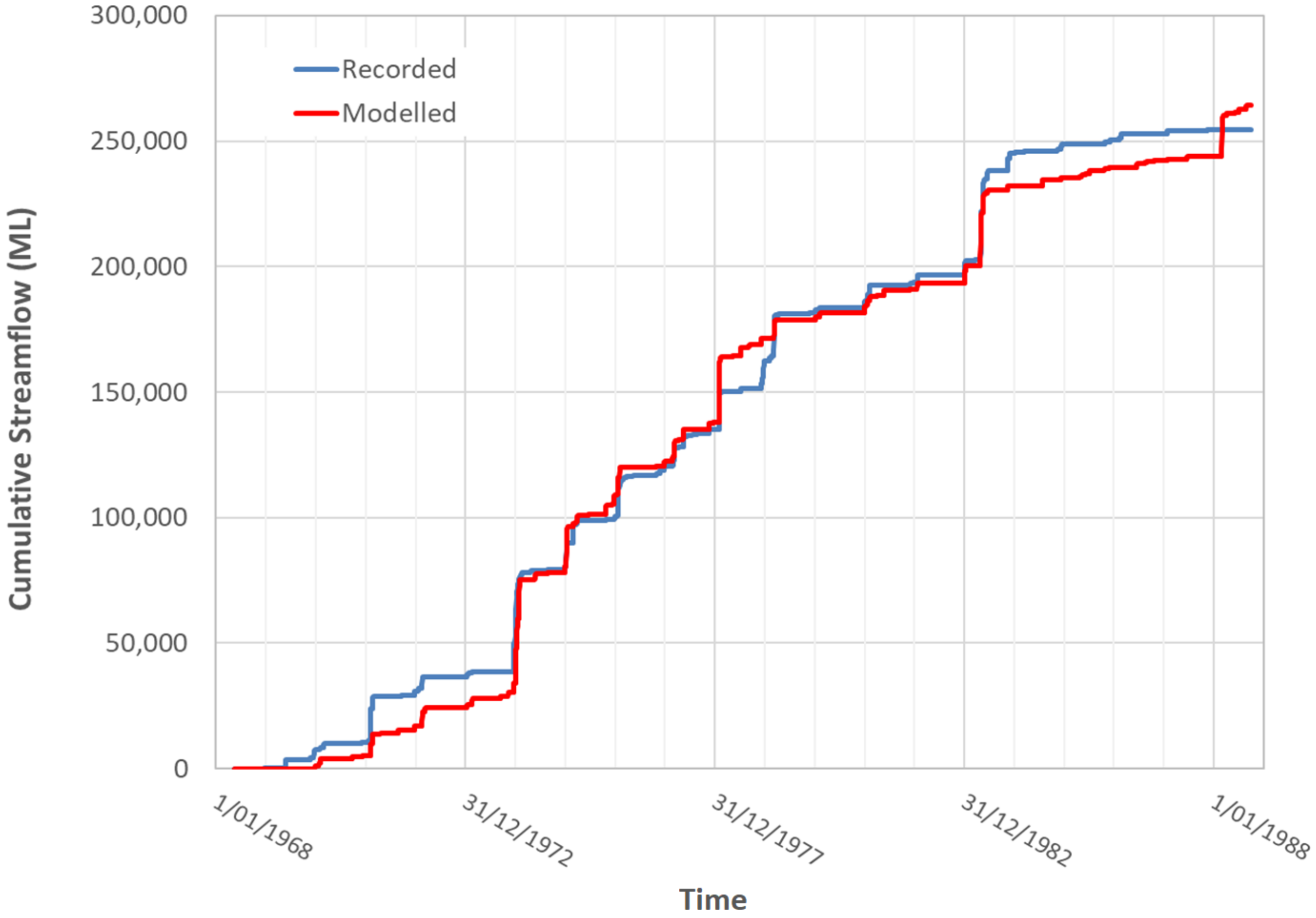


Figure 5.4: Calibration Results – Cumulative Streamflow Volume

5.4 Streamflow Assessment Results

The streamflow model was simulated for a continuous 135-year period producing daily streamflow results for the Base Case and Project Case scenarios at each of the reporting locations outlined in Table 5.1. The streamflow results for both scenarios were analysed to compare annual and monthly flow volumes and daily flow duration exceedance. The streamflow assessment results for the Base Case and Project Case scenarios and the relative change in flow are presented in Table 5.3. Figure 5.5 presents daily flow duration exceedance plots at the key reporting locations for Base Case and Project Case scenarios.

The streamflow assessment results show:

- Streamflow volumes (annual and monthly) and daily flow duration are reduced by 2.0% to 2.66%, which reduces to a 1.1% reduction upstream of the confluence with Boomerang Creek and a 0.24% reduction downstream of the confluence.
- Streamflow volumes (annual and monthly) and daily flow duration are reduced by 0.29% immediately adjacent to the Project area, which reduces to a 0.23% reduction downstream on Phillips Creek upstream of the confluence with the Isaac River.
- Streamflow reduction on both One Mile Creek (and downstream confluences) and Phillips Creek are equivalent to the catchment area reduction presented in Table 5.1.
- The streamflow assessment results show that loss of streamflow from the Project area will have negligible impact on the One Mile Creek (including Boomerang Creek) and Phillips Creek streamflow volumes and duration characteristics.

The streamflow impacts on the Isaac River were not assessed using the streamflow model as it does not have capability to assess spatial variation in rainfall across a large catchment like the Isaac River. The total Project area of 2.21 km^2 represents less than 0.04 % of the Isaac River catchment area at the Phillips Creek confluence (5,648 km^2). This demonstrates that any loss in streamflow from the Project area will have negligible impact on Isaac River streamflow or existing water licences.

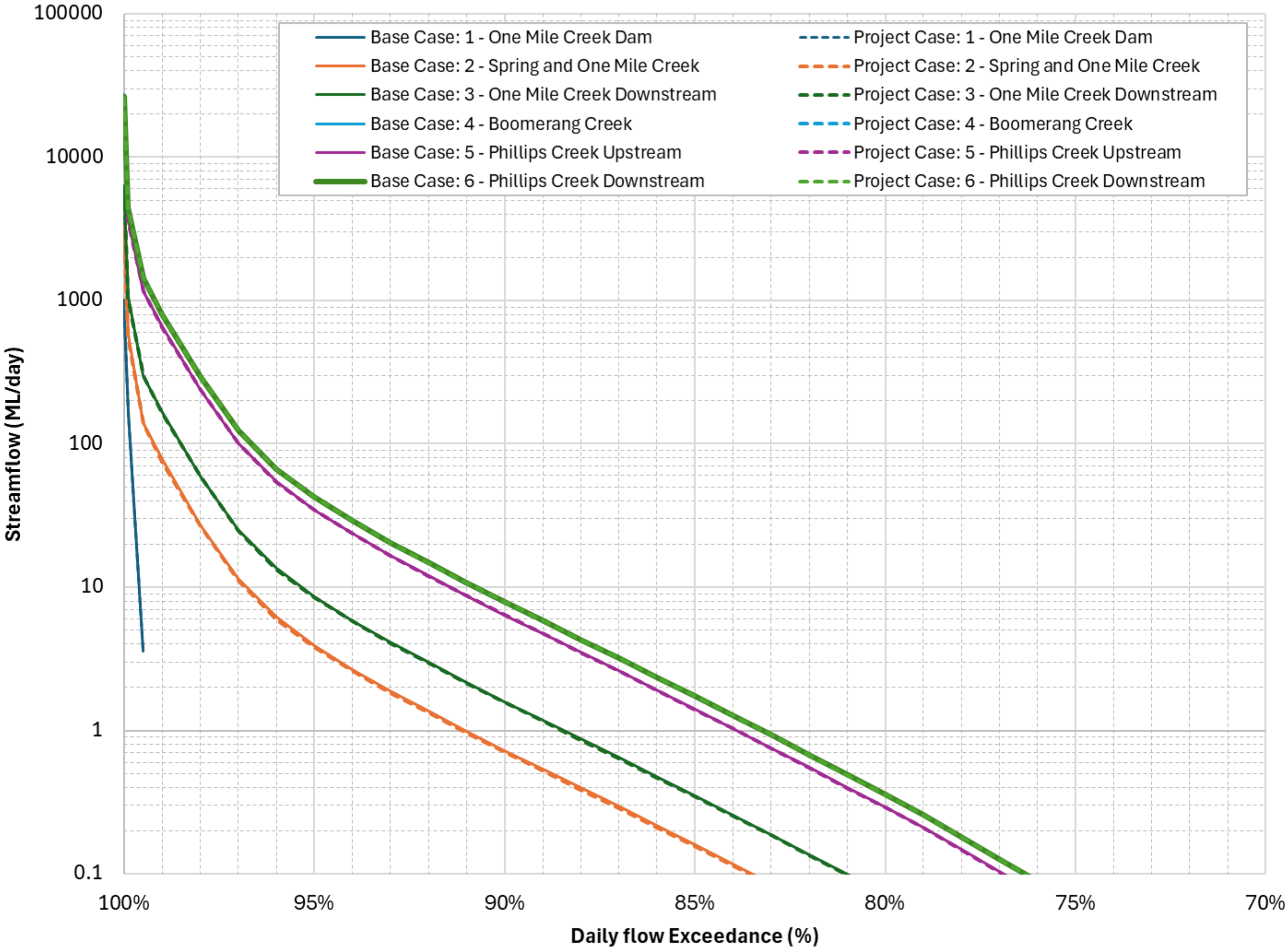


Figure 5.5: Streamflow Assessment Results – Daily Flow Duration

TABLE 5.3: STREAMFLOW ASSESSMENT RESULTS

Statistic	1 - One Mile Creek Dam			2 - Spring and One Mile Creek			3 - One Mile Creek Downstream			4 - Boomerang Creek			5 - Phillips Creek Upstream			6 - Phillips Creek Downstream		
	Base Case	Project Case	Change	Base Case	Project Case	Change	Base Case	Project Case	Change	Base Case	Project Case	Change	Base Case	Project Case	Change	Base Case	Project Case	Change
Annual Flow Results (ML/year)																		
Mean	220	220	-	1,380	1,349	*2.24%*	2,763	2,732	*1.12%*	12,761	12,730	*0.24%*	10,246	10,216	*0.29%*	12,612	12,583	*0.23%*
80th Percentile	190	190	-	1,822	1,778	*2.42%*	3,794	3,750	*1.16%*	18,060	18,016	*0.24%*	14,571	14,529	*0.29%*	17,936	17,894	*0.23%*
90th Percentile	980	980	-	4,635	4,534	*2.17%*	8,920	8,827	*1.04%*	39,055	38,962	*0.24%*	31,070	30,981	*0.29%*	38,247	38,157	*0.23%*
95th Percentile	1,285	1,285	-	5,636	5,520	*2.05%*	10,812	10,697	*1.07%*	48,153	48,038	*0.24%*	38,265	38,154	*0.29%*	47,103	46,992	*0.23%*
Daily Flow Exceedance (ML/day)																		
80th Percentile	0	0	-	0.033	0.032	*2.66%*	0.07	0.07	*1.21%*	0.356	0.355	*0.25%*	0.291	0.290	*0.29%*	0.358	0.357	*0.23%*
90th Percentile	0	0	-	0.73	0.71	*2.66%*	1.59	1.57	*1.21%*	7.84	7.82	*0.25%*	6.41	6.39	*0.29%*	7.89	7.87	*0.23%*
95th Percentile	0	0	-	3.92	3.82	*2.66%*	8.59	8.49	*1.21%*	42.4	42.3	*0.25%*	34.6	34.5	*0.29%*	42.6	42.5	*0.23%*
99th Percentile	0	0	-	77.48	75.42	*2.66%*	165.9	163.9	*1.21%*	807.2	805.2	*0.25%*	651.3	649.4	*0.29%*	801.7	799.8	*0.23%*
Mean Monthly Flow (ML/month)																		
January	65.5	65.5	-	337.7	330.5	*2.14%*	662.1	654.8	*1.09%*	3007.8	3000.6	*0.24%*	2403.7	2396.8	*0.29%*	2958.9	2952.0	*0.23%*
February	67.1	67.1	-	364.2	356.3	*2.17%*	718.1	710.2	*1.10%*	3277.9	3270.0	*0.24%*	2623.0	2615.5	*0.29%*	3228.9	3221.3	*0.23%*
March	32.2	32.2	-	195.9	191.5	*2.22%*	391.0	386.6	*1.11%*	1801.7	1797.4	*0.24%*	1445.7	1441.5	*0.29%*	1779.6	1775.4	*0.23%*
April	14.1	14.1	-	86.2	84.3	*2.23%*	172.2	170.3	*1.11%*	793.8	791.9	*0.24%*	637.0	635.2	*0.29%*	784.1	782.3	*0.23%*
May	6.7	6.7	-	68.2	66.6	*2.40%*	141.5	139.8	*1.16%*	671.3	669.7	*0.24%*	543.0	541.4	*0.29%*	668.4	666.8	*0.23%*
June	0.0	0.0	-	37.0	36.1	*2.66%*	81.2	80.2	*1.21%*	400.4	399.4	*0.25%*	327.1	326.2	*0.29%*	402.7	401.8	*0.23%*
July	0.2	0.2	-	33.0	32.1	*2.64%*	72.1	71.2	*1.21%*	354.6	353.8	*0.25%*	289.5	288.7	*0.29%*	356.4	355.6	*0.23%*
August	5.9	5.9	-	35.8	35.0	*2.23%*	71.5	70.7	*1.11%*	329.6	328.8	*0.24%*	264.5	263.8	*0.29%*	325.6	324.9	*0.23%*
September	3.4	3.4	-	26.0	25.4	*2.31%*	52.8	52.2	*1.14%*	247.2	246.6	*0.24%*	199.1	198.6	*0.29%*	245.1	244.6	*0.23%*
October	0.3	0.3	-	26.0	25.4	*2.63%*	56.7	56.1	*1.21%*	278.8	278.1	*0.25%*	227.5	226.9	*0.29%*	280.1	279.4	*0.23%*
November	1.7	1.7	-	35.3	34.4	*2.53%*	75.4	74.5	*1.19%*	365.3	364.4	*0.25%*	297.1	296.2	*0.29%*	365.7	364.9	*0.23%*
December	24.6	24.6	-	146.3	143.1	*2.21%*	291.4	288.2	*1.11%*	1340.5	1337.3	*0.24%*	1075.0	1071.9	*0.29%*	1323.3	1320.2	*0.23%*

6. FLOODING ASSESSMENT

6.1 Overview

Two-dimensional flood models of Spring Creek and Phillips Creek were used to assess potential flooding impacts associated with the Project. Existing hydrology and hydraulics models developed as part of the SRM Flood Study were used for this assessment (Engeny Water Management, 2021). The existing models were updated to represent the Base Case and Project Case scenarios and simulated for design flood events ranging from the 10% AEP to the probable maximum flood (PMF). Potential flooding impacts relating to the Project were assessed from the change in flood model results between the Base Case and Project Case scenarios. The following sections describe the model development and assessment of flooding impacts for the Project.

6.2 Previous Modelling

Hydrology models were developed for each creek intersecting the SRM ML and the Phillips Creek hydrology model was calibrated to streamflow gauging data and the design hydrology was validated to flood frequency analysis (FFA). Two-dimensional hydraulic models were developed for each creek and used to assess design flooding for the mine for a range of design flood events ranging. The hydrology and hydraulic reporting presented in Section 6.3 and Section 6.3.6, respectively, reproduce information from the Spring Creek and Phillips Creek flood model development from the Saraji Mine Flood Study report (Engeny Water Management, 2021).

6.3 Hydrology

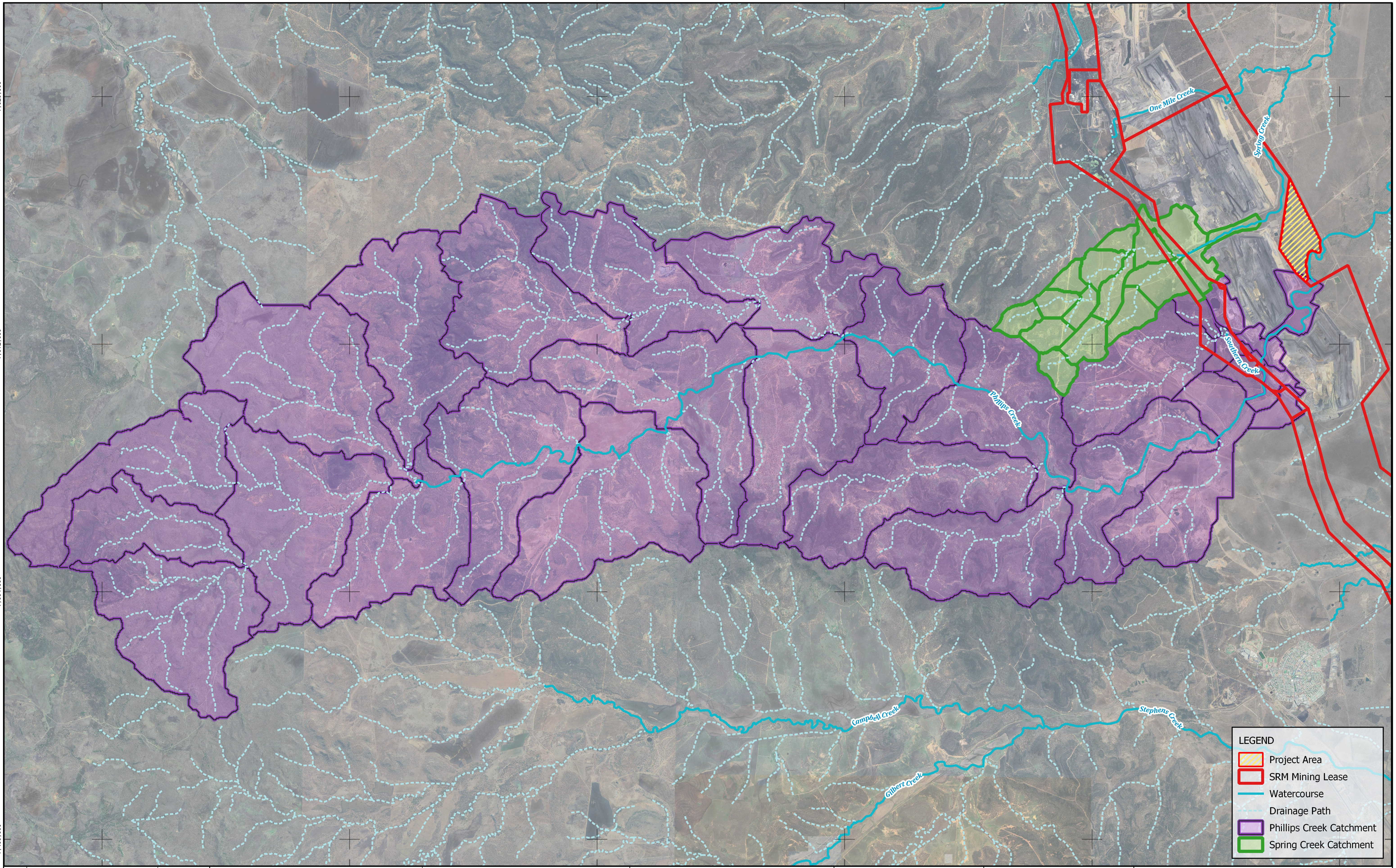
6.3.1 Model Development

Design hydrology for the Spring Creek and Phillips Creek catchments was assessed using the rainfall runoff model software RORB. Delineation of the waterway catchments and model sub-catchments was done using SRM LiDAR survey and satellite topographic survey (SRTM). The adopted sub-catchment delineation for Spring and Phillips Creeks is shown in Figure 6.5 and summarised in Table 6.1.

Catchment and streamflow routing was completed using the standard lumped catchment approach in RORB which are defined by the RORB routing parameter (kc) and the non-linearity routing parameter (m).

TABLE 6.1: HYDROLOGY MODEL CATCHMENT SUMMARY

Creek	Total Catchment Area (km^2)	Number of Sub-catchments
Spring Creek	20	16
Phillips Creek	382	30



R	DETAILS	DATE
1	Draft Issue	07-05-2024
2	Draft Issue	24-05-2024
3	Final Issue	11-06-2024

DRAWN	MB	CHECKED	AB
APPROVED	AB	DATE	11-06-2024

NOTES:

SCALE @ A3 - 1:110000
ADG66 / AMG Zone 55

DATA SOURCE
QLD Government Open Data Source

ENGENY

BMA
BHP Mitsubishi Alliance

Figure 6.1

BM Alliance Coal Operations Pty Ltd
Saraji Mine
Grevillea Pit Continuation Project Surface Water Assessment
Sub-catchment Definition

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Streamflow Assessment.qgz

6.3.2 Phillips Creek Hydrology Calibration

The Phillips Creek RORB model was calibrated to the two (2) largest recorded flow events at the Phillips Creek downstream (DS) gauge; the January 2008 and December 2010 flood events. Streamflow gauging data for the Phillips Creek DS gauging station was provided by BMA for both historic events.

No pluviographic rainfall data was available within the Phillips Creek catchment for either event. For the January 2008 event, pluviographic rainfall for the Deverill (130410A) DRDMW gauging station (location; 23.0623ºS, 148.5935ºE) was adopted. For the December 2010 event, pluviographic rainfall for the Clermont (130207A) DRDMW gauging station (location; 23.0623ºS, 148.5935ºE) was adopted. These gauging stations were selected based on comparison of the temporal pattern recorded at each station compared to the streamflow data recorded at the Saraji DS gauging station.

Gauge height data for the Phillips Creek DS gauge was supplied by BMA for both the January 2008 and December 2010 flood events. Stream height data was converted to flow (m^3/s) using a rating curve for the Phillips Creek DS gauge supplied by SRM. The supplied rating data is shown in Figure 6.4.

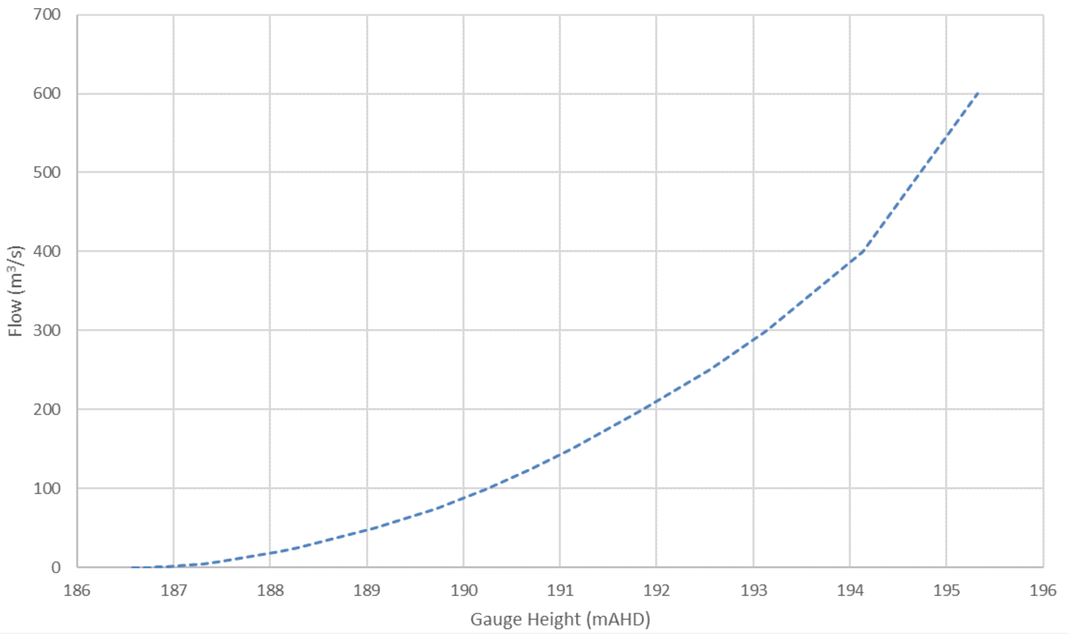


Figure 6.2: Phillips Creek Downstream Gauge Rating Curve

The January 2008 and December 2010 events were simulated in the RORB model by applying rainfall depths and temporal patterns from either the Deverill (130410A) or Clermont (130207A) rainfall stations to all sub-catchments within the RORB model.

The RORB model was calibrated to the historic flood events by varying model parameters to match modelled and recorded flow at the Phillips Creek DS gauge. The adopted RORB calibration parameters are summarised in Table 6.2. Figure 6.3 and Figure 6.4 show the modelled and recorded flood hydrographs at the Phillips Creek DS gauging station for the January 2008 and December 2010 events, respectively. For both historic flood events, modelled hydrographs compare well to recorded values.

The following observations are made regarding the calibration results and selected parameters:

- Based on the shape of the recorded flood hydrograph, it appears likely that the gauge malfunctioned during the January 2008 flood event and the peak flow was not completely captured. In this instance, a peak flow slightly higher than that recorded has been adopted.
- The adopted initial loss (IL) values for both historic events simulated are likely to be influenced by the poor spatial distribution of rainfall data. For the January 2008 event a relatively high value was adopted, while for the December 2010 event a low value was adopted.
- Recorded water levels during the January 2008 event exceeded the rating curve for the gauge. The supplied rating curve was extrapolated to estimate flow during the peak of the 2008 event.
- The timing of the modelled peak for the December 2010 flood event proceeds the recorded peak by 6 hours to 10 hours. This is likely due to the distance of the available rainfall gauge data used for the calibration (Clermont) from the Phillips Creek catchment.

