CENTENNIAL

Water Management Plan

Charbon Colliery

October 2021

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DOCUMENT CONTROL

DOCUMENT DETAILS	Name:	Charbon Colliery Water Management Plan
	Author:	Lachlan Hammersley; Tyler Tinkler (GHD Pty Ltd)
	Revision No.:	4
	Document Status	Draft for review

DETAILS OF CHANGE

Revision	Trigger	Date	Brief details of change
1	PA 08_0211	02/10/2012	Initial WMP
2	Transition to closure and maintenance	27/02/2017	Remove elements relevant only to active mining operations
3	PA 08_0211 MOD1	30/10/2019	Reflect MOD1 conditions Reflect changes to EPL Update baseline data Derive SSGVs Reflect changes to water management
4	PA 08_0211 MOD2, 2021 Independent Environmental Audit	25/10/2021	Reflect MOD2 conditions Update baseline data Update of current site activities

Glossary

Alkalinity	A measure of the ability of an aqueous solution to neutralise acids. Alkalinity of natural waters is due primarily to the presence of hydroxides, bicarbonates and carbonates. It is expressed in units of calcium carbonate ($CaCO_3$).
Alluvial	Deposition from running waters.
Aquifer	An underground layer of permeable material from which groundwater can be usefully extracted.
Baseline monitoring	Monitoring conducted over time to collect a body of information to define specific characteristics of an area (e.g. species occurrence or water quality) prior to the commencement of a specific activity.
Bore	Constructed connection between the surface and a groundwater source that enables groundwater to be transferred to the surface either naturally or through artificial means.
BTEX	Refers to the chemicals benzene, toluene, ethylbenzene and xylene. These compounds occur naturally in crude oil.
Catchment	The land area draining through the main stream, as well as tributary streams, to a particular location.
Clean water	Water that has not come into physical contact with coal or mined carbonaceous material.
Dewatering	The removal or pumping of water from a surface water storage.
Dirty water	Water that has an elevated sediment load.
Discharge rate	The quantity of water per unit of time flowing in a stream, for example cubic metres per second or megalitres per day.
Electrical conductivity	A measure of the concentration of dissolved salts in water.
Geomorphology	Scientific study of landforms, their evolution and the processes that shape them. In this report relates to the form and structure of waterways.
Groundwater	Water occurring naturally below ground level.
Guideline	A numerical concentration or narrative statement that provides appropriate guidance for a designated water use or impact.
Ion	Electrically charged atom.
Licensed discharge point	A location where the premises discharge water in accordance with conditions stipulated within the site Environment Protection License.
Median	The middle value, such that there is an equal number of higher and

	lower values. Also referred to as the 50th percentile.
Percentile	The value of a variable below which a certain percent of observations fall. For example, the 80th percentile is the value below which 80 percent of values are found.
pH	The value taken to represent the acidity or alkalinity of an aqueous solution. It is defined as the negative logarithm of the hydrogen ion concentration of the solution.
Potable water	Water of a quality suitable for drinking.
Riparian	Pertaining to, or situated on, the bank of a river or other water body.
Runoff	The amount of rainfall which actually ends up as streamflow, also known as rainfall excess.
Run of mine	Raw coal production (unprocessed).
Sediment	Soil or other particles that settle to the bottom of lakes, rivers, oceans and other waters.
Surface water	Water that is derived from precipitation or pumped from underground and may be stored in dams, rivers, creeks and drainage lines.
Tributary	A stream or river that flows into a main river or lake.
Trigger value	The concentration or load of physicochemical characteristics for surface waters that have been determined as appropriate for the discharge to surface waters. These values may be determined based on background concentrations or guideline values for aquatic ecosystem protection. They indicate a risk of impact if exceeded and should ‘trigger’ action to conduct further investigations or to implement management or remedial processes.
Turbidity	A measure of clarity (turbidity) of water. Turbidity in excess of 5 NTU is just noticeable to the average person.

Abbreviations

BOM	Bureau of Meteorology
Centennial	Centennial Coal Company Limited
Charbon	Charbon Colliery
CHPP	Coal handling and processing plant
DPIE	Department of Planning, Industry and Environment
DPIE Water	Department of Planning, Industry and Environment - Water
DPI Water	Department of Primary Industries Water, now DPIE Water
EC	Electrical conductivity
EPA	Environment Protection Authority
EPL	Environment protection licence
ESCP	Erosion and sediment control plan
GDE	Groundwater dependent ecosystem
ha	Hectare
km	Kilometre
L/s	Litre per second
LDP	Licensed discharge point
m	Metre
mg/L	Milligram per litre
Mining Act	Mining Act 1992
ML	Megalitre
ML/day	Megalitre per day
ML/year	Megalitre per year
mm	Millimetre
NRAR	Natural Resource Access Regulator
NTU	Nephelometric turbidity unit
OEH	Office of Environment and Heritage, now DPIE Environment, Energy and Science

PCD	Pollution control dam
REA	Reject emplacement area
ROM	Run of mine
RUSLE	Revised Universal Soil Loss Equation
RWMP	Regional Water Management Plan
SILO	Scientific Information for Land Owners
TARP	Trigger action response plan
TDS	Total dissolved solids
TSS	Total suspended solids
WAL	Water access licence
WMP	Water management plan
µS/cm	Microsiemens per centimetre

1. BACKGROUND

1.1 Introduction

Charbon Colliery (Charbon) is a closed underground (bord and pillar) and open cut coal mine, located approximately 87 km north-west of Lithgow and 3 km south of Kandos, as shown in Figure 1-1, in the Western Coalfield of NSW. The mine is owned and operated by Charbon Coal Pty Limited (Charbon Coal), a joint venture between Centennial Coal Company Limited (Centennial) and SK Networks Resources (Wyong) Australia Pty Ltd.

After over 90 years of mining, Charbon has depleted its coal reserves and has ceased mining coal. Underground coal production at Charbon ceased in April 2014 and open cut coal mining operations ceased in August 2015. Since 2015, activities have generally been related to decommissioning, rehabilitation and closure.

In September 2010, project approval for the continuation of operations at Charbon was granted by the NSW Planning Assessment Commission on behalf of the Minister for Planning under Part 3A of the *NSW Environmental Planning and Assessment Act 1979* (PA 08_0211). PA 08_0211 allowed for the extraction, processing and road transport of product coal during mining operations.

In July 2019, the Minister for Planning and Public Spaces approved Modification 1, to allow the transfer up to 170 ML/year of water to Airly Mine by rail.

In August 2021, the Minister for Planning and Public Spaces approved Modification 2, to allow Rail transfer of coarse coal reject material from Clarence Colliery to Charbon and the extension of rail water transfers from Charbon to Airly Mine.

An approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* also applies to the site as issued on 19 November 2010 by the then Commonwealth Department of Sustainability, Water, Populations and Communities for the continuation of operations at Charbon.

Charbon operates under 15 mining tenements issued under the NSW *Mining Act 1992* (Mining Act) and Environment Protection Licence (EPL) 528 issued under the *NSW Protection of the Environment Operations Act 1997*. Charbon currently covers an area of approximately 2,692 ha and consists of six former open cut areas; two former underground mining areas; a rail loop and loading facilities; and a coal handling and processing plant (CHPP). Key components of the mine are shown in Figure 1-2.

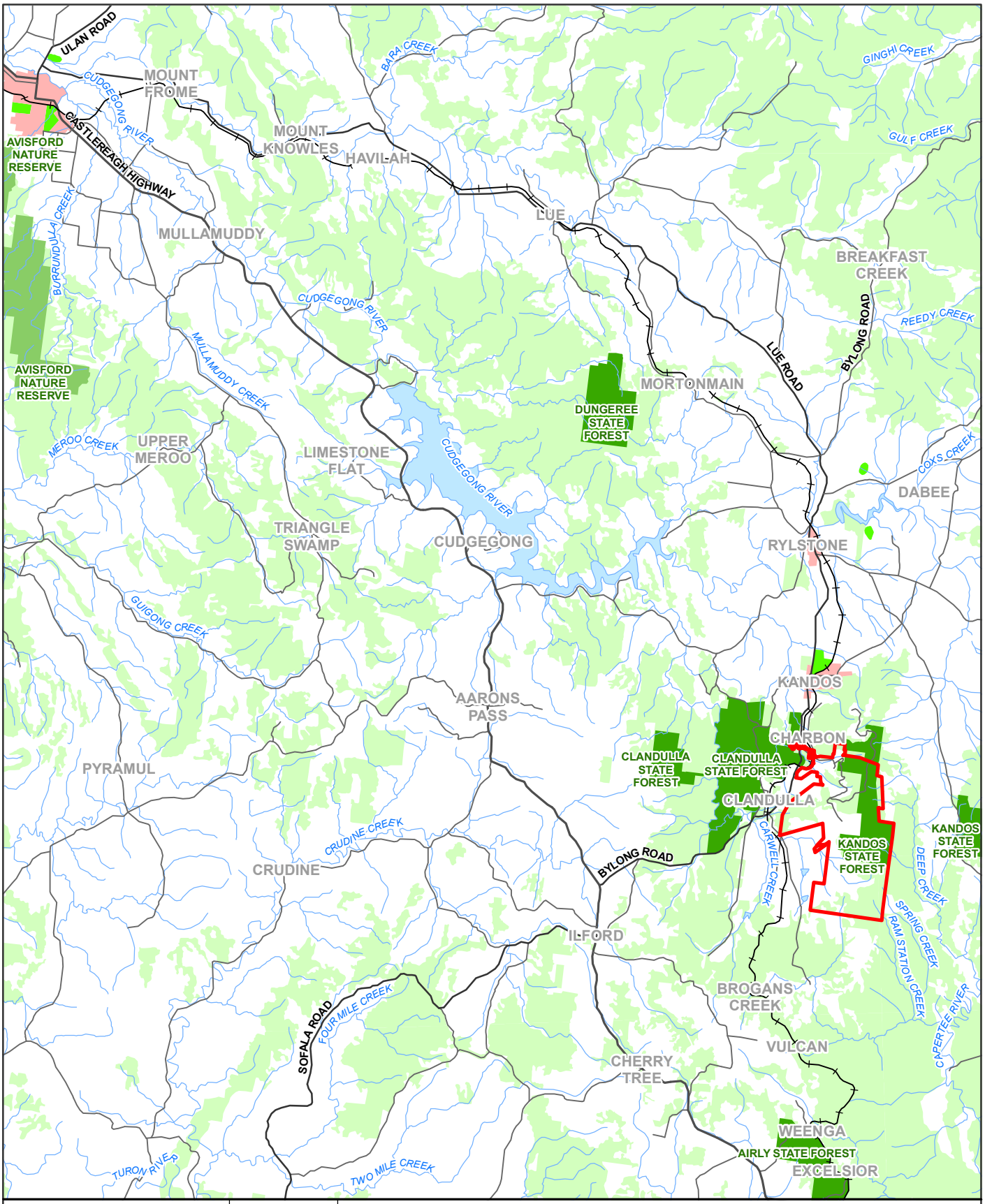
1.2 Project Description

Mining at the Charbon ceased in August 2015 and there is no future mining planned at the site, therefore activities are generally related to the decommissioning, rehabilitation and closure, including:

- Progressive rehabilitation to the proposed final landform that generally mimics the existing landform. This includes all activities through to the final establishment of the desired post mining vegetation communities including seeding and land management activities such as weed and feral animal control and bushfire management.
- Temporary stabilisation as required. Prior to the reestablishment of vegetation cover, temporary control measures will be utilised for erosion and sediment control.

- Decommissioning and demolition activities. Subject to the preparation of a demolition and disposal strategy all infrastructure will be decommissioned, demolished and removed from site with the exception of some connecting roads and tracks, which will be maintained for land management and firefighting access, as well as some dams and water management structures.
- Transfer of up to 170 ML/year of water to Airly Mine using rail transport via the Wallerawang – Gwabegar Rail Line.
- Movement of coal rejects from the Northern reject emplacement area (REA) to the Main REA, and initially cap Main REA Cell 4 as part of a capping trial to create a vegetated free draining cap as part of the ultimate closure works. Reject material would be sourced primarily from the Northern REA as required as part of the decommissioning of the Northern REA and form part of the capping material.
- Import and use of coarse coal reject from Centennial's Clarence Colliery in the backfilling of the Charbon open cut void.

No exploration, construction, mining operations, coal processing or coal transport activities are required or proposed.



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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

LEGEND

- Project Site Boundary
- Principal Road
- Secondary Road
- Minor Road
- Existing Rail
- Waterbody
- Built Up Area
- Recreation area
- Nature Conservation
- State Forest
- Forest Or Shrub
- Waterway

LOCATION	WCS
SEAM	Lithgow
DRAWN	GHD
CHECKED	TT
APPROVED	ZL
SCALE	refer to scalebar

Charbon Colliery
Water Management Plan

Locality plan

CENTENNIAL

DATE 16/09/2021

Figure 1-1

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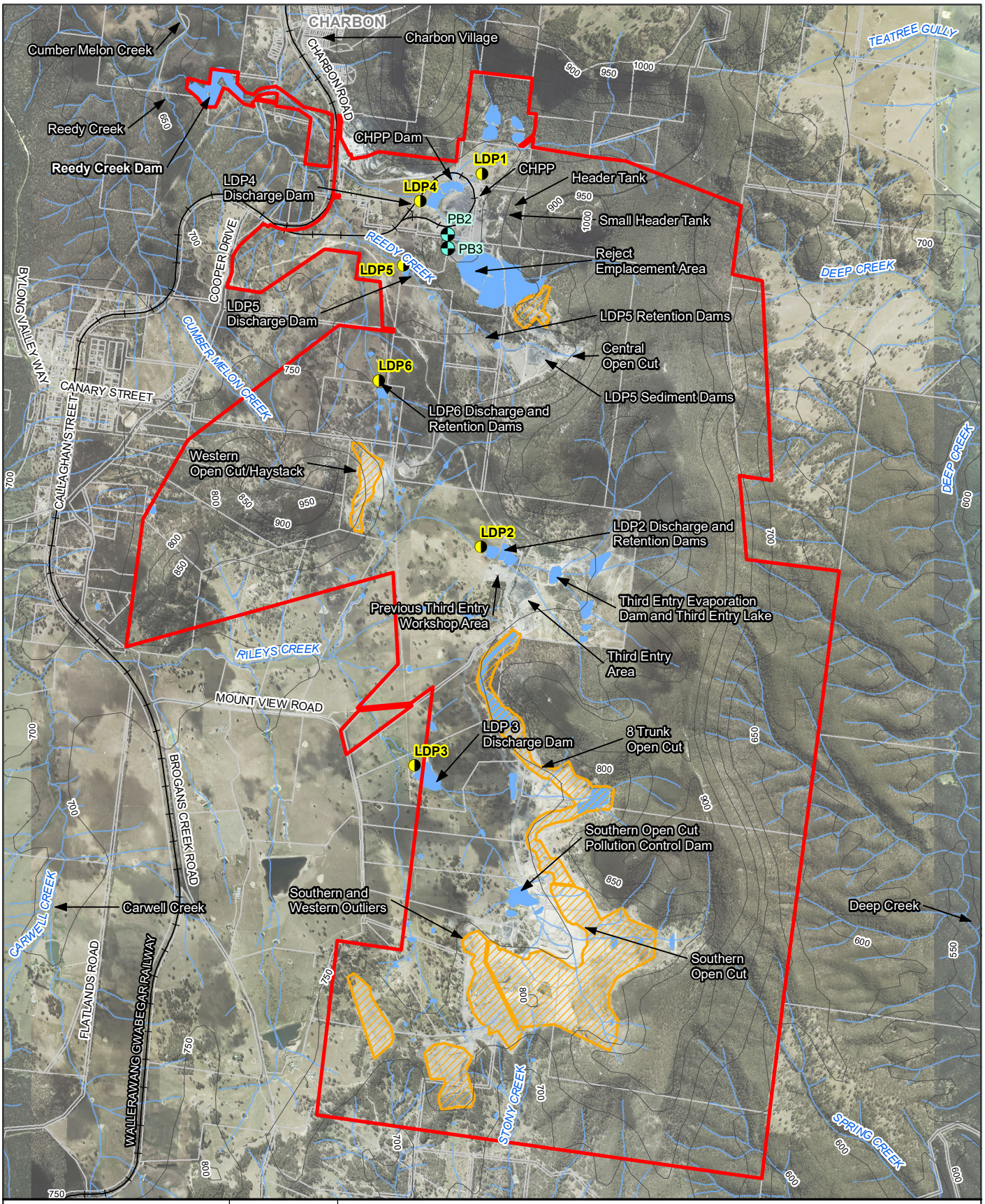

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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

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LEGEND

- Project Site Boundary
- Historical Surface Extraction Area
- Licensed Discharge Point
- Groundwater wells
- Railway
- Contour (50m)
- Waterway
- Cadastre

LOCATION	WCS
SEAM	Lithgow
DRAWN	GHD
CHECKED	TT
APPROVED	ZL
SCALE	refer to scalebar

Charbon Colliery
Water Management Plan

Site Features

CENTENNIAL

DATE 12/10/2021

Figure 1-2

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1.3 Approvals and Licensing Requirements

1.3.1 Development Consent

The Water Management Plan (WMP) addresses specific water components of the conditions of development consent PA 08_0211. The relevant requirements of the WMP content are outlined in Appendix A, along with the sections of the plan where these have been addressed.

1.3.2 Statement of Commitments

In addition to the conditions of development consent PA 08_0211 presented in Appendix A, Charbon also committed to the management strategies and monitoring activities for surface water, groundwater, watercourse stability and aquatic ecology outlined in Table 1-1.

Table 1-1 Statement of Commitments

Commitment	Where addressed
MP 08_0211	
9.1 Prepare a Sediment and Erosion Control Plan.	Appendix G
9.2 Prepare updated site water balance.	Section 3.5
9.3 Prepare a salinity balance.	Section 3.5
9.4 Prepare a Surface and Groundwater Water Management Plan which will include detailed water monitoring and response protocols in consultation with the NSW Office of Water.	This WMP.
9.5 Complete an assessment of downstream impacts to drainage lines and creeks.	Section 4.4, Section 5.3.1
9.6 Complete an assessment of onsite irrigation of effluent.	Section 3.4
MP 08_0211 MOD1	
The surface water monitoring program will be amended so that the monitoring of the sources of water transferred to Airly Mine (CHPP Dam 3, LDP4 Discharge Dam and Reedy Creek Dam) is consistent with the monitoring of the surface water at Airly Mine in terms of frequency and parameters analysed.	Section 4.2.1
MP 08_0211 MOD2	
Groundwater monitoring at Charbon will include: continued monitoring of groundwater quality at existing monitoring bores PB2 and PB3;	Section 4.3
Groundwater monitoring at Charbon will include: visual inspections as part of monthly site inspections at temporarily backfilled adits for signs of groundwater seepage; and	Section 4.1
Groundwater monitoring at Charbon will include: installation of three monitoring bores down gradient of emplacement areas and upgradient of receptors.	Section 4.3

1.3.3 Environment Protection Licence

Charbon holds EPL 528, with water licensed to be discharged from the site through the following licensed discharge points (LDPs):

- LDP1 – Spray irrigation of treated wastewater from the wastewater treatment facility located in the vicinity of the pit top facilities area.
- LDP2 – Located at the outlet of the LDP2 Discharge Dam into Rileys Creek.
- LDP3 – Located at the outlet of the LDP3 Discharge Dam into Rileys Creek.
- LDP4 – Located at the outlet of the LDP4 Discharge Dam into Reedy Creek.
- LDP5 – Located at a "V-notch" weir below LDP5 Discharge Dam into Reedy Creek.
- LDP6 – Located at the outlet of the LDP6 Discharge Dam into Reedy Creek.

Water quality concentration limits for LDP2, LDP3, LDP4, LDP5 and LDP6, as outlined in EPL 528, are summarised in Table 1-2. The limits specified in Table 1-2 do not apply when the discharge occurs solely as a result of rainfall which exceeds a total of 44 mm over any consecutive five day period. No water quality concentration limits are specified by EPL 528 for LDP1.

Table 1-2 Licensed Discharge Point Water Quality Concentration Limits

Parameter	Units	100 percentile concentration limits
Oil and grease	mg/L	10
pH	pH units	6.5–8.5
Total suspended solids (TSS)	mg/L	50
Turbidity	NTU	50

1.3.4 Surface Water and Groundwater Licenses

Charbon holds water access licences (WALs) and water supply works and use approvals under *Water Management Act 2000 (WM Act)* under the following water sharing plans, as summarised in Table 1-3 and Table 1-4:

- Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2011.
- Water Sharing Plan for the Macquarie Bogan Unregulated Rivers Water Sources 2012.

Charbon also holds bore licences under the *Water Act 1912* as summarised in Table 1-5.

Table 1-3 Water Access Licenses

WAL Number	Category	Water Source	Share components	Related Approval
WAL 27890	Aquifer	Sydney Basin MDB (Groundwater)	30 ML	80WA706142
WAL 35022	Unregulated River	Upper Cudgegong River (Surface)	105 ML	80CA717719
WAL 35023	Unregulated River	Upper Cudgegong River (Surface)	231 ML	80WA717721

Table 1-4 Water Supply Works Approvals

Approval	Kind of approval	Expiry	Summary of approval	Related Licences
80WA706142	Water supply works	15/01/2025	Three groundwater bores	WAL 27890
80CA717719	Water supply works and water use	03/10/2025	Bywash dam and pump, irrigation	WAL 35022
80WA717721	Water supply works	03/10/2025	Bywash dam and two pumps	WAL 35023
80WA717722 80WA706037`	Water supply works Basic rights	03/10/2025 Perpetuity	Two dams and two diversion pipes One groundwater bore	None 80BL236248

Table 1-5 Bore Licences

Bore licence	Expiry	Water source	Summary of approval
80BL236248	Perpetuity	Sydney Basin MDB (Groundwater)	Extraction of 10 ML per year of groundwater for domestic and stock use
80BL243771	Perpetuity	Sydney Basin MDB (Groundwater)	Extraction of 5 ML per year of groundwater as nominated on licence condition

Maximum Harvestable Rights

Landholders are entitled to collect a portion of runoff from their property and store it in one or more dams up to a certain size, known as a 'harvestable right', which is determined from the total contiguous area of land ownership. In the Central and Eastern Divisions of NSW (where Charbon is located), landholders may capture and use up to 10% of the average regional rainfall runoff for their property in a dam on a first or second order watercourse without requiring a licence under the WM Act. The maximum harvestable right is the total volume of rainfall runoff that a landholder is entitled to use without requiring a licence. If the maximum harvestable right for a site is exceeded, licensing for the volume of water extracted from the surface water source exceeding the harvestable right is required under the WM Act.

Exemption from requirement for access licence

As specified by Clause 31 of the Water Management (General) Regulation 2018, dams solely for the capture, containment and recirculation of drainage and/or effluent, consistent with best management practice to prevent the contamination of a water source, are considered to be 'excluded works' and are exempt from the requirement for a water supply works approval. The use of water from such dams is also exempt from the requirement for a WAL under Clause 21 of the Regulation.

This exemption applies to the water storages that comprise the dirty water management system at Charbon (refer to Section 3.2.2). Notwithstanding this exemption, the storages on minor (first and second order) watercourses would, at least partially, be exempt as part of the harvestable rights. There are nine storages identified at Charbon located on major (third or greater order) watercourses. The current approval under the WM A*ct* for these storages are summarised in Table 1-6.

Table 1-6 Approvals for storage works on major water sources

Water storage	Relevant approvals
LDP3 Discharge Dam	80WA717722
Southern Open Cut Pollution Control Dam	80WA717722
LDP3 Discharge Precapture Sediment Dam	
Third Entry Evaporation Dam	Exempt as part of the dirty water management system
Third Entry Pollution Control Dam	
LDP2 Discharge Dam	
LDP4 Discharge Dam	
Reedy Creek Dam	80WA717721

The application of the exemption during rehabilitation and closure will be subject to further investigation and consultation.

Water used in mining activities

An amendment to the WM Act (Section 60I) came into effect 1 March 2013. This amendment provides that a WAL is required to take, remove or divert water from a water source (whether or not water is returned to that water source) or to relocate water from one part of an aquifer to another part of an aquifer in the course of carrying out a mining activity. Various activities are captured by the amendment including mining, mineral exploration and petroleum exploration. There are no longer mining or exploration activities undertaken at Charbon and hence the amendment is not relevant to the current water management system.

Controlled activity approval

Any works proposed within the defined riparian zone of a creek are to be carried out in accordance with the WM Act. Works undertaken on waterfront land (i.e. adjacent to a river, lake or estuary) require a controlled activity approval, unless defined as exempt. As part of gaining controlled activity approvals NRAR are to be consulted in relation to proposed activities within existing riparian corridors, such as rehabilitation works, which would provide a means of determining the suitability of engineering controls and general mitigation measures.

1.4 Water Management Plan Objectives

The WMP has been developed to address the approvals and licensing requirements presented in Section 1.3 through the completion of the following:

- Collate and review existing information relating to water management at Charbon.
- Establish an understanding of the water management system at the site.
- Develop catchment plans for the site layout.
- Identify the clean and dirty water management systems.
- Determine the water management requirements and water monitoring requirements.

2. ENVIRONMENT

2.1 Climate

Charbon has operated site a weather station since 2004 (located at latitude 32.919 south and longitude 149.980 east). Development of this WMP required a longer historical record. A historical record of daily rainfall data was obtained from the Scientific Information for Land Owners (SILO) database operated by the Queensland Department of Science, Information Technology and Innovation. SILO patched point data is based on historical data from a particular Bureau of Meteorology (BOM) station with missing data 'patched in' by interpolating data from nearby stations. SILO data was obtained for Rylstone (Ilford Rd) Station (station number 62026), which is located approximately 10 km north of Charbon.

Figure 2-1 presents the cumulative frequency of annual total rainfall and evaporation from the SILO dataset between 1889 and 2020. In addition, the figure also presents the comparison between SILO rainfall to site-based rainfall recorded from 2004 to 2020.

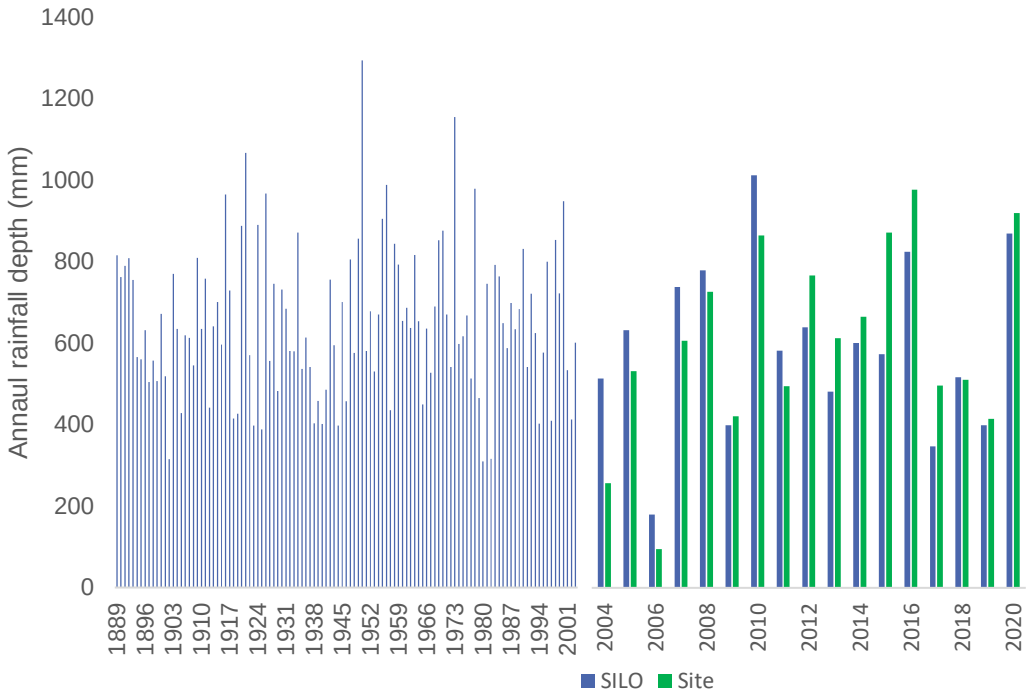


Figure 2-1 Comparison of annual rainfall depths

The annual statistics associated with Figure 2-1 for the SILO data range are:

- Minimum rainfall total – 178 mm in 2006.
- Median rainfall total – 633 mm.
- Average rainfall total – 644 mm.
- Maximum rainfall total – 1,293 mm in 1950.

Historical data from the closest BOM station which records evaporation, Bathurst Agricultural Station (station number 63005), was reviewed and average monthly evaporation rates were determined based on record from 1966 to 2016. A plot of average monthly pan evaporation is compared to average monthly rainfall from the historical record in Figure 2-2.

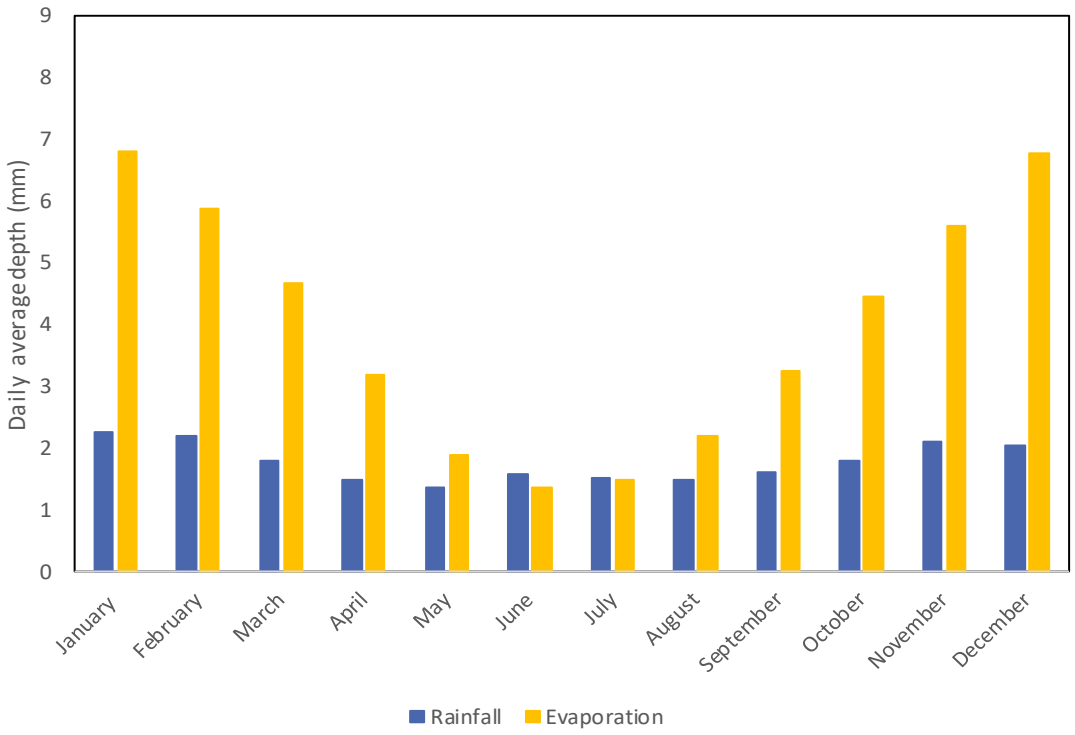


Figure 2-2 Monthly Average Evaporation and Rainfall

Figure 2-2 shows that evaporation varies seasonally, having higher records in summer compared to winter. The site has an average monthly net rainfall deficit in all parts of the year except during winter months.

2.2 Hydrology

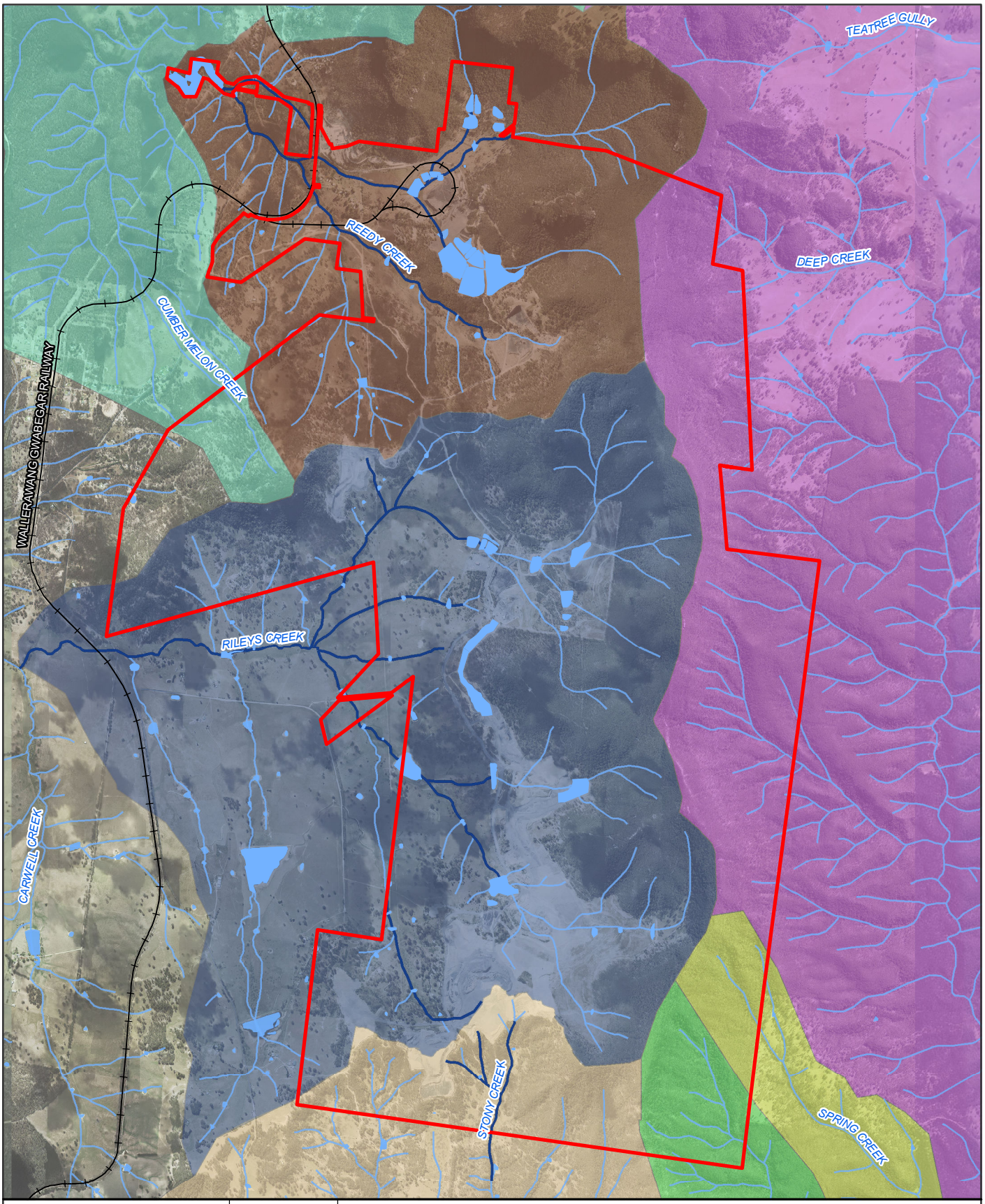
The Charbon mining leases extend along the western edge of the Great Dividing Range. Due to smaller ridges extending from the main range to the west, the mining lease boundaries extends into four local catchments: Reedy Creek and Rileys Creek, part of the Macquarie-Bogan River catchment; and Stony Creek and Deep Creek, part of the Hawkesbury-Nepean catchment, as shown in Figure 2-3.

