NARRABRI MINE

WATER MANAGEMENT PLAN

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WHC_PLN_NAR_WATER MANAGEMENT PLAN

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Acronyms and abbreviations

Acronym	Description
˚C	Degrees Celsius
µS/cm	microSiemens per centimetre
AEP	annual exceedance probability
AHD	Australian Height Datum
AIP	Aquifer Interference Policy
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZG	Australian and New Zealand Guidelines
Approved Methods	*The Approved Methods for the Sampling and Analysis of Water Pollutants in NSW*
ARI	average recurrence interval
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AS/NZS	Australian / New Zealand Standard
AWBM	Australian Water Balance Model
BAM	Biodiversity Assessment Method
BCD	Biodiversity Conservation Division
BoM	Bureau of Meteorology
BSAL	biophysical strategic agricultural land
CCC	Community Consultative Committee
CHPP	Coal Handling and Preparation Plant
CoC	The conditions of consent for SSD 10269
Dam Safety Act	*Dams Safety Act 2015* (NSW)
DEM	digital elevation model
DO	Dissolved oxygen
DotE	Commonwealth Department of the Environment
DPE	Department of Planning and Environment
DPI	The NSW Department of Primary Industries
DPE Water	The Water group within DPE
DSNSW	Dams Safety NSW
EC	electrical conductivity
EIS	Environmental Impact Statement
EL	exploration lease
EMS	Environmental Management Strategy
EPA	NSW Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EP&A Regulation	*Environmental Planning and Assessment Regulation 2021* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)

Acronym	Description
EPL	environment protection licence under the POEO Act
ESCP	Erosion and Sediment Control Plan
FM Act	*Fisheries Management Act 1994* (NSW)
FMPs	Floodplain Management Plans
GAB	Great Artesian Basin
GDE	groundwater dependent ecosystems
GSC	Gunnedah Shire Council
GWMP	Groundwater Management Plan
IAPUM	Independent Advisory Panel for Underground Mining
IEA	Independent environmental audit
HDPE	high-density polyethylene
IESC	Independent Expert Scientific Committee
kL	kilolitres
kL/day	kilolitres per day
km	kilometre
km^2	square kilometre
LiDAR	light detection and ranging
L/s	litres per second
m	metre
MDB	Murray Darling Basin
mg/L	milligrams per litre
MF	microfiltration
Mining Act	*Mining Act 1992 (*NSW)
ML	megalitre
MLA	mining lease application
ML/day	megalitres per day
ML/year	megalitres per year
mm	millimetre
mm/year	millimetres per year
MNES	Matters of National Environmental Significance
MOP	Mining Operations Plan
MOV	maximum operating volume
Mtpa	million tonnes per annum
NCOPL	Narrabri Coal Operations Pty Ltd
NRAR	Natural Resources Access Regulator
NSC	Narrabri Shire Council
NSW	New South Wales

Acronym	Description
NWQMS	National Water Quality Management Strategy
POEO Act	*Protection of the Environment Operations Act 1997* (NSW)
REA	Reject emplacement area
RO	Reverse osmosis
ROM	Run of mine
SB	storage basin
SD	Sediment dam
SSD	State Significant Development
Stage 3	The Narrabri Underground Mine Stage 3 Extension Project
STP	sewage treatment plant
SWB	Site Water Balance
SWMP	Surface Water Management Plan
TARP	trigger action response plan
TDS	total dissolved solids
TOC	total organic carbon
TSS	total suspended solids
WAL	water access licence
WHC	Whitehaven Coal Limited
WM Act	*Water Management Act 2000* (NSW)
WMP	Water Management Plan
WQOs	Water Quality and River Flow Objectives
WSP	Water sharing plan

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1. Introduction

1.1 Background

The Narrabri Mine is an existing underground coal mining operation situated in the Gunnedah Coalfield, approximately 25 kilometres (**km**) southeast of Narrabri and approximately 60 km northwest of Gunnedah, within the Narrabri Shire Council (**NSC**) Local Government Area, in New South Wales (**NSW**). It is operated by Narrabri Coal Operations Pty Ltd (**NCOPL**), on behalf of the Narrabri Mine Joint Venture[1], which consists of two Whitehaven Coal Limited's (**WHC**) wholly owned subsidiaries, and other joint-venture partners.

Stage 1 was approved in November 2007 (as PA 05_0102) under Part 3A of the *Environmental Planning and Assessment Act 1979* (**EP&A Act**). Development of Stage 1 included site establishment and the construction of coal processing infrastructure commencing in 2008, with production using continuous miner mining methods up to 2.5 million tonnes per annum (**Mtpa**) commencing in 2010.

Project Approval 08_0144 for Stage 2 of the Narrabri Mine was issued under Part 3A of the EP&A Act in 2010, which allowed the Narrabri Mine to convert to a longwall mining operation to extract coal from the Hoskissons Coal Seam. Project Approval 08_0144 allowed for the production and processing of up to 11 Mtpa of Run of Mine (**ROM**) coal until July 2031. Approval under the *Environment Protection and Biodiversity Conservation Act 1999* (**EPBC Act**) was granted on 21 January 2011 (**EPBC 2009/5003**) and the Narrabri Mine converted to a longwall mining operation within Mining Lease 1609, in 2012. Following the determination of Stage 2, PA 05_0102 for Stage 1 was surrendered on 2 August 2011.

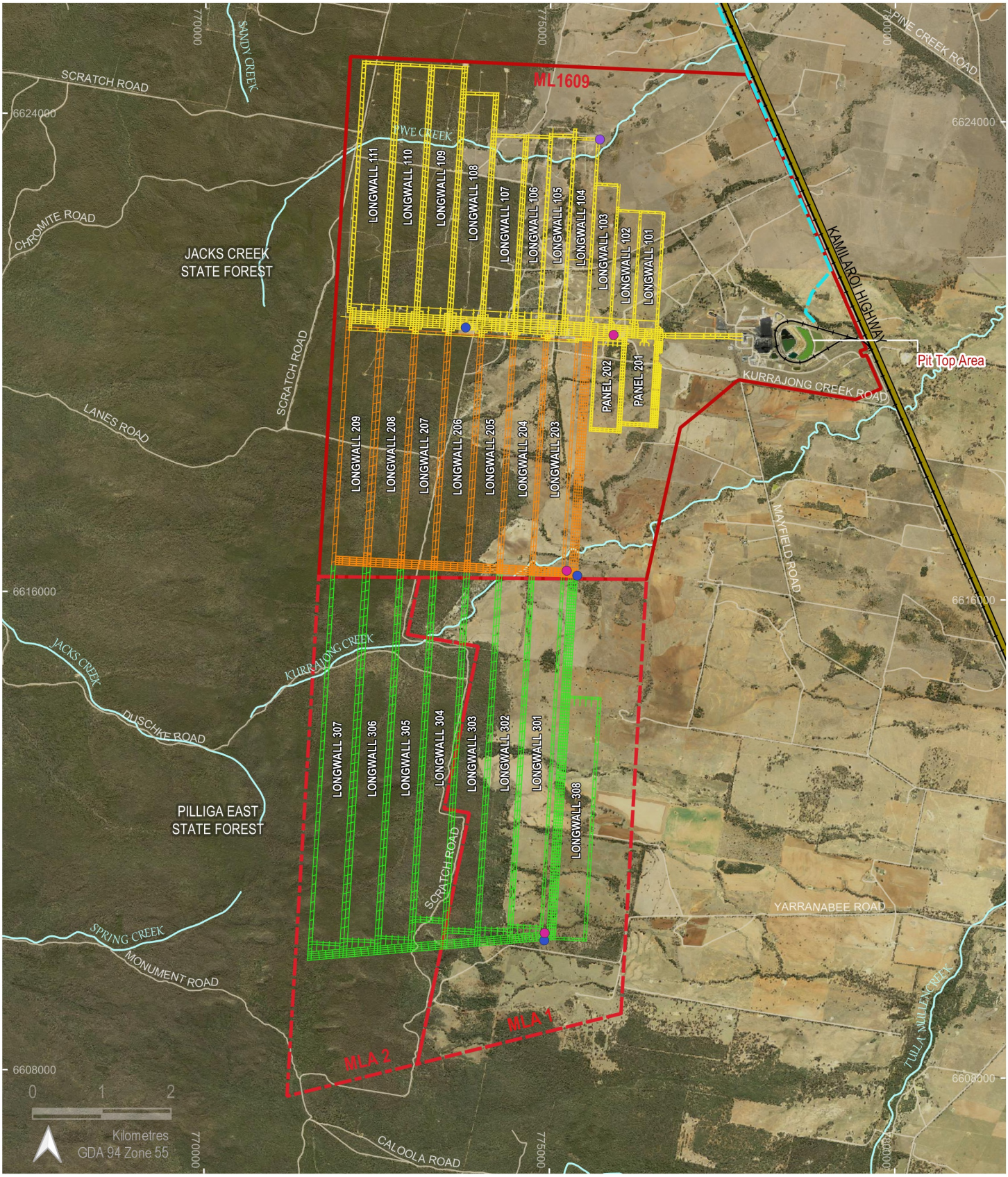
The Narrabri Underground Mine Stage 3 Extension Project (**Stage 3**) involves a southern extension to the previously approved Stage 2 mining area (approximately 609 ha of additional surface development footprint) to gain access to additional areas of coal reserves within Mining Lease Application (**MLA**) 1 and 2, an increase in the mine life to 2044, and the development of supporting surface infrastructure. Bord and pillar mining operations for panels LW 201 and LW 202 were previously approved as modification 7 (Mod 7) to PA 08_0144.

The Stage 3 Extension Project State Significant Development (**SSD**) was granted approval under section 4.38 of the EP&A Act on 1 April 2022, following the determination by the Independent Planning Commission (**SSD-10269)**. Approval under the EPBC Act (**EPBC 2019/8427**) is pending.

Under the Stage 3 SSD-10269 Conditions of Consent (**CoC**), NCOPL is required to surrender PA 08_0144 no more than 12 months from the date of commencement of the Stage 3 development in accordance with the *Environmental Planning and Assessment Regulation 2021* (**EP&A Regulation**). Until then, the CoC prevail to the extent of any inconsistency with the conditions of PA 08_0144.

The Narrabri Mine underground mining layout is shown in Figure 1-1 and the surface development footprint is shown in Figure 1-2.

[1] For full details on the joint venture ownership, refer to the introduction of the Environmental Management Strategy.



WHITEHAVEN COAL

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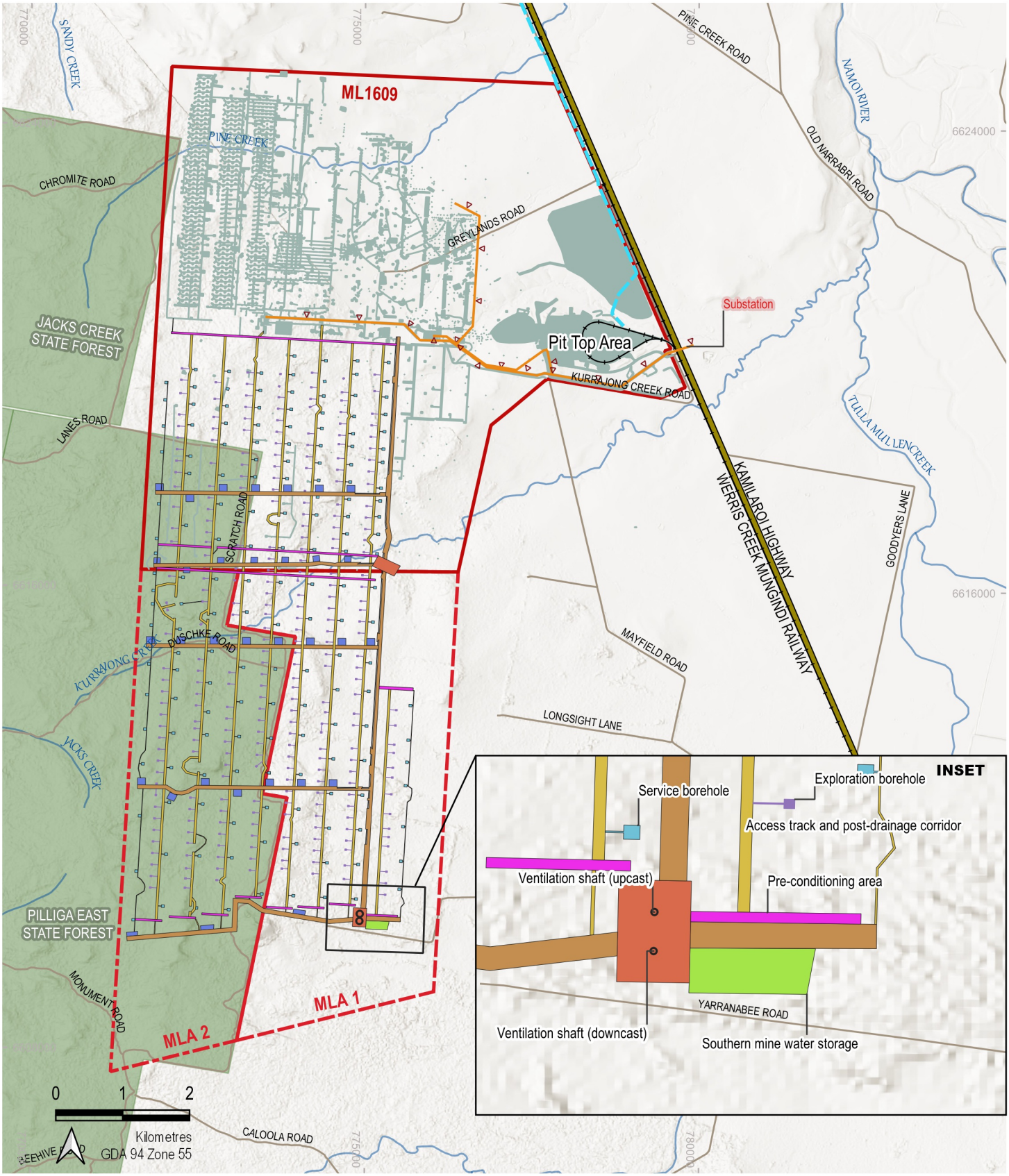
LEGEND

- ML1609
- MLA1
- MLA2
- Namoi River pipeline (buried)
- Stage 2 underground mining layout
- Stage 3 - 200 series underground mining layout
- Stage 3 - 300 series underground mining layout
- Ventilation complex (downcast)
- Ventilation complex (upcast)
- Ventilation complex (upcast - decommissioned)
- Highway
- Road
- Watercourse
- Railway

NARRABRI MINE

FIGURE 1-1
Underground Mining Layout



WHITEHAVEN COAL

ONWARD CONSULTING

LEGEND

- ML1609
- MLA1
- MLA2
- State forest
- Namoi River pipeline (buried)
- Electricity transmission line (constructed)
- Highway
- Road
- Watercourse
- Railway
- Stage 2 surface development
- Access track and post-drainage corridor
- Exploration borehole
- Pre-conditioning area
- Service borehole
- Service borehole and power reticulation
- Services corridor
- Southern mine water storage
- Ventilation complex

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FIGURE 1-2
Surface Development Footprint

1.2 Purpose and scope

This Water Management Plan (**WMP** or **Plan**) has been developed in accordance with CoC B35 and CoC B36, the applicable Commonwealth and NSW State regulatory framework for water management, the requirements of the Water Group within the Department of Planning and Environment (**DPE Water**) and the requirements of the Environment Protection Authority (**EPA**).

This WMP includes the following sub-plans as attachments:

- Attachment 1 – Site Water Balance
- Attachment 2 – Erosion and Sediment Control Plan
- Attachment 3 – Surface Water Management Plan
- Attachment 4 – Groundwater Management Plan

As required by CoC B38, NCOPL will implement the WMP as approved by the Planning Secretary. In accordance with CoC B37, NCOPL will not commence construction until this Plan is approved by the Planning Secretary.

This WMP forms part of the Narrabri Mine Environmental Management Strategy (**EMS**).

1.3 Objectives

The objectives of this WMP are to:

- provide details of the relevant statutory requirements, including any relevant approval, licence or lease conditions;
- describe the measures to be implemented to ensure compliance with the water management performance measures in accordance with CoC B34;
- detail the structure of the water management documentation that together forms the WMP for the Narrabri Mine;
- describe the protocol for managing and reporting any incident, non-compliance or exceedance of any water quality impact assessment or performance criterion, complaint, or failure to comply with other statutory requirements;
- detail the regulatory reporting requirements;
- describe the protocol for periodic review of this Plan; and
- identify the roles and responsibilities for implementation of this Plan.

1.4 Preparation and consultation

This Plan has been prepared by Mr. Servaes van der Meulen and Mr. Mark Vile of Onward Consulting Pty Ltd, who are qualified and competent environmental practitioners with more than 20 years' experience each. Considering their individual and combined industry knowledge and professional expertise in water management, both Servaes and Mark are deemed to be suitably qualified and experienced for the preparation of this WMP, as required by CoC B36(a).

In accordance with CoC A20 and B36(b), the draft WMP (Revision A) was provided to DPE Water and the EPA on 19 July 2022 for review and comment.

Appendix A provides the correspondence from the consultation process, including a reconciliation table with the response to comments and a cross reference to the corresponding section of the WMP where these comments have been addressed (Table A-1).

1.5 Access to information

In accordance with CoC E17(a)(iii), the WMP will be made publicly available on the WHC website following approval by the Department of Planning and Environment (**DPE**). Any subsequent revision of the WMP approved by the DPE will be made publicly available on the website, and the superseded version will be removed to ensure the information is kept up to date in accordance with CoC E17(b). A copy of this Plan will also be kept on the Narrabri Mine site server. Any printed copies of this Plan are uncontrolled.

2. Roles and responsibilities

All NCOPL employees and contractors (and their sub-contractors) are responsible for the environmental performance of their activities and for complying with all legal requirements and obligations. All personnel will be required to comply with the statutory approval requirements of the activities they undertake, and any potential environmental impacts from all activities will be managed in accordance with the relevant strategies, plans and programs.

In accordance with CoC E1, the EMS sets out the roles, responsibilities, authorities and accountabilities of all key personnel involved in the environmental management of operations at Narrabri Mine, which encompasses the requirements and obligations under this WMP.

3. Statutory requirements

3.1 Environmental Planning and Assessment Act 1979

The EP&A Act provides the statutory basis and framework for planning and environmental assessment in NSW. The EP&A Act includes provisions to ensure that the potential environmental impacts of a development are assessed and considered in the decision-making process. Stage 3 is permissible with development consent under the *State Environmental Planning Policy (Resources and Energy) 2021*, and is identified as 'State Significant Development' under section 4.38 of the EP&A Act, and Clause 8 and Schedule 1 of the *State Environmental Planning Policy (Planning Systems) 2021*.

3.1.1 Project approval and development consent

The Stage 3 Extension Project (SSD 10269) was approved on 1 April 2022. The Narrabri Mine also incorporates the development formerly authorised under Project Approval 08_0144, until such time as this development consent is surrendered, in accordance with CoC A16.

In accordance with CoC E5(b), Appendix B, Table B-1 provides a summary of the relevant CoC relating to surface water, groundwater, erosion and sediment control and associated water management infrastructure, and outlines the section of the WMP (including sub-plans) in which each of these conditions have been addressed.

In accordance with CoC E5(c), Appendix C, Table C-1 provides a summary of the relevant commitments or recommendations within the Environmental Impact Statement (**EIS**) relating to surface water, groundwater, erosion and sediment control and associated water management infrastructure, and outlines the section of the WMP (including sub-plans) in which each of these commitments have been addressed. These relevant commitments or recommendations include those as amended or added to by the:

- Applicant's Submission Report submitted 31 May 2021;
- Applicant's Amendment Report submitted 31 May 2021; and
- Applicant's final Biodiversity Development Assessment Report dated September 2021.

3.2 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (**POEO Act**) regulates pollution from a facility or activity through the placement of conditions in an environment protection licence (**EPL**). Activities requiring an EPL are listed in Schedule 1 of the POEO Act and include mining for coal and coal works.

The POEO Act provides the statutory framework for managing water pollution in NSW. It is supported by the *Protection of the Environment Operations (General) Regulation 2021,* which among other functions prescribes certain matters for the purposes of the definition of water pollution.

It is an offence under section 120 of the POEO Act to pollute waters. However, section 121 and section 122 of the POEO Act provides a defence against prosecution under section 120 where the pollution was regulated by an EPL or regulation which was not contravened.

3.2.1 Environment protection licence

NCOPL is the holder of EPL 12789. The EPL will be varied to reflect all Stage 3 related development and operational activities.

In accordance with CoC E5(b), Appendix B, Table B-2 provides a summary of the relevant EPL conditions relating to surface water, groundwater, erosion and sediment control and associated water management infrastructure, and outlines the section of the WMP (including sub-plans) in which each of these conditions have been addressed.

3.3 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is designed to protect national environmental assets, known as Matters of National Environmental Significance (**MNES**), which include a water resource associated with a large coal mining development (the water trigger).

The *Significant Impact Guidelines 1.3: Coal Seam Gas and Large Coal Mining Developments – Impacts on Water Resources* (**Significant Impact Guidelines for Water Resources**) (Commonwealth Department of the Environment [**DotE**] 2013) has been developed to assist large coal mining development applicants to determine whether a development is likely to have significant impacts on a water resource.

3.3.1 EPBC Act approvals

The Stage 3 project was deemed a controlled action on 30 September 2019 (**EPBC 2019/8427**), which included a water resource included as a controlling provision for the proposed action. The proposed action under EPBC 2019/8427 excludes the Stage 2 Narrabri Mine longwall mining operations, which was granted EPBC Act approval in 2011 (**EPBC 2009/5003)** (last varied on 19 March 2020).

Narrabri Mine is subject to EPBC 2009/5003 and EPBC 2019/8427 (once granted) under the EPBC Act.

Condition 4 of EPBC 2009/5003 states that in order to minimise potential impacts on EPBC Act listed threatened species and communities within the mine site, prior to any Works commencing and in accordance with the NSW Director General's Assessment Report and approval conditions (26 July 2010), the person undertaking the action must develop and implement a Water Management Plan. The final version of this plan must be submitted to the Department.

3.4 Mining Act 1992

The *Mining Act 1992* (**Mining Act**) regulates the licensing, land access, and operations for coal mines operating in NSW. Under the Mining Act, all resource activities must be licensed, including exploration activities.

3.4.1 Mining lease

NCOPL are the holder of Mining Lease 1609 (**ML 1609**) issued in January 2008, which prescribe conditions for the protection of water resources. NCOPL are required to implement all practicable measures to prevent and/or minimise any harm to the environment that may result from the construction, operation, or rehabilitation of the development.

Condition 17(2)(c) requires all exploratory drill holes to be permanently sealed with cement plugs to prevent surface discharge of groundwaters.

This Plan will be updated with any relevant conditions associated with future mining leases, once these have been granted.

3.5 Water Management Act 2000

The NSW *Water Management Act 2000* (**WM Act**) provides for the protection, conservation and ecologically sustainable development of the water sources of the State. The WM Act includes the concept of "no more than minimal harm" for both the granting of water access licences (**WALs**) and the granting of approvals. The WM Act licensing regimes for the management of water resources apply to water sources that are the subject of a Water Sharing Plan (**WSP**).

All surface water and groundwater associated with the Narrabri Mine, including extraction from the Namoi River, is governed by the WM Act. The following WSPs are relevant to the Narrabri Mine:

- *Water Sharing Plan for the Upper Namoi and Lower Namoi Regulated River Water Sources 2016* (Lower Namoi Regulated River Water Source);
- *Water Sharing Plan for the Namoi and Peel Unregulated Rivers Water Sources 2012*;
- *Water Sharing Plan for the NSW Murray Darling Basin (**MDB**) Porous Rock Groundwater Sources 2020 – Gunnedah-Oxley Basin MDB Groundwater Source* (Gunnedah Oxley Basin MDB [Other] Management Zone);
- *Water Sharing Plan for the NSW Great Artesian Basin (**GAB**) Groundwater Sources 2020 – Southern Recharge Groundwater Source*; and
- *Water Sharing Plan for the Namoi Alluvial Groundwater Sources 2020 – Upper Namoi Zones 2, 4 and 5 and the Lower Namoi Groundwater Sources*.

The EP&A Act, section 4.41(1)(g) stipulates that SSDs authorised by a development consent do not require a water use approval, a water management work approval or an activity approval under the WM Act.

Water take and licensing associated with each of the WSPs is detailed in Attachment 1.

3.5.1 Water Management (General) Regulation 2018

Item 12 of Schedule 4 of the Water Management (General) Regulation 2018 provides exemptions in relation to water take from or by means of an 'excluded work' as defined in Schedule 1. Items of relevance to the Narrabri Mine under Schedule 1 are:

1 Dams solely for the control or prevention of soil erosion:

(a) from which no water is reticulated (unless, if the dam is fenced off for erosion control purposes, to a stock drinking trough in an adjoining paddock) or pumped, and
(b) the structural size of which is the minimum necessary to fulfil the erosion control function, and
(c) that are located on a minor stream.
3 Dams solely for the capture, containment and recirculation of drainage and/or effluent, consistent with best management practice or required by a public authority (other than Landcom or the Superannuation

Administration Corporation or any of their subsidiaries) to prevent the contamination of a water source, that are located on a minor stream.

The NCOPL water management dams are considered to be excluded works under item 3, Schedule 1 as per the harvestable rights assessment (refer to Appendix C of the EIS for further detail on the harvestable rights assessment).

3.6 Dam Safety Act 2015

The *Dams Safety Act 2015* (**Dams Safety Act**) establishes the role of Dams Safety NSW (**DSNSW**) to ensure the safety of dams in NSW, including surveillance of declared dams. DSNSW is empowered with various enabling functions under the Dams Safety Act and the *Mining Act 1992*. The DSNSW has a general responsibility for the safety of all dams, and a special responsibility for declared dams. Determination of whether a dam is a declared dam is based on an assessment of its consequence category, which considers potential downstream impacts of dam failure.

The DSNSW has declared all of the dams located in the Pit Top Area rail loop (Dams A1, A2, A3, B, C and D) with a significant consequence category under the Dams Safety Act. Specific management requirements are addressed in the respective Dam Safety Emergency Plans and Operation and Maintenance Plans developed for each dam.

3.7 Relevant guidelines and standards

The following guidelines have been utilised during the preparation of the WMP and accompanying documents:

- *Guidelines for Groundwater Documentation for SSD/SSI Projects. Technical guideline* (DPE 2022);
- *Approved Methods for the Sampling and Analysis of Water Pollutants in NSW* (EPA 2022);
- *AS/NZS 5667.1:1998 Water quality—Sampling Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples*;
- *AS/NZS 5667.11:1998 Water Quality – Sampling – Guidance on Sampling of Groundwater*
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC 2000);
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG 2018);
- *Australian Guidelines for Water Quality Monitoring and Reporting* (ANZECC and ARMCANZ 2000);
- *Environmental Guidelines: Use of Effluent by Irrigation* (DEC 2004);
- *Erosion and Sediment Control of Unsealed Roads - A Field Guide for Erosion and Sediment Control Maintenance Practices* (OEH 2012);
- *Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management* (DPI 2013);
- *Groundwater Quality Protection Policy* (DLWC 1998);
- *Managing Urban Stormwater – Soils and Construction, Volume 1* (Blue Book) (Landcom 2004);
- *Managing Urban Stormwater – Soils and Construction, Volume 2A: Installation of Services* (DECC 2008);
- *Managing Urban Stormwater – Soils and Construction, Volume 2C: Unsealed Roads* (DECC 2008);
- *Managing Urban Stormwater – Soils and Construction, Volume 2D: Main Road Construction* (DECC 2008);

- *Managing Urban Stormwater – Soils and Construction, Volume 2E Mines and Quarries* (DECC 2008);
- *NSW Aquifer Interference Policy* (2012);
- *NSW Guidelines for controlled activities on waterfront land* (DPI Water 2012);
- *Using monitoring data to assess groundwater quality and potential environmental impacts* (QLD DES 2021); and
- *Why do fish need to cross the road? fish passage requirements for waterway crossings* (NSW Fisheries 2003).

4. Implementation and management

4.1 Site water management system

The Narrabri Mine water management system is based on the containment and re-use of mine water and diversion of upstream water around the Pit Top Area, and includes use of the following infrastructure:

- up-catchment diversion structures to separate runoff from undisturbed and mining-affected areas;
- storage dams to collect mine water or Pit Top Area runoff for treatment and/or reuse;
- water treatment facilities to treat mine water for beneficial re-use;
- sediment dams for treatment of sediment laden runoff from disturbed areas;
- brine storage dams to collect brine waste product for subsequent reuse/disposal; and
- Namoi River pump station, alluvial production bore and pipeline for supply of raw water.

4.2 Site water balance overview

A site water balance has been developed to simulate performance of the site water management system over the life of mine.

The site water balance modelling demonstrates that the proposed site water management system has sufficient capacity and flexibility to accommodate a wide range of groundwater inflows and climate scenarios while:

- providing security of supply for mining operations;
- containing brine on-site, with no uncontrolled off-site release; and
- maintaining a low risk of uncontrolled off-site release of mine water and Pit Top Area water.

The site water balance modelling conducted for the Stage 3 EIS demonstrates that make-up water demands can be met with water licences currently held by NCOPL and sufficient water licences are held for incidental groundwater take.

A detailed description of the Site Water Balance (**SWB**) is provided in Attachment 1.

4.3 Erosion and sediment control overview

Erosion and sedimentation impacts can result from the following activities:

- Exploration boreholes, pre-conditioning areas and gas management areas;
- Ventilation shafts and service borehole pads;
- Services corridors, access tracks and other infrastructure, including those traversing watercourses; and
- Disturbance associated with pipelines, access roads or other ancillary infrastructure.

Erosion and sediment control structures will be designed, installed and maintained in accordance with *Managing Urban Stormwater Soils and Construction* (Landcom, 2004) and *Volume 2E: Mines and Quarries* (DECC 2008) to minimise the potential for soil erosion and transport of sediment off-site.

A detailed description of erosion and sediment controls is provided in the Erosion and Sediment Control Plan (**ESCP**) (Attachment 2).

4.4 Surface water management overview

The water management system incorporates up-catchment diversion structures around the Pit Top Area to minimise the runoff from undisturbed areas captured by on-site water storages. Short-term sediment management measures will be implemented for exploration boreholes, pre-conditioning areas and gas management areas to minimise potential water quality impacts.

Runoff from Narrabri Mine disturbance areas and areas under active rehabilitation will be captured in sediment dams and:

- transferred to the Narrabri Mine site water management system for re-use in mine operations; and/or
- controlled release via licensed discharge points, in accordance with the requirements of EPL 12789 following rainfall events that exceed sediment dam design capacity.

Whilst subsidence is predicted to increase the surface area of depressions in drainage lines, the total volume of water retained in the local waterways by the additional surface depressions will be negligible.
Direct hydraulic connection to the surface due to mine subsidence is considered unlikely to possible and given the ephemeral nature of streams, the potential diversion of flows into underlying strata will be negligible.

Major changes in channel geomorphology along watercourses traversing the mining areas are unlikely.

A detailed description of surface water management is provided in the Surface Water Management Plan (**SWMP**) (Attachment 3).

4.5 Groundwater management overview

Sub-surface fracturing can cause significant changes in hydraulic properties, and potentially provide pathways for groundwater movement. Discontinuous fracturing will normally be expected to occur above the mining area, causing an increase in rock mass storage capacity and horizontal permeability, without direct hydraulic connection to the workings. Groundwater levels will be lowered in the medium to long terms as a consequence of these impacts. It is expected that the majority of bores will be impacted by horizontal shear movements at strata unit boundaries or vertical tensile strains due to bedding parting separation. The impacts are expected to increase with severity where wells or bores are intersected by A-Zone fracturing. Bores located outside the limits of longwall mining or above chain pillars (e.g. the two Santos bores) are still at risk to horizontal bedding shear movements. The potential for significant bore casing impact (i.e. loss of well function due to closure or rupture of casing) have been based on horizontal shear displacement and vertical strain estimates.

Mine dewatering activities will create hydraulic gradients towards the mine; therefore, any contamination or poor quality groundwater generation will likely flow to the underground mine workings and be transferred to the site water management system. The mined area will remain as a local groundwater sink in the long-term and groundwater from the surrounding groundwater system will continue to flow towards the area for some time after mining has ceased.

The volume of brine to be reinjected will be negligible in the context of the overall pore space available in the goaf (i.e. less than 2%), and flows from the surrounding groundwater system will dilute the brine. Therefore, underground disposal of brine is not predicted to influence the quality of the surrounding groundwater system.

Groundwater modelling completed for the Narrabri Mine indicates:

- minimal drawdown (less than 2 m) in the 'highly productive' Namoi River alluvium and Pilliga Sandstone;
- negligible impact on access to water in known registered production bores in 'highly productive' aquifers; and
- negligible changes to baseflow in the Namoi River. It is unlikely that Stage 3 will result directly or indirectly in a substantial change in the hydrology of groundwater resources.

Negligible impacts on groundwater quality in nearby aquifers are anticipated during operation and post-mining (including following the re-injection of brine towards the completion of mining).

A detailed description of groundwater management is provided in the Groundwater Management Plan (**GWMP**) (Attachment 4).

5. Trigger action response plans

Trigger action response plans (**TARPs**) have been developed to identify, assess and respond to triggers such as potential exceedances and are implemented to manage risk to operations, personnel and the environment. These TARP(s) have been fully detailed and addressed in each of the relevant sub-plans.

6. Incidents and non-compliance

6.1 Incident notification

An incident is defined under the CoC as *an occurrence or set of circumstances that causes or threatens to cause material harm and which may or may not be or cause a non-compliance*.

Material harm, as defined under the CoC, is harm to the environment that:

involves actual or potential harm to the health or safety of human beings or to the environment that is not trivial, or
results in actual or potential loss or property damage of an amount, or amounts in aggregate, exceeding $10,000, (such loss includes the reasonable costs and expenses that would be incurred in taking all reasonable and practicable measures to prevent, mitigate or make good harm to the environment)

This definition excludes "harm" that is authorised under either the CoC or any other statutory approval (e.g., EPL).

In accordance with CoC E9, NCOPL will notify DPE and any other relevant agencies immediately as it becomes aware of an incident. Incident notification will be made in writing via the Department's Major Projects Website and identify the development (including the development application number and name) and set out the location and nature of the incident.

Notifications to the EPA will be made by contacting the Environment Line on 131 555 and written details of the notification will be provided within 7 days of the date on which the incident occurred.

Incident reporting and emergency response is further described in the EMS.

6.2 Non-compliance and adaptive management

The CoC defines a non-compliance as *an occurrence, set of circumstances or development that is a breach of this consent.* For clarity, 'this consent' is referring to development consent SSD-10269.

In accordance with CoC E4, where an exceedance of the relevant criteria or performance measures has occurred, NCOPL will, at the earliest opportunity, take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur. All reasonable and feasible options for remediation (where relevant) will be considered and a report submitted to the DPE describing those options and any preferred remediation measures or other course of action.

In accordance with CoC E10, within seven days of becoming aware of a non-compliance, NCOPL will notify DPE of the non-compliance[2]. The notification will be made in writing via the Department's Major Projects Website and identify the development (including the development application number and name), set out the CoC 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.

NCOPL will implement any reasonable remediation measures as directed by the Planning Secretary, to the satisfaction of the Planning Secretary.

[2] A non-compliance which has been notified as an incident under Section 6.1 does not need to be notified as a non-compliance under section 6.2.

7. Reporting, evaluation and review

7.1 EPL Annual Return

In accordance with Condition R1 of EPL 12789, NCOPL will submit an Annual Return to the EPA within 60 days after the end of the reporting period (anniversary date), using the form provided by the EPA.

7.2 Annual Review

NCOPL will review the performance of its site water management system for the previous calendar year and report results within the Annual Review to the satisfaction of the Planning Secretary and in accordance with CoC E11. Table B-1, Appendix B lists all components of the Annual Review.

The Annual Review, as required under CoC E12, will be submitted to DPE, the IAPUM (via DPE as Secretariat), NSC and Gunnedah Shire Council (**GSC**), and other regulatory agencies and made available to the Community Consultative Committee (**CCC**) and any interested person upon request. The Annual Review will also be made publicly available on the WHC website.

NCOPL will report on the following specific components related to water management in the Annual Review:

- water take at the site each year (direct and indirect), including water take where a water licence is required and where an exemption applies. Where a water licence is required, the water take will be reviewed against existing water licences;
- performance reporting on channel form and any remedial actions undertaken to enable a more detailed assessment and review of River Style condition and future geomorphic recovery; and
- water quality results from the monitoring network and consideration if any additional monitoring sites are required, or if optimisation of the existing monitoring sites, frequency of sampling and analytical suite will be undertaken.

In addition, all data on groundwater levels, quality, and data quality control will be provided separately to DPE Water in csv format to accompany the Annual Review.

7.3 Water register

The Water NSW online water accounting system will be used to place and amend water orders, report water usage and manage water account statements and allocation assignments.

7.4 Monitoring records

In accordance with EPL 12789 Condition M1, the results of any monitoring required to be conducted under the EPL (or a load calculation protocol) must be recorded and retained by NCOPL.

NCOPL will retain all monitoring and reporting records as follows:

- in a legible form, or in a form that can readily be reduced to a legible form;
- kept for at least 4 years after the monitoring or event to which they relate took place; and

- produced in a legible form to any authorised officer of the EPA who asks to see them.

The following records must be kept in respect of any samples required to be collected for the purposes of the EPL:

- the date(s) on which the sample was taken;
- the time(s) at which the sample was collected;
- the point at which the sample was taken; and
- the name of the person who collected the sample.

7.5 Independent Environmental Audit

Within one year of commencement of the development, and every three years thereafter (unless the Planning Secretary directs otherwise), NCOPL will commission an Independent Environmental Audit (**IEA**) of the development, to be conducted in accordance with CoC E13 and CoC E14. The IEA will be led and conducted by a suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the Planning Secretary.

The IEA process and requirements are further described in the EMS.

7.6 WMP review and evaluation

In accordance with CoC E7, NCOPL will review the suitability of the WMP within three months of the:

- submission of an incident report under CoC E9 or E10;
- submission of an Annual Review under CoC E11;
- submission of an IEA under CoC E13;
- approval of any modification of the CoC (unless the conditions require otherwise); or
- notification of a change in development phase under CoC A14.

As required by CoC E8, if the review under CoC E7 determines that the WMP requires revision to either improve the environmental performance of the development, cater for a modification or comply with a direction, the revised document will be submitted to the Planning Secretary for approval within six weeks of the review. The revision status of this WMP is indicated in section 11.

A dedicated review register will be maintained which will provide the details of the review of all relevant strategies, plans and programs that need to be reviewed as required by CoC E7.

7.7 Improvement measures

Consent condition E5(g) requires this Plan to include a program to investigate and implement ways to improve the environmental performance of the development over time. Improvement measures may be investigated through review of the following:

- monitoring data, and any assessment of trends;
- audit outcomes, including audits of the water management measures;
- incident reports, including any community complaints; and
- industry leading practice in mine water management.

Reasonable and feasible improvement measures will be implemented and documented as a management measure in a revision to the Plan as described in section 7.6.

CoC E5(j) states that the Plan is to include a protocol for periodic review of the Plan. The protocol for review is set out by CoC E7, E8 and E11, which have been addressed in section 7.6.

8. Complaints management

Any complaints received in relation to water will be managed in accordance with the complaints management protocol as follows:

- publicly advertised telephone complaints line, 1800WHAVEN, will be in place to receive complaints.
- each complaint received will be recorded in a Complaints Register, which will include the following details:
  - date and time of complaint;
  - method by which a complaint was made;
  - personal details the complainant wishes to provide or, if no such details are provided, a note to that effect;
  - nature of the incident that led to the complaint;
  - action taken by NCOPL in relation to the complaint (i.e., any required remedial actions), including any follow-up contact with the complainant; and
  - if no action was taken, the reason why no action was taken.
- the Environmental Superintendent will be responsible for ensuring that an initial response is provided within 24 hours of receipt of a complaint (except in the event of complaints recorded when the mine is not operational or outside of usual business hours).
- once the identified measures are undertaken, the Environmental Superintendent will sign off on the relevant complaint within the Complaints Register.
- if necessary, follow-up monitoring will take place to confirm the source of the complaint is adequately mitigated.
- a summary of the complaints will be maintained by NCOPL and made available to the Community Consultative Committee, the complainant (on request) and on the WHC website. A summary of complaints received every 12 months will be provided in the Annual Review.

Condition M5.3 and M5.4 of EPL 12789 require NCOPL to retain all records of a complaint for at least four years after the complaint was made and the record must be produced to any authorised officer of the EPA who asks to see them.

In the event that any complainant considers that NCOPL has not adequately addressed their concerns, the NCOPL representative will convene additional meetings with the complainant. If the complainant believes the matter remains unresolved, and no further agreement can be reached as to additional measures to be undertaken, then they may refer the matter to DPE.

9. References

Department of the Environment (2013). *Significant impact guidelines 1.3: Coal seam gas and large coal mining developments—impacts on water resources.*

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

Landcom (2004). *Managing Urban Stormwater, Soils and Construction*.

NSW Environment Protection Authority (March 2020). *Environment Protection Licence 12879.*

NSW Independent Planning Commission (April 2022). *Development Consent SSD 10269, Narrabri Underground Mine Stage 3 Extension Project.*

Resource Strategies Pty Ltd (October 2020). *Narrabri Underground Mine Stage 3 Extension Project – Environmental Impact Statement.* Prepared for Narrabri Coal Operations Pty Ltd.

10. Glossary

Term	Definition
Access track	Cleared and graded track constructed where existing tracks are not available.
Adaptive management	Adaptive management includes monitoring subsidence impacts and subsidence effects and, based on the results, modifying the mining plan as mining proceeds to ensure that the effects, impacts and/or associated environmental consequences remain within predicted and designated ranges and in compliance with the conditions of this consent.
Alluvium	Sediment (gravel, sand, silt, clay) transported by water (i.e. deposits in a stream channel or floodplain).
Angle of draw	The angle between the vertical and the line joining the edge of the mining void with the limit of vertical subsidence, usually taken as 20 mm.
Aquatic	Living in or on water or concerning water.
Aquifer	A sub-surface rock formation containing water in recoverable quantities.
Average Recurrence Interval (ARI)	The expected value or average value of the periods between exceedances of a given event magnitude. A term used in water engineering. Also known as “return period”.
Baseline	The condition already present in an area before the commencement of a specific activity.
Batter	Retaining walls are structures that hold or retain soil.
Biodiversity	The diversity of different species of plants, animals and micro-organisms, including the genes they contain, in the ecosystem of which they are part.
Bord and pillar	A method of mining coal where pillars of coal are left behind as supports.
Brine	Water strongly impregnated with salt.
Bund (or bunding)	Wall of a secondary containment system, usually in the form of an embankment, used to prevent sediment and liquids from entering the environment.
C-factor	The cover management factor that represents the effect of ground/crop cover on erosion.
Calendar year	A period of 12 months from 1 January to 31 December.
Catchment	The entire land area from which water (e.g. rainfall) drains to a specific watercourse or water body.
Chain pillar	a chain pillar provides support to the gateroads that are subjected to changing loading conditions in a longwall coal mine.
Cliff	A continuous rock face, including overhangs, having a minimum length of 20 metres, a minimum height of 10 metres and a minimum slope of 2 to 1 (>63.4°).
Conditions of Consent (CoC)	SSD 10269 issued under s4.38 of the EP&A Act.
Construction	The carrying out of all physical works to enable mining operations to be carried out and decommissioning, including erection of buildings, infrastructure and other works and demolition, but not including pre-construction activities.
Coir	The fibre from the outer husk of a coconut, typically used to create geofabric matting.
Date of commencement	The date notified to the Department by the Applicant under CoC A14.
Department	The NSW Department of Planning and Environment (DPE).

Term	Definition
Decommissioning	The permanent cessation of active use of the mine, including demolition of buildings, infrastructure and other works.
Dispersion	Describes the behaviour of clay particles separating from one other in a moist soil.
Earth embankment	A raised impounding structure made from compacted soil.
Ecosystem	An interacting system of animals, plants, other organisms and non-living parts of the environment.
Effluent	Liquid waste that is being discharged to a natural body of water.
Electrical Conductivity (EC)	The ability of a substance (either solid, liquid or gas) to transmit electricity.
Environmental Impact Statement	The Environmental Impact Statement titled *Narrabri Underground Mine Stage 3 Extension project – Environmental Impact Statement*, prepared by Resource Strategies Pty Ltd on behalf of the Applicant and dated October 2020, as amended or added to by the Applicant's *Submissions Report* submitted 31 May 2021, the Applicant's *Amendment Report* submitted 31 May 2021, the Applicant's final *Biodiversity Development Assessment Report* dated September 2021, and the Applicant's *Additional Information on GHGEs* dated 15 October 2021 and 17 December 2021.
Environment	Includes all aspects of the surroundings of humans, whether affecting any human as an individual or in his or her social groupings.
Ephemeral	Relates to the amount of time that surface water persists in a watercourse or wetland; ephemeral watercourses flow only during significant rainfall events and for a short-time following rainfall events. Also known as intermittent.
Erosion	Wearing away of rock or soil caused by physical or chemical processes.
Feasible	Means what is possible and practical in the circumstances.
Fracturing	a separation in a geologic formation involving discontinuities in displacement across surfaces or narrow zones.
Goaf	The mined-out area into which the immediate roof strata breaks.
Groundwater	All waters occurring below the land surface; the upper surface of the soils saturated by groundwater in any particular area is called the water table.
Groundwater Dependent Ecosystem (GDE)	An ecosystem that has its species composition and natural ecological processes wholly or partially determined by groundwater.
Incident	An occurrence or set of circumstances that causes or threatens to cause material harm and which may or may not be or cause a non-compliance.
Land	Part B of the CoC defines land to mean the whole of a lot, or contiguous lots owned by the same landowner, in a current plan registered at the Land Titles Office at the date of the CoC.
Longwall	A form of underground coal mining where a long wall of coal is mined in a single slice.
Material harm	Material harm to the environment is defined in the CoC (SSD 10269).
Mine water	Water that accumulates within, or drains from, active mining and infrastructure areas and any other areas where runoff may have come into contact with carbonaceous material.
Minimise	Implement all reasonable and feasible mitigation measures to reduce the impacts of Narrabri Mine.
Mining operations	The carrying out of mining, including the extraction, processing, stockpiling and transportation of coal on the site and the associated removal, storage and/or emplacement of vegetation, topsoil, overburden and reject material; and includes underground development necessary for mining operations to be carried out

Term	Definition
	(such as installation and use of electricity, water, communications and other services and infrastructure).
Mitigation	Activities associated with reducing the impacts of the development.
Narrabri Mine	The development approved under the CoC, together with the development approved under project approval 05_0102 and project approval 08_0144.
Negligible	Small and unimportant, such as to be not worth considering.
Non-compliance	Any exceedance of a consent/licence criteria is considered a non-compliance. However, the type of regulatory action taken by a regulatory authority will depend on a number of factors, in accordance with the authority's prosecution policies and guidelines.
Percentile	The value below which a certain percent of numerical data falls.
Permeate	Filtered water that has passed through a fine membrane.
pH	A measure of the degree of acidity or alkalinity of a solution; expressed numerically (logarithmically) on a scale of 1 to 14, on which 1 is most acid, 7 is neutral, and 14 is most basic (alkaline).
Plan	Water Management Plan (or sub plan when used within one).
Planform	A body of water's outline or morphology as defined by the still water line.
Planning Secretary	Planning Secretary under the EP&A Act, or nominee.
Pollution	Under the POEO Act, the definition of pollution is: *(a) water pollution, or* *(b) air pollution, or* *(c) noise pollution, or* *(d) land pollution.*
Pollution incident	Under the POEO Act means an incident or set of circumstances during or as a consequence of which there is or is likely to be a leak, spill or other escape or deposit of a substance, as a result of which pollution has occurred, is occurring or is likely to occur.
Reasonable	Means applying judgement in arriving at a decision, taking into account: mitigation benefits, cost of mitigation versus benefits provided, community views and the nature and extent of potential improvements.
Rehabilitation	The restoration of land disturbed by the development to ensure it is safe, stable and non-polluting over the short, medium and long term.
Remediation	Activities associated with partially or fully repairing or rehabilitating the impacts of the development or controlling the environmental consequences of this impact.
Riparian	Pertaining to, or situated on, the bank of a body of water, especially a watercourse such as a river.
Runoff	A portion of precipitation (rain, hail and snow) that flows across the ground surface as water.
Sediment	Particles derived from rocks or biological materials that have been transported by air or water.
Sedimentation	Deposition or accumulation of mineral or organic matter deposited by air or water.
Shandying	The process of mixing untreated groundwater with potable water for it to be appropriate for watering stock.

Term	Definition
Slope	Ranging between 18° and 35° with numerous continuous rock outcrops with lengths greater than 20 m and heights greater than 5 m or discontinuous rock outcrops or rock face features with lengths less than 20 m, heights less than 5 m and slopes greater than 55°.
Stratigraphic units	a volume of rock of identifiable origin and relative age range.
Subsidence	The totality of subsidence effects, subsidence impacts and environmental consequences of subsidence impacts.
Subsidence effects	Deformation of the ground mass due to mining, including all mining-induced ground movements, such as vertical and horizontal displacement, tilt, strain and curvature.
Subsidence impacts	Physical changes to the ground and its surface caused by subsidence effects, including tensile and shear cracking of the rock mass, localised buckling of strata caused by valley closure and upsidence and surface depressions or troughs.
Stage 2	Narrabri Mine Stage 2 approved under PA 08_0144.
Stage 3	Narrabri Underground Mine Stage 3 Extension Project approved under SSD 10269.
Toe of batter	The portion of the footing at the front of the retaining wall/batter.
Total suspended solids (TSS)	A common measure used to determine suspended solids concentrations in a waterbody and expressed in terms of mass per unit of volume (e.g. milligrams per litre).
Tributary	A smaller watercourse, which discharges into a larger watercourse.
Turbidity	A measure used to determine the cloudiness or haziness of a liquid (typically water) that is caused by particles typically invisible to the naked eye.
Watercourse	A river, creek or other stream, including a stream in the form of an anabranch or tributary, in which water flows permanently or intermittently, regardless of the frequency of flow events: In a natural channel, whether artificially modified or not, or in an artificial channel that has changed the course of the stream. It also includes weirs, lakes and dams.
Water sharing plan	Legislated plans under the *Water Management Act 2000* that establish rules for sharing water between the environment and water users. Water licences are issued to water users in accordance with water sharing plans.

11. Review history

Revision	Comments	Author	Authorised by	Date
0A	Approved by Department of Planning and Environment on 5 October 2023	Onward Consulting	Manager HSE	29 November 2022

Appendix A - Consultation records

Department of Planning and Environment

Our ref: OUT22/13626

Brent Baker

Manager HSW – Narrabri Coal Operations

Whitehaven Coal
Locked Bag 1002
Narrabri NSW 2390

Email: [redacted]

24 August 2022

Subject: Narrabri Underground Mine Stage 3 Extension Project – Water Management Plan (SSD-10269-PA-18)

Dear Mr Baker

I refer to your request for advice sent on 19 July 2022 to the Department of Planning and Environment (DPE) Water about the above matter.

The Department of Planning and Environment- Water recommends that the risk identification and assessment in the Surface Water Management Plan and the Trigger Action Response Plan (TARP) better address geomorphic risks; and the performance targets for private bores be more clearly defined.

Please note more detailed information in Attachment A.

Should you have any further queries in relation to this submission please do not hesitate to contact DPE Water Assessments at [redacted]

Yours sincerely,

Mitchell Isaacs
Chief Knowledge Officer
Department of Planning and Environment: Water

Attachment A

Detailed advice regarding the Narrabri Underground Mine Stage 3 Extension Project – Water Management Plan (SSD-10269-PA-18)

1.0 Groundwater issues

1.1 Recommendation

That the proponent:

1 sets the proposed groundwater triggers for drawdown at private bores to a maximum of 2 metres for provision of 'make good' to apply, and

2 Clearly articulate the response procedure should the performance targets for drawdown at private bores as listed in Table 4-4 be exceeded in a given year.

1.2 Explanation

The WMP is generally well-structured and provides the relevant information as required in the various statutory requirements. The proponent has reconciled DPE Water groundwater recommendations to include the nominated trigger levels, complaints resolution process and several additional monitoring bores including one along the eastern edge of the Stage 3 mining operations. A nominated process for collation of baseline data for new monitoring infrastructure prior to establishing performance targets is presented.

However, one minor issue of note requires further detail. The performance targets established for private bores as listed in Table 4-4 are not clearly articulated with the appropriate text. Clear interpretation is required of when the 'make good' provision would apply. This should include consideration of the 2 metre criteria in the Aquifer Interference Policy (AIP) criteria and identification of the stage when the action and response procedure is triggered if nominated targets are presenting a drawdown threshold for a given year.

Several of the private bores listed in '*Table 4-4 Private bore proposed groundwater level triggers*' of the Groundwater Management Plan have nominated groundwater level triggers that exceed the 2 metre AIP 'minimal impact consideration' for drawdown before make good applies. Table 4-4 possibly presents the modelled drawdown to private bores year by year and the 'make good' would apply to any of those bores listed if the watertable decline exceeds 2m, however the messaging is not transparent at this stage. This needs to be reconciled to fulfil conditions B27-B30.

2.0 Surface water issues

2.1 Recommendation

That the proponent ensure that:

1. the risk identification and assessment section of the Surface Water Management Plan:
    a. include geomorphic risks resulting from increase tilt, strain induced cracking and consequential bed incision in watercourses crossing the underground mining footprint, and
    b. indicate which watercourses are more prone to incision and destabilisation.
2. the TARP include a section on geomorphic risk, with triggers to response and indicative mitigation measures should channel destabilisation occur due to mining-induced subsidence.

2.2 Explanation

The Surface Water Management Plan (SWMP) does not adequately identify risks to watercourses overlying the mining footprint. Although subsidence troughs are expected to increase ponding and out of bank flow, the greater concern is the potential for headward (upstream) bed incision and development or extension of knickpoints or headcuts. The risk of knickpoint migration is not addressed in section 3.2 of the SWMP.

Extension of knickpoints or development of headcuts creates risks of pool loss and increased rates of bank attack and erosion both within the mining footprint and for some distance upstream of the mine site. The likelihood of subsidence-induced channel deformation, bed slope increase and risk of knickpoint development should be included in the risk assessment section of the Surface Water Management Plan.

Section 4.5 includes a procedure for monitoring subsidence impacts on channel form, including baseline channel cross section, bankfull level and wetted perimeter and ongoing surveys of channel change. This is an expected commitment to address likely and potential subsidence effects that should have been identified in the risk assessment section of the Surface Water Management Plan.

The monitoring arrangements set out in Table 4-7 are adequate, considering the significance and sensitivity of the watercourses that overly the mining subsidence footprint. However, watercourse surveys and high resolution DEM surveys are only effective if risks have been identified for watercourse integrity and response actions or mitigation are set out in the TARPs. The monitoring arrangements should be justified based on site risk and likelihood of bed incision and destabilisation following mining subsidence.

There are no geomorphologic triggers, response or remedial measures included in Table 5-1 Trigger Action Response Plan. Geomorphic impacts should be incorporated into the table to indicate the reaches of watercourses that will have altered bed slopes following mining subsidence and likely effects of increased channel gradients.

The TARP must include actions and response measures to be implemented following channel surveys that indicate channel bed slopes have increased to mobilisation or incision thresholds using standard geomorphological analysis techniques. These measures must include assessment where any necessary bed control structure(s), bank reinforcement or other measures will be constructed and monitoring of the effectiveness of such measures.

End Attachment A

Table A-1 DPE Water consultation recommendations

Consultation feedback	Outcome	Document reference
1.0 Groundwater issues		
1.1 Recommendation That the proponent: **1.** Sets the proposed groundwater triggers for drawdown at private bores to a maximum of 2 metres for provision of 'make good' to apply, and **2.** Clearly articulate the response procedure should the performance targets for drawdown at private bores as listed in Table 4-4 be exceeded in a given year.	**1.** Table 4-4 of the GWMP (see excerpt below) provides the proposed groundwater level triggers for drawdown at private bores (i.e. maximum of 2 meters) for provision of the make good agreements. **Table 4-4 Yearly interim and 2m AIP groundwater level triggers for private bores (m AHD)**	Section 4.6.3 of the GWMP (Attachment 4 of the WMP)

Bore	2m drawdown trigger level	Predicted year 2m drawdown reached
WB10 (GW013858)	280.6	2092
WB11 (House Bore)	302.6	2300
WB12 (257_Bore)	222.4	2035
WB13 (GW008634)	305.2	2133
WB14 (GW026121)	284.6	2509
WB15 (Windmill Bore)	211.7	2051
WB16 (South Caloola)	244.1	2044
WB17 (GW903687 - Solar Bore)	212.0	2044
WB18 (Mentone Bore)	212.3	2028

Consultation feedback	Outcome	Document reference
	2. Section 4.6.3 has been updated to state: Interim yearly trigger values for the nine privately owned bores that have a predicted drawdown of more than 2m (adopted trigger levels m AHD) are presented in Table 4-4. The interim groundwater levels have been derived from the recalibrated numerical groundwater model (AGE 2020) based on the maximum predicted drawdown for each bore. The yearly trigger levels will be confirmed following collection of baseline groundwater level data over six to eight monitoring events. If a trigger level is exceeded for a given year, the TARP (section 5) will be initiated. If the drawdown meets or exceeds the 2 m AIP criteria, the 'make good' agreements will apply (refer to section 3.4).	
2.0 Surface water issues		
2.1 Recommendation That the proponent ensure that: **1.** the risk identification and assessment section of the Surface Water Management Plan: a. include geomorphic risks resulting from increase tilt, strain induced cracking and consequential bed incision in watercourses crossing the underground mining footprint, and b. indicate which watercourses are more prone to incision and destabilisation. **2.** the TARP include a section on geomorphic risk, with triggers to response and indicative mitigation measures should channel destabilisation occur due to mining-induced subsidence.	**1.** Section 3.2 of the SWMP has been renamed to 'Mine subsidence impacts' and includes detail on the predicted geomorphic impacts resulting from an increase in tilt and strain induced cracking. Section 3.2.1 'Channel geomorphology' has been added which provides detail on the watercourses which are prone to incision and stabilisation (refer to Table 3-2). Table 3-2 details the geomorphic risks specific to each watercourse. Additional minor amendments throughout section 3.2 have been made to better explain the risks identified. **2.** The TARP in section 5 of the SWMP has been updated to include a section on geomorphic risk (i.e. Changes in water course morphology). The section includes triggers to respond and actions required should changes in channel morphology occur.	Section 3.2, Section 3.2.1 and Section 5 of the SWMP (Attachment 3 of the WMP)

DOC22/640841

06 Sept 2022

Brent Baker
Environmental Superintendent
Whitehaven Coal Limited
Email: [redacted]

No Comment to Planning Advice Request

Dear Mr Baker

Thank you for the request for advice from the NSW Environment Protection Authority (EPA) on the Narrabri Underground Mine Stage 3 Extension Project – Water Quality Management Plan (SSD-10269-PA-18) at Whitehaven Coal Limited.

The EPA does not provide advice on, or endorsement of, any management plans developed for planning assessments. Accordingly, the EPA will not be providing further comment to this request.

If you have any questions about this request, please contact me on (02) 6773 7000 or via email at info@epa.nsw.gov.au.

Yours sincerely

REBECCA SCRIVENER
A/Manager Regional Operations
Regulatory Operations Regional West

Department of Planning and Environment

Our ref: SSD-10269-PA-18

Brent Baker
Manager HSE
Narrabri Coal Operations Pty Ltd
10 Kurrajong Creek Road
Baan Baa, NSW, 2390

05/10/2023

Subject: Narrabri Coal Stage 3 – Water Mangement Plan

Dear Mr. Baker

I refer to your submission, requesting review and approval of the Water Mangement Plan for the Narrabri Coal Stage 3 project. I also acknowledge your response to the Department's review comments and request for additional information.

I note the Water Mangement Plan has been prepared in consultation with DPE Water and EPA, and contains the information required by the conditions of approval.

The Department has carefully reviewed the document and is satisfied that it meets the requirements of the relevant conditions in development consent (SSD-10269).

Accordingly, as nominee of the Planning Secretary, I approve the Water Mangement Plan (Rev 0A, dated 29 November 2022). Please note, each of the sub plans associated with this Water Mangement Plan are being approved individually.

Please ensure you make the document publicly available on the project website at the earliest convenience.

If you wish to discuss the matter further, please contact Wayne Jones on (02) 6575 34056.

Yours sincerely

Stephen O'Donoghue
Director
Resource Assessments
as nominee of the Secretary

Appendix B - Compliance conditions relevant to this Plan

Table B-1 - SSD 10269 consent conditions relevant to this Plan

Condition	Requirement	Document reference
Obligation to minimise harm to the environment		
A1.	In addition to meeting the specific performance measures and criteria established under this consent, the Applicant must implement all reasonable and feasible measures to prevent, and if prevention is not reasonable and feasible, minimise, any material harm to the environment that may result from the construction and operation of the development, and any rehabilitation required under this consent.	Section 4 Section 6.2 Attachment 1 Attachment 2 Attachment 3 Attachment 4
Evidence of Consultation		
A20.	Where conditions of this consent require consultation with an identified party, the Applicant must: (a) consult with the relevant party prior to submitting the subject document; and (b) provide details to the Department of the consultation undertaken including: (i) the outcome of that consultation, matters resolved and unresolved; and (ii) details of any matters not resolved between the party consulted and the Applicant and how the Applicant has addressed the matters not resolved.	Section 1.4 Appendix A
Staging, combining and updating strategies, plans or programs		
A21.	With the approval of the Planning Secretary, the Applicant may:	
	(a) prepare and submit any strategy, plan or program required by this consent on a staged basis (if a clear description is provided as to the specific stage and scope of the development to which the strategy, plan or program applies, the relationship of the stage to any future stages and the trigger for updating the strategy, plan or program);	No staging of the WMP proposed
	(b) combine any strategy, plan or program required by this consent (if a clear relationship is demonstrated between the strategies, plans or programs that are proposed to be combined);	No combining of WMP with another plan proposed
	(c) update any strategy, plan or program required by this consent (to ensure the strategies, plans and programs required under this consent are updated on a regular basis and incorporate additional measures or amendments to improve the environmental performance of the development); and	Section 7.6
	(d) combine any strategy, plan or program required by this consent with any similar strategy, plan or program required by an adjoining mining consent or approval, in common ownership or management.	No combining of WMP with another plan proposed
Compliance		
A30.	The Applicant must ensure that all of its employees, contractors (and their sub-contractors) are made aware of, and are instructed to comply with, the conditions of this consent relevant to activities they carry out in respect of the development.	Section 2
Applicability of guidelines		
A31.	References in the conditions of this consent to any guideline, protocol, Australian Standard or policy are to such guidelines, protocols, Standards or policies in the form they are in as at the date of inclusion (or later update) in the condition.	Section 3.7

Condition	Requirement	Document reference
A32.	However, consistent with the conditions of this consent and without altering any limits or criteria in this consent, the Planning Secretary may, in respect of ongoing monitoring and management obligations, agree to or require compliance with an updated or revised version of such a guideline, protocol, Standard or policy, or a replacement of them.	
Water Supply		
B25.	The Applicant must ensure that it has sufficient water for all stages of the development, and if necessary, adjust the scale of the development to match its available water supply.	Attachment 1
B26.	The Applicant must report on water take at the site each year (whether direct or indirect and whether licensable or exempt) in the Annual Review, including water taken under each water licence. **Note:** Under the *Water Act 1912* and/or the *Water Management Act 2000*, the Applicant is required to obtain all necessary water licences for the development.	Section 7.2 Attachment 1
Compensatory Water Supply		
B27.	Prior to the commencement of development under this consent, the Applicant must notify owners of licensed privately-owned groundwater bores that are predicted to have a drawdown of greater than 2 metres as a result of the development. This notification must set out the terms whereby the Applicant proposes to give effect to landowner entitlements and the Applicant's responsibilities under conditions B28 to B32 (i.e. a 'make good' agreement).	Attachment 4
B28.	The Applicant must provide a compensatory water supply to any landowner of privately-owned land whose rightful water supply is adversely and directly impacted (other than an impact that is minor or negligible) as a result of the development, to the satisfaction of the Planning Secretary. The burden of proof that any loss of surface water or groundwater access is not due to mining impacts rests with the Applicant.	Attachment 3 Attachment 4
B29.	The compensatory water supply measures must provide an alternative long-term supply of water that is equivalent, in quality and volume, to the loss attributable to the development. Equivalent water supply will be provided as soon as practicable after commencement of development under this consent, unless otherwise agreed with the landowner.	Attachment 3 Attachment 4
B30.	If the Applicant is unable to provide an alternative long-term supply of water, then the Applicant must provide compensation, to the satisfaction of the Planning Secretary. **Notes:** • *The Water Management Plan (see condition B34) is required to include trigger levels for investigating potentially adverse impacts on water supplies.*	Attachment 3 Attachment 4
B31.	The Applicant must complete all measures that it is required to undertake under conditions B28 – B30 within two years of the date of commencement of development under this consent.	Attachment 3 Attachment 4
B32.	If the Applicant and a landowner cannot agree on whether the loss of water is to be attributed to the development or the measures to be implemented under conditions B28 – B31, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Planning Secretary for resolution.	Attachment 3 Attachment 4
Water Discharges		
B33.	The Applicant must ensure that all surface discharges from the site comply with all relevant provisions of the POEO Act, including any discharge limits (both volume and quality) set for the development in any EPL.	Attachment 1 Attachment 3
Water Management Performance Measures		

Condition	Requirement	Document reference
B34.	The Applicant must comply with the performance measures in Table 4.	Attachment 1 Attachment 2 Attachment 3 Attachment 4

Table 4: Water management performance measures

Feature	Performance measure
Namoi River	Negligible environmental consequences.
Namoi Alluvium	No subsidence impact or environmental consequence greater than predicted in the EIS.
Water management – general	• Maintain separation between clean, dirty (i.e. sediment-laden) and mine water management systems; • Minimise the use of clean and potable water on the site; • Maximise water recycling, reuse and sharing opportunities; • Minimise the use of make-up water from external sources; • Design, install, operate and maintain water management systems in a proper and efficient manner; and • Minimise risks to the receiving environment and downstream water users.
Erosion and sediment control works ^	• Design, install and maintain new erosion and sediment controls in accordance with the guidance series *Managing Urban Stormwater: Soils and Construction including Volume 1: Blue Book* (Landcom, 2004), *Volume 2A: Installation of Services* (DECC, 2008), *Volume 2C: Unsealed Roads* (DECC,2008), *Volume 2D: Main Road Construction* (DECC, 2008) and *Volume 2E: Mines and Quarries* (DECC, 2008). • Design, install and maintain any new infrastructure located within 40 metres of watercourses in accordance with the guidance series for *Controlled Activities on Waterfront Land* (DPI Water 2012); • Design, install and maintain any new creek crossings generally in accordance with the *Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management* (DPI 2013) and *Why Do Fish Need To Cross The Road? Fish Passage Requirements for Waterway Crossings* (NSW Fisheries 2003); and • Ensure all new works on waterfront land are consistent with the guidance series for *Controlled Activities on Waterfront Land (DPI Water, 2012)*.
Clean water diversions and storage infrastructure	Maximise as far as reasonable and feasible the diversion of clean water around disturbed areas on the site, except where clean water is captured for use on the site.
Sediment dams	Design, install and maintain sediment dams in accordance with the guidance *series Managing Urban Stormwater: Soils and Construction – Volume 1* (Landcom, 2004) and *2E Mines and Quarries* (DECC, 2008).
Chemical and hydrocarbon storage	Chemical and hydrocarbon products to be stored in bunded areas in accordance with the relevant Australian Standard.
Mine water discharges	Negligible environmental consequences beyond those predicted in the document/s listed in condition A2(c).
Treated water discharges	Discharges to the Namoi River are: • below 250 mg/l Total Dissolved Solids (50th percentile, all samples, volume based);

Condition	Requirement	Document reference
	• below 350 mg/l Total Dissolved Solids (all samples, volume based); and • pH between 6.5 and 8.5 (all samples).	
	Aquatic and riparian ecosystems: • Negligible environmental consequences beyond those predicted in the document/s listed in condition A2(c); and • Develop site-specific in-stream water quality objectives in accordance with the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ, 2000) and *Using the ANZECC Guidelines and Water Quality Objectives in NSW* (DEC, 2006), or its latest version.	
	^ *For these performance measures, 'new' means constructed after the grant of SSD 10269.*	
Water Management Plan		
B35.	The Applicant must prepare a Water Management Plan for the development to the satisfaction of the Planning Secretary.	Section 1.2
B36.	This plan must:	
	(a) be prepared by a suitably qualified and experienced person/s;	Section 1.4
	(b) be prepared in consultation with DPIE Water and the EPA;	
	(c) describe the measures to be implemented to ensure that the Applicant complies with the water management performance measures (see Table 4);	Attachment 1 Attachment 2 Attachment 3 Attachment 4
	(d) build on existing monitoring programs and utilise existing data from nearby mines, where practicable;	Attachment 3 Attachment 4
	(e) include a:	
	(i) **Site Water Balance** that includes details of:	Attachment 1
	• predicted annual inflows to and outflows from the site;	
	• sources and security of water supply for the life of the development (including authorised entitlements and licences);	
	• water storage capacity;	
	• water use and management on the site, including any water transfers or sharing with other industries;	
	• a program to regularly review modelling of the likelihood of uncontrolled discharges from the site;	
	• licensed discharge points and limits; and	
	• reporting procedures, including annual revision of the site water balance;	
	(ii) **Erosion and Sediment Control Plan** that:	Attachment 2
	• is consistent with the requirements of *Managing Urban Stormwater: Soils and Construction - Volume 1: Blue Book* (Landcom, 2004) and *Volume 2E: Mines and Quarries* (DECC, 2008);	
	• identifies activities that could cause soil erosion or generate sediment;	

Condition	Requirement	Document reference
	• describes measures to minimise soil erosion and the potential for the transport of sediment to downstream waters;	
	• describes the location, function, and capacity of erosion and sediment control structures; and describes what measures will be implemented to maintain (and if necessary, decommission) the structures over time;	
	(iii) **Surface Water Management Plan** that includes:	Attachment 3
	• detailed baseline data on channel stability, water flows and water quality in the sections or parts of watercourses and/or water bodies potentially impacted by the development, including:	
	- formal records of creek flow conditions will be initiated at selected sites;	
	- stream and riparian vegetation health;	
	- channel stability (geomorphology); and	
	- water supply for other surface water users;	
	• a detailed description of the surface water management system;	
	• details of any proposed discharges of treated water to the Namoi River, including:	
	- measures for the continuous monitoring and recording of volumes of water discharged to the Namoi River; and	
	- a water quality monitoring program for discharged waters;	
	• consideration of alternatives to direct measurement or prediction of creek flows to support surface water take licensing;	
	• details of the proposed metering, monitoring and modelling measures;	
	• detailed plans, design objectives and performance criteria for water management infrastructure including:	
	- any approved creek diversions or restoration works associated with the development;	
	- water run-off diversions and catch drains;	
	- erosion and sediment controls;	
	- any water storages, including mine water management systems; and	
	- reinstated drainage networks on rehabilitated areas of the site;	
	• surface water performance criteria, including trigger levels for identifying and investigating any potentially adverse impacts (or trends) associated with the development for;	
	- water supply for other water users;	
	- channel stability;	
	- downstream surface water flows and quality;	

Condition	Requirement	Document reference
	- stream and riparian vegetation heath; and	
	- post-mining water pollution from rehabilitated areas of the site;	
	• a program to regularly review brine management and identify any beneficial use options for brine;	
	• treated water and mine water;	
	• a program to monitor and evaluate:	
	- compliance with the relevant performance measures listed in Table 4 and the performance criteria in this plan;	
	- controlled and uncontrolled discharges and seepage/leachate from the site;	
	- surface water inflows, outflows and storage volumes, to inform the Site Water Balance; and	
	- the effectiveness of the surface water management system and the measures in the Erosion and Sediment Control Plan;	
	- reporting procedures for the results of the monitoring program, including notifying other water users of any elevated results; and	
	- a trigger action response plan to respond to any exceedances of the performance measures, and repair, mitigate and/or offset any adverse surface water impacts of the development, including measures to provide compensatory water supply to any affected water user under condition B26 of this Schedule; and	
	(iv) **Groundwater Management Plan** that includes:	Attachment 4
	• detailed baseline data of groundwater levels, yield and quality for groundwater resources potentially impacted by the development; including groundwater supply for other water users;	
	• measures to identify relationships between measured electrical conductivity and total dissolved solids in mine water and groundwater in the Hoskissons Seam and adjoining aquifers;	
	• a monitoring program for groundwater dependent ecosystems which may be impacted by the development, including (but not limited to) mapped 'high priority' features on the Namoi River floodplain, Tulla Mullen Creek and Little Sandy Creek and the Mayfield, Hardys and Eather Springs;	
	• a detailed description of the groundwater management system;	
	• details of the proposed metering, monitoring and modelling measures;	
	• groundwater performance criteria, including trigger levels for identifying and investigating any potentially adverse groundwater impacts (or trends) associated with the development (including for brine reinjection), on	

Condition	Requirement	Document reference
	- regional and local aquifers (alluvial and hardrock); and	
	- groundwater supply for other water users such as licensed privately-owned groundwater bores;	
	• implementation of the IAPUM's recommendations concerning installation of multilevel piezometer nests above longwalls 111, 203 and 204;	
	• a program to monitor and evaluate:	
	- compliance with the relevant performance measures listed in Table 4 and the performance criteria of this plan;	
	- water loss/seepage from water storages into the groundwater system;	
	- groundwater inflows, outflows and storage volumes, to inform the Site Water Balance;	
	- the hydrogeological setting of any nearby alluvial aquifers and the likelihood of any indirect impacts from the development;	
	- the effectiveness of the groundwater management system;	
	- the impact of any brine re-injection on salt concentrations in surrounding aquifers, for a period of 10 years following any such re-injections or such other period as required by the Planning Secretary;	
	• reporting procedures for the results of the monitoring program, including notifying other water user of any elevated results;	
	• a trigger action response plan to respond to any exceedances of the relevant performance measures and groundwater performance criteria, and repair, mitigate and/or offset any adverse groundwater impacts of the development;	
	• regular review of the groundwater model for the development, including:	
	- review within two years from the commencement of longwall mining under this consent and every five years thereafter throughout the life of the development (unless the Planning Secretary agrees otherwise) in consultation with DPIE Water;	
	- during the first review, consideration of all comments received regarding the groundwater model included in the EIS from DPE Water, the IESC and the IAPUM; and	
	- implementation of the IAPUM's recommendations which relate to review and development of the groundwater model (including that the five-year groundwater model review period be shortened to three years if greater than predicted impacts on groundwater are identified above the mine);	
	- independent peer review if requested by the Planning Secretary; and	
	- comparison of monitoring results with modelled predictions;	

Condition	Requirement	Document reference
	and	
	• a plan to respond to any exceedances of the performance measures; and	
	(v) a protocol to report on the measures, monitoring results and performance criteria identified above in the Annual Review.	
B37.	The Applicant must not commence construction until the Water Management Plan is approved by the Planning Secretary.	Section 1.2
B38.	The Applicant must implement the Water Management Plan as approved by the Planning Secretary.	
Adaptive management		
E4.	The Applicant must assess and manage development-related risks to ensure that there are no exceedances of the criteria and performance measures in this consent. Any exceedance of these criteria or performance measures constitutes a breach of this consent and may be subject to penalty or offence provisions under the EP&A Act or EP&A Regulation. Where any exceedance of these criteria or performance measures has occurred, the Applicant must, at the earliest opportunity:	Section 4 Section 6.2 Section 7.2
	(a) take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur;	
	(b) consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Department describing those options and any preferred remediation measures or other course of action; and	
	(c) implement reasonable remediation measures as directed by the Planning Secretary.	
	to the satisfaction of the Planning Secretary.	
Management Plan requirements		
E5.	Management plans required under this consent must be prepared in accordance with relevant guidelines, and include:	
	(a) summary of relevant background or baseline data;	Attachment 1 Attachment 2 Attachment 3 Attachment 4
	(b) details of:	
	i) the relevant statutory requirements (including any relevant approval, licence or lease conditions);	Section 3
	ii) any relevant limits or performance measures and criteria; and	Section 1.3
	iii) the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;	Attachment 1 Attachment 2 Attachment 3 Attachment 4
	(c) any relevant commitments or recommendations identified in the document/s listed in condition A2(c);	Section 3.1.1 Appendix C
	(d) a description of the management measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;	Attachment 1 Attachment 2

Condition	Requirement	Document reference
		Attachment 3 Attachment 4
	(e) a program to monitor and report on the:	
	i) impacts and environmental performance of the development; and	Section 4
	ii) effectiveness of the management measures set out pursuant to paragraph (d);	Attachment 1 Attachment 2 Attachment 3 Attachment 4
	(f) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	Section 5 Attachment 1 Attachment 2 Attachment 3 Attachment 4
	(g) a program to investigate and implement ways to improve the environmental performance of the development over time;	Section 7.7
	(h) a protocol for managing and reporting any:	
	i) incident, non-compliance or exceedance of any impact assessment criterion or performance criterion;	Section 6.1 Section 6.2
	ii) complaint; or	Section 8
	iii) failure to comply with other statutory requirements;	Section 6.2
	(i) public sources of information and data to assist stakeholders in understanding environmental impacts of the development; and	Section 3.7 Section 9
	(j) a protocol for periodic review of the plan.	Section 7.6
E6.	The Applicant must ensure that management plans prepared for the development are consistent with the conditions of this consent and any EPL issued for the site.	Section 3.1.1 Section 3.2.1 Appendix B
Revision of strategies, plans and programs		
E7.	Within three months of the:	Section 7.6
	a) submission of an incident report under condition E9 or E10;	
	b) submission of an Annual Review under condition E11;	
	c) submission of an Independent Environmental Audit under condition E13;	
	d) approval of any modification of the conditions of this consent (unless the conditions require otherwise); or	
	e) notification of a change in development phase under condition A14,	
	the suitability of existing strategies, plans and programs required under this consent must be reviewed by the Applicant.	
E8.	If necessary, to either improve the environmental performance of the development, cater for a modification or comply with a direction, the strategies, plans and programs required under this consent must be revised, to the satisfaction of the Planning Secretary. Where revisions are required, the revised document must be submitted to the Planning Secretary for approval within six weeks of the review.	Section 7.6
	***Note**: This is to ensure strategies, plans and programs are updated on a regular basis and to incorporate any recommended measures to improve the environmental performance of the development.*	

Condition	Requirement	Document reference
Incident notification		
E9.	The Applicant must immediately notify the Department and any other relevant agencies immediately after it becomes aware of an incident. The notification must be in writing via the Department's Major Projects Website and identify the development (including the development application number and name) and set out the location and nature of the incident.	Section 6.1
Non-compliance notification		
E10.	Within seven days of becoming aware of a non-compliance, the Applicant must notify the Department of the noncompliance. The Notification must be in writing via the Department's Major Projects Website and identify the development (including the development application number and name), set out the condition of this 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. ***Note**: A non-compliance which has been notified as an incident does not need to also be notified as a non-compliance.*	Section 6.2
Annual Review		
E11.	By the end of March in each year after the commencement of the development, or other timeframe agreed by the Planning Secretary, a report must be submitted to the Department reviewing the environmental performance of the development, to the satisfaction of the Planning Secretary. This review must: (a) describe the development (including any rehabilitation) that was carried out in the previous calendar year, and the development that is proposed to be carried out over the current calendar year; (b) include a comprehensive review of the monitoring results and complaints record of the development over the previous calendar year, including a comparison of these results against the: (i) relevant statutory requirements, limits or performance measures/criteria; (ii) requirements of any plan or program required under this consent; (iii) monitoring results of previous years; and (iv) relevant predictions in the document/s listed in condition A2(c); (c) identify any non-compliance or incident which occurred in the previous calendar year, and describe what actions were (or are being) taken to rectify the non-compliance and avoid reoccurrence; (d) evaluate and report on: (i) the effectiveness of the noise and air quality management systems; and (ii) compliance with the performance measures, criteria and operating conditions of this consent; (e) include an addendum report on Scope 1 and Scope 2 GHGE, which reports: (i) annual methane and annual total CO_{2-e} emissions (both categorised by source) and emissions intensity (based on ROM coal production); (ii) overall annual emissions intensity, benchmarked against representative industry sectors and the predictions in the EIS, and performance measures in Table 3; and (iii) measures undertaken to minimise Scope 1 and Scope 2 GHGE, including actions under condition B19, and estimated reductions in CO_{2-e} as a result of measures implemented; (f) identify any trends in the monitoring data over the life of the development;	Section 7.2

Condition	Requirement	Document reference
	(g) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and (h) describe what measures will be implemented over the next calendar year to improve the environmental performance of the development.	
E12.	Copies of the Annual Review must be submitted to the IAPUM (via the Department as Secretariat), NSC and GSC and regulatory agencies and made available to the CCC and any interested person upon request.	Section 7.2
Independent Environmental Audit		
E13.	Within one year of commencement of development under this consent, and every three years after, unless the Planning Secretary directs otherwise, the Applicant must commission and pay the full cost of an Independent Environmental Audit of the development.:	Section 7.5
E14.	Within three months of commencing an Independent Environmental Audit, or other timeframe agreed by the Planning Secretary, the Applicant must submit a copy of the audit report to the Planning Secretary, and any other NSW agency that requests it, together with its response to any recommendations contained in the audit report, and a timetable for the implementation of the recommendations. The recommendations must be implemented to the satisfaction of the Planning Secretary.	
Access to information		
E17.	Before the commencement of construction until the completion of all rehabilitation required under this consent, the Applicant must:	
	a) make the following information and documents (as they are obtained, approved or as otherwise stipulated within the conditions of this consent) publicly available on its website: i) the documents referred to in condition A2(c) of this consent; ii) all current statutory approvals for the development; iii) all approved strategies, plans and programs required under the conditions of this consent; iv) the proposed staging plans for the development if construction, mining operations or decommissioning is to be staged; v) minutes of CCC meetings; vi) regular reporting on the environmental performance of the development in accordance with the reporting requirements in any plans or programs approved under the conditions of this consent; vii) a comprehensive summary of the monitoring results of the development, reported in accordance with the specifications in any conditions of this consent, or any approved plans and programs; viii) a summary of the current phase and progress of the development; ix) contact details to enquire about the development or to make a complaint; x) a complaints register, updated monthly; xi) the Annual Reviews of the development; xii) audit reports prepared as part of any Independent Environmental Audit of the development and the Applicant's response to the recommendations in any audit report; xiii) any other matter required by the Planning Secretary; and	Section 1.5 Section 3 Section 6 Section 7 Section 8
	b) keep such information up to date, to the satisfaction of the Planning Secretary.	Section 1.5

Table B-2 - EPL 12789 conditions relevant to this Plan

Condition	Requirement	Document reference
Discharges to Air and Water and Applications to Land		
P1	**Location of monitoring/discharge points and areas** P1.3 The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.	Attachment 3 Attachment 4

EPA ID No.	Type of Monitoring Point	Type of Discharge Point	Location Description including NCOPL ID No.
11	Wet weather discharge Discharge water quality monitoring	Wet weather discharge Discharge water quality monitoring	Discharge point (SD4) on northern side of mine boundary.
13	Wet weather discharge Discharge water quality monitoring	Wet weather discharge Discharge water quality monitoring	Discharge point (SD2) on southern side of mine boundary.
14	Ambient Water Quality Monitoring		Upstream of mine discharge point on Kurrajong Creek Tributary 1 KC1US
15	Ambient Water Quality Monitoring		Downstream of mine discharge point on Kurrajong Creek Tributary 1 KC1DS
16	Ambient Water Quality Monitoring		Upstream of mine discharge point on Kurrajong Creek Tributary 2 KC2US
17	Ambient Water Quality Monitoring		Downstream of mine discharge point on Kurrajong Creek Tributary 2 KC2DS
18	Wet weather discharge Discharge water quality monitoring	Wet weather discharge Discharge water quality monitoring	Discharge point (SD7) on western side of mine boundary
19	Ambient Water Quality Monitoring		Upstream location of Kurrajong Creek (KCUS)

Condition	Requirement				Document reference
	20	Ambient Water Quality Monitoring		Downstream location of Kurrajong Creek (KCDS)	
	21	Ambient Water Quality Monitoring		Northern portion of mining area (PCa) in Pine Creek	
	22	Ambient Water Quality Monitoring		Monitoring point (PC1) in Pine Creek Tributary 1	
	24	Water Quality Monitoring	Water Quality Monitoring	Discharge point (NR1) at Namoi River	
	25	Ambient Water Quality Monitoring	Ambient Water Quality Monitoring	Discharge point (NRUS) at Namoi River	
	26	Ambient Water Quality Monitoring	Ambient Water Quality Monitoring	Discharge point (NRDS) at Namoi River	
	27	Wet weather discharge Discharge water quality monitoring	Wet weather discharge Discharge water quality monitoring	Discharge point (SD8) at Ventilation Shaft	
	28	Groundwater Monitoring Bore		P28	
	29	Groundwater Monitoring Bore		P29	
	30	Groundwater Monitoring Bore		P30	
	31	Groundwater Monitoring Bore		P31	
	32	Groundwater Monitoring Bore		P32	
	33	Groundwater Monitoring Bore		P33	
	34	Groundwater Monitoring Bore		P34	
	35	Groundwater Monitoring Bore		P58	

P1.4 Point W1 in the table, is identified in this licence for the purpose of monitoring of weather parameters at that point.