TABLE 6.2: ADOPTED CALIBRATION EVENT PARAMETERS

Parameter	January 2008	December 2010
Initial Rainfall Loss, IL	120 mm	0 mm
Continuing Rainfall Loss, CL	2.5 mm/h	2.0 mm/h
Routing storage coefficient, kc	20.58	20.58
Routing exponent, m	0.8	0.8

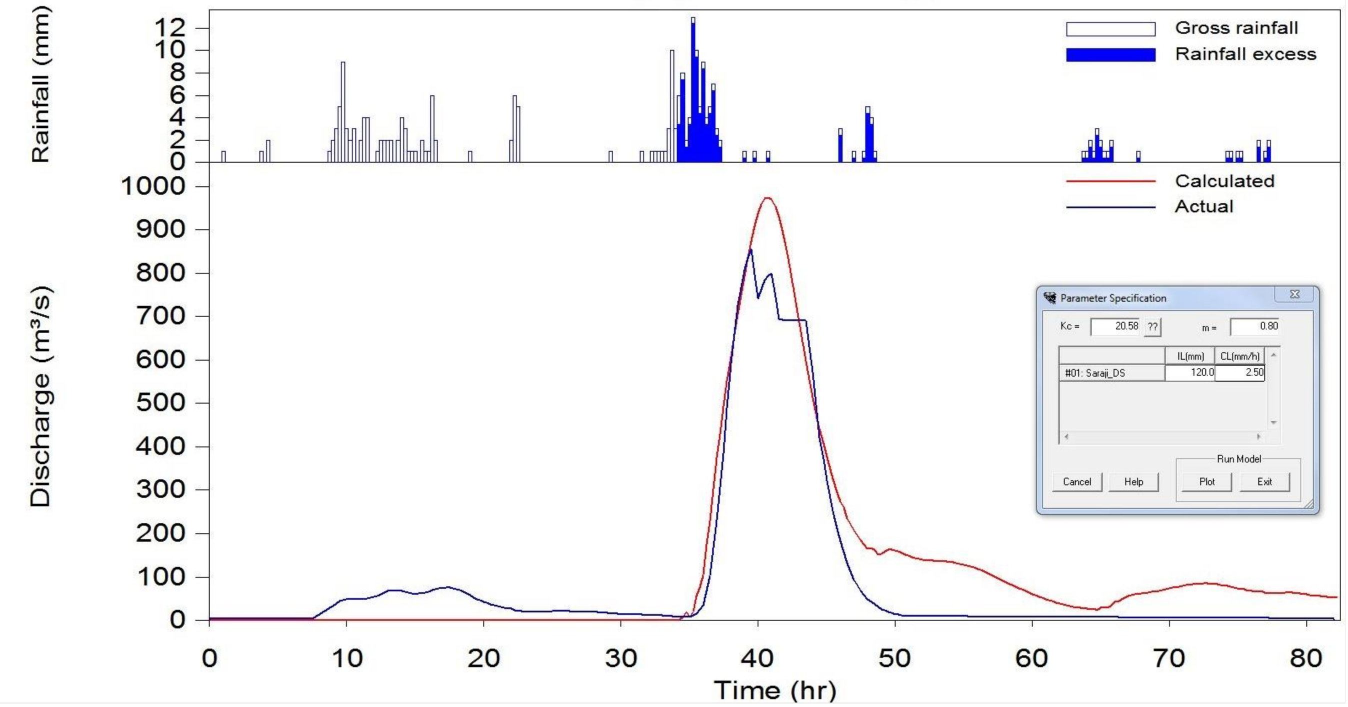


Figure 6.3: Comparison of Modelled and Recorded Flows at Saraji Downstream, January 2008 Event

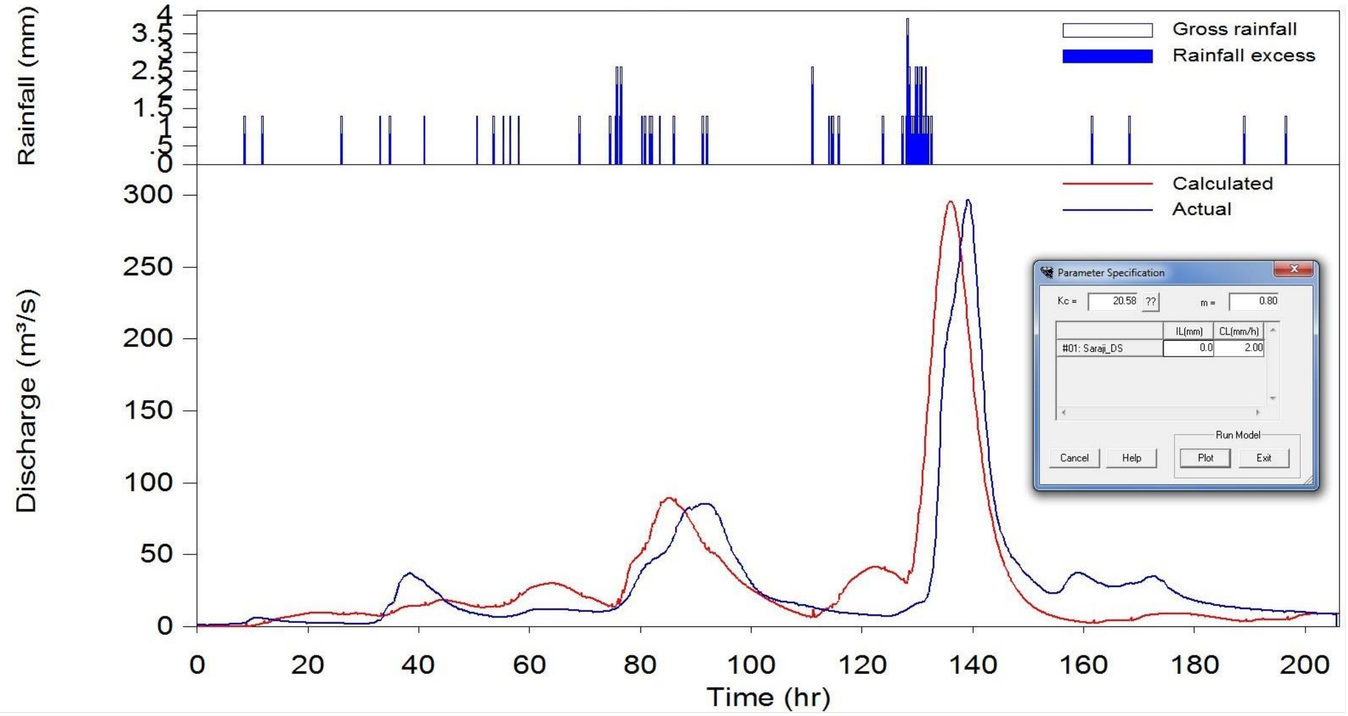


Figure 6.4: Comparison of Modelled and Recorded Flows at Saraji Downstream, December 2010 Event

6.3.3 Design Storm Rainfall and Losses

6.3.3.1 Design Rainfall

Design rainfall depths have been developed for SRM using the Australian Rainfall and Runoff 2016 Intensity-Frequency-Duration generation tool available on the BoM website (www.bom.gov.au). Intensity-Frequency-Duration data was generated for each of the waterways at SRM. Analysed flood events included the 50%, 10%, 5%, 1%, and 0.1% AEPs, as well as the probable maximum precipitation (PMP). Climate change scenarios for the 1% and 0.1% AEP events were also included.

Areal Reduction Factors have been calculated for each creek catchment area and are used to convert point rainfall estimates to areal rainfall estimates. Areal Reduction Factors for all relevant creeks have been calculated using the methodology for catchments between 10 km^2 and 1,000 km^2 for the Semi-Arid Inland QLD Zone (Ball, et al., 2019).

The temporal pattern ensemble approach (Ball, et al., 2019) was used to develop flood hydrographs and peak flow estimates for all storm events up to the 0.1% AEP. This involved simulation of a series of temporal patterns for each storm duration and AEP to produce an ensemble of flood hydrographs. The East Coast North region temporal patterns were used for events up to the 1% AEP, with standard patterns were used for Spring Creek and the areal patterns were used for Phillips Creek due to the catchment size being larger than 75 km^2. The PMP historical storm temporal patterns from the Generalised Short Duration Method and Generalised Tropical Storm Method were adopted for the 0.1% AEP.

The peak flow for each storm duration was determined from the individual storm ensemble which produced the closest peak flow to the average of the ensemble of 10 storms (Ball, et al., 2019). Then the storm duration with the highest peak flow was then selected as the critical storm for the AEP.

6.3.3.2 Design Losses

ILs have been sourced from the ARR Online Data Hub (Ball, et al., 2019) for each SRM creek catchment. Continuing losses (CL) were adopted from the Phillips Creek calibration events. Adopted losses for the hydrology model include:

- Phillips Creek:
  - Initial Loss – 54 mm.
  - Continuing Loss – 2.5 mm/hr.
- Spring Creek:
  - Initial Loss – 47 mm.
  - Continuing Loss – 2.5 mm/hr.

The storm burst hyetograph and pre-burst specific to each rainfall event and duration sourced from ARR Online Data Hub was adopted with the losses for Spring Creek.

Due to the catchment characteristics (i.e. size of the catchment) of Phillips Creek in comparison to Spring Creek, the pre-burst losses were not adopted. It is expected that the initial losses would be higher during a flood event as the pre-burst storm would not be evenly distributed throughout the catchment. As such an IL of 54 mm and CL of 2.5 mm/hr was adopted for Phillips Creek.

For all 0.1% AEP design flood events modelled, a log-scaled IL loss between the 1% AEP and PMP was adopted in accordance with recommendations from the ARR guidelines (Ball, et al., 2019).

6.3.3.3 Extreme Event Rainfall Estimation

The PMP rainfall estimates for durations less than 6 hours were determined using the BoM guidelines Estimating Probable Maximum Precipitation in Australia: Generalised Short Duration Method (Bureau of Meteorology, 2003), and estimates for durations greater than 24 hours were determined from the Guidebook to the Estimation of Probable Maximum Precipitation Generalised Tropical Storm Method (Bureau of Meteorology, 2003). For intermediate durations, interpolation between the estimates was undertaken. The full ensemble of 10 historical rainfall patterns were simulated in RORB to determine the average peak flow for adoption.

6.3.4 Design Hydrology Results

The hydrology models for each catchment were simulated for the 50%, 10%, 5%, 1% and 0.1% AEP design storm events and PMP event. The peak flow and critical storm duration results at the key upstream inflow location to the hydraulic models for Phillips Creek and Spring Creek are summarised in Table 6.3.

TABLE 6.3: HYDROLOGY MODEL PEAK FLOW ESTIMATES AND CRITICAL STORM DURATION

Waterway	Annual Exceedance Probability					
	50%	10%	5%	1%	0.1%	PMP
Spring Creek (m^3/s)	29 *18 Hour TP8*	73 *4.5 Hour TP5*	103 *3 Hour TP8*	157 *2 Hour TP6*	313 *1.5 Hour DA74*	1,237 *1.5 Hour ME72*
Phillips Creek (m^3/s)	80 *24 Hour TP6*	520 *24 Hour TP10*	689 *24 Hour TP10*	1,252 *12 Hour TP5*	2,221 *12 Hour AS66*	8,884 *6 Hour AS66*

6.3.5 Design Hydrology Validation

The 10% and 1% AEP peak flows estimated from the hydrology models were validated using the following methods:

- Regional Flood Frequency Estimation Model (RFFE).
- Quantile Regression Technique (QRT).
- Scaled Flood Frequency Analysis.

The RFFE is a recommended peak flow validation method from the ARR 2019 guidelines (Ball, et al., 2019). The RFFE provides peak flow estimations based on the catchment area and a catchment shaping factor, determined using the catchment centroid and outlet coordinates. The RFFE peak flow estimates were calculated using the ARR RFFE Model online tool (http://rffe.arr-software.org/).

Validation was also undertaken using the Queensland Department of Transport and Main Roads QRT (Palmen & Weeks, 2008) which is a method for peak flow estimations for rural catchments up to 1,000 km^2 in area. Like the RFFE, the QRT provides a peak flow estimate using a rainfall intensity and total catchment area.

The FFA provides peak flow estimates for different AEPs by developing a fitted distribution from recorded peak flows from historical flood events. The DRDMW previously operated a now closed streamflow gauging station on Phillips Creek.

The FFA was undertaken as part of the Phillips Creek (130409A) stream gauging station using the 21 years of historic flow records, incorporating additional recent flood flow observations from the Saraji DS gauge. The FFA results have been summarised in Figure 6.5. An annual maximum peak flow series was produced from the gauged data and the Log Pearson Type 3 (LPIII) distribution was fitted to the data as per Book 4 of ARR 2019. The 1% AEP peak flow for Phillips Creek gauging station is estimated to be 1,112 m^3/s.

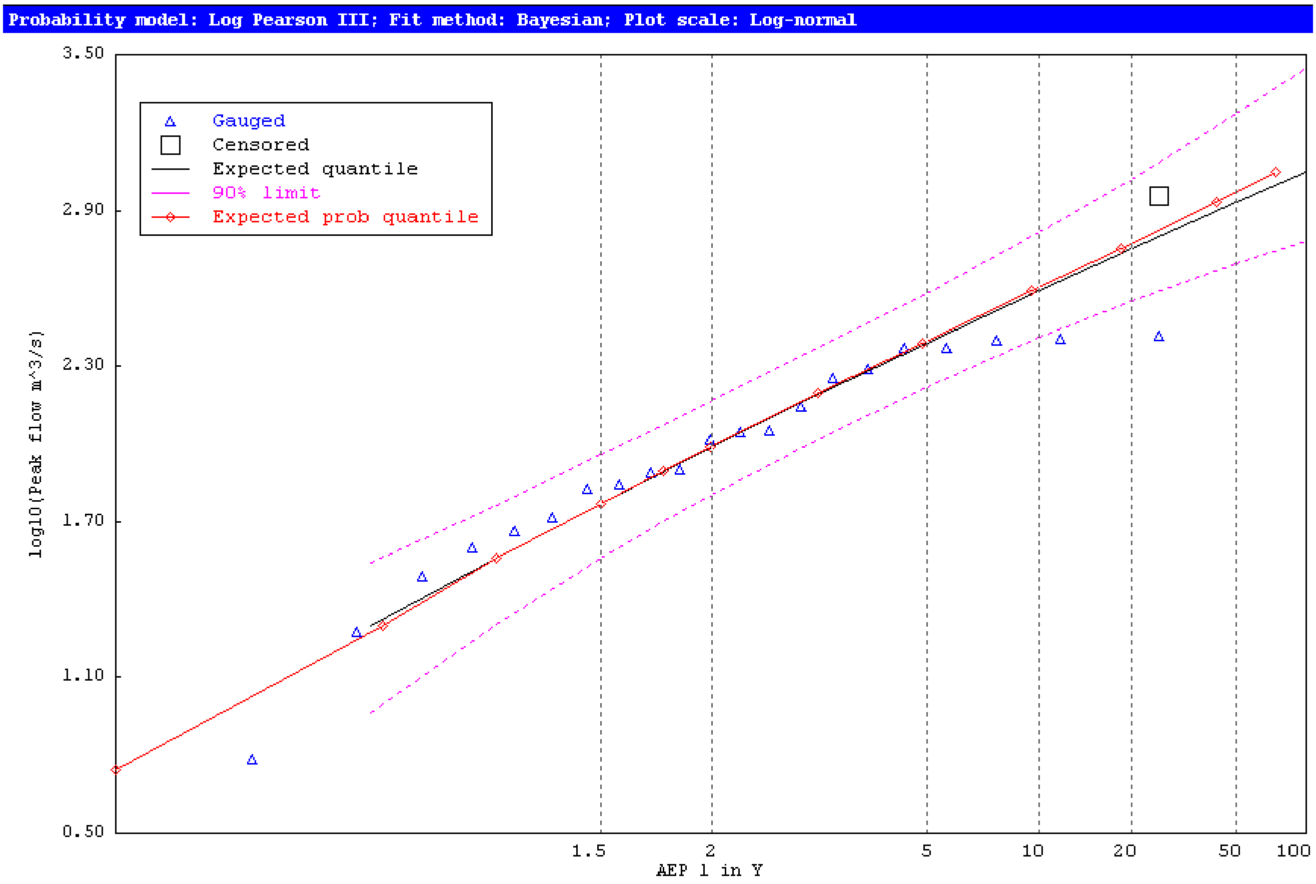


Figure 6.5: Phillips Creek Bayesian LPIII Annual Series Flood Frequency Plot

The Phillips Creek FFA has been used to validate the Spring Creek model by scaling the flood frequency peak flow estimates using the following equation.

$$Q_u = \left(\frac{A_u}{A_g}\right)^n Q_g$$

Where *Qu* is the estimated peak flow for the ungauged catchment, *Au* is the area for the gauged catchment, *Ag* is the catchment area for the stream gauging station, *Qg* is the peak flow for the gauging station determined from the flood frequency analysis, and the exponent *n* is determined from the regional flood frequency regression analysis undertaken by the Queensland Department of Transport and Main Roads (Palmen & Weeks, 2008).

The peak flow validation is summarised in Table 6.4. The peak flows calculated from the XPRAFTS and RORB models for each waterway generally lay within the extent of the three validation estimate methods. The runoff hydrographs calculated from the hydrology models were considered suitable for determining flood level estimates.

TABLE 6.4: HYDROLOGY MODEL VALIDATION – PEAK FLOWS AT CATCHMENT OUTLET

Waterway	AEP	Hydrology Model (m^3/s)	QRT (m^3/s)	RFFE (m^3/s)	Phillips Creek Scaled FFA (m^3/s)
Spring Creek	10%	42	47	20	57
	1%	159	144	40	180
Phillips Creek	10%	520	391	423	391
	1%	1252	1064	751	1,112

6.3.6 Climate Change

The latest update of the ARR Guidelines (Version 4.2) provided updated considerations for assessing climate change with design hydrology. Updated guidance includes consideration of future climate projections based on Shared Socioeconomic Pathways (SSP) to align with the International Panel on Climate Change (IPCC). ARR V4.2 provides the following equation for scaling design rainfall depths and storm losses based on the rate of global temperature increase (Equation 1.6.1 of ARR v4.2):

$$I_p = I \times (1 + \frac{\alpha}{100})^{\Delta T}$$

where,

- *Ip* is the project (future) design rainfall depth when accounting for climate change.
- α is the rate of change parameter, and varies with storm duration, starting at 1.15 for 1 hour and decreasing to 1.08 for 24 hours.
- *I* is the design rainfall depth or intensity.
- *ΔT* is the most up-to-date estimate of global temperature projection for the design period of interest and selected climate scenario relative to a baseline time period. When used in conjunction with the 2016 IFD curves the baseline is recommended to be the 1961-1990 period.

It is noted the same equation is used for determining scaling factors for initial loss (IL) and continuing loss (CL) with specific rate of change parameters (α) provided for various regions across Australia.

Climate change has been assessed for the Project based on the shared socioeconomic and emissions pathway SSP2-4.5, and a long-term projection year (2090). The long-term projection has been selected as the climate change scenarios are used to assess the final void flood protection and immunity post closure. Climate change factors for scaling rainfall are provided in Table 6.5, and for scaling initial and continuing losses for the Project are provided in Table 6.6.

TABLE 6.5: CLIMATE CHANGE SCALING FACTORS FOR RAINFALL

Scenario	Storm Duration (hours)									
	<=1	1.5	2	3	4.5	6	9	12	18	>=24
SSP2-4.5 - Long Term (2090)	1.40	1.36	1.34	1.31	1.28	1.26	1.24	1.23	1.21	1.20
SSP5-8.5 - Long Term (2090)	1.77	1.69	1.64	1.58	1.52	1.49	1.45	1.42	1.39	1.37

TABLE 6.6: CLIMATE CHANGE SCALING FACTORS FOR RAINFALL LOSSES

Scenario	Initial Loss	Continuing Loss
SSP2-4.5 - Long Term (2090)	1.03	1.05
SSP5-8.5 - Long Term (2090)	1.04	1.08

The design hydrology model for Spring Creek and Phillips Creek were updated based on the climate change scaling factors and simulated for the 50%, 10%, 5%, 1% and 0.1% AEP design storm events and PMP event to produce peak flow estimates and flood hydrographs. The climate change scenario hydrology results at the key upstream inflow location to the hydraulic models for Phillips Creek and Spring Creek are summarised in Table 6.3.

TABLE 6.7: CLIMATE CHANGE SCENARIO HYDROLOGY RESULTS

Waterway	Climate Change Scenario	Annual Exceedance Probability					
		50%	10%	5%	1%	0.1%	PMP
Spring Creek (m^3/s)	Baseline	29 *18 Hour*	73 *4.5 Hour*	103 *3 Hour*	157 *2 Hour*	313 *1.5 Hour*	1,237 *1.5 Hour*
	SSP2-4.5	44 *9 Hour*	125 *3 Hour*	163 *3 Hour*	239 *2 Hour*	466 *1.5 Hour*	1,732 *1 Hour*
	SSP5-8.5	59 *4.5 Hour*	173 *3 Hour*	222 *2 Hour*	325 *1.5 Hour*	608 *1.5 Hour*	2,258 *1 Hour*
Phillips Creek (m^3/s)	Baseline	80 *24 Hour*	520 *24 Hour*	689 *24 Hour*	1,252 *12 Hour*	2,221 *12 Hour*	8,884 *6 Hour*
	SSP2-4.5	177 24 Hour	735 *12 Hour*	1,016 *12 Hour*	1,724 *12 Hour*	3,068 *9 Hour*	11,511 *6 Hour*
	SSP5-8.5	277 *24 Hour*	983 *12 Hour*	1,310 *12 Hour*	2,109 12 Hour	3,747 *9 Hour*	13,912 *6 Hour*

6.4 Hydraulics

6.4.1 Model Development

6.4.1.1 Model Topography and Extent

Hydraulic modelling was undertaken using two-dimensional (2D) unsteady flow modelling software (TUFLOW) to quantify the flood behaviour within each creek system. Two separate hydraulic models were developed for Spring Creek and Phillips Creek. The topography for both models was developed based on various aerial surveys of SRM captured more recent than 2020. The 2D model bathymetries were defined by a 3 m grid resolution, to provide sufficient definition of the active creek channel widths. The model extents are shown in Figure 6.6 and Figure 6.7.

The model bathymetry was raised around the proposed mining extent in the Project area to assess the maximum potential flooding impacts associated with the Project footprint.

The model extent and topography were modified for the PMF event as it results in flood ingress to existing mining pits and a large flood extent leaving the downstream model boundary. To assess maximum potential flood impacts associated with the Project area and a PMF event, the model bathymetry was raised around the existing mining pits (applied only in PMF simulations) to prevent flood ingress. The downstream model extent and boundary was also extended for the PMF event based on the increased flood extent.

6.4.1.2 Boundary Conditions

Boundary conditions are required in the model to define hydrology inflows, flow leaving the model domain and interfaces between the one dimensional and two-dimensional model domains. The following boundary conditions were used in the models:

- Upstream: The upstream boundary condition used the 'SA' type boundary, allocating flow to the defined model grid cells based on the design hydrograph from the hydrologic model (flow per unit of time) input.
- Downstream and Pit Inflows: The outflow boundary conditions of all models have been represented as a normal depth based on low flow channel grades at the downstream extent of the models. These boundaries are located a sufficient distance downstream in all models to not influence the flood behaviour in the Project area.
- Dimensional boundaries: Interfaces between the one-dimensional (culverts) and two-dimensional (drains) elements used a 'SX' boundary.

ENGENY

6.4.1.3 Hydraulic Roughness

The modelled Manning's roughness coefficients used in the model are based on visual observation and aerial photography of the Project area. Landuse delineation and the associated Manning's roughness values adopted for the hydraulic models include:

- Light vegetation/spoil - 0.05
- Active channel - 0.035
- Riparian zone/bush - 0.07
- Mining areas/hardstand/water - 0.025
- Stockpile - 0.04

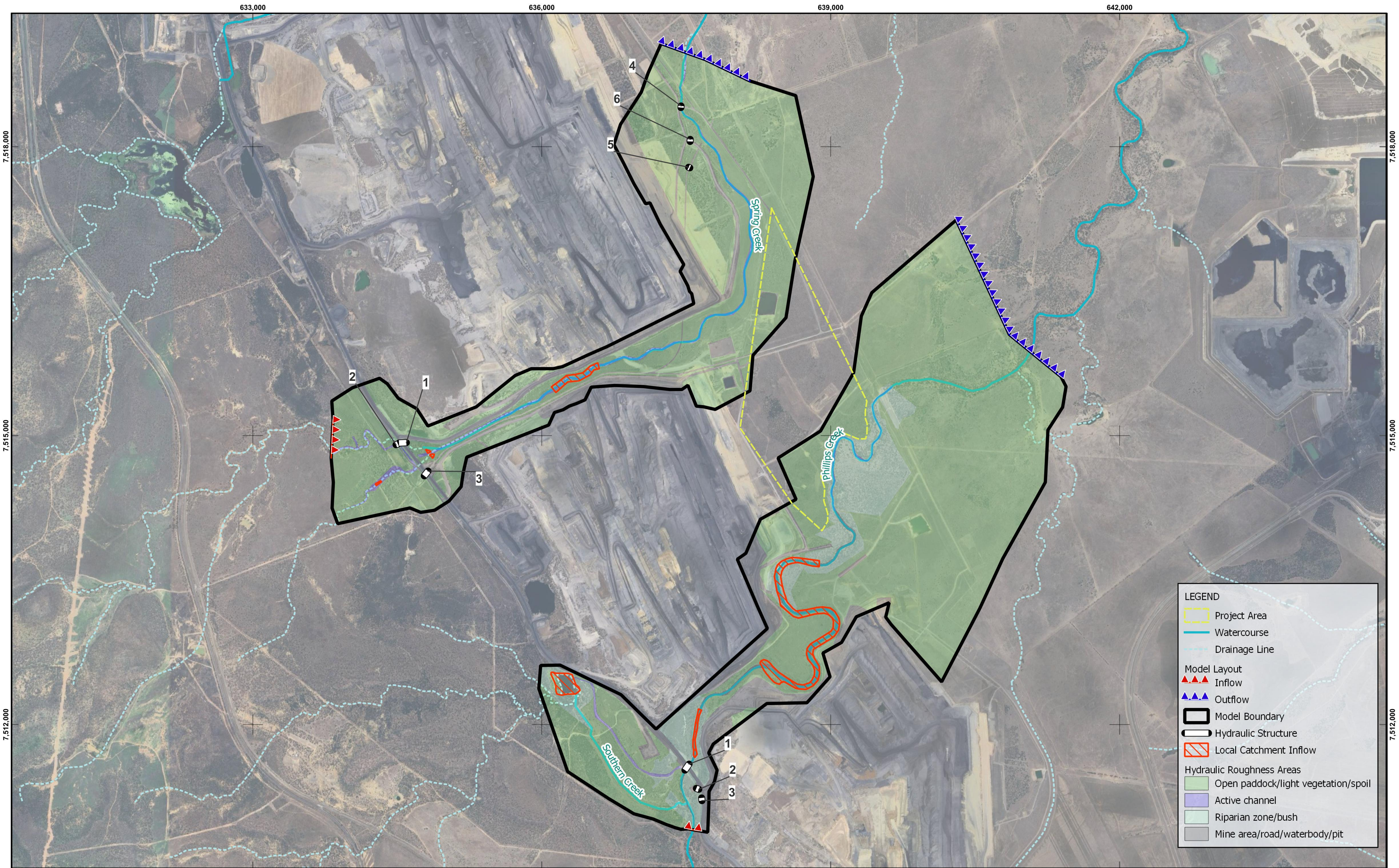
The Manning's roughness delineation adopted for the hydraulic models are shown in Figure 6.6.

6.4.1.4 Hydraulic Structures

The details of the existing hydraulic structures (culverts, weirs and drainages) were previously obtained from survey capture of structures, surveyed during 2017 by the SRM survey department, with additional pipe details obtained as part of the SRM flood study (Engeny Water Management, 2021). Culvert structures on the Spring Creek and Phillips Creek systems are presented in Table 6.8. The hydraulic structure details used for the hydraulic model were adopted from a mix of existing and new survey data. Where structure invert levels were not available, the levels were inferred from the available topography survey.

TABLE 6.8: HYDRAULIC STRUCTURE DETAILS

Model	ID	Structure Details	Dimensions	Mannings Roughness
Spring Creek	1 – Upstream Light Vehicle Road	Corrugated metal pipe	5 x 1.2m	0.02
	2 – Upstream Haul Road	Corrugated metal pipe	5 x 1.2m	0.02
	3 – Public Road Tunnel	Road underpass tunnel	5m diameter tunnel	0.02
	4 – Downstream Back Access Road	Concrete box culvert	2 x 1.8m x 1.2m	0.013
	5 – Old Back Access Road	Corrugated metal pipe	2 x 2.1m	0.02
	6 – Old Back Access Road	Corrugated metal pipe	2 x 2.1m	0.02
Phillips Creek	1 – Upstream Haul Road	Corrugated metal pipe	3 x 2.25m	0.02
	2 – Roadside Drain	Concrete pipe	2 x 1.2m	0.015
	3 – Roadside Drain	Concrete pipe	2 x 1.2m	0.015



R	DETAILS	DATE
1	Final Issue	07-05-2024

DRAWN	AB	CHECKED	BK
APPROVED	BK	DATE	07-05-2024

NOTES:

N

0 0.8 1.6 km

SCALE @ A3 - 1:35,000
AGD66 / AMG 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

BMA
BHP Mitsubishi Alliance

Figure 6.6

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Hydraulic Model Layouts

Drg Ref:
QC1000-216

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Streamflow Assessment.qgz

6.4.2 Project Case Model

The base case model was updated to include blockage of the Project area to represent the potential loss of floodplain flow area and storage for the Project. The Project Case flood model results were then directly compared with the Base Case results for peak flood depth and velocity to identify the maximum potential flooding impacts for the Project.

6.4.3 Model Simulation

The Base Case and Project Case scenario hydraulic models for both Phillips Creek and Spring Creek were simulated for the 10%, 1%, 0.1% AEP and PMF events. Peak flood depth and velocity results for the Base Case scenario are presented in Appendix A. Change in peak flood depth and velocity results from the Project Case are presented in Appendix B. The following sections discuss the flood model results and the identified flood impacts from the Project Case scenario.

6.5 Flood Assessment Results

The flood assessment results for the Base Case scenario in Appendix A show the following flooding interactions with the Project area:

- Phillips Creek:
  - The Project area is mostly unaffected by flooding up to the 1% AEP flood event with only minor flooding occurring in the 1% AEP, extending a maximum of 120 m into the Project area and inundating less than 2.4% of the Project area (5.3 ha).
  - The 0.1% AEP flood event inundates the southern fringes of the Project area that border the Phillips Creek channel, extending a maximum of 140m into the Project area and inundating less than 3.7% of the Project area (8.0 ha).
  - Flooding in Phillips Creek is controlled in several locations by existing levees in the Base Case that are currently used to provide flood protection to existing SRM infrastructure (refer section 7).
- Spring Creek:
  - The Project area is mostly unaffected by flooding up to and including the 0.1% AEP flood event, due to the existing Spring Creek diversion that is bordered by flood protection levees with greater than 0.1% AEP flood immunity.
  - There is a minor breakout flow path from the Spring Creek diversion upstream of the Project area resulting in minor overtopping into the existing Grevillea Pit and sheet flows towards the Project area without significant inundation.

