Centennial Coal



STATEMENT OF ENVIRONMENTAL EFFECTS

Airly Mine Extension Project

State Significant Development 5581

Modification 2

Main Report & Appendices

April 2019

Centennial Coal
Airly

Airly Mine

SSD 5581 – Modification 2

STATEMENT OF ENVIRONMENTAL EFFECTS

Prepared for:

Centennial Airly Pty Limited

Prepared by:

Centennial Coal Company Limited

Level 18, 1 Market St
Sydney NSW 2000

STATEMENT OF VALIDITY

Submission of *Statement of Environmental Effects*
Under Section 4.55(2) of the *Environmental Planning and Assessment Act 1979*

Development Application

Applicant Name	Centennial Airly Pty Limited
Applicant Address	Level 18, 1 Market St, Sydney NSW 2000
Development	Airly Mine Extension Project
Development Description	Modification 2 to Airly Mine's Consent SSD 5581 for activities described in **Section 1.3** and **Chapter 4.0** of this document.
Land to be Developed	Refer to Schedule of Land (**Appendix A**)
Environmental Impact Assessment	*Statement of Environmental Effects*

Document Preparation

Name	Nagindar Singh
Qualifications	BSc, MSc, PhD
Company	Centennial Coal Company Limited
Address	Level 18, 1 Market St, Sydney NSW 2000

Declaration

I certify I have prepared the *Statement of Environmental Effects*, and to the best of my knowledge:

- It contains all available information that is relevant to the environmental impact assessment of the development to which this statement relates.
- It is true in all material particulars and does not, by its presentation or omission of information, materially mislead.



EXECUTIVE SUMMARY

Background

Airly Mine commenced operations in 1998. The mine currently operates under State Significant Development consent SSD 5581 pertaining to the *Airly Mine Extension Project* (the Project). The Project was approved on 15 December 2016. The consent allows mining operations at Airly Mine for a period of 20 years from the date of commencement (31 January 2017), and rehabilitation to be undertaken after this period. SSD 5581 consent will lapse on 31 January 2037.

Proposed Modification

Centennial Airly is proposing a modification to Airly Mine's consent SSD 5581 to receive up to 170 ML/year of water at the Airly Mine pit top from Charbon Colliery using rail transport.

The proposed modification elements are:

- importation of up to 170 ML/year of water from Charbon Colliery by rail
- minor amendments to existing water management system at the pit top to allow discharge of water from the trains to existing onsite storages.

The proposed modification will facilitate mining at Airly Mine at the approved level, which has an ongoing water shortage, sufficient to limit its long-term mining potential. The 170 ML/year water corresponds to the process water deficit identified in the site water balance in a dry year for the approved activities in SSD 5581 consent. It is proposed to operate one water laden train per day in the water transfer scheme to allow the transfer of up to 170 ML/year of water. However, trains will be operated on an as-needs basis. Fewer trains may be operated based on the deficit identified on average, while in a wet year the water transfer scheme may not be operated regularly, given no deficit has been identified for wet conditions.

The SSD 5581 Project Application Area boundary will remain unchanged and no major changes to the site will be required. The existing water management system will not change significantly. Surface water harvested from the site and the licensed Production Bore will continue to be utilised as process water prior to importing additional water from Charbon Colliery.

Hours of operations are not proposed to change from the approved 24 hours per day and seven days per week.

The approved train movements comprising 5 maximum train movements per day and an average of 2 train movements in a calendar year will not change. The proposed one water laden train per day to arrive at Airly pit top will fall within the limits of train movements approved in SSD 5581.

Charbon Colliery will concurrently modify its consent SSD 08_0211 (Charbon MOD 1) to transfer up to 170 ML/year of water to Airly Mine by rail. That modification is the subject of a separate *Statement of Environmental Effects* (Centennial Coal, 2019).

Environmental Impact Assessment

This *Statement of Environmental Effects* (SEE) has been prepared to support the modification application by Centennial Airly to be submitted under Section 4.55(2) of the *Environment Planning and Assessment Act 1979* (EP&A Act). The SEE describes the proposed modification, and assesses the potential environmental impacts due to the modification elements. Measures that will be required to mitigate potential environmental impacts, wherever relevant, are also described in the SEE.

The SEE has been prepared to meet the form of Part 1 Clause 2(4) of Schedule 1 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation), and it includes information required under Clause 115 of the EP&A Regulation for Section 4.55 modifications.

The impacts of the importation of the maximum 170 ML/year of surface water from onsite water storages at Charbon Colliery using rail transport have been assessed in this SEE. Given the minor nature of the proposed modification, no environmental issues were assessed as presenting high-risk. The impact of the proposed importation of water for storage within the existing water management system at Airly Mine, and subsequent use as process water was considered as moderate to low risk. A Surface Water Impact Assessment (GHD, 2019a) has been prepared by GHD Pty Ltd to support the modification application. A noise impact assessment (SLR, 2019) has been prepared to assess the impact of the one water laden train per day arriving at the Airly pit top from the north on the Wallerawang-Gwabegar Rail Line. The Airly Mine Extension Project Environmental Impact Statement (AMEP EIS) assessed the impact of trains arriving at the Airly pit top from the south on the Wallerawang-Gwabegar Rail Line.

Surface Water Impact Assessment

The aim of the Surface Water Impact Assessment (GHD, 2019a) prepared to support the modification applications was two-fold:

- to determine the process water deficits that are likely to impact on Airly Mine's ability to operate at the approved level under all rainfall conditions (wet year, dry year and average rainfall year)
- to assess the impact of the importation of the maximum 170 ML/year on the downstream environment.

As noted above, the proposed 170 ML/year importation volume corresponds to a dry year deficit for all approved activities at Airly Mine. On average, the water deficit is forecast at 64 ML/year while no deficit is forecast for a wet year. The transfer of water from Charbon Colliery to Airly Mine will occur on an as needs basis, to ensure water that is imported will not increase the likelihood of discharges to Airly Creek.

The following sections provide summaries of the assessment outcomes. A more detailed summary is provided in **Section 7.2** of this SEE, however to gain a full understanding of the surface water impacts, the Surface Water impact Assessment (GHD, 2019a), appended as **Appendix C** to this SEE, should be read in its entirety.

Water and Salt Balance

The main inflow at Airly Mine is direct rainfall and catchment runoff, which can report as discharge to Airly Creek, but discharges occur only occasionally. There are some losses to evaporation and seepage from storages, and the main loss due to operations is for dust suppression.

Water balance modelling in GoldSim shows that the discharges off site due to the modification, estimated at 27 ML/year on average, will be significantly less than the approved condition which showed a discharge of 76 ML/year. No discharge is expected in a dry year. The site water balance for the proposed conditions remains unchanged for all approved activities. In this regard, the modification will not affect off site discharge average volumes or the frequency of discharges.

Surface Water Quality

Water imported at Airly Mine from Charbon Colliery has the potential to increase the electrical conductivity (EC), turbidity, the total suspended solid concentration, the total nitrogen and phosphorous concentrations and concentrations of dissolved and manganese in the water management system at Airly Mine. However, as the median concentrations of the water quality parameters in the Charbon Colliery water are below the site specific guidelines values (SSGVs) for Airly Creek and Airly Mine's EPL 12374 concentration limits, the likelihood of potential off site discharges exceeding the SSGVs and EPL 12374 concentration limits will not increase as a result of the modification. With the implementation of the management controls for no discharge off site to Airly Creek, the likelihood of water sourced from Charbon Colliery directly entering the receiving

environment without dilution is extremely low. Therefore, the potential impact to Airly Creek due to the modification is low. EPL 12374 specifies water quality limits in discharges, which Airly Mine is required to comply with at all times.

Downstream Surface Water Users

Three licensed surface water users have been identified on Coco Creek, downstream from the Airly Mine pit top water management system. Based on the water and salt balance and surface water quality assessments, adverse impacts to downstream water users are unlikely to occur due to the low risk of potential impacts and the ephemeral nature of Airly Creek.

Aquatic Ecology

Given the low risk of discharge off site to Airly Creek, there is a low risk of impacts to macroinvertebrates and native fish in Airly Creek. There is a low likelihood of introducing non-endemic macroinvertebrate species to Airly Creek, as it is unlikely that they would survive the water transfer and management system between Charbon Colliery and Airly Mine. No new invasive macroinvertebrates or fish species that could potentially be spread to Airly Creek have been identified at Charbon Colliery.

Cumulative Impacts

The modification is not expected to result in any measurable impacts to water quantity or quality downstream of Airly Mine. Given there are no other developments in the vicinity of Airly Mine, cumulative impacts are unlikely to occur.

Water Licensing

The Project proposes to receive up to 170 ML/year from Charbon Colliery. No other changes to extraction or use of water at Airly Mine are proposed. Therefore, no changes to licences held for Airly Mine are required by the Project due to the modification. Charbon Colliery holds sufficient licences for the extraction of the up to 170 ML/year of water from the Reedy Creek Dam catchment to supply to Airly Mine.

Noise Assessment

As noted above, the modification is not seeking to increase the number of trains approved in Airly Mine's consent. One water laden train per day from Charbon Colliery will be operated within the constraints of the approved limits in SSD 5581.

The Noise Impact Assessment (SLR, 2019) assessed the impact of trains from Charbon Colliery, arriving on the Wallerawang-Gwabegar Rail Line from the north at the Airly pit top. The noise assessment assesses the impact of the noise associated with the change in direction of water trains on the Wallerawang-Gwabegar Rail Line as well as wagons bunching when reversing into the Airly Rail Loop.

While the modification is not proposing to change any approved activities at the pit top, with the potential to significantly increase noise emissions, the noise assessment (SLR, 2019) has established project trigger noise levels for the receptors assessed with reference to the now in force *Noise Policy for Industry* (EPA, 2017). It is noted that the modification is not seeking to increase approved noise levels above those already contained in SSD 5581.

There are no expected exceedances of consented operational noise criteria or the trigger levels in *Rail Infrastructure Noise Guideline* (EPA, 2013) for the day and night periods and passbys for trains on the Wallerawang-Gwabegar Rail Line between Charbon Colliery and Airly Mine.

Environmental Impacts

The table below presents an overview of the environmental outcomes from technical assessments prepared for the SEE and the other environmental aspects considered in the SEE.

Summary of Assessments of Other Environmental Aspects

Issue	Overview of Key Findings
Surface Water Resources	The Project will reduce reliance on groundwater extraction at Airly Mine. Modelling shows there will be no increase in the frequency or magnitude of offsite discharges due to the modification. Given that Centennial Airly will implement management measures for no offsite discharges, the potential impacts on Airly Creek water quality will not be measurable. Downstream licensed surface water users on Coco Creek are unlikely to be impacted as a result of the modification due to the low risk of potential impacts and the management controls to be implemented to minimise offsite discharges. Given the low risk of discharge of water off site, the likelihood of impacts on the macroinvertebrates and fish in Airly Creek is low. Cumulative impacts with respect to surface water quality and quantity are not expected.
Noise	There are no expected exceedances of consented operational noise criteria or the trigger levels in *Rail Infrastructure Noise Guideline* (EPA, 2013) for the day and night periods and passbys.
Traffic and Transport	There are no expected road traffic consequences due to the modification. Upgrades of the existing infrastructure will require few delivery trucks while operations will require minimal staffing and consequently minimal vehicle movements. Total vehicle movements will fall within the levels assessed in the AMEP EIS. Train movements for the water transfer scheme will remain within the approved train movements in SSD 5581, except that the water laden trains will arrive at the pit top from the north on Wallerawang-Gwabegar Rail Line.
Biodiversity	No native vegetation clearing will occur during the upgrade activities. The modification will not generate any measurable impacts on any threatened species, populations and ecological communities, and their habitats, listed under the BC Act or the EPBC Act.
Air Quality	The limited construction proposed is not predicted to measurably change local air quality. Air quality monitoring is undertaken to ensure the site meets relevant air quality criteria in the consent.
Greenhouse Gas Emissions	The modification will generate GHG emissions, which will contribute to associated global environmental effects. However, the increase in GHG emissions resulting from the modification will not measurably increase the total Australian emissions and will be a small fraction of approved emissions assessed in the AMEP EIS.
Cultural Heritage	Given the minor new construction works will be restricted to already disturbed areas at the pit top, and that, no items of Aboriginal or historic cultural heritage significance exist within the works area, it is unlikely the existing cultural heritage values (Aboriginal, historic) of the site will be degraded due to the modification.
Visual Amenity	Given there will be only upgrade of the existing water management infrastructure at the pit top the modification will have no consequences on the visual amenity to the site or region.
Waste	The modification is not expected to affect the existing Airly Mine waste management strategy for residual waste and recyclable materials.
Groundwater Resources	Groundwater usage from the Production Bore will be reduced. Mine inflow predictions from the recalibrated Airly Mine groundwater model are significantly less than in approved in the AMEP EIS. On these bases, the impacts on the groundwater resources by Airly Mine are expected to be less than assessed in the AMEP EIS.

Environmental Management System

Airly Mine has a well-established Environmental Management System (EMS) developed in accordance with the Centennial Coal's EMS Framework to manage its operations in a sustainable manner. The EMS ensures the effective management of environmental issues and compliance with all regulatory requirements. The EMS incorporates a large number of Environmental Management Plans (EMPs) designed to assist in meeting community expectations and regulatory conditions, including the conditions of the Airly Mine Environment Protection Licence (EPL) 12374.

Following approval of the modification, the existing EMPs will be reviewed and updated for the modification, as appropriate, and will take into consideration the environmental assessments undertaken as part of this SEE, the commitments made and all relevant revised consent conditions.

Community Consultation

Airly Mine maintains an open two-way communication with the local community, Department of Planning and Environment and other government agencies. The prime method of community communication is via the Airly Community Consultative Committee (Airly CCC).

The proposed modifications to Airly Mine's consent SSD 5581 and Charbon Colliery's consent SSD 08_0211 were tabled and discussed at the most recent Charbon and Inglenook CCC meeting in December 2018 and then at Airly CCC in January 2019. These meetings briefed the members on the need for the modifications and the various alternatives of water transfer options that had been considered. The CCCs were also briefed on the specific details of water quantity and quality of the transferred water. Details of the consultation with the community are included in **Chapter 6.0**. Consultation with the local community will be ongoing.

The broader community will be notified of the proposed modification through an advertisement placed in the local newspaper following lodgement of the modification application. The community will also be asked to take part in the modification assessment process through the public exhibition process, whereby the community will be invited to make formal submissions on the modification.

Government Consultation

Consultations with Department of Planning and Environment, Environment Protection Authority, Lithgow City Council and Mid-Western Regional Council have been undertaken in meetings with presentations given on the modification elements, alternatives investigated and the interrelationships between the Charbon MOD 1 and Airly MOD 2. For consultation with the two Councils, the technical assessment outcomes were also included in the presentations. Consultation with other agencies including Department of Industry – Lands and Water and Forestry Corporation of NSW and National Parks and Wildlife service has been undertaken through provision of letters describing the proposed modifications. Details of these consultations are described in **Chapter 6.0**. Consultation with government will be ongoing.

Justification and Conclusion

Airly Mine is a well-established underground coal mine, with well-established community relationships. Airly Mine has recently identified a significant water shortfall and Charbon Colliery has a significant licensed surplus, which is not required for site management or rehabilitation at that site. Transfer of water from one site to the other provides benefits to Airly Mine from employment and economic perspectives as the mine will continue to be operated, and will be in a position to operate at the full capacity as approved in its consent SSD 5581.

The importation of water by Airly Mine from Charbon Colliery poses a low risk of downstream impacts in Airly Creek. However, with the implementation of operational management controls for no discharge to Airly Creek to minimise harm to the environment, the Airly Mine Extension Project, as modified, will present an overall minimal residual consequence.

The economic and social benefits described in the Airly Mine Extension Project *Environment Impact Statement* will be fully realised if the mine can operate at the approved level. These benefits can be achieved with little to no risk of adverse environmental impact at Airly Mine or along the rail transport route. The rail transfer system will have little if any negative effect on the local or wider community.

In conclusion, the modification is a very minor alteration of the approved Airly Mine Extension Project and is substantially the same development. The adverse environmental impacts of the proposed modification elements are predicted not to be significant. Any potential impact can be managed appropriately to minimise harm to the environment. The benefits of the modification can therefore be achieved with little or no risk of adverse impacts on the receiving environment. The modification meets the relevant objects of the EP&A Act and is consistent with the four principles of the ecologically sustainable development. It meets all government policies. On these bases, the modification will meet environmental performance requirements to be considered for approval.

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1 INTRODUCTION

1.1 Overview

Centennial Airly Pty Limited (Centennial Airly) is proposing to modify State Significant Development (SSD) 5581 consent, which granted approval to the Airly Mine Extension Project (the Project). The consent was granted under Section 4.38 (previous Section 89E) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) on 15 December 2016 by the then Planning Assessment Commission of NSW, as delegate of the Minister of Planning. The consent allows mining operations at Airly Mine for a period of 20 years from the date of commencement, and rehabilitation to be undertaken after this period. The consent will lapse on 31 January 2037. The SSD 5581 consent has been modified once under Section 4.55(1A) of the EP&A Act, and that modification was approved on 30 August 2018.

The Project is a controlled action (EBPC 2013/7076) pursuant to Sections 130(1) and 133 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The approval EBPC 2013/7076 was granted on 18 May 2017, and has effect until 31 March 2047.

Airly Mine is located 5 kilometres (km) northeast of the village of Capertee within the Lithgow Local Government Area, approximately 40 km north-northwest of Lithgow and approximately 171 km northwest of Sydney (**Figure 1**). The Project is on the northern fringe of the Western Coalfields, and is partly located within the Mugii Murum-ban State Conservation Area. The Project Application Area is shown in **Figure 2**.

The consent SSD 5581 allows for the operation of an underground coal mine using partial extraction techniques. The consent allows for the construction and operation of surface infrastructure. It allows mining of coal from the Lithgow Seam at the rate of 1.8 million tonnes per annum (Mtpa). The mine is approved to operate 24 hours per day, seven days per week. Airly Mine operates under Environment Protection Licence (EPL) 12374.

The SEE contains a comprehensive and relevant assessment of the matters pertinent to the proposed modification to a level of detail commensurate with the scale of the modification, industry standards and the legislative framework under which it is permissible.

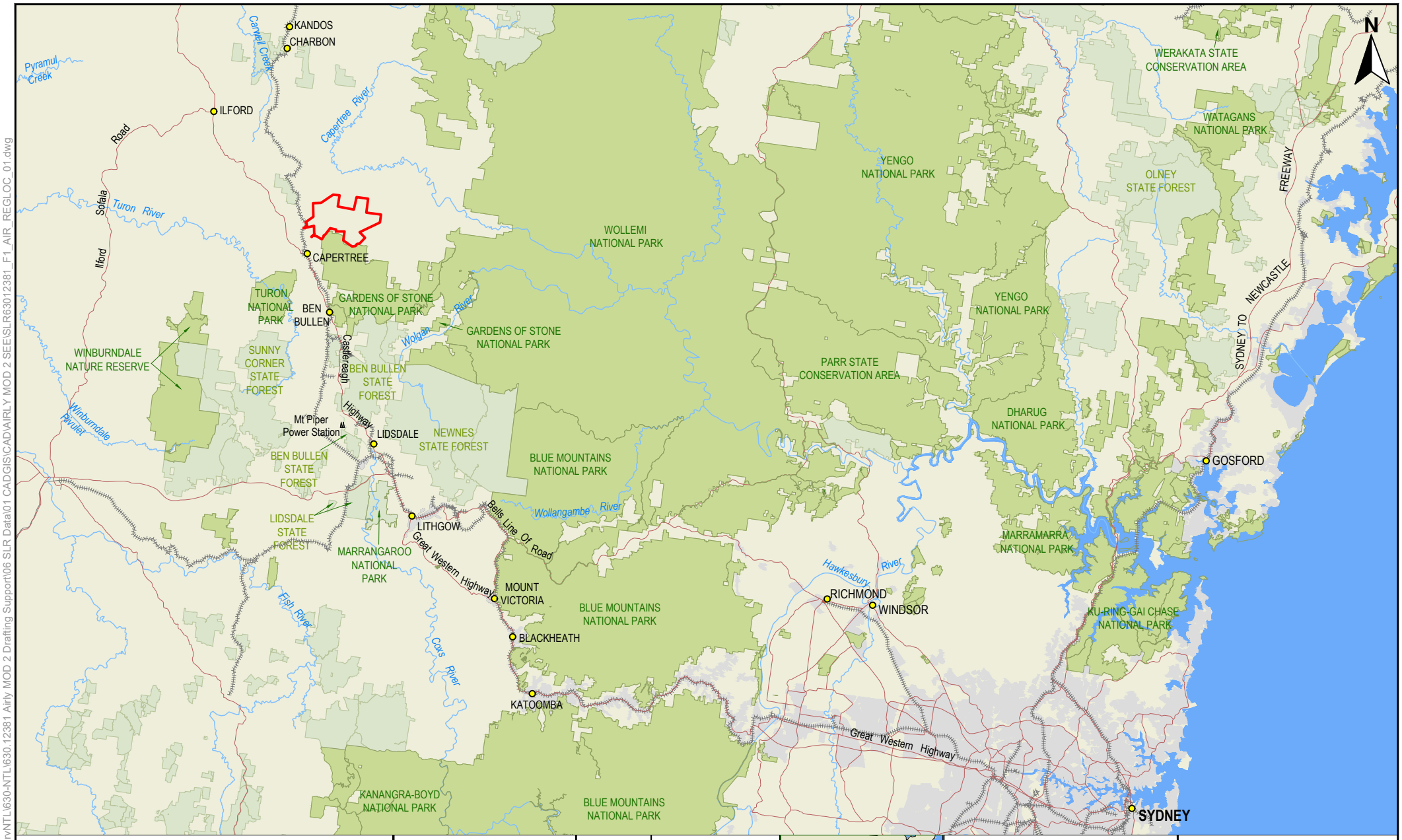
1.2 Background

Airly Mine is an existing underground coal mine producing high quality thermal coal which is supplied to both domestic and export markets. Mining at Airly commenced in 1994, under a development consent granted in 1993 (DA 162/91).

The mine is currently operating under SSD 5581. The supporting documents for SSD 5581 are the *Airly Mine Extension Project Environmental Impact Statement* (AMEP EIS) (Golder Associates, 2014a), the Independent Review Panel's Report (IPRP Report, 2016), and the MOD 1 *Statement of Environmental Effects* (Centennial Coal, 2018a) and associated further assessments and response to submissions documents.

The development consent SSD 5581 allows mining operations to continue until 31 January 2037 and permits:

- extraction of 1.8 Mtpa of run-of-mine (ROM) coal by partial extraction mining methods
- transportation of coal by rail to Eraring Power Station and to coal terminals for the export markets
- operation of supporting infrastructure
- rehabilitation.



LEGEND:

- Project Site Boundary
- Major Roads
- Watercourse
- Railway
- Built-up Areas
- City / Township / Village
- State Forest
- National Park

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Figure 1
Regional Location Map

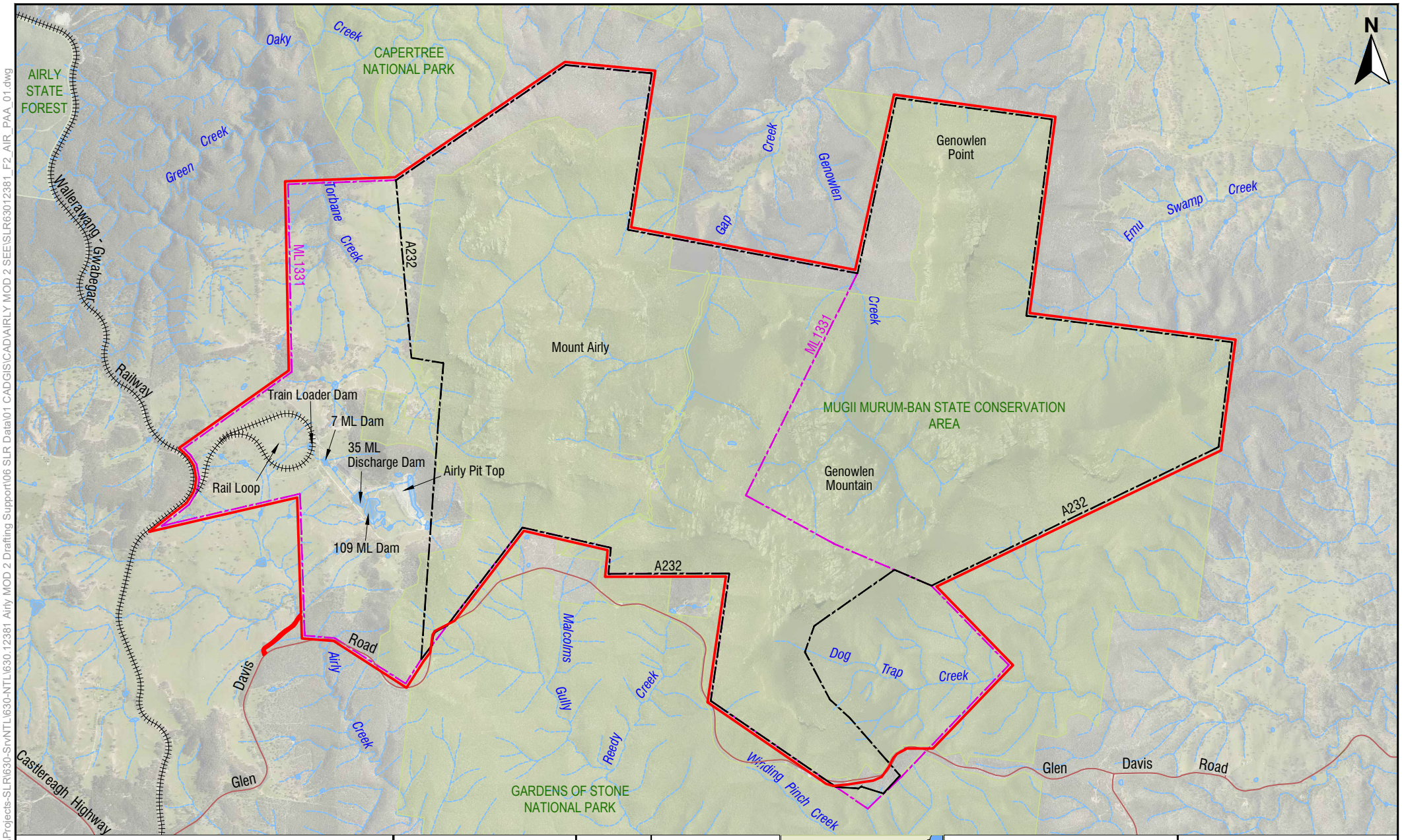
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LEGEND:

- Project Application Area
- A232 Authorisation Boundary (offset for clarity)
- ML1331 Current Lease Boundary (offset for clarity)
- Major Roads
- Watercourse
- Railway
- State Forest
- National Park / State Conservation Area

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DATE	05.03.2019
SEAM	LITHGOW
REFERENCE	SLR63012381_F2_AIR_PAA_01.dwg
SCALE	1 : 50000



Figure 2

Project Application Area and Mining Tenements

0 1.0 2.0 KM

Centennial Coal
Airly

Prepared by: SLR

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1.3 Proposed Modification

Centennial Airly is proposing a modification to Airly Mine's consent SSD 5581 to receive up to 170 ML/year of water at the Airly Mine pit top from Charbon Colliery using rail transport. The 170 ML/year water corresponds to the process water deficit identified in the site water balance in a dry year for the approved activities in the SSD 5581 consent. The reasons for the identified deficit are provided in **Section 1.6**.

The proposed modification elements are as follows:

- importation of up to 170 ML/year of water from Charbon Colliery by rail
- minor amendments to existing water management system at the pit top to allow discharge of water from the trains to existing onsite storages.

The proposed modification will facilitate mining at Airly Mine at the approved level, which has an ongoing water shortage, sufficient to limit its long-term mining potential. It is proposed to operate one water laden train per day in the water transfer scheme to allow the transfer of up to 170 ML/year of water. However, trains will be operated on an as-needs basis. Fewer trains may be operated for an average deficit forecast to 64 ML/year, while in a wet year the water transfer scheme may not be operated regularly because the no deficit is forecast.

The SSD 5581 Project Application Area boundary will remain unchanged and no major changes to the site infrastructure will be required. The existing water management will not change. Surface water harvested from the site and the existing production bore will continue to be utilised as process water prior to importing water from Charbon Colliery.

Hours of operations are not proposed to change from the approved 24 hours per day and seven days per week.

The approved train movements in SSD 5581, comprising 5 maximum train movements per day and an average of 2 train movements in a calendar year, will not change. The proposed one water laden train per day to arrive at Airly pit top will fall within the limits of train movements approved in SSD 5581.

1.4 The Applicant

Centennial Airly Pty Limited (Centennial Airly) is the Applicant for the proposed modification. The postal address of Centennial Airly is: Level 18, 1 Market St Sydney NSW 2000.

1.5 Modification Approval Pathway

The Airly Mine Extension Project was approved on 15 December 2016 as a State Significant Development (SSD 5581) under Section 4.38 (previous Section 89E) Part 4 Division 4.7 of the EP&A Act.

SSD consents may be modified under Section 4.55(2) of the EP&A Act provided that "*the consent as modified relates is substantially the same development as the development for which consent was originally granted and before that consent as originally granted was modified*". SSD 5581 has been modified once previously.

Centennial Airly is proposing to modify the SSD 5581 consent, under Section 4.55(2) of the EP&A Act, to receive up to 170 ML/day of water at the Airly pit top from Charbon Colliery using rail transport. This approval pathway was confirmed by the Department of Planning and Environment (DPE) in an email dated 30 January 2019.

When assessing an application under Section 4.55(2), the consent authority is required to consider evaluation relevant criteria outlined in Section 4.15(1), including any relevant environmental planning instruments. The proposed modification meets the relevant provisions of a number of planning instruments discussed in **Chapter 5.0** and **Section 9.6**.

Consideration has been given to other State and Commonwealth legislation relevant to the proposed modification (**Chapter 5.0**).

There will be minimal change to the existing site water management apart from the importation of water, and there will be no requirements for additional water access licences under the *Water Management Act 2000*.

The proposed modification will not impact on threatened species, endangered populations, ecological communities and other matters listed under the *Threatened Species Conservation Act 2016* (BC Act) or the EPBC Act (**Section 7.4**).

1.6 Modification Need

Centennial Airly is proposing to modify Airly Mine's consent SSD 5581 for the receipt of up to 170 ML/year of water from Charbon Colliery by rail. This volume of water has been identified as the deficit in the process water demand in a dry year. The need for importation of water at Airly Mine has arisen because of the reduced volumes of water available from the site's three main water sources, namely, groundwater inflows, surface dams and the existing production bore, for reasons discussed below (**Section 1.6.1**). The combined volume of water from these site sources is not sufficient to meet the process water demand when the mine commences extraction in the Panel and Pillar Zone of the mining area in 2019. As a result, Airly Mine will not be able to operate at the approved 1.8 Mtpa production rate without sourcing water from an external source.