2.2.1 Reedy Creek Catchment

Reedy Creek catchment is the northernmost catchment and contains the following site features: CHPP, run of mine (ROM) stockpiles, REA, Mine Washery Dam, pit top services area, coal loading infrastructure, rail loop and portions of the Western Open Cut. Reedy Creek flows into Reedy Creek Dam. Overflows from the Reedy Creek Dam enter Cumber Melon Creek, which drains into the Cudgegong River, which is impounded at Lake Windamere to the north-west of the site.

2.2.2 Rileys Creek Catchment

Rileys Creek catchment lies to the south of Reedy Creek catchment and comprises the following site features: Southern Open Cut, 8 Trunk Open Cut, 9 Trunk Open Cut, Western Outlier, Third Entry Area, 3rd Entry and 8 Trunk Infrastructure Areas. This catchment contains numerous farm dams that contain local minor flows. Rileys Creek drains into Carwell Creek, to the west, which drains into the Cudgegong River, then into Lake Windamere.



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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

LEGEND

- Project Site Boundary
- Railway
- Surface Water Storages
- Waterway
- Waterway affected by project
- Cumber Melon Creek
- Deep Creek
- Reedy Creek
- Rileys Creek
- Spring Creek
- Stony Creek
- Unnamed

LOCATION	WCS
SEAM	Lithgow
DRAWN	GHD
CHECKED	TT
APPROVED	ZL
SCALE	refer to scalebar

Charbon Colliery
Water Management Plan

Watercourses

CENTENNIAL

DATE 16/09/2021

Figure 2-3

GIS Filename: G:\22\0105001\GIS\Maps\Deliverables\Western\Charbon\12516257\WaterManagementPlan\12516257_WMP003_Watercourses_1.mxd

2.2.3 Stony Creek Catchment

Stony Creek is located on the western side of the ridgeline, which runs along the eastern border of the site, and drains to the south of the mining leases. Only portions of the Southern Open Cut and portions of the Southern and Western Outliers lie within the Stony Creek catchment. Stony Creek drains into Ulumbra Creek which flows south-east into the Capertee River that drains into the Hawkesbury-Nepean River system.

2.3 Geology

Charbon is located in the southern part of the Western Coalfield of NSW, on the western edge of the Sydney Basin. The outcrop geology near Charbon is shown in Figure 2-4. The basement stratigraphy, from higher to lower, includes (EMM 2020):

- Jurassic/Tertiary aged volcanic breccia, sandstone and basalt located on the peak of Haystack Mountain to the north of Charbon.
- Triassic aged Narrabeen Group sandstones and claystones that generally outcrops along the ridgeline that runs north to south through the holding boundary.
- Permian aged Illawarra Coal Measures including the Irondale, Lidsdale and Lithgow coal seams. The Permian Illawarra Coal measures outcrop within the holding boundary to the east, west and south of the ridgeline and just outside the holding boundary to the north.
- Underlying Shoalhaven Group conglomerate, sandstone shale and siltstones.

2.4 Hydrogeology

2.4.1 Groundwater Sources

The local groundwater sources that occur near the holding boundary are generally low yielding and are predominantly within the weathered and/or fractured sandstone and coal seams that occur within Haystack Mountain. They are classified as ‘less productive’ by the criteria specified in the NSW Aquifer Interference Policy (i.e. the yield is typically less than 5 L/s and/or the total dissolved solids (TDS) concentration is typically greater than 1,500 mg/L).

The regional groundwater sources occur within the Shoalhaven Group and the underlying metamorphic rocks.

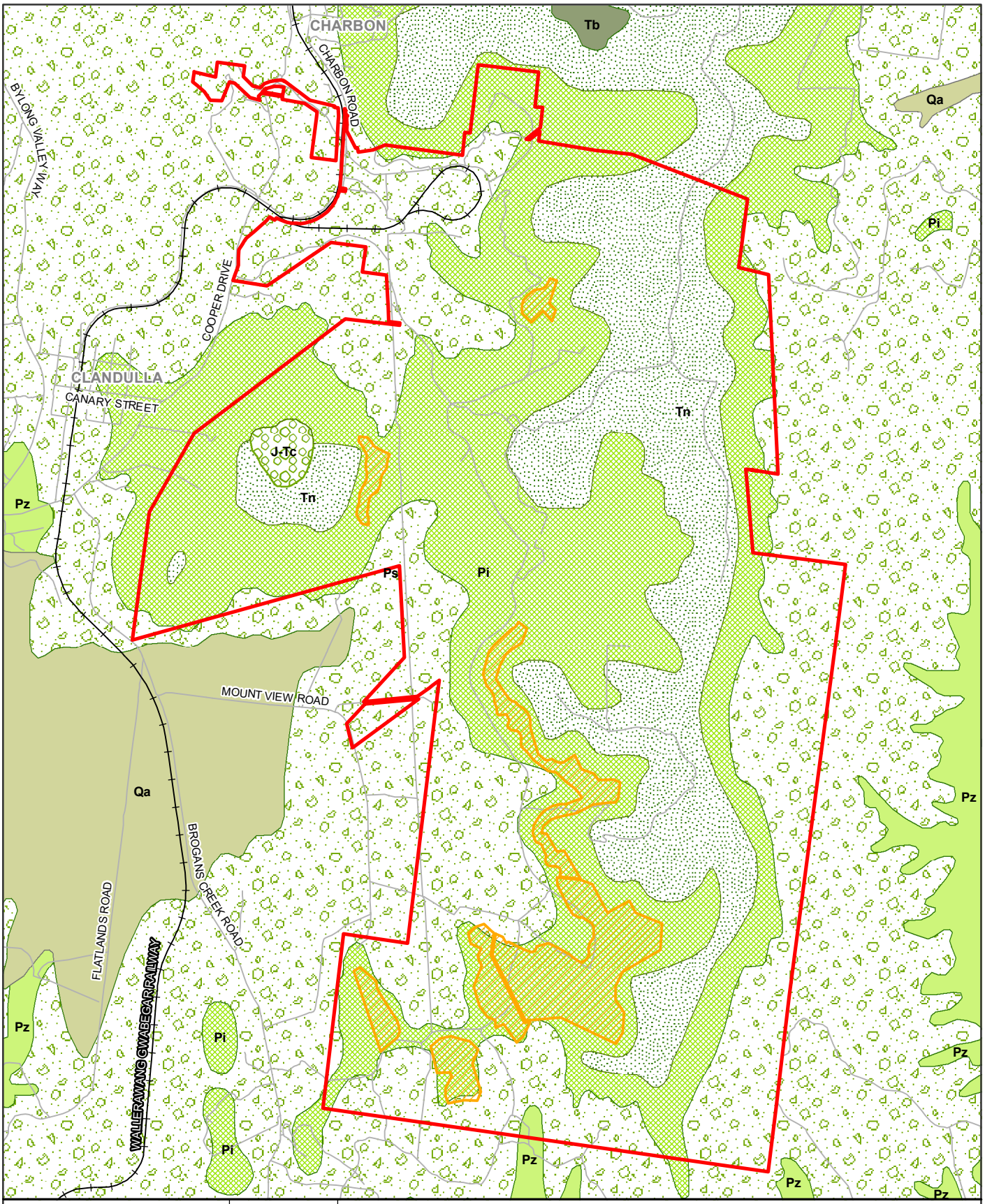
Alluvium

The alluvium near Charbon forms an unconfined shallow aquifer. Alluvial sediments are within valley floor drainage lines and are of limited extent within the site (EMM 2020).

Permian Coal Measures

The aquifer associated with the Permian coal measures sub-crops at the base of the ridgeline that runs north-south through the holding boundary. The coal seams including the Irondale, Lidsdale and Lithgow coal seams form unconfined, free draining, unsaturated aquifers (EMM 2020). The underground workings have been generally dry workings with minimal groundwater inflow. The Permian coal measures located in the vicinity of the site are recharged by rainfall infiltration and limited infiltration from the overlying strata.

No significant groundwater systems were intersected by the open cut mining operations at Charbon. Groundwater seepage was generally not observed from these dry workings, except after significant rainfall events where ephemeral perched seeps may produce short periods of low flows.



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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

LEGEND

- Project Site Boundary
- Existing Surface Extraction Area
- Road
- Railway
- Jurassic Tertiary (J-Tc)
- Illawarra Coal Measures (Pi)
- Shoalhaven Group (Ps)
- Metamorphic rocks (Pz)
- Quaternary (Qa)
- Jurassic Tertiary (Tb)
- Triassic Formations (Tn)

LOCATION	WCS
SEAM	Lithgow
DRAWN	GHD
CHECKED	TT
APPROVED	ZL
SCALE	refer to scalebar

Charbon Colliery
Water Management Plan

Geological map

CENTENNIAL

DATE 16/09/2021

Figure 2-4

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Regional Groundwater

The regional groundwater system is located below the underground mine workings within the Shoalhaven Group and the underlying metamorphic rocks. The Lithgow Seam is located approximately 40 m to 60 m above the regional groundwater elevation at nearby bore sites.

The regional groundwater aquifer near the site is confined and typically saturated. The regional aquifer is recharged from rainfall infiltration and seepage from local drainage lines. The regional groundwater system is considered unlikely to be hydraulically connected to coal seam groundwater (EMM 2020).

2.4.2 Groundwater Users

Registered Bores

A search of the NSW bore database (BOM 2021) indicated that there were 42 bores within 4 km of the Charbon holding boundary. The majority of the bores were registered as monitoring or test bores (24 bores); with the remaining bores registered for stock, domestic or irrigation purposes (14 bores), mining (two bores); and two bores had an unknown registered purpose. Registered bore details are provided in Appendix C and locations are shown in Figure 2-5.

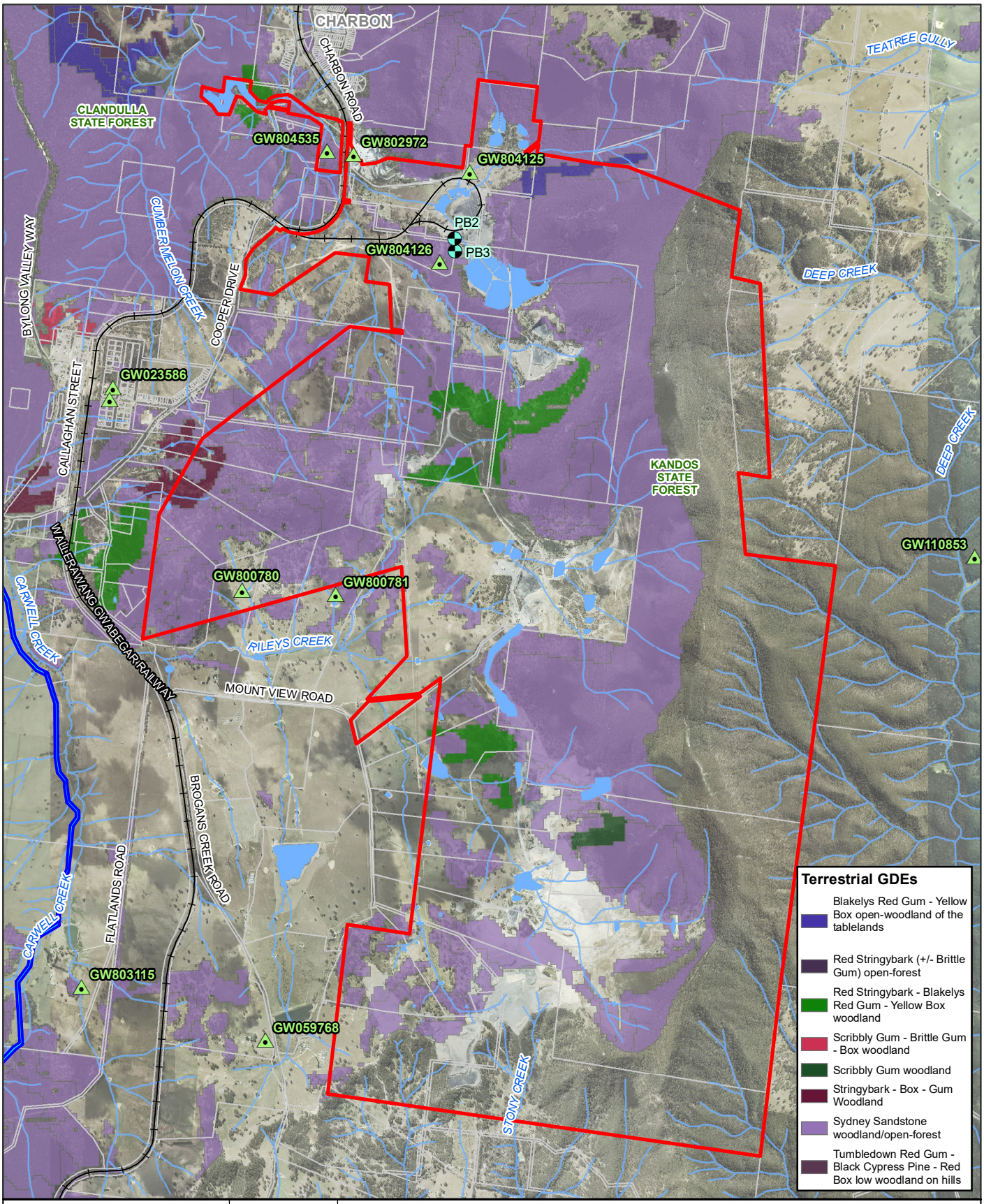
The identified registered bores include the production bores at Charbon. The majority of the identified monitoring bores are related to the historical Kandos cement plant and associated works located near the township of Kandos to the north of Charbon.

Groundwater Dependent Ecosystems

A search of the groundwater dependent ecosystems (GDEs) atlas (BOM 2021) identified:

- Low potential for terrestrial GDEs vegetation communities in the vicinity of the site. Due to the first water bearing fractures of the Shoalhaven aquifer occurring approximately 30–50 m BGL, it is unlikely that this vegetation utilises groundwater from this aquifer (EMM 2020).
- Moderate potential aquatic GDEs along watercourses in the vicinity of the site including Carwell Creek, Capertee River, Cudgegong River and Cumber Melon Creek may receive flow from groundwater.

The results of the search are shown in Figure 2-5.



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0 175 350 700 1,050 1,400

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

LEGEND

- Project Site Boundary
- Railway
- Waterway
- Cadastre
- Registered groundwater bore
- Production Bore
- Aquatic GDEs

LOCATION	WCS
SEAM	Lithgow
DRAWN	GHD
CHECKED	TT
APPROVED	ZL
SCALE	refer to scalebar

Charbon Colliery
Water Management Plan

Registered groundwater bores and GDEs

CENTENNIAL

DATE 5/10/2021

Figure 2-5

GIS Filename: \\ghdnet\ghd\AU\Newcastle\Projects\22\0105001\GIS\Maps\Deliverables\Western\Charbon\12516257\WaterManagementPlan\12516257_WMP005_RegisteredGWBores_2.mxd

3. WATER MANAGEMENT

3.1 Water Management Overview and Objectives

The management of water at Charbon includes both clean and dirty water management systems.

Surface water runoff from areas where there has been no coal handling or any disturbance is considered clean water, as it is unlikely to be contaminated with coal fines or sediment. Where practical, runoff is diverted around dirty water and coal-contact catchments to avoid mixing with clean water runoff. Clean water runoff is typically from natural and impervious catchments such as areas of vegetation and sealed roads.

Dirty water is runoff from disturbed areas and areas likely to contain suspended sediment. Coal-contact water is runoff from catchments where coal storage, transportation, handling or processing has occurred and is managed within the dirty water management system.

Charbon has site-specific water objectives that include:

- Maximise the separation of clean and dirty surface water systems.
- Manage water discharge from site, in terms of volume and quality, to a level that is acceptable for environmental management and community expectations.
- Minimise water discharges from the premises by maximising, where practicable, opportunities for the reuse and recycling of water on site, including irrigation of rehabilitated areas and other vegetated areas. Irrigation activities are only undertaken to an extent such that runoff is not created.
- Minimise discharges of dirty water from the premises.
- Manage discharge to natural waterways in accordance with the EPL 528 conditions.

3.2 Surface Water Management

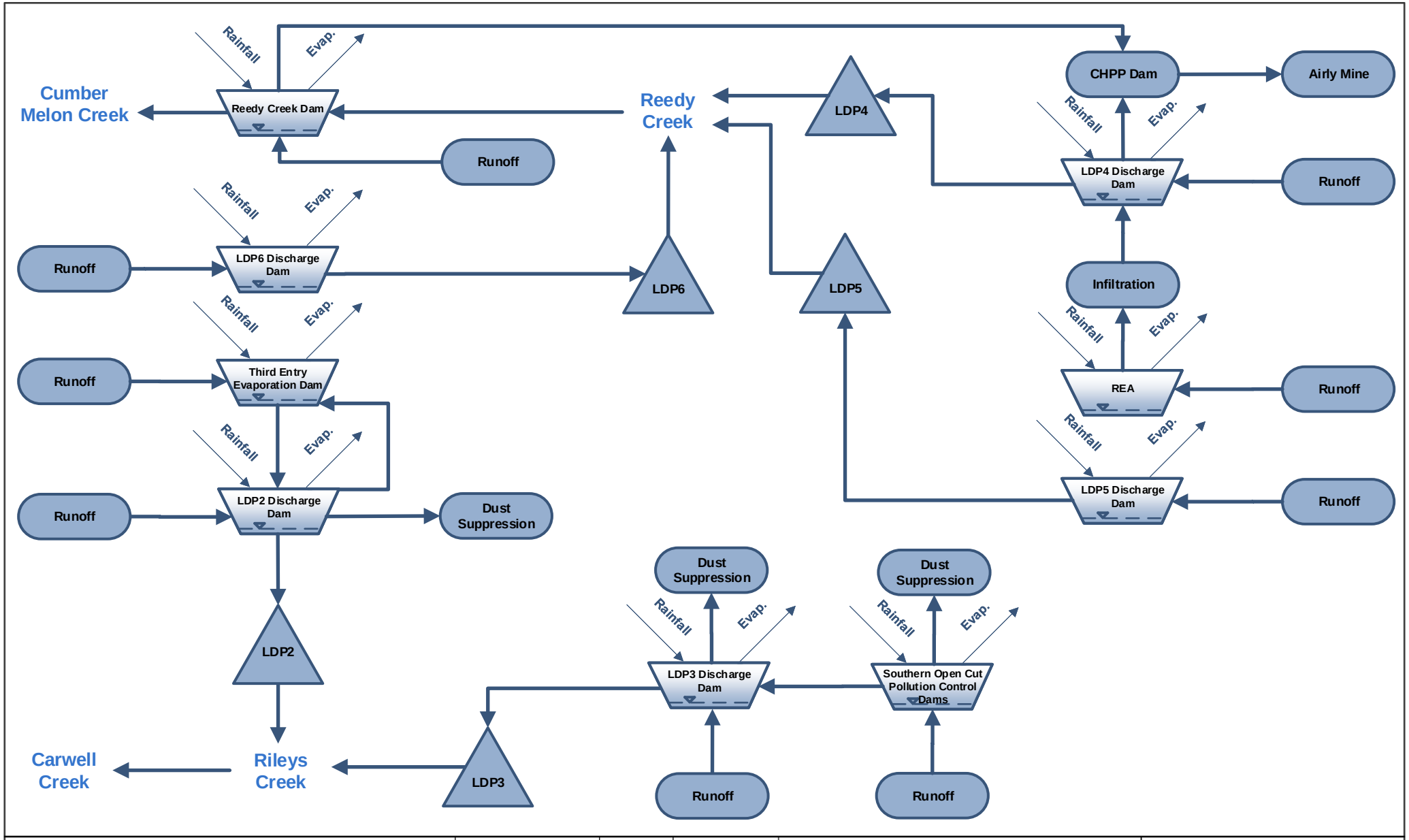
A schematic of the overall water management system at Charbon is provided in Figure 3-1. The surface water management features of the site are discussed in Sections 3.2.1 and 3.2.2.

3.2.1 Clean Water Management

The current clean water management features for Charbon are shown in Figure 3-2. Charbon has one storage that captures and manages clean water on site, which is Reedy Creek Dam. This dam has a capacity of 220 ML and overflows downstream of the site into Cumber Melon Creek. Whilst the dam is a clean water source, Charbon discharges to its catchment via LDP4, LDP5 and LDP6.

Charbon has approval under WAL 35023 to extract up to 231 ML/year from Reedy Creek Dam. Water from the dam was historically used to supplement the water supply to the CHPP and other water demands of the site when mining operations were occurring. Water can be pumped to CHPP Dam 3, which supplies the train loading manifold that is used to transfer water to Airly Mine via rail.

Three drainage easements exist within the site boundaries that convey catchment runoff west and north as shown in Figure 3-2. The drainage easement is an agricultural drainage structure purpose built for harvesting runoff. The Charbon operations cannot impede flow within these structures, where they exist. Therefore, where the clean or dirty water management systems interact with the drainage easement, structures, culverts or diversions are required. Dirty water runoff from mining operations is diverted away from contributing to drainage easements.



Surface storage

Surface process

Licensed discharge point

Surface water flow

LOCATION	Charbon
SEAM	Lithgow / Lidsdale / Irondale
DRAWN	JM
CHECKED	TT
APPROVED	ZL
SCALE	NTS

Charbon Colliery
Water Management Plan

Water management schematic

CENTENNIAL

DATE Oct 2021

Figure 3-1

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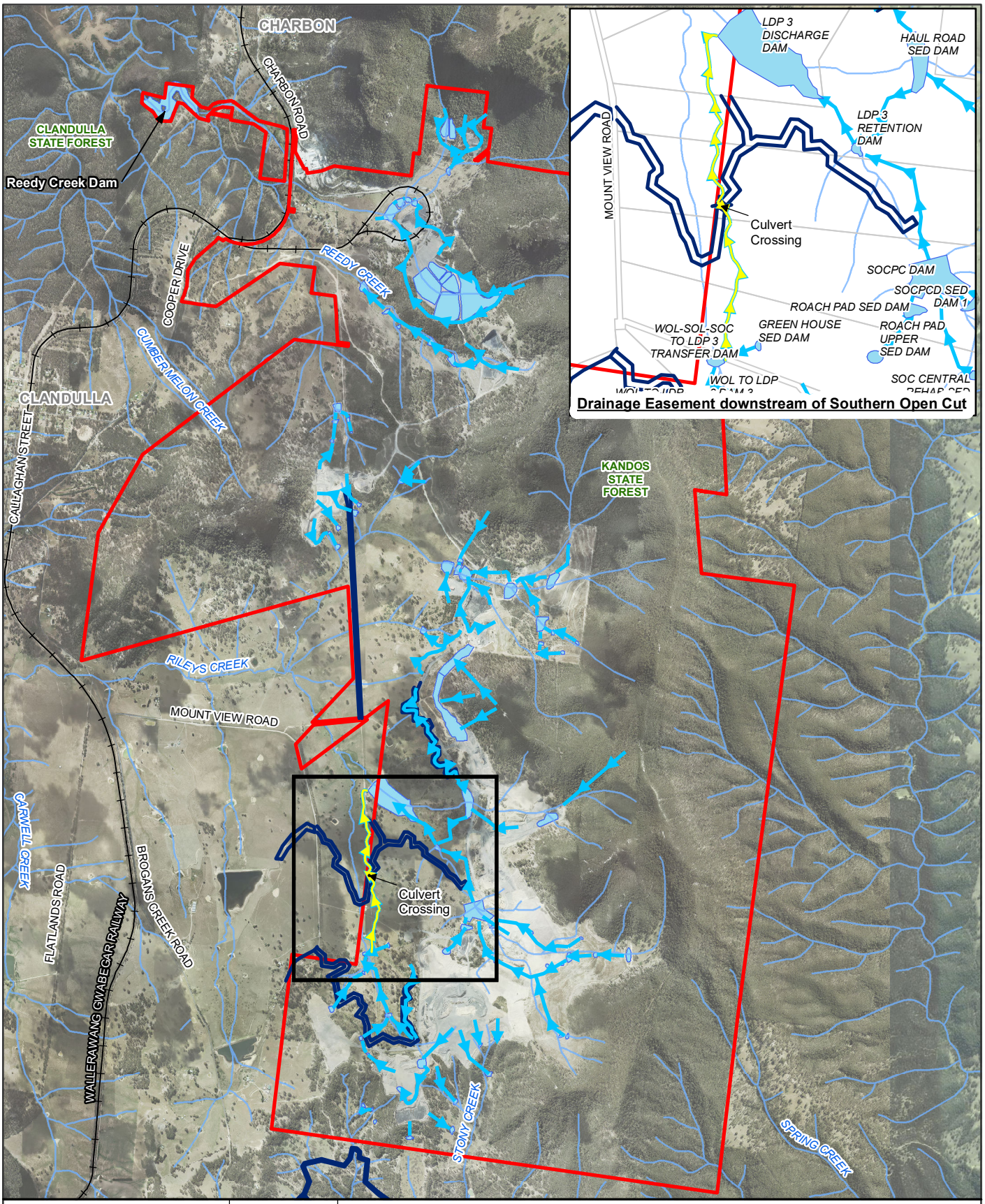

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0 170 340 680 1,020 1,360

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

LEGEND

- Project Site Boundary
- Railway
- Waterway
- Flow Path
- Drainage Easement

LOCATION	WCS
SEAM	Lithgow
DRAWN	GHD
CHECKED	TT
APPROVED	ZL
SCALE	refer to scalebar

Charbon Colliery
Water Management Plan

Clean water management systems

CENTENNIAL

DATE 16/09/2021

Figure 3-2

GIS Filename: G:\22\0105001\GIS\Maps\Deliverables\Western\Charbon\12516257\WaterManagementPlan\12516257_WMP007_CleanWater_Management_1.mxd

Clean water diversions redirect clean catchment runoff away from dirty water catchment areas, including open channel around the REAs. Historical mining activities, including contour mining longitudinally along the eastern slopes, limited opportunities for diversion of upslope catchment away from mining activities (refer to Section 3.5.3).

As rehabilitation progresses, dirty water runoff will decrease and clean water management will accordingly increase. Dirty water within the Western (WOL) and Southern Outliers (SOL) and Stony Creek (along the southern boundary) during mining operations was contained within the disturbance areas. Since cessation of mining, the western and southern outlier open cut pits have been backfilled and rehabilitation established. Runoff reports to a number of water storages located downstream of the rehabilitated areas. These areas have established vegetation cover and the potential erosion and soil loss hazard is very low. Therefore, these storages are considered clean water storages and are not actively dewatered to the dirty water management system. Charbon will continue to monitor the progress of rehabilitation in these areas.

3.2.2 Dirty Water Management

To minimise the potential impacts of dirty water, dirty water is generally directed into various sediment dams or pollution control dams (PCDs) for treatment through settling prior to discharge through LDPs. A plan indicating the dirty water management system is presented in Figure 3-3.

The dirty water management structures at Charbon form the basis of the permanent erosion and sediment control at the site. The function of dirty water management structures is to:

- Retain dirty water and increase the residence time to improve water quality to within limits suitable for discharge.
- Transfer dirty water to central water storages to manage and control discharges of treated water and minimise the potential for discharge of dirty water to the environment.
- Minimise discharges by maximising, where practicable, opportunities for the reuse and recycling of water on site, including irrigation of rehabilitated and other vegetated areas. Irrigation activities are only undertaken to an extent such that runoff is not created.

LDP4 and Pit Top Area

The Pit Top Area includes the REA, ROM Stockpile, product stockpile, surface facilities and CHPP. This area is a closed system; isolated via clean water cut-off drains. During rehabilitation, there is no significant stockpiling of coal at the Pit Top Area.

The LDP4 Discharge Dam is the ultimate dirty water management storage for the Pit Top Area, receiving inflows from the series of cascading CHPP Dams. The water levels in the LDP4 Discharge Dam are managed via the existing pipe and pump network within the rail loop to minimise discharges from this dam. Captured water within LDP4 Discharge Dam is treated and discharged to Reedy Creek. Discharges offsite flow into Reedy Creek and into Reedy Creek Dam via the culvert in the rail loop.

CHPP Dam 3 receives transfers from Reedy Creek Dam and LDP4 Discharge Dam which supplies the train loading manifold that is used to transfer water to Airly Mine via rail

Reject Emplacement Areas

There are two REAs at Charbon, namely the Main REA and Northern REA. These facilities to store coarse rejects and fine tailings that were produced during the operation of the coal mine. The Main REA was the primary tailings deposition structure during recent operations, with the Northern REA utilised historically for tailings and reject impoundment.

Rain falling on the REA surface is collected in storages within the six REA cells, collectively referred to as the Tailings Dam. Water then either evaporates or infiltrates to the LDP4 Discharge Dam. A similar arrangement is in place for the Northern REA.

LDP5 Discharge and Retention Dams

A series of retention dams are located downstream of the Central Open Cut area receiving runoff from the dirty water catchment. Dirty water generated within the extraction area of the Central Open Cut is maintained within the disturbance area by directing the water to an in-pit sump.

When required, water is pumped from the in-pit sump to a series of retention ponds that contribute downstream to the LDP5 Discharge Dam. Discharge from LDP5 occurs via a v-notch weir, which has been installed to monitor the volume and frequency of discharges.

LDP6 and Western Open Cut Area

Dirty water collected within the extraction area of the Western Open Cut is directed either into the Haystack (HS) Sediment Dams, to the east (which are pumped to LDP2) or LDP6 sediment and retention dams, to the north. Where transfers are to LDP6, the primary PCD is the LDP6 Discharge Dam.

LDP2 Discharge Dam and Third Entry PCDs

The Third Entry Evaporation Dam is located nearby the Third Entry area and receives runoff from the local dirty water catchment and pumped transfers from the series of pollution control, and retention dams located within Third Entry area. The dam is used to evaporate excess water. Seepage from the Third Entry Evaporation Dam historically reported into the underground workings, although flow rates have likely reduced as the system has moved towards equilibrium. The Third Entry Lake can provide additional storage capacity for dirty water runoff.

The LDP2 Discharge Dam and Third Entry PCDs are located within and downstream of the Third Entry area and collects runoff from the local dirty water catchment and pumped from HS Sediment Dams. Water is pumped from the Third Entry PCD to the Third Entry Evaporation Dam and Third Entry Lake to minimise overflows through LDP2 to Rileys Creek.

8 Trunk Open Cut void

Dirty water generated is contained within the void. When required, water can be pumped from the in-pit sump to either the Southern Open Cut Pollution Control Dam (SOCPCD) or the 8 Trunk Haul Road to LDP2 Transfer Dam. Water can then be discharged through LDP3 or LDP2 respectively. Dewatering of void will be required to the approved emplacement of material imported from Clarence Colliery.

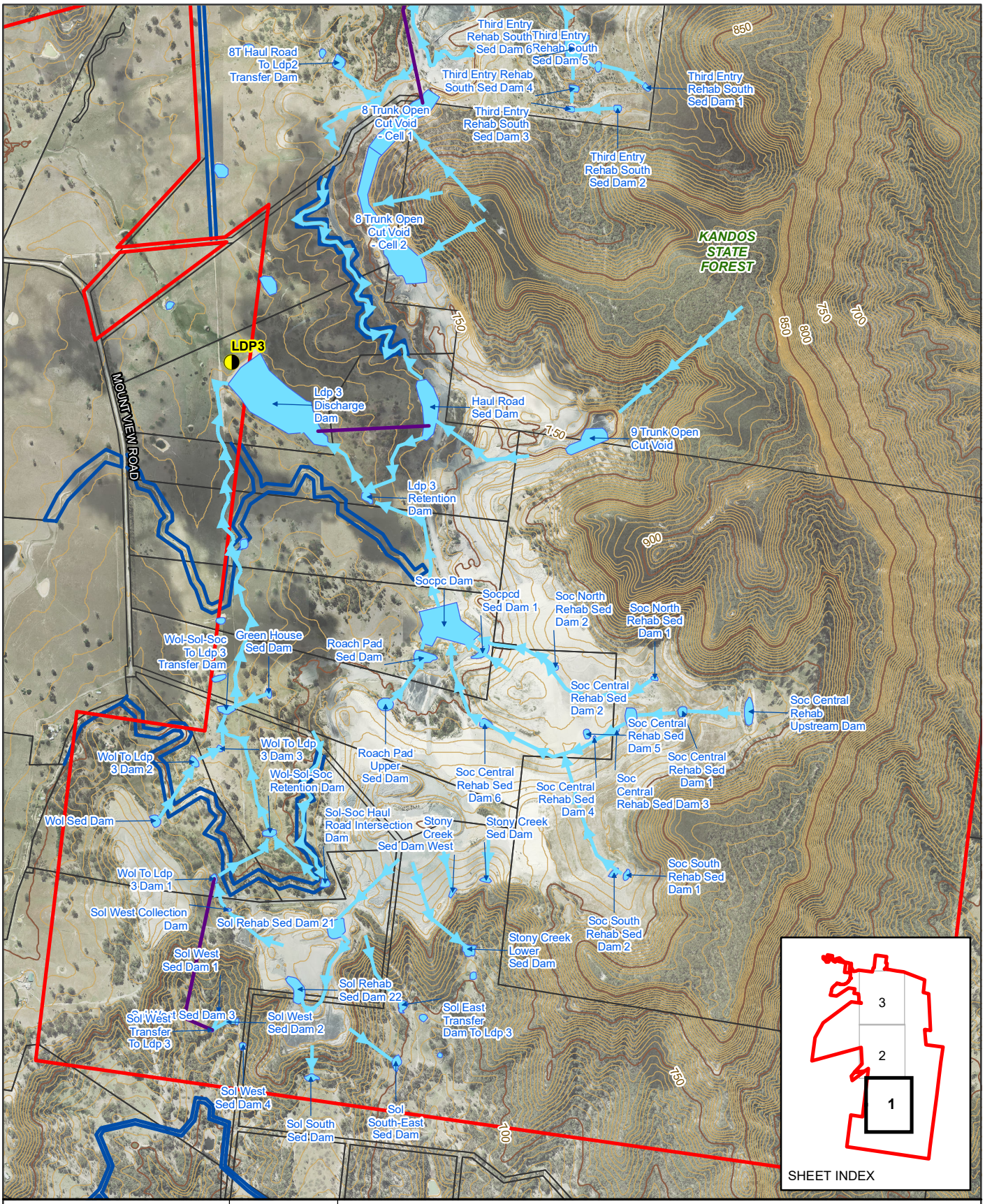
Where dirty water cannot be directed to an in-pit sump, dirty water diversions have been constructed to direct water into the Haul Road Dam via table drains to 8 Trunk Haul Road to LDP2.

LDP3 Discharge Dam and Southern Open Cut

The SOCPCD is located nearby the Southern Open Cut. The dam receives catchment runoff and supplies water for dust suppression. Overflows are directed to the LDP3 Discharge Dam. The Southern Open Cut area includes large areas of rehabilitation in the east.

The LDP3 Discharge Dam is located directly downstream of the SOCPCD and collects catchment runoff and overflows from the SOCPCD and Haul Road Sed Dam. Overflows from the dam are directed to Rileys Creek via LDP3. Sediment loads are managed through a pre-capture basin located directly upstream of the LDP3 Discharge Dam.

The 9 Trunk Open Cut void has been backfilled and rehabilitated, with a number of small sediment dams form along the contour banks that report to the Haul Road Dam.