6.5.1 Flood Interactions with the Project Area

The Base Case flood results show where flood interactions with the planned mining is likely to occur. A break line was used in the flood model along the planned extent of mine activity to represent the Projects encroachment on the floodplain to assess potential flooding impacts. These locations can be used to infer where levees will likely be required to maintain pit flood immunity. The 0.1% AEP flood extent for the Base Case and Project Case scenarios for Phillips Creek are shown in Figure 6.7 as well as locations along the southeast extent of the Project area where levees are required to provide 0.1% AEP pit flood protection immunity. The levees can be constructed progressively as the mine progresses.

The 0.1% AEP flood breakouts out of the Spring Creek diversion upstream of the Project area and results in overtopping to the existing Grevillea pit and minor inundation of the Project area. The breakout flow path could be mitigated by raising existing roads or constructing flood protection levees to provide 0.1% AEP flood immunity to the existing Grevillea pit. Mitigating the existing breakout flow path would also provide the Project area with 0.1% AEP flood immunity from Spring Creek.

No additional flood protection levees are required on the northern extent of the Project area to provide 0.1% AEP flood immunity from Spring Creek.

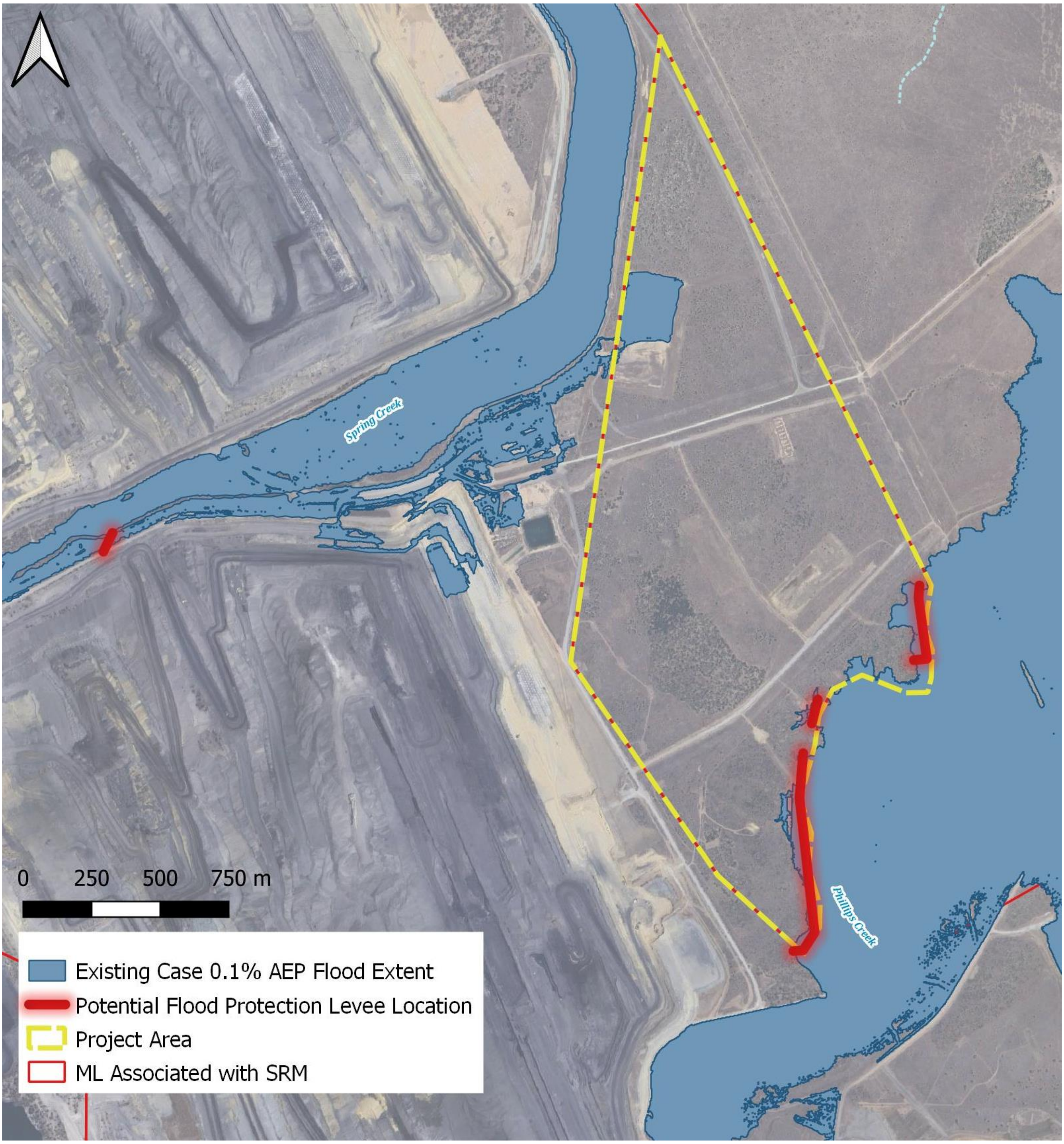


Figure 6.7: Flooding Interactions with the Project Area

6.5.2 Flood Impacts

The Project Case flood results were compared with the Base Case results to produce change in flood height (afflux) and velocity result grids to allow analysis of the potential flooding impacts associated with the Project. The flood impact results for events up to the 0.1% AEP show the following:

- Phillips Creek:
  - The Project does not affect flooding in Phillips Creek in all flood events up to and including the 1% AEP flood event.

- The Project is expected to increase peak flood depths in Phillips Creek in isolated locations up to 300 mm in the 0.1% AEP flood event.
  - Peak flood velocities in the 0.1% AEP flood event are expected to increase by a maximum 0.2 m/s in the Phillips Creek channel adjacent to the Project area. This increase in peak flood velocity is not expected to have a significant impact on the waterway condition considering the very rare occurrence and similar peak flood velocities occur in other locations unaffected by the mine.
- Spring Creek:
  - The Project does not impact Spring Creek flooding in flood events up to the 1% AEP.
  - The Project area has minor flood interactions in the 0.1% AEP from a breakout flow path in the upstream Spring Creek diversion with the Project case scenario showing no impact to flooding.

6.5.3 Climate Change Sensitivity

The Base Case and Project Case hydraulic models were simulated with climate change adjusted flood hydrographs for the 1% AEP and 0.1% AEP events to determine changes in peak flood depths and flood impacts associated with the Project. Appendix C provides mapping of the Base Case and afflux results for the climate change scenarios. The climate change sensitivity assessment shows:

- The 1% AEP Base Case peak flood depths adjacent the Project were increased by 0.6m for the SSP2-4.5 climate change pathway and 0.9 m for the SSP5-8.5 pathway in Phillips Creek.
- Similarly, 0.1% AEP peak Base Case flood depths adjacent the Project were increased by 0.5m for the SSP2-4.5 climate change pathway and 0.8m for the SSP5-8.5 pathway in Phillips Creek.
- The spatial extent of Phillips Creek flood impacts for the 1% and 0.1% AEP climate change sensitivity scenarios are generally consistent with the no climate change results.
- Spring Creek flood impacts are shown to worsen for the 0.1% AEP climate change scenario as it overtops the existing levees with floodwaters draining towards the northeast. The Project Case landform blocks this flow path and redirects flood waters to the main channel resulting in the reported increase in flood levels.
- The 1% AEP flood depth impact for the Project Case is shown to increase by 2mm on average for the SSP2-4.5 climate change pathway and 5mm for the SSP5-8.5 pathway (note that impacts are relative to the climate change adjusted Base Case scenario).
- The 0.1% AEP flood depth impact for the Project Case is shown to increase by 10mm on average for the SSP2-4.5 climate change pathway and 20mm for the SSP5-8.5 pathway (note that impacts are relative to the climate change adjusted Base Case scenario).

Generally the assessed impacts for the climate change sensitivity scenario are similar to the no climate change results and does not change conclusions associated with the potential flooding impacts of the Project.

6.5.4 Peak Flood Levels Against Final Landform

The 0.1% AEP climate change (SSP2-4.5) scenario flood results adjacent to the final landform that will inform the final void flood protection requirements are shown in Figure 6.8. Figure 6.8 includes a long section following the future final landform flood protection bund showing peak flood levels for the 0.1% AEP climate change scenario events. The peak flood level results show approximately 3m in flood elevation difference in Phillips Creek along the Project area with an upstream elevation of 199.6 to 200 m AHD and a downstream elevation of 196.6 to 196.8 m AHD adjacent the Project area.

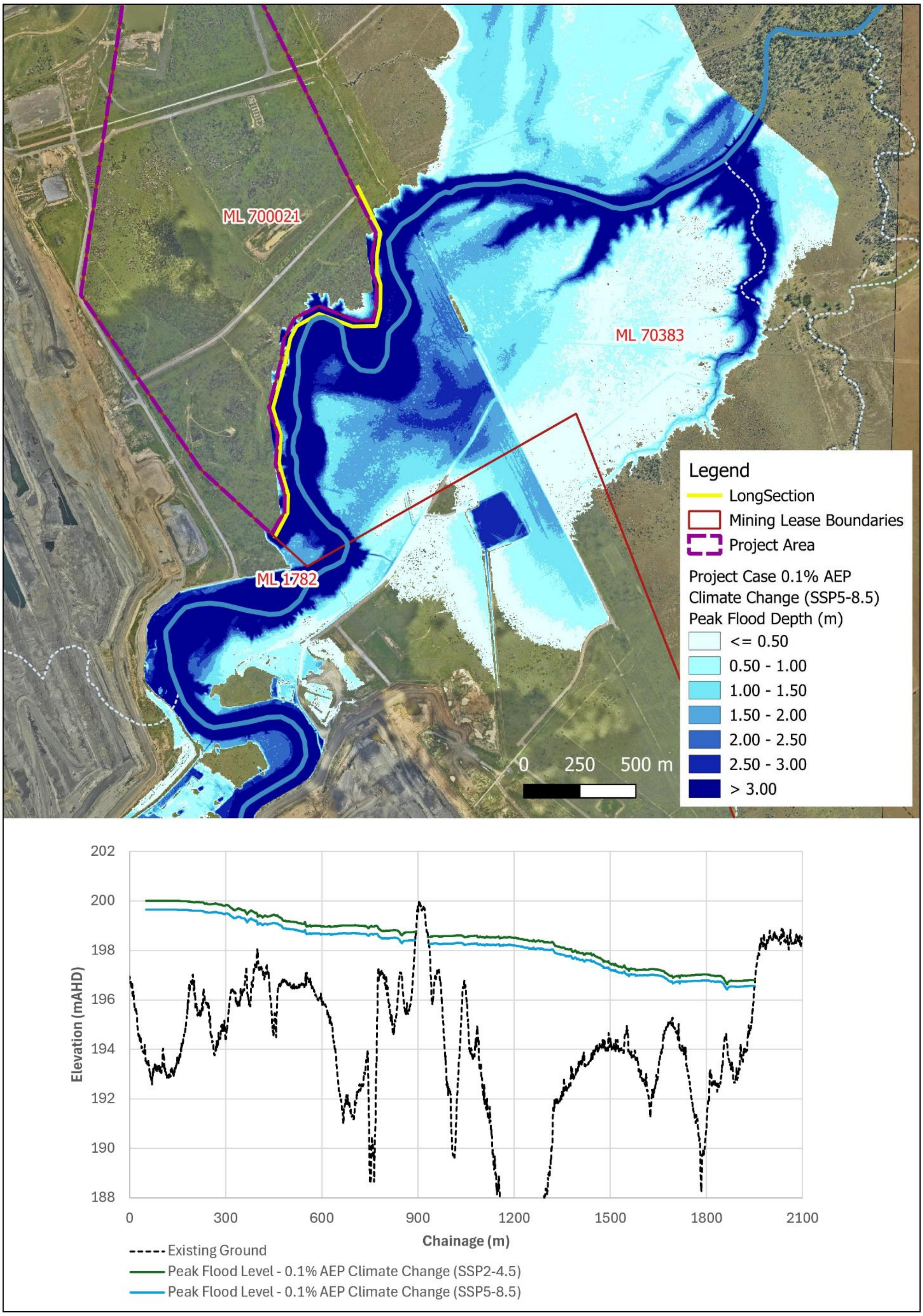


Figure 6.8: 0.1% AEP Climate Change Scenario Peak Flood Levels Against Final Landform

6.5.5 Probable Maximum Flood Behaviour

The PMF is used to identify risks and potential impacts for the Grevillea Pit final void arrangement and landform design in the Project area. The PMF results are based on existing conditions with break lines in the model topography preventing overtopping into existing pits to assess the maximum potential inundation of the Project area and Grevillea Pit final void.

The Phillips Creek PMF results show flooding inundates approximately 15% of the Project area which is mostly within existing gullies along the southwest boundary. PMF peak velocity is generally below 1 m/s inside the Project area and above 1.5m/s along the Project boundary. The Spring Creek PMF results show the existing Spring Creek diversion flood protection levees are overtopped with floodwaters spreading and inundating 29% of the Project area, with peak flood depths between 0.5m and 1.5m and peak velocity between 0.5m/s and 1.5 m/s.

The Project Case scenario PMF simulation included additional break lines in the model topography around the planned extent of mining for the Project to demonstrate the maximum potential flood impact. The Project Case results show the Phillips Creek PMF depths are increased by up to 500mm in areas immediately adjacent the Project area and increased by 20mm to 50mm on the southern side of Phillips Creek at the downstream extent of the model. Peak flood depths on the northern side of Phillips Creek area reduced by 50mm to 100mm immediately downstream of the Project and reduced by 10mm to 20mm at the downstream extent of the model. Phillips Creek PMF impacts are not expected to propagate to the downstream Lake Vermont Mine.

The results also show large changes in PMF inundation in Spring Creek due to the Project area preventing overtopping of the nearby Spring Creek diversion levees to the east and directing more flow to the north and the main creek. The Spring Creek PMF flood extent northeast of the Project is significantly reduced with flood depths adjacent the Project area increasing by greater than 500mm and increasing by 100mm to 300mm downstream at the downstream model extent.

This indicates the Grevillea Pit final landform for the Project has potential to influence flood immunity of adjacent SRM final voids and will need to be considered with the closure design as part of the PRCP after the Projects approval (discussed in Section 9).

6.5.6 Potential Final Void Flood Ingress Volumes

The existing approved PRCP for SRM presents outcomes and assessment for the Grevillea Pit closure landform (BMA, 2024). The final landform assessed in the approved PRCP includes mining proposed as part of this Project. The final voids are proposed to be groundwater sinks and maintain a pit lake with elevated salinity and no risk of overtopping. The final void will be protected by a final landform bund designed to provide 0.1% AEP flood immunity with 1 m freeboard post closure which maintains the planned flood protection standard per the current approved PRCP for SRM (BMA, 2024). A PMF event could feasibly overtop the landform bund, posing the risk of filling the voids storage capacity and overtop. Although the existing approved PRCP landform bund design standard and the Grevillea Pit void arrangement is maintained for the Project, the potential for the PMF event to overwhelm the void storage capacity has been assessed.

The 0.1% AEP climate change (SSP2-4.5) scenario flood results have been reviewed to produce a concept bund arrangement to assess the PMF event and the potential void inflow volumes. The Phillips Creek flood model was simulated with the concept bund arrangement for the PMF event with climate change factored hydrology for the SSP5-8.5 projection pathway (refer Section 6.3.6) to conservatively assess potential overtopping volumes. The flood model results show 75 GL of water could potentially overtop the final landform bund and into the void in the PMF climate change scenario. This volume is 42% of the current operational Grevillea Pit capacity of over 180 GL, and 13% of the Grevillea Pit final void capacity of over 600 GL (BMA, 2024). This demonstrates the Grevillea Pit final void has a very low risk of filling and spilling from a PMF event.

ENGENY

7. WATER BALANCE ASSESSMENT

7.1 Overview

The Project will increase the overall catchment area reporting to the SRM water management system which has the potential to place demands on the system operation and containment performance. This impact on the existing water management system has been assessed using the existing SRM water balance model developed by BMA Water Planning. The following sections present the water balance assessment for the Project and the assessment of potential impacts to the existing water management system.

7.2 Existing Water Management System

The SRM mine water management system is managed by a pump and pipeline water infrastructure that dewaters active mining pits through transfer storages to primary water storages. The primary water storage at SRM is currently the Jacaranda Pit (refer to Figure 7.1 for location). Water from the Jacaranda Pit is used to:

- Supply water to the Coal Handling and Preparation Plant (from mine dewatering and recover of water from the tailings dam);
- Supply water for dust suppression; and
- Undertake mine water releases in compliance with the SRM EA conditions.

SRM also has several other storages used to capture and contain mine affected or sediment laden water. Water in these storages is transferred via the pipeline network to supply Coal Handling and Preparation Plant and dust suppression water demands or to the primary water storages. The SRM water management system has a total available storage capacity of 51 GL, which is mostly within bulk water storage pits.

The current catchment areas reporting to the SRM water management system are shown in Figure 7.1, and a schematic of the water management system is provided in Figure 7.2.

7.3 Project Water Balance Assessment

Grevillea Pit will initially continue to dewater to Jacaranda Pit via the existing pipeline and highwall staging dam network. As mining advances, it is expected the pit dewatering system will be progressively relocated west of the advancing pit to maintain ability to dewater. There are no known significant changes to the SRM water management system that will occur over the life of the Project.

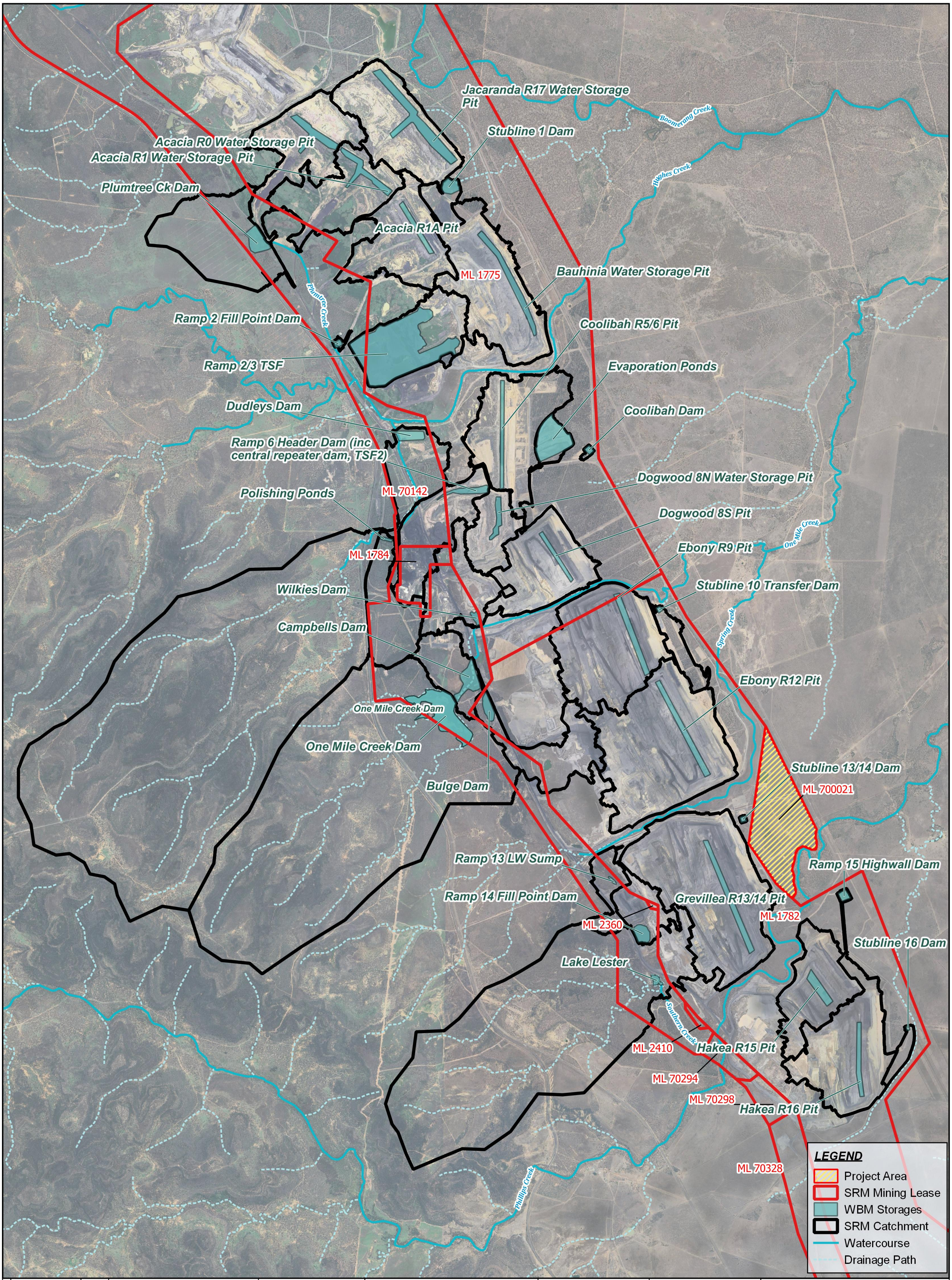
The Project will increase the catchment area reporting to the water management system with the progression of Grevillea Pit by a maximum of 221 ha over the Project life. The increase in the water management system catchment area over the Project life is summarised in Table 7.1. It is noted the Base Case catchment area increases over time, in accordance with the planned progression of approved SRM mining pits.

The Project is estimated to account for less than 2.3% of the total SRM disturbance area reporting to the SRM water management system. This is predicted to have no material change to the operation of the SRM water management system.

TABLE 7.1: IMPACT TO SRM WATER MANAGEMENT SYSTEM CATCHMENT AREA

Item	FY25 (Start of Project)	FY43 to FY54 (End of mining ML700021)
Water management system catchment area without the Project **(Base Case)**[1]	9,020 ha	9,649 ha
Additional are associated with the Project	Nil	221 ha
Water management system catchment area with the Project **(Project Case)**	9,020 ha	9,870 ha
% Change to the Base Case SRM Water Management System Catchment Area	No Change	2.3%

[1] *Excludes the Lake Lester and One Mile Creek Dam catchment areas*



R	DETAILS	DATE
1	Draft Issue	03-05-2024
2	Draft Issue	24-05-2024
3	Final Issue	11-06-2024

DRAWN	MB	CHECKED	AB
APPROVED	AB	DATE	11-06-2024

NOTES:

SCALE @ A3 - 1:65000
ADG66 / AMG Zone 55

DATA SOURCE
QLD Government Open Data Source

ENGENY

BMA
BHP Mitsubishi Alliance

Figure 7.1

BM Alliance Coal Operations Pty Ltd
Saraji Mine
Grevillea Pit Continuation Project Surface Water Assessment
Water Balance Model Storages and Catchments

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Streamflow Assessment.qgz

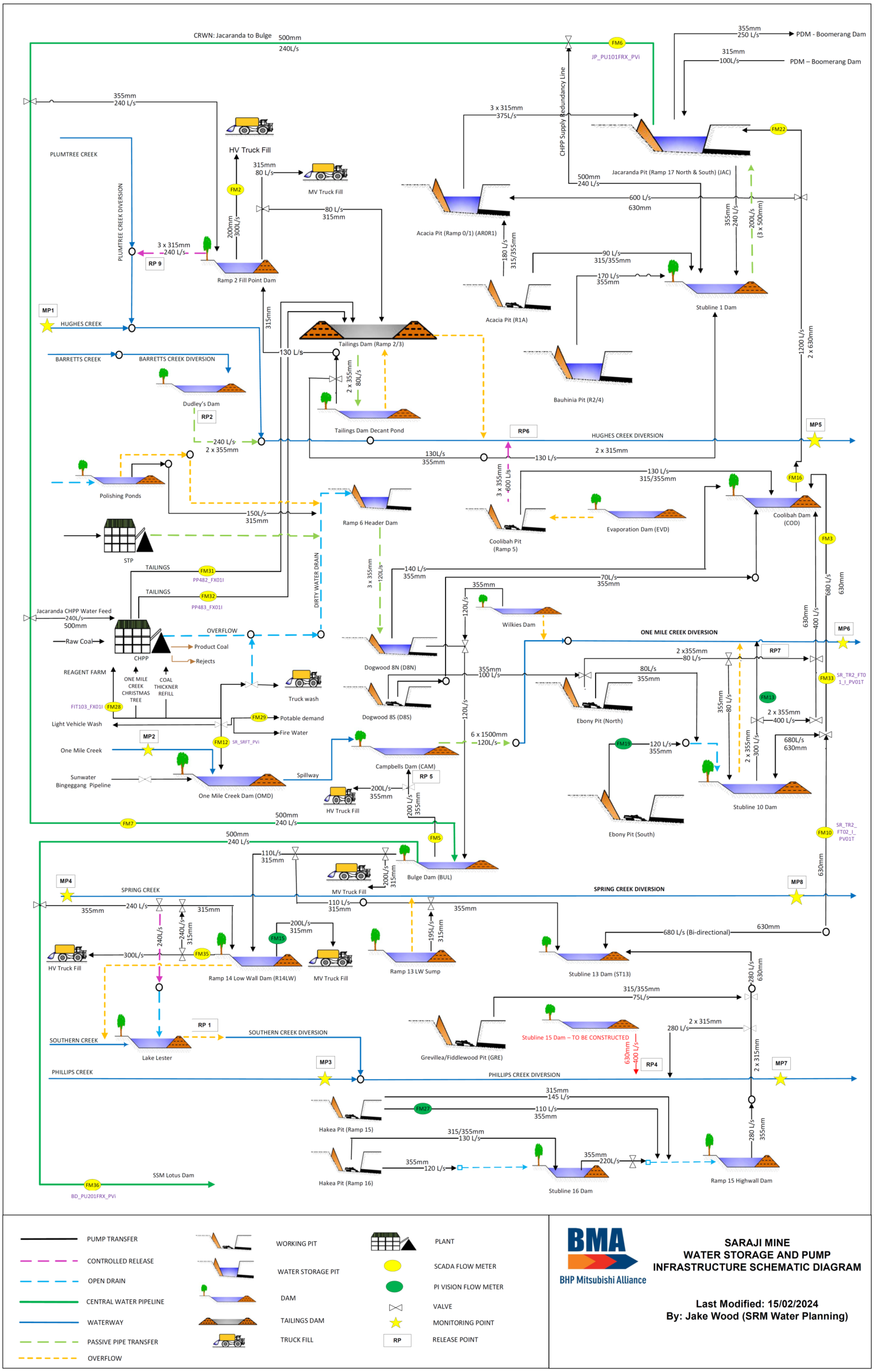


Figure 7.2: Water Management System Schematic

7.4 Water Balance Model

BMA Water Planning maintain a current water balance of the Central Region Mining area which includes the operations of Caval Ridge, Peak Downs, Saraji and Saraji South mines. The water balance model was developed in the GoldSIM modelling software and represents the key mine water management storages across the Central Region Mining operations. The model has probabilistic inputs which allows for the probability of system response to be assessed. The model simulates water inflows and outflows from each storage including transfers on a daily basis.

The current SRM water inventory is 37.7 GL and was used for the forecast starting inventory for both scenarios. The total dedicated storage capacity is approximately 51 GL and was used to assess containment risks.

7.4.1 Production Schedule, Water Demands and Supply

Site water demands at SRM are supplied from mine affected water storages and externally supplied raw water from the Bingegang Pipeline. BMA have an existing allocation of 1,700 ML/year from the Bingegang System which will not be affected by the Project. The Project will also not affect water demands at SRM based on the Project maintaining existing production rates of the Coal Handling and Preparation Plant and their being negligible change in dust suppression demands from the change in production haulage for the Project.

7.4.2 Mine Water Releases

SRM is permitted to release mine affected water from site during natural flow events in the receiving waterways as specified in Environmental Authority EPML00862313. Mine water releases are permitted to Hughes Creek, One Mile Creek and Phillips Creek when flow in the local creeks exceed a minimum flow (0.1 m^3/s to 1.0 m^3/s) and flow in the receiving regional waterway (Isaac River) exceeds 3 m^3/s (refer Table 7.3). Electrical conductivity (EC) of the released water must be below 10,000 µS/cm and have a pH between 6.5 and 9.0 (refer Table 7.2).

The release conditions do not prescribe maximum release rates, instead releases can occur at a rate which maintains EC at the downstream monitoring points below defined electrical conductivity limits (refer Table 7.4 and Table 7.5). Maximum release rates are determined during release events using a dilution model that considers the receiving waterway flow and EC and the released EC to ensure downstream EC remains below trigger limits.