EPA identification number	Type of Monitoring Point	Description of Location
W1	Weather analysis	Weather station identified as "W1" on map titled EPL 12789 Monitoring Locations" dated 21/02/2017 - EPA DOC17/131971.

Limit Conditions		
L1	**Pollution of waters** L1.1 Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the *Protection of the Environment Operations Act 1997*.	Section 3.2 Attachment 3 Attachment 4

Condition	Requirement	Document reference
L2	**Concentration limits** L2.1 For each monitoring/discharge point or utilisation area specified in the table/s below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table. L2.2 Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges. L2.3 To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in L2.4. L2.4 Water and/or Land Concentration Limits	Attachment 3

Point 11, 13, 18, 27

Pollutant	Units of measure	50th percentile conc	90th percentile conc	3DGM conc limit	100th percentile conc
Oil and Grease	mg/L	-	-	-	10
TSS	mg/L	-	-	-	50

Point 11, 13, 18, 24, 27

Pollutant	Units of measure	50th percentile conc	90th percentile conc	3DGM conc limit	100th percentile conc
pH	pH	-	-	-	6.5-8.5

Point 24

Pollutant	Units of measure	50th percentile conc	90th percentile conc	3DGM conc limit	100th percentile conc
TDS	mg/L	250	-	-	350

L2.5 The TTS concentration limits specified for Points 11, 13, 18 and 27 may be exceeded for water discharged provided that:

a) the discharge occurs solely as a result of rainfall measured at the premises that exceeds 38.4 millimetres over any consecutive 5 day period immediately prior to the discharge occurring; and

b) all practical measures have been implemented to dewater all sediment dams within 5 days of rainfall such that they have sufficient capacity to store run off from a 38.4 millimetre, 5 day rainfall event.

Note: 38.4 mm equates to the 5 day 90%ile rainfall depth for Gunnedah sourced from Table 6.3a *Managing Urban Stormwater: Soils and Construction Volume 1*: 4th edition, March 2004.

Monitoring and Recording Conditions

M1	**Monitoring records** M1.1 The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition. M1.2 All records required to be kept by this licence must be: a) in a legible form, or in a form that can readily be reduced to a legible form;	Section 7.4 Attachment 3 Attachment 4

Condition	Requirement	Document reference
	b) kept for at least 4 years after the monitoring or event to which they relate took place; and c) produced in a legible form to any authorised officer of the EPA who asks to see them. M1.3 The following records must be kept in respect of any samples required to be collected for the purposes of this licence: a) the date(s) on which the sample was taken; b) the time(s) at which the sample was collected; c) the point at which the sample was taken; and d) the name of the person who collected the sample.	
M2	**Requirement to monitor concentration of pollutants discharged** M2.1 For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns: M2.3 Water and/or Land Monitoring Requirements	Attachment 3 Attachment 4

Point 11, 13, 18, 27

Pollutant	Units of measure	Frequency	Sampling Method
Conductivity	µS/cm	Special Frequency 1	In situ
Oil and Grease	mg/L	Special Frequency 1	Grab sample
pH	pH	Special Frequency 1	In situ
TOC	mg/L	Special Frequency 1	Grab sample
TSS	mg/L	Special Frequency 1	Grab sample

Point 14, 15, 16, 17, 19, 20, 21, 22

Pollutant	Units of measure	Frequency	Sampling Method
Conductivity	µS/cm	Special Frequency 2	In situ
Oil and Grease	mg/L	Special Frequency 2	Grab sample
pH	pH	Special Frequency 2 Special Frequency 3	In situ
TOC	mg/L	Special Frequency 2	Grab sample
TSS	mg/L	Special Frequency 2	Grab sample
TDS	mg/L	Special Frequency 3	Grab sample

Point 28. 29, 30, 31, 32, 33, 34, 35

Pollutant	Units of measure	Frequency	Sampling Method
Bicarbonate	mg/L	Quarterly	Representative sample
Calcium	mg/L	Quarterly	Representative sample
Carbonate	mg/L	Quarterly	Representative sample
Chloride	mg/L	Quarterly	Representative sample

Condition	Requirement	Document reference

Electrical Conductivity	µS/cm	Quarterly	In situ
Magnesium	mg/L	Quarterly	Representative sample
pH	pH	Quarterly	In situ
Potassium	mg/L	Quarterly	Representative sample
Sodium	mg/L	Quarterly	Representative sample
Standing Water Level		Quarterly	In situ
Sulfate	mg/L	Quarterly	Representative sample

M2.4 For the purposes of the table(s) above Special Frequency 1 means the collection of samples as soon as practicable after each discharge commences and in any case not more than 12 hours after each discharge commences.

M2.5 For the purposes of the table(s) above Special Frequency 2 means the collection of samples quarterly (in the event of flow during the quarter) at a time when there is flow and as soon as practicable after each wet weather discharge from points 11, 13,18 or 27 commences and in any case not more than 12 hours after each discharge commences.

M2.6 Note: Groundwater monitoring has not been formally included in the licence. However, the licensee is required to undertake groundwater monitoring in accordance with the Department of Planning and Environment approved "Stage 2 Water Management Plan" required under Schedule 4, condition 18 of the Project Approval (08_0144) for the Stage 2 project. The results of this monitoring are required to be reported in the Annual Review.

M2.7 For the purposes of the table(s) above Special Frequency 3 means the collection of samples as soon as practicable after each discharge commences from point NR1 and in any case not more than 4 hours after each discharge.

M3 — **Testing methods – concentration limits** — Attachment 3, Attachment 4

M3.2 Subject to any express provision to the contrary in this licence, monitoring for the concentration of a pollutant discharged to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication unless another method has been approved by the EPA in writing before any tests are conducted.

M4 — **Requirement to monitor weather** — Attachment 2, Attachment 3, Attachment 4

M4.1 For each monitoring point specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the parameter specified in Column 1. The licensee must use the sampling method, units of measure, averaging period and sample at the frequency, specified opposite in the other columns:

Point W1				
Parameter	**Units of measure**	**Frequency**	**Averaging Period**	**Sampling Method**
Rainfall	mm	Continuous	1 hour	AM-4
Wind speed @ 10 metres	m/s	Continuous	15 minute	AM-2 & AM-4
Wind direction @ 10 metres	°	Continuous	15 minute	AM-2 & AM-4
Temperature @ 2 metres	°C	Continuous	15 minute	AM-4

Condition	Requirement					Document reference
	Temperature @ 10 metres	°C	Continuous	15 minute	AM-4	
	Sigma theta @ 10 metres	°	Continuous	15 minute	AM-2 & AM-4	
	Solar radiation	W/m2	Continuous	15 minute	AM-4	
	Additional requirements - siting - measurement				AM-1 & AM-4 AM-2 & AM-4	
M5	**Record of pollution complaints** M5.1 The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies. M5.2 The record must include details of the following: a) the date and time of the complaint; b) the method by which the complaint was made; c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect; d) the nature of the complaint; e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and f) if no action was taken by the licensee, the reasons why no action was taken. M5.3 The record of a complaint must be kept for at least 4 years after the complaint was made. M5.4 The record must be produced to any authorised officer of the EPA who asks to see them.					Section 8
M6	**Telephone complaints line** M6.1 The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence. M6.2 The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.					Section 8
Reporting conditions						
R1	**Annual return documents** R1.1 The licensee must complete and supply to the EPA an Annual Return in the approved form comprising: 1. a Statement of Compliance, 2. a Monitoring and Complaints Summary, 3. a Statement of Compliance - Licence Conditions, 4. a Statement of Compliance - Load based Fee, 5. a Statement of Compliance - Requirement to Prepare Pollution Incident Response Management Plan, 6. a Statement of Compliance - Requirement to Publish Pollution Monitoring Data; and 7. a Statement of Compliance - Environmental Management Systems and Practices.					Section 7.1

Condition	Requirement	Document reference
	At the end of each reporting period, the EPA will provide to the licensee notification that the Annual Return is due. R1.2 An Annual Return must be prepared in respect of each reporting period, except as provided below. R1.3 Where this licence is transferred from the licensee to a new licensee: a) the transferring licensee must prepare an Annual Return for the period commencing on the first day of the reporting period and ending on the date the application for the transfer of the licence to the new licensee is granted; and b) the new licensee must prepare an Annual Return for the period commencing on the date the application for the transfer of the licence is granted and ending on the last day of the reporting period. R1.4 Where this licence is surrendered by the licensee or revoked by the EPA or Minister, the licensee must prepare an Annual Return in respect of the period commencing on the first day of the reporting period and ending on: a) in relation to the surrender of a licence - the date when notice in writing of approval of the surrender is given; or b) in relation to the revocation of the licence - the date from which notice revoking the licence operates. R1.5 The Annual Return for the reporting period must be supplied to the EPA via eConnect EPA or by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date'). R1.6 The licensee must retain a copy of the Annual Return supplied to the EPA for a period of at least 4 years after the Annual Return was due to be supplied to the EPA. R1.7 Within the Annual Return, the Statements of Compliance must be certified and the Monitoring and Complaints Summary must be signed by: a) the licence holder; or b) by a person approved in writing by the EPA to sign on behalf of the licence holder. **Note:** The term "reporting period" is defined in the dictionary at the end of this licence. Do not complete the Annual Return until after the end of the reporting period. **Note:** An application to transfer a licence must be made in the approved form for this purpose.	
R2	**Notification of environmental harm** R2.1 Notifications must be made by telephoning the Environment Line service on 131 555. R2.2 The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred. **Note:** The licensee or its employees must notify all relevant authorities of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act.	Section 6.1
R3	Written report R3.1 Where an authorised officer of the EPA suspects on reasonable grounds that:	Section 6.1

Condition	Requirement	Document reference
	a) where this licence applies to premises, an event has occurred at the premises; or b) where this licence applies to vehicles or mobile plant, an event has occurred in connection with the carrying out of the activities authorised by this licence, and the event has caused, is causing or is likely to cause material harm to the environment (whether the harm occurs on or off premises to which the licence applies), the authorised officer may request a written report of the event. R3.2 The licensee must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request. R3.3 The request may require a report which includes any or all of the following information: a) the cause, time and duration of the event; b) the type, volume and concentration of every pollutant discharged as a result of the event; c) the name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event; d) the name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort; e) action taken by the licensee in relation to the event, including any follow-up contact with any complainants; f) details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event; and g) any other relevant matters. R3.4 The EPA may make a written request for further details in relation to any of the above matters if it is not satisfied with the report provided by the licensee. The licensee must provide such further details to the EPA within the time specified in the request.	
R4.2	**Other reporting conditions** The licensee must submit to the EPA Armidale Office within 30 days of obtaining the quarterly groundwater sampling results (required under condition M2.3), a report that provides: 1. The quarterly ground water sampling results; and 2. Delineation of potential pollution sources and 3. A graph of the sampling results, inclusive of historical results, that allows visualisation of the trends over time being shown by sample results.	Attachment 4
Pollution studies and reduction programs		
U2	**Ground water characterisation and leak detection** U2.1 For EPL monitoring points 28, 29, 30, 31, 32, 33 and 34, the licensee must submit as part of their annual return, a groundwater monitoring report that includes and is not limited to: 1. An annual review and summary of quarterly findings from the ongoing groundwater sampling occurring on the premises and 2. A delineation of potential groundwater pollution sources. This report must be submitted as part of the annual return.	Attachment 4

Appendix C - Key EIS commitments

Table C-1 - Key EIS water management commitments

Source	Aspect	Details	Reference
Groundwater			
EIS Section 6.4.3	Namoi Alluvial Bore	Water will be extracted from NCOPL's existing alluvial bore located adjacent to the Namoi River during periods when required (e.g. when supply from the underground mining area is insufficient to meet the mines water demands, and sufficient allocation from the Namoi River [i.e. utilising NCOPL's existing Namoi River pump] is unavailable.	Attachment 1 Attachment 4
EIS Section 6.4.3	Namoi Alluvial Bore	NCOPL's bore is located within the Upper Namoi Zone 5 groundwater source (within the WSP for the Namoi Alluvial Groundwater Sources). Water will be extracted in accordance with the relevant WALs held by NCOPL and the rules prescribed in the WSP.	Attachment 1 Attachment 4
EIS Section 6.4.3	Namoi Alluvial Bore	All extraction from the alluvial bore will be conducted in accordance with the licensed entitlements issued by DPIE – Water, and in accordance with the rules in the relevant WSP.	Attachment 1 Attachment 4
EIS Section 6.4.4	Groundwater Licensing	Entitlements will be transferred from other Whitehaven operations to cover Stage 3 requirements for the Gunnedah Oxley Basin MDB. In the event NCOPL is not able to obtain sufficient entitlements from other Whitehaven operations, there is sufficient market depth in the Gunnedah Oxley Basin MDB Groundwater Source.	Attachment 1 Attachment 4
EIS Section 6.4.4	Groundwater Licensing	For the predicted licensing requirements in the Lower Namoi Groundwater Source, NCOPL will seek and obtain the appropriate entitlements on the open market in accordance with the appropriate trading rules of the *Water Sharing Plan for the Namoi Alluvial Groundwater Sources 2020*.	Attachment 1 Attachment 4
EIS Section 6.4.4	Groundwater Licensing	At the completion of Stage 3, relevant entitlements will be surrendered to account for groundwater take post-mining in accordance with the AIP.	Attachment 1 Attachment 4
EIS Section 6.4.4	Groundwater Licensing	Reporting of the water quality results from the monitoring network will be included in the Annual Review. The Annual Review will consider if any additional monitoring sites are required, or if optimisation of the existing monitoring sites, frequency of sampling and analytical suite will be undertaken.	Section 7.2 Attachment 4
EIS Section 6.4.4	Groundwater Monitoring	The recommendations of the Groundwater Assessment (Appendix B), in regard to the continuation of groundwater monitoring, will be adopted for Stage 3. In addition, consistent with the recommendations made by AGE, NCOPL will establish additional groundwater monitoring locations in the vicinity of Pine, Kurrajong and Tulla Mullen Creeks (or tributaries) (locations will be confirmed in consultation with relevant regulatory agencies and landowners).	Attachment 4

Source	Aspect	Details	Reference
EIS Section 6.4.4	Groundwater Monitoring - Groundwater Levels	Groundwater monitoring will be undertaken in accordance with the Water Management Plan (NCOPL, 2017a) (or the latest approved version) and Extraction Plans for Narrabri Mine. The current monitoring regime involves monthly measurement of water levels in piezometers, and continuous automated monitoring of water levels from the network of VWPs.	Attachment 4
EIS Section 6.4.4 BDAR Section 6.2.22	Groundwater Monitoring - Groundwater Levels	Ongoing monitoring will also be used to assess the extent and rate of drawdown and depressurisation against model predictions.	Attachment 4
EIS Section 6.4.4	Groundwater Monitoring - Groundwater Levels	Reporting of the water level results from the monitoring network will be included in the Annual Review. The reporting will include comparison to climate trends and surface water monitoring results to identify changes in the surface water and groundwater interactions (e.g. comparison of groundwater levels to rainfall and estimated recharge). The Annual Review will also identify if any improvements are required to the monitoring network, or if optimisation of the existing monitoring sites will be undertaken.	Attachment 4
EIS Section 6.4.4	Groundwater Monitoring - Groundwater Quality	Groundwater quality sampling will continue to be conducted to monitor groundwater quality during operations and post-mining in accordance with the Water Management Plan (NCOPL, 2017a) (or the latest approved version) and Extraction Plans for Narrabri Mine. The current monitoring regime includes monthly sampling of piezometers (EC and pH), as well as annual sampling for a broader suite of parameters. Monthly sampling and analysis of water from the box cut sump will continue for Stage 3 (or as otherwise described in the Water Management Plan [NCOPL, 2017a] [or the latest approved version]).	Attachment 4
EIS Section 6.4.4	Groundwater Monitoring - Groundwater Inflow	NCOPL will implement continuous monitoring of TDS, pH and temperature of groundwater inflows (e.g. via monitoring at the box cut sump). In addition, the current monthly analysis of water from the box cut sump will continue for Stage 3.	Attachment 1 Attachment 4
EIS Section 6.4.4	Numerical Model Review	The numerical model developed and used for the Groundwater Assessment (Appendix B) will be used as a management tool for the periodic review and validation of predicted groundwater impacts through the life of Narrabri Mine. The validity of the groundwater model predictions will: • be assessed from time to time, and if the data indicates significant deviation from the model predictions, an updated groundwater simulation model will be developed. • the groundwater simulation model will also be recalibrated at the frequency described in the Water Management Plan (NCOPL, 2017a) (or the latest approved version). • the results of the groundwater monitoring program will assist to refine any future numerical	Attachment 4

Source	Aspect	Details	Reference
		models.	
EIS Section 6.4.4	Numerical Model Review	Revised outputs from the numerical model will be reported periodically over the life of Narrabri Mine and incorporated into reviews of the site water balance.	Attachment 4
EIS Section 6.4.4 Submissions Report Section 4.1.1	Make Good Provisions	NCOPL has committed to 'make good' provisions for affected groundwater users. Appropriate make good provisions for a Project-related drawdown greater than 2 m at a groundwater bore may include: • deepening the affected groundwater bore (including lowering pump set and/or provision of new pump set and power supply if required); • construction of a new groundwater bore (including provision of a new pump set and power supply if required); and/or • provision of an alternative water supply of suitable quality and quantity. These contingency measures will be assessed on a case-by-case basis (i.e. including an assessment of the bore details and viability of any proposed measures), and implemented in consultation with the affected landholder and relevant regulators prior to drawdown exceeding the AIP minimal harm criterion.	Attachment 4
EIS Section 6.4.4 Submissions Report Section 4.1.1	Make Good Provisions	Ongoing groundwater monitoring, as well as any updates to the groundwater model, will also be used to confirm the predicted drawdown at these bores. Any groundwater monitoring at the bores will be described in the Water Management Plan (subject to agreement with the landholder).	Attachment 4
EIS Section 6.4.5	Adaptive Management	Monitoring locations, methods, trigger levels and contingencies relating to groundwater will be detailed in an update of the Water Management Plan and Extraction Plans for Narrabri Mine. In the event that groundwater monitoring identifies an exceedance of an established trigger, NCOPL will implement a response plan in accordance with the Water Management Plan.	Attachment 4
EIS Section 6.4.5	Adaptive Management	In the event that water levels deviate significantly from those predicted by the groundwater model, a suitably qualified hydrogeologist will undertake a review to determine the reason for this deviation. The review will consider the impact of mining and other factors that could result in declining water levels, including climatic conditions, rainfall recharge and pumping from privately-owned bores and/or nearby operations.	Attachment 4
Submissions Report Section 4.2.1	Validation of actual groundwater take and licensing and predictions	NCOPL supports the development of a comprehensive water balance to directly measure groundwater take as it occurs at the underground operations to validate groundwater take predictions and to inform model updates and licence requirements.	Attachment 1 Attachment 4

Source	Aspect	Details	Reference
		Section 7 of the Surface Water Assessment (WRM, 2020) describes the water balance modelling undertaken for the Narrabri Mine operations. Water balance modelling has been continually refined and updated since mining operations commenced to incorporate changes in procedures and metered water data. The model is deemed by WRM to be suitably calibrated and sufficient to be used to define the volume of dewatered groundwater, separate from returned underground mine-filtered water. The process used to calculate these volumes (i.e. by analysing flow metre data for pumps into and out of the mine) is described in Section 5.5 of the Surface Water Assessment. NCOPL will continue collecting and metering all inflows and outflows and to use the water balance model to calculate the groundwater take.	
Submissions Report Section 4.2.1	Other licensing matters	NCOPL will report on water take at the site each year (direct and indirect) in the Annual Review.	Section 7.2 Attachment 1
Submissions Report Section 4.2.1	Other licensing matters	NCOPL will ensure that relevant nomination of work dealing applications for Water Access Licences proposed to account for water take by Narrabri Mine have been completed prior to the water take occurring.	Attachment 1 Attachment 4
Submissions Report Section 4.2.1	Numerical Model Review – groundwater level records	Further Quality Assurance checks carried out by NCOPL environmental staff during field data collection in the future will be described in the Stage 3 Water Management Plan.	Attachment 4
Submissions Report Section 4.2.1	Groundwater data quality assurance	The Water Management Plan will be updated to incorporate Stage 3. The Water Management Plan will include data quality assurance and control protocols and will consider comments provided.	Attachment 4
Submissions Report Section 4.2.1	Depth of cracking prediction	As discussed in Sections 5.2.11 and D 2.5.6.1 (in Appendix D) of the Groundwater Assessment (AGE, 2020) site-specific data, in the form of groundwater data for the nested monitoring facility (P57) installed above Longwall 108A, has already been used to estimate potential heights of fracturing and calibrate the groundwater model. Modelled hydraulic parameters in the A and D-Zones are, therefore, already constrained by site-specific data. Furthermore, as summarised in Section D 5 in Appendix D of the Groundwater Assessment, a range of possible alternative parameters for functions affecting both hydraulic conductivity and storage above longwall panels have been assessed as part of the predictive uncertainty analysis. Further data collection above future longwall panels is also proposed. Additional data from these further sites will be considered as part of future re-calibration of subsidence predictions.	Attachment 4
Submissions Report Section 4.2.1	Groundwater Monitoring - Groundwater Quality	As documented in Appendix E of the 2019 Annual Review (NCOPL, 2020b), groundwater samples taken from the Narrabri Mine are regularly tested to confirm arsenic and cobalt concentrations and are typically at or close to detection limits. Testing for antimony, molybdenum and selenium has not	Attachment 4

Source	Aspect	Details	Reference
		routinely been undertaken historically but will be added to the Stage 3 Water Management Plan following approval.	
Submissions Report Section 4.2.1	Additional monitoring recommendations	Installation of six additional nested VWP installations are proposed to the west, south and east of Narrabri Mine. The additional VWPs will be installed as soon as practicable, following determination of Stage 3 as part of the updated Water Management Plan.	Attachment 4
Submission Report Section 4.2.2	Cumulative impacts – Narrabri Gas Project	Majority of the predicted drawdown is due to Narrabri Mine. This will be confirmed by updates to the groundwater model, which will occur at regular intervals throughout Stage 3. Model updates will consider the latest groundwater monitoring data available at the time, therefore, model updates will have regard to any impacts that may be occurring at the time due to the operation of Narrabri Mine and Narrabri Gas Project.	Attachment 4
Submissions Report Section 4.2.3	Additional monitoring recommendations	In addition to the further VWP installations outlined above, NCOPL will assess the feasibility of using helium gas, or other tracers/indicators to investigate seam to surface connectivity above selected longwall panels.	Attachment 4
Surface Water			
EIS Section 6.5.3	Water Management System	Stage 3 will involve the use of the existing/approved water management infrastructure with minor augmentations and extensions, including the progressive developments of pumps, pipelines, water storages and other water management infrastructure.	Attachment 1 Attachment 3
EIS Section 6.5.3	Water Management System	The objectives and design criteria of Narrabri Mine site water management system will be to: • protect the integrity of local and regional water resources; • separate runoff from undisturbed, rehabilitated and mining-affected areas; • design and manage the system to operate reliably throughout the life of Narrabri Mine in all seasonal conditions, including both extended wet and dry periods; • provide water for use in mining and CHPP operations that is of sufficient volume and quality, including during periods of extended dry weather; • provide sufficient storage capacity in the system to store, treat and discharge runoff as required, including during periods of extended wet weather; and • maximise the re-use of water on-site.	Attachment 1 Attachment 3
EIS Section 6.5.3	Flow Regime - Changes in Contributing Catchment	Runoff from Narrabri Mine disturbance areas and areas under active rehabilitation will be captured in sediment dams and: • transferred to Narrabri Mine site water management system for re-use in mine operations;	Attachment 1 Attachment 3

Source	Aspect	Details	Reference
		and/or • controlled release via licensed discharge points, in accordance with the requirements of EPL 12789 following rainfall events that exceed sediment dam design capacity.	
EIS Section 6.5.3	Flow Regime - Changes in Contributing Catchment	Short-term sediment management measures will be implemented for exploration boreholes, pre-conditioning areas and gas management areas to minimise potential water quality impacts.	Attachment 2
EIS Section 6.5.3	Surface Water Quality	Sediment dams will continue to be dewatered following runoff events and will comply with EPL 12789 limits for wet weather discharges from licensed discharge points.	Attachment 1 Attachment 2 Attachment 3
EIS Section 6.5.3	Surface Water Quality	The controlled release of treated water, which will be undertaken in accordance with EPL 12789, will not adversely impact Namoi River water quality.	Attachment 1 Attachment 3
EIS Section 6.5.3	Namoi River Surface Water Extraction	Consistent with current practice, water will be preferentially extracted from the Namoi River in accordance with WALs held by NCOPL. When low or no-flow conditions in the Namoi River prevent the extraction of water from the river (or other circumstances such as the Namoi River pump station not being operational), groundwater will be extracted from NCOPL's bore to provide a supplementary water supply, in accordance with WALs held by NCOPL.	Attachment 1 Attachment 3
EIS Section 6.5.3	Namoi River Surface Water Extraction	Extraction from the Namoi River will be conducted in accordance with the licensed entitlements issued under the *Upper Namoi and Lower Namoi Regulated River Water Sources 2016*.	Attachment 1 Attachment 3
EIS Section 6.5.4	Subsidence Remediation	Despite the minor nature of potential reduction in catchment flows due to mine subsidence, the existing stream impact management measures (outlined in the Extraction Plan Water Management Plan [NCOPL, 2017[or the latest approved version]) will continue to be implemented for Stage 3.	Attachment 3
EIS Section 6.5.4	Subsidence Remediation	In addition, subsidence remediation of ponding areas will include: • ponding areas located in areas with no significant vegetation and the water quality of the ponded water is non-saline to be allowed to self-correct. • ponding areas located in areas with significant vegetation to be assessed and remedial measure (e.g. drainage) developed and implemented in consultation with the landholder and a suitably qualified specialist (e.g. hydrogeologist, geomorphologist).	Attachment 3

Source	Aspect	Details	Reference
EIS Section 6.5.4	Water Management Plan – Site Water Balance	Review and progressive refinement of the site water balance will continue annually over the life of Narrabri Mine to record the status of inflows, storage and consumption (e.g. usage, return water from co-disposal areas, dust suppression and filtered water releases or beneficial re-use) and to optimise water management performance.	Attachment 1
EIS Section 6.5.4	Water Management Plan - Erosion and Sediment Control Plan	The Erosion and Sediment Control Plan component of the Water Management Plan will be reviewed and updated for Stage 3 to identify measures to minimise soil erosion and transport of sediment off-site.	Attachment 2
EIS Section 6.5.4	Water Management Plan - Surface Water Monitoring Program	The existing surface water monitoring network will continue to be implemented for Stage 3. The network will include the installation of two additional receiving water monitoring sites recommended by WRM (2020) within MLAs 1 and 2, locations will be confirmed in consultation with relevant government agencies and landowners.	Attachment 3
EIS Section 6.5.4	Water Management Plan - Surface Water Monitoring Program	The site water monitoring network of sediment dams and sediment basins will continue to be implemented for Stage 3, in accordance with the Water Management Plan (NCOPL, 2017a) (or the latest approved version). In addition, the Southern Mine Water Storage will be included in the monitoring network.	Attachment 1 Attachment 3
EIS Section 6.5.4	Water Management Plan - Surface Water Monitoring Program	The suite of monitoring parameters will remain as per the approved Water Management Plan (NCOPL, 2017a) (or the latest approved version) with the addition of the following parameters to monitor the potential impacts of Stage 3 waste materials: • total alkalinity; • acidity; • sulphate; • As; • Co; • Mo; • Sb; and • Se. The frequency of monitoring will remain as per the approved Water Management Plan (NCOPL, 2017a) (or the latest approved version).	Attachment 3
EIS Section 6.5.4	Water Management Plan - Surface and	The Surface and Groundwater Response Plan and TARPs (NCOPL, 2017a; 2017c) will be reviewed and updated for Stage 3. The Surface and Groundwater Response Plan will describe any additional	Attachment 3

Source	Aspect	Details	Reference
	Groundwater Response Plan	measures and procedures that will be implemented over the life of Narrabri Mine to respond to any potential exceedances of surface water-related criteria and contingent mitigation compensation, and/or offset options if downstream private surface water users or riparian vegetation are adversely affected by Narrabri Mine.	
EIS Section 6.5.4	Water Management Plan - Permeate Discharge and Transfer Control and Monitoring Plan	Consistent with Schedule 4, Condition 13(d) of Project Approval 08_0144, a Permeate Discharge and Transfer Control and Monitoring Plan will be prepared to monitor potential Namoi River water quality impacts prior to commencing controlled releases to the Namoi River. In addition, NCOPL will investigate options for the beneficial re-use of excess water or underground injection of excess mine water.	Attachment 3
EIS Section 6.5.5	Adaptive Measures	As described in Section 6.5.4, the existing TARP for the Narrabri Mine (NCOPL, 2017a; 2017c) will be updated to incorporate Stage 3.	Attachment 3
EIS Section 6.5.5	Adaptive Measures	In addition, the Surface and Groundwater Response Plan will describe any additional measures and procedures that will be implemented over the life of Narrabri Mine to respond to any potential exceedances of surface water-related criteria and contingent mitigation, compensation, and/or offset options if downstream private surface water users or riparian vegetation are adversely affected by Narrabri Mine.	Attachment 3
BDAR Section 7.1	Lower Darling River aquatic ecological community	**Biodiversity Measure 1** The main impact of Narrabri Mine on biodiversity is clearance of vegetation and habitat. The purpose of a Vegetation Clearance Protocol is to minimise the impacts of clearing on vegetation and fauna present during clearing. The Vegetation Clearance Protocol will include, but not be limited to: • mine staff and contractors involved in vegetation clearance works will be made aware of clearing limits in the relevant Stage 3 approval documentation and of restricted access areas; • micro-siting of access tracks and other disturbance to minimise clearance of trees with hollows and drainage features (creeks); • the area cleared at any particular time will generally be no greater than that required to accommodate development needs for the following 12 months; • clearance authorisation process with final signoff for the areas to be cleared by the Environment Superintendent or delegate; • clear delineation of the areas to be cleared on the ground prior to clearing activities (e.g. paint, flagging tape and posts) and restriction of clearing to within these areas (signposts to alert personnel not to enter vegetation outside of the disturbance areas);	Attachment 2

Source	Aspect	Details	Reference
BDAR Section 7.2	Lower Darling River aquatic ecological community	**Biodiversity Measure 2** Surface disturbance areas associated with the Development Footprint will be rehabilitated and revegetated (when the surface facilities are no longer required or at the end of the mine life where no further ongoing beneficial use is identified). Mine components that will be progressively rehabilitated include goaf gas drainage infrastructure, service boreholes, access tracks and post drainage corridor and pre-conditioning area. Other mine components, such as the vents and services corridors, will typically be decommissioned following mine closure.	Attachment 2
BDAR Section 7.6	Lower Darling River aquatic ecological community	**Biodiversity Measure 6** The potential for localised Project-related channel erosion on Kurrajong Creek and other ephemeral creek lines has been assessed by WRM (2020) and will be managed using appropriate sediment and erosion controls.	Attachment 2
BDAR Section 7.7	Lower Darling River aquatic ecological community	**Biodiversity Measure 7** The Land Management Plan (ELA, 2019c) (or its latest approved version) provides a monitoring programme for creek lines for the purpose of monitoring changes to creek condition and triggering management actions, if required (e.g. stabilising damaged and eroded banks).	Attachment 2
BDAR Section 7.8	Lower Darling River aquatic ecological community	**Biodiversity Measure 8** Construction of drainage line crossings will be undertaken in accordance with the policy and guideline document of DPI-Fisheries NSW *Why do fish need to cross the road?* (Fairfull and Witheridge, 2003) as required by the Fisheries *NSW Policy and Guidelines for Fish Habitat Conservation and Management* (DPI, 2013). The waterways traversed by the Development Footprint are Class 3 (Minimal fish habitat) and Class 4 (Unlikely fish habitat) (Fairfull and Witheridge, 2003). Crossings will involve installation of fords or culverts.	Attachment 2
BDAR Section 7.13	Lower Darling River aquatic ecological community	**Biodiversity Measure 13** Remediation of mine subsidence effects (e.g. surface cracking and minor erosion). A preliminary assessment will be undertaken to minimise impact of remediation actions. Prior to any remediation of surface cracks, NCOPL will undertake a review of environmental impacts that may result from the remediation at the specific location and consider whether remediation of surface cracks is environmentally beneficial or if alternative methods of remediating the crack are warranted (e.g. without machinery). The review will consider, among other factors, avoidance of known locations of threatened flora species.	Attachment 2 Attachment 3

Attachment 1 - Site Water Balance

NARRABRI MINE

SITE WATER BALANCE

	NARRABRI MINE ENVIRONMENTAL MANAGEMENT SYSTEM	Document owner:	Environmental Superintendent
		Document approver:	Manager HSE
		Revision period:	Annually
		Revision:	0A
		Last revision date:	29 November 2022

WHC_PLN_NAR_ SITE WATER BALANCE

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1. Introduction

1.1 Background

The Narrabri Mine is an existing underground coal mining operation situated in the Gunnedah Coalfield, approximately 25 kilometres (**km**) southeast of Narrabri and approximately 60 km northwest of Gunnedah, within the Narrabri Shire Council (**NSC**) Local Government Area, in New South Wales (**NSW**). It is operated by Narrabri Coal Operations Pty Ltd (**NCOPL**), on behalf of the Narrabri Mine Joint Venture[1], which consists of two Whitehaven Coal Limited's (**WHC**) wholly owned subsidiaries, and other joint-venture partners.

The Narrabri Underground Mine Stage 3 Extension Project (**Stage 3**) involves a southern extension to the previously approved Stage 2 mining area (approximately 609 ha of additional surface development footprint) to gain access to additional areas of coal reserves within Mining Lease Application (**MLA**) 1 and 2, an increase in the mine life to 2044, and the development of supporting surface infrastructure[2].

1.2 Purpose and scope

This Site Water Balance (**SWB** or **Plan**) has been developed in accordance with the Stage 3 Extension Project State Significant Development (**SSD**) 10269 Conditions of Consent (**CoC**) B36(e)(i), the requirements of the NSW Water Group within the Department of Planning and Environment (**DPE Water**) and the Environment Protection Authority (**EPA**).

As required by CoC B38, NCOPL will implement the SWB as approved by the Planning Secretary. In accordance with CoC B37, NCOPL will not commence construction until this SWB is approved by the Planning Secretary.

This SWB forms Attachment 1 of the Narrabri Mine Water Management Plan (**WMP**), developed in accordance with CoC B35 to CoC B38.

1.3 Objectives

The objectives of this Site Water Balance are to:

- detail the predicted annual inflows to and outflows from the site;
- describe the measures to be implemented to ensure compliance with the water management performance measures in accordance with CoC B34;
- provide detail on the water sources and security of water supply for the life of mine (including authorised entitlements and licences);
- provide the water storage capacity;
- include detail on the water use and management on the site;
- include a program to regularly review modelling of the likelihood of uncontrolled discharges from the site;
- describe the process for annual revision of the Site Water Balance; and

[1] For full details on the joint venture ownership, refer to the introduction of the Environmental Management Strategy.

[2] For full detail on the background of the Narrabri Mine, refer to the overarching WMP.

- describe the measures to be implemented to ensure compliance with the water management performance measures.

1.4 Regulatory requirements

In accordance with CoC E5(b), Appendix A provides a summary of the relevant regulatory requirements relating to water management water and outlines the section of this document in which each of these conditions and commitments have been addressed.

In accordance with CoC E5(c), Appendix B provides a summary of the relevant commitments or recommendations within the Environmental Impact Statement **(EIS)** and outlines the section of the WMP (including sub-plans) in which each of these commitments have been addressed. These relevant commitments or recommendations include those as amended or added to by the:

- Applicant's Submission Report submitted 31 May 2021;
- Applicant's Amendment Report submitted 31 May 2021; and
- Applicant's final Biodiversity Development Assessment Report dated September 2021.

A detailed overview of the statutory requirements relating to water management is described in section 3 of the WMP.

1.5 Definitions

The terminology used within this SWB are defined in the WMP.

2. Baseline data

2.1 Climate

Long-term meteorological data for the region is available from nearby Bureau of Meteorology (**BoM**) meteorological stations and an on-site weather station. A summary of this data is provided in Table 2-1.

2.1.1 Rainfall and evaporation

Generally, the rainfall records indicate moderate-to-low seasonality, with higher rainfall being recorded in the summer months and lower rainfall in the winter months. The mean and median annual rainfalls at the Narrabri Mine are estimated at 603 millimetres (**mm**) and 597 mm, respectively. The mean monthly rainfalls vary during the year from a low of 35 mm in April to a high of 78 mm in January. The summer average monthly rainfalls (59 mm to 78 mm) are generally higher than the equivalent winter month rainfalls (37 mm to 47 mm).

The mean and median annual potential evaporation is estimated at 1,502 mm and 1,499 mm, respectively. Evaporation varies seasonally, with high evaporation rates occurring in the months between October and March. The potential evaporation rate during the summer months is greater (up to almost 3 to 4 times) than the evaporation rate during the winter months. In addition, average potential evaporation exceeds average rainfall for all months of the year.

2.1.2 Temperature

The data from the Narrabri West Post Office (Station 053030) indicates that temperatures in the vicinity of Narrabri Mine are warmest from December to February and coolest from June to August. Average daily temperatures are highest in January (average daily maximum of 33.8°C) and lowest in July (average daily minimum of 3.7°C).

2.1.3 Humidity

Relative humidity records from the Narrabri West Post Office (Station 053030) generally exhibit a uniform seasonal pattern for the period of record (1962 - 2002). The lowest morning (9.00 am) monthly average relative humidity was recorded in October (57 per cent) and the highest recorded in June (84%). The lowest afternoon (3.00 pm) monthly average relative humidity was recorded in October and December (37%) and the highest recorded in June (52%).

Table 2-1 Relevant meteorological data in the vicinity of Narrabri Mine

Period of record	Average monthly rainfall (mm)			Average monthly evaporation (mm)	Average daily temperature (°C)				Average monthly relative humidity (%)	
	Narrabri West Post Office (053030)	Boggabri Post Office (055007)	Narrabri Mine	SILO Data Drill[1]	Narrabri West Post Office (053030)		Narrabri Mine		Narrabri West Post Office (053030)	
	1891 - 2018	1884 - May 2020	2008-2020	1889-2020	1962-2002		2008-2020		1962-2002	
					Min	Max	Min	Max	9am	3pm
January	82.9	71.5	63.8	200	19.3	33.8	20.7	34.7	61	38
February	61.1	63.5	59.5	166	19.1	33.2	19.1	32.7	65	40
March	60.0	46.6	58.1	152	16.4	31.2	16.9	30.1	64	39
April	38.1	33.4	26.6	105	11.9	27.3	12.6	26.1	66	42
May	46.7	41.2	42.2	74	8.3	22.5	8.0	21.6	78	49
June	49.0	43.5	52.3	53	5.2	18.7	6.1	17.6	84	52
July	45.2	40.5	30.2	58	3.7	18.0	4.3	17.4	82	50
August	39.9	37.7	39.1	77	4.6	19.8	4.5	19.4	73	42
September	40.8	37.9	43.7	106	7.6	23.4	7.9	23.4	65	39
October	51.4	49.8	44.8	148	11.7	27.1	12.0	27.4	57	37
November	60.3	59.4	78.7	174	14.8	30.1	16.1	31.1	59	39
December	75.7	62.2	66.8	199	17.7	33.0	18.5	32.9	59	37
Annual average monthly	**54.3**	**48.9**	**50.5**	**126**	**11.7**	**26.5**	**12.2**	**26.2**	**68**	**42**
Annual average total	**651.1**	**587.2**	**605.8**	**1,502**	**-**	**-**	**-**	**-**	**-**	**-**

Source: Rainfall and evaporation data extracted from Appendix C of the Stage 3 EIS. Temperature and humidity data sourced from Narrabri West Post Office (BoM 2022)

[1] Scientific Information for Landowners. SILO is a database of Australian climate data from 1889 to the present. It provides daily meteorological datasets for a range of climate variables in ready-to-use formats suitable for biophysical modelling, research and climate applications.

3. Implementation and management

3.1 Water management system

3.1.1 Water management system objectives

The proposed water management strategy for the Narrabri Mine is based on targeted management of water from different sources based on anticipated water quality. Water categories on the site are outlined in Table 3-1.

Table 3-1 Water categories

Water Category	Description
External	Raw water imported to the Narrabri Mine from the Namoi River or the Namoi Bore.
Clean	Surface runoff from the Narrabri Mine site areas where water quality is unaffected by mining operations. Clean water includes runoff from undisturbed areas and any fully rehabilitated areas.
Permeate	Water treated by the reverse osmosis (**RO**) or microfiltration (**MF**) plants, suitable for use in the underground workings or controlled release to the Namoi River in accordance with environmental protection licence under the POEO Act (**EPL**) 12789.
Dirty water	Surface runoff water from Narrabri Mine site areas that are disturbed by mining operations. This runoff may contain silt and sediment, but does not contain other pollutants (e.g. chemicals, hydrocarbons). This water can be released from site in accordance with EPL 12789, if required.
Mine water	Water pumped from the underground workings and surface water from Narrabri Mine site areas affected by mining operations which has potentially been in contact with coal and other pollutants (e.g. chemicals and hydrocarbons). Mine water areas include sumps, coal stockpile areas, service ponds and fuel storage areas and is managed to avoid its discharge from the Narrabri Mine.
Brine	Water with elevated concentrations of total dissolved solids (**TDS**), a waste by-product or concentrate produced by the mine's water treatment plants.

The objectives of the Narrabri Mine water management system are to ensure:

- clean water runoff from undisturbed catchment areas is diverted away from the mining area, where practicable;
- dirty water is re-used in the water management system or released into the receiving environment if water quality meets EPL requirements;
- mine water (including water that accumulates within, or drains from, active mining areas, coal reject emplacement areas and Coal Handling Preparation Plant [**CHPP**] infrastructure areas) and groundwater collected within the underground is contained and reused on-site or licensed discharge to the Namoi River following appropriate treatment;
- no discharge of mine water or brine water off-site; and
- on-site water demands are satisfied whilst minimising external water requirements.

3.1.2 Water management system configuration

The current and forecast site catchment areas, land use and water management infrastructure within the Pit Top Area is shown in Figure 3-1.

Figure 3-2 shows a schematic representation of the water circuit for the Narrabri Mine water management system.

3.1.3 Water management system infrastructure

The current and forecast site catchment areas, land use and water management infrastructure within the Pit Top Area is shown in Figure 3-1. NCOPL will utilise the water storages within the Pit Top Area to capture dirty and mine water runoff as well as mine water pumped from the underground workings. Water contained in mine water dams is transferred to the water treatment facilities for treatment and/or re-used on-site (e.g. CHPP operations, washdown and/or dust suppression).

The permeate water and brine produced from the water treatment facilities is stored in the permeate and brine dams, respectively, prior to re-use. The permeate water is used in underground mining operations or transferred to the Namoi River for controlled release.

Brine is stored in the brine dams at the Pit Top Area and may be used for dust suppression on coal stockpiles. Evaporator spray systems are installed on the brine dam (Dam B2) to increase evaporation of brine in order to remove excess water from the site water management system. A seawater RO module is currently installed as an additional control measure to concentrate brine to reduce brine water inventory. Additional evaporator spray systems and increased water treatment plant capacity may be commissioned in the future as part of adaptive management of the mine water management system.

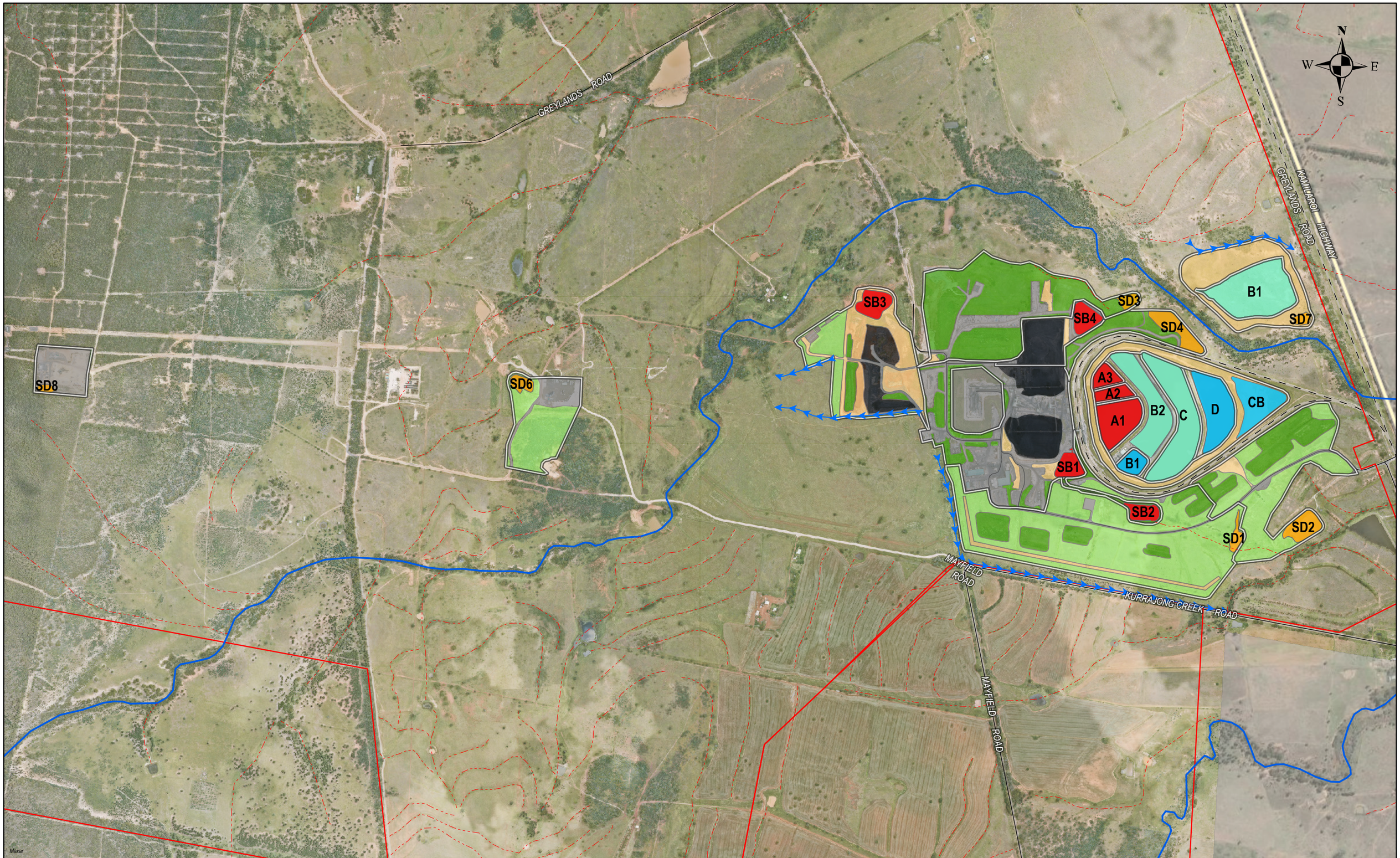
The Pit Top Area, mine water and brine dams have been designed to contain and re-use water on-site. This involves operating the dams with a maximum operating level to provide freeboard for storm runoff storage.

External water is used to supplement mining operations water demands and to supply a separate water treatment facility used to produce potable water. If required, potable water can also be transported via truck to the Narrabri Mine by a licensed contractor to supplement the potable water supply from the water treatment facility.

Water storages

The NCO site water management system includes storages for management of the on-site water types described in Table 3-1.

Details of the site water storages and operating rules are provided in Table 3-2.



Paper size A3

Scale: 1:15,000

150 0 150 300 450 600 750

Metres

Spatial Reference
Name: GDA 1994 MGA Zone 55
Datum: GDA 1994
Projection: Transverse Mercator

Legend

Roads
- Primary road
- Local road

Railways
- Railway - Tamworth

Hydrolines
- Minor streams
- Non-minor streams
- clean water drain

Existing Water Management System

Dam Type
- Brine Water
- Dirty Water
- Mine Water
- Raw Water

Catchments
- Narrabri Catchment

LandUse
- Coal/ Rejects
- Hardstand
- Disturbed Cleared
- Disturbed Veg
- Natural
- Rehab
- Narrabri mine lease

WHITEHAVEN COAL PTY LTD

Figure 3-1: NARRABRI WATER MANAGEMENT SYSTEM

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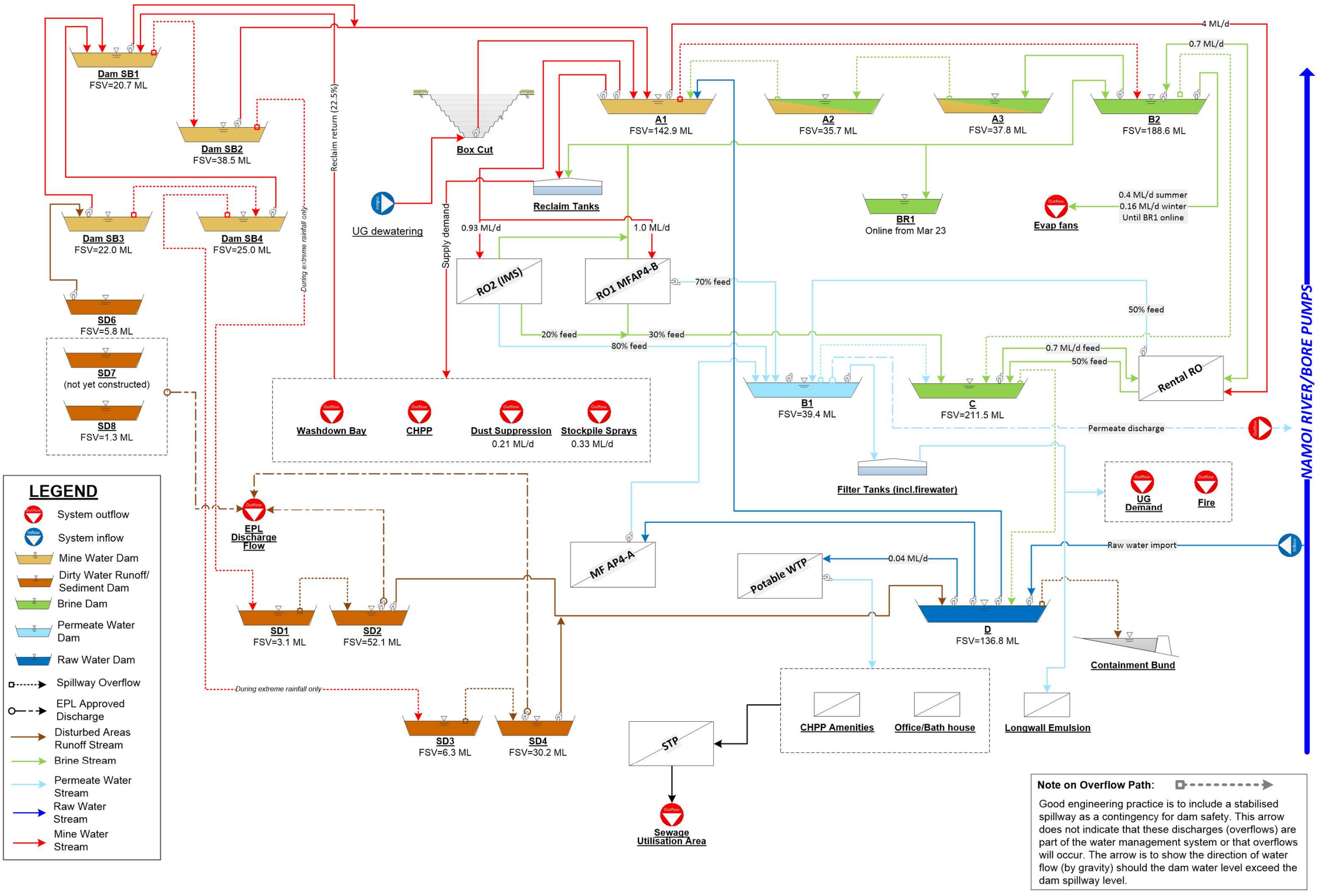


Figure 3-2 Narrabri Mine site water management schematic

Table 3-2 Water storage and transfers at the Narrabri Mine and operating rules

Water management system element	Storage capacity (ML)	Spills to	Operation
A1	142.9	B2	Operated as a mine water storage. Receives Box Cut and storage basin (**SB**) dam dewatering up to maximum operating volume (**MOV**).
A2	35.7	A1	Operated as a mine water storage. Does not receive active inflows above MOV. If needed, excess brine is diluted with mine water and stored for short periods.
A3	37.8	A2	Operated as a mine water storage. Does not receive active inflows above MOV. If needed, excess brine is diluted with mine water and stored for short periods.
B1	39.4	C	Permeate water storage. Receives RO permeate up to MOV.
B2	188.6	C	Brine water storage. Receives RO brine up to MOV.
C	211.5	D	Brine water storage. Receives excess RO brine from B2 up to MOV.
D	136.8	Containment Bund	Raw water storage. Receives excess RO permeate from B1 up to MOV.
Containment Bund	40.1	Offsite	Emergency excess raw water storage. Operated empty.
SB1	20.7	SB2	Pit top runoff dam. Dewatered to A dams when MOV exceeded.
SB2	38.5	SD1	Pit top runoff dam. Dewatered to A dams when MOV exceeded.
SB3	22.0	Offsite	Rejects Emplacement Area runoff dam. Dewatered to A dams via SB1 when MOV exceeded.
SB4	25.0	SD3	Pit top runoff dam. Dewatered to A dams via SB1 when MOV exceeded.
SD1	3.1	SD2	Dirty water storage, managed in accordance with EPL 12789.
SD2	52.1	Offsite	Dirty water storage, managed in accordance with EPL 12789.
SD3	6.3	SD4	Dirty water storage, managed in accordance with EPL 12789.
SD4	30.2	Offsite	Dirty water storage, managed in accordance with EPL 12789.
SD6	5.8	Offsite	Dirty water storage, managed in accordance with EPL 12789.
SD8	1.3	Offsite	Dirty water storage, managed in accordance with EPL 12789.
BR1	470	Offsite	New brine dam to be commissioned by March 2023. Receives RO brine up to 400 ML MOV. Receives brine once B2 and C are full to their respective MOVs

Additional approved mine water and brine dams

An additional approved water management storage dam (i.e. the Southern Mine Water Storage; see location in Figure 1-2 in the WMP) will be required directly south of Longwall 210 to store water from mine dewatering activities. A pipeline between the Southern Mine Water Storage area and the Pit Top Area will be installed to facilitate transfer of water. The pipeline/s will be installed within services corridors and other cleared areas.

NCOPL may progressively construct brine dams (BR2 to BR5) within the approved brine storage area located in the area to the north of BR1, which is currently under construction (Figure 3-1). The need for additional brine

storages and timing of commissioning will be assessed against the actual groundwater inflows and site water system performance over the life of mine.

Drains and pipelines

The water management system includes ancillary infrastructure to enable the transfer of water including sumps, drains, tanks, pumps, pipelines and associated power supply. Minor augmentations and extensions to this infrastructure will be progressively implemented.

Clean water management system

NCOPL will divert clean water where possible and practical around disturbed areas on the site. Clean water captured for use on the site will comply with the *Water Management Act 2000* (**WM Act**). This includes:

- the construction of clean and dirty water drains/banks or other drainage structures to divert sediment laden water from working areas to sediment controls and ensures separation of clean water from dirty water; and
- diversion of clean water catchment areas around area of disturbance that could generate dirty or contaminated water.

Table 3-2 details the operating rules for water storages and transfers to ensure dams are maintained below their MOV to prevent unauthorised spills to clean water catchments.

3.1.4 Treatment

Three RO plants are used to reduce the mine water and brine inventories on site during the operational period:

- RO1: 1 ML/d feed rate from A1 at 70% efficiency;
- RO2: 0.93 ML/d feed rate from A1 at 80% efficiency; and
- Seawater RO (interim measure): 0.7 ML/d feed rate from B2 or C at 50% efficiency.

The RO1 and RO2 modules are operated according to the following principles:

- The A series dam inventories are above the combined MOV, until the combined inventory drops to below 80% of the combined MOV; and
- The Brine dam inventories are less than the 80% of the combined Brine MOV.

The seawater module is operated according to the following principles:

- when the feed dam TDS concentration is less than 37,500 mg/L; and
- when the receiving dam inventory is less than the MOV.

The seawater module would be decommissioned once the BR1 Dam is commissioned in March 2023.

3.1.5 Potable water

Potable water may be transported to site by a licensed contractor as required to supplement the potable water supply from the water treatment facility.

3.1.6 Measures to minimise clean and potable water use

The beneficial use options assessment for brine, treated water, and mine water will be reviewed and revised in accordance with section 3.1.1 of the Surface Water Management Plan (**SWMP**) (Attachment 3 of the WMP). The scope of the assessment includes options for beneficial reuse of permeate/filtered water onsite and sharing with other water users. The beneficial use of brine, treated water, and mine water will facilitate the minimisation of clean and potable water use.

3.2 Water demands

The modelled water demands from the mine water management system include:

- Mine surface demands:
  - Run of Mine **(ROM)**/product stockpile sprays;
  - Dust suppression;
  - CHPP and washdown (Pit Top area demands);
- Underground permeate water demands:
  - Underground water demand;
  - Longwall emulsion and vent humidity loss;
- Fire water use; and
- Potable water use.

3.2.1 Mine demands

Mine water demand (CHPP, wash bay, stockpile sprays and surface water dust suppression) was assessed based on flow meter records from the mine site. At present the mine monitoring can track mine water demand for surface dust suppression and stockpile sprays separately (dust suppression demand determined by subtraction from flowmeter records) but cannot separate mine water demand between the CHPP and wash bay.

A percentage of the mine demand (CHPP, washdown and stockpile spray) returns to the water management system via SB1. Based on recorded data and calibration of the site water balance model it appears that 22.5% of the total mine demand is recycled into the site water management system via SB1.

Stockpile sprays

A demand of 0.33 megalitres per day (**ML/day**) was adopted for the ROM and product coal stockpile sprays based on the available Narrabri Mine site data.

Haul road dust suppression

Haul road dust suppression rates of 0.21 ML/day was adopted based on available Narrabri Mine site data.

Pit Top Area demands

A Pit Top Area runoff demand (CHPP and washdown) of 0.039 kilolitres per run-of-mine (**kL/ROM**) tonne was adopted based on available Narrabri Mine site data. The Pit Top Area water would be sourced from Dam A1.

This estimated consumption rate has been applied to the forecast ROM tonnages, and the resulting forecast Pit Top Area runoff demand is provided in Table 3-3.

Table 3-3 Annual pit top area and underground permeate demands

Year	ROM tonnage (Mtpa)	Gross Pit Top Area usage (ML/yr)	Gross underground permeate water use (ML/yr)
FY23	6.04	236	387
FY24	7.32	285	468
FY25	8.43	329	540
FY26	8.48	331	543
FY27	9.69	378	620

3.2.2 Underground permeate water use

A fraction of the underground permeate demand returns to the boxcut sump via underground dewatering, and is calculated as follows:

- Underground demand return = [underground permeate water demand + longwall emulsion] – [increase in coal moisture + vent humidity extraction];
- If the above result returns a negative number (i.e. losses exceed inflows) then there is no underground demand return for that day;
- The increase in coal moisture is based on an increase of 2% by mass from in-situ to ROM; and
- The vent humidity extraction is assumed to be 133 ML/yr (0.37 ML/day) based on calculations by NCO personnel.

There is a flowmeter recording the amount of permeate water that is gravity fed into the underground, and also a flowmeter that records the amount of water that is dewatered from the underground mine to the Box Cut sump. By using the above calculation and the flowmeter records, the volume of groundwater extracted from the underground mine can be estimated by subtraction.

Underground demand

An underground permeate water demand of 0.064 kL/ROM tonne was adopted based on recorded underground permeate water use and ROM coal production. This estimated consumption rate has been applied to the forecast ROM tonnages, and the resulting forecast underground permeate water usage is provided in Table 3-3.

Longwall emulsion and vent humidity loss

A constant longwall emulsion demand of 6.33 ML/yr (0.0175 ML/day) was adopted in the model, based on advice from NCO personnel.

A constant vent humidity loss of 133 ML/yr (0.37 ML/day) has been adopted in the water balance model.

3.2.3 Fire water use

A fire water demand of 1.747 kilolitres per day (**kL/day**) has been adopted for this assessment.

3.2.4 Potable water use

A potable water demand of 40 kL/day has been adopted for this assessment.

3.2.5 Evaporation fan losses

Four evaporation fans are operated on the B2 brine dam until the new BR1 brine dam is commissioned in March 2023. The fans have been modelled based on the following assumptions:

- 18 litres per second (**L/s**) combined feed rate;
- 8 hr per day operation; and
- 50% efficiency in summer months, 20% efficiency in winter months.

3.3 Water sources and security

Water inflows for the site include:

- direct rainfall on water surface of storages;
- catchment runoff from disturbed areas;
- groundwater inflows to underground;
- supplementary licensed extraction from the Namoi River and/or Namoi River alluvium (external water); and
- potable water transported to site by a licensed contractor, as required.

NCOPL will continue the use of the site water treatment facilities to treat water for supply to underground mining operations, site potable water requirements and licensed discharge to the Namoi River. The capacity of the water treatment facilities will be reviewed as part of the periodic review of the site water balance (section 6) and the capacity of the water treatment facilities may be adjusted as necessary.

Water will be preferentially sourced from groundwater inflows to underground workings and catchment runoff and infiltration. Supplementary water supply required over the life of mine will be sourced from the Namoi River and/or Namoi River alluvium in accordance with allocations in water licence entitlements (Table 3-4).

3.3.1 Water licensing

NCOPL will ensure sufficient water entitlements are held in a Water Access Licence (**WAL**) to account for the maximum predicted take for each water source, including the associated WAL dealings prior to take occurring.

Water sharing plans (**WSP**) relevant to the Narrabri Mine are:

- *WSP for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2020;*
- *WSP for the NSW Great Artesian Basin Groundwater Sources 2020;*
- *WSP for the Namoi Alluvial Groundwater Sources 2020;*
- *WSP for the Upper Namoi and Lower Namoi Regulated River Water Sources 2016;* and
- *WSP for the Namoi and Peel Unregulated Rivers Water Sources 2012.*

Details of the current WALs held by NCOPL for the Narrabri Mine are summarised in Table 3-4. The predicted annual volumes required to be licensed over the life of mine and post-mining, based on groundwater modelling and site water balance modelling, are also summarised in Table 3-4.

NCOPL holds sufficient licences to cover the predicted licensing requirements, with the exception of the following water sources:

- Gunnedah Oxley Basin Murray Darling Basin (**MDB**) Groundwater Source regulated by the *WSP for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2020*; and
- Lower Namoi Groundwater Source regulated by the *WSP for the Namoi Alluvial Groundwater Sources 2020*.

Licensing requirements for the *WSP for the Namoi and Peel Unregulated Rivers Water Sources 2012* (Eulah Creek Water Source) relating to subsidence induced water take is outlined in section 3.3 of the SWMP (Attachment 3 of the WMP).

For the predicted licensing requirements in the Lower Namoi Groundwater Source, NCOPL will seek and obtain the appropriate entitlements on the open market in accordance with the appropriate trading rules of the *WSP for the Namoi Alluvial Groundwater Sources Order 2020*. Based on recent water trading statistics, there is sufficient market depth in the Lower Namoi Groundwater Source to accommodate the very small allocation required.

To address the identified shortfall in the *Gunnedah-Oxley Basin MDB Groundwater Source*, allocation would be transferred from other Whitehaven operations to meet the operational requirements (refer to section 3.1.1 in the Groundwater Management Plan (**GWMP**) [Attachment 4 of the WMP]). Based on recent water trading statistics, there is sufficient market depth in Gunnedah Oxley MDB Groundwater Source in the event NCOPL is not able to obtain sufficient entitlements from other WHC operations.

Additional entitlements for the Gunnedah Oxley Basin MDB Groundwater Source may also be obtained via the controlled allocation order process. Under section 65 of the WM Act, the Minister for Water can make a controlled allocation order to make new entitlements available in water sources with unassigned water. Controlled allocation orders relevant to the Gunnedah Oxley Basin MDB Groundwater Source have been made in 2013, 2014, 2017 and 2020. There is approximately 181,528 megalitre per year (**ML/year**) of unassigned water in the Gunnedah Oxley Basin MDB Groundwater Source.

At the end of mining, relevant entitlements will be surrendered to account for groundwater take post-mining in accordance with the Aquifer Interference Policy (**AIP**).

Table 3-4 Water licensing summary for the Narrabri Mine

Water Sharing Plan	Water source (Management Zone)	Licence category	WAL number	Nominated works	Allocation (Unit Shares)	Entitlement (Unit Shares) held by NCOPL	Peak volume requiring licensing during mining (ML/year[1])	Peak volume requiring licensing post-mining (ML/year[1])	Estimated year to exceed entitlement
Groundwater									
NSW Murray-Darling Basin Porous Rock Groundwater Sources Order 2020	Gunnedah Oxley Basin MDB Groundwater Source	Aquifer	WAL 29549	90WA822539	818	1,221	2,310	2,310	2023
			WAL 43017[2]	- [2]	403				
NSW Great Artesian Basin Groundwater Sources 2020	GAB Southern Recharge Groundwater Source	Aquifer	WAL 15922	90WA822539	248	248	42	88	NA
Namoi Alluvial Groundwater Sources Order 2020	Upper Namoi Zone 5 Groundwater Source	Aquifer	WAL 12833	90WA812891	67	260	10	64	NA
			WAL 20131		150				
			WAL 12822		43				
	Lower Namoi Groundwater Source	Aquifer	-	-	Nil	Nil	0	1	> 2149
Surface water									
Upper Namoi and Lower Namoi Regulated Water Sources 2016	Lower Namoi Regulated River Water Source	Regulated River (High Security)	WAL 6762	90CA802130	20	20	44	193	NA
		Regulated River (General Security)	WAL 2671		48	658			
			WAL 2728		10				
			WAL 20152		600				

Note:

[1] Licensing requirement for groundwater includes direct pit inflows and induced leakage.

[2] NCOPL purchased 403 units of the Gunnedah Oxley Basin Groundwater Source and have submitted an application to assign nominated works to the WAL.

3.3.2 Groundwater inflows

Table 3-5 presents the adopted groundwater inflows to the mining pit, based on groundwater model predictions from the site groundwater model and adjusted for the purpose of site water balance forecasting. The adjustment is based on recorded data of groundwater extracted from the underground, which has historically indicated actual inflows are significantly lower than predicted. The groundwater model inflows are therefore considered conservative. The water balance model has used scaled back inflows which are less than the predicted inflows, but greater than the actual inflows. Therefore, the water balance model is still applying a conservative estimate to groundwater inflows and accounting for the potential increase in inflows over time. NCOPL will continue to license groundwater inflows as predicted in the groundwater model.

Table 3-5 Adopted groundwater inflows

Year	Groundwater inflow (ML/yr)
2022	668
2023	703
2024	754
2025	810
2026	883
2027	972

3.3.3 Catchment runoff

Rainfall runoff model

The Australian Water Balance Model (**AWBM**) (Boughton, 2004) was used to estimate daily runoff from daily rainfall. The AWBM is a saturated overland flow model which allows for variable source areas of surface runoff. The AWBM uses a group of connected conceptual storages (three surface water storages and one ground water storage) to represent a catchment. Water in the conceptual storages is replenished by rainfall and is reduced by evapotranspiration. Simulated surface runoff occurs when the storages fill and overflow.

The AWBM model uses daily rainfalls and estimates of catchment evapotranspiration to calculate daily values of runoff using a daily balance of soil moisture. The model has a baseflow component which simulates the recharge and discharge of a shallow subsurface store. Runoff depth calculated by the AWBM model is converted into runoff volume by multiplying by the contributing catchment area. The model parameters define the storage depths, the proportion of the catchment draining to each of the storages, and the rate of flux between them.

Catchment runoff was modelled using the AWBM rainfall-runoff model. Catchments across the site have been characterised into the following land use types:

- natural (undisturbed catchments, fully rehabilitated spoil and pre-strip areas).
- compacted (haul roads, pit floor, mine infrastructure).
- spoil (unrehabilitated overburden emplacement areas).

Catchment areas

Figure 3-1 shows the adopted catchments and land use. Catchment areas for each storage are shown in Table 3-6.

Table 3-6 Adopted catchment areas

Dam	Catchment area (ha)	Dam	Catchment area (ha)
A1	3.7	SB4	6.3
A2	1.1	SD1	43.3
A3	1.1	SD2	22.1
B1	1.1	SD3	25.1
B2	4.7	SD4	6.1
C	7.3	SD6	7.6
D	4.2	SD7	2.0
Containment bund	10.6	SD8	2.0
SB1	29.1	Box Cut	6.0
SB2	1.9	BR1	8.5
SB3	19.9		

3.3.4 External supplementary water supply

Make-up water demands will be met via licensed surface water extraction from the Namoi River and/or the Namoi alluvial production bore. Water will be extracted from NCOPL's existing alluvial bore located adjacent to the Namoi River during periods when supply from the underground mining area is insufficient to meet the mine's water demands, and sufficient allocation from the Namoi River (i.e. utilising NCOPL's existing Namoi River pump) is unavailable. NCOPL's bore is located within the Upper Namoi Zone 5 Groundwater Source (within the *WSP for the Namoi Alluvial Groundwater Sources Order 2020*).

External supplementary water from the Namoi River and/or the Namoi alluvial production bore will be extracted in accordance with the licensed entitlements allocated under the relevant WALs held by NCOPL (Table 3-4) and the rules prescribed in the WSP.

3.4 Discharge

Licensed discharge points and limits are outlined in section 4 of the SWMP (Attachment 3 of the WMP).

3.4.1 Mine water releases

In accordance with EPL requirements, no releases of mine water were simulated as part of the water balance. No overflow or release of mine water has ever occurred from the mine.

3.4.2 Dirty water releases

Controlled discharge from sediment dams to the receiving environment can occur from SD2, SD4, SD7 and SD8 if rainfall exceeds the design standard, in accordance with Condition L2.5 of EPL 12789.

3.4.3 Permeate water releases

Permeate produced by the water treatment plant that is surplus to requirements may be discharged to the Namoi River as required in accordance with Condition P1.3 of EPL 12789 as described in the SWMP (Attachment 3 of the WMP). The pipeline used for the transfer of water from the Namoi River to the mine will be modified to allow for water transfer in the opposite direction. Any discharge to the Namoi River will be directly from the RO plants, or from Dam B1 in accordance with the SWMP (Attachment 3 of the WMP).

The maximum discharge rate and volume to the river will limited by the capacity of the pipeline. Leak detection will be installed on the pipeline and discharge will be through a diffuser. An auto shut-off valve will be connected through remote process control linked to in-line pH and EC monitoring probes.

3.5 Water balance

The Goldsim water balance model was used to undertake a forecast simulation of the NCO site water balance under varying climatic conditions over the five-year period FY23 to FY27. The model simulates all major components of the water management system on a daily time step. The simulated inflows and outflows included in the model are provided in Table 3-7.

Climatic conditions were represented by extracting five-year periods of rainfall from the historical rainfall record which goes back to 1889. Each five-year climate sequence represented by the model is referred to as a “realisation”. The first realisation used recorded rainfall data from 1889 to 1894. The second realisation used data from 1890 to 1895, and so on. The historical rainfall record (1889 to 2022) provides 129 realisations.

Table 3-7 Simulated inflows and outflows to the mine water management system

Inflows	Outflows
Direct rainfall on water surface of storages	Evaporation from water surface of storages
Catchment runoff	Stockpile sprays
Groundwater inflows to underground	Dust suppression demand
External water supply	Pit Top area usage
Mine water return	Underground demand
Underground permeate water demand	Longwall emulsion and vent humidity loss
	Evaporation fan losses
	Permeate water-controlled release
	Fire water and potable demands
	Offsite release from storages

The Goldsim model was used to assess the performance of the proposed water management system, including:

- A dams combined inventory;
- Brine dam inventory;
- SB dam combined inventory;
- Box Cut inundation risk; and
- the overall water balance within the water management system.

Figure 3-2 shows the conceptualisation of the mine water management system adopted for the water balance model. Whilst the coal process water circuit was not explicitly modelled, the estimated net water demand from the CHPP was included in the model.

It is important to note that there is inherent uncertainty with respect to some components of the water balance (e.g. catchment yield/rainfall runoff, mining area groundwater inflows). Best estimates of these parameters have been adopted and these estimates will continue to be checked and refined against on-site observations as operations progress.

Long term daily rainfall and evaporation data for NCO was obtained from the SILO database (https://www.longpaddock.qld.gov.au/silo/) for the period January 1889 to December 2021 (133 years). Average monthly rainfall and evaporation are shown in Figure 3-3. Morton's lake evaporation was adopted to represent evaporation for the simulation of the site water balance.

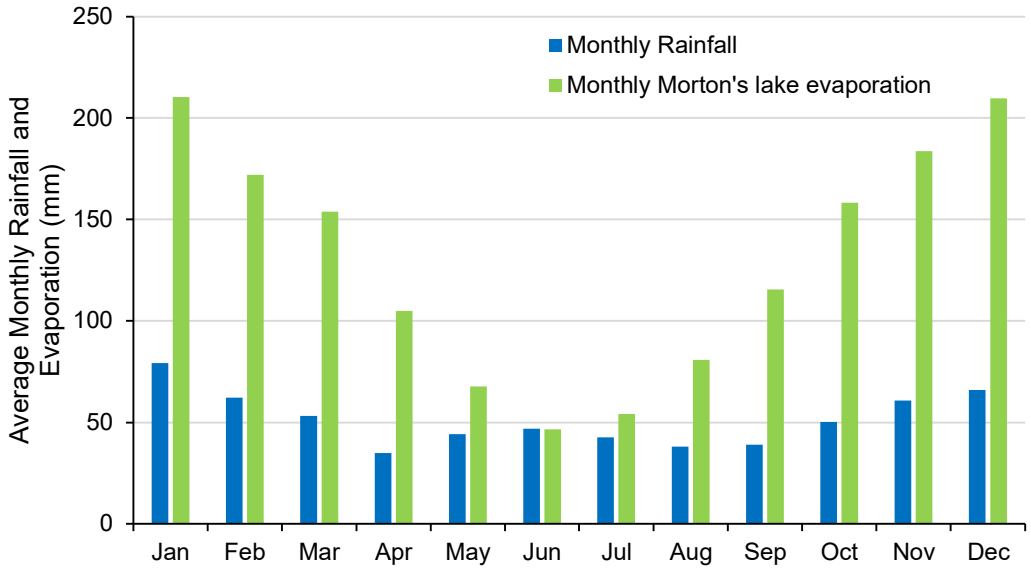


Figure 3-3 Average monthly rainfall and evaporation from SILO Database

3.5.1 Forecast simulation results interpretation

In interpreting the results of a forecast simulation, it should be noted that the results provide a statistical analysis of the water management system's performance over the 5-year forecast period, based on 129 realisations with different climatic sequences.

The model results are presented as a probability of exceedance. For example, the 10th percentile represents 10% probability of exceedance and the 90th percentile results represent 90% probability of exceedance. There is an 80% chance that the result will lie between the 10th and 90th percentile traces.

Whether a percentile trace corresponds to wet or dry conditions depend upon the parameter being considered. For site water storage, where the risk is that available capacity will be exceeded, the lower percentiles correspond to wet conditions. For example, there is only a small chance that the 1 percentile storage volume will be exceeded, which would generally correspond to very wet conditions.

For external site water supply volumes, where the risk is that insufficient water will be available, there is only a small chance that more than the 1 percentile water supply volume would be required. This would generally correspond to very dry climatic conditions.

It is important to note that a percentile trace shows the likelihood of a particular value on each day and does not represent continuous results from a single model realisation. For example, the 50th percentile trace does not represent the model time series for median climatic conditions.