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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

LEGEND

- Project Site Boundary
- Surface water storages
- Cadastre
- Contour (50m)
- Contour (5m)
- Licensed Discharge Point
- Drainage Easement
- Flow Path

LOCATION	WCS
SEAM	Lithgow
DRAWN	GHD
CHECKED	TT
APPROVED	ZL
SCALE	refer to scalebar

Charbon Colliery
Water Management Plan

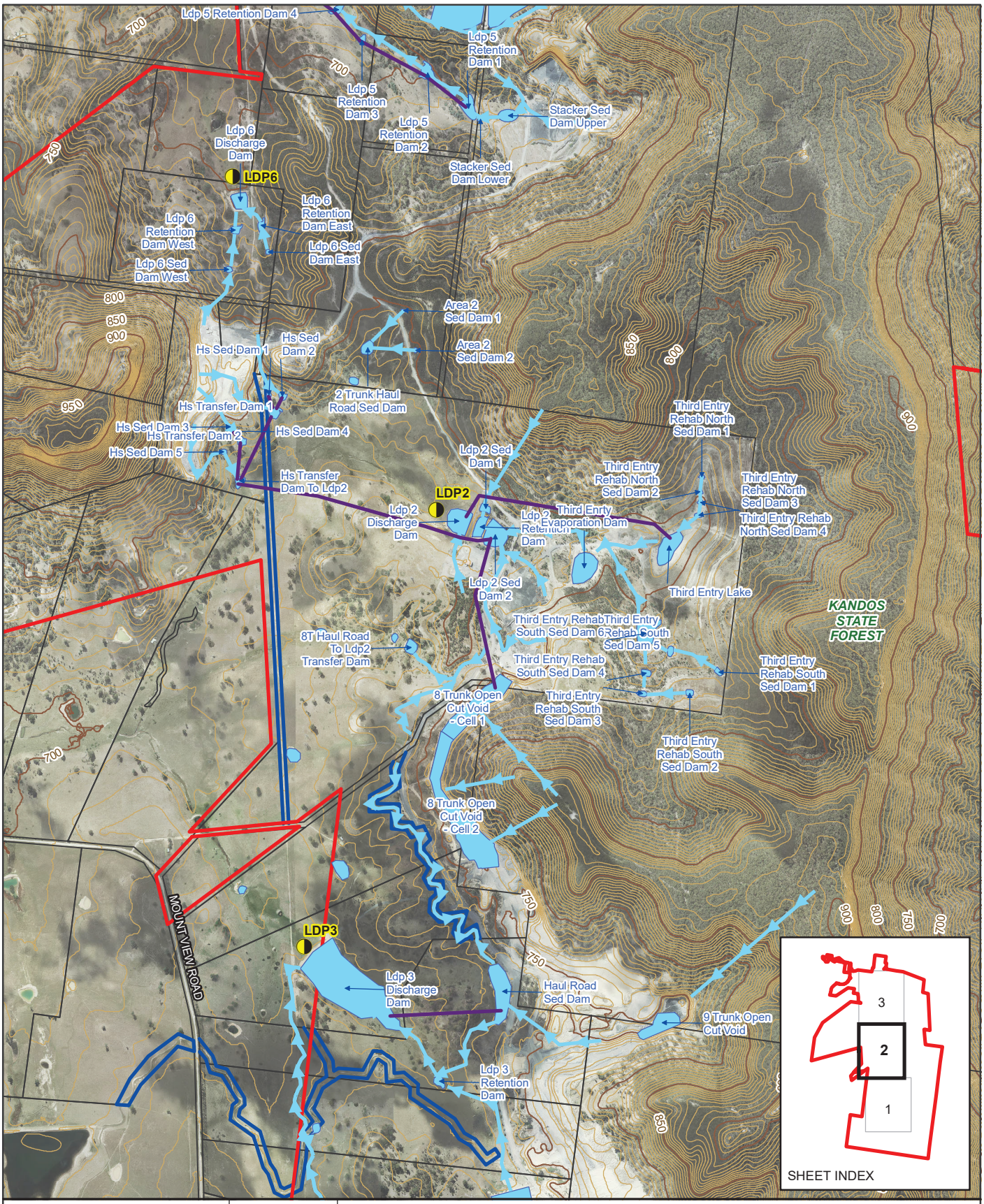
Dirty water management
Sheet 1 of 3

CENTENNIAL

DATE 5/10/2021

Figure 3-2

GIS Filename: N:\AU\Newcastle\Projects\22\0105001\GIS\Maps\Deliverables\Western\Charbon\12516257\WaterManagementPlan\12516257_WMP008_DirtyWater_Management_DDP_2.mxd



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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

LEGEND

- Project Site Boundary
- Surface water storages
- Cadastre
- Contour (50m)
- Contour (5m)
- Licensed Discharge Point
- Drainage Easement
- Flow Path

LOCATION	WCS
SEAM	Lithgow
DRAWN	GHD
CHECKED	TT
APPROVED	ZL
SCALE	refer to scalebar

Charbon Colliery
Water Management Plan

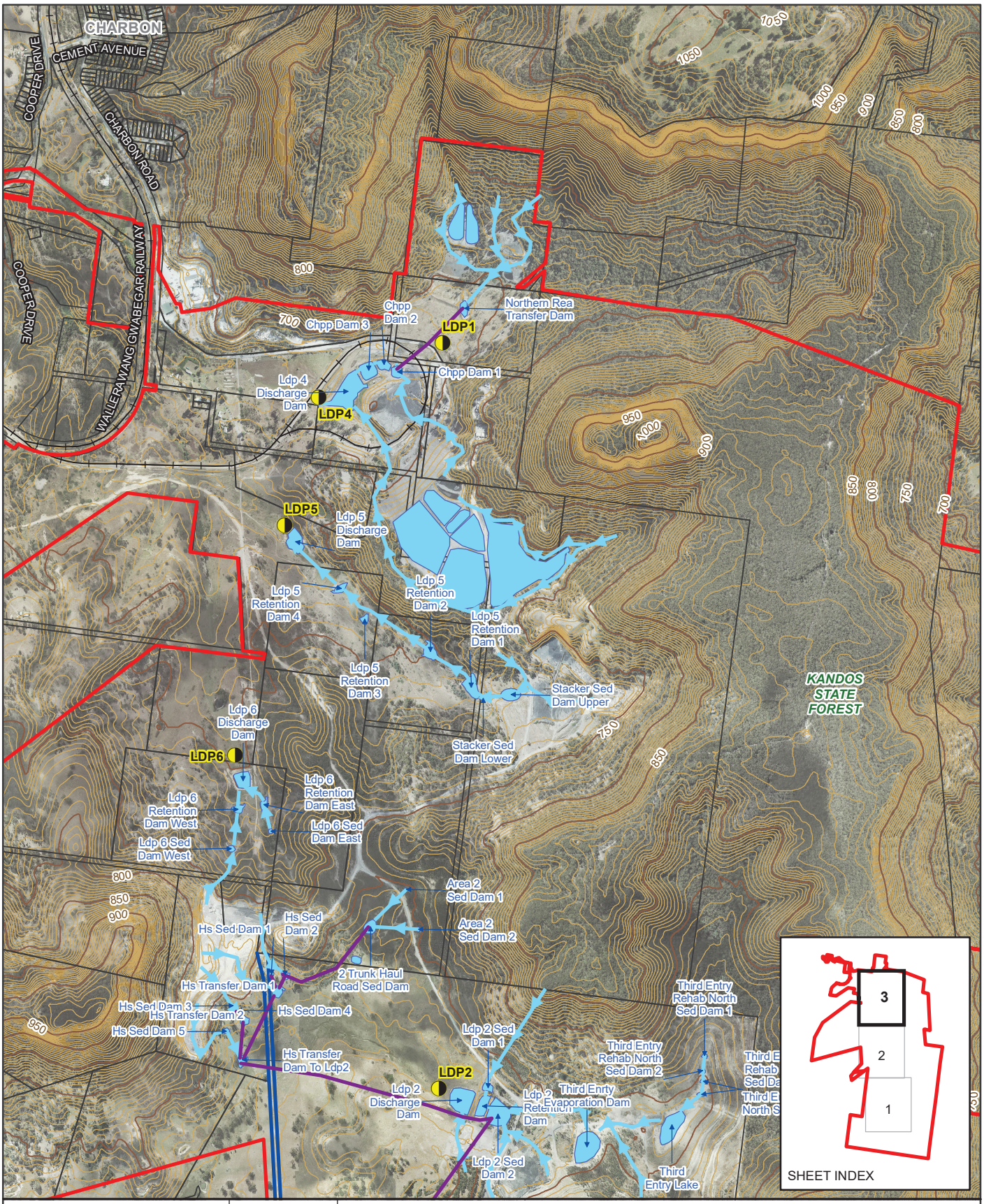
Dirty water management
Sheet 2 of 3

CENTENNIAL

DATE 5/10/2021

Figure 3-2

GIS Filename: N:\AU\Newcastle\Projects\22\0105001\GIS\Maps\Deliverables\Western\Charbon\12516257\WaterManagementPlan\12516257_WMP008_DirtyWater_Management_DDP_2.mxd



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0 87.5 175 350 525 700

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

LEGEND

- Project Site Boundary
- Surface water storages
- Cadastre
- Contour (50m)
- Contour (5m)
- Licensed Discharge Point
- Drainage Easement
- Flow Path
- Pipeline connections for transfers

LOCATION	WCS
SEAM	Lithgow
DRAWN	GHD
CHECKED	TT
APPROVED	ZL
SCALE	refer to scalebar

Charbon Colliery
Water Management Plan

Dirty water management
Sheet 3 of 3

CENTENNIAL

DATE 10/10/2021

Figure 3-2

GIS Filename: \\ghdnet\ghd\AU\Newcastle\Projects\22\0105001\GIS\Maps\Deliverables\Western\Charbon\12516257\WaterManagementPlan\12516257_WMP008_DirtyWater_Management_DDP_1.mxd

3.2.3 Capacity Assessment

A capacity assessment was undertaken on all dirty water surface water storages at Charbon. The capacity of all storages were assessed for adequacy to capture and retain dirty water in the event of a rainfall event in accordance with Managing Urban Stormwater: Soils and Construction, Volume 1 and Volume 2E (Landcom 2004; DECC 2008) guidelines.

Table 3-1 provides the assessment criteria that were used in the evaluation of the capacity of the surface water management system.

Table 3-1 Dirty water storage capacity assessment basis

Criteria	Value	Basis
Rainfall event (settling volume estimation)	44 mm	95th percentile 5 day management period design rainfall depth for Bathurst adopted for site consistent with EPL 528
Sediment pond type	"Type D" soils that contain a significant proportion of fine (<0.005 mm) "dispersible" materials that will never settle unless flocculated	Assumed worst case of Landcom (2004) Table F2
Volumetric runoff coefficient – dirty water	0.69	Landcom (2004) Table F2, based on design rainfall depth and soil hydrologic group
Volumetric runoff coefficient – undisturbed and rehabilitated areas	0.22	Landcom (2004) states that "lower values can be adopted where a significant proportion of the site is to remain undisturbed (i.e. vegetated)." Volumetric runoff coefficient adopted based on site water balance modelling results (refer to Section 3.5)
Sediment loss calculation (sediment volume estimation)	Revised Universal Soil Loss Equation (RUSLE) to estimate a two-month sediment load for required storage estimation.	Landcom (2004), Section 6.3.4 (i)
Soil erodibility factor (K)	0.05	Worst case from Landcom (2004) Section A3
Length slope factor	Varies – 0.05 to 13	Landcom (2004) Section A4 based on slope length and slope gradient calculated from surface contours
Practice factor – dirty water	1.3	Landcom (2004), Figure A5

Criteria	Value	Basis
Cover factor – dirty water	1	Landcom (2004), Table A2

The dirty water management system at Charbon functions as individual systems operating around each LDP, with the 8 Trunk Void and REAs operating as self-contained system for the purpose of dirty water management. Table 3-2 provides a comparison of the current capacity with the total required storage volumes for each LDP system. Existing storage capacities are based on analysis of LiDAR survey, supplemented by bathymetry field survey undertaken in quarter four of 2016.

Table 3-2 Dirty water storage capacity assessment summary

Location	Cumulative capacity (ML)	Cumulative capacity required (ML)	Comments on adequacy
LDP2	107.8	39.3	Relies on effective transfer of water from HS sediment dams to LDP2 system and transfer from LDP2 to large storage at Third Entry Lake.
LDP3	136.0	72.2	Adequate
LDP4	34.0	15.6	Adequate
LDP5	10.4	18.6	Inadequate, existing storage provide 56% of required capacity
LDP6	9.2	5.5	Adequate

The capacity assessment indicates that the:

- Adequacy of the 2 Trunk Haul Road area, Haystack area and 8 Trunk Haul Road sediment dam rely on pumped transfer capacity to the LDP2 system.
- The overall adequacy of the LDP2 system relies on pumped transfer capacity from LDP2 discharge dam to the relatively large storage of the Third Entry Lake.
- The LDP5 system has inadequate storage capacity.

3.3 Groundwater Management

3.3.1 Historical Mine Workings

Historically, during mining, the underground workings and open cut pits were generally dry with minimal groundwater seepage, except for short periods of low flows following significant rainfall events. Charbon holds bore licence 80BL243771 under the *Water Act 1912* for the extraction of up to 5 ML/year from the underground workings.

3.3.2 Production Bores

Four bores were drilled by Charbon in early 2007 to investigate the potential supply of groundwater for use in operations. Two bores (B1 and B4) were unsuccessful while two bores, Production Bore 2

(PB2) and Production Bore 3 (PB3), were converted to be used as production bores. Locations of these bores are shown in Figure 1-2.

Charbon holds WAL27890 and 80WA706142 which permit the extraction of to 30 ML/year from the production bores. Groundwater from two production bores was used to supplement the surface water supply system for use in the Southern Open Cut, Charbon Underground and CHPP. Following the cessation of mining operations at Charbon, the two production bores are inactive.

3.4 Amenities and Wastewater

Charbon is supplied with potable water by connection to a municipal water supply.

Sewage and other wastewater from the bathhouse and site office within the surface facilities area is treated using an approved biocycle treatment facility. Treated water is used to irrigate landscaped areas and areas undergoing rehabilitation within the Colliery via LDP1 (which allows for the discharge of effluent from the onsite sewage treatment system via irrigation) and is covered under EPL 528. The treatment facilities are serviced by a licensed contractor, as required.

Additionally, sewage and other wastewater within other sections of the Colliery Holding, namely within the Third Entry Areas, is managed through pump-out septic systems or chemical toilets. These systems are emptied as required by a suitably licenced contractor and the material transported to a suitable disposal facility.

In 2011, a Use of Effluent by Irrigation Assessment was completed in accordance with Statement of Commitment (SOC) 9.6, as appended to PA 08_0211 (GSSE 2011). The report assessed the irrigation area that is currently under effluent spray irrigation activities at Charbon, and determined that the current wastewater treatment system is largely operating in accordance with the Effluent Guidelines. The assessment included a physical and chemical analysis of the effluent, landform and soil suitability analysis of the irrigation area, and water and nutrient fate modelling within the irrigation area.

The effluent was found to be highly unlikely to contain potentially harmful contaminants, being low in nutrient concentration, resulting in a low runoff and percolation risk. The irrigation area was deemed to be a suitable receiving environment for spray irrigation activities with regards to landform, soil characteristics, and the quality and quantity of effluent being applied. The effluent pathogen levels were found to exceed the guideline limits, and the implementation of a further pathogen reduction component was recommended to ensure that the system operates in complete accordance with the Effluent Guidelines. A chlorine dosing system was installed in 2012.

Due to the low personnel numbers relative to approved mining operations, the irrigation system is not often required; with evaporation sufficient to manage wastewater volumes.

3.5 Site Water Balance

The site water balance was updated for Charbon as part of the Surface Water Impact Assessment (SWIA) to support the Statement of Environmental Effects for MOD1 (GHD 2019). The water cycle was modelled based on the current site conditions (at the time of completing the SWIA) using a historical time series of rainfall data extending over 130 years.

A summary of the predicted average annual inputs and outputs for the Charbon water management system is provided in Table 3-3. Potable and wastewater volumes are considered negligible and not considered in the water balance modelling.

Table 3-3 Summary of Site Water Balance Results

Water management element	Water transfer (ML/year)	Salt transfer (tonne/year)
INPUTS		
Direct rainfall onto storages	163	2
Catchment runoff	769	243
TOTAL INPUTS	**932**	**245**
OUTPUTS		
Evaporation from storages	248	0
Dust suppression	89	44
Seepage	71	25
Discharge to Cumber Melon Creek	124	35
Discharge through to Rileys Creek	232	87
Transfer to Airly Mine	166	57
TOTAL OUTPUTS	**930**	**248**
CHANGE IN STORAGE		
Surface water storages	2	-3
TOTAL CHANGE IN STORAGE	**2**	**-3**
BALANCE		
Inputs – outputs – change in storage	0	0

Table 3-3 shows that, during rehabilitation, the average annual water balance for Charbon is typical of an agricultural catchment. The predominant inflows are direct rainfall and catchment runoff, which, after allowing for losses to evaporation and usage for dust suppression, report as discharges to Cumber Melon Creek and Rileys Creek.

The actual transfer of up to 170 ML/year to Airly Mine depend on the actual production rate, rainfall and water storage volumes at Airly Mine and Charbon Colliery. Transfers to Airly Mine essentially correspond to a reduction in the discharges to Cumber Melon Creek, with some slight differences in direct rainfall, catchment runoff and evaporation.

3.5.1 Sources and Security of Water Supply

Water for operations at Charbon Colliery is sourced from catchment runoff captured in dirty water management system and Reedy Creek Dam. Although unregulated surface water in an inherently unreliable water supply, water balance modelling did not identify a potential water shortage under a range of potential rainfall conditions. This is consistent with the water demands during current operations at Chabon are small relative to the water demands during mining and coal processing operations.

3.5.2 Discharge Frequency

Water captured in the dirty water management system that is not lost to evaporation or required for dust suppression is treated and discharged via LDPs. In the event of a rainfall event that exceeds the design criteria of the dirty water management system, the relevant water storage would fill to capacity and water would discharge to the downstream environment.

The water balance model presented in GHD (2019) was used to estimate the range of discharge volume under a range of rainfall conditions sampled from the historical rainfall record. The daily flow percentiles for each LDP are presented in Figure 3-6. For clarity, the results are shown with a logarithmic y-axis.

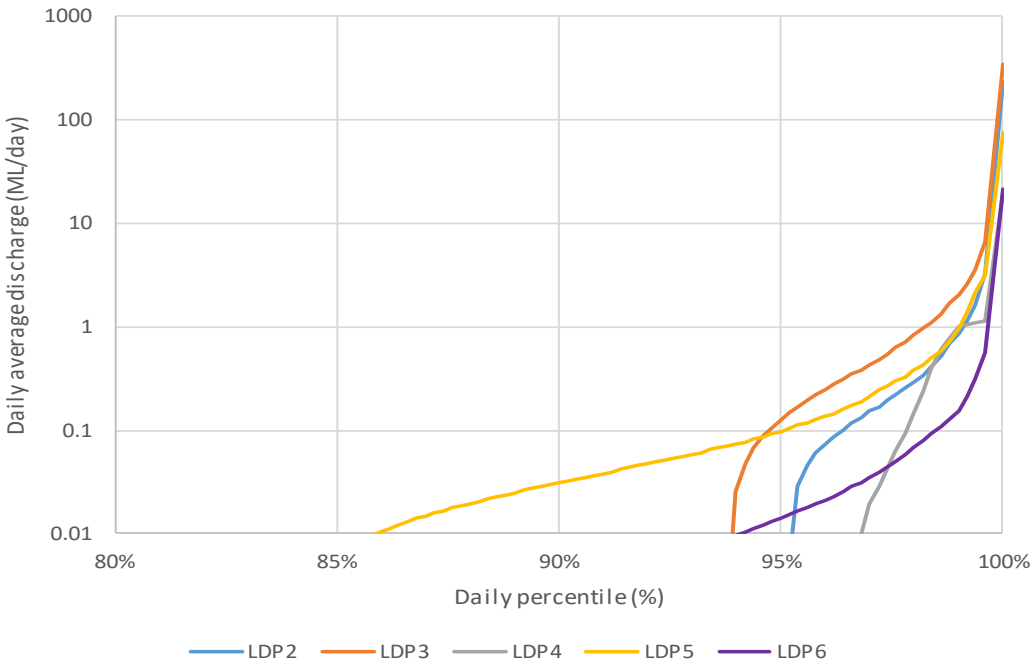


Figure 3-6 Modelled Discharge Frequency

Figure 3-6 shows that discharges are only expected to occur on about 15% of days (i.e. 85% days with no discharge) for LDP5 and about 5% of days (i.e. 95% of days with no discharges) for the other LDPs. Controlled discharges via the LDPs occur only following monitoring and treatment as required. Simulated discharge volumes greater than about 1 to 10 ML/day approximately correspond to discharges as a result of rainfall exceeding the design criteria of the dirty water management system. Figure 3-6 show that such discharges are relatively rare, occurring on less than about 2% of days. The maximum discharge volumes shown in Figure 3-6 are representative of the potential discharge in the very unlikely event of rare flood such as the 1% annual exceedance probability.

3.5.3 Clean Water Capture Within Water Management System

The total clean catchment contributing to the water management system at Charbon was estimated by water balance modelling to be 200 ML/year on average, ranging between 64 ML/year (10th percentile) and 303 ML/year (90th percentile). Clean catchment runoff is typically captured from the catchments to the east of Charbon, from the elevated areas of the Great Dividing Range. Diversion of this runoff is not practical due to the topographic constraints of the catchment. The only use of this water on site is dust suppression or as a loss from the catchment via evaporation. The capture of clean water is incidental to the presence of water storages solely for the capture, containment and recirculation of drainage and/or effluent, consistent with best management practice to prevent the contamination of a water source. The relevant licences and exemptions are described in Section 1.3.4.

4. MONITORING REQUIREMENTS

4.1 Inspections

The requirements for site inspections at Charbon are summarised in Table 4-1.

Table 4-1 Inspection Program

Location	Frequency	Parameters	Basis for monitoring
Dirty water management structures	Monthly, and, as soon as access is practical following rainfall events that exceed 20 mm in 24 hours	Visual inspection of capacity, structural integrity and apparent effectiveness	PA 08_0211 Schedule 5 2(d): Effectiveness of any management measures
Adits: 1 Trunk, 3 Trunk, 3 Trunk, 4 Trunk, 8 Trunk, Haystack	Monthly	Groundwater seepage/drainage (visual inspection)	PA 08_0211 Schedule 3 32(c): Potential acid mine drainage
Effluent irrigation area	Monthly	Surface runoff or drift from the irrigation area (visual inspection)	PA 08_0211 Schedule 3 32(c): Potential leakage or spillage from effluent irrigation.
Main REA and Northern REA	Monthly	Material movement, structural integrity, condition, presence of seepage, downstream watercourses (visual inspection)	PA 08_0211 Schedule 3 32(c): Potential leakage or spillage from reject emplacement area

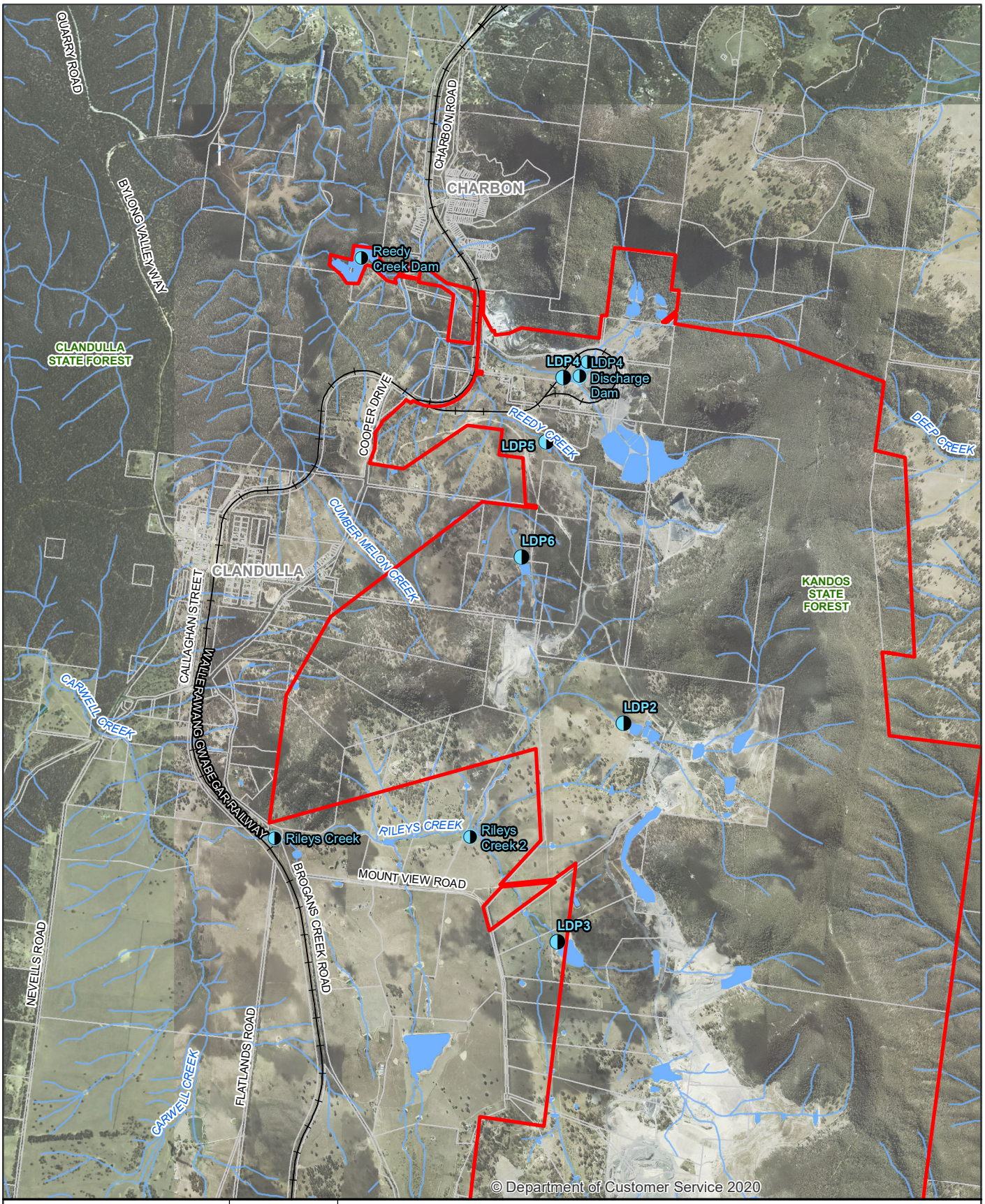
4.2 Surface Water

4.2.1 Surface Water Quality

Figure 4-1 presents the location of surface water monitoring locations for Charbon.

There is no requirement to monitor the quality of discharge of LDP1, notwithstanding the general requirements for operation of the wastewater system in accordance with condition O4 of EPL 528.

Table 4-2 summarises the sampling frequency and monitored parameters.



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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

LEGEND

- Project Site Boundary
- Railway
- Waterway
- Cadastre
- Surface water monitoring location

LOCATION	WCS
SEAM	Lithgow
DRAWN	GHD
CHECKED	TT
APPROVED	ZL
SCALE	refer to scalebar

Charbon Colliery
Water Management Plan

Surface water monitoring locations

CENTENNIAL

DATE 19/10/2021

Figure 4-1

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Table 4-2 Surface Water Quality Monitoring Frequency and Parameters

Location	Frequency	Parameters	Basis for monitoring
LDP2, LDP3, LDP4, LDP5, LDP6	Daily during any discharge	**Physicochemical parameters**: Electrical conductivity (EC), pH, total suspended solids (TSS), turbidity. **Other:** Oil and grease	EPL requirement
	Weekly during any discharge	**Metals (dissolved):** aluminium, arsenic, boron, cadmium, cobalt, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, zinc. **Metals (total):** selenium **Nutrients**: nitrate, nitrite, nitrate + nitrite, total Kjeldahl nitrogen, total nitrogen, total phosphorus. **Major ions**: alkalinity, sulfate, calcium, chloride, magnesium, potassium, sodium. **Other:** water hardness, alkalinity (including bicarbonate)	Comparison to the SSGVs and/or aquatic ecosystem protection guideline values
Rileys Creek, Rileys Creek 2, Reedy Creek Dam	Weekly during any discharge, commencing second day of discharge*	**Physicochemical parameters**: EC, pH, TSS, turbidity, DO. **Metals (dissolved):** aluminium, arsenic, boron, cadmium, cobalt, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, zinc. **Metals (total):** selenium **Nutrients:** ammonia, nitrate, nitrite, nitrate + nitrite, total Kjeldahl nitrogen, total nitrogen, total phosphorus. **Major ions:** alkalinity, calcium, chloride, magnesium, potassium, sodium, sulfate **Other:** oil and grease	Downstream locations
Cudgegong River	Monthly	**Physicochemical parameters-**: EC, oil and grease, pH, TSS, turbidity, DO. **Metals (dissolved):** aluminium, arsenic, boron, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, zinc. **Metals (total):** selenium	Reference site

Location	Frequency	Parameters	Basis for monitoring
		Nutrients: ammonia, nitrate, nitrite, nitrate + nitrite, total Kjeldahl nitrogen, total nitrogen, total phosphorus. **Major ions:** alkalinity, calcium, chloride, magnesium, potassium, sodium, sulfate **Other:** oil and grease	
CHPP Dam 3, LDP4 Discharge Dam, Reedy Creek Dam	Monthly	**Physicochemical parameters**: biochemical oxygen demand (BOD), DO, EC, pH, TDS, TSS, turbidity. **Nutrients**: ammonia, nitrate, nitrite, nitrate + nitrite, total Kjeldahl nitrogen, total nitrogen, total phosphorus. **Major ions**: alkalinity, calcium, chloride, magnesium, potassium, sodium, sulfate. **Metals (dissolved):** aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, vanadium, zinc. **Metals (total):** aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, vanadium, zinc. **Other parameters**: oil and grease	MOD 1 statement of commitments

*To allow for water transit time between the LDP and monitoring location. If discharge event is only one day then samples will be collected on the day following discharge.

4.2.2 Surface Water Quantity

The surface water quantity monitoring program is summarised in Table 4-3.

Table 4-3 Surface Water Quantity Monitoring Frequency and Parameters

Location	Frequency	Parameters	Basis for monitoring
Reedy Creek Dam	Continuous in accordance with the NSW non-urban water metering framework.	Volume of water extracted	WAL 35023
CHPP Dam 3	Annual	Volume of water extracted	Condtion 42A of SSD 08_0211 MOD1

Location	Frequency	Parameters	Basis for monitoring
LDP2, LDP3, LDP4, LDP5, LDP6	When dischargingbg	Volume of water discharged	Annual site water balance

4.3 Groundwater

The existing groundwater monitoring program was reviewed as part of the water resources assessment for MOD2 (EMM 2020). The groundwater monitoring program is summarised in Table 4-4.

In addition to existing groundwater monitoring locations, three new monitoring bores will be installed down gradient of the emplacement areas and upgradient of receptors in the following areas:

- Western Open Cut
- Central Open Box Cut
- 8 Trunk Open Cut

The exact location of the monitoring bores will be confirmed prior to the commencement of CCR importation and due diligence assessments will be completed prior to installation. Currently the existing sites, PB2 and PB3 are not monitored. Monitoring at these two sites will recommence prior to CCR importation.

Table 4-4 Groundwater Quality Monitoring Frequency and Parameters

Location	Frequency	Parameters[2]	Basis for monitoring
PB2, PB3, and three proposed bores	Quarterly[1]	**Physical:** Groundwater level. **Physicochemical parameters**: EC, DO, pH, TDS. **Major ions**: Alkalinity, calcium, chloride, magnesium, potassium, sodium, sulfate. **Metals (dissolved):** Aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, vanadium, zinc.	MOD2 Statement of Commitments

[2] The analyte suite can be modified if results show consistent detections below the laboratory limit of reporting (LOR) for analytes.

No groundwater monitoring is required for perched groundwater above the regional aquifer.

No groundwater monitoring of the private bores that surround the site is required during the rehabilitation and closure phase of the Project.

4.4 Watercourse Stability

A visual inspection is conducted annually by suitably qualified professionals in the reaches shown in Figure 4-2 to identify any instabilities that may form because of discharge activities at Charbon. Annual inspections will identify the following within the creek lines or flow paths:

- Degree of valley confinement and bedrock influences.
- Presence and continuity of a channel.
- Channel planform (number of channels, sinuosity).
- Channel and floodplain geomorphic features.
- Nature of channel and floodplain sediments.
- Presence of headcuts or other instabilities.

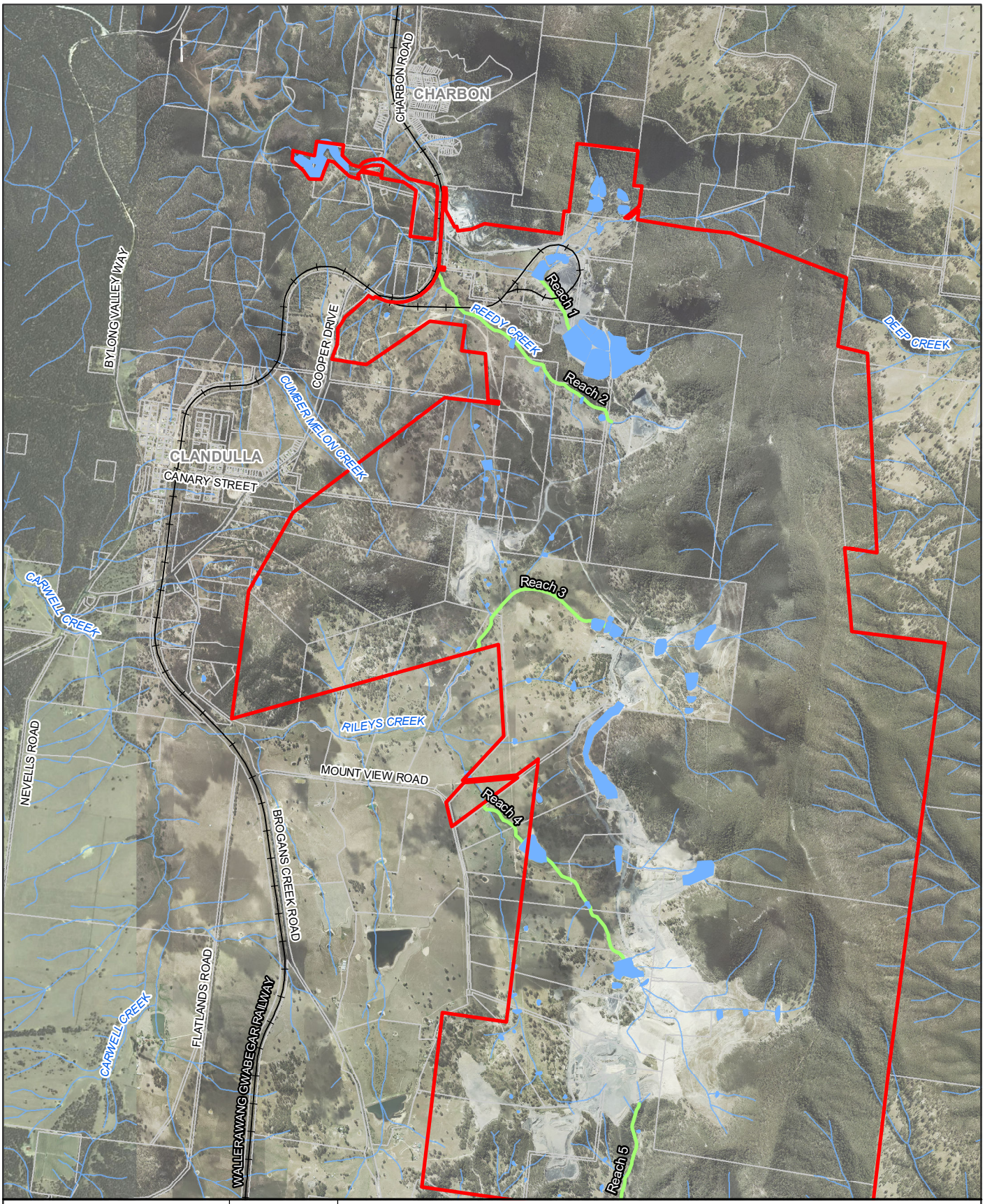
4.5 Aquatic Ecology

Monitoring of aquatic ecology at Charbon is undertaken twice a year (in autumn and spring) at the following locations, as shown in Figure 4-3:

- CUDR – Cudgegong River downstream of Rylstone Reservoir.
- RYLR – Rylstone Reservoir located on the Cudgegong River about 15 km upstream of Charbon.
- RILEY02 – Rileys Creek upstream of Brogans Creek Road, located downstream of LDP2 and LDP3.
- RILEY – Rileys Creek at Brogans Creek Road, located downstream of LDP2 and LDP3.
- RECD – Reedy Creek Dam located on Reedy Creek downstream of LDP4, LDP5 and LDP6.