Supply of water from Charbon Colliery's onsite storages and using rail transport to transfer water to Airly pit top has been identified as the best option out of the three options assessed for water source (Angus Place Colliery underground water, Charbon Colliery surface water) and mode of transport (rail, road haulage), as this option results in the lowest numbers of the sensitive residential receptors that could be potentially impacted due to noise emissions. Road haulage would have resulted in additional traffic on Glen Davis Road.

1.6.1 Airly Mine Consent SSD 5581 and Proposed Modification

A recent review of the Airly Mine water balance shows there will be a deficit in process water of approximately 170 ML/year in a dry year (GHD, 2019a). This predicted water deficit has occurred because of the following issues.

1. **Groundwater inflows**: Mine inflow predictions in the *Airly Mine Extension Project Environmental Impact Statement* (AMEP EIS) (Golder Associates, 2014a) and GHD (2014a) have recently been reviewed with more recent monitoring data (**Section 4.3**). Predictive simulations show the mine inflows in the year of maximum prediction (2030) is 76 ML/year, whichis significantly less than the 183 ML/year predicted in the AMEP EIS. Further, monitoring data indicates all of the predicted groundwater inflows and additional process water are currently absorbed in the mined coal. As a result, the predicted mine inflows are removed from the underground as product coal moisture, and no mine inflows can be reclaimed and reused as process water. This is not expected to change in the future (GHD, 2019b).
2. **Surface dams**: A prolonged dry period recently has decreased water run-off into surface water dams. While there has been some recent rain, it has not been sufficient to fill dams to the pre-drought levels and water levels have not returned to pre-drought levels as the process water demand is greater than the rate of water harvesting.
3. **Production Bore**: The Production Bore has a licensed draw of 158 ML/year (permitted as a maximum rate of 5 L/s) from the Shoalhaven aquifer but flow rates dropped to <1 L/s in 2018, and continue to decrease. Investigations show that the early higher pumping rates from the Production Bore will not be possible in the future, and current pumping rates are similar for other Shoalhaven aquifer bores in the area.

This maximum volume of water to be imported is based on the dry year deficit in process water (GHD, 2019a), which will be the constraint volume for full operations. The actual volume of water to be imported will be based on an as-needs basis, and the 170 ML/year of water will not be imported should the onsite dams at Airly pit top harvest sufficient water to sustain operations.

To allow the importation of the maximum 170 ML/year of water from Charbon Colliery by rail, Centennial Airly is proposing to modify the consent SSD 5581 consent (Airly MOD 1). This SEE will support the modification application.

1.6.2 Charbon Colliery Consent SSD 08_0211 and Proposed Modification

Modelling undertaken as part of a water availability feasibility study shows that Charbon Colliery can supply the required deficit from its onsite dams (LDP 4 Dam, CHPP Dams, Reedy Creek Dam) to sustain Airly Mine's life of mine operations.

There are additional advantages of sourcing water from Charbon Colliery:

- Charbon holds adequate water access licences (336 ML/year) to extract water from the Reedy Creek dam catchment to meet the maximum Airly's process water deficit in a dry year, although the volumes actually extracted could be less than this volume given water from LDP 4 Dam will also be extracted.
- The quality of water from Charbon's onsite storages is better than the Airly Creek water, and better than the Production Bore water, which has an electrical conductivity (EC) of 4500 µS/cm.

Charbon Colliery has ceased mining and is being rehabilitated in accordance with their current Mining Operations Plans. Consequently, Charbon does not require access to its licensed 336 ML/year water extraction limit on water access licences WAL35022 and WAL35023, and can make the 170 ML/year extraction from the Reedy Creek Dam catchment available for transfer to Airly Mine. Water required for rehabilitation activities at the site are being sourced from other onsite water storages (Centennial Coal, 2019; GHD, 2019c).

To facilitate water transfer to Airly Mine, the Charbon Colliery consent requires a modification, which is the subject of a separate SEE (Centennial Coal, 2019). The modification will be assessed in accordance with Section 4.55(2) of the EP&A Act.

Given the interaction between the Charbon MOD 1 and Airly MOD 2, the two modification applications will be submitted at the same time to allow their assessments to be undertaken in parallel.

1.7 Environmental Assessment Considerations

No Secretary's Environmental Assessment Requirements were issued for the modification. Centennial Airly identified the proposed modification elements in a letter to the Department of Planning and Environment (DPE) dated 27 November 2018. The letter outlined the proposed modification elements, the technical assessments for the SEE and sought DPE's agreement on the approval pathway (**Section 1.5**) and the adequacy of the technical assessments proposed. This approval pathway and scope of assessments was confirmed by DPE in an email dated 30 January 2019.

1.8 Document Purpose

This SEE has been prepared on behalf of Centennial Airly Pty Limited to support an application for modification to Airly Mine's consent under Section 4.55(2) of the EP&A Act.

The proposed modification elements are noted in **Section 1.3**, and discussed in detail in **Section 4.2.** The SEE has been prepared to meet the content of Part 1 Clause 2(4) of Schedule 1 of EP&A Act and includes information required under Clause 115 of the EP&A Regulation (**Section 5.3.1**).

The SEE describes the proposed modification, provides an assessment of its potential impacts and details measures that will be implemented to minimize the identified impacts. The information will be used by DPE and relevant government agencies to assess the merits of the proposed modification, and make recommendations to the determining authority on whether the proposed modification should be approved.

1.9 Document Structure

The SEE document sets out the proposed modification in the context of the existing and approved environment, planning considerations, key environmental issues, potential impacts, mitigation measures and residual impacts. The SEE is presented as one volume comprising the main report and appendices.

The main report comprises the following chapters.

Chapter 1.0 provides a background and an overview of the proposed modification.

Chapter 2.0 provides a brief site description.

Chapter 3.0 provides brief discussions of the approved operations.

Chapter 4.0 provides details of the modification elements for which approval is sought and compares the current approved operations with the proposed operations as modified.

Chapter 5.0 describes the regulatory framework relevant to the modification.

Chapter 6.0 describes the stakeholder consultation undertaken in respect of the modification.

Chapter 7.0 assesses potential environmental impacts and outlines management and mitigation measures as necessary to minimise impacts from the modification.

Chapter 8.0 provides the Statement of Commitments.

Chapter 9.0 provides modification justification and conclusion.

2 SITE DESCRIPTION

2.1 Site Location

Airly Mine is located 5 km northeast of the village of Capertee within the Lithgow Local Government Area, approximately 40 km north-northwest of Lithgow and approximately 171 km northwest of Sydney (**Figure 1**). The Project is on the northern fringe of the Western Coalfields and is partly located within the Mugii Murum-ban State Conservation Area. The Project Application Area is shown in **Figure 2**.

The Gardens of Stone National Park and Ben Bullen State Forest lie almost immediately to the south of the Project Application Area, whilst Wollemi National Park is approximately 35 km to the east. The Gardens of Stone National Park is part the Greater Blue Mountains World Heritage Area. The Capertee National Park lies immediately to the north of the Project Application Area, while most of the Project Application Area is within the Mugii Murrum-ban State Conservation Area (Mugii Murrum-ban SCA).

The Mugii Murrum-ban SCA is characterised by two mesas (Mount Airly and Genowlan Mountain), pagodas, cliffs and dissected sandstone gorges. The Mugii Murrum-ban SCA boundary is shown in **Figure 2,** and has an area of 3,650 ha. The reserve has significant natural and cultural heritage values and also contains significant mineral resources. As a state conservation area, Mugii Murum-ban SCA is reserved to protect environmental and cultural heritage values while permitting mining and exploration.

The Castlereagh Highway is the major arterial road in the region and Glen Davis Road links the Mine Access Road with the Castlereagh Highway.

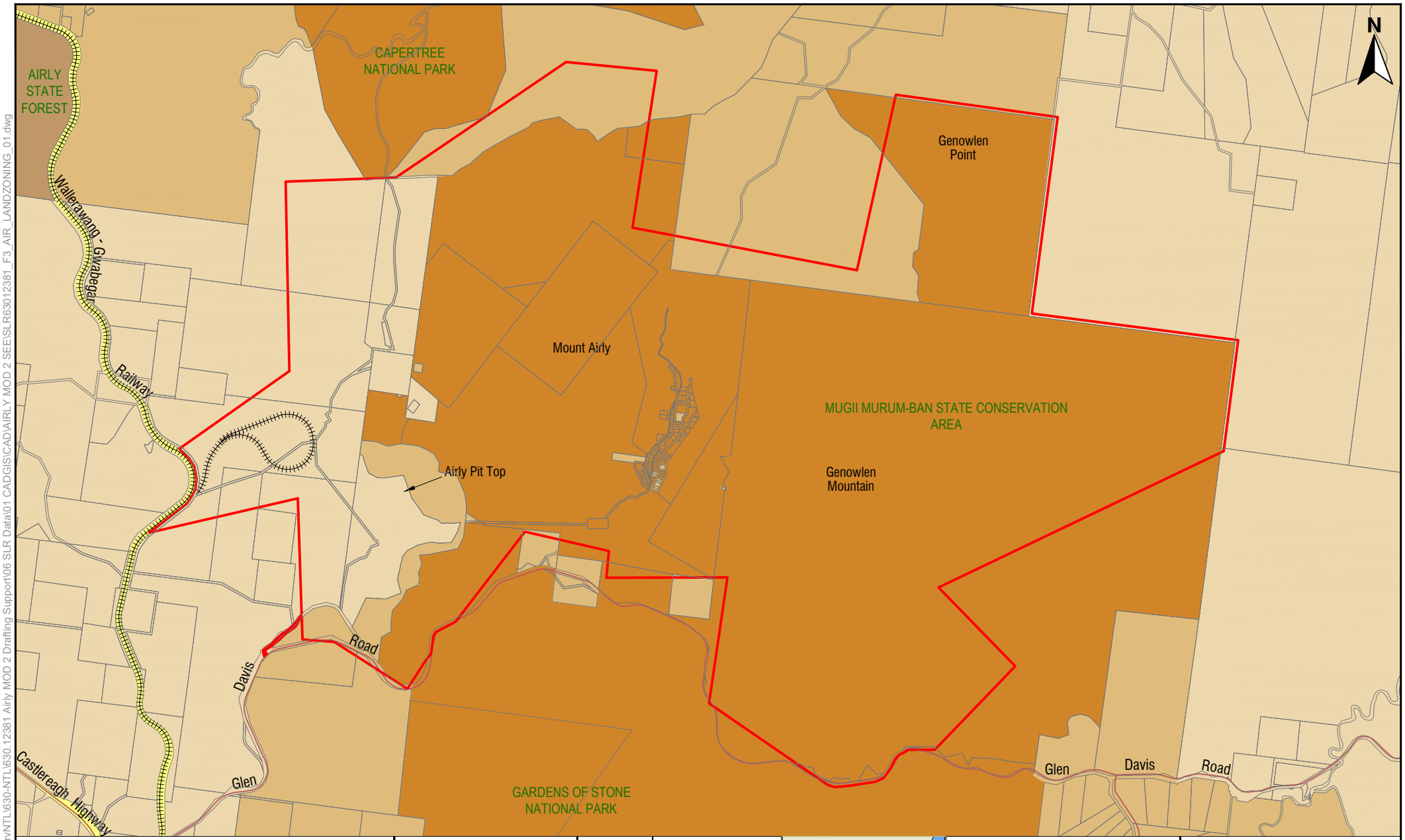
2.2 Project Application Area

The Project Application Area includes Mining Lease ML1331 and Authorisation 232 (A232) with areas of 2,744 ha and 3,096 ha respectively, and is shown in **Figure 2**. The Project Application Area encompasses an area of 3,982 ha and is characterised by environmental features such as rock outcrops, sandstone cliffs and deep valleys. Approximately 3,090 ha or approximately 78% of the Project Application Area is within the 3,650 ha Mugii Murrum-ban SCA.

2.3 Land Zoning

The Project Application Area falls under the *Lithgow Local Environmental Plan 2014* (Lithgow LEP). The Lithgow LEP commenced on 19 December 2014 and is the principal planning instrument affecting land use in the Lithgow Local Government Area. Under the Lithgow LEP the Project Application Area encompasses the following zones, shown in **Figure 3.**

- E1 National Parks and Nature Reserves
- RU1 Primary Production
- RU2 Rural Landscape



LEGEND:

- Project Site Boundary
- Major Roads
- Watercourse
- Railway

Land zoning within Project Application Area:

E1	National Parks and Nature Reserves
RU1	Primary Production
RU2	Rural Landscape
RU3	Forestry
SP2	Infrastructure

Land Zones sourced from Lithgow Local Environmental Plan 2014

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Figure 3
Land Zoning

0 1.0 2.0 KM

Centennial Coal
Airly

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2.4 Land Ownership

Land ownership within and surrounding the Project Application Area consists of Crown Land, land owned by Centennial Coal, privately owned land and land owned and managed by the National Parks and Wildlife Service NSW. The land ownership is shown in **Figure 4**. Most land in the Project Application Area (Mugii Murrum-ban SCA) is owned by the National Parks and Wildlife Service NSW and most of the remainder is owned by Centennial Airly. There are two freehold private properties in the Project Application Area, one being the Parr property on the southern fringe of the Project Application Area, and the second being the Wilkinson property in Airly Gap.

A schedule of land relevant to the Project Application Area is provided in **Appendix A**.

2.5 Land Uses

Land use in the vicinity of the Airly Mine consists of rural residential, grazing, underground coal mining, coal handling infrastructure, transport infrastructure, commercial forestry, recreation (including tourism) and nature conservation within the Mugii Murum-ban SCA and nearby National Parks (Capertee National Park and Gardens of Stone National Park. Centennial Coal owns a property known as 'Bernina' which extends from the Wallerawang-Gwabegar rail line in the east to the Castlereagh Highway in the west. The property is mostly cleared and used for cattle grazing. The nearest large urban centre is Lithgow, located approximately 40 km south-southeast from the Airly Mine pit top.

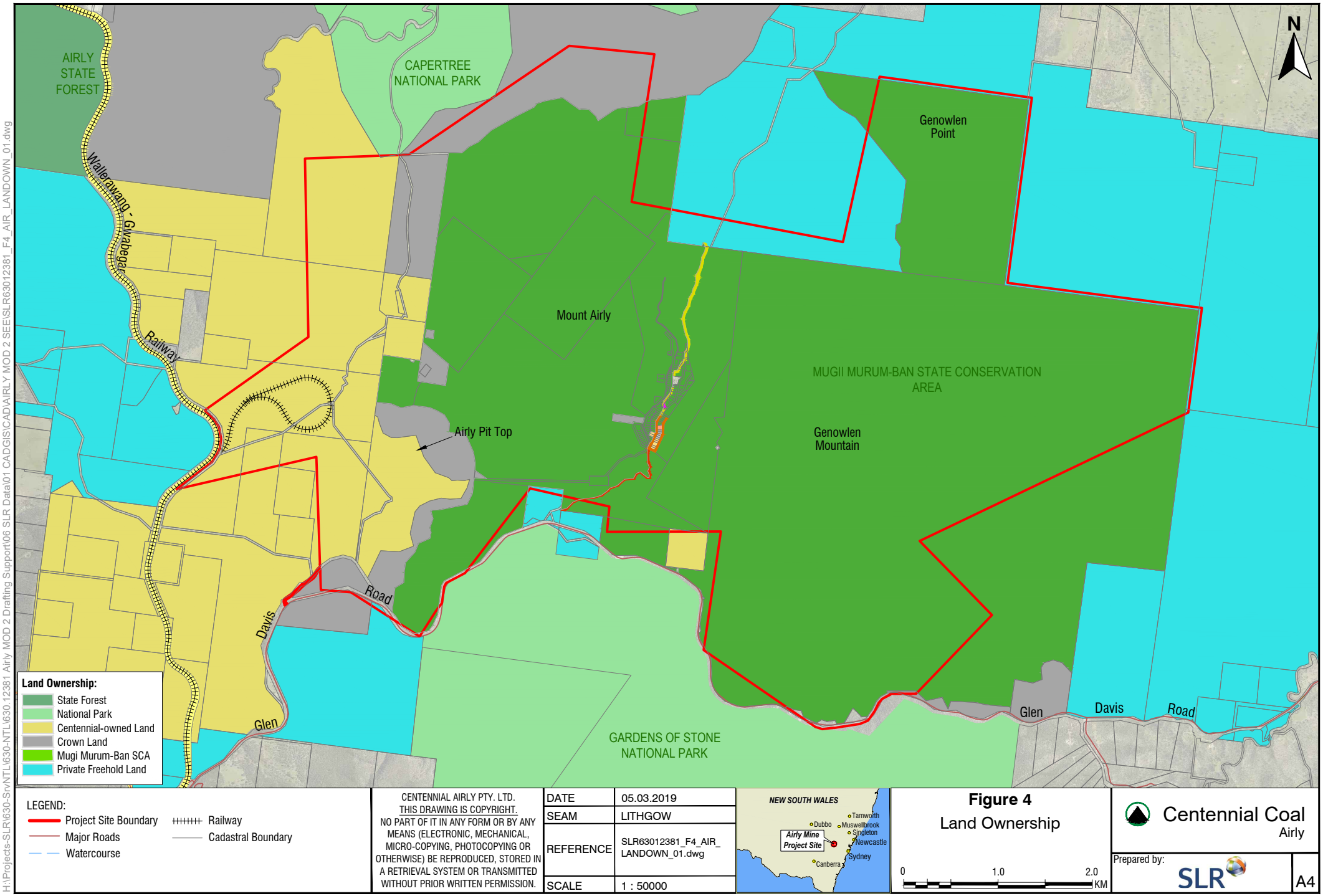
The majority of the Project Application Area consists of rugged unpopulated bush land including the Mugii-Murum-ban SCA.

Airly Mine pit top is 5 km northeast of Capertee and is within Capertee Valley. The Capertee Valley is known to have significant natural and historic heritage value. It is the world's second largest canyon being 1 km longer than the Grand Canyon, but not quite as deep. Visitors come to the area for environmental tourism (e.g. bird watching), four wheel driving, camping, bushwalking, photography. Bird watching in particular is an important attraction to the Capertee Valley. The valley is blessed with a remarkable diversity of birds, especially species that can be difficult to find in other areas. It's a stronghold for declining woodland birds, those species which have suffered most as a result of extensive clearing for agriculture throughout inland south-eastern Australia e.g. Regent Honeyeater. The bmbirding.com.au website states the Capertee Valley is home to more species of birds, than anywhere else in the Southern Hemisphere.

Historically, oil shale mining and associated petroleum production was an important land use in the vicinity, with large mining and industrial complexes at Glen Davis, Glen Alice and Newnes. The historical remains of these mines and works are significant tourist attractions.

The land use within the Project Application Area is dominated by the Mugii Murum-ban SCA, which covers 3,062 ha and is used for recreational and conservation. A portion of the Project Application Area (480 ha) is cleared of native vegetation and forms sections of grazing properties owned by Centennial Airly. Due to slope and soil type constraints, the areas cleared of native vegetation within the Project Application Area are not suited to cultivation; the current use of cattle grazing is the most suitable.

Two Centennial-owned properties are located in the Project Application Area. 'Carinya', located to the north of the surface facilities area, includes areas of cleared land used for cattle grazing although areas in the north of the property still predominantly contain native vegetation with high connectivity values. 'Airly' which is the property that encompasses the surface facilities area includes mostly cleared land and is also used for cattle grazing.



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SEAM	LITHGOW
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Figure 4
Land Ownership

Centennial Coal
Airly

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2.6 Topography

Airly Mine is characterised by steep and rugged topography, as well as lower lying, undulating areas. The topography is of the Project Application Area is dominated by Mount Airly to the west and Genowlan Mountain to the east. Site elevation varies from over 1000 m Australian Height Datum (AHD) to less than 750 m AHD in the south-eastern section of the site. The Airly Mine surface facilities area is located at the foot of Mount Airly at an elevation of about 780 m AHD.

2.7 Soils

The majority of the Project Application Area comprises the Hassans Walls Soil Landscape. There are 11 Soil Landscapes that exist within the Project Application Area. The dominant soil type is the Hassans Walls Soil Landscape, covering approximately 55% of the Project Application Area, followed by the Warragamba Soil Landscape at approximately 16%.

The Hassans Walls Soil Landscape consists of cliffs derived from Narrabeen Group sandstones and steep colluvial talus side slopes developed over the Illawarra Coal Measures and the Shoalhaven Group. Open forest and open woodland is associated with this landscape. This Soil Landscape is susceptible to erosion given its sandy basis and is generally unsuitable for cultivation or grazing due to severe limitations, however some gentler slopes and narrow drainage flats are capable of light grazing.

The majority of the Project Application Area comprises soils with low to moderately low inherent fertility. The one exception is the Mount Tomah Soil Landscape with moderately high inherent fertility, however, this Soil Landscape has limitations associated with steep slopes and mass movement, and covers a very small proportion of the Project Application Area.

2.8 Hydrology

Airly Mine lies within the Capertee River catchment, which is part of the Greater Hawkesbury/Nepean catchment.

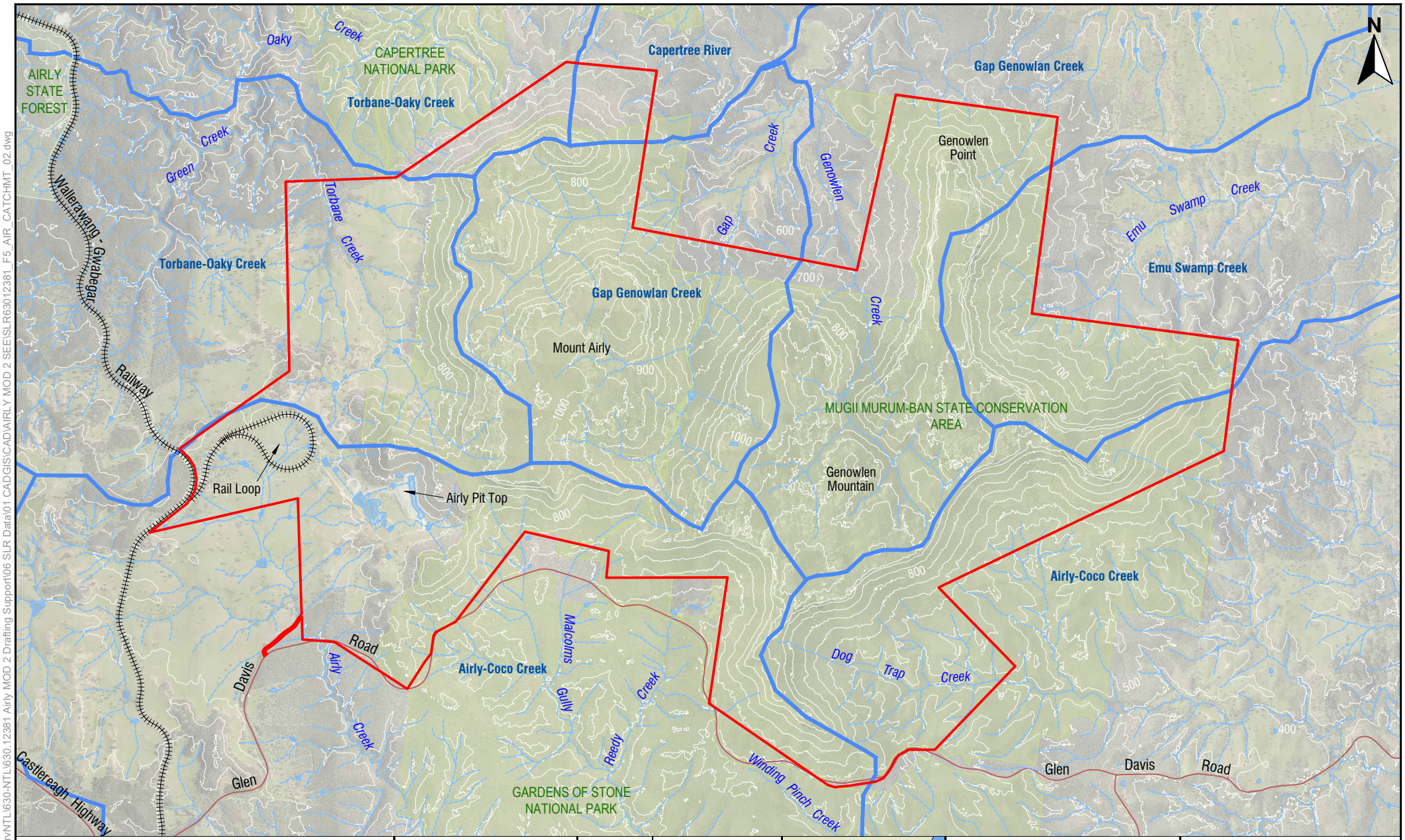
The Project Application Area has a dendritic drainage network which is divided into four sub-catchments (**Figure 5**) as follows:

- Torbane-Oaky Creek sub-catchment
- Airly-Coco Creek sub-catchment
- Gap-Genowlan Creek sub-catchment
- Emu Swamp Creek sub-catchment.

The Airly Creek system drains the southern sector of the site and flows into Coco Creek, which joins the Capertee River in the northeast direction from the mine approximately 17 km northeast of the surface facilities area. Sections of Airly and Coco Creeks flow through the Gardens of Stone National Park, however the Coco Creek and Capertee River confluence is not located with the Gardens of Stone National Park. The Capertee River flows in a south-east direction to its confluence with the Wolgan River to form the Colo River, which ultimately contributes to the Hawkesbury River and Broken Bay.

Surface runoff from a small area of the north-east of the site drains to Emu Swamp Creek, which flows in a north-east direction and joins the Capertee River approximately 10 km downstream.

Dog Tap Creek drains the southeast sector of the Project Application Area and is part of the Airly-Coco Creek sub-catchment.



LEGEND:

- Project Application Area
- Catchment Boundary
- Major Roads
- Watercourse
- Contour (50m interval)
- Railway
- State Forest
- National Park / State Conservation Area

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SEAM	LITHGOW
REFERENCE	SLR63012381_F5_AIR_CATCHMT_02.dwg
SCALE	1 : 50000



Figure 5
Catchment Areas

0 1.0 2.0 KM

Centennial Coal
Airly

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Surface runoff from the northern sections of the site drains into Gap Creek and Genowlan Creek. The two creeks, which are groundwater fed in parts, drain northwards approximately 2 km before converging into the greater Genowlan Creek. Genowlan Creek continues to drain in a northeast direction until its confluence with the Capertee River approximately 8 km downstream. The Gap-Genowlan Creek sub-catchment occupies the largest portion of the site, with 1558 ha draining to the creek system.

The north-west section of the site area is drained by the Torbane-Oaky Creek system. Torbane Creek joins Oaky Creek approximately 2 km downstream of the site.

All of the watercourses draining the Airly Mine Project Application Area are ephemeral. Generally, these watercourses flow for relatively brief periods following significant rainfall events. Flows within Airly Creek, Oaky Creek, Coco Creek and Genowlan Creek become perennial outside the development consent boundary.

2.9 Geology

The Airly Mine Project Application Area is located within the northern edge of the Western Coalfield of NSW, on the western edge of the Sydney Basin. The area is underlain by Triassic sandstone of the Narrabeen Group, which is underlain by the Permian Illawarra Coal Measures. Further, below the coal measures lie the Shoalhaven Group sedimentary rocks, which are in turn underlain by a range of metamorphic strata comprising quartzite, shales, sandstones, limestone and tuff. There are small patches of quaternary alluviums adjacent to Gap and Genowlan Creeks.

The Grose sandstone of the Triassic Narrabeen Group outcrops throughout the plateau and cliffs of Mount Airly and Genowlan Mountain, with small areas of Tertiary basalt outcrop at the higher elevations. The Triassic strata are up to 200 m thick.

The Permian Illawarra Coal Measures outcrop around the Triassic formations at lower elevations, including the zone between Mount Airly and Genowlan Mountain. The Lithgow Seam within the lower Illawarra Coal Measures is the target coal seam at Airly Mine. The seam outcrops completely within the site boundary and is therefore disconnected to the areas of occurrence of this seam located several kilometres to the south and north-west. The thickness of the Lithgow Seam ranges between 3 m and 4 m with an average thickness of 3.4 m.

The depth of cover above the Lithgow Seam ranges from less than 20 m in areas of outcrop and in the Gap Creek area, up to approximately 310 m. The seam dips gradually to the east at around 1 degree. The average thickness of the Permian overburden is 105 m.

Interbedded siltstone and sandstone of the older Shoalhaven Group outcrop across the surface facilities area and beyond the Airly Project Application Area boundary. Metamorphic rocks also outcrop beyond the site in areas of lower elevation.

2.10 Hydrogeology

Local and regional groundwater sources are both relevant to Airly Mine. There is minimal hydraulic connection between the local and regional groundwater sources given the highly differing water qualities between the various aquifers.

- *Alluvium and Quaternary strata*: Alluvium is the soil and loose rock material that is located at the surface and overlies the rock mass below. These provide baseflow to Gap and Genowlan Creeks (including The Grotto and The Oasis), potential habitat to vegetation and stygofauna groundwater dependent ecosystems (GDEs) and supply a small number of users along Genowlan Creek downstream of the Project Application Area.
- *Narrabeen Sandstone of the Triassic:* The local porous and fractured rock groundwater sources include the Narrabeen Sandstone and coal seams of the Illawarra Coal Measures. These sources are recharged by rainfall via fractures within overlaying strata, and seep out of

the side of the mountains or directly into watercourses. They comprise the local groundwater source within the Project Application Area and provide a potential habitat to stygofauna and feeds seepage areas/springs.

- *Illawarra Coal Measures of the late Permian*: Local groundwater sources within the Project Application Area that provides baseflow to Gap and Genowlan Creeks and feed seepage areas/springs such as the Village Spring.
- *Shoalhaven Group of the early Permian*: The upper regional groundwater source occurs within siltstone and sandstone of the Shoalhaven Group that underlies the Permian strata. This stratum lies approximately 5 m below the floor of the Lithgow Seam and is generally 100 – 150 m thick. This regional groundwater source supplies a small number of registered users, including Airly pit top.
- *Lower Devonian Metamorphic Strata*: Below the Shoalhaven Strata lies a 'highly productive' groundwater source within Devonian metamorphic strata containing shale, sandstone and limestone. Recharge areas occur to the north, south and east of the Project Application Area and groundwater flow is generally to the east. This fresh regional groundwater source provides the majority of registered groundwater users (Section 10.3.2) to the east of the Project Application Area.

The alluvium, Narrabeen Sandstone Triassic and Permian aquifer systems are defined as localised sources of groundwater because they are isolated from the surrounding land by virtue of being elevated above the valley floor in the Mount Airly and Genowlan Mountain structures. The Shoalhaven and Devonian aquifers are defined as regional groundwater sources due to them being connected to the broader land mass of the valley floor.

2.11 Climate

2.11.1 Temperature

Long term data (for 27 years from 1991 to 2018) from the Bureau of Meteorology (BOM) weather station Nullo Mountain (Station # 062100) is presented in **Table 1**.