Overall water balance

Water balance results from the 129 modelled realisations are presented in Table 3-8, for median climatic conditions. The results are the average of realisations and will include wet and dry periods distributed throughout the forecast period.

Rainfall yield for each year is affected by the variation in climatic conditions within the adopted climate sequence. It should be recognised that the following components of the water balance are subject to climatic variability:

- rainfall runoff;
- evaporation (including the enhanced evaporation from the evaporation fans, until the BR1 dam is commissioned in March 2023);
- imported water requirement; and
- site releases/spills.

Hence, actual values of these components of the water balance will vary from year to year and may be outside the range of simulated results.

The results show that, for a median climatic year:

- The average annual external water demand supplied from external licensed sources is approximately 61 ML/year and a peak demand of up to 150 ML/yr. The mine has sufficient licenses to account for the peak demand.
- Evaporation from dam water surfaces ranges between approximately 464 ML/year and 515 ML/year.
- Combined runoff and direct rainfall contribute between 368 ML/year and 482 ML/year.

Table 3-8 Annual water balance – all realisations (median climatic conditions)

Year	Annual water balance (ML/period)				
	FY23	FY24	FY25	FY26	FY27
Water inputs					
Direct rainfall + catchment runoff	368	417	482	425	460
External water supply	0	29	61	55	37
Underground inflow (groundwater inflow + mine water return)	773	867	975	1,088	1,171
Total inputs	**1,140**	**1,313**	**1,518**	**1,568**	**1,668**
Water outputs					
Evaporation (incl enhanced fan evaporation)	492	464	485	483	515
Total net mine water demand	301	336	374	407	409
Total net permeate water demand	314	387	469	539	543
Total net potable water demand	15	15	15	15	15
Total controlled permeate water release	69	7	2	0	2
Offsite release	4	34	65	91	34
Total outputs	**1,195**	**1,243**	**1,409**	**1,535**	**1,518**
Change in stored volume	**-54**	**70**	**109**	**33**	**150**

A Dams combined inventory

Figure 3-4 shows the forecast A series dam inventory for the reporting period. The following summary of results is provided:

- A1 would be the only mine water storage until the BR1 brine dam is commissioned in March 2023.
- The RO treatment rate would need to be upgraded before FY27, to account for the increasing groundwater inflows into the underground. For the purposes of this assessment, it is assumed that the RO2 feed rate would be increased by 50% to manage the system.
- For median (50%ile) climatic conditions and drier, the A series dam inventory would generally fluctuate around 80% of their MOV.
- The A series dam would reach their combined full storage volume (**FSV**) during 10%ile wet climatic conditions and spill to B2.

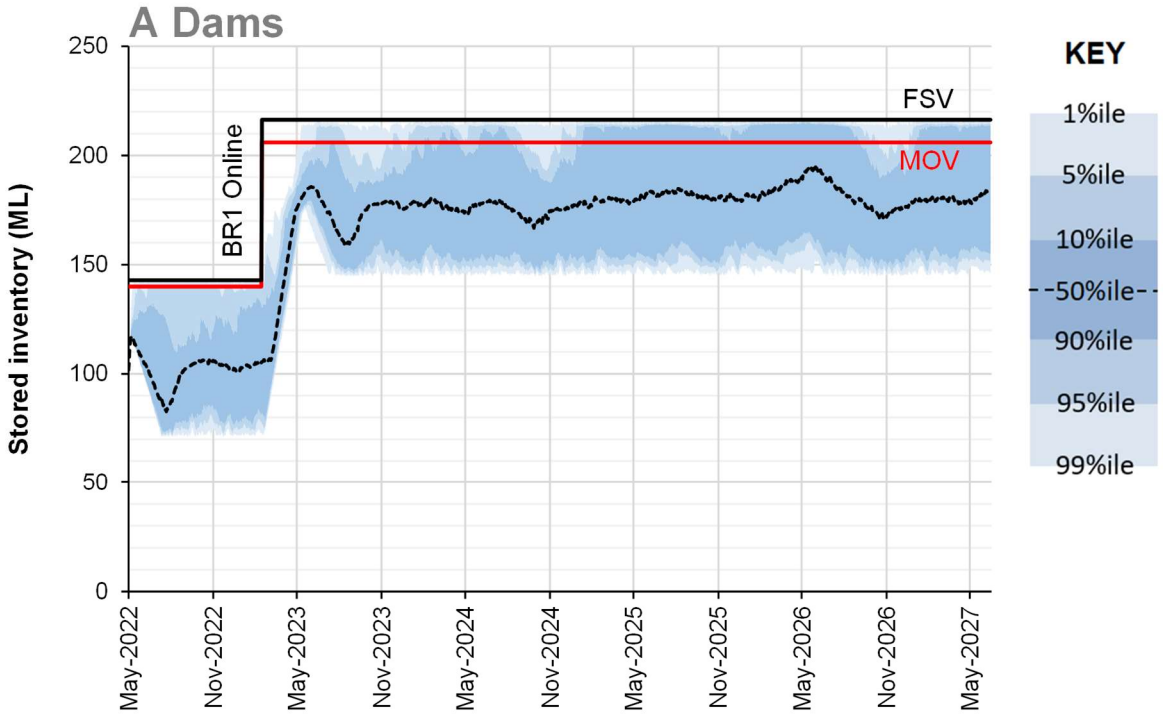


Figure 3-4 Forecast A Dams combined inventory

Brine Dam inventory

Figure 3-5 shows the forecast brine dam inventory for the reporting period. The following summary of results is provided:

- At the start of the simulation B2 and C are the principal brine water storages. After March 2023 BR1 will be operated as brine water once construction is complete.
- If needed, excess brine is diluted with Mine water and stored in A2 and A3 for short periods until the brine squeeze can reduce brine inventories.
- The combined brine water inventory would progressively decrease while the Seawater RO is online, until it is decommissioned in March 2023. Beyond this point, the brine inventory would steadily increase.
- BR1 will be commissioned by March 2023, to provide additional brine storage.
- During extreme wet climatic conditions, BR1 would store up to 400 ML by the end of 2026, which suggests that a new brine dam (i.e. BR2) may be required by 2027. The requirement for an additional brine dam will be re-assessed on an annual basis.

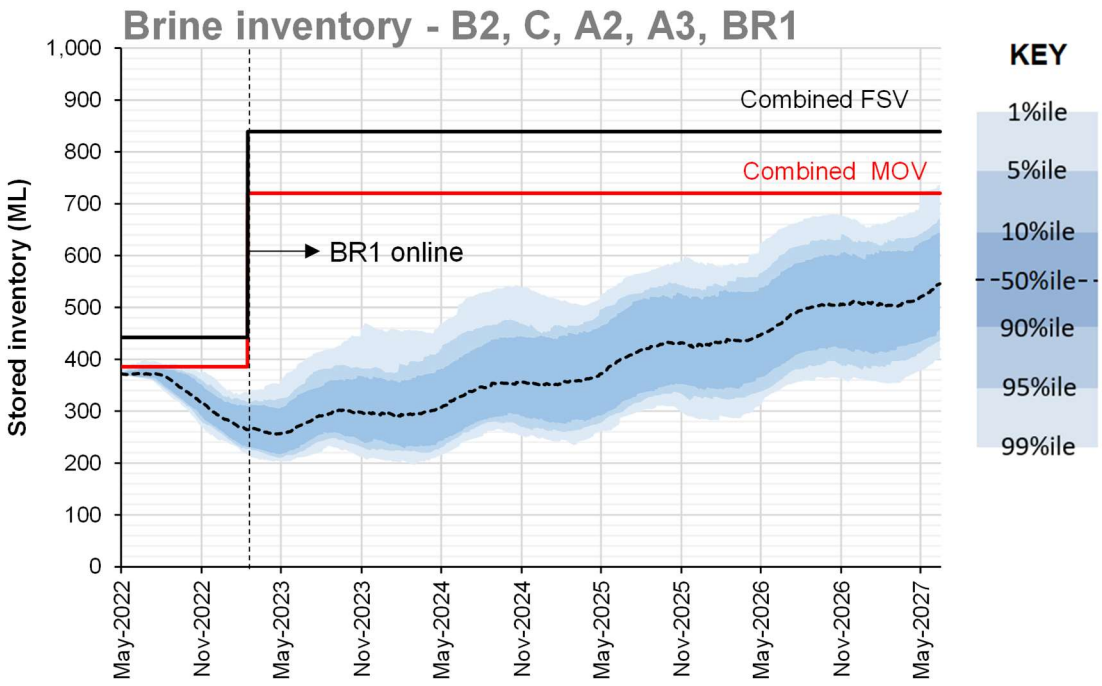


Figure 3-5 Forecast Brine Dam inventory

SB Dam combined inventory

Figure 3-6 shows the combined SB Dam inventory over the simulation, showing that the combined inventory would remain below the combined FSV and there are no forecast spills from the dam up to the 1% AEP.

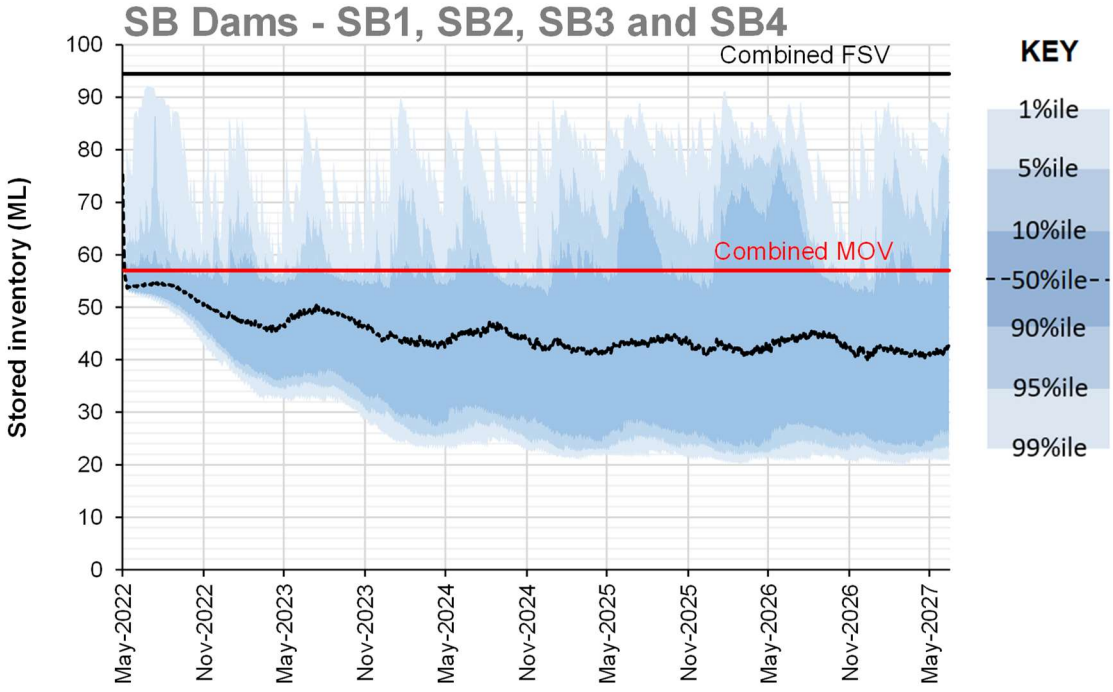


Figure 3-6 Forecast SB Dam combined inventory

Box Cut inundation risk

Figure 3-7 shows the Box Cut inundation risk, showing that the Box Cut may be inundated by up to 20 ML during extreme wet climatic conditions at the start of the simulation. This occurs due to the limited available capacity in the brine dams. There is no further modelled Box Cut inundation risk after BR1 is commissioned in March 2023.

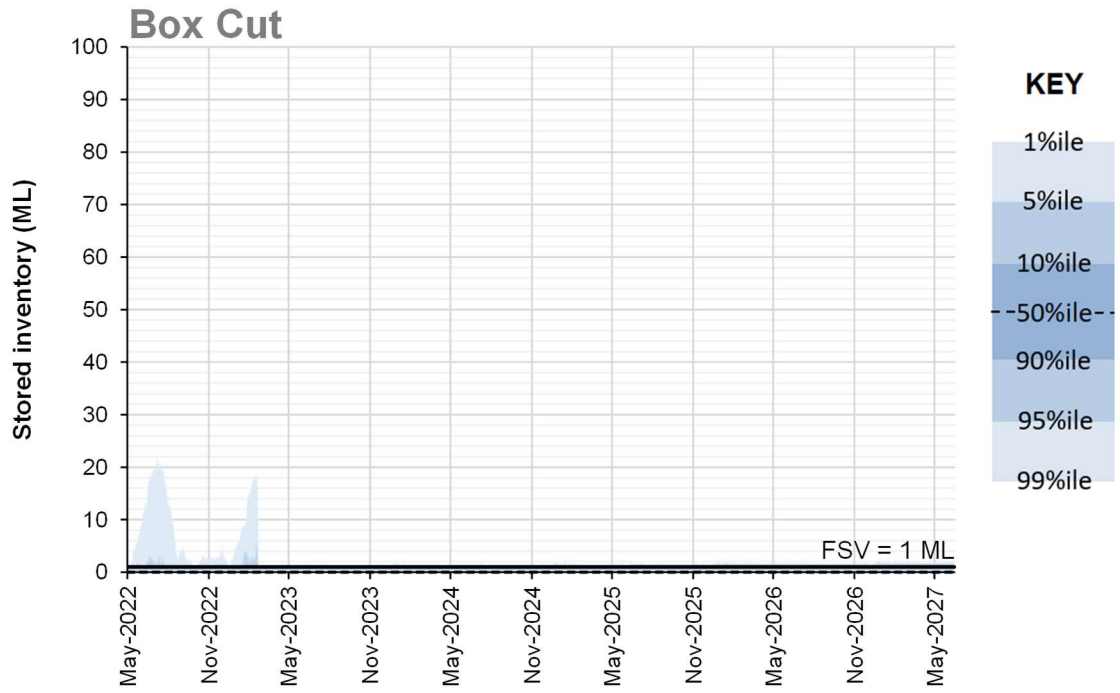


Figure 3-7 Forecast SB Dam combined inventory

Permeate and raw water combined inventory

Figure 3-8 shows the combined Permeate and Raw water dam inventory (including B1, D and the Containment Bund) across the simulation period. It shows that the combined inventory will be maintained below the combined MOV for the majority of climatic conditions, due to the ability to release permeate to the Namoi River.

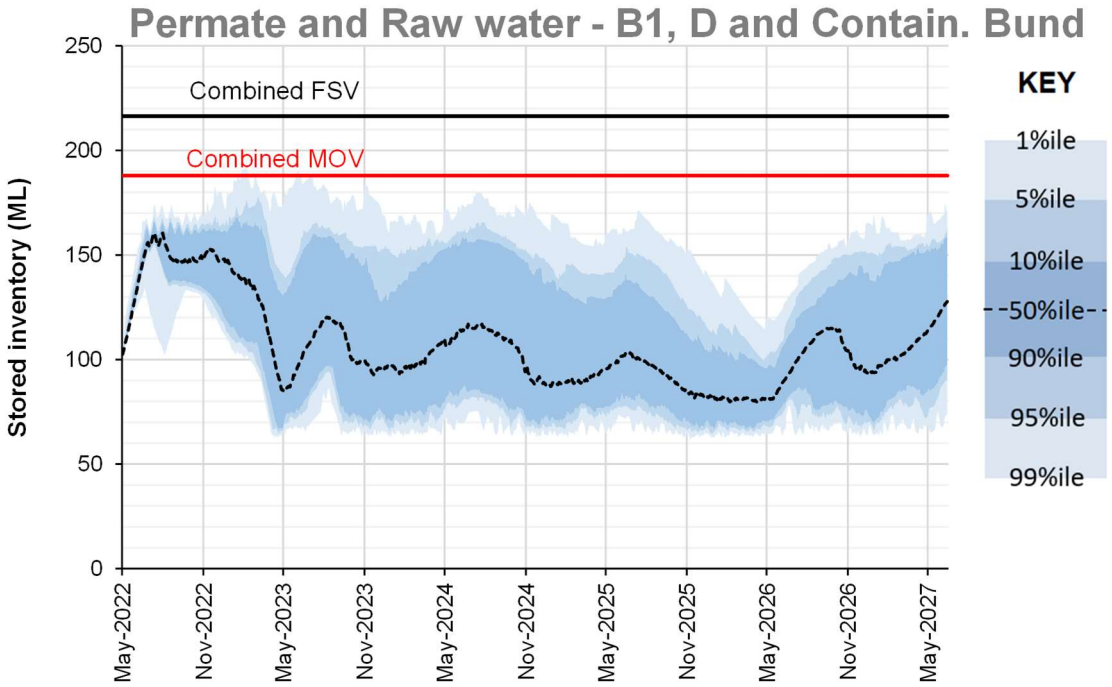


Figure 3-8 Forecast permeate and raw water inventory

Figure 3-9 shows the annual volumes of the permeate releases to the Namoi River. It shows that the requirement for permeate release would be highest in the first year of the simulation (up to 130 ML), after which it reduces significantly. The reduction corresponds with the increased production rates and permeate water demands.

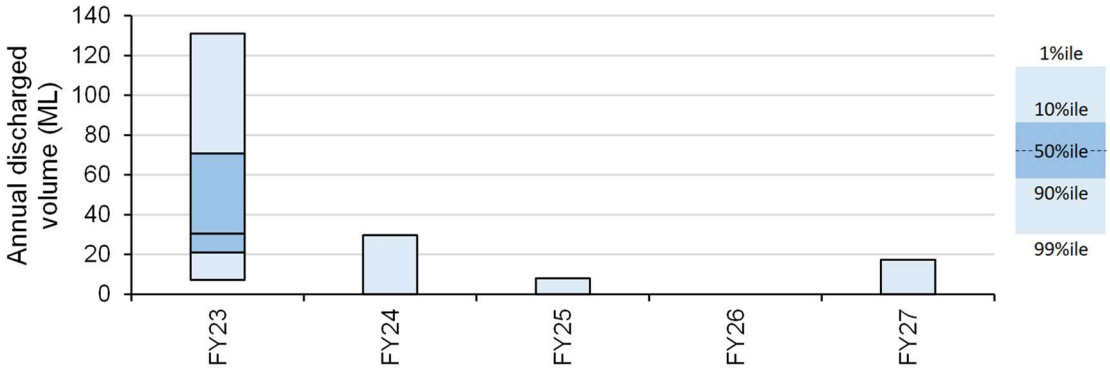


Figure 3-9 Forecast annual permeate release volumes to the Namoi River

External water requirements

Figure 3-10 shows the forecast annual (July-June) external water requirements from the Namoi River. It shows that during extreme dry conditions, up to 140 ML may be required in FY26.

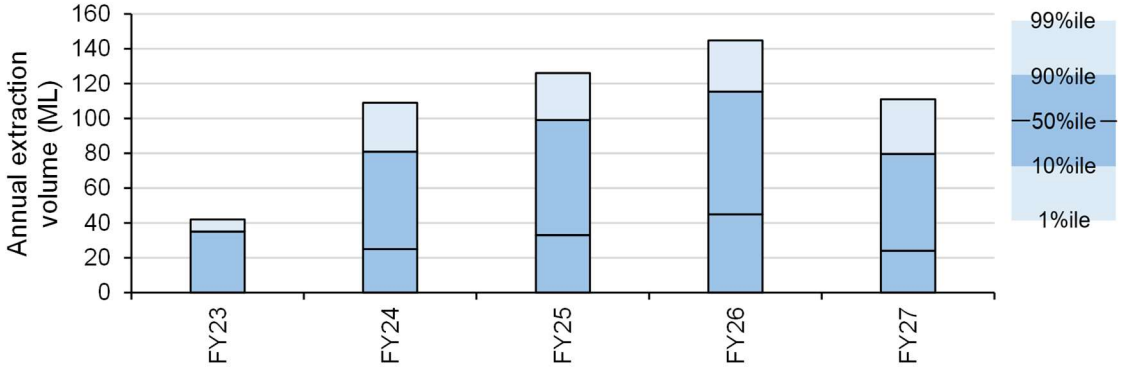


Figure 3-10 Forecast external water requirements

Offsite uncontrolled spills

The water balance model results show that there were no spills from A1, A2, A3, B2 or C to the receiving environment for any of the climatic conditions assessed.

The SB dams would be sufficiently managed during operations as to prevent uncontrolled spills to the receiving environment.

3.5.2 Adaptive management

The model results presented above represent the application of the adopted water management system rules over the mine life, regardless of climatic conditions. In reality, there are numerous options for adaptive management of the water management system to accommodate climatic conditions. For example, when excess water is available on site, NCOPL may increase the application of water for dust suppression or share excess water with other users in accordance with approvals requirements. These alternative management approaches will be used to reduce the risks top operations associated with climatic variability.

4. Site water balance monitoring program

4.1 Water storages and volumes

Storage levels (and volumes) at each water storage will be monitored in accordance with the SWMP (Attachment 3 of the WMP). Flowmeters will be used to record the transfer of water around the mine site, with mine water pumped from the underground working monitored in accordance with the GWMP (Attachment 4 of the WMP).

An analysis of the likelihood of uncontrolled discharges from the site will be conducted annually as part of the comparison of the actual behaviour of the site water management system to the predicted outcomes of the site water balance modelling (section 6).

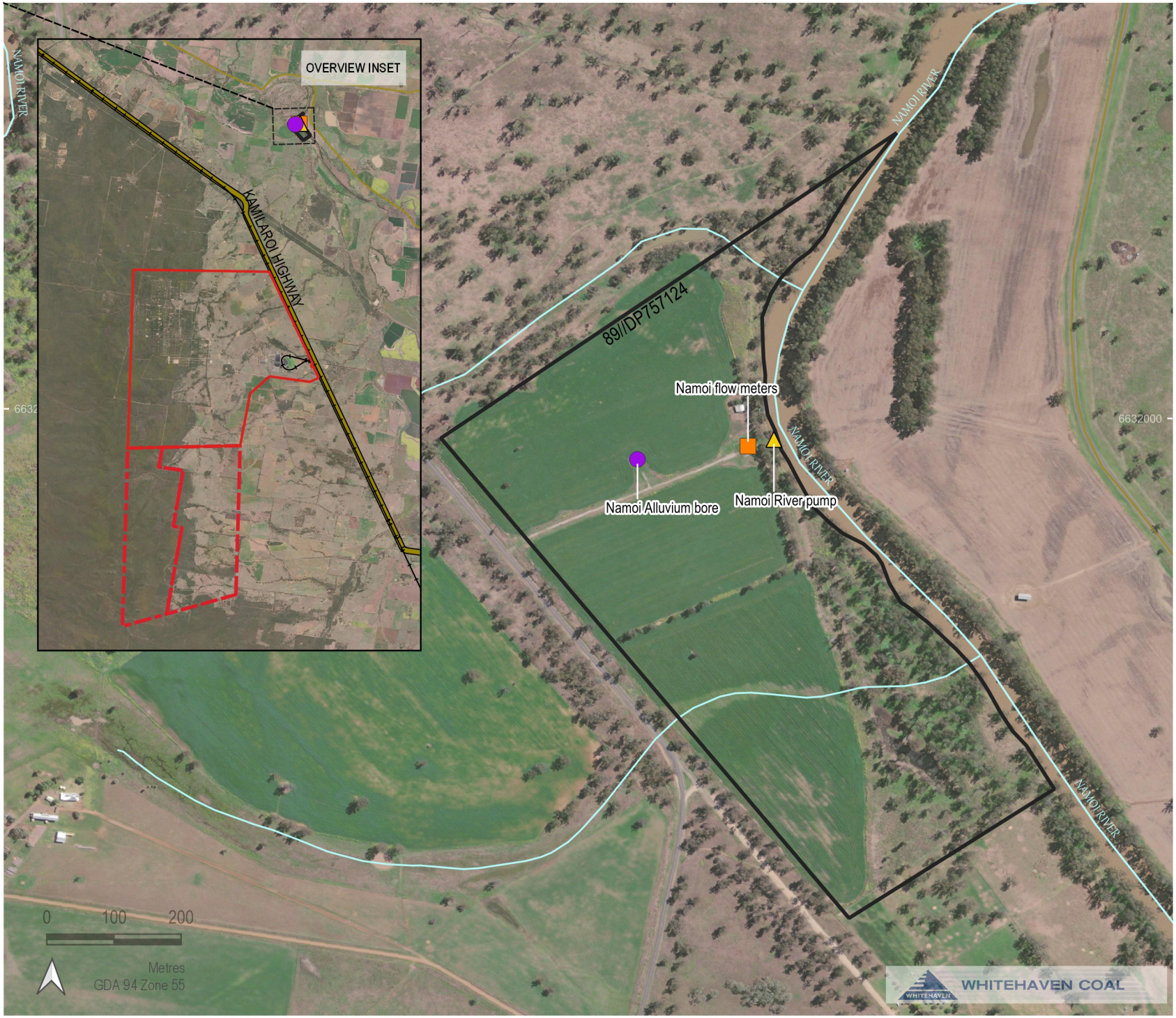
4.2 Water take

The quantity of water captured, intercepted or extracted from the Narrabri Mine will be determined using a range of methods including measurement, simulation and estimation. NCOPL will continue collecting and metering all inflows and outflows and to use the water balance model to calculate the groundwater take. Flow meters required for water take (under a WAL) will meet the requirements of the relevant water supply work approval.

NCOPL will record the metered quantities of water pumped to the Narrabri Mine via the pipeline from the Namoi River pump station and alluvial production bore. Flow meters required for water take under work approvals are located on the property 'Broadwater' Lot 89 DP 757124 and are shown in Figure 4-1. These flowmeters meet the requirements of the NSW Metering Policy.

The approach for monitoring surface water take associated with water losses from surface cracking and ponding in watercourses is outlined in section 4.4.1 of the SWMP (Attachment 3 of the WMP).

The forecast quantity of surface water and groundwater water take will be reviewed against the water licence entitlements described in section 3.3.1 to determine if contingency measures will be required to reduce water take or if additional water licences will be required (refer to the Trigger Action Response Plan [**TARP**] in section 5).



LEGEND

- ML1609
- MLA 1
- MLA2
- Lot 89 DP 757124
- Namoi flow meters
- Namoi Alluvium bore
- Namoi River pump
- Highway
- RoadSegment
- Railway
- Watercourse

ONWARD CONSULTING

NARRABRI MINE

FIGURE 4-1

Location of Metering Points for Licensed Water Take

4.3 Meteorological monitoring

Meteorological monitoring is undertaken at the on-site weather station (W1) to provide data to support environmental monitoring and design work. The following parameters will continue to be monitored at W1:

- rainfall;
- temperature at 2 metres (**m**);
- temperature at 10 m;
- sigma theta;
- total solar radiation;
- wind direction at 10 m;
- wind speed at 10 m; and
- relative humidity.

5. Trigger Action Response Plan

The TARP presented in Table 5-1 includes triggers to respond to any exceedances of the site water balance related criteria and performance measures.

Table 5-1 Site water balance TARP

Method	Status	Trigger	Action	Response
Mine water and brine inventory				
To ensure long term behavior of the mine water management system is within predicted forecast tolerances. To ensure that additional brine storages and water treatment plant upgrades can be implemented as required. **Sites**: • Dams SB1, SB2, SB3, SB4, A1, A2, A3, B2, BR1 & C **Parameter**: • Total stored mine water volume in SB1, SB2, SB3, SB4, A1, A2 and A3. • Total stored brine volume in A2, A3, B2, C and BR1. **Analysis:** • Compare total mine water volume and total brine volume with forecast water balance results in the Site Water Balance. **Frequency:** • Annual	**Normal**	Total stored volume of mine water or total stored volume of brine is below the predicted 10th percentile (wet climatic conditions) forecast inventories in the Site Water Balance.	None required.	Continue routine monitoring of stored water volume.
	Level 1	Total stored volume of mine water or total stored volume of brine exceeds the predicted 10th percentile (wet climatic conditions) forecast inventories in the Site Water Balance (but remains below the predicted 5th percentile).	Engage hydrologist to confirm calibration of water balance model to identify the reason for inventory exceedance.	Use recalibrated water balance model to undertake forecast modelling to confirm or revise the proposed timing of site water management system upgrades.
	Level 2	Total stored volume of mine water or total stored volume of brine exceeds the predicted 5th percentile (wet climatic conditions) forecast inventories in the Site Water Balance or exceeds the MOV.	Revise site water balance model to inform and develop a contingency plan to reduce inventories as required.	Implement contingency plan to reduce water level in storages to provide less than the MOV. This may involve increasing dust suppression / stockpile spray use, transferring water between storages, or treating additional water in the water treatment plant
Water take				
To ensure sufficient water entitlement is available for the operation of the Narrabri Mine and water is extracted in accordance with the relevant WALs held by NCOPL and the rules prescribed in the WSP. **Sites**: • Underground workings • Namoi River pump and alluvial production bore **Parameter**:	**Normal**	Forecast water take indicates sufficient water entitlement (licensed take) is available for the modelled operational scenario.	None required.	Continue routine water balance forecast modelling and monitoring of water take.

Method	Status	Trigger	Action	Response
• Total passive intake of aquifer water (modelled predictions). • Total metered quantities of water pumped to the Narrabri Mine via the pipeline from the Namoi River pump station and alluvial production bore. **Analysis:** • Water balance forecast modelling. • Review actual and forecast water take against the water licence entitlements. **Frequency:** • Annual	**Level 1**	Forecast water take indicates insufficient water entitlement (licensed take) is available for the modelled operational scenario.	Conduct preliminary quality assurance of water balance scenario modelling inputs and outputs to confirm prediction. Revise modelled operational scenario as required.	Transfer additional entitlements from other Whitehaven operations (where feasible) or obtain additional allocation on the open market in accordance with the appropriate trading rules of the relevant WSP.
	Level 2	Trend in actual water take indicates risk of exceeding allocation during the water year (reporting period).	Identify measures to further maximise water use reduction, water recycling and beneficial reuse options for mine water and dirty water to ensure sufficient water supply is made available to meet demand.	• Implement measures to further maximise water use reduction, water recycling and beneficial reuse options for mine water and dirty water to ensure sufficient water supply is made available to meet demand. • Transfer additional entitlements from other Whitehaven operations (where feasible) or obtain additional allocation on the open market in accordance with the appropriate trading rules of the relevant WSP.

6. Reporting, evaluation and review

Results of the site water balance model will be reviewed against the impact assessment criteria in this plan on an annual basis. NCOPL will use this information to review and determine if improvements are required.

All internal and external reporting and periodic review of this Plan will be undertaken in accordance with section 7 of the WMP. The revision status of this Plan is indicated in section 8.

The site water balance model will be revisited on an annual basis to compare the actual behaviour of the Narrabri Mine site water management system to the predicted outcomes of the site water balance modelling. The review will include:

- validation of the calibration parameters of the water balance model to ensure that the model adequately simulates observed conditions on site;
- an analysis of the likelihood of uncontrolled discharges from the site for the following year; and
- a site water balance for each calendar year.

Surface water and groundwater inflows, outflows and storage volumes data obtained as part of the SWMP (Attachment 3 of the WMP) and GWMP (Attachment 4 of the WMP) will be used to inform the validation/calibration of the site water balance model.

Annual inflow and outflow volumes will be reviewed prior to secondary extraction and will be detailed in the relevant Extraction Plan.

The Annual Review will report on the water captured, intercepted or extracted from the site (direct and indirect) in the previous water year (1 July – 30 June), including water taken under each water licence. The report will include:

- water licence number;
- WSP, source and management zone (as applicable);
- entitlement;
- passive take/inflows;
- active pumping (if applicable); and
- total take.

7. References

Boughton (2004). *The Australian water balance model, Environmental Modelling and Software*. Vol. 19, pp. 943-956.

Bureau of Meteorology (BoM) (2022). *Summary Statistics Narrabri West Post Office*. Available at http://www.bom.gov.au/climate/averages/tables/cw_053030.shtml

NSW Department of Primary Industries – Office of Water (2012). *Aquifer Interference Policy*.

NSW Independent Planning Commission (April 2022). *Development Consent SSD 10269, Narrabri Underground Mine Stage 3 Extension Project.*

Resource Strategies Pty Ltd (October 2020). *Narrabri Underground Mine Stage 3 Extension Project – Environmental Impact Statement.* Prepared for Narrabri Coal Operations Pty Ltd.

8. Review history

Revision	Comments	Author	Authorised by	Date
0A	Approved by Department of Planning and Environment on 14 September 2023	Onward Consulting	Manager HSE	29 November 2022

Department of Planning and Environment

Our ref: SSD-10269-PA-21

Brent Baker
Manager HSE
Narrabri Coal Operations Pty Ltd
10 Kurrajong Creek Road
Baan Baa, NSW, 2390

14/09/2023

Subject: Narrabri Coal Stage 3 – Site Water Balance

Dear Mr. Baker

I refer to your submission, requesting review and approval of the Site Water Balance for the Narrabri Coal Stage 3 project. I also acknowledge your response to the Department's review comments and request for additional information.

I note the Site Water Balance has been prepared in consultation with DPE Water and EPA, and contains the information required by the conditions of approval.

The Department has carefully reviewed the document and is satisfied that it meets the requirements of the relevant conditions in Development Consent (SSD-10269).

Accordingly, as nominee of the Planning Secretary, I approve the Site Water Balance (Rev 0A, dated 29 November 2022).

Please ensure you make the document publicly available on the project website at the earliest convenience.

If you wish to discuss the matter further, please contact Wayne Jones on (02) 6575 34056

Yours sincerely

Stephen O'Donoghue
Director
Resource Assessments
As nominee of the Planning Secretary

Appendix A - Compliance conditions relevant to this Plan

Table A-1 SSD 10269 consent conditions directly relevant to this Plan

Condition	Requirement	Document reference
Obligation to minimise harm to the environment		
A1.	In addition to meeting the specific performance measures and criteria established under this consent, the Applicant must implement all reasonable and feasible measures to prevent, and if prevention is not reasonable and feasible, minimise, any material harm to the environment that may result from the construction and operation of the development, and any rehabilitation required under this consent.	Section 1.3 Section 3 Section 6.2 of the WMP
Evidence of Consultation		
A20.	Where conditions of this consent require consultation with an identified party, the Applicant must: (a) consult with the relevant party prior to submitting the subject document; and (b) provide details to the Department of the consultation undertaken including: (i) the outcome of that consultation, matters resolved and unresolved; and (ii) details of any matters not resolved between the party consulted and the Applicant and how the Applicant has addressed the matters not resolved.	Section 1.4 of WMP
Staging, combining and updating strategies, plans or programs		
A21.	With the approval of the Planning Secretary, the Applicant may:	
	(a) prepare and submit any strategy, plan or program required by this consent on a staged basis (if a clear description is provided as to the specific stage and scope of the development to which the strategy, plan or program applies, the relationship of the stage to any future stages and the trigger for updating the strategy, plan, or program);	No staging of SWB proposed
	(b) combine any strategy, plan or program required by this consent (if a clear relationship is demonstrated between the strategies, plans or programs that are proposed to be combined);	No combining of SWB with another plan proposed
	(c) update any strategy, plan or program required by this consent (to ensure the strategies, plans and programs required under this consent are updated on a regular basis and incorporate additional measures or amendments to improve the environmental performance of the development); and	Section 6
	(d) combine any strategy, plan or program required by this consent with any similar strategy, plan or program required by an adjoining mining consent or approval, in common ownership or management.	No combining of SWB with another plan proposed
Compliance		
A30.	The Applicant must ensure that all of its employees, contractors (and their sub-contractors) are made aware of, and are instructed to comply with, the conditions of this consent relevant to activities they carry out in respect of the development.	Section 2 of the WMP
Applicability of guidelines		
A31.	References in the conditions of this consent to any guideline, protocol, Australian Standard or policy are to such guidelines, protocols, Standards or policies in the form they are in as at the date of inclusion (or later update) in the condition.	Section 3.7 of the WMP
A32.	However, consistent with the conditions of this consent and without altering any limits or criteria in this consent, the Planning Secretary may, in respect of ongoing monitoring and management obligations, agree to or require compliance with an updated or revised version of such a guideline, protocol, Standard or policy, or a replacement of them.	
Water Supply		

Condition	Requirement	Document reference
B25.	The Applicant must ensure that it has sufficient water for all stages of the development, and if necessary, adjust the scale of the development to match its available water supply.	Section 3.3
B26.	The Applicant must report on water take at the site each year (whether direct or indirect and whether licensable or exempt) in the Annual Review, including water taken under each water licence. **Note:** Under the *Water Act 1912* and/or the *Water Management Act 2000*, the Applicant is required to obtain all necessary water licences for the development.	Section 6.1
Water Discharges		
B33.	The Applicant must ensure that all surface discharges from the site comply with all relevant provisions of the POEO Act, including any discharge limits (both volume and quality) set for the development in any EPL.	Section 3.4
Water Management Performance Measures		
B34.	The Applicant must comply with the performance measures in Table 4. ***Table 4: Water management performance measures*** **Feature** / **Performance measure** Water management – general: • Maintain separation between clean, dirty (i.e. sediment-laden) and mine water management systems; • Minimise the use of clean and potable water on the site; • Maximise water recycling, reuse and sharing opportunities; • Minimise the use of make-up water from external sources; • Design, install, operate and maintain water management systems in a proper and efficient manner; and • Minimise risks to the receiving environment and downstream water users. Mine water discharges: Negligible environmental consequences beyond those predicted in the document/s listed in condition A2(c).	Section 3.1 Section 3.3 Section 3.4 Section 3.5
Water Management Plan		
B36.	This plan must:	
	(a) be prepared by a suitably qualified and experienced person/s;	Section 1.4 of the WMP
	(b) be prepared in consultation with DPIE Water and the EPA;	
	(c) describe the measures to be implemented to ensure that the Applicant complies with the water management performance measures (see Table 4);	Section 3
	(d) build on existing monitoring programs and utilise existing data from nearby mines, where practicable;	Section 4
	(e) include a:	
	(i) **Site Water Balance** that includes details of:	
	• predicted annual inflows to and outflows from the site;	Section 3.2 Section 3.3 Section 3.4 Section 3.5

Condition	Requirement	Document reference
	• sources and security of water supply for the life of the development (including authorised entitlements and licences);	Section 3.3
	• water storage capacity;	Section 3.1.3 Section 4.1
	• water use and management on the site, including any water transfers or sharing with other industries;	Section 3.1.6 Section 3.3.1
	• a program to regularly review modelling of the likelihood of uncontrolled discharges from the site;	Section 4.1 Section 5 Section 6
	• licensed discharge points and limits; and	Section 3.4
	• reporting procedures, including annual revision of the site water balance;	Section 6
Management Plan requirements		
E5.	Management plans required under this consent must be prepared in accordance with relevant guidelines, and include:	
	a) summary of relevant background or baseline data;	Section 2
	b) details of:	
	i) the relevant statutory requirements (including any relevant approval, licence or lease conditions);	Section 1.4
	ii) any relevant limits or performance measures and criteria; and	Section 3.3.1 Section 3.4
	iii) the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;	Section 4 Section 5
	c) any relevant commitments or recommendations identified in the document/s listed in condition A2(c);	Appendix B
	d) a description of the management measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;	Section 3
	e) a program to monitor and report on the:	
	i) impacts and environmental performance of the development; and	Section 4
	ii) effectiveness of the management measures set out pursuant to paragraph (d);	
	f) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	Section 5
	g) a program to investigate and implement ways to improve the environmental performance of the development over time;	Section 7.6 of the WMP
	h) a protocol for managing and reporting any:	
	i) incident, non-compliance or exceedance of any impact assessment criterion or performance criterion;	Section 6 of WMP

Condition	Requirement	Document reference
	ii) complaint; or	Section 8 of WMP
	iii) failure to comply with other statutory requirements;	Section 6.2 of WMP
	i) public sources of information and data to assist stakeholders in understanding environmental impacts of the development; and	Section 3.7 of the WMP
	j) a protocol for periodic review of the plan.	Section 6
E6.	The Applicant must ensure that management plans prepared for the development are consistent with the conditions of this consent and any EPL issued for the site.	Appendix A Appendix B

Appendix B - Key EIS commitments

Table B-1 Key EIS commitments

Source	Aspect	Details	Reference
EIS Section 6.4.3	Namoi Alluvial Bore	Water would be extracted from NCOPL's existing alluvial bore located adjacent to the Namoi River during periods when required (e.g. when supply from the underground mining area is insufficient to meet the Project water demand, and sufficient allocation from the Namoi River [i.e. utilising NCOPL's existing Namoi River pump] is unavailable.	Section 3.3
EIS Section 6.4.3	Namoi Alluvial Bore	NCOPL's bore is located within the Upper Namoi Zone 5 groundwater source (within the WSP for the Namoi Alluvial Groundwater Sources). Water would be extracted in accordance with the relevant WALs held by NCOPL and the rules prescribed in the WSP.	Section 3.3
EIS Section 6.4.3	Namoi Alluvial Bore	All extraction from the alluvial bore would be conducted in accordance with the licensed entitlements issued by DPIE – Water, and in accordance with the rules in the relevant WSP.	Section 3.3
EIS Section 6.4.4	Groundwater Licensing	Entitlements would be transferred from other Whitehaven operations to cover Project requirements for the Gunnedah Oxley Basin MDB. In the event NCOPL is not able to obtain sufficient entitlements from other Whitehaven operations, there is sufficient market depth in the Gunnedah Oxley Basin MDB Groundwater Source.	Section 3.3 Section 5
EIS Section 6.4.4	Groundwater Licensing	For the predicted licensing requirements in the Lower Namoi Groundwater Source, NCOPL would seek and obtain the appropriate entitlements on the open market in accordance with the appropriate trading rules of the *Water Sharing Plan for the Namoi Alluvial Groundwater Sources 2020*.	Section 3.3 Section 5
EIS Section 6.4.4	Groundwater Licensing	At the completion of the Project, relevant entitlements would be surrendered to account for groundwater take post-mining in accordance with the AIP.	Section 3.3.1
EIS Section 6.5.3	Water Management System	The Project would involve the use of the existing/approved water management infrastructure with minor augmentations and extensions, including the progressive developments of pumps, pipelines, water storages and other water management infrastructure.	Section 3.1
EIS Section 6.5.3	Water Management System	The objectives and design criteria of the Project site water management system would be to: • protect the integrity of local and regional water resources; • separate runoff from undisturbed, rehabilitated and mining-affected areas; • design and manage the system to operate reliably throughout the life of the Project in all seasonal conditions, including both extended wet and dry periods; • provide water for use in mining and CHPP operations that is of sufficient volume and quality, including during periods of extended dry weather; • provide sufficient storage capacity in the system to store, treat and discharge runoff as	Section 3.1.1 Section 3.1 of Attachment 3 of WMP

Source	Aspect	Details	Reference
		required, including during periods of extended wet weather; and • maximise the re-use of water on-site.	
EIS Section 6.5.3	Flow Regime - Changes in Contributing Catchment	Runoff from Project disturbance areas and areas under active rehabilitation would be captured in sediment dams and: • transferred to the Project site water management system for re-use in mine operations; and/or • controlled release via licensed discharge points, in accordance with the requirements of EPL 12789 following rainfall events that exceed sediment dam design capacity.	Section 3.1.1 Section 3.4.2
EIS Section 6.5.3	Surface Water Quality	The controlled release of treated water, which would be undertaken in accordance with EPL 12789, would not adversely impact Namoi River water quality.	Section 3.4.3
EIS Section 6.5.3	Namoi River Surface Water Extraction	Consistent with current practice, water would be preferentially extracted from the Namoi River in accordance with WALs held by NCOPL. When low or no-flow conditions in the Namoi River prevent the extraction of water from the river (or other circumstances such as the Namoi River pump station not being operational), groundwater would be extracted from NCOPL's bore to provide a supplementary water supply, in accordance with WALs held by NCOPL.	Section 3.3.4
EIS Section 6.5.3	Namoi River Surface Water Extraction	Extraction from the Namoi River would be conducted in accordance with the licensed entitlements issued under the *Upper Namoi and Lower Namoi Regulated River Water Sources 2016*.	Section 3.3.1 Section 3.3.4
EIS Section 6.5.4	Water Management Plan – Site Water Balance	Review and progressive refinement of the site water balance would continue annually over the life of the Project to record the status of inflows, storage and consumption (e.g. usage, return water from co-disposal areas, dust suppression and filtered water releases or beneficial re-use) and to optimise water management performance.	Section 6
Submissions Report Section 4.2.1	Other licensing matters	NCOPL would report on water take at the site each year (direct and indirect) in the Annual Review.	Section 6
Submissions Report Section 4.2.1	Other licensing matters	NCOPL would ensure that relevant nomination of work dealing applications for Water Access Licences proposed to account for water take by the Project have been completed prior to the water take occurring.	Section 3.3.1

Attachment 2 - Erosion and Sediment Control Plan

NARRABRI MINE

EROSION AND SEDIMENT CONTROL PLAN

	NARRABRI MINE ENVIRONMENTAL MANAGEMENT SYSTEM	Document owner:	Environmental Superintendent
		Document approver:	Manager HSE
		Revision period:	3 years
		Revision:	0A
		Last revision date:	29 November 2022

WHC_PLN_NAR_EROSION AND SEDIMENT CONTROL PLAN

Prepared by:

Title	Name	Signature	Date
Senior Environmental Manager	S. van der Meulen Onward Consulting		29 November 2022
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Onward document number:
NCO-003K-0A-PLN

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1. Introduction

1.1 Background

The Narrabri Mine is an existing underground coal mining operation situated in the Gunnedah Coalfield, approximately 25 kilometres (**km**) southeast of Narrabri and approximately 60 km northwest of Gunnedah, within the Narrabri Shire Council (**NSC**) Local Government Area, in New South Wales (**NSW**). It is operated by Narrabri Coal Operations Pty Ltd (**NCOPL**), on behalf of the Narrabri Mine Joint Venture[1], which consists of two Whitehaven Coal Limited's (**WHC**) wholly owned subsidiaries, and other joint-venture partners.

The Narrabri Underground Mine Stage 3 Extension Project (**Stage 3**) involves a southern extension to the previously approved Stage 2 mining area (approximately 609 ha of additional surface development footprint) to gain access to additional areas of coal reserves within Mining Lease Application (**MLA**) 1 and 2, an increase in the mine life to 2044, and the development of supporting surface infrastructure[2].

1.2 Purpose and scope

This Erosion and Sediment Control Plan (**ESCP** or **Plan**) has been developed in accordance with the Stage 3 Extension Project State Significant Development (**SSD**) 10269 Conditions of Consent (**CoC**) B36(e)(ii), the applicable regulatory framework industry guidelines for erosion and sediment control, and the requirements of the Water Group within the Department of Planning and Environment (**DPE Water**) and the Environment Protection Authority (**EPA**).

As required by CoC B38, NCOPL will implement the ESCP as approved by the Planning Secretary. In accordance with CoC B37, NCOPL will not commence construction until this Plan is approved by the Planning Secretary.

This ESCP forms Attachment 2 of the Narrabri Mine Water Management Plan (**WMP**), developed in accordance with CoC B35 to CoC B38.

1.3 Objectives

The objectives of this Plan are to:

- provide details of the relevant statutory requirements, including any relevant approval, licence or lease conditions;
- describe the measures to be implemented to ensure compliance with the water management performance measures in accordance with CoC B34;
- identify the activities that could cause soil erosion or generate sediment;
- describe the measures to minimise soil erosion and the potential for the transport of sediment to downstream waters;
- ensure the erosion and sediment controls implemented onsite are in accordance with the required industry guidelines;
- describe the location, function, and capacity of erosion and sediment control structures; and

[1] For full details on the joint venture ownership, refer to the introduction of the Environmental Management Strategy.

[2] For full detail on the background of the Narrabri Mine, refer to the overarching WMP.

- describe the measures to be implemented to maintain (and if necessary, decommission) the structures over time.

1.4 Regulatory requirements

In accordance with CoC E5(b), Appendix A provides a summary of the relevant regulatory requirements relating to erosion and sediment control and outlines the section of the ESCP in which each of these conditions and commitments have been addressed.

In accordance with CoC E5(c), Appendix B provides a summary of the relevant commitments or recommendations within the EIS relating to erosion and sediment control and outlines the section of the WMP (including sub-plans) in which each of these commitments have been addressed. The relevant commitments or recommendations include those as amended or added to by the:

- Applicant's Submission Report submitted 31 May 2021;
- Applicant's Amendment Report submitted 31 May 2021; and
- Applicant's final Biodiversity Development Assessment Report dated September 2021.

A detailed overview of the statutory requirements relating to water management is described in section 3 of the WMP.

1.5 Definitions

The terminology used within this ESCP are defined in the WMP.

2. Baseline data

2.1 Topography, landforms, geology and land use

Narrabri Mine is located in the North West Slopes and Plains region of NSW, which includes the Namoi River valley and associated agricultural land uses, and elevated, vegetated country managed as State Forests and National Parks.

Topography in the vicinity of the mine is characterised by the vegetated, hilly country of Jacks Creek State Forest and Pilliga East State Forest to the west, grading down to the alluvial plains associated with the Namoi River approximately 5 km east of the underground mining area. Further east, topography is dominated by the ranges of the Mount Kaputar National Park. Topography ranges from approximately 370 m Australian Height Datum (**AHD**) in the south-west to approximately 240 m AHD in the east of the mining area.

A majority of the mining lease is characterised as gently to moderately undulating grazing land, with isolated landform features such as minor cliffs, rock outcrops and steep slopes have been identified within the vicinity of the site.

Land use varies from east to west, reflecting topography and increasing vegetation cover. The eastern portion of the mining lease is predominantly cleared (except for some remnant riparian vegetation), with land uses including grazing of cattle, sheep and horses and some limited cereal cropping and horticulture.

To the west, vegetation cover increases with topography to the Pilliga East State Forest and Jacks Creek State Forest, which are managed by the Forestry Corporation of NSW.

2.2 Soils

The soils associated with the Narrabri Mine have been variably affected by soil erosion, as evidenced by many sets of soil conservation banks and waterway systems, particularly on the Purlawaugh Formation and Garrawilla Volcanics. Most of the soils display low to moderate erodibility with the exception of sandy topsoils, which are susceptible to erosion quickly if unprotected.

Soil formations within the underground mining area include Pilliga Sandstone, Garrawilla Volcanics and Napperby Siltstone. Dominant soil types derived from these formations are orthic tenosols, vertosols, dermosols and sodosols. Vertosols located in the southern end of MLA 1 generally have dispersive (ESP>15) subsoils (2rog Consulting 2020).

2.3 Regional drainage network

Narrabri Mine is located in the Namoi River catchment and within the tributary sub catchments of Kurrajong Creek, Pine Creek, and Tulla Mullen Creek. The Namoi River flows in a north westerly direction at a distance of approximately 4 to 5 km to the east of the eastern boundary of the mine. The Namoi River has a catchment area of approximately 28,500 km^2 to Narrabri.

The Namoi River catchment has been used extensively for agricultural activities for over 100 years. It is one of Australia's most developed irrigation areas, supporting significant cotton and broad acre cropping (mainly sorghum, sunflower and wheat) as well as other crops, and some livestock grazing.

2.4 Local drainage network

The northern portion of the mining area (ML 1609) is located within the catchments of Kurrajong and Pine Creeks. The main Kurrajong Creek channel originates to the west of the Narrabri Mine within the Pilliga East State Forest and drains in a north-easterly direction. It is predominately a 3rd order watercourse under the Strahler stream ordering system[3].

MLAs 1 and 2 are located within the Kurrajong and Tulla Mullen Creek catchments, with both catchments draining to Tulla Mullen Creek to the east. Tulla Mullen Creek Tributary 1 originates to the west of the mining lease within the Pilliga East State Forest and drains in a north-easterly and then easterly direction. Tulla Mullen Creek Tributary 1 is a 1st order watercourse under the Strahler stream ordering system. It becomes a 3rd order watercourse as it crosses longwall 207.

The creeks are all ephemeral with minimal to no baseflow. Further detail on channel characteristics is provided in section 2.3.1 of the Surface Water Management Plan (**SWMP**) (Attachment 3 of the WMP).

Several farm dams which were constructed prior to the Narrabri Mine and not used in the mine water management system are also located across these drainage lines with two farm dams on Kurrajong Creek to be decommissioned prior to longwall mining.

2.5 Surface water quality

In relation to assessing effectiveness of erosion and sediment controls, the surface water quality in the watercourses associated with the Narrabri Mine can be characterised as having variable levels of total suspended solids (**TSS**), with median values ranging from approximately 20 milligrams per litre (**mg/L**) to 132 mg/L. Baseline surface water quality and monitoring is discussed in detail in section 2 of the SWMP (Attachment 3 of the WMP).

[3] Strahler stream order defined using the methodology described in Schedule 2 of the *Water Management (General) Regulation 2018*.

3. Implementation and management

3.1 Potential sources of erosion and sedimentation

Erosion and sedimentation can result directly or indirectly from:

- surface runoff and erosion from vegetation clearing, topsoil stripping and soil stockpiles;
- surface runoff from the construction and maintenance of unsealed roads and newly constructed embankments and drains;
- surface runoff from the construction and maintenance of new infrastructure required under the Stage 3 SSD 10269;
- erosion of drainage channels;
- disturbed areas not yet rehabilitated; and/or
- operation of the Reject Emplacement Area (**REA**).

Elevated winds may also result in erosion of finer material during clearing and soil stripping activities, and from exposed surfaces and stockpiles.

Subsidence modelling identified that there will be a likely maximum subsidence of approximately 2.8 m for each of the proposed panels with resulting consequences of increased erosion risk. There is also the potential for altered flow patterns to occur as a result of slope changes (as described in Appendix A of the EIS).

3.1.1 Topography and slope stability

The gently to moderately undulating surface topography across the mining area is generally <17.6% meaning there is an extremely low likelihood of mass movement of landslips. Areas with slopes <17.6% are anticipated to have low erosion rates, except for creek channels which may undergo re-adjustment following subsidence. In areas with dispersive soils and slope >17.6%, any soil exposure is likely to increase erosion.

The development of the Narrabri Mine will result in the following changes to existing topography and landforms:

- surface disturbance associated with the Surface Development Footprint (Figure 1-2 in WMP);
- subsidence from underground longwall mining; and
- rehabilitation of the Surface Development Footprint and previously disturbed areas.

Subsidence cracking at the surface or sub-surface can provide erosion initiation points. Additionally, with alteration to surface topography, it follows that surface runoff patterns and soil moisture patterns may also be altered. In areas with shallow water tables, ponding from groundwater can also occur.

Overall, a significant risk of erosion that is directly attributable to subsidence is not predicted.

3.2 General principles

NCOPL will adopt the following principles to manage erosion and sedimentation:

- design and construction of appropriate erosion and sediment controls prior to disturbance of any land in accordance with *Managing Urban Stormwater: Soils and Construction including Volume 1: Blue Book* (**Blue Book**) (Landcom, 2004) and *Managing Urban Stormwater: Soils and Construction including Volume 2E: Mines and quarries*;
- limiting the extent of the disturbance to the practical minimum;
- diversion of clean water around disturbed areas where practicable to do so;
- reducing the velocity of water flowing across exposed surfaces and in areas where water concentrates;
- monitoring weather conditions and forecasts (including rainfall prediction maps) to allow for adequate planning for significant rain events;
- stabilisation of exposed surfaces (i.e. non-persistent cover crop) in areas not required for operational purposes;
- revegetating earth embankments and bunds;
- protecting natural drainage lines and watercourses by the construction of erosion control devices such as diversion banks (up-slope of the area to be disturbed), channels and sediment basins;
- during periods of active subsidence, ground cover vegetation will be maintained and cultivation avoided to improve surface soil stability and minimise erosion risk;
- services corridors, access tracks and other infrastructure will be designed, installed, and maintained in accordance with the NSW Fisheries *Policy and Guidelines for Fish Habitat Conservation and Management,* and *Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings*; with consideration given to the *Guidelines for Controlled Activities on Waterfront Land*;
- personnel responsible for installing and maintaining erosion and sediment control devices will be competent in the effective installation and construction of such controls; and
- regularly inspecting erosion and sediment control devices and repair and/or redesign as required.

Appendix C provides the applicable standard drawings obtained from the “Blue Book”. These drawings are to be referred to when planning and constructing erosion and sediment control devices, with consideration given to the guidelines published by NSW Fisheries and the *Guidelines for Controlled Activities on Waterfront Land*.

The following sections outline all reasonable and feasible management measures to be implemented at the Narrabri Mine.

3.2.1 Erosion control measures

In addition to the general principles, the following measures will be implemented to control erosion across the site:

- the separation of ‘clean’ (offsite) run-on water from ‘dirty’ (onsite) (e.g. sediment laden) runoff where practicable;
- slope lengths will be maintained at appropriate lengths (where necessary) to prevent concentrated flow forming to reduce erosion risk;
- exposed soils will be stabilised with soil stabilisers (where necessary) to reduce erosion;
- stockpiles of soil material will be sited in low-hazard areas clear of watercourses;

- stockpiles will be stabilised in accordance with the requirements in section 3.5; and
- dust suppression (e.g. water cart) will be carried out whenever necessary to minimise sediments becoming air borne due to wind erosion.

3.2.2 Drainage control measures

Drainage controls will be designed in accordance with Table 6.1 of the Blue Book (Volume 2E). In addition to the minimum design criteria, the following measures will be implemented to control concentrated flows across the site:

- effectively separate 'clean' and 'dirty' runoff where practicable;
- construct clean and dirty water diversion drains/banks or other drainage structures to contain sediment laden runoff in sediment controls;
- appropriately line drainage channels to prevent erosion (i.e. vegetation, rock lining or synthetic material);
- reduce the risk of erosion by constructing appropriate drainage structures to direct flows and reduce velocities, including:
    - locating energy dissipaters at the outlet of drainage controls;
    - installing slope breaks (contours) to reduce slope length;
    - establishing appropriate drainage on all access tracks; and
    - installing appropriate watercourse crossings.

3.2.3 Sediment control measures

Sediment controls shall be designed in accordance with Table 6.1 of the Blue Book (Volume 2E). In addition to the minimum design criteria, the following measures will be implemented to minimise sedimentation across the site:

- construct sediment control measures in appropriate areas downslope of disturbed areas. Various types of sediment controls that may be used include (but are not limited to):
    - sediment dams (refer to section 3.4.1);
    - sediment fence or coir logs;
    - mulch berms; and
    - excavate sumps and checks sediment dams;
- any discharge of water from site will comply with Condition L2 of EPL 12789 (refer to section 4.2 of the SWMP [Attachment 3 of the WMP]);
- sediment controls will be desilted as when required; and
- sediment controls will only be removed after adequate stabilisation of disturbed surfaces is achieved.

3.2.4 Stabilisation measures

In addition to the general principles, the following measures will be implemented for stabilisation:

- all reasonable endeavours will be made to implement the most appropriate stabilisation measures in the shortest practicable timeframe, considering seasonal rainfall conditions;

- soil stabilisers or mulch will be used in conjunction with topsoil and seeding[4] where required to achieve stabilisation requirements;
- stabilisation of waterways including their beds and banks is to be commenced immediately after the completion of any works within these areas with consideration given to the guidelines published by NSW Fisheries and the *Guidelines for Controlled Activities on Waterfront Land*; and
- temporary soil stabilisers will be used where necessary to stabilise exposed construction areas and access tracks.

3.3 Permit to Work procedure

Prior to the commencement of any ground disturbance activities, a Permit to Work (**Permit**) is required to be completed in accordance with the site procedure 'Permit to Work – Surface Disturbance and Penetration Work.' The Permit will include strategies to minimise impacts as follows:

- the extent of disturbance and any "no-go" zones will be demarcated using well-defined barrier tape, survey marks or an effective alternative prior to any construction, clearing or stripping works commencing;
- erosion and sediment control measures shall be installed prior to disturbance where practicable;
- disturbance will not occur immediately prior to forecast rain or during periods of rain;
- land clearing will occur progressively and will be limited to the areas associated with the current phase of works only;
- critical aspects of in-stream works will be scheduled for forecasted dry weather periods, and watercourses and adjacent areas will be left undisturbed until the point immediately prior to access track works or other works in these areas commencing; and
- disturbance and clearing in and around natural watercourses will be minimised as much as possible.

Where required, the Permit is to include a site-specific ESCP outlining the erosion and sediment control measures (see section 3.2) that will be implemented prior to disturbance occurring.

Prior to the commencement of any ground disturbance works, a site-specific ESCP will be reviewed by the Environmental Superintendent or delegate as part of the Permit process. All site-specific ESCPs will be developed in accordance with the Blue Book and this Plan. Approval of the proposed disturbance will be conditional on the installation of any required erosion and sediment control measures being verified prior to or commencement of the disturbance and/or at specified stages during works.

3.4 Site specific strategies

The key erosion and sediment control structures at the Narrabri Mine are described below, including their locations, function, and capacity.

3.4.1 Sediment dams and sediment basins

Runoff from operational areas that cannot be stabilised will be captured in the Pit top Area sediment control structures, and:

[4] Seeding on privately owned land or within a State Forest will be in consultation with the private landholder and/or the Forestry Corporation of NSW.

- transferred to the site water management system[5] for re-use in mine operations; and/or
- controlled release via licensed discharge points, in accordance with the requirements of Condition L2 of EPL 12789.

The general principles for sediment control structures are:

- sediment control structures and associated infrastructure will be designed, installed and maintained in accordance with the Blue Book to ensure adequate capacity (Volume 2E);
- sediment clean-out will be conducted as required. Removed sediment will be relocated to locations that will not result in future erosion or pollution hazard;
- water levels in sediment dams will be managed appropriately with weather forecasts taken into consideration and made ready for the significant rain event, where feasible. Water may be taken and used for activities that will not result in a pollution hazard (e.g. dust control); and
- controlled discharges of water may occur accordance with Condition L2 of EPL 12789.

The locations, function and capacity of the Pit Top Area sediment dams and sediment basins are detailed further in Section 3.1.3 of the SWB (Attachment 2 of the WMP).

3.4.2 Ventilation shaft sites

Ventilation shaft pads will be designed and constructed such that any runoff will be retained on the pad itself or in sediment basins. Sediment basins will perform the function of capturing run off that would otherwise be discharged to the local drainage network or impacting undisturbed vegetation. Drilling process water during construction of the vent shafts will be stored in temporary in-ground lined sumps or above-ground tanks.

Sediment basins will be progressively constructed and decommissioned as the ventilation shaft sites and infrastructure are developed and decommissioned over the mine life. The locations of the proposed vent shafts are outlined in section 1.1 of the WMP.

Sediment basins will be designed, installed, and maintained in accordance with the Blue Book to ensure adequate capacity (Volume 2E).

3.4.3 Pit Top Area

A series of dirty water diversion drains have been designed and constructed to perform the function of diverting runoff from the Pit Top Area (Figure 1-1 of the WMP) to the sediment control structures. These diversion drains and structures have been retained to allow for continued water management across the Pit Top Area.

3.5 Soils and stockpile management

Soils

Inspections of stripped areas are to be undertaken to observe any signs of erosion and appropriate erosion and sediment controls will be implemented as per section 3.2.

[5] Refer to the Site Water Balance (Attachment 1 of the WMP) for further detail on the site water management system.

NCOPL will implement land management planning and actions as detailed further in the relevant Extraction Plan/s to assist in minimising erosion through the maintenance of groundcover, repairing residual soil cracks and managing areas of poor drainage following mining of the longwall panels. Land management actions are to include amelioration of erosion should it occur.

Stockpiles

Soil stockpiles will be managed to prevent erosion and sedimentation and may consider implementation of the following measures:

- topsoil and subsoils should be kept separate to prevent mixing of soils;
- topsoil stockpiles should be retained at a height of no more than 2 m, and subsoil stockpiles at a height of no more than 3 m, with slopes no greater than 1(V):2(H) and a slightly roughened surface to minimise erosion;
- wherever practicable, soil should not be trafficked, deeply ripped or removed in wet conditions to avoid breakdown in soil structure;
- topsoil stockpiles should be seeded with a non-persistent cover crop to reduce erosion potential as soon as practicable after stockpiling. Where seasonal conditions preclude adequate development of a cover crop, stockpiles should be treated (e.g. with a straw/vegetative mulch/cleared vegetation/geomesh) to improve stability;
- vehicle access to soil stockpiles should be restricted;
- if unacceptable weed generation is observed on soil stockpiles, a weed control program should be implemented;
- topsoil and sub soil stockpile placement will (where practicable) avoid location in drainage lines and areas of concentrated surface water flows, or where unavoidable, have drainage diversion structures installed to prevent erosion, and where required, sediment control fencing will be placed immediately down-slope of stockpiles until stable vegetation cover has established; and
- inspection (once completed) with scheduled ongoing maintenance as required.

3.5.1 Works in watercourses and riparian corridors

Watercourses and adjacent riparian corridors are considered to be sensitive environments and are particularly prone to erosion when vegetation has been removed and soils are exposed. Waterfront land includes the bed and bank of any watercourse and all land within 40 m of the highest bank of a watercourse. The *Guidelines for Controlled Activities on Waterfront Land*[6] will be reviewed for any new infrastructure located on the waterfront land, and riparian corridor widths as defined by the guidelines will be considered in determining appropriate controls.

[6] The *Guidelines for Controlled Activities on Waterfront Land* (DPI Water 2012) provide the planning requirements for controlled activities carried out in, on, or under waterfront land are regulated by the *Water Management Act 2000* (**WM Act**). Section 4.41 of the *Environmental Planning and Assessment Act 1979* (**EP&A Act**) provides that a controlled activity approval is not required under the WM Act for an SSD that is authorised by a development consent granted under Division 4.7 of Part 4 of the EP&A Act (notwithstanding that the proposed activity must conducted in compliance with the conditions of SSD-10269).

Additional controls and provisions will be implemented when works need to occur within watercourses and on waterfront land, as follows:

- any creek or watercourse crossing will be designed, installed and maintained generally in accordance with the NSW Fisheries *Policy and Guidelines for Fish Habitat Conservation and Management* and *Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings*[7];
- vegetation and soil disturbance will be minimised as much as practicable;
- grass vegetation removal and stripping works will only commence in these locations immediately prior to works commencing;
- with exception of emergency works, all works in watercourses are to be scheduled for a period when the 3-day weather forecast predicts rainfall is unlikely, and where possible, will be completed within this period;
- if rainfall is imminent while works are occurring in watercourses, reasonable measures will be undertaken to minimise exposed soils within the watercourse (up to the top bank of the watercourse, both sides); and
- where required, exposed access track surfaces will have a trafficable erosion control methodology applied.

3.5.2 Access tracks

Unsealed roads and access tracks will be developed in accordance with the Blue Book guidance series. The management principles are as follows:

- assess the implications of potential soil loss and water quality during planning;
- plan controls during the design phase;
- minimise the area of disturbance;
- control water flow from the top of and through the designated work area;
- rehabilitate disturbed lands as soon as possible; and
- maintain erosion and sediment control measures appropriately.

Access tracks in watercourses will be constructed and maintained in accordance with section 3.5.1.

3.5.3 Reject Emplacement Area

A detailed Capping Assessment and Closure Design study was completed in 2022 (ATC Williams 2022) which addresses erosion and sediment control risks during capping and closure. The following erosion and sediment controls will be applied during operation and capping practices:

- maintain perimeter drains and associated sediment basin;
- revegetation of capped surface by the use of hydromulch (with tackifier); and
- remove check dams and sediment fences when vegetation established.

Stripped topsoil is to be stockpiled in accordance with the requirements set out in section 3.5.

[7] Section 4.41 of the (**EP&A Act**) provides that permits under s201, s205 and s219 of the NSW *Fisheries Management Act 1994* are not required for an SSD that is authorised by a development consent granted under Division 4.7 of Part 4 of the EP&A Act.

3.5.4 Subsidence

Surface cracking

Monitoring of surface cracking associated with mine subsidence and the implementation of remedial measures will be undertaken to minimise potential impacts of short-term erosion during first flush events.

The management and remediation strategies surface cracking include:

- visual monitoring of the surface following subsidence to identify cracks that could lead to safety, access or erosion issues;
- restricting access by livestock and unauthorised personnel to areas of active subsidence;
- allow smaller cracks (<100 mm) to fill by natural erosive forces;
- remedial works for larger cracks (>100 mm) to occur within six months of its development;
- development of site-specific management plans for areas that require broader remediation (e.g. persistent cracking areas);
- any “non-natural” cracks or erosion deemed to be in excess of natural rates to be repaired and remedial measures (e.g. check dams or drop structures) installed;
- ponding located in areas with no significant vegetation and the water quality of the ponded water is non-saline is to be left to self-correct; and
- ponding located in areas with significant vegetation to be assessed and remedial measures (e.g. drainage) developed and implemented in consultation with a geomorphologist.

Prior to any remediation of surface cracks, NCOPL will undertake a preliminary assessment of potential environmental impacts that may result from the remediation at the specific location and consider whether remediation of surface cracks is environmentally beneficial or if alternative methods of remediating the crack are warranted (e.g. without machinery).

Slope instability

The following measures will be implemented to manage slope instability:

- monitor surface slope displacement along subsidence crosslines (in addition to general subsidence monitoring);
- infill surface cracking to prevent excessive ingress of runoff into the slopes;
- conduct mitigation works such as re-grading, installation of new contour banks and revegetation of exposed areas in areas that are significantly affected by erosion after mining;
- regularly review and appraise any significant changes to surface slopes after each longwall is extracted;
- in the unlikely event of large-scale slope instability and erosion stabilisation, remediation actions will be undertaken such as:
    - installation of deep sub-surface drainage trenches and the construction of catch drains along slope crests so that surface run-off is controlled; and
    - stabilisation works undertaken along sections of bank which are damaged or steeply eroded.

3.5.5 Maintenance

All drainage, erosion and sediment control measures will be maintained until their function is no longer required and adequate surface stabilisation is achieved. The maintenance activities during this period will include:

- all water, debris, and sediment removed from control measures will be disposed of or re-used in a manner that will not create an erosion or pollution hazard;
- effectiveness of sediment traps, check dams and silt fences will be maintained;
- remove spilled soil or other materials from hazard areas, including lands closer than five metres from areas of likely concentrated or high velocity flows especially waterways and hardstand areas;
- ensure drains are operating effectively and implement any necessary repairs as soon as practicable;
- construct additional erosion and/or sediment controls as required to ensure the desired protection is given to downslope lands and waterways, i.e. make ongoing changes to drawings where it proves inadequate in practice or is subjected to changes in conditions on the work-site or elsewhere in the catchment; and
- assess rehabilitated areas have established sufficient groundcover to reduce the erosion hazard effectively and initiate repair as appropriate.

If the erosion and sediment control structures identified as requiring repair and/or redesign cannot be addressed immediately, the timeframe for the modification, repair or replacement of the structure will be based on an assessment of the risk to the surrounding environment.

3.5.6 Rehabilitation

Operational sediment and erosion control works will be maintained during the establishment of revegetation. Once self-sustaining stable final landforms have been achieved within an area, key elements of the operational sediment control structures will be either left as passive water control storages or removed to allow the area to become free draining.

The following general rehabilitation measures will be implemented:

- progressively rehabilitating disturbed land and constructing drainage controls to improve stability of rehabilitated land;
- ripping of rehabilitation areas to promote infiltration;
- provide soil conditions that minimise the risk of soil loss via wind and water erosion during and after rehabilitation are to be considered; and
- restrict access to rehabilitated areas.

Rehabilitation activities will be conducted in accordance with the Rehabilitation Management Plan.

4. Monitoring program

NCOPL has implemented a monitoring and maintenance program that ensures erosion and sediment control measures are appropriately operated and maintained to ensure the controls remain effective. The effectiveness of erosion and sediment controls is monitored in the following ways:

- inspection of controls to assess if damage/erosion has occurred and remedial work is required. Repeated damage in the same location will trigger review of the controls and if additional controls are required;
- inspection of sediment controls to determine if dewatering or desilting is required; and
- monitoring of water quality to determine if water quality is being impacted, or the water is suitable to discharge.

All site monitoring data including site inspection records, rainfall records, dates of water quality testing, testing results will be documented on-site in accordance with the WMP and its sub plans. The currency of the documentation will be maintained for the duration of the works.

4.1 Inspections

Sediment and erosion controls will be inspected following a rainfall event measured at the premises that exceeds 38.4 mm over any consecutive 5-day period[8].

Inspections are to be carried out by competent personnel who have:

- a good working knowledge of the correct installation, operation, and maintenance procedures for the full range of drainage, erosion and sediment control measures used on the site;
- an understanding of site environmental values that could be impacted; and
- an ability to provide advice and guidance on appropriate erosion and sediment control measures.

4.2 Surface water quality monitoring and reporting

Erosion and sediment transport can result in a degradation of water quality which may impact downstream water bodies and users. Changes in water quality are generally observed as an increase in TSS and turbidity. The surface water monitoring program detailed in section 4 of the SWMP (Attachment 3 of the WMP) will be used to assess the performance of erosion and sediment controls.

[8] 38.4 mm equates to the 5-day 90%ile rainfall depth for Gunnedah sourced from Table 6.3a *Managing Urban Stormwater: Soils and Construction Volume 1: 4th edition*, March 2004.

5. Trigger Action Response Plan

The trigger action response plan (**TARP**) (Table 5-1) includes triggers to respond to any exceedance of the surface water related criteria and performance measures. The TARP also includes trigger levels for identifying and investigating any potential adverse impacts (or trends) associated with downstream surface water quality and post-mining water pollution from rehabilitated areas.

Table 5-1 Trigger Action Response Plan

Method	Status	Trigger	Action	Response
Sediment build-up in sediment dams				
Ensure capacity of sediment dams is maintained. **Sites**: • All sediment dams **Parameter**: • Sediment level **Analysis**: • Confirm sediment zone volume is not impeded by sediment build-up. **Frequency**: • Quarterly.	**Normal**	Sediment zone volume not impeded by sediment build-up so as to have sufficient capacity to store run off from a 38.4 mm 5-day rainfall event (95th percentile rainfall event).	• Record sediment level. • Continue to inspect control structure.	None required.
	Level 1	Sediment level within control structure approaching settlement zone of sediment dam.	• Record sediment level. • Arrange for desilting of control structures.	Desilt control structures prior to next rain event and review structures efficiency.
	Level 2	Sediment level within control structure exceeds settlement zone of sediment dam.	• Record sediment level. • Arrange for immediate desilting of control structures.	• Immediately desilt control structures and review structures efficiency. • Investigate and determine cause of sediment levels exceeding settlement zone.
Sediment dam capacity				
Ensure there is sufficient storage for high rainfall event. **Sites**: • All sediment dams **Parameter**: • Water level **Analysis**: • Confirm water level is below maximum operating volume (MOV) for each dam. **Frequency**: • Quarterly.	**Normal**	Water level is less than MOV level.	• Record water level. • Continue ongoing inspection and maintenance of sediment dams.	None required.
	Level 1	Water level is above MOV level.	• Record water level. • Arrange for sediment dam to be dewatered.	Dewater sediment dam within 5 days of a rainfall event such that they have sufficient capacity to store run off from a 38.4 mm 5-day rainfall event (95th percentile rainfall event).
	Level 2	Discharge from dam.	• Record water level and estimated discharge volume. • Conduct water sampling in accordance with SWMP (Attachment 3 of the WMP)	• Dewater sediment dam within 5 days of a rainfall event such that they have sufficient capacity to store run off from a 38.4 mm 5-day rainfall event (95th percentile rainfall event). • Investigate and determine cause of discharge from dam.
Condition of erosion and sediment control infrastructure				
Inspection to identify damage to erosion and sediment control infrastructure, such as washouts of drainage lines etc. **Sites**:	**Normal**	Erosion and sediment control infrastructure in good condition, with no damage observed.	Continue ongoing inspection and maintenance of erosion and sediment control infrastructure.	None required.

Method	Status	Trigger	Action	Response
• All erosion and sediment control structures. **Parameter**: • Damage/failure of structure. **Analysis**: • Visual inspection. **Frequency**: • After rainfall event of greater than 38.4 mm over any consecutive 5-day period.	**Level 1**	Erosion and sediment control infrastructure in good condition, with minor defects/issue observed.	• Record visual observations, including photographs. • Arrange for remedial actions to be implemented.	• Desilt control structures and review efficiency of structures. • Implement remedial actions to address defects/issues.
	Level 2	Failure or damage to erosion and sediment control infrastructure observed.	• Record visual observations, including photographs. • Develop remedial action plan to repair structures.	• Desilt control structures and review efficiency of structures. • Repair control structures where failure has occurred.

6. Reporting, evaluation and review

Results of the surface water quality monitoring program will be reviewed against the impact assessment criteria and used to determine if erosion and sediment control infrastructure and stabilisation works require improvements (i.e. repair and/or re-design).

All internal and external reporting and periodic review of this Plan will be undertaken in accordance with section 7 of the WMP. The revision status of this Plan is indicated in section 8.

7. References

2rog Consulting (2020) *Narrabri Underground Mine Stage 3 Extension Project Agricultural Impact Statement.* Prepared for Narrabri Coal Operations Pty Ltd.

ATC Williams (2022) *Narrabri Mine Rejects Emplacement Area Capping Assessment and Closure Design.* Prepared for Narrabri Coal Operations Pty Ltd.

Department of Environment and Climate Change (DECC) (2008) *Volume 2A: Installation of Services*.

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

Department of Environment and Climate Change (DECC) (2008) *Volume 2E: Mines and Quarries*.

Department of Primary Industries (DPI) (2012) *Guidelines for Controlled Activities on Waterfront Land.*

Fisheries NSW (2003) *Policy and Guidelines for Fish Habitat Conservation and Management*.

Fairfull, S. and Witheridge, G. (2003) *Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings.*

Fisheries NSW (2003) *Policy and Guidelines for Fish Habitat Conservation and Management*.

Landcom (2004) *Managing Urban Stormwater: Soils and Construction including Volume 1: Blue Book.*

NSW Independent Planning Commission (April 2022). *Development Consent SSD 10269, Narrabri Underground Mine Stage 3 Extension Project.*

Resource Strategies Pty Ltd (2020) *Narrabri Underground Mine Stage 3 Extension Project – Environmental Impact Statement*. Prepared for Narrabri Coal Operations Pty Ltd.

R.W. Corkery & Co Pty Ltd (2009) *Environmental Assessment for the Narrabri Coal Mine Stage 2 Longwall Project*. Prepared for Narrabri Coal Operations Pty Ltd.

8. Review history

Revision	Comments	Author	Authorised by	Date
0A	Approved by Department of Planning and Environment on 29 September 2023	Onward Consulting	Manager HSE	29 November 2022

Department of Planning and Environment

Our ref: SSD-10269-PA-22

Brent Baker
Manager HSE
Narrabri Coal Operations Pty Ltd
10 Kurrajong Creek Road
Baan Baa, NSW, 2390

29/09/2023

Subject: Narrabri Coal Stage 3 – Erosion and Sediment Control Plan

Dear Mr. Baker

I refer to your submission, requesting review and approval of the Erosion and Sediment Control Plan for the Narrabri Coal Stage 3 project. I also acknowledge your response to the Department's review comments and request for additional information.

I note the Erosion and Sediment Control Plan has been prepared in consultation with DPE Water and EPA, and contains the information required by the conditions of approval.

The Department has carefully reviewed the document and is satisfied that it meets the requirements of the relevant conditions in Development Consent (SSD-10269).

Accordingly, as nominee of the Planning Secretary, I approve the Erosion and Sediment Control Plan (Rev 0A, dated 29 November 2022).

Please ensure you make the document publicly available on the project website at the earliest convenience.

If you wish to discuss the matter further, please contact Wayne Jones on (02) 6575 34056.