An assessment of aquatic habitat and sampling of macroinvertebrates, water quality and sediment quality is undertaken at each monitoring location. Reports are produced annually that assess the potential impact from Charbon on downstream watercourses. The most recent interpretive report is GHD (2021).

GHD (2021) recommended that an alternative impact site further upstream in Rileys Creek be investigated. This location, RILEY02 was monitored for the first time in the spring 2021 aquatic ecology survey.



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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

LEGEND

- Project Site Boundary
- Railway
- Waterway
- Cadastre
- Watercourse Stability Monitoring

LOCATION	WCS
SEAM	Lithgow
DRAWN	GHD
CHECKED	TT
APPROVED	ZL
SCALE	refer to scalebar

Charbon Colliery
Water Management Plan

Watercourse stability monitoring

CENTENNIAL

DATE 16/09/2021

Figure 4-2

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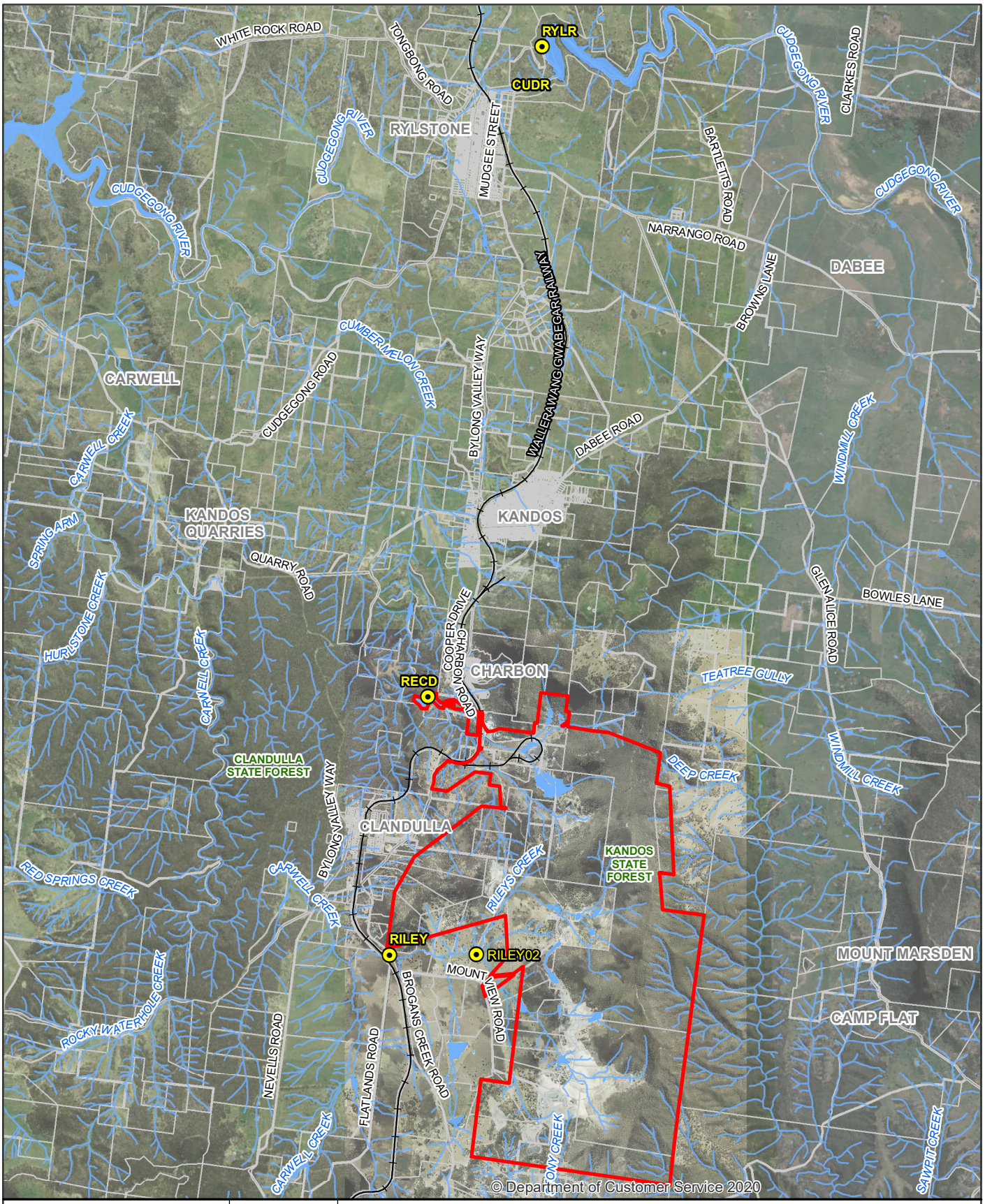

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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

LEGEND

- Project Site Boundary
- Railway
- Waterway
- Waterbody
- Cadastre
- Aquatic ecology monitoring location

LOCATION	WCS
SEAM	Lithgow
DRAWN	GHD
CHECKED	TT
APPROVED	ZL
SCALE	refer to scalebar

Charbon Colliery
Water Management Plan

Aquatic ecology monitoring locations

CENTENNIAL

DATE 19/10/2021

Figure 4-3

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5. BASELINE DATA

5.1 Surface and Groundwater Environment

5.1.1 Surface Water Quality

Surface water quality data collected under the monitoring requirements in Section 4.2.1 since January 2010 are presented in Appendix E. Where the analytical result was below the LOR for a particular parameter, then the detection limit was included in the analysis, as recommended by ANZG (2018).

5.1.2 Surface Water Quantity

Observed active water transfers subject to volumetric limits are summarised in Table 5-1.

Table 5-1 Measured Water Transfers

Year	Extraction from Reedy Creek Dam (WAL35023) (ML)	Transfers to Airly Mine (ML)
Ending 30 June 2019	0	80
Ending 30 June 2020	0	18.85

Flow volumes are recorded at each LDP, however this monitoring is no longer required by EPL 528. The annual total measured discharge volumes are summarised in Table 5-2. Flow volumes were measured with a flow meter.

Table 5-2 Measured LDP Discharge Volumes

Year	LDP2 (ML/year)	LDP3 (ML/year)	LDP4 (ML/year)	LDP5 (ML/year)	LDP6 (ML/year)
2016	65.9	238.3	72.8	86.5	32.7
2017	5.2	112.6	43.7	11.4	5.1
2018	0	7.9	10.4	0	0
2019	1.1	10.7	8.8	0	0
2020	10.9	15.7	18.0	6.2	7.7

5.2 Groundwater

Groundwater quality data collected under the monitoring requirements in Section 4.3 since January 2010 are presented in Appendix E. Where the analytical result was below the LOR for a particular parameter, then the detection limit was included in the analysis, as recommended by ANZG (2018).

Monitoring of groundwater ceased in 2020 and will recommenced following approval of MOD2.

5.3 Watercourse Stability and Aquatic Ecology

5.3.1 Watercourse Stability

Given that most of waterways downstream of LDP locations are of the *Channelised Fill River* style, the waterways can be considered to be moderately to highly disturbed. These systems have been impacted by past and present agricultural practices including land clearance, grazing and the presence of online farm dams. As a result, natural riparian vegetation is limited to some isolated pockets, and valley fill surfaces are covered primarily by pasture grasses. The Valley Fill section immediately downstream of the LDP4 is dominated by reeds (either *Typha sp*. or *Phragmites australis*). Similarly, the reaches immediately upstream of Reedy Creek Dam are also colonised heavily with reed vegetation due to the influence of the dam on water levels and drainage in these sections.

Channel development through head cut retreat is also occurring along some watercourse sections, including within the Valley Fill downstream of LDP2. Further, the section of waterway upstream of the proposed LDP5 has been subject to the deposition of coal chitter as a result of gully erosion within an upstream REA. The downstream transport of this material has been limited by the presence of an existing dam located upstream of LDP5.

There have been no major changes to the Riley Creek catchment since baseline conditions were assessed in 2012.

5.3.2 Aquatic Ecology

Macroinvertebrate metrics indicate that the macroinvertebrate community downstream of Charbon is in a fair condition. The ephemeral nature of the waterways, historic land clearing and agricultural land use, which are characteristic of the area, denotes that less sensitive taxa are expected at these sites. The macroinvertebrate community at reference site CUDR has generally been in the best condition due to the permanent flow provided by Rylstone Reservoir and variety of instream habitats. The impoundments RYLR and RECD, which hold permanent water, have exhibited greater diversity of macroinvertebrate families and greater numbers of pollution sensitive taxa, when compared to RILEY, which has been water limited in recent sampling events (between 2018 and 2019).

When comparing the two impoundment sites, the macroinvertebrate community at RECD, located downstream of LDP5, is generally in poorer condition than reference site RYLR, due to poorer water quality and uniformity of instream habitat. Generally, macroinvertebrate metrics demonstrate that the community found at RECD is made up of pollution tolerant families. The discharge from Charbon has contributed to the elevated electrical conductivity within Reedy Creek Dam which has likely had some influence on the macroinvertebrate community. However, the variety of microhabitats available in Rylstone Reservoir, which includes variable substrate particle size and both emergent and submerged macrophyte, promotes higher diversity at RYLR. RECD by comparison has uniform muddy substrate and the instream habitat is largely limited to Typha spp. stands which has contributed to the poor quality macroinvertebrate community.

6. RESPONSE PLANS

6.1 Triggers

6.1.1 Surface Water

Water quality objectives for surface water are set based on the protection of the aquatic ecosystem. Monitoring data for site water storages is assessed against concentration limits specified in EPL 528. Trigger values for surface water quality monitoring are provided in Table 6-1.

Table 6-1 Surface Water Quality Trigger Values

Parameter	Unit	Trigger value	Source
Physiochemical parameters			
Oil and grease	mg/L	10	EPL 528
pH	pH units	6.5–8.5	EPL 528
TSS	mg/L	50	EPL 528
Turbidity	NTU	50	EPL 528

Site specific guideline values for Charbon were derived as per ANZG (2018) and ANZECC (2000) based on monitoring data from the reference site Cudgegong River (refer to Appendix D; known as CUDR in the aquatic ecology monitoring program). The SSGVs in Appendix D correspond to the default guidelines values for aquatic ecosystem protection (ANZG 2018; ANZECC 2000) for all parameters except EC, which is based on the reference site 80th percentile, and dissolved mercury, selenium and silver, which is based on the standard LORs. Any monitoring data for locations downstream of the LDPs, such as part of aquatic ecology monitoring, should be assessed against the SSGVs.

Further assessment is planned to confirm the applicability of derived SSGVs to the receiving environment considering:

- Influence of land uses within both Reedy Creek and Rileys Creek catchment.
- Alternative reference catchments that are closer to the Charbon site.

An additional monitoring site within Rileys Creek has been proposed as part of the revised monitoring program in response to the further works on SSGVs (refer to Section 4.2).

6.1.2 Groundwater

The groundwater triggers are currently based on the occurrence of complaints from surrounding landholders relating to identified issues in privately owned bores.

Site specific groundwater quality triggers will be developed prior to emplacement of material imported from Clarence Colliery, considering baseline data from existing and proposed monitoring bores.

6.2 Performance Criteria

Performance criteria have been developed on baseline information. These criteria form the basis of the WMP Trigger Action Response Plans (TARPs) provided in Appendix F.

6.2.1 Surface Water Management

The performance criteria for surface water management are outlined in Table 6-2.

Table 6-2 Surface Water Management Criteria

Aspect	Criteria
Capture of dirty water runoff	Storages sized in accordance with DECC (2008) and Landcom (2004) and maintained within the capacity of each storage.
Erosion and sediment control	Minimising disturbance area.
Hydrocarbon management	Chemical and hydrocarbon storage to be in accordance Australian Standard AS1940:2004.
Potential acid mine drainage	No downstream stream health impacts from acid mine drainage
Potential leakage or spillage from reject emplacement area	No downstream stream health impacts from reject emplacement areas
Potential leakage or spillage from effluent irrigation	No downstream stream health or human health impacts from effluent irrigation areas

6.2.2 Groundwater Management

presents the groundwater environment management criteria for Charbon.

Table 6-3 Groundwater Management Criteria

Aspect	Criteria
Groundwater quality	No impact on groundwater quality of privately owned bores of surrounding landholders.
Groundwater level	No impact on groundwater levels of privately owned bores of surrounding landholders.

Whilst groundwater monitoring is no longer undertaken at Charbon, an allowance for landowner complaints with respect to groundwater supply are to be considered in order to enact investigations and monitoring if required.

6.2.3 Discharge Management

Discharge management includes both discharge volume and quality. The criteria applied for discharges from LDPs at Charbon are presented in Table 6-4.

Table 6-4 Discharge Management Criteria

Aspect	Criteria
Discharge water quality	Below EPL 528 limits. See Table 6-1.
Discharge location	No off-site discharges of dirty water other than via LDPs.
Downstream water users	No complaints regarding surface water supply from downstream landholders.
Watercourse stability	No changes in watercourse stability due to discharges.
Downstream water quality	Low risk to aquatic ecosystems (identified through assessment against current SSGVs considering new monitoring locations). Refer to Appendix D.

6.3 Trigger Action Response Plans

TARPs are provided in Appendix F for:

- Surface water operation.
- Groundwater environment.
- Discharge management.
- Stream health.

7. SITE SPECIFIC REVIEWS AND REPORTS

7.1 Incident and Non-Compliance Notification

In the event an incident occurs, notification to DPIE and any other relevant agencies must occur immediately. The notification must be in writing via the DPIE Major Projects Website and include development (including the development application number and name), the location and nature of the incident.

In the event that Charbon becomes aware of a non-compliance, DPIE must be notified within a period of seven days. The notification must follow the same requirements as an incident notification but must also include:

- The condition of the consent that the development is non-compliant with;
- Why it does not comply and the reasons for the non-compliance (if known); and
- What actions have been, or will be, undertaken to address the non-compliance.

7.2 Annual Review

Charbon will prepare an Annual Review for each calendar year in accordance with the requirements of PA 08_0211. Specifically for water management, the Annual Review will include a:

- Summary of monitoring data and results, and any corrective actions.
- Review performance criteria and any related trigger values.

7.3 Annual Return

EPL 528 requires the company to submit an Annual Return to the EPA on an annual basis. The annual return is a statement of compliance with the conditions of the licence and a report on the pollutant loads generated by Charbon.

7.4 Site Water Balance

The site water balance will be reviewed and revised on an annual basis against site observations and reported in the Annual Review.

8. REFERENCES

AECOM (2016) *Centennial Charbon: Remedial Action Plan*, prepared by AECOM Australia Pty Ltd for Charbon Coal Pty Ltd.

ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Australian and New Zealand Environment and Conservation Council.

ANZG (2018) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*: *Default Guideline Values*, http://www.waterquality.gov.au/anz-guidelines/guidelinevalues/default

BOM (2021) *National Groundwater Information System*, Bureau of Meteorology (site accessed: http://www.bom.gov.au/water/groundwater/ngis).

BOM (2021) *Atlas of Groundwater Dependent Ecosystems*, Bureau of Meteorology (site accessed: http://www.bom.gov.au/water/groundwater/gde/map.shtml).

DECC (2008) *Managing Urban Stormwater: Soils and Construction – Volume 2E Mines and Quarries*, NSW Department of Environment and Climate Change.

DPI Water (2016) *Dams in NSW, Do you need a licence?*, Department of Primary Industries, Water, March 2016, (site accessed: http://www.water.nsw.gov.au/__data/assets/pdf_file/0005/599117/Dams-in-nsw-do-you-need-a-licence.pdf)

EMM (2020) Charbon Colliery- Modification 2 – Water resources assessment. Report J180459 RP#8 prepared by EMM Consulting for Charbon Coal Pty Limited. Retrieved from https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=MP08_0211-MOD-2%2120201002T015102.379%20GMT

GeoTerra (2009) *Groundwater Assessment of the Continued Operation of the Charbon Colliery*, prepared by Geo Terra Pty Ltd for Charbon Coal Pty Ltd.

GHD (2021) Charbon Colliery aquatic ecology and watercourse stability monitoring 2020, in draft, prepared by GHD Pty Ltd for Charbon Coal Pty Ltd.

GHD (2019) *Charbon Colliery – Modification 1: Water and salt balance assessment*, prepared by GHD Pty Ltd for Charbon Coal Pty Ltd.

GSSE (2011) Use of Effluent by Irrigation Assessment, prepared by GSSE for Charbon Coal Pty Ltd.

Landcom (2004) *Managing Urban Stormwater: Soils and Construction – Volume 1*, 4th edition.

NRMMC (2006) *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks* (Phase 1), National Resource Management Ministerial Council, Environment Protection and Heritage Council, Australian Health Ministers' Conference.

APPENDICES

Appendix A – Development Consent PA 08_0211 Conditions

Table A.1 Consent conditions

Condition		Where addressed
Schedule 3 29.	The proponent must prepare and implement a Water Management Plan for the project to the satisfaction of the Planning Secretary. This plan must:	This WMP
(a)	Be prepared in consultation with DPIE Water and EPA, and be submitted to the Planning Secretary for approval within 12 months of the date of this approval.	Appendix B
(b)	Include a: a Site Water Balance. an Erosion and Sediment Control Plan; Surface Water and Groundwater Monitoring Programs; and detailed performance criteria, including trigger levels for identifying and investigating any potentially adverse impacts (or trends) associated with the development for downstream surface water flows and quality, including post-mining water pollution from rehabilitated areas of the site.	Section 3.5 Refer to the Erosion and Sediment Control Plan (Appendix G) Section 4 Section 6
30.	The Site Water Balance must:	Section 3.5
(a)	Include details of: Sources and security of water supply. Water use on-site. Water management on-site. Any off-site water transfers. A program for the ongoing verification and refinement of the site water balance model. Reporting procedures.	Section 3.5 Section 7.4
(b)	Undertake the first model verification within 12 months of the granting of the project approval.	Section 7.4
(c)	Investigate and implement all reasonable and feasible measures to minimise water use by the project.	Section 3.5
31.	The Erosion and Sediment Control Plan must:	Refer to the Erosion and Sediment Control Plan (Appendix G)
(a)	Be consistent with the requirements of Managing Urban Stormwater: Soils and Construction, Volume 1 and 2E, 4th Edition, 2004 (Landcom).	Refer to the Erosion and Sediment Control Plan (Appendix G)
(b)	Identify all activities that could cause soil erosion and generate sediment.	Refer to the Erosion and Sediment Control

Condition		Where addressed
		Plan (Appendix G)
(c)	Describe all measures to minimise soil erosion and the potential for the transport of sediment to downstream waters.	Refer to the Erosion and Sediment Control Plan (Appendix G)
(d)	Describe the location, function and capacity of erosion and sediment control structures.	Refer to the Erosion and Sediment Control Plan (Appendix G)
(e)	Describe what measures would be implemented to maintain the structures over time.	Refer to the Erosion and Sediment Control Plan (Appendix G)
32.	The Surface Water Monitoring Program must include:	Section 4.2
(a)	Baseline data of surface water flows and quality in creeks and other waterbodies that could potentially be affected by the project.	Section 5
(b)	Surface water and stream health impact assessment criteria.	Section 6.2.1 and 6.2.2
(c)	A program to monitor and assess: Impacts on surface water flows and quality. Impacts on the surface water supply of potentially affected landowners. Bank stability, riparian vegetation and macroinvertebrate populations along creek lines and ephemeral drainage lines downstream of all licensed discharge points. Potential acid mine drainage. Potential leakage or spillage from reject emplacement area and effluent irrigation.	Section 4 Section 6
(d)	A program for the ongoing verification and refinement of the surface water model.	Section 7.4
(e)	Reporting procedures for the results of the monitoring program and model verification.	Section 7.4
33.	The Groundwater Monitoring Program must include:	Section 4.3
(a)	Baseline data of the natural variation in groundwater levels, yield and quality.	Section 5
(b)	Groundwater impact assessment criteria (including for monitoring bores and privately-owned bores).	Section 4
(c)	A program to monitor the impacts of underground or open cut mining on groundwater resources.	Section 4 No longer required

Condition		Where addressed
		following cessation of mining operations
(d)	A program to monitor and assess potential acid mine drainage.	Section 4.1
Schedule 5, 2.	The Proponent must ensure that the Management Plans required under this approval are prepared in accordance with any relevant guidelines by a suitably qualified expert/s whose appointment is endorsed by the Planning Secretary. The Plans must include:	Section 1
(a)	Detailed baseline data.	Section 5
(b)	A description of: The relevant statutory requirements (including any relevant approval, licence or lease conditions). Any relevant limits or performance measures/criteria. The specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures.	Section 1.3
(c)	A description of the measures that would be implemented to comply with the relevant statutory requirements, limits or performance measures/criteria.	Section 3
(d)	A program to monitor and report on the: Impacts and environmental performance of the project. Effectiveness of any management measures.	Section 4 Section 6
(e)	A contingency plan to manage any unpredicted impacts and their consequences.	Appendix F
(f)	A program to investigate and implement ways to improve the environmental performance of the project over time.	Section 7
(g)	A protocol for managing and reporting any: Incidents. Complaints. Non-compliances with statutory requirements. Exceedances of the impact assessment criteria and/or performance criteria.	Section 6.3 Appendix F
(h)	A protocol for periodic review of the plan.	Section 7

Appendix B – Consultation

SUBMISSION FOR APPROVAL DETAILS	**Revision**	**Circulation date**	**Feedback date**	**Approval date**
	1			
	2	27/02/2017	10/02/2017	
	3	30/10/2019		
	4	25/10/2021		

CONSULTATION DETAILS	**Department**	**Circulation date**	**Feedback date**
	Department of Planning and Environment	27/02/2017	
	DPI Water	22/12/2016	10/02/2017
	EPA	22/12/2016	03/02/2017
	DPIE Water	25/10/2021	
	EPA	25/10/2021	

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27 February 2017

Mr. Clay Preshaw
A/Director Resource Assessments
Department of Planning & Environment
GPO Box 39
Sydney NSW 2001

Dear Mr Preshaw

Charbon Colliery – Revised Water Management Plan

In accordance with correspondence dated 11 October 2016 and 16 December 2016, Charbon Coal has prepared a revised Water Management Plan for the Charbon Colliery. A copy of this revised Water Management Plan has been enclosed for your consideration and approval.

The revised Water Management Plan has been prepared in consultation with the NSW Environment Protection Authority, NSW Office of Environment and Heritage, WaterNSW and the NSW Department of Primary Industries – Water.

If you have any questions in regards to this matter, please contact me on my mobile 0407 207 530 or email james.wearne@centennialcoal.com.au.

Yours sincerely

James Wearne
Group Approvals Manager

Enclosed:

- Charbon Colliery – Water Management Plan

Centennial Coal Company Limited ABN 30 003 714 538

Your reference :
Our reference : EF13/2766; DOC17/646650-02
Contact : Ms Sheridan Ledger; (02) 6332 7608

Mr Bob Miller
Mine Manager
Charbon Coal Mine
PO Box 84
KANDOS NSW 2848

3 February 2017

Dear Mr Miller

CHARBON COAL MINE
DRAFT WATER MANAGEMENT PLAN

I refer to the draft water management plan (WMP) for the Charbon Coal Mine (the Mine) received by the Environment Protection Authority (EPA) on 22 December 2016.

Please note that the EPA does not generally review or provide comment on management plans. However, given the EPA's ongoing concern regarding water management at the Mine, the EPA has in this instance, reviewed the WMP and provides the following comment. It should be noted that the EPA will not approve or endorse the final version of the WMP.

General Comments

It is the EPA's understanding that the revised WMP has been developed as a result of the Mine now being in a closure and rehabilitation phase which may take a number of years to finalise. The EPA is aware that the Mine has limited staff at the current time to manage onsite water. As such, any WMP for the Mine should ensure that water can be managed in the most effective and efficient manner possible and allow for adequate flexibility.

Further, it is important that any water management system at the Mine must allow for sufficient capacity and ensures that sediment loads from the large disturbed areas into water storages at the Mine are minimised as far as practicable.

As you would be aware, the EPA has been working with the Mine regarding the water management system, with some of the requested changes to the existing water management system now being complete. The EPA notes that some of the recent improvements made to the water management system at the Mine have not been included and there are some inaccuracies in the mapping of the current system. These are detailed below:

- SOCPD is shown in figures 3-3 and 3-4 to connect to the culvert;
- The new culvert draining to LDP3 is not shown on figure 3-3 or 3-4 as per figure 3-2;
- Sediment dam 1 is not shown. This dam is important aspect of the WMP given the large disturbance area immediately upslope of the SOCPD, as Sediment dam 1 can minimise sediment loads discharging into the SOCPD; and
- The Haystack dam/s connection to LDP2 is not illustrated.

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Matters to be addressed

The EPA notes in section 3.2.3 that the capacity assessment for the surface water storages is based on a 5 day 90th percentile rainfall event of 40mm. Having regard to the Landcom 2004/DECC 2008 version of the "Blue Book" the EPA cannot determine why such a value has been utilised. In relation to the sizing of sediment dams, the EPA takes a conservative approach and requires sediment basins have a settling zone volume utilising the 95th percentile 5-day rainfall duration. This is based upon the EPA's experience with the difficulties in managing sediment basins, especially on sites where there are a large number of dams and in the case of the Mine, this is considered more applicable given the limited staffing.

At the current time, the EPL for the Mine includes conditions which relate to a 5 day 95th percentile rainfall event of 56mm for Lithgow. The EPA is aware that Centennial Coal considers that rainfall at the Mine to be generally more consistent with that of Mudgee, however no formal representations have been made to the EPA requesting variation of these conditions. At the current time, the EPL for the Moolarben Coal Mine includes conditions which relate to a 5 day 95th percentile rainfall event of 44mm for Bathurst. The Mine is required to re-assess the storage capacity in accordance with a rainfall event which can be justified. Additionally the site water balance provided in the WMP may also require alteration as a result.

The EPA considers that the following matters should also be addressed:

- Water management for the area between the SOCPD and the haul road dam needs to be determined;
- Discharges from the Stony Creek dams – the WMP indicates that discharges do not go through an LDP or properly sized sediment dams.
- Discharges from 8 Trunk Open Void Cell 1 – the WMP indicates this dirty water drains to farm dams and not through an LDP or properly sized sediment dams.

Should you have any further enquiries in relation to this matter please contact Ms Sheridan Ledger at the EPA Central West Office (Bathurst) by telephoning (02) 6332 7608.

Yours sincerely

DARRYL CLIFT
Head Central West Unit
Environment Protection Authority

Department of Primary Industries
Water

Contact Tim Baker
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Our ref OUT17/7013

James Wearne
Centennial Coal
PO Box 1000
TORONTO NSW 2283

Dear James

CHARBON COLLIERY – WATER MANAGEMENT PLAN/EROSION AND SEDIMENT CONTROL PLAN

I refer to your letter dated 22nd December 2016 requesting comments from DPI Water in relation to Charbon Colliery's revised Water Management Plan. It is understood the review of this plan is to reflect the current closure and rehabilitation phases of operations at the site. DPI Water has reviewed the plan and provides the following comments.

Water Management Plan

- As the WMP is providing direction towards closure and rehabilitation DPI Water requests advice on the long term management of the existing water storages. This is to confirm which storages are to be retained/decommissioned and the long term purposes of those storages, eg. clean water or dirty water collection for industrial or agricultural use. This information is critical in providing advice on additional licensing requirements for the site. The separation of clean and dirty water is important for maximising clean runoff through the site and minimising additional license requirements.
- Where dams on first or second order streams are to be retained for clean water capture, the size of these dams will need to be consistent with the Maximum Harvestable Rights Dam Capacity for the property. If they exceed this capacity they will need to be resized or licensing will be required. Further information on MHRDC can be accessed at the following link: http://www.water.nsw.gov.au/water-licensing/basic-water-rights/harvesting-runoff/calculator
- DPI Water advises LDP3 Discharge Dam and the Southern Open Cut Pollution Control Dam are currently licensed for "Conservation of Water" under Water Supply Work Approval 80WA717722. This licence limits water use to stock and domestic use and does not authorise the use of water from these dams for "industrial or mining use". Confirmation is therefore requested on the proposed use of these dams during rehabilitation and closure to confirm licensing requirements.
- In Appendix E, the action to address Trigger 2 for clean water diversion refers to the requirement to cut a channel. Construction of this channel may require an approval under the *Water Management Act 2000*, therefore it is recommended DPI Water be included for consultation.
- In Appendix E, the action to address trigger 2 for groundwater level indicates water will be provided to effected landowners 6 months after the impact has occurred. It is

recommended the water be provided as soon as it is recognised the impact is due to mining activities and that the investigation to achieve this should be completed within 3 months.

- Where rehabilitation works are to be completed within or adjacent to watercourses, DPI Water recommends these works be carried out consistently with the "Guidelines for Controlled Activities on Waterfront Land (DPI Water 2012)". These can be accessed at the following link: http://www.water.nsw.gov.au/water-licensing/approvals/controlled-activity

Erosion and Sediment Control Plan

- As this plan is providing direction towards mine closure and rehabilitation DPI Water recommends the plan identify how and where works are to change from the previous operational period. The current plan provides general strategies and approaches relevant to the operational phase.
- DPI Water supports design and implementation of erosion and sediment control structures in accordance with Managing Urban Stormwater: Soils and Construction, Volume 1 (Landcom 2004) and Volume 2E – Mines and Quarries (DECC 2008).
- This plan refers to surface water take from clean catchment areas upstream of existing open cut operations. Quantification of this take on an annual basis is requested to enable DPI Water to consider licensing requirements and its relevance to the WMP.

Should you have any further queries in relation to this submission please do not hesitate to contact Tim Baker on (02) 6841 7403.

Yours sincerely

Vickie Chatfield
Regional Manager
Water Regulatory Operations
10 February 2017

Table B.1 Consultation comments

Comment	Response
Letter from DPI Water, dated 10/2/2017	
As the WMP is providing direction towards closure and rehabilitation DPI Water requests advice on the long term management of the existing water storages. This is to confirm which storages are to be retained/decommissioned and the long term purposes of those storages, e.g. clean water or dirty water collection for industrial or agricultural use. This information is critical in providing advice on additional licensing requirements for the site. The separation of clean and dirty water is important for maximising clean runoff through the site and minimising additional license requirements.	General words to be added to address this.
Where dams on first or second order streams are to be retained for clean water capture, the size of these dams will need to be consistent with the Maximum Harvestable Rights Dam Capacity for the property. If they exceed this capacity they will need to be resized or licensing will be required. Further information on MHRDC can be accessed at the following link: http://www.water.nsw.gov.au/water-licensing/basic-water-rights/harvesting-runoff/calculator	This will be implemented following complete rehabilitation of site. Storages used in the water management system currently satisfy an exemption criteria
DPI Water advises LDP3 Discharge Dam and the Southern Open Cut Pollution Control Dam are currently licensed for “Conservation of Water” under Water Supply Work Approval 80WA717722. This license limits water use to stock and domestic use and does not authorise the use of water from these dams for “industrial or mining use”. Confirmation is therefore requested on the proposed use of these dams during rehabilitation and closure to confirm licensing requirements.	No industrial reuse occurs on site. Water is currently only used for dust suppression.
In Appendix E, the action to address Trigger 2 for groundwater level indicates water will be provided to effected landowners 6 months after the impact has occurred. It is recommended the water be provided as soon as it is recognised the impact is due to mining activities and the investigation to achieve this should be completed within 3 months.	Noted
Where rehabilitation works are to be completed within or adjacent to watercourses, DPI Water recommends these works be carried out consistently with the “Guidelines for Controlled Activities on Waterfront Land (DPI Water 2012)”. These can be accessed at the following link: http://www.water.nsw.gov.au/water-licensing/approvals/controlled-activity	Noted. Reference to be added to discussion within the erosion and sediment control plans.
As the erosion and sediment control plan is providing direction towards mine closure and rehabilitation DPI Water recommends the plan identify how and where works are to change from the previous operational period. The current plan provides general strategies and approaches relevant to the operational phase	The plan proposes the controls and strategies for erosion and sediment controls whilst rehabilitation and closure planning is undertaken. Landform works will be within the catchment being managed by the existing water

Comment	Response
Letter from DPI Water, dated 10/2/2017	
	management system
DPI Water supports design and implementation of erosion and sediment control structures in accordance with Managing Urban Stormwater: Soils and Construction, Volume 1 (Landcom 2004) and Volume 2E – Mines and Quarries (DECC 2008)	Noted
The erosion and sediment control plan refers to surface water take from clean catchment areas upstream of existing open cut operations. Quantification of this take on an annual basis is requested to enable DPI Water to consider licensing requirements and its relevance to the WMP.	Refer to the water and salt balance for the water cycle and predicted runoff volumes predicted.
Letter from EPA, date 3 February 2017	
In section 3.2.3 the capacity assessment for the surface water storages is based on a 5 day 90th percentile rainfall event of 40mm. Having regard to the Landcom 2004/DECC 2008 version of the “Blue Book” the EPA cannot determine why such a value has been utilised. In relation to the sizing of sediment dams, the EPA takes a conservative approach and requires sediment basins have a settling zone volume utilising the 95th percentile 5-day rainfall duration. This is based upon the EPA’s experience with the difficulties in managing sediment basins, especially on sites where there are a large number of dams and in the case of the Mine, this is considered ore applicable given the limited staffing.	Noted, criteria updated.
At the current time, the EPL for the Mine includes conditions which relate to a 5 day 95th percentile rainfall event of 56mm for Lithgow. The EPA is aware the Centennial Coal considers that rainfall at the Mine to be generally more consistent with that of Mudgee, however no formal representations have been made to the EPA requesting variation of these conditions. At the current time, the EPL for the Moolarben Coal Mine includes conditions which relate to a 5 day 95th percentile rainfall event of 44mm for Bathurst. The Mine is required to re-assess the storage capacity in accordance with a rainfall event which can be justified. Additionally the site water balance provided in the WMP may also require alteration as a result.	Estimates for water management storage capacities and related defined criteria have been updated to reflect 44 mm.