The SRM EA includes nine (9) release points, with three (3) being currently inactive (RP2, RP6 and RP10) which cannot currently undertake controlled releases.

Mine water releases are included in the water balance model as follows:

- The Australian Water Balance Model (AWBM) is used to simulate daily streamflow in the local creek systems including Hughes Creek, One Mile Creek and Phillips Creek.
- Isaac River flows are simulated using the AWBM with spatially varied rainfall to capture variation across the catchment of the Isaac River.
- Release decision logic determines releases occur when:
  - Modelled local and regional flow exceeds the criteria in Table F4 of the EA (Table 7.3 below);
  - Whether the total site inventory is above the system trigger to initiate a release; and
  - There is available water in the releases storages.
- The maximum allowable release rate for the total site and each of the RPs is then calculated based on a dilution calculation of modelled flow in the waterways, the mine water release limit for EC (Table 7.2) and the downstream monitoring point EC trigger limit (Table 7.4)
- The maximum release rate is then calculated based on either the calculated maximum release rate or the capacity of the release infrastructure at each release point, including:
  - RP1 – Ramp 14 Low Wall Dam via Lake Lester: 240 L/s.
  - RP4 – Farmhouse Dam and Ramp 15 Highwall Dam: 200 L/s to 250 L/s.
  - RP5 – Bulge Dam via Campbells Dam: 200 L/s.
  - RP7 – Stubline 10 Dam: 300 L/s.
  - RP9 – Ramp 2 Fill Point Dam: 60 L/s.
- The calculated release rate for each release point is then factored by 30% (reduced by 70%) to account for release efficiency (reduced efficiency from access, manual operation and timing of sampling).

The mine water release conditions from the EA used inform the release logic in the water balance model are provided in Table 7.2 to Table 7.5.

TABLE 7.2: MINE AFFECTED WATER RELEASE LIMITS (TABLE F2 OF THE EA)

Quality Characteristics	Release Limit	Monitoring Frequency
Electrical Conductivity (µS/cm)	10,000	Real-time monitoring of pH, EC and flow during active release. Where real time monitoring is not available, daily sampling during active release as soon as possible after commencement of active release, when safe access permits.
pH (pH units)	6.5 (minimum) 9.0 (maximum)	

TABLE 7.3: MINE AFFECTED WATER RELEASE DURING FLOW EVENTS (TABLE F4 OF THE EA)

Receiving waters	Release Point (RP)	Gauging Station	Gauging Station Easting (GDA94)	Gauging Station Northing (GDA94)	Period	Receiving Water Flow Criteria for Discharge (m3/s)	Receiving Water Flow Recording Frequency
Isaac River	All RPs	Deverill	642,119	7,658,391	All times	>3 m³/s	Continuous (minimum frequency hourly mean)
Hughes Creek	RP2 RP3 RP6 RP9	Gauging Station 1	634,503	7,525,720	1 November to 31 March	>0.1 m³/s	
					1 April to 31 October	>1.0 m³/s	
One Mile Creek	RP5 RP7	Gauging Station 2	636,582	7,520,210	1 November to 31 March	>0.1 m³/s	
					1 April to 31 October	>1.0 m³/s	
Phillips Creek	RP1 RP4 RP10	Gauging Station 3	639,138	7,513,910	1 November to 31 March	>0.1 m³/s	
					1 April to 31 October	>1.0 m³/s	

TABLE 7.4: ELECTRICAL CONDUCTIVITY LIMITS AT DOWNSTREAM MONITORING POINTS (TABLE F4A OF THE EA)

Period	Isaac River MP9 and MP10	Hughes Creek MP5	One Mile Creek MP6	Phillips Creek MP7
1 November to 31 March	2,000 µS/cm	6,000 µS/cm	6,000 µS/cm	10,000 µS/cm
1 April to 31 October	2,000 µS/cm	2,000 µS/cm	2,000 µS/cm	2,000 µS/cm

TABLE 7.5: RECEIVING WATERS CONTAMINANT TRIGGER LEVELS (TABLE F5 OF THE EA)

Quality Characteristics	Release Limit	Monitoring Frequency
pH (pH units)	6.5 to 9.0	Real-time monitoring of pH, EC and flow during active or passive release. Where real time monitoring is not available, daily sampling during active or passive release as soon as possible after commencement of release, when safe access permits.
Electrical Conductivity (µS/cm)	80th percentile of values specified in **Table F4A**	

7.4.2.1 Historical Release Events

Historical mine water releases have been reviewed to identify the performance of historical releases and compare with model results for validation and inform the assessment of potential impacts for the Project. Releases at SRM have primarily been undertaken from RP1, RP4 and RP6, with historical release events being completed from 2013 to 2017. SRM recently completed several releases during January and February of 2025, and are the only releases completed since 2017.

The 2025 releases were undertaken from RP1 (Lake Lester) and RP4 (Pumped release from highwall dewatering pipeline) from Table F1 of the Environmental Authority. RP1 and RP4 discharge to Phillips Creek with the downstream compliance monitoring points being MP7 (Phillips Creek Downstream) for the local waterway and MP10 (Isaac River at Beef Road) for the regional waterway. Details of the recent release events from RP1 and RP4 during 2025 are shown in Table 7.6.

A total of 49.2 ML was discharged to Phillips Creek from RP1 and RP4 during 2025. Monitoring data for the 2025 release events show:

- The receiving waterways were shown to be above the flow criteria in the EA during each event (Table F4 of the EA)
- Maximum discharge rates from RP1 and RP2 where between 150 L/s and 200 L/s.
- RP1 and RP4 were also shown to remain below End of Pipe water quality conditions (Table F2 of the EA)
- MP7 and MP10 were shown to remain below the receiving waters contaminant trigger levels for all events (Table F5 and F4A of the EA).
- Dissolved metals at the RP’s were shown to be below the limit of reporting for all events.
- Dissolved metals at the downstream monitoring sites were shown to be equal or lower than concentrations at the upstream monitoring point (MP3) that’s used to capture background water quality conditions.

The flow monitoring and water quality data presented with the release event reporting demonstrated the release events were successfully completed in accordance with the EA release conditions indicating no environmental harm. Reporting of previous *Fitzroy Basin Coal Mine Water Release*s on the DETSI website on the (DETSI, n.d.) also shows all releases from Saraji since 2013 have been compliant with the sites EA.

TABLE 7.6: 2025 RELEASE EVENTS

Value	Event 1 16 January 2025	Event 2 6-8 February 2025		Event 3 15-16 February 2025
Release Point	RP4	RP1	RP4	RP1
Release Period/s	16-Jan 10:15 to 17:00	6-Feb 11:30 to 17:00, 7-Feb 09:40 to 8-Feb 14:00	6-Feb 13:00 to 17:00, 7-Feb 07:30 to 17:00	15-Feb 14:10 to 16-Feb 16:10
Peak Discharge Rate and Volume	150 L/s, 3.65 ML	200L/s, 3.96 ML; and 200 L/s, 17.3 ML	200L/s, 3.48 ML; and 200 L/s, 6.85 ML	200 L/s, 14 ML
Receiving Waterway Flow	**MP7:** 42.3m³/s **Isaac River:** 6.7m³/s	**MP7:** 9.35 m³/s **Isaac River:** 239 m³/s		**MP7:** 173 m³/s **Isaac River:** 23.5 m³/s
Maximum Discharged EC	603	838	1,430	1,640
Maximum Receiving Waterway EC	**MP7:** 239 **MP10:** 777	**MP7:** 877 **MP10:** 294		**MP7:** 319 **MP10:** 298

7.5 Results

7.5.1 Inventory

The Base Case and Project Case scenarios were simulated by the BMA Water Planning team and provided total site inventory result outputs to assess the Project impact on the water management system. The water balance model forecast results comparing total site water inventory for the Base Case and Project Case scenarios is shown in Figure 7.3. The Base Case results show the total site inventory is expected to decrease under all climate scenarios with the median inventory fluctuation around 12.5 GL after 2037. The 95th percentile inventory results are expected to reduce down to approximately 25 GL showing no risk of exceeding the water management system storage capacity.

The Project Case scenario total inventory results slightly deviate from the Base Case results after the first 7 to 10 years, in line with the planned Grevillea Pit progression. The Project Case 95th percentile results are marginally higher than the Base Case results and also show no risk of exceeding the system storage capacity. The water balance assessment shows the Project has negligible impact to the SRM water management system operation and containment risk.

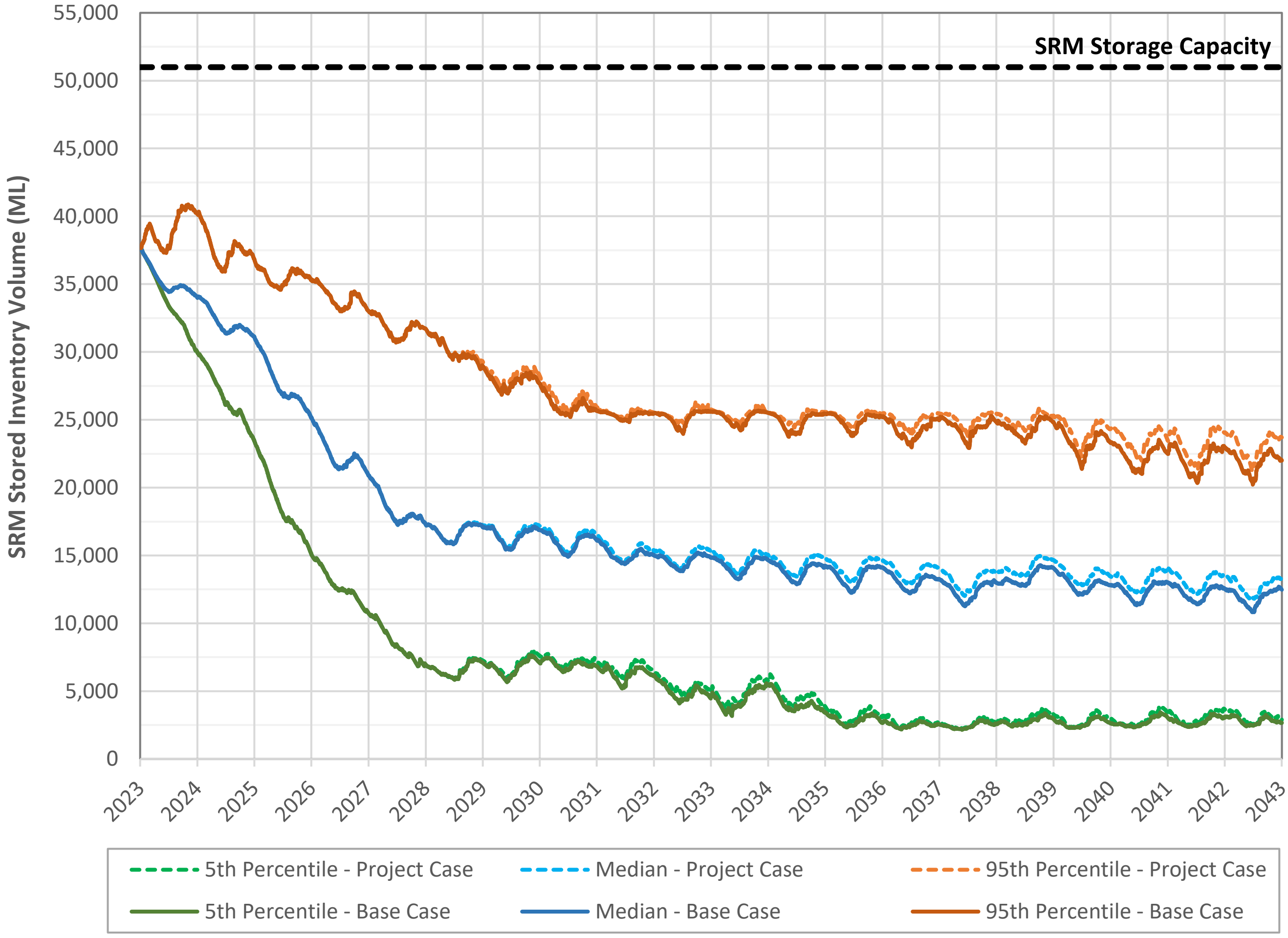


Figure 7.3: Water Balance Results – Total Site Inventory

7.5.2 Mine Water Release Volumes

Annual release volumes predicted for the Base Case and Project Case model simulations were compared to determine the potential increase in mine affected water releases from Saraji under release conditions in the EA. Figure 7.4 shows the change in modelled 95th percentile annual mine water release volumes. The model results show that the additional catchment area from the Project has the potential to increase annual release volumes by 15 ML in the 95th percentile climate scenario, with an average increase of 7 ML/year after year 2029. The base case release volumes in the 95th percentile climate scenario are low which is a function of the existing release conditions and the available storage capacity at Saraji. The results indicate the system is not reliant on mine water releases to prevent accumulation in inventory during wet periods. The increase in predicted release volumes is negligible and not expected to increase the risk of impacts to downstream water quality or flow regime.

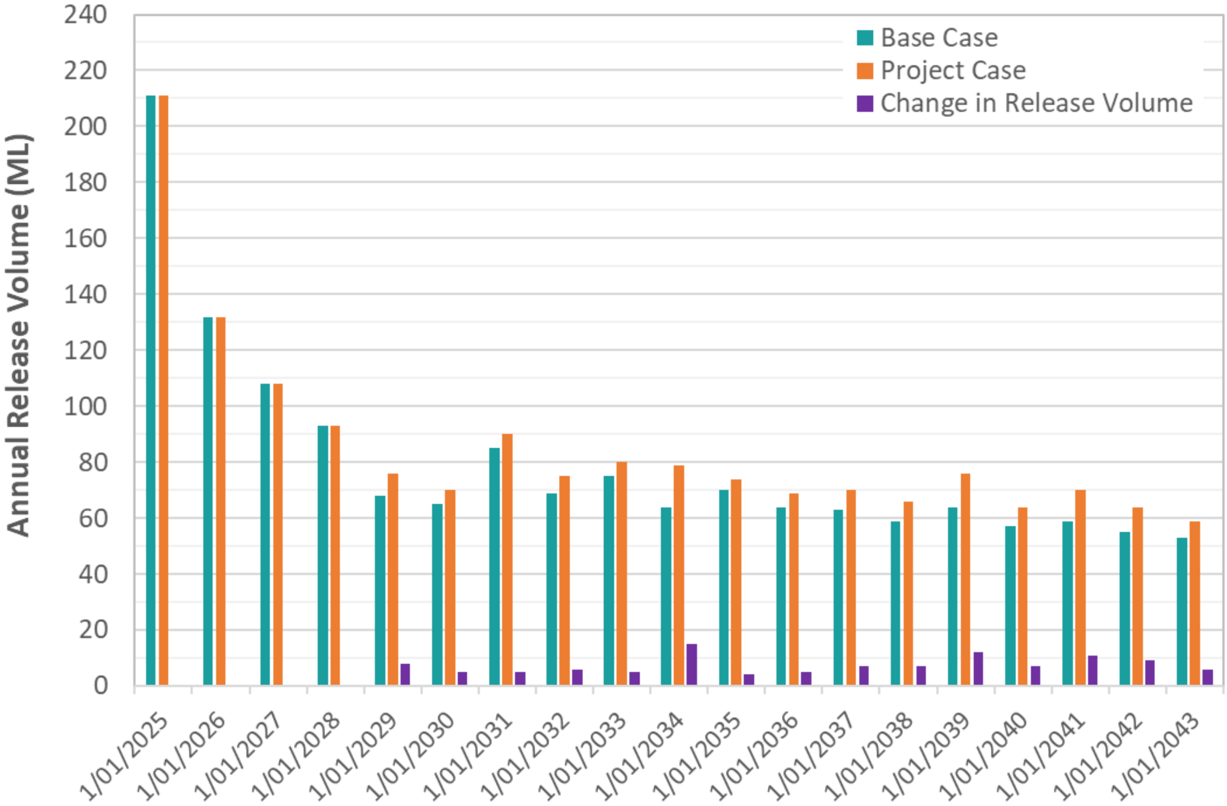


Figure 7.4: Mine Water Release Volumes

7.6 Climate Change

Climate change has been considered as part of the model development and in accordance with the BHP corporate strategy and Climate Change Adaptation in Mine Water Planning and Hydrologic Assessments Guideline (BMA, 2023). A comprehensive study was undertaken by BMA Water Planning to understand climate change science and quantify climate projections in mine water planning and hydrologic assessments. The study includes extensive literature review and projects completed by CSIRO, BoM and the Queensland Government's Department of Environment, Science and Innovation (DESI) as well as numerous academic publications.

The data used for the climate change assessment was based on Australian Terrestrial Ecosystem Research Network (TERN) data. TERN is supported by the Australian Government through the National Collaborative Research Infrastructure Strategy. The data used includes the changes in both rainfall and evaporation trends for a range of climate models. The overall trend predicted an overall reduction in annual rainfall and an increase in evaporation. These factors combined overall has the outcome of reduced site predicted inventories, indicating climate change will not materially impact the outcomes of the Project.

8. IMPACT ASSESSMENT

Potential surface water impacts identified for the Project include the following:

- Reduction in streamflow duration and volume in the nearby waterways from loss of the Project area catchment.
- Increased or changed flood behaviour in Phillips Creek and Spring Creek due to the Project footprint.
- Impacts to environmental values from impacts to mine water containment by increasing the overall catchment contained by the SRM water management system.

The potential surface water impacts were assessed in Sections 5, 6 and 7 to determine the magnitude of the potential impact and need for mitigation or management measures. The assessed potential surface water impacts related to the Project are summarised in the following sections.

8.1 Streamflow Impacts

Potential streamflow impacts were assessed using a nodal link hydrology model of One Mile Creek and Phillips Creek to quantify the change in streamflow duration and volumes due to the loss of catchment within the Project area (refer in Section 5). The assessment of streamflow impacts identified the following:

- The maximum potential catchment area reduction at the locations runoff from the Project area enters the main waterway for One Mile Creek is 1.8% (Catchment 2) and for Phillips Creek is 0.3% (Catchment 5).
- Streamflow volume and duration at the same locations was determined to have a maximum potential reduction of 2.0% to 2.66% in One Mile Creek and 0.29% in Phillips Creek (both streamflow volume and duration).
- Streamflow impacts are shown to diminish downstream as the receiving waterway catchment increases, with One Mile Creek having a maximum potential reduction in streamflow volume of 1.1%, upstream of the One Mile Creek confluence with Boomerang Creek, and a 0.24% reduction downstream of the confluence.
- Phillips Creek has a maximum potential reduction in streamflow volume of 0.23% upstream of its confluence with the Isaac River.
- There are no existing water licences on Phillips Creek or One Mile Creek between SRM and the Isaac River and therefore no impacts to water resources (water entitlements) are expected.
- The maximum potential reduction in streamflow duration in both creek systems is minor in terms of frequency, duration and magnitude of flow events, and expected to have negligible impact on streamflow-dependant riparian ecology.
- The total Project area of 2.21 km^2 represents less than 0.04% of the Isaac River catchment area at the Phillips Creek confluence (5,648 km^2) which is expected to correspond to a similar reduction streamflow, demonstrating negligible impact to flow characteristics in the Isaac River or existing water licences.

The streamflow impacts identified for the Project represent the maximum potential impact based on containing the entire Project area within the SRM water management system which could only occur towards end of the Project life. The assessed impacts can only occur during the operational phase of the Project as rehabilitation and reshaping of the final void for closure will return catchment to the surrounding creek systems. Mitigation or management measures are not considered to be required for the assessed streamflow impacts.

8.2 Flooding Impacts

Two-dimensional flood models of Spring Creek and Phillips Creek were used to quantify changes in flood behaviour associated with the Project footprint as presented in Section 6. Models were developed to represent Base Case and Project Case scenarios and simulated for design flood events ranging from the 10% AEP to the PMF. Potential flooding impacts relating to the Project were quantified from the change in flood model results between the Base Case and Project Case scenarios.

The assessment of flooding impacts identified the following:

- Frequent flood events do not inundate the Project area, with flooding in Phillips Creek beginning to inundate the Project area in a 1% AEP event at the southern boundary, inundating less than 2.8% of the Project area.
- The Project area is unaffected by flooding in Spring Creek up to the 1% AEP flood event.

- Minor flooding of the Project area occurs in a 0.1% AEP flood event in Spring Creek due to a breakout flow path from the upstream diversion that also results in overtopping to the existing Grevillea Pit.
- The Project does not affect flooding in Phillips Creek in all flood events up to and including the 1% AEP flood event.
- The Project is shown to increase peak flood depths in Phillips Creek by up to 300 mm in the 0.1% AEP flood event in very isolated locations immediately adjacent the Project boundary.
- The Project peak flood velocities in the 0.1% AEP flood event are expected to increase by a maximum 0.2 m/s in the Phillips Creek channel adjacent to the Project area. This increase in peak flood velocity is not expected to have a significant impact on the waterway condition considering the very rare frequency of the event and the resultant velocity remaining below 3 m/s where impacts occur.
- Flood impacts in the Phillips Creek 0.1% AEP flood event are isolated to areas immediately adjacent the Project boundary and are not expected to impact third parties or the Phillips Creek channel condition.
- The Project does not impact flooding in Spring Creek in all flood events up to the 0.1% AEP flood event.
- A PMF event in Spring Creek and Phillips Creek results in 44% of the Project area being inundated.
- Potential impacts during a PMF event show flooding increases that would need to be considered as part of the closure planning and design for the surrounding SRM final voids.

The flooding assessment represents the maximum potential flooding impact associated with the Project as the full planned disturbance extent was represented in the Project Case scenario flood model to assess impacts. The flooding impacts for the Project are considered negligible, however will be present for both the operational phase of the Project and post closure. Grevillea Pit will be reshaped and rehabilitated for closure and incorporate flood protection landforms to maintain void flood immunity in accordance with the SRM EA conditions. Final void flood protection landforms will remain within the Project area and not produce additional flooding impacts than those determined from this assessment.

8.2.1 Pit Flood Immunity

The flood impact assessment identified flooding from Phillips Creek will enter the Project area at the southern boundary and will require flood protection levees to prevent ingress to the mining pit. The assessment also identified Spring Creek overtops into the existing Grevillea Pit and will require a flood protection levee to prevent ingress. Figure 6.7 shows the location of flooding interactions with the Project area and potential locations of flood protection levees required for pit flood protection.

8.2.2 Final Void Flood Risks

The Grevillea Pit final void will be protected by a landform bund, designed to provide 0.1% AEP flood protection with an additional 1m freeboard as per the approved PRCP for SRM. The Project will not impact or change the proposed flood immunity of the void however the risk of a PMF overtopping the flood protection landform bund and filling the final void has been assessed. Flood modelling of the PMF event with climate change factored hydrology (SSP5-8.5), determined flood inflow volumes will be approximately 13% of the final void storage capacity indicating a very low risk of the void filling and overtopping (refer Section 6.5.6).

8.3 Water Management System Impacts

Impacts to the SRM water management system containment performance due to the Projects increase in overall catchment area was assessed using a water balance model as presented in Section 7. The water balance model was used to assess the Base Case and Project Case scenarios to quantify the change in predicted system inventories and release volumes.

The assessment of impacts on the SRM water management system identified the following:

- The Project will increase the catchment area reporting to the water management system with the progression of Grevillea Pit by a maximum of 221 ha over the Project life, accounting for less than 2.3% of the total SRM water management system catchment area.
- The Base Case results show the total site inventory is expected to decrease under all climate scenarios with the median inventory fluctuation around 12.5 GL after 2037.
- The Project is expected to result in marginally higher total system water inventories, however under 95th percentile climate conditions both the Base Case and Project Case total system inventory is expected to reduce below 25 GL, showing no risk of exceeding the system storage capacity.
- 95th percentile release volumes are small in the Base Case scenario indicating the system is not reliant on undertaking mine water releases in accordance with the sites EA to manage inventory.

- The Project is expected to increase 95th percentile release volumes by an average of 7 ML/year which is considered negligible, and not material in terms of frequency or duration of release events.
- Monitoring data from historical release events shows previous releases were compliant with the existing EA Conditions, which is expected to be maintained for the Project.
- The results show the Project will have negligible impact on the overall water management system performance and have a negligible impact on release volumes.

The existing SRM water management plan will provide sufficient mitigation of potential impacts of the Project on the SRM water management system through annual updates requiring review of the system performance and any improvements to prevent environmental harm. The existing REMP will monitor and assess any adverse impacts to surface water EVs and ensure the water management plan is effective. Mitigation and management measures for the Project are discussed in Section 9.

8.4 Cumulative Impacts

8.4.1 Streamflow Impacts

The Projects individual impact on streamflow's is considered negligible based on the relatively small area of the Project (refer Section 8.1). Phillips Creek and One Mile Creek downstream of the Project area, before their confluence with the Isaac River waterways are also impacted by mining from existing SRM operations, Peak Downs Mine (PDM) and Lake Vermont Mine (LVM). Disturbance from these mines and the associated reduction in streamflow volume was considered in the streamflow assessment. The long-term cumulative impact would be negligible. The rehabilitation strategy for Grevillea Pit remains the same for the existing approved mine and the Project. For the Project, the void will progress slightly further east, however, maintain a similar final void catchment area. This indicates the long-term reduction in streamflow volumes downstream of the mine will likely be less than the maximum catchment reduction assessed in Section 5, and likely have negligible contribution to the cumulative impact to downstream streamflow conditions.

8.4.2 Mine Water Releases

SRM is permitted to undertake mine affected water releases to Hughes Creek, One Mile Creek and Phillips Creek under the existing Environmental Authority (DETSI, 2025). One Mile Creek enters Hughes Creek which collects Boomerang Creek and Ripstone Creek before entering the Issaac River, and Phillips Creek flows directly into the Issac River. Hughes Creek can also receive mine affected water releases from PDM via Boomerang Creek and Ripstone Creek (DETSI, 2025) and Phillips Creek can also receive mine affected water releases from LVM (DETSI, 2024). The location of the mining operations with permitted release conditions to Hughes Creek and Phillips Creek are shown in Figure 8.1.

The water balance assessment identified the additional catchment area from the Project could result in a slight increase in release volumes from SRM. The slight increase in release volumes is considered negligible in terms of impacts on water quality in receiving waters on an individual basis (refer Section 7.4.2), however the potential cumulative impact has also been reviewed. Cumulative Impacts on receiving waterway quality has been assessed for Phillips Creek and Hughes Creek (and its tributaries) from SRM releases coinciding with release from other mining operations.

A summary of release conditions for SRM, PDM and LVM for releases to Hughes Creek and Phillips Creek is provided in Table 8.1. The conditions show existing releases to Hughes Creek and its upstream tributaries are permitted to occur during periods of low flow in the local waterway (0.1 m^3/s) and regional waterway (3 m^3/s). The release conditions prescribe continuous monitoring of the Isaac River and require releases to stop if the water quality trigger level for EC is exceeded (2,000 µS/cm). Water quality triggers in the local waterways are not prescribed.

LVM is permitted to release to Phillips Creek under normal release conditions and enhanced release conditions. The LVM normal release conditions require a low flow in Phillips Creek and a range of flow conditions in the Isaac River before releases can occur. The monitoring locations for receiving water quality against trigger levels are on Phillips Creek and the Isaac River which prescribe lower EC limits than the SRM EA and other mining operations in the Isaac River catchment. The enhanced release conditions allow releases of water up to 8,000 µS/cm, during low flow conditions in Phillips Creek and when Isaac River flow exceeds 1 m^3/s. The conditions include downstream monitoring against trigger limits for Phillips Creek only, which is equal to the Isaac River trigger limits enforced by the other mines.