Yours sincerely

Stephen O'Donoghue
Director
Resource Assessments
As nominee of the Planning Secretary

Appendix A - Compliance conditions relevant to this Plan

Table A-1 SSD 10269 consent conditions directly relevant to this Plan

Condition	Requirement	Document reference
Obligation to minimise harm to the environment		
A1.	In addition to meeting the specific performance measures and criteria established under this consent, the Applicant must implement all reasonable and feasible measures to prevent, and if prevention is not reasonable and feasible, minimise, any material harm to the environment that may result from the construction and operation of the development, and any rehabilitation required under this consent.	Section 1.3 Section 3 Section 6.2 of the WMP
Evidence of Consultation		
A20.	Where conditions of this consent require consultation with an identified party, the Applicant must: (a) consult with the relevant party prior to submitting the subject document; and (b) provide details to the Department of the consultation undertaken including: (i) the outcome of that consultation, matters resolved and unresolved; and (ii) details of any matters not resolved between the party consulted and the Applicant and how the Applicant has addressed the matters not resolved.	Section 1.4 of the WMP
Staging, combining and updating strategies, plans or programs		
A21.	With the approval of the Planning Secretary, the Applicant may:	
	a) prepare and submit any strategy, plan or program required by this consent on a staged basis (if a clear description is provided as to the specific stage and scope of the development to which the strategy, plan or program applies, the relationship of the stage to any future stages and the trigger for updating the strategy, plan or program);	No staging of ESCP proposed
	b) combine any strategy, plan or program required by this consent (if a clear relationship is demonstrated between the strategies, plans or programs that are proposed to be combined);	No combining of ESCP with another plan proposed
	c) update any strategy, plan or program required by this consent (to ensure the strategies, plans and programs required under this consent are updated on a regular basis and incorporate additional measures or amendments to improve the environmental performance of the development); and	Section 6
	d) combine any strategy, plan or program required by this consent with any similar strategy, plan or program required by an adjoining mining consent or approval, in common ownership or management.	No combining of ESCP with another plan proposed
Compliance		
A30.	The Applicant must ensure that all of its employees, contractors (and their sub-contractors) are made aware of, and are instructed to comply with, the conditions of this consent relevant to activities they carry out in respect of the development.	Section 2 of the WMP
Applicability of guidelines		
A31.	References in the conditions of this consent to any guideline, protocol, Australian Standard or policy are to such guidelines, protocols, Standards or policies in the form they are in as at the date of inclusion (or later update) in the condition.	Section 3.7 of the WMP
A32.	However, consistent with the conditions of this consent and without altering any limits or criteria in this consent, the Planning Secretary may, in respect of ongoing monitoring and management obligations, agree to or require compliance with an	

Condition	Requirement	Document reference
	updated or revised version of such a guideline, protocol, Standard or policy, or a replacement of them.	
Water Management Performance Measures		
B34.	The Applicant must comply with the performance measures in Table 4. ***Table 4: Water management performance measures***	Section 3 Section 5

Feature	Performance measure
Water management – general	• Maintain separation between clean, dirty (i.e. sediment-laden) and mine water management systems; • Minimise the use of clean and potable water on the site; • Maximise water recycling, reuse and sharing opportunities; • Minimise the use of make-up water from external sources; • Design, install, operate and maintain water management systems in a proper and efficient manner; and • Minimise risks to the receiving environment and downstream water users.
Erosion and sediment control works	• Design, install and maintain new erosion and sediment controls in accordance with the guidance series *Managing Urban Stormwater: Soils and Construction including Volume 1: Blue Book* (Landcom, 2004), *Volume 2A: Installation of Services* (DECC, 2008), *Volume 2C: Unsealed Roads* (DECC,2008), *Volume 2D: Main Road Construction* (DECC, 2008) and *Volume 2E: Mines and Quarries* (DECC, 2008). • Design, install and maintain any new infrastructure located within 40 metres of watercourses in accordance with the guidance series for *Controlled Activities on Waterfront Land* (DPI Water, 2012); • Design, install and maintain any new creek crossings generally in accordance with the Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (DPI, 2013) and Why Do Fish Need To Cross The Road? Fish Passage Requirements for Waterway Crossings (NSW Fisheries 2003); and • Ensure all new works on waterfront land are consistent with the guidance series for *Controlled Activities on Waterfront Land* (DPI Water, 2012).
Clean water diversions and storage infrastructure	Maximise as far as reasonable and feasible the diversion of clean water around disturbed areas on the site, except where clean water is captured for use on the site.

Condition	Requirement		Document reference
	Sediment dams	Design, install and maintain sediment dams in accordance with the guidance series *Managing Urban Stormwater: Soils and Construction – Volume 1* (Landcom, 2004) and *2E Mines and Quarries* (DECC, 2008).	
	Mine water discharges	Negligible environmental consequences beyond those predicted in the document/s listed in condition A2(c).	
Water Management Plan			
B36.	This plan must:		
	(a) be prepared by a suitably qualified and experienced person/s;		Section 1.4 of the WMP
	(b) be prepared in consultation with DPIE Water and the EPA;		
	(c) describe the measures to be implemented to ensure that the Applicant complies with the water management performance measures (see Table 4 above);		Section 3
	(d) build on existing monitoring programs and utilise existing data from nearby mines, where practicable;		Section 4
	(e) include a:		
	(ii) **Erosion and Sediment Control Plan** that:		
	• is consistent with the requirements of *Managing Urban Stormwater: Soils and Construction - Volume 1: Blue Book* (Landcom, 2004) and *Volume 2E: Mines and Quarries* (DECC, 2008);		Section 3
	• identifies activities that could cause soil erosion or generate sediment;		Section 3.1
	• describes measures to minimise soil erosion and the potential for the transport of sediment to downstream waters;		Section 3
	• describes the location, function, and capacity of erosion and sediment control structures; and		Section 3
	• describes what measures would be implemented to maintain (and if necessary, decommission) the structures over time;		Section 3 Section 4
Management plan requirements			
E5.	Management plans required under this consent must be prepared in accordance with relevant guidelines, and include:		
	a) summary of relevant background or baseline data;		Section 2
	b) details of:		
	i) the relevant statutory requirements (including any relevant approval, licence or lease conditions);		Section 1.4
	ii) any relevant limits or performance measures and criteria; and		Section 1.3 Section 3 Appendix C
	iii) the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;		
	c) any relevant commitments or recommendations identified in the document/s listed in condition A2(c);		Appendix B
	d) a description of the management measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;		Section 3

Condition	Requirement	Document reference
	e) a program to monitor and report on the:	
	i) impacts and environmental performance of the development; and	Section 4
	ii) effectiveness of the management measures set out pursuant to paragraph (d);	
	f) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	Section 5
	g) a program to investigate and implement ways to improve the environmental performance of the development over time;	Section 7.6 of the WMP
	h) a protocol for managing and reporting any:	
	i) incident, non-compliance or exceedance of any impact assessment criterion or performance criterion;	Section 6 of the WMP
	ii) complaint; or	Section 8 of the WMP
	iii) failure to comply with other statutory requirements;	Section 6.2 of the WMP
	i) public sources of information and data to assist stakeholders in understanding environmental impacts of the development; and	Section 3.7 of the WMP
	j) a protocol for periodic review of the plan.	Section 6
E6.	The Applicant must ensure that management plans prepared for the development are consistent with the conditions of this consent and any EPL issued for the site.	Appendix A Appendix B

Table A-2 EPL 12789 compliance conditions directly relevant to this Plan

Condition	Requirement	Document reference
Discharges to Air and Water and Applications to Land		
P1	**Location of monitoring/discharge points and areas** P1.3 The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.	Section 3 Attachment 3 of the WMP

EPA ID No.	Type of Monitoring Point	Type of Discharge Point	Location Description including NCOPL ID No.
11	Wet weather discharge Discharge water quality monitoring	Wet weather discharge Discharge water quality monitoring	Discharge point (SD4) on northern side of mine boundary.
13	Wet weather discharge Discharge water quality monitoring	Wet weather discharge Discharge water quality monitoring	Discharge point (SD2) on southern side of mine boundary.
14	Ambient Water Quality Monitoring		Upstream of mine discharge point on Kurrajong Creek Tributary 1 KC1US
15	Ambient Water Quality Monitoring		Downstream of mine discharge point on Kurrajong Creek Tributary 1 KC1DS
16	Ambient Water Quality Monitoring		Upstream of mine discharge point on Kurrajong Creek Tributary 2 KC2US
17	Ambient Water Quality Monitoring		Downstream of mine discharge point on Kurrajong Creek Tributary 2 KC2DS
18	Wet weather discharge Discharge water quality monitoring	Wet weather discharge Discharge water quality monitoring	Discharge point (SD7) on western side of mine boundary

Condition	Requirement			Document reference
	19	Ambient Water Quality Monitoring		Upstream location of Kurrajong Creek (KCUS)
	20	Ambient Water Quality Monitoring		Upstream location of Kurrajong Creek (KCDS)
	21	Ambient Water Quality Monitoring		Northern portion of mining area (PCa) in Pine Creek
	22	Ambient Water Quality Monitoring		Monitoring point (PC1) in Pine Creek Tributary 1
	24	Water Quality Monitoring	Water Quality Monitoring	Discharge point (NR1) at Namoi River
	25	Ambient Water Quality Monitoring	Ambient Water Quality Monitoring	Discharge point (NRUS) at Namoi River
	26	Ambient Water Quality Monitoring	Ambient Water Quality Monitoring	Discharge point (NRDS) at Namoi River
	27	Wet weather discharge Discharge water quality monitoring	Wet weather discharge Discharge water quality monitoring	Discharge point (SD8) at Ventilation Shaft

P1.4 Point W1 in the table, is identified in this licence for the purpose of monitoring of weather parameters at that point.

EPA identification number	Type of Monitoring Point	Description of Location
W1	Weather analysis	Weather station identified as "W1" on map titled EPL 12789 Monitoring Locations" dated 21/02/2017 - EPA DOC17/131971.

Limit Conditions

L2

Concentration limits

L2.1 For each monitoring/discharge point or utilisation area specified in the table\s below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table.

L2.3 To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in L2.4.

L2.4 Water and/or Land Concentration Limits

Point 11, 13, 18, 27					
Pollutant	**Units of measure**	**50th percentile conc**	**90th percentile conc**	**3DGM conc limit**	**100th percentile conc**

Section 3.2.3
Section 3.4.1
Attachment 3 of the WMP

Condition	Requirement	Document reference

Oil and Grease	mg/L	-	-	-	10

Point 11, 13, 18, 24, 27					
Pollutant	**Units of measure**	**50th percentile conc**	**90th percentile conc**	**3DGM conc limit**	**100th percentile conc**
pH	pH	-	-	-	6.5-8.5

Point 11, 13, 18, 27					
Pollutant	**Units of measure**	**50th percentile conc**	**90th percentile conc**	**3DGM conc limit**	**100th percentile conc**
TSS	mg/L	-	-	-	50

Point 24					
Pollutant	**Units of measure**	**50th percentile conc**	**90th percentile conc**	**3DGM conc limit**	**100th percentile conc**
TDS	mg/L	250	-	-	350

L2.5 The TTS concentration limits specified for Points 11, 13, 18 and 27 may be exceeded for water discharged provided that:

a) the discharge occurs solely as a result of rainfall measured at the premises that exceeds 38.4 millimetres over any consecutive 5 day period immediately prior to the discharge occurring; and

b) all practical measures have been implemented to dewater all sediment dams within 5 days of rainfall such that they have sufficient capacity to store run off from a 38.4 millimetre, 5 day rainfall event.

Note: 38.4 mm equates to the 5 day 90%ile rainfall depth for Gunnedah sourced from Table 6.3a *Managing Urban Stormwater: Soils and Construction Volume 1*: 4th edition, March 2004.

Monitoring and Recording Conditions

M2

Requirement to monitor concentration of pollutants discharged

M2.1 For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:

M2.3 Water and/or Land Monitoring Requirements

Section 4.2
Appendix 3 of the WMP

Point 11, 13, 18, 27			
Pollutant	**Units of measure**	**Frequency**	**Sampling Method**
Conductivity	Micro siemens per cm	Special Frequency 1	In situ
Oil and Grease	mg/L	Special Frequency 1	Grab sample
pH	mg/L	Special Frequency 1	In situ

Condition	Requirement	Document reference

TOC	mg/L	Special Frequency 1	Grab sample
TSS	mg/L	Special Frequency 1	Grab sample

Point 14, 15, 16, 17, 19, 20, 21, 22			
Pollutant	**Units of measure**	**Frequency**	**Sampling Method**
pH	pH	Special Frequency 2	In situ

Point 11, 14, 15, 16, 17, 19, 20, 21, 22			
Pollutant	**Units of measure**	**Frequency**	**Sampling Method**
Conductivity	Micro siemens per cm	Special Frequency 2	In situ
Oil and Grease	mg/L	Special Frequency 2	Grab sample
TOC	mg/L	Special Frequency 2	Grab sample
TSS	mg/L	Special Frequency 2	Grab sample

M2.4 For the purposes of the table(s) above Special Frequency 1 means the collection of samples as soon as practicable after each discharge commences and in any case not more than 12 hours after each discharge commences.

M2.5 For the purposes of the table(s) above Special Frequency 2 means the collection of samples quarterly (in the event of flow during the quarter) at a time when there is flow and as soon as practicable after each wet weather discharge from points 11, 13,18 or 27 commences and in any case not more than 12 hours after each discharge commences.

M2.7 For the purposes of the table(s) above Special Frequency 3 means the collection of samples as soon as practicable after each discharge commences from point NR1 and in any case not more than 4 hours after each discharge.

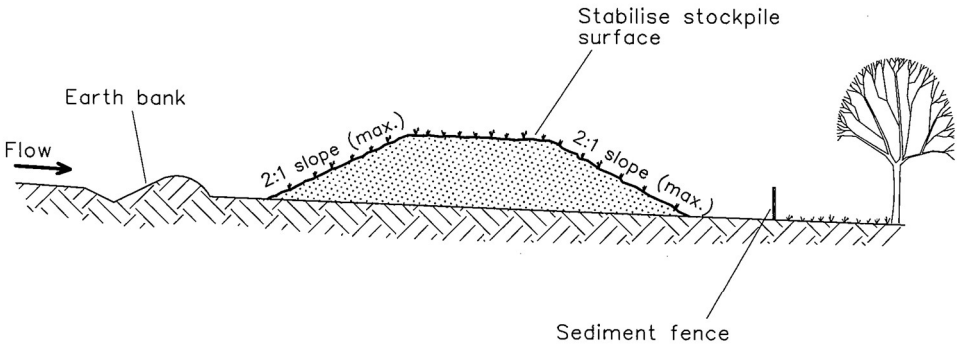
Appendix B - Key EIS commitments

Table B-1 Key EIS erosion and sediment control commitments

Source	Aspect	Details	Document reference
EIS Section 6.5.3	Flow Regime - Changes in Contributing Catchment	Runoff from Narrabri Mine disturbance areas and areas under active rehabilitation will be captured in sediment dams and: • transferred to Narrabri Mine site water management system for re-use in mine operations; and/or • controlled release via licensed discharge points, in accordance with the requirements of EPL 12789 following rainfall events that exceed sediment dam design capacity.	Section 3.4.1
EIS Section 6.5.3	Flow Regime - Changes in Contributing Catchment	For the exploration boreholes, pre-conditioning areas and gas management areas, short-term sediment management measures in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom 2004) will be implemented to minimise potential water quality impacts.	Section 3.4.2
EIS Section 6.5.3	Surface Water Quality	Sediment dams will continue to be dewatered following runoff events and will comply with EPL 12789 limits for wet weather discharges from licensed discharge points.	Section 3.4.1 Section 4.2 Section 5
EIS Section 6.5.4	Water Management Plan - Erosion and Sediment Control Plan	The Erosion and Sediment Control Plan component of the Water Management Plan will be reviewed and updated for Stage 3 to identify measures to minimise soil erosion and transport of sediment off-site.	This sub-plan
Amended BDAR Section 7.1	Lower Darling River aquatic ecological community	**Biodiversity Measure 1** The main impact of Narrabri Mine on biodiversity is clearance of vegetation and habitat. The purpose of a Vegetation Clearance Protocol is to minimise the impacts of clearing on vegetation and fauna present during clearing. The Vegetation Clearance Protocol will include, but not be limited to: • mine staff and contractors involved in vegetation clearance works will be made aware of clearing limits in the relevant Stage 3 approval documentation and of restricted access areas; • micro-siting of access tracks and other disturbance to minimise clearance of trees with hollows and drainage features (creeks); • the area cleared at any particular time will generally be no greater than that required to accommodate development needs for the following 12 months; • clearance authorisation process with final signoff for the areas to be cleared by the Environment	Section 3.3

Source	Aspect	Details	Document reference
		Superintendent or delegate; • clear delineation of the areas to be cleared on the ground prior to clearing activities (e.g. paint, flagging tape and posts) and restriction of clearing to within these areas (signposts to alert personnel not to enter vegetation outside of the disturbance areas).	
Amended BDAR Section 7.2	Lower Darling River aquatic ecological community	**Biodiversity Measure 2** Surface disturbance areas associated with the Development Footprint will be rehabilitated and revegetated (when the surface facilities are no longer required or at the end of the mine life where no further ongoing beneficial use is identified). Mine components that will be progressively rehabilitated include goaf gas drainage infrastructure, service boreholes, access tracks and post drainage corridor and pre-conditioning area. Other mine components, such as the vents and services corridors, will typically be decommissioned following mine closure.	Section 3.5.6
Amended BDAR Section 7.6	Lower Darling River aquatic ecological community	**Biodiversity Measure 6** The potential for localised Project-related channel erosion on Kurrajong Creek and other ephemeral creek lines has been assessed by WRM (2020) and will be managed using appropriate sediment and erosion controls.	Section 3.2
Amended BDAR Section 7.8	Lower Darling River aquatic ecological community	**Biodiversity Measure 8** Construction of drainage line crossings will be undertaken in accordance with the policy and guideline document of DPI-Fisheries NSW *Why do fish need to cross the road?* (Fairfull and Witheridge, 2003) as required by the Fisheries *NSW Policy and Guidelines for Fish Habitat Conservation and Management* (DPI, 2013). The waterways traversed by the Development Footprint are Class 3 (Minimal fish habitat) and Class 4 (Unlikely fish habitat) (Fairfull and Witheridge, 2003). Crossings will involve installation of fords or culverts.	Section 3.5.1
Amended BDAR Section 7.13	Lower Darling River aquatic ecological community	**Biodiversity Measure 13** Remediation of mine subsidence effects (e.g. surface cracking and minor erosion). A preliminary assessment will be undertaken to minimise impact of remediation actions. Prior to any remediation of surface cracks, NCOPL will undertake a review of environmental impacts that may result from the remediation at the specific location and consider whether remediation of surface cracks is environmentally beneficial or if alternative methods of remediating the crack are warranted (e.g. without machinery). The review will consider, among other factors, avoidance of known locations of threatened flora species.	Section 3.5.4

Appendix C - Applicable standard drawings

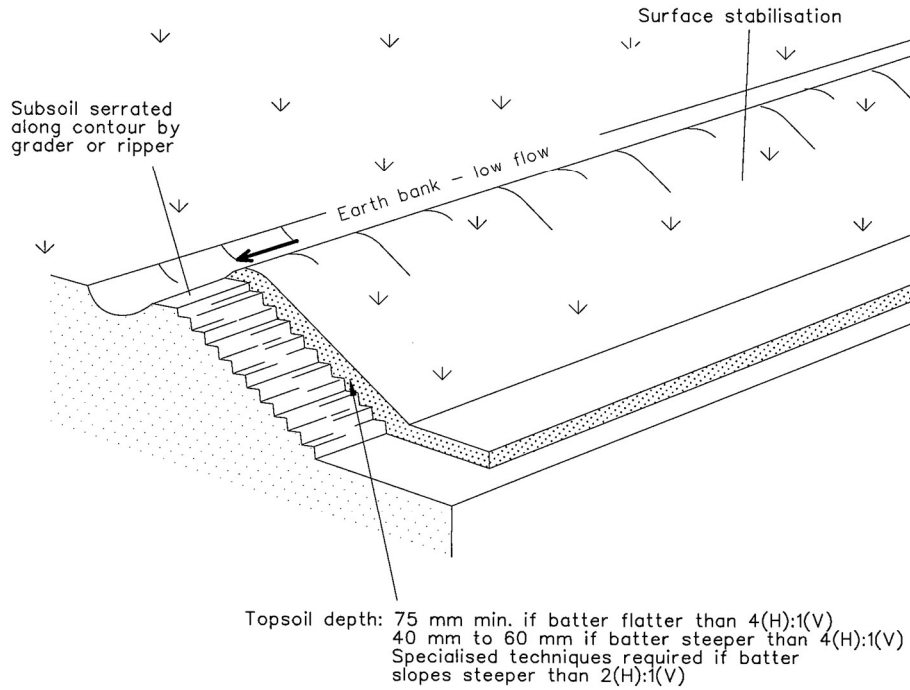


Construction Notes

1. Place stockpiles more than 2 (preferably 5) metres from existing vegetation, concentrated water flow, roads and hazard areas.
2. Construct on the contour as low, flat, elongated mounds.
3. Where there is sufficient area, topsoil stockpiles shall be less than 2 metres in height.
4. Where they are to be in place for more than 10 days, stabilise following the approved ESCP or SWMP to reduce the C-factor to less than 0.10.
5. Construct earth banks (Standard Drawing 5-5) on the upslope side to divert water around stockpiles and sediment fences (Standard Drawing 6-8) 1 to 2 metres downslope.

STOCKPILES **SD 4-1**

Source: Blue Book

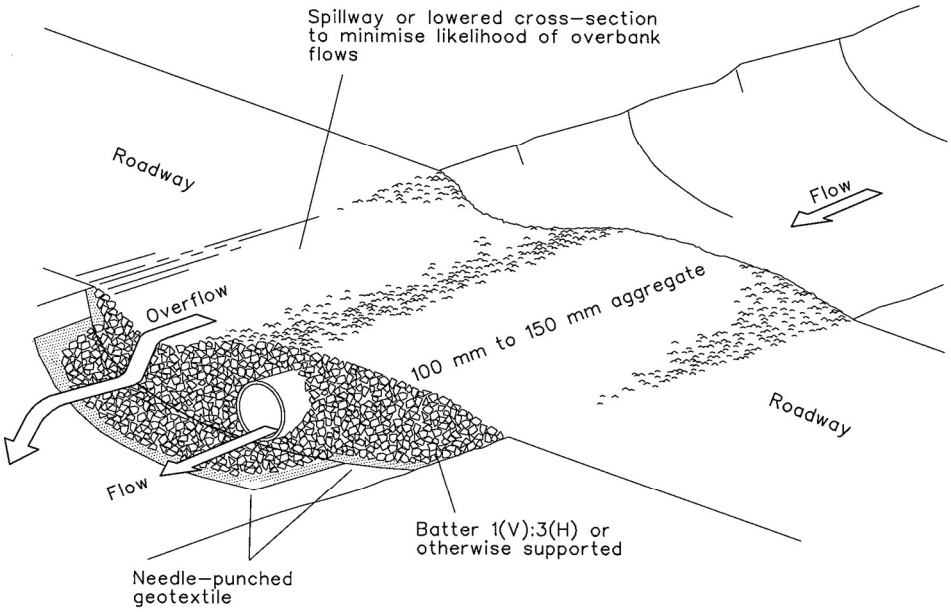


Construction Notes

1. Scarify the ground surface along the line of the contour to a depth of 50 mm to 100 mm to break up any hardsetting surfaces and to provide a good bond between the respread material and subsoil.
2. Add soil ameliorants as required by the ESCP or SWMP.
3. Rip to a depth of 300 mm if compacted layers occur.
4. Where possible, replace topsoil to a depth of 40 to 60 mm on lands where the slope exceeds 4(H):1(V) and to at least 75 mm on lower gradients.

REPLACING TOPSOIL **SD 4-2**

Source: Blue Book

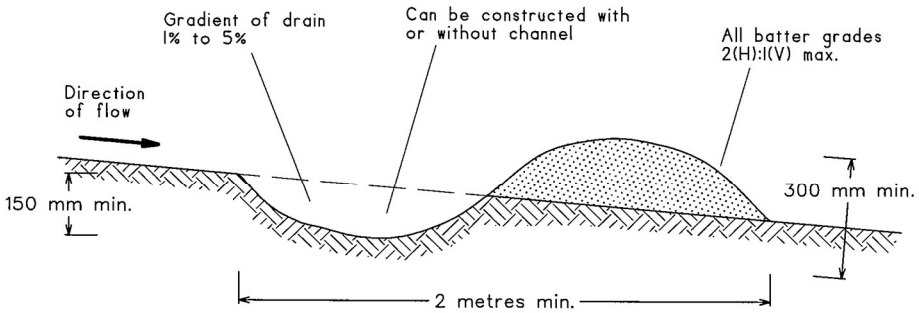


Construction Notes

1. Prohibit all traffic until the access way is constructed.
2. Strip any topsoil and place a needle-punched textile over the base of the crossing.
3. Place clean, rigid, non polluting aggregate or gravel in the 100 mm to 150 mm size class over the fabric to a minimum depth of 200 mm.
4. Provide a 3-metre wide carriageway with sufficient length of culvert pipe to allow less than a 3(H): 1 (V) slope on side batters.
5. Install a lower section to act as an emergency spillway in greater than design storm events.
6. Ensure that culvert outlets extend beyond the toe of fill embankments.

TEMPORARY WATERWAY CROSSING **SD 5-1**

Source: Blue Book



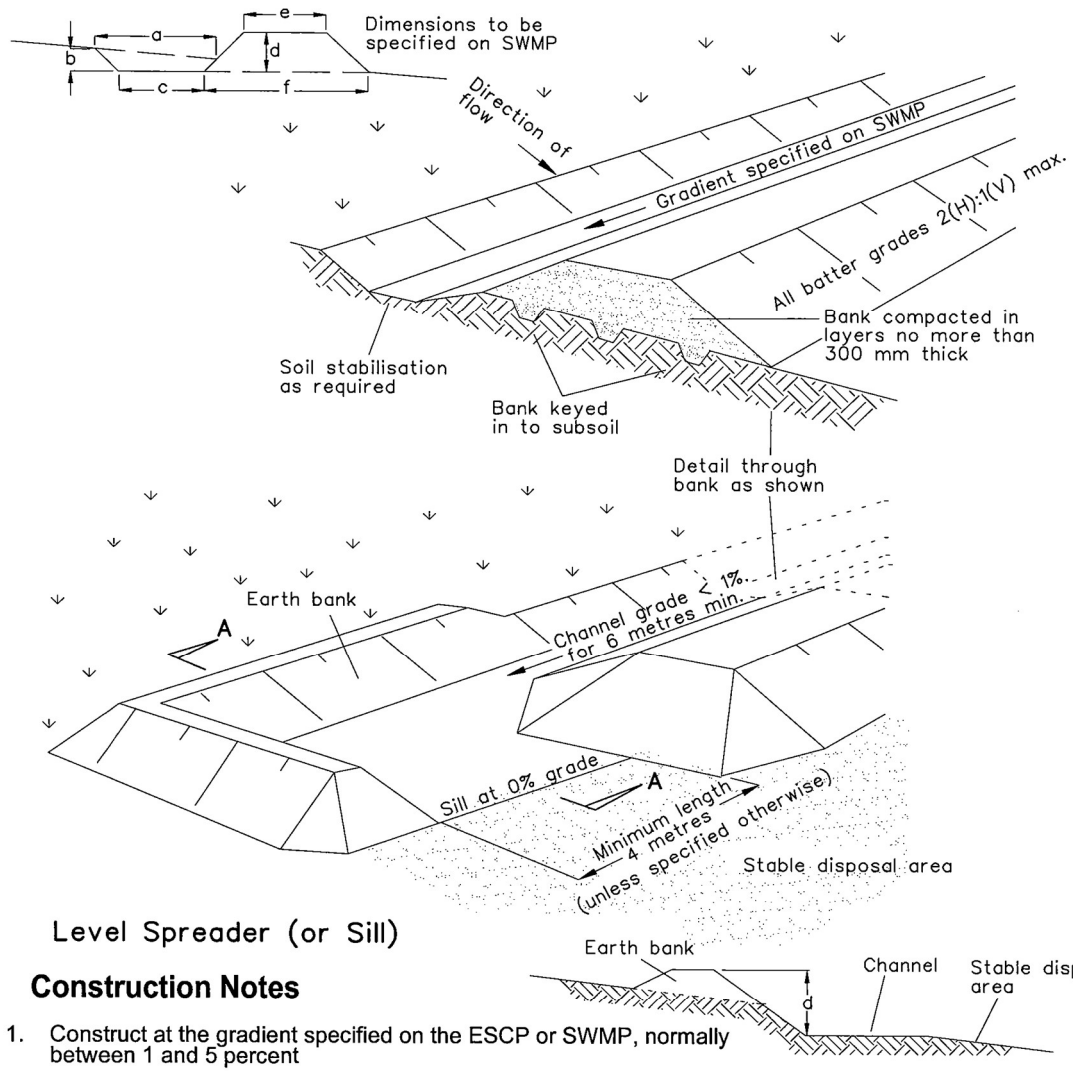
NOTE: Only to be used as temporary bank where maximum upslope length is 80 metres.

Construction Notes

1. Build with gradients between 1 percent and 5 percent.
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V shaped.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction.

EARTH BANK (LOW FLOW) **SD 5-5**

Source: Blue Book

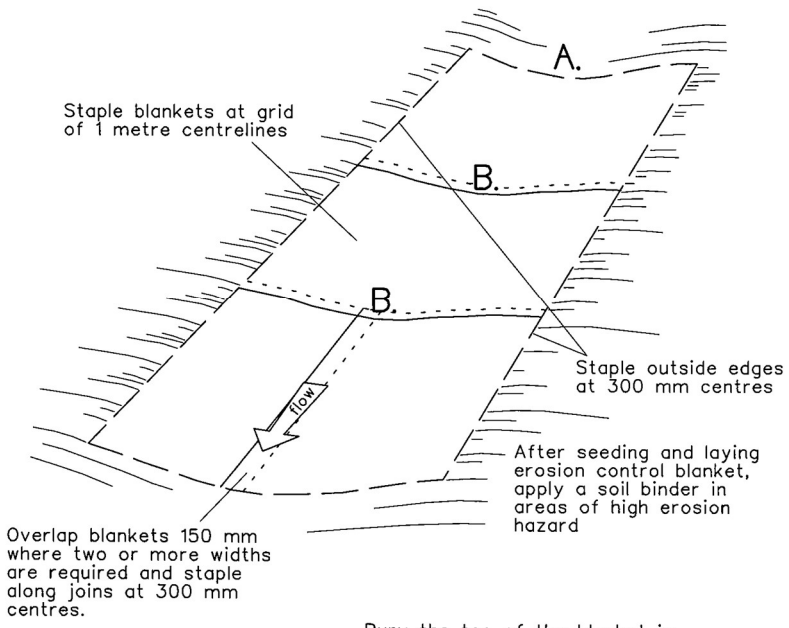


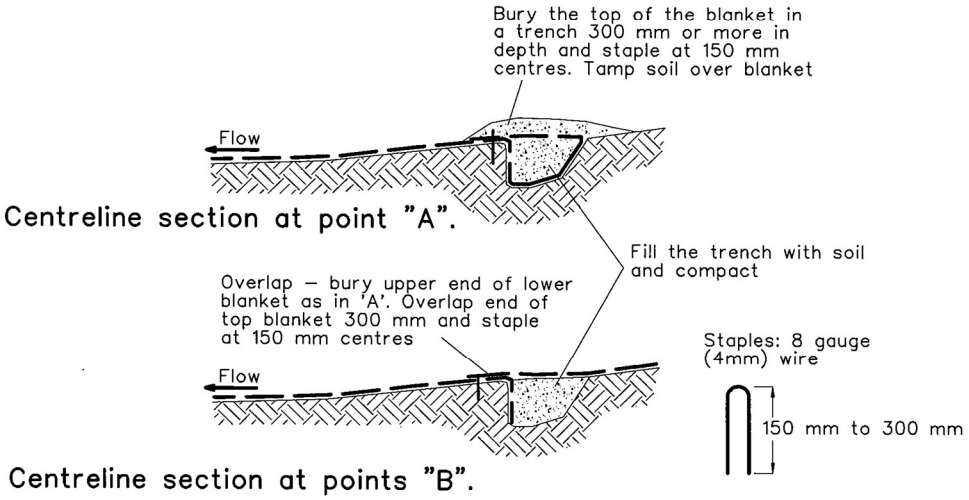
Construction Notes

1. Construct at the gradient specified on the ESCP or SWMP, normally between 1 and 5 percent
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V-shaped, at the dimensions shown on the SWMP.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction following Table 5.2 in Landcom (2004).
7. Where discharging to erodible lands, ensure they outlet through a properly constructed level spreader.
8. Construct the level spreader at the gradient specified on the ESCP or SWMP, normally less than 1 percent or level.
9. Where possible, ensure they discharge waters onto either stabilised or undisturbed disposal sites within the same subcatchment area from which the water originated. Approval might be required to discharge into other subcatchments.

EARTH BANK (HIGH FLOWS) **SD 5-6**

Source: Blue Book



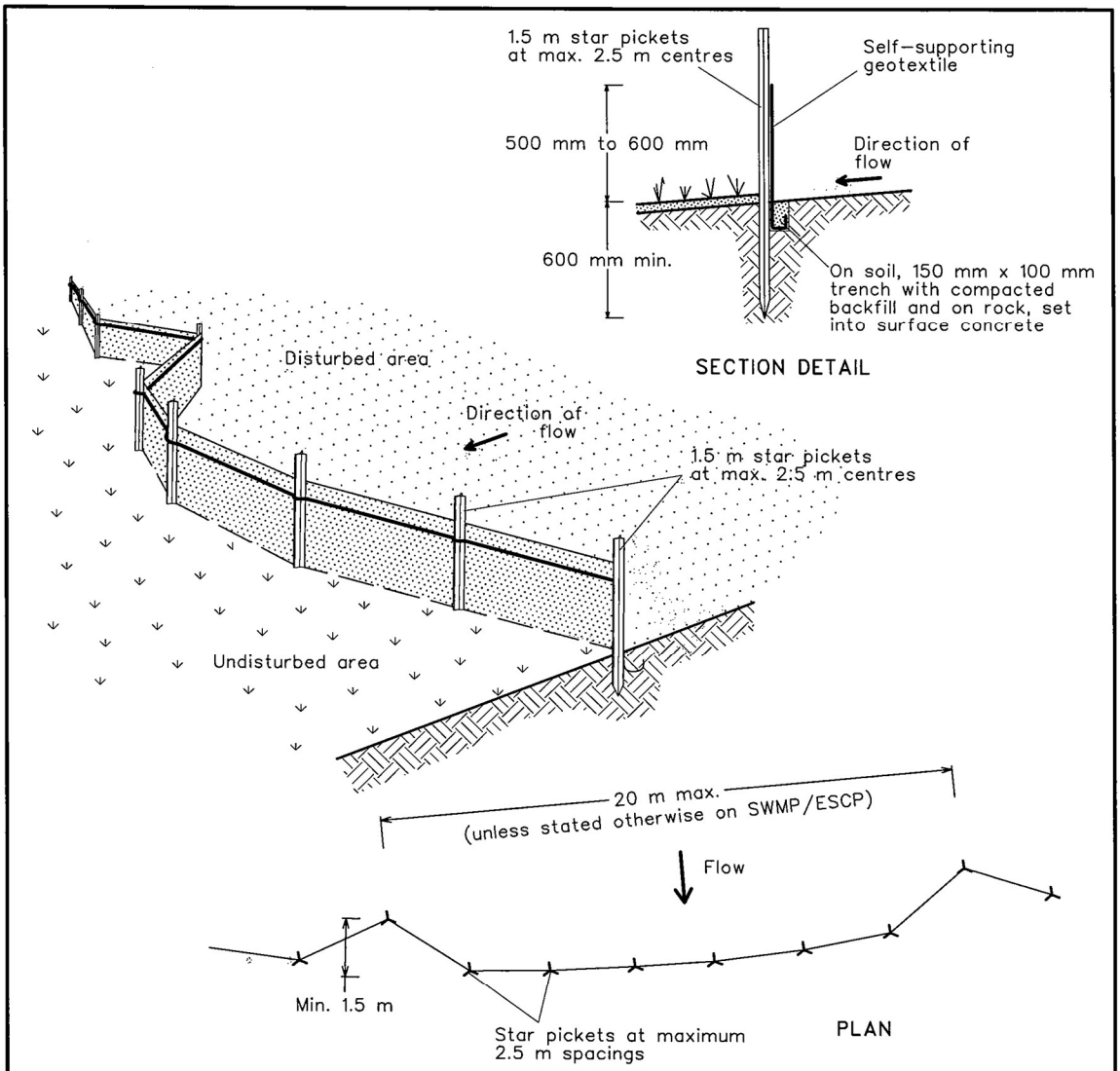


Construction Notes

1. Remove any rocks, clods, sticks or grass from the surface before laying matting
2. Ensure that topsoil is at least 75 mm deep.
3. Complete fertilising and seeding before laying the matting.
4. Ensure fabric will be continuously in contact with the soil by grading the surface carefully first.
5. Lay the fabric in "shingle-fashion", with the end of each upstream roll overlapping those downstream. Ensure each roll is anchored properly at its upslope end (Standard Drawing 5-7b).
6. Ensure that the full width of flow in the channel is covered by the matting up to the design storm event, usually in the 10-year ARI time of concentration storm event.
7. Divert water from the structure until vegetation is stabilised properly.

RECP : CONCENTRATED FLOW **SD 5-7**

Source: Blue Book

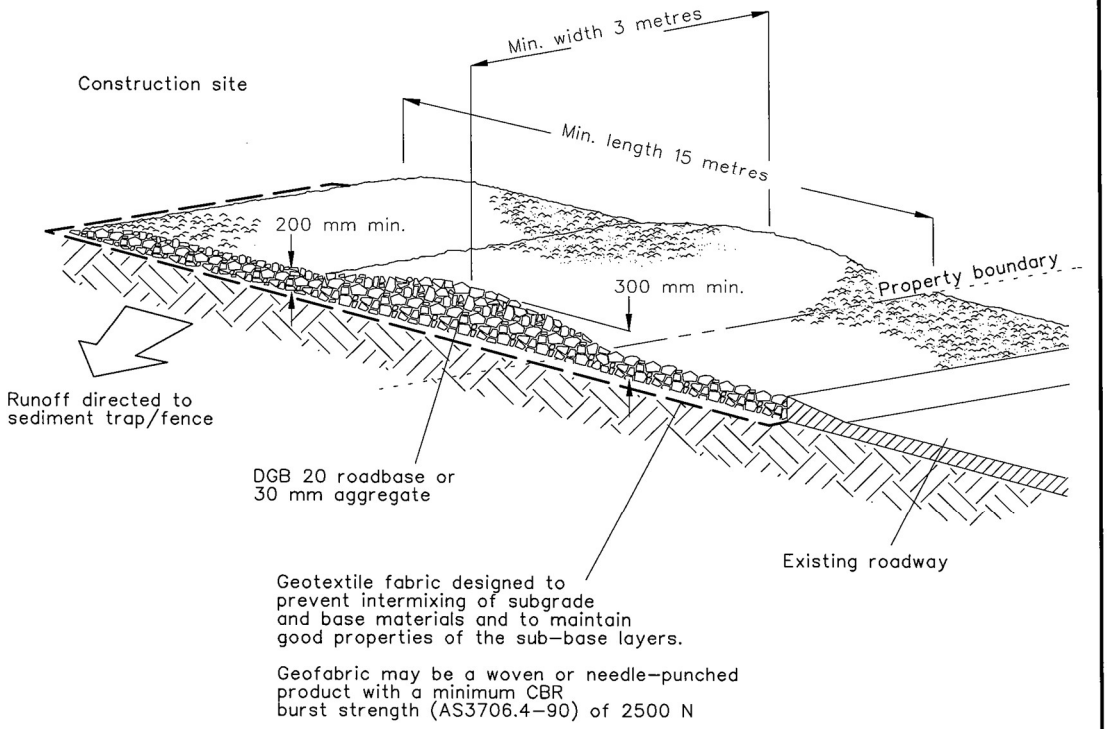


Construction Notes

1. Construct sediment fences as close as possible to being parallel to the contours of the site, but with small returns as shown in the drawing to limit the catchment area of any one section. The catchment area should be small enough to limit water flow if concentrated at one point to 50 litres per second in the design storm event, usually the 10-year event.
2. Cut a 150-mm deep trench along the upslope line of the fence for the bottom of the fabric to be entrenched.
3. Drive 1.5 metre long star pickets into ground at 2.5 metre intervals (max) at the downslope edge of the trench. Ensure any star pickets are fitted with safety caps.
4. Fix self-supporting geotextile to the upslope side of the posts ensuring it goes to the base of the trench. Fix the geotextile with wire ties or as recommended by the manufacturer. Only use geotextile specifically produced for sediment fencing. The use of shade cloth for this purpose is not satisfactory.
5. Join sections of fabric at a support post with a 150-mm overlap.
6. Backfill the trench over the base of the fabric and compact it thoroughly over the geotextile.

SEDIMENT FENCE **SD 6-8**

Source: Blue Book

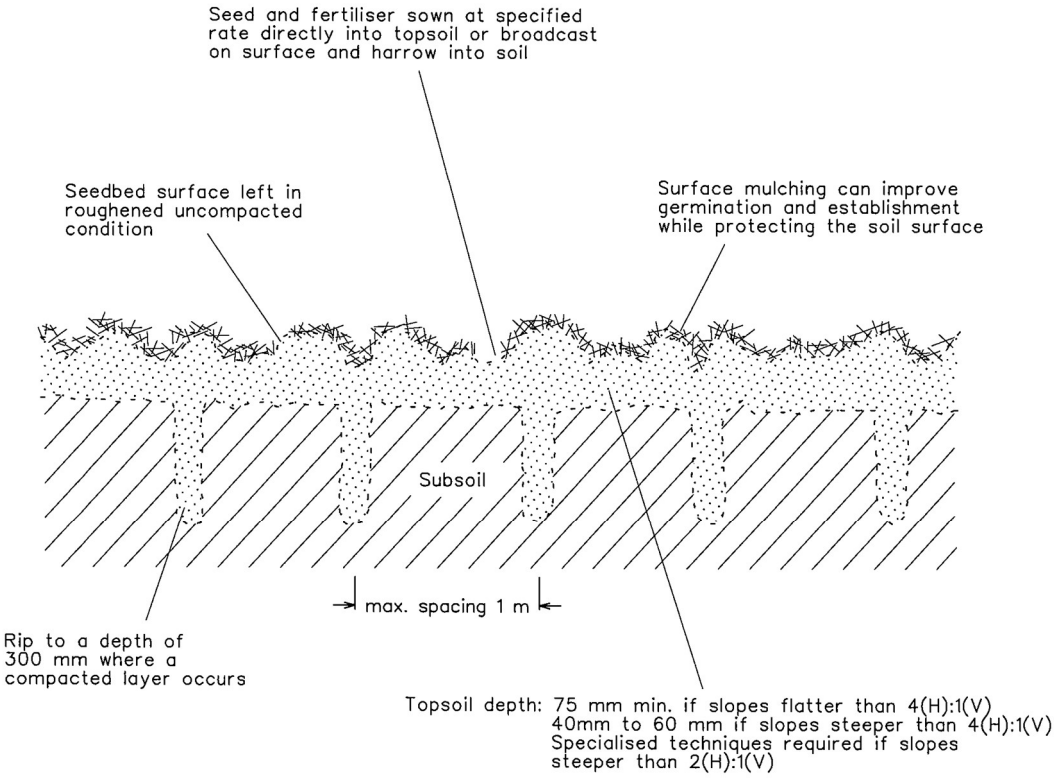


Construction Notes

1. Strip the topsoil, level the site and compact the subgrade.
2. Cover the area with needle-punched geotextile.
3. Construct a 200-mm thick pad over the geotextile using road base or 30-mm aggregate.
4. Ensure the structure is at least 15 metres long or to building alignment and at least 3 metres wide.
5. Where a sediment fence joins onto the stabilised access, construct a hump in the stabilised access to divert water to the sediment fence

STABILISED SITE ACCESS **SD 6-14**

Source: Blue Book



Construction Notes

1. Loosen compacted soil before sowing any seed. If necessary, rip the soil to a depth of 300 mm. Avoid rotary hoe cultivation.
2. Work the ground only as much as necessary to achieve the desired tilth and prepare a good seedbed.
3. Avoid cultivation in very wet or very dry conditions.
4. Cultivate on or close to the contour where possible, not up and down the slope.

SEEDBED PREPARATION **SD 7-1**

Source: Blue Book

CONSTRUCTION

1. REFER TO APPROVED PLANS FOR LOCATION AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. CLEAR THE FOUNDATION AREA OF THE OUTLET STRUCTURE (IF ANY), AND INSTALL AS PER SEPARATE INSTRUCTIONS.

3. EXCAVATE THE SETTLING POND IN ACCORDANCE WITH THE APPROVED PLANS. UNLESS OTHERWISE SPECIFIED, THE EXCAVATED PIT SHOULD HAVE A SIDE SLOPE OF 2:1(H:V) OR FLATTER.

4. APPROPRIATELY STABILISE ANY BANK SUBJECT TO DIRECT INFLOW.

5. ESTABLISH ALL NECESSARY UP-SLOPE DRAINAGE CONTROL MEASURES TO ENSURE THAT SEDIMENT-LADEN RUNOFF IS APPROPRIATELY DIRECTED INTO THE SEDIMENT TRAP.

6. TAKE ALL NECESSARY MEASURE TO MINIMISE THE SAFETY RISK CAUSED BY THE STRUCTURE.

MAINTENANCE

1. CHECK EXCAVATED SEDIMENT TRAPS AFTER EACH RUNOFF EVENT AND MAKE REPAIRS IMMEDIATELY.

2. INSPECT THE BANKS FOR SLUMPING OR EXCESSIVE SCOUR.

3. IF FLOW THROUGH THE STRUCTURE IS REDUCED TO AN UNACCEPTABLE LEVEL DUE TO BLOCKAGE OF THE OUTLET STRUCTURE (IF ANY), THEN MAKE ALL NECESSARY REPAIRS AND MAINTENANCE TO RESTORE THE DESIRED FLOW CONDITIONS.

4. CHECK THE STRUCTURE AND SURROUNDING CHANNEL BANKS FOR DAMAGE FROM OVERTOPPING FLOWS AND MAKE REPAIRS AS NECESSARY.

5. REMOVE SEDIMENT AND RESTORE ORIGINAL SEDIMENT STORAGE VOLUME WHEN COLLECTED SEDIMENT EXCEEDS 30% OF THE PIT VOLUME.

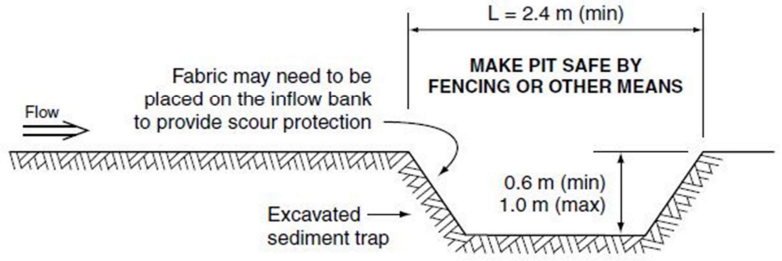
6. DISPOSE OF SEDIMENT AND DEBRIS IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

REMOVAL

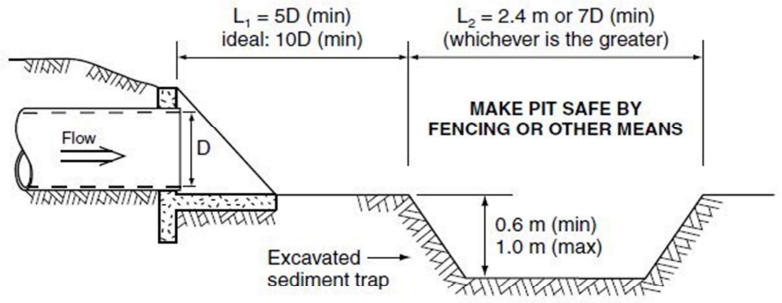
1. WHEN THE UP-SLOPE DRAINAGE AREA HAS BEEN STABILISED, REMOVE ALL MATERIALS INCLUDED DEPOSITED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

2. ALL WATER AND SEDIMENT SHOULD BE REMOVED FROM THE BASIN PRIOR TO THE DAM'S REMOVAL. DISPOSE OF SEDIMENT AND WATER IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

3. BRING THE DISTURBED AREA TO A PROPER GRADE, THEN SMOOTH, COMPACT AND STABILISE AND/OR REVEGETATE AS REQUIRED.



(a) Excavated sediment trap located within a minor drainage path



Where space is not available, make optimum use of the available space

(b) Excavated sediment trap located downstream of a stormwater outlet

Drawn:	Date:		
GMW	Apr-10	Excavated Sediment Trap	EST-01

Catchments & Creeks Pty Ltd

Source: International Erosion Control Association Best Practice Erosion and Sediment Control Guideline (IECA, 2008)

MATERIALS

(i) MULCH MUST COMPLY WITH THE REQUIREMENTS OF AS4454.

(ii) MAXIMUM SOLUBLE SALT CONCENTRATION OF 5dS/m.

(iii) MOISTURE CONTENT OF 30 TO 50% PRIOR TO APPLICATION.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION AND EXTENT. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, MATERIAL TYPE, OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. WHEN SELECTING THE LOCATION OF A MULCH FILTER BERM, TO THE MAXIMUM DEGREE PRACTICAL, ENSURE THE BERM IS LOCATED:

(i) TOTALLY WITHIN THE PROPERTY BOUNDARIES;

(ii) ALONG A LINE OF CONSTANT ELEVATION (PREFERRED, BUT NOT ALWAYS PRACTICAL);

(iii) AT LEAST 1m, IDEALLY 3m, FROM THE TOE OF A FILL EMBANKMENT;

(iv) AWAY FROM AREAS OF CONCENTRATED FLOW.

3. ENSURE THE BERM IS INSTALLED IN A MANNER THAT AVOIDS THE CONCENTRATION OF FLOW ALONG THE BERM, OR THE UNDESIRABLE DISCHARGE OF WATER AROUND THE END OF THE BERM.

4. ENSURE THE BERM HAS BEEN PLACED SUCH THAT PONDING UP-SLOPE OF THE BERM IS MAXIMISED.

5. ENSURE BOTH ENDS OF THE BERM ARE ADEQUATELY TURNED UP THE SLOPE TO PREVENT FLOW BYPASSING PRIOR TO WATER PASSING OVER THE BERM.

6. ENSURE 100% CONTACT WITH THE SOIL SURFACE.

7. WHERE SPECIFIED, TAKE APPROPRIATE STEPS TO VEGETATE THE BERM.

MAINTENANCE

1. DURING THE CONSTRUCTION PERIOD, INSPECT ALL BERMS AT LEAST WEEKLY AND AFTER ANY SIGNIFICANT RAIN. MAKE NECESSARY REPAIRS IMMEDIATELY.

2. REPAIR OR REPLACE ANY DAMAGED SECTIONS.

3. WHEN MAKING REPAIRS, ALWAYS RESTORE THE SYSTEM TO ITS ORIGINAL CONFIGURATION UNLESS AN AMENDED LAYOUT IS REQUIRED OR SPECIFIED.

4. REMOVE ACCUMULATED SEDIMENT IF THE SEDIMENT DEPOSIT EXCEEDS A DEPTH OF 100mm OR 1/3 THE HEIGHT OF THE BERM.

5. DISPOSE OF SEDIMENT IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

REMOVAL (IF REQUIRED)

1. WHEN DISTURBED AREAS UP-SLOPE OF THE BERM ARE SUFFICIENTLY STABILISED TO RESTRAIN EROSION, THE BERM MAYBE REMOVED.

2. REMOVE ANY COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

3. REHABILITATE/REVEGETATE THE DISTURBED GROUND AS NECESSARY TO MINIMISE THE EROSION HAZARD.

Recommended maximum berm spacing

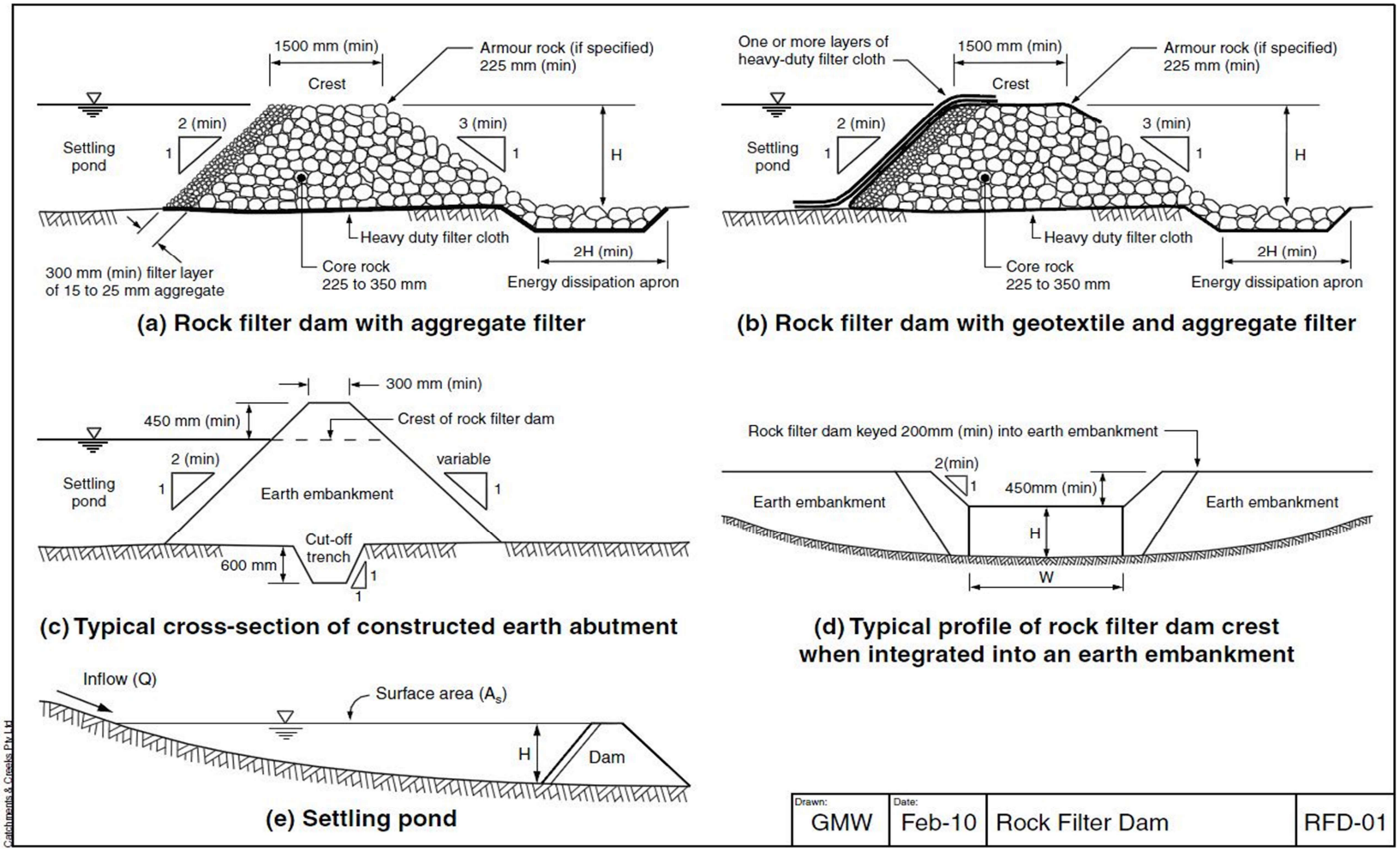
Land slope	Max spacing
< 2%	30 m
5%	25 m
10%	15 m
20%	8 m

Figure 1 - Typical placement of mulch filter berm

Drawn:	Date:		
GMW	Apr-10	Mulch Filter Berms	MB-01

Catchments & Creeks Pty Ltd

Source: IECA Best Practice Erosion and Sediment Control Guideline (IECA, 2008)



Source: IECA Best Practice Erosion and Sediment Control Guideline (IECA, 2008)

MATERIALS

PRIMARY CORE ROCK: WELL GRADED, HARD, ANGULAR, EROSION RESISTANT ROCK, WITH MEAN SIZE AS SPECIFIED IN THE APPROVED PLAN, BUT NOT LESS THAN 225mm, OR GREATER THAN 350mm.

ARMOUR ROCK: WELL GRADED, HARD, ANGULAR, EROSION RESISTANT ROCK, WITH MEAN SIZE AS SPECIFIED IN THE APPROVED PLAN, BUT NOT LESS THAN 225mm.

AGGREGATE FILTER: 15 TO 25mm CLEAN AGGREGATE.

GEOTEXTILE FILTER FABRIC: HEAVY-DUTY NON-WOVEN, NEEDLE-PUNCHED FILTER FABRIC, MINIMUM 'BIDIM' A34 OR EQUIVALENT.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. CLEAR THE FOUNDATION AREA OF THE ROCK FILTER DAM OF WOODY VEGETATION AND ORGANIC MATTER. DELAY CLEARING THE UP-SLOPE POND AREA UNTIL THE DAM IS FORMED AND IS ABLE TO ACT AS A SUITABLE SEDIMENT TRAP, OTHERWISE AN ALTERNATIVE TEMPORARY DOWNSTREAM SEDIMENT TRAP MAY BE REQUIRED DURING CONSTRUCTION OF THE ROCK FILTER DAM.

3. IF SPECIFIED ON THE PLANS, EXCAVATE A CUT-OFF TRENCH ALONG THE CENTRE-LINE OF THE DAM AND EARTH ABUTMENTS (IF ANY).

4. COVER THE FOUNDATION AREA AND CUT-OFF TRENCH WITH HEAVY-DUTY FILTER FABRIC BEFORE BACKFILLING WITH THE CORE ROCK. OVERLAP ADJOINING FABRIC SHEETS A MINIMUM OF 600mm.

5. CONSTRUCT THE ASSOCIATED EARTH ABUTMENT (IF ANY). ALL CUT AND FILL SLOPES SHOULD BE 2:1(H:V) OR FLATTER. THE DOWNSTREAM FACE OF EARTH ABUTMENTS SHOULD BE 3:1(H:V) OR FLATTER. EARTH ABUTMENTS SHOULD BE CONSTRUCTED OF WELL-COMPACTED, EROSION RESISTANT SOIL THAT IS FREE OF VEGETATION AND ROOTS. OVERFILL EARTH ABUTMENTS 150mm TO ALLOW FOR SETTLEMENT.

6. PLACE THE CORE ROCK FOR THE ROCK FILTER DAM. ENSURE THE UPSTREAM FACE IS 2:1(H:V) OR FLATTER, AND THE DOWNSTREAM FACE IS 3:1(H:V) OR FLATTER.

7. ENSURE THE ROCK IS MACHINE PLACED WITH THE SMALLER ROCKS WORKED INTO THE VOIDS OF THE LARGER ROCKS.

8. IF SPECIFIED, CONSTRUCT THE SPILLWAY SECTION USING THE SPECIFIED ARMOUR ROCK. THE SPILLWAY SHOULD HAVE A MINIMUM PROFILE DEPTH OF 300mm. THE SPILLWAY WEIR CREST MUST BE LEVEL ACROSS ITS FULL WIDTH. THE MAXIMUM LONGITUDINAL SLOPE OF THE ROCK SPILLWAY SHOULD BE 3:1(H:V). THE MINIMUM THICKNESS OF ARMOUR ROCK PROTECTION SHOULD BE 500mm, OR TWICE THE NOMINAL ROCK SIZE, WHICHEVER IS THE GREATER.

9. ENSURE THE SPILLWAY OUTLET SECTION EXTENDS DOWNSTREAM PAST THE TOE OF THE FORMED EMBANKMENT UNTIL STABLE CONDITIONS ARE REACHED, OR A DISTANCE EQUAL TO THE HEIGHT OF THE DAM, WHICHEVER IS THE GREATER. THE EDGES OF THE SPILLWAY SHOULD BE LEFT FLUSH WITH THE SURROUNDING GROUND.

10. INSTALL THE SPECIFIED FILTER (AGGREGATE AND/OR FILTER CLOTH) ON THE UPSTREAM FACE OF THE ROCK FILTER DAM.

11. IF FILTER CLOTH IS USED, THEN:
(i) EXTEND THE FABRIC OVER THE CREST OF THE ROCK FILTER DAM INTO THE SPILLWAY CHUTE;
(ii) CONSIDER THE PLACEMENT OF SEVERAL LAYERS OF OVERLAPPING FABRIC, THUS ALLOWING EACH LAYER TO BE REMOVED INDIVIDUALLY ONCE THE FABRIC BECOMES BLOCKED WITH SEDIMENT.

12. CLEAR THE SETTLING POND AREA OF WOODY VEGETATION AND ORGANIC MATTER TO THE DIMENSIONS SPECIFIED WITHIN THE PLANS.

13. WHERE NECESSARY, EXCAVATE THE UPSTREAM SETTLING POND AND/OR SEDIMENT STORAGE PIT IN ACCORDANCE WITH THE APPROVED PLANS. EXCAVATED PITS TYPICALLY HAVE SIDE SLOPES OF 2:1(H:V) OR FLATTER UNLESS STEEPER SLOPES ARE KNOWN TO BE STABLE.

14. STABILISE ANY ASSOCIATED EARTH EMBANKMENTS IMMEDIATELY AFTER CONSTRUCTION THROUGH APPROPRIATE COMPACTION, VEGETATION AND/OR EROSION CONTROL MATTING.

15. ESTABLISH ALL NECESSARY UP-SLOPE DRAINAGE CONTROL MEASURES TO ENSURE THAT SEDIMENT-LADEN RUNOFF IS APPROPRIATELY DIRECTED INTO THE SEDIMENT TRAP.

16. TAKE ALL NECESSARY MEASURE TO MINIMISE THE SAFETY RISK CAUSED BY THE STRUCTURE.

MAINTENANCE

1. CHECK ALL ROCK FILTER DAMS AFTER EACH RUNOFF EVENT AND MAKE REPAIRS IMMEDIATELY.

2. INSPECT ALL ROCK AND EARTH EMBANKMENTS FOR UNDERCUTTING OR UNDESIRABLE SEEPAGE FLOWS.

3. IDEALLY, ROCK FILTER DAMS SHOULD DISCHARGE (FROM FULL) OVER NO LESS THAN 8 HOURS. IF DRAINAGE IS TOO RAPID, THEN ADDITIONAL FILTER AGGREGATE MAYBE REQUIRED TO ACHIEVE OPTIMUM HYDRAULIC PERFORMANCE.

4. IF FLOW THROUGH THE STRUCTURE IS REDUCED TO AN UNACCEPTABLE LEVEL, THE UPSTREAM FILTER MEDIUM (AGGREGATE OR FILTER CLOTH) SHOULD BE REMOVED AND REPLACED.

5. IF A GREATER DEGREE OF WATER TREATMENT (FILTRATION) IS REQUIRED, EXTRA GEOTEXTILE FILTER FABRIC SHOULD BE PLACED OVER THE UPSTREAM FACE OF THE STRUCTURE.

6. CHECK THE STRUCTURE AND DOWNSTREAM CHANNEL BANKS FOR DAMAGE FROM OVERTOPPING FLOWS. MAKE REPAIRS AS NECESSARY.

7. IMMEDIATELY REPLACE ANY ROCK DISPLACED FROM THE SPILLWAY.

8. REMOVE SEDIMENT AND RESTORE ORIGINAL SEDIMENT STORAGE VOLUME WHEN COLLECTED SEDIMENT EXCEEDS 10% OF THE SPECIFIED STORAGE VOLUME.

9. DISPOSE OF SEDIMENT AND DEBRIS IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

REMOVAL

1. WHEN THE UP-SLOPE DRAINAGE AREA HAS BEEN STABILISED, REMOVE ALL MATERIALS INCLUDED DEPOSITED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

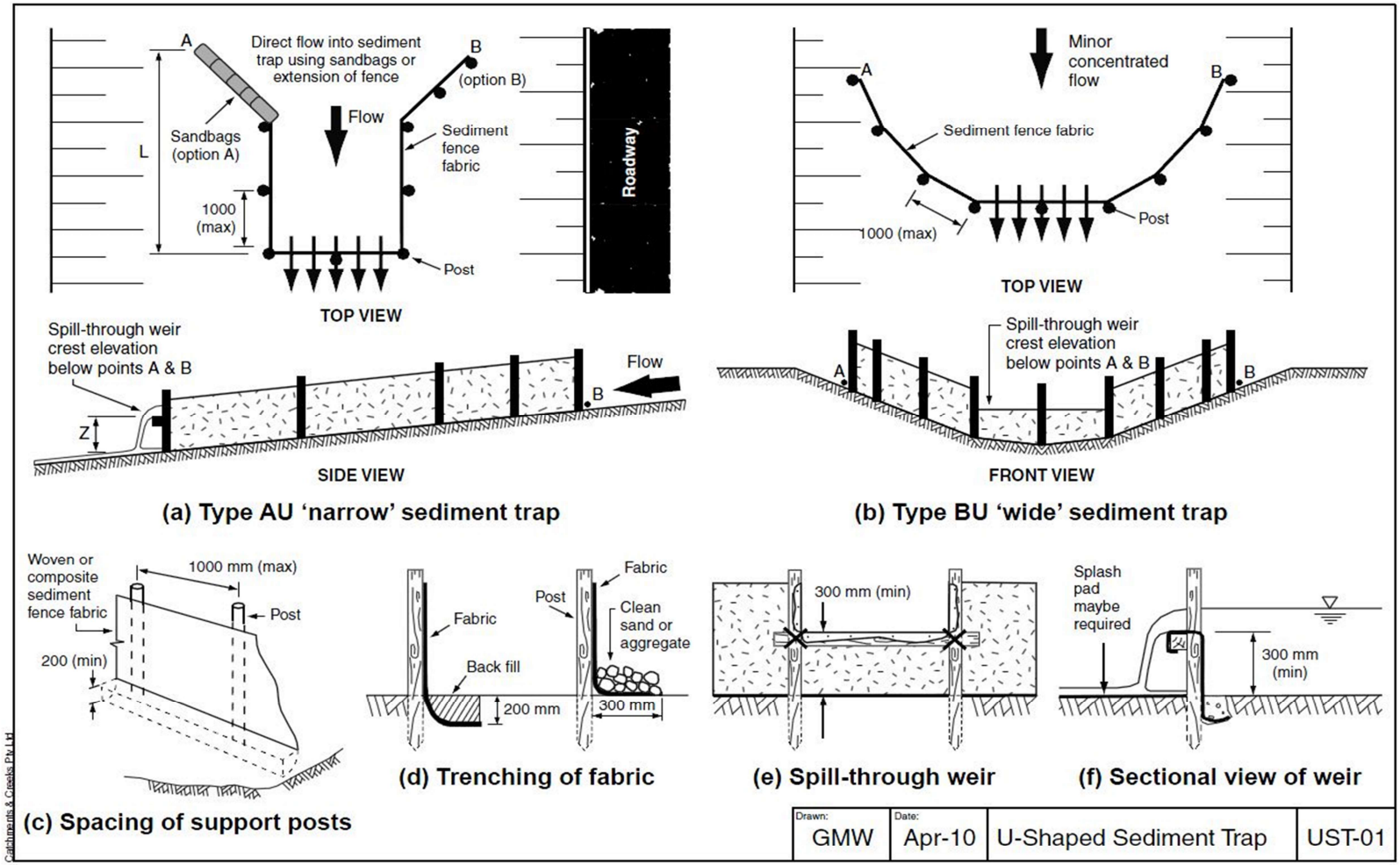
2. ALL WATER AND SEDIMENT SHOULD BE REMOVED FROM THE SETTLING POND PRIOR TO THE DAM'S REMOVAL. DISPOSE OF SEDIMENT AND WATER IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

3. BRING THE DISTURBED AREA TO A PROPER GRADE, THEN SMOOTH, COMPACT AND STABILISE AND/OR REVEGETATE AS REQUIRED TO MINIMISE THE EROSION HAZARD.

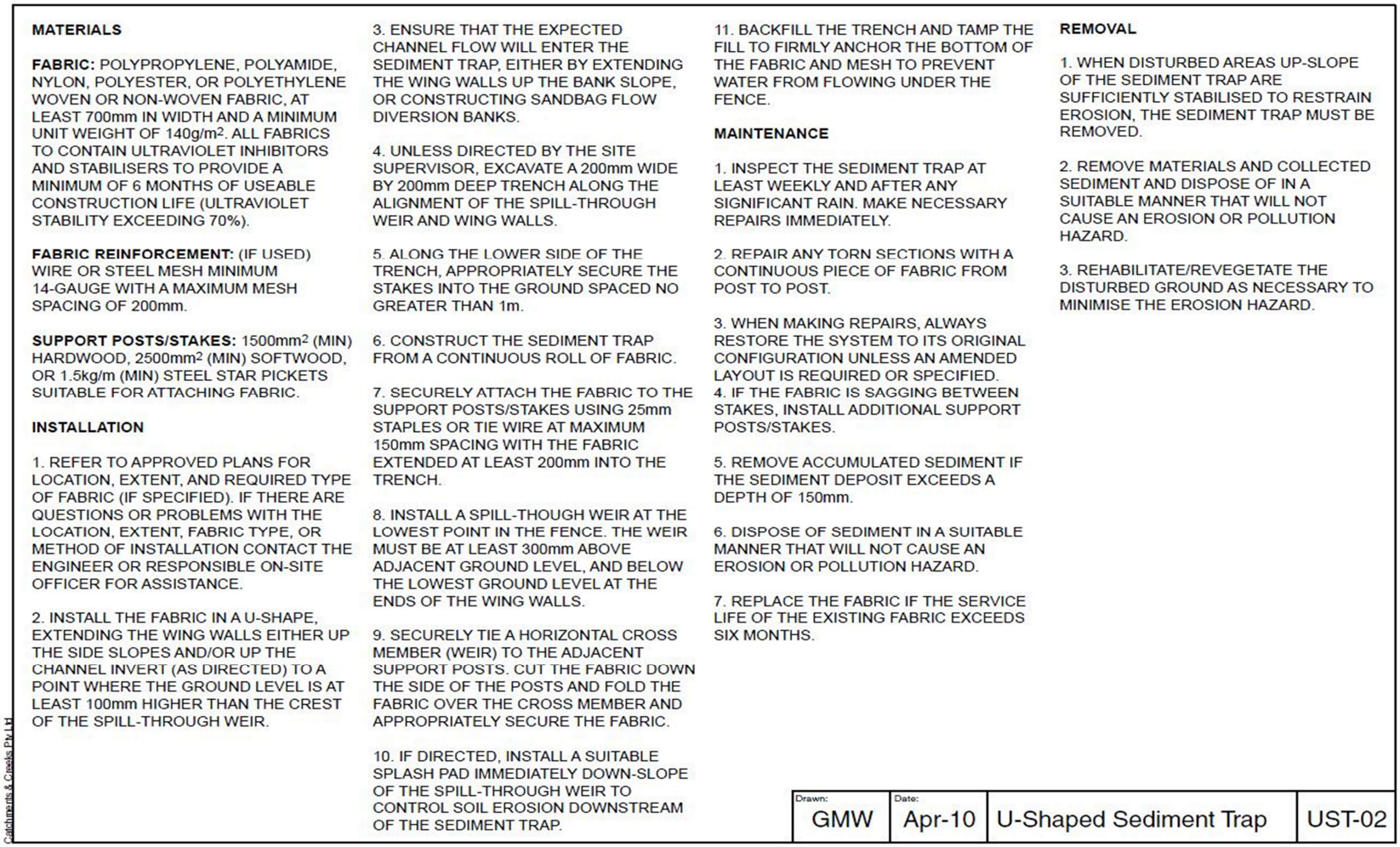
Drawn:	Date:		
GMW	Apr-10	Rock Filter Dam	RFD-02

Catchments & Creeks Pty Ltd

Source: IECA Best Practice Erosion and Sediment Control Guideline (IECA, 2008)



Source: IECA Best Practice Erosion and Sediment Control Guideline (IECA, 2008)



MATERIALS

FABRIC: POLYPROPYLENE, POLYAMIDE, NYLON, POLYESTER, OR POLYETHYLENE WOVEN OR NON-WOVEN FABRIC, AT LEAST 700mm IN WIDTH AND A MINIMUM UNIT WEIGHT OF 140g/m^2. ALL FABRICS TO CONTAIN ULTRAVIOLET INHIBITORS AND STABILISERS TO PROVIDE A MINIMUM OF 6 MONTHS OF USEABLE CONSTRUCTION LIFE (ULTRAVIOLET STABILITY EXCEEDING 70%).

FABRIC REINFORCEMENT: (IF USED) WIRE OR STEEL MESH MINIMUM 14-GAUGE WITH A MAXIMUM MESH SPACING OF 200mm.

SUPPORT POSTS/STAKES: 1500mm^2 (MIN) HARDWOOD, 2500mm^2 (MIN) SOFTWOOD, OR 1.5kg/m (MIN) STEEL STAR PICKETS SUITABLE FOR ATTACHING FABRIC.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND REQUIRED TYPE OF FABRIC (IF SPECIFIED). IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, FABRIC TYPE, OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. INSTALL THE FABRIC IN A U-SHAPE, EXTENDING THE WING WALLS EITHER UP THE SIDE SLOPES AND/OR UP THE CHANNEL INVERT (AS DIRECTED) TO A POINT WHERE THE GROUND LEVEL IS AT LEAST 100mm HIGHER THAN THE CREST OF THE SPILL-THROUGH WEIR.

3. ENSURE THAT THE EXPECTED CHANNEL FLOW WILL ENTER THE SEDIMENT TRAP, EITHER BY EXTENDING THE WING WALLS UP THE BANK SLOPE, OR CONSTRUCTING SANDBAG FLOW DIVERSION BANKS.

4. UNLESS DIRECTED BY THE SITE SUPERVISOR, EXCAVATE A 200mm WIDE BY 200mm DEEP TRENCH ALONG THE ALIGNMENT OF THE SPILL-THROUGH WEIR AND WING WALLS.

5. ALONG THE LOWER SIDE OF THE TRENCH, APPROPRIATELY SECURE THE STAKES INTO THE GROUND SPACED NO GREATER THAN 1m.

6. CONSTRUCT THE SEDIMENT TRAP FROM A CONTINUOUS ROLL OF FABRIC.

7. SECURELY ATTACH THE FABRIC TO THE SUPPORT POSTS/STAKES USING 25mm STAPLES OR TIE WIRE AT MAXIMUM 150mm SPACING WITH THE FABRIC EXTENDED AT LEAST 200mm INTO THE TRENCH.

8. INSTALL A SPILL-THOUGH WEIR AT THE LOWEST POINT IN THE FENCE. THE WEIR MUST BE AT LEAST 300mm ABOVE ADJACENT GROUND LEVEL, AND BELOW THE LOWEST GROUND LEVEL AT THE ENDS OF THE WING WALLS.

9. SECURELY TIE A HORIZONTAL CROSS MEMBER (WEIR) TO THE ADJACENT SUPPORT POSTS. CUT THE FABRIC DOWN THE SIDE OF THE POSTS AND FOLD THE FABRIC OVER THE CROSS MEMBER AND APPROPRIATELY SECURE THE FABRIC.

10. IF DIRECTED, INSTALL A SUITABLE SPLASH PAD IMMEDIATELY DOWN-SLOPE OF THE SPILL-THROUGH WEIR TO CONTROL SOIL EROSION DOWNSTREAM OF THE SEDIMENT TRAP.

11. BACKFILL THE TRENCH AND TAMP THE FILL TO FIRMLY ANCHOR THE BOTTOM OF THE FABRIC AND MESH TO PREVENT WATER FROM FLOWING UNDER THE FENCE.

MAINTENANCE

1. INSPECT THE SEDIMENT TRAP AT LEAST WEEKLY AND AFTER ANY SIGNIFICANT RAIN. MAKE NECESSARY REPAIRS IMMEDIATELY.

2. REPAIR ANY TORN SECTIONS WITH A CONTINUOUS PIECE OF FABRIC FROM POST TO POST.

3. WHEN MAKING REPAIRS, ALWAYS RESTORE THE SYSTEM TO ITS ORIGINAL CONFIGURATION UNLESS AN AMENDED LAYOUT IS REQUIRED OR SPECIFIED.
4. IF THE FABRIC IS SAGGING BETWEEN STAKES, INSTALL ADDITIONAL SUPPORT POSTS/STAKES.

5. REMOVE ACCUMULATED SEDIMENT IF THE SEDIMENT DEPOSIT EXCEEDS A DEPTH OF 150mm.

6. DISPOSE OF SEDIMENT IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

7. REPLACE THE FABRIC IF THE SERVICE LIFE OF THE EXISTING FABRIC EXCEEDS SIX MONTHS.

REMOVAL

1. WHEN DISTURBED AREAS UP-SLOPE OF THE SEDIMENT TRAP ARE SUFFICIENTLY STABILISED TO RESTRAIN EROSION, THE SEDIMENT TRAP MUST BE REMOVED.

2. REMOVE MATERIALS AND COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

3. REHABILITATE/REVEGETATE THE DISTURBED GROUND AS NECESSARY TO MINIMISE THE EROSION HAZARD.

Drawn:	Date:		
GMW	Apr-10	U-Shaped Sediment Trap	UST-02

Catchments & Creeks Pty Ltd

Source: IECA Best Practice Erosion and Sediment Control Guideline (IECA, 2008)

Attachment 3 - Surface Water Management Plan

NARRABRI MINE

SURFACE WATER MANAGEMENT PLAN

Prepared by:

Title	Name	Signature	Date
Senior Environmental Manager	S. van der Meulen Onward Consulting		29 November 2022
Director	Mark Vile Onward Consulting		29 November 2022

Onward document number:
NCO-003K-0A-PLN

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1. Introduction

1.1 Background

The Narrabri Mine is an existing underground coal mining operation situated in the Gunnedah Coalfield, approximately 25 kilometres (**km**) southeast of Narrabri and approximately 60 km northwest of Gunnedah, within the Narrabri Shire Council (**NSC**) Local Government Area, in New South Wales (**NSW**). It is operated by Narrabri Coal Operations Pty Ltd (**NCOPL**), on behalf of the Narrabri Mine Joint Venture[1], which consists of two Whitehaven Coal Limited's (**WHC**) wholly owned subsidiaries, and other joint-venture partners.

The Narrabri Underground Mine Stage 3 Extension Project (**Stage 3**) involves a southern extension to the previously approved Stage 2 mining area (approximately 609 ha of additional surface development footprint) to gain access to additional areas of coal reserves within Mining Lease Application (**MLA**) 1 and 2, an increase in the mine life to 2044, and the development of supporting surface infrastructure[2].

1.2 Purpose and scope

This Surface Water Management Plan (**SWMP** or **Plan**) has been developed in accordance with the Stage 3 Extension Project State Significant Development (**SSD**) 10269 Conditions of Consent (**CoC**) B36(e)(iii), the applicable Commonwealth and NSW State regulatory framework for surface water management, the requirements of the NSW Water Group within the Department of Planning and Environment (**DPE Water**) and the Environment Protection Authority (**EPA**).

As required by CoC B38, NCOPL will implement the SWMP as approved by the Planning Secretary. In accordance with CoC B37, NCOPL will not commence construction until this Plan is approved by the Planning Secretary.

This SWMP forms Attachment 3 of the Narrabri Mine Water Management Plan (**WMP**), developed in accordance with CoC B35 to CoC B38.

1.3 Objectives

The objectives of this Plan are to:

- provide details of the relevant statutory requirements, including any relevant approval, licence or lease conditions;
- describe the measures to be implemented to ensure compliance with the water management performance measures in accordance with CoC B34;
- provide baseline data on channel stability, water flows and water quality within surface waters potentially impacted by the development;
- detail the Narrabri Mine surface water management system, including plans, design objectives, performance criteria and management measures for water management infrastructure;
- detail any proposed discharges of treated water to the Namoi River;

[1] For full details on the joint venture ownership, refer to the introduction of the Environmental Management Strategy.

[2] For full detail on the background of the Narrabri Mine, refer to the overarching WMP.

- provide alternatives to direct measurement or prediction of creek flows to support surface water take licensing;
- provide the adopted surface water criteria, including trigger levels for identifying and investigating any potentially adverse impacts;
- detail the program to regularly review brine management and identify beneficial use options for each water type;
- detail a program to monitor and evaluate:
    - compliance with the relevant performance measures and criteria;
    - controlled and uncontrolled discharges and seepage/leachate from the site;
    - surface water inflows, outflows and storage volumes;
    - the effectiveness of the surface water management system and the measures in the Erosion and Sediment Control Plan; and
    - reporting procedures for the results of the monitoring program.
- detail the trigger action response plan (**TARP**) to respond to any exceedances of the performance measures and manage any surface water impacts of the Narrabri Mine.

1.4 Regulatory requirements

In accordance with CoC E5(b), Appendix A provides a summary of the relevant regulatory requirements relating to surface water and outlines the section of the WMP (including sub-plans) in which each of these conditions and commitments have been addressed.

In accordance with CoC E5(c), Appendix B provides a summary of the relevant commitments or recommendations within the EIS relating to surface water and outlines the section of the WMP (including sub-plans) in which each of these commitments have been addressed. These relevant commitments or recommendations include those as amended or added to by the:

- Applicant's Submission Report submitted 31 May 2021;
- Applicant's Amendment Report submitted 31 May 2021; and
- Applicant's final Biodiversity Development Assessment Report dated September 2021.

A detailed overview of the statutory requirements relating to water management is described in section 3 of the WMP.

1.5 Definitions

The terminology used within this SWMP are defined in the WMP.

2. Baseline data

The local drainage network is discussed in the Erosion and Sediment Control Plan (**ESCP**) (Attachment 2 of the WMP).