Comment	Response
Letter from DPI Water, dated 10/2/2017	
The EPA considers that the following matters should also be addressed: - Water management for the area between the SOCPD and the haul road dam needs to be determined. - Discharges from the Stony Creek dams – the WMP indicates that discharges do not go through an LDP or properly sized sediment dams. - Discharges from 8 Trunk Open Void Cell 1 – the WMP indicates this dirty water drains to farm dams and not through an LDP or property sized sediment dams.	Further details provided in Section 3.2

Appendix C – Registered Groundwater Bores

Table C.1 Registered Groundwater Bores

Bore	Depth (m)	Authorised purpose	WBZ[1] (m bgl[2])	SWL[3] (m bgl[2])	Yield (L/s)	TDS (mg/L)	Strata
GW804126	121	Mining	45-46, 58-59, 64-65, 72-73	7	0.76, 0.63, 0.51, 0.95	–	Sandstone
GW804125	130	Mining	35-37, 58-59, 78-79	13	0.16, 1.01, 0.13	–	Sandstone
GW014210	31.7	Stock	9.1-10.3, 27.7-28.3	8.5, 12.2	0.63, 2.27	1,001-3,000	clay, sand, Shale
GW110853	67	Stock, domestic	25.6-25.9, 52.1-52.7	15	–	–	Sandstone
GW031269	30.5	Unknown	–	–	–	–	Shale, silty
GW031268	30.5	Unknown	–	–	–	–	Shale, silty
GW070872	45.7	Stock, domestic	29-30.5, 42.7-43.3	18.3	0.38	–	Unknown
GW056687	31.3	Stock, domestic	24.6-25	2	0.15	Fresh	Sandstone
GW800786	42	Stock, domestic	36-36.2	12	0.18	–	Limestone
GW804917	40	Stock, irrigation	26-27, 32-33	20	0.8, 1	–	Shale
GW801159	27	Stock, domestic	15-15.5, 25-25.3	3.5	0.5	–	Shale
GW803115	50	Stock, domestic	29-31	3	0.8	–	Shale
GW025278	76.2	Domestic	16.7-18.2	12.8	0.88	3,001-7,000	Basalt
GW023586	18.2	Domestic	–	–	–	–	Unknown
GW059768	45.7	Stock, domestic	32-32.3, 35-35.3, 39.6-39.9, 41.1-41.4	24.3	1.25, 0.63, 1.25, 1.38	–	Shale

Bore	Depth (m)	Authorised purpose	WBZ[1] (m bgl[2])	SWL[3] (m bgl[2])	Yield (L/s)	TDS (mg/L)	Strata
GW800780	25	Stock, domestic	14.5-14.7, 17.8-18	–	0.5, 2	–	Shale
GW800781	25	Stock, domestic	13-13.1, 18-18.2	9.5	0.5	–	Shale
GW804535	–	Stock, domestic	–	–	–	–	–
GW802972	56	Test bore	18-18.5, 32-33, 41-42	14	0.63, 0.63, 0.99	–	Limestone
GW803360	5.2	Monitoring bore	–	–	–	–	Silty clay, shale, sandstone
GW803361	7.15	Monitoring bore	–	–	–	–	Silty clay, shale, sandstone
GW803359	7.8	Monitoring bore	–	–	–	–	Silty clay, shale, sandstone
GW803362	4.75	Monitoring bore	–	–	–	–	Silt, Clay, shale, sandstone
GW804535	-	Water Supply	-	-	-	-	-
GW804881	9	Monitoring bore	7-9	7.49	–	–	Sandy clay
GW804882	15	Monitoring bore	–	–	–	–	Shale
GW804880	15	Monitoring bore	–	8.85	–	–	Sandy clay, clay, shale
GW804876	14	Monitoring bore	12-14	6.38	–	–	Clay
GW804875	12.5	Monitoring bore	10.5-12.5	7.54	–	–	Clay
GW804877	15	Monitoring	–	–	–	–	Sandy clay,

Bore	Depth (m)	Authorised purpose	WBZ[1] (m bgl[2])	SWL[3] (m bgl[2])	Yield (L/s)	TDS (mg/L)	Strata
		bore					clay, shale
GW804886	5	Monitoring bore	3.5-5	1.76	–	–	Sandy gravelly clay, sandy clay
GW804884	12	Monitoring bore	10.4-12	9.84	–	–	Sandy clay
GW804878	15	Monitoring bore	–	–	–	–	Sandy clay, sandstone
GW804883	15	Monitoring bore	–	–	–	–	Sandy clay
GW804879	11	Monitoring bore	–	6.88	–	–	Gravelly sandy clay
GW804873	15	Monitoring bore	14-15	10.21	–	–	Sandy clay
GW804871	15.1	Monitoring bore	11.2-15	12.19	–	–	Sandy gravelly clay, sand
GW804872	14	Monitoring bore	10.5-11.5	8.91	–	–	Clay
GW804885	10	Monitoring bore	8-11	7.36	–	–	Sandy gravelly clay
GW804889	15	Monitoring bore	–	–	–	–	Sandy clay, shale
GW804888	15	Monitoring bore	13.7-15	10.74	–	–	Gravelly sand, shale
GW804887	15	Monitoring bore	–	–	–	–	Fill, gravelly sandstone, shale
GW804874	15	Monitoring bore	–	–	–	–	Clayey sand, shale, claystone

1. WBZ – water-bearing zone.

2. bgl – below ground level.

3. SWL – standing water level.

Appendix D – Site Specific Guideline Values

SSGVs have been developed based on the monitoring data for reference site Cudgegong River, which was sampled 31 times between March 2017 and September 2019.

The SSGVs were calculated as per ANZG (2018) and ANZECC (2000), which recommend the use of at least 2 years of monthly sampling data for a reference site. SSGVs are calculated based on the 80th percentile of the reference site data, or the 20th percentile for stressors that can cause problems at low levels, such as pH. The SSGVs derived are presented in Table D.1 below. For dissolved concentrations of the metals mercury, selenium and silver, the standard laboratory limits of reporting (LORs) have been adopted as the SSGVs.

Table D.1 SSGVs

Parameter	Unit	20th percentile	80th percentile	DGV	SSGV	Source
Physicochemical parameters						
EC	µS/cm	NA	564	350	564	80th percentile from reference data
pH	pH units	7.20	7.80	6.5-8.0	6.5-8.0	ANZECC (2000) DGV
Turbidity	NTU	NA	4.7	25	25	ANZECC (2000) DGV
Dissolved metals						
Aluminium	mg/L	NA	0.01	0.055	0.055	ANZECC (2000) DGV
Arsenic	mg/L	NA	0.001	0.013	0.013	ANZECC (2000) DGV
Boron	mg/L	NA	0.05	0.94	0.94	ANZG (2021) DGV
Cadmium	mg/L	NA	0.0001	0.0002	0.0002	ANZECC (2000) DGV
Chromium	mg/L	NA	0.001	0.001	0.001	ANZECC (2000) DGV
Copper	mg/L	NA	0.001	0.0014	0.0014	ANZECC (2000) DGV
Lead	mg/L	NA	0.001	0.0034	0.0034	ANZECC (2000) DGV
Manganese	mg/L	NA	1.220	1.900	1.900	ANZECC (2000) DGV
Mercury	mg/L	NA	0.0001	0.00006	0.0001	Standard LOR
Nickel	mg/L	NA	0.002	0.011	0.011	ANZECC (2000) DGV
Selenium	mg/L	NA	0.01	0.005	0.01	Standard LOR

Parameter	Unit	20th percentile	80th percentile	DGV	SSGV	Source
Silver	mg/L	NA	0.001	0.00005	0.001	Standard LOR
Zinc	mg/L	NA	0.005	0.008	0.008	ANZECC (2000) DGV

Appendix E – Water Quality Data

Surface Water

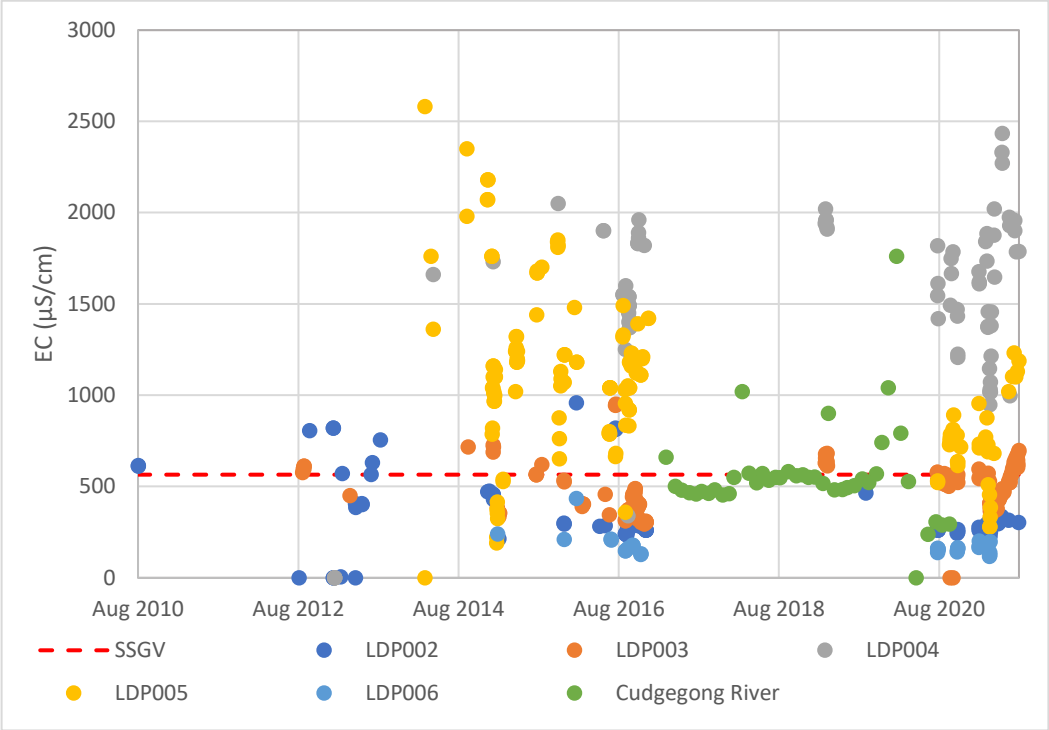

Figure E-1 Electrical Conductivity Recorded in LDP Discharge and reference site

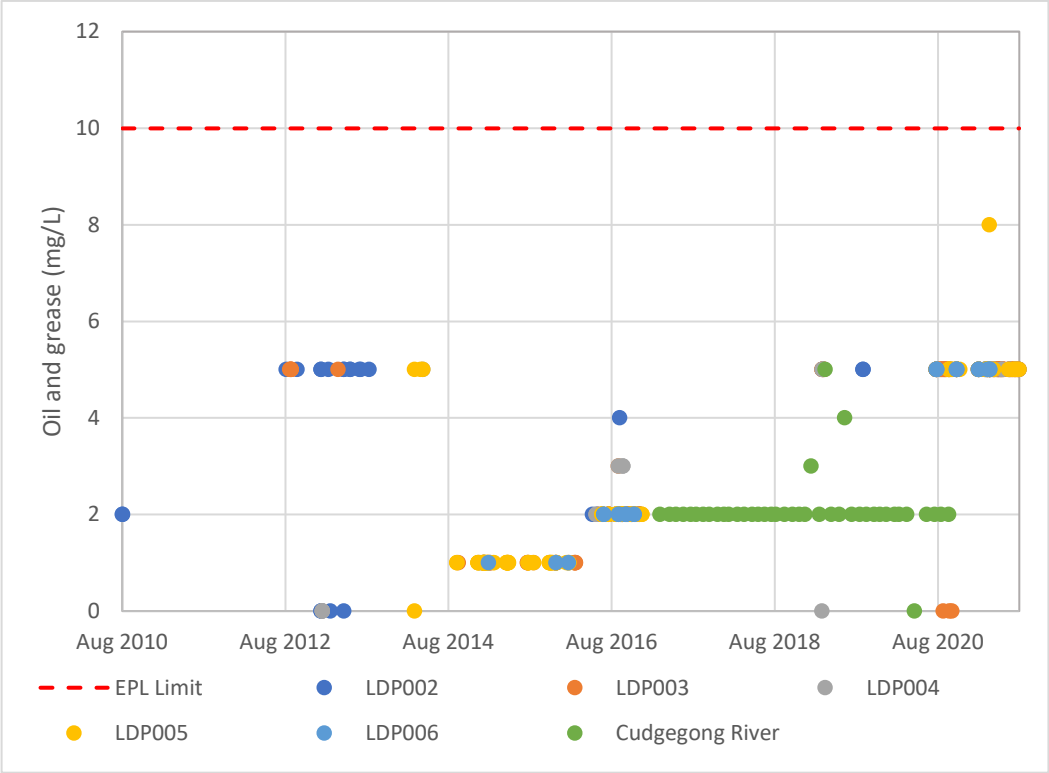

Figure E-2 Oil and Grease Recorded in LDP Discharge and reference site

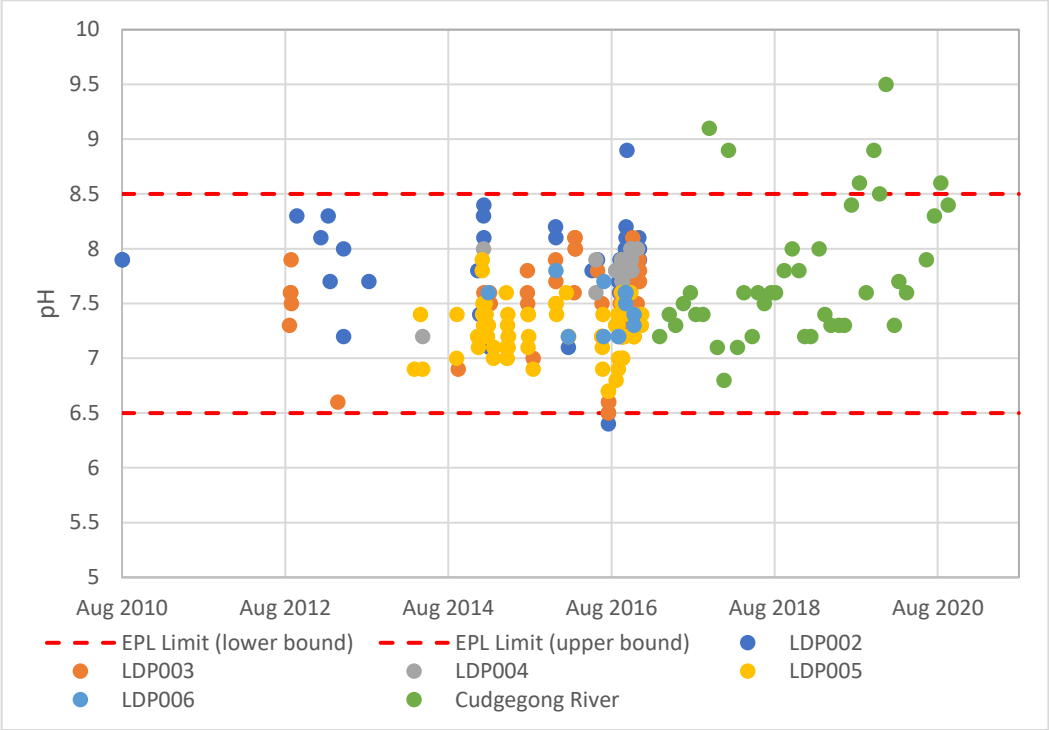

Figure E-3 pH Recorded in LDP Discharge and reference site

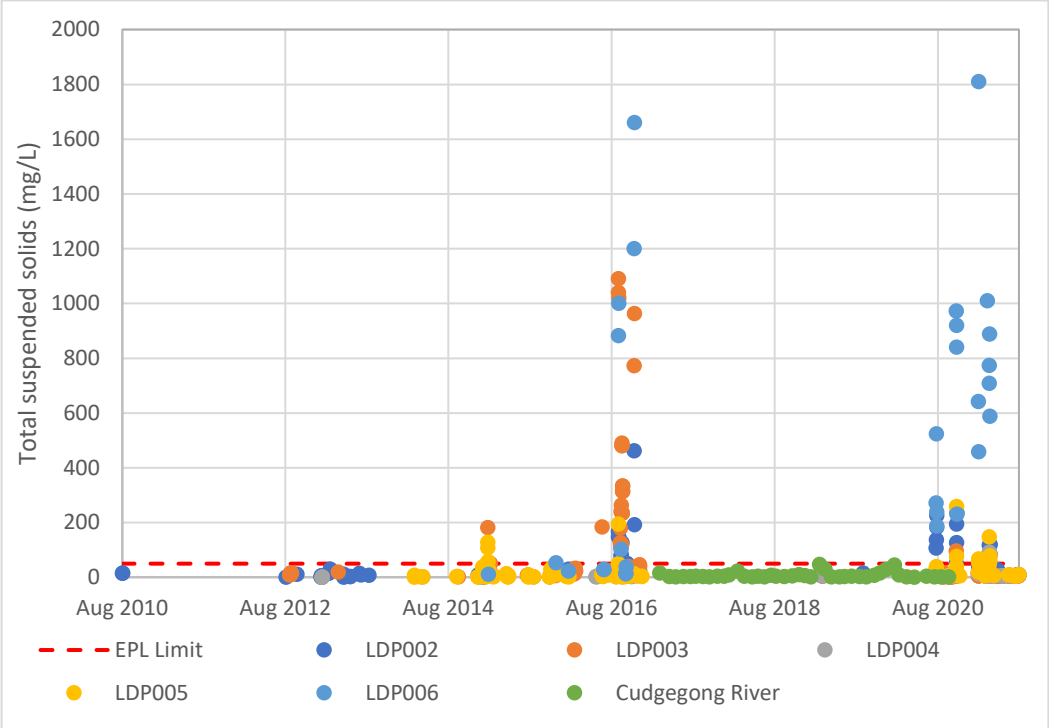

Figure E-4 Total Suspended Solids Recorded in LDP Discharge and reference site

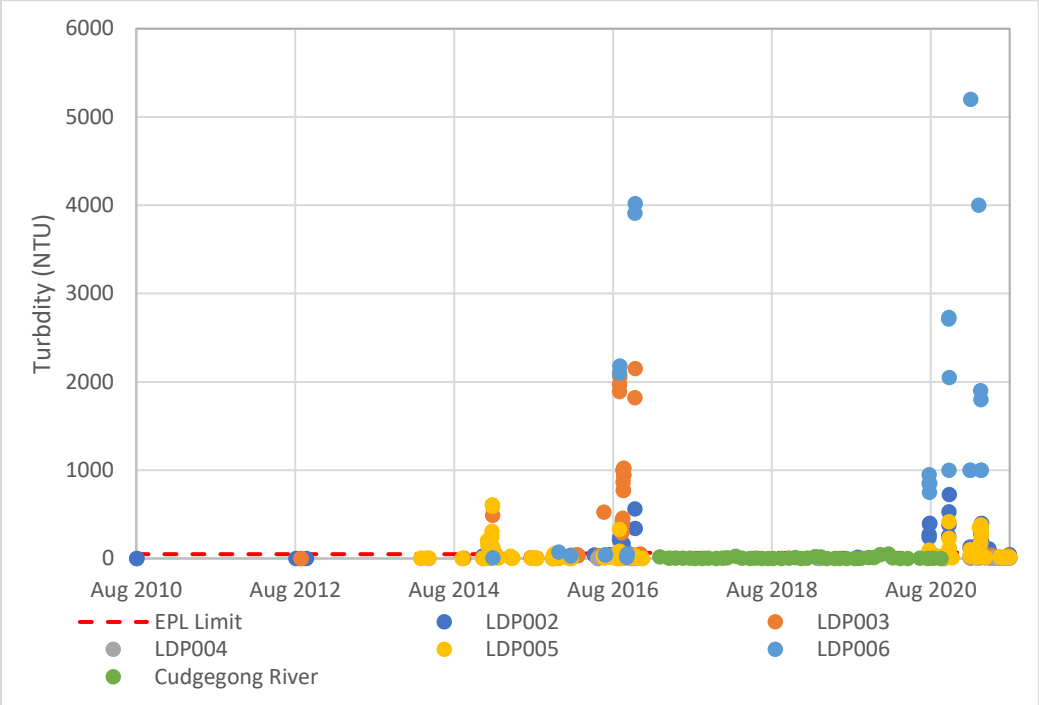

Figure E-5 Turbidity Recorded in LDP Discharge and reference site

Table E.1a Surface Water Quality Data – LDP discharge

Parameter	Units	EPL 528 limit	LDP002		LDP003		LDP004		LDP005		LDP006	
			Count	Median	Count	Median	Count	Median	Count	Median	Count	Median
EC	µS/cm	–	91	289	206	474.5	77	1646	139	1050	29	161
Oil and grease	mg/L	10	89	5	205	5	76	5	138	2	28	5
pH	pH units	6.5–8.5	50	7.9	83	7.6	25	7.8	94	7.3	12	7.45
TSS	mg/L	50	90	22.5	206	6	77	6	139	6	29	524
Turbidity	NTU	50	76	45	199	19.9	76	6.75	138	11	28	1000

Table E.1b Surface Water Quality Data – reference site

Parameter	Units	Cudgegong River	
		Count	Median
EC	µS/cm	41	527
Oil and grease	mg/L	41	2
pH	pH units	41	7.6
TSS	mg/L	41	4
Turbidity	NTU	41	2.4