Table 1 – Distribution of Temperature (^{o}C) – Nullo Mountain (BOM Station # 062100)

Temperature ^{o}C	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean maximum	24.2	22.9	20.2	16.8	12.9	9.6	9.2	10.9	14.3	17.5	20	22.4	16.7
Highest	36.4	37.4	32	27.7	21	16.8	17.3	20.6	26.4	28.1	34.2	32.7	37.4
Lowest maximum	11.7	10.6	9.3	4.1	1.4	1.3	0.2	1.9	4.6	4.9	7.5	9.6	0.2
Mean minimum	13.6	13.3	11.4	8.6	5.7	3.5	2.5	3	5.6	7.9	10.1	11.9	8.1
Lowest	4.4	3.8	2.9	-0.8	-2.2	-3.4	-3.6	-4.1	-3.7	-1.1	0.2	1.8	-4.1
Highest minimum	23.6	25.6	21.4	15.8	12.9	10.7	12	12.6	18.4	18.6	22.2	22.9	25.6

2.11.2 Rainfall

GHD (2019a) provides a rainfall analysis based on Scientific Information for Land Owners (SILO) database hosted by the Science Delivery Division of the Queensland Government's Department of

Environment and Science. SILO point data consist of interpolated estimates based on historically observed data from Bureau of Meteorology stations. This analysis for the period 1889 and 2018 shows the following:

- minimum annual rainfall was 347 mm (1982)
- average annual rainfall was 731 mm
- median annual rainfall was 721 mm
- maximum annual rainfall was 1530 mm (1950).

2.11.3 Evaporation

Evaporation varies seasonally, being higher in summer than in winter. There is also a similar, but less pronounced, seasonal variation in monthly rainfall totals. This seasonal variation is typical of the mild and cool temperature climate of the site (GHD, 2019).

2.11.4 Wind

A summary of the annual wind behaviour predicted by CALMET for the Airly pit top for the year 2014 (SLR, 2019) shows the predominant wind direction is seasonally dependent, with the seasonal wind roses indicating that:

- Summer winds blow from the east and east-southeast, with very few winds from the north and west
- autumn winds blow from the west-southwest
- winter winds are the strongest and the majority blow from between the south east-southeast and south, and between west-southwest and west directions
- spring winds blow from east and south directions, with very few winds from the north.

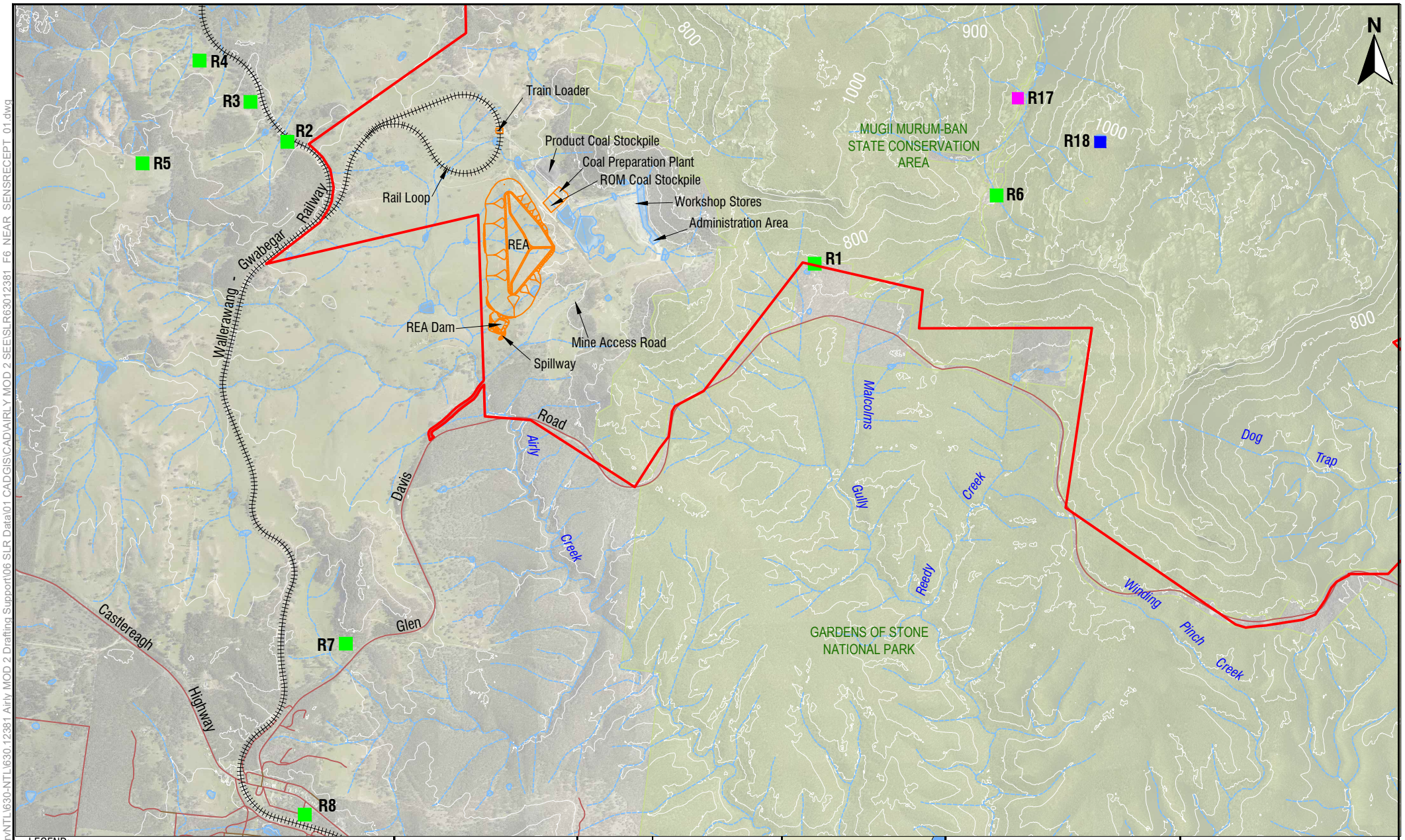
2.12 Sensitive Receptors

A number of sensitive residential receptors exist in the vicinity of the Project and these are shown in **Figure 6**. The residential receptors along Wallerawang-Gwabegar Rail Line in the vicinity of the Airly Rail Loop entrance with the potential to be impacted by the modification are identified are R2 – R5 in **Figure 6**.

The sensitive water receptors have been identified as:

- Airly Creek which is the receiving environment for discharges from the Airly Mine pit top water management system
- waterways downstream of Airly Creek (**Section 2.8**)
- licensed surface water users on Coco Creek (**Section 7.2.2.8**)
- aquatic ecology maintained in Airly Creek (**Section 7.2.2.9**).

The GDEs are likely to occur within the shallow alluvial aquifer zones, where groundwater levels are shallow and exist as moist sheltered gully forests. They are unlikely to be entirely groundwater dependent and are termed facultative ecosystems. The GDEs that may exist within the Project Application Area are not listed as high priority GDEs in the Water Sharing Plans (WSP). These GDEs will not be impacted by the modification.



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DATE	29.03.2019
SEAM	LITHGOW
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Figure 6
Nearest Sensitive Receptors

Centennial Coal
Airly

Prepared by: SLR

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2.13 Wallerawang-Gwabegar Rail Line Users

Airly Mine uses the Wallerawang-Gwabegar Rail Line to dispatch coal off site. The Airly rail loop joins the Wallerawang-Gwabegar Rail Line approximately 4 km north of Capertee. Airly Mine is approved to operate a maximum of 5 trains per day and an average of 2 trains per day in a calendar year. Trains arrive at the pit top from the south, and coal laden trains travel to the south on the Wallerawang-Gwabegar Rail Line.

The Wallerawang-Gwabegar Rail Line is currently not operated to a fixed timetable. It is reported that the section from Kandos to Torbane is currently unused, although there are plans to operate occasional tourist trains from Rylstone to Kandos, and possibly onto Lithgow.

3 APPROVED OPERATIONS

3.1 Overview of Approved Operations

Airly Mine was originally granted development consent DA 162/91 for the Airly Coal Project by the then Minister for Planning on 14 April 1993 pursuant to Section 4.59 (previous Section 101) of the EP&A Act for a period of 21 years. The development consent was modified on six occasions and its expiry date was extended to 31 January 2017. This consent was surrendered on 31 January 2018, in accordance with Condition 10 under Schedule 2 of State significant development consent SSD 5581.

The consent SSD 5581, that Airly Mine currently operates under, was granted on 15 December 2016 in accordance with the Section 4.38 (previous Section 89E) under Part 4 Division 4.7 (previous Division 4.1) of the EP&A Act by the then NSW Planning Assessment Commission. The consent allows mining until 31 January 2037. The supporting document for SSD 5581 is the *Airly Mine Extension Project Environmental Impact Statement* (AMEP EIS) (Golder Associates, 2014a), which describes in detail the operations approved under the consent. SSD 5581 incorporates the operations approved under the DA 162/91 as modified. In summary, SSD 5594 allows Airly Mine to:

- extract up to 1.8 Mtpa of ROM coal from the Lithgow seam underlying the Project Application Area using underground mining techniques
- develop underground access roadways and extract coal using partial extraction methods within the ML1331 and the A232 area
- use various partial extraction mining methods that will manage subsidence not to exceed 125 mm in previously unmined areas and minimise further potential subsidence impacts in areas where the historical New Hartley Shale Mine has already impacted the environment
- operate and maintain the existing ancillary surface infrastructure for mine access, underground ventilation, electricity, water, materials supply, and communications at the pit top, and upgrade this infrastructure as required for mining operations
- handle ROM coal through a crushing and screening plant at the pit top for transfer to the existing and proposed stockpiles as required to meet market demands
- complete the construction of the coal handling and preparation plant (CHPP) through construction of a Coal Preparation Plant (CPP) and associated overland conveyors, required for the beneficiation of ROM coal
- use the existing and new overland conveyor systems for the transfer of ROM and product coal from the underground to the CPP and coal stockpiles prior to despatch to offsite locations
- construct a life of mine reject emplacement area (REA) for the co-disposal of reject materials from the CPP
- use the existing water storage dams at the pit top to meet operational water demands
- construct an appropriately sized new water management dam and an associated licensed discharge point (REA LDP) for the proposed life of mine REA
- dispatch ROM and product coal off site using the existing rail load out facilities for the export and domestic markets
- undertake exploration, predominantly borehole drilling, to further refine the existing geological model
- operate 24 hours per day and seven days per week
- provide employment to a full time workforce of up to 135 full time employees and 20 contractors

- progressively rehabilitate exploration boreholes and disturbed areas at the pit top no longer required
- undertake life-of-mine rehabilitation at the pit top disturbance areas to create final landforms commensurate with the surrounding areas.

3.2 Existing Approvals

3.2.1 Approvals

Airly Mine operates under the development consent SSD 5581 and EPBC 2013/7076 Approvals outlined in **Table 2**.

Table 2 – Approvals

Reference	Description	Issued by	Issue Date	Expiry Date

SSD 5581	State significant development consent permitting:
	• Annual production limit of 1.8 Mtpa ROM coal
	• Consent life of 20 years from date of commencement
	• Operations 24 hours per day, 7 days per week
	• Employment of 155 full time equivalent personnel including up to 20 contractors
	• Surface operations comprising:
	  ○ Coal handling, processing and stockpiling
	  ○ Mine ventilation
	  ○ Underground mine access
	  ○ Ancillary infrastructure
	  ○ Reject material emplacement
	  ○ Water management
	  ○ Waste management
	• Coal transportation off site to domestic markets and export using rail
	• Land preparation
	• Rehabilitation – progressive and life of mine
	• Exploration activities.
		NSW Planning Assessment Commission	15 December 2016	31 January 2037

EPBC 2013/7076	To expand underground mining operations at the existing Airly Mine near Capertee in the Western Coalfields of NSW.	Department of the Environment and Energy	18 May 2017	31 March 2047

3.2.2 Other Regulatory Requirements

Airly Mine has a number of other approvals, licences and permits as listed in **Table 3**.

Table 3 – Approvals and Licences

Type	Approval Number	Regulatory Authority	Issue Date	Details
Mining Operations Plan (01 January 2018 – 31 December 2024)	N/A	Department of Planning and Environment (Division of Resources and Geosciences)	January 2018	The objectives of the MOP are to meet requirements of statutory guidelines for reporting on operational activities at Airly Mine. The MOP satisfies the requirements of a Rehabilitation Management Plan, required by Condition 29 under Schedule 4 of SSD 5581.
Environment Protection Licence	EPL 12374	NSW EPA	12 December Anniversary Date	EPL 12374 authorises the mining for coal up to 2,000,000 tpa, and coal works up to 2 Mtpa. The EPL also limits water discharge quality. Monitoring is undertaken in accordance with the licence and results reported to the EPA via an *Annual Return*. The EPL is renewed annually on 12 December.
Consent	N/A	National Parks And Wildlife Service	07/07/2016	Drilling of coal exploration boreholes In Mugii Murum-ban State Conservation Area
Licence for Minor Works and Occupation	BMB 18-11	National Parks And Wildlife Service	24/09/2018	Subsidence monitoring activities within Mugii Murum-ban State Conservation Area
Extraction Plan – Cliff Line Zone of First Workings	N/A	Department of Planning and Environment (Division of Resources and Geosciences)	16/10/2017	Extraction Plan for the Cliff Line Zone of First Workings, approved on 16/10/2017 and reviewed annually
Extraction Plan – Quartering and Splitting	N/A	Department of Planning and Environment (Division of Resources and Geosciences)	30/08/2018	Extraction Plan for Quartering and Splitting in Trial Mining Area (Panels 206 & 207) granted on 30/08/2018 and reviewed annually
Onsite Sewage Management System (Ecomax)	Ref. 105413	Lithgow City Council	18/08/2018	Approval to operate the Ecomax onsite sewage management system
Groundwater Licences	Water Access Licence (WAL) 24386	Department of Industry – Water	17/02/11	In perpetuity for the extraction of groundwater (volumetric limit of 158 ML/annum) from the Sydney Basin North Water Source

Type	Approval Number	Regulatory Authority	Issue Date	Details
	WAL 36565	Department of Industry – Water	16/10/13	In perpetuity for the extraction of groundwater (volumetric limit of 120 ML/annum) from the Sydney Basin North Water Source
Groundwater monitoring licences	10BL604518	Department of Industry – Water	14/02/2011	In perpetuity for monitoring bore ARP01
	10BL604520	Department of Industry – Water	14/02/2011	In perpetuity for monitoring bores ARP02A and ARP03A
	10BL604521	Department of Industry – Water	14/02/2011	In perpetuity for monitoring bores ARP04 and ARP05
	10BL605352	Department of Industry – Water	28/03/2013	In perpetuity for monitoring bores ARP06, ARP07, ARP08, ARP09
	10BL605794	Department of Industry – Water	19/08/2016	In perpetuity for monitoring bore ARP11
	10BL605793	Department of Industry – Water	17/08/16	In perpetuity for monitoring bores ARP12, ARP13, ARP13SP, ARP14, ARP15, ARPSP

3.2.3 Mining Tenements

The relevant mining tenements for Airly Mine are provided in **Table 4.**

Table 4 – Mining Tenements

Reference	Title Holder	Grant Date	Expiry Date	Area (ha)
ML1331	Centennial Airly Pty Limited	12/10/93 Renewed 8/5/2014	12 October 2035	2745
A232	Centennial Airly Pty Limited	1980 Renewed 03/06/10 Renewed 21/5/2015	20 October 2019	3054
MLA559	Centennial Airly Pty Limited	Application submitted on 25 May 2018		

3.3 Existing Operations

3.3.1 Project Life

Airly Mine is approved to carry out mining operations for a period of 20 years from the date of commencement (31 January 2017) with rehabilitation to be undertaken after the 20 years of mining. The expiry date for mining operations is 31 January 2037.

3.3.2 Hours of Operation

Airly Mine is approved to undertake mining operations 24 hours a day, 7 days a week.

3.3.3 Employment

The approved workforce number is a total of 155 full time equivalent (FTE) personnel comprising to up to 135 full time employees and 20 contractors.

3.3.4 Site Access

The Airly Mine pit top is accessed via the Mine Access Road, off Glen Davis Road, approximately 3 km from Capertee village.

3.3.5 Coal Production Rate

The maximum ROM production limit is 1.8 million tonne in any calendar year.

3.3.6 Mining Method, Mining Area and Mine Schedule

Airly Mine is an underground mine using a combination of first workings and partial extraction mining methods. The mine is not approved to a fixed mine plan over the entire mining area due to the flexible nature of the first workings, partial pillar extraction and panel and pillar mining methods approved in the Project. The mining area is divided into mining zones of varying mining systems to engineer the desired subsidence level for each zone. The mining area is divided into five mining zones described below, and shown in **Figure 7**.

- **Panel and Pillar Zone**: This is the plateau area with cover depths of >160 m. The maximum void width is 61 m and highly sub-critical. Long term stable pillars are to be left between the voids to limit the level of subsidence. This zone covers the majority of the mining area.
- **Cliff Line and First Workings Zone**: This is an area of first workings defined by setback of 30 m from both the crest and toe of the cliffs. In the vicinity of the cliffs affected by subsidence due to previous oil shale mining the setback from the crest is defined by half the depth of cover.
- **Partial Pillar Extraction Zone**: This zone extends from the Cliff Line Zone to typically the 100 m depth contour and is the zone of partial pillar stripping, creating limited spans (15.5 m to 25.5 m) and leaving long- term stable pillars remaining to provide overburden support.
- **Shallow Zone**: This is also a zone of first workings between the 100 m and 20 m depth of cover contours.
- **New Hartley Shale Mine Potential Interaction Zone**: First workings only (subsidence <20 mm) are allowed in this zone.

The maximum subsidence effects for the four mining zones with approved subsidence >20 mm are included in **Table 5**.

Table 5 – Maximum Subsidence Effects for the Approved Mining Zones (excluding New Hartley Shale Mine Potential Interaction Zone)

Parameter	Cliff Line and First Workings Zone	Panel and Pillar Zone	Partial Pillar Extraction Zone	Shallow Zone
Vertical subsidence (mm)	65	106	65	25.5
Tensile strain (mm/m)	0.3	1	1.1	0.4
Compressive strain (mm/m)	0.5	2	1.9	0.6
Tilt (mm/m)	1.1	3	2.6	1.1
Fractured zone height (metres above seam)	<10	70	35	<10

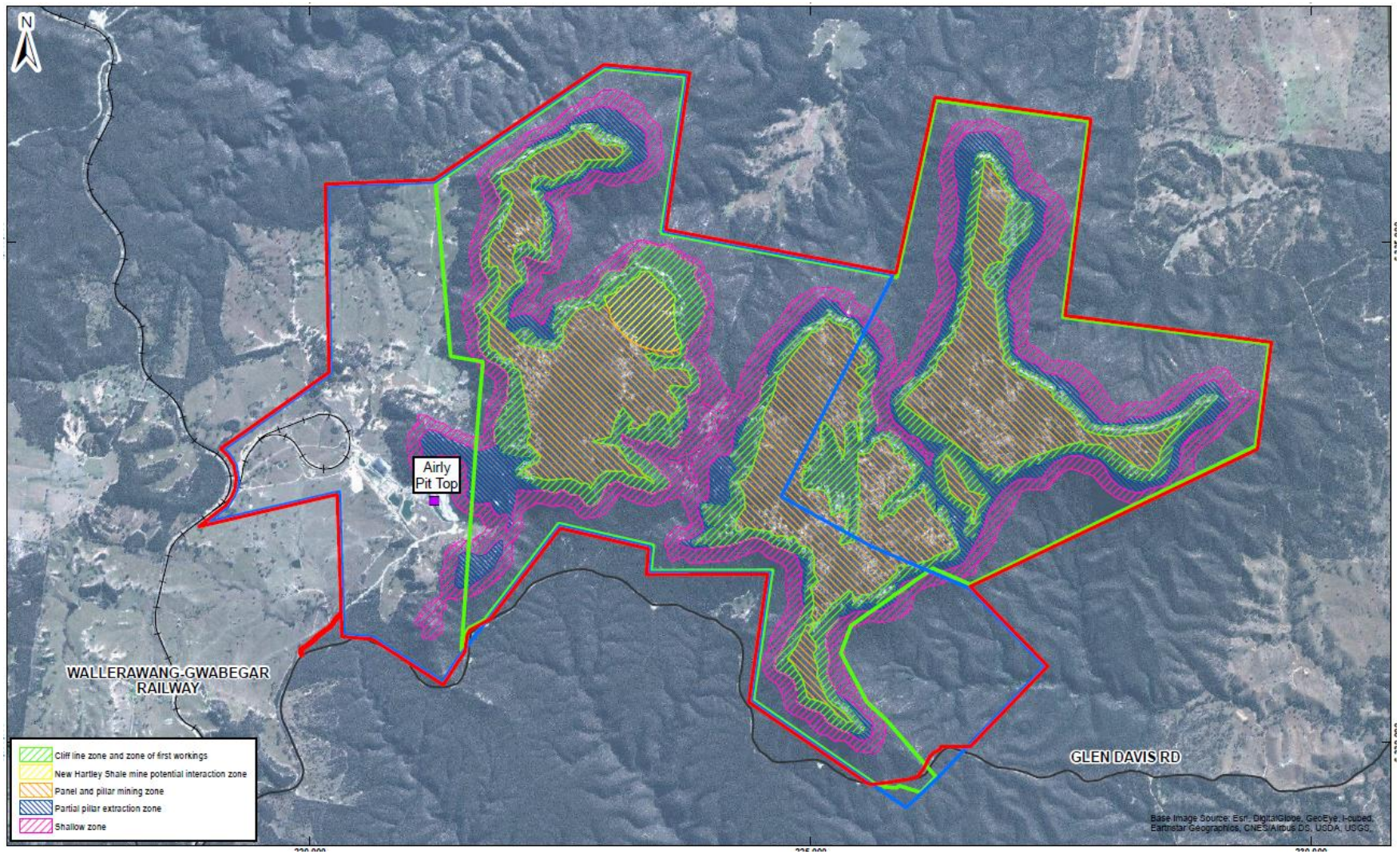


Figure 7 – General Layout of Mining Zones

Over the majority of the mining area (excluding the New Hartley Shale Mine Potential Interaction Zone) maximum subsidence will be managed to 125 mm, maximum tensile strain to 2 mm/m, maximum compressive strain to 2 mm/m, and maximum tilt to 3 mm/m. No surface cracking is expected for these zones.

The consent SSD 5581 places the following **restrictions on mining** (Schedule 3 Condition 1) following approval of Airly MOD 1 in August 2018.

"The Applicant must not carry out any second workings:

a) in the Panel and Pillar Zone within an angle of draw of 26.5 degrees of the crest of any cliffs identified in the Cliff Line Zone of First Workings before at least four adjacent extraction panels in the Panel and Pillar Zone beneath Mount Airly have been completed

b) in the Partial Pillar Extraction Zone within an angle of draw of 26.5 degrees of the toe of any cliffs identified in the Cliff Line Zone of First Workings before it has completed the Trial Mining Area in Panels 206 and 207 as shown in Appendix 11 of SSD 5581

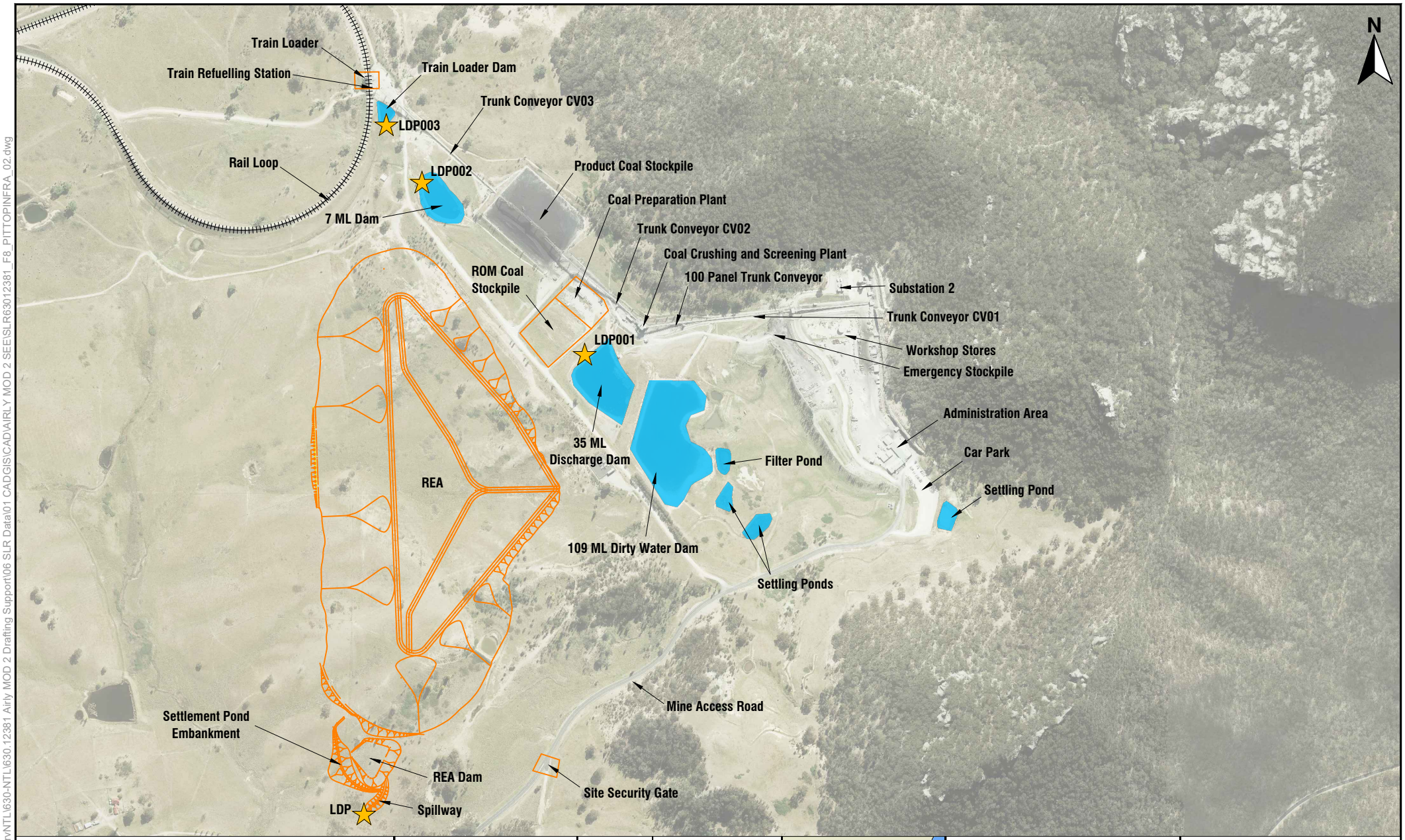
c) within an angle of draw of 26.5 degrees plus 50 metres of the limit of the New Hartley Shale Mine workings."

The 20 year mine schedule is appended to the SSD 5581 consent as Figure 3 in Appendix 3. Mining has continued from the existing workings in the west, and has to date progressed generally eastwards under Mount Airly, Gap Creek and Genowlan Mountain.

3.3.7 Surface Infrastructure

The Airly Mine pit top infrastructure (**Figure 8**) comprises mine support facilities that support surface and underground operations, as follows:

- Site access road and car park
- Underground mine access and associated infrastructure
- Coal handling, stockpiling and coal transport infrastructure
- Rail Loop
- Bath house facilities
- Onsite sewerage system (Ecomax)
- Ventilation facilities
- Workshop, services and administration infrastructure, telecommunications systems
- Underground water management
- Surface water management systems including separation of dirty and clean water flow paths.



LEGEND:
- Proposed Licensed Discharge Point
- Railway
- Surface Water Storage
- Infrastructure (not constructed)

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Figure 8
Pit Top Infrastructure

0 200 400 M

Centennial Coal
Airly

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3.4 Coal Handling, Stockpiling, Processing

3.4.1 Coal Handling

The coal handling at the site is undertaken using a system of surface and underground conveyors with the capability of operation at 500 tonne per hour. The system of conveyors (when fully constructed) will allow ROM coal to be transferred from the underground to the Product Coal Stockpile and the ROM Coal Stockpile in the vicinity of the Coal Preparation Plant (CPP) when the CPP is constructed and the ROM Coal Stockpile has been established.

In the event the Product Coal Stockpile becomes full, coal from the underground conveyor system is currently placed on the ROM Emergency Stockpile by truck and front end loader. When the Product Coal Stockpile level falls sufficiently, the diverted coal from the ROM Emergency Stockpile is fed back onto the surface conveyor using a front-end loader. There is no facility to divert coal directly from the underground conveyor to the ROM Emergency Stockpile.

3.4.2 Coal Stockpiles

Three stockpiles are approved at the pit top as follows:

- a 30,000 tonne ROM Emergency Stockpile
- a 200,000 tonne Product Coal Stockpile
- a 40,000 tonne ROM Coal Stockpile (not yet established) in the vicinity of the CPP.

3.4.3 Coal Processing

A CPP with a processing capacity of 500 tonne per hour with water recycling facility is approved but is not constructed.

3.5 Coal Transport

All coal is transported from Airly Mine by rail. Coal from the Product Coal Stockpile is reclaimed via a reclaim tunnel onto a conveyor, which transfers coal to the rail bin from which coal is loaded into trains for transport off site to domestic and overseas markets.

3.6 Reject Materials Management

A co-disposal reject emplacement area (REA) for the management of both fine and coarse reject materials from the CPP is approved, however has not been constructed to date. The approved REA will, when constructed, have an associated REA Dam and a new licensed discharge point.

3.7 Underground Water Management

Airly Mine operates a mine dewatering system, comprising pipelines, underground impoundment dams and pump stations, to pump mine inflows from the underground to the 109 ML Dirty Water Dam for storage and subsequent use as process water. A series of pipelines also exist to transfer process water underground.

3.8 Surface Water Management

The water management structures at the pit top allows for the separation and storage of clean and dirty water and provide process water for operations. Sources of water at the site include:

- direct rainfall onto storages and catchment runoff
- external water supply (for bathhouse and amenities)
- groundwater inflows to the underground workings

- the Production Bore.

The water management structures comprise:

- a series of concrete lined clean and dirty water diversion drains
- a number of small coarse settling ponds for trapping coarse sediment located near the car park and in the vicinity of the 109 ML Dirty Water Dam
- dirty water dams comprising the 109 ML Dirty Water Dam and a 7 ML Dam into which overflows from the Product Coal Stockpile and a Train Loader Dam where fine sediments settle out
- a 35 ML Discharge Dam used for the storage of clean / settled water, and which overflows via LDP001 into Airly Creek. It receives surface run-off from non-disturbed areas and either overflow or piped water fed by gravity from the 109 ML Dirty Water Dam following de-silting.

The primary water demands are for underground mining operations, surface dust suppression, machinery washdown, fire-fighting storage and staff amenities, and the approved CPP.