TABLE 8.1: SUMMARY OF EXISTING RELEASE CONDITIONS TO PHILLIPS AND HUGHES CREEK

Creek System	Mining Operation and Release Point ID	Local Flow Criteria	Regional Flow Criteria.	Electrical Conductivity Release Limit	Downstream Trigger Electrical Conductivity Limit
Boomerang Creek	Peak Downs Mine: RP4, RP7, RP15 and RP16	0.1 m^3/s	3 m^3/s	10,000 µS/cm	Isaac River: 2,000 µS/cm
Ripstone Creek	Peak Downs Mine: RP3, RP5, RP12 and RP13	0.1 m^3/s	3 m^3/s	10,000 µS/cm	Isaac River: 2,000 µS/cm
Hughes Creek	Saraji Mine: RP2, RP3, RP6, RP9	0.1 m^3/s (during wet season)	3 m^3/s	10,000 µS/cm	Isaac River: 2,000 µS/cm Hughes Creek: 6,000 µS/cm (During wet season).
One Mile Creek	Saraji Mine: RP5, RP7	0.1 m^3/s (during wet season)	3 m^3/s	10,000 µS/cm	Isaac River: 2,000 µS/cm One Mile Creek: 6,000 µS/cm (During wet season).
Phillips Creek	Saraji Mine: RP1, RP4, RP10	0.1 m^3/s during wet season	3 m3/s	10,000 µS/cm	Isaac River: 2,000 µS/cm Phillips Creek: 10,000 µS/cm (During wet season).
Phillips Creek	Lake Vermont Mine: RP4, RP5, RP6, RP7, RP8	1.0 m^3/s	37.5 m3/s	5,500 µS/cm (high flow conditions)	Phillips Creek: 1,000 µS/cm Isaac River: 1,000 µS/cm
Phillips Creek	Lake Vermont Mine (Enhanced Release Conditions): RP4, RP5, RP6, RP7, RP10	0.1 m^3/s	1 m3/s	8,000 µS/cm	Phillips Creek: 2,000 µS/cm

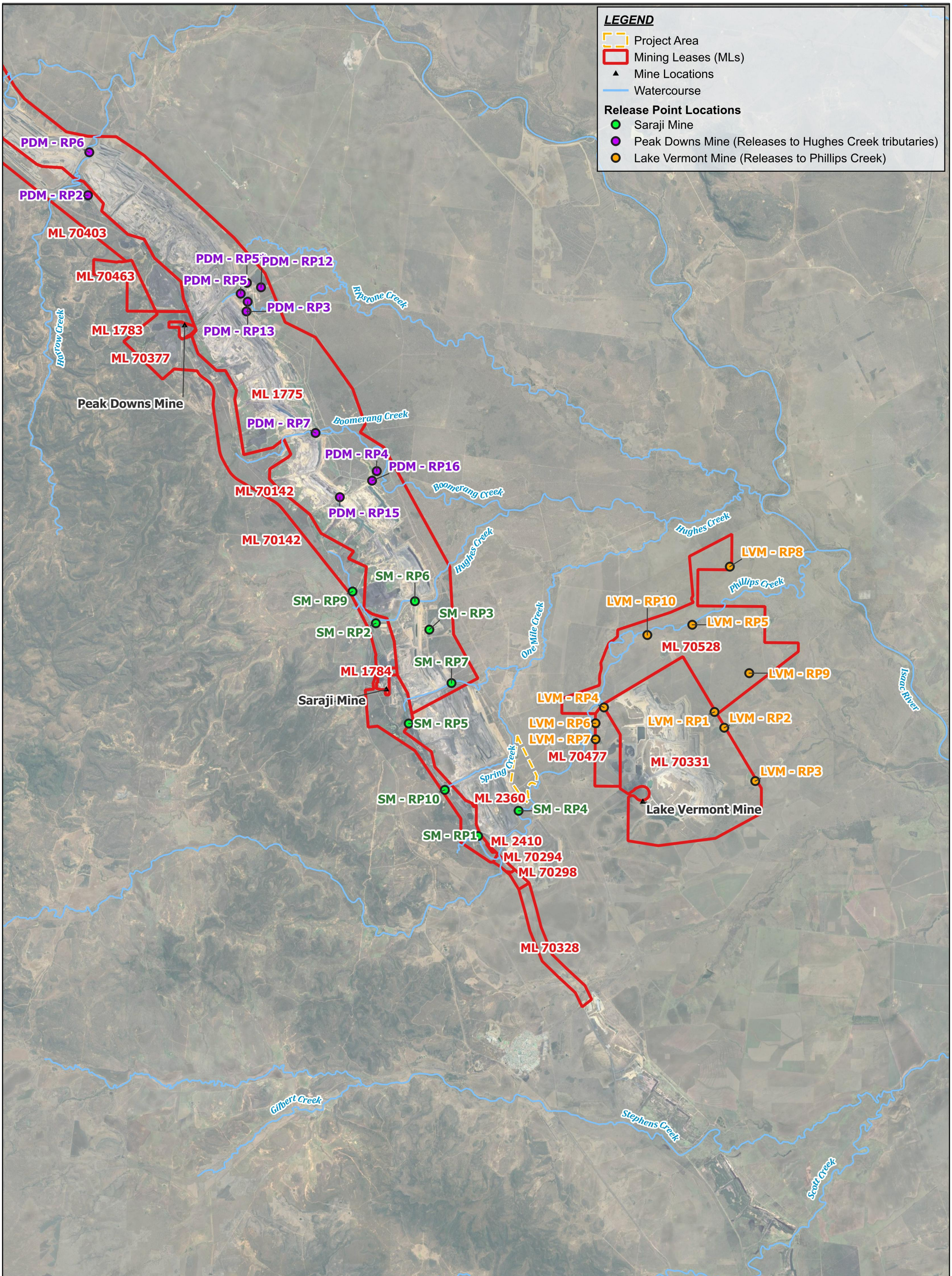
The existing release conditions to Phillips Creek and Hughes Creek show instream EC during release events from the mines can be up to 10,000 µS/cm with minimal local waterway flow to provide dilution. Maximum release rates are not specified for PDM and SRM, instead releases are based on maintaining the downstream monitoring points below the water quality trigger limits. The EA conditions also require continuous monitoring of flow, EC and pH at the downstream monitoring points to identify if the downstream triggers are exceeded and the releases needs to cease.

Inofrmaiton on historical releases show Lake Vermont have previously completed 4 release events to Phillips Creek (via RP4) between 2015 and 2017, occurring over a total of 9 days (DETSI, n.d.). All events were determined to be compliant with the Lake Vermont EA conditions. This indicates that LVM have historically undertaken a small number of releases to Phillips Creek.

Peak Downs has completed 16 releases to Boomerang Creek (via RP4 and RP7) and 21 release to Ripstone Creek (via RP3, RP5 and RP12) since January 2013 (DETSI, n.d.). The average duration of releases from PDM to Ripstone Creek and Boomerang Creek was 3 days and primarily occurred via Boomerang Dam (RP4) and the Ripstone Diversion (RP5). Releases from PDM were also all determined to be compliant with the PDM EA conditions.

The predicted incremental increase in release volumes from SRM are expected to contribute negligible cumulative impacts to the receiving water quality because:

- The Base Case (no Project) predicted release volumes are small in very large wet years (95th percentile) (refer Section 7.5.2).
- Incremental increase in release volumes from the Project are also very small, with negligible change in the duration or frequency of release events.
- The existing release conditions include continuous monitoring at downstream monitoring points to inform water quality compliance during release events and inform when releases need to cease.
- Continuous monitoring is also required by the other mining operations EA conditions, which identify when background water quality is impacted from concurrent releases from other operations.
- Historical releases at Saraji Mine, Lake Vermont Mine and Peak Downs Mine were all determined to be compliant with the existing release conditions.



R	DETAILS	DATE
1	Draft Issue	07-05-2024
2	Final Issue	30-06-2025

DRAWN	ZM	CHECKED	AB
APPROVED	AB	DATE	30-06-2025

NOTES:

SCALE @ A3 - 1:170,000
GDA94 / MGA Zone 55

DATA SOURCE
QLD Government Open Data Source

ENGENY

BMA
BHP Mitsubishi Alliance

Figure 8.1

BM Alliance Coal Operations Pty Ltd
Saraji Mine
Mine Water Release Locations to Hughes and Phillips Creek

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC SWA Figures.qgz

9. MITIGATION AND MANAGEMENT MEASURES

The identified surface water impacts for the Project were determined to be negligible on existing surface water resources, flooding and EVs. The Project involves continuation of mining in an existing pit and existing controls in the SRM EA are suitable for managing potential surface water impacts. Based on the impact assessment the following mitigation and management measures are recommended:

- Flood protection levees to prevent ingress to the mining pit during the operational phase of the Project.
- Continued implementation of a Water Management Plan (WMP) to allow annual review of the water management system effectiveness for preventing adverse impacts to EVs.
- Continued implementation of an Erosion and Sediment Control Plan (ESCP) to manage erosion and containment of sediments for disturbance areas.
- Continued implementation of a REMP to monitor and assess any adverse impacts to surface water EVs.

The following sections detail the mitigation and management measures.

9.1 Flood Protection Levees

Flood protection levees are required in the following locations to prevent flood ingress in a 0.1% AEP event to the existing and future Grevillea pit extent;

- Along the southern boundary of the Project area to prevent ingress from Phillips Creek into the future pit extent; and,
- At the breakout flow path location on the existing Spring Creek diversion to prevent ingress to the existing Grevillea Pit.

As the levees will be used to prevent the ingress of clean flood water to a pit that would be encroached in a 0.1% flood AEP event, they will be deemed a Regulated Structures under the Manual for assessing consequence categories and hydraulic performance of structures (the Manual) (DESI, 2024). The levees will therefore need to provide 0.1% AEP flood protection with a suitable freeboard allowance in accordance with the hydraulic performance criteria for regulated levees (DESI, 2024).

9.2 Water Management Plan

The primary purpose of a mining project WMP 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). There is an existing WMP detailing SRM water management infrastructure, maintenance requirements and containment performance standards which is implemented in accordance with current SRM EA conditions. The purpose of the WMP is to manage water resources and to minimise the potential for adverse impacts to the local and regional environment (BMA, 2022).

The existing WMP will continue to be implemented and updated annually based on SRM mining activities. The existing plan will not require significant modification to sufficiently manage potential for adverse surface water impacts associated with the Project.

9.3 Erosion and Sediment Control Plan

An ESCP has been developed in accordance with the existing SRM EA to manage processes and activities associated with erosion control and the release of sediment. The existing ESCP is considered sufficient for managing erosion and sediment control for the Project without significant modification. The objectives of the ESCP include:

- Minimise and mitigate erosion and sedimentation as well as erosion impacts associated with clearing of vegetation along banks of drainage lines;
- Prevent the degradation of water quality resulting from erosion and sedimentation through continued monitoring and improvement measures;
- Separation of runoff from disturbed and undisturbed areas where practicable;
- Diversion of water from disturbed catchments into mine water storages or sediment dams;
- Diversion of clean water away from areas of existing or planned disturbance;

- Rehabilitation of disturbed areas to allow vegetation propagation and regrowth;
- Improvement to the integrity of areas prone to erosion through temporary and permanent erosion control techniques; and,
- The provision of information necessary to implement effective erosion control measures (BMA, 2020).

9.4 Receiving Environment Monitoring Program

A REMP has been developed as a requirement of the SRM EA. The purpose of the REMP is to monitor and describe any adverse impacts to surface water EVs due to authorised mining activities (Gauge, 2023), and is designed to ensure the WMP is effective, ensure downstream water quality is not adversely being impacted, and demonstrate compliance with SRM discharge limits as outlined in the EA. The REMP is updated annually, with the most recent iteration being monitoring water quality, streamflow, sediments and bio-indicators between July 2021 and June 2022, and historically back to 2010 (Gauge, 2023). The existing REMP will be suitable for monitoring adverse impacts associated with the Project and overall SRM mine activities to inform the need for mitigation measures.

10. REFERENCES

ANZECC and ARMCANZ. (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.*

Ball, J., Babister, M., Nathan, R., Weeks, W., Weinmann, E., Retallick, M., & Testoni, I. (2019). *Australian Rainfall and Runoff: A Guide to Flood Estimation.* Commonwealth of Australia (Geoscience Australia).

BMA. (2020). *SRM Plan - Erosion and Sediment Control Plan.*

BMA. (2022). *SRM Plan - Water Management Plan.*

BMA. (2024). *Progressive Rehabilitation and Closure Plan - Saraji Mine, Version 4.0, BMA-SRM-PRCP-v3.*

Bureau of Meteorology. (2003). *Revision of the Generalised Tropical Storm Method of Estimating Probable Maximum Precipitation.*

Bureau of Meteorology. (2003). *The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method.*

Bureau of Meteorology. (2024). *Design Rainfall Data System (2016)*. Retrieved from http://www.bom.gov.au/water/designRainfalls/revised-ifd/

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

DEHP. (2011). *Isaac River Sub-basin Environmental Values and Water Quality Objectives: Basin No. 130 (part), including all waters of the Isaac River Sub-basin (including Connors River).*

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

DESI. (2023b). *SILO - Australian Climate Data*. Retrieved from https://www.longpaddock.qld.gov.au/silo/

DESI. (2024). *Manual for assessing consequence categories and hydraulic performance of structures (ESR/2016/1933).*

DETSI. (2024). *Environmental authority EPML00318213 – Lake Vermont Coal Mine. Effective 13 November 2024.*

DETSI. (2025). *Environmental authority EPML00318213 - Peak Downs Mine. Effective 14 February 2025.*

DETSI. (2025). *Environmental Authority EPML00862313 - Saraji Mine. Effective 28 May 2025.*

DETSI. (n.d.). *Fitzroy Basin coal mine water releases*. Retrieved from Department of Environment, Tourism, Sience and Innovation: Environment : https://environment.desi.qld.gov.au/management/activities/mining/mine-water-releases/previous

DRDMW. (2024, May). *Water Monitoring Information Portal*. Retrieved from https://water-monitoring.information.qld.gov.au/

Engeny Water Management. (2021). *Saraji Mine Flood Study Update.*

Gauge. (2023). *Receiving Environment Monitoring Program.*

NHMRC. (2011). *Australian Drinking Water Guidelines.*

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.

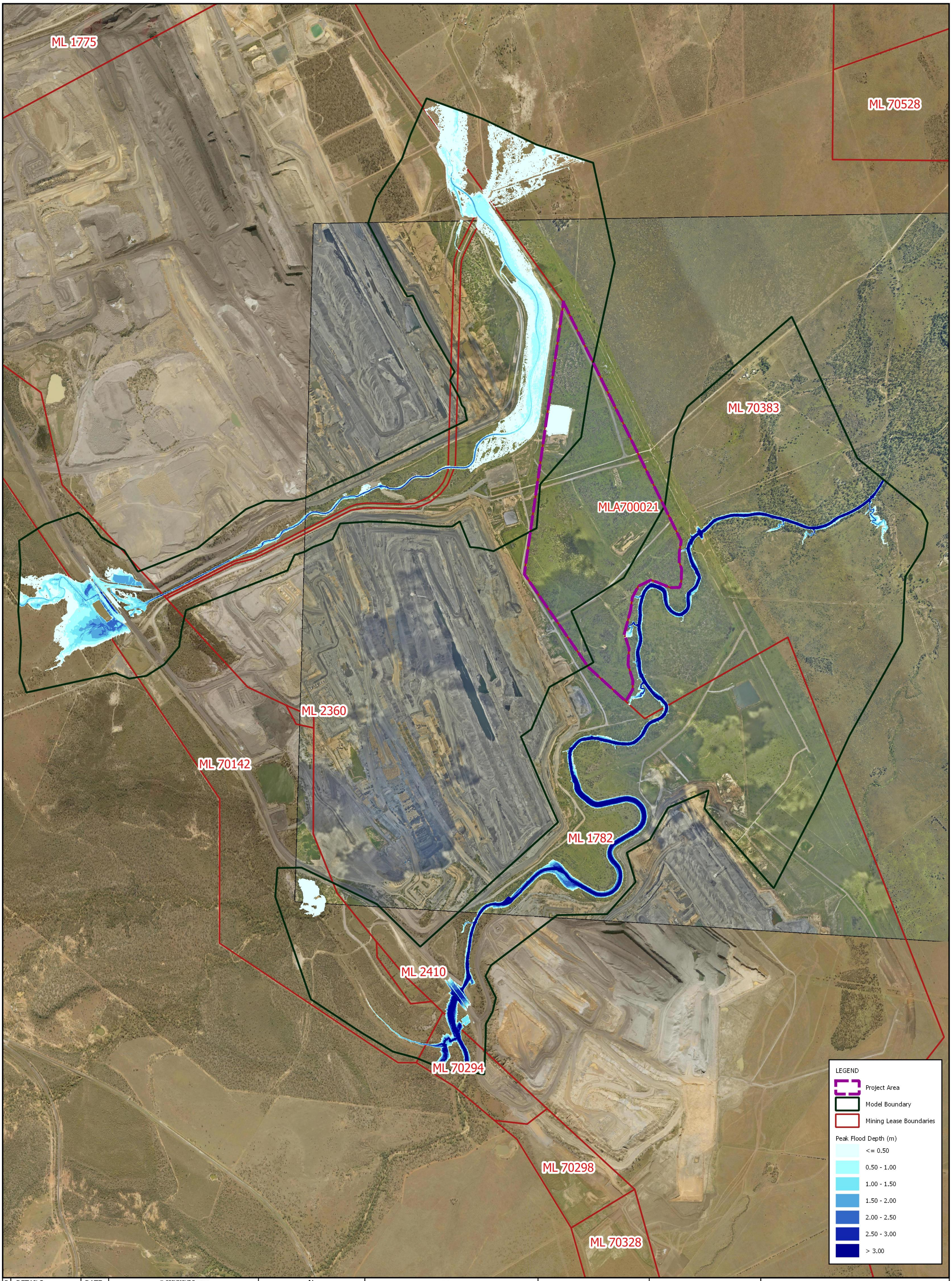
(d) Engeny does not give any warranty nor accept any liability in relation to the completeness or accuracy of the works, which may be inherently reliant upon the completeness and accuracy of the input data and the agreed scope of works. All limitations of liability shall apply for the benefit of the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

APPENDIX A: BASE CASE FLOOD MAPPING



R	DETAILS	DATE
1	Final Issue	03-05-2024

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	03-05-2024

NOTES:

N

0 0.2 0.4 km

SCALE @ A3 - 1:28,000
AGD66 / AMG 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

BMA
BHP Mitsubishi Alliance

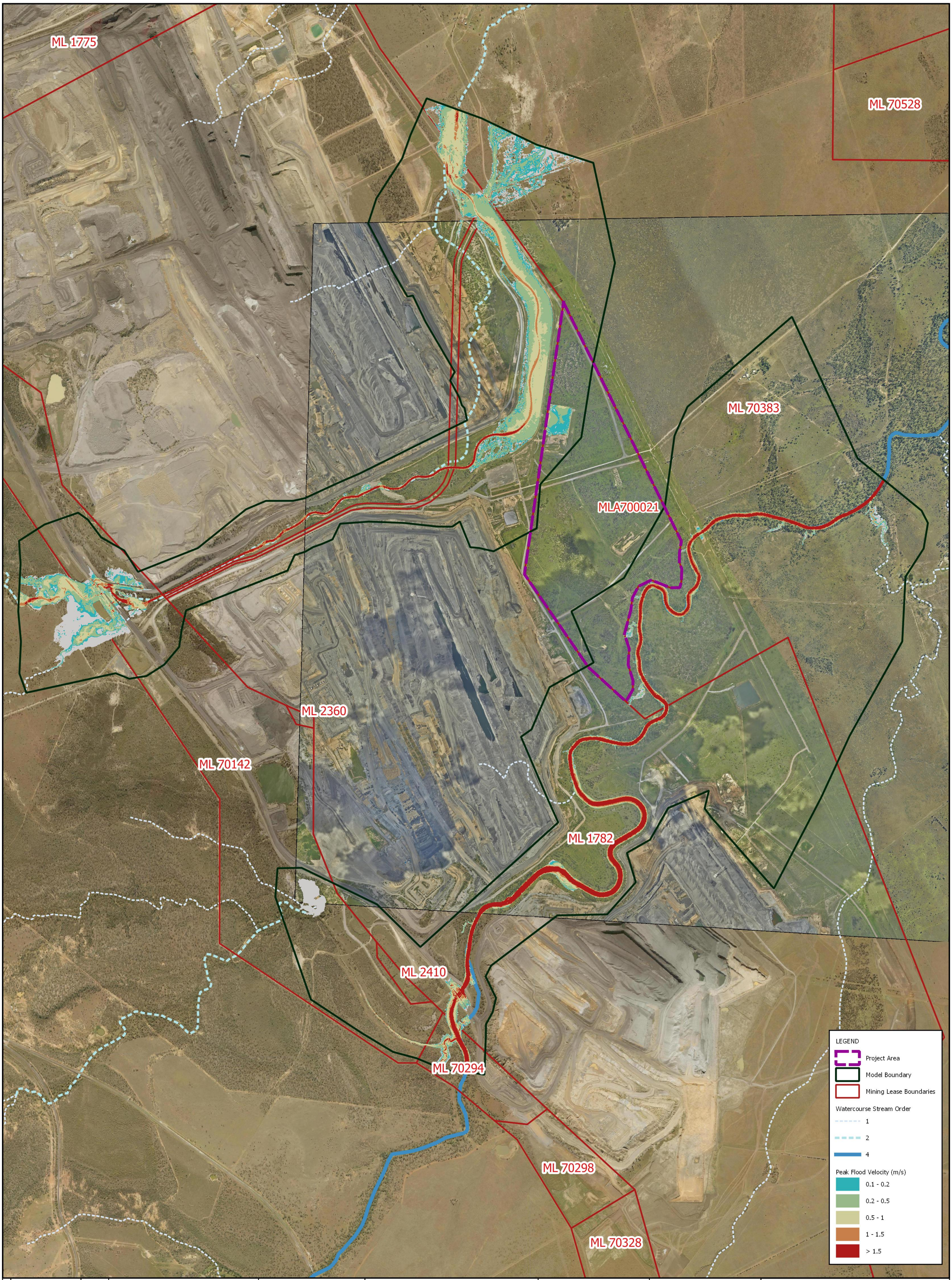
Figure 1

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Base Case 10% AEP Flood Depth

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS.qgz



R	DETAILS	DATE
1	Final Issue	03-05-2024

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	03-05-2024

NOTES:

N

0 0.2 0.4 km

SCALE @ A3 - 1:28,000

AGD66 / AMG zone 55

DATA SOURCE
QLD Government Open Data Source

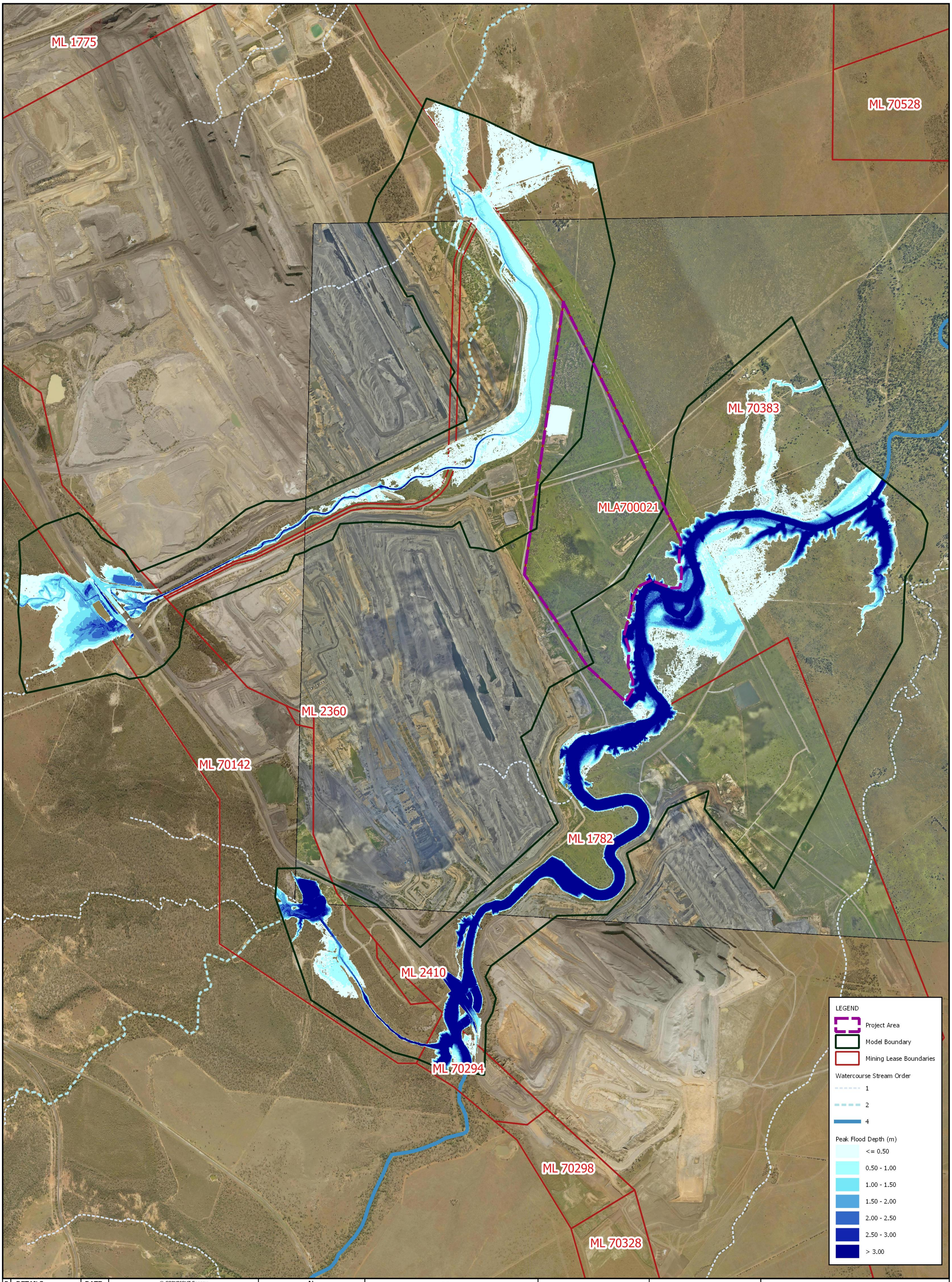
Figure 2

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Base Case 10% AEP Flood Velocity

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS.qgz



R	DETAILS	DATE
1	Final Issue	03-05-2024

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	03-05-2024

NOTES:

SCALE @ A3 - 1:28,000
AGD66 / AMG 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

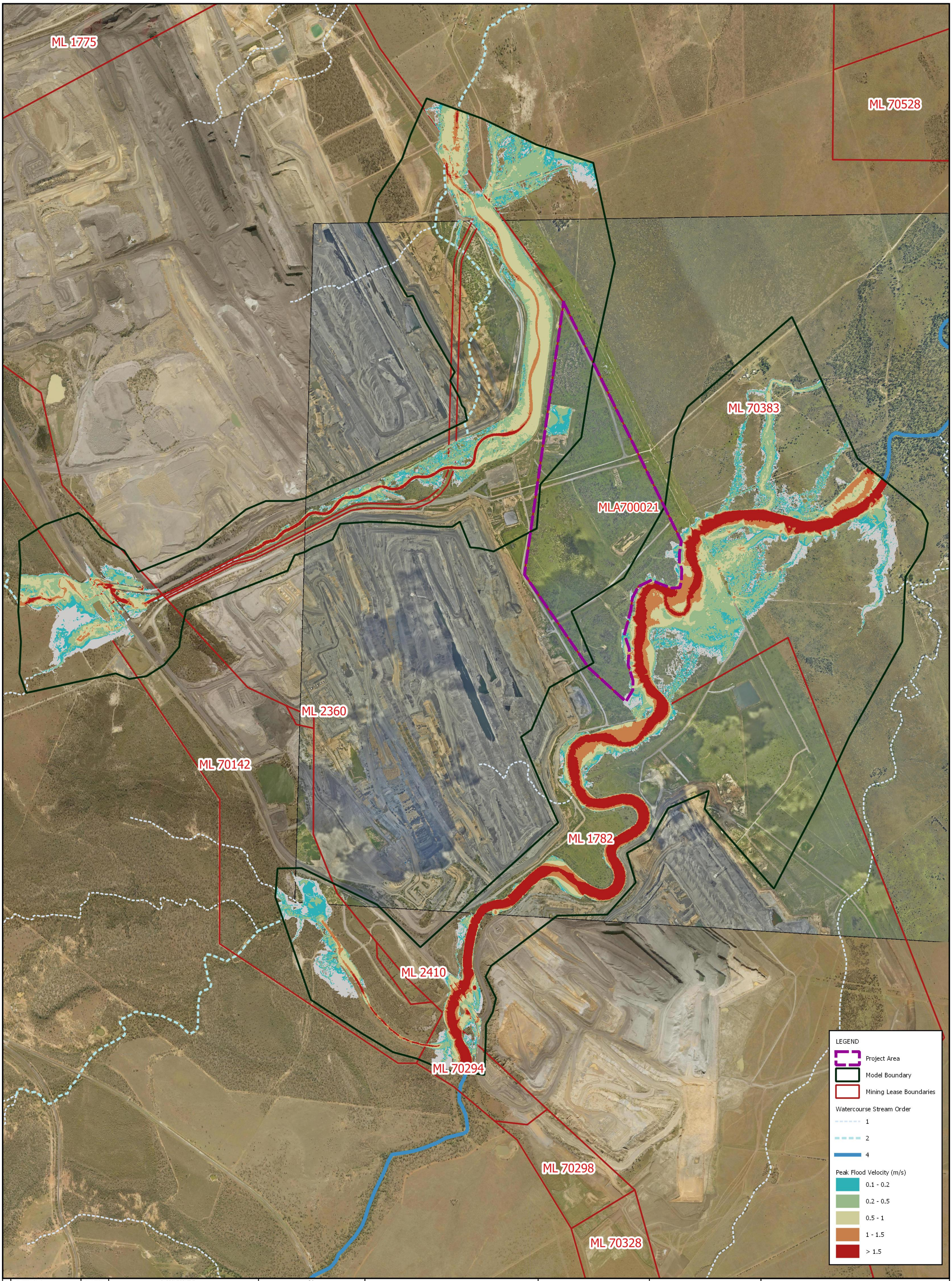
Figure 3

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Base Case 1% AEP Flood Depth