Groundwater

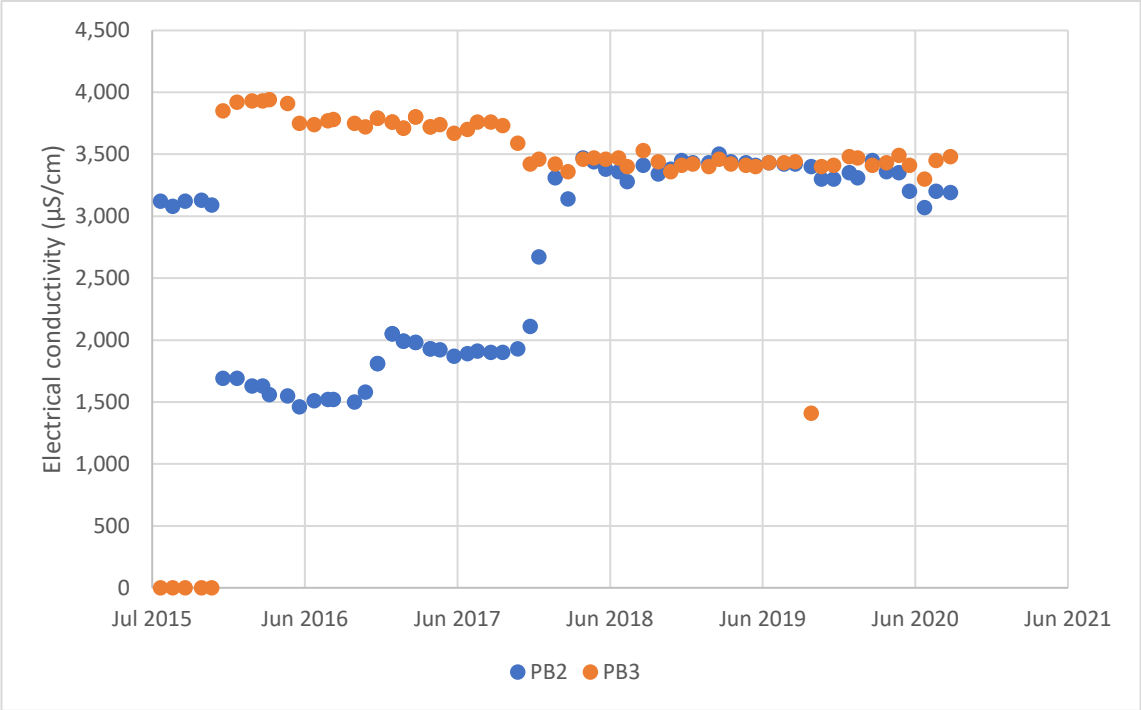

Figure E-6 Electrical Conductivity Recorded at PB2 and PB3

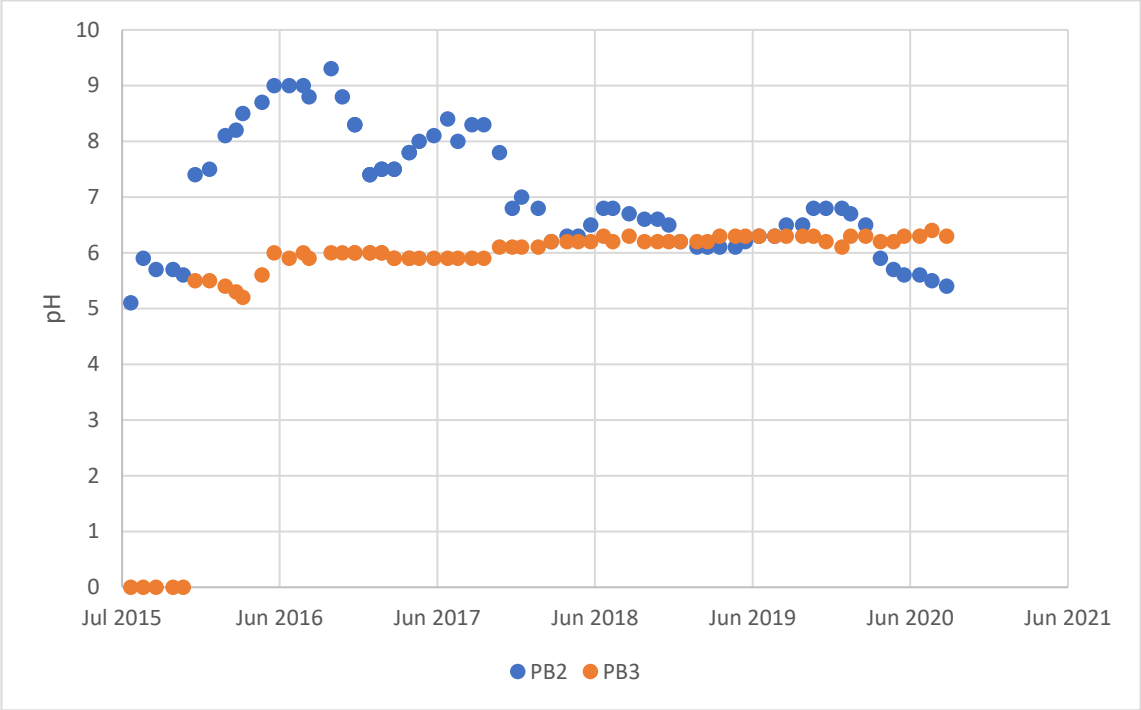

Figure E-7 pH Recorded at PB2 and PB3

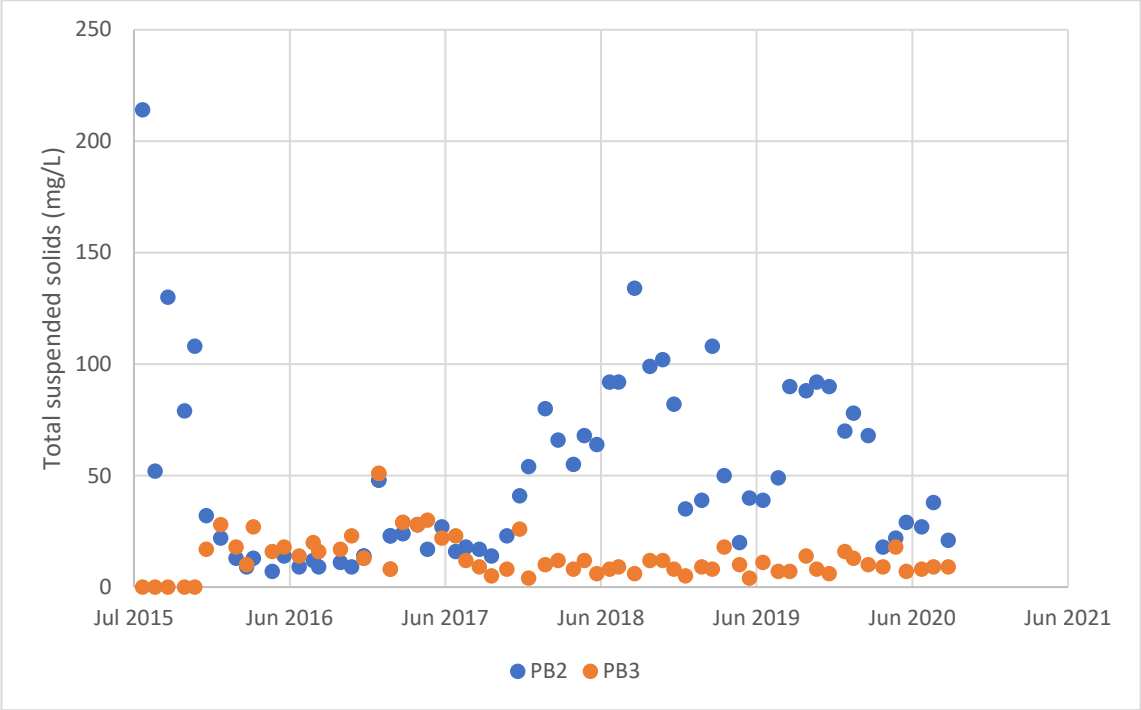

Figure E-8 Total Suspended Solids Recorded at PB2 and PB3

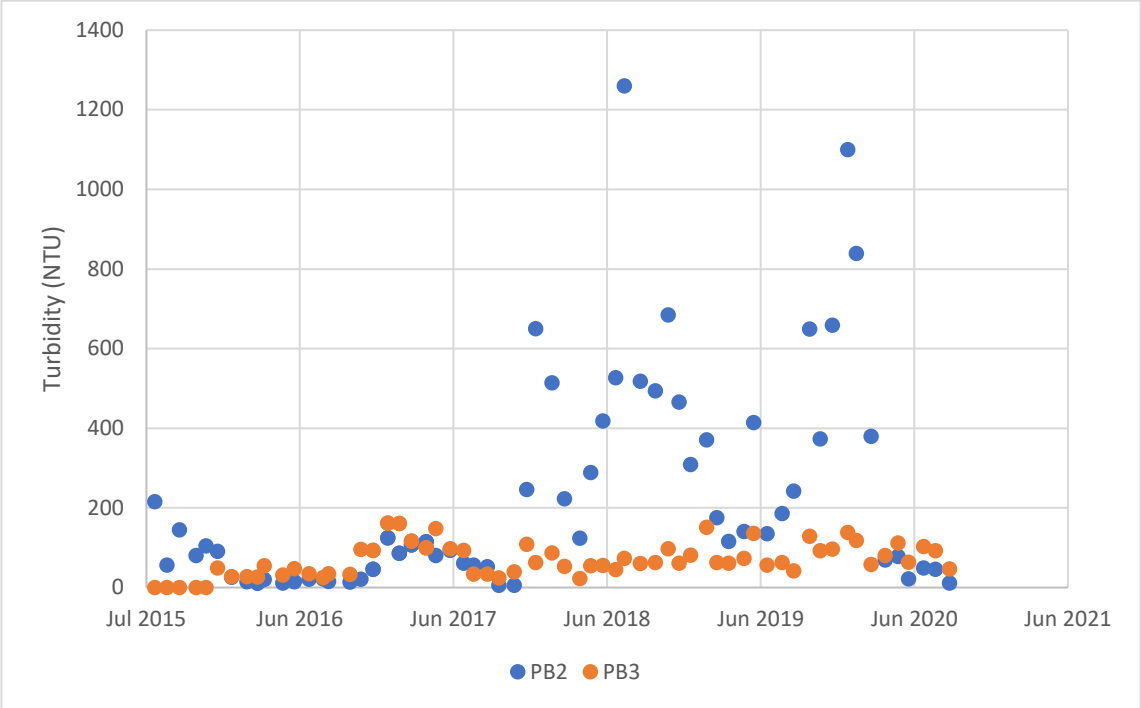

Figure E-9 Turbidity Recorded at PB2 and PB3

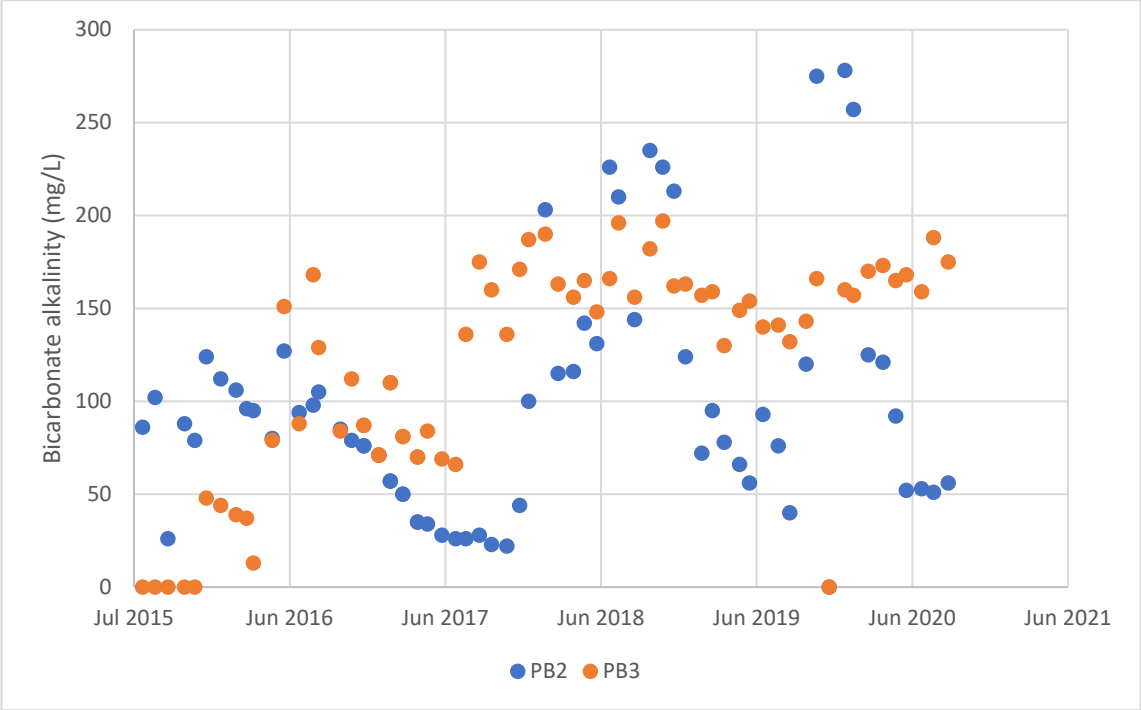

Figure E-10 Bicarbonate Alkalinity Recorded at PB2 and PB3

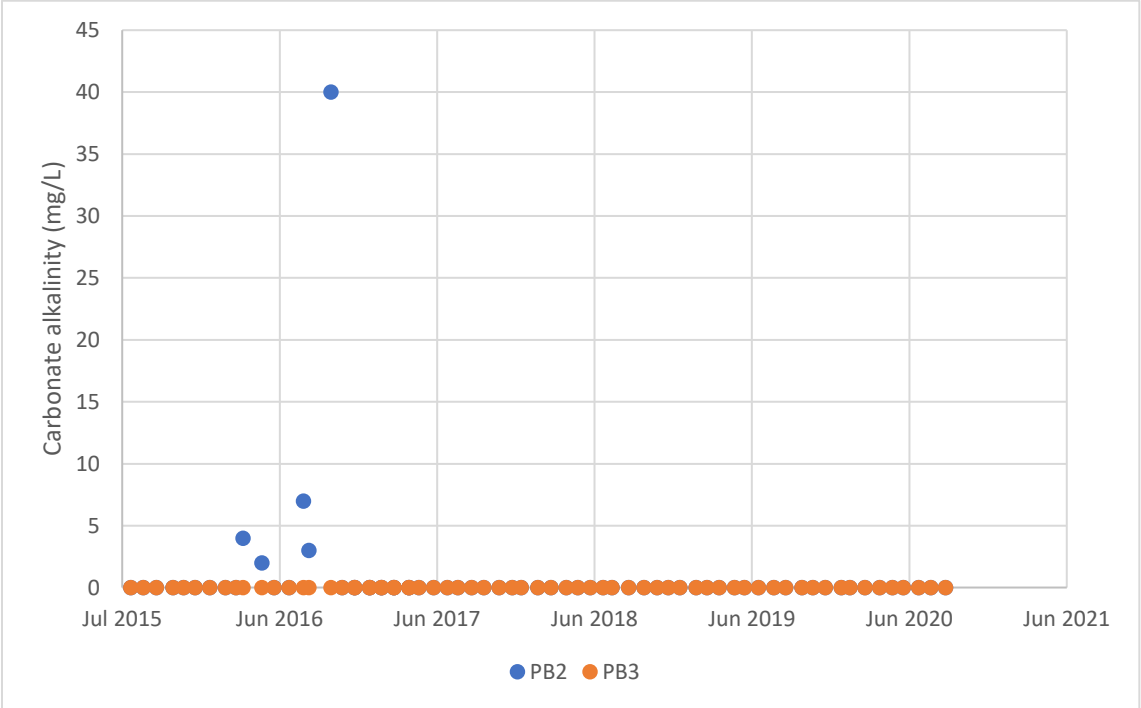

Figure E-11 Carbonate Alkalinity Recorded at PB2 and PB3

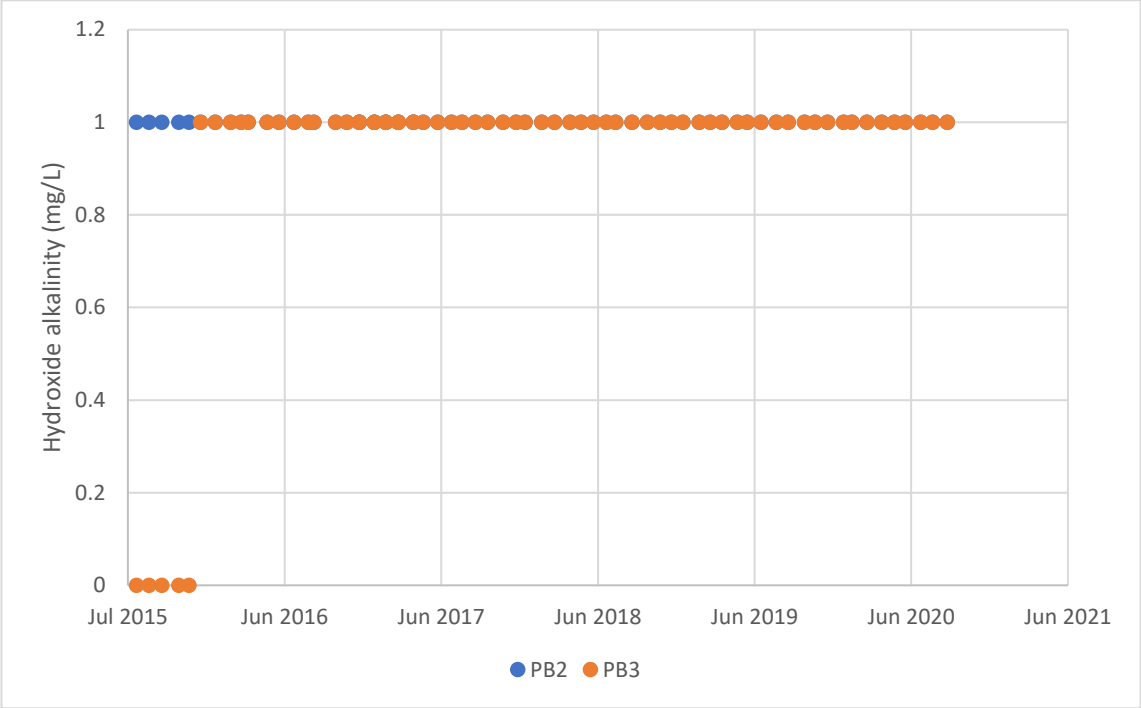

Figure E-12 Hydroxide Alkalinity Recorded at PB2 and PB3

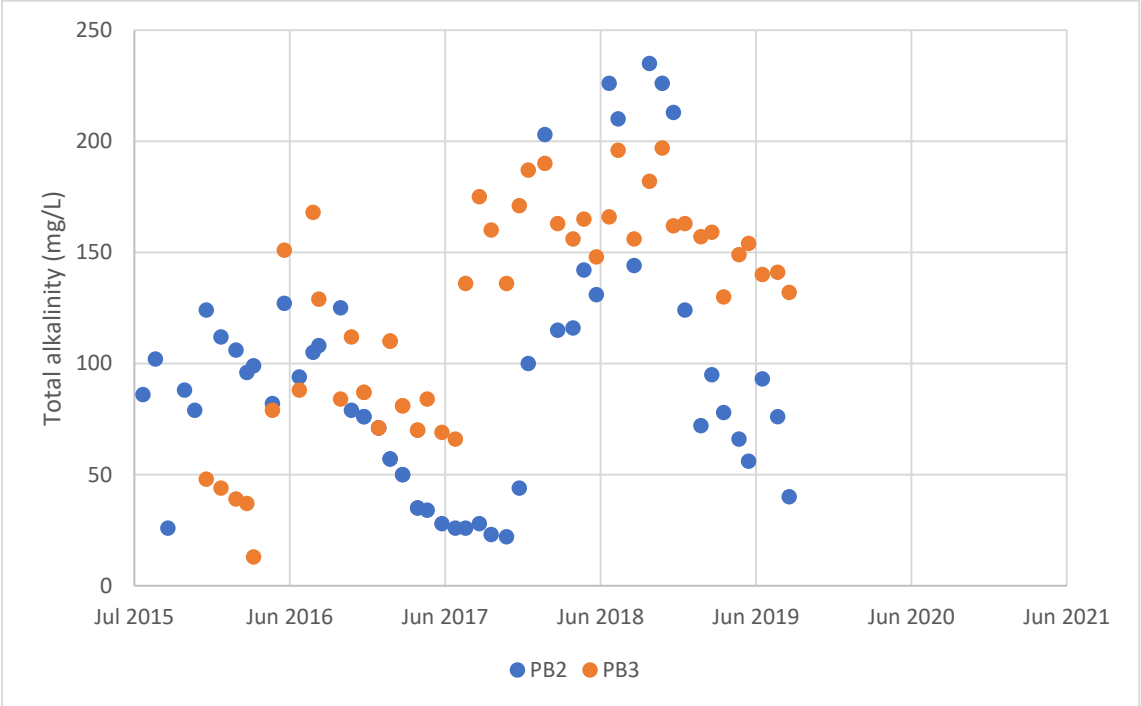

Figure E-13 Total Alkalinity Recorded at PB2 and PB3

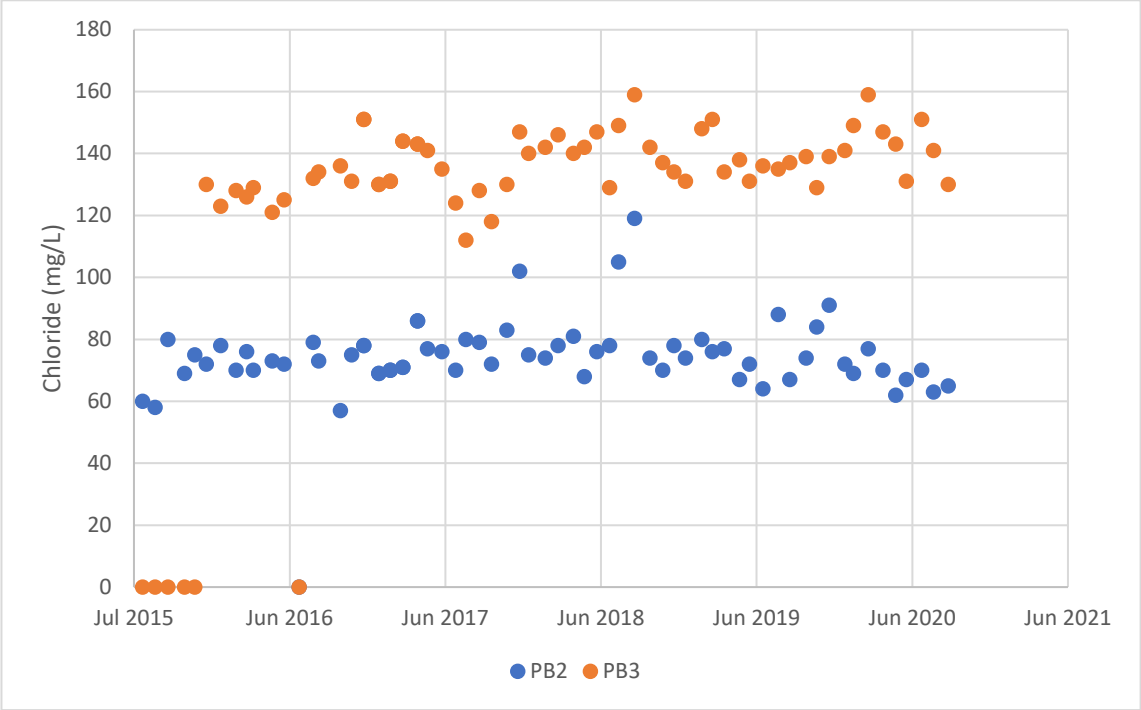

Figure E-14 Chloride Recorded at PB2 and PB3

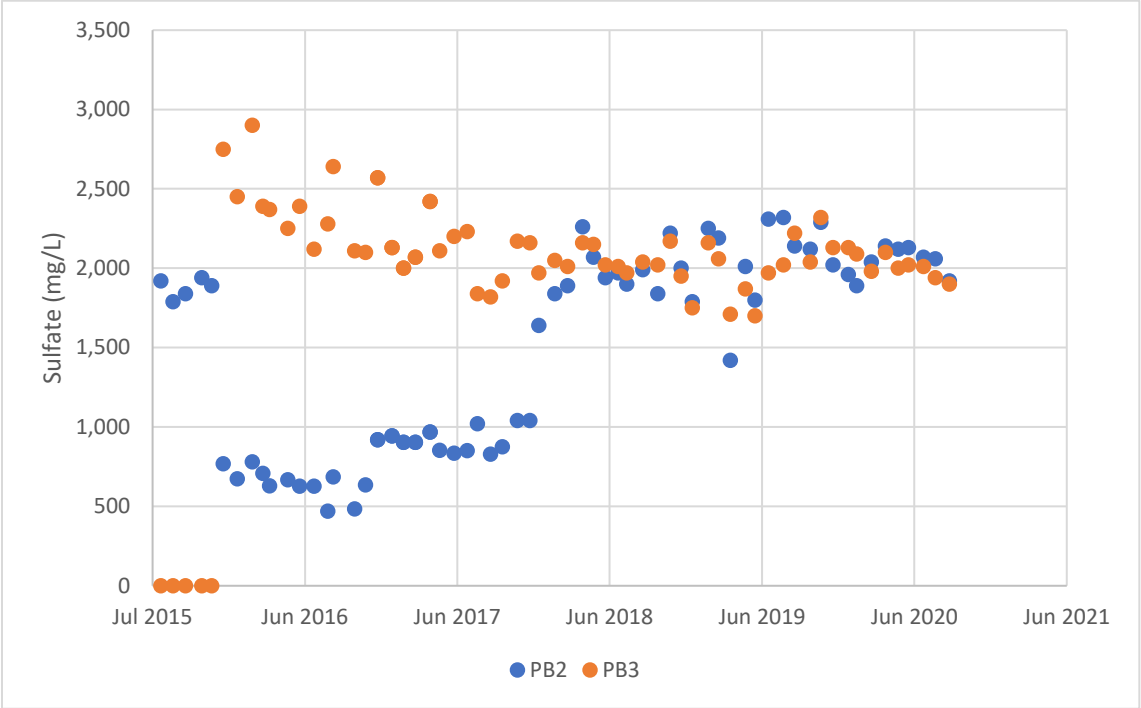

Figure E-15 Sulfate Recorded at PB2 and PB3

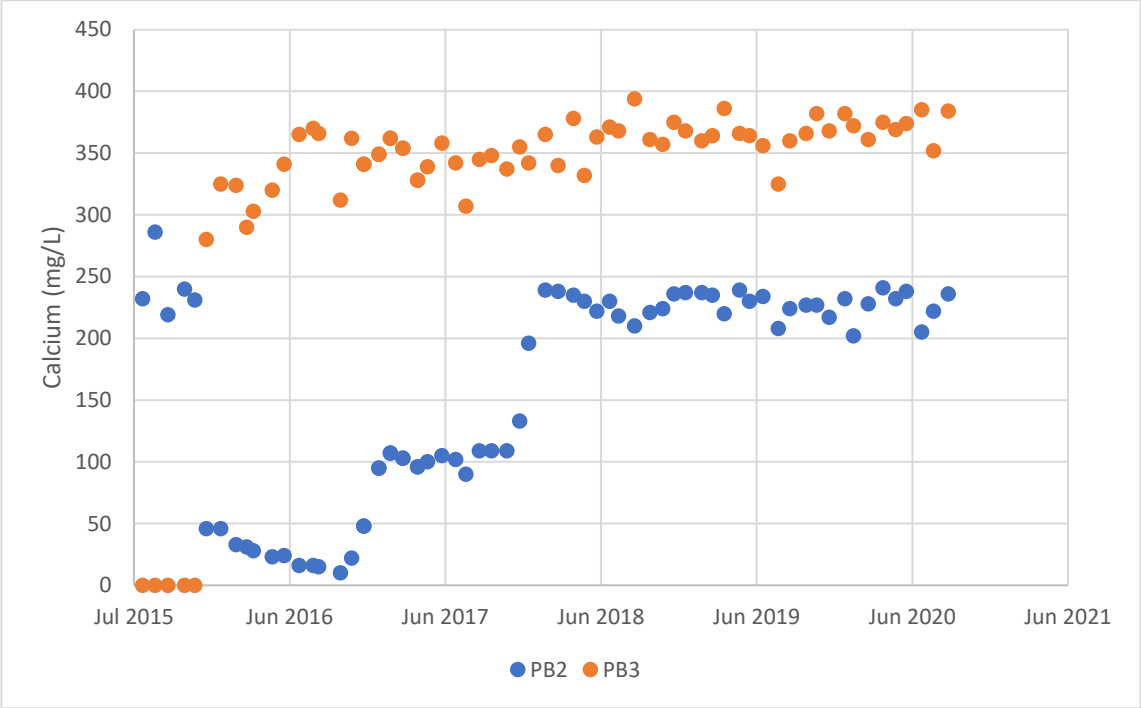

Figure E-16 Calcium Recorded at PB2 and PB3

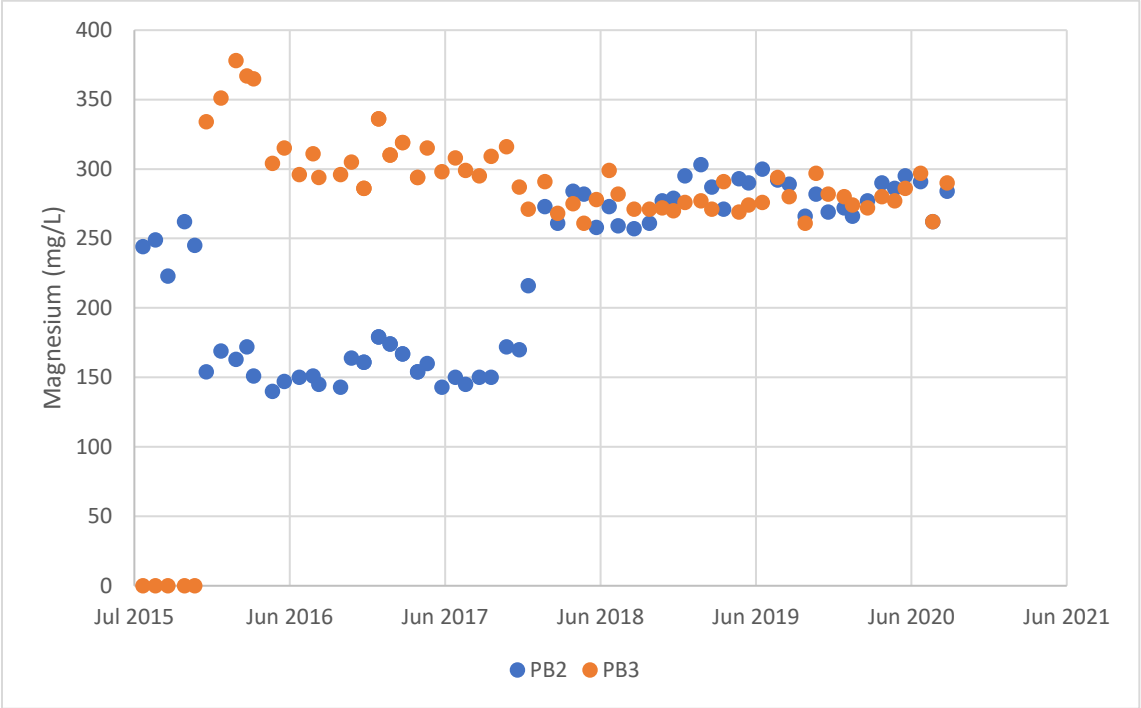

Figure E-17 Magnesium Recorded at PB2 and PB3

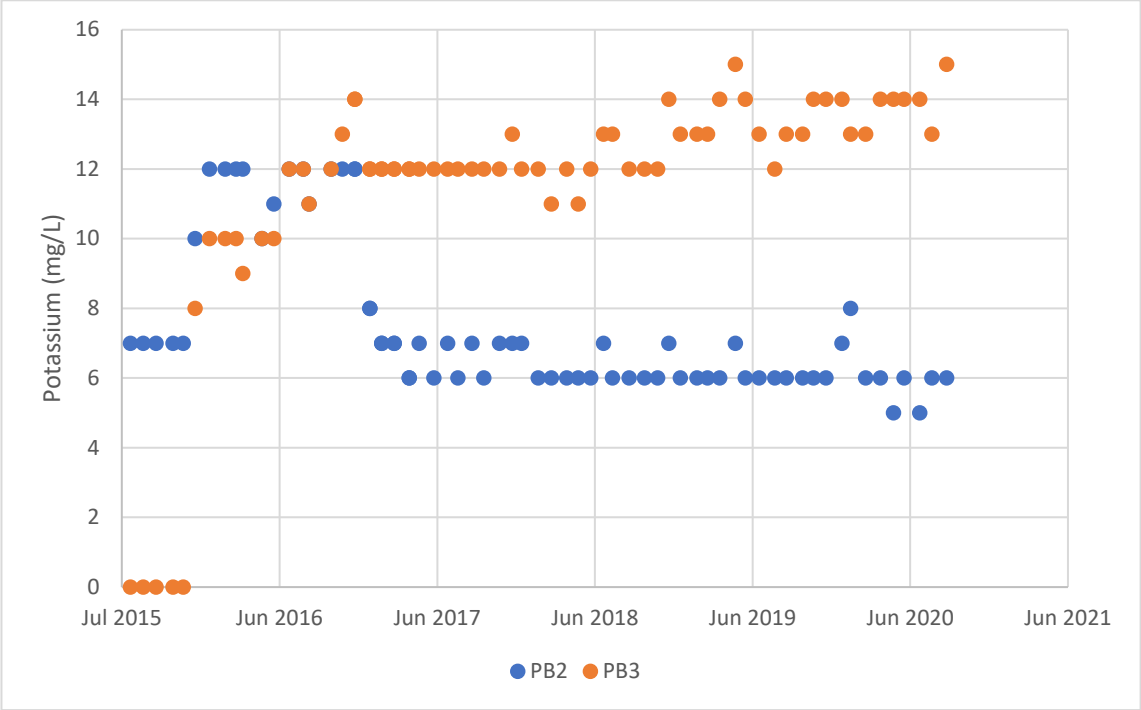

Figure E-18 Potassium Recorded at PB2 and PB3

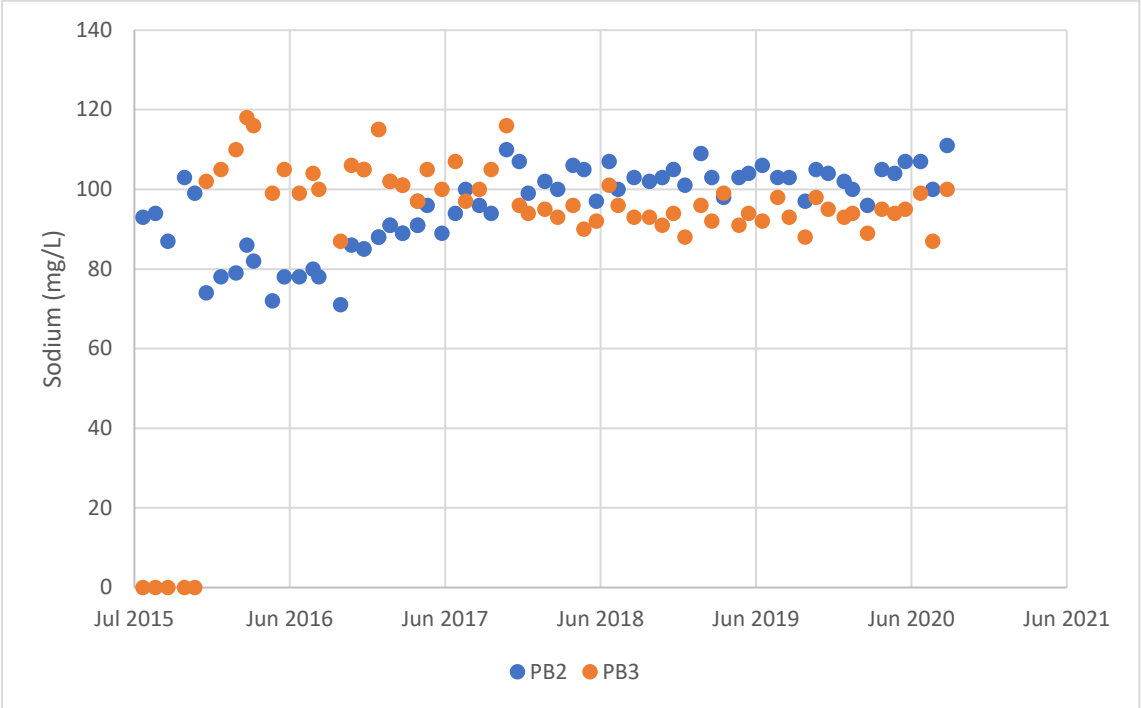

Figure E-19 Sodium Recorded at PB2 and PB3

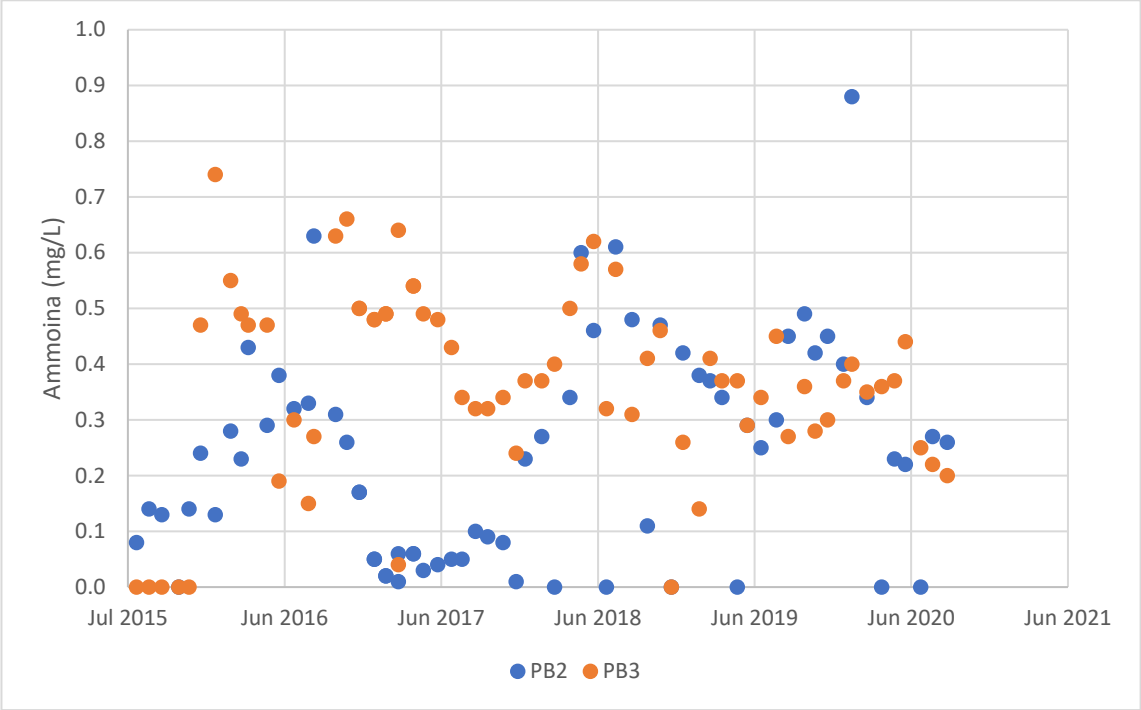

Figure E-20 Ammonia Recorded at PB2 and PB3

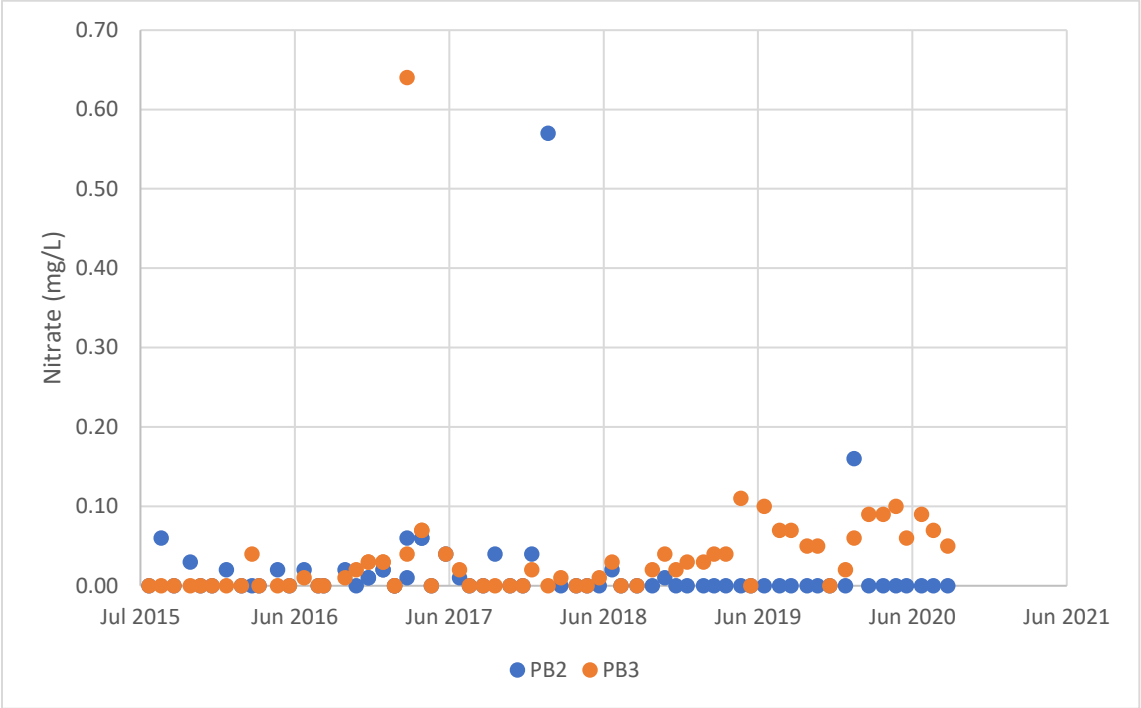

Figure E-21 Nitrate Recorded at PB2 and PB3

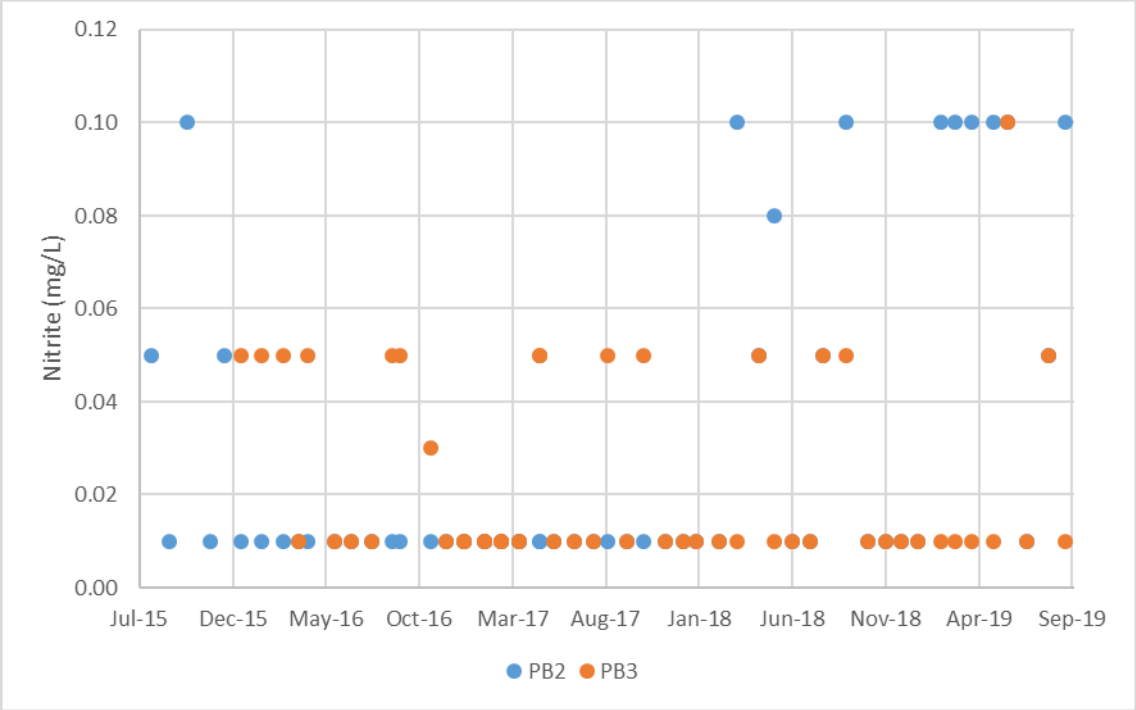

Figure E-22 Nitrite Recorded at PB2 and PB3

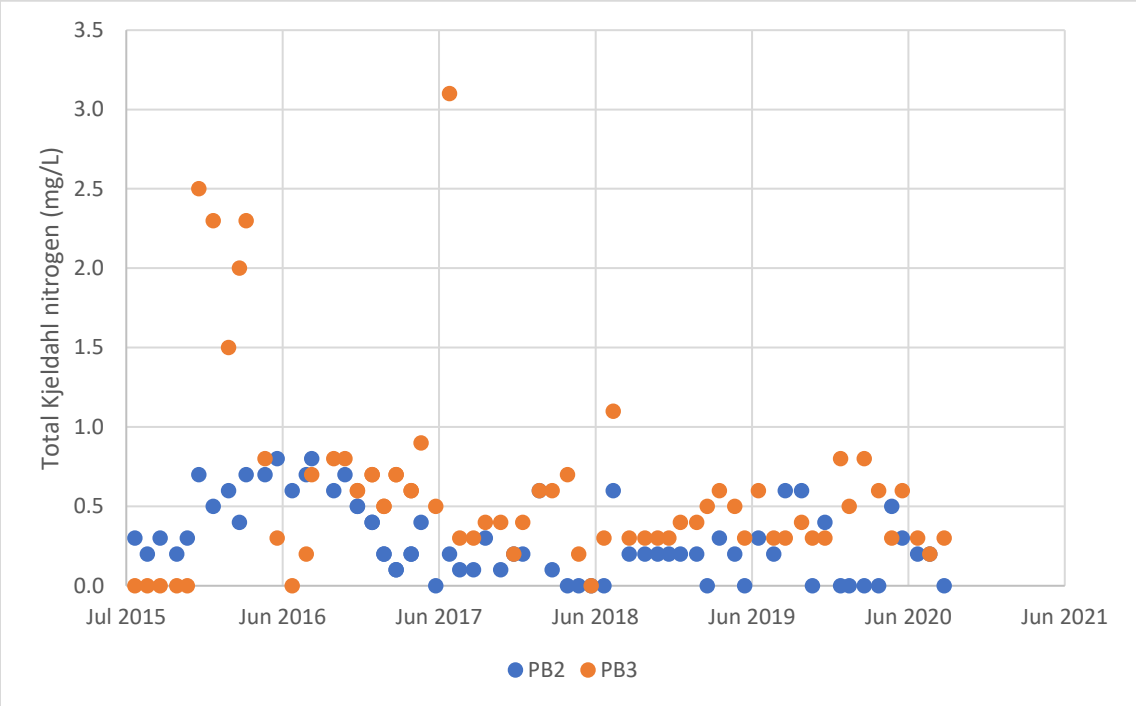

Figure E-23 Total Kjeldahl Nitrogen Recorded at PB2 and PB3

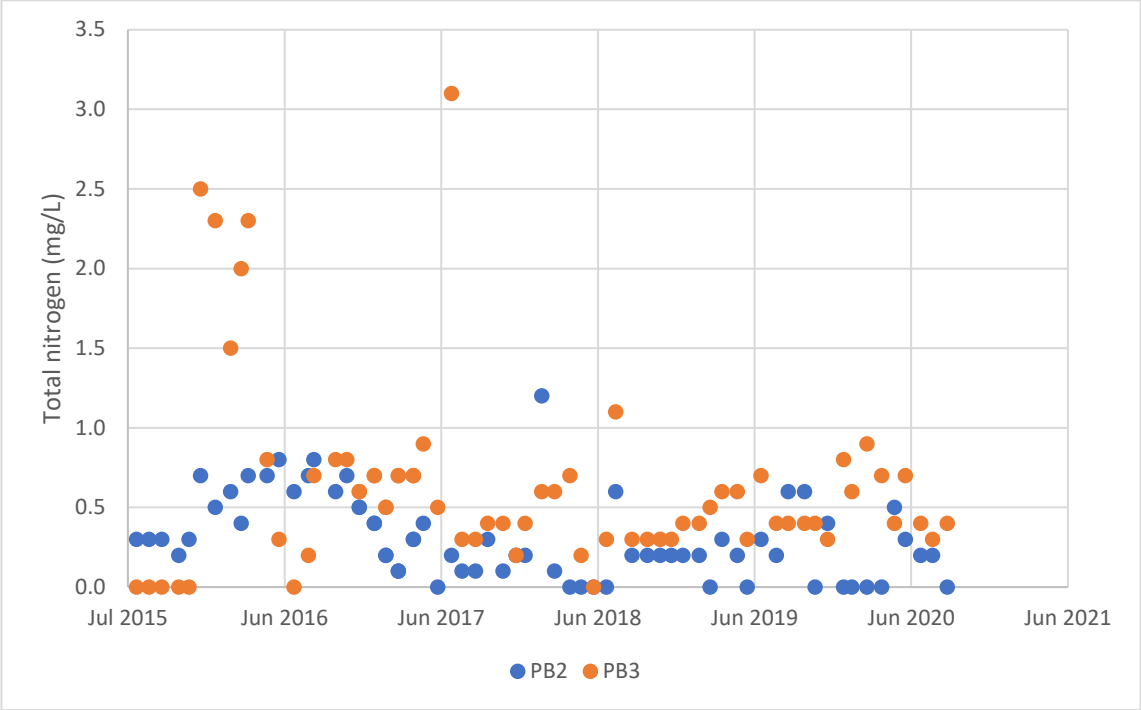

Figure E-24 Total Nitrogen Recorded at PB2 and PB3

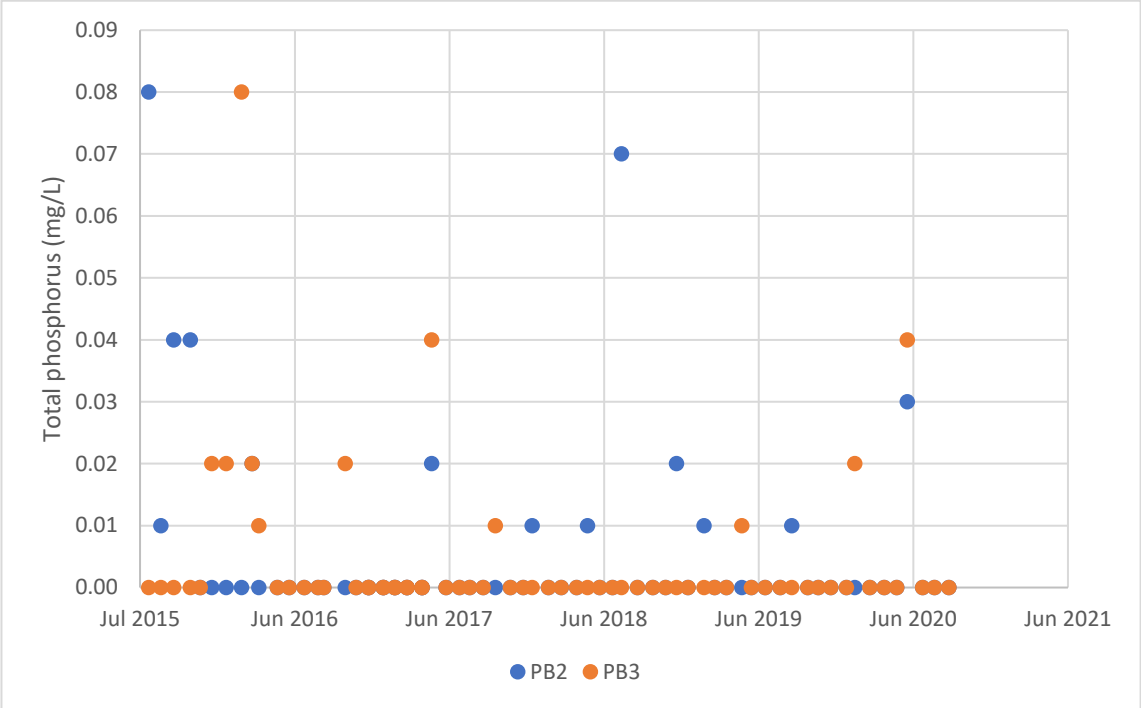

Figure E-25 Total Phosphorus Recorded at PB2 and PB3

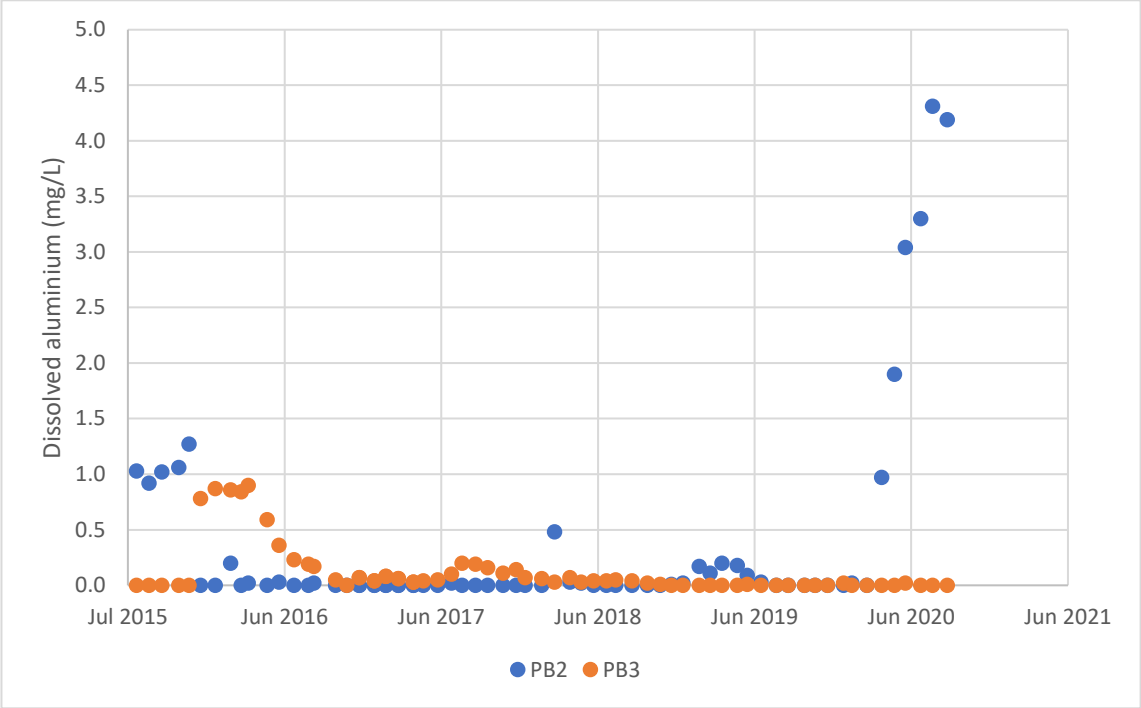

Figure E-26 Dissolved Aluminium Recorded at PB2 and PB3