The layout of the existing surface water management system is shown in **Figure 8**, including the concept design of the approved REA, the REA Dam and an associated licensed discharge point (REA LDP).

3.8.1 Clean Water Management

Surface water runoff from areas where there is no coal storage, transportation, handling or processing or any disturbance is considered to be clean water, as it is unlikely to be contaminated with coal fines or sediment. Runoff is diverted around dirty water and coal-contact catchments to avoid mixing (**Figure 8**). The clean surface water management system diverts runoff from natural (undisturbed) and impervious catchments, such as areas of vegetation, sealed roads and sealed car parks.

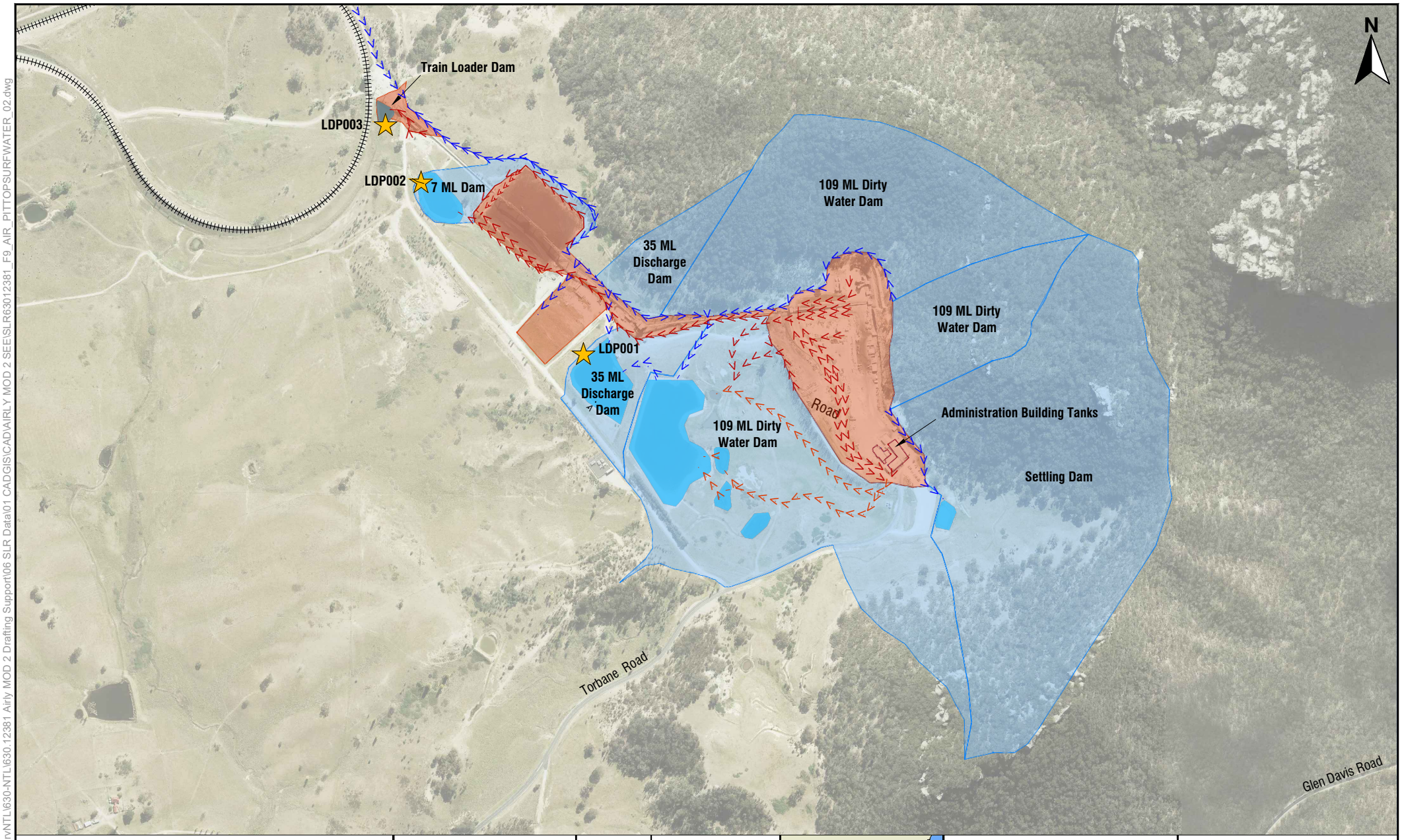
The 35 ML Discharge Dam is the main clean water storage at Airly Mine. The dam receives surface water runoff from the northern perimeter clean water drainage system and piped transfers and overflows from the 109 ML Dirty Water Dam. Water is supplied to the Process Water Tank from the 35 ML Discharge Dam. Overflows from the dam discharge through LDP001 to Airly Creek.

3.8.2 Dirty Water Management

Dirty water is runoff from disturbed areas and areas likely to contain suspended sediment, oils, grease and hydrocarbons. This typically includes workshop and fuel storage areas. Coal-contact water is runoff from catchments where coal storage, transportation, handling or processing occurs and is managed within the dirty water management system.

The dirty water management structures at Airly Mine (**Figure 8**) form the basis of sediment control at the site. Dirty water runoff (coal-contact and sediment-laden water) is managed by a number of dirty water storages which enable suspended solids to settle out of the water column. Small primary dams trap coarse sediment, which overflow into the 109 ML Dirty Water Dam where fine sediments settle. The dirty water management structures are regularly de-silted to maximise available storage capacity.

Sediment-laden water from the eastern hardstand area is directed via diversion bunds to an active filter pond, where it is managed and released to the 109 ML Dirty Water Dam if capacity is available.



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LEGEND:

- Proposed Licensed Discharge Point
- Railway
- Surface Water Storage
- Clean Water Diversion
- Dirty Water Diversion
- Clean Water Catchment
- Dirty Water Catchment

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SEAM	LITHGOW
REFERENCE	SLR63012381_F9_AIR_PitTopSWMS_02.dwg
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Figure 9

Pit Top Surface Water Management System

0 200 400 M

Centennial Coal
Airly

Prepared by: SLR

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3.8.3 Licensed Discharge Points

Airly Mine operates under Environment Protection Licence (EPL) 12374. Three licensed discharge points are included in EPL 12374 as follows (**Figure 8**):

- LDP001 (located on the 35 ML Discharge Dam)
- LDP002 (located on the 7 ML Dam)
- LDP003 (located on the Train Loader Dam).

Limits on water quality of discharges through LDP001 to LDP003 are stipulated in EPL 12374.

3.9 Water Flow and Quality Monitoring

Water flow and quality monitoring is undertaken in accordance with the *Airly Water Management Plan* being art of the *Western Region Water Management Plan* (Centennial Coal, 2018b). **Figure 9** shows the monitoring locations for both flow and water quality monitoring.

As per EPL12374, water quality monitoring is undertaken monthly during discharges at LDP001, LDP002 and LDP003 for electrical conductivity (EC), pH, total suspended solid concentration (TSS), and oil & grease.

Water quality monitoring sites comprise sites at the pit top as well sites for Gap Creek and Genowlan Creek. Continuous flow monitoring is undertaken at LDP001, Gap Creek and Genowlan Creek. A V-notch weir is planned to be installed at the Genowlan Creek 2 site in 2019, to provide continuous flow monitoring.

The water quality assessment in this SEE (**Section 7.2.2.2**) utilised water quality data from the following monitoring locations:

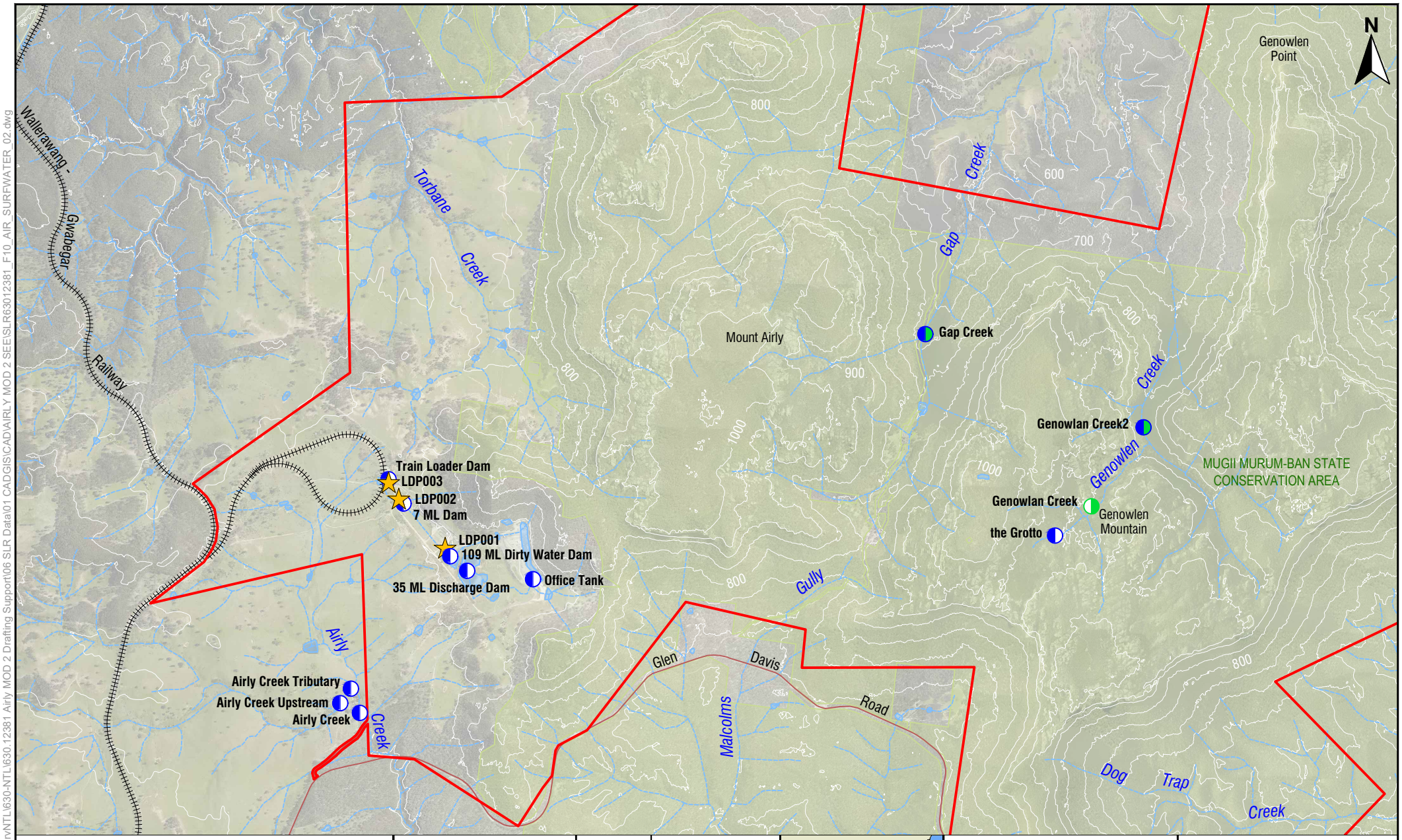
- Airly Creek Upstream – located on Airly Creek upstream of Airly Mine surface facilities area
- Airly Creek – located downstream of Airly Creek Upstream monitoring site and the Airly Mine surface facilities area
- 35 ML Discharge Dam – the main clean water storage for Airly Mine surface facilities area. Overflows from the dam discharge through LDP001 to Airly Creek.

Statistical summary of the water quality data (10^{th} percentile, median and 90^{th} percentile) and associated time series graphs from these locations are provided in Appendix D of the Surface Water Assessment (GHD, 2019a) prepared for this SEE.

3.10 Process Water

Process water, used to meet operational requirements, is obtained in priority order from the following sources:

- **Mine inflows** (when available)
- **Surface dams** comprising the 35 ML Discharge Dam which receives surface run-off and settled water from the 109 ML Dirty Water Dam
- **Production Bore** (WAL 24386) is licensed to pump water up to 158 ML per annum (**Table 4**).



LEGEND:

- Project Application Area
- Flow Monitoring
- Flow and Water Quality Monitoring
- Water Quality Monitoring
- Major Roads
- Watercourse
- Railway
- National Park / State Conservation Area

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0 0.75 1.5 KM

Figure 10

Surface Water Monitoring Locations

Centennial Coal
Airly

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As noted in **Section 1.6.1**, the seepage of groundwater into the underground workings has been reported to be negligible generally. The seepage has not been sufficient to require regular mine dewatering. Monitoring data to date indicates that groundwater inflows and additional process water used in underground operations is entrained in the ROM coal. As a result, to date no groundwater inflows are available to be reclaimed and reused as process water.

Clean water from the 35 ML Discharge Dam is pumped into the Process Water Tank (part of the water management facility) located on the pit top hard stand area. Process water is distributed via pipeline for dust suppression and fire-fighting supply to both underground and surface facility areas.

Extraction from the Production Bore, other than for monitoring purposes, commenced in 2017, with approximately 21 ML extracted during the latter part of 2017. In 2018, the maximum actual extraction rate achieved from the bore was limited to 2 L/s, with a total of 39 ML extracted through the year. Water from the production bore was initially pumped to the 109 ML Dirty Water Dam, then by gravity pipeline to the 35 ML Discharge Dam and then pumped to the process water tank within the water management facility.

As noted in **Section 1.6.1**, water from the production bore cannot be relied on as a sustainable source of water from the site. In late 2018, the average flow rate reduced to below 0.8 L/s, and has continued to decrease over time. The actual extraction rates achieved are considerably less than the sustainable yield of the bore calculated from the pumping tests undertaken at the time of installation, which were the basis for the water supply works approval limit of 5 L/s and by the WAL 24386 of 158 ML/year.

Water from the Production Bore and onsite storages will continue to be used at the site, if available.

3.11 Amenities and Wastewater Management System

As Airly Mine is not connected to a municipal water supply, drinking water is supplied by bottled water. Water for amenities is harvested from the rooftops of the administration and facilities buildings and supplemented by trucked water. Wastewater from the administration buildings and bathhouse is directed to the Ecomax effluent treatment system for disposal via soil infiltration.

3.12 Waste Management

3.12.1 Production Waste

No production waste comprising reject materials from ROM coal beneficiation is generated at Airly Mine as the CPP has not been constructed.

3.12.2 Non-Production Waste

Waste management at Airly Mine is managed in accordance with the MOP with all potentially hazardous material stored and/or bunded appropriately in accordance with relevant standards. A waste management and recycling strategy is currently implemented and Airly Mine has a contract with JR Richards for waste disposal.

3.13 Environmental Management

Airly Mine operates under an Environmental Management Strategy (EMS) (Centennial Coal, 2018c) developed to adhere to Centennial Coal's Environmental Policy. The Centennial Coal Environmental Policy promotes environmental awareness and is designed to minimise impacts and thus manage its operations in a sustainable manner.

The EMS incorporates a number of Environmental Management Plans (EMPs) designed to assist in meeting community expectations and regulatory conditions, including the conditions of the EPL 12374.

The current EMPs are as follows:

- Airly Mine Extraction Plan and associated management plans

- Airly Mine Noise Management Plan
- Airly Mine Air Quality and Greenhouse Management Plan
- Airly Mine Water Management Plan, comprising:
  - Site Water Balance
  - Surface Water Management Plan
  - Groundwater Management Plan
- Airly Mine Biodiversity Management Plan
- Airly Traffic Management Plan
- Airly Mine Historic Heritage Management Plan
- Airly Mine Aboriginal Cultural Heritage Management Plan
- Exploration Activities and Minor Surface Infrastructure Management Plan
- Rehabilitation Management Plan (Mining Operations Plan)

3.14 Rehabilitation and Final Landform

Rehabilitation activities at Airly Mine are undertaken in accordance with the Mining Operations Plan (01 January 2018 – 31 December 2024). The MOP has been prepared in accordance with the Department of Industry – Division of Resources and Energy (DRE) publication titled *ESG3: Mining Operations Plan (MOP) Guidelines* (Division of Resources and Energy, 2013).

The MOP has been prepared to address the requirements of the Rehabilitation Management Plan (Condition 29 under Schedule 4) in SSD 5581, and Condition 3 of ML1331.

Since Airly Mine is an underground mine, the relatively small disturbance footprint associated with surface infrastructure means that there are limited opportunities for progressive rehabilitation. However, progressive rehabilitation to the extent that is appropriate, is undertaken in areas in areas that cease to be used for mining or mining related activities. These activities are undertaken as soon as is reasonably practicable.

The progress of any rehabilitation works at Airly Mine is reported annually in the *Annual Return* by 31 March of each year, as required to meet the requirements of Condition 3 under Schedule 5 of SSD 08_0211, and in accordance with the *Post-approval requirements for State significant mining development – Annual Review Guideline* (DPE, 2015). The *Annual Review* is submitted to regulators and made available to the community via Airly Mine's website.

4 PROPOSED MODIFICATION

4.1 Overview

Centennial Airly Pty Limited is proposing a modification to Airly Mine's consent SSD 5581 to receive up to 170 ML/year of water at the Airly Mine pit top from Charbon Colliery using rail transport. The 170 ML/year water corresponds to the process water deficit identified in the site water balance in a dry year for the approved activities in SSD 5581 consent. The reasons for the identified deficit are provided in **Section 1.6**.

The proposed modification elements are:

- importation of up to 170 ML/year of water from Charbon Colliery by rail
- minor amendments to existing water management system at the pit top to allow discharge of water from the trains to existing onsite storages.

The proposed modification will facilitate mining at Airly Mine at the approved level. It is proposed to operate one water laden train per day in the water transfer scheme to allow the transfer of up to 170 ML/year of water. However, trains will be operated on an as needs basis. Fewer trains may be operated for the deficit forecast on average, while in a wet year the water transfer scheme may not be operated regularly because no deficit has been forecast.

The SSD 5581 Project Application Area boundary will remain unchanged and no major changes to the site infrastructure will be required. The existing water management will not change. Surface water harvested from the site and water available from the Production Bore will continue to be utilised as process water prior to importing additional water from Charbon Colliery.

Hours of operations are not proposed to change from the approved 24 hours per day and seven days per week.

The approved train movements comprising 5 maximum train movements per day and an average of 2 train movements in a calendar year will not change. The proposed one water laden train per day to arrive at Airly pit top will fall within the limits of train movements approved in SSD 5581.

4.2 Proposed Modification Details

Table 6 summarises and compares the relevant components of the operations approved under SSD 5581, and the operations that are proposed to be modified. Those operations that are subject of this SEE are discussed in more detail below.

4.2.1 Rail Loop and Train Movements

Airly Mine is approved to operate a maximum 5 trains per day and an average of 2 trains per day in a calendar year. As discussed in **Section 2.13**, trains arrive at the pit top from the south along the Wallerawang-Gwabegar Rail Line, and coal laden trains leave the site from the rail loop to head towards the south to reach final destinations. In the modification, there is no proposal to increase the number of train movements, however the modification is proposing to operate 1 train per day from Charbon Colliery along the Wallerawang-Gwabegar Rail Line arriving at the Airly pit top from the north. The train movement could occur either in the day or the night period. Trains for the transport of coal off site from the pit top will take precedence over trains from Charbon Colliery transferring water to the pit top.

Table 6 – Key Features of the Proposed Modification and Comparison with Approved Operations

Key Feature	Description of Approved Operations	Proposed Change
Project Life	20 years from date of commencement (31 January 2017) with expiry date of 31 January 2037.	• No change
Development Consent Boundary	Corresponds to Mining Lease ML1331 and Authorisation 232 (A232) boundaries (**Figure 2**) with a total area 3,982 ha.	• No change
Hours of Operation	24 hours per day, 7 days per week	• No change
Employment	155 FTE personnel including contractors	• No change
Mining Method and Mining Area	Underground mining using a combination of first workings and partial extraction mining methods, with restrictions in mining and subsidence levels (**Section 3.3.6**). • Panel and Pillar Zone • Cliff Line and First Workings Zone • Partial Pillar Extraction Zone • Shallow Zone • New Hartley Shale Mine Potential Interaction Zone.	• No change
ROM Coal Production	1.8 Mtpa	• No change
Coal Handling, Stockpiling and Processing	• A system of surface and underground conveyors constructed to operate at 500 tonne per hour. • Three coal stockpiles: o a 30,000 tonne ROM Emergency Stockpile o a 200,000 tonne Product Coal Stockpile o a 40,000 tonne ROM Coal Stockpile (not yet established) in the vicinity of the CPP. • A CPP (processing capacity of 500 tonne per hour with water recycling facility) is approved but is not constructed.	• No change
Coal Transport	• Rail transport of coal to domestic power stations and for export. • Average of 2 trains per day or maximum 5 trains per day on the Wallerawang-Gwabegar Rail Line	• No change to the number of train movements, but proposal to operate 1 water laden train per day arriving on the Wallerawang-Gwabegar from the north.
Reject Management	• Co-disposal REA (5.3 Mm^3 capacity) for emplacement of fine and coarse reject materials (approved, not constructed). • Reject materials to be hauled from CPP to REA using trucks (approve, not operated). .	• No change
Site Access	Mine Access Road off Glen Davis Road, 3 km from Capertee Village	• No change
Mine Support Facilities	• Underground access and associated infrastructure	• No change

Key Feature	Description of Approved Operations	Proposed Change
	• Engineering and services • Coal handling, preparation and transport infrastructure • Support services and administration at the Pit Top • Non- mine owned infrastructure	
Underground Water Management	A mine dewatering system, comprising pipelines, underground impoundment dams and pump stations, to pump mine inflows from the underground to the 109 ML Dirty Water Dam for storage and subsequent use as process water.	• No change

Surface Water Management	• A system of water management structures comprising settling ponds, clean and dirty water diversion drains allow separation and storage of clean and dirty water at the pit top, for use as process water.
	• Clean and dirty water dams comprise:
	  ○ 109 ML Dirty Water Dam
	  ○ 7 ML Dam
	  ○ Train Loader Dam
	  ○ REA Dam and REA LDP (not constructed)
	  ○ 35 ML Discharge Dam
	• Three Licensed discharge points on EPL 12374, with limits on discharge water quality - LDP001, LDP002, LDP003.
		• No change

Process Water	• Process water is obtained in priority order from the following sources:
	  ○ Mine inflows (when available)
	  ○ Surface dams
	  ○ Production Bore (Bore Licence Number 10BL603503)
		Water from an external source (Charbon Colliery) will be imported to a maximum 170 ML/year to supplement existing site sources.

Mine Ventilation	Two electrically powered centrifugal fans (exhausting types), attached to the northern-most access adit or portal at the pit top. Air intake through the remaining three access portals.	• No change
Waste Management	Undertaken as per Airly Mine	• No change
Rehabilitation	Progressive and life of mine	• No change
Exploration	Within ML1331 and A232	• No change

The total number of train movements required for the receipt of water from Charbon Colliery at the Airly pit top and the existing approved transportation of 1.8 Mtpa of coal off site will fall within the approved train movement limits approved in SSD 5581, noted above. No increase in train movements are sought in the modification.

Trains will operate with one locomotive and 15 wagons. Each wagon will be retrofitted with two ISO containers, each with a 26,000 L capacity. Each train will therefore carry up to 780 kL of water at a time, which would generate approximately 217 trains per year at full demand of 170 ML per year of water in a dry year. Fewer trains will be operated when additional water from Charbon Colliery is not required.

The rolling stock and locos for the operation of the water transfer scheme will be provided by Centennial Airly, specifically for the transfer of water from Charbon Colliery to Airly Mine, and will be available on an as needs basis. As noted in **Section 2.13**, the Wallerawang-Gwabegar Rail Line between Charbon Colliery and Airly pit tops does not operate passenger or other services on a fixed timetable and as such, the water trains could be scheduled as required to transport water to Airly Mine pit top.

A water laden train from Charbon Colliery travelling south along the Wallerawang-Gwabegar line will not be able to directly enter the Airly rail loop. Instead, it will travel past the Airly rail loop entry, and after stopping for a short duration, it will reverse into the Airly rail loop. On the return trip to Charbon Colliery, the empty train will reverse out of the rail loop into the Wallerawang-Gwabegar rail line past the Airly rail loop entry, and after stopping for a short duration will travel back to Charbon Colliery.

4.2.2 Surface Water Management

No major changes to the existing water management system are required to facilitate the modification, specifically to manage the imported water from Charbon Colliery. Water from the trains will be discharged using flexible hoses into an existing drainage line which runs along the rail loop embankment (**Photograph 1**) to flow by gravity into the Train Loader Dam (**Figure 7**). Collected water in the Train Loader Dam will be pumped to the 109 ML Dam using an existing pipeline for settlement and storage. Following settlement, water will be pumped to the 35 ML Discharge Dam, then the Process Water Tank for use as process water under the existing water management system, described in **Section 3.3.11**.

The following amendments to the existing infrastructure will be implemented:

- Train Loader Dam will be enlarged, and the existing pump that pumps water from this dam to the 109 ML Dirty Water Dam will be upgraded to ensure the water that flows to this dam from the trains is pumped, at a rate similar to that of the inflow, to the 109 ML Dirty Water Dam, and no discharge occurs through any resulting surcharge of the receiving system.
- The existing pipeline between the Train Loader Dam and the 109 ML Dirty Water Dam will be upgraded to allow higher water transfer rates.
- A review of the velocities of water discharge into the receiving drainage line will be undertaken to ensure that scouring does not occur. If the discharge velocities are too high and there is a potential for scouring within the drainage line then the affected sections will be lined (shotcrete or rolled erosion control products) to prevent scouring.

These minor amendments to the existing infrastructure will be wholly contained within the already disturbed areas, and there will be no impacts on biodiversity through native vegetation clearing. No sites of archaeological (Aboriginal and historic heritage) significance will be impacted by the minor upgrades.



Photograph 1 – Existing Drainage Line along Airly Rail Loop

A number of mitigation measures will be implemented to ensure that water from onsite storages (including the imported water from Charbon Colliery) will not discharge to Airly Creek, described below.

- Volumes of water in onsite storages will be controlled at all times via continuous water level monitoring.
- Importation of water from Charbon Colliery will only be undertaken as required when surface storages are <75% full.
- Sufficient freeboard (at least 25%) in all onsite dams will be maintained at all times through:
  - pumping of water between dams as required
  - no importation of water.
- Water will only be imported from Charbon Colliery if there is no risk of discharges as a result of a five consecutive day total rainfall of 44 mm, allowed under Condition L2.5 of EPL 12374.

4.2.3 Construction

4.2.3.1 Duration and Personnel

The proposed upgrade works are expected to take up to six weeks and it will take six contractors to complete the works.

4.2.3.2 Hours

The hours for the upgrade works to the Airly water management system will be aligned with the recommended standard hours for construction work included in the *Interim Construction Noise Guideline* (DECCW, 2009). Construction works will be restricted to:

- Monday to Friday – 7 am to 6 pm

- Saturday – 8 am to 1 pm
- No work on Sundays and public holidays.

4.3 Revised Mine Inflows from Recalibrated Groundwater Model

The existing Airly Mine numerical MODFLOW groundwater model (GHD, 2014a), used to provide mine inflows into the existing workings, was developed in 2014 during the preparation of the AMEP EIS (Golder Associates, 2014a). The predicted mine inflows was used to inform the Groundwater Impact Assessment (GHD, 2014a) that supported the AMEP EIS. The groundwater model report was subject to a third party review (Dr Noel Merrick, HydroSimulations), as required by the NSW Aquifer Interference Policy.

Mine inflow predictions in the AMEP EIS have recently been reviewed with more recent monitoring data. To date, only very small volumes of water have been intercepted during mining (**Section 3.10**). Further, monitoring data indicates all of the predicted groundwater inflows and additional process water are currently absorbed by the mined coal. As a result, the predicted mine inflows are removed from the underground as coal moisture and no mine inflows can be reclaimed and reused as process water.

The existing groundwater model has been recalibrated with the monitoring data. The recalibration undertaken is described in a Groundwater Assessment letter report (GHD, 2019b) appended as Appendix A in the Surface Water Impact Assessment (GHD, 2019a).

Figure 11 shows results of predicted mine inflows for the 1.8 Mtpa production rate over the Panel and Pillar Zone (**Figure 7**). Two prediction scenarios have been run for the approved 1.8 Mtpa production rate:

- **Scenario 1** – assumes that the vertical and horizontal hydraulic conductivity will increase up to a height of approximately 18 m above the panel and pillar mining zone. This fracture height corresponds to six times the height of the mine workings, and corresponds to fractured zone above panel and pillar mining areas. However, due to the thicknesses of the layers modelled, the height modelled was 23 m above the mine workings.
- **Scenario 2** – assumes that the vertical and horizontal hydraulic conductivity will increase up to a height of 75 m above the panel and pillar mining zone, which is the maximum height of the fracture zone predicted by Golder Associates (2014b). This height of fracturing is considered conservative, however mine inflow using this height of fracturing is closer to the expected mine inflows then provided by Scenario 1 predictive simulations.

Detailed discussions on the mine inflows results are provided in GHD (2019b). Predictive simulations included in **Figure 11** show the mine inflows in the year of maximum prediction (2030) are 61 ML/year for Scenario 1 and 76 ML/year for Scenario 2. Both predictions are significantly less than the approximately 183 ML/year predicted in the AMEP EIS in 2030, also shown in **Figure 11**. This is not expected to change in the future (GHD, 2019b).

As noted above, and based on the recommendation provided in GHD (2019b), the mine inflows predictions from Scenario 2 (76 ML/year) have been utilised in the determination of the site water balance included in the SEE (**Section 7.2**). Scenario 2 mine inflows are conservative given that the height of fracturing of 75 m (GHD, 2014b) adopted in this scenario is closer to the 60 m height of fracturing estimate reported recently by Strata2 (2019).

Given the mine inflows predictions in GHD (2019b) are conservative, then the actual contributions of mine inflows in meeting the process water demand at Airly Mine will be conservative. Regardless, the site water balance table included in **Section 7.2** show the predicted mine inflows are removed from the underground as product coal moisture, and no mine inflows can be reclaimed and reused as process water.

The Groundwater Assessment report has been peer reviewed by Dr Noel Merrick (HydroSimulations) and the peer review letter is included in Appendix A of the Surface Water Assessment (GHD, 2019a).