2.1 Surface water quality

2.1.1 Regional water quality

Water quality of the Namoi River is generally characterised by moderate alkalinity and elevated electrical conductivity (**EC**) relative to the default trigger values for ecosystem protection in upland rivers (>150 m altitude) in the ANZECC and ARMCANZ guidelines. EC values in the Namoi River at Gunnedah have ranged between 200 micro-Siemens per centimetre (**µS/cm**) and 900 µS/cm every year since 2001 and there is no significant trend to the data.

Basic water quality indicators such as EC, turbidity, total suspended solids (**TSS**), and nutrients were monitored on a monthly basis as part of the five-year Namoi Water Quality Project, starting in July 2002. Residues of herbicides and insecticides were also measured. Outcomes from the project found that:

- the majority of sites had median EC results that did not meet the ANZECC and ARMCANZ default trigger values for the protection of aquatic ecosystems of south-eastern Australia. Median EC values were below 650 µS/cm below Boggabri, which is suitable for irrigation water;
- median total phosphorus and total nitrogen was in excess of the ANZECC and ARMCANZ default trigger values in conjunction with low flows; and
- all sites in the Namoi River basin were found to have high enough total phosphorus concentration present to encourage algae growth.

2.1.2 Local water quality

Surface water quality monitoring has been undertaken by NCOPL at ten sites along the watercourses draining the Narrabri Mine since July 2007 (Figure 4-1). In addition, NCOPL established surface water monitoring sites along Tulla Mullen Creek Tributary 1 and Tributary 2 in 2017 (UT1DS and UT2DS) and another along Kurrajong Creek Tributary 1 (KC1TOP) to establish background water quality.

Sampling has been undertaken during or immediately following flow events for EC, pH, TSS, oil and grease and total organic carbon (**TOC**). Since the monitoring program began, there has been minimal disturbance within the catchment areas draining to monitoring sites KCUS, KCDS, KC1US, KC2US, UT1DS and UT2DS other than minor disturbance for exploration works. Monitoring sites KC1DS and KC2DS are downstream of the Pit Top Area and may be affected if there are discharges of disturbed runoff from the sediment dams.

Monitoring locations PC1 and PCa are located downstream of the ML 1609 longwall panel subsidence zones and gas pre-drainage drill sites. Limited data is available at KC1TOP, PCUS and PC3US.

The surface water quality in the water courses draining the Narrabri Mine can be characterised as:

- slightly alkaline, with median laboratory measured pH values ranging from 7.0 to 7.7 (within the ‘Ecosystem’ trigger value range);

- fresh, with median EC values ranging from approximately 63 µS/cm to 207 µS/cm (within the 'Ecosystem' trigger values range);
- variable levels of TSS, with median values ranging from approximately 20 mg/L to 132 mg/L;
- not affected by oil and grease contamination; and
- exhibiting low levels of TOC, with median values ranging from approximately 10 mg/L to 15.5 mg/L.

Water quality samples collected during the January 2020 runoff events were also analysed for dissolved and total metals. No previous water quality samples at any monitoring sites have been analysed for dissolved and total metals; therefore, baseline data is limited. Dissolved metal concentrations at more than half of the monitoring sites exceeded the water quality objectives (**WQO's**) 'Ecosystem' trigger values for iron, chromium, copper and zinc. Concentrations for all other heavy metal toxicants were below the WQO's 'Ecosystem' trigger values.

The differences in water quality between undisturbed monitoring locations (KCUS, KC1US and KC2US) and those located downstream of the Narrabri Mine (KCDS, KC1DS, KC2DS, PC and PC1) is small. Further, there has not been an increasing (or decreasing) trend in recorded water quality over time.

Table 2-1 provides a comparison of surface water quality data against the WQO's 'Ecosystem' trigger values for EC, pH, TSS, oil and grease and TOC.

Table 2-1 Comparison of surface water quality with the WQO's 'Ecosystem' trigger values

Water quality parameter		Sampling site										Namoi WQO trigger value*[a]
		Kurrajong Creek						Pine Creek		Tulla Mullen Creek		
		KCUS	KCDS	KC1US	KC1DS	KC2US	KC2DS	PC	PC1	UT1DS^	UT2DS^	
pH	20th %ile	7.1	7.1	7.1	7.1	6.7	6.8	6.9	7.2	-	-	6.5 – 8.0
	Median	7.4	7.4	7.3	7.5	7.0	7.1	7.2	7.4	7.7	7.1	
	80th %ile	7.6	7.6	7.6	7.7	7.3	7.4	7.4	7.7	-	-	
	N	50	39	32	54	47	47	56	55	1	1	
Electrical conductivity (µs/cm)	20th %ile	72.0	121.0	83.0	114.0	45.4	71.2	58.0	59.0	-	-	30 - 350
	Median	206.5	203.0	125.0	171.0	63.0	95.0	90.5	99.0	148	54	
	80th %ile	490.2	440.4	192.0	322.6	85.2	162.4	148.0	160.0	-	-	
	N	50	39	32	54	47	47	56	55	1	1	
Total suspended solids (mg/L)	20th %ile	25.0	16.8	18.6	21.2	8.2	16.0	16.8	31.6	-	-	NA
	Median	132.0	64.0	54.0	57.0	26.0	30.5	82.0	74.0	20	124	
	80th %ile	373.0	241.2	192.6	121.4	46.8	94.2	206.0	205.6	-	-	
	N	48	39	32	54	47	44	55	55	1	1	
Oil and grease (mg/L)	20th %ile	<5	<5	<5	<5	<5	<5	<5	<5	-	-	NA
	Median	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	
	80th %ile	<5	<5	<5	<5	<5	<5	5.4	<5	-	-	
	N	48	37	30	51	45	44	55	55	1	1	
Total organic carbon (mg/L)	20th %ile	7.0	7.0	8.0	9.0	9.0	12.0	7.4	7.0	-	-	NA
	Median	10.0	10.0	11.0	11.0	12.0	15.0	10.0	10.0	10	15	

Water quality parameter		Sampling site									Namoi WQO trigger value*a
		Kurrajong Creek						Pine Creek		Tulla Mullen Creek	
		KCUS	KCDS	KC1US	KC1DS	KC2US	KC2DS	PC	PC1	UT1DS^	UT2DS^	
	80th %ile	13.0	14.2	12.0	15.0	16.0	20.0	14.0	14.0	-	-	
	N	46	35	30	51	44	43	53	51	1	1	

* a Namoi River Water Quality and River Flow Objectives 'Ecosystem' trigger values.
N = Number of samples. NA = No WQO trigger value provided for this parameter
^ Monitoring point UT1DS renamed to TCDS and monitoring point UT2DS renamed to TC2DS.

2.2 Surface water flows

All watercourses traversing the mining area are ephemeral with minimal to no baseflow observed over a 15-year period, since NCOPL have been monitoring the waterways. Due to the highly ephemeral nature of the waterways, there is no recorded flow data.

2.3 Channel stability and riparian vegetation

2.3.1 Channel stability

The channel of Pine Creek and the channels of its tributaries are generally small, shallow, and ill-defined. The banks of the channels tend to be vertical indicating that the soils are highly dispersive adjacent to the drainage lines. The bed of Pine Creek and its tributaries generally consists of the same material as the surrounding soils (i.e., within the same horizon).

The main Kurrajong Creek channel originates to the west of the Narrabri Mine within the Pilliga East State Forest and drains in a north-easterly direction. It is predominately a third order watercourse under the Strahler stream ordering system. A large proportion of the creek channel consists of a broad flow path with no recognised low flow channel, however in some sections downstream, the creek channel is incised with vertical banks approximately 0.8 m deep and 10 m wide. Creek bed material predominantly consists of a sandy loam with intermittent sand deposition. The bed slope is between approximately 0.40% to 0.95%. There is a 4 metre (**m**) headcut separating the downstream incised channel and the upstream ill-defined channel immediately downstream of the mining area. The drop is associated with historical headward erosion of the channel bed (i.e. not due to the existing Narrabri Mine) and will likely continue to progress upstream with successive flood events.

Tulla Mullen Creek Tributary 1 originates to the west of the mining lease within the Pilliga East State Forest and drains in a north-easterly and then easterly direction, before draining into Tulla Mullen Creek. Tulla Mullen Creek Tributary 1 is a first order watercourse under the Strahler stream ordering system. It then becomes a third order watercourse as it crosses longwall 207. The channel of Tulla Mullen Creek Tributary 1 is generally V-shaped with a 1 m to 2 m wide base. The creek bed generally consists of a sandy loam with bed slope between approximately 0.95% to 1.2%.

2.3.2 Riparian vegetation

The riparian vegetation along Tulla Mullen Creek is mapped on the Groundwater Dependent Ecosystem Atlas (BoM, 2020) as a 'high potential' groundwater dependent ecosystem (**GDE**) feature. This feature is consistent with Plant Community Type (**PCT**) 399 Red Gum – Tea Tree Creek Woodland with a few small patches of PCT 244 Poplar Box Grassy Woodland. The vegetation is likely to be a facultative GDE[3] given the groundwater is approximately 5.2 meters below ground level (**mbgl**). The natural groundwater fluctuation estimated at groundwater bores in the locality is approximately 5.1 m.

The riparian vegetation on the Namoi River is mapped as PCT 53 Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains and PCT 78 River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion, both mapped as 'high potential' GDEs. The vegetation in this location is also likely to be a facultative given the groundwater

[3] Facultative GDEs require groundwater in some locations but not in others, particularly where an alternative source of water can be accessed to maintain ecological function.

is approximately 6.8 mbgl. The groundwater fluctuation estimated at bores in the locality is approximately 8.7 m.

2.4 Water supply for other surface water users

There are a number of major storages in the Namoi River catchment, namely the Keepit, Chaffey and Split Rock dams located on the Namoi, Peel and Manilla Rivers, respectively, which provide water for the licensed water users in the region under the licensing and approvals provisions of the WM Act. These provisions apply to water sources that are the subject of a WSP.

3. Implementation and management

3.1 Surface water management system

The Narrabri Mine water management system includes:

- up-catchment diversion structures to separate runoff from undisturbed and mining-affected areas;
- storage dams to collect mine water or Pit Top Area runoff for treatment and/or reuse;
- water treatment facilities to treat mine water for beneficial re-use or licensed discharge to the Namoi River;
- sediment dams for treatment of sediment laden runoff from disturbed areas;
- brine storage dams to collect brine waste product for subsequent reuse/disposal; and
- the Namoi River pump station, alluvial production bore and pipeline for supply of raw water and associated raw water storage dams.

The water management system also includes ancillary infrastructure to enable the transfer of water including sumps, drains, tanks, pumps, and pipelines. NCOPL will implement minor augmentations and extensions to the above infrastructure, including the progressive development of pumps, pipelines, water storage and other water management requirements to achieve the following general water management performance measures:

- maintain separation between clean, dirty (i.e. sediment-laden) and mine water management systems;
- minimise the use of clean and potable water on the site;
- maximise water recycling, reuse and sharing opportunities;
- minimise the use of make-up water from external sources;
- design, install, operate and maintain water management systems in a proper and efficient manner; and
- minimise risks to the receiving environment and downstream water users.

The Narrabri Mine site water management system will remain relatively the same as part of Stage 3. New brine storage dams and sediment dams will be built as documented in the Stage 3 EIS. Section 3 of the Site Water Balance (**SWB**) (Attachment 1 of the WMP) provides a detailed description of the site water management system and its function.

The Narrabri Mine water balance is influenced by groundwater inflows, water treatment plant operation, site water demands and runoff from surface water catchments. An operational simulation model (Goldsim) was configured for the Stage 3 EIS to simulate the operations of all major components of the water management system and to assess the dynamics of the mine water balance under conditions of varying rainfall and catchment conditions throughout the development of the mine. The current water balance modelling presented in the SWB (Attachment 1 of the WMP) indicates that:

- there will be no uncontrolled releases of mine water or brine from the site water management system, meaning the development of the mine will not adversely affect surface water quality in downstream receiving waters; and
- over time the mine is predicted to produce excess water to meet operational demands from underground and surface runoff, with external water demands declining to zero over time.

Containment of water potentially affected by coal or other substances is stored within low permeability lined ponds within the Pit Top Area.

Chemical and hydrocarbon products will be stored in bunded areas in accordance with *Australian Standard 1940:2017 The storage and handling of flammable and combustible liquids* (Standards Australia, 2017).

3.1.1 Brine management and beneficial reuse options

The NCOPL brine storage dams are managed to ensure there is sufficient operational storage under all climate conditions, with no uncontrolled discharges. These dams are managed in accordance with the Dam Operating Manual which includes consideration of the following:

- real time monitoring of water levels;
- weekly inspections of the dam structure;
- monthly internal reporting of the sites water inventory compared to forecast modelling;
- annual inspections by an external dam's engineer;
- emergency response TARPs; and
- annual water balance modelling to forecast brine inventories and assess the timing of construction of new brine storage dams.

NCOPL has implemented a program for the ongoing review of brine management and to identify any beneficial use options for brine, treated water, and mine water in accordance with the requirements of CoC B36(e)(iii). The program, documented in the *Narrabri Coal Mine Brine Management and Beneficial Use Options Report* (WRM, 2019), includes recommendations for brine management based on an assessment of:

- the reverse osmosis (**RO**) water treatment capacity;
- super concentration of brine (brine squeeze);
- the construction of additional brine storage dams;
- increase in brine use;
- use of mechanical evaporators; and
- use of evaporation covers.

In addition, a beneficial use options assessment was undertaken which included:

- permeate/filtered water onsite reuse, release and/or irrigation;
- brine onsite reuse, storage and/or evaporation; and
- mine water onsite reuse and treatment via the RO treatment plants.

Towards the completion of mining, the brine stored within the brine storage ponds will be reinjected into the longwall goaf through the disused goaf gas drainage holes. The brine dams will be decommissioned and rehabilitated once dewatered.

The brine management and beneficial use options assessment will be reviewed, and where necessary, revised, every five years.

3.1.2 Discharge to the Namoi River

As detailed in the SWB (Attachment 1 of the WMP), some of the permeate produced by the water treatment plant will be surplus to requirements and may be discharged to the Namoi River. The existing and approved pipeline currently used for the transfer of water from the river to the mine will be modified to allow for water transfer in the opposite direction. Any discharge to the Namoi River will be directly from the RO plants, or from a dedicated permeate storage. The discharge rate and volume to the river will be sized appropriate to the site water balance surplus. Leak detection will be installed on the pipeline and discharge at the river will be through a diffuser. An auto shut-off valve will be connected through remote process control linked to in-line pH and EC monitoring probes.

Discharge will be in accordance with the conditions of EPL 12789 and meet the following criteria:

- 50% of all samples (volume based) are to be below 250 mg/L of total dissolved solids (**TDS**);
- 100% of all samples (volume based) are to be below 350 mg/L TDS; and
- pH values of all sampled water are to be between 6.5 and 8.5.

The monitoring and sampling of water discharges to the Namoi River is further described in section 4.3.

3.1.3 Clean water management

The NCOPL Clean water management system is design to comply with the WM Act for the take of clean water. Where possible and practical to do so, NCOPL diverts clean water around the mine operation. Clean water take at NCOPL is grouped into four categories:

- **Licensed Extraction** - take from an approval extraction source using a water access license, the only licensed extraction point at NCOPL is the Namoi River pump.
- **Excluded works exemption** - clean water runoff into mine and dirty water dams where it is not possible or practical to divert does not need to be accounted for.
- **Harvestable rights** – NCOPL does not use any water from Harvestable rights dams, however there are approximately 51 farms dams within the NCOPL mine lease which were constructed prior to the mine
- **Mixed rights** – clean runoff captured in mine or dirty water dams where it is possible of practical to divert (SD5 and SD6)

Table 3-1 summaries NCOPL compliance with harvestable rights and mixed rights within the mine lease. NCOPL has an excess harvestable rights allowance of 111 ML.

Table 3-1 Summary of Narrabri Mine Harvestable Rights allowance

Description	Volume (ML)
Mining Lease area = 5298 hectares	
Maximum harvestable rights allowance	344
Harvestable rights dam capacity	233
Available harvestable rights allowance	111
Mixed rights allowance	85
Mixed rights used by site	8
Available mixed rights	77

3.2 Mine subsidence impacts

The predicted geomorphic impacts resulting from an increase in tilt and strain induced cracking are:

- surface cracking and shearing ranging in width from 100 mm to 400 mm could occur with occasional (<5% probability) wider cracks up to approximately 390 mm in sand or loam, and up to approximately 780 mm in clay or rock;
- surface gradients are likely to increase or decrease by up to 2.5% (±1.5º) along creeks;
- discontinuous, or B-Zone sub-surface fracturing is likely to interact with D-Zone surface cracks where cover depths are <300 m above the 306 m wide panels and <390 m above the wider longwalls, meaning creek flows may be temporarily re-routed into open cracks to below-surface pathways and re-surface downstream of the mining extraction limits (within the mining area);
- the majority of potential ponding areas already exist and will develop further along the watercourses and are likely to remain 'in-channel'; and
- the maximum change in pond depths is estimated to range from -0.1 m to 0.9 m (average of 0.6 m).

The relevant Mine Subsidence Assessment undertaken for each Extraction Plan will present a more comprehensive estimate of the predicted mine subsidence impacts.

Further detail of the impacts for each creek system are given in the following sections.

3.2.1 Channel geomorphology

The potential impacts of subsidence on stream function will be limited, since the overlying terrain has gentle slopes, and the streambeds are not deeply incised. Impacts are expected to primarily be erosion and ponding in streambeds associated with changes in slope from each longwall subsidence trough, which has the potential for development or extension of knickpoints or headcuts. Major changes in channel geomorphology along Kurrajong Creek, Tulla Mullen Creek Tributary 1, and other minor watercourses are unlikely. Given the ephemeral nature of the creeks, bed changes, erosion and potential incision are expected to occur as part of naturally occurring phenomena.

Table 3-2 describes the potential geomorphic risks to specific watercourses that are potentially prone to incision and destabilisation.

Table 3-2 Watercourse geomorphic risks

Watercourse	Geomorphic risks
Kurrajong Creek	• Pre- and post-subsidence channels are located within well-confined valleys. Therefore, major changes in channel geomorphology due to changes in channel location (avulsions) are unlikely. • Some 1st order channels may drain at alternate locations and cause localised bank scour, particularly above Longwall 207 and Longwall 209. • Contour banks above Longwall 203 and Longwall 204 may drain in two directions, causing contour banks to silt up and overtop, potentially resulting in minor downstream erosion by the concentration of flow. • In-channel ponding is expected to occur above all longwall panels upstream of each chain pillar and are expected to accumulate sediment over time. • Overbank ponding is expected to the south of Kurrajong Creek along Longwall 203. • The hydraulic and geomorphic characteristics of the channel at the previously identified and recorded headcut located downstream of the mining area is expected to be unchanged by the development.
Tulla Mullen Creek Tributary 1	• Pre- and post-subsidence channels are located within well-confined valleys. Therefore, major changes in channel geomorphology due to changes in channel location (avulsions) are unlikely. • In-channel ponding is expected to occur above all longwall panels upstream of each chain pillar and are expected to accumulate sediment over time. • Contour banks above Longwall 203 and Longwall 210 may drain in two directions, causing contour banks to silt up and overtop, potentially resulting in minor downstream erosion by the concentration of flow. • An existing farm dam located on cleared agricultural land across Longwall 203 draining to the south of Tulla Mullen Creek Tributary 1 will experience additional ponding.

Subsidence monitoring of creek lines will be conducted to determine if channel changes are mining-induced and will identify any requirements for remediation works (refer to section 4.5).

Erosion

Bed erosion and potential incision is expected to occur on the downstream side of each chain pillar due to an increase in channel slope. The loose sand bed material eroded from these reaches are expected to accumulate in the subsidence trough immediately upstream of the next chain pillar. This process is expected to occur across each chain pillar as mining progresses upstream.

As the beds across the chain pillars erode and the subsidence depressions accumulate the sediment, the only significant long term bed form change is predicted to l be at the upstream end of the most western longwall panel, which will remain with an increased slope, and at the eastern side of the most downstream panel, which will have a reduced bed slope. The streams are all first and second order watercourses with very little catchment at the upstream end of the most western longwall panel, significantly reducing the potential for long-term impacts, including the development or extension of knickpoints or headcuts.

The surface cracking associated with mine subsidence will expose soils to short term erosion during the first flush, which may temporarily increase turbidity and TSS in the local watercourse. It is expected that turbidity and TSS would revert back to background conditions for subsequent flow events as the cracks fill in and repair. As a result, water quality impacts associated with mine subsidence is not expected to be long term or significant.

Surface cracking associated with mine subsidence and the implementation of remedial measures (in accordance with section 3.5.4 of the ESCP [Attachment 2 of the WMP]) will be monitored to minimise potential impacts of short-term erosion during first flush events (refer to section 4.5).

Ponding

Impacts associated with existing subsidence (e.g. ponding) above Longwall 101 to Longwall 110 within Pine Creek and Pine Creek Tributary 1 are generally consistent with the predicted impacts, with maximum ground subsidence depths up to approximately 2.75 m.

Potential post-mining ponding locations have been identified for Stage 3, with the assessment of pre-mining surface level contours indicating that the majority of potential ponding areas already exist and will develop further along the watercourses and are likely to remain 'in-channel'. The maximum change in pre- and post-mining pond depth (where positive represents an increase in pond depth) is estimated to range from -0.1 m to 0.9 m (average of 0.6 m).

Subsidence remediation of ponding areas will include:

- ponding located in areas with no vegetation, or if vegetation is not affected, will be allowed to self-correct; and
- ponding located in areas with affected vegetation, or if ponding significantly alters or affects flows, will be assessed and remedial actions (that present the lowest environmental impact) developed in consultation with a geomorphologist.

The Stage 3 EIS has indicated that downstream riparian vegetation will already be adapted to the existing intermittent and infrequent flow conditions, and any change will be significantly less than the natural variation in flow. The total area of native vegetation predicted to be impacted by ponding is 3.6 hectares (**ha**). Riparian vegetation monitoring will be conducted in accordance with the Biodiversity Management Plan.

Detailed measures for surface crack remediation and ponding impacts will be documented in the relevant Extraction Plan/s. Remediation works within a watercourse will be undertaken in consideration of the *Guidelines for Controlled Activities on Waterfront Land* (NRAR 2018).

3.3 Local catchment flows

A summary of the reduction in local creek catchment areas is provided in Table 3-3. There will be a minor reduction in catchment flows associated with the proposed Southern Mine Water Storage (approximately 4.6 ha) shown in Figure 1-2 of the WMP. The reduction in Namoi River flows due to catchment excision will be insignificant.

Table 3-3 Existing and proposed changes to local creek catchments

Watercourse	Pre-mining catchment area (ha)	Catchment excised (ha)			Total catchment excised (%)
		Existing Narrabri Mine	Incremental change due to Stage 3 development	Total	
Pine Creek	6,800	0.0	0.0	0.0	0.00
Kurrajong Creek	5,500	247.3	0.0	247.3	4.50
Tulla Mullen Creek	10,700	0.0	4.6	4.6	0.04

Note: Does not include ventilation shaft and borehole sediment dam catchment impacts.

Subsidence was predicted to increase the surface area of depressions in drainage lines from 8.3 ha (existing case) to 16.7 ha (impacted case). The removal of the existing farm dams associated with Kurrajong Creek and Kurrajong Creek Tributary 1 will reduce the surface area under the impacted case to 13.2 ha. The total volume of water retained in the local waterways by the additional surface depressions, assuming no remediation or infilling, will be 41.8 ML without the removal of the farm dams and 24.5 ML when the dams are removed. There will be a negligible to no impact on the flow regime of the watercourses as this volume is negligible when compared to the expected mean annual runoff volume for Kurrajong Creek and Tulla Mullen Creek Tributary 1 to the eastern boundary (combined) of 1,230 ML.

There will be negligible baseflow changes to the Namoi River during the life of mine. However, there will be minor reductions in baseflow in the Namoi River post-mining. The predicted reduction in baseflows in the Namoi River will not measurably affect overall baseflow.

For the purpose of restoring flow in watercourses within and in the vicinity of the mine, NCOPL will decommission the two farm dams located on Kurrajong Creek (as discussed above) as well as other farm dams (where necessary) subject to obtaining relevant approvals.

The maximum annual take of water from subsidence surface cracks (conservatively assuming the cracks will be filled twice between each six-month rehabilitation period), is estimated to be:

- 3,500 m^3 or 3.5 ML for the 1st and 2nd order watercourses;
- 700 m^3 or 0.7 ML for the 3rd order watercourses; and
- a total of 4,200 m^3 or 4.2 ML from all watercourses.

This capture volume is negligible when compared with the expected average annual runoff volume from all local catchments of more than 2,800 ML. For the predicted surface water take due to surface cracking within first and second order watercourses (up to 3.5 ML/annum), NCOPL may rely on its harvestable right entitlement for the water storages.

A water access license may be required for the take from the third order watercourses issued under the *WSP for the Namoi and Peel Unregulated Rivers Water Sources 2012* (Eulah Creek Water Source) and the harvestable right defined under the WM Act may be used for the take from the first and second order watercourses. NCOPL will obtain the appropriate licence under the Eulah Creek Water Source once the subsidence induced water take requirement is quantified as outlined in section 4.4.1.

3.4 Namoi River surface water extraction

Licensed surface water extraction from the Namoi River will be undertaken when supply from the underground mining area is insufficient to meet the mine's water demands and external make-up water is required. Water will be extracted in accordance with the licensed entitlements allocated under the relevant water access licenses (**WALs**) held by NCOPL (section 3.3.1 of the SWB [Attachment 1 of the WMP]) and the rules prescribed in the WSP.

The SWB modelling (section 3.5 of the SWB [Attachment 1 of the WMP]) demonstrates that make-up water demands can be met with water licences currently held by NCOPL.

3.5 Flooding

The Narrabri Mine Pit Top Area (with the exception of the Namoi River pump station, alluvial production bore and the pipeline) is located outside the Upper Namoi Valley floodplain management plan extent and at least 20 m in elevation above the Namoi River floodplain (i.e. outside the 100-year average recurrence interval (**ARI**) flood extent). As such, the Namoi River will not inundate the Pit Top Area.

Conversely, the impact of the Namoi River pump station, alluvial production bore and pipeline on the Namoi River Floodplain will be negligible, given they are mostly underground with minimal above-ground components. Consequently, the development and operation of Narrabri Mine will not have any significant impact on Namoi River flooding.

Flooding from the local watercourses has been assessed and does not pose a risk to operational areas, as the watercourses are small.

3.6 Water supply for other surface water users

Farm dams located downstream of the Narrabri Mine that potentially draw on creek flows may require compensation measures should surface flows or water quality be impacted by mining operations, taking into account allowable water capture associated with harvestable water rights under the WM Act. In accordance with CoC B32, if NCOPL and a landowner cannot agree on whether the loss of water is to be attributed to the development or the measures to be implemented under CoC B28 to CoC B31, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Planning Secretary for resolution.

In addition, appropriate impact management strategies for farm dams and soil contour banks will be described in the relevant Extraction Plan/s. Remediation will occur to any of the farm dams if significant drawdown is observed.

3.7 Sewage treatment and effluent management

The onsite sewage treatment plant will be used to treat wastewater from bath house facilities with the effluent (treated water) discharged to a suitable transpiration area. On-site sewage treatment and disposal will be managed in accordance with the requirements of the NSC.

3.8 Water management of rehabilitated areas

NCOPL will progressively rehabilitate disturbed land and construct drainage controls to improve soil stability and ripping to promote infiltration. Runoff from areas under active rehabilitation will be captured in sediment dams and either transferred to the site water management system for reuse in mine operations or undergo controlled release following rainfall events that exceed sediment dam design capacity via licensed discharge points (in accordance with EPL 12789). Operational sediment and erosion control devices will be maintained during the establishment of revegetation.

Once self-sustaining stable final landforms have been achieved within an area, key elements of the operational sediment control structures will be either left as passive water control storages or removed to allow the area to become free draining.

Section 3.5.6 of the ESCP (Attachment 2 of the WMP) provides measures for erosion and sediment control in rehabilitated areas.
Surface water monitoring program

3.9 Monitoring standards

Surface water monitoring at Narrabri Mine will be undertaken in accordance with the Australian Standard for Water Quality Sampling *AS/NZS 5667.1:1998* and the *Approved Methods for the Sampling and Analysis of Water Pollutants in NSW* (EPA 2022). Laboratory analysis will be undertaken by a laboratory which has the relevant accreditation by the National Association of Testing Authorities (**NATA**).

3.10 Water storages

3.10.1 Sediment dams

Condition L2 of EPL 12789 specifies the concentration limits for each sediment dam discharge monitoring point. The impact assessment criteria detailed in Table 4-1 are relevant to water discharged from the Narrabri Mine.

Table 3-4 Sediment dam discharge concentration limits

Pollutant	Units of Measure	100 percentile concentration limit	Monitoring location
Oil and Grease	mg/L	10	SD2, SD4, SD7, and SD8
pH	pH	6.5 - 8.5	SD2, SD4, SD7, and SD8
Total Suspended Solids (TSS)	mg/L	50	SD2, SD4, SD7, and SD8

The TSS concentration limits in Table 4-1 may be exceeded for water discharged provided that:

- the discharge occurs solely as a result of rainfall measured at the premises that exceeds 38.4 mm over any consecutive 5-day period[4] immediately prior to the discharge occurring; and
- all practical measures have been implemented to dewater all sediment dams within 5 days of rainfall such that they have sufficient capacity to store run off from a 38.4 mm, 5-day rainfall event.

[4] 38.4 mm equates to the 5-day 90%ile rainfall depth for Gunnedah sourced from Table 6.3a *Managing Urban Stormwater: Soils and Construction Volume 1: 4th edition,* March 2004.

Table 4-2 below details the sediment dam monitoring program and Figure 4-1 shows the sediment dam monitoring locations.

Table 3-5 Sediment dam monitoring program

Monitoring location	Coordinates (GDA 94 / MGA 55)		Parameters	Frequency
	Easting	Northing		
SD1	778977	6619758	**Field analysis:** • Water level / storage volume • EC • pH • Turbidity • Dissolved oxygen (**DO**) • Temperature **Laboratory analysis:** • pH • EC • TDS • TSS • Turbidity • TOC • Oil & Grease • Metals and metalloids - aluminium, arsenic, cadmium, chromium, copper, lead, nickel, selenium, zinc, iron, molybdenum, antimony, mercury, cobalt.	• Monthly (water level) • Quarterly (water quality) • During discharge event but within 12 hours of discharge from SD2, SD4, SD7 and SD8 (monitoring required from SD2, SD4, SD7 and SD8 only).
SD2	779147	6619777		
SD3	778498	6620790		
SD4	778725	6620664		
SD6	775632	6620750		
SD7	779219	6620708		
SD8	773846	6620368		

3.10.2 Rail loop dams and sediment basins

No discharge of mine water from the rail loop storage dams or the sediment basins is licensed to occur under EPL 12789.

Table 4-3 below details the mine water storage monitoring program and Figure 4-1 shows rail loop dams and sediment basin monitoring locations.

Table 3-6 Mine water storage monitoring program

Monitoring location[1]	Coordinates (GDA 94 / MGA 55)		Parameters	Frequency
	Easting	Northing		
Sediment basins				
SB1	778249	6619758	**Field analysis:** • Water level / storage volume • EC • pH • Turbidity • DO • Temperature **Laboratory analysis[2]:** • pH • EC • TDS • TSS • Turbidity • TOC • Oil & Grease • Metals and metalloids - aluminium, arsenic, cadmium, chromium, copper, lead, nickel, selenium, zinc, iron, molybdenum, antimony, mercury, cobalt.	• Monthly (water level) • Quarterly (water quality)
SB2	778549	6619835		
SB3	777336	6620765		
SB4	778309	6620726		

Monitoring location[1]	Coordinates (GDA 94 / MGA 55)		Parameters	Frequency
	Easting	Northing		
Rail Loop Dams				
A1	778483	6620267	**Field analysis:** • Water level / storage volume • EC • pH • Turbidity • DO • Temperature **Laboratory analysis[2]:** • pH • EC • TDS • TSS • Turbidity • TOC • Oil & Grease • Total algae, Alkalinity, Acidity, Sulfate and Sodium Adsorption Ratio • Metals and metalloids - aluminium, arsenic, cadmium, chromium, copper, lead, nickel, selenium, zinc, iron, molybdenum, antimony, mercury, cobalt.	• Monthly (water level) – *excluding boxcut*. • Quarterly (water quality)
A2	778419	6620387		
A3	778393	6620458		
B1	778507	6620082		
B2	778614	6620327		
Boxcut[3]	777827	6620316		
C	778748	6620293		

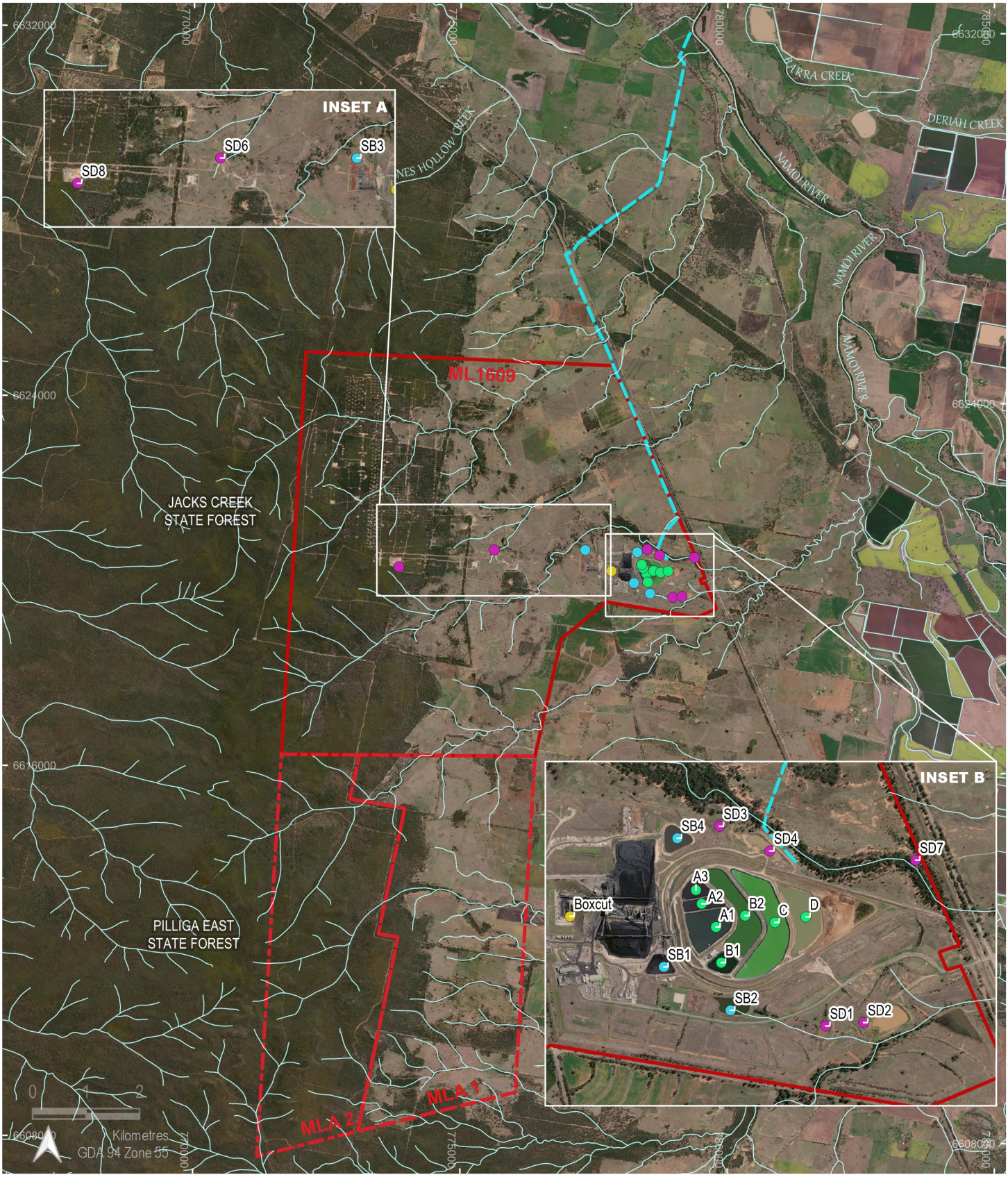
Monitoring location[1]	Coordinates (GDA 94 / MGA 55)		Parameters	Frequency
	Easting	Northing		
D	778887	6620323		

Note:

[1] The new brine ponds (BR1 to BR5) will be progressively added to the monitoring program following construction of each pond.

[2] Metals (except arsenic and selenium), sodium adsorption ratio and algae are not analysed for the boxcut.

[3] Additional monitoring of water quality entering the underground mine workings is included in the Groundwater Management Plan (**GWMP [Attachment 4 of the WMP]**).



WHITEHAVEN COAL

ONWARD CONSULTING

LEGEND

- ML1609
- MLA1
- MLA2
- Namoi River pipeline (buried)
- Watercourse

Surface water monitoring locations

- Boxcut
- Rail loop dam
- Sediment basin
- Sediment dam

NARRABRI MINE

FIGURE 4-1

Mine water storage and sediment dam monitoring locations

3.11 Treated water discharge

The criteria listed in Table 4-3 are relevant to excess treated water discharged from the Narrabri Mine to the Namoi River. The concentration limits are in accordance with EPL 12789 Condition L.2 and CoC B34. In accordance with EPL 12789 condition M2.7, NCOPL will collect samples as soon as practicable after each discharge commences from point NR1 and in any case not more than 4 hours after each discharge.

Table 3-7 Namoi River discharge criteria and sampling requirements

ID	Parameter	Unit	Concentration limit		Method	Frequency
			50%-ile	100%-ile		
NR1	pH	pH	-	6.5-8.5	In situ	As soon as practicable after each discharge commences from point NR1 and in any case not more than 4 hours after each discharge
	TDS	mg/L	250	350	Grab sample	
	EC[1]	µs/cm	(417) ^	(583) ^	In-situ	
NRUS	pH	pH	-	-	In situ	
	TDS	mg/L	-	-	Grab sample	
NRDS	pH	pH	-	-	In situ	
	TDS	mg/L	-	-	Grab sample	

Note:

^The numbers in brackets are not concentration limits, but represent a proxy for the TDS limits through measurement of EC. A factor of 0.6 has been adopted to represent the relationship between TDS and EC at the Narrabri Mine. The adopted value is considered reasonable and is based on known relationships throughout Australia. Monitoring data has shown the factor is very conservative but will be used until an accurate TDS to EC conversion factor has been established.

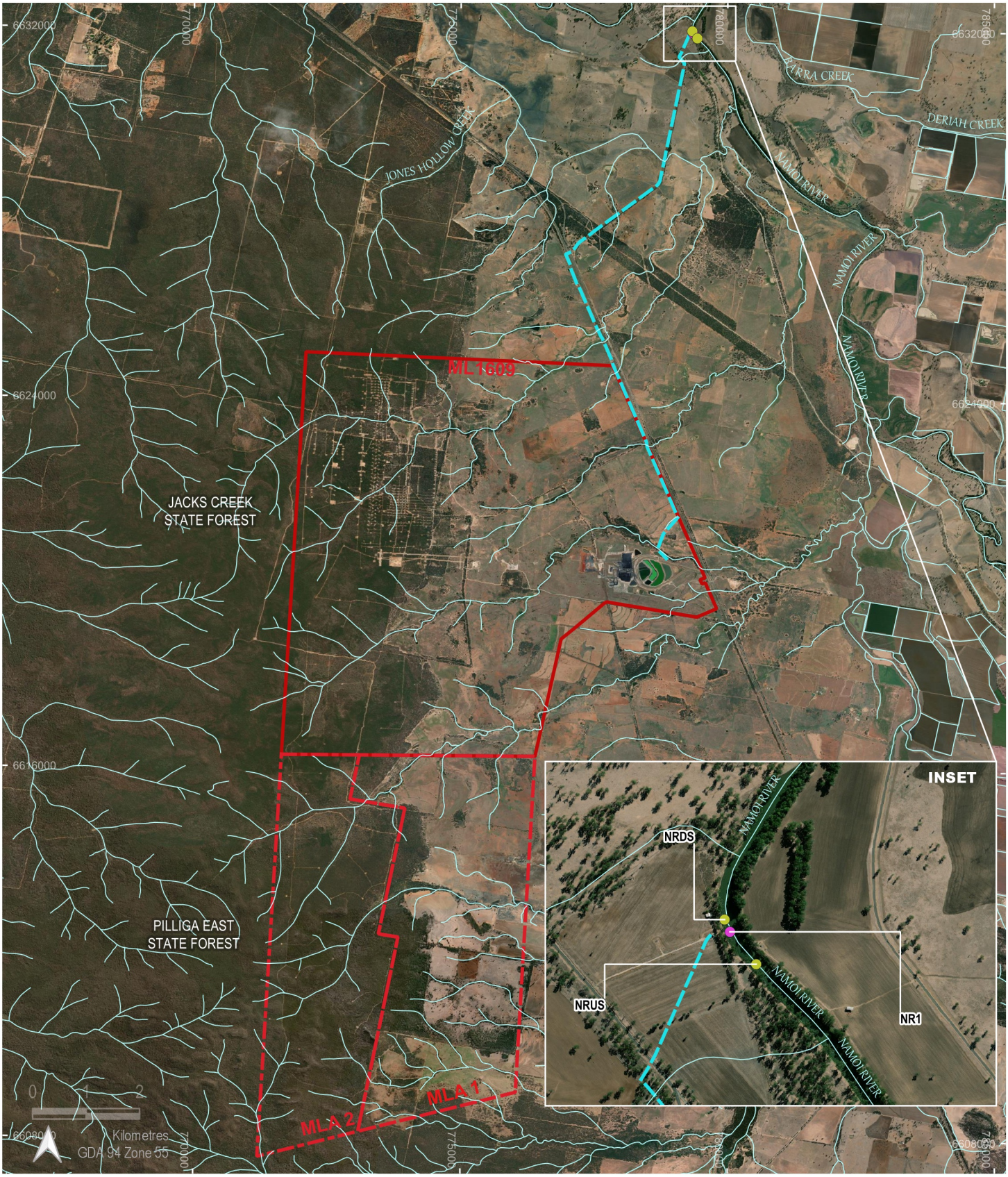
Continuous (in-line) pH and EC monitoring of the permeate will occur at the water treatment plant as an internal operational control. Grab samples for pH and TDS will be obtained at the discharge location NR1. No discharge will occur at any time if the pH or EC values are outside of the criteria in Table 4-3.

Samples of representative ambient river water will be collected at NRUS and NRDS for laboratory analysis for TDS. In-situ (field) pH analysis will be conducted using an appropriately calibrated and multi-parameter water quality meter. All permeate discharge data, including date, time, duration, volumes and the *in-situ* and laboratory analysis results will be recorded and reported as required.

The coordinates of the Namoi River discharge and monitoring locations are presented in Table 4-4, with the locations shown in Figure 4-2.

Table 3-8 Permeate discharge and monitoring locations

NCOPL ID	Eastings	Northings	EPL site ID	Comment / monitoring purpose
NR1	779308	6631939	EPL 24	Discharge point at the Namoi River
NRUS	779387	6631803	EPL 25	Upstream ambient water quality monitoring point for Namoi River discharge point (NR1)
NRDS	779319	6631992	EPL 26	Downstream ambient water quality monitoring point for Namoi River discharge point (NR1)



WHITEHAVEN COAL

ONWARD CONSULTING

LEGEND

- ML1609
- MLA1
- MLA2
- Namoi River monitoring point
- Namoi River discharge point
- Namoi River pipeline (buried)
- Watercourse

NARRABRI MINE

FIGURE 4-2
Namoi River Discharge and Monitoring Points

3.12 Surface water creeks

The surface water impact assessment criteria for monitoring locations downstream of the Narrabri Mine have been established with reference to baseline data presented in section 2.1. The impact assessment criteria has been established for the purpose of assessing potential impacts on the receiving environment from mining operations in accordance with the *Australian & New Zealand Guidelines For Fresh & Marine Water Quality Australian* (ANZG 2018) and the *NSW Water Quality Objectives* (DEC 2006).

The impact assessment criteria have been derived from historical surface water quality data which has been collected at the Narrabri Mine since July 2017, as described in section 2.1.2.

The site specific impact assessment criteria for downstream receiving waters are:

- pH is outside the range of 6.5 – 8.0 for three consecutive readings.
- Stage 1 EC, TSS and TOC above 90% probability of being different from those already measured (i.e. 90% confidence level).
- Stage 2 EC, TSS and TOC above 95% probability of being different from those already measured (i.e. 95% confidence level).

The surface water quality impact assessment criteria and corresponding monitoring location are presented in Table 4-6.

Table 3-9 Downstream surface water impact assessment criteria

Parameter	Trigger	Monitoring location[1]				
		PCa	PC1	KC1DS	KC2DS	KCDS
pH[2]	-	6.5 - 8.0	6.5 - 8.0	6.5 - 8.0	6.5 - 8.0	6.5 - 8.0
EC (µs/cm)	Stage 1	163.5	235.0	580.0	181.5	477.3
	Stage 2	169.3	511.9	741.0	204.0	572.0
Total suspended solids (mg/L)	Stage 1	288.0	259.5	252.2	108.0	439.2
	Stage 2	315.7	470.3	372.4	334.6	533.9
Total organic carbon (TOC)	Stage 1	15.6	18.0	20.0	22.8	16.7
	Stage 2	16.8	20.3	21.2	24.0	18.9

Notes:

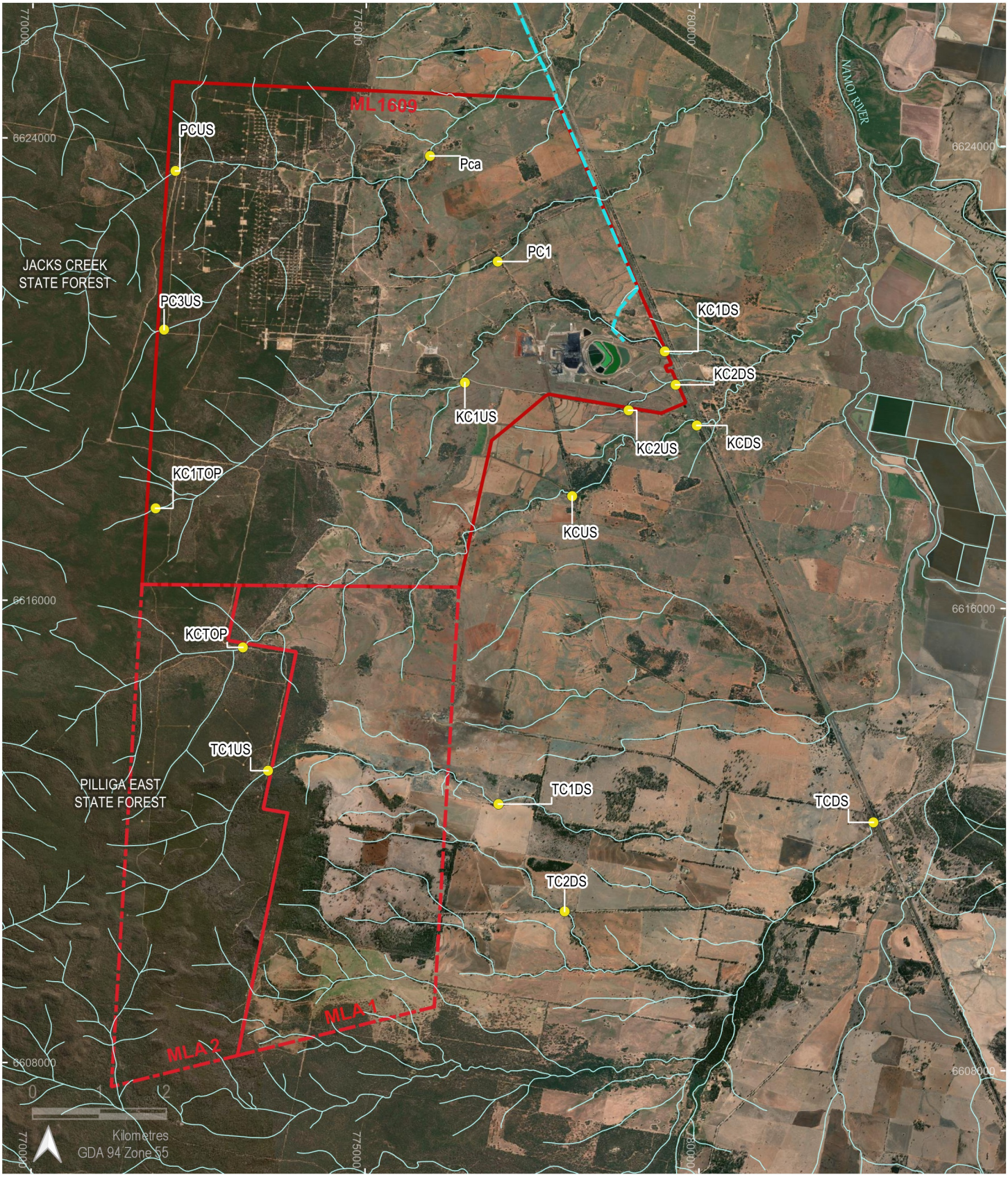
[1] Impact assessment criteria will be derived for monitoring location TCDS once sufficient baseline data has been collected.
[2] Namoi River Water Quality and River Flow Objectives 'Ecosystem' trigger values.

Table 4-7 details the surface water monitoring program and Figure 4-3 presents the monitoring locations. Any new sites that may be established will require the collection of sufficient baseline data to derive site specific impact assessment criteria as defined in this section.

Table 3-10 Surface water monitoring program

Monitoring location	Coordinates (GDA 94 / MGA 55)		Parameters	Frequency
	Easting	Northing		
PCUS	771758	6623420	**Field analysis:** • EC • pH • Turbidity • DO • Temperature • Laboratory analysis: • pH • EC • TDS • TSS • Turbidity • TOC • Oil & Grease • Metals and metalloids - aluminium, arsenic, cadmium, chromium, copper, lead, nickel, selenium, zinc, iron, molybdenum, antimony, mercury, cobalt.	• Quarterly, in the event of flow during the quarter • During discharge event from SD2, SD4, SD7 and SD8 but within 12 hours of discharge^. Locations to be monitored during discharge events include: ▪ During discharge from SD2 – KC2US and KC2DS will be monitored. ▪ During discharge from SD4 and/or SD7 – KC1US and KC1DS will be monitored. ▪ During discharge from SD8 – KC1TOP and KC1US will be monitored.
PCa	775957	6623752		
PC1	776973	6621935		
PC3US	771974	6620707		
KC1TOP	771851	6617614		
KC1US	776483	6619836		
KC1DS	779479	6620404		
KC2US	778937	6619379		
KC2DS	779642	6619827		
KCUS	778093	6617886		
KCDS	779961	6619127		
TCDS	782609	6612284		
KCTOP	773161	6615221		
TC1US	773540	6613092		
TC2DS	777985	6610701		
TC1DS	776993	6612548		

Note:
^ Sample collected when safe to do so and access permits, generally during daylight hours.



WHITEHAVEN COAL

ONWARD CONSULTING

LEGEND

- ML1609
- MLA1
- MLA2
- Ambient flow monitoring point
- Namoi River pipeline (buried)
- Watercourse

NARRABRI MINE

FIGURE 4-3
Surface Water Monitoring Locations

3.12.1 Stream flow

In accordance with CoC B36(e)(iii), NCOPL are required to consider alternatives to measuring or predicting creek flows for the purpose of supporting water take licensing, to improve understanding of the hydrology, and to interpret water quality and erosion observations.

An assessment will be undertaken by a surface water specialist within 12 months of commencement of Stage 3 to consider alternative methodologies of measuring and/or predicting creek flows. Following the assessment, the appropriate method (if feasible) for formally recording creek flow conditions and contingency measures will be incorporated into this Plan.

An approach for quantifying losses of stream flow from surface cracking and ponding for a range of climatic scenarios will be established and included in this Plan following the assessment. The aim of this monitoring is to determine the requirement for a WAL under the *WSP for the Namoi and Peel Unregulated Rivers Water Sources 2012* (Eulah Creek Water Source).

To detect potential surface water ingress into the underground workings the monitoring of underground dewatered volumes is undertaken in accordance with the Groundwater Management Plan (Attachment 4 of the WMP). A significant increase in the monitored flow following surface runoff would indicate that surface water may have reached the underground workings.

3.13 Channel geomorphology and riparian vegetation

Observations of any subsidence effects such as surface cracking, ponding, and erosion will be recorded and reported to the Environment Superintendent as they are identified. Surface cracks are considered permanent if they have not closed within one month of the longwall face passing. Where this occurs, appropriate management measures will be implemented as detailed in the relevant Extraction Plan/s.

Visual inspections will be performed to determine surface crack locations and extent of ponding within the predicted subsidence zones. Monitoring will record the location, the extent of ponding (size) and if there is significant vegetation that may require monitoring of vegetation health. Where significant impacts to vegetation are detected (e.g. canopy dieback), vegetation monitoring will be conducted in accordance with the Biodiversity Management Plan. For ponding where there is little or no vegetation, the extent of ponding will be monitored to assess the risk of downstream impacts (i.e. water quality).

Creek line subsidence surveys will be designed to identify the main geomorphic zones and to provide quantitative information to document changes in channel cross-section, bed erosion and deposition. Geomorphic zones will be defined during baseline surveys based on stream order, dominant channel bed material, bed stability, and channel geometry etc.

Locations for cross-sections will also be determined during the baseline surveys to confirm channel parameters (i.e. channel width, depth, area, and bank full level). A reach of at least 100 m in length will be surveyed from each geomorphic zone and at least four cross sections recorded at equal intervals along the reach. Two to three reaches each at least 100 m long within a control zone will also be surveyed to provide information on natural channel variability between survey periods. These control surveys will provide an indication of natural variability due to rainfall events that can be used to determine if channel changes are mining-induced (e.g. changes to channel area and bed slope, erosion of channel banks and bed, or sediment deposition). Permanent pegs will be established at each cross-section to ensure comparability of cross-section sequences.

Creek line surveys will be undertaken annually and after a significant rainfall event (defined as a 5-day 90th percentile rainfall event which is 38.4 mm over 5 consecutive days). Restriction of flows and hence restriction

of fish passage will be assessed following a rainfall event to facilitate appropriate restorative measures (if required). The final location of on-going monitoring reaches and cross-sections will be determined following the completion of the baseline survey.

Table 4-7 provides the creek line subsidence monitoring program which is detailed further in the relevant Extraction Plan/s.

Table 3-11 Summary of creek line subsidence monitoring program

Aspect/feature	Frequency	Method and analysis	Parameters
Surface cracking and ponding			
Surface cracking	During active subsidence, monthly and following a significant rainfall event (defined as a rainfall event >38.4 mm over 5 consecutive days).	Visual inspections directly behind to longwall face to: • identify areas of surface cracking and ponding. • identify erosion/potential erosion. • record nature and extent of sedimentation (location, extent, depth, sediment calibre). • identify a decline in riparian vegetation health in ponded areas. • determine appropriate management response.	• surface crack GPS location, depth and width. • bed and bank stability. • erosion and potential for erosion (e.g., nick points, head cuts). Vegetation health is to be monitored in accordance with the relevant Extraction Plan.
Watercourses and ponding	Baseline and then quarterly during active subsidence	Visual inspection and photographs within the active subsidence zone to: • Identify areas of ponding, including vegetation. • Identify erosion/potential erosion. • Record nature and extent of sedimentation (location and approximate extent/depth). • Determine appropriate management response.	• Ponding GPS location, width, depth, area, presence of vegetation. • Bed and bank stability. • Watercourse erosion and potential for erosion (e.g., knickpoints, head cuts).
Remote sensing			
Topography and landscape morphology	Baseline then every 3 years (triennially).	LiDAR over entire site.	• high resolution topography. • creek line slope and volumes.
Vegetative cover characteristics and erosion monitoring	Baseline and then annually.	Multi-spectral imaging.	• vegetative biomass and cover (pasture). • erosion.
Creek line surveys			

Aspect/feature	Frequency	Method and analysis	Parameters
Geomorphic survey	Baseline and then annually for a period of 2 years following longwall mining.	In watercourses with a predicted risk of altered bed slopes following subsidence and likely effects of increased channel gradients (e.g. upstream and downstream of chain pillars)	• mapping and description. • survey (100 m reach).
Channel survey	Baseline and then annually for a period of 2 years following longwall mining.	• effectiveness of gully erosion stabilisation methods. • cross-section diagrams.	• identification of ponding - GPS location, width, depth, area, significant vegetation. • channel parameters. • advancement of gully erosion.
Direct field survey	Following changes detected during remote sensing.	• field inspection. • sampling/testing as required.	Determined during field survey.

3.14 Meteorological monitoring

The meteorological monitoring program is described in the SWB (Attachment 1 of the WMP).

4. Trigger Action Response Plan

The TARP (Table 5-1) includes triggers to respond to any exceedances of the surface water related criteria and performance measures. The TARP also includes trigger levels for identifying and investigating any potential adverse impacts associated with channel stability and riparian vegetation health.

TARPs for water supply for other water users will be developed as part of the relevant Extraction Plan/s.

The previous Surface and Groundwater Response Plan is now incorporated into the TARP (Table 5-1) and the exceedance notification and reporting requirements are detailed in section 6 and section 7 of the WMP.

Table 4-1 Surface water TARP

<table>
<tr><th>Method</th><th>Status</th><th>Trigger</th><th>Action</th><th>Response</th></tr>
<tr><td colspan="5">Water quality creeks</td></tr>
<tr><td rowspan="2">To identify potential surface water quality impacts as a result of mining activities (e.g. via run off, subsidence cracking, ponding, erosion, changes in water course morphology).

Sites:
• PCa, PC1, KC1DS, KC2DS, KCDS.

Parameters:
• Field - EC, pH
• Laboratory - TSS, TOC

Frequency:
• Quarterly.
• During flow event (as practical).
• During discharge event from SD2, SD4, SD7 and SD8 but within 12 hours of discharge (as practical).

Analysis:
• Comparison to water quality impact assessment criteria (with consideration to upstream water quality and water quality trends over time).</td><td>Normal</td><td>Water quality below established trigger levels and CoC B34 performance measures met.</td><td>None required.</td><td>• Continue to implement surface water management measures in accordance with this Plan.
• Continue routine surface water monitoring and evaluation of results.</td></tr>
<tr><td>Level 1</td><td>• Less than pH 6.5 or greater than pH 8.0.
• EC, TSS and TOC exceeding Stage 1 trigger shown below.
<table><tr><th rowspan="2">Parameter</th><th rowspan="2">Trigger</th><th colspan="5">Monitoring location</th></tr><tr><th>PCa</th><th>PC1</th><th>KC1DS</th><th>KC2DS</th><th>KCDS</th></tr><tr><td>EC (µs/cm)</td><td>Stage 1</td><td>163.5</td><td>235.0</td><td>580.0</td><td>181.5</td><td>477.3</td></tr><tr><td>Total suspended solids (mg/L)</td><td>Stage 1</td><td>288.0</td><td>259.5</td><td>252.2</td><td>108.0</td><td>439.2</td></tr><tr><td>Total organic carbon (TOC)</td><td>Stage 1</td><td>15.6</td><td>18.0</td><td>20.0</td><td>22.8</td><td>16.7</td></tr></table></td><td>Conduct preliminary quality assurance of data to confirm an exceedance.</td><td>For a single exceedance, the exceedance will be recorded, with no further contingency or notification measures required. If pH or a Stage 1 trigger is exceeded at the same location for three consecutive sampling events, then the actions required for Level 2 will be implemented.</td></tr>
</table>

<table>
<tr><th>Method</th><th>Status</th><th>Trigger</th><th>Action</th><th>Response</th></tr>
<tr><td></td><td>Level 2</td><td>

Less than pH 6.5 or greater than pH 8.0 for three consecutive monitoring events.
EC, TSS and TOC exceeding Stage 1 trigger (shown below) for the same parameter exceeded at the same location for three consecutive monitoring events.
EC, TSS and TOC exceeding Stage 2 trigger (shown below).

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Trigger</th><th colspan="5">Monitoring location</th></tr>
<tr><th>PCa</th><th>PC1</th><th>KC1DS</th><th>KC2DS</th><th>KCDS</th></tr>
<tr><td rowspan="2">EC (µs/cm)</td><td>Stage 1</td><td>163.5</td><td>235.0</td><td>580.0</td><td>181.5</td><td>477.3</td></tr>
<tr><td>Stage 2</td><td>169.3</td><td>511.9</td><td>741.0</td><td>204.0</td><td>572.0</td></tr>
<tr><td rowspan="2">Total suspended solids (mg/L)</td><td>Stage 1</td><td>288.0</td><td>259.5</td><td>252.2</td><td>108.0</td><td>439.2</td></tr>
<tr><td>Stage 2</td><td>315.7</td><td>470.3</td><td>372.4</td><td>334.6</td><td>533.9</td></tr>
<tr><td rowspan="2">Total organic carbon (TOC)</td><td>Stage 1</td><td>15.6</td><td>18.0</td><td>20.0</td><td>22.8</td><td>16.7</td></tr>
<tr><td>Stage 3</td><td>16.8</td><td>20.3</td><td>21.2</td><td>24.0</td><td>18.9</td></tr>
</table>
</td><td>

Conduct preliminary quality assurance of data to confirm an exceedance.
Environmental Superintendent to implement contingency and notification measures as per section 6 of the WMP.

</td><td>

Hydrologist (or similar specialist) to review sampling and climate data and compare to upstream value to confirm likely mining impact or otherwise. If mine related, undertake physical inspection of affected surface and creeks to identify potential source of water quality degradation.
Implement appropriate management or contingency response (i.e. repair of subsidence cracking, remediation of ponding, erosion control works and rehabilitation).

</td></tr>
<tr><td colspan="5">Water quality sediment dam storages</td></tr>
<tr><td rowspan="2">Sites:
All licensed discharge points (SD2, SD4, SD7 and SD8).
Parameters:
Field - pH
Laboratory - TSS, oil and grease
Frequency:
During discharge event but within 12 hours of discharge from SD2, SD4, SD7 and SD8.
Analysis:
Comparison to water quality impact assessment criteria. Used to identify potential discharge non-compliance.</td><td>Normal</td><td>Discharge water quality below established trigger levels and performance measures met.</td><td>None required.</td><td>

Continue to implement surface water management measures in accordance with this Plan.
Continue routine surface water monitoring and evaluation of results.

</td></tr>
<tr><td>Level 2</td><td>
Discharge exceeding impact assessment criteria.
<table>
<tr><th>Pollutant</th><th>Units of Measure</th><th>100 percentile concentration limit</th></tr>
<tr><td>Oil and Grease</td><td>mg/L</td><td>10</td></tr>
<tr><td>pH</td><td>pH</td><td>6.5 - 8.5</td></tr>
<tr><td>Total Suspended Solids (TSS)</td><td>mg/L</td><td>50</td></tr>
</table>
Note:
The TSS concentration limit may be exceeded for water discharged provided that:

the discharge occurs solely as a result of rainfall measured at the premises that exceeds 38.4 mm over any consecutive 5-day period immediately prior to the discharge occurring; and
all practical measures have been implemented to dewater all sediment dams within 5 days of rainfall such that they have sufficient capacity to store run off from a 38.4 mm, 5-day rainfall event.

</td><td>

Environmental Superintendent to implement contingency and notification measures as per section 6 of the WMP.
Environmental Superintendent to implement Pollution Incident Response Management Plan (PIRMP).

</td><td>

Report exceedance in accordance with the WMP.
Investigate cause of exceedance and implement identified adaptive management measures.

</td></tr>
<tr><td colspan="5">Water level in rail loop water storages A1, A2, A3, B1, B2, C, D – these storages are classified as a Declared Dam and managed in accordance with the required Dam Operations and Maintenance Manual</td></tr>
</table>

Method	Status	Trigger	Action	Response
Discharges to the Namoi River				
In situ sampling using multi-parameter probe to monitor the filtered water quality from the RO plants prior to and during discharge to the Namoi River at location NR1. **Sites**: • RO plant. **Parameters**: • Field – pH, EC **Frequency**: • Prior to and continuous during discharge. **Analysis**: • Comparison to the impact assessment criteria. Used to identify potential discharge non-compliance.	**Normal**	• Less than 417 µS/cm EC as a proxy for 250 mg/L TDS (50th percentile value). • Greater than pH 6.7 or less than pH 8.3.	Continue discharge and continuous monitoring.	None required.
	Level 1	**Level 1A** Greater than 417 µS/cm EC as a proxy for 250 mg/L TDS (50th percentile value). **Level 1B** • Greater than 525 µS/cm EC as a proxy for 315 mg/L TDS (90th percentile value). • Less than pH 6.7 or greater than pH 8.3 (within 0.2 units of pH limit).	**Level 1A** Monitor and adjust the RO treatment and discharge as required to maintain filtered water quality within discharge limits. **Level 1B** Cease release.	**Level 1A** None required. **Level 1B** Adjust the RO treatment to within 50th percentile and monitor water quality for 24 hours before recommencing discharge.
	Level 2	• Exceed limits: ▪ EC – greater than 580 µS/cm as a proxy for TDS limit of 350 mg/L. ▪ pH – less than pH 6.5 and greater than pH 8.5.	• Cease release. • Environmental Superintendent to implement contingency and notification measures as per section 6 of the WMP. • Environmental Superintendent to implement Pollution Incident Response Management Plan (**PIRMP**).	• Report exceedance in accordance with the WMP. • Investigate cause of exceedance and implement identified adaptive management measures.
Vegetation health (ponding)				
To ensure that surface water ponding does not result in adverse impacts to vegetation health. **Sites:** • Within the subsidence zone above undermined longwall panels. **Parameters**: • Identification of changes in topography that leads to ponding. **Frequency**: • Monthly visual inspection when ponded water is present.	**Normal**	No adverse impacts on vegetation observed.	None required.	• Continue to implement surface water management measures in accordance with this Plan. • Continue routine surface water ponding monitoring and evaluation of results.
	Level 1	Identified adverse impacts on vegetation, apparent from visual observations during monthly inspections.	Record visual observations, including photographs.	Investigate options to dewater the ponded area to limit further impacts on vegetation health and implement identified adaptive management measures.

Method	Status	Trigger	Action	Response
• Annual multi-spectral imaging. • Three yearly LiDAR survey. **Analysis**: • Identification of potential ponding areas via changes in topography. Identified via creek line surveys and LiDAR survey. • Riparian vegetation health.	**Level 2**	Significant impacts to vegetation identified (e.g. canopy dieback, tree death).	Record visual observations, including photographs.	• Should vegetation be at risk, undertake a geomorphological assessment to determine options to have the subsidence ponded area freely drain. • Undertake survey to identify vegetation community and impacted area. The disturbance will be recorded in the site clearing register.
Changes in water course morphology				
To determine if subsidence due to mining is impacting on the morphology of creeks. This may occur in the channel and the wider floodplain. **Sites:** • In watercourses with a predicted risk of altered bed slopes and likely effects of increased channel gradients (e.g. upstream and downstream of chain pillars). **Parameters:** • Identification of changes in planform, creek grade, bank erosion and sedimentation. **Frequency:** • Annually. **Analysis:** • Identified via creek annual creek line surveys and subsidence visual inspections.	**Normal**	No identified impacts on water course morphology.	None required.	• Continue to implement surface water management measures in accordance with this Plan. • Continue routine creek line monitoring program and evaluation of results.
	Level 1	Changes in channel cross-section, bed erosion, incision and deposition identified.	Record observations, including photographs.	• A qualified geomorphologist will be consulted to develop an action plan which may involve further monitoring or remediation (with consideration given to application of the River Style Framework for classifying channel condition and recovery). • Implement geomorphologists action plan. • Implement contingency and notification measures as per section 6 of the WMP.
	Level 2	Further monitoring identifies remediation works are not performing (i.e. ineffective control measure.	Record observations, including photographs.	• As for Level 1 • If implemented erosion control measures are found to be failing, review causes and replace with like or better. Continue monitoring.

5. Reporting, evaluation and review

Monitoring results will be reviewed against the impact assessment criteria detailed in this Plan. Where an exceedance of the relevant criteria or performance measures has occurred, NCOPL will implement the TARP (Table 5-1) and the procedures outlined in section 6.2 of the WMP. NCOPL will notify potentially affected water users when an elevated monitoring result becomes known and provide updates throughout any investigation or assessment.

All internal and external reporting and the review of this Plan will be undertaken in accordance with section 7 of the WMP. The revision status of this Plan is indicated in section 8.

6. References

Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000). *Water Quality Guidelines.*

Australian and New Zealand guidelines for fresh and marine water quality (ANZG 2018) Accessed from https://www.waterquality.gov.au/anz-guidelines

Cunningham, W.L., and Schalk, C.W., comps. (2011), *Groundwater technical procedures of the U.S. Geological Survey*: *U.S. Geological Survey Techniques and Methods* 1–A1, 151 p.

Eco Logical Australia (ELA) (2021). *Subsidence Pond Management - 2020 Monitoring Report*. Prepared for Narrabri Coal Operations Pty Ltd.

NSW Environment Protection Authority (January 2022). *Approved methods for the sampling and analysis of water pollutants in NSW.*

NSW Independent Planning Commission (April 2022). *Development Consent SSD 10269, Narrabri Underground Mine Stage 3 Extension Project.*

NSW Water Quality and River Flow Objectives (2006). *Namoi River Water Quality and River Flow Objectives.* Accessed from https://www.environment.nsw.gov.au/ieo/namoi/report-02.htm#TopOfPage

Resource Strategies Pty Ltd (October 2020) *Narrabri Underground Mine Stage 3 Extension Project – Environmental Impact Statement.* Prepared for Narrabri Coal Operations Pty Ltd.

Standards Australia (2017) *Australian Standard 1940:2017 The storage and handling of flammable and combustible liquids.*

7. Review history

Revision	Comments	Author	Authorised by	Date
0A	Approved by Department of Planning and Environment on 5 October 2023	Onward Consulting	Manager HSE	29 November 2022

Department of Planning and Environment

Our ref: SSD-10269_PA-23

Brent Baker
Manager HSE
Narrabri Coal Operations Pty Ltd
10 Kurrajong Creek Road
Baan Baa, NSW, 2390

05/10/2023

Subject: Narrabri Coal Stage 3 – Surface Water Management Plan

Dear Mr. Baker

I refer to your submission, requesting review and approval of the Surface Water Management Plan for the Narrabri Coal Stage 3 project. I also acknowledge your response to the Department's review comments and request for additional information.

I note the Surface Water Management Plan has been prepared in consultation with DPE Water and EPA, and contains the information required by the conditions of approval.

The Department has carefully reviewed the document and is satisfied that it meets the requirements of the relevant conditions in Development Consent (SSD-10269).

Accordingly, as nominee of the Planning Secretary, I approve the Surface Water Management Plan (Rev 0A, dated 29 November 2022).

Please ensure you make the document publicly available on the project website at the earliest convenience.

If you wish to discuss the matter further, please contact Wayne Jones on (02) 6575 34056.

Yours sincerely

Stephen O'Donoghue
Director
Resource Assessments
As nominee of the Planning Secretary

Appendix A - Compliance conditions relevant to this Plan

Table A-1 SSD 10269 consent conditions relevant to this Plan

Condition	Requirement	Document reference
Obligation to minimise harm to the environment		
A1.	In addition to meeting the specific performance measures and criteria established under this consent, the Applicant must implement all reasonable and feasible measures to prevent, and if prevention is not reasonable and feasible, minimise, any material harm to the environment that may result from the construction and operation of the development, and any rehabilitation required under this consent.	Section 1.3 Section 3 Section 6.2 of the WMP
Evidence of Consultation		
A20.	Where conditions of this consent require consultation with an identified party, the Applicant must: (a) consult with the relevant party prior to submitting the subject document; and (b) provide details to the Department of the consultation undertaken including: (i) the outcome of that consultation, matters resolved and unresolved; and (ii) details of any matters not resolved between the party consulted and the Applicant and how the Applicant has addressed the matters not resolved.	Section 1.4 of the WMP
Staging, combining and updating strategies, plans or programs		
A21.	With the approval of the Planning Secretary, the Applicant may:	
	a) prepare and submit any strategy, plan or program required by this consent on a staged basis (if a clear description is provided as to the specific stage and scope of the development to which the strategy, plan or program applies, the relationship of the stage to any future stages and the trigger for updating the strategy, plan, or program);	No staging of SWMP proposed
	b) combine any strategy, plan or program required by this consent (if a clear relationship is demonstrated between the strategies, plans or programs that are proposed to be combined);	No combining of SWMP with another plan proposed
	c) update any strategy, plan or program required by this consent (to ensure the strategies, plans and programs required under this consent are updated on a regular basis and incorporate additional measures or amendments to improve the environmental performance of the development); and	Section 6
	d) combine any strategy, plan or program required by this consent with any similar strategy, plan or program required by an adjoining mining consent or approval, in common ownership or management.	No combining of SWMP with another plan proposed
Compliance		
A30.	The Applicant must ensure that all of its employees, contractors (and their sub-contractors) are made aware of, and are instructed to comply with, the conditions of this consent relevant to activities they carry out in respect of the development.	Section 2 of the WMP
Applicability of guidelines		
A31.	References in the conditions of this consent to any guideline, protocol, Australian Standard or policy are to such guidelines, protocols, Standards or policies in the form they are in as at the date of inclusion (or later update) in the condition.	Section 3.7 of the WMP
A32.	However, consistent with the conditions of this consent and without altering any limits or criteria in this consent, the Planning Secretary may, in respect of ongoing monitoring and management obligations, agree to or require compliance with an	

Condition	Requirement	Document reference
	updated or revised version of such a guideline, protocol, Standard or policy, or a replacement of them.	
Compensatory Water Supply		
B28.	The Applicant must provide a compensatory water supply to any landowner of privately-owned land whose rightful water supply is adversely and directly impacted (other than an impact that is minor or negligible) as a result of the development, to the satisfaction of the Planning Secretary. The burden of proof that any loss of surface water or groundwater access is not due to mining impacts rests with the Applicant.	Section 3.6
B29.	The compensatory water supply measures must provide an alternative long-term supply of water that is equivalent, in quality and volume, to the loss attributable to the development. Equivalent water supply will be provided as soon as practicable after commencement of development under this consent, unless otherwise agreed with the landowner.	
B30.	If the Applicant is unable to provide an alternative long-term supply of water, then the Applicant must provide compensation, to the satisfaction of the Planning Secretary. **Notes:** ▪ *The Water Management Plan (see condition B34) is required to include trigger levels for investigating potentially adverse impacts on water supplies.*	
B31.	The Applicant must complete all measures that it is required to undertake under conditions B28 – B30 within two years of the date of commencement of development under this consent.	NA
B32.	If the Applicant and a landowner cannot agree on whether the loss of water is to be attributed to the development or the measures to be implemented under conditions B28 – B31, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Planning Secretary for resolution.	Section 3.6
Water Discharges		
B33.	The Applicant must ensure that all surface discharges from the site comply with all relevant provisions of the POEO Act, including any discharge limits (both volume and quality) set for the development in any EPL.	Section 3.1.2 Section 4.3 Section 5
Water Management Performance Measures		
B34.	The Applicant must comply with the performance measures in Table 4 (of the CoC). ***Table 4: Water management performance measures***	

Feature	Performance measure	
Namoi River	Negligible environmental consequences.	Section 3.1.2 Section 3.3 Section 3.5
Water management – general	• Maintain separation between clean, dirty (i.e. sediment-laden) and mine water management systems; • Minimise the use of clean and potable water on the site; • Maximise water recycling, reuse and sharing opportunities; • Minimise the use of make-up water from external sources; • Design, install, operate and maintain water management systems in a proper and efficient manner; and • Minimise risks to the receiving environment and downstream water users.	Section 3.1

Condition	Requirement		Document reference
	Clean water diversions and storage infrastructure	Maximise as far as reasonable and feasible the diversion of clean water around disturbed areas on the site, except where clean water is captured for use on the site.	
	Chemical and hydrocarbon storage	Chemical and hydrocarbon products to be stored in bunded areas in accordance with the relevant Australian Standard.	Section 3.1
	Mine water discharges	Negligible environmental consequences beyond those predicted in the document/s listed in condition A2(c).	Section 3.1
	Treated water discharges	Discharges to the Namoi River are: • below 250 mg/L Total Dissolved Solids (50th percentile, all samples, volume based); • below 350 mg/L Total Dissolved Solids (all samples, volume based); and • pH between 6.5 and 8.5 (all samples).	Section 3.1.2 Section4.3 Section 4.3 Section 5
	Aquatic and riparian ecosystems	• Negligible environmental consequences beyond those predicted in the document/s listed in condition A2(c); and • Develop site-specific in-stream water quality objectives in accordance with the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ, 2000) and Using the ANZECC Guidelines and *Water Quality Objectives in NSW* (DEC, 2006), or its latest version.	Section 3 Section 4 Section 5
Water Management Plan			
B36.	This plan must:		
	(c) be prepared by a suitably qualified and experienced person/s;		Section 1.4 of the WMP
	(d) be prepared in consultation with DPE Water and the EPA;		
	(e) describe the measures to be implemented to ensure that the Applicant complies with the water management performance measures (see Table 4);		Section 3
	(f) build on existing monitoring programs and utilise existing data from nearby mines, where practicable;		Section 4
	(g) include a:		
	(iii) **Surface Water Management Plan** that includes:		
	• detailed baseline data on channel stability, water flows and water quality in the sections or parts of watercourses and/or water bodies potentially impacted by the development, including:		Section 2
	▪ formal records of creek flow conditions will be initiated at selected sites;		Section 2.2 Section 4.4.1
	▪ stream and riparian vegetation health;		Section 2.3
	▪ channel stability (geomorphology); and		Section 2.3
	▪ water supply for other surface water users;		Section 2.4
	• a detailed description of the surface water management system;		Section 3.1

Condition	Requirement	Document reference
	• details of any proposed discharges of treated water to the Namoi River, including:	Section 3.1.2
	▪ measures for the continuous monitoring and recording of volumes of water discharged to the Namoi River; and	Section 3.1.2
	▪ a water quality monitoring program for discharged waters;	Section 4.3
	• consideration of alternatives to direct measurement or prediction of creek flows to support surface water take licensing;	Section 4.4.1
	• details of the proposed metering, monitoring and modelling measures;	Section 3.5 of the SWB (Attachment 1 of the WMP) Section 3.4 Section 4
	• detailed plans, design objectives and performance criteria for water management infrastructure including:	
	▪ any approved creek diversions or restoration works associated with the development;	Section 3.2
	▪ water run-off diversions and catch drains;	Section 3.1
	▪ erosion and sediment controls;	Section 3.2 Section 3.8 ESCP (Attachment 2 of the WMP)
	▪ any water storages, including mine water management systems; and	Section 3.1
	▪ reinstated drainage networks on rehabilitated areas of the site;	Section 3.8 ESCP (Attachment 2 of the WMP)
	• surface water performance criteria, including trigger levels for identifying and investigating any potentially adverse impacts (or trends) associated with the development for:	
	▪ water supply for other water users;	Section 3.6
	▪ channel stability;	Section 4.5
	▪ downstream surface water flows and quality;	Section 4.4 Section 5
	▪ stream and riparian vegetation heath; and	Section 4.5 Section 5
	▪ post-mining water pollution from rehabilitated areas of the site;	Section 3.8
	• a program to regularly review brine management and identify any beneficial use options for brine, treated water and mine water;	Section 3.1
	• a program to monitor and evaluate:	

Condition	Requirement	Document reference
	▪ compliance with the relevant performance measures listed in Table 4 and the performance criteria in this plan;	Section 4 Section 5
	▪ controlled and uncontrolled discharges and seepage/leachate from the site;	Section 4.2.1 Section 4.3
	▪ surface water inflows, outflows and storage volumes, to inform the Site Water Balance; and	Section 4.2 SWB (Attachment 1 of the WMP)
	▪ the effectiveness of the surface water management system and the measures in the Erosion and Sediment Control Plan;	Section 4 Section 5
	▪ reporting procedures for the results of the monitoring program, including notifying other water users of any elevated results; and	Section 6
	▪ a trigger action response plan to respond to any exceedances of the performance measures, and repair, mitigate and/or offset any adverse surface water impacts of the development, including measures to provide compensatory water supply to any affected water user under condition B27 of this Schedule; and	Section 5
Management Plan requirements		
E5.	Management plans required under this consent must be prepared in accordance with relevant guidelines, and include:	
	(a) summary of relevant background or baseline data;	Section 2
	(b) details of:	
	(i) the relevant statutory requirements (including any relevant approval, licence or lease conditions);	Section 3 of the WMP
	(ii) any relevant limits or performance measures and criteria; and	Section 4
	(iii) the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;	Section 4 Section 5
	(c) any relevant commitments or recommendations identified in the document/s listed in condition A2(c)	Appendix B
	(d) a description of the management measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;	Section 3
	(e) a program to monitor and report on the:	
	i) impacts and environmental performance of the development; and	Section 4 Section 5 Section 6
	ii) effectiveness of the management measures set out pursuant to paragraph (d);	
	(f) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	Section 5
	(g) a program to investigate and implement ways to improve the environmental performance of the development over time;	Section 7.6 of the WMP
	(h) a protocol for managing and reporting any:	

Condition	Requirement	Document reference
	i) incident, non-compliance or exceedance of any impact assessment criterion or performance criterion;	Section 6 of the WMP
	ii) complaint; or	Section 8 of the WMP
	iii) failure to comply with other statutory requirements;	Section 6.2 of the WMP
	(i) public sources of information and data to assist stakeholders in understanding environmental impacts of the development; and	Section 3.7 of the WMP
	(j) a protocol for periodic review of the plan.	Section 6
E6.	The Applicant must ensure that management plans prepared for the development are consistent with the conditions of this consent and any EPL issued for the site.	Appendix A Appendix B

Table A-2 EPL 12789 conditions relevant to this Plan

Condition	Requirement	Document reference
Discharges to Air and Water and Applications to Land		
P1	**Location of monitoring/discharge points and areas** P1.3 The following points referred to in the table are identified in this license for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.	Section 4

EPA ID No.	Type of monitoring point	Type of discharge point	Location description including NCOPL ID no.
11	Wet weather discharge Discharge water quality monitoring	Wet weather discharge Discharge water quality monitoring	Discharge point (SD4) on northern side of mine boundary.
13	Wet weather discharge Discharge water quality monitoring	Wet weather discharge Discharge water quality monitoring	Discharge point (SD2) on southern side of mine boundary.
14	Ambient Water Quality Monitoring		Upstream of mine discharge point on Kurrajong Creek Tributary 1 KC1US
15	Ambient Water Quality Monitoring		Downstream of mine discharge point on Kurrajong Creek Tributary 1 KC1DS
16	Ambient Water Quality Monitoring		Upstream of mine discharge point on Kurrajong Creek Tributary 2

Condition	Requirement			Document reference

			KC2US
17	Ambient Water Quality Monitoring		Downstream of mine discharge point on Kurrajong Creek Tributary 2 KC2DS
18	Wet weather discharge Discharge water quality monitoring	Wet weather discharge Discharge water quality monitoring	Discharge point (SD7) on western side of mine boundary
19	Ambient Water Quality Monitoring		Upstream location of Kurrajong Creek (KCUS)
20	Ambient Water Quality Monitoring		Upstream location of Kurrajong Creek (KCDS)
21	Ambient Water Quality Monitoring		Northern portion of mining area (PCa) in Pine Creek
22	Ambient Water Quality Monitoring		Monitoring point (PC1) in Pine Creek Tributary 1
24	Water Quality Monitoring	Water Quality Monitoring	Discharge point (NR1) at Namoi River
25	Ambient Water Quality Monitoring	Ambient Water Quality Monitoring	Discharge point (NRUS) at Namoi River
26	Ambient Water Quality Monitoring	Ambient Water Quality Monitoring	Discharge point (NRDS) at Namoi River
27	Wet weather discharge Discharge water quality monitoring	Wet weather discharge Discharge water quality monitoring	Discharge point (SD8) at Ventilation Shaft

P1.4 Point W1 in the table, is identified in this licence for the purpose of monitoring of weather parameters at that point.