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS.qgz



R	DETAILS	DATE
1	Final Issue	03-05-2024

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	03-05-2024

NOTES:

SCALE @ A3 - 1:28,000
AGD66 / AMG 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

BMA
BHP Mitsubishi Alliance

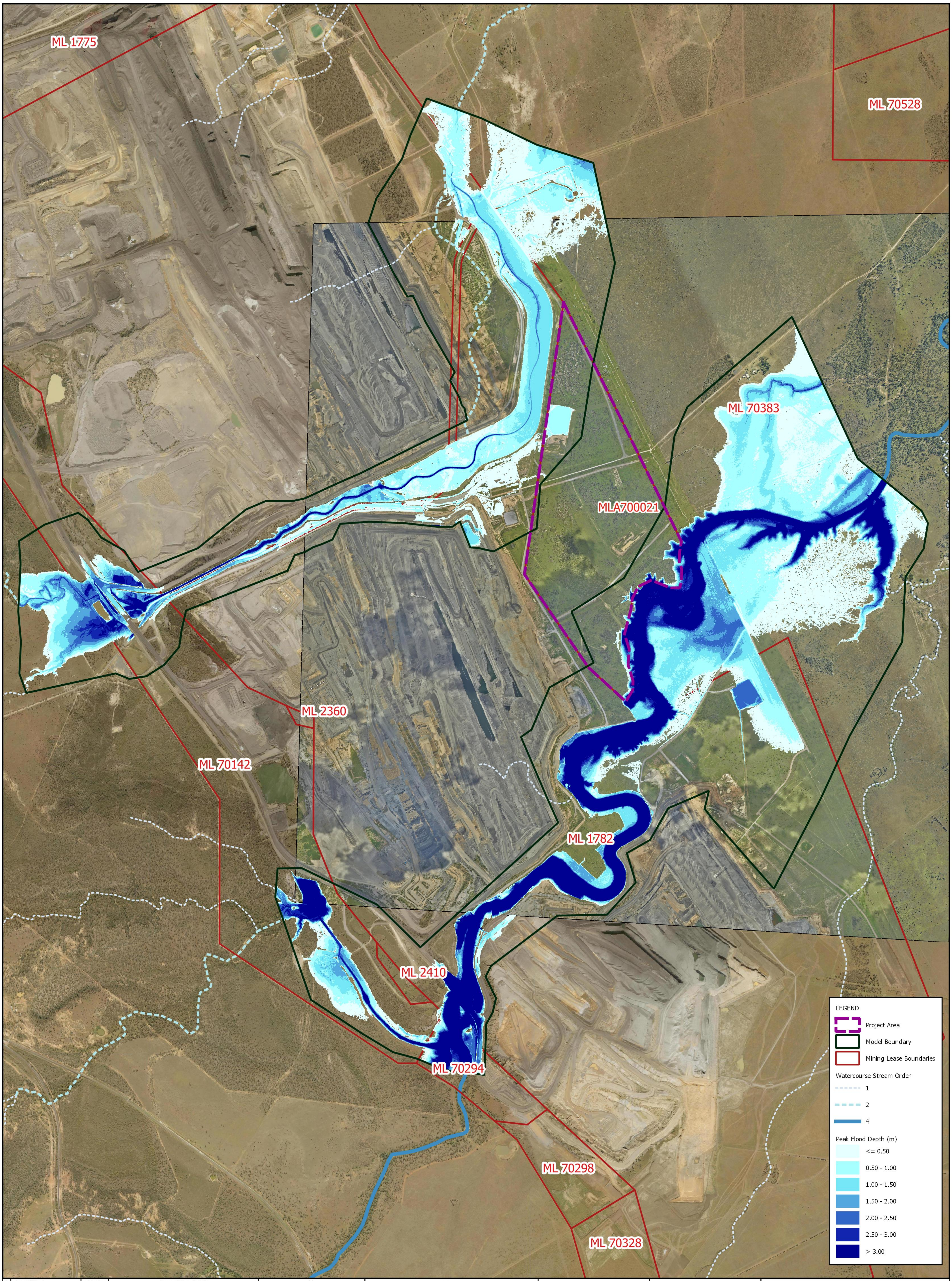
Figure 4

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Base Case 1% AEP Flood Velocity

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS.qgz



R	DETAILS	DATE
1	Final Issue	03-05-2024

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	03-05-2024

NOTES:

N
0 0.2 0.4 km
SCALE @ A3 - 1:28,000
AGD66 / AMG 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

BMA
BHP Mitsubishi Alliance

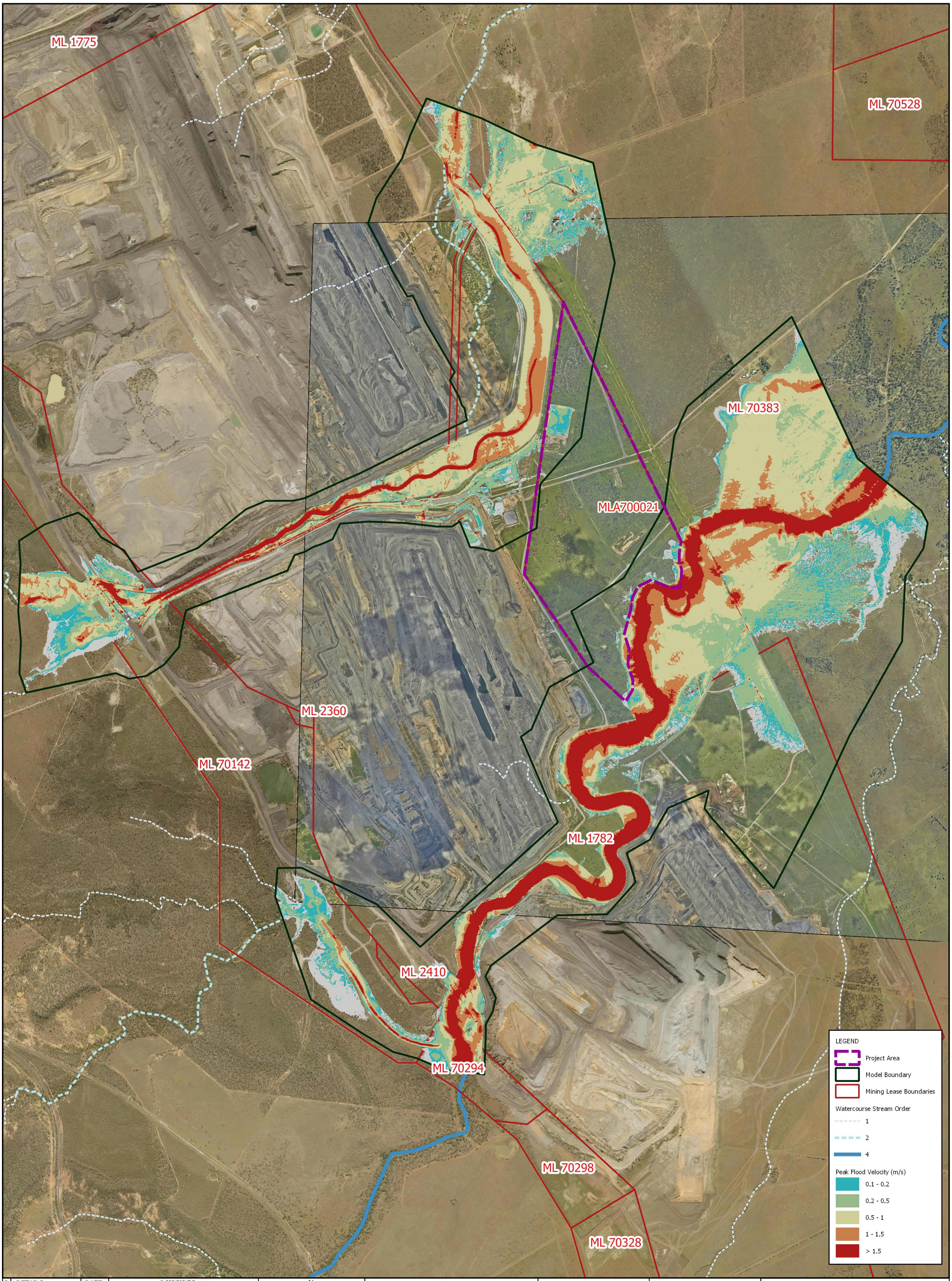
Figure 5

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Base Case 0.1% AEP Flood Depth

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS.qgz



R	DETAILS	DATE
1	Final Issue	03-05-2024

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	03-05-2024

NOTES:

N

0 0.2 0.4 km

SCALE @ A3 - 1:28,000
AGD66 / AMG 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

BMA
BHP Mitsubishi Alliance

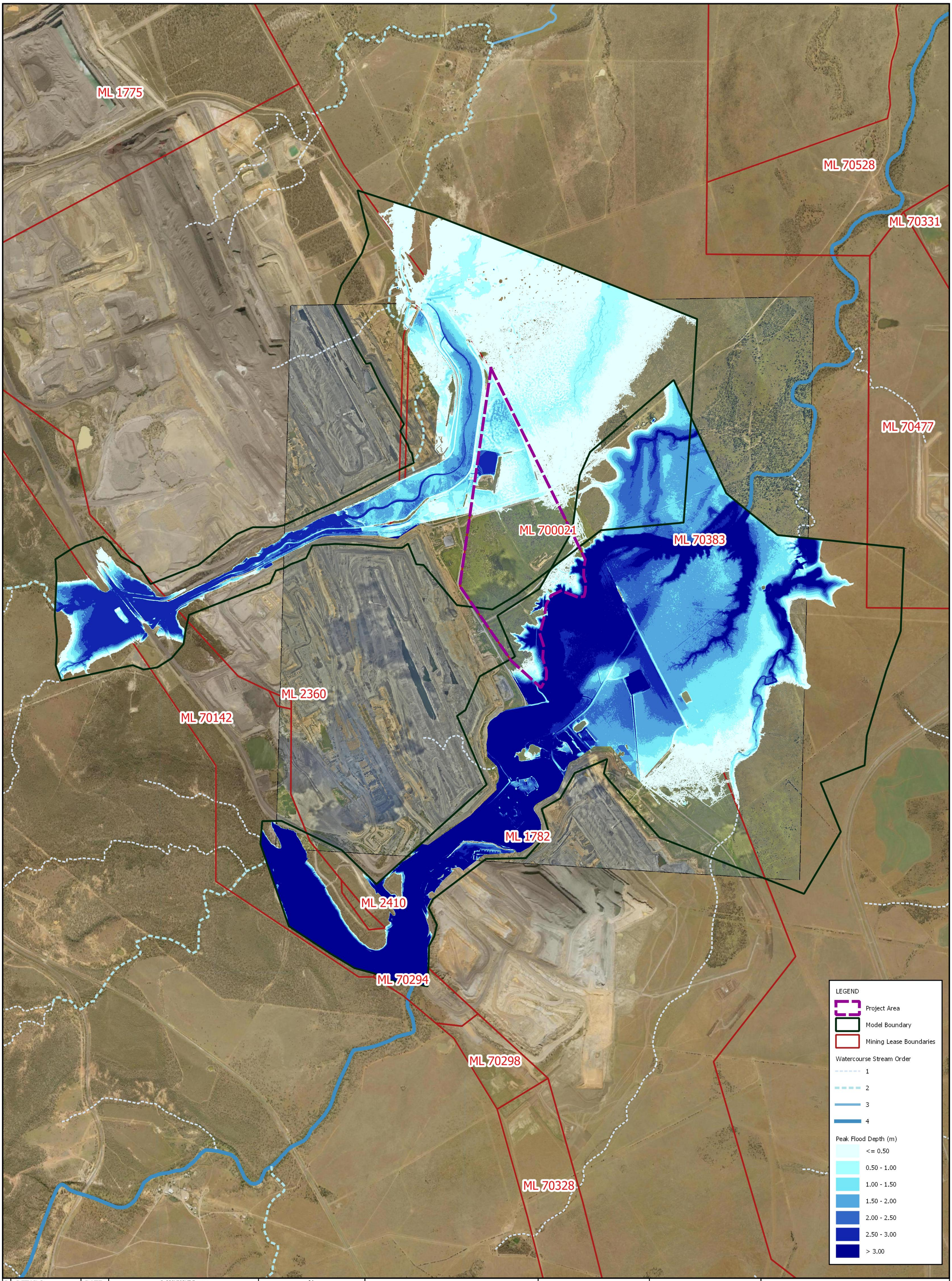
Figure 6

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Base Case 0.1% AEP Flood Velocity

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS.qgz



R	DETAILS	DATE
1	Final Issue	23-05-2024

© COPYRIGHT Engeny
This drawing is confidential and shall only be used for the purpose of this project.

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	23-05-2024

NOTES:

N
0 0.3 0.6 km
SCALE @ A3 - 1:35,000
AGD66 / AMG 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

BMA
BHP Mitsubishi Alliance

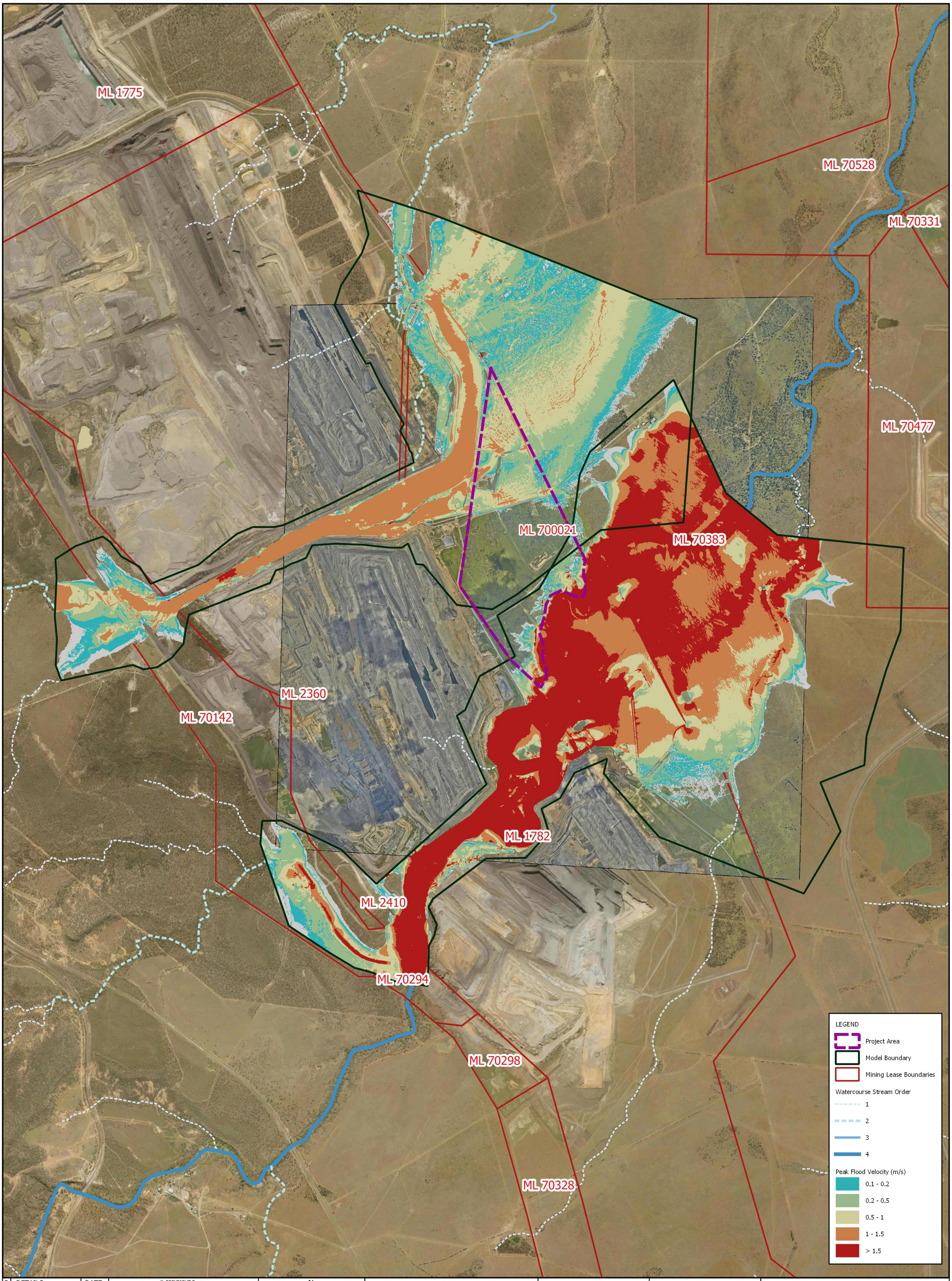
Figure 7

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Base Case Probable Maximum Flood Depth

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS_FIGURES.qgz



R	DETAILS	DATE
1	Final Issue	23-05-2024

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	23-05-2024

NOTES:

N

0 0.3 0.6 km

SCALE @ A3 - 1:35,000
AGD66 / AMG 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

BMA
BHP Mitsubishi Alliance

Figure 8

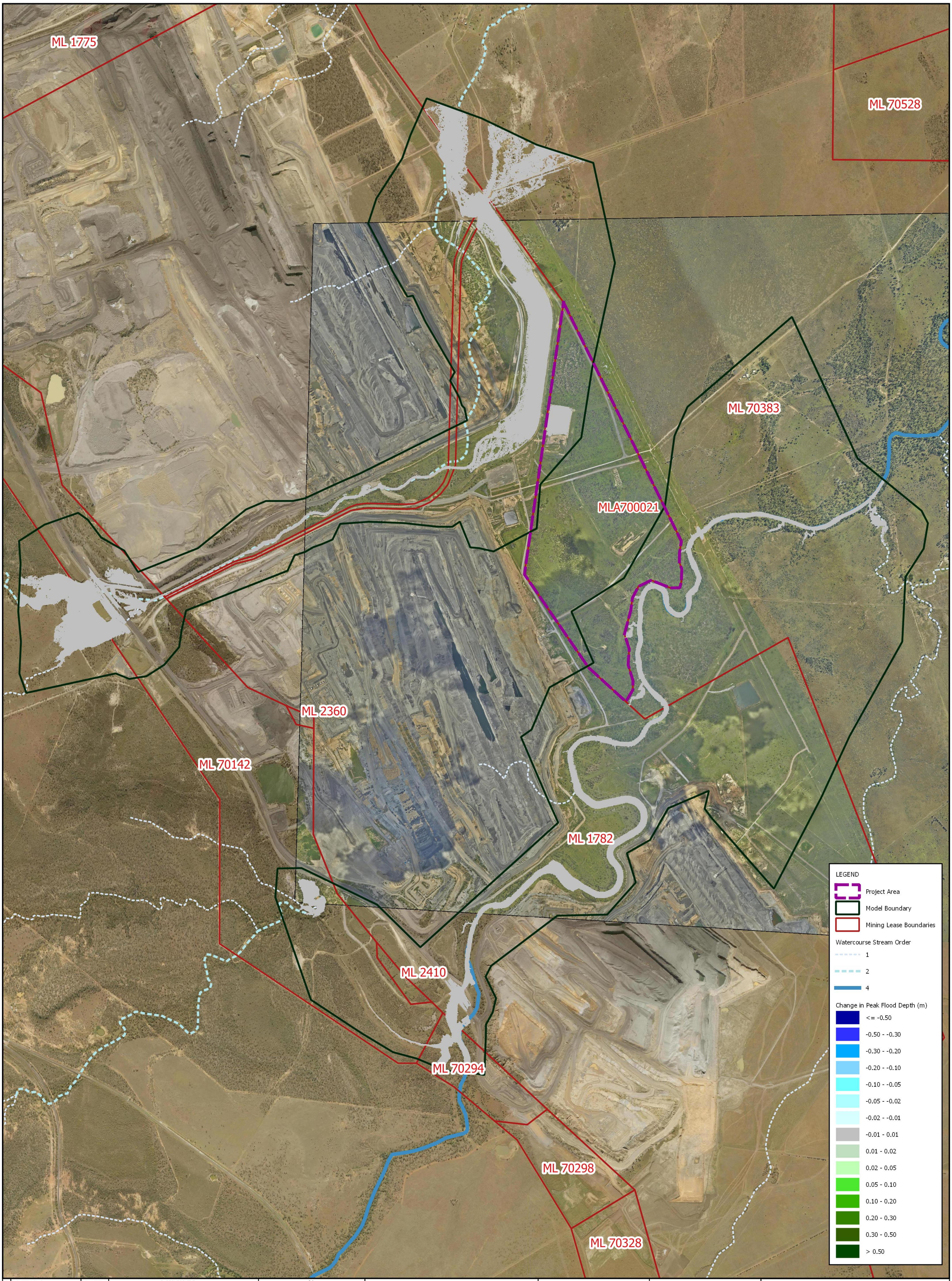
BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Base Case Probable Maximum Flood Velocity

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS_FIGURES.qgz

APPENDIX B: FLOOD IMPACT MAPPING



R	DETAILS	DATE
1	Final Issue	03-05-2024

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	03-05-2024

NOTES:

N

0 0.2 0.4 km

SCALE @ A3 - 1:28,000
AGD66 / AMG 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

BMA
BHP Mitsubishi Alliance

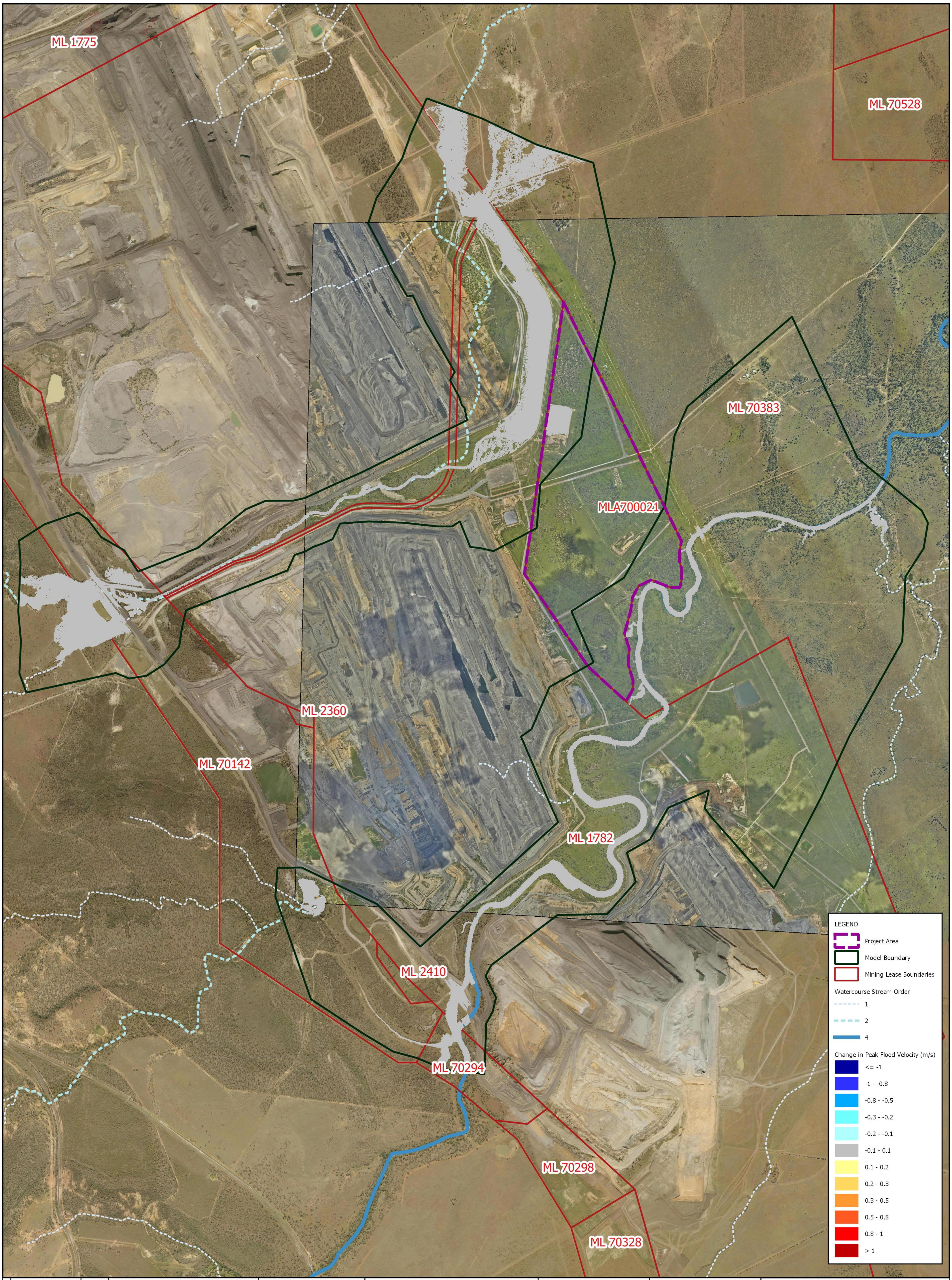
Figure 9

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Change in 10% AEP Flood Depth

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS.qgz



R	DETAILS	DATE
1	Final Issue	03-05-2024

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	03-05-2024

NOTES:

N

0 0.2 0.4 km

SCALE @ A3 - 1:28,000
AGD66 / AMG 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

BMA
BHP Mitsubishi Alliance

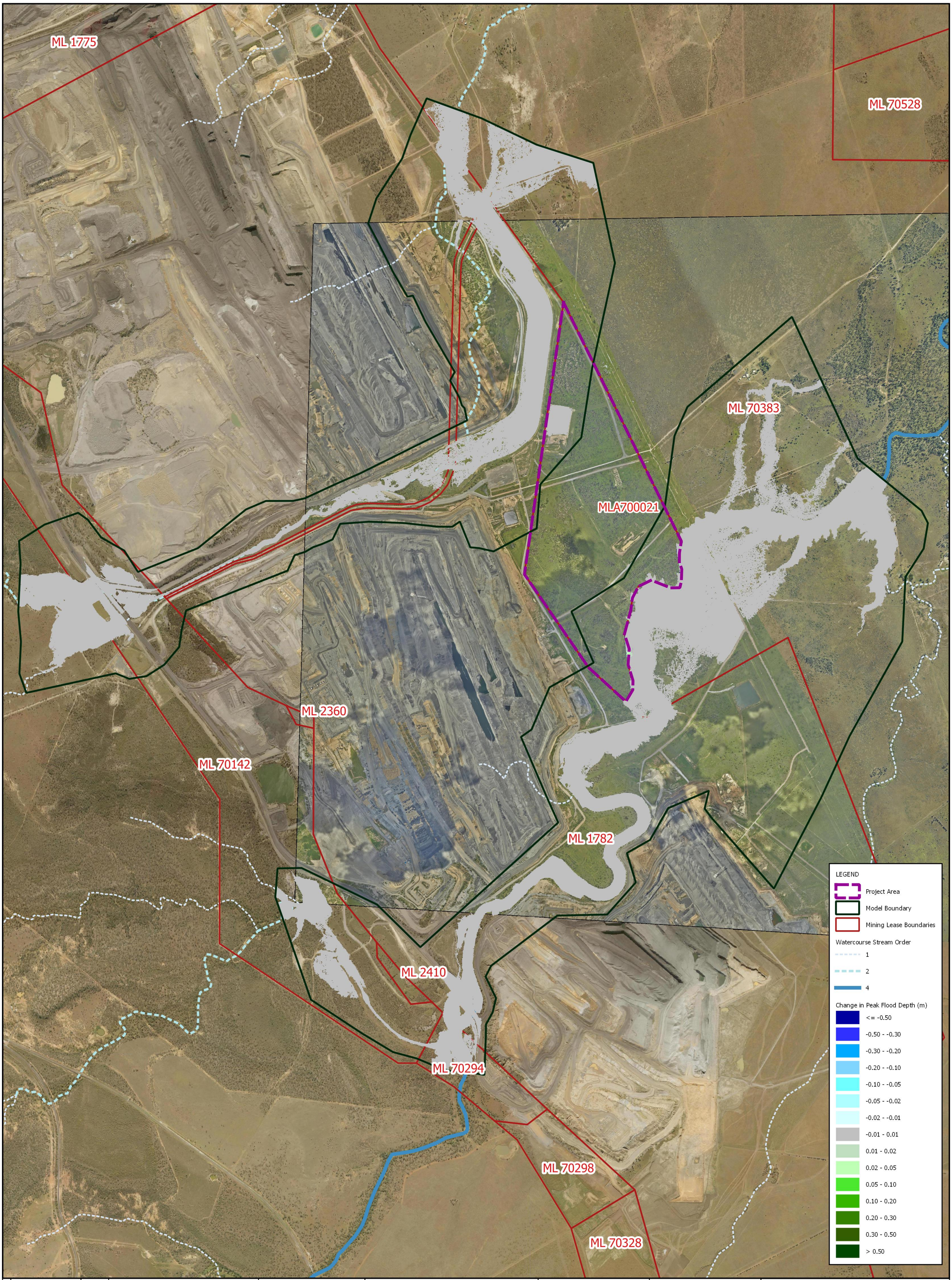
Figure 10

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Change in 10% AEP Flood Velocity