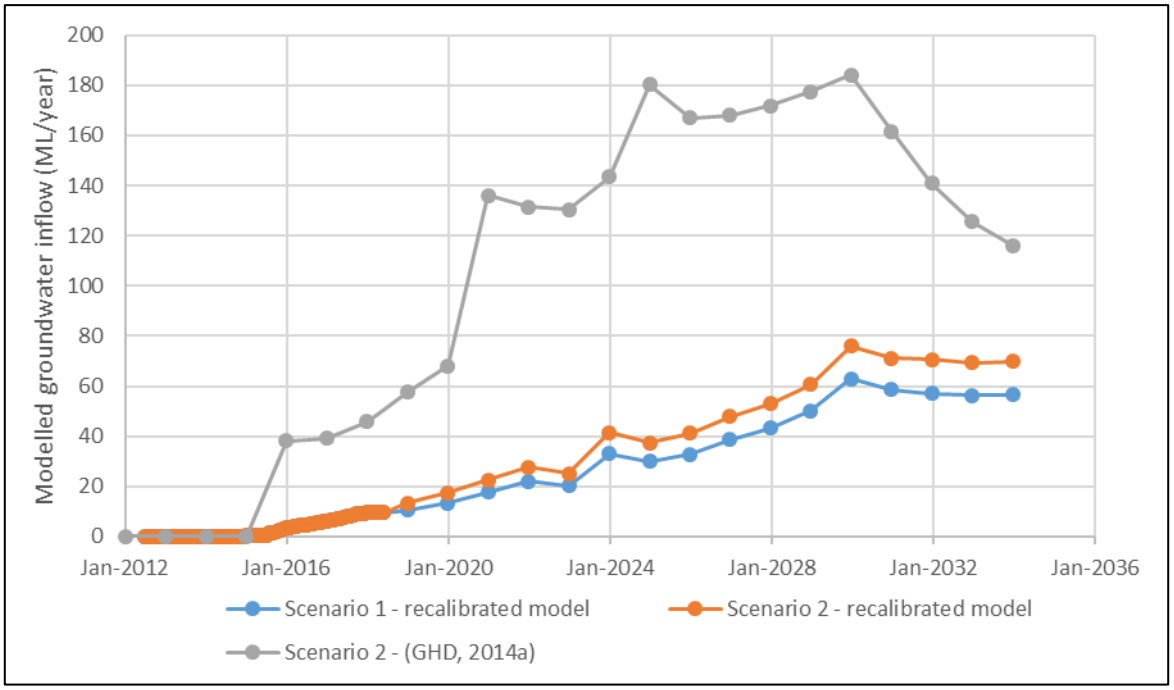


Figure 11 – Revised Mine Inflows (Adapted from GHD, 2019b)

4.4 Water Licensing

The Project Application Area is regulated by two Water Sharing Plans (WSP), made under Section 50 of the *Water Management Act 2000* (WM Act). The Greater Metropolitan Region Groundwater Sources WSP (GMR WSP) regulates groundwater resources while the Greater Metropolitan Region Unregulated River Water Sources WSP (GMRU WSP) regulates surface water resources.

Airly Mine is located within the Capertee River Management Zone which is part of the Hawkesbury and Lower Nepean Rivers Water Source covered by the GMRU WSP.

Groundwater extraction and interception is from the Sydney Basin North Groundwater Source which is covered by the GMR WSP.

Airly Mine holds two Water Access Licences (WAL) under the WM Act from the Sydney Basin North Groundwater Source with a total volumetric limit of 278 ML/year (**Table 3**):

- WAL24386 (for the Production Bore) with volumetric limit of 158 ML/year
- WAL36565 with volumetric limit of 120 ML/year.

These WALs collectively cover the mine inflows and the Production Bore extraction. The water supply work approval associated with the production Bore is 10WA112537.

As noted in the SEE for Charbon MOD 1 (Centennial Coal, 2019) and Section 1.6.2, Charbon Colliery holds water access licences (WAL35022 and WAL35023) which allow a total of 336 ML/year water extraction from the Reedy Creek catchment. The total volumetric limit covers the extraction of the 170 ML/year of water for Airly Mine as water from other onsite storages are used for rehabilitation at the site.

The water transfer scheme between Charbon Colliery and Airly Mine will require water to be transferred from the Macquarie-Bogan catchment into the Hawkesbury-Nepean catchment, which are managed by different water sharing plans. A review shows that none of the following guiding documents prohibit such water transfer:

- *Water Management Act* 2000
- *Water Management (General) Regulation 2018*
- *Access Licence Dealing Principles Order 2004*
- *Water Sharing Plans (Regulated, Unregulated or Metropolitan)*.

4.5 Environmental Management

Airly Mine will continue to undertake monitoring and reporting in accordance with the existing EMS as described in **Section 3.4**. The management plans will continue to be reviewed regularly and updated as required. Monitoring results will continue to be reported in accordance with the EPL 12374 requirements, and on an annual basis in an *Annual Review*.

4.6 Rehabilitation and Final Landform

As the proposed modification does not entail changes to the existing surface infrastructure and only minor works within disturbed areas are required, there will be no change to the rehabilitation activities due to the modification.

5 REGULATORY FRAMEWORK

5.1 Introduction

This chapter describes the applicable State and Commonwealth legislation under which the proposed modification has been assessed and will be determined.

5.2 Approval Pathway

The Airly Mine Extension Project was approved on 15 December 2016 as a State Significant Development (SSD 5581) under Section 4.38 (previously Section 89E) Part 4 Division 4.7 (previous Division 4.1) of the *Environmental Planning and Assessment Act 1979*.

SSD consents may be modified under Section 4.55(2) of the EP&A Act provided that "the consent as modified relates is substantially the same development as the development for which consent was originally granted and before that consent as originally granted was modified". SSD 5581 has been modified once previously.

Centennial Airly is proposing to modify the SSD 5581 consent, under section 4.55(2) of the EP&A Act, to receive up to 170 mL/day of water at the Airly pit top from Charbon Colliery using rail transport. This approval pathway was confirmed by DPE in an email dated 30 January 2019.

5.3 NSW State Legislation

5.3.1 Environmental Planning and Assessment Act 1979

The EP&A Act is the principal legislation overseeing the assessment and determination of development proposals in NSW. It aims to encourage the proper management, development and conservation of resources, environmental protection and ecologically sustainable development. The objects of the EP&A Act generally seek to promote management and conservation of natural and artificial resources, while also permitting appropriate development to occur. The consistency of the modification with the relevant objects under Section 1.3 of the EP&A Act is summarised in **Table 7**.

Table 7 – Objects of the EP&A Act

Object	Consistency of the Modification
(a) to promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources,	The modification will facilitate the operation of Airly Mine that itself will provide significant social and economic welfare to the local and wider community, principally by the generation of employment and payment of taxes and royalties. The Airly EIS assessed the social and economic benefits of the Project, prior to approval. The operations of the Airly Mine at the approved level will ensure the social and economic benefits identified in the Airly EIS will materialise at the approved level The modification will have very minor impacts on the State's natural environment.
(b) to facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment	Various iterations were made of the proposed water transfer scheme that is the subject of this modification. While trucking of water was economically justifiable due to low capital expenditure, rail transport was chosen as it reduces social and environmental impacts and provides a far better ecologically sustainable outcome.
(c) to promote the orderly and economic use and development of land	The orderly and economic use of land is served by development that is permissible under the relevant planning regime and in accordance with the prevailing planning controls. The modification comprises a permissible development which is consistent with the statutory and strategic planning controls and proposes a minor alteration to an approved coal mine and represents an orderly and economic use of land.

Object	Consistency of the Modification
(d) to promote the delivery and maintenance of affordable housing	Not applicable to the proposal.
(e) to protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats	No native vegetation clearing will be undertaken as a result of the modification and the minor amendments to the existing infrastructure works will be restricted to previously disturbed areas.
(f) to promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage)	No new clearing or excavation will be undertaken outside areas previously disturbed and yet to be rehabilitated. No impacts to built or cultural heritage are predicted.
(g) to promote good design and amenity of the built environment	Not applicable to the proposal.
(h) to promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants	Not applicable to the proposal.
(i) to promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State	Extensive consultation with many different levels of government (Federal, State, local) was undertaken during the preparation of the *Airly Mine Extension Project Environmental Impact Statement* (Golder Associates, 2014a). The assessment process and determination again included consultation with different levels of government, including local government. The modification will be assessed and determined under Section 4.55(2) of the EP&A Act and the process will be undertaken by the DPE in consultation with other relevant government agencies. Consultation with DPE, Mid-Western Regional Council and Lithgow City Council has been undertaken during the preparation of the SEE for the modification (**Section 6.3**).
(j) to provide increased opportunity for public involvement and participation in environmental planning and assessment.	Appropriate consultation with a wide range of stakeholder was undertaken during the preparation of Airly EIS (Golder Associates, 2014a). Consultation has been ongoing since the granting of consent through regular Airly Community Committee (CCC) meetings. More recent CCC meetings have briefed the group on the modification assessed in this SEE. Community consultation undertaken for the modification has been extensive (**Section 6.4**). The community will have the opportunity to comment on the modification application during the public exhibition of the SEE.

Section 4.55(2) of the EP&A Act notes the following:

> *"A consent authority may, on application being made by the applicant or any other person entitled to act on a consent granted by the consent authority and subject to and in accordance with the regulations, modify the consent if:*
>
> > *(a) it is satisfied that the development to which the consent as modified relates is substantially the same development as the development for which consent was originally granted and before that consent as originally granted was modified (if at all), and*

(b) it has consulted with the relevant Minister, public authority or approval body (within the meaning of Division 4.8) in respect of a condition imposed as a requirement of a concurrence to the consent or in accordance with the general terms of an approval proposed to be granted by the approval body and that Minister, authority or body has not, within 21 days after being consulted, objected to the modification of that consent, and

(c) it has notified the application in accordance with:

(i) the regulations, if the regulations so require, or

(ii) a development control plan, if the consent authority is a council that has made a development control plan that requires the notification or advertising of applications for modification of a development consent, and

(d) it has considered any submissions made concerning the proposed modification within the period prescribed by the regulations or provided by the development control plan, as the case may be."

When assessing an application under Section 4.55(2) of the EP&A Act, the consent authority is required to consider evaluation criteria outlined in Section 4.15(1) as are relevant (**Section 9.6**), including any relevant environmental planning instruments. The proposed modification meets the relevant provisions of a number of planning instruments as discussed in **Section 0** and **Section** Error! eference source not found..

An application for modification of development consent must contain the information stipulated in Clause 115 of the *Environment Planning and Assessment Regulation, 2000* (EP&A Regulation).

Table 8 provides the relevant requirements for the proposed modification and notes where those requirements have been addressed in the SEE.

Table 8 – Clause 115 Requirements for Section 4.55(2) Applications

Requirement	Where Addressed in SEE
(a) The name and address of the applicant.	**Section 1.4**
(b) A description of the development to be carried out under the consent.	**Chapter 3.0**
(c) The address, and formal particulars of title, of the land on which the development is to be carried out.	**Section 2.4** and **Appendix A**.
(d) A description of the proposed modification to the development consent.	**Chapter 4.0**
(e) A statement that indicates either: (i) that the modification is merely intended to correct a minor error, misdescription or miscalculation, or (ii) that the modification is intended to have some other effect, as specified in the statement.	N/A **Chapter 9.0.** The modification will have minimal environmental impacts.
(f) A description of the expected impacts of the modification.	**Chapter 7.0**
(g) An undertaking to the effect that the development (as to be modified) will remain substantially the same as the development that was originally approved.	**Section 9.2.** The development as modified will remain substantially the same as the development that was originally approved in consent SSD 5581.
(h) If the applicant is not the owner of the land, a statement signed by the owner of the land to the effect that the owner consents to the making of the application (except where the application for the	Landowner's consent is generally required for SSD projects unless they are "public notification developments" under Clause 49(5)EP&A Regulation. Such development includes State significant

Requirement	Where Addressed in SEE
consent the subject of the modification was made, or could have been made, without the consent of the owner),	developments set out in Clause 5 of Schedule 1 of *State Environmental Planning Policy (State and Regional Development) 2011*. Clause 5 specifically lists coal mining as such a development. Consequently, landowner's consent is not required for this modification application and instead Centennial Airly will be required to give notice of the application by: (a) *by written notice to the owner of the land before the application is made, or* *(b) by advertisement published in a newspaper circulating in the area in which the development is to be carried out no later than 14 days after the application is made*. Landowners will be notified of the application to modify through an advertisement placed in local newspapers within 14 days following lodgement of the modification application.
(i) A statement as to whether the application is being made to the Court (under Section 4.55) or to the consent authority (under Section 4.56) and, if the consent authority so requires, must be in the form approved by that authority.	The application is being made to the consent authority.

Note: Item (i) is verbatim from the EP&A Regulation. The EP&A Act notes that Section4.55 is relevant to consent authorities and Section 4.56 refers to application made to the Court.

5.3.2 Other Key NSW State Legislation

The existing approvals relevant for Airly Mine are described in **Section 3.2.2.**

Table 9 lists the key NSW State legislation and indicates the implications, if any, for the modification.

Table 9 – Other Key NSW State Legislation

Relevant State Legislative Act	Project Implications (approvals, licences and/or authorities)
Protection of the Environment Operations Act 1997	Centennial Airly Pty Limited is the licensee of EPL 12374, which authorises the mining of coal up to 2 Mtpa, and coal works up to 2 Mtpa. EPL 12374 has listed three separate licensed discharge points (LDP001, LDP002, LDP003). All LDPs have water quality limits in discharges. The listed limits for the LDPs do not apply when the discharge occurs solely as a result of rainfall measured at the premises which exceeds a total of 44 mm of rainfall over any consecutive 5-day period.
Mining Act 1992	Airly Mine holds several mining tenements listed in **Table 3**, granted under the *Mining Act 1992*. Airly Mine operates under a Mining Operations Plan (MOP) which addresses the requirements of Condition of ML 1331. The MOP has been prepared in accordance with the Department of Industry – Division of Resources and Energy (DRE) publication titled *ESG3: Mining Operations Plan (MOP) Guidelines* (DRE 2013).
Water Management Act 2000	The *Water Management Act 2000* (WM Act) is intended to ensure that water resources are conserved and properly managed for sustainable use benefitting both present and future generations. Water sharing plans prepared in accordance with the WM Act include rules for protecting the environment and administrating water licensing and trading. The Project Application Area is regulated by two Water Sharing Plans (WSP), made

Relevant State Legislative Act	Project Implications (approvals, licences and/or authorities)
	under Section 50 of the WM Act. The Greater Metropolitan Region Groundwater Sources WSP (GMR WSP) regulates groundwater resources while the Greater Metropolitan Region Unregulated River Water Sources WSP (GMRU WSP) regulates surface water resources. With respect to surface water, Airly Mine is located within the Capertee River Management Zone which is part of the Hawkesbury and Lower Nepean Rivers Water Source covered by the GMRU WSP. Groundwater extraction and interception is from the Sydney Basin North Groundwater Source which is covered by the GMR WSP. Airly Mine holds two Water Access Licences (WAL) under the WM Act from the Sydney Basin North Groundwater Source with a total volumetric limit of 278 ML/year (**Table 3**): • WAL24386 (for the Production Bore) with volumetric limit of 158 ML/year • WAL36565 (mine in flows) with volumetric limit of 120 ML/year. Extraction from the Production Bore will continue to be undertaken, as available. The new revised mine inflows predictions from the recalibrated groundwater model (**Section 4.3**) show a maximum of 76 ML in the year 2030. The volumetric limit in WAL36565 is adequate for the mine inflows into the existing workings, and no additional allocation on the WAL will be required due to the modification.
Work Health and Safety (Mines and Petroleum Sites) Act 2013	*Work Health and Safety (Mines and Petroleum Sites) Act 2013* aims to securing and promoting the health and safety of persons at work at mines, petroleum sites or related places, and to protect workers at mines and petroleum sites and other persons against harm to their health and safety through the elimination or minimisation of risks arising from work. Centennial Airly currently holds all necessary approvals under the *Work Health and Safety (Mines and Petroleum Sites) Act 2013*.
Mine Subsidence Compensation Act 1961	The Project Application Area boundary is not in a Mine Subsidence District. The modification will not require approval by the Mine Subsidence Board given no significant surface improvements are proposed.
Dams Safety Act 1978	The modification does not propose any underground mining or surface disturbance on or in the vicinity of any dams prescribed under the *Dam Safety Act 1978*.
Crown Lands Act 1989	There is Crown land within the Project Application Area boundary but not within the areas proposed for the installation and operation of new infrastructure by the modification.
Roads Act 1993	Section 138 of the *Roads Act 1993* requires consent be obtained prior to disturbing or undertaking work in, on or over a public road. No consent will be required for the modification given that no disturbance or works on public roads are proposed.
Biodiversity Conservation Act 2016	The *Biodiversity Conservation Act 2016* replaced the *Threatened Species and Conservation Act* and aims to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development. The modification will not remove native vegetation during the minor works proposed in the modification. The proposed modification therefore will not impact any listed species, communities or areas of outstanding biodiversity value.
National Parks and Wildlife Act 1974	The *National Parks and Wildlife Act 1974* (NPW Act) contains provisions for the protection and management of national parks, historic sites, nature reserves and Aboriginal heritage. The entire area of proposed minor upgrade works has been disturbed by the construction of the onsite storage dams, other water management structures, and the

Relevant State Legislative Act	Project Implications (approvals, licences and/or authorities)
	rail loop. The existence of any Aboriginal sites within the works site is highly improbable due to the disturbed nature in the area. No sites wee identified in the vicinity of the proposed works in the AMEP EIS (Golder Associates, 2014a). Aboriginal heritage sites exist within the Project Application Area boundary and are listed in the *Western Region Aboriginal Cultural Heritage Management Plan* (Centennial Coal, 2018d). These items will continue to be monitored and managed in accordance with the protocols identified in the plan.
Aboriginal Land Rights Act 1983	The *Aboriginal Land Rights Act 1983* provides for the constitution of local, regional and State Aboriginal Land Councils and a mechanism for Land Councils to claim Crown land. There are no known granted claims over Crown Land in the Project Application Area boundary
Heritage Act 1977	Historical archaeological relics, buildings, structures, archaeological deposits and features are protected under the *Heritage Act 1977*. Items of historic heritage significance exist within the Project Application Area, however not in the area of proposed works. Therefore the modification will not impact any heritage items protected under the Heritage Act. These items are listed in the *Western Region Historic Heritage Management Plan* (Centennial Coal 2018e) and will continue to be managed in accordance with the monitoring programs included in the plan.
Contaminated Land Management Act 1997	The *Contaminated Land Management Act 1997* establishes a process for the investigation and remediation of contaminated land. The relevance of this legislation to the proposed modification is outlined in **Section 5.4.4**.
Forestry Act 2012	Airly Mine does not hold any occupation permit under the *Forestry Act 2012*.

5.4 State Environmental Planning Policies

State Environmental Planning Policies (SEPPs) are Environmental Planning Instruments (EPIs) prepared by the Minister to address issues significant to NSW. The SEPPs outlined below contain provisions that are relevant to the proposed modification, and therefore are matters to be considered by the consent authority in determining the modification application.

5.5 SEPP (State and Regional Development) 2011

State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP) identifies development to which the SSD assessment and determination process under Division 4.7 in Part 4 of the EP&A Act applies. Pursuant to Section 4.36 (previous Section 89C) of the EP&A Act the Airly Mine Extension Project at the time of submission in 2014 was classified as an SSD and it was declared to be such by Schedule 1 of SRD SEPP. Clause 5 of the Schedule 1 of SRD SEPP identifies a development for the purposes of coal mining as an SSD.

5.6 SEPP (Mining, Petroleum Production and Extractive Industries) 2007

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP) aims to provide for the proper management and development of mineral, petroleum and extractive material resources for the social and economic welfare of NSW.

Part 3 of the Mining SEPP stipulates matters for consideration by the consent authority before determining an application for consent in respect of development for the purposes of mining. Specifically, Clauses 12 to 17 (inclusive) requires consideration to be given to the compatibility of projects with other surrounding land uses, including the existing and potential extraction of minerals,

natural resource management and environmental management, resource recovery, transportation and rehabilitation.

The information presented in this SEE addresses relevant matters for consideration prescribed in the abovementioned clauses. The assessments undertaken have assessed the modification elements adequately, and in accordance with the government policies and guidelines. Emphasis has been placed on anticipation and prevention of potential environmental and social impacts, with various mitigation measures, management strategies, and monitoring activities proposed to minimise adverse impacts.

Mining SEPP Part 3 matters for consideration that are particularly relevant to this modification are as follows.

- Clause 12AB that in part limits cumulative noise emissions. **Section 7.3** provides an assessment of the noise that would be produced as a result of the modification. The Project as modified will continue to meet the noise criteria in the consent SSD 5581. Rail noise will comply with the trigger levels for the day and night periods and passbys in the *Rail Infrastructure Noise Guideline* (EPA, 2013).
- Clause 12 refers to the consideration of the compatibility of the application on other land uses in the vicinity. The modification will not change the approved land use of Airly Mine, which commenced operations in 1998.
- Clause 13 refers to the consideration of the compatibility of the application with mining, petroleum production and extractive industry in the vicinity. The nearest industry, Sibelco lime processing facility at Charbon is located approximately 7 km from Airly Mine pi top. Neither the approved operation nor the proposed modification will change the compatibility of Airly Mine with other mines, petroleum production or extractive industries in the vicinity.
- Clause 14 requires a consideration of impacts on surface and groundwater, threatened species, biodiversity and greenhouse gas emissions. **Chapter 7.0** provides details in the impacts of the modification on these aspects.
- Clause 16 has the effect of discouraging road transport of materials. The modification will not entail the haulage of water on public roads.

5.7 SEPP (Sydney Drinking Water Catchment) 2011

State Environmental Planning Policy (*Sydney Drinking Water Catchment*) *2011* applies to land within the Sydney drinking water catchment. The Project Application Area is not within the Sydney drinking water catchment.

5.8 SEPP No. 55 – Remediation of Land

SEPP No. 55 – Remediation of Land (SEPP 55) provides for a state-wide planning approach to the remediation of contaminated land in order to reduce the risk to human health or any other aspect of the environment.

Clause 7(1) of SEPP 55 provides that a consent authority must not consent to the carrying out of any development on land unless:

- it has considered whether the land is contaminated
- if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out, and

- if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose.

Centennial Coal undertook a contaminated site assessment across all its other sites in 2012 in accordance with the *Contaminated Land Management Act 1997* to determine whether any site triggered the Duty to Report criteria. Given that the Airly pit top infrastructure was very recently built and the potential for contamination at the pit top was low, no contaminated site assessment was undertaken at this site. Given that the site actively reduces potential for any contamination, through implementation of best management practices, the site have not undertaken a contaminated site assessment.

A Remediation Action Plan (RAP), relating to the environmental management and remediation strategy for soil and/or water contamination at the site, will be prepared as part of the Mine Closure and a Rehabilitation MOP within five years of the mine ceasing mining operations.

With the continued implementation of best management practices for hydrocarbons at the site, as well as effective implementation of the approved environmental management plans and work health and safety management systems, the potential for contamination and associated issues remains low for Airly Mine, and the proposed modification will not alter this position.

5.9 SEPP No. 44 – Koala Habitat Protection

SEPP No. 44 – Koala Habitat Protection provides for the protection of koala habitat by ensuring that areas subject to development proposals are considered for their value as habitat or potential habitat for koalas. The Greater Lithgow LGA is listed under Schedule 1 of SEPP No. 44 as an area to which the SEPP applies.

The AMEP EIS and the biodiversity assessment included as Appendix H considered the Project Application Area to contain core koala habitat.

No tree will be removed for the modification and consequently there will be no impact on potential koala habitat.

5.10 SEPP No. 33 – Hazardous and Offensive Development

SEPP No. 33 - Hazardous and Offensive Development (SEPP 33) regulates, amongst other things, the determination of development applications to carry out what is defined in SEPP 33 as development for the purposes of a "potentially hazardous industry" or "potentially offensive industry".

The proposed modification elements would not result in the emission of a polluting discharge in a manner which would have a significant adverse impact in its locality or on the existing or likely future development on other land.

On the above bases, the proposed modification does not comprise a "potentially hazardous industry" or a "potentially offensive industry" within the meaning of these expressions in SEPP 33. Therefore a preliminary hazard analysis was not prepared as required by Clause 12 of SEPP 33 and nor does Clause 13 of SEPP 33 apply to the consent authority's determination of the modification.

5.11 Lithgow Local Environment Plan 2014

The *Lithgow Local Environmental Plan 2014* (Lithgow LEP) is the principal planning instrument affecting land use in the Lithgow Local Government Area (LGA). The Lithgow LEP commenced on 19 December 2014. The aims of the Lithgow City LEP include the encouragement of the proper management, development and conservation of natural resources and the built environment within the Lithgow LGA, by protecting, enhancing or conserving, amongst other things, timber, minerals, soil, water quality, stream environment and other natural resources.

The land use zones that apply to the proposed modification have changed due to the implementation of the Lithgow LEP, which repealed the Lithgow Local Environmental Plan 1994, when compared to the zonings that were included in the AMEP EIS. The Project Application Area encompasses three zones:

- E1 National Parks and Nature Reserves
- RU1 Primary Production
- RU2 Rural Landscape

Sub-clause 7(1)(a) of the Mining SEPP also states that development for the purpose of underground mining may be carried out on any land with development consent. In relation to any inconsistency between the Mining SEPP and an LEP, sub-clause 5(3) provides that the Mining SEPP prevails to the extent of the inconsistency. On this basis, any provision in the Lithgow LEP that would otherwise operate to prohibit the proposed modification has no effect, and accordingly, the proposed modification is permissible with development consent on the land in which the proposed modification will be carried out that is within the Lithgow LGA.

5.12 Other Considerations

5.12.1 Water Sharing Plans

Water Sharing Plans (WSP) prepared in accordance with the *Water Management Act 2000* (WM Act) include rules for protecting the environment, extractions, managing licence holders' water accounts, and water trading within defined areas and specified water sources. The Water Sharing Plans provide the basis for equitable sharing of surface water and groundwater between water users, including the environment

The site is covered by two WSPs made under Section 50 of the WM Act, which are the Greater Metropolitan Region Unregulated River Water Sources WSP and the Greater Metropolitan Region Groundwater Sources WSP. Each WSP consists of several water sources that are regulated by a water extraction entitlement.

Airly Mine holds two WALs for the extraction of groundwater. A total of 278 ML/year is licensed for extraction from the Sydney Basin North groundwater source as part of the WSP for the Greater Metropolitan Region Groundwater Sources. WAL 24386 (158 ML/year) licenses the take of water from the Production Bore (water supply work approval 10WA112537). WAL 36565 (120 ML/year) licenses the extraction of water from the underground workings as mine inflows.

5.12.2 Basic Landholder Rights

Under the WM Act, extraction of water for basic landholder rights is protected by allocating and prioritising water for basic landholder rights. Of the three types of basic landholder rights in NSW under the WM Act (domestic and stock rights, Native title rights, harvestable rights), the harvestable rights apply to Airly Mine.

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

The AMEP EIS (Golder Associates, 2014a) found that, based on the contiguous area of property under ownership of Centennial Airly at the Airly Mine site of 1710 ha, the maximum harvestable right

for Airly Mine (10% of the average rainfall runoff of the total area) was 128 ML/year. The capacity of existing dams (excluding dams located in the surface facilities area, which are exempt as they are primarily used for the environmental purpose of erosion and sediment control) was estimated to be approximately 70 ML, and therefore, the remaining harvestable rights for the Project are 58 ML/year. The predicted volume of clean catchment runoff captured by the mine water management system was estimated to be 28 ML/year. As this volume is within the maximum harvestable rights, there is no requirement for licensing of clean catchment runoff by Centennial Airly under the WM Act.

5.13 Strategic Regional Land Use Policy

The NSW Government's Strategic Regional Land Use Policy (DP&I, 2012) was introduced in September 2012 and sets out a range of initiatives to better balance growth in the mining industry with the need to protect agricultural land and water resources. The Policy includes a package of measures including the preparation of Strategic Regional Land Use Plans (SRLUP) that identify and map Strategic Agricultural Land (SAL) and Critical Industry Clusters (equine and viticulture land uses) within these areas.

The existing SRLUPs do not apply to the Project Application Area. Notwithstanding, matters relating to soil landscapes, land use impacts, land capability and agricultural suitability were addressed in the AMEP EIS. Section 10.8 of the AMEP EIS discussed the soils, land suitability and agricultural suitability aspects of the Project Application Area. These assessments concluded that the Project Application Area did not contain biophysical SAL.

5.14 NSW Aquifer Interference Policy

The NSW *Aquifer Interference Policy* (AIP) (DPI, 2012) is a key component of the NSW Government's Strategic Regional Land Use Policy. The AIP clarifies the water licensing and approval requirements for aquifer interference activities, including the taking of water from an aquifer in the course of carrying out mining, and defines the considerations for assessing potential impacts to key water-dependent assets.

The AIP indicates that where mining results in the loss of water from an overlying source that is covered by a Water Sharing Plan, a water access licence is required under the *Water Management Act 2000* to account for this take of water. According to the AIP, proponents of a mining project seeking development consent under Part 4 of the EP&A Act must provide estimates of all quantities of water likely to be taken from any water source during and following cessation of the activity and all predicted impacts associated with the activity.

Airly Mine holds two WALs for the extraction of groundwater. A total of 278 ML/year is licensed for extraction from the Sydney Basin North groundwater source under the WSP for the Greater Metropolitan Region Groundwater Sources. WAL 24386 (158 ML/year) licenses the take of water from the Production Bore (water supply work approval 10WA112537). WAL 36565 (120 ML/year) licenses the extraction of water from the underground workings as mine inflows.

The proposed modification is not proposing to extract a larger volume of groundwater than allowed on two WALs held by Airly Mine for the extraction of a total of 278 ML/year Sydney Basin North groundwater source.

5.15 Commonwealth Legislation

5.15.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Commonwealth Department of the Environment and Energy (DEE) and provides a legal framework to protect and manage nationally important flora, fauna, ecological communities and heritage places defined as matters of 'national environmental significance'. An action that "*has, will have or is likely to have a significant impact on a matter of National Environmental Significance*" (MNES) may not be

undertaken without prior approval from the Commonwealth Environment Minister, as provided under Part 9 of the EPBC Act. Approval under the EPBC Act is also required where actions are proposed on, or will affect, Commonwealth land and its environment.

Potential impacts on any MNES are subject to assessments of significance pursuant to the EPBC Act *Significant Impact Guidelines 1.1* (DoE 2013a). If a significant impact is considered likely, a referral under the EPBC Act must be submitted to the Commonwealth Environment Minister.

5.15.1.1 Previous Referrals

Airly Mine holds approval EBPC 2013/7076 under the EPBC Act with the following controlling provisions.

- World Heritage properties
- National heritage places
- Listed threatened species and communities
- Water resources/trigger

5.15.1.2 Proposed Modification

The modification will not impact on any World Heritage properties of any National Heritage places. The following sections discuss relevance of the modification to listed threatened ecological communities and water resources

Potential Impacts to Threatened Ecological Communities

The proposed modification is not proposing to remove any native vegetation for the installation of the minor infrastructure. Only heavily disturbed areas will be utilised for the works. As such an impact assessment against the *Significant Impact Guidelines 1.1: Matters of National Environmental Significance* (DoE, 2013a) was not undertaken.

Potential Impacts to Water Resources

The proposed modification has the potential to impact on MNES with respect to water resources. The *Significant Impact Guidelines 1.3: Significant Impact Guidelines 1.3: Coal Seam Gas and Large Coal Mining Developments – Impacts on Water Resources*, includes general criteria for whether an action is likely to have a significant impact on water resources, which are for the possibility for direct or indirect changes:

- the hydrology of a water resource
- the water quality of a water resource.