EPA identification number	Type of Monitoring Point	Description of Location
W1	Weather analysis	Weather station identified as "W1" on map titled EPL 12789 Monitoring Locations" dated 21/02/2017 - EPA DOC17/131971.

Limit Conditions

L2	**Concentration limits** L2.1 For each monitoring/discharge point or utilisation area specified in the table/s below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table. L2.2 Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges.	Section 4

Condition	Requirement	Document reference

L2.3 To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in L2.4.

L2.4 Water and/or Land Concentration Limits

Point 11, 13, 18, 27					
Pollutant	**Units of measure**	**50th percentile conc**	**90th percentile conc**	**3DGM conc limit**	**100th percentile conc**
Oil and Grease	mg/L	-	-	-	10
TSS	mg/L	-	-	-	50

Point 11, 13, 18, 24, 27					
Pollutant	**Units of measure**	**50th percentile conc**	**90th percentile conc**	**3DGM conc limit**	**100th percentile conc**
pH	pH	-	-	-	6.5-8.5

Point 24					
Pollutant	**Units of measure**	**50th percentile conc**	**90th percentile conc**	**3DGM conc limit**	**100th percentile conc**
TDS	mg/L	250	-	-	350

L2.5 The TSS concentration limits specified for Points 11, 13, 18 and 27 may be exceeded for water discharged provided that:

a) the discharge occurs solely as a result of rainfall measured at the premises that exceeds 38.4 millimetres over any consecutive 5 day period immediately prior to the discharge occurring; and

b) all practical measures have been implemented to dewater all sediment dams within 5 days of rainfall such that they have sufficient capacity to store run off from a 38.4 millimetre, 5 day rainfall event.

Note: 38.4 mm equates to the 5 day 90%ile rainfall depth for Gunnedah sourced from Table 6.3a *Managing Urban Stormwater: Soils and Construction Volume 1*: 4th edition, March 2004.

Monitoring and Recording Conditions

M1	M1. Monitoring records M1.1 The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition. M1.2 All records required to be kept by this licence must be: (a) in a legible form, or in a form that can readily be reduced to a legible form; (b) kept for at least 4 years after the monitoring or event to which they relate took place; and (c) produced in a legible form to any authorised officer of the EPA who asks to see them. M1.3 The following records must be kept in respect of any samples required to be collected for the purposes of this licence:	Section 7.4 of WMP

Condition	Requirement	Document reference
	(a) the date(s) on which the sample was taken; (b) the time(s) at which the sample was collected; (c) the point at which the sample was taken; and (d) the name of the person who collected the sample.	
Monitoring and Recording Conditions		
M2	**Requirement to monitor concentration of pollutants discharged** M2.1 For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns: M2.3 Water and/or Land Monitoring Requirements	Section 4

Point 11, 13, 18, 27

Pollutant	Units of measure	Frequency	Sampling Method
Conductivity	µS/cm	Special Frequency 1	In situ
Oil and Grease	mg/L	Special Frequency 1	Grab sample
pH	pH	Special Frequency 1	In situ
TOC	mg/L	Special Frequency 1	Grab sample
TSS	mg/L	Special Frequency 1	Grab sample

Point 14, 15, 16, 17, 19, 20, 21, 22

Pollutant	Units of measure	Frequency	Sampling Method
Conductivity	µS/cm	Special Frequency 2	In situ
Oil and Grease	mg/L	Special Frequency 2	Grab sample
pH	pH	Special Frequency 2 Special Frequency 3	In situ
TOC	mg/L	Special Frequency 2	Grab sample
TSS	mg/L	Special Frequency 2	Grab sample
TDS	mg/L	Special Frequency 3	Grab sample

M2.4 For the purposes of the table(s) above Special Frequency 1 means the collection of samples as soon as practicable after each discharge commences and, in any case, not more than 12 hours after each discharge commences.

M2.5 For the purposes of the table(s) above Special Frequency 2 means the collection of samples quarterly (in the event of flow during the quarter) at a time when there is flow and as soon as practicable after each wet weather discharge from points 11, 13,18 or 27 commences and in any case not more than 12 hours after each discharge commences.

M2.7 For the purposes of the table(s) above Special Frequency 3 means the collection of samples as soon as practicable after each discharge commences from point NR1 and in any case not more than 4 hours after each discharge.

M3	**Testing methods – concentration limits** M3.2 Subject to any express provision to the contrary in this licence, monitoring for the concentration of a pollutant discharged to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication unless	Section 4.1

<table>
<tr><th>Condition</th><th>Requirement</th><th>Document reference</th></tr>
<tr><td></td><td>another method has been approved by the EPA in writing before any tests are conducted.</td><td></td></tr>
<tr><td>M4</td><td>Requirement to monitor weather
M4.1 For each monitoring point specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the parameter specified in Column 1. The licensee must use the sampling method, units of measure, averaging period and sample at the frequency, specified opposite in the other columns:
<table>
<tr><th colspan="5">Point W1</th></tr>
<tr><th>Parameter</th><th>Units of measure</th><th>Frequency</th><th>Averaging Period</th><th>Sampling Method</th></tr>
<tr><td>Rainfall</td><td>mm</td><td>Continuous</td><td>1 hour</td><td>AM-4</td></tr>
</table></td><td>Section 4.6</td></tr>
</table>

Appendix B - Key EIS commitments

Table B-1 Key EIS surface water management commitments

Source	Aspect	Details	Reference
EIS Section 6.5.3	Water Management System	Stage 3 will involve the use of the existing/approved water management infrastructure with minor augmentations and extensions, including the progressive developments of pumps, pipelines, water storages and other water management infrastructure.	Section 3.1
EIS Section 2.12.4	Sewage and Effluent	At the Pit Top Area, the existing wastewater treatment plant will continue to be used to treat effluent on-site, with the treated water discharged to a rehabilitation area. Treated effluent will be irrigated in accordance with the *Environmental Guidelines: Use of Effluent by Irrigation* (Department of Environment and Conservation, 2004), and managed in accordance with the Water Management Plan (NCOPL, 2017a) (or the latest approved version).	Section 3.7
EIS Section 6.5.3	Flow Regime - Changes in Contributing Catchment	Runoff from Narrabri Mine disturbance areas and areas under active rehabilitation will be captured in sediment dams and: • transferred to Narrabri Mine site water management system for re-use in mine operations; and/or • controlled release via licensed discharge points, in accordance with the requirements of EPL 12789 following rainfall events that exceed sediment dam design capacity.	Section 3.8
EIS Section 6.5.3	Surface Water Quality	Sediment dams will continue to be dewatered following runoff events and will comply with EPL 12789 limits for wet weather discharges from licensed discharge points.	Section 4.2.1 ESCP (Attachment 2 of WMP)
EIS Section 6.5.3	Surface Water Quality	The controlled release of treated water, which will be undertaken in accordance with EPL 12789, will not adversely impact Namoi River water quality.	Section 3.1.2 Section 4.3
Section 6.5.4	Water Management Plan - Permeate Discharge and Transfer Control and Monitoring Plan	Consistent with Schedule 4, Condition 13(d) of Project Approval 08_0144, a Permeate Discharge and Transfer Control and Monitoring Plan will be prepared to monitor potential Namoi River water quality impacts prior to commencing controlled releases to the Namoi River. In addition, NCOPL will investigate options for the beneficial re-use of excess water or underground injection of excess mine water.	Section 3.1.2 Section 4.3

Source	Aspect	Details	Reference
EIS Section 6.5.4	Subsidence Remediation	Despite the minor nature of potential reduction in catchment flows due to mine subsidence, the existing stream impact management measures (outlined in the Extraction Plan Water Management Plan [NCOPL, 2017[or the latest approved version]) will continue to be implemented for Stage 3.	Section 3.2
EIS Section 6.5.4	Subsidence Remediation	In addition, subsidence remediation of ponding areas will include: • ponding areas located in areas with no significant vegetation and the water quality of the ponded water is non-saline to be allowed to self-correct. • ponding areas located in areas with significant vegetation to be assessed and remedial measures (e.g. drainage) developed and implemented in consultation with the landholder and a suitably qualified specialist (e.g. hydrogeologist, geomorphologist).	Section 3.2
EIS Section 6.5.4	Water Management Plan - Surface Water Monitoring Program	The existing surface water monitoring network will continue to be implemented for Stage 3. The network will include the installation of two additional receiving water monitoring sites (KCTOP and UT1US) recommended by WRM (2020) within MLAs 1 and 2, locations will be confirmed in consultation with relevant government agencies and landowners.	Section 4
EIS Section 6.5.4	Water Management Plan - Surface Water Monitoring Program	The site water monitoring network of sediment dams and sediment basins will continue to be implemented for Stage 3, in accordance with the Water Management Plan (NCOPL, 2017a) (or the latest approved version). In addition, the Southern Mine Water Storage will be included in the monitoring network.	Section 4
EIS Section 6.5.4	Water Management Plan - Surface Water Monitoring Program	The suite of monitoring parameters will remain as per the approved Water Management Plan (NCOPL, 2017a) (or the latest approved version) with the addition of the following parameters to monitor the potential impacts of Stage 3 waste materials: • total alkalinity; • acidity; • sulphate; • As; • Co; • Mo; • Sb; and	Section 4

Source	Aspect	Details	Reference
		• Se. The frequency of monitoring will remain as per the approved Water Management Plan (NCOPL, 2017a) (or the latest approved version).	
Section 6.5.4	Water Management Plan - Surface and Groundwater Response Plan	The Surface and Groundwater Response Plan and TARPs (NCOPL, 2017a; 2017c) will be reviewed and updated for Stage 3. The Surface and Groundwater Response Plan will describe any additional measures and procedures that will be implemented over the life of Narrabri Mine to respond to any potential exceedances of surface water-related criteria and contingent mitigation compensation, and/or offset options if downstream private surface water users or riparian vegetation are adversely affected by Narrabri Mine.	Section 5
EIS Section 6.5.5	Adaptive Measures	As described in Section 6.5.4, the existing TARP for the Narrabri Mine (NCOPL, 2017a; 2017c) will be updated to incorporate Stage 3.	Section 5
BDAR Section 7.13	Lower Darling River aquatic ecological community	**Biodiversity Measure 13** Remediation of mine subsidence effects (e.g. surface cracking and minor erosion). A preliminary assessment will be undertaken to minimise impact of remediation actions. Prior to any remediation of surface cracks, NCOPL will undertake a review of environmental impacts that may result from the remediation at the specific location and consider whether remediation of surface cracks is environmentally beneficial or if alternative methods of remediating the crack are warranted (e.g. without machinery). The review will consider, among other factors, avoidance of known locations of threatened flora species.	Section 3.2

Attachment 4 - Groundwater Management Plan

NARRABRI MINE

GROUNDWATER MANAGEMENT PLAN

Prepared by:

Title	Name	Signature	Date
Senior Environmental Manager	S. van der Meulen Onward Consulting		1 December 2022
Director	Mark Vile Onward Consulting		1 December 2022

Onward document number:
NCO-003K-0A-PLN

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1. Introduction

1.1 Background

The Narrabri Mine is an existing underground coal mining operation situated in the Gunnedah Coalfield, approximately 25 kilometres (**km**) southeast of Narrabri and approximately 60 km northwest of Gunnedah, within the Narrabri Shire Council (**NSC**) Local Government Area, in New South Wales (**NSW**). It is operated by Narrabri Coal Operations Pty Ltd (**NCOPL**), on behalf of the Narrabri Mine Joint Venture[1], which consists of two Whitehaven Coal Limited's (**WHC**) wholly owned subsidiaries, and other joint-venture partners.

The Narrabri Underground Mine Stage 3 Extension Project (**Stage 3**) involves a southern extension to the previously approved Stage 2 mining area (approximately 609 hectares (ha) of additional surface development footprint) to gain access to additional areas of coal reserves within Mining Lease Application (**MLA**) 1 and 2, an increase in the mine life to 2044, and the development of supporting surface infrastructure[2].

1.2 Purpose and scope

This Groundwater Management Plan (**GWMP** or **Plan**) has been developed in accordance with the Stage 3 Extension Project State Significant Development (**SSD**) 10269 Conditions of Consent (**CoC**) B36(e)(iv), the applicable Commonwealth and NSW State regulatory framework for groundwater management, the requirements of the Water Group within the Department of Planning and Environment (**DPE Water**) and the requirements of the Environment Protection Authority (**EPA**).

As required by CoC B38, NCOPL will implement the GWMP as approved by the Planning Secretary. In accordance with CoC B37, NCOPL will not commence construction until this Plan is approved by the Planning Secretary.

This GWMP forms Attachment 4 of the Narrabri Mine Water Management Plan (**WMP**), developed in accordance with CoC B35 to CoC B38.

1.3 Objectives

The objectives of this Plan are to:

- provide details of the relevant statutory requirements, including any relevant approval, licence or lease conditions;
- describe the measures to be implemented to ensure compliance with the water management performance measures in accordance with CoC B34;
- provide baseline data for groundwater levels, yield, quality and supply for other water users;
- detail the potential impacts to groundwater and groundwater users as a result of the development;
- provide a detailed description of the groundwater management system;
- provide details of the proposed metering, monitoring and modelling measures;
- detail the groundwater performance criteria, including trigger levels for identifying and investigating any potentially adverse groundwater impacts (or trends) associated with the development;

[1] For full details on the joint venture ownership, refer to the introduction of the Environmental Management Strategy.

[2] For full detail on the background of the Narrabri Mine, refer to the overarching WMP.

- provide a program to monitor and evaluate:
  - compliance with the relevant performance measures;
  - water loss/seepage from water storages into the groundwater system;
  - groundwater inflows, outflows and storage volumes, to inform the Site Water Balance (**SWB**);
  - the hydrogeological setting of any nearby alluvial aquifers and the likelihood of any indirect impacts from the development;
  - the effectiveness of the groundwater management system; and
  - a monitoring program for groundwater dependent ecosystems (GDEs) which may be impacted by the development.
- detail a trigger action response plan (**TARP**) to respond to any exceedances of the relevant performance measures and groundwater performance criteria, and repair, mitigate and/or offset any adverse groundwater impacts of the development; and
- describe the regular review of the groundwater model for the Narrabri Mine.

1.4 Regulatory requirements

In accordance with CoC E5(b), Appendix A provides a summary of the relevant regulatory requirements relating to groundwater and outlines the section of the GWMP in which each of these conditions have been addressed.

In accordance with CoC E5(c), Appendix B provides a summary of the relevant commitments or recommendations within the EIS relating to groundwater and outlines the section of the GWMP in which each of these commitments have been addressed. These relevant commitments or recommendations include those as amended or added to by the:

- Applicant's Submission Report submitted 31 May 2021;
- Applicant's Amendment Report submitted 31 May 2021; and
- Applicant's final Biodiversity Development Assessment Report dated September 2021.

A detailed overview of the statutory requirements relating to water management is described in section 3 of the WMP.

1.5 Definitions

The terminology used within this GWMP are defined in the WMP.

2. Baseline data

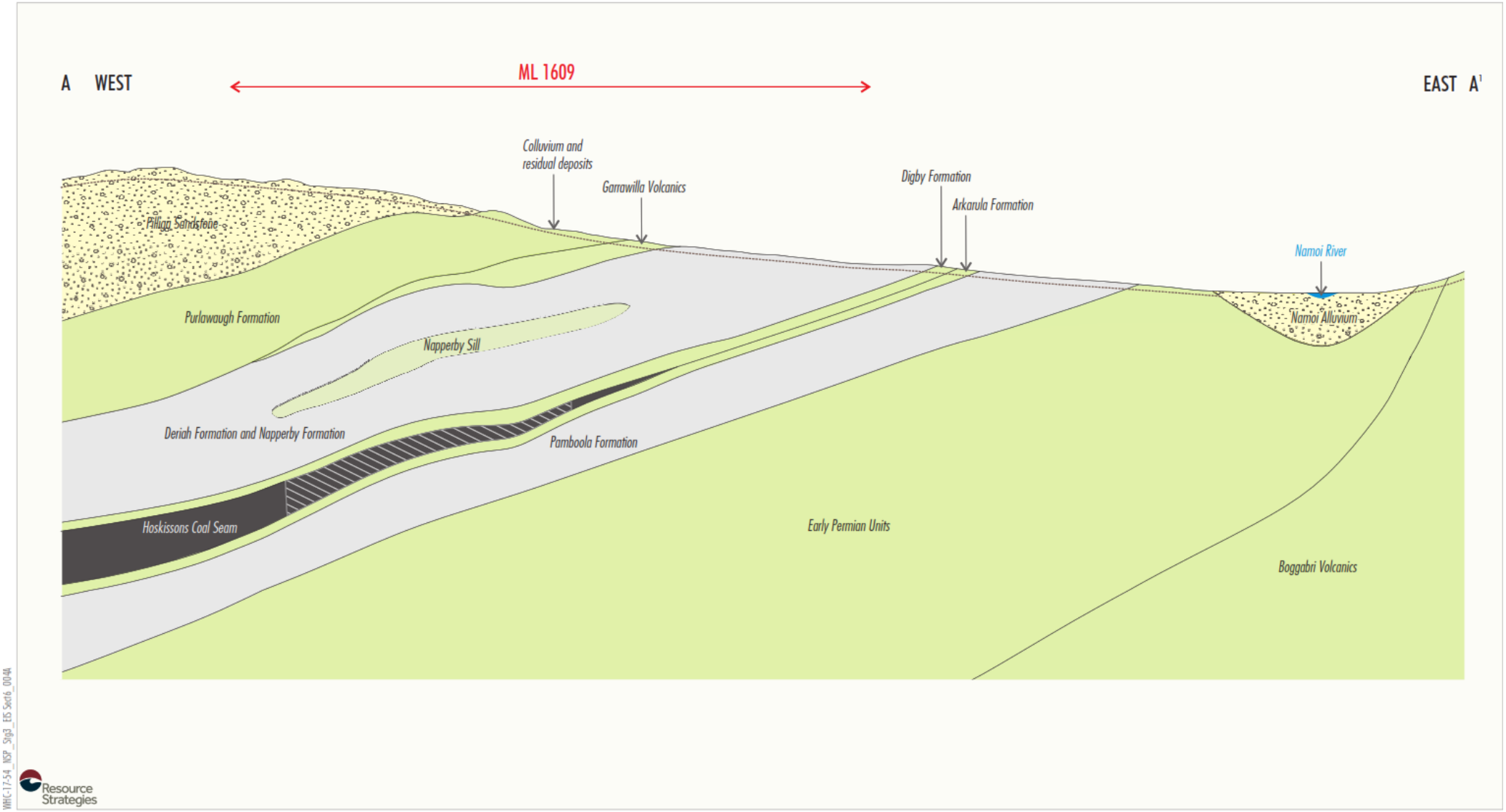
2.1 Groundwater regime

The Narrabri Mine is located within the Mullaley Sub-basin, which forms part of the larger Gunnedah Basin. The western half of the mining lease is also located on the eastern margin of the Surat Basin. In general, the Surat and Gunnedah Basin stratigraphic units are characterised by a dip to the west at an angle of less than 10 degrees and outcrops to along the Namoi River valley.

The main stratigraphic units occurring in the vicinity of the Narrabri Mine are the:

- Gunnedah Basin Units inclusive of:
  - the Napperby Formation and Digby Formations of Triassic age; and
  - Permian coal measures within the Black Jack Group including the Hoskissons Coal Seam, Arkarula Formation and Pamboola Formations (which are locally characterised by an east [shallowest] to west [deepest] dip).
- Surat Basin Units of Jurassic age, which include the Pilliga Sandstone, Purlawaugh Formation and Garrawilla Volcanics; and
- Quaternary alluvium which consists of unconsolidated clays, silts, sands and gravels associated with the Namoi River and its associated tributaries.

A conceptual geological cross-section showing the main stratigraphic units occurring in the vicinity of the mine is provided in Figure 2-1.



WHC-17-54_NSP_Stg3_EIS Sect6_0044

Source: AGE (2020)

LEGEND
- Highly Productive Aquifer
- Minor Aquifer (Less Productive)
- Aquitard/Poor Aquifer
- Target Coal Seam
- Underground Mining Area

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NARRABRI MINE

FIGURE 2-1
Conceptual Geological Cross-Section

A conceptual hydrogeological model of the existing groundwater regime was developed for the Stage 3 EIS based on a review of the available baseline groundwater data and relevant Water Sharing Plans (**WSP**).

The key 'highly productive' aquifers in the vicinity of the Narrabri Mine are:

- Jurassic-aged Pilliga Sandstone; and
- alluvium associated with the Namoi River.

A 'highly productive' source is defined by the Aquifer Interference Policy (**AIP**) as a groundwater source which has been declared in regulations and datasets, based on the following criteria:

- has a total dissolved solids (**TDS**) concentration less than 1,500 milligrams per litre (**mg/L**); and
- contains water supply works that can yield water at a rate greater than 5 litres per second (**L/s**).

Other units present in the vicinity of the mine are considered to be 'less productive' aquifers, as they don't meet the appropriate criteria for TDS and/or yield to be considered 'highly productive'.

2.1.1 Pilliga sandstone

The Pilliga Sandstone is the youngest consolidated formation in the immediate vicinity of the mine and outcrops across the western half of the mining lease. The Pilliga Sandstone is an important regional aquifer dominated by well sorted, fine to coarse-grained sandstones that are typically highly porous and permeable and producing high yields of good quality groundwater.

The sandstone thickness varies from zero at the mapped limit of the formation to approximately 80 m to 120 m at the western margin of the mining lease. The sandstone continues to thicken further west, reaching thicknesses greater than 500 m.

The Pilliga Sandstone above the underground mining area forms part of the Southern Recharge Groundwater Source within the *WSP for the NSW Great Artesian Basin Groundwater Sources 2020*. However, recharge to the Great Artesian Basin (**GAB**) in the vicinity of the mine is low (less than 5 millimetres per year [**mm/year**]) and therefore is not a significant recharge zone for the GAB. Recharge to the Pilliga Sandstone primarily occurs in the Warrumbungles area, where higher rainfall results in estimated recharge rates in excess of 40 mm/year.

2.1.2 Alluvial groundwater system, Colluvium and Regolith

The Namoi River is a major watercourse that flows in a north-westerly direction approximately 4 to 5 km to the north and east of the Narrabri Mine. The alluvial sediments associated with the Namoi River are subdivided into two formations, although they are not always distinguishable. The Gunnedah Formation occurs towards the base of the alluvium, which typically comprises well sorted sand and gravel interbedded with clay, and is, therefore, the target for most water supply bores in the region. The overlying Narrabri Formation typically comprises extensive overbank clays with fewer sand/gravel units, suggesting generally lower permeability and aquifer potential.

The Namoi River alluvium is generally thickest (greater than 100 m) to the east of the Namoi River and thins towards the edges of mapped alluvium and along the tributaries.

The Namoi River alluvium to the east of the site forms part of the Upper Namoi Zone 5, Namoi Valley (Gin's Leap to Narrabri) Groundwater Source (Zone 5) within the *WSP for the Namoi Alluvial Groundwater Sources Order 2020.*

DPE Water has mapped areas of the alluvium associated with the Namoi River and its tributaries as a 'highly productive' groundwater source under the AIP. To the west of the 'highly productive' alluvium associated with the Namoi River are areas of undifferentiated Quaternary colluvium and residual soils (or regolith). Both the colluvium and regolith cover, where present, are thought to be relatively thin and dominated by low permeability clay strata, which are the result of weathering and decomposition of the underlying consolidated strata.

Alluvium to the south of the Narrabri Mine associated with the Tulla Mullen Creek is not mapped as 'highly productive' and has been formed from a different depositional environment to the Namoi River alluvium (i.e. Quaternary piedmont deposits).

2.1.3 Other units

Underlying the Pilliga Sandstone are the Jurassic-aged Purlawaugh Formation and Garrawilla Volcanics that form part of the Southern Recharge Groundwater Source within the *WSP for the NSW Great Artesian Basin Groundwater Sources 2020.* However, unlike the Pilliga Sandstone, these units are considered 'less productive' under the AIP. Like other generally low hydraulic units within the region, sandstone units are occasionally present in the Purlawaugh Formation and can support minor extraction for stock and domestic purposes.

The Purlawaugh Formation has lower hydraulic conductivity than the Pilliga Sandstone and acts as an aquitard.

Triassic-aged units in the vicinity of the mine include the Napperby Formation and Digby Formation, which form part of the Gunnedah-Oxley Basin Murray Darling Basin (**MDB**) Groundwater Source within the *WSP for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2020*. The Gunnedah-Oxley Basin MDB Groundwater Source also encompasses late Permian units including the Hoskissons Coal Seam (i.e. the Narrabri Mine coal resource). Triassic and Permian units in the vicinity of the mine are also identified as 'less productive' units under the AIP.

2.2 Groundwater levels

NCOPL has historically undertaken monitoring of groundwater levels in the Namoi Alluvium, Pilliga Sandstone, Purlawaugh Formation, Garrawilla Volcanics, Napperby Formation, Digby Formation, Hoskissons Coal Seam, Arkarula Formation, Pamboola Formation and various older units.

Regional groundwater level contours for the Namoi Alluvium indicate that groundwater flows generally south to north along the Namoi River, consistent with topography and flow direction of the river. Intensive groundwater use for irrigation results in seasonal water table drawdown in excess of 15 m in areas of the Namoi Alluvium.

Regional groundwater flow directions in the Pilliga Sandstone are towards the north-west, show little or no temporal variation, and do not appear to be affected by climate, Narrabri Mine dewatering and other extraction.

Deeper units show varying levels of response to the Narrabri Mine operations, from little or no response in the Purlawaugh Formation, to substantial depressurisation in the Hoskissons Coal Seam, as should be expected given the nature of mining operations.

Detailed baseline data on groundwater levels is presented in Appendix C.

2.3 Groundwater quality

Both the Namoi Alluvium and the Pilliga Sandstone are characterised by relatively low salinity and variability. The median electrical conductivity (**EC**) for both aquifers is less than 700 microSiemens per centimetre (**µS/cm**), suggesting the water is relatively fresh.

The Garrawilla Volcanics has an EC of approximately 2,630 µS/cm, suggesting brackish to moderately saline groundwater. In addition, median EC values for the Purlawaugh and Napperby Formations suggest moderately saline conditions on average but show a high degree of variability and relatively fresh water in some cases, suggesting that potentially useful freshwater aquifers can be encountered within these formations.

Data for the Hoskissons Coal Seam suggest moderately saline conditions based on the median EC value of 6,180 µS/cm, whilst data for the two deepest units monitored within the mining lease, the Arkarula and Pamboola Formations, suggest median EC values in excess of 15,000 µS/cm. The relatively high salinity values recorded in samples taken from the Arkarula Formation may reflect the depth of this unit and the lack of any known outcrop areas. Residence times with the strata may therefore be substantial resulting in relatively high salinity groundwater.

Table 2-1 provides a summary of the field EC data by hydrostatic unit.

Table 2-1 Summary statistics, field EC data by hydrostratigraphic unit

Formation	No of bores	No of tests	Field EC (µS/cm)					
			Mean	Min	25%	50%	75%	Max
Alluvium	9	92	2292	597	704	853	5860	7050
Pilliga Sandstone	4	93	1410	129	256	393	2900	5440
Purlawaugh Formation	4	181	8343	293	674	4880	18960	34900
Garrawilla Volcanics	9	360	4606	274	1379	2630	4158	20200
Napperby Formation	9	438	9632	1020	3083	7040	17628	33100
Hoskissons Coal Seam	1	5	5580	1410	4070	6180	7490	8750
Arkarula Formation	1	15	19230	1140	15915	23770	25015	25420
Pamboola Formation	3	174	14785	1050	3468	17175	25025	27340

Results of the initial Stage 3 bore census (ENRS 2020) indicate that privately-owned water supply bores in the vicinity of the mine and surrounds have a wide range of salinity. Groundwater quality was tested in the field as part of the third Stage 3 bore census at 26 privately owned bores (AGE 2021). The EC ranged from 521 µS/cm to 22,680 µS/cm.

Detailed baseline data on groundwater quality is presented in Appendix C.

2.4 Groundwater yield

The Narrabri Hydrogeological Sheet (1:250 000) (NSW Water Resources Commission) indicates that the site is mapped primarily as Jurassic sediments (Purlawaugh Formation), which are rarely considered as aquifers and have yields generally less than 0.5 L/s. This map also identifies a small area in the south-east portion of ML 1609 as part of the Gunnedah Basin sequence, with low yields similar to the Purlawaugh Formation. The

geological unit in the Narrabri area with the highest potential yields is the Garrawilla Volcanics of the *NSW GAB Groundwater Sources Southern Recharge Groundwater Source*. However, this formation is not regionally extensive and not considered a highly productive groundwater source.

2.5 Groundwater use

There are more than 2,200 bores in the regional context, comprising approximately 1,500 water supply bores and approximately 700 bores drilled for non-water supply purposes (e.g. monitoring, exploration or dewatering). Registered water supply bores in the broader region are located predominantly within the Namoi alluvium and include a number of bores used for irrigation purposes that tap into the 'highly productive' Namoi Alluvium aquifer.

Closer to the site, however, groundwater use is less prevalent and less intensive. Privately-owned registered water supply bores in the immediate vicinity of the mine are predominantly used for stock and domestic purposes, which reflects the lack of highly productive formations immediately to the east (outside the extent of Namoi alluvium), and lack of development to the west (i.e. within the Pilliga East State Forest).

Groundwater is also extracted from NCOPL's existing alluvial bore located adjacent to the Namoi River when required (e.g. when supply from the underground mining area is insufficient to meet water demands, and sufficient allocation from the Namoi River [i.e. utilising NCOPL's existing Namoi River pump] is unavailable).

The existing alluvial bore is located within the Upper Namoi Zone 5 groundwater source (within the *WSP for the Namoi Alluvial Groundwater Sources 2012*), and water is extracted in accordance with the relevant water access licence (**WAL**) held by NCOPL and the rules prescribed in the WSP. Refer to section 3.3.1 of the Site Water Balance (**SWB**) (Attachment 1 of the WMP).

3. Implementation and management

3.1 Groundwater inflows

The predicted annual groundwater volumes (water take) for each groundwater source over the life of mine (based on the Stage 3 EIS groundwater modelling) is presented in Table 3-1. Details of the current groundwater WALs held by NCOPL are summarised in Table 3-2

At the end of mining, relevant entitlements will be surrendered to account for groundwater take post-mining in accordance with the AIP.

Table 3-1 Predicted annual groundwater volumes per water source

Year	Total (ML/year)	*NSW Murray-Darling Basin Porous Rock Groundwater Sources Order 2020* (ML/year)	*NSW Great Artesian Basin Groundwater Sources 2020* (ML/year)	*Namoi Alluvial Groundwater Sources Order 2020* (ML/year)	*Upper and Lower Namoi Regulated River Water Source* (ML/year)
2022	1099	1093	6	0	0
2023	1284	1277	7	0	0
2024	1420	1409	10	0	1
2025	1491	1478	12	0	1
2026	1578	1563	14	0	1
2027	1631	1613	16	0	2
2028	1760	1738	19	0	3
2029	1815	1790	21	0	4
2030	1901	1871	24	0	6
2031	1981	1946	28	0	7
2032	2029	1991	29	0	9
2033	2096	2053	32	0	11
2034	2112	2064	34	0	14
2035	2188	2134	36	1	17
2036	2259	2199	37	2	21
2037	2279	2216	36	3	24
2038	2337	2267	38	4	28
2039	2365	2290	40	4	31
2040	2406	2310	42	10	44
2041	2404	2310	42	10	42
2042	2332	2242	42	8	40
2043	2265	2170	42	9	44

Table 3-2 Current Water Access Licence entitlements

Water Sharing Plan	Water source (Management Zone)	Licence category	WAL number	Nominated works	Allocation (Unit Shares)	Entitlement (Unit Shares) held by NCOPL	Peak volume requiring licensing during mining (ML/year[1])	Peak volume requiring licensing post-mining (ML/year[1])	Estimated year to exceed entitlement
Groundwater									
NSW Murray-Darling Basin Porous Rock Groundwater Sources Order 2020	Gunnedah Oxley Basin MDB Groundwater Source	Aquifer	WAL 29549	90WA822539	818	1,221	2,310	2,310	2023
			WAL 43017[2]	- [2]	403				
NSW Great Artesian Basin Groundwater Sources 2020	GAB Southern Recharge Groundwater Source	Aquifer	WAL 15922	90WA822539	248	248	42	88	NA
Namoi Alluvial Groundwater Sources Order 2020	Upper Namoi Zone 5 Groundwater Source	Aquifer	WAL 12833	90WA812891	67	260	10	64	NA
			WAL 20131		150				
			WAL 12822		43				
	Lower Namoi Groundwater Source	Aquifer	-	-	Nil	Nil	0	1	> 2149

3.1.1 Water licensing

NCOPL holds sufficient licences to cover the predicted licensing requirements, with the exception of the following water sources:

- Gunnedah Oxley Basin MDB Groundwater Source regulated by the *WSP for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2020*; and
- Lower Namoi Groundwater Source regulated by the *WSP for the Namoi Alluvial Groundwater Sources 2020*.

For the predicted licensing requirements in the Lower Namoi Groundwater Source, NCOPL will seek and obtain the appropriate entitlements on the open market in accordance with the appropriate trading rules of the *WSP for the Namoi Alluvial Groundwater Sources Order 2020*. Based on recent water trading statistics, there is sufficient market depth in the Lower Namoi Groundwater Source to accommodate the very small allocation required.

Based on recent water trading statistics, there is sufficient market depth in Gunnedah Oxley MDB Groundwater Source to secure the additional entitlement. Additional entitlements for the Gunnedah Oxley Basin MDB Groundwater Source may also be obtained via the controlled allocation order process. Under section 65 of the *Water Management Act 2000,* the Minister for Water can make a controlled allocation order to make new entitlements available in water sources with unassigned water. Controlled allocation orders relevant to the Gunnedah Oxley Basin MDB Groundwater Source have been made in 2013, 2014, 2017 and 2020. There is approximately 181,528 megalitre per year **(ML/year**) of unassigned water in the Gunnedah Oxley Basin MDB Groundwater Source.

Water licence transfer strategy

To address the identified shortfall in the Gunnedah-Oxley Basin MDB Groundwater Source, allocation may also be transferred from other WHC operations to meet the operational requirements. NCOPL will conduct an annual assessment to validate actual groundwater take and predicted future water take. The assessment will consider available water take entitlement and any need to transfer entitlement from other WHC mining operations.

The aim of the assessment will be to ensure that cumulative impacts are taken into account if transferring entitlement between other WHC sites during operation and post mining, and to demonstrate that there is a viable pathway to obtain the necessary entitlement from any allocation surplus. NCOPL must ensure sufficient water entitlement is held in a WAL or WALs to account for the maximum predicted take for each water source prior to take occurring. The assessment will:

- consider the availability of entitlement from other WHC mine sites;
- account for peak water take for Stage 3; and
- consider the operational and post-operational take in each year until post-operational groundwater equilibrium is reached.

By doing this, NCOPL will identify if mine operations may significantly limit the availability of any WHC allocation surplus for transfer that may still require entitlement to address ongoing impacts at a particular mine. The assessment will be based on the other mine sites closing at the currently approved mine life date and will also re-evaluate the availability of entitlement should any of these operations have their mine life extended, while taking into account post operational requirements in accordance with the AIP.

3.2 Groundwater drawdown

Sub-surface fracturing can cause significant changes in hydraulic properties, and potentially provide pathways for groundwater movement. Discontinuous fracturing will normally be expected to occur above the mining area, causing an increase in rock mass storage capacity and horizontal permeability, without direct hydraulic connection to the workings. Groundwater levels will be lowered in the medium to long terms as a consequence of these impacts.

Drawdown greater than 2 m within the 'highly productive' Pilliga Sandstone is constrained to small areas close to the western boundary of the mining lease, due to the intervening 'less productive' formations between the Pilliga Sandstone and the Hoskissons Coal Seam (e.g. the Purlawaugh formation). Impacts are predicted to occur post-mining due to the high level of inertia (time-lag) in groundwater systems that are poorly connected to surficial recharge sources.

Substantial drawdown (or depressurisation in confined aquifers) is predicted in the groundwater systems of the 'less productive' Permian-aged porous rock in the near vicinity of the site. Recovery of the groundwater water table and pressures within the porous rock groundwater system is predicted to occur over many decades following the cessation of mining.

Privately-owned bores predicted to experience greater than 2 m drawdown are listed in section 4.6.3.

3.3 Alluvial groundwater system discharge

During operations, net discharge from other groundwater systems to the Quaternary alluvium is predicted to reduce by up to approximately 0.22 ML/day (or 80 ML/year), compared with the baseline model prediction for net discharge to the alluvium of around 15 ML/day (or 5,475 ML/year). Net discharge reduction will increase to a maximum of approximately 0.66 ML/day (or 240 ML/year) around 150 years after mining ceases, before returning to equilibrium.

A proportion of groundwater discharging to the Quaternary alluvium would ultimately discharge to the Namoi River. During operations, net discharge from the Quaternary alluvium to the Namoi River is predicted to reduce by up to approximately 0.08 ML/day (or 28 ML/year), compared with the baseline model predictions for net discharge to the river of around 13 ML/d (or 4,745 ML/year). Net discharge reduction will increase to a maximum of approximately 0.39 ML/day (or 142 ML/year) around 150 years after mining ceases, before returning to equilibrium.

3.4 Groundwater users

Groundwater modelling conducted for the Stage 3 EIS indicates that:

- predicted drawdowns at all bores accessing 'highly productive' aquifers (i.e. the Namoi Alluvium and Pilliga Sandstone) are within the AIP minimal harm impact criterion (i.e. less than 2 m drawdown); and
- nine privately-owned stock and domestic water supply bores accessing 'less productive' aquifers are predicted to experience drawdowns exceeding the AIP minimal harm impact criterion (i.e. more than 2 m drawdown) as listed in Table 3-3.

Table 3-3 Private bores predicted to experience more than 2 m drawdown

Bore	Property name	Formation	Predicted maximum cumulative drawdown (m)	Water column length (m)	Percentage reduction in water column (%)	Timing of maximum drawdown (year)
WB10 (GW013858)	Nindethana (east)	Napperby Formation	10.93	17.71	62%	2055
WB11 (House Bore)	Towri	Garrawilla Volcanics	2.72	17.6	15%	2360
WB12 (257_Bore)	Wilga	Arkarula Formation/Pamboola Formation	12.61	36.5	35%	2043
WB 13 (GW008634)	South End	Garrawilla Volcanics/Napperby Formation	0.86 - 3.35	62.8	4-17%	2113
WB 14 (GW026121)	Nindethana (west)	Garrawilla Volcanics	4.57	4-8	57 - 100%	2191
WB15 (Windmill Bore)	Riverview	Napperby Formation	4.61	8.70	54%	2050
WB16 (South Caloola)	South Caloola	Napperby Formation	5.46	4.71	100%	2067
WB17 (GW903687-Solar Bore)	Turra	Napperby Formation	5.62	11.3	50%	2050
WB18 (Mentone Bore)	Mentone	Napperby Formation	13.11	6.5	100%	2050

Impairment of supply is only expected at six of the nine bores since the predicted drawdown represents a relatively minor proportion of the standing water column observed in the other three bores and hence the yield of these bores may not be significantly impaired. Additionally, due to the slow rates of anticipated groundwater drawdown, many of these impacts are not expected to occur for decades. Consistent with their use for stock and domestic purposes, none of the bores are associated with WALs with licensed extraction quantities.

For all private bores predicted to be drawn down more than 2 m, NCOPL will:

- conduct a groundwater yield test;
- conduct annual groundwater level and quality monitoring;
- monitor any drawdown as it develops; and
- implement 'make good' measures which may include:
  - deepening the affected groundwater bore;
  - constructing a new groundwater bore;
  - providing an alternative water supply of suitable quality and quantity; and/or
  - compensation, to the satisfaction of the Planning Secretary in accordance with CoC B28 to B30.

In accordance with CoC B31, NCOPL will complete all compensatory water supply measures required under CoC B27 to CoC B30 within two years of the date of commencement of the development. In accordance with CoC B32, if NCOPL and a landowner cannot agree on whether the loss of water is to be attributed to the development or the measures to be implemented under CoC B28 to CoC B31, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Planning Secretary for resolution.

CoC B27 states that prior to the commencement of development under the CoC, NCOPL must notify owners of licensed privately-owned groundwater bores that are predicted to have a drawdown of more than 2 m as a result of the development. This notification must set out the terms whereby NCOPL proposes to give effect to landowner entitlements and NCOPLs responsibilities under conditions B28 to B32 (i.e. a 'make good' agreement).

NCOPL has committed to make good measures at all privately owned bores where the AIP's 2 m minimal impact criterion may be exceeded. Make good provisions and contingency measures will be applied in accordance with the terms of any formal make-good agreement.

Ongoing groundwater monitoring described in section 4, as well as any updates to the groundwater model, will be used to confirm the predicted drawdown at these bores.

3.5 Namoi Alluvial bore

Water will be extracted from NCOPL's existing alluvial bore located adjacent to the Namoi River during periods when supply from the underground mining area is insufficient to meet the mine water demand, and sufficient allocation from the Namoi River (i.e. utilising NCOPL's Namoi River pump) is unavailable. NCOPL's bore is located within the Upper Namoi Zone 5 Groundwater Source (within the *WSP for the Namoi Alluvial Groundwater Sources Order 2020*).

Water will be extracted in accordance with the licensed entitlements allocated under the relevant WALs held by NCOPL (section 3.3.1 of the SWB [Attachment 1 of the WMP]) and the rules prescribed in the WSP. Therefore, minimal impacts to the groundwater source and other users are predicted as a result of the ongoing use of the alluvial bore by NCOPL.

3.6 Groundwater quality

Mine dewatering activities will create hydraulic gradients towards the mine; therefore, any contamination or poor-quality groundwater generation will likely flow to the underground mine workings and be transferred to the site water management system. The mined area will remain as a local groundwater sink in the long-term and groundwater from the surrounding groundwater system will continue to flow towards the area after mining has ceased.

Disposal of brine into the underground workings has been assessed in the Stage 3 EIS Groundwater Assessment. The volume of brine to be reinjected will be negligible in the context of the overall pore space available in the goaf (i.e. less than 2%), and flows from the surrounding groundwater system will dilute the brine. Therefore, underground disposal of brine is not predicted to influence the quality of the surrounding groundwater system.

In accordance with CoC B36(e)(iv), NCOPL will monitor the impact of any brine re-injection into the goaf on salt concentrations in surrounding aquifers, for a period of 10 years following any such reinjection or such other period as required by the Planning Secretary.

The monitoring program detailed in section 4.5 will be updated prior to the end of mine life (i.e. prior to post mining) to include the monitoring of brine re-injection, including establishment of trigger values for identifying and investigating potentially adverse groundwater impacts and trends.

3.7 Groundwater dependent ecosystems

The magnitude of predicted drawdown at 'high priority' GDEs will be significantly less than the estimated seasonal water table variation, and the drawdown will occur at a very slow rate. Minor changes to the groundwater regime may not have any adverse impacts on facultative GDEs that utilise groundwater as required (i.e. opportunistically); however, these ecosystems can dieback if reduced access to groundwater is prolonged, or if the change is too rapid that the trees are not able to adapt. No GDEs where predicted maximum drawdowns exceed 5 m (a threshold mentioned by the Independent Expert Scientific Committee **(IESC)** as being of interest [IESC and DPIE–Water 2021]) are mapped in areas overlying the longwall panels. Maximum impacts of more than 5 m are predicted at a small number of GDE sites to the east and south-east of the mine.

Three springs are identified as being potentially significant. The Mayfield Spring lies immediately to the east of the mine and has historically been used for stock-watering. The other two springs are the Hardys Spring and Eather Spring, located approximately 3.5 km and 5.5 km south of MLAs 1 and 2, respectively. Maximum drawdowns of less than 5 centimetres (**cm**) are predicted at all three springs. It is therefore considered unlikely that discharge from these springs will be significantly affected.

Post-closure re-injection of relatively small amounts of brine into goaf areas is not expected to impact water quality in adjacent units or at GDEs which are located at surface between 165 m and 400 m above the coal seams. Section 4.2.3 and section 4.5 detail the monitoring program for the GDE sites.

4. Groundwater monitoring

The Narrabri Mine groundwater monitoring program (section 4.5) provides for the collection of water quality and water level data. As groundwater monitoring considers local variations whenever possible, NCOPL utilises an analysis of historical data to determine the suitability of groundwater for a particular purpose at a monitoring location. Continued monitoring also provides for the ongoing collection of data to inform management decisions in relation to potential groundwater impacts arising from operations.

Key components of the groundwater monitoring program include:

- measurement of water levels in seepage, standpipe, and production bores;
- water quality sampling of seepage, standpipe and production bores;
- continuous measurement of water levels at the VWPs;
- continuous monitoring of water quality entering the underground mine workings;
- manual reading of the volume of groundwater pumped to surface from the box cut;
- water level and quality analysis at affected bores (more than2m predicted drawdown) in accordance with the 'make good' agreement (refer to section 3.4 and section 4.2.4); and
- photographs and site observations at identified springs and high priority GDE sites.

4.1 Existing monitoring network

The existing groundwater monitoring network includes groundwater quality sampling and field data collection from 45 individual monitoring locations comprising:

- 32 standpipe piezometers of which:
  - 21 are for general water quality and water level monitoring purposes; and
  - 11 are for monitoring of seepage around water management infrastructure.
- 7 vibrating wire piezometer locations (multi-level) with 4 individual sensors for water level monitoring; and
- one spring (Mayfield) for water quality and water monitoring.

Utilising this data, impact assessment criteria (trigger values) have been adopted (section 4.6) for:

- mine water inflow volume/rate;
- groundwater quality; and
- groundwater levels.

The groundwater monitoring network (including the additional groundwater monitoring locations described in the following sections) is shown on Figure 4-1 and is detailed in Table D-1, Appendix D. It is noted that as mining progresses, a number of the monitoring locations in Table D-1 will become obsolete due to undermining. As this occurs, NCOPL will assess the monitoring requirements and locations for replacement and revise this Plan accordingly (refer to section 4.4).

4.2 Additional monitoring network

4.2.1 New Quaternary Alluvium bores

NCOPL will establish additional bores at six new monitoring locations. Each location will comprise:

- two shallow standpipe monitoring bores monitoring groundwater levels and water quality in the Quaternary Alluvium and the immediately underlying bedrock; and
- a nested VWP facility including monitoring of all groundwater levels in consolidated units from the Hoskissons Coal Seam to the ground surface (VWPs to provide an 'early warning' of potential impacts).

The new monitoring bore locations are shown in Figure 4-1 (i.e. locations located upstream and downstream of the mine on Pine Creek, Kurrajong Creek, and Tulla Mullen/Sandy Creeks (or tributaries). Following commencement of the Stage 3 development, the monitoring bores described above will be installed. Bores P62 to P64, P68 to P70, P71 to P73 and P74 to P76 will be used as primary early warning monitoring bores for groundwater drawdown (refer to section 4.6.3). Trigger levels will be established for these bores according to the maximum predicted drawdown at these locations and following the collection of baseline data over six to eight monitoring events.

Indicative bore depths are based on the middle of the geology layers and are included in Table D-1, Appendix D. These depths are to be confirmed during drilling and inspection of bore logs. Once the bore details are confirmed, Table D-1 in Appendix D will be updated accordingly.

Surface water levels and field water quality parameters in any standing pools at the six locations will also be monitored (refer to section 4.2.3).

NCOPL will also assess the feasibility of using helium gas, or other tracers/indicators to investigate seam to surface connectivity above selected longwall panels.

4.2.2 Multilevel piezometer nests

NCOPL are required to install three multilevel piezometer nests in accordance with CoC B36(e)(iv) and as described in the IAPUM advice (IAPUM 2021):

- one additional multilevel piezometer nest at the northern end of longwall 111 (P77) on the centreline of the longwall and directly east of existing monitoring site P17;
- two nests within the extension mine area along the centreline of the first two longwalls to be mined (i.e. longwall 301 [P78] and longwall 302 [p79]), 300 m from their southern limit; and
- monitoring depths are to be in the middle of each of the main formations.

The locations of the additional VWPs are shown on Figure 4-1.

Following commencement of the Stage 3 development, the additional VWP bores described above will be installed. The indicative depths are based on the middle of the geology layers and are included in Table D-1, Appendix D. This Plan will be updated to confirm the new bore locations and details as presented in Table D-1, Appendix D. These depths are to be confirmed during drilling and inspection of bore logs. Additionally, the number of VWP sensors per bore will be limited based on diameter and other construction constraints and the number of sensors is to be confirmed with the VWP installation contractor.

4.2.3 Groundwater features

NCOPL are required to monitor at a number of potential 'high priority' GDE sites which have a predicted drawdown in excess of the relevant AIP threshold. These areas are predominantly located within the *Gunnedah Oxley Basin MDB Groundwater Source* and include areas which are mapped as being dominated by Red Gum, River Red Gum, shallow freshwater wetland sedgeland with smaller areas of Ironbark and Box grassy woodland. The majority of these mapped GDEs are located close to Tulla Mullen Creek to the southeast of the Narrabri Mine and in areas close to the Namoi River to the north-east.

Monitoring is also proposed at a number of other GDE sites including Hardy's, Mayfield, and Eather Springs and Blairmore Feature 1 and 2. Quaternary Alluvium monitoring bores P71, P72, P74 and P75 (Figure 4-1) are located within, or in close proximity to, the GDEs associated with Sandy Creek and its tributaries. These monitoring bores can provide additional data on ground water level and quality for determining potential impacts if required.

The monitoring includes an annual evaluation to observe any changes to surface conditions (e.g. vegetation), flow rates, water level and/or water quality (EC and pH). Four photographs will be taken at each site comprising upstream, downstream, at the left bank and at the right bank. The location, direction and date of each photograph taken will be recorded. The monitoring results will then be used to determine if there are any potential impacts occurring on the GDEs as a result of mining operations.

If potential impacts are observed, NCOPL will engage a suitable qualified hydrogeologist to undertake further assessment.

The monitoring locations described above are shown on Figure 4-1.

4.2.4 Privately-owned bores

As discussed in section 3.4, NCOPL has committed to conduct a groundwater yield test (where allowed by the installed bore head works), conduct annual groundwater level and quality monitoring, monitor any drawdown as it develops, and implement 'make good' agreements at privately owned bores with more than 2m drawdown.

Yield tests will be conducted at commencement of the monitoring agreement/s to determine a baseline of pumping equilibrium. Monitoring will also include water quality analysis for EC and pH and an annual laboratory analysis for physical parameters, cations, anions, dissolved metals, and nutrients.

Groundwater level and quality monitoring will be conducted in accordance with the monitoring program summary provided in section 4.5.

4.3 Relationship between measured EC and TDS

In accordance with Condition B36(e)(iv), NCOPL will identify relationships between measured EC and TDS in mine water and groundwater in the Hoskissons Seam and adjoining aquifers.

EC and TDS will be monitored via:

- routine monitoring data from the box-cut (refer to the SWMP [Attachment 3 of the WMP]);
- groundwater collected within the longwall panels i.e. targeting the Hoskissons Seam; and

- monitoring bores associated in adjoining aquifers i.e. Garrawilla, Napperby, Purlawaugh and Watermark.

The groundwater collected within the longwall panels will be sampled monthly for an initial 6-month period to collect adequate baseline data. Following this, the groundwater collected within the longwall panels will be sampled annually.

The relationship between EC and TDS will be analysed during the annual Hydrogeologist review (refer to section 6.3).

4.4 Groundwater monitoring network review

Where existing monitoring bores are to be impacted by subsidence, suitable alternatives will be required to be installed in consultation with a suitably qualified hydrogeologist. Baseline data collection will be required prior to mining activities commencing.

Those monitoring bores predicted to be impacted by subsidence will be detailed in the relevant Extraction Plan.

If there are any other significant changes to the groundwater monitoring network, this will be conducted in consultation with a suitably qualified hydrogeologist.

4.5 Groundwater monitoring program summary

The Narrabri Mine groundwater monitoring program is summarised in Table 4-1 and the monitoring locations are shown on Figure 4-1. A detailed list of all monitoring locations and the type of monitoring conducted at each location is provided in Table D-1, Appendix D.

Table 4-1 Groundwater monitoring program

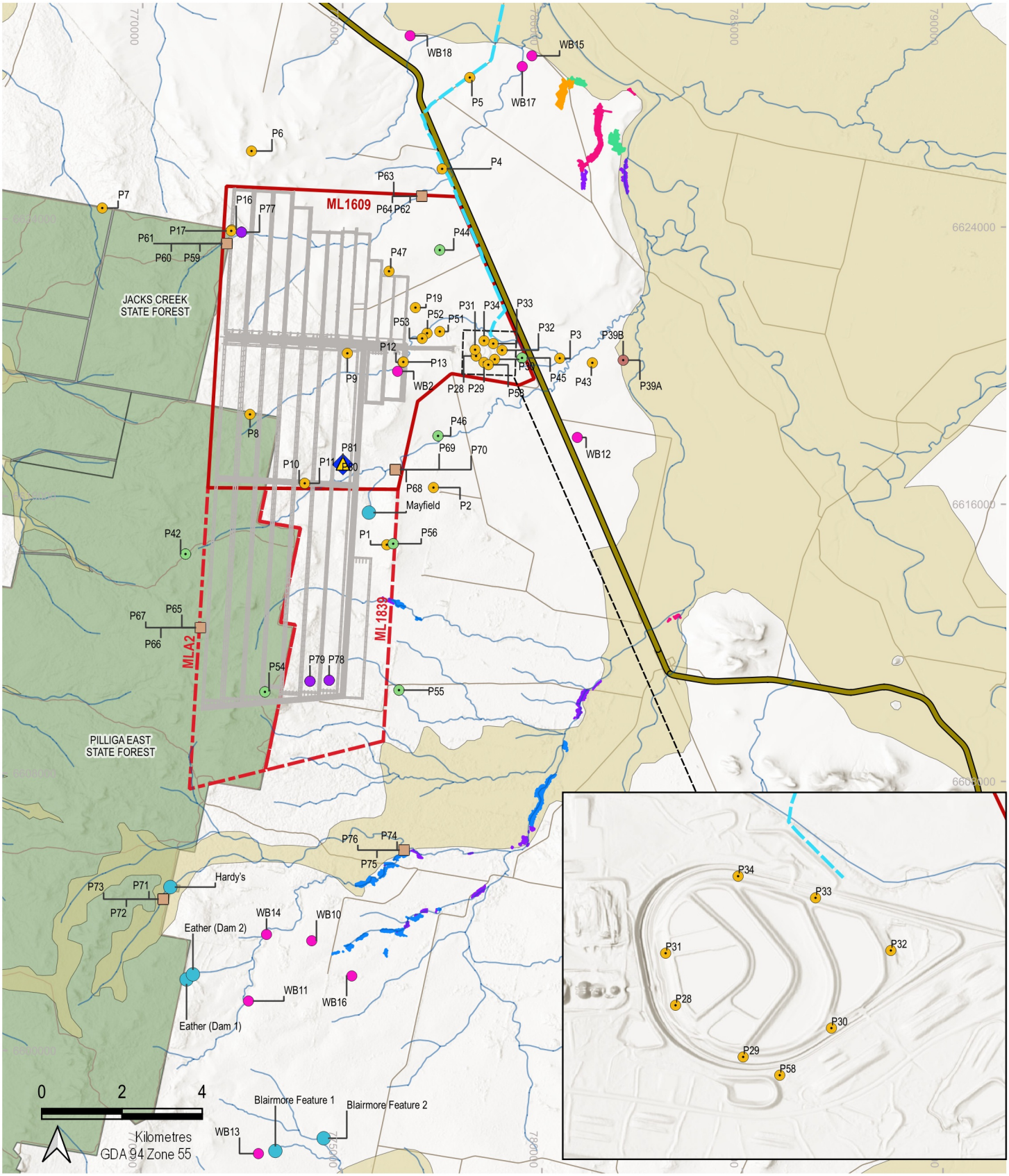
Monitoring focus	Monitoring type	Monitoring parameters	Frequency
Groundwater	VWPs **Sites:** P42, P44, P45, P46, P54, P55, P56, P61, P64, P67, P70, P73, P76, P77, P78, P79.	Pressure data.	Continuous with quarterly download of data
	Standpipes **Sites:** P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, P16, P17, P19, P28, P29, P30, P31, P32, P33, P34, P39A, P39B, P43, P47, P51, P52, P53, P58, WB2, P59, P60, P62, P63, P65, P66, P68, P69, P71, P72, P74, P75.	• Water level • Field EC and pH • Laboratory analysis: ▪ physical parameters (e.g. alkalinity, ED, TDS, TSS and pH); ▪ cations (e.g. calcium, magnesium, sodium and potassium); ▪ anions (e.g. carbonate, bicarbonate, sulphate, chloride and fluoride); ▪ dissolved metals (e.g. aluminium, antimony, arsenic, boron, cobalt, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, silver, selenium and zinc); and ▪ nutrients (e.g. ammonia, nitrate, phosphorous and reactive phosphorous).	• Quarterly for water level, EC and pH • Annually for all other parameters
	Additional monitoring of water quality entering the underground mine workings (i.e. in the mine water collection system via the monitoring at the box cut sump).	• TDS • pH • temperature.	Continuous

Monitoring focus	Monitoring type	Monitoring parameters	Frequency
	Additional monitoring of water quality entering the underground mine workings (i.e. within longwall panels).	• EC • TDS	Initial 6-month period and annually thereafter.
	Mine water pumping inflow and outflow.	Discharge rate	Monthly meter read
	Private bores with more than 2m predicted drawdown **Sites:** WB10, WB11, WB12, WB13, WB14, WB15, WB16, WB17, and WB18.	• Water level • Field EC and pH • Laboratory analysis: ▪ physical parameters (e.g. alkalinity, ED, TDS, TSS and pH); ▪ cations (e.g. calcium, magnesium, sodium and potassium); ▪ anions (e.g. carbonate, bicarbonate, sulphate, chloride and fluoride); ▪ dissolved metals (e.g. aluminium, antimony, arsenic, boron, cobalt, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, silver, selenium and zinc); and ▪ nutrients (e.g. ammonia, nitrate, phosphorous and reactive phosphorous).	Annually
Subsidence (subsurface cracking)	Subsidence calibration borehole P80 and geotechnical borehole P81 above LW 203^ – deep borehole piezometers, shallow standpipe piezometers and deep wireline extensometers.	• Water level • Displacement.	Continuous

Monitoring focus	Monitoring type	Monitoring parameters	Frequency
GDEs	Hardy's Mayfield, and Eather springs, Blairmore Feature 1 and 2, and mapped high priority GDEs.	• Site photographs (x4) and observations of: ▪ flow rates ▪ surface water levels and field water quality (EC and pH) in any standing pools. ▪ vegetation health.	Annually

Notes:

^ Location above LW 203 as recommended in the *Mine Subsidence Assessment for Longwalls LW203 to LW206 at the Narrabri Underground Mine* (Ditton Geotechnical Services 2022) and shown on Figure 4-1. The depths and formations associated with P81 will be determined during drilling.



WHITEHAVEN COAL

ONWARD CONSULTING

LEGEND

- ML1609
- MLA1
- MLA2
- Alluvium
- State forest
- Namoi River pipeline (buried)
- Surface disturbance area
- Highway
- Roads
- Watercourse

Groundwater monitoring sites

- Groundwater monitoring - standpipe nested
- Groundwater monitoring - standpipe single
- Groundwater monitoring - VWP nested
- New groundwater feature monitoring site
- New VWP location
- Privately owned bores >2m drawdown
- Quaternary Alluvium bores
- Subsidence calibration borehole
- Geotechnical Bore

High priority GDEs

- Box grassy woodland
- Narrow-leaved Ironbark
- Red Gum
- River Red Gum
- Shallow freshwater wetland sedgeland

NARRABRI MINE

FIGURE 4-1

Groundwater Monitoring Locations

4.6 Groundwater impact assessment criteria

4.6.1 Baseline data collection

Groundwater level and quality information has been routinely collected since 2007, some two years prior to commencement of mine operations in 2009. Whilst this is not the case for all monitoring locations, measurements and sampling is undertaken as soon as a location becomes operational. Historical water quality sampling and field data collection has been undertaken at 42 monitoring locations and the Mayfield Spring. These locations are screened within the various geological units identified in section 2.1. Depending on the monitoring location, NCOPL has collected groundwater data over a period ranging from three to 12 years.

This data collection enabled the establishment of baseline and background water level and water quality data. Through this process, it was established that unique water types exist with a rather large variation across each geological zone and across all monitoring bores. Because of the high variability in groundwater chemistry, it is therefore not feasible to single out individual bores for the establishment of background references.

Historical water level measurements have been collected at monitoring locations and used to inform calibration of, and updates to, the numerical groundwater modelling undertaken for the Narrabri Mine. To further demonstrate how baseline groundwater data was applied in the groundwater impact assessment (AGE 2020), the steady state and transient model simulated water levels in all available monitoring bores within the bedrock and alluvial aquifers. A total of 262 monitoring points were used to calibrate the model, comprising:

- 129 NSW State groundwater monitoring points, predominantly completed into the Namoi Alluvium;
- 115 monitoring points which form part of the Narrabri Mine monitoring network including a number of nested VWP facilities; and
- 18 monitoring points installed in the area to the west of the existing Narrabri Mine as part of the Narrabri Gas Project EIS.

4.6.2 Groundwater quality

Where suitable, the guideline water quality objectives for stock drinking water (beef cattle) and long-term irrigation have been adopted. These guideline values assume that groundwater is abstracted for the purpose associated with the identified environmental values and are based on guidance provided in OEH (2006) and ANZG (2018). However, because of the high variability in groundwater chemistry, groundwater quality may not meet the water quality objectives set in the ANZG (2018) at all locations and/or at all times.

As a result, water quality trigger values (Appendix E) have been developed for EC based on an assessment of historical data (AGE 2021) and utilising the methodology described in the Queensland Department of Science, Information Technology and Innovation guidelines "*Using monitoring data to assess groundwater quality and potential environmental impacts*" (DSITI 2017). In summary, the monitoring locations have been selected based on the suitability of the water quality (e.g irrigation or stock [beef cattle] drinking) and monitoring purpose.

The pH trigger values (Appendix E) have been derived from the ANZG (2018) recommended irrigation long term application pH range.

Since no significant drawdown and hence no significant water quality impacts are anticipated in the Namoi Alluvium and/or the Pilliga Sandstone, triggers have only been derived in a single monitoring bore in each of these aquifers.

Triggers for EC and pH

If pH is outside the range of 6.0 – 8.5 for three consecutive readings or the EC trigger value of 5,970 (µS/cm) is exceeded for three consecutive readings, the TARP (Level 2) will be initiated.

Two tiered triggers for EC

For those monitoring locations where water quality is unsuitable for use as irrigation / stock watering or where the intended purpose is seepage monitoring, two tiered EC triggers will be utilised. These triggers are not static values and are derived using the rolling median calculated from the eight most recent data points and plotted on a time series chart (control chart) that includes:

- individual data points;
- the 80th percentile calculated from the long-term dataset; and
- the 95th percentile calculated from the long-term dataset.

Two triggers are then identified as follows:

- Tier 1 – where the rolling median exceeds the 80th percentile of long-term data; and
- Tier 2 – where three consecutive exceedances of the 95th percentile of the long-term data occur. If this occurs, the TARP (Level 2) will be initiated.

The Tier 1 trigger provides a method for assessing a gradual change in groundwater quality over the medium term via use of the rolling median. Whilst the Tier 2 trigger is intended to detect an event related change over the short term.

Table 4-2 details the monitoring bores with an EC groundwater quality trigger.

Table 4-2 Monitoring bores with groundwater quality trigger criteria

Location ID	Easting (MGA 55)	Northing (MGA 55)	Bore Depth (m)	Screen Interval (m bgl)	Formation	Trigger criteria
P1	776116	6614694	50	44-50	Garrawilla Volcanics	ANZG (stock), bore specific
P2	777282	6616355	50	44-50	Napperby Formation	EC two tiered
P3	780433	6620115	45	34-40	Pamboola Formation	EC two tiered
P4	777490	6625553	30	24-30	Napperby Formation	EC two tiered
P6	772726	6626021	90	78-90	Pilliga Sandstone	ANZG (irrigation)
P7	768998	6624338	90	78-90	Pilliga Sandstone	ANZG (irrigation)
P8	772697	6618421	65	57-63	Purlawaugh Formation	ANZG (stock)
P9	775127	6620209	30	24-30	Purlawaugh Formation	EC two tiered
P10	774063	6616444	130	118-130	Napperby Formation (no sill)	EC two tiered
P11	774066	6616447	50	44-50	Purlawaugh Formation	EC two tiered
P12	776513	6619964	90	84-90	Napperby Formation (above sill)	ANZG (stock)
P13	776526	6619972	30	24-30	Garrawilla Volcanics/Napperby	ANZG (stock)
P16	772233	6623740	146	137-146	Garrawilla Volcanics	ANZG (stock), bore
P19	776827	6621543	187	184-187	Pamboola Formation	To be determined – never monitored
P29	778541	6619978	25	19-25	Napperby Formation (above sill)	EC two tiered
P31	778318	6620343	15	42248	Napperby Formation (above sill)	EC two tiered
P32	778993	6620335	15	41883	Napperby Formation (above sill)	EC two tiered
P39A	782024	6620076	80	72-78	Watermark Formation	ANZG (stock)
P39B	782018	6620077	32	15-30	Tullamullen Alluvium	ANZG (irrigation), bore specific
P43	781248	6619992	66	59-65	Watermark Formation	EC two tiered

Location ID	Easting (MGA 55)	Northing (MGA 55)	Bore Depth (m)	Screen Interval (m bgl)	Formation	Trigger criteria
P47	776166	6622586	31	8-30.5	Garrawilla Volcanics	ANZG (stock)
P51	777437	6620859	17	44174	Garrawilla Volcanics	EC two tiered
P52	777118	6620808	24	18-21	Napperby Formation	EC two tiered
P53	776995	6620655	24	18-21	Garrawilla Volcanics	EC two tiered
WB2	776382	6619701	26	22-26	Garrawilla Volcanics	ANZG (stock)

4.6.3 Groundwater levels

Water level trigger values have been developed for monitoring locations with sufficient pre-mining baseline data based on the maximum predicted drawdown generated from the recalibrated numerical groundwater model (AGE 2020). In cases where the maximum predicted drawdown exceeds the bottom of the bore "a conservative trigger level of one metre above the base of bore screen was adopted". The resulting annual trigger levels for each monitoring bore are presented in Table 4-3 (adopted trigger levels m AHD). Should observed water levels fall below the adopted trigger levels shown in Table 4-3, the TARP (section 5) will be initiated.

Interim yearly trigger values for the nine privately owned bores that have a predicted drawdown of more than 2m (adopted trigger levels m AHD) are presented in Table 4-4. The interim groundwater levels have been derived from the recalibrated numerical groundwater model (AGE 2020) based on the maximum predicted drawdown for each bore. The yearly trigger levels will be confirmed following collection of baseline groundwater level data over six to eight monitoring events. If a trigger level is exceeded for a given year, the TARP (section 5) will be initiated.

If the drawdown meets or exceeds the 2 m AIP criteria, the 'make good' agreements will apply (refer to section 3.4).

Early warning

Several of the new VWPs detailed in section 4.2.1 will be used as primary early warning detection for groundwater level drawdown at the boundary of the alluvium (i.e. predicted 2m drawdown contour) once trigger levels have been established.

NCOPL will also utilise existing monitoring bores P3, P4 and P5 as primary early warning detection bores (Figure 4-1). Monitoring bores P3, P4 and P5 are 45, 30 and 30 m deep, respectively and are constructed in the bedrock below the regolith (Napperby and Pamboola formations). These bores have groundwater level triggers as per Table 4-3. If drawdown exceeds the trigger level/s detailed in Table 4-3 or Table 4-4, the TARP (section 5) will be initiated.

The predicted groundwater levels at monitoring bores with no triggers will also be used as an internal early warning system for NCOPL.

Table 4-3 Groundwater level triggers for life of mine (m AHD)

Location ID	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
P1	271.4	271.4	271.4	271.4	271.4	271.4	271.4	271.4	271.4	271.4	271.4	271.4	271.4	271.4	271.4	271.4	271.4	271.4	271.4	271.4	271.4	271.4	271.4
P2	242.7	240.4	238.4	236.8	235.5	234.3	233.2	232.2	231.3	230.4	229.6	229.0	228.5	228.0	227.6	227.2	226.8	226.4	226.2	226.2	226.2	226.1	226.0
P3*	223.7	223.4	223.1	222.8	222.5	222.2	221.9	221.5	221.2	220.9	220.7	220.4	220.1	219.8	219.5	219.2	219.0	218.7	218.5	218.2	218.0	217.8	217.6
P4*	228.3	228.0	227.8	227.6	227.4	227.2	227.0	226.9	226.7	226.5	226.4	226.2	226.0	225.9	225.7	225.6	225.4	225.2	225.1	224.9	224.8	224.7	224.6
P5*	205.4	205.2	205.0	204.7	204.5	204.2	203.9	203.6	203.3	202.9	202.5	202.2	201.8	201.4	201.1	200.7	200.3	199.9	199.5	199.2	198.8	198.4	198.1
P8	271.5	271.5	271.5	271.5	271.5	271.4	270.9	270.3	269.9	269.6	269.5	269.3	269.2	269.2	269.1	269.1	269.0	269.0	269.0	268.9	268.9	268.9	268.9
P9	267.7	267.7	262.4	262.8	263.3	263.6	263.8	264.0	264.1	264.2	264.2	264.2	264.3	264.3	264.3	264.3	264.3	264.3	264.3	264.3	264.3	264.3	264.2
P10	274.2	272.5	270.2	267.6	264.4	261.0	257.9	255.2	253.2	251.8	250.8	250.0	249.4	248.8	248.3	247.7	247.0	246.2	245.5	244.9	244.5	244.1	243.8
P11	279.7	279.7	279.6	277.8	273.1	272.9	272.9	272.9	273.2	273.3	273.4	273.5	273.8	273.9	273.9	274.0	274.0	274.0	274.0	274.0	274.0	274.0	274.0
P12	197.1	195.6	194.0	193.1	192.4	191.8	191.3	190.8	190.2	189.6	189.2	188.9	188.7	188.5	188.2	188.0	187.8	187.6	187.4	187.2	187.0	186.8	186.6
P13	267.0	266.9	266.8	266.7	266.6	266.5	266.4	266.3	266.2	263.4	262.6	262.4	262.3	262.2	262.2	262.2	262.2	262.2	262.2	262.2	262.2	262.2	262.2
P16	244.0	242.8	242.1	241.5	240.9	240.4	239.8	239.3	238.7	237.3	236.0	235.3	234.8	234.3	233.7	232.9	232.3	231.7	231.4	231.1	230.8	230.6	230.4
WB2	257.9	257.8	257.7	257.6	257.5	257.4	257.4	257.3	255.9	249.7	250.9	251.2	251.4	251.6	251.8	251.9	252.0	252.1	252.2	252.3	252.4	252.4	252.4
P39B*	222.1	222.1	222.1	222.1	222.1	222.1	222.1	222.1	222.1	222.1	222.1	222.1	222.1	222.1	222.1	222.1	222.1	222.1	222.1	222.1	222.1	222.1	222.1

Note:
*Primary early warning monitoring bores

Table 4-4 Yearly interim and 2m AIP groundwater level triggers for private bores (m AHD)

Bore	2m drawdown trigger level	Predicted year 2m drawdown reached	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
WB10 (GW013858)	280.6	2092	282.8	282.8	282.8	282.8	282.8	282.8	282.8	282.8	282.7	282.7	282.7	282.7	282.7	282.7	282.6	282.6	282.6	282.5	282.4	282.4	282.2	282.1	282.0
WB11 (House Bore)	302.6	2300	304.6	304.6	304.6	304.6	304.6	304.6	304.6	304.6	304.6	304.6	304.6	304.6	304.6	304.6	304.6	304.6	304.5	304.5	304.5	304.5	304.5	304.5	304.5
WB12 (257_Bore)	222.4	2035	223.9	223.9	223.8	223.7	223.6	223.5	223.4	223.2	223.1	223.0	222.8	222.7	222.5	222.4	222.3	222.1	222.0	221.8	221.7	221.5	221.4	221.2	221.1
WB13 (GW008634)	305.2	2133	307.2	307.2	307.2	307.2	307.2	307.2	307.2	307.2	307.2	307.2	307.2	307.2	307.2	307.2	307.2	307.2	307.2	307.2	307.2	307.2	307.2	307.2	307.2
WB14 (GW026121)	284.6	2509	286.7	286.7	286.7	286.7	286.7	286.7	286.7	286.7	286.7	286.7	286.7	286.7	286.7	286.7	286.6	286.6	286.6	286.6	286.6	286.6	286.6	286.6	286.6
WB15 (Windmill Bore)	211.7	2051	213.6	213.6	213.5	213.5	213.5	213.4	213.4	213.3	213.2	213.2	213.1	213.0	213.0	212.9	212.8	212.7	212.7	212.6	212.5	212.4	212.4	212.3	212.2
WB16 (South Caloola)	244.1	2044	246.2	246.2	246.2	246.2	246.2	246.2	246.2	246.2	246.2	246.2	246.2	246.2	246.1	246.0	245.7	245.5	245.3	245.1	244.9	244.7	244.5	244.3	244.1
WB17 (GW903687 - Solar Bore)	212.0	2044	213.8	213.7	213.6	213.6	213.5	213.4	213.3	213.3	213.2	213.1	213.0	212.9	212.9	212.8	212.7	212.6	212.5	212.4	212.3	212.3	212.2	212.1	212.0
WB18 (Mentone Bore)	212.3	2028	213.5	213.3	213.1	212.9	212.7	212.5	212.3	212.1	211.9	211.7	211.5	211.4	211.2	211.0	210.9	210.7	210.4	210.2	210.0	209.7	209.5	209.3	209.1

5. Trigger Action Response Plan

The TARP provided in Table 5-1 has been developed to focus upon appropriate triggers and associated response actions for mitigation of impacts to groundwater and other water users.

The responses proposed incorporate an assessment and development of management measures deemed appropriate for each individual event should it occur.

The triggers for instigation of response actions will occur when observed changes to monitored parameters exceed specified trigger levels. Such changes in observed parameters or conditions may include:

- sudden inrush of groundwater into the mine in exceedance of predicted inflows;
- trigger value exceedances in observed water quality or groundwater levels between sampling rounds; and
- significant variation from model predictions.

The trigger values for each monitoring methodology outlined in Table 5-1 are provided in the following sections of this Plan:

- Groundwater levels – section 4.6.3; and
- Groundwater quality – Appendix E.

Where groundwater level triggers are exceeded for three consecutive monitoring events (Level 2), this will result in an additional assessment by a hydrogeologist as defined in the TARP (Table 5-1). The primary aim of the assessment will be to assess if the trigger level exceedance is related to mining activities. The assessment will include collation or consideration of the following data sets:

- groundwater level records both for the mine monitoring network and other local monitoring bores (where relevant);
- surface water level or flow records for the mine monitoring network;
- updated local climate data;
- mine inflow volumes;
- mine subsidence monitoring data;
- available information on other local activities which might influence groundwater levels (other resource extraction activities, landholder bore operations etc); and
- validation of the numerical model 2m drawdown zone in the upper regolith/alluvium (for early warning monitoring bores only). If drawdowns outside the expected range occur, it should then be considered to install additional monitoring bores closer to the alluvium and the conditions re-assessed.

These data sets will then be reviewed to confirm whether or not the observed exceedance/s is likely to be related to operation of the Narrabri Mine and/or other external factors (climate, other local activities etc).

Where necessary, the existing Groundwater Flow Model (AGE 2020) can then be used to further quantify the contribution of difference sources of impact. Where trigger exceedances appear to be related to subsidence impacts, then the existing numerical model can be re-run with updated climate data and revised parameterisation of fracture zones above the mine to quantify the contribution of these two stresses to the observed drawdown.

Table 5-1 Trigger Action Response Plan

Method	Status	Trigger	Action	Response
Groundwater levels				
To provide baseline water level data and to identify water level impacts in comparison to predicted drawdown considering natural variations. To verify that impacts on aquifers are consistent with model predictions. **Sites:** P1, P2, P3*, P4*, P5*, P8, P9, P10, P11, P12, P13, P16, WB2, P39B*, WB10^, WB11^, WB12^, WB13^, WB14^, WB15^, WB16^, WB17^, and WB18^. **Parameters:** Water level. **Frequency:** Quarterly manual monitoring of groundwater levels and automatic groundwater level monitoring via VWPs (downloaded quarterly). Privately owned bores - Annually	**Normal**	Routine monitoring indicates water level below trigger levels.	None required	Continue routine groundwater monitoring and evaluation of results.
	Level 1	Routine monitoring indicates drawdown exceeds trigger level (i.e. single exceedance) (Table 4-3 and Table 4-4).	Conduct preliminary quality assurance of data to confirm an exceedance.	• For a single exceedance, the exceedance will be recorded, with no further contingency or notification measures required. If a water level trigger is exceeded at the same location for three consecutive sampling events, then the actions required for Level 2 will be implemented. • For privately owned bores, notify landholder that exceedance has occurred.
	Level 2	Routine monitoring indicates drawdown exceeds trigger level over three consecutive monitoring events OR drawdown meets or exceeds the AIP 2 m drawdown criteria (Table 4-3 and Table 4-4).	• Conduct preliminary quality assurance of data to confirm an exceedance. • Environmental Superintendent to implement contingency and notification measures as per section 6 of the WMP.	• Engage hydrogeologist to undertake assessment and report on any identified changes/likely causes and recommendations. • Implement contingency responses as agreed with government agencies and in accordance with hydrogeologist recommendations. • For privately owned bores, notify landholder that exceedance has occurred. If the AIP 2 m drawdown criteria is exceeded, the make good agreements will be implemented which may include compensatory water supply (CoC B28 to B32).