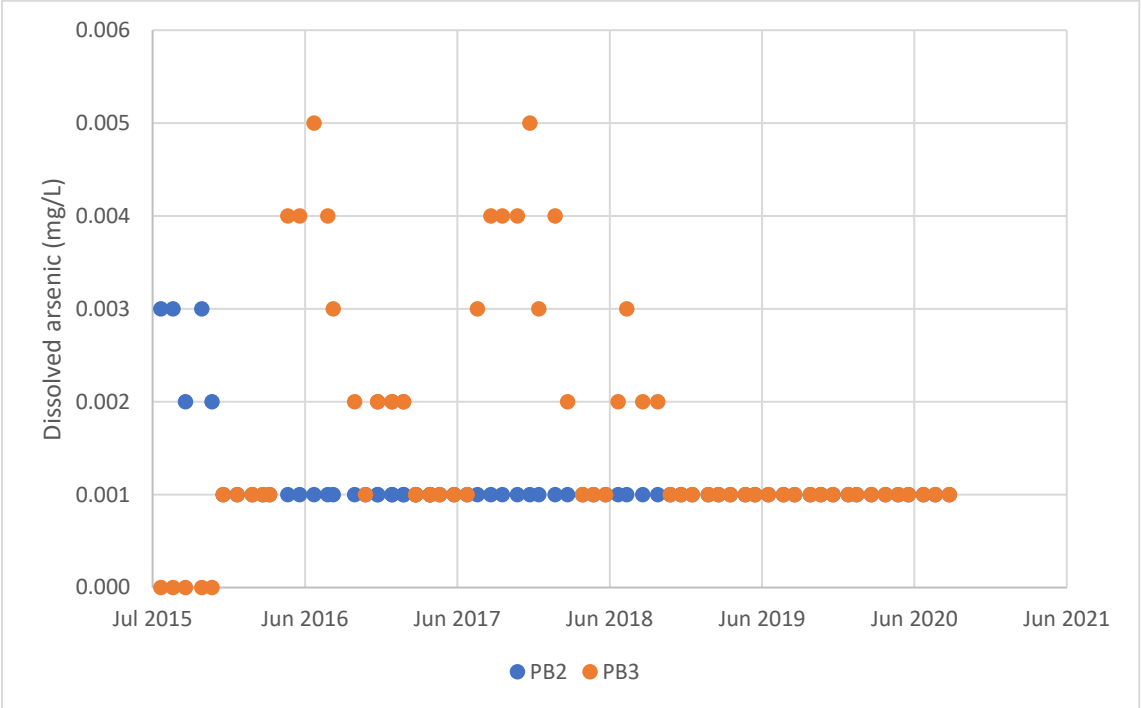

Figure E-27 Dissolved Arsenic Recorded at PB2 and PB3

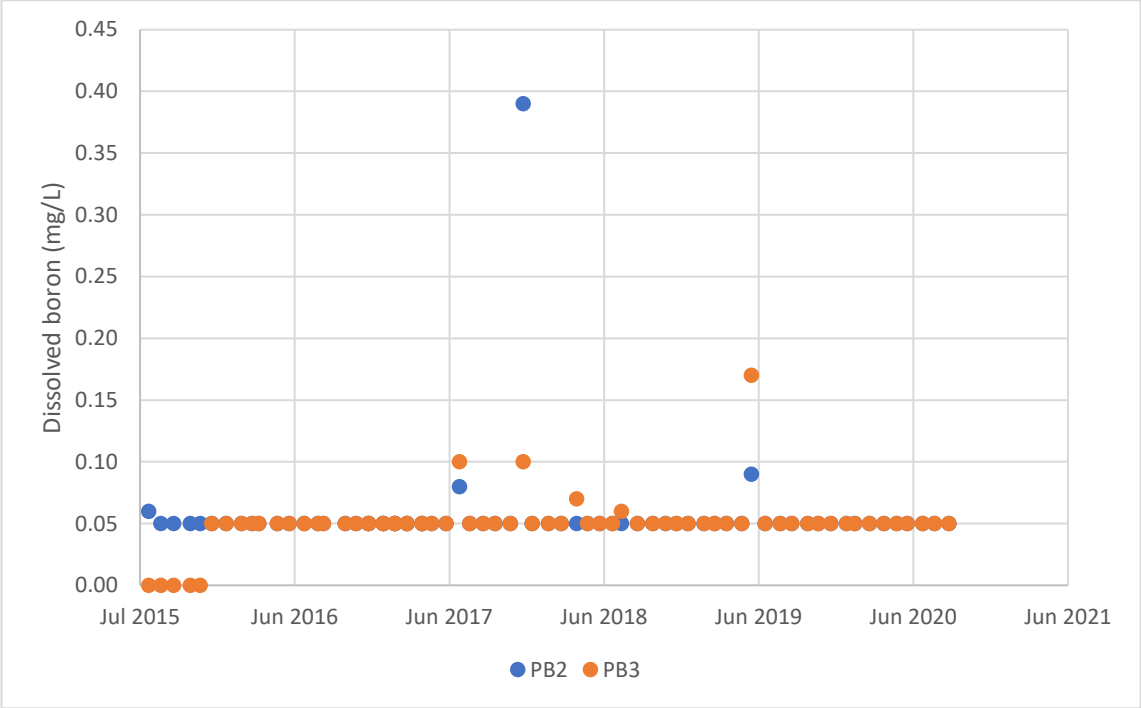

Figure E-28 Dissolved Boron Recorded at PB2 and PB3

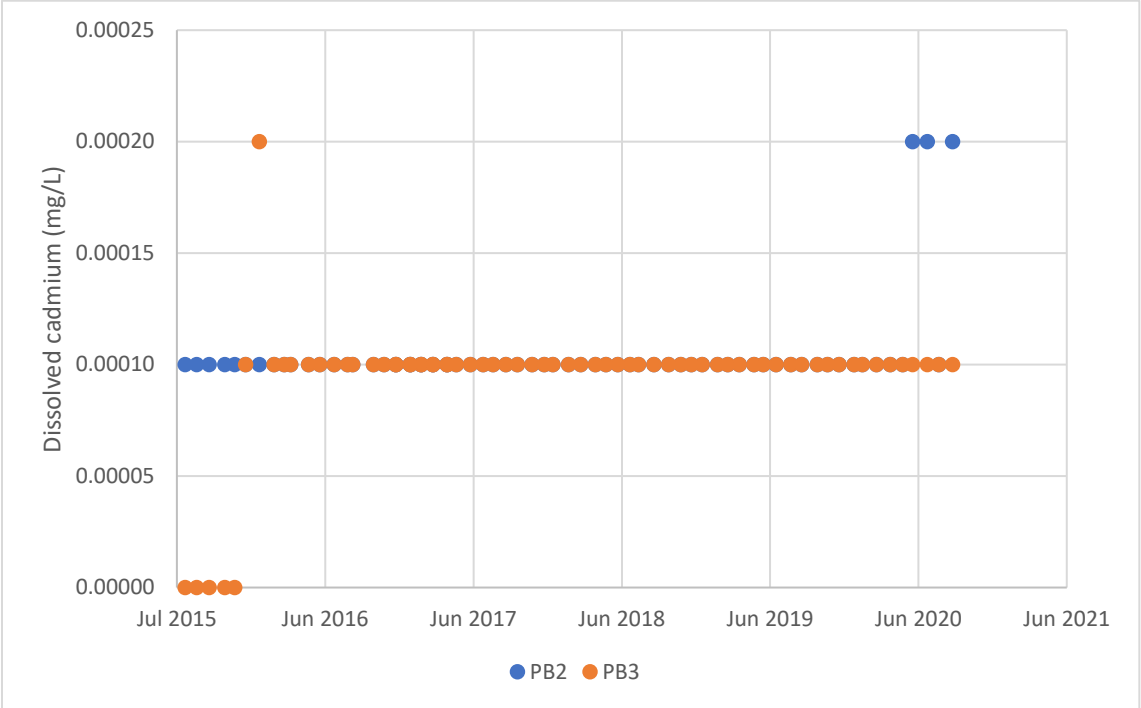

Figure E-29 Dissolved Cadmium Recorded at PB2 and PB3

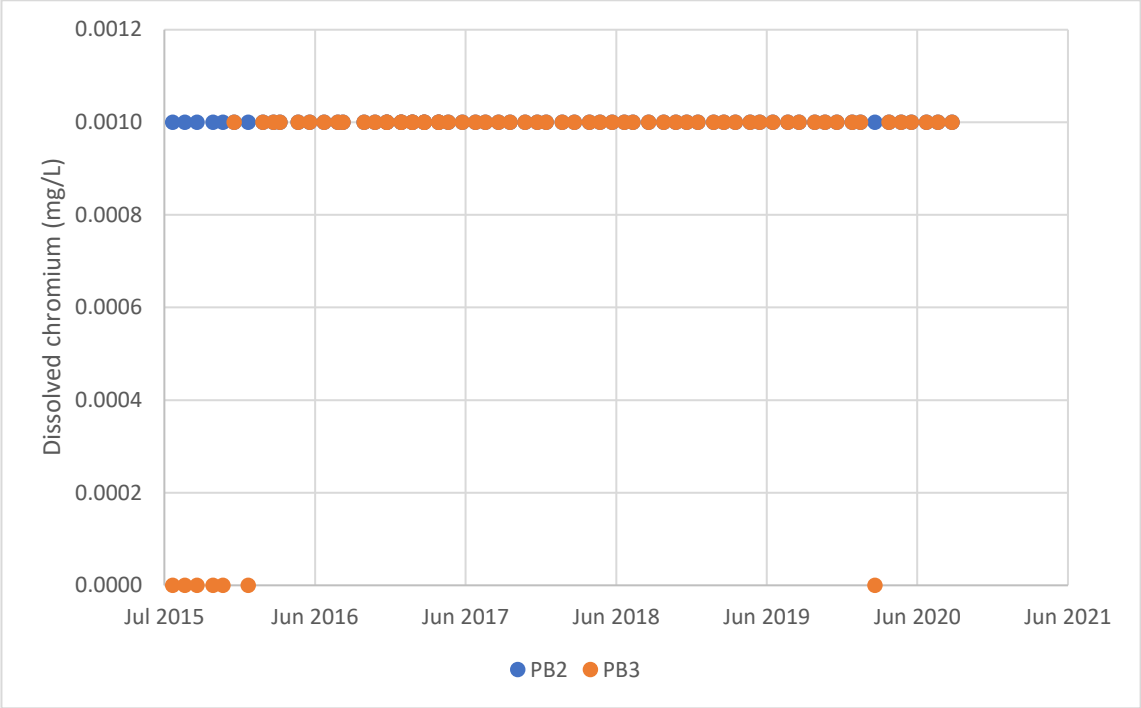

Figure E-30 Dissolved Chromium Recorded at PB2 and PB3

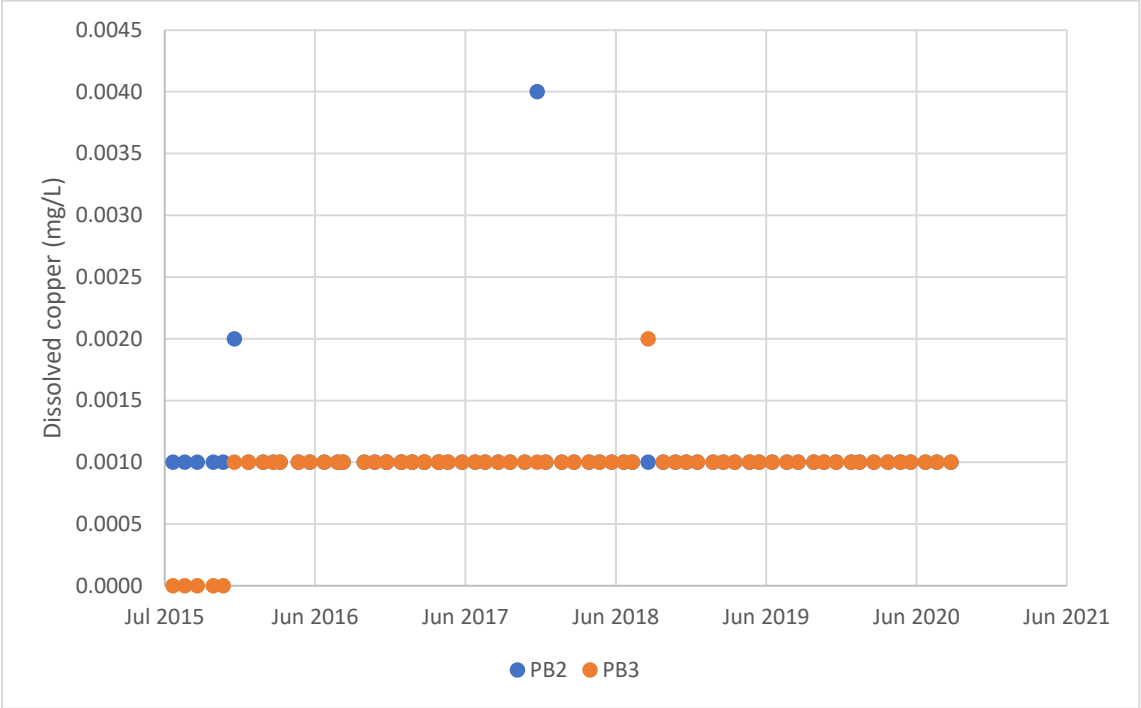

Figure E-31 Dissolved Copper Recorded at PB2 and PB3

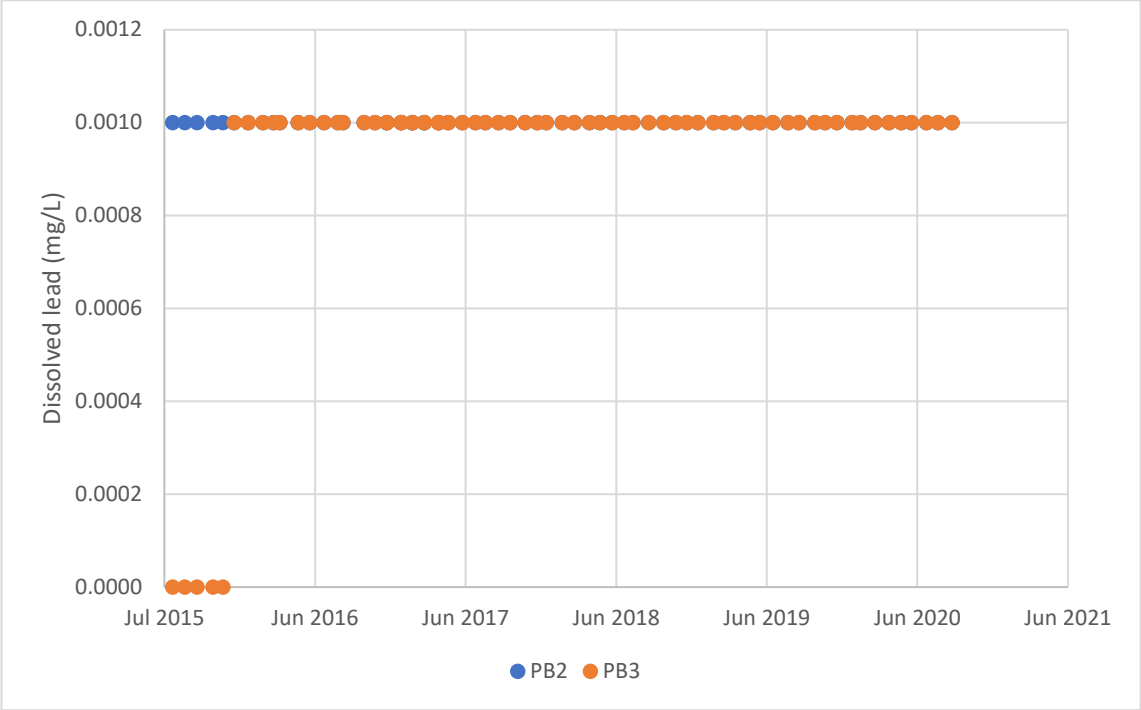

Figure E-32 Dissolved Lead Recorded at PB2 and PB3

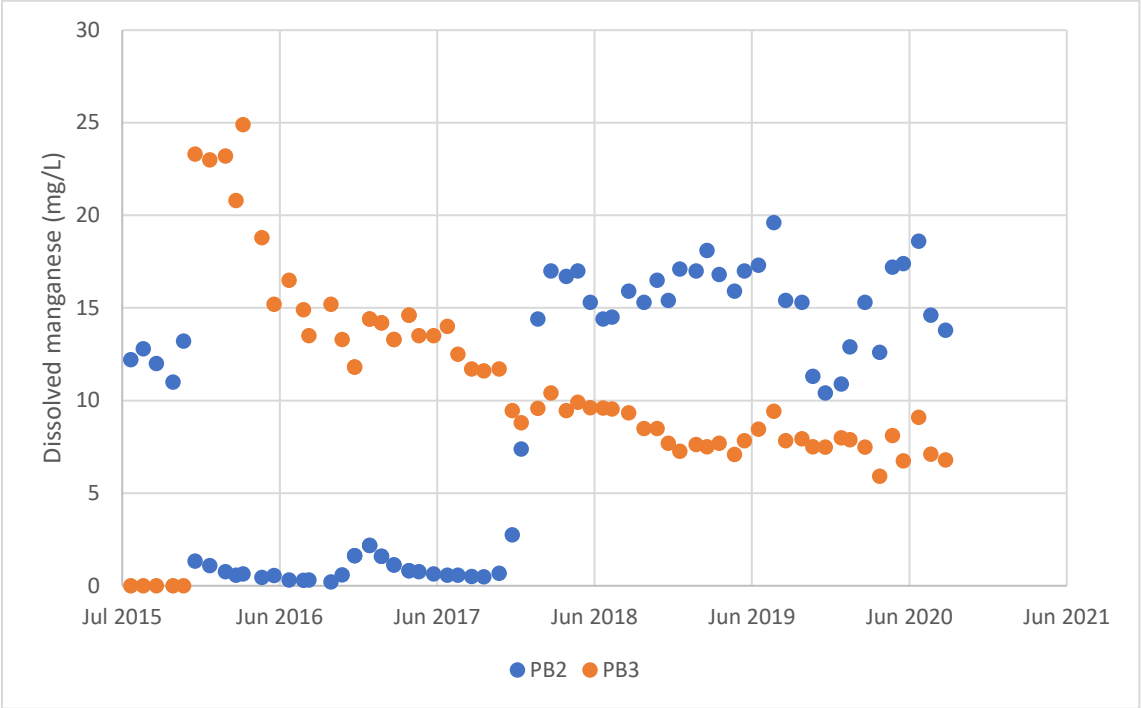

Figure E-33 Dissolved Manganese Recorded at PB2 and PB3

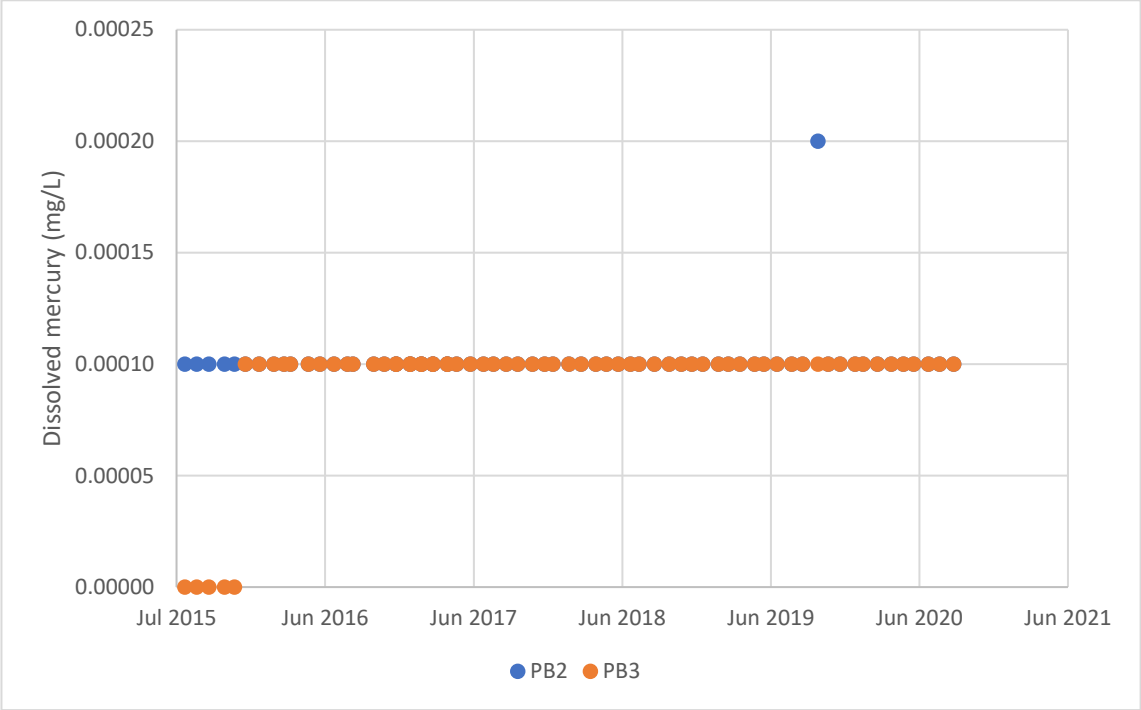

Figure E-34 Dissolved Mercury Recorded at PB2 and PB3

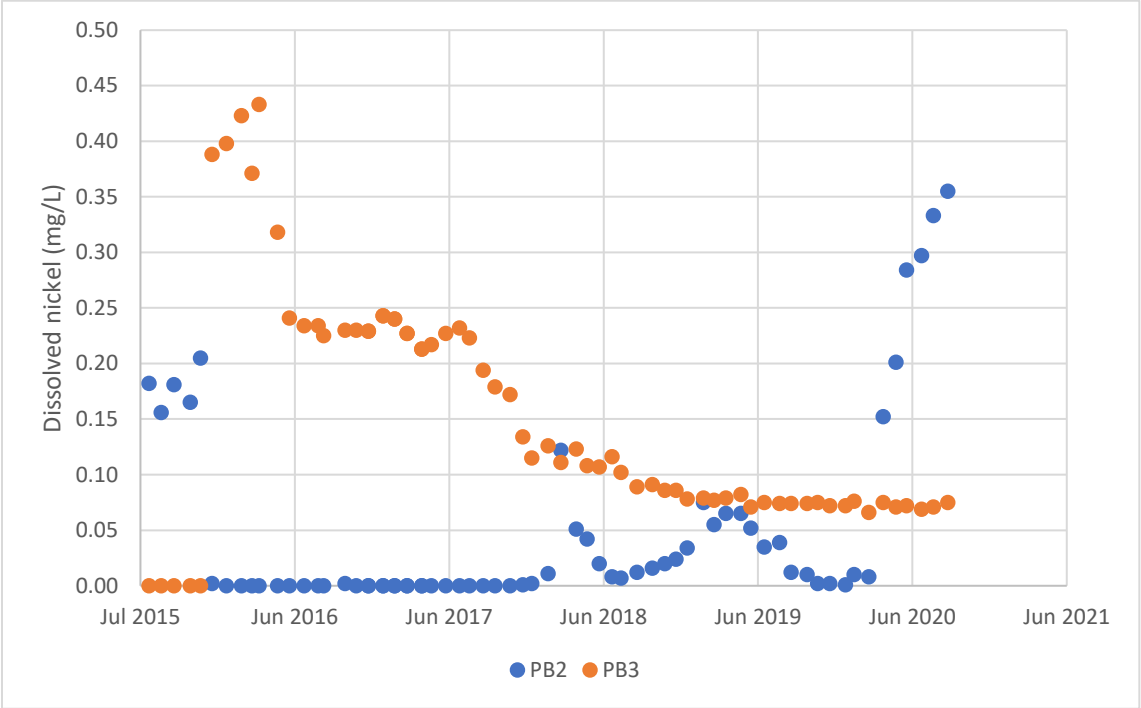

Figure E-35 Dissolved Nickel Recorded at PB2 and PB3

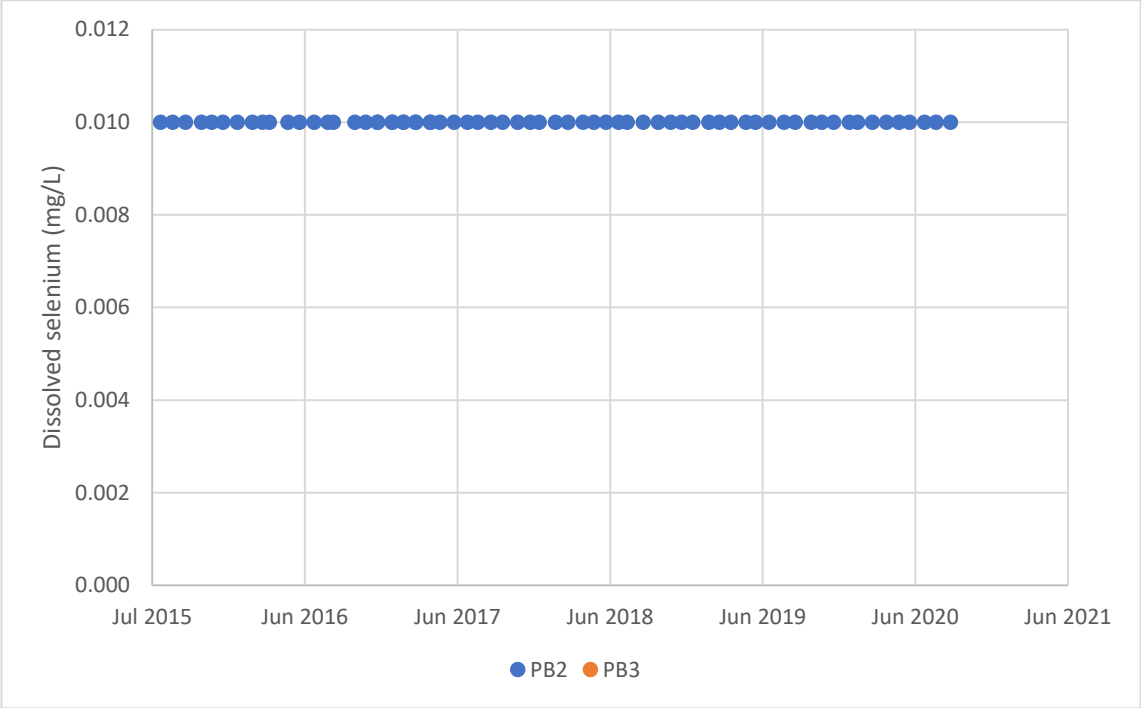

Figure E-36 Dissolved Selenium Recorded at PB2 and PB3

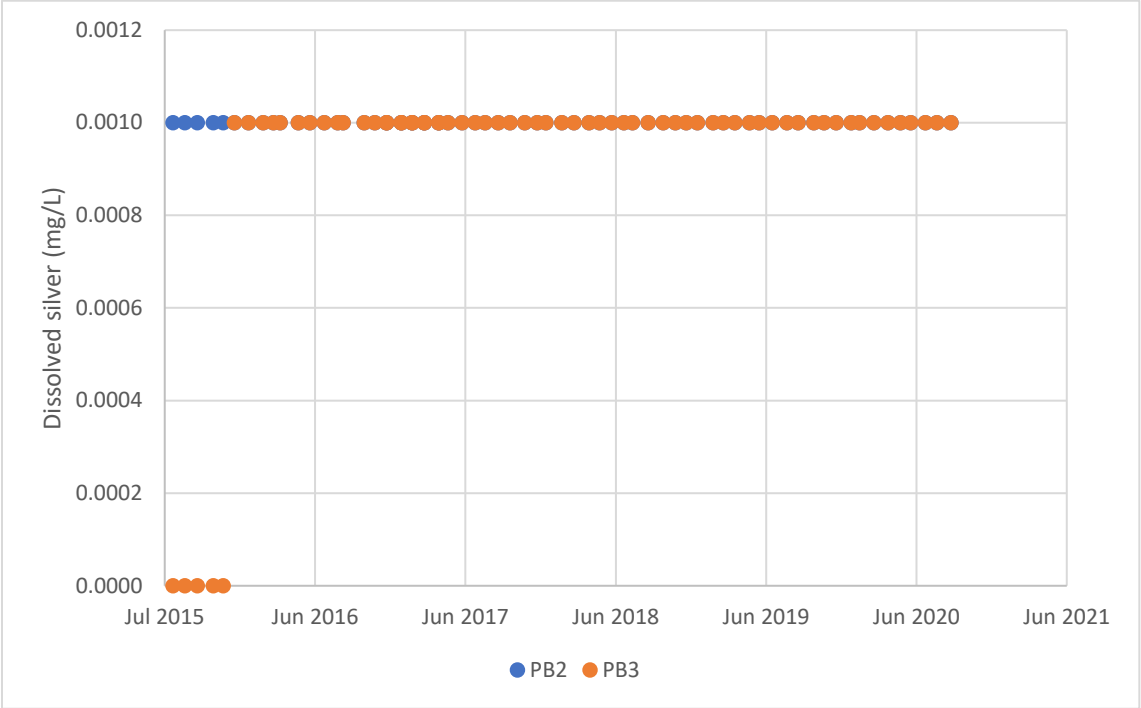

Figure E-37 Dissolved Silver Recorded at PB2 and PB3

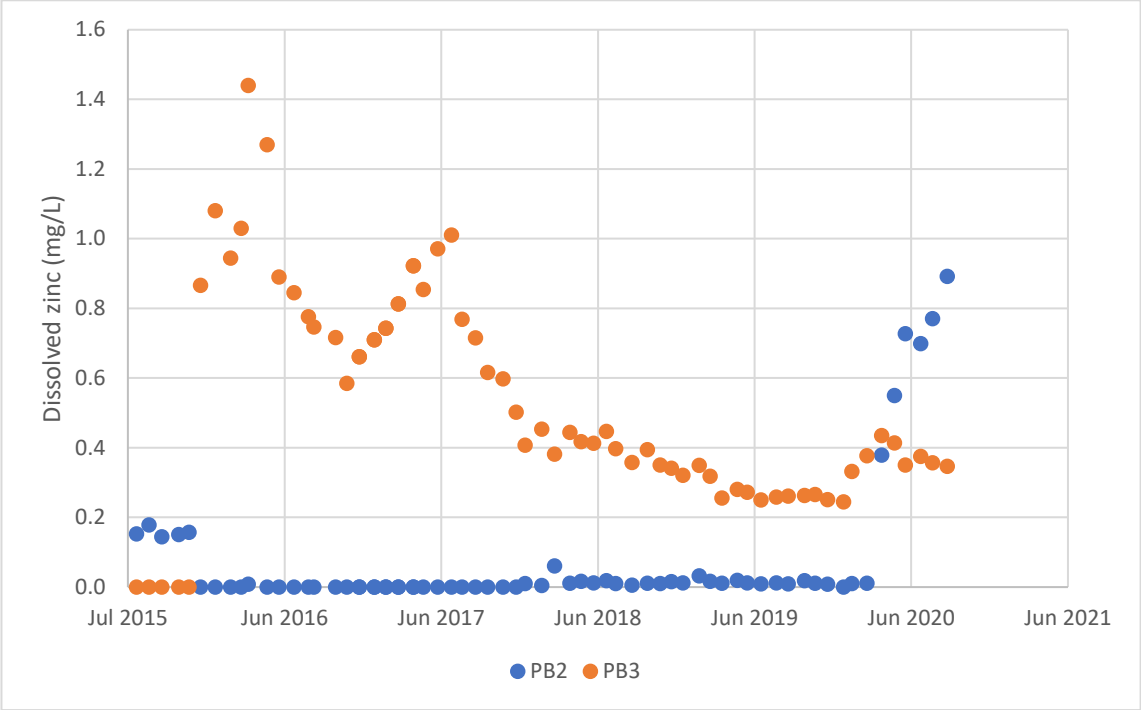

Figure E-38 Dissolved Zinc Recorded at PB2 and PB3

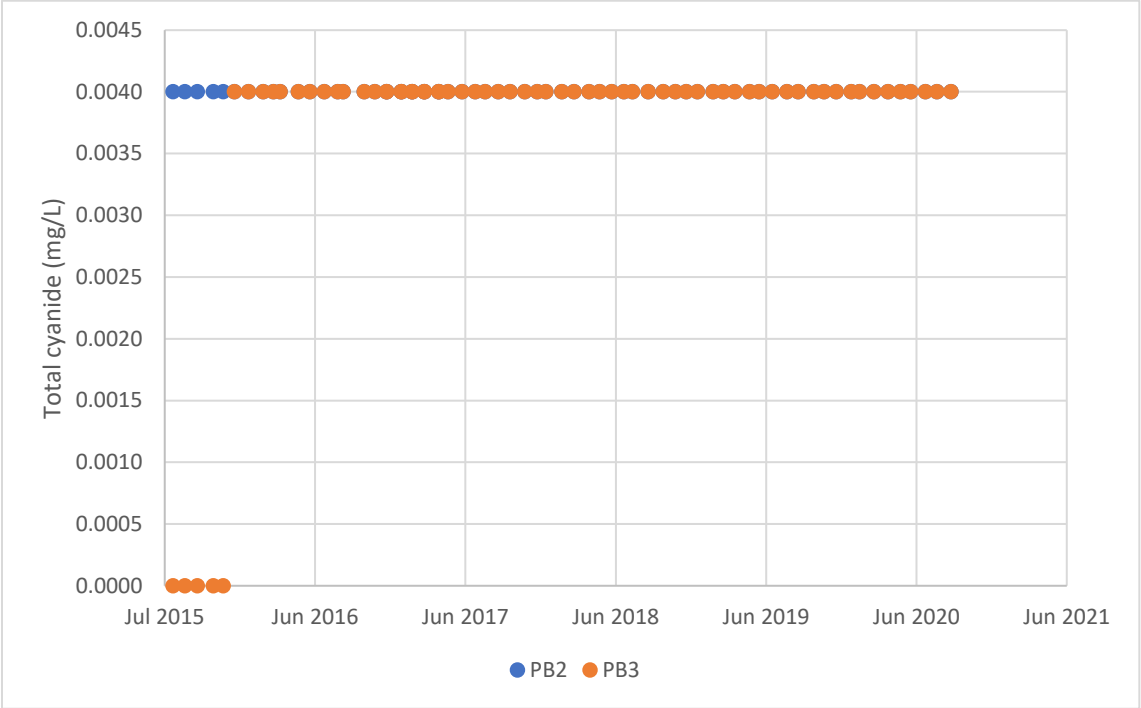

Figure E-39 Total Cyanide Recorded at PB2 and PB3

Table E.2 Groundwater Quality Data

Parameter	Unit	PB2				PB3			
		Count	Minimum	Median	Maximum	Count	Minimum	Median	Maximum
Physiochemical parameters									
EC	µS/cm	68	1460	3105	3500	63	1410	3480	3940
pH	pH units	68	5.1	6.8	9.3	63	5.2	6.1	6.4
TSS	mg/L	68	7	36.5	214	63	4	12	51
Turbidity	NTU	68	5.3	111	1260	63	22.3	63.2	162
Major anions									
Bicarbonate alkalinity	mg/L	68	1	85.5	278	63	1	148	197
Carbonate alkalinity	mg/L	68	1	1	40	63	1	1	1
Hydroxide alkalinity	mg/L	68	1	1	1	63	1	1	1
Total alkalinity	mg/L	68	1	87	278	63	1	148	197
Chloride	mg/L	68	1	74	119	63	1	136	159
Sulfate	mg/L	68	470	1795	2320	63	1700	2100	2900
Major cations									
Calcium	mg/L	68	10	209	286	63	280	360	394