According to the *Significant Impact Guidelines 1.3*: *Coal Seam Gas and Large Coal Mining Developments – Impacts on Water Resources* (DoE 2013b), the value of the water resource needs to be confirmed such that impacts from actions can be evaluated on their significance. The guidelines indicate that key factors for evaluating a water resource's value include its utility for all third party users. Third party user categories specific to the modification include:

- provisioning services (e.g. use by other industries and use as drinking water)
- cultural services (e.g. recreation and tourism, science and education)
- supporting services (e.g. maintenance of ecosystem function).

If evidence can be provided that proposed actions would not materially affect the availability and quality for third party users, then the likelihood of an action having a significant impact would be reduced (DoE 2013b).

The *Significant Impact Guidelines for Coal Seam Gas and Large Coal Mining Developments – Impacts on Water Resources* (DoE 2013b) are considered in the Surface Water Assessment (GHD, 2019a), appended as **Appendix C** to this SEE. The outcomes of the assessment are summarised in **Section 7.1.3.7**, and confirm that the proposed modification will be compliant with the all impact criteria (hydrological characteristics and water quality) assessed.

Given the proposed modification will not have or is not likely to have a significant impact on an MNES Airly Mine's consent as modified will operate within the constraints of the EPBC Approval 2013/7076. Therefore, a referral to DEE in relation to the modification is not required.

5.15.2 Native Title Act 1993

The *Native Title Act 1993* recognises that Aboriginal people may have rights and interests to certain land and waters which derive from their traditional laws and customs. Native title may be recognised in places where Indigenous people continue to follow their traditional laws and customs and have maintained a link with their traditional country.

Although there is a presumption of native title in any area where an Aboriginal community or group can establish a traditional or customary connection with that area, there are a number of ways that native title can be extinguished. For example, land that was designated as having freehold title prior to 1 January 1994 extinguishes native title, as does any commercial, agricultural, pastoral or residential lease. Land that has been used for the construction or establishment of public works also extinguishes any native title rights and interests for as long as they are used for that purpose. Other land tenure, such as mining leases, may be subject to native title depending on when the lease was granted.

No new mining leases will be required in relation to the proposed modification. There is an existing native title claim on the MLA559 application (**Table 4**). Centennial Coal has commenced negotiations with the claimants through the right to negotiate process under the Act.

6 STAKEHOLDER ENGAGEMENT

6.1 Introduction

This chapter provides information on consultation undertaken with stakeholders with respect to the proposed modification in accordance with a stakeholder engagement strategy developed specifically for Airly MOD 2. It is noted that the consultation meetings described below for Airly MOD 2 also discussed the proposed Charbon MOD 1 (Centennial Coal, 2019) modification elements and assessment outcomes given the interrelationships between the two modifications. Issues raised on both modifications have been addressed in the SEEs for the modifications, as appropriate. The consultation outcomes are discussed in **Section 6.6**.

6.2 Modification Stakeholder Engagement Strategy

The project specific engagement strategy provided a framework to identify and appropriately consult with stakeholders that may be influenced by or have an interest in the proposed modification elements. The strategy identified the following groups as key stakeholders.

- Local community
- Non-government organisations, including special interest groups
- Government (Local and State)
- Aboriginal stakeholders
- National Parks and Wildlife Service

The engagement strategy was underpinned by Centennial Coal's *Environment and Community Management Standard 023* which sets out the minimum requirements for effective consultation and engagement with all stakeholders who have an interest in the mine's operations. The standard requires consultation with stakeholders on proposed modifications to Airly Mine's consent SSD 5581.

Centennial Airly is committed to the timely, orderly, consistent and credible dissemination of appropriate information within the constraints of legal and regulatory requirements to all interested stakeholders. To date, no major complaints have been received from the community on Airly Mine's operations.

6.3 Consultation with Government

6.3.1 Department of Planning and Environment

At a face to face meeting held with officers of DPE on 23 October 2018 to discuss Airly Mine's need to import water to meet the identified process water deficit, it was noted that sourcing water from Charbon Colliery and transporting water to Airly Mine could be a long term solution. It was articulated at that meeting that Airly Mine will propose to modify its consent SSD 5581 (Airly MOD 2) to import water from an external source (Charbon Colliery) in order to operate at the approved level.

A letter was sent to DPE on 27 November 2018 with a description of the modification elements for both Charbon MOD 1 and Airly MOD 2, the proposed approval pathway for the modification and the technical assessments proposed to be undertaken for the preparation of the SEEs supporting the modification applications. DPE provided a response to the letter on 30 January 2019 to confirm (i) the Department was satisfied the proposals represent a modification to the original projects and that Section 4.55(2) of the EP&A Act is the appropriate approval pathway for the modification applications, and (ii) that "*the Department considers that potential water impacts and noise impacts should be considered. In terms of water impacts, the assessment should include a revised site water balance for each site and consider potential impacts to downstream water users. The SEE should include details of consultation with the community and agencies undertaken".*

6.3.2 Environment Protection Authority

A meeting was held with the EPA officers to discuss both the Charbon MOD 1 and Airly MOD 2, specifically to discuss:

- elements of both modifications
- outcomes of technical assessments undertaken for the SEEs
- management controls to be implemented at Airly Mine for ensuring no discharge of water from the water management system to Airly Creek
- a summary of the rehabilitation activities undertaken at the site.

No specific issues were raised by the EPA on the proposed modifications.

It was confirmed at the meeting that Charbon's EPL 528 will not require a variation to transfer water off site, and Airly Mine's EPL 12374 will not require a variation to import water from Charbon Colliery.

6.3.3 Department of Industry – Lands and Water

A letter discussing the recalibration undertaken of the Airly Mine groundwater model, revised mine inflow predictions for Airly's approved operations, the rationale for the Charbon MOD 1 and Airly MOD 2 (refer **Section 1.6**) was provided to Department of Industry - Lands and Water on 13 March 2019. A meeting request to discuss the recalibration of the Airly Groundwater Model and mine inflows predictions from the recalibrated model in further detail was requested in the letter.

6.3.4 Mid-Western Regional Council

Two meetings have been held with Mid-Western Regional Council (MWRC) to discuss the proposed modification elements and the technical assessment outcomes, as follows.

- Meeting held with elected councillors and senior managers on 20 February 2019, to discuss a number of Centennial Coal projects, including the proposed Charbon MOD 1.
- Meeting held with the Development team on 26 February 2019 to discuss the modification elements, the outcomes of technical assessments included in the SEE for Charbon MOD 1, and the indicative timeline for SEE submission and assessment phase. The presentation also discussed the interactions with the Airly MOD 2.

No issues were raised in relation to the two proposed modifications during the meeting of 20 February 2019. Matters raised at the meeting held on 26 February 2019, when both Charbon MOD 1 and Airy MOD 2 were discussed, are included in **Appendix B** in **Table B1**. This table also provides responses to matters raised and / or provides SEE section references where the issues have been addressed.

6.3.5 Lithgow City Council

Two meetings have been held with Lithgow City Council (LCC) to discuss the proposed modification elements and the technical assessment outcomes for Airly MOD 2, as follows.

- Meeting held with two councillors (Thompson and Ring) on 06 December 2018.
- Meeting held with the Development team on 07 March 2019 to discuss the modification elements, the outcomes of technical assessments included in the SEE for Airly MOD 2, and the indicative timeline for SEE submission and assessment phase. The presentation also discussed the interactions with the Charbon MOD 1.

No issues were raised in relation to the two proposed modifications.

6.3.6 National Parks and Wildlife Service

A letter describing the Airly MOD 2, the rationale behind the proposal, implications of the proposal with the current operations, and the timeline for the submission of the SEE was provided to National Parks and Wildlife Service on 22 March 2019.

6.4 Consultation with Community

Centennial Coal operations consult with the local community on an ongoing basis. Centennial Airly is aware of its community obligations and the importance of open communication with the community. Charbon keeps the local community affected by its operations informed of its direction, plans and environmental performance. This is achieved by the following engagement mechanisms:

- Charbon Colliery & Inglenook Community Consultative Committee (Charbon and Inglenook CCC)
- holding open days and displays at local shows
- a 24 hour telephone complaints line
- engaging in informal discussions with local residents as required.

6.4.1 Airly Mine Community Consultative Committee

An extraordinary meeting of the Airly Mine Community Consultative Committee (Airly CCC) was held on 15 January 2019. While the main focus of the meeting was the proposed modification to Airly Mine's consent SSD 5581 (MOD 2) to receive water at the pit top from Charbon Colliery, the Airly CCC members also raised issues on the Charbon MOD 1. Matters raised at the meeting and in an email prior to the meeting are included in **Appendix B** in **Table B1**. This table also provides responses to matters raised and / or provides SEE section references where the issues have been addressed.

6.4.2 Charbon Colliery & Inglenook Community Consultative Committee

Charbon Colliery has ongoing consultation with the local community. Meetings are held regularly with the Charbon Colliery & Inglenook Community Consultative Committee (Charbon and Inglenook CCC). The Charbon and Inglenook CCC includes local community representatives, special interest group representatives (Rystone District Environment Society, Running Stream Water Users Association), and representatives from Mid-Western Regional Council and Lithgow City Council.

At the CCC extraordinary meeting of 11 December 2018 Charbon MOD 1 was discussed and a description of the modification elements was provided to the members. Given the interactions between Airly MOD 2 and Charbon MOD 1, information on the Airly MOD 2 elements were also discussed.

Matters raised at the meeting are included in **Appendix B** in **Table B1**. This table also provides responses to matters raised and / or provides SEE section references where the issues have been addressed.

6.4.3 Rylstone District Environment Society

A meeting was held with the Rylstone District Environment Society (RDES) on 26 February 2016 to discuss the proposed modifications Charbon MOD 1 and Airly MOD 2. Matters raised at this meeting and in an email prior to the meeting are included in **Appendix B** in **Table B1**. This table also provides responses to matters raised and / or provides SEE section references where the issues have been addressed.

6.4.4 Registered Aboriginal Parties

The Centennial Western Region operations engage with 11 Registered Aboriginal Parties (RAPs) on Aboriginal cultural heritage matters pertinent to approvals and including Aboriginal cultural heritage identification, monitoring and management across its operations.

A six-monthly meeting with the RAPs is also organised, in accordance with the approved *Western Region Aboriginal Cultural Heritage Management Plan* (Centennial Coal 2018d), to provide information on the activities undertaken of each operation and the approvals being prepared by each operation. The *Western Region Aboriginal Cultural Heritage Management Plan* lists all the RAPs for Centennial's Western Operations.

Two methods have been used to inform the RAPs about the proposed modifications Charbon MOD 1 and Airly MOD 2, as follows.

- A letter describing the proposed modifications and the rationale for the modifications was sent to the RAPs on 04 March 2019
- The proposed modifications will be discussed at the next six-monthly meeting with the RAPs, to be held in May 2019.

6.5 Ongoing Consultation

6.5.1 Community

The broader community will be notified of the proposed Charbon MOD 1 and Airly MOD 2 through advertisements placed in the local newspapers (Lithgow Mercury and Mudgee Guardian) following lodgement of the modification applications. The community will be invited to make formal submissions on the modification through the public exhibition process.

Consultation with the community and other stakeholders will continue through CCCs (Charbon and Inglenook CCC, Airly CCC) and engagement with individual community members, as required, to ensure the community remains informed of the outcomes of the modification application.

6.5.2 Government

Centennial Coal regularly engages with government agencies to report on its environmental performance. This is facilitated through a number of means including:

- LCC and MWRC representation on the Charbon and Inglenook CCC and Airly CCC
- provision of CCC minutes to all stakeholders and making it available on the Centennial Coal websites soon after the meeting of the CCC has been held
- provision of *Annual Review* from each site to the DPE and other relevant government agencies
- liaison with and reporting to the EPA with regard to performance against EPL conditions
- provision of the *Annual Licence Return* to the EPA
- provision of the National Pollution Inventory (NPI) to DEE.

Centennial Airly will continue to consult with the relevant government agencies during the assessment of the proposed modification.

6.6 Consultation Outcomes

Matters raised during meetings with the government (**Section 6.3**) and the community (**Section 6.4**) are included in **Appendix B** in **Table B1**. This table also provides responses to matters raised and / or provide SEE section references where the issues have been addressed.

7 ASSESSMENT AND MANAGEMENT OF KEY ENVIRONMENTAL ISSUES

7.1 Introduction

The modification proposes the establishment of a water transfer scheme between Charbon Colliery and Airly Mine. Up to 170 ML/year of surface run-off water from existing onsite storages at Charbon Colliery (LD4 Dam, CHP Dams, Reedy Creek Dams) will be transferred to Airly pit top by rail transport. Minor upgrades to the existing water management infrastructure at Airly pit top to facilitate the receipt of water will be required. The proposed works (**Section 4.2**) will not require any clearing of native vegetation as installation of the new infrastructure will be undertaken in already disturbed areas.

Given the major component of the modification is the importation of water from an external source for storage and use by Airly Mine for its operations, a surface water assessment has been prepared to assess the change in the site's water and salt balances, and the potential downstream impacts on water quality and aquatic ecology in Airly Creek should there be discharges of water from Airly Mine's water management system, and any altered availability of surface water to downstream licensed water users.

A Noise Impact Assessment (SLR, 2019), included in **Section 7.3**, has been prepared to assess the impact of trains from Charbon Colliery arriving on the Wallerawang-Gwabegar Rail Line from the north at the Airly pit top. The rail noise for trains arriving from the north to enter the Airly Rail Loop was not assessed in the Airly EIS. Water laden trains from Charbon Colliery will not be able to directly enter the Airly Rail Loop. Instead, they will travel past the Airly rail loop entry, and after stopping for a short duration, they will reverse into the Airly rail loop. On the return trip to Charbon, the empty train will reverse out of the rail loop into the Wallerawang-Gwabegar Rail Line past the Airly rail loop entry, and after stopping for a short duration will travel back to Charbon Colliery. The noise assessment assesses the impact of the noise associated with the change in direction of water trains on the Wallerawang-Gwabegar Rail Line as well as wagons bunching when reversing into the rail loop.

Other environmental matters, as described in **Section 7.4**, have been considered despite there being no proposal to clear any native vegetation, and that there is no proposal to increase train movements. Operation of the one train per day falls within the assessed approved train movements for Airly Mine under SSD 5581.

7.2 Surface Water

7.2.1 Introduction

A Surface Water Impact Assessment for the modification was prepared by GHD Pty Ltd *Airly Mine Extension Project Modification 2*: *Surface Water Assessment* (GHD, 2019a), which is provided in full in **Appendix C**. This report informs this section of the SEE.

The purpose of the Surface Water Impact Assessment was to quantify:

- establish the baseline conditions for water management system
- identify components of the modification with the potential to affect the surface water environment.
- undertake an assessment of the potential impacts of the modification on:
    - water and salt balance
    - water quality
    - downstream water users, including licensed water users and basic landholder rights
    - aquatic ecology in Airly Creek.

7.2.2 Existing Environment

7.2.2.1 Surface Hydrology

The hydrology of the Project Application Area is discussed in detail in **Section 2.8**. The proposed modification has the potential to impact on the Airly-Coco Creek catchment, and accordingly this catchment is the focus of the surface water assessment discussions.

7.2.2.2 Surface Water Quality

As discussed in **Section 3.9**, water quality monitoring is undertaken at a number of locations within the pit top water management system with the potential to discharge into Airly Creek via LD001 – LDP003. GHD (2019a) provides a statistical analysis of relevant water quality data (median data) for Airly Creek upstream and downstream, and the 35 ML Discharge Dam that overflows via LDP001. This analysis is reproduced in **Table 10** and compared to EPL 12374 limits and site-specific guideline values (SSGV) recommended by *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG, 2018). The SSGVs are included in the *Airly Mine Water Management Plan* (Centennial Coal, 2018b). Appendix D of GHD (2019a) provides a more comprehensive statistical analysis (10^{th}, 50^{th}, 90^{th} percentiles) of historical water quality data and time series graphs.

Physicochemical Parameters

Table 10 shows that electrical conductivity (EC) at Airly Creek Upstream and Airly Creek monitoring sites was generally between 1300 µS/cm and 3300 µS/cm. The Airly Creek catchment has been observed to be naturally brackish and is closely related to the geology of the catchment, having the same water type as found in the underlying Shoalhaven Group aquifer. The median EC result for both Airly Creek catchment sites was found to exceed the EPL 12374 limit for LDP001 discharge of 2244 µS/cm.

The 35 ML Discharge Dam has reported a lower EC level, typically between 500 µS/cm and 1000 µS/cm. An increasing trend in EC within the 35 ML Discharge Dam has been observed over the previous 12 months, with a maximum EC recording of 3120 µS/cm in October 2018. This is attributable to the increase use of groundwater from the Production Bore since 2017, which has a median concentration of 4830 µS/cm based on 71 samples collected between July 2012 and October 2018.

The pH levels for both Airly Creek monitoring sites were found to range between 6.5 and 8.5, indicating slightly acidic to slightly alkaline water. Observations from the 35 ML Discharge Dam are more alkaline, with pH recorded between 7.5 and 9.5. The median pH level at the 35 ML Discharge Dam of 8.4 exceeded the upper SSGV of 8.0, but is within the EPL 12374 limit.

Results for TSS concentration were generally below 25 mg/L at both Airly Creek monitoring sites and the 35 ML Discharge Dam. In general, concentration of TSS recorded at the Airly Creek site was elevated compared to the upstream site. The Airly Creek site had a 90th percentile concentration of 74 mg/L compared to 5 mg/L for the Airly Creek Upstream site and 8 mg/L for the 35 ML Discharge Dam.

The majority of turbidity results have been below 10 NTU for Airly Creek monitoring sites and the 35 ML Discharge Dam. Monitoring results for Airly Creek were found to vary up to a maximum of 262 NTU in 2013 and 2014; however results have been less than 50 NTU for all sites since mid-2014.

Nutrients

Ammonia concentration results have generally been below 0.1 mg/L for all monitoring sites, with similar results for the Airly Creek catchment sites and the 35 ML Discharge Dam. No exceedances of the EPL 12374 concentration limit and SSGV of 0.32 mg/L were observed.

Table 10 – Summary of Surface Water Quality Results

Parameter	Units	EPL 12374 LDP001 limits		SSGVs (Airly Creek)	Airly Creek upstream		Airly Creek		35 ML Discharge Dam	
		90th %tile	100th %tile		Count	Median	Count	Median	Count	Median
Physicochemical parameters										
EC	µS/cm	2244		2709	25	2710	71	2390	103	900
pH	pH units		6.5–9.0	6.5–8.0	25	7.5	71	7.4	103	8.4
TSS	mg/L	50		25	25	2	71	4	103	2
Turbidity	NTU	40		25	24	1.9	45	2	78	1.5
Nutrients										
Ammonia	mg/L		0.32	0.32	25	0.01	45	0.02		
Total nitrogen	mg/L	2		0.7	25	0.4	45	0.5		
Total phosphorus	mg/L	0.5		0.056	25	0.01	45	0.02		
Dissolved metals										
Aluminium	mg/L			0.027	25	0.01	46	0.01	81	0.01
Antimony	mg/L			0.001	24	0.001	45	0.001	80	0.001
Arsenic	mg/L		0.024		25	0.001	46	0.001	81	0.001
Barium	mg/L			0.017	25	0.015	46	0.016	81	0.048
Beryllium	mg/L			0.001	25	0.001	46	0.001	81	0.001
Boron	mg/L			0.09	25	0.05	45	0.05	81	0.05
Cadmium	mg/L				25	0.0001	46	0.0001	81	0.0001
Chromium	mg/L				25	0.001	46	0.001	81	0.001
Cobalt	mg/L			0.001	25	0.001	46	0.001	81	0.001
Copper	mg/L		0.013	0.001	25	0.001	46	0.001	81	0.001
Iron	mg/L			0.3	25	0.07	67	0.05	102	0.05
Lead	mg/L			0.001	25	0.001	47	0.001	82	0.001
Manganese	mg/L			1.2	25	0.126	68	0.157	102	0.014
Mercury	mg/L				23	0.0001	45	0.0001	81	0.0001
Molybdenum	mg/L			0.001	25	0.001	46	0.001	81	0.001
Nickel	mg/L		0.1	0.008	25	0.005	46	0.006	81	0.002
Selenium	mg/L				25	0.01	46	0.01	81	0.01
Silver	mg/L			0.001	24	0.001	45	0.001	80	0.001
Zinc	mg/L		0.072	0.0076	25	0.005	46	0.006	81	0.005
Other parameters										
Oil & grease	mg/L		10	5	25	5	70	5	103	5

Parameter	Units	EPL 12374 LDP001 limits		SSGVs (Airly Creek)	Airly Creek upstream		Airly Creek		35 ML Discharge Dam	
		90th %tile	100th %tile		Count	Median	Count	Median	Count	Median

Source (GHD, 2019a). Note DGV is the default guideline value recommended by ANZG (2018). Pink cells indicate where the median result exceeded either the EPL 528 limits or the relevant DGV.

The majority of total nitrogen concentration results have ranged between the LOR of 0.1 mg/L and 1 mg/L, with the Airly Creek monitoring sites generally slightly elevated compared to the 35 ML Discharge Dam.

Total phosphorus was typically below 0.05 mg/L for Airly Creek Upstream and the 35 ML Discharge Dam. Results for the Airly Creek monitoring site were slightly elevated by comparison, with a median concentration of 0.02 mg/L for Airly Creek and 0.01 mg/L for both Airly Creek Upstream and the 35 ML Discharge Dam.

Dissolved Metals

Dissolved metals at all sites were generally at or below the limit of reporting (LOR) for the majority of parameters, with the exception of results for dissolved cobalt, copper, iron, manganese, nickel and zinc.

Results for dissolved aluminium concentration at Airly Creek Upstream, Airly Creek and 35 ML Discharge Dam generally ranged between the LOR of 0.01 mg/L and 0.02 mg/L, with all results since 2015 found to be below the SSGV of 0.027 mg/L.

Dissolved arsenic results were generally reported to be less than the LOR of 0.001 mg/L for all Airly Mine monitoring sites, with the exception of one result of 0.002 mg/L reported for the 35 ML Discharge Dam in December 2016. All observed results were less than the EPL 12374 dissolved arsenic limit of 0.024 mg/L for LDP001 discharge.

The concentration of dissolved barium recorded at the Airly Creek Upstream and Airly Creek monitoring sites were similar, with median results of 0.015 mg/L and 0.016 mg/L respectively. Results for the 35 ML Discharge Dam were generally higher, with all observations found to exceed the SSGV of 0.017 mg/L.

Results for dissolved cadmium were below the LOR of 0.0001 mg/L for all monitoring sites, with the exception of one sample of 0.0003 mg/L recorded in October 2012 at both Airly Creek site and the 35 ML Discharge Dam.

All dissolved chromium results for Airly Creek Upstream, Airly Creek and the 35 ML Discharge Dam were less than the LOR and SSGV of 0.001 mg/L.

Dissolved cobalt was observed to generally be below the LOR of 0.001 mg/L for the Airly Creek Upstream site and the 35 ML Discharge Dam. Results for the Airly Creek site were elevated by comparison, with several results above the SSGV of 0.001 mg/L. A maximum dissolved cobalt concentration of 0.02 mg/L was observed at the Airly Creek monitoring site in July 2017.

The majority of dissolved copper results for all sites ranged between the LOR of 0.001 mg/L and 0.004 mg/L, with an outlier maximum result of 0.02 mg/L reported for Airly Creek in May 2014. Approximately 40% of LDP4 discharge results exceeded the Airly Creek SSGV of 0.001 mg/L. Two results for the Airly Creek monitoring site were found to exceed the EPL 12374 limit for LDP001 of 0.013 mg/L.

Dissolved iron concentrations at the Airly Creek Upstream and Airly Creek sites generally range between the LOR of 0.05 mg/L and 0.2 mg/L. A maximum of 0.7 mg/L has been recorded at the Airly Creek monitoring site in December 2014. Results for the 35 ML Discharge Dam at Airly Mine were generally below the LOR.

Dissolved lead concentrations at all monitoring sites have consistently been reported below the LOR and SSGV of 0.001 mg/L, with the exception of one observation of 0.002 mg/L in the 35 ML Discharge Dam in April 2012.

Reported dissolved manganese concentrations for Airly Creek Upstream, Airly Creek and the 35 ML Discharge Dam monitoring locations were found to range between 0.03 mg/L and 0.89 mg/L. The 35 ML Discharge Dam was found to be slightly lower than the Airly Creek sites, with a median value of 0.014 mg/L for the 35 ML Discharge Dam compared to 0.126 mg/L for Airly Creek Upstream and 0.157 for Airly Creek. All results for the Airly Creek Upstream site and the 35 ML Discharge Dam were below the SSGV of 1.2 mg/L, however several results recorded at Airly Creek were exceeded the SSGV.

Airly Creek Upstream, Airly Creek and the 35 ML Discharge Dam monitoring sites have consistently reported dissolved mercury concentrations below the LOR of 0.0001 mg/L.

Concentrations of dissolved nickel generally varied from 0.002 mg/L to 0.012 mg/L at the Airly Creek monitoring sites. Results for the 35 ML Discharge Dam were generally slightly less than for the Airly Creek monitoring sites, with a median value of 0.002 mg/L. All results for all three monitoring sites were below the EPL 12374 limit for LDP001 discharge of 0.1 mg/L, however several results for Airly Creek Upstream and Airly Creek were found to exceed the SSGV of 0.008 mg/L.

Results for dissolved silver have been reported to be below the LOR and SSGV of 0.001 mg/L for all monitoring sites, with the exception of one observation of 0.003 mg/L in the 35 ML Discharge Dam in June 2014.

Dissolved zinc concentrations were found to typically vary between the LOR of 0.005 mg/L and 0.008 mg/L for the Airly Creek Upstream site and the 35 ML Discharge Dam. Results for the Airly Creek monitoring site were elevated compared to the Airly Creek Upstream site and the 35 ML Discharge Dam, generally ranging between the LOR and 0.021 mg/L. All results for the Airly Creek Upstream, Airly Creek and 35 ML Discharge Dam sites were below the EPL 12374 limit of 0.072 mg/L for LDP001 discharge. However, the SSGV of 0.0076 mg/L was exceeded on occasion at all three monitoring sites, with over 30% of results for Airly Creek exceeding the SSGV.

Dissolved metal concentrations of antimony, beryllium, boron, molybdenum and selenium were generally less than the LOR and the respective SSGVs. Isolated cases of a few exceedances of Airly Creek SSGVs have occurred in discharges from 35 ML Discharge Dam.

7.2.2.3 Water Licensing

As discussed in **Section 4.3** and **Section 5.6.1**, the Airly Mine Project Application Area is covered by two WSPs under the WM Act for the extraction of groundwater. A total of 278 ML/year is licensed for extraction from the Sydney Basin North groundwater source under the WSP for the Greater Metropolitan Region Groundwater Sources. WAL 24386 (158 ML/year) licenses the take of water from the Production Bore (water supply work approval 10WA112537), which is used to supplement water for use in mining activities. WAL 36565 (120 ML/year) licenses the extraction of water from the underground workings.

7.2.2.4 Sensitive Water Receptors

The sensitive water receptors have been identified as:

- Airly Creek which is the receiving environment for discharges from the Airly Mine pit top water management system
- waterways downstream of Airly Creek (**Section 2.8**)
- licensed surface water users on Coco Creek (**Section 7.2.2.8**)
- aquatic ecology maintained in Airly Creek.

GDEs have not been identified as receptors as they are not likely to be impacted by the proposed modification.

7.2.2.5 Water and Salt Balance Assessment Method

Water and salt balance, as a result of inflows, outflows and storage, was modelled using the GoldSim model that was developed for the AMEP Surface Water Impact Assessment (GHD 2014b). The water and salt balance included in the AMEP EIS (referred here as the approved (EIS) site water and salt balance) has become out-dated. The inputs and outputs utilised in the EIS water and salt balance has been updated to reflect recent observed conditions, and which differ from the EIS estimates. These updates to the site water and salt balance model are reflected in scenarios considered in the surface water impact assessment (GHD, 2019a) used to inform the SEE. Differences between the scenarios are described below.

It is noted that, to assess the impact of rainfall on the site, modelling for the baseline conditions and proposed conditions was completed by using a historical time series of daily rainfall data extending over 129 years, from January 1889 to December 2018. A total of 129 simulations were applied, with each simulation modelling a different rainfall pattern from the record. The “dry” and “wet” year results included in the proposed conditions are based on an equilibrium modelling approach with the driest and wettest rainfall year on record being repeated continuously as the simulated rainfall.

In all scenarios, catchments utilised at the pit top in the site water and salt balance include contributions from the approved REA, and the associated REA dam and the REA licensed discharge point (**Figure 8**), although this infrastructure is not constructed.

In all scenarios, the site water and salt balance results are presented for the predicted site conditions in the year 2030. As discussed in **Section 4.3**, groundwater inflows into the underground workings are predicted to peak in 2030, and therefore are comparable to the site water balance presented for the approved conditions in the AMEP EIS (Golder Associates, 2014a) and GHD (2014b).

Approved Conditions

The approved conditions scenario is as per the AMEP EIS and GHD (2014b), where groundwater inflows of up to 180 ML/year were expected to report as mine inflows in the underground workings and able to be recovered for reuse as process water. This is no longer the case and mine inflows predictions from the recalibrated groundwater model are significantly lower at 76 ML/year in 2030 (**Section 4.3**).

It is noted that the water and salt balances for the approved conditions were reported as average, and no water and salt balances for the dry and wet conditions are available for comparisons with the baseline wet and dry conditions, determined in the recent update of the GoldSim model (**Section 7.2.3.2**).

Baseline Conditions

The water and salt balance GoldSim model developed for the AEMP EIS and water assessments (GHD 2014a,b) has been updated to reflect the following.

- New information including dust suppression water usage records, catchment runoff parameters has been used in the updated model.
- The revised groundwater inflows into the underground workings predicted by recalibrated hydrogeological modelling are significantly less than previously reported.
- The degrading reliability of the Production Bore has been taken into consideration. The average flow rate from the bore has been gradually reducing and the bore is now unreliable in terms of sustainable yields.

The baseline conditions represent the scenario where all approved activities are undertaken, using the updated water and salt balance model. This effectively simulates a "do nothing" scenario for Airly Mine and is used to provide a comparison to the proposed conditions.

The baseline conditions site water and salt balance has assumed:

- the existing water management system and the approved operation of the CPP and REA, REA Dam at the toe of the REA and a planned LDP (REA LDP)
- approved maximum production rate of 1.8 Mtpa of ROM coal
- approved maximum workforce of 155 FTE personnel.

A deficit is modelled to exist under baseline conditions when process water demand exceeds harvested surface water runoff. To model this deficit, sufficient water to supply all approved operations was simulated to be available from Process Water Tank, which supplies the process water for mining operations. The difference between water required (i.e. the outflows from the Process Water Tank) and the water available (i.e. the inflow to the Process Water Tank) was used to quantify the deficit for the site.