Method	Status	Trigger	Action	Response
Groundwater quality				
To assess performance of water management infrastructure. **Sites:** P1, P2, P3, P4, P6, P7, P8, P9, P10, P11, P12, P13, P16, P19, P29, P31, P32, P39A, P39B, P43, P47, P51, P52, P53, WB2, WB10^, WB11^, WB12^, WB13^, WB14^, WB15^, WB16^, WB17^, and WB18^. **Parameters:** EC and pH **Frequency:** Quarterly	**Normal**	Routine monitoring indicates water quality below the EC or pH trigger value.	No action	Continue routine groundwater monitoring and evaluation of results.
	Level 1	Routine monitoring indicates water quality exceeds the EC or pH trigger value (single exceedance).	Conduct preliminary quality assurance of data to confirm an exceedance.	For a single exceedance, the exceedance will be recorded, with no further contingency or notification measures required. If a water level trigger is exceeded at the same location for three consecutive sampling events, then the actions required for Level 2 will be implemented.
	Level 2	Routine monitoring indicates water quality exceeds the EC or pH trigger value over three consecutive monitoring events.	• Conduct preliminary quality assurance of data to confirm an exceedance. • Environmental Superintendent to implement contingency and notification measures as per section 6 of the WMP.	• Engage hydrogeologist to undertake assessment and report on any identified changes/likely causes and recommendations. • Implement contingency responses as agreed with government agencies and in accordance with hydrogeologist recommendations.

Notes:
***Primary early warning monitoring bores**
^Private landholder bore

6. Reporting, evaluation and review

Monitoring results will be reviewed against the impact assessment criteria detailed in section 4.6 and Appendix E. Where an exceedance of the relevant criteria or performance measures has occurred, NCOPL will implement the actions outlined in the TARP (Table 5-1) and the procedures outlined in section 6.2 of the WMP. In accordance with CoC B36(e)(iv), NCOPL will notify other water users of any elevated monitoring results.

Reporting of the water level results from the monitoring network will be included in the Annual Review. The reporting will include a comparison to climate trends and surface water monitoring results to identify changes in the surface water and groundwater interactions (e.g. comparison of groundwater levels to rainfall and estimated recharge).

All internal and external reporting and the review of this document will be undertaken in accordance with section 7 of the WMP.

6.1 Data quality assurance plan

6.1.1 Data collection

The following data quality assurance/quality control (**QA/QC**) procedures will be followed during groundwater level, groundwater quality, and mine inflow data collection:

Groundwater level monitoring

- The primary instrumentation that requires QA/QC checks include steel tapes and electric tapes used to measure groundwater levels. These are to be checked for any defaults before every monitoring event. Maintain the tape in good working condition by periodically checking the tape for breaks, kinks, and possible stretch.
- The electric tape is to be recalibrated annually (or more frequently if it is used often) or if the tape has been subjected to abnormal stress that may have caused it to stretch. Cunningham and Schalk (2011) provides more guidance on the use of electrical measuring tapes.
- Pressure transducers used to monitor water levels will be assessed by QA/QC procedures as specified by the vendor and as described in Cunningham and Schalk (2011). Additionally, calibration and maintenance information of specific brands of pressure transducers are provided by the manufacturers and should be consulted.
- The procedure to identify any anomalies and/or outliers is to be followed to validate and justify abnormal data entries. Continuous decline in levels is to be validated against potential default equipment, changes in monitoring bore construction due to subsidence, changes in levels due to climate, changes in level due to mining and changes in level due to agricultural use. Groundwater level hydrographs will be developed for each monitoring point to identify any outliers in the data collected. If such outliers are identified in the monitoring data, these will be highlighted appropriately and excluded from comparisons with trigger elevations.
- The methods for analysis of groundwater level data are summarised in Figure 6-1. The flowchart outlines the pre-processing steps, including QA/QC undertaken for groundwater level data analysis.
- As indicated in Figure 6-1, manual standing water levels and electronic pressure logger/VWP data will be converted to a reduced water level with respect to Australian heigh datum (m AHD). Pressure logger data will be adjusted to remove the effects of barometric pressure changes where required.

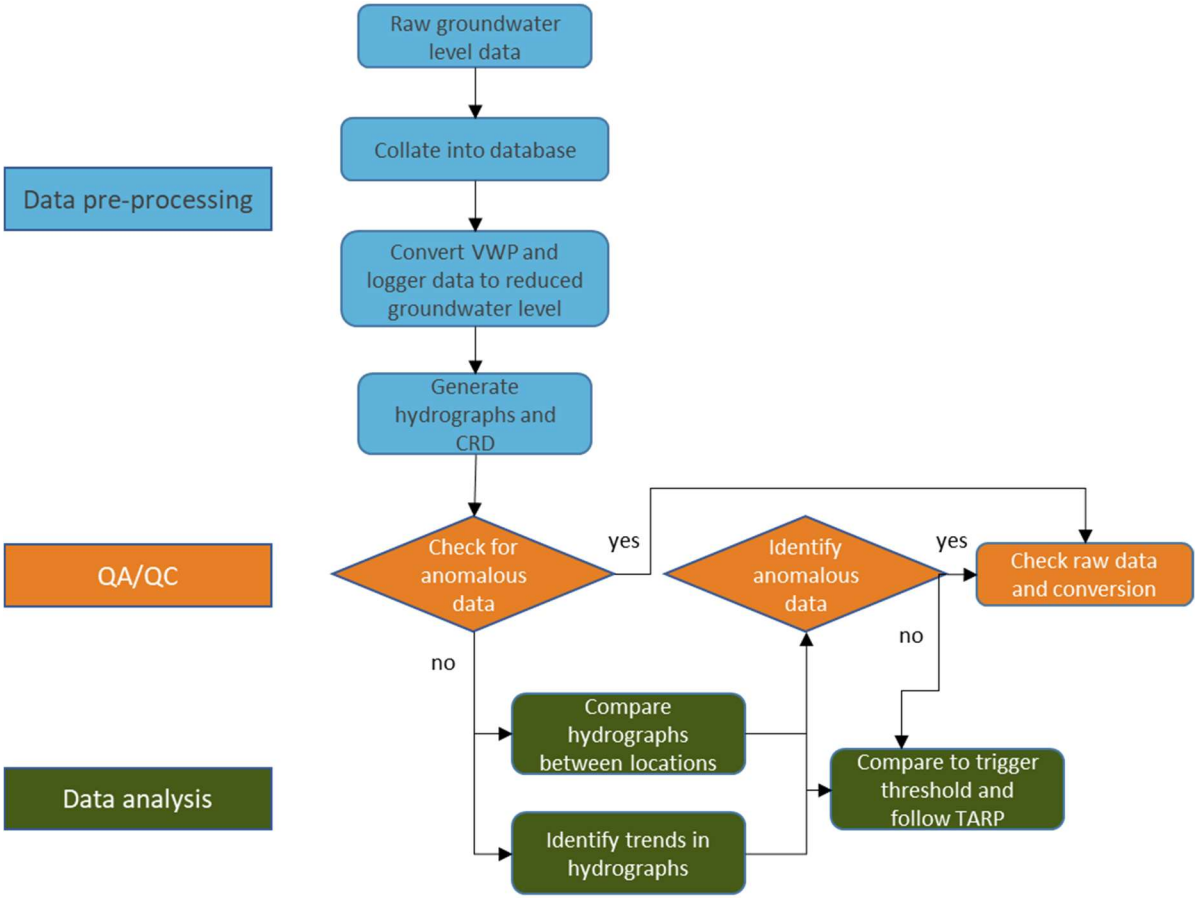


Figure 6-1 Groundwater level data pre-processing and analysis flowchart

Groundwater quality monitoring

Field:

The following field sampling QA/QC procedures will be applied in order to prevent cross-contamination and preserve sample integrity:

- samples are to be collected in clearly labelled bottles with appropriate preservation solutions;
- samples are to be delivered to the laboratories within the specified holding times; and
- pH and EC/TDS (salinity are also measured in the field with calibrated field measurement equipment and then compared against laboratory data).

In addition, a duplicate sample is collected in the field to assess sampling and laboratory analysis accuracy.

Laboratory:

The laboratories conduct their own internal QA/QC program to assess the repeatability of the analytical procedures and instrument accuracy. These programs include analysis of laboratory sample duplicates, spike samples, certified reference standards, surrogate standards/spikes, and laboratory blanks.

Data:

The selected groundwater monitoring bores will have water samples collected for water quality analysis and field pH and EC measurements. The methodology for analysis of groundwater quality data is summarised in Figure 6-2. Similar to the water level flowchart (Figure 6-1), this flowchart outlines the pre-processing, including QA/QC, as well as the steps that will be undertaken for groundwater quality data analysis.

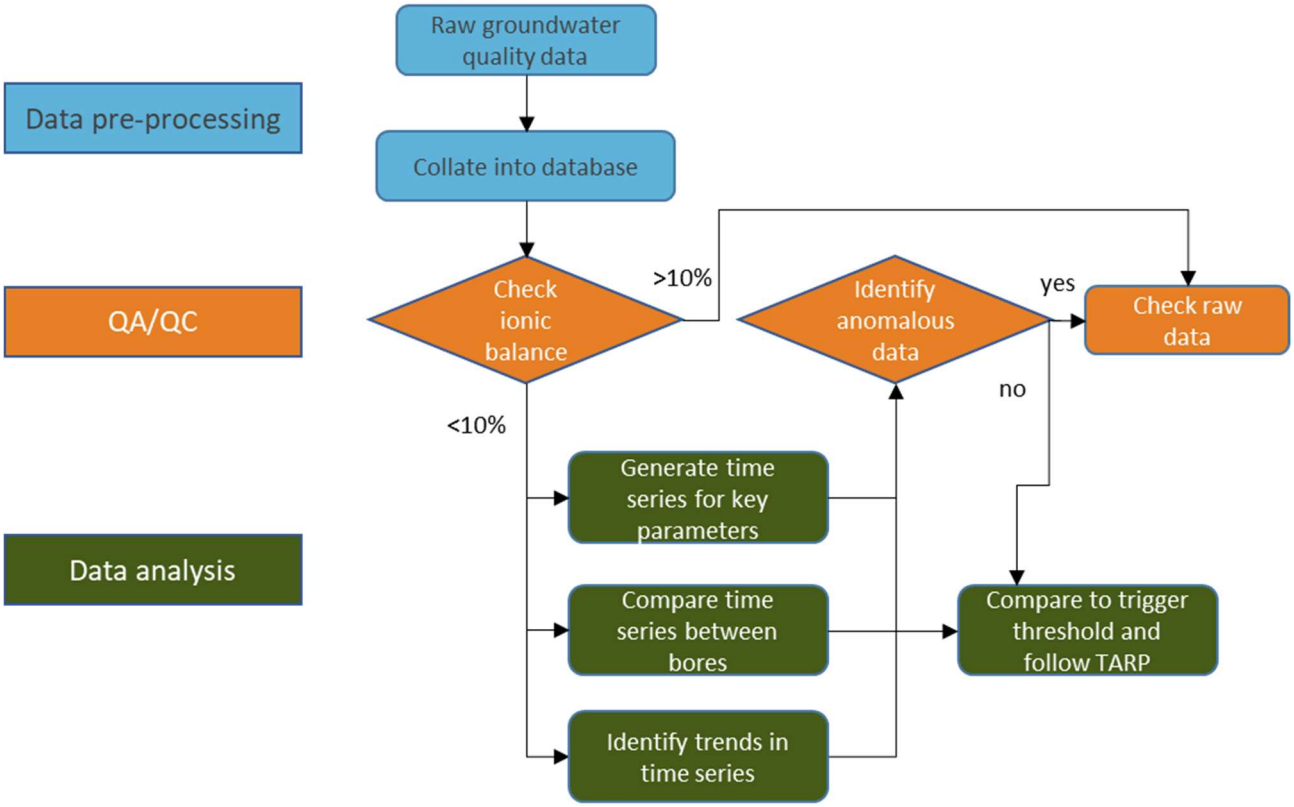


Figure 6-2 Groundwater quality data pre-processing and analysis procedures

6.1.2 Data analysis

All data on groundwater levels, groundwater quality, and data quality control is to be provided in a csv format to accompany the release of Annual Reviews.

6.2 Groundwater model

The numerical model developed for the Stage 3 EIS (AGE 2020) will be used as a management tool for the periodic review and validation of predicted groundwater impacts through the life of mine. NCOPL will update the model two years after the commencement of the Stage 3 development and every five years thereafter in consultation with DPE Water. If significant impacts on groundwater above the mine are identified, then NCOPL will reduce the period from five years to three years for at least the second update to capture new knowledge acquired.

The results of the groundwater monitoring program will assist to refine the numerical model, having regard to any impacts that may be occurring at the time due to the cumulative operation of Narrabri Mine and the Narrabri

Gas Project. Model calibration will predominantly use the available groundwater level data, estimated actual mine inflows and estimated baseflows in major local water courses.

In accordance with CoC B36(iv), during the first review, NCOPL will take into consideration all comments received regarding the groundwater model included in the Stage 3 EIS from DPE Water, the Independent Expert Scientific Committee (**IESC**) and the IAPUM.

Other circumstances which may trigger further development or refinement of the groundwater model include:

- a significant change to the mine plan and/or sequence;
- acquisition of new hydrogeological information, such as groundwater levels and aquifer properties (i.e. hydraulic conductivity) which are different to calibrated values used in the model; and
- groundwater drawdown and inflows which significantly exceed model predictions for that stage of mining.

Revised outputs from the numerical model will be reported periodically over the life of mine and incorporated into reviews of the Site Water Balance.

Should any review or post-audit indicate a significant variance from the model predictions with respect to either water quality or groundwater levels, then the implications of such variance will be assessed, and appropriate response actions implemented in consultation with DPE Water as appropriate. This may also include an independent peer review as requested by the Planning Secretary.

6.3 Annual hydrogeologist review

As part of the annual monitoring program, NCOPL will commission an experienced hydrogeologist to collate and review the monitoring data collected. The hydrogeologist will provide the findings in an Annual Hydrogeologists Report, including a summary of the mine's environmental performance over the preceding year in relation to groundwater inflows, groundwater levels (including early warning of groundwater level impact) and groundwater quality (e.g. the EC Tier 1 trigger 80th percentile rolling median as described in section 4.6.2), and compare observed groundwater quality and groundwater levels to the trigger values presented in Appendix E.

The review will also:

- compare any observed impacts with those predicted in the groundwater modelling and, if significant variation is found between predicted impacts and observed operational monitoring data, then notification of proposed remediation will be submitted to DPE Water;
- revise trigger levels as additional monitoring information becomes available and, if required, the GWMP will be updated to reflect any changes to site-specific trigger levels listed in Appendix E;
- identify relationships between measured EC and TDS in mine water and groundwater in the Hoskissons Seam and adjoining aquifers from the collection of adequate samples over time and evaluating this data for comparison (i.e. trends) as required by CoC B36(e)(iv);
- implement procedures from ANZG (2018) to establish, update and report on site-specific baseline status, variability and the early detection of state trends and change against trigger values for each water-quality objective using control charts and with uncertainty estimated from quality control measures; and
- establish and assess the ongoing suitability of appropriate factors for converting EC to TDS for each sampling site with consideration of the influence of major ionic composition.

7. References

Australasian Groundwater & Environmental Consultants (AGE) (October 2020). *Groundwater Assessment Narrabri Mine Stage 3 Extension Project*. Prepared for Narrabri Coal Operations Pty Ltd

Australasian Groundwater & Environmental Consultants (AGE) (May 2021). *Narrabri Underground Mine Stage 3 Extension Project Round 3 Bore Census.* Prepared for Narrabri Coal Operations Pty Ltd

Australasian Groundwater & Environmental Consultants (AGE) (31 May 2021). *Memorandum RE: Narrabri Underground Mine Stage 3 Extension Project – Impact Assessment Addendum*

Australasian Groundwater & Environmental Consultants (AGE) (June 2021). *Memorandum RE: Proposed groundwater quality trigger values and locations.* Prepared for Narrabri Coal Operations Pty Ltd

Queensland Department of Environment and Science (DES) (2021). *Using monitoring data to assess groundwater quality and potential environmental impacts.* Version 2. Queensland Government, Brisbane.

Independent Advisory Panel for Underground Mining (September 2021). *Advice Re: Narrabri Underground Mine Stage 3 Extension Project*

NSW Department of Primary Industries – Office of Water (2012). *Aquifer Interference Policy*.

NSW Office of Environment and Heritage (OEH) (2006). *NSW Water Quality and River Flow Objectives.* Retrieved from https://www.environment.nsw.gov.au/ieo/Namoi/index.htm

NSW Water Resources Commission, 1986-1988. *Australia 1:250 000 hydrogeological series / compiled by Hydrogeological Section, Water Resources Commission of New South Wales*

Queensland Department of Science, Information Technology and Innovation (March 2017). *Using monitoring data to assess groundwater quality and potential environmental impacts.* Version 1.

Whitehaven Coal Narrabri Coal Operations Pty Ltd (21 July 2021). *Narrabri Underground Mine Stage 3 Extension Project – IESC and DPIE-Water Responses and Groundwater Monitoring Clarifications*

8. Review history

Revision	Comments	Author	Authorised by	Date
0A	Approved by Department of Planning and Environment on 5 October 2023	Onward Consulting	Manager HSE	1 December 2022

Department of Planning and Environment

Our ref: SSD-10269-PA-24

Brent Baker
Manager HSE
Narrabri Coal Operations Pty Ltd
10 Kurrajong Creek Road
Baan Baa, NSW, 2390

05/10/2023

Subject: Narrabri Coal Stage 3 – Ground Water Management Plan

Dear Mr. Baker

I refer to your submission requesting review and approval of the Ground Water Management Plan for the Narrabri Coal Stage 3 project. I also acknowledge your response to the Department's review comments and request for additional information.

I note the Ground Water Management Plan has been prepared in consultation with DPE Water and EPA, and contains the information required by the conditions of approval.

The Department has carefully reviewed the document and is satisfied that it meets the requirements of the relevant conditions in Development Consent (SSD-10269).

Accordingly, as nominee of the Planning Secretary, I approve the Ground Water Management Plan (Rev 0A, dated 29 November 2022).

Please ensure you make the document publicly available on the project website at the earliest convenience.

If you wish to discuss the matter further, please contact Wayne Jones on (02) 6575 3406).

Yours sincerely

Stephen O'Donoghue
Director
Resource Assessments
As nominee of the Planning Secretary

Appendix A - Compliance conditions relevant to this Plan

Table A-1 SSD 10269 consent conditions directly relevant to this Plan

Condition	Requirement	Document reference
Obligation to minimise harm to the environment		
A1.	In addition to meeting the specific performance measures and criteria established under this consent, the Applicant must implement all reasonable and feasible measures to prevent, and if prevention is not reasonable and feasible, minimise, any material harm to the environment that may result from the construction and operation of the development, and any rehabilitation required under this consent.	Section 1.3 Section 3 Section 6.2 of the WMP
Evidence of Consultation		
A20.	Where conditions of this consent require consultation with an identified party, the Applicant must: (a) consult with the relevant party prior to submitting the subject document; and (b) provide details to the Department of the consultation undertaken including: (i) the outcome of that consultation, matters resolved and unresolved; and (ii) details of any matters not resolved between the party consulted and the Applicant and how the Applicant has addressed the matters not resolved.	Section 1.4 of WMP
Staging, combining and updating strategies, plans or programs		
A21.	With the approval of the Planning Secretary, the Applicant may:	
	a) prepare and submit any strategy, plan or program required by this consent on a staged basis (if a clear description is provided as to the specific stage and scope of the development to which the strategy, plan or program applies, the relationship of the stage to any future stages and the trigger for updating the strategy, plan or program);	No staging of GWMP proposed
	b) combine any strategy, plan or program required by this consent (if a clear relationship is demonstrated between the strategies, plans or programs that are proposed to be combined);	No combining of GWMP with another plan proposed
	c) update any strategy, plan or program required by this consent (to ensure the strategies, plans and programs required under this consent are updated on a regular basis and incorporate additional measures or amendments to improve the environmental performance of the development); and	Section 6
	d) combine any strategy, plan or program required by this consent with any similar strategy, plan or program required by an adjoining mining consent or approval, in common ownership or management.	No combining of GWMP with another plan proposed
Compliance		
A30.	The Applicant must ensure that all of its employees, contractors (and their sub-contractors) are made aware of, and are instructed to comply with, the conditions of this consent relevant to activities they carry out in respect of the development.	Section 2 of the WMP
Applicability of guidelines		
A31.	References in the conditions of this consent to any guideline, protocol, Australian Standard or policy are to such guidelines, protocols, Standards or policies in the form they are in as at the date of inclusion (or later update) in the condition.	Section 3.7 of the WMP
A32.	However, consistent with the conditions of this consent and without altering any limits or criteria in this consent, the Planning Secretary may, in respect of ongoing monitoring and management obligations, agree to or require compliance with an	

Condition	Requirement	Document reference
	updated or revised version of such a guideline, protocol, Standard or policy, or a replacement of them.	
Compensatory Water Supply		
B27.	Prior to the commencement of development under this consent, the Applicant must notify owners of licensed privately-owned groundwater bores that are predicted to have a drawdown of greater than 2 metres as a result of the development. This notification must set out the terms whereby the Applicant proposes to give effect to landowner entitlements and the Applicant's responsibilities under conditions B28 to B32 (i.e. a 'make good' agreement).	Section 3.4 Section 5
B28.	The Applicant must provide a compensatory water supply to any landowner of privately-owned land whose rightful water supply is adversely and directly impacted (other than an impact that is minor or negligible) as a result of the development, to the satisfaction of the Planning Secretary. The burden of proof that any loss of surface water or groundwater access is not due to mining impacts rests with the Applicant.	
B29.	The compensatory water supply measures must provide an alternative long-term supply of water that is equivalent, in quality and volume, to the loss attributable to the development. Equivalent water supply will be provided as soon as practicable after commencement of development under this consent, unless otherwise agreed with the landowner.	
B30.	If the Applicant is unable to provide an alternative long-term supply of water, then the Applicant must provide compensation, to the satisfaction of the Planning Secretary. **Notes:** ▪ *The Water Management Plan (see condition B34) is required to include trigger levels for investigating potentially adverse impacts on water supplies.*	
B31.	The Applicant must complete all measures that it is required to undertake under conditions B28 – B30 within two years of the date of commencement of development under this consent.	
B32.	If the Applicant and a landowner cannot agree on whether the loss of water is to be attributed to the development or the measures to be implemented under conditions B28 – B31, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Planning Secretary for resolution.	
Water Management Performance Measures		
B34.	The Applicant must comply with the performance measures in Table 4. ***Table 4: Water management performance measures***	Section 3 Section 5

Feature	Performance measure
Namoi Alluvium	No subsidence impact or environmental consequence greater than predicted in the EIS.
Water management – general	• Maintain separation between clean, dirty (i.e. sediment-laden) and mine water management systems; • Minimise the use of clean and potable water on the site; • Maximise water recycling, reuse and sharing opportunities; • Minimise the use of make-up water from external sources; • Design, install, operate and maintain water

Condition	Requirement		Document reference
		management systems in a proper and efficient manner; and • Minimise risks to the receiving environment and downstream water users.	
	Mine water discharges	Negligible environmental consequences beyond those predicted in the document/s listed in condition A2(c).	
Water Management Plan			
B36.	This plan must:		
	(c) be prepared by a suitably qualified and experienced person/s;		Section 1.4 of the WMP
	(d) be prepared in consultation with DPIE Water and the EPA;		
	(e) describe the measures to be implemented to ensure that the Applicant complies with the water management performance measures (see Table 4);		Section 3
	(f) build on existing monitoring programs and utilise existing data from nearby mines, where practicable;		Section 4
	(g) include a:		
	(iv) **Groundwater Management Plan** that includes:		
	• detailed baseline data of groundwater levels, yield and quality for groundwater resources potentially impacted by the development; including groundwater supply for other water users;		Section 2
	• measures to identify relationships between measured electrical conductivity and total dissolved solids in mine water and groundwater in the Hoskissons Seam and adjoining aquifers;		Section 6.3
	• a monitoring program for groundwater dependent ecosystems which may be impacted by the development, including (but not limited to) mapped 'high priority' features on the Namoi River floodplain, Tulla Mullen Creek and Little Sandy Creek and the Mayfield, Hardys and Eather Springs;		Section 4.2.3 Section 4.5
	• a detailed description of the groundwater management system;		Section 3
	• details of the proposed metering, monitoring and modelling measures;		Section 4 Section 6 Section 3.5 of the SWB (Attachment 1 of the WMP)
	• groundwater performance criteria, including trigger levels for identifying and investigating any potentially adverse groundwater impacts (or trends) associated with the development (including for brine reinjection), on		
	- regional and local aquifers (alluvial and hardrock); and		Section 4.6 Section 5 Appendix E
	- groundwater supply for other water users such as licensed privately-owned groundwater bores;		Section 4.6.3 Section 5
	• implementation of the IAPUM's recommendations concerning installation of multilevel piezometer nests above longwalls 111,		Section 4.2.2

Condition	Requirement	Document reference
	203 and 204;	
	• a program to monitor and evaluate:	Section 4 Section 5 Section 6
	- compliance with the relevant performance measures listed in Table 4 and the performance criteria of this plan;	
	- water loss/seepage from water storages into the groundwater system;	
	- groundwater inflows, outflows and storage volumes, to inform the Site Water Balance;	
	- the hydrogeological setting of any nearby alluvial aquifers and the likelihood of any indirect impacts from the development;	
	- the effectiveness of the groundwater management system;	
	- the impact of any brine re-injection on salt concentrations in surrounding aquifers, for a period of 10 years following any such re-injections or such other period as required by the Planning Secretary;	
	• reporting procedures for the results of the monitoring program, including notifying other water user of any elevated results;	Section 6
	• a trigger action response plan to respond to any exceedances of the relevant performance measures and groundwater performance criteria, and repair, mitigate and/or offset any adverse groundwater impacts of the development;	Section 5
	• regular review of the groundwater model for the development, including:	Section 6.2
	- review within two years from the commencement of longwall mining under this consent and every five years thereafter throughout the life of the development (unless the Planning Secretary agrees otherwise) in consultation with DPIE Water;	
	- during the first review, consideration of all comments received regarding the groundwater model included in the EIS from DPE Water, the IESC and the IAPUM; and	
	- implementation of the IAPUM's recommendations which relate to review and development of the groundwater model (including that the five-year groundwater model review period be shortened to three years if greater than predicted impacts on groundwater are identified above the mine);	
	- independent peer review if requested by the Planning Secretary; and	
	- comparison of monitoring results with modelled predictions; and	
	• a plan to respond to any exceedances of the performance measures; and	Section 5 Section 6.3
Management Plan requirements		
E5.	Management plans required under this consent must be prepared in accordance with relevant guidelines, and include:	

Condition	Requirement	Document reference
	a) summary of relevant background or baseline data;	Section 2
	b) details of:	
	i) the relevant statutory requirements (including any relevant approval, licence or lease conditions);	Section 1.4
	ii) any relevant limits or performance measures and criteria; and	Section 3 Section 4.6 Appendix E
	iii) the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;	Section 4.6 Section 5 Appendix E
	c) any relevant commitments or recommendations identified in the document/s listed in condition A2(c);	Appendix B
	d) a description of the management measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;	Section 3
	e) a program to monitor and report on the:	
	i) impacts and environmental performance of the development; and	Section 4
	ii) effectiveness of the management measures set out pursuant to paragraph (d);	
	f) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	Section 5
	g) a program to investigate and implement ways to improve the environmental performance of the development over time;	Section 7.6 of the WMP
	h) a protocol for managing and reporting any:	
	i) incident, non-compliance or exceedance of any impact assessment criterion or performance criterion;	Section 6 of the WMP
	ii) complaint; or	Section 8 of the WMP
	iii) failure to comply with other statutory requirements;	Section 6.2 of the WMP
	i) public sources of information and data to assist stakeholders in understanding environmental impacts of the development; and	Section 3.7 of the WMP
	j) a protocol for periodic review of the plan.	Section 6
E6.	The Applicant must ensure that management plans prepared for the development are consistent with the conditions of this consent and any EPL issued for the site.	Appendix A Appendix B

Table A-2 EPL 12789 conditions relevant to this Plan

<table>
<tr><th>Condition</th><th>Requirement</th><th>Document reference</th></tr>
<tr><td colspan="3">Discharges to Air and Water and Applications to Land</td></tr>
<tr><td>P1</td><td>Location of monitoring/discharge points and areas
P1.3 The following points referred to in the table are identified in this license for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.

<table>
<tr><th>EPA ID No.</th><th>Type of monitoring point</th><th>Type of discharge point</th><th>Location description including NCOPL ID no.</th></tr>
<tr><td>28</td><td>Groundwater Monitoring Bore</td><td></td><td>P28</td></tr>
<tr><td>29</td><td>Groundwater Monitoring Bore</td><td></td><td>P29</td></tr>
<tr><td>30</td><td>Groundwater Monitoring Bore</td><td></td><td>P30</td></tr>
<tr><td>31</td><td>Groundwater Monitoring Bore</td><td></td><td>P31</td></tr>
<tr><td>32</td><td>Groundwater Monitoring Bore</td><td></td><td>P32</td></tr>
<tr><td>33</td><td>Groundwater Monitoring Bore</td><td></td><td>P33</td></tr>
<tr><td>34</td><td>Groundwater Monitoring Bore</td><td></td><td>P34</td></tr>
<tr><td>35</td><td>Groundwater Monitoring Bore</td><td></td><td>P58</td></tr>
</table></td><td>Section 4
Appendix D</td></tr>
<tr><td colspan="3">Monitoring and Recording Conditions</td></tr>
<tr><td>M2</td><td>Requirement to monitor concentration of pollutants discharged
M2.1 For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:

M2.3 Water and/or Land Monitoring Requirements

<table>
<tr><th colspan="4">Point 28. 29, 30, 31, 32, 33, 34, 35</th></tr>
<tr><th>Pollutant</th><th>Units of measure</th><th>Frequency</th><th>Sampling Method</th></tr>
<tr><td>Bicarbonate</td><td>mg/L</td><td>Quarterly</td><td>Representative sample</td></tr>
<tr><td>Calcium</td><td>mg/L</td><td>Quarterly</td><td>Representative sample</td></tr>
<tr><td>Carbonate</td><td>mg/L</td><td>Quarterly</td><td>Representative sample</td></tr>
<tr><td>Chloride</td><td>mg/L</td><td>Quarterly</td><td>Representative sample</td></tr>
<tr><td>Electrical Conductivity</td><td>µS/cm</td><td>Quarterly</td><td>In situ</td></tr>
<tr><td>Magnesium</td><td>mg/L</td><td>Quarterly</td><td>Representative sample</td></tr>
<tr><td>pH</td><td>pH</td><td>Quarterly</td><td>In situ</td></tr>
<tr><td>Potassium</td><td>mg/L</td><td>Quarterly</td><td>Representative sample</td></tr>
<tr><td>Sodium</td><td>mg/L</td><td>Quarterly</td><td>Representative sample</td></tr>
</table></td><td>Section 4
Appendix D</td></tr>
</table>

Condition	Requirement	Document reference

Standing Water Level		Quarterly	In situ
Sulfate	mg/L	Quarterly	Representative sample

M2.6 Note: Groundwater monitoring has not been formally included in the licence. However, the licensee is required to undertake groundwater monitoring in accordance with the Department of Planning and Environment approved "Stage 2 Water Management Plan" required under Schedule 4, condition 18 of the Project Approval (08_0144) for the Stage 2 project. The results of this monitoring are required to be reported in the Annual Review.

Appendix B - Key EIS commitments

Table B-1 Key EIS groundwater management commitments

Source	Aspect	Details	Reference
Submissions Report Section 4.2.1	Validation of actual groundwater take and licensing and predictions	NCOPL supports the development of a comprehensive water balance to directly measure groundwater take as it occurs at the underground operations to validate groundwater take predictions and to inform model updates and licence requirements. Section 7 of the Surface Water Assessment (WRM, 2020) describes the water balance modelling undertaken for the Narrabri Mine operations. Water balance modelling has been continually refined and updated since mining operations commenced to incorporate changes in procedures and metered water data. The model is deemed by WRM to be suitably calibrated and sufficient to be used to define the volume of dewatered groundwater, separate from returned underground mine-filtered water. The process used to calculate these volumes (i.e. by analysing flow meter data for pumps into and out of the mine) is described in Section 5.5 of the Surface Water Assessment. NCOPL will continue collecting and metering all inflows and outflows and to use the water balance model to calculate the groundwater take.	Section 3.1 Section 3.2 Section 3.3 Section 3.4 Section 3.5 Section 4
EIS Section 6.4.4	Groundwater Monitoring	The recommendations of the Groundwater Assessment (Appendix B), in regard to the continuation of groundwater monitoring, will be adopted for Stage 3. In addition, consistent with the recommendations made by AGE, NCOPL will establish additional groundwater monitoring locations in the vicinity of Pine, Kurrajong and Tulla Mullen Creeks (or tributaries) (locations will be confirmed in consultation with relevant regulatory agencies and landowners).	Section 4.2.1
EIS Section 6.4.4	Groundwater Monitoring - Groundwater Levels	Groundwater monitoring will be undertaken in accordance with the Water Management Plan (NCOPL, 2017a) (or the latest approved version) and Extraction Plans for Narrabri Mine. The current monitoring regime involves monthly measurement of water levels in piezometers, and continuous automated monitoring of water levels from the network of VWPs.	Section 4
EIS Section 6.4.4 Amended BDAR Section 6.2.22	Groundwater Monitoring - Groundwater Levels	Ongoing monitoring will also be used to assess the extent and rate of drawdown and depressurisation against model predictions.	Section 4.6 Section 5 Section 6.3
EIS Section 6.4.4	Groundwater Monitoring - Groundwater Levels	Reporting of the water level results from the monitoring network will be included in the Annual Review. The reporting will include comparison to climate trends and surface water monitoring results to identify changes in the surface water and groundwater interactions (e.g. comparison of groundwater levels to rainfall and estimated recharge). The Annual Review will also identify if any improvements are required to the monitoring network, or if optimisation of the existing monitoring sites will be undertaken.	Section 6 Section 6.2
EIS Section 6.4.4	Groundwater Monitoring - Groundwater Quality	Reporting of the water quality results from the monitoring network would be included in the Annual Review. The Annual Review would consider if any additional monitoring sites are required, or if optimisation of the existing monitoring sites, frequency of sampling and analytical suite should be undertaken.	Section 6 Section 6.3
EIS Section 6.4.4	Groundwater Monitoring - Groundwater Quality	Groundwater quality sampling will continue to be conducted to monitor groundwater quality during operations and post-mining in accordance with the Water Management Plan (NCOPL, 2017a) (or the latest approved version) and Extraction Plans for Narrabri Mine. The current monitoring regime includes monthly sampling of piezometers (EC and pH), as well as annual sampling for a broader suite of parameters. Monthly sampling and analysis of water from the box cut sump will continue for Stage 3 (or as otherwise described in the Water Management Plan [NCOPL, 2017a] [or the latest approved version]).	Section 4
Submissions Report Section 4.2.1	Groundwater Monitoring - Groundwater Quality	Testing for antimony, molybdenum and selenium has not routinely been undertaken historically but will be added to the Stage 3 Water Management Plan following approval.	Section 4.5
EIS Section 6.4.4	Groundwater Monitoring - Groundwater Inflow	NCOPL will implement continuous monitoring of TDS, pH and temperature of groundwater inflows (e.g. via monitoring at the box cut sump). In addition, the current monthly analysis of water from the box cut sump will continue for Stage 3.	Section 4.5
EIS Appendix B Section 8.2	Additional monitoring recommendations	Water samples will also be routinely collected and sent for laboratory analysis. Such data can also provide an early warning of unexpected increases in inflow.	Section 4.5 Section 5
Submissions Report Section 4.2.1	Additional monitoring recommendations	Installation of six additional nested VWP installations are proposed to the west, south and east of Narrabri Mine. The additional VWPs will be installed as soon as practicable, following determination of Stage 3 as part of the updated Water Management Plan.	Section 4.2.2
Submissions Report Section 4.2.3	Additional monitoring recommendations	In addition to the further VWP installations outlined above, NCOPL will assess the feasibility of using helium gas, or other tracers/indicators to investigate seam to surface connectivity above selected longwall panels.	Section 4.2.1
EIS Appendix B Section 8.2 Submissions Report Section 4.2.3	Potential impacts to GDEs	Regular site visits to the Mayfield Spring, Hardys Spring and Eather Spring (Dams 1 and 2) sites are recommended to observe any changes to flow rates and surface conditions and to confirm whether these features are groundwater dependent. Depending on the results of the Spring visits, further ongoing groundwater and surface water monitoring at these sites, similar to that described above for local creeks, may also be required to confirm predicted impacts.	Section 4.2.3 Section 4.5

Source	Aspect	Details	Reference
EIS Section 6.4.4	Numerical Model Review	The numerical model developed and used for the Groundwater Assessment (Appendix B) will be used as a management tool for the periodic review and validation of predicted groundwater impacts through the life of Narrabri Mine. The validity of the groundwater model predictions will: • be assessed from time to time, and if the data indicates significant deviation from the model predictions, an updated groundwater simulation model will be developed. • the groundwater simulation model will also be recalibrated at the frequency described in the Water Management Plan (NCOPL, 2017a) (or the latest approved version). • the results of the groundwater monitoring program will assist to refine any future numerical models.	Section 6.2
EIS Section 6.4.4	Numerical Model Review	Revised outputs from the numerical model will be reported periodically over the life of Narrabri Mine and incorporated into reviews of the site water balance.	Section 6.2 Section 6.3
Submissions Report Section 4.2.1	Numerical Model Review	Consistent with Project Approval 08_0144, the current site Water Management Plan for the Narrabri Mine (NCOPL, 2017) includes a commitment to re-calibrate the Project groundwater model two years after commencement of longwall extraction and every five years thereafter. A similar commitment in the updated Water Management Plan for the Project is proposed, whereby the groundwater model would be updated two years after approval of the Project and every five years thereafter. The Water Management Plan would also identify a number of other circumstances, which may trigger further development and/or re-calibration of the model as follows: • a significant change to the mine plan; • acquisition of new hydrogeological information, such as groundwater levels and aquifer properties (i.e. hydraulic conductivity), which are different to calibrated values used in the model; and • groundwater drawdown and inflows which significantly exceed model predictions for that stage of mining.	Section 6.1
Submissions Report Section 4.2.1	Numerical Model Review – verification of groundwater level records at VWP installations	Further Quality Assurance checks carried out by NCOPL environmental staff during field data collection in the future will be described in the Stage 3 Water Management Plan.	Section 6.1
Submissions Report Section 4.2.1	Groundwater data quality assurance	The Water Management Plan will be updated to incorporate Stage 3. The Water Management Plan will include data quality assurance and control protocols and will consider comments provided.	Section 6.1
Submission Report Section 4.2.2	Numerical Model Review – Cumulative impacts with the Narrabri Gas Project	Majority of the predicted drawdown is due to Narrabri Mine. This will be confirmed by updates to the groundwater model, which will occur at regular intervals throughout Stage 3. Model updates will consider the latest groundwater monitoring data available at the time, therefore, model updates will have regard to any impacts that may be occurring at the time due to the operation of Narrabri Mine and Narrabri Gas Project.	Section 6.2
EIS Section 6.4.4 Submissions Report Section 4.1.1	Make Good Provisions	NCOPL has committed to 'make good' provisions for affected groundwater users. Appropriate make good provisions for a Project-related drawdown greater than 2 m at a groundwater bore may include: • deepening the affected groundwater bore (including lowering pump set and/or provision of new pump set and power supply if required); • construction of a new groundwater bore (including provision of a new pump set and power supply if required); and/or • provision of an alternative water supply of suitable quality and quantity. These contingency measures will be assessed on a case-by-case basis (i.e. including an assessment of the bore details and viability of any proposed measures), and implemented in consultation with the affected landholder and relevant regulators prior to drawdown exceeding the AIP minimal harm criterion.	Section 3.4
EIS Section 6.4.4 Submissions Report Section 4.1.1	Make Good Provisions	Ongoing groundwater monitoring, as well as any updates to the groundwater model, will also be used to confirm the predicted drawdown at these bores. Any groundwater monitoring at the bores will be described in the Water Management Plan (subject to agreement with the landholder).	Section 4.5 Section 6.2
EIS Section 6.4.5	Adaptive Management	Monitoring locations, methods, trigger levels and contingencies relating to groundwater will be detailed in an update of the Water Management Plan and Extraction Plans for Narrabri Mine. In the event that groundwater monitoring identifies an exceedance of an established trigger, NCOPL will implement a response plan in accordance with the Water Management Plan.	Section 4 Section 5 Appendix E
EIS Section 6.4.5	Adaptive Management	In the event that water levels deviate significantly from those predicted by the groundwater model, a suitably qualified hydrogeologist will undertake a review to determine the reason for this deviation. The review will consider the impact of mining and other factors that could result in declining water levels, including climatic conditions, rainfall recharge and pumping from privately-owned bores and/or nearby operations.	Section 5
Submissions Report Section 4.2.1	Depth of cracking prediction	As discussed in Sections 5.2.11 and D 2.5.6.1 (in Appendix D) of the Groundwater Assessment (AGE, 2020) site-specific data, in the form of groundwater data for the nested monitoring facility (P57) installed above Longwall 108A, has already been used to estimate potential heights of fracturing and calibrate the groundwater model. Modelled hydraulic parameters in the A and D-Zones are, therefore, already constrained by site-specific data. Furthermore, as summarised in Section D 5 in Appendix D of the Groundwater Assessment, a range of possible alternative parameters for functions affecting both hydraulic conductivity and storage above	Section 6.2

Source	Aspect	Details	Reference
		longwall panels have been assessed as part of the predictive uncertainty analysis. Further data collection above future longwall panels is also proposed. Additional data from these further sites will be considered as part of future re-calibration of subsidence predictions.	
EIS Appendix C Section 9.1	Water Management Plan	The Water Management Plan will be reviewed and revised to incorporate Stage 3. The Water Management Plan will describe the operational site water management system and will include provisions for review of the site water balance, erosion and sediment controls, water monitoring and management. The existing Water Management Plan will also be revised to incorporate any proposed beneficial re-use of excess filtered water or underground injection of excess mine water.	The WMP including Attachment 1 Attachment 2 Attachment 3 Attachment 4
EIS Section 6.5.4 EIS Appendix C Section 9.1	Water Management Plan – Site Water Balance	Review and progressive refinement of the site water balance will continue annually over the life of Narrabri Mine to record the status of inflows, storage and consumption (e.g. usage, return water from co-disposal areas, dust suppression and filtered water releases or beneficial re-use) and to optimise water management performance. The results of Site Water Balance reviews will be reported in the Annual Review.	Attachment 1 of the WMP
EIS Section 6.5.4	Water Management Plan - Erosion and Sediment Control Plan	The Erosion and Sediment Control Plan component of the Water Management Plan will be reviewed and updated for Stage 3 to identify measures to minimise soil erosion and transport of sediment off-site.	Attachment 2 of the WMP
EIS Appendix C Section 9.1	Water Management Plan	The Surface Water Monitoring Plan will be reviewed and updated for Stage 3. A recommended monitoring program is provided in Section 9.3.	Attachment 3 of the WMP
EIS Section 6.5.4	Water Management Plan - Surface Water Monitoring Program	The existing surface water monitoring network will continue to be implemented for Stage 3. The network will include the installation of two additional receiving water monitoring sites recommended by WRM (2020) within MLAs 1 and 2, locations will be confirmed in consultation with relevant government agencies and landowners.	Attachment 3 of the WMP
EIS Section 6.5.4	Water Management Plan - Surface Water Monitoring Program	The site water monitoring network of sediment dams and sediment basins will continue to be implemented for Stage 3, in accordance with the Water Management Plan (NCOPL, 2017a) (or the latest approved version). In addition, the Southern Mine Water Storage will be included in the monitoring network.	Attachment 3 of the WMP
EIS Section 6.5.4	Water Management Plan - Surface Water Monitoring Program	The suite of monitoring parameters will remain as per the approved Water Management Plan (NCOPL, 2017a) (or the latest approved version) with the addition of the following parameters to monitor the potential impacts of Stage 3 waste materials: • total alkalinity; • acidity; • sulphate; • As; • Co; • Mo; • Sb; and • Se. The frequency of monitoring will remain as per the approved Water Management Plan (NCOPL, 2017a) (or the latest approved version).	Attachment 3 of the WMP
Section 6.5.4	Water Management Plan - Surface and Groundwater Response Plan	The Surface and Groundwater Response Plan and TARPs (NCOPL, 2017a; 2017c) will be reviewed and updated for Stage 3. The Surface and Groundwater Response Plan will describe any additional measures and procedures that will be implemented over the life of Narrabri Mine to respond to any potential exceedances of surface water-related criteria and contingent mitigation compensation, and/or offset options if downstream private surface water users or riparian vegetation are adversely affected by Narrabri Mine.	Section 5