Parameter	Unit	PB2				PB3			
		Count	Minimum	Median	Maximum	Count	Minimum	Median	Maximum
Magnesium	mg/L	68	140	247	303	63	261	291	378
Potassium	mg/L	68	5	7	12	63	8	12	15
Sodium	mg/L	68	71	98.5	111	63	87	97	118
Nutrients									
Ammonia	mg/L	68	0.01	0.23	0.88	63	0.04	0.37	0.74
Nitrate	mg/L	68	0.01	0.02	0.57	63	0.01	0.04	0.64
Nitrite	mg/L	68	0.01	0.01	0.1	63	0.01	0.01	0.1
Total Kjeldahl nitrogen	mg/L	67	0.1	0.3	1	61	0.2	0.5	3.1
Total nitrogen	mg/L	67	0.1	0.3	1.2	61	0.2	0.6	3.1
Total phosphorus	mg/L	68	0.01	0.01	0.08	63	0.01	0.01	0.08
Dissolved metals									
Aluminium	mg/L	68	0.01	0.01	4.31	63	0.01	0.04	0.9
Arsenic	mg/L	68	0.001	0.001	0.003	63	0.001	0.001	0.005
Boron	mg/L	68	0.05	0.05	0.39	63	0.05	0.05	0.17
Cadmium	mg/L	68	0.0001	0.0001	0.0002	63	0.0001	0.0001	0.0002

Parameter	Unit	PB2				PB3			
		Count	Minimum	Median	Maximum	Count	Minimum	Median	Maximum
Chromium	mg/L	68	0.001	0.001	0.001	61	0.001	0.001	0.001
Copper	mg/L	68	0.001	0.001	0.004	63	0.001	0.001	0.002
Lead	mg/L	68	0.001	0.001	0.001	63	0.001	0.001	0.001
Manganese	mg/L	68	0.202	11.15	19.6	63	5.92	9.61	24.9
Mercury		68	0.0001	0.0001	0.0002	63	0.0001	0.0001	0.0001
Nickel		68	0.001	0.0045	0.355	63	0.066	0.123	0.433
Silver		68	0.001	0.001	0.001	63	0.001	0.001	0.001
Zinc		68	0.005	0.0085	0.892	63	0.245	0.447	1.44
Total metals									
Selenium		68	0.01	0.01	0.01	63	0.01	0.01	0.01
Other parameters									
Total cyanide		68	0.004	0.004	0.004	63	0.004	0.004	0.004

Appendix F – Trigger Action Response Plans

Surface water operation TARP

Aspect	Normal	Trigger 1	Trigger 2	Notifications in response
Capture of dirty water runoff	Minor rainfall forecast – water storage volumes on-site kept as low as practicable	Significant rainfall forecast – water storage volumes as low as practicable **Action: Prepare site for pending rainfall** **Action: Develop dewatering and treatment options post-rainfall event.** **Action: Implement appropriate mitigation control as required.**	Significant and prolonged rainfall forecast – water storage volumes on-site elevated **Action: Review dam condition and sediment captured.** **Action: Undertake water quality sampling and add flocculant if necessary to accelerate dewatering prior to rainfall**.	**Trigger 1: Notify Environmental Coordinator/Mine Manager.** **Trigger 2: Review EPL and Pollution Incident Response Management Plan (PIRMP) notification requirements if discharges have occurred.** **If incident or non-conformance has occurred undertake necessary reporting procedures (Section 7.1)**

Aspect	Normal	Trigger 1	Trigger 2	Notifications in response
Erosion and sediment control	All controls are appropriately in place and well maintained. Land disturbance procedure followed prior to disturbance activity	Controls in place, however are not maintained or are inappropriately installed and laid out. **Action: Review ESCP for the disturbance activity.** **Action: Review catchment area and works being undertaken relevant to the disturbance area or activities.**	Controls not in place or rainfall event has led to sediment migrating off site. **Action: Install temporary sediment controls to capture sediment.** **Action: Stabilise disturbance areas with a temporary rolled erosion control product.**	**Trigger 1: Notify Environmental Coordinator** **Trigger 2: Notify Mine Manager.** **Review EPL and Pollution Incident Response Management Plan (PIRMP) notification requirements** **If incident or non-conformance has occurred undertake necessary reporting procedures (Section 7.1)**
Hydrocarbon management	No spills on site. All hydrocarbon supplies are stored appropriately.	Spillage occurs on site. **Action: Utilise spill kit.** **Action: Review circumstances that led to the spill**	Major spill occurs on site **Action: Implement procedures in the PIRMP** **Action: Isolate area and prevent spill from migrating away.** **Action: Engage waste contractor to clean up spill.** **Action: Review any potential contamination.**	**Trigger 1: Notify Environmental Coordinator** **Trigger 2: Notify Mine Manager.** **If incident or non-conformance has occurred undertake necessary reporting procedures (Section 7.1)**

Aspect	Normal	Trigger 1	Trigger 2	Notifications in response
Potential acid mine drainage	Seepage from adits assessed to have groundwater characteristics or unlikely to have downstream impacts.	Seepage from adits with potential downstream impacts. **Action: Capture and contain seepage water if practical.** **Action: Assess source, water quality and potential downstream impacts of seepage.**	Seepage from adits causing adverse downstream impacts. **Action: Assess source, water quality and potential downstream impacts of seepage.** **Action: Capture and contain seepage water.** **Action: Investigate treatment options.**	**Trigger 1: Notify Environmental Coordinator / Notify Mine Manager.** **Trigger 2:** **Review EPL and Pollution Incident Response Management Plan (PIRMP) notification requirements** **If incident or non-conformance has occurred undertake necessary reporting procedures (Section 7.1).**

Aspect	Normal	Trigger 1	Trigger 2	Notifications in response
Potential leakage or spillage from reject emplacement area	No leakage or spillage from reject emplacement areas. Leakage from reject emplacement areas assessed as unlikely to have downstream impacts.	Leakage from reject emplacement areas with unknown potential downstream impacts. Spillage from reject emplacement area. **Action: Capture and contain water if practical.** **Action: Assess source, water quality and potential downstream impacts of leakage or spillage.**	Leakage or seepage from reject emplacement areas with potential adverse downstream impacts downstream impacts. **Action: Assess source, water quality and potential downstream impacts of water.** **Action: Capture and contain water.** **Action: Investigate capping or treatment options.**	**Trigger 1: Notify Environmental Coordinator/ Notify Mine Manager.** **Trigger 2:** **Review EPL and Pollution Incident Response Management Plan (PIRMP) notification requirements** **If incident or non-conformance has occurred undertake necessary reporting procedures (Section 7.1)**

Aspect	Normal	Trigger 1	Trigger 2	Notifications in response
Potential leakage or spillage from effluent irrigation.	No surface water runoff or drift from the effluent irrigation area.	Surface water runoff or drift from the effluent irrigation area. **Action: Implement procedures in the PIRMP.** **Action: Assess capacity and performance of treatment system and irrigation area.**	Capacity and performance of treatment system and effluent irrigation area assessed as inadequate. **Action: Implement improvement works to rectify inadequacy.**	**Trigger 1: Notify Environmental Coordinator** **Trigger 2: Notify Mine Manager.** **Review EPL and Pollution Incident Response Management Plan (PIRMP) notification requirements** **If incident or non-conformance has occurred undertake necessary reporting procedures (Section 7.1)**

Groundwater Environment TARP

Aspect	Normal	Trigger 1	Trigger 2	Notifications in response
Groundwater quality and level	No complaints from adjacent bore owners regarding groundwater quality and level.	Complaint from an adjacent bore owner regarding declining groundwater quality and level. **Action: Environmental Coordinator to initiate an investigation to determine if the change in groundwater quality and level is due to mining**	Investigation into Stage 1 Trigger identifies that change in groundwater quality and level is due to mining related activity. **Action: Loss of appropriate water supply from an adjacent landholder will need to be replaced by Centennial. If**	**Trigger 1: Notify Environmental Coordinator** **Notify any other potentially effected landowners as soon as practical.** **Trigger 2: Notify Mine Manager**

Aspect	Normal	Trigger 1	Trigger 2	Notifications in response
		related activity. Investigation to be undertaken within 3 months. **Action: An independent review process for land owner will be available**	**environmental impacts are unacceptable, remediation options will be considered and future monitoring.**	**If incident or non-conformance has occurred undertake necessary reporting procedures (Section 7.1).**

Discharge Management TARP

Aspect	Normal	Trigger 1	Trigger 2	Notifications in response
Discharge quality from LDP	Discharge quality is within limits defined by EPL.	Water quality parameters exceed EPL limit for at least one parameter at one site. **Action: Undertake investigation.** **Action: Repeat sampling.**	Water quality parameters exceed EPL limits for multiple parameters or multiple sites. **Action: Consider reconfiguration of pit top surface water management infrastructure.**	**Trigger 1: Notify Environmental Coordinator** **Trigger 2: Notify Mine Manager** **Review EPL and Pollution Incident Response Management Plan (PIRMP) notification requirements** **If incident or non-conformance has occurred undertake necessary reporting procedures (Section 7.1)**

Aspect	Normal	Trigger 1	Trigger 2	Notifications in response
Discharges off-site from non-LDP	No discharge from non-LDP locations.	Discharge from non-LDP discharge location for one day. **Action: Implement temporary infrastructure to cease discharges where practical** **Action: Implement monitoring program.**	Discharge from a non-LDP defined discharge location over multiple days. **Action: Capture event with photographs.** **Action: Undertake investigation.** **Action: Implement monitoring program.**	**Trigger 1: Notify Environmental Coordinator** **Trigger 2: Notify Mine Manager.** **Review EPL and Pollution Incident Response Management Plan (PIRMP) notification requirements** **If incident or non-conformance has occurred undertake necessary reporting procedures (Section 7.1)**

Stream Health TARP

Aspect	Normal	Trigger 1	Trigger 2	Notifications in response
Geomorphic condition and watercourse stability				
Watercourse stability	Watercourse stability monitoring indicates no areas of new instabilities from visual inspections.	Watercourse monitoring indicates one or more areas of instabilities in watercourses. **Action: Seek to stabilise the instabilities, which may include advice from a geomorphic specialist.** **Action: Investigate cause for instabilities and whether recent works have created the instability.**	Watercourse monitoring indicates one or more areas of instabilities in watercourses, causing sediment loads to migrate and or impacts to riparian vegetation. Discharges leading to impacts off site **Action: Seek to stabilise the instabilities, which may include advice from a geomorphic specialist.** **Action: Investigate cause for instabilities, and whether recent works have created the instability**.	**Trigger 1: Notify Environmental Coordinator** **Trigger 2: Notify Mine Manager.** **If incident or non-conformance has occurred undertake necessary reporting procedures (Section 7.1)**

Aspect	Normal	Trigger 1	Trigger 2	Notifications in response
Aquatic ecology				
Downstream water quality	Monitoring indicates that water quality is consistent with background or of low risk to aquatic ecosystems indicated by SSGVs.	Monitoring indicates that water quality results are outside the SSGVs for one or more parameters. **Action: Investigate upstream sources of water quality including a review of catchment inputs.** **Action: Undertake repeat sampling within one week.** **Action: Engage Aquatic Ecologist to assess the data**	Deterioration in downstream water quality for aquatic biota (determined by Aquatic Ecologist) and Stage 1 investigations indicate degraded water quality is due to site operations **Action: Inspect waterway upstream of monitoring location.** **Action: Undertake analysis further downstream to determine potential extent**	**Trigger 1: Notify Environmental Coordinator/Mine Manager.** **Trigger 2:** **If incident or non-conformance has occurred undertake necessary reporting procedures (Section 7.1)**

Appendix G – Erosion and Sediment Control Plan

CENTENNIAL

Erosion and Sediment Control Plan

Charbon Colliery

October 2021

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List of Appendices

DOCUMENT CONTROL

DOCUMENT DETAILS	Name:	Charbon Colliery Erosion and Sediment Control Plan
	Author:	Lachlan Hammersley; Tyler Tinkler (GHD Pty Ltd)
	Revision No.:	4
	Document Status	For consultation

DETAILS OF CHANGE	Revision	Trigger	Date	Brief details of change
	1	PA 08_0211	02/10/2012	Initial WMP
	2	Transition to closure and maintenance	27/02/2017	Remove elements relevant only to active mining operations
	3	PA 08_0211 MOD1	30/10/2019	Reflect MOD1 consent conditions Reflect changes to EPL 528 Update baseline data and derive SSGVs Reflect changes to water management with progressive rehabilitation
	4	PA 08_0211 MOD2, 2021 Independent Environmental Audit	25/10/2021	Update of current site activities

Glossary

Australian Height Datum	A common national surface level datum approximately corresponding to sea level
Average recurrence interval	A statistical estimate of the average period in years between the occurrence of a flood of a given size or larger, e.g. floods with a discharge equivalent to the 1 in 100 year average recurrence interval flood event will occur on average once every 100 years.
Catchment	The land area draining through the main stream, as well as tributary streams, to a particular location.
Clean water	Water that has not come into physical contact with coal or mined carbonaceous material and does not have an elevated sediment load.
Dirty water	Water that has an elevated sediment load.
Discharge	The quantity of water per unit of time flowing in a stream, for example cubic metres per second or mega litres per day.
Electrical conductivity	A measure of the concentration of dissolved salts in water.
Guideline	A numerical concentration or narrative statement that provides appropriate guidance for a designated water use or impact.
Licensed discharge point	A location where the premises discharge water in accordance with conditions stipulated within the site Environmental Protection License.
Percentile	The value of a variable below which a certain percent of observations fall. For example, the 80th percentile is the value below which 80 percent of values are found.
pH	The value taken to represent the acidity or alkalinity of an aqueous solution. It is defined as the negative logarithm of the hydrogen ion concentration of the solution.
Rehabilitation	The treatment or management of disturbed water or land for the purpose of establishing a safe and stable environment.
Riparian	Pertaining to, or situated on, the bank of a river or other water body.
Runoff	The amount of rainfall which actually ends up as streamflow, also known as rainfall excess.
Sediment	Soil or other particles that settle to the bottom of lakes, rivers, oceans and other waters.
Stabilisation	The provision of adequate measures (vegetation …) to prevent erosion from occurring (Landcom 2004).

Surface water	Water that is derived from precipitation or pumped from underground and may be stored in dams, rivers, creeks and drainage lines.
Topography	Representation of the features and configuration of land surfaces.
Tributary	A stream or river that flows into a main river or lake.
Trigger value	The concentration or load of physicochemical characteristics of an aquatic ecosystem, below which there exists a low risk that adverse ecological effects will occur. They indicate a risk of impact if exceeded and should ‘trigger’ action to conduct further investigations or to implement management or remedial processes.
Turbidity	A measure of clarity (turbidity) of water. Turbidity in excess of 5 NTU is just noticeable to the average person.

Abbreviations

AHD	Australian Height Datum
Charbon	Charbon Colliery
CHPP	Coal handling and processing plant
DPIW	Department of Primary Industries Water
DPIEW	Department of Planning Industry and Environment - Water
EPA	Environment Protection Authority
EPL	Environment protection licence
ESC	Erosion and sediment control
ESCP	Erosion and sediment control plan
ha	Hectare
km	Kilometre
L/s	Litre per second
LDP	Licensed discharge point
m	Metre
mg/L	Milligram per litre
Mining Act	*Mining Act 1992*
ML	Megalitre
ML/day	Megalitre per day
mm	Millimetre
NTU	Nephelometric turbidity unit
OEH	Office of Environment and Heritage
PCD	Pollution control dam
POEO Act	*Protection of the Environment Operations Act 1997*
ROM	Run of mine
RUSLE	Revised Universal Soil Loss Equation
SD	Standard drawing

SMP	Soil management plan
t/ha	Tonne per hectare
TSS	Total suspended solids
WMP	Water management plan
µS/cm	Microsiemens per centimetre

1. Background

1.1 Approvals and Licensing Requirements

1.1.1 Development Consent

This ESCP addresses the requirements of the conditions of development consent PA 08_0211 relevant to erosion control. The relevant requirements of the ESCP content are outlined in Appendix A, along with the sections of the plan where these have been addressed.

This plan is intended to read only as a part of the Charbon Colliery Water Management Plan.

1.1.2 Guidelines

The key guidelines applicable for the ESCP are:

- Managing Urban Stormwater: Soils and Construction (the Blue Book), Volume 1 and Volume 2E – Mines and Quarries (Landcom 2004; DECC 2008a).
- Best Practice for Erosion and Sediment Control (IECA 2008).

2. Erosion and Soil Loss Hazards

ESCPs are required to safeguard against soil loss and in turn, minimise the risk of downstream water quality impacts. Some additional risks that erosion and sedimentation may cause include:

- Increased runoff volumes and velocities due to the removal of vegetation, land disturbance and the introduction of impervious surfaces on the hard stand areas.
- Increased potential for sedimentation to occur from increased erosion and runoff associated with open cut mining, stockpiling of material and the construction of surface facilities, and access roads/tracks.
- Potential for increased scour of drainage lines and waterways during the construction of surface facilities adjacent to concentrated flow paths.
- Potential decline in water quality and degradation of local amenities through increased potential for transfer of sediment to nearby watercourses.

Appropriate soil management techniques can assist with reducing erosion and sedimentation. In addition, if appropriate soil management techniques and stripping procedures are not followed this may lead to the degradation of valuable topsoil and subsoil resources that are required in rehabilitation.

Erosion and sediment controls are a fundamental part of the current activities of the site as it progresses from care and maintenance to a closure and rehabilitation phase. Erosion and sediment controls mitigate the impacts of the disturbance activities on watercourses and the surrounding environment. Standard ESC techniques and management principles will be used in accordance with the requirements of the Landcom (2004), DECC (2008a) and IECA (2008) or the most relevant guidelines and standards at the time .

2.1 Constraints Assessment

The ESCP has been based on the constraints summarised in Table 2-1.

Table 2-1 Constraints Assessment

Aspect	Criteria
Soil landscape/type	Collingwood, Three Sisters / dispersible
Soil texture group	D
Soil hydrologic group	D
Rainfall erosivity – R Factor	1,190
Soil erodibility – K Factor	0.05 (GSSE 2009 indicate soils typically <0.05)
Inherent soil fertility	Moderate to low
Sediment yield estimate	Revised universal soil loss equation (RUSLE) – 2 month load
Overall slope gradients	Existing landforms typically less than 5% but increases up to 40% in some isolated areas
Flow length	150 m to >600 m

A site-specific erosion risk assessment was undertaken for the total area of disturbance. This considered the following:

- Average monthly rainfall for Charbon (BOM 2016) and monthly rainfall erosivity values for Bathurst (IECA 2008).
- Area of disturbance (approximately 295.2 ha).
- Soil loss classes (refer to Table 4.2 in Landcom 2004).

The results of the risk assessment are provided for each month in Table 2-2.

Table 2-2 Site Specific Erosion Risk

Month	Average Rainfall (mm)	Erosion Risk Rating
January	70.6	Very high
February	64.7	Very high
March	52.4	High
April	44.0	Moderate
June	43.1	Moderate
July	48.5	Moderate
August	46.9	Low-moderate
September	47.6	Low-moderate
October	47.3	Moderate
November	54.6	High
December	62.6	High

The results of Table 2-2 indicate the winter and spring months of August and September present the lowest risk for significant rainfall events that would likely cause erosion of disturbed catchments.

3. Erosion and soil loss controls

3.1 General Erosion and Sediment Controls and Management Principles

ESCs for Charbon may be achieved by implementing the following key principles:

- Reducing the disturbance footprint through rehabilitation.
- Separation/diversion of 'clean' water catchment runoff from disturbed areas runoff to minimise sediment-laden and mine water volumes for management.
- Ensuring sediment-laden runoff is treated via designated sediment control devices.
- Appropriate storage of overburden stockpiles in areas away from roadways and other drainage lines.
- Implementing an effective maintenance program for the site.

3.2 Stockpiling

Where longer term (i.e. greater than six months) stockpiling of material is required, a maximum stockpile height of approximately 3 m is preferred. Longer term soil stockpiles are recommended to be sown with fast-growing ground cover vegetation as soon as possible after stockpiling. Appropriate temporary sediment controls will be installed and maintained until the ground cover vegetation becomes established. Material stockpiles are to be constructed with a slope no greater than 2:1 (H:V) and the stockpile surface left slightly roughened. Placement within natural or constructed drainage lines will be avoided.

3.3 Erosion and Sediment Controls

Prior to any disturbance activities, ESC measures should be installed. The following are ESC features that may be utilised at the site.

3.3.1 Sediment Filter Fences

Sediment filter fences are to be installed downslope of disturbance areas which are either not protected by existing control measures or require additional temporary protection against erosion and sedimentation. Sediment filter fences filter runoff leaving the site, trapping sediment and allowing filtered water to pass. Sediment filter fences should be constructed downslope of disturbed areas not subject to concentrated flows, where sediment-laden water could potentially enter clean downstream receiving waters. Flow capacity of fences are typically between 10 L/s to 20 L/s.

Sediment filter fences are placed on the contour or slightly convex to the contour. Each end of the fence should be turned uphill to create a stilling pond up slope of the fence. Where possible, a sediment filter fence should consist of a series of overlapping fences. Each fence should be no longer than about 40 m. They should not intercept large concentrated or channelised flows. The fences should be constructed in accordance with the Sediment Fence Standard Drawing (SD) 6-8 (provided in Appendix B). Sediment filter fences require regular maintenance with trapped sediments removed, pickets straightened, filter cloth re-secured and tightened.

3.3.2 Check Dam and Flow Break Structures

Check dams may be installed within existing swale drains or existing drainage channels, which are not able to be regularly graded. The use of check dams must be limited to temporary ESC in open channels. Check dam structures must include a spill point at an invert that is lower than the edge of channel invert.

The reduced flow capacity of the channel as a result of the check dams should be considered in sizing the channel.

The check dams should typically be installed at a minimum of 40 m intervals. As with sediment filter fences, check dams may be installed prior to any works commencing on the site in existing channels and immediately after the construction of new channels. Inspections of the check dams after rain should take place with removal of the collected sediment as required. Damaged check dams should be repaired or replaced as required as part of follow-up works.

Check dam structures can vary in form and materials. Typical details for the use of coir logs (Log-01 Geo Logs), straw bales (SD 6-7) and other various RMS applications (refer to MD.G38.A05.A. and MD.G38.A06.A) have been provided in Appendix B. If sandbags are used, they should be filled to no more than about three quarts full. It is important not to overfill the sandbags as this can cause gaps when the sandbags are wedged together.

3.3.3 Dirty Water Open Channels

Runoff from areas exposed during the works is to be controlled by construction of temporary contour and diversion drains. These drains generally take the form of channels constructed across a slope, with a berm along the downslope side of the drain. Contour and diversion drains should be constructed immediately after a construction site is cleared to intercept and divert runoff from the site to nearby stable areas at non-erosive velocities. The drains should be designed and constructed to have a longitudinal grades of approximately 1% to 2%.

3.3.4 In-Slope Berm and Stilling Basins

In-slope berms (also preferred) are a horizontal shelf that is used to break the continuity of the otherwise long slopes. The aim of this control is to strengthen the slope and control the flow of runoff (DITR 2006). In-slope berms constructed on site typically are a width of 4 m with a longitudinal grade of 0.5%. Berms are constructed at varying intervals down the face of the landform dependent upon the overall grade and length of the face.

Stilling basins are a structure, typically used as part of the final landform, to slow water flow, mitigate some sediment transfer and promote infiltration into the soil profile. Stilling basins are to be constructed at the end of in-slope berms and are to be integrated into the slope, cascading in a sequence where possible. Spillways must be stabilised with geo-fabric or suitable alternative.

Typical details relating to the formation of compost filter berms and earth banks have been provided in Appendix B, (refer to CFB-01 and SD 5-5) otherwise dimensions and form of berms and stilling basins are further detailed on site.

3.3.5 Deep Contour Ripping

Deep contour ripping allows for a reduction in water runoff and erosion and promotes infiltration and wetting of the rehabilitation landform profile. Deep contour ripping is a key step in the establishment of a quality seedbed. Deep contour ripping also increase the surface roughness, which assist in trapping runoff and seed, improving vegetation establishment (compared to smooth surfaces: DITR 2006).

The deep ripping dozer operations are to be completed by a contractor experienced in deep contour ripping intended for mine rehabilitation seedbed preparation.

Following deep contour ripping, further machinery access should be avoided to maintain the well-formed erosion resistant profile in order to assist in the establishment of a suitable seedbed.

3.4 Haul Roads

To ensure any potential surface water impacts associated with the haul road are minimised, the following measures should be undertaken:

- Roadside drainage, such as table drains, are to be maintained regularly throughout the life of the Project.
- A series of mitre drains should be constructed to take water from the table drains away from the haul road to appropriate disposal areas. The runoff would be split at regular intervals to keep the volume of water in each mitre drain to an appropriate level. This could be achieved by spacing the drains as close together as practicable. The spacing would not exceed 50 m, with the drains spaced closer together on higher gradients. Mitre drains would be revegetated as soon as practical after construction.
- Sediment fencing or sand bags could be used to control the sediment at the end of the mitre drains, and controls would be periodically inspected to maintain their performance.

3.5 Fire Trails and Access Tracks

Fire trails and/or access tracks are to conform to the appropriate standards described in Managing Urban Stormwater: Soils and Construction Vol. C – Unsealed Roads (DECC 2008b) and/or described by the NSW Rural Fire Service. Surface drainage is to be optimised and stabilised, thereby reducing roadside erosion and sedimentation. Appropriate control measures are recommended to be constructed on all fire/access roads with cross fall drainage at 3% either side of the road crown to promote immediate water shed from the road surface.

Table drains, mitre drains, culverts and cross drains may be used to safely convey the water from the track surface so to prevent runoff from eroding them or adjacent land. Mitre drain spacing should not exceed 50 m. Cross drains will be placed every 20 m to 90 m depending on the road grade and soil erodibility.

Cut and fill batters associated with service tracks will be formed to a safe slope and stabilised by vegetation. Where cut batters are greater than 1.5 m, stabilisation methods will be applied to these areas such as laying back, revegetation and drainage. Stabilisation may be assisted by spreading topsoil and/or by applying mulch over the exposed batter surface. Where fill batters are greater than 2:1, re-grading may be required.

Where access tracks are required to cross any watercourses, they will generally be constructed so that they cross perpendicular to the watercourse, subject to other constraints.

The tracks will be inspected following heavy traffic usage or exceptionally large storm events, to determine maintenance requirements. Periodic maintenance may include checking the drainage systems to remove any debris that bay block culverts, cross rain outlets and table drains.

4. Maintenance procedures

4.1 Monitoring and Maintenance of Erosion and Sediment Control

Charbon undertake regular general inspections of the site are undertaken to ensure that all environmental controls outlined in this management plan are functioning effectively. These inspections should be undertaken monthly and undertaken after runoff events (greater than 20 mm of rain in 24 hours). Monthly checks will target temporary measures and permanent features as detailed in the checklist. Any signs of erosion along the length of the drains should be noted and remedial works undertaken as required. Where significant erosion is observed, additional erosion controls, such as establishment of vegetation cover, armouring of the channel surface and construction of rock scour protection at the entry and discharge locations, will be implemented.

Regular visual checks should be made of any temporary sediment controls such as sediment filter fences and sandbag weirs to ensure that they are functioning adequately and repaired where required.

4.1.1 Roads

The internal roads will be visually inspected to ensure that the appropriate mitigation measures are functioning to convey surface flows from the road and work areas without causing erosion to the road or work areas on the adjacent land. Where significant erosion is observed to be occurring on a regular basis, additional controls such as additional mitre drains, scour protection of road drainage, and re-grading of the road surface, will be implemented. Maintenance requirements on roads are to be undertaken as soon as practicable.

4.1.2 Dams and Diversion Works

Regular visual checks will be made of the clean water dams as part of the monthly inspections to ensure that there is no undesirable sediment build up in the dams, and that dams are in a stable condition. The inspections also enable correct scheduling of de-silting works and prompt repairs and/or replacement of damaged works. Flocculants may be employed to assist in the removal of fine dispersive sediment from the water column in turbid dams. When the design capacity of a sediment dam has been reduced by more than approximately 20%, the dam is to be de-silted. The silt from the dam is removed so that it is not able to be washed back into the dam. Maintenance requirements on dams and diversions are to be undertaken as soon as practicable following the inspection.

Any pipelines or waterways constructed to transfer water from these dams will be inspected to confirm that there are no leaks, erosion or blockages to flow. Any signs of erosion at the points of discharge will be noted and remedial works undertaken as required. Where significant erosion is observed additional erosion controls, such as new rock scour protection at the discharge locations, will be constructed.

4.1.3 Sediment Controls

Regular visual checks will be made to confirm that there is no excessive sediment build up in the dams, and that the sedimentation controls are in a stable condition. Any sediment fencing and sand bag sediment filters will also be inspected to ensure that they are functioning adequately. Maintenance requirements on sediment controls are to be undertaken as soon as practicable following the inspection.

5. References

ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Australian and New Zealand Environment and Conservation Council.

DECC (2008a) *Managing Urban Stormwater: Soils and Construction – Volume 2E Mines and Quarries*, NSW Department of Environment and Climate Change.

DECC (2008b) *Managing Urban Stormwater: Soils and Construction – Volume 2C Unsealed Roads*, NSW Department of Environment and Climate Change.

DITR (2006) *Leading Practice Sustainable Development Program for the Mining Industry*, Department of Industry, Tourism and Resources, Commonwealth of Australia

GHD (2016) *Charbon Colliery Landscape Management Plan*, prepared by GHD Pty Ltd for Charbon Coal Pty Ltd.

GSSE (2009) *Continued Operation of the Charbon Colliery: Soils Assessment*, prepared by GSS Environmental for Charbon Coal Pty Ltd.

GSSE (2011) *Charbon Colliery Continuation of Mining EIS: Erosion and Sediment Control Plan*, prepared by GSS Environmental for Charbon Coal Pty Ltd.

IECA (2008) *Best Practice for Erosion and Sediment Control*, International Erosion Control Association.

Landcom (2004) *Managing Urban Stormwater: Soils and Construction – Volume 1*, 4th Edition.

APPENDICES

Appendix A – Development Consent PA 08_0211 Conditions

Condition		Where addressed
31.	The Erosion and Sediment Control Plan must:	
(a)	Be consistent with the requirements of Managing Urban Stormwater: Soils and Construction, Volume 1 and 2E, 4th Edition, 2004 (Landcom).	Section 1.1.2
(b)	Identify all activities that could cause soil erosion and generate sediment.	Section 2
(c)	Describe all measures to minimise soil erosion and the potential for the transport of sediment to downstream waters.	Section 3.3 Permanent sediment control is described in the Charbon WMP
(d)	Describe the location, function and capacity of erosion and sediment control structures.	Permanent sediment control structures are described in the Charbon WMP
(e)	Describe what measures would be implemented to maintain the structures over time.	Section 4

Appendix B – Typical Control Measures

Typical details have been sourced from *Managing Urban Stormwater; Soils and Construction, Volume 1* (Landcom 2004), *Best Practice Erosion & Sediment Control* (IECA 2008) and *Model (Road) Drawings, Soil and water management (G38)* (RMS 2009)

- CFB-01 Compost Filter Berm (IECA 2008)
- Log-01 Geo Logs (coir logs) (IECA 2008)
- SD 4-2 Replacing topsoil (Landcom 2004)
- SD 5-5 Earth bank (low flow) (Landcom 2004)
- SD 6-7 Straw Bale Filter (Landcom 2004)
- SD 6-8 Sediment Fence (Landcom 2004)
- MD.G38.A05.A – Check Dams in Drains and Gullies (RMS 2009)
- MD.G38.A06.A – Drop Down Structures (RMS 2009)