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS.qgz



R	DETAILS	DATE
1	Final Issue	03-05-2024

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	03-05-2024

NOTES:

N

0 0.2 0.4 km

SCALE @ A3 - 1:28,000
AGD66 / AMG 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

BMA
BHP Mitsubishi Alliance

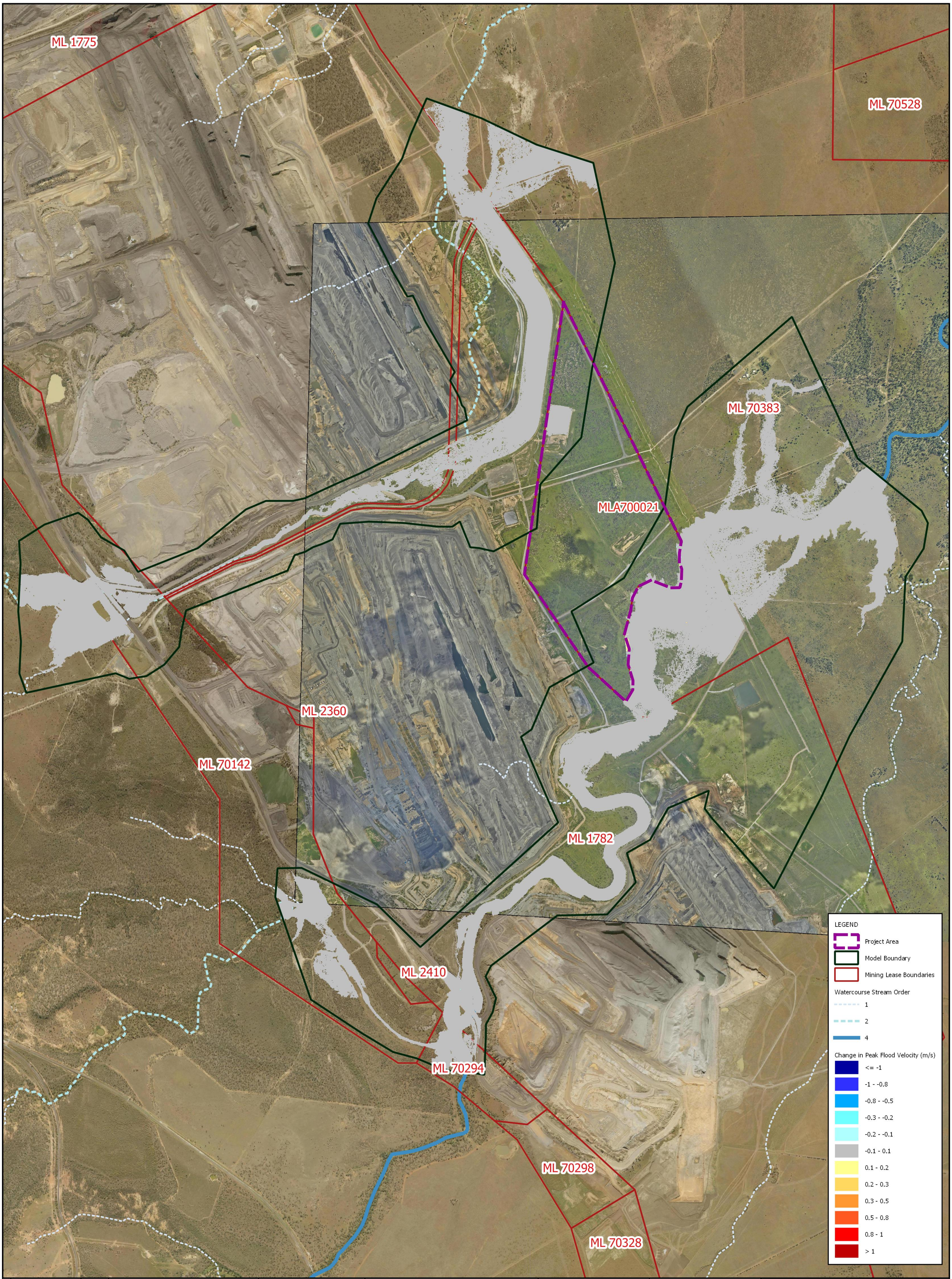
Figure 11

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Change in 1% AEP Flood Depth

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS.qgz



R	DETAILS	DATE
1	Final Issue	03-05-2024

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	03-05-2024

NOTES:

N

0 0.2 0.4 km

SCALE @ A3 - 1:28,000
AGD66 / AMG 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

BMA
BHP Mitsubishi Alliance

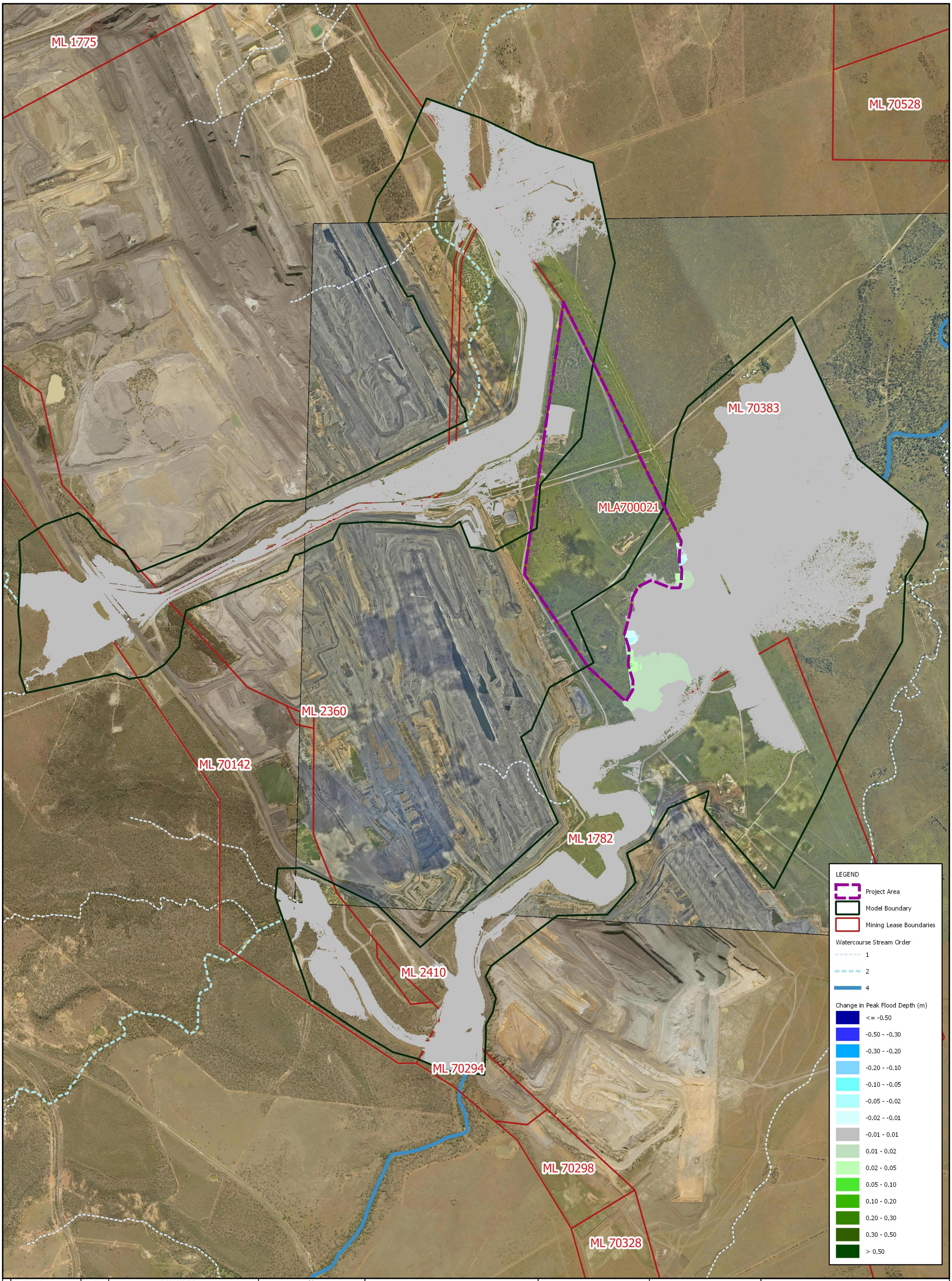
Figure 12

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Change in 1% AEP Flood Velocity

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS.qgz



R	DETAILS	DATE
1	Final Issue	03-05-2024

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	03-05-2024

NOTES:

N

0 0.2 0.4 km

SCALE @ A3 - 1:28,000
AGD66 / AMG 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

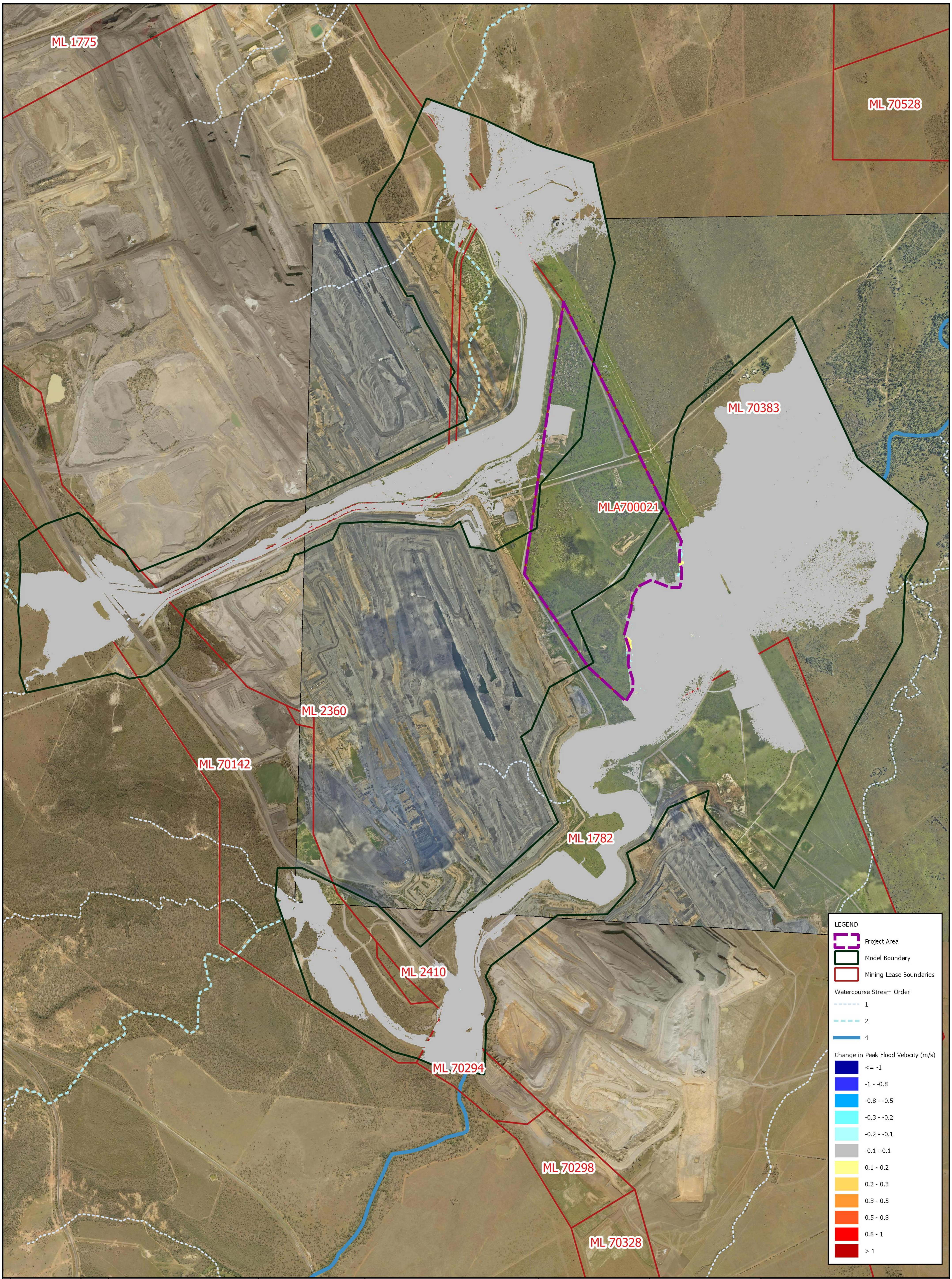
BMA
BHP Mitsubishi Alliance

Figure 13
BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Change in 0.1% AEP Flood Depth

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS.qgz



R	DETAILS	DATE
1	Final Issue	07-05-2024

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	07-05-2024

NOTES:

SCALE @ A3 - 1:28,000
AGD66 / AMG 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

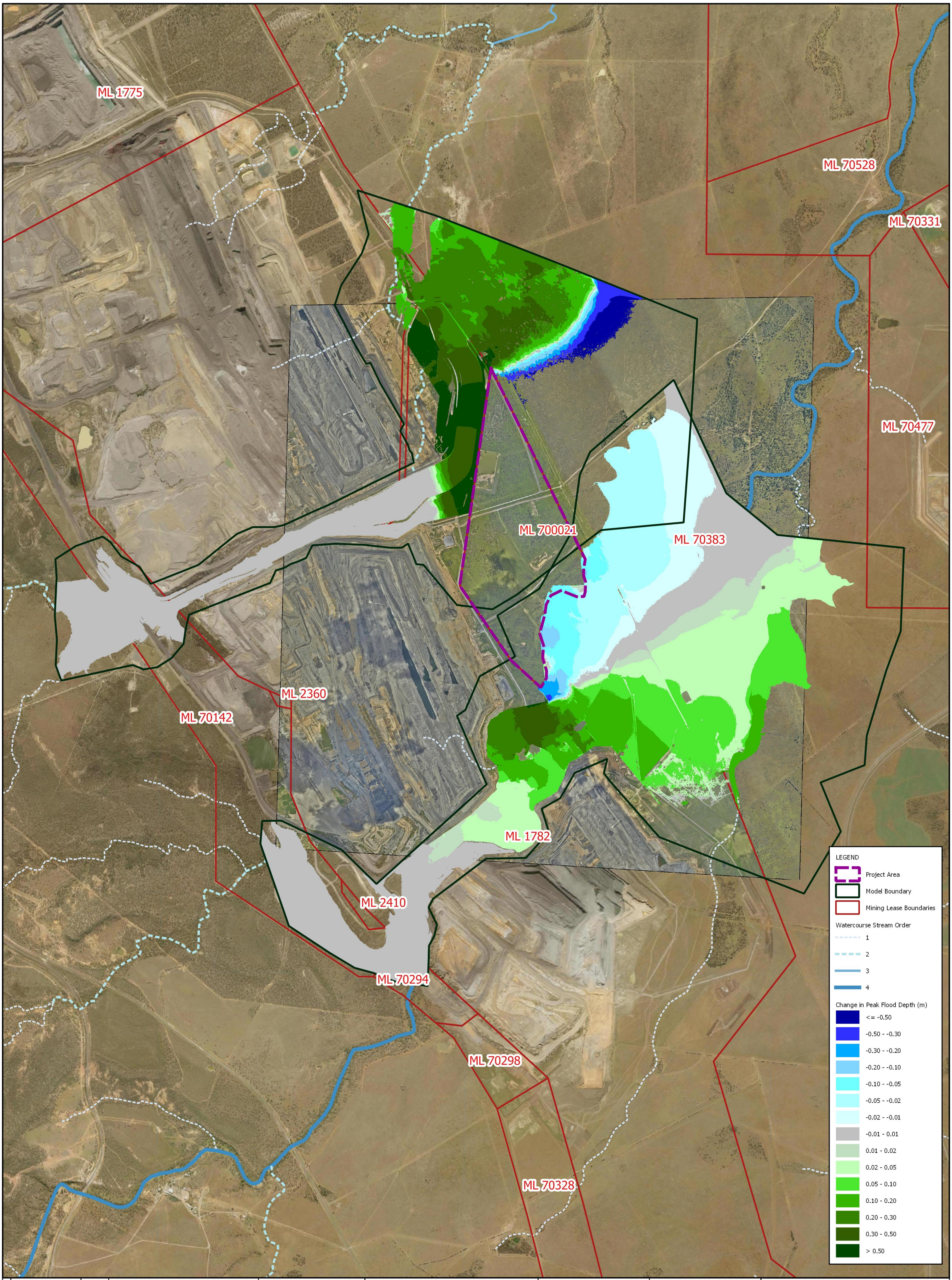
BMA
BHP Mitsubishi Alliance

Figure 14
BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Change in 0.1% AEP Flood Velocity

Drg Ref.

\\online.com\files\BNEManagement\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS.qgz



R	DETAILS	DATE
1	Final Issue	23-05-2024

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	23-05-2024

NOTES:

N

0 0.3 0.6 km

SCALE @ A3 - 1:35,000
AGD66 / AMG 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

BMA
BHP Mitsubishi Alliance

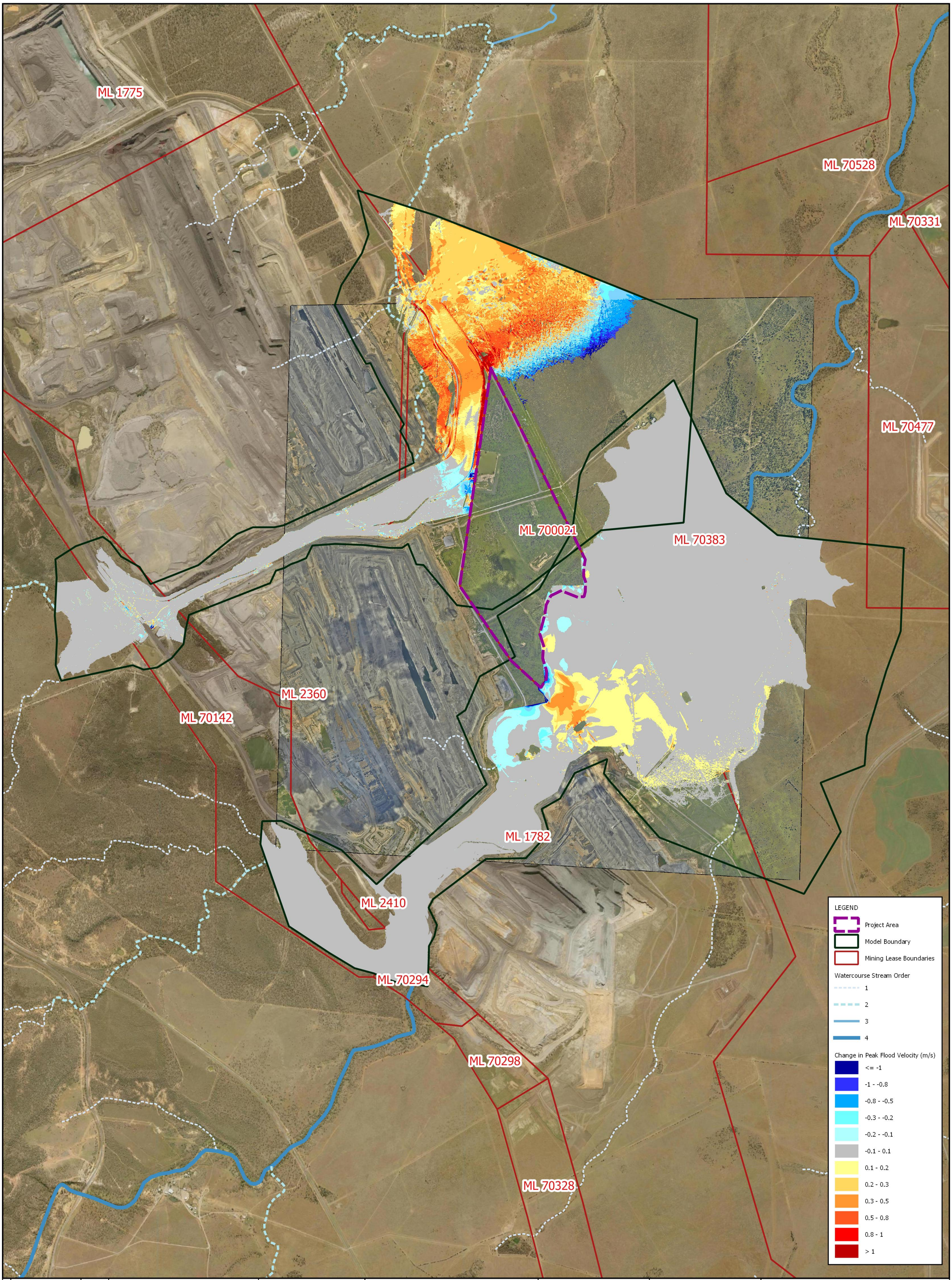
Figure 15

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Change in Probable Maximum Flood Depth

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS_FIGURES.qgz



R	DETAILS	DATE
1	Final Issue	24-05-2024

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	24-05-2024

NOTES:

N
0 0.3 0.6 km
SCALE @ A3 - 1:35,000
AGD66 / AMG 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

BMA
BHP Mitsubishi Alliance

Figure 16

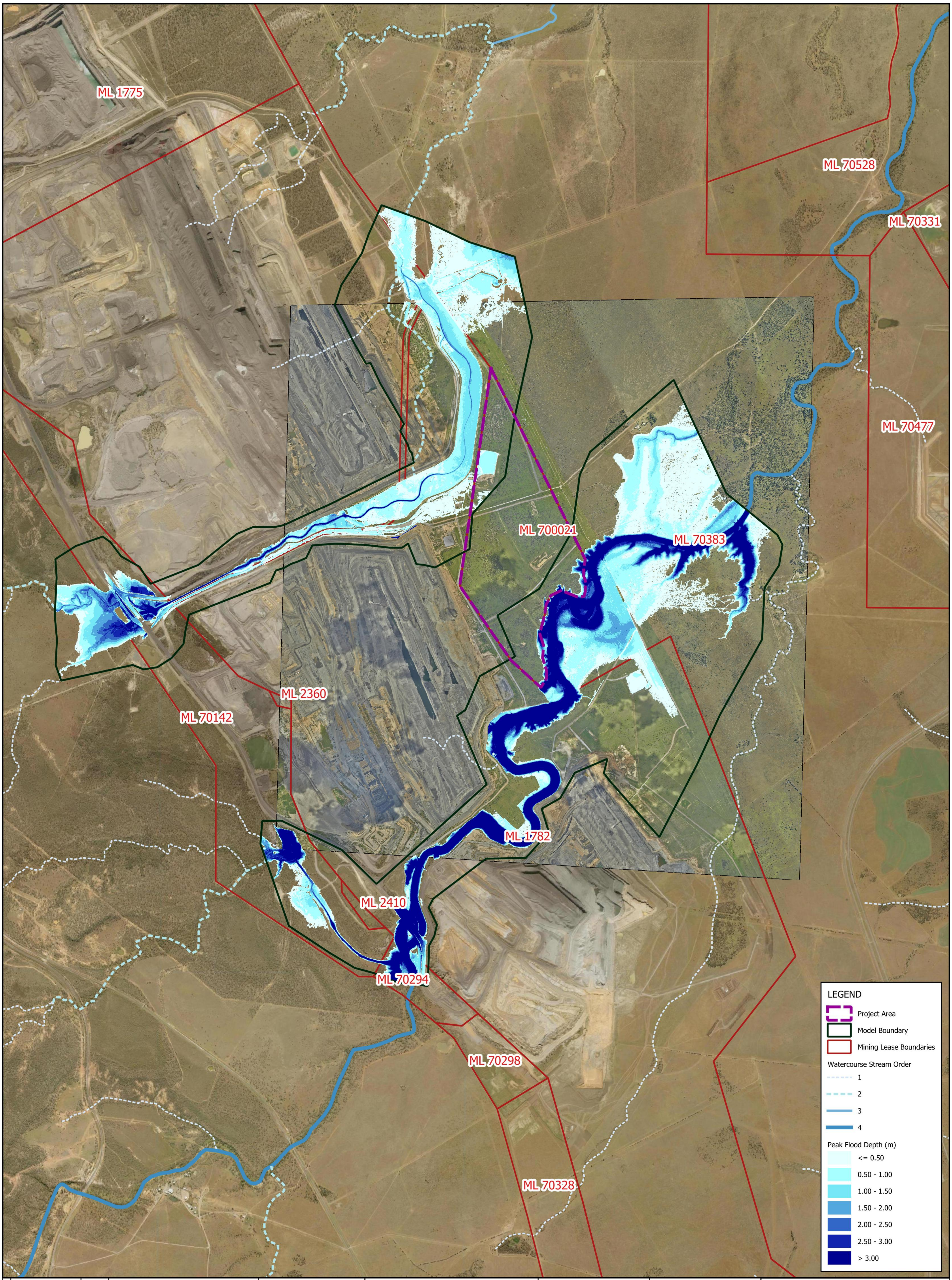
BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Change in Probable Maximum Flood Velocity

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS_FIGURES.qgz

APPENDIX C: CLIMATE CHANGE SENSITIVITY



R	DETAILS	DATE
1	Final Issue	01-08-2025

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	01-08-2025

NOTES:

N

0 0.3 0.6 km

SCALE @ A3 - 1:35,000
AGD66 / AMG 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