For the purpose of the salt balance, the EC of water supplied from the Process Water Tank was assumed to be equal to the median observed EC of the 35 ML Discharge Dam (which supplies the Process Water Tank). This EC was selected as it is lowest reasonable representative value of process water at Airly Mine and therefore would show the greatest potential impact of the modification on the salt balance under proposed conditions..

Proposed Conditions

Proposed conditions reflect the changes to the site water management system due to the modification. Therefore, the proposed conditions are the same as the baseline conditions, but rather than simulating a process water deficit, the model simulated the transfer of up to 170 ML/year of water from Charbon Colliery to the Train Loader Dam. This transfer was modelled to occur as required when the surface water storages were simulated to be less than 75% full. The transfer of water was limited to up to one train per day, with up to 30 containers of 26,000 L capacity each able to be delivered to Airly Mine.

The water from Charbon Colliery is proposed to be sourced from both Reedy Creek Dam (median EC of 1485 µS/cm) and LDP4 Discharge Dam (median EC of 1830 µS/cm), however the proportions of contributions from the water sources to be supplied to Airly Mine depends on day to day operational conditions will not be fixed. Water will be sourced from both dams, or from Reedy Creek Dam only. The median EC of LDP4 discharge is higher at 2320 µS/cm (**Table 16**) and therefore was adopted as the modelled EC of the transfer from Charbon Colliery. This was a conservative assumption for the purpose of assessing the potential impact of the modification on the site salt balance at Airly Mine. In reality, the EC of the water transported to Airly Mine will be lower than the modelled EC given that the EC of the Reedy Creek Dam water is significantly lower than the LDP4 discharge.

7.2.2.6 Water Balance Results – Approved and Baseline Conditions

A summary of the annual water balance results is provided in Figure 5-5 of GHD (2019a). The annual water balance for 2030 for the baseline conditions is provided in **Table 11**. For comparison, this table also includes the approved water balance from the AMEP EIS (Golder Associates, 2014a) and GHD (2014b). The EIS approved results are presented as an average, whereas the baseline condition results are presented as an average, and dry and wet rainfall year balances. It is noted that the average results for the baseline condition differs from the approved condition in that it shows a deficit of 64 ML/year. The deficit increases to 168 ML/year in a dry year. Further details are provided below.

Table 11 – Annual Water Balance for Approved and Baseline Conditions (2030)

Water Management Element	Approved conditions (ML/year)	Baseline conditions (ML/year)		
		Average (mean)	Dry year	Wet year
INPUTS				
Direct rainfall onto storages and catchment runoff	195	165	34	724
External potable water supply	1	1	1	0.3
Groundwater inflows into underground workings	180	74	74	74
Extraction from production bore	1	0	0	0
In situ coal moisture	46	45	45	45
TOTAL INPUTS	**422**	**285**	**154**	**843**
OUTPUTS				
Evaporation	45	49	49	54
Dust suppression	100	5	6	4
Sewage to Ecomax effluent treatment system	2	2	2	2
Discharge through LDP001	76	28	0	517
Discharge through LDP002	0	0	0	0
Discharge through LDP003	0	0	0	0
Discharge through planned REA LDP	0.5	0.5	0	0
Product coal moisture	142	208	208	208
Moisture retained in rejects	57	57	57	57
TOTAL OUTPUTS	**422**	**349**	**322**	**843**
CHANGE IN STORAGE				
Surface water storages	0	0	0	0
Underground water storages	0	0	0	0
TOTAL CHANGE IN STORAGE	**0**	**0**	**0**	**0**
BALANCE				
Deficit	0	**64**	**168**	0
Inputs – outputs – change in storage	0	0	0	0

Note: (i) Small discrepancies in totals are due to rounding of numbers in the GoldSim Model.

Deficits in Baseline Conditions

The average baseline condition results show a deficit compared to the approved scenario (which did not show a deficit) despite the activities and operations being the same for the two scenarios for the purposes of the site water balances. The deficits are identified as:

- 64 ML/year on average
- 168 ML/year in a dry year

- No deficit in a wet year.

The basic finding of the new modelling presented in this SEE is that the mine requires additional water to operate at the approved level. The identified deficits occur for the following reasons.

- The mine inflows into the existing workings are expected to be significantly less than predicted under approved conditions in the AMEP EIS. As discussed in **Section 4.3**, the existing groundwater model was recalibrated recently with additional data acquired since the time of the AMEP EIS submission in 2014. Groundwater inflows are expected to be unchanged with rainfall conditions.
- Direct rainfall and catchment run-off, which on average is the largest source of water into the Airly Mine water management system in 2030, is lower for the baseline condition, due to the refinement in catchment areas, runoff parameters and water storage geometry based on new operational data. This has resulted in a reduction in inputs from 195 ML/year in the EIS approved case to 166 ML/year in the baseline case.
- Water associated with the product coal moisture is forecast to be the largest output from the site, under both the approved condition and the baseline condition. This volume is an increase compared to approved conditions, as all groundwater inflows are expected to report as product coal moisture, and not be able to be recovered and reused under the baseline conditions. Moisture retained in rejects is unchanged, and both the coil moisture and the reject moisture are expected to be insensitive to rainfall conditions.

In the dry year site water balance the deficit for the baseline condition is shown as 168 ML/year in **Table 11**. In a wet year, there are no predictions of a water deficit.

Table 11 shows a significant difference in dust suppression water usage between the approved and the baseline conditions. The revised dust suppression demand reflects site observations of dust suppression usage since 2014, which is less conservative than the demand of 100 ML/year assumed by the water balance model under approved conditions.

All other inputs / outputs for the baseline average conditions are similar to the approved inputs and outputs.

Discharges through LDP001

From **Table 11**, it can be seen that on average, discharges through LDP001 to Airly Creek are modelled to be lower under the baseline conditions than the approved conditions. This reflects the reduction in predicted groundwater inflows into underground workings (**Section 4.3**), which at the time of AMEP EIS Surface Water Assessment (GHD, 2014b) were expected to be transferred to the surface water system for reuse and discharge through LDP001. In the baseline conditions, any groundwater inflows are expected to report only as product coal moisture, and therefore discharges via LDP001 are only expected due to rare rainfall events. Discharges via LDP001 are expected to higher in the wet year and no discharges are predicted in the dry year.

When daily water discharges through LDP001 are considered, modelling shows that under existing conditions for all 129 historical rainfall patterns modelled, discharges off-site through LDP001 to Airly Creek are expected to occur only due to rare rainfall events (refer to **Figure 13** for percentiles of daily flow rates for base case). All discharges modelled under existing conditions were predicted to occur as a result of rainfall events exceeding 44 mm over five days, which is the rainfall depth for a 95th percentile, five day rainfall event design criteria for the 35 ML Discharge Dam. Discharges were predicted to occur on less than 2% of days modelled, with the maximum daily discharge estimated to be about 30 ML/day.

Discharge through LDP002, LDP003 and REA LDP

No discharges through LDP002 or LDP003 occur in the approved conditions or for the baseline conditions. The simulated predicted average discharge through a future planned LDP (REA LDP) from the REA Dam show some discharges are predicted for the baseline conditions for the REA Dam.

Product Coal Moisture and Moisture Retained in Reject Material

Water associated with the product coal moisture is forecast to be the largest output from the site, on average. This volume is an increase compared to the approved conditions, as all groundwater inflows are now expected to report as product coal moisture and not be able to be recovered and reused under the baseline conditions. Moisture retained in rejects is unchanged.

Product coal moisture and moisture retained in reject materials are expected to be insensitive to rainfall conditions.

7.2.2.7 Salt Balance Results – Approved and Baseline Conditions

The salt balance is an extension of the water balance model with expected concentrations of salt applied to water inflows into the system. Figure 5-7 of the Surface Water Assessment (GHD, 2019a) shows the annual salt transfers for the baseline condition. This salt balance is based on the water annual transfers shown in Figure 5-5 of GHD (2019a), and discussed in **Section 7.2.2.1**. The inputs and outputs for the salt balance under the baseline conditions in 2030 are summarised in **Table 12**. The salt balance results are broadly similar to the water balance results presented in **Table 11**.

Table 12 – Annual Salt Balance for Approved and Baseline Conditions (2030)

Water Management Element	Approved conditions (tonne/year)	Baseline conditions (tonne/year)		
		Average	Dry year	Wet year
INPUTS				
Direct rainfall onto storages and catchment runoff	58	49	10	179
External potable water supply	0	0	0	0
Groundwater inflows into underground workings	109	41	41	41
Extraction from Production Bore	3	0	0	0
In situ coal moisture	28	25	25	25
TOTAL INPUTS	**198**	**115**	**76**	**245-**
OUTPUTS				
Evaporation	0	0	0	0
Dust suppression	53	3	4	1
Sewage to Ecomax effluent treatment system	0	1	0.5	1
Discharge through LDP001	35	10	0	147
Discharge through LDP002	0	0	0	0
Discharge through LDP003	0	0	0	0
Discharge through planned REA LDP	0.2	0.2	0	0

Water Management Element	Approved conditions (tonne/year)	Baseline conditions (tonne/year)		
		Average	Dry year	Wet year
Product coal moisture	78	110	135	76
Moisture retained in rejects	31	30	37	21
TOTAL OUTPUTS	**198**	**153**	**176**	**245**
CHANGE IN STORAGE				
Surface water storages	0	0	0	0
Underground water storages	0	0	0	0
TOTAL CHANGE IN STORAGE	**0**	**0**	**0**	**0**
BALANCE				
Deficit	0	**38**	**100**	0
Inputs – outputs – change in storage	0	0	0	0

Note: Small discrepancies in totals are due to rounding of numbers in the GoldSim Model.

On average, the largest source of salt into the water management system for the baseline conditions is direct rainfall onto storages and catchment runoff. This is less and greater than in the dry year and wet year cases respectively, in proportion with rainfall. The result for the baseline conditions is lower than the approved conditions, on average, approximately proportional to the difference in water flows provided in **Table 11**.

The salt associated with groundwater inflows is the second largest input into the water management system and is independent of rainfall conditions. The salt flux for the baseline conditions is lower than for approved conditions, approximately proportional to the difference in water flows shown in **Table 11.** It is also due to the refined estimates of groundwater salinity based on site monitoring data.

In the baseline conditions, salt lost via dust suppression is relatively minor, in the dry year, the mass lost was slightly higher, due to less dilution by rainfall and catchment runoff, and slightly lower in the wet year, due to greater dilution. The salt lost in approved conditions was significantly greater, approximately proportional to the difference in water flows due to the very high dust suppression water demand used in site water balance, which has been significantly reduced in the re-run of the site water balance for this SEE due to availability of more monitoring data. .

Discharges through LDP001

In the baseline conditions, some salt is discharged via LDP001 on average, however this is significantly less than under approved conditions, as the reduction in predicted groundwater inflows means that discharges are only expected due to rare rainfall events. In the wet year, the mass of salt discharged is higher than the average year, however, this is not proportional (but is less than) to difference in water flows provided in **Table 11**, due to dilution within the water management system. No discharges were simulated in the dry year condition.

Daily salt discharges through LDP001 to Airly Creek have been modelled based on existing conditions with reference to base case predicted discharge flow rates shown **Figure 13.** The EC of the discharge water ranges from approximately 300 µS/cm to a maximum of 850 µS/cm.

Discharge through LDP002, LDP003 and REA LDP

In all modelled baseline cases, no discharges were simulated via LDP002 or LDP003, while the mass of salt discharged via the planned REA LDP from the REA Dam was less than 1 tonne/year on average in approved and baseline conditions.

7.2.2.8 Downstream Licensed Surface Water Users

Table 13 presents the identified surface water users and the associated approvals in the area of potential impact. Three lots have approvals for surface water diversion works (pumps) and are licensed to extract from the Hawkesbury and Lower Nepean River Water Source (WaterNSW, 2018). These users are located on Coco Creek, approximately 20 km downstream of the Airly Mine pit top. The locations of these downstream surface water users are shown in **Figure 12**.

Table 13 – Downstream Licensed Surface Water Users

Lot/DP	Approval number	Kind of approval	Work type	Use	WAL number	WAL share components
Lot 10, DP 247318	10CA104429	Water supply works and water use	Diversion works – pumps	Irrigation	26541	12 ML/year
Lot 4, DP 866875	10CA105445	Water supply works and water use	Diversion works – pumps, storages	Irrigation	25906	5 ML/ year
					26039	42.5 ML/ year
Lot 42, DP 751640	10CA105144	Water supply works and water use	Diversion works – pumps, storages	Irrigation	26728	4 ML/ year
					26601	45 ML/ year

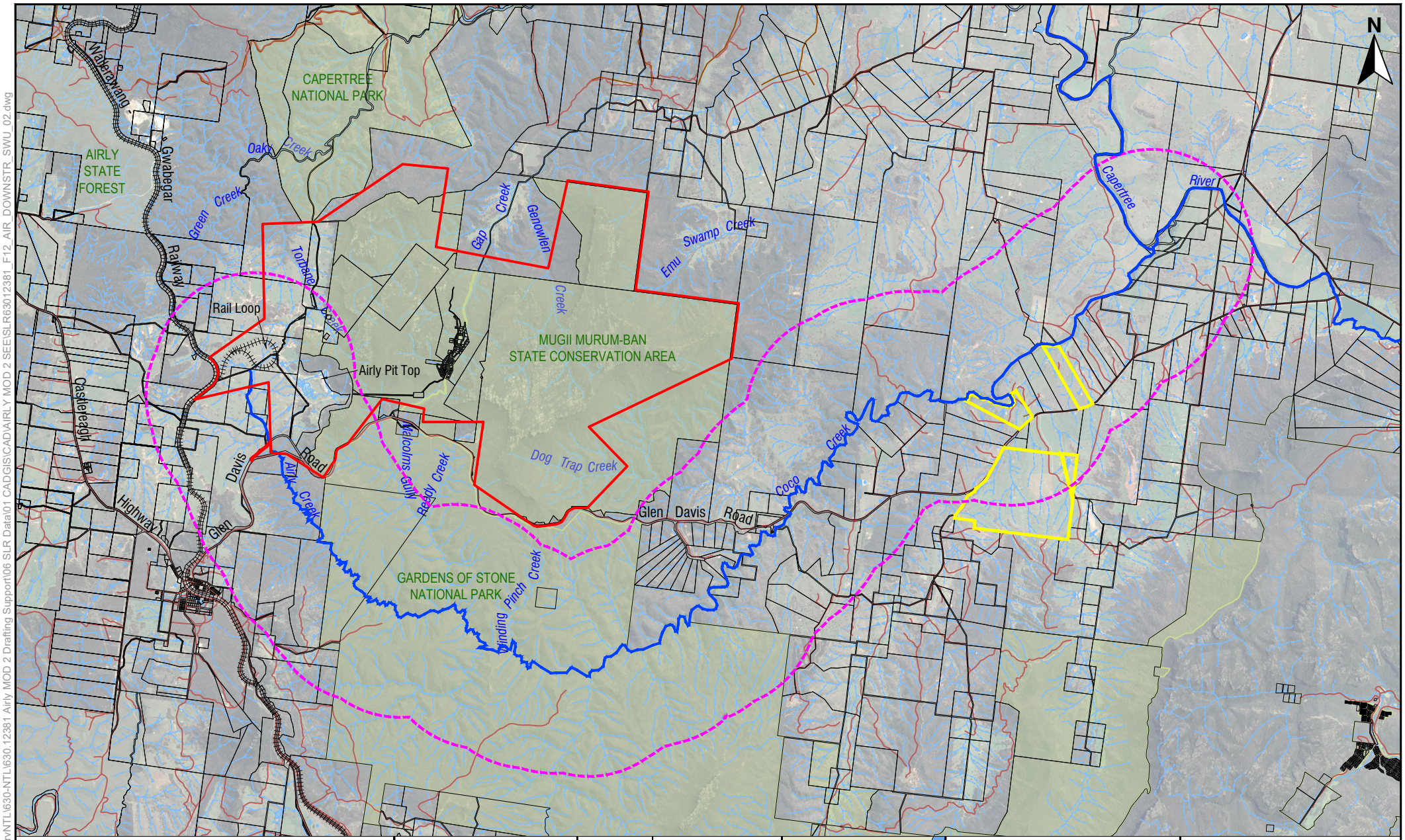
7.2.2.9 Aquatic Ecology

Aquatic ecology monitoring was undertaken in Airly Creek and other waterways relevant to Airly Mine operations as part of the AMEP EIS over three sampling events (Cardno 2014). Macroinvertebrates, fish and habitat condition was monitored during each sampling event. Routine (post-EIS) aquatic ecology monitoring is conducted biannually in Airly Creek with seven monitoring rounds completed between spring 2015 and spring 2018. Macroinvertebrates, water quality and habitat condition are monitored during each sampling event.

Cardno (2014) identified that the macroinvertebrate community of Airly Creek was impaired due to historic clearing of the riparian vegetation, agricultural, historic mining and the ephemeral nature of the waterway (Cardno, 2014). Cardno conducted three fish surveys of Airly Creek using backpack electrofishing and identified one fish species, the invasive *Gambusia holbrooki* (Plague minnow) as occurring in Airly Creek (Cardno, 2014).

The results of routine (post- EIS) monitoring program have confirmed the findings of Cardno (2014) in regard to macroinvertebrates, which are comprised largely of pollution tolerant taxa due to poor water quality relating to the agricultural land use, riparian zone clearing and water scarcity and the related influence of these factors on instream habitat (GHD, 2018).

A search under the EPBC Act Protected Matters Report did not identify any invasive species as occurring in the Reedy Creek catchment at Charbon Colliery, although the invasive fish species *Gambusia holbrooki* has been collected opportunistically during macroinvertebrate monitoring. Predation by *Gambusia holbrooki* is a Key Threatening Process listed under the *Fisheries Management Act 1994*. *Gambusia holbrooki* has also been recorded in Airly Creek in high numbers (Cardno, 2014). No invasive macroinvertebrate species were identified in the Protected Matters Report as likely to occur at Charbon Colliery.


N
CAPERTREE NATIONAL PARK
AIRLY STATE FOREST
MUGII MURUM-BAN STATE CONSERVATION AREA
GARDENS OF STONE NATIONAL PARK
Wallerawang
Gwabegar Railway
Rail Loop
Airly Pit Top
Castlereagh Highway
Glen Davis Road
Oaky Creek
Green Creek
Torbane Gap
Gap Creek
Genowlen Creek
Ernu Swamp Creek
Capertree River
Dog Trap Creek
Reedy Creek
Malcolms Gully
Airly Creek
Coco Creek
Pinch Creek
LEGEND:
Project Application Area
Cadastal Boundary
Downstream Watercourse
Works Approval Search Area
Licensed Water User
Major Roads
Watercourse
Railway
State Forest
National Park / State Conservation Area
CENTENNIAL AIRLY PTY. LTD.
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DATE 03.04.2019
SEAM LITHGOW
REFERENCE SLR63012381_F12_AIR_DOWNSTR_SWU_02.dwg
SCALE 1 : 100000
NEW SOUTH WALES
Airly Mine Project Site
Dubbo
Tamworth
Muswellbrook
Singleton
Newcastle
Sydney
Canberra
Figure 12
Downstream Surface Water Users
0 2.0 4.0 KM
Centennial Coal
Airly
Prepared by:
SLR
A4
H:\Projects-SLR\630-SrvNTL\630-NTL\630.12381 Airly MOD 2 Drafting Support\06 SLR Data\01 CAD\GIS\CAD\AIRLY MOD 2 SEE\SLR63012381_F12_AIR_DOWNSTR_SWU_02.dwg

Biannual aquatic monitoring is also undertaken in Reedy Creek Dam at Charbon Colliery, and the aquatic environment of this source of water for Airly Mine is well understood (Centennial Coal, 2019).

7.2.3 Impact Assessment

7.2.3.1 Water Balance – Baseline and Proposed Conditions

A summary of the average annual water balance results for baseline and proposed conditions is provided in **Table 14**. The data for the approved scenario (as was presented in the AMEP EIS (Golder Associates, 2014a) is presented in **Table 11**. As noted above, the baseline condition is the site water balance for the approved Project activities, remodelled with updated modelling assumptions and contemporary monitoring data.

Average results and results for wet and dry years are provided for baseline and proposed conditions. The only difference in the results for the baseline and the proposed case is that the forecast process water deficit is supplied by water imported from Charbon Colliery. This is not unexpected given there are no other new operational activities proposed in the modification or amendments to the existing operations which would result in changes to the inputs and outputs noted in **Table 14**.

The results of the dry year indicate that proposed transfer rate of 170 ML/year is sufficient to supply the approved production and activities (including the operation of the approved CPP and REA) at Airly Mine in all rainfall conditions that could reasonably be expected based on the historical rainfall record. In the wet year, no transfer from Charbon Colliery would be required and therefore, the site water balance would be unchanged by the modification in a wet year.

Table 14 – Annual Water Balance for Baseline and Proposed Conditions (2030)

Water Management Element	Average (ML/year)		Dry year (ML/year)		Wet year (ML/year)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Inputs						
Direct rainfall and runoff	165	165	34	34	724	724
External potable water supply	1	1	1	1	0.3	0.3
Groundwater inflows	74	74	74	74	74	74
Extraction from Production Bore	0	0	0	0	0	0
In situ coal moisture	45	45	45	45	45	45
Transfer from Charbon Colliery	0	**64**	0	**168**	0	**0**
Total Inputs	**285**	**349**	**154**	**322**	**843**	**843**
Outputs						
Evaporation	49	49	49	49	54	54
Dust suppression	5	5	6	6	4	4
Sewage to Ecomax system	2	2	2	2	2	2
Discharge through LDP001	28	28	0	0	517	517
Discharge through LDP002	0	0	0	0	0	0
Discharge through LDP003	0	0	0	0	0	0
Discharge through REA LDP	0.5	0.5	0	0	0	0

Water Management Element	Average (ML/year)		Dry year (ML/year)		Wet year (ML/year)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Product coal moisture	208	208	208	208	208	208
Moisture in rejects	57	57	57	57	57	57
Total Outputs	**349**	**349**	**322**	**322**	**843**	**843**
Change in Storage						
Surface storages	0	0	0	0	0	0
Underground storages	0	0	0	0	0	0
Total Change in Storage	0	0	0	0	0	0
Balance						
Deficit	**64**	0	**168**	0	**0**	0
Change in storage	0	0	0	0	0	0

Note: (i) Small discrepancies in totals are due to rounding of numbers in the GoldSim Model.(ii) Deficits identified under the baseline conditions (in red) are shown as transfers (in green) in the proposed conditions.

Discharge through Licensed Discharge Points

Table 11 indicates that the EIS approved conditions estimated that 76 ML/year would be discharged from LDP001 on average. **Table 14** shows that on average, LDP001 discharges are predicted at 27 ML/year, which is significantly reduced from the EIS approved case. Of note, modelling indicates that there is no difference between the baseline conditions and the proposed conditions, or in other words, the modification will not affect off site water discharge average volumes.

Discharges off site through LDP001 to Airly Creek will occur due to rainfall events exceeding 44 mm over five days, which is the rainfall depth for a 95th percentile, five day rainfall event design criteria for the 35 ML Discharge Dam. Discharges were predicted to occur on less than 2% of days modelled, with the maximum daily discharge estimated to be about 30 ML/day for the baseline conditions and proposed conditions.

Figure 13 presents the percentiles of the *daily LDP001 discharges* predicted for the baseline conditions and proposed conditions for all 129 historical rainfall patterns modelled. The minor differences between the baseline and proposed conditions are due to differences in modelling implementation between the two scenarios modelled, and not due to a change or increase in likelihood of discharges due to the proposed modification. In both the baseline and the proposed scenarios, discharges are only expected due to rainfall events.

Of note, the water balance model results did not forecast transfers from Charbon Colliery (for the proposed conditions) *at the same time* as discharges through LDP001, since discharges would occur only when the site water storages were filled by rainfall runoff, in which case water transfers from Charbon Colliery would not occur, as the storages would be more than 75% full (**Section 7.2.8**).

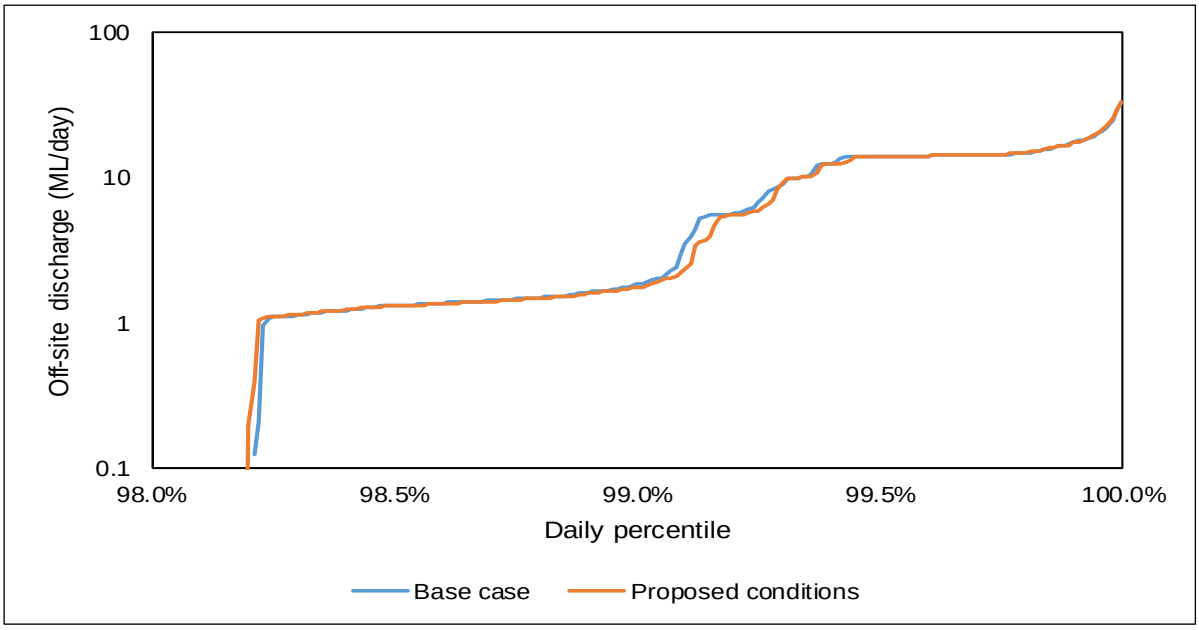


Figure 13 – Predicted Daily LDP001 Discharges for Baseline and Proposed Conditions

7.2.3.2 Salt Balance – Baseline and Proposed Conditions

The predicted annual salt transfers for the proposed conditions are presented in Figure 6-3 of GHD (2019a), which may be compared to Figure 5-7 for the salt transfers for the baseline conditions. The average annual inputs and outputs for the salt balance for the baseline conditions and proposed conditions are compared in **Table 15** for the year 2030, consistent with the water balance shown in **Table 14**.

Table 15 – Annual Salt Balance for Baseline and Proposed Conditions (2030)

Water Management Element	Average (tonne/year)		Dry year (tonne/year)		Wet year (tonne/year)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Inputs						
Direct rainfall and runoff	49	49	10	10	179	179
External potable water supply	0	0	0	0	0	0
Groundwater inflows	41	41	41	41	41	41
Extraction from production bore	0	0	0	0	0	0
In situ coal moisture	25	25	25	25	25	25
Transfer from Charbon Colliery	0	**98**	0	**260**	0	**0**
Total Inputs	**115**	**213**	**76**	**335**	**245**	**245**
Outputs						
Evaporation	0	0	0	0	0	0
Dust suppression	3	4	4	9	1	1
Sewage to Ecomax system	1	1	1	1	1	1
Discharge through LDP001	10	13	0	0	147	147

Water Management Element	Average (tonne/year)		Dry year (tonne/year)		Wet year (tonne/year)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Discharge through LDP002	0	0	0	0	0	0
Discharge through LDP003	0	0	0	0	0	0
Discharge through REA LDP	0.2	0.2	0	0	0	0
Product coal moisture	110	154	135	254	76	76
Moisture retained in rejects	30	42	37	71	21	21
Total Outputs	**153**	**213**	**176**	**335**	**245**	**245**
Change in Storage						
Surface storages	0	0	0	0	0	0
Underground storages	0	0	0	0	0	0
Total Change in Storage	0	0	0	0	0	0
Balance						
Deficit	**38**	0	**100**	0	0	**0**
Change in storage	0	0	0	0	0	0

Note: (i) Small discrepancies in totals are due to rounding of numbers in the GoldSim Model. (ii) Deficits identified under the baseline conditions (in brown) are shown as transfers (in purple) in the proposed conditions

Table 15 shows that the water imported from Charbon Colliery (proposed conditions) is saltier than which was modelled for the deficit in the baseline conditions. As discussed in **Section 7.2.2.5**, the baseline condition salt balance utilised the median EC of the 35 ML Discharge Dam, at 900 µS/cm (**Table 16**). This EC is significantly less than the EC utilised in the salt balance modelling for the proposed condition.

For the proposed scenario modelling, it has been assumed the EC of the water transferred from Charbon Colliery will have a median EC of 2320 µS/cm, equivalent to the median EC of the LDP4 Discharge at Charbon Colliery. As noted in **Section 7.2.3.5**, this assumption of the EC of the imported water is conservative, given that water from Charbon Colliery will be sourced from both LDP4 Discharge Dam as well as Reedy Creek Dam (with some contributions from CHPP Dams) and all dams have all with different ECs (**Table 16**). The EC of the blended water for transfer to Airly Mine is likely to be lower than the modelled EC of 2320 µS/cm. For this reason, the salt balance results for the proposed scenarios (average and dry year) are consistently and proportionally higher than the baseline condition results. The significance of this result is discussed below (**Section 7.2.3.3**).

In the wet year, no transfer from Charbon Colliery is expected to be required and therefore the site salt balance would be unchanged for the Project.

Discharges through Licensed Discharge Points

Figure 14 presents the percentiles of the EC corresponding to the daily volume of water predicted to be discharged through LDP001 into Airly Creek for the baseline conditions and proposed conditions (as shown in **Figure 13**). EC was modelled to range up to approximately 800 µS/cm for the baseline conditions and 1700 µS/cm for the proposed conditions. These maximum EC values are generally lower than the EC presented in **Section 7.2.3.3**, since some dilution of water at Airly Mine would occur due to rainfall before any discharges occurred.

The difference in the salt levels discharged via LDP001 shown in **Figure 14** and data presented in **Table 15** for the proposed scenario is due to the methodology employed in the site salt balance

modelling. As noted previously, the assumption of the median EC (2320 µS/cm) of the imported water is conservative, given that water from Charbon Colliery will be sourced from LDP4 Dam (median EC 1485 µS/cm) and LDP4 Discharge Dam (median EC 1830 µS/cm). The EC of the water actually transferred from Charbon Colliery is likely to be lower than the modelled EC of 2320 µS/cm, and therefore the EC of potential discharges is likely to be lower.