Appendix C - Baseline groundwater level and quality data

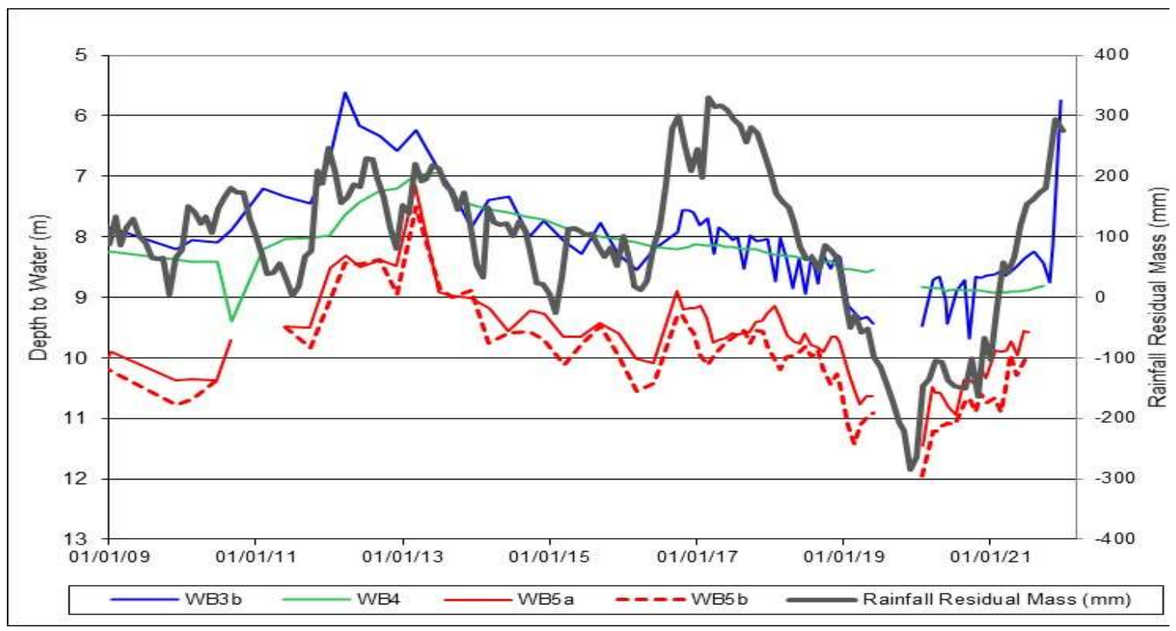


Figure C-1: Hydrograph for Selected Alluvial Monitoring Bores

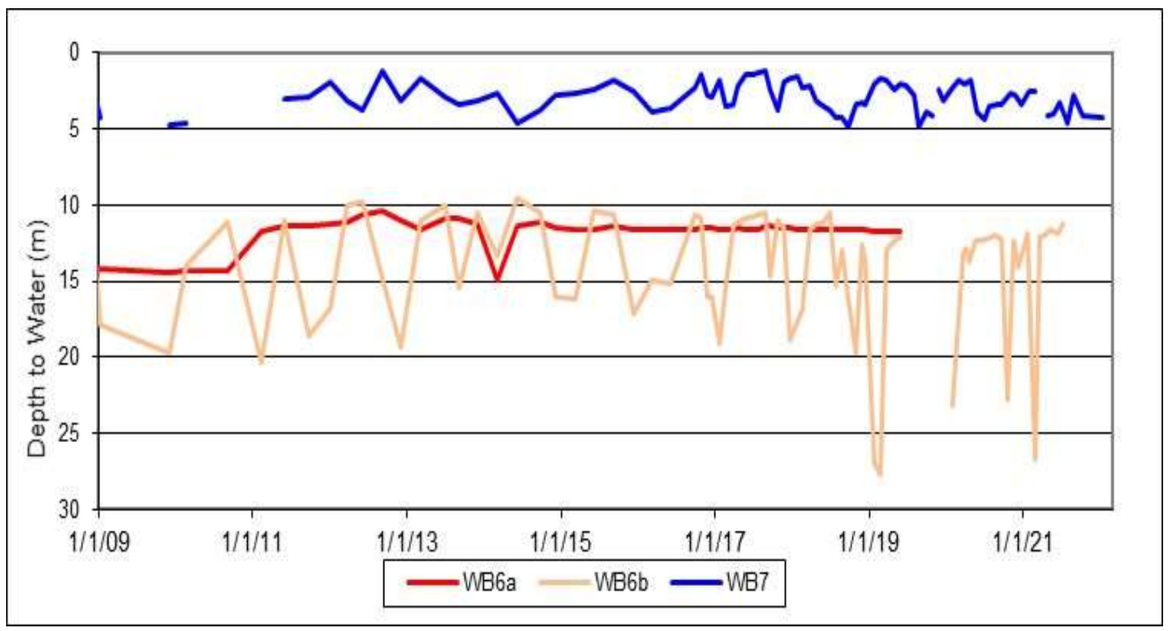


Figure C-2: Hydrograph for Selected Alluvial Monitoring Bores

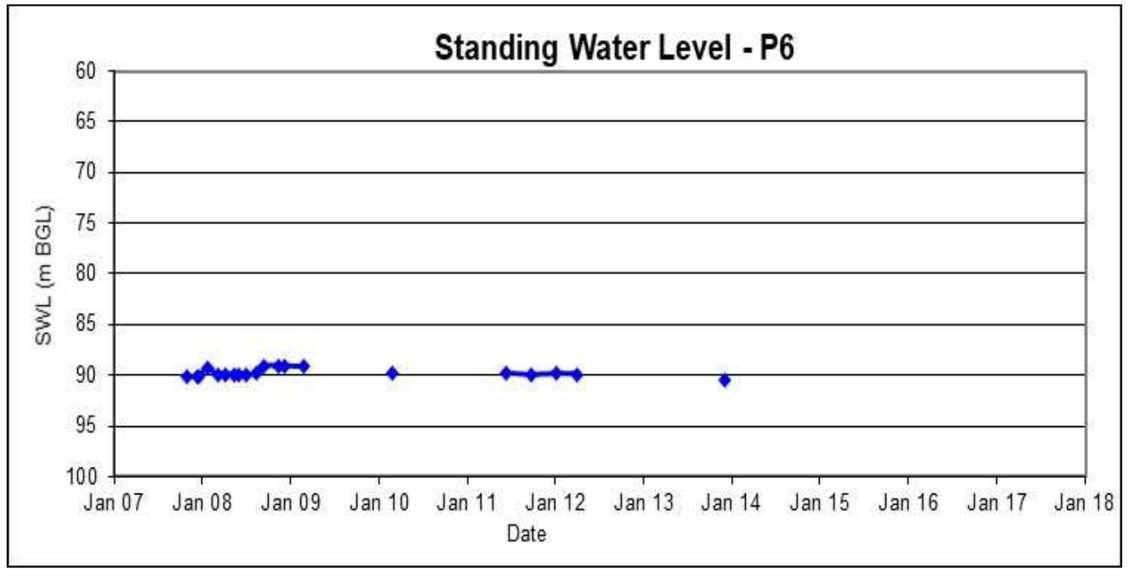


Figure C-3: Hydrograph for P6

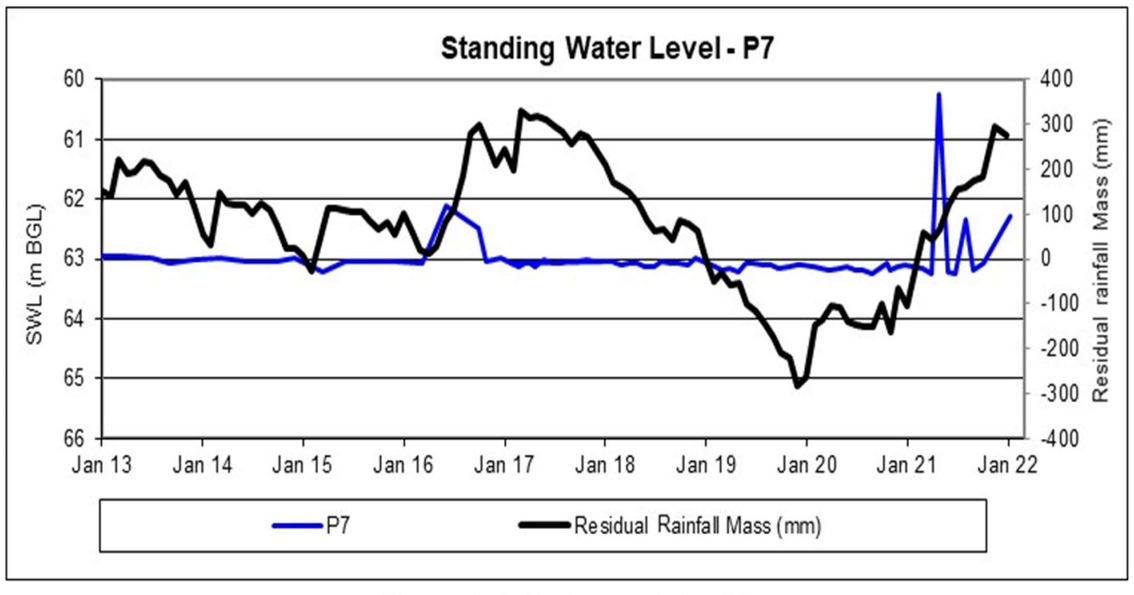


Figure C-4: Hydrograph for P7

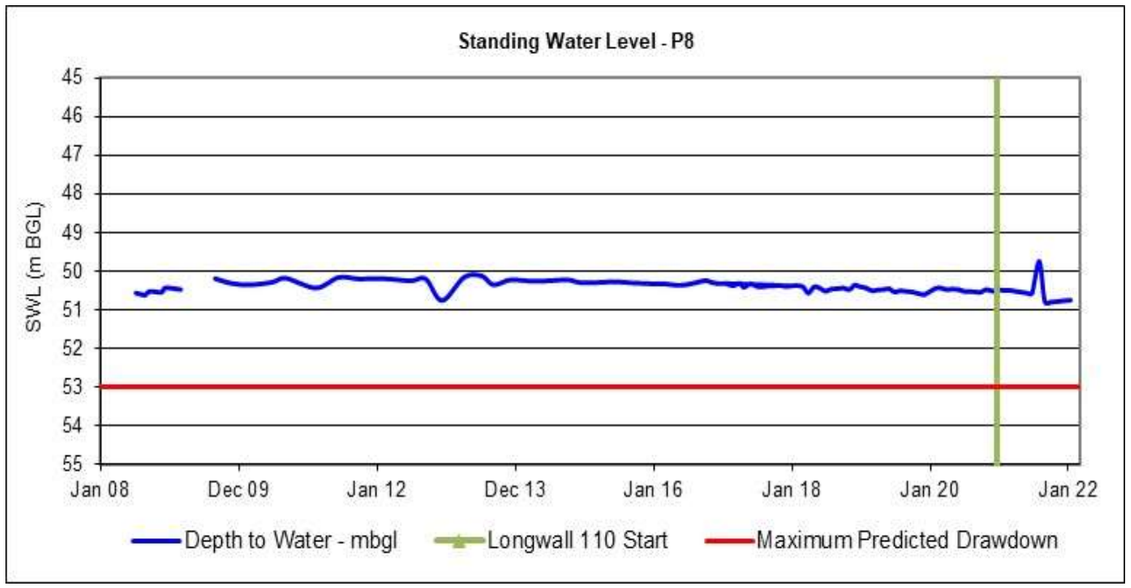


Figure C-5: Hydrograph for P8

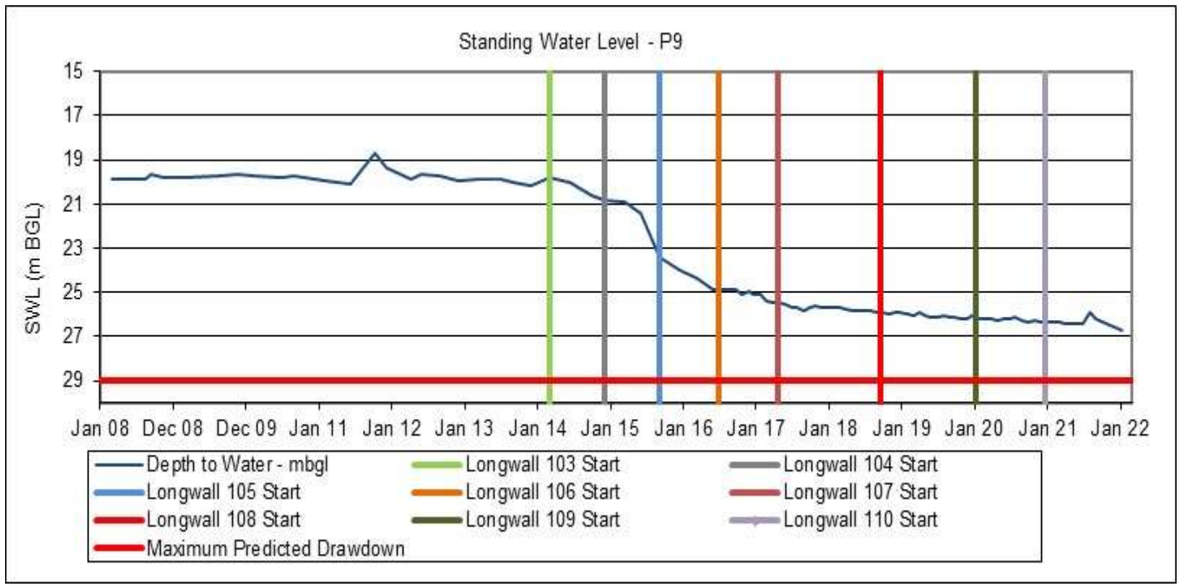


Figure C-6: Hydrograph for P9

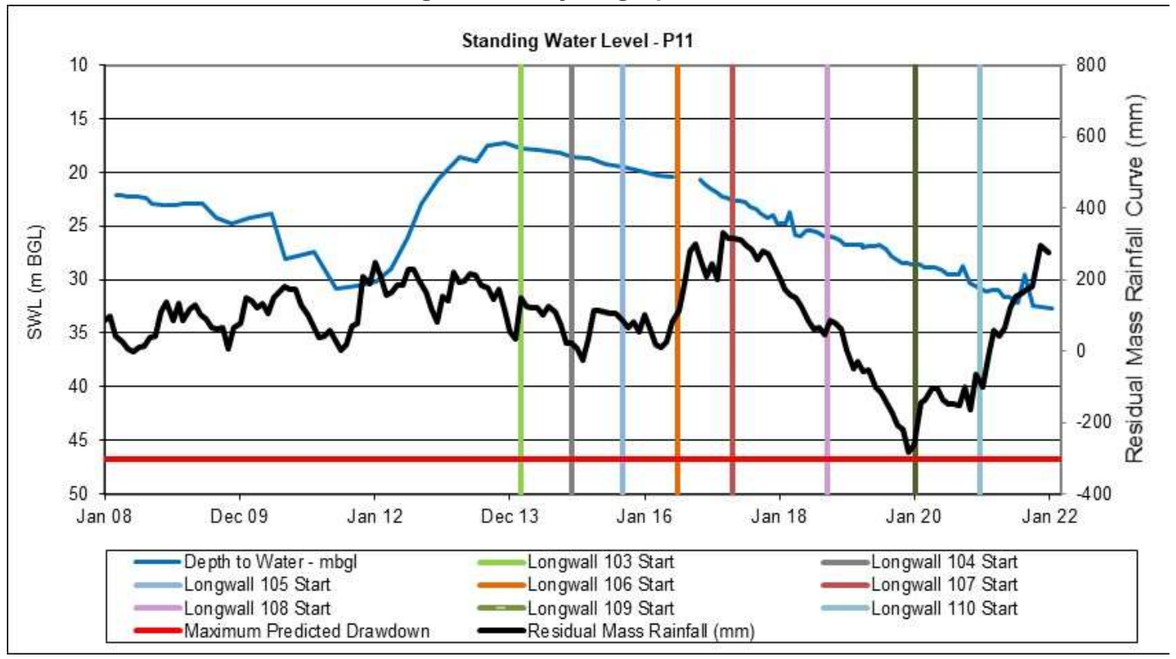


Figure C-7: Hydrograph for P11

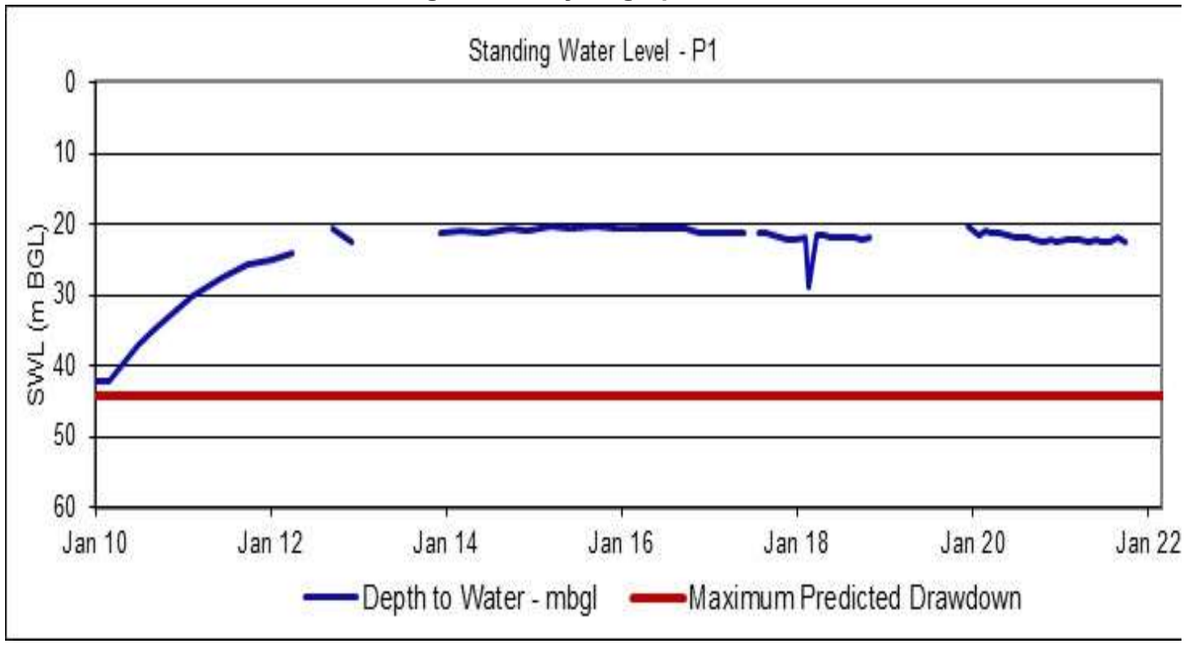


Figure C-8: Hydrograph for P1

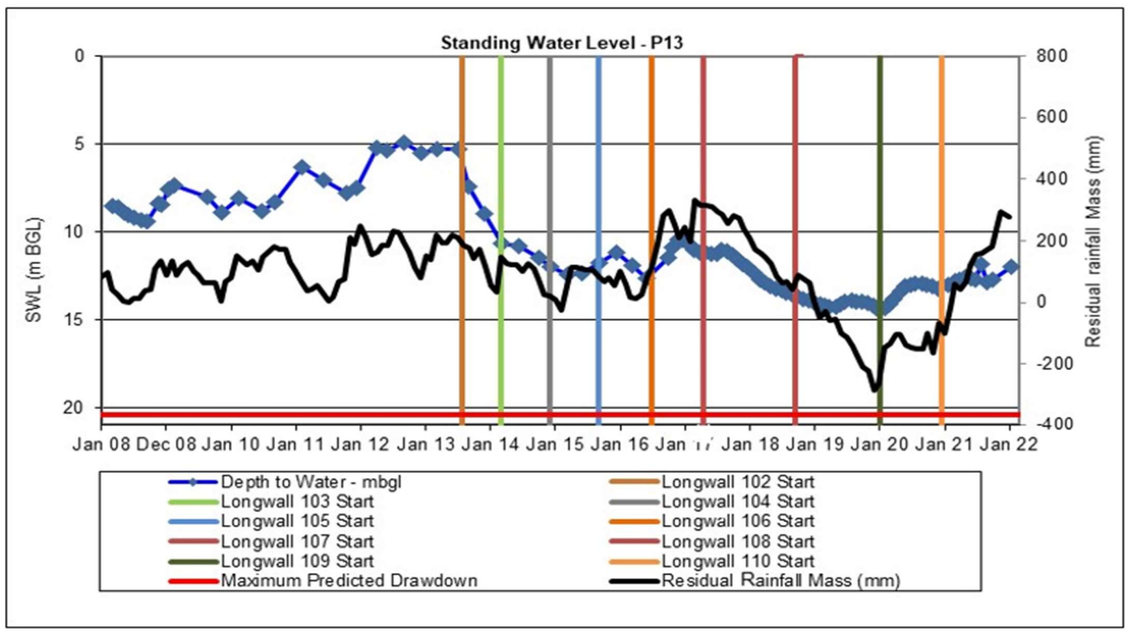


Figure C-9: Hydrograph for P13

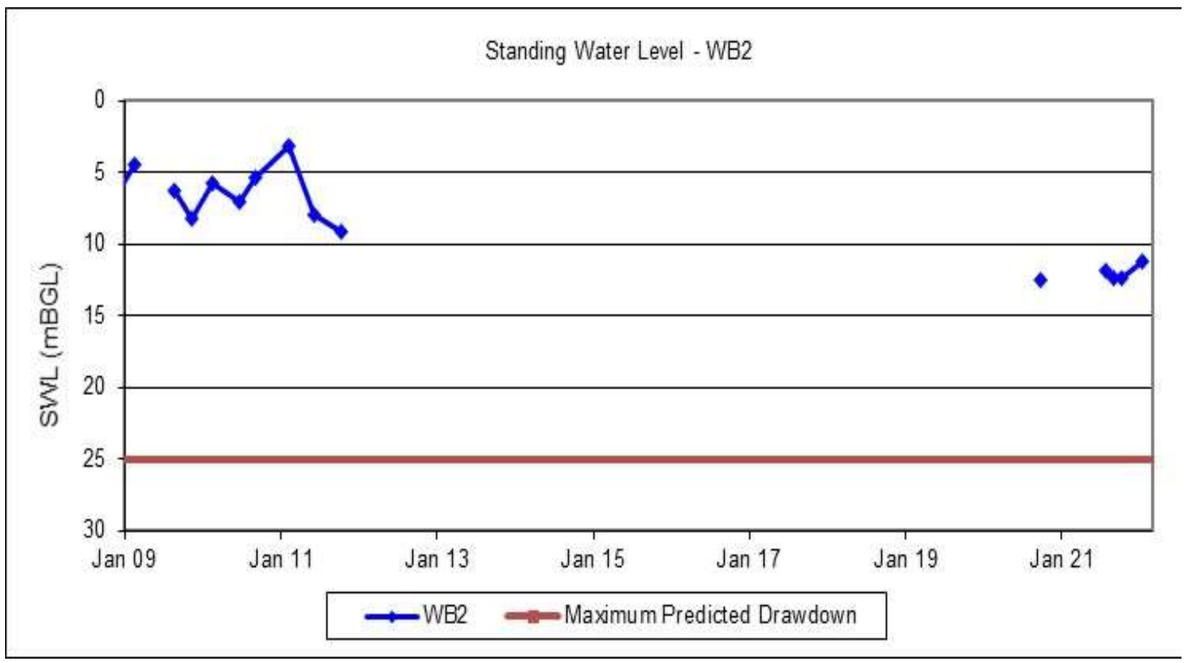


Figure C-10: Hydrograph for WB2

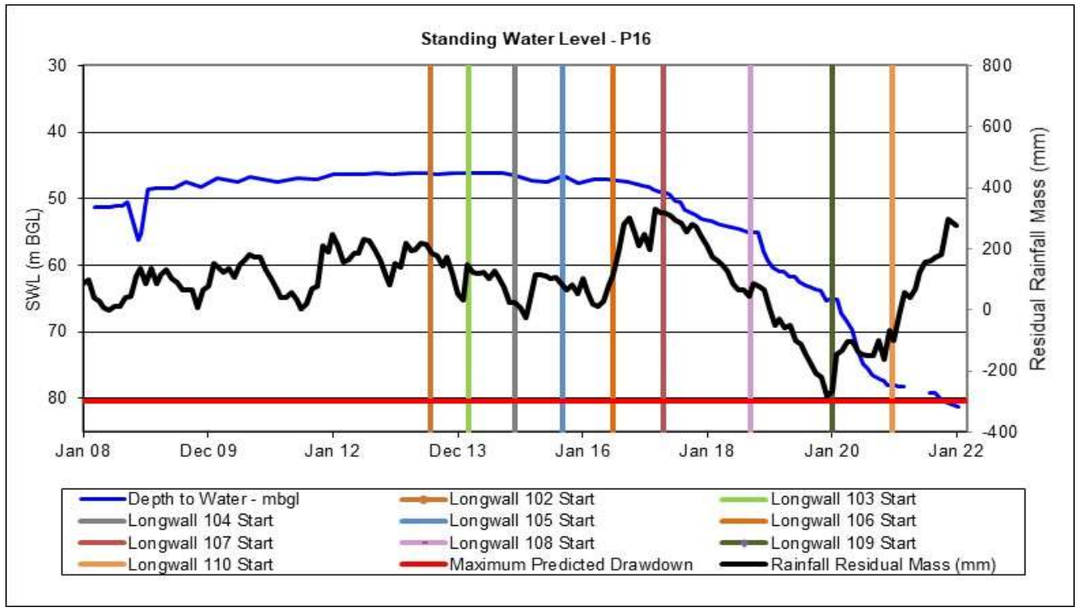


Figure C-11: Hydrograph for P16

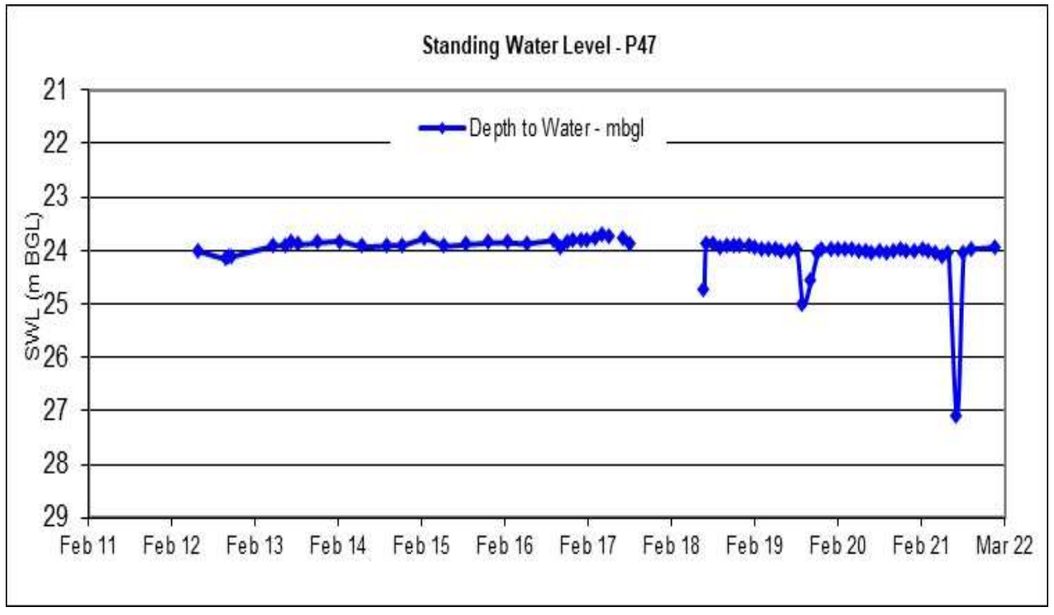


Figure C-12: Hydrograph for P47

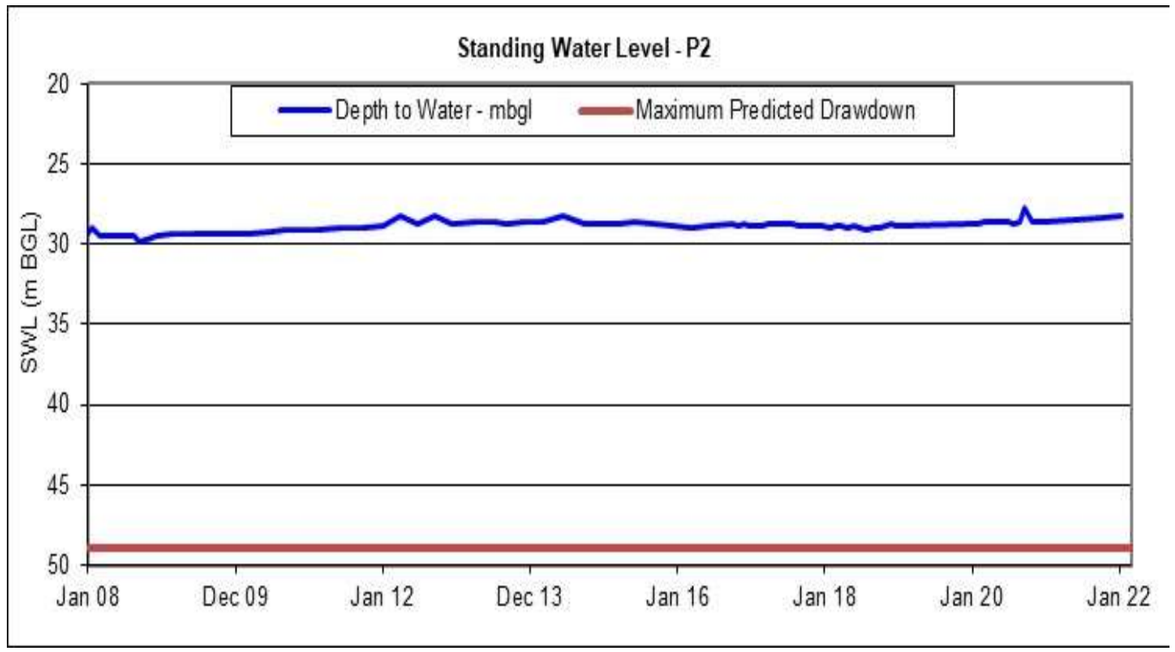


Figure C-13: Hydrograph for P2

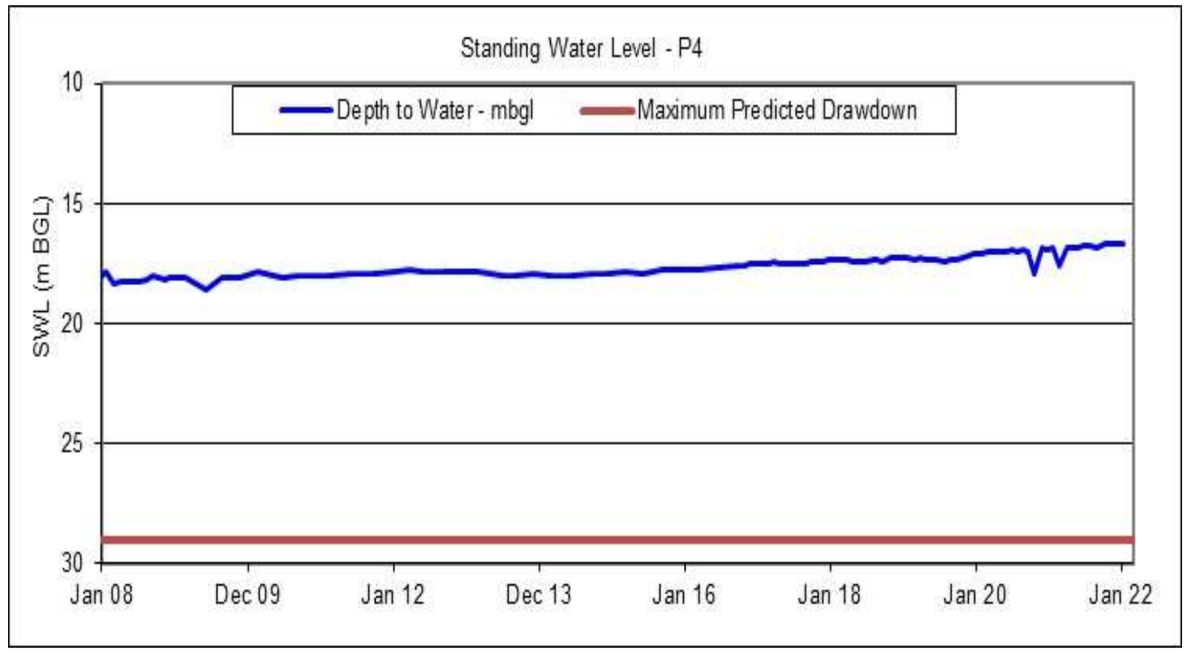


Figure C-14: Hydrograph for P4

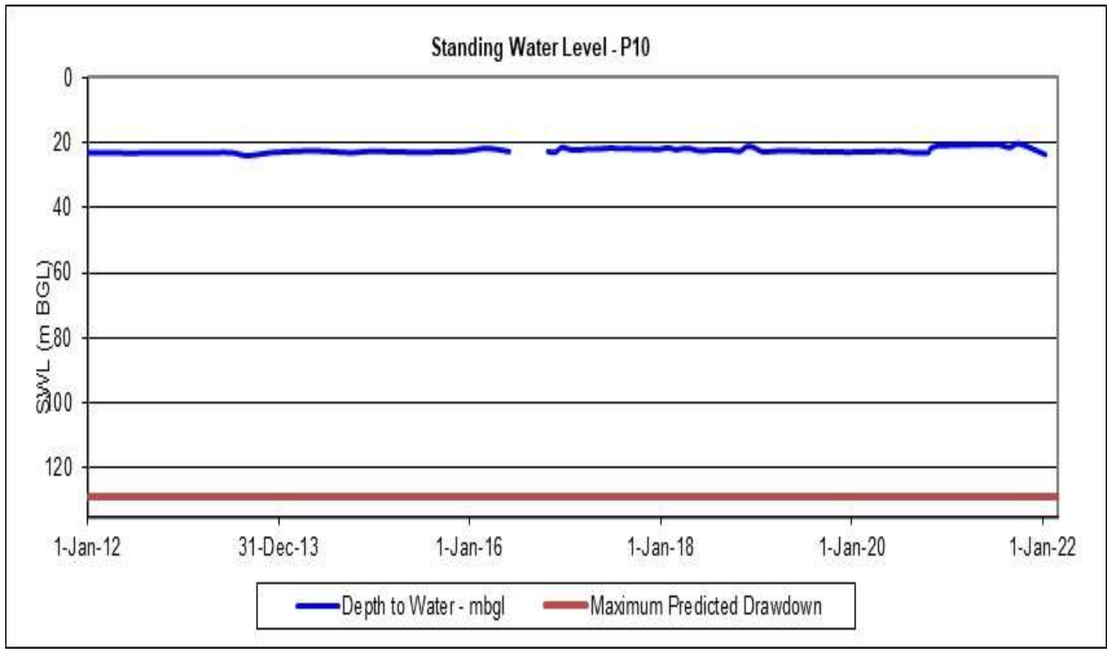


Figure C-15: Hydrograph for P10

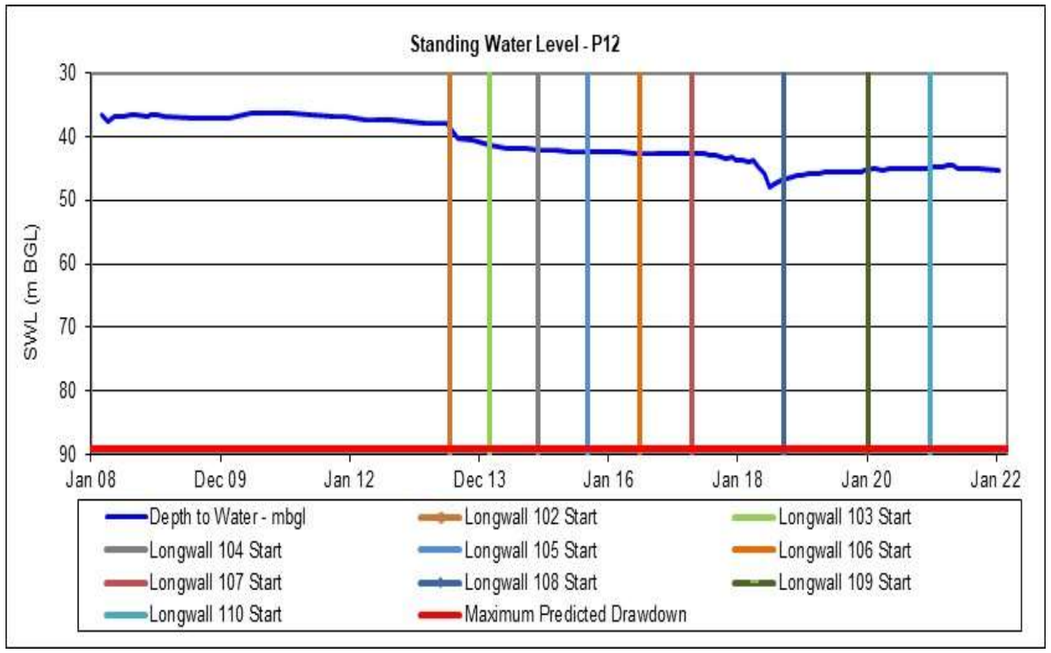


Figure C-16: Hydrograph for P12

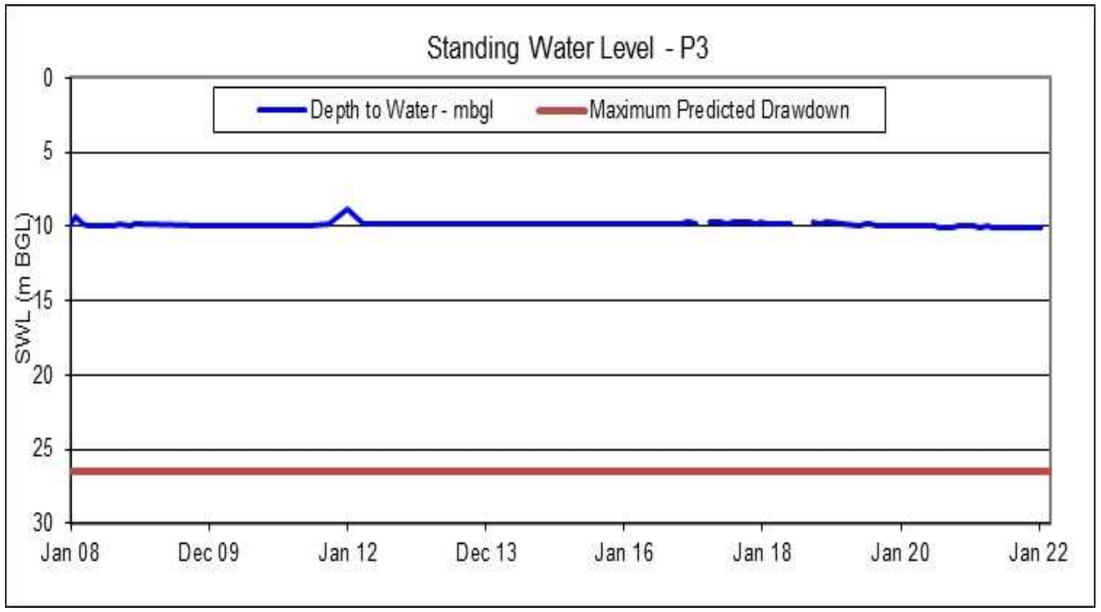


Figure C-17: Hydrograph for P3

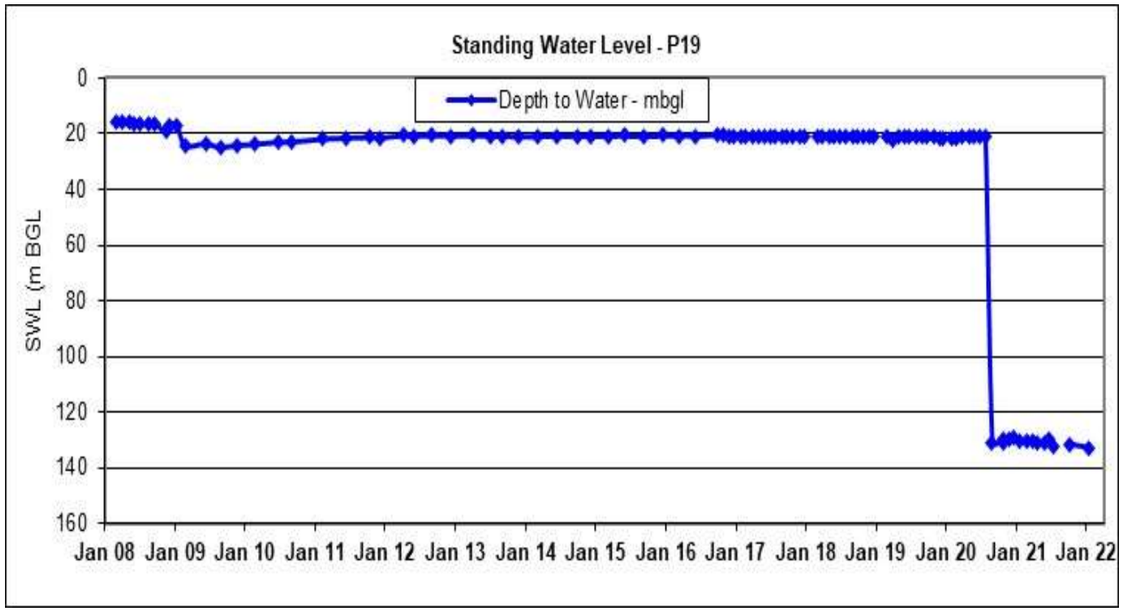


Figure C-18: Hydrograph for P19

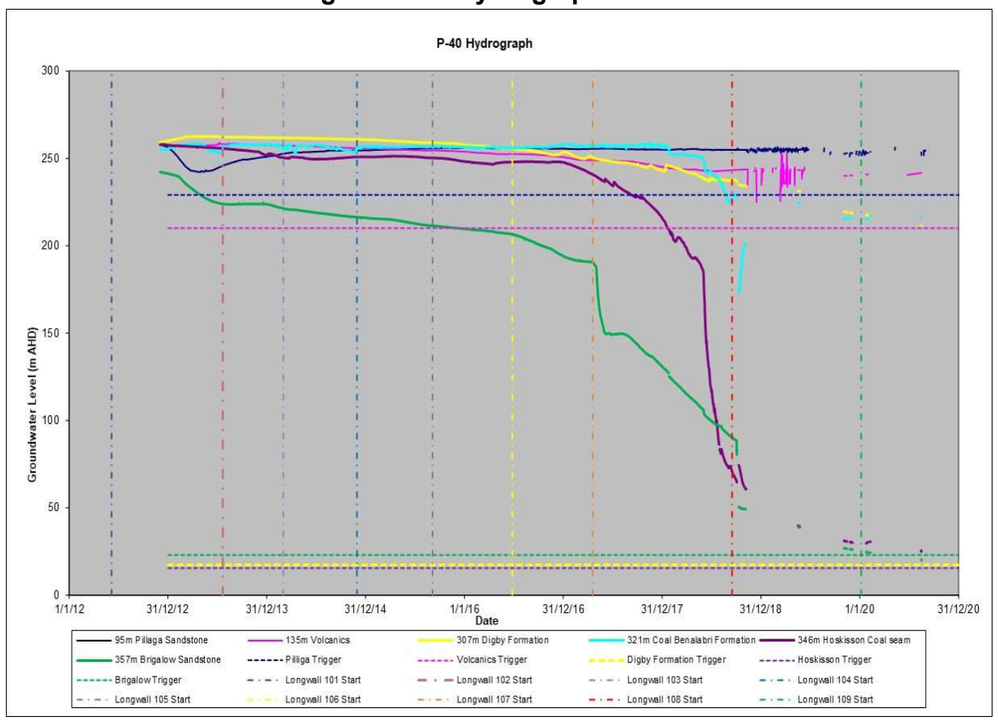


Figure C-19: Hydrograph for P40

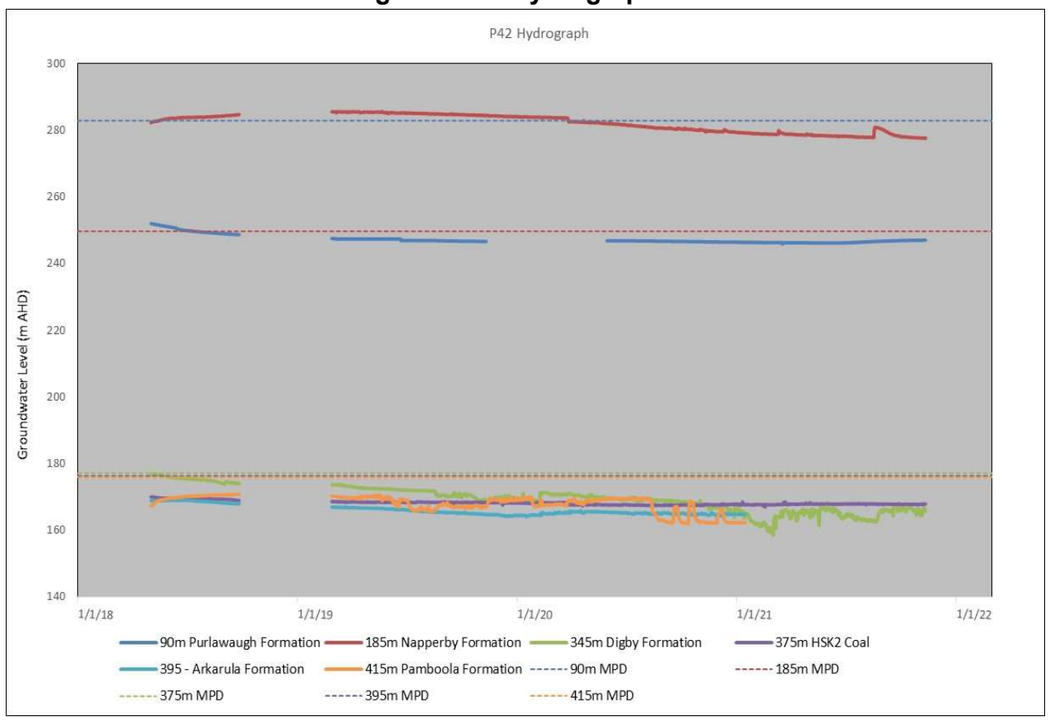


Figure C-20: Hydrograph for P42

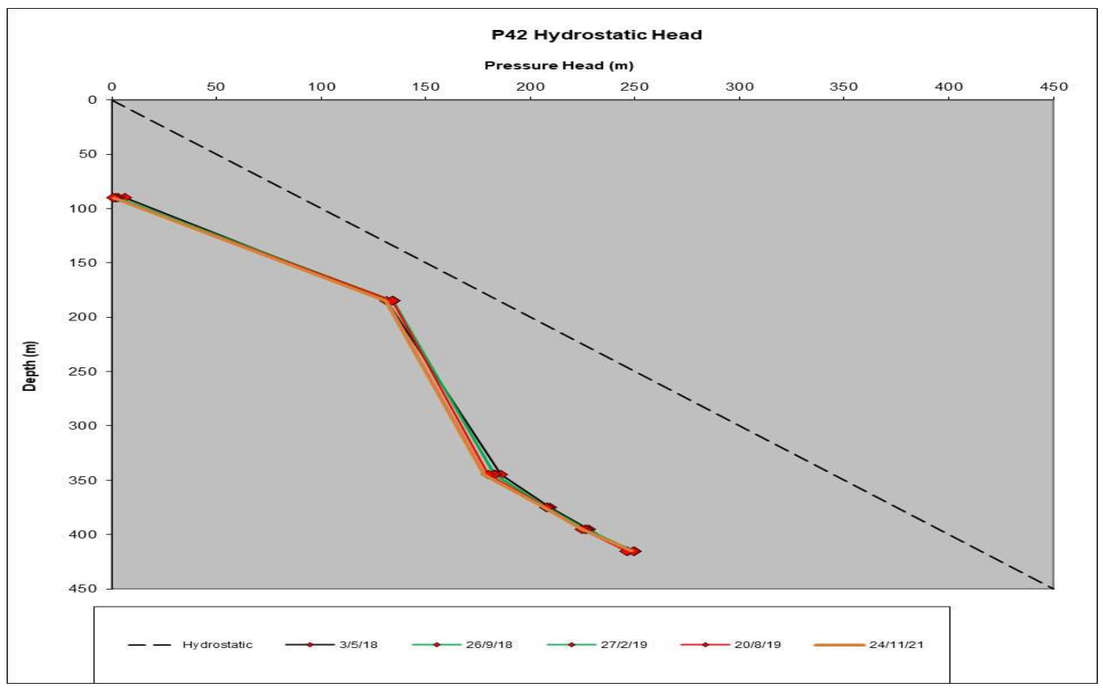


Figure C-21: Hydrostatic Profile for P42

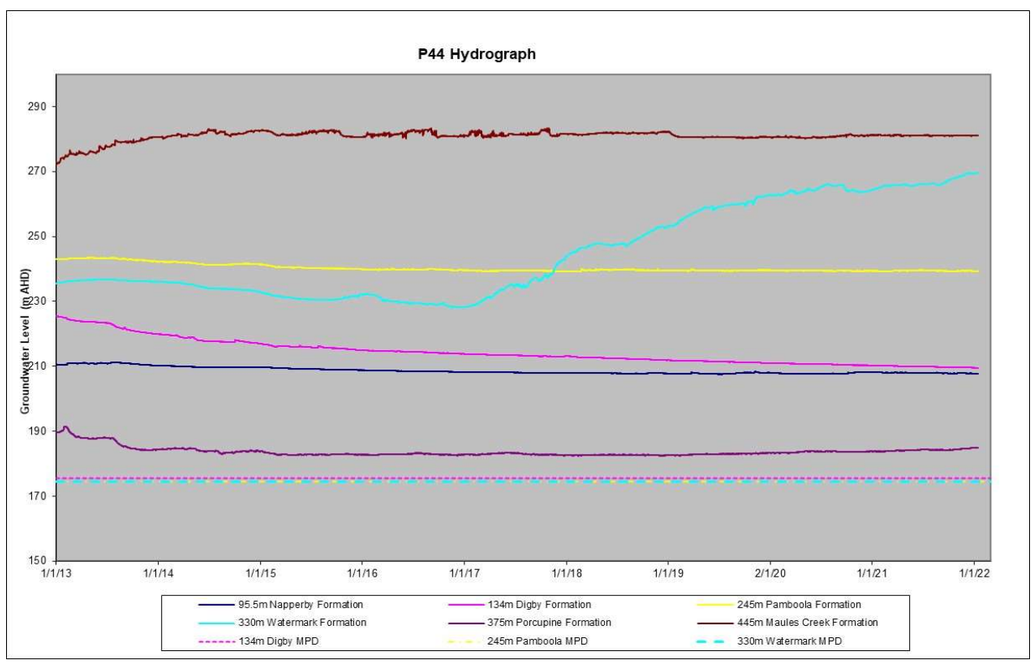


Figure C-22: Hydrograph for P44

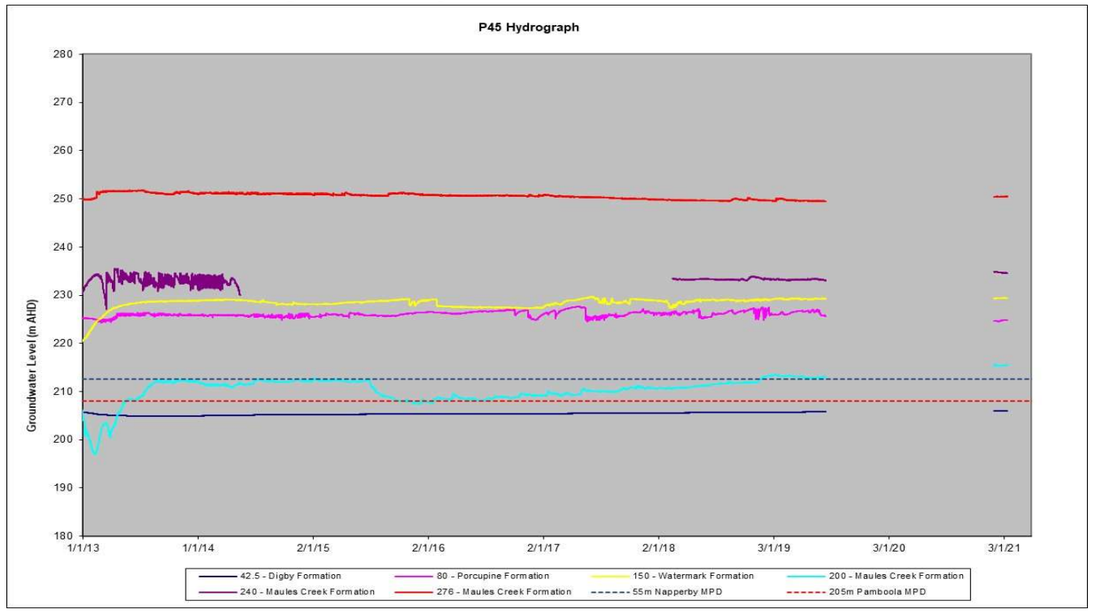


Figure C-23: Hydrograph for P45

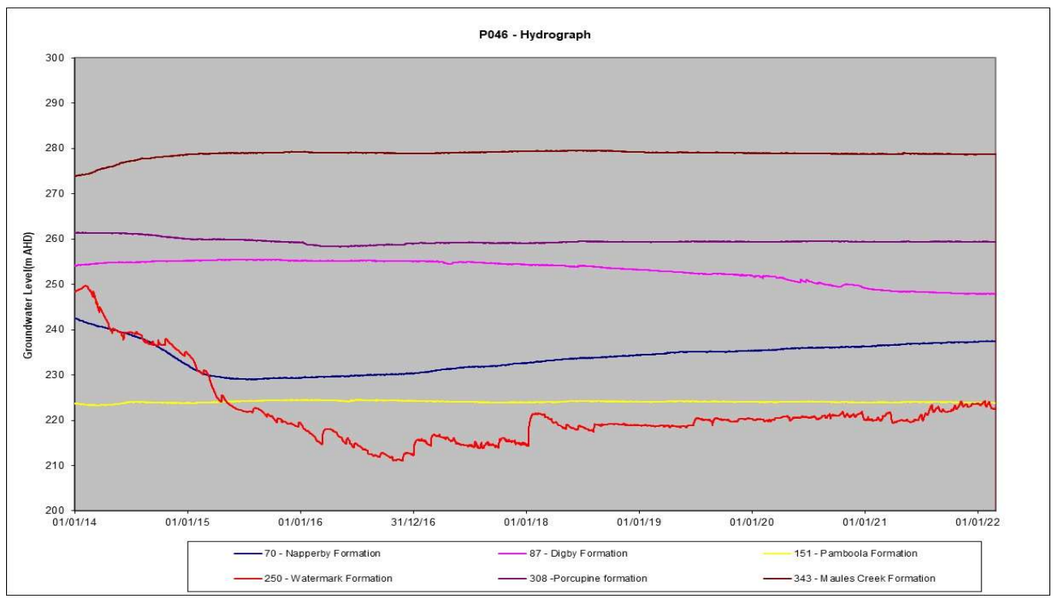


Figure C-24: Hydrograph for P46

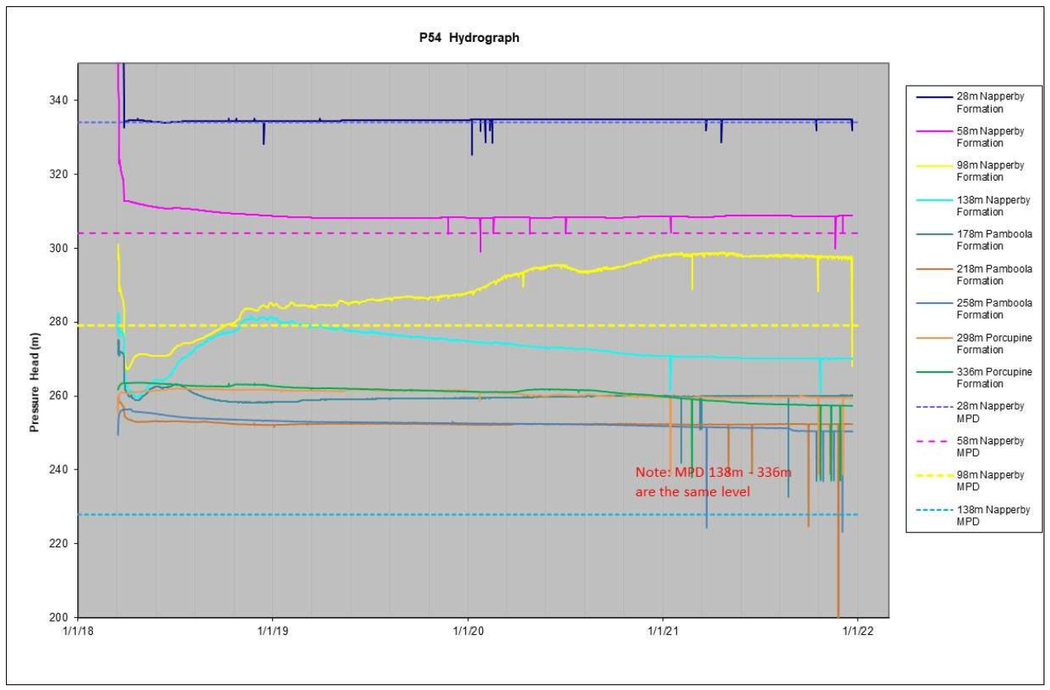


Figure C-25: Hydrograph for P54

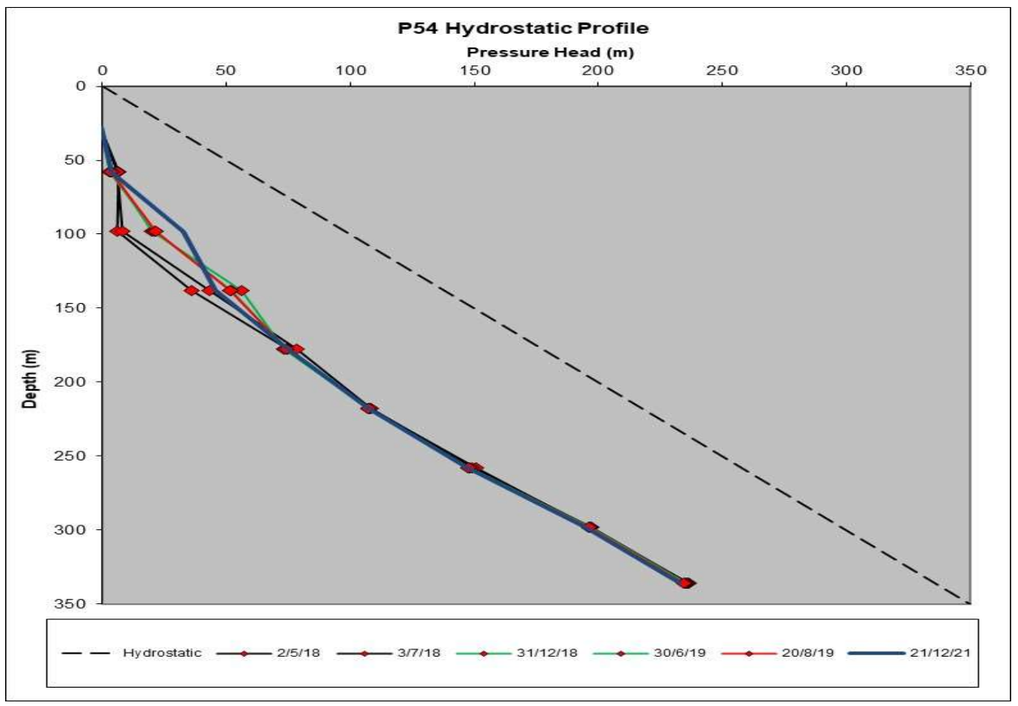


Figure C-26: Hydrostatic Profile for P54

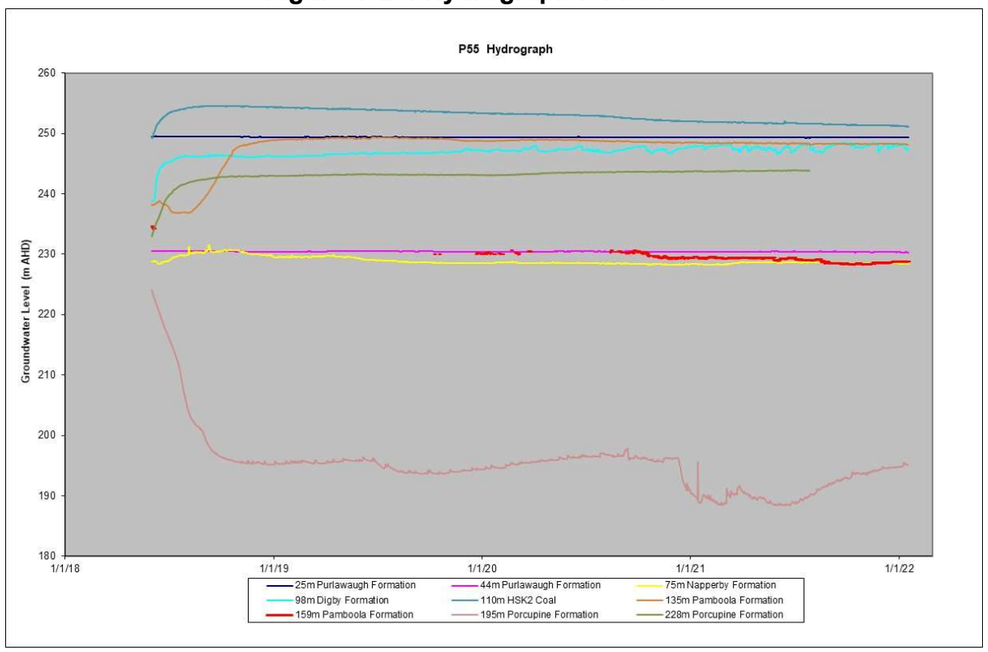


Figure C-27: Hydrograph for P55

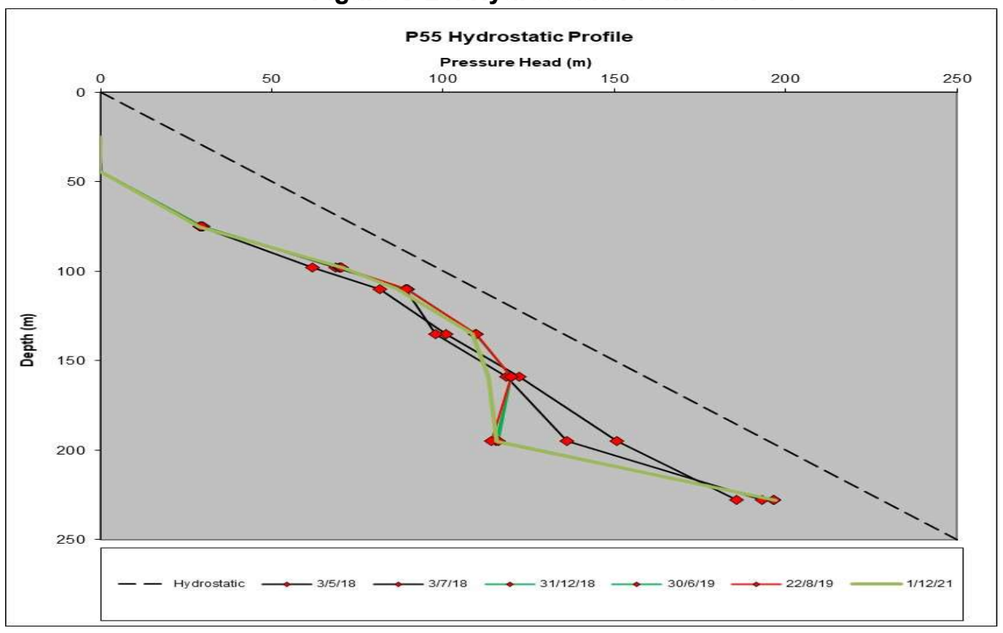


Figure C-28: Hydrostatic profile for P55

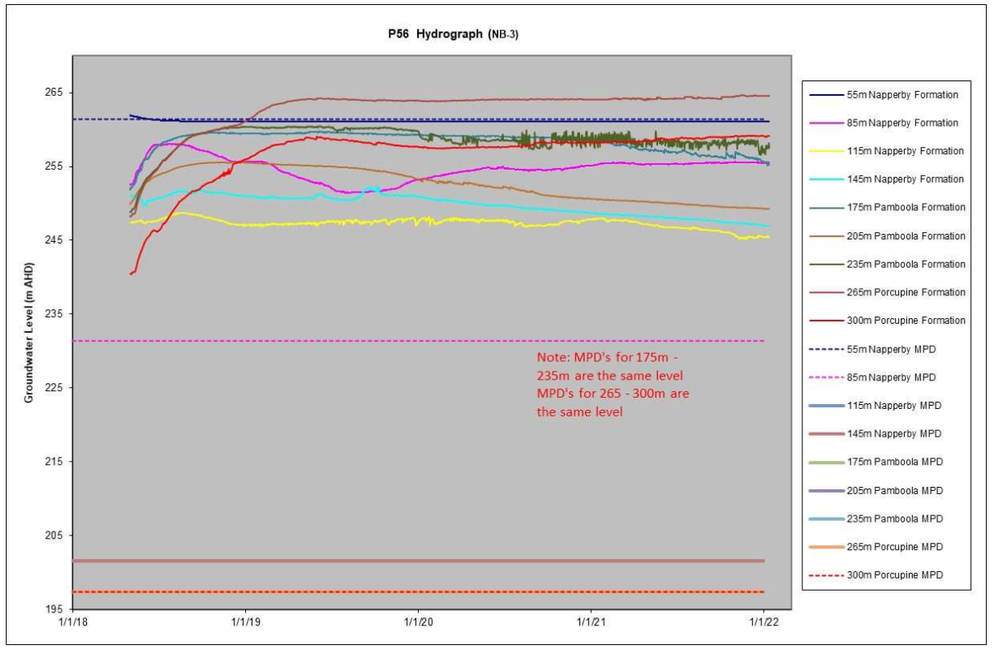


Figure C-29: Hydrograph for P56

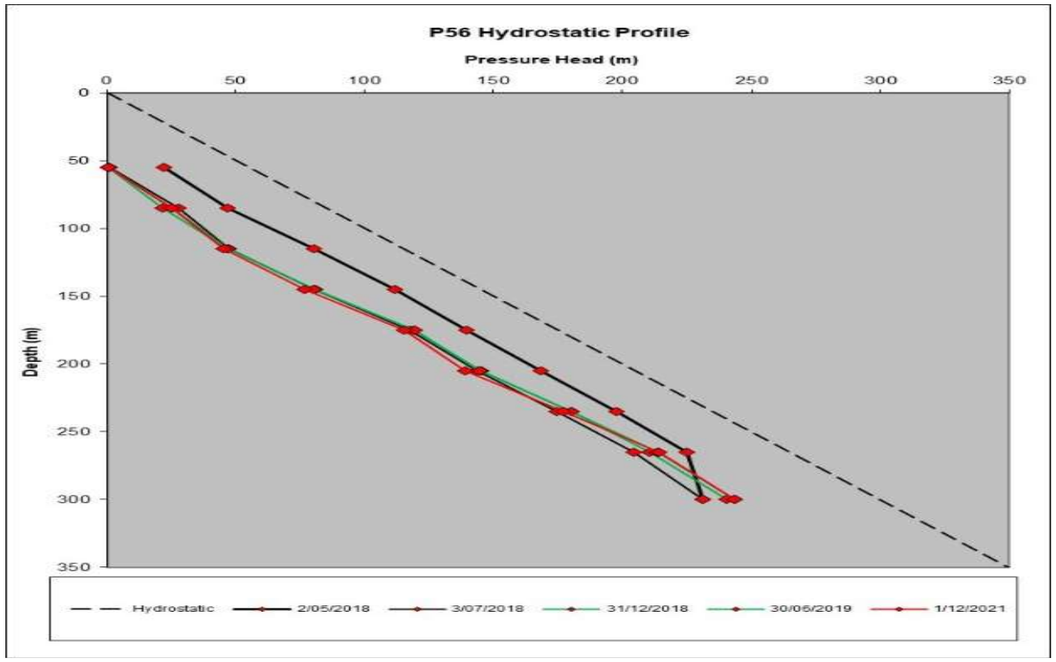


Figure C-30: Hydrostatic Profile for P56

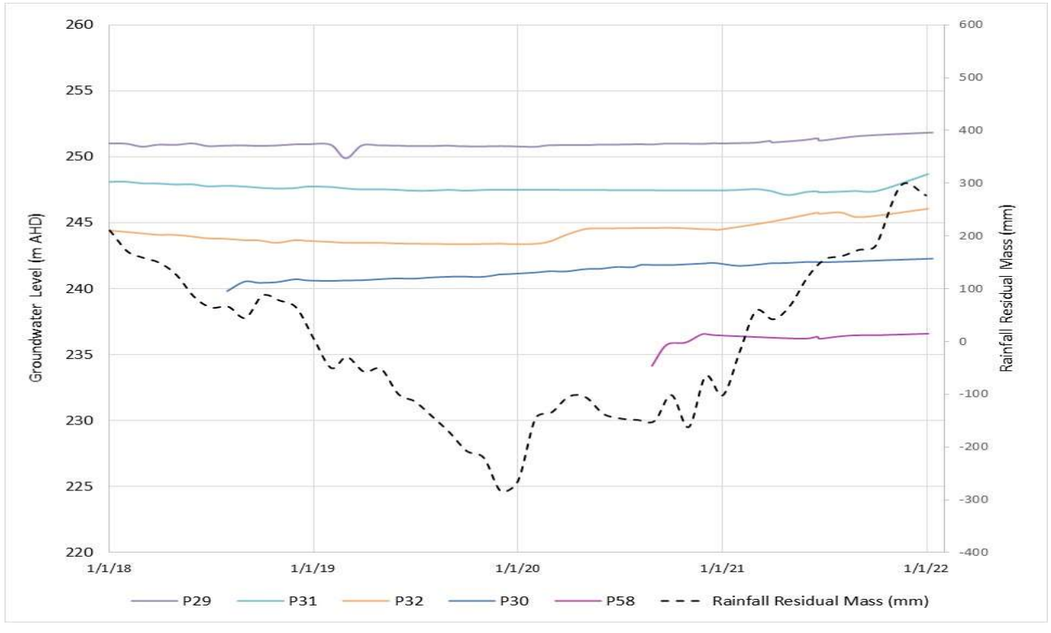


Figure C-31: Groundwater Levels Surrounding Rail Loop Dams

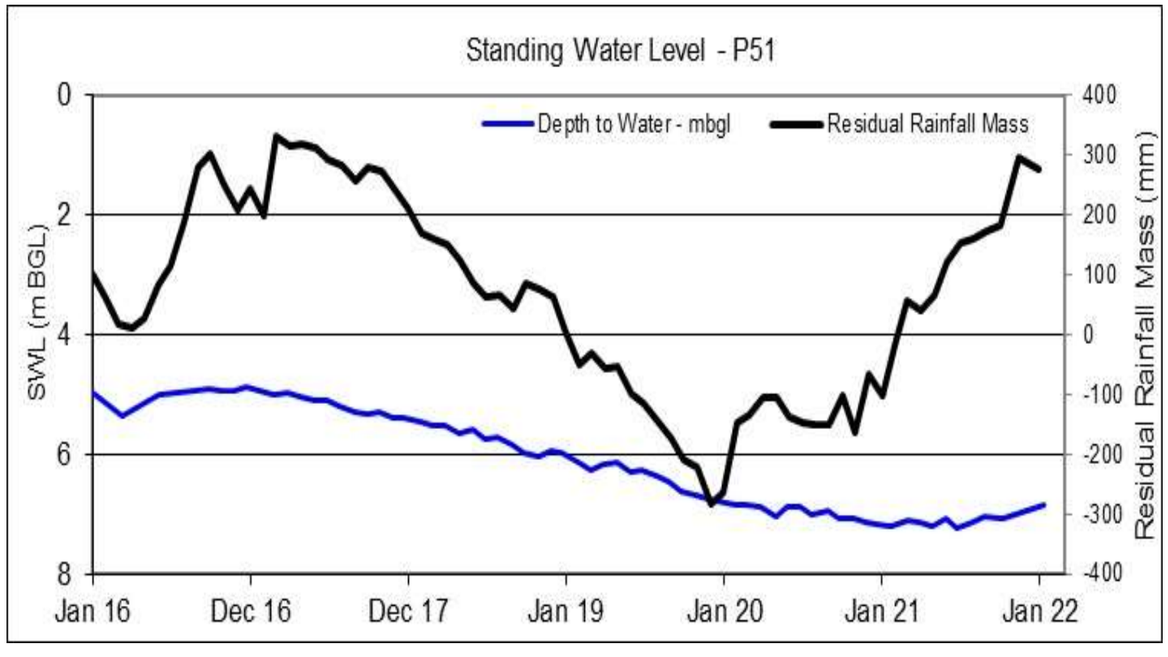


Figure C-32: Hydrograph for P51

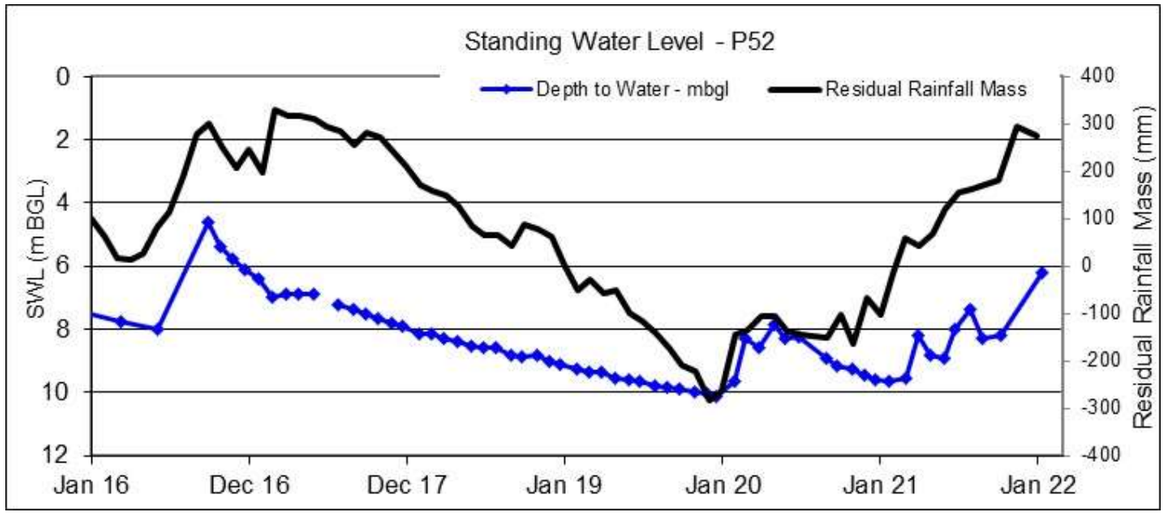


Figure C-33: Hydrograph for P52

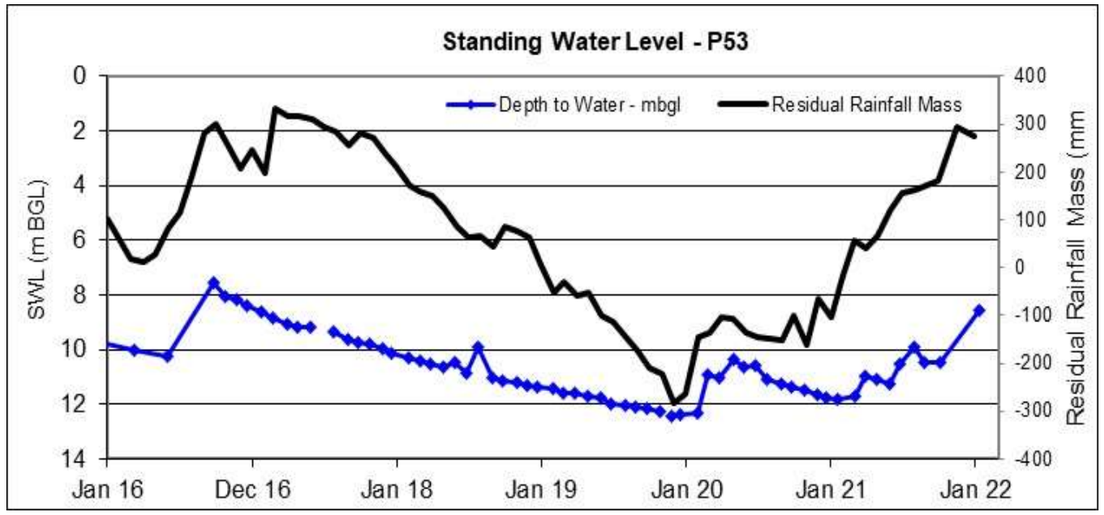


Figure C-34: Hydrograph for P53

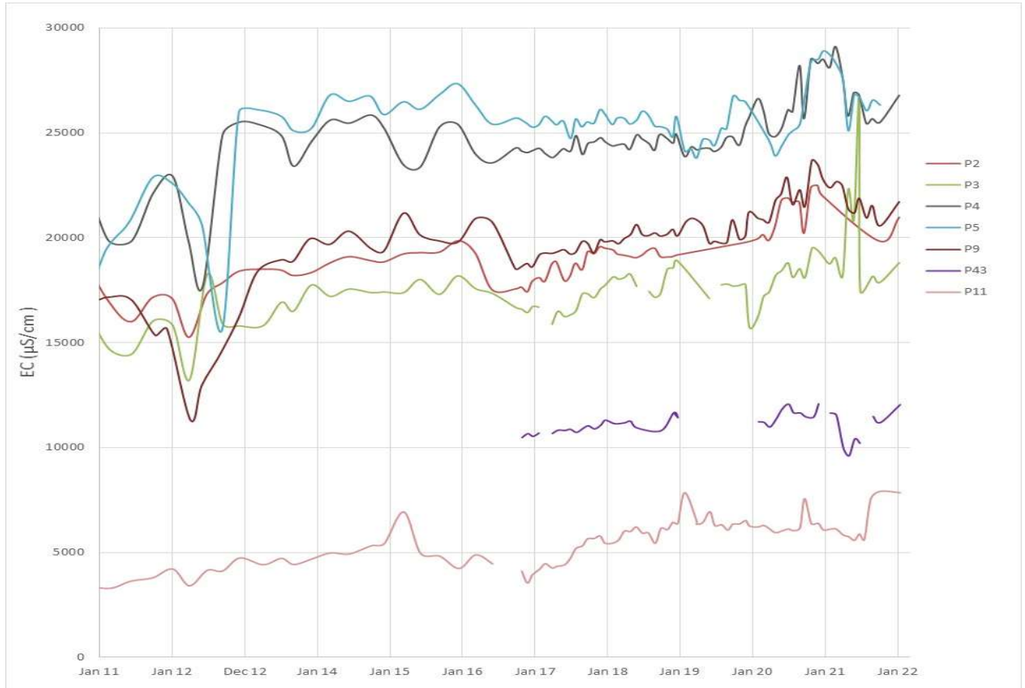


Figure C-35 Electrical Conductivity (EC) for Selected Shallow Piezometers

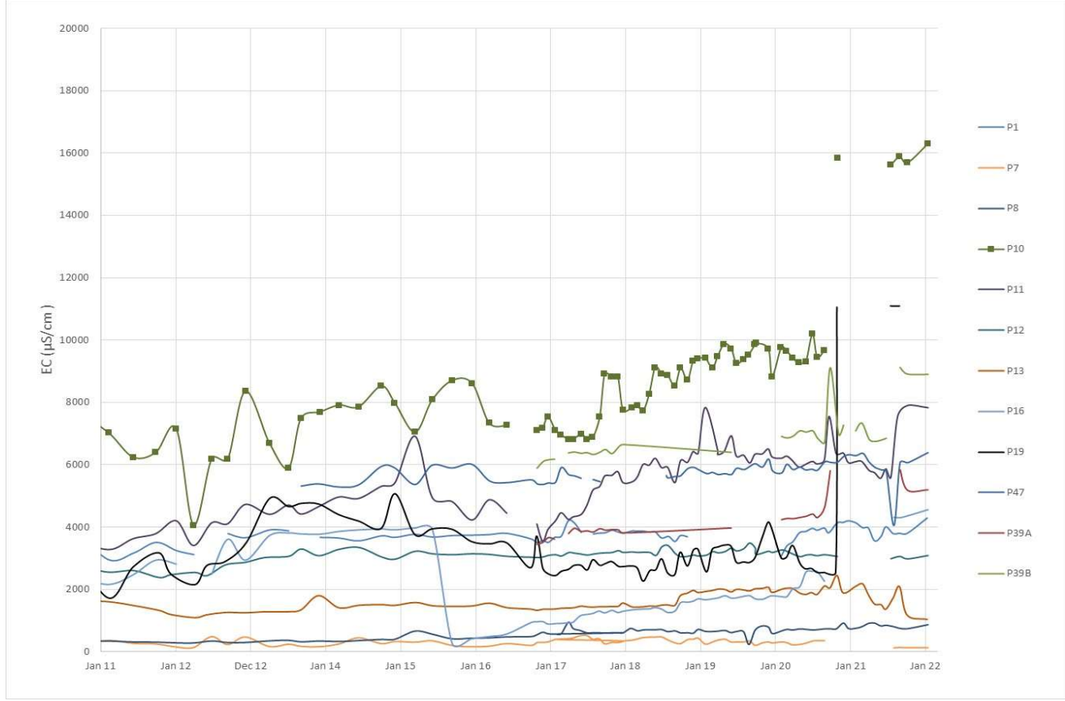


Figure C-36 Electrical Conductivity (EC) for Selected Deep Piezometers

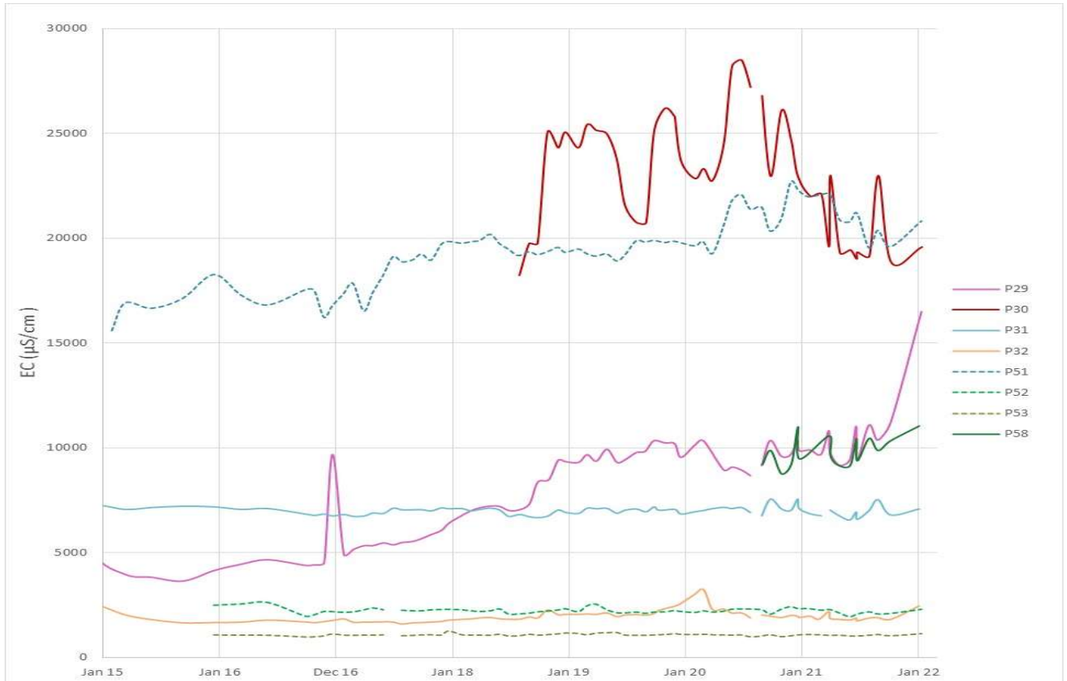


Figure C-37 Electrical Conductivity (EC) for Rail Loop and REA Network

Appendix D - Groundwater monitoring network

Table D-1 Groundwater monitoring network

Location ID	Monitoring type	Owner	Coordinates (MGA55)		Bore depth (m)	Screen interval (mbgl)	Formation	Monitoring purpose	Trigger criteria	
			Easting	Northing					Level	Quality
P1	Standpipe	Narrabri Coal Operations	776116	6614694	50	44-50	Garrawilla Volcanics	level and quality	predicted drawdown	ANZG (stock)
P2	Standpipe	Narrabri Coal Operations	777282	6616355	50	44-50	Napperby Formation	level and quality	predicted drawdown	EC two tiered
P3	Standpipe	Private	780433	6620115	45	34-40	Pamboola Formation	level and quality	predicted drawdown	EC two tiered
P4	Standpipe	Private	777490	6625553	30	24-30	Napperby Formation	level and quality	predicted drawdown	EC two tiered
P5	Standpipe	Stock Route	778180	6628195	30	24-30	Pamboola Formation	Level	predicted drawdown	na
P6*	Standpipe	Private	772726	6626021	90	78-90	Pilliga Sandstone	level and quality	na	ANZG (irrigation)
P7	Standpipe	State Forest	768998	6624338	90	78-90	Pilliga Sandstone	level and quality	na	ANZG (irrigation)
P8	Standpipe	State Forest	772697	6618421	65	57-63	Purlawaugh Formation	level and quality	predicted drawdown	ANZG (stock)
P9	Standpipe	State Forest	775127	6620209	30	24-30	Purlawaugh Formation	level and quality	predicted drawdown	EC two tiered
P10	Standpipe	State Forest	774063	6616444	130	118-130	Napperby Formation (no sill)	level and quality	predicted drawdown	EC two tiered
P11	Standpipe	Narrabri Coal Operations	774066	6616447	50	44-50	Purlawaugh Formation	level and quality	predicted drawdown	EC two tiered
P12	Standpipe	Narrabri Coal Operations	776513	6619964	90	84-90	Napperby Formation(above sill)	level and quality	predicted drawdown	ANZG (stock)
P13	Standpipe	Narrabri Coal Operations	776526	6619972	30	24-30	Garrawilla Volcanics/Napperby	level and quality	predicted drawdown	ANZG (stock)
P16	Standpipe	State Forest	772233	6623740	146	137-146	Garrawilla Volcanics	level and quality	predicted drawdown	ANZG (stock)
P17*	Standpipe	State Forest	772222	6623712	56	47-56	Purlawaugh Formation	level and quality	na	na
P19	Standpipe	Narrabri Coal Operations	776827	6621543	187	184-187	Pamboola Formation	level and quality	na	To be determined – never monitored
P28*	Standpipe	Narrabri Coal Operations	778343	6620162	25	19-25	Napperby Formation (above sill)	seepage	na	na
P29	Standpipe	Narrabri Coal Operations	778541	6619978	25	19-25	Napperby Formation (above sill)	seepage	na	EC two tiered
P30	Standpipe	Narrabri Coal Operations	778808	6620071	15	9-15	Napperby Formation (above sill)	seepage	na	na
P31	Standpipe	Narrabri Coal Operations	778318	6620343	15	9-15	Napperby Formation (above sill)	seepage	na	EC two tiered
P32	Standpipe	Narrabri Coal Operations	778993	6620335	15	9-14	Napperby Formation (above sill)	seepage	na	EC two tiered
P33*	Standpipe	Narrabri Coal Operations	778772	6620523	15	9-14	Napperby Formation (above sill)	seepage	na	na

Location ID	Monitoring type	Owner	Coordinates (MGA55)		Bore depth (m)	Screen interval (mbgl)	Formation	Monitoring purpose	Trigger criteria	
			Easting	Northing					Level	Quality
P34*	Standpipe	Narrabri Coal Operations	778542	6620604	15	9-14	Napperby Formation (above sill)	seepage	na	na
P39A	Standpipe	Private	782024	6620076	80	72-78	Watermark Formation	level and quality	na	ANZG (stock)
P39B	Standpipe	Private	782018	6620077	32	15-30	Tullamullen Alluvium	level and quality	na	ANZG (irrigation), bore specific
P42_185	VWP	Narrabri Coal Operations	771092	6614376	427	185	Purlawaugh Formation	level	na	na
P42_345	VWP	Narrabri Coal Operations	771092	6614376	427	345	Digby Formation	level	na	na
P42_375	VWP	Narrabri Coal Operations	771092	6614376	427	375	Benelabri Formation	level	na	na
P42_395	VWP	Narrabri Coal Operations	771092	6614376	427	395	Hoskissons Coal Seam	level	na	na
P42_415	VWP	Narrabri Coal Operations	771092	6614376	427	415	Arkarula Formation	level	na	na
P42_90	VWP	Narrabri Coal Operations	771092	6614376	121	90	Pilliga Sandstone	level	na	na
P43	Standpipe	Private	781248	6619992	66	59-65	Watermark Formation	level and quality	na	EC two tiered
P44_134	VWP	Narrabri Coal Operations	777434	6623212	471	134	Digby Formation	level	na	na
P44_245	VWP	Narrabri Coal Operations	777434	6623212	471	245	Arkarula Formation	level	na	na
P44_330	VWP	Narrabri Coal Operations	777434	6623212	471	330	Arkarula Formation	level	na	na
P44_375	VWP	Narrabri Coal Operations	777434	6623212	471	375	Arkarula Formation	level	na	na
P44_445	VWP	Narrabri Coal Operations	777434	6623212	471	445	Arkarula Formation	level	na	na
P44_95	VWP	Narrabri Coal Operations	777434	6623212	98	95	Napperby Formation	level	na	na
P45_42	VWP	Narrabri Coal Operations	779491	6620117	291	42.5	Digby Formation	level	na	na
P45_80	VWP	Narrabri Coal Operations	779491	6620117	291	80	Arkarula Formation	level	na	na
P45_150	VWP	Narrabri Coal Operations	779491	6620117	291	150	Watermark Formation	level	na	na
P45_200	VWP	Narrabri Coal Operations	779491	6620117	291	200	Watermark Formation	level	na	na
P45_240	VWP	Narrabri Coal Operations	779491	6620117	291	240	Watermark Formation	level	na	na
P45_276	VWP	Narrabri Coal Operations	779491	6620117	291	276	Watermark Formation	level	na	na
P46_70	VWP	Narrabri Coal Operations	777395	6617847	396	70	Napperby Formation	level	na	na

Location ID	Monitoring type	Owner	Coordinates (MGA55)		Bore depth (m)	Screen interval (mbgl)	Formation	Monitoring purpose	Trigger criteria	
			Easting	Northing					Level	Quality
P46_87	VWP	Narrabri Coal Operations	777395	6617847	396	87	Digby Formation	level	na	na
P46_151	VWP	Narrabri Coal Operations	777395	6617847	396	151	Pamboola Formation	level	na	na
P46_250	VWP	Narrabri Coal Operations	777395	6617847	396	250	Watermark Formation	level	na	na
P46_308	VWP	Narrabri Coal Operations	777395	6617847	396	308	Porcupine Formation	level	na	na
P46_34	VWP	Narrabri Coal Operations	777395	6617847	396	343	Leard Formation	level	na	na
P47	Standpipe	Narrabri Coal Operations	776166	6622586	31	8-30.5	Garrawilla Volcanics	level and quality	na	ANZG (stock)
P51	Standpipe	Narrabri Coal Operations	777437	6620859	17	9-12	Garrawilla Volcanics	seepage	na	EC two tiered
P52	Standpipe	Narrabri Coal Operations	777118	6620808	24	18-21	Napperby Formation	seepage	na	EC two tiered
P53	Standpipe	Narrabri Coal Operations	776995	6620655	24	18-21	Garrawilla Volcanics	seepage	na	EC two tiered
P54_30	VWP	State Forest	773079	6610419	348	30	Pilliga Sandstone	level	na	na
P54_60	VWP	State Forest	773079	6610419	348	60	Purlawaugh Formation	level	na	na
P54_100	VWP	State Forest	773079	6610419	348	100	Purlawaugh Formation	level	na	na
P54_140	VWP	State Forest	773079	6610419	348	140	Napperby Formation	level	na	na
P54_180	VWP	State Forest	773079	6610419	348	180	Napperby Formation	level	na	na
P54_220	VWP	State Forest	773079	6610419	348	220	Napperby Formation	level	na	na
P54_260	VWP	State Forest	773079	6610419	348	260	Napperby Formation	level	na	na
P54_300	VWP	State Forest	773079	6610419	348	300	Benelabri Formation	level	na	na
P54_338	VWP	State Forest	773079	6610419	348	338	Arkarula Formation	level	na	na
P55_68	VWP	Narrabri Coal Operations	776425	6610503	230	68	Napperby Formation	level	na	na
P55_91	VWP	Narrabri Coal Operations	776425	6610503	230	91	Napperby Formation	level	na	na
P55_103	VWP	Narrabri Coal Operations	776425	6610503	230	103	Digby Formation	level	na	na
P55_128	VWP	Narrabri Coal Operations	776425	6610503	230	128	Arkarula Formation	level	na	na
P55_152	VWP	Narrabri Coal Operations	776425	6610503	230	152	Pamboola Formation	level	na	na

Location ID	Monitoring type	Owner	Coordinates (MGA55)		Bore depth (m)	Screen interval (mbgl)	Formation	Monitoring purpose	Trigger criteria	
			Easting	Northing					Level	Quality
P55_188	VWP	Narrabri Coal Operations	776425	6610503	230	188	Pamboola Formation	level	na	na
P55_221	VWP	Narrabri Coal Operations	776425	6610503	230	221	Pamboola Formation	level	na	na
P56_55	VWP	Narrabri Coal Operations	776277	6614725	368	55	Napperby Formation	level	na	na
P56_85	VWP	Narrabri Coal Operations	776277	6614725	368	85	Napperby Formation	level	na	na
P56_115	VWP	Narrabri Coal Operations	776277	6614725	368	115	Napperby Formation	level	na	na
P56_145	VWP	Narrabri Coal Operations	776277	6614725	368	145	Napperby Formation	level	na	na
P56_175	VWP	Narrabri Coal Operations	776277	6614725	368	175	Arkarula Formation	level	na	na
P56_205	VWP	Narrabri Coal Operations	776277	6614725	368	205	Pamboola Formation	level	na	na
P56_235	VWP	Narrabri Coal Operations	776277	6614725	368	235	Pamboola Formation	level	na	na
P56_265	VWP	Narrabri Coal Operations	776277	6614725	368	265	Watermark Formation	level	na	na
P56_300	VWP	Narrabri Coal Operations	776277	6614725	368	300	Porcupine Formation	level	na	na
P58	Standpipe	Narrabri Coal Operations	778649	6619912	40	32-38	Napperby Formation	seepage	na	EC two tiered
WB2	Standpipe	Narrabri Coal Operations	776382	6619701	26	22-26	Garrawilla Volcanics	level and quality	predicted drawdown	To be determined
WB10 (GW013858)	Standpipe (Stock and domestic)	Private	774254	6603250	33.5	24.3-30.3	Napperby Formation	level	predicted drawdown	To be determined
WB11 (House bore)	Standpipe (Stock and domestic)	Private	772678	6601496	58	unknown	Garrawilla Volcanics	level	predicted drawdown	To be determined
WB12 (257_bore)	Standpipe	Private	780874	6617836	100	60-75	Arkarula Formation and Pamboola Formation	level	predicted drawdown	To be determined
WB13 (GW008634)	Standpipe (Stock and domestic)	Private	772930	6597095	78.3	25.9-30.4 and 70.7-78.2	Garrawilla Volcanics/Napperby Formation	level	predicted drawdown	To be determined
WB14 (GW026121)	Standpipe	Private	773126	6603421	20.1	unknown	Garrawilla Volcanics	level	predicted drawdown	To be determined
WB15 (Windmill Bore)	Standpipe	Private	779733	6628836	20	Unknown	Napperby Formation	level	predicted drawdown	To be determined
WB16 (South Caloola)	Standpipe	Private	775254	6602244	41	Unknown	Napperby Formation	level	predicted drawdown	To be determined
WB17 (GW903687 - Solar Bore)	Standpipe (Stock and domestic)	Private	779491	6628525	23.88	Unknown	Napperby Formation	level	predicted drawdown	To be determined
WB18 (Mentone Bore)	Standpipe (Stock and domestic)	Private	776686	6629386	16.69	Unknown	Napperby Formation	level	predicted drawdown	To be determined
Mayfield	GDE	Narrabri Coal Operations	775670	6615617	na	na	Pilliga Sandstone	Flow rate and surface conditions	na	na

Location ID	Monitoring type	Owner	Coordinates (MGA55)		Bore depth (m)	Screen interval (mbgl)	Formation	Monitoring purpose	Trigger criteria	
			Easting	Northing					Level	Quality
Eather (Dam 1)	GDE	-	771133	6602103	na	na	na	Flow rate and surface conditions	na	na
Eather (Dam 2)	GDE	-	771292	6602251	na	na	na	Flow rate and surface conditions	na	na
Hardy's	GDE	-	770726	6604763	na	na	na	Flow rate and surface conditions	na	na
Blairmore Feature 1	GDE	-	773353	6597177	na	na	na	Flow rate and surface conditions	na	na
Blairmore Feature 2	GDE	-	774557	6597554	na	na	na	Flow rate and surface conditions	na	na
Quaternary Alluvium bore P59	Standpipe	Narrabri Coal Operations	772114	6623344	To be confirmed	4-6	Alluvium/Colluvium	level and quality	To be determined	To be determined
Quaternary Alluvium bore P60	Standpipe	Narrabri Coal Operations	772114	6623344	40	28-34	Pilliga Sandstone	level and quality	To be determined	To be determined
Quaternary Alluvium bore P61-1	VWP	Narrabri Coal Operations	772114	6623344	28	na	Pilliga Sandstone	level	To be determined	na
Quaternary Alluvium bore P61-2	VWP	Narrabri Coal Operations	772114	6623344	93	na	Purlawaugh	level	To be determined	na
Quaternary Alluvium bore P61-3	VWP	Narrabri Coal Operations	772114	6623344	147	na	Garawilla	level	To be determined	na
Quaternary Alluvium bore P61-4	VWP	Narrabri Coal Operations	772114	6623344	212	na	Napperby	level	To be determined	na
Quaternary Alluvium bore P61-5	VWP	Narrabri Coal Operations	772114	6623344	71	na	Basalt Sill	level	To be determined	na
Quaternary Alluvium bore P61-6	VWP	Narrabri Coal Operations	772114	6623344	24	na	Digby Formation	level	To be determined	na
Quaternary Alluvium bore P62	Standpipe	Narrabri Coal Operations	776984	6624759	To be confirmed	4-6	Alluvium/Colluvium	level and quality	To be determined	To be determined
Quaternary Alluvium bore P63	Standpipe	Narrabri Coal Operations	776984	6624759	50	40-45	Napperby	level and quality	To be determined	To be determined
Quaternary Alluvium bore P64-1	VWP	Narrabri Coal Operations	776984	6624759	5	na	Alluvium/Colluvium	level	To be determined	na
Quaternary Alluvium bore P64-2	VWP	Narrabri Coal Operations	776984	6624759	43	na	Napperby	level	To be determined	na
Quaternary Alluvium bore P64-3	VWP	Narrabri Coal Operations	776984	6624759	90	na	Basalt Sill	level	To be determined	na
Quaternary Alluvium bore P64-4	VWP	Narrabri Coal Operations	776984	6624759	114	na	Napperby Base Sill	level	To be determined	na
Quaternary Alluvium bore P64-5	VWP	Narrabri Coal Operations	776984	6624759	134	na	Digby Formation	level	To be determined	na
Quaternary Alluvium bore P64-6	VWP	Narrabri Coal Operations	776984	6624759	143	na	Hoskissons ^	level	To be determined	na
Quaternary Alluvium bore P65	Standpipe	Narrabri Coal Operations	771467	6612256	To be confirmed	3-5	Alluvium/Colluvium	level and quality	To be determined	To be determined
Quaternary Alluvium bore P66	Standpipe	Narrabri Coal Operations	771467	6612256	40	30-35	Pilliga Sandstone	level and quality	To be determined	To be determined

Location ID	Monitoring type	Owner	Coordinates (MGA55)		Bore depth (m)	Screen interval (mbgl)	Formation	Monitoring purpose	Trigger criteria	
			Easting	Northing					Level	Quality
Quaternary Alluvium bore P67-1	VWP	Narrabri Coal Operations	771467	6612256	30	na	Pilliga Sandstone	level	To be determined	na
Quaternary Alluvium bore P67-2	VWP	Narrabri Coal Operations	771467	6612256	106	na	Purlawaugh	level	To be determined	na
Quaternary Alluvium bore P67-3	VWP	Narrabri Coal Operations	771467	6612256	168	na	Garawilla	level	To be determined	na
Quaternary Alluvium bore P67-4	VWP	Narrabri Coal Operations	771467	6612256	243	na	Napperby	level	To be determined	na
Quaternary Alluvium bore P67-5	VWP	Narrabri Coal Operations	771467	6612256	301	na	Basalt Sill	level	To be determined	na
Quaternary Alluvium bore P67-6	VWP	Narrabri Coal Operations	771467	6612256	354	na	Digby Formation	level	To be determined	na
Quaternary Alluvium bore P68	Standpipe	Narrabri Coal Operations	776329	6616863	To be confirmed	4-6	Alluvium/Colluvium	level and quality	To be determined	To be determined
Quaternary Alluvium bore P69	Standpipe	Narrabri Coal Operations	776329	6616863	50	40-45	Napperby	level and quality	To be determined	To be determined
Quaternary Alluvium bore P70-1	VWP	Narrabri Coal Operations	776329	6616863	5	na	Alluvium/Colluvium	level	To be determined	na
Quaternary Alluvium bore P70-2	VWP	Narrabri Coal Operations	776329	6616863	41	na	Napperby	level	To be determined	na
Quaternary Alluvium bore P70-3	VWP	Narrabri Coal Operations	776329	6616863	83	na	Basalt Sill	level	To be determined	na
Quaternary Alluvium bore P70-4	VWP	Narrabri Coal Operations	776329	6616863	125	na	Digby Formation	level	To be determined	na
Quaternary Alluvium bore P70-5	VWP	Narrabri Coal Operations	776329	6616863	133	na	Hoskissons ^	level	To be determined	To be determined
Quaternary Alluvium bore P71	Standpipe	Narrabri Coal Operations	770548	6604413	To be confirmed	4-6	Alluvium/Colluvium	level and quality	To be determined	To be determined
Quaternary Alluvium bore P72	Standpipe	Narrabri Coal Operations	770548	6604413	50	40-45	Purlawaugh	level and quality	To be determined	To be determined
Quaternary Alluvium bore P73-1	VWP	Narrabri Coal Operations	770548	6604413	22	na	Pilliga Sandstone	level	To be determined	na
Quaternary Alluvium bore P73-2	VWP	Narrabri Coal Operations	770548	6604413	41	na	Purlawaugh	level	To be determined	na
Quaternary Alluvium bore P73-3	VWP	Narrabri Coal Operations	770548	6604413	91	To be confirmed	Garawilla	level	To be determined	na
Quaternary Alluvium bore P73-4	VWP	Narrabri Coal Operations	770548	6604413	180	To be confirmed	Napperby	level	To be determined	na
Quaternary Alluvium bore P73-5	VWP	Narrabri Coal Operations	770548	6604413	273	na	Digby Formation	level	To be determined	na
Quaternary Alluvium bore P73-6	VWP	Narrabri Coal Operations	770548	6604413	285	na	Hoskissons	level	To be determined	na
Quaternary Alluvium bore P74	Standpipe	Narrabri Coal Operations	776555	6605888	To be confirmed	4-6	Alluvium/Colluvium	level and quality	To be determined	To be determined
Quaternary Alluvium bore P75	Standpipe	Narrabri Coal Operations	776555	6605888	20	12-16	Napperby	level and quality	To be determined	To be determined

Location ID	Monitoring type	Owner	Coordinates (MGA55)		Bore depth (m)	Screen interval (mbgl)	Formation	Monitoring purpose	Trigger criteria	
			Easting	Northing					Level	Quality
Quaternary Alluvium bore P76-1	VWP	Narrabri Coal Operations	776555	6605888	4	na	Alluvium/Colluvium		To be determined	na
Quaternary Alluvium bore P76-2	VWP	Narrabri Coal Operations	776555	6605888	8	na	Napperby		To be determined	na
Quaternary Alluvium bore P76-3	VWP	Narrabri Coal Operations	776555	6605888	21	na	Basalt Sill		To be determined	na
Quaternary Alluvium bore P76-4	VWP	Narrabri Coal Operations	776555	6605888	43	na	Napperby Base Sill	level	To be determined	na
Quaternary Alluvium bore P76-5	VWP	Narrabri Coal Operations	776555	6605888	66	na	Digby Formation		To be determined	na
Quaternary Alluvium bore P76-6	VWP	Narrabri Coal Operations	776555	6605888	79	na	Hoskissons ^		To be determined	na
P77-1	VWP	Narrabri Coal Operations	772478	6623677	24	To be confirmed	Pilliga Sandstone	level	na	na
P77-2	VWP	Narrabri Coal Operations	772478	6623677	82	To be confirmed	Purlawaugh Formation	level	na	na
P77-3	VWP	Narrabri Coal Operations	772478	6623677	134	To be confirmed	Garawilla Volcanics	level	na	na
P77-4	VWP	Narrabri Coal Operations	772478	6623677	198	To be confirmed	Napperby Formation	level	na	na
P77-5	VWP	Narrabri Coal Operations	772478	6623677	245	To be confirmed	Basalt Sill	level	na	na
P77-6	VWP	Narrabri Coal Operations	772478	6623677	261	To be confirmed	Napperby Base Sill	level	na	na
P77-7	VWP	Narrabri Coal Operations	772478	6623677	294	To be confirmed	Digby Formation	level	na	na
P78-1	VWP	Narrabri Coal Operations	774682	6610770	29	To be confirmed	Garawilla Volcanics	level	na	na
P78-2	VWP	Narrabri Coal Operations	774682	6610770	110	To be confirmed	Napperby Formation	level	na	na
P78-3	VWP	Narrabri Coal Operations	774682	6610770	166	To be confirmed	Basalt Sill	level	na	na
P78-4	VWP	Narrabri Coal Operations	774682	6610770	182	To be confirmed	Napperby Base Sill	level	na	na
P78-5	VWP	Narrabri Coal Operations	774682	6610770	203	To be confirmed	Digby Formation	level	na	na
P79-1	VWP	Narrabri Coal Operations	774203	6610738	17	To be confirmed	Purlawaugh Formation	level	na	na
P79-2	VWP	Narrabri Coal Operations	774203	6610738	56	To be confirmed	Garawilla Volcanics	level	na	na
P79-3	VWP	Narrabri Coal Operations	774203	6610738	136	To be confirmed	Napperby Formation	level	na	na
P79-4	VWP	Narrabri Coal Operations	774203	6610738	193	To be confirmed	Basalt Sill	level	na	na
P79-5	VWP	Narrabri Coal Operations	774203	6610738	209	To be confirmed	Napperby Base Sill	level	na	na

Location ID	Monitoring type	Owner	Coordinates (MGA55)		Bore depth (m)	Screen interval (mbgl)	Formation	Monitoring purpose	Trigger criteria	
			Easting	Northing					Level	Quality
P79-6	VWP	Narrabri Coal Operations	774203	6610738	228	To be confirmed	Digby Formation	level	na	na
P80-1	VWP	Narrabri Coal Operations	775019	6616999	31.82	To be confirmed	Garawilla Volacnics	level	na	na
P80-2	VWP	Narrabri Coal Operations	775019	6616999	80.07	To be confirmed	Napperby Formation	level	na	na
P80-3	VWP	Narrabri Coal Operations	775019	6616999	132.32	To be confirmed	Basalt Sill	level	na	na
P80-4	VWP	Narrabri Coal Operations	775019	6616999	161.57	To be confirmed	Napperby Base Sill	level	na	na
P80-5	VWP	Narrabri Coal Operations	775019	6616999	188.11	To be confirmed	Digby Formation	level	na	na
P81	Wireline extensometer	Narrabri Coal Operations	775019	6617032	270	To be confirmed	To be confirmed	displacement	na	na
P82										

Notes:

* Historically dry with insufficient water to sample

^the Hoskissons Coal Seam might not be present at the eastern sites (new sites 2, 4 and 6) or thinned out significantly.

Appendix E - Groundwater quality trigger values

Groundwater quality – seepage monitoring bores

Derived trigger values for six shallow monitoring bores located around the mine brine storage points are summarised in Table E-1 and Table E-2 for bores completed into the Napperby Formation and Garrawilla Volcanics, respectively. Water quality impacts are considered likely at these locations, hence trigger values for these monitoring points have predominantly been derived using a control charting approach (DES 2021).

Table E-1 Proposed trigger values for seepage monitoring bores situated in the Napperby Formation

Parameter	P29 [1]		P31 [1]		P32 [1]		P52 [1]	
	Tier 1 (80th)	Tier 2 (95th)	Tier 1 (80th)	Tier 2 (95th)	Tier 1 (80th)	Tier 2 (95th)	Tier 1 (80th)	Tier 2 (95th)
EC (µS/cm)	9,732	11,337	7,110	7,195	2,170	2,938	2,300	2,533
pH	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**
	6.0^	8.5^	6.0^	8.5^	6.0^	8.5^	6.0^	8.5^

Notes:
[1] Tier 1 and Tier 2 control charting method (DES 2021)
^ ANZG (2018) irrigation, long term application

Table E-2 Proposed trigger values for seepage monitoring bores situated in the Garrawilla Volcanics

Parameter	P51 [1]		P53 [1]	
	Tier 1 (80th)	Tier 2 (95th)	Tier 1 (80th)	Tier 2 (95th)
EC (µS/cm)	19,500	19,860	1,107	1,169
pH	**Min.**	**Max.**	**Min.**	**Max.**
	6.0^	8.5^	6.0^	8.5^

Notes:
[1] Tier 1 and Tier 2 control charting method (DES 2021))
^ ANZG (2018) irrigation, long term application

Groundwater Quality Trigger Values – strata likely to experience drawdown impacts

Water quality triggers have been derived for a number of locations in each unit as summarised below in Table E-3, Table E-4, Table E-5, Table E-6, and Table E-7.

Table E-3 Garrawilla Volcanics monitoring locations and proposed trigger values

Parameter	WB2, P13, P47 [1]	P1 [1]	P16 [1]
EC (µS/cm)	5,970	5,970	5,970
pH	**Min.**		**Max.**
	6.0^		8.5^

Notes:
[1] ANZG (2018) livestock drinking water (beef cattle)
^ ANZG (2018) irrigation, long term application

Table E-4 Napperby Formation monitoring locations and proposed trigger values

Parameter	P2[3]		P4[3]		P10[3]		P12	
	Tier 1 (80th)	Tier 2 (95th)	Tier 1 (80th)	Tier 2 (95th)	Tier 1 (80th)	Tier 2 (95th)		
EC (µS/cm)	19,342[1]	19,731[1]	24,912[1]	25,610[1]	8,894[1]	9,426[1]	5,970[2]	
pH	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
	6.0^	8.5^	6.0^	8.5^	6.0^	8.5^	6.0^	8.5^

Notes:
[1] Tier 1 and Tier 2 control charting method (DES 2021)
[2] ANZG (2018) livestock drinking water (beef cattle)
[3] Review of EC data for the Napperby Formation monitoring locations P2, P4 and P10 suggests that salinity (EC) values for groundwater at these locations is unsuitable for use as livestock drinking water. These locations are recommended for exclusion from ongoing assessment against the livestock drinking water trigger values.
^ ANZG (2018) irrigation, long term application

Table E-5 Purlawaugh Formation monitoring locations and proposed trigger values

Parameter	P8		P9 [1 3]		P11 [1 3]	
			Tier 1 (80th)	Tier 2 (95th)	Tier 1 (80th)	Tier 2 (95th)
EC (µS/cm)	5,970[2]		20,330[1]	21,190[1]	6,052[1]	6,546[1]
pH	Min.	Max.	Min.	Max.	Min.	Max.
	6.0^	8.5^	6.0^	8.5^	6.0^	8.5^

Notes:
[1] Tier 1 and Tier 2 control charting method (DES 2021)
[2] ANZG (2018) livestock drinking water (beef cattle)
[3] Review of EC data for the Purlawaugh Formation monitoring locations P9 and P11 suggests that salinity (EC) values for groundwater at these locations is unsuitable for use as livestock drinking water. These locations are recommended for exclusion from ongoing assessment against the livestock drinking water trigger values.
^ ANZG (2018) irrigation, long term application

Table E-6 Watermark Formation monitoring locations and proposed trigger values

Parameter	Proposed trigger value (P39a)		P43 [1 3]	
			Tier 1 (80th)	Tier 2 (95th)
EC (µS/cm)	5,970[2]		11,162[1]	11,412[1]
pH	Min.	Max.	Min.	Max.
	6.0^	8.5^	6.0^	8.5^

Notes:
[1] Tier 1 and Tier 2 control charting method (DES 2021)
[2] ANZG (2018) livestock drinking water (beef cattle)
[3] Review of EC data for the Watermark Formation monitoring location P43 suggests that salinity (EC) values for groundwater at these locations is unsuitable for use as livestock drinking water. These locations are recommended for exclusion from ongoing assessment against the livestock drinking water trigger values.
^ ANZG (2018) irrigation, long term application

Table E-7 Pamboola Formation monitoring locations and proposed trigger values

Parameter	P3 [1 2]	
	Tier 1 (80th)	Tier 2 (95th)
EC (µS/cm)	18,016[1]	18,564[1]
pH	Min.	Max.
	6.0^	8.5^

Notes:
[1] Tier 1 and Tier 2 control charting method (DSITI, 2017)
[2] Review of EC data for the Pamboola Formation monitoring location P3 suggests that salinity (EC) values for groundwater at these locations is unsuitable for use as livestock drinking water. These locations are recommended for exclusion from ongoing assessment against the livestock drinking water trigger values.
^ ANZG (2018) irrigation, long term application

Groundwater Quality Trigger Values – Strata unlikely to experience drawdown impacts

Consistent with the level of impact (i.e. no significant groundwater level or water quality impacts are predicted in the Pilliga Sandstone or the Namoi Alluvium), water quality triggers have been derived for at least one monitoring point in each aquifer. In each case, the closest monitoring point to the mine lease was selected. Adopted trigger values are summarised below in Table E-8 and Table E-9.

As shown for parameters where the historic baseline data suggest that the groundwater will not be suitable for long term irrigation (the dominant use of groundwater in these aquifers) then bore specific triggers, based on the 80th percentile of the observed data, have been developed. Trigger values for other parameters have been set based on ANZG guideline values (ANZG 2018).

Table E-8 Alluvium monitoring locations and proposed trigger values

Parameter	P39b	
EC (µS/cm)	6,546 [1]	
pH	Min.	Max.
	6.0^	8.5^

Notes:
[1] Bore specific 80th percentile
^ ANZG (2018) irrigation, long term application.

Table E-9 Pilliga Sandstone monitoring locations and proposed trigger values

Parameter	P6, P7	
EC (µS/cm)	2,327 [1]	
pH	Min.	Max.
	6.0^	8.5^

Notes:
[1] Converted from TDS trigger using equation 4.6 (ANZECC, 2000). ANZG (2018) Irrigation
^ ANZG (2018) irrigation, long term application

Groundwater Quality Trigger Values – Private Bores

As shown in Table E-10, groundwater trigger values have been derived for the nine privately owned bores with a predicted drawdown of more than2 m. No historic data is currently available for these bores and hence the initial EC trigger value is based on ANZG guideline values for beef cattle watering (ANZG 2018).

The nine new privately owned bores discussed in section 4.6 will require sufficient baseline data to be collected to determine if water quality trigger values will be required and included in the monitoring program.

Table E-10 Privately owned bores proposed trigger values

Parameter	Trigger values	
EC (µS/cm)	5,970[1]	
pH	**Min.**	**Max.**
	6.0^	8.5^

Notes:
[1] ANZG (2018) livestock drinking water (beef cattle)
^ ANZG (2018) irrigation, long term application