BMA
BHP Mitsubishi Alliance

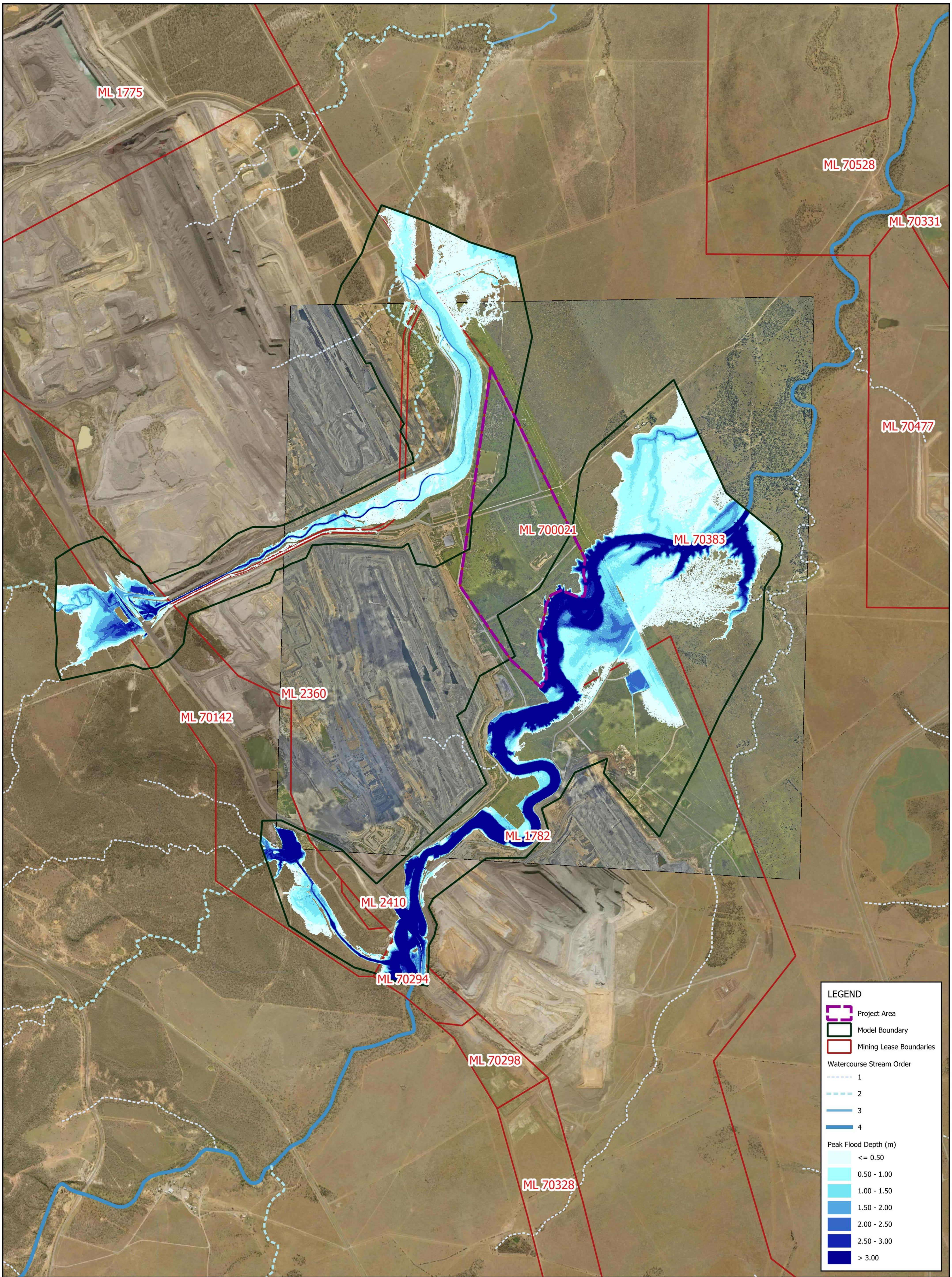
Figure 1

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Base Case 1% AEP Flood Depth
Climate Change Sensitivity (SSP2-4.5)

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS_FIGURES.qgz



R	DETAILS	DATE
1	Final Issue	01-08-2025

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	01-08-2025

NOTES:

SCALE @ A3 - 1:35,000
AGD66 / AMG 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

BMA
BHP Mitsubishi Alliance

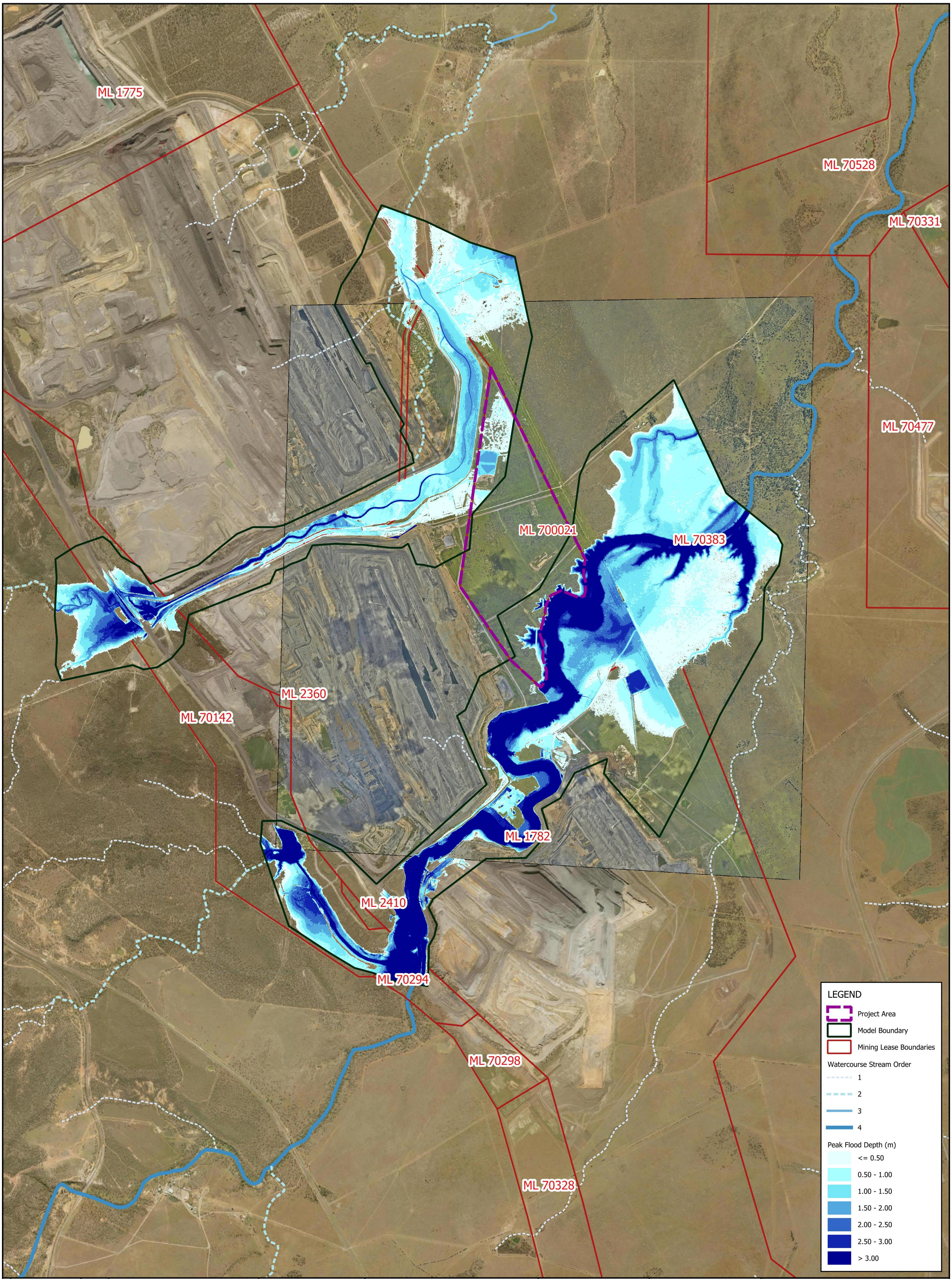
Figure 2

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Base Case 1% AEP Flood Depth
Climate Change Sensitivity (SSP5-8.5)

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS_FIGURES.qgz



R	DETAILS	DATE
1	Final Issue	01-08-2025

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	01-08-2025

NOTES:

N

0 0.3 0.6 km

SCALE @ A3 - 1:35,000
AGD66 / AMG zone 55

DATA SOURCE
QLD Government Open Data Source

ENGENY

BMA
BHP Mitsubishi Alliance

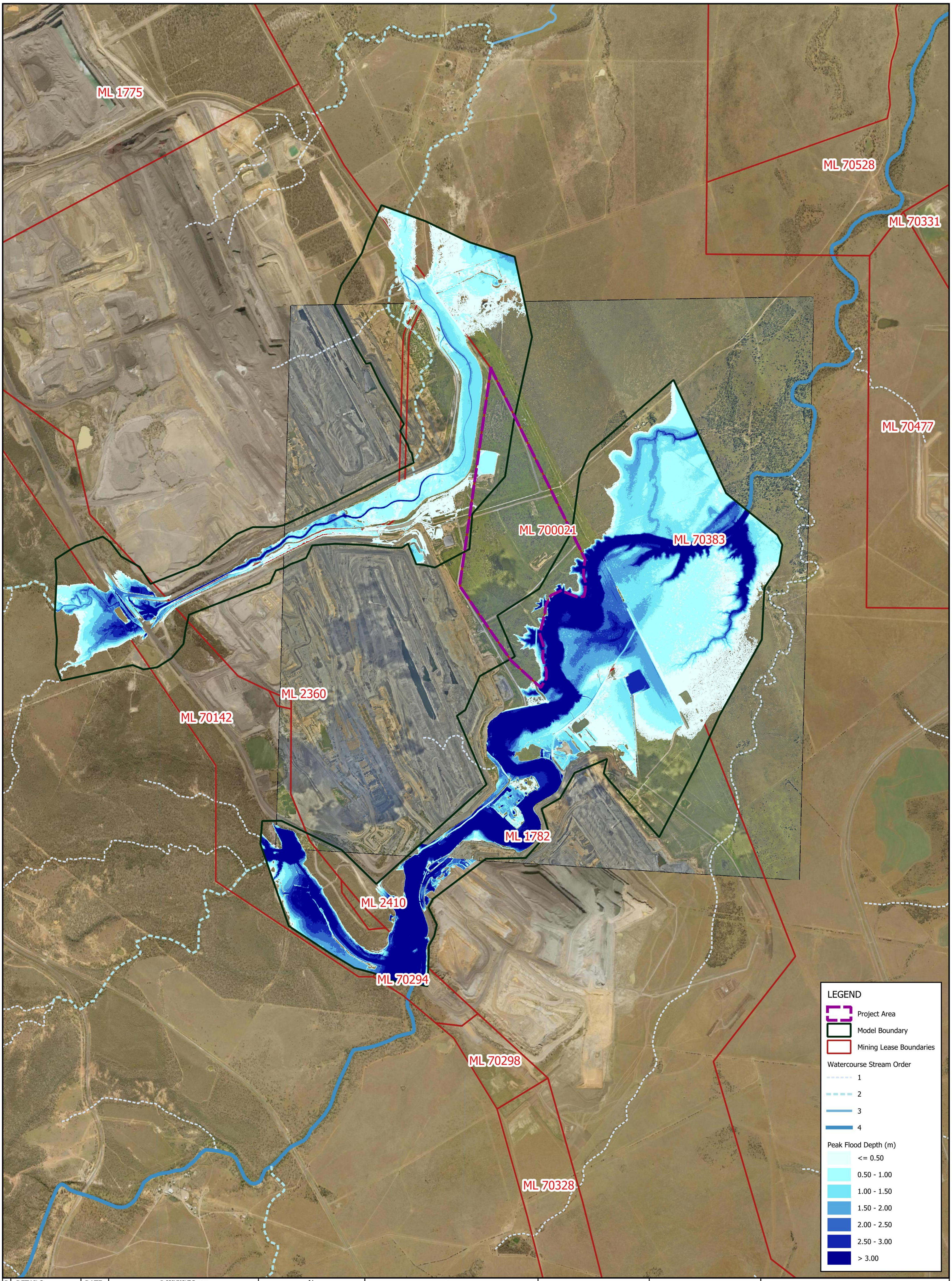
Figure 3

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Base Case 0.1% AEP Flood Depth
Climate Change Sensitivity (SSP2-4.5)

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS_FIGURES.qgz



R	DETAILS	DATE
1	Final Issue	01-08-2025

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	01-08-2025

NOTES:

N

0 0.3 0.6 km

SCALE @ A3 - 1:35,000
AGD66 / AMG 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

BMA
BHP Mitsubishi Alliance

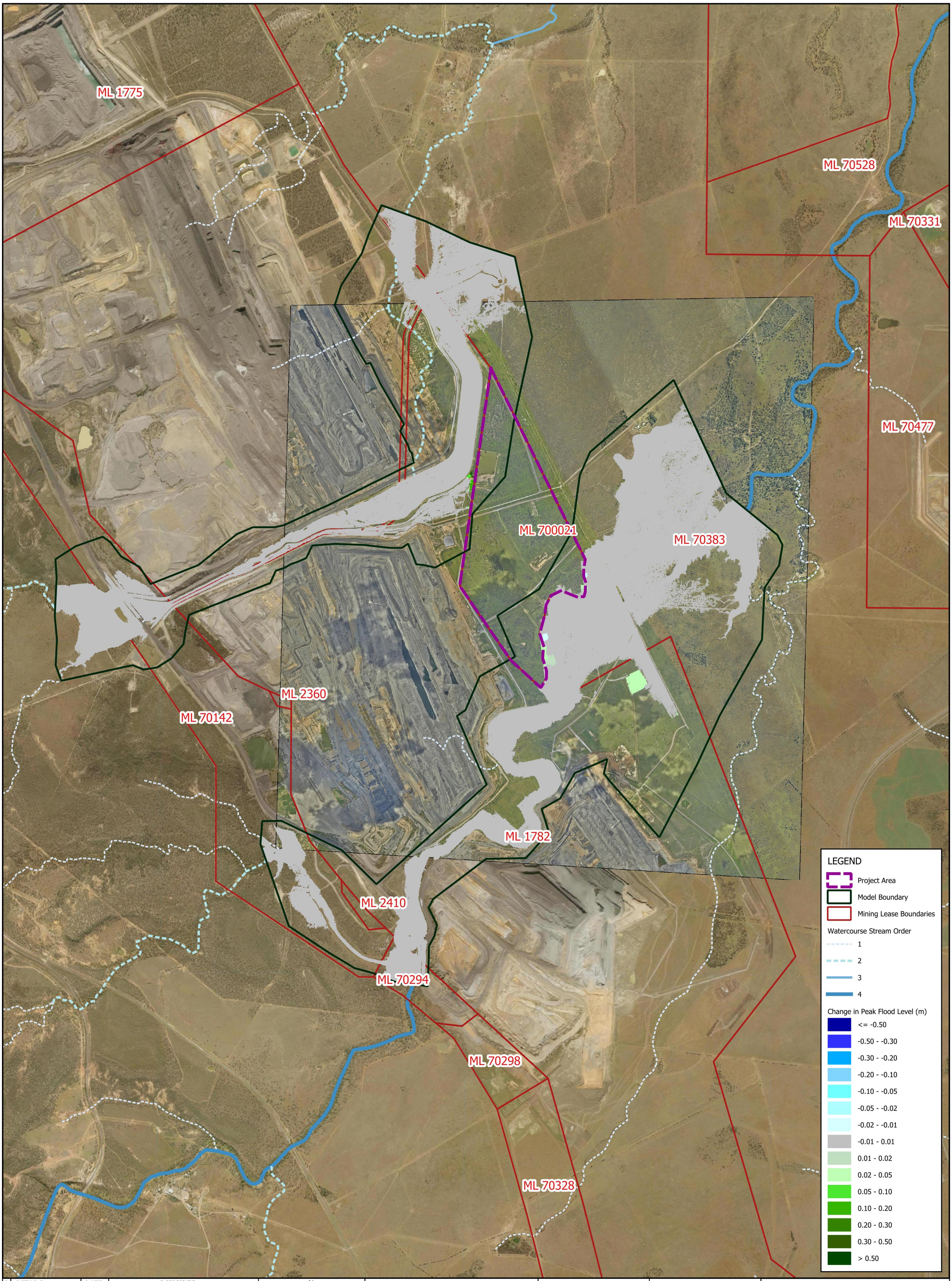
Figure 4

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Base Case 0.1% AEP Flood Depth
Climate Change Sensitivity (SSP5-8.5)

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS_FIGURES.qgz



R	DETAILS	DATE
1	Final Issue	01-08-2025

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	01-08-2025

NOTES:

N

0 0.3 0.6 km

SCALE @ A3 - 1:35,000
AGD66 / AMG 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

BMA
BHP Mitsubishi Alliance

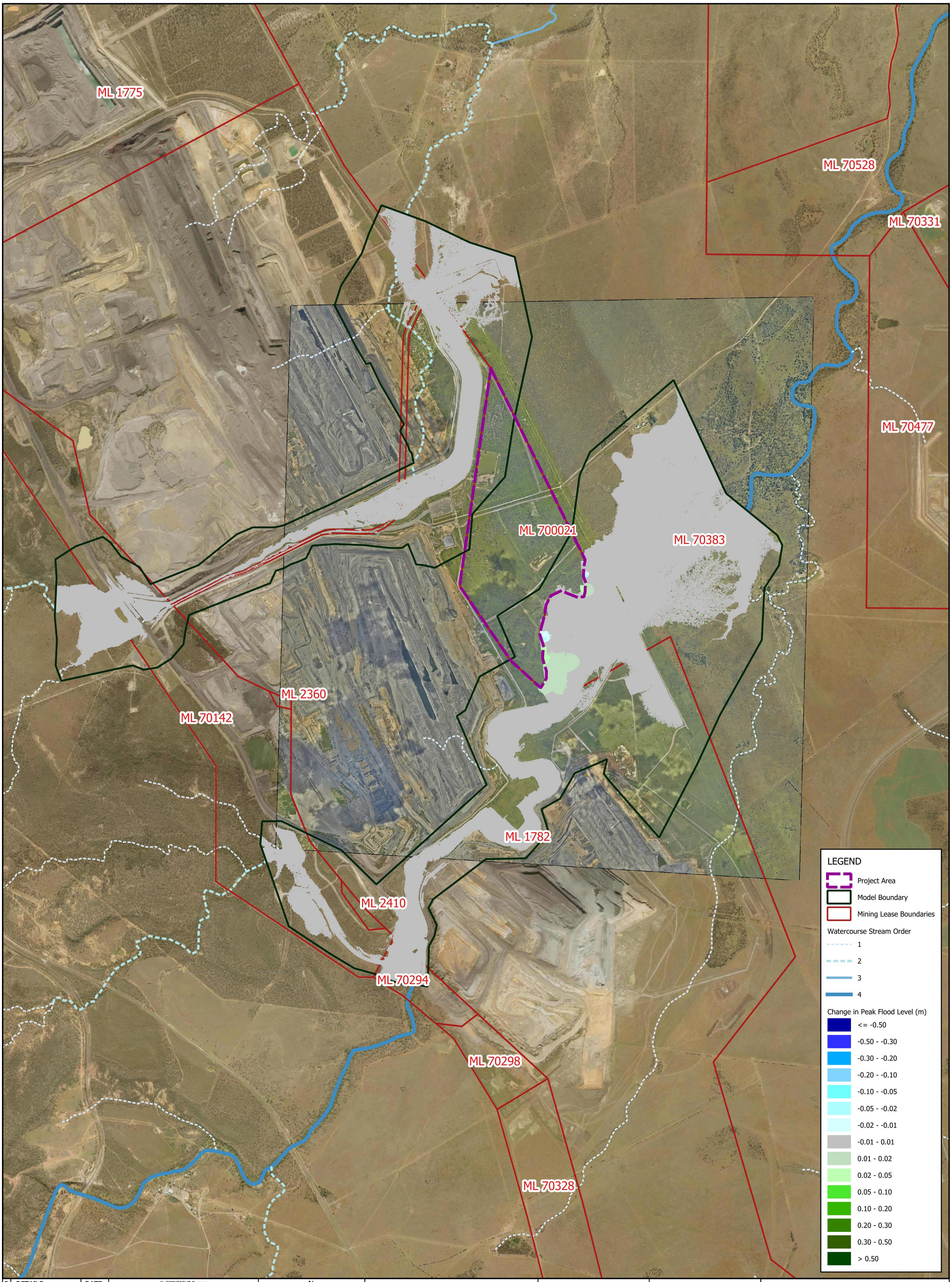
Figure 5

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Change in 1% AEP Flood Level
Climate Change Sensitivity (SSP2-4.5)

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS_FIGURES.qgz



R	DETAILS	DATE
1	Final Issue	01-08-2025

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	01-08-2025

NOTES:

N

0 0.3 0.6 km

SCALE @ A3 - 1:35,000
AGD66 / AMG 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

BMA
BHP Mitsubishi Alliance

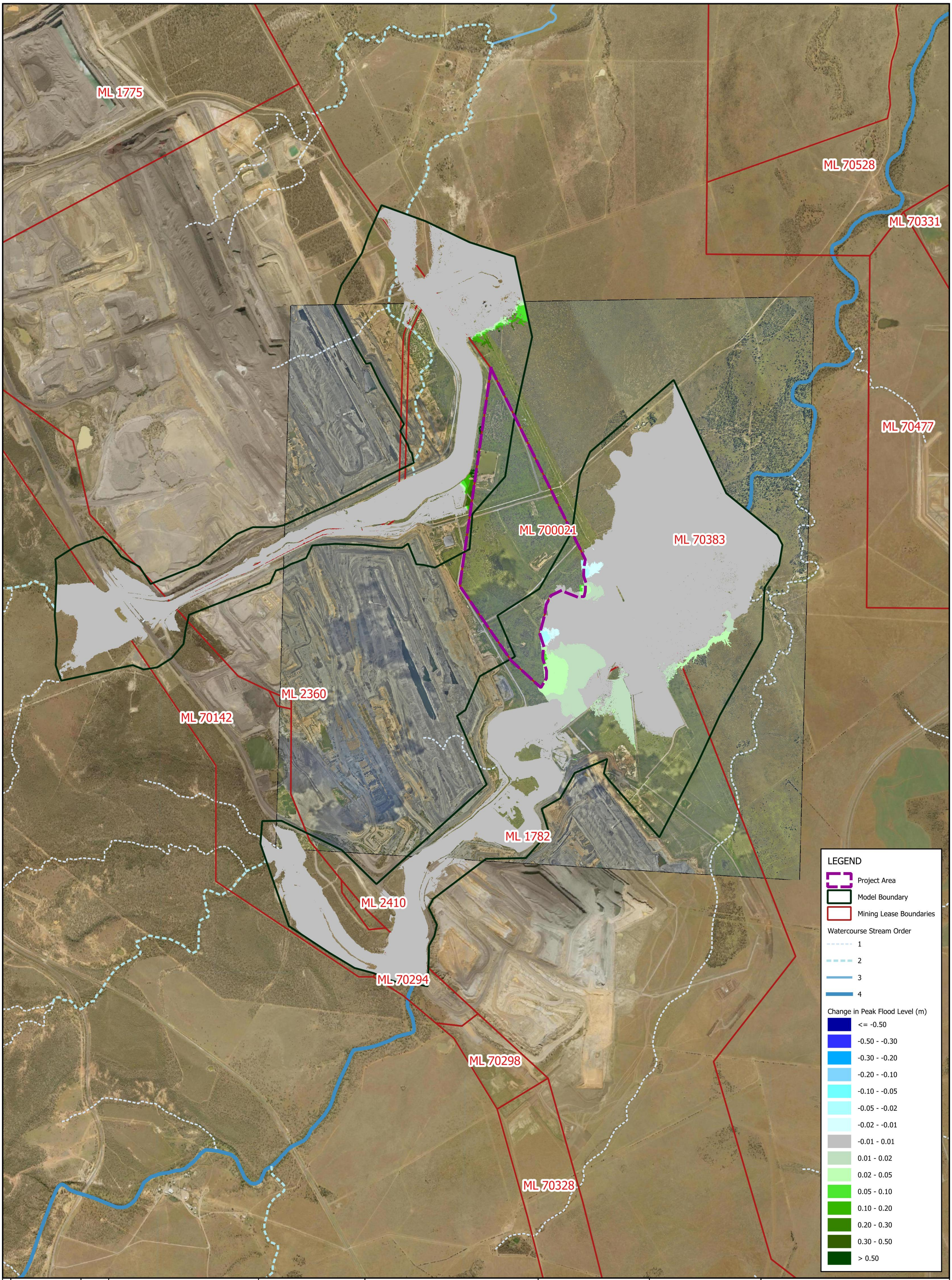
Figure 6

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Change in 1% AEP Flood Level
Climate Change Sensitivity (SSP5-8.5)

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS_FIGURES.qgz



R	DETAILS	DATE
1	Final Issue	01-08-2025

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	01-08-2025

NOTES:

N
0 0.3 0.6 km
SCALE @ A3 - 1:35,000
AGD66 / AMG zone 55

DISCLAIMER
Engeny has endeavoured to ensure accuracy and completeness of the data. Engeny accepts 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

BMA
BHP Mitsubishi Alliance

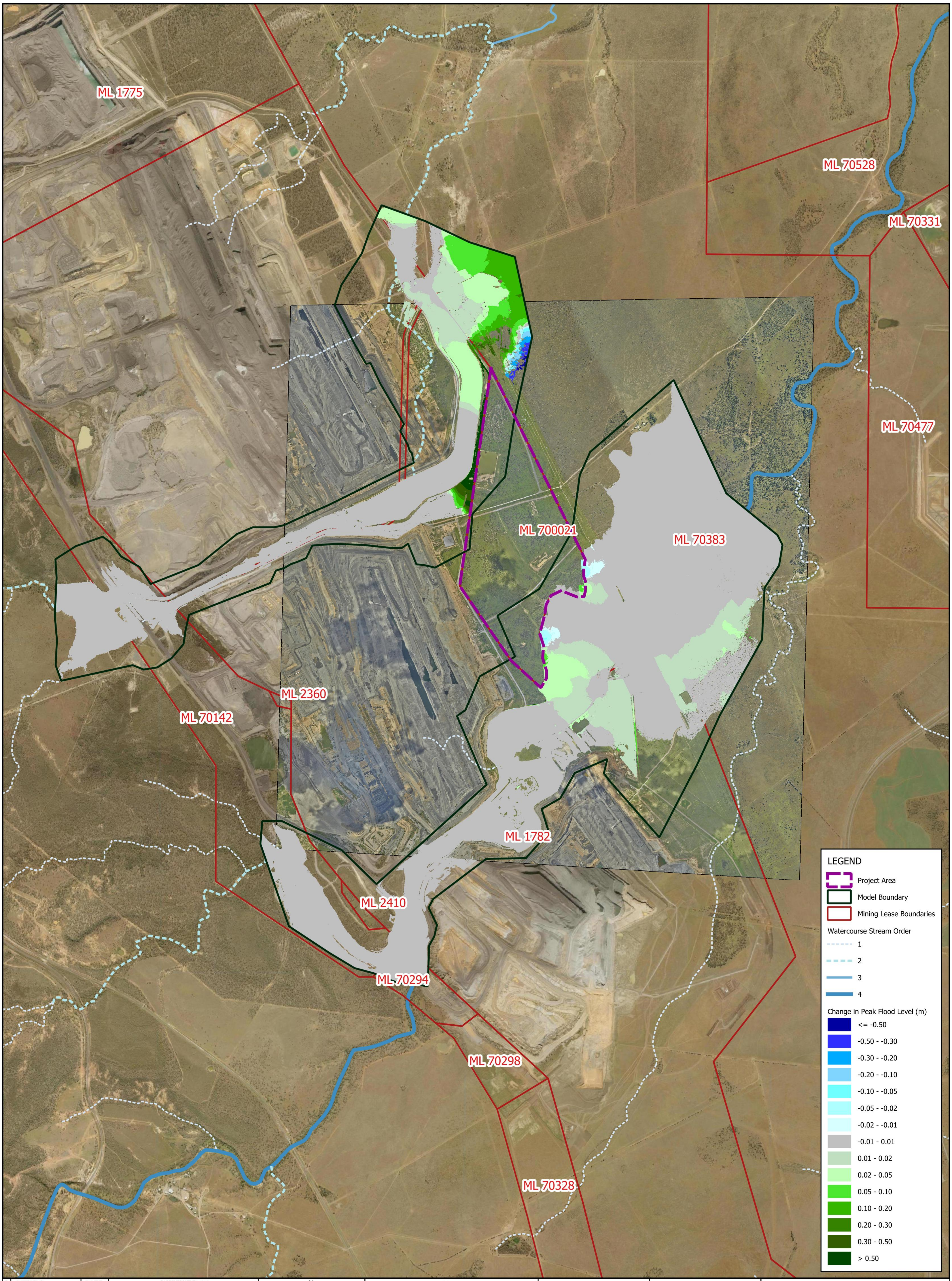
Figure 7

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Change in 0.1% AEP Flood Level
Climate Change Sensitivity (SSP2-4.5)

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS_FIGURES.qgz



R	DETAILS	DATE
1	Final Issue	01-08-2025

DRAWN	SS	CHECKED	AB
APPROVED	AB	DATE	01-08-2025

NOTES:

N

0 0.3 0.6 km

SCALE @ A3 - 1:35,000
AGD66 / AMG zone 55

DATA SOURCE
QLD Government Open Data Source

ENGENY

BMA
BHP Mitsubishi Alliance

Figure 8

BM Alliance Coal Operations Pty Ltd
Saraji Mine Grevillea Pit Continuation Project
Surface Water Assessment

Change in 0.1% AEP Flood Level
Climate Change Sensitivity (SSP5-8.5)

Drg Ref.

Q:\Projects\QC1000 BHP (BMA)\QC1000_216 Saraji EPBC Approval\05 Design\QGIS\Workspaces\QC1000_216_Saraji EPBC Approval_Flood Assessment_SJS_FIGURES.qgz