The result presented in **Figure 14** for the proposed conditions is conservative. There could be a potential impact on discharge water quality as a result of the modification, however the water quality discussions included in **Section 7.2.3.3** should be taken in consideration to provide context to the proposed condition predictions presented in **Figure 14**.

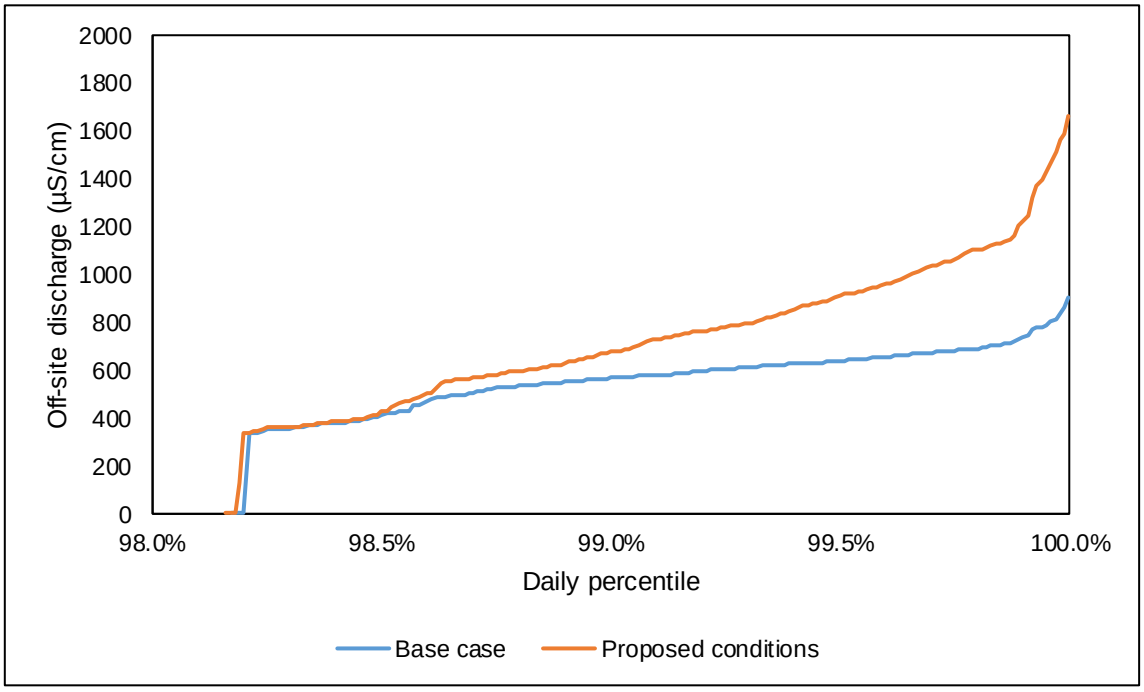


Figure 14 – Predicted Electrical Conductivity in Daily LDP001 Discharges for Baseline and Proposed Conditions

7.2.3.3 Surface Water Quality

The introduction of water from Charbon Colliery to Airly Mine has the potential to affect the water quality of the water management system and potential discharges to Airly Creek. The median water quality results for the relevant sites at Airly Mine (Airly Creek Upstream, Airly Creek, and 35 ML Discharge Dam) and Charbon Colliery (LDP4 Discharge, LDP4 Dam and Reedy Creek Dam, which are the water transfer sources) are provided in **Table 16**. The concentration limits for water quality parameters in LDP001 discharges specified by EPL 12374 and the SSGVs for the Airly Creek catchment are also provided in **Table 16**. Exceedances of the LDP001 limits or SSGVs are highlighted in pink.

As noted in **Section 7.2.2.2**, the full statistical summary of water quality at the monitoring sites Airly Mine Airly Creek Upstream, Airly Creek, and 35 ML Discharge Dam are presented in Appendix D of GHD (2019a). The full statistical summaries of water quality from the Charbon Colliery sites are also included. Time series graphs of all monitoring sites are also included in Appendix D of GHD (2019a).

The following sections provide comparisons of the water quality parameters between the imported Charbon Colliery water and the water quality of Airly Mine water. Direct comparisons are made

between water quality data from the two mine sites. Water quality from the Charbon Colliery water sources are also directly compared with Airly Mine's EPL 12374 and Airly Creek SSGVs. These comparisons should be considered conservative since water from Charbon Colliery sources will be blended from the LDP4 Dam and Reedy Creek Dam and the blending volume ratio depends on operational conditions. Water quality of the blended water may not necessarily reflect the water quality of any one source dam at Charbon Colliery.

The imported water will be blended with water in Airly Mine dams. Given that the blending ratio in the water management system will not be known when the water importation commences, the water quality of the Airly Mine water management system and any potential discharges via LDP001 are not able to be predicted until the water quality monitoring has been undertaken over a period of time to provide statistically robust data. .

Physicochemical Parameters

The EC recorded at Charbon Colliery generally ranged between 1300 µS/cm and 2500 µS/cm for LDP4 discharge and the LDP4 Discharge Dam. Results for Reedy Creek Dam were typically lower, with a median value of 1485 µS/cm compared to median values of 1830 µS/cm for LDP4 Discharge and 2320 µS/cm for the LDP4 Discharge Dam. All results for EC at Charbon Colliery were less than the SSGV for the Airly Creek catchment, however results for LDP4 Discharge and the LDP4 Discharge Dam have exceeded the EPL 12374 limit for LDP001 discharge since 2017. Generally, the EC reported for Charbon Colliery water sources was found to be less than the EC observed at the Airly Creek Upstream and Airly Creek monitoring sites.

The pH results for Charbon Colliery indicate slightly alkaline water, with pH typically ranging from 7.5 to 8.5. All results were within the EPL 12374 limits for LDP001 discharge; however a number of results exceeded the upper SSGV of 8.0 for LDP4 discharge, LDP4 Discharge Dam and Reedy Creek Dam. The median pH of the water at Charbon Colliery varies between 7.8 and 8.0 and falls within the EPL 12374 100th percentile pH range.

TSS concentrations were generally below the SSGV of 25 mg/L, with all results below the EPL 12374 limit for LDP001 discharge of 50 mg/L. Occasional results reported for Charbon Colliery monitoring sites were found to be elevated compared to Airly Mine monitoring sites.

Turbidity results for Charbon Colliery monitoring sites were found to be below the EPL 12374 limit for LDP001 discharge, with the exception of one sample at 63 NTU in March 2017. The majority of results were below the SSGV of 25 NTU, with the median results for LDP discharge, LDP4 Discharge Dam and Reedy Creek Dam below 7 NTU. The results for Charbon Colliery were generally elevated compared to Airly Mine monitoring sites, with median values below 2 NTU for the Airly Creek Upstream, Airly Creek and 35 ML Discharge Dam sites

Nutrients

Limited results are available for nutrients from Charbon Colliery sites. Relatively low concentrations of ammonia, total nitrogen and total phosphorus have been observed, with all results below relevant SSGVs and EPL 12374 limits for LDP001 discharge. Similar results are observed at both Airly Mine and Charbon Colliery monitoring sites. Accordingly, the transfer of water from Charbon to Airly is not expected to affect any off-site discharges to Airly Creek.

Table 16 –Surface Water Quality at Airly Mine and Charbon Colliery

Parameter	Units	EPL 12374 LDP001 limits		*SSGVs Airly Creek	Airly Mine Water Quality Monitoring Sites						Charbon Colliery Water Quality Monitoring Sites					
					Airly Creek upstream		Airly Creek		35 ML Discharge Dam (Airly)		LDP4 Discharge (Charbon)		LDP4 Dam (Charbon)		Reedy Creek Dam (Charbon)	
		90th percentile	100th percentile		Count	Median	Count	Median	Count	Median	Count	Median	Count	Median	Count	Median
Physicochemical parameters																
EC	µS/cm	2244		2709	25	2710	71	2390	103	900	47	1830	16	2320	42	1485
pH	pH units		6.5–9.0	6.5–8.0	25	7.5	71	7.4	103	8.4	47	7.8	28	8.0	44	8.0
TSS	mg/L	50		25	25	2	71	4	103	2	47	6	25	8	44	2
Turbidity	NTU	40		25	24	1.9	45	2	78	1.5	46	4.7	25	3.9	6	6.1
Nutrients																
Ammonia	mg/L		0.32	0.32	25	0.01	45	0.02			1	0.01	6	0.01	1	0.01
Total nitrogen	mg/L	2		0.7	25	0.4	45	0.5			1	0.4	6	0.2	1	0.4
Total phosphorus	mg/L	0.5		0.056	25	0.01	45	0.02			1	0.05	6	0.02	1	0.01
Dissolved metals																
Aluminium	mg/L			0.027	25	0.01	46	0.01	81	0.01					1	0.01
Antimony	mg/L			0.001	24	0.001	45	0.001	80	0.001					1	0.001
Arsenic	mg/L		0.024		25	0.001	46	0.001	81	0.001	7	0.001	1	0.001	4	0.001
Barium	mg/L			0.017	25	0.015	46	0.016	81	0.048						
Beryllium	mg/L			0.001	25	0.001	46	0.001	81	0.001						

Table 16 –Surface Water Quality at Airly Mine and Charbon Colliery

Parameter	Units	EPL 12374 LDP001 limits		*SSGVs Airly Creek	Airly Mine Water Quality Monitoring Sites						Charbon Colliery Water Quality Monitoring Sites					
					Airly Creek upstream		Airly Creek		35 ML Discharge Dam (Airly)		LDP4 Discharge (Charbon)		LDP4 Dam (Charbon)		Reedy Creek Dam (Charbon)	
		90th percentile	100th percentile		Count	Median	Count	Median	Count	Median	Count	Median	Count	Median	Count	Median
Boron	mg/L			0.09	25	0.05	45	0.05	81	0.05	1	0.05				
Cadmium	mg/L				25	0.0001	46	0.0001	81	0.0001	7	0.0001	1	0.0001	4	0.0001
Chromium	mg/L				25	0.001	46	0.001	81	0.001	7	0.001	7	0.001	4	0.001
Cobalt	mg/L			0.001	25	0.001	46	0.001	81	0.001	1	0.001				
Copper	mg/L		0.013	0.001	25	0.001	46	0.001	81	0.001	7	0.001	1	0.001	13	0.001
Iron	mg/L			0.3	25	0.07	67	0.05	102	0.05					10	0.05
Lead	mg/L			0.001	25	0.001	47	0.001	82	0.001	6	0.001	1	0.001	4	0.001
Manganese	mg/L			1.2	25	0.126	68	0.157	102	0.014	1	0.05			10	0.194
Mercury	mg/L				23	0.0001	45	0.0001	81	0.0001	7	0.0001	1	0.0001	4	0.0001
Molybdenum	mg/L			0.001	25	0.001	46	0.001	81	0.001						
Nickel	mg/L		0.1	0.008	25	0.005	46	0.006	81	0.002	7	0.008	1	0.002	4	0.003
Selenium	mg/L				25	0.01	46	0.01	81	0.01	2	0.01			2	0.01
Silver	mg/L			0.001	24	0.001	45	0.001	80	0.001					1	0.001
Zinc	mg/L		0.072	0.0076	25	0.005	46	0.006	81	0.005	7	0.005	1	0.005	13	0.005
Other parameters																
Oil & grease	mg/L		10	5	25	5	70	5	103	5	47	2	11	2	42	2

Source: (GHD, 2019a). Note DGV is the default guideline value recommended by ANZG (2018). Pink cells indicate where the median result exceeded either the Airly Mine EPL 12374 limits or the relevant SSGV. *from the *Airly Mine Water Management Plan* (Centennial Coal (2018b)

Dissolved Metals

All results for dissolved aluminium, antimony, arsenic, boron, cadmium, cobalt, lead, selenium and silver were found to be below the relevant LOR for LDP4 discharge, LDP4 Discharge Dam and Reedy Creek Dam. No results for dissolved barium, beryllium and molybdenum were available from Charbon Colliery monitoring sites. Dissolved metals monitored at the Airly Mine sites were generally at or below the LOR for the majority of parameters, with the exception of results for dissolved iron, manganese, nickel and zinc.

Results for dissolved chromium at Charbon Colliery monitoring sites were below the LOR of 0.001 mg/L, with the exception of one results reported for the LDP4 discharge of 0.004 mg/L in January 2018. All dissolved chromium results for Airly Mine monitoring sites were also below the LOR.

Dissolved copper results for LDP4 Discharge Dam and Reedy Creek Dam were reported to be below the LOR of 0.001 mg/L. Dissolved copper has been observed above the LOR on four occasions within samples from the LDP4 discharge, with three exceedances of the SSGV of 0.001 mg/L. All results were below the EPL 12374 limit of 0.013 mg/L for LDP001 discharge. Results for Charbon Colliery were similar to those for Airly Mine monitoring sites, with a median value of 0.001 mg/L for all sites.

Limited observations for dissolved iron have been undertaken at Charbon Colliery. The majority of samples from Reedy Creek Dam have been below the LOR of 0.05 mg/L, with the exception of one result for 0.22 mg/L reported in March 2012. Results indicate that dissolved iron concentrations were generally lower in Reedy Creek Dam than at the Airly Creek monitoring sites.

Concentrations of dissolved manganese at Charbon Colliery monitoring sites were found to range between 0.05 mg/L and 0.4 mg/L, which is elevated compared to the Airly Mine monitoring sites. The median dissolved manganese result for Reedy Creek Dam of 0.194 mg/L is higher than the median results for all three Airly Mine monitoring sites. However, all results for LDP4 discharge and Reedy Creek Dam were below the SSGV of 1.2 mg/L.

Dissolved mercury has been detected a total of three times at the Charbon Colliery monitoring sites analysed, with a maximum of 0.0013 mg/L reported for Reedy Creek Dam in January 2018. However, this result is considered to be erroneous as the total mercury result from the same sample was less than the LOR of 0.0001 mg/L. All results at the Airly Mine monitoring sites were found to be below the LOR.

The majority of dissolved nickel results for LDP4 discharge, LDP4 Discharge Dam and Reedy Creek Dam varied between 0.002 mg/L and 0.009 mg/L. Two results for LDP4 discharge were found to exceed the SSGV of 0.008 mg/L, however all results were below the EPL 12374 limit for LDP001 discharge of 0.1 mg/L. Median results were similar to the values for the Airly Creek monitoring sites.

Dissolved zinc concentrations were observed at the Charbon Colliery monitoring sites to generally range between the LOR of 0.005 mg/L and 0.02 mg/L. Occasional results for LDP4 discharge and Reedy Creek Dam were found to exceed the SSGV of 0.0076 mg/L, however all results were below the EPL 12374 limit for LDP001 discharge of 0.072 mg/L. Results were similar at the monitoring sites at Airly Mine and Charbon Colliery.

Implications of Water Quality in LDP001 Discharges due to Imported Water

The quality of the water proposed to be imported from Charbon Colliery is comparable to the water quality of Airly Creek and the 35 ML Discharge Dam, however EC, TSS, turbidity, total nitrogen and phosphorous and dissolved, manganese and nickel were found to be slightly elevated at Charbon Colliery in comparison to Airly Mine. It is possible that the importation of water from Charbon Colliery for use during dry periods may result in increases in the concentrations of these parameters within the water management system at Airly Mine. However, as the median water quality at Charbon Colliery is below the SSGVs for Airly Creek and EPL limits at Airly Mine, it is expected that the likelihood of potential off site discharges exceeding the SSGVs and EPL limits will not increase as a result of the modification.

The water balance modelling presented in **Section 7.2.3.1** predicted that discharges from the 35 ML Discharge Dam would occur due to overflows of the dam under high rainfall events and prolonged wet periods, and therefore discharge would be highly unlikely occur under zero or low flow conditions in Airly Creek. Based on the salt balance modelling (**Section 7.2.3.1**), the flow weighted average EC of off-site discharges through LDP001 under proposed conditions is predicted to be approximately 750 µS/cm, which is within the historical range observed in Airly Creek and below the SSGV of 2709 µS/cm.

Onsite water management measures, discussed in **Section 7.2.8**, would minimise the risk of discharge off-site. As water sourced from Charbon Colliery would only be used during periods of low rainfall, the risk of this water directly entering the receiving environment without dilution and causing environmental harm is extremely low. Therefore, the potential impact to Airly Creek as a result of the modification is considered to be low.

Airly Mine's EPL 12374 stipulate water quality limits in discharges, which Airly Mine will be required to comply with at all times.

7.2.3.4 Downstream Surface Water Users

The results of the site water discharge and salt balance calculations, (**Section 7.3.2.1** and **Section 7.3.2.2**) and water quality impact assessment (**Section 7.3.2.3**) indicate that no adverse change to the frequency or water quality of potential discharges from Airly Mine are expected as a result of the modification. Adverse impacts to downstream water users are unlikely to occur as a result of the modification due to the low risk of potential impacts and the mitigation and management measures proposed in **Section 7.2.8** to minimise offsite discharge volume and frequency.

7.2.3.5 Aquatic Ecology

Macroinvertebrates

As identified in **Section 7.2.3.3**, it is possible that the importation of water from Charbon Colliery for use during dry periods may result in an increase in the concentration of dissolved manganese and nickel in the water management system at Airly Mine. Given the pollution tolerant nature of the macroinvertebrate community in Airly Creek, and that the median concentrations of these metals have been recorded below the SSGVs for Airly Creek, there is a low risk of impacts to the macroinvertebrate community of Airly Creek.

In the unlikely event that discharges did occur of through the 35 ML Discharge Dam after the importation of water from Charbon Colliery commences, there is a low likelihood of introducing non-endemic macroinvertebrate species to Airly Creek, as some macroinvertebrate taxa collected in Reedy Creek Dam have not previously been observed in Airly Creek. Such an introduction has the potential to influence the macroinvertebrate community by altering the population dynamics (e.g. the balance between predators and grazers) or increasing competition for endemic species. However, it is likely that macroinvertebrates would not survive the transportation from Charbon Colliery to Airly Mine, either due to damage during pumping, oxygen depletion during transport or changes in ionic composition and lack of habitat in the water management system at Airly Mine. Given these factors and the on-site water management measures, which will minimise the risk of discharging water off-site, the risk of introducing non-endemic macroinvertebrate species to Airly Creek is low.

Plague Minnow

No fish were observed in Airly Creek other than the invasive *Gambusia holbrooki* (Plague Minnow) in high numbers (Cardno 2014). This fish was also observed in Reedy Creek Dam.

It is reasonable to assume that Plague Minnow individuals would be entrained by the pump system at Reedy Creek Dam. It is uncertain if the fish would survive the multiple pumping process from Reedy Creek Dam to CHPP Dam 1 to the rail tankers and then rail transit and discharge at Airly Mine. Research by the Narrandera Fisheries Centre (Lee Baumgartner et al, 2007) indicates that large

irrigation pumps kill or injure 16% of small fish entrained by the pump. Extrapolating this figure for the double pumping to be used at Charbon would suggest that up to 30% of small fish would be killed or injured. While there is no direct evidence from the Reedy Creek Dam or CHPP Dam 3 pump stations, it is reasonable to assume that at least some Plague Minnow would survive the transfer to Airly.

Plague Minnow were identified in all three aquatic monitoring rounds at Airly Creek reported in Cardno, (2014), indicating that a viable population exists there. Given that Airly Creek can be considered the potential receiving environment for water transferred from Charbon (should an overflow from Airly's water management system occur), the potential transfer of live Plague Minnow or its eggs from Charbon to Airly would not increase the range of this invasive fish, in Airly Creek or further downstream.

7.2.3.6 NSW Water Quality and River Flow Objectives 2006 Assessment

The NSW Water Quality and River Flow Objectives (DECCW, 2006) provide the agreed environmental values and long-term goals for each catchment in NSW and are intended to be considered in assessing and managing the potential impacts of activities on waterways.

The Project is in the Hawkesbury-Nepean River catchment. There are no environmental objectives for the Hawkesbury-Nepean River, as, at the time of the objectives were approved, the Healthy Rivers Commission had completed a public enquiry and recommended water quality objectives for the catchment. These objectives were for nutrients, namely 0.035 mg/L for total phosphorus and 0.7 mg/L for total nitrogen. (NSW Government, 2001: Table 2, p. 22). These trigger levels are less stringent than the ANZECC (2000) guideline levels for upland rivers applied in this assessment.

7.2.3.7 Significant Impact Guidelines Assessment

Table 17 presents an assessment of the modification against the EPBC Act *Significant Impact Guidelines for Coal Seam Gas and Large Coal Mines* (DoE (2013a). This assessment concludes that for each item in the Significant Impact Guidelines 1.3, the assessment criteria due to the proposed modification are either not applicable to the proposed modification or the impacts are not significant.

Table 17 – Impact Assessment against Significant Impact Guidelines

Impact criteria	Comment
Hydrological characteristics	
Changes in the water quantity, including the timing of variations in water quantity.	No impact. No change to extraction from water resources is proposed. The proposal is not expected to have any measurable increase in offsite discharges.
Changes in the integrity of hydrological or hydrogeological connections, including substantial structural damage.	No impact. No change to extent of the underground or surface parts of the site is proposed.
Changes in the area or extent of a water resource.	No impact. No change to the approved surface water catchments of the surface facilities area is proposed.
Water quality	
Substantially reduces the amount of water available for human consumptive uses or for other uses, including environmental uses, which are dependent on water of the appropriate quality.	No changes to water extraction at Airly Mine are proposed. No change to offsite discharge quantities is expected.

Impact criteria	Comment
Creates risk to human or animal health or to the condition of the natural environment as a result of the change in water quality.	The importation of the water from Charbon Colliery has the potential to increase the EC, turbidity, TSS, total nitrogen and phosphorous concentrations, and concentrations of dissolved manganese and nickel at concentrations in the water management system at Airly Mine. However, as the median concentrations of water quality parameters at Charbon Colliery are below the SSGVs for Airly Creek and EPL 12374 concentration limits at Airly Mine, the likelihood of potential off site discharges exceeding the SSGVs and EPL 12374 limits will not increase as a result of the modification. With the adoption of proposed water management measures for no discharges off site, the likelihood of water sourced from Charbon Colliery directly entering the receiving environmental without dilution is extremely low. Therefore, the potential impact to Airly Creek is considered to be low.
Causes persistent organic chemicals, heavy metals, salt or other potentially harmful substances to accumulate in the environment.	
There is a significant worsening of local water quality (where current local water quality is superior to local or regional water quality objectives).	
Seriously affects the habitat or lifestyle of a native species dependent on a water resource.	No impact. The modification has the potential to increase concentrations of dissolved metals manganese and nickel in the water management system at Airly Mine, albeit these concentrations are lower than the SSGVs of these metals in Airly Creek. Given the pollution tolerant nature of the macroinvertebrate community observed in Airly Creek, and that the median concentrations of metals have been recorded below the SSGVs for Airly Creek, there is a low risk of impacts to the macroinvertebrate community of Airly Creek. No fish were observed in Airly Creek other than the invasive *Gambusia holbrooki.* Therefore, no impacts to native fish are expected within Airly Creek as a result of the Project.
Causes the establishment of an invasive species (or the spread of an existing invasive species) that is harmful to the ecosystem function of the water resource.	No impact. No invasive macroinvertebrate species were identified in the Protected Matters Report (DEE 2019) as likely to occur at Charbon Colliery. The invasive fish species *Gambusia holbrooki* has been observed at Reedy Creek Dam at Charbon Colliery and also been in Airly Creek in high numbers Therefore, there is no risk of spreading this invasive fish species to the Airly Creek catchment.
High quality water is released into an ecosystem which is adapted to a lower water quality.	Not applicable. No changes to the frequency or magnitude of potential off-site discharges are expected (refer to Section 6.2.1). The quality of water in the water management system at Airly Mine and Charbon Colliery is not considered high (refer to Section 5.4)..

7.2.4 Cumulative Impacts

The modification is not expected to result in any measurable impacts to water quantity or quality downstream of Airly Mine. Given this, and that there are no other developments in the vicinity of Airly Mine, cumulative impacts are unlikely to occur as a result of the proposed modification.

7.2.5 Water Licensing

The Project proposes to receive up to 170 ML/year from Charbon Colliery and no other changes to extraction or use of water at Airly Mine are proposed. Therefore, no changes to any licences held for Airly Mine are required by the Project. Charbon Colliery holds sufficient licences for the extraction of the up to 170 ML/year of water from the Reedy Creek Dam catchment.

7.2.6 Impact Summary

Table 18 summarises the predicted impacts on water flows and quality.

Table 18 – Surface Water Impact Summary

Component	Existing conditions	Potential impacts
Water balance	Airly Mine has a process water deficit, due to groundwater inflows being lower than predicted and the existing production bore becoming unreliable.	No increase in the likelihood of potential off-site discharges, compared to the baseline conditions.
	Offsite discharges are only expected as a result of rare rainfall events in excess of the 95th percentile, five day event (44 mm of rainfall inn five days)	A reduced reliance on local and regional groundwater sources at Airly Mine.
Salt balance	The main salt influx at Airly Mine is from direct rainfall and catchment runoff. The main outflow of salt from Airly Mine, is salt within product coal.	The salt balance modelling (based on a conservative EC of in discharge water) indicates there could be a potential increase in the salinity of the offsite discharges. However, the more detailed water quality assessment (see below) found that the potential is low.
Water quality	Airly Creek is categorised brackish with EC in the range of 1300 µS/cm to 3300 µS/cm. Similar EC is observed at Charbon Colliery, with EC generally recorded between 1300 µS/cm and 2500 µS/cm.	The importation of the water from Charbon Colliery has the potential to increase EC, turbidity and TSS, total nitrogen and phosphorous, and dissolved manganese and nickel concentrations in the water management system at Airly Mine. However, as the median concentrations of water quality parameters in the Charbon Colliery water are below the SSGVs for Airly Creek and EPL 12374 concentration limits at Airly Mine, the likelihood of potential off site discharges exceeding the SSGVs and EPL 12374 limits will not increase as a result of the modification. With the implementation of management control measures for no offsite discharges, the likelihood of water sourced from Charbon Colliery directly entering the receiving environment without dilution is extremely low. Therefore, the potential impact to Airly Creek due to modification is low.
	The pH of Charbon Colliery source water is typically within from 7.5 to 8.5, a range that is within the range of Airly Creek.	
	Historical range of TSS, turbidity and nutrients at Charbon Colliery is comparable to Airly Creek catchment.	
	Concentrations of dissolved manganese and nickel are elevated in Charbon Colliery water.	
Downstream water users	Three downstream properties have works approvals related to surface water in potential area of impact.	Adverse impacts to downstream water users are unlikely to occur due to the low risk of potential impacts and the ephemeral nature of Airly Creek. Discharge through LDP001 will not occur with the implementation of operational controls.
Aquatic ecology	The macroinvertebrate community of Airly Creek is mainly pollution tolerant taxa due to poor water quality because of agricultural land use and riparian zone clearing.	Given the low risk of discharge, there is a low risk of impacts to macroinvertebrates and native fish in Airly Creek. There is a low likelihood of introducing non-endemic macroinvertebrate species to Airly Creek, as it is unlikely that they would survive in the water transfer and management system. No new invasive macroinvertebrates or fish species that could be spread to Airly Creek have been identified at Charbon Colliery.
	The invasive *Gambusia holbrooki* (Plague minnow) is already present in Airly Creek and Reedy Creek Dam at Charbon Colliery.	
	No invasive macroinvertebrate species were identified in the Protected Matters Report as likely to occur at Charbon	

Component	Existing conditions	Potential impacts
	Colliery.	
Licensing requirements	Charbon Colliery holds licenses to extract up to 336 ML annually from the Upper Cudgegong River water source.	No additional surface water licence allocations are required by either Airly Mine or Charbon Colliery.

7.2.7 Consequence of Potential Impacts

The environmental consequences of Airly Mine receiving up to 170 ML/year of water and managing the water within its existing water management system and no discharges off site are negligible. Water quality and aquatic ecology of Airly Creek are unlikely to be impacted by the modification. The downstream water users on Coco Creek are unlikely to be impacted by the modification with respect to water quality and flows due to the low risk of potential impacts and the mitigation and management proposed in **Section 7.2.8** to minimise off-site discharge volume and frequency.

7.2.8 Mitigation Measures

The following management measures will be implemented to minimise the risk of discharge of water from LDP001 to Airly Creek.

- The importation of water from Charbon Colliery will only be undertaken as required, and when Airly Mine surface water storages are less than 75% full. However, a 25% freeboard maintained will be maintained in all dams at all times.
- The water level in surface water storages will be continuously monitored.
- The water level in surface water storages will be maintained with sufficient freeboard to contain the 95th percentile, five day rainfall event of 44 mm.
- Water will only be imported from Charbon Colliery if there is no risk of discharges as a result of a five consecutive day total rainfall of 44 mm, allowed under Condition L2.5 of EPL 12374.

A review of the size of surface water storages and transfer systems (pipelines and pumps) in accordance with the 'Blue Book' design specifications where applicable have commenced. Upgrades to the relevant infrastructure will be implemented prior to the commencement of the importation of water to ensure that the surface water management system is sufficient to capture the 95th percentile, five day rainfall event. This would minimise the risk of uncontrolled discharges off site.

7.2.9 Management and Monitoring

Water Management Structures

Centennial Airly staff inspect manage and inspect surface water management structures for capacity, structural integrity and effectiveness. Maintenance of any erosion and sediment control structures are implemented when visual defects are observed. Maintenance of any erosion and sediment control structures are implemented when visual defects are observed. Sediment accumulated within storages is removed as required to maintain storage capacity.

Water Quality

A site-specific water management plan for Airly Mine has also been developed, and included in the *Western Region Water Management Plan* (Centennial Coal, 2018b). The management plan addresses the specific water management requirements for the mine and contains a comprehensive surface water monitoring program for the entire Airly Mine water management system. Monitoring includes water quality and level of water storages at the surface facilities area and water quality, flow and stability of watercourses surrounding the surface facilities area.

Trigger action response plans (TARPs) are provided in the site-specific water management plan. These TARPs provide guidance on the immediate actions that should be taken in response to any impacts of the site's operation identified as part of the monitoring program. Generally, responses include investigation and monitoring, determination of the risk of impact and remedial measures to be implemented. The TARPs also include reporting, training and personnel responsibilities.

The surface water monitoring program at Airly Mine will continue as per the current format in the Water Management Plan. Analyses of the data, taken from the time of the commencement of the water importation will be rigorously analysed every six months to establish any statistically significant changes in the Airly pit top water quality when compared against the historical trends.

Aquatic Ecology

Biannual aquatic ecology monitoring will be continued in Airly Creek in order to identify any changes that occur in the event of a discharge from Airly Mine. The aquatic ecology monitoring program design and methodology is outlined in the *Airly Mine Water Management Plan* (Centennial Coal, 2018b).

7.2.10 Conclusion

The Surface Water Impact Assessment (GHD, 2019a) has assessed the impacts of the modification on the local and regional hydrology.

Water imported by Airly Mine from Charbon Colliery has the potential to increase the EC, turbidity, the total suspended solid concentration, the total nitrogen and phosphorous concentrations and concentrations of dissolved and manganese in the water management system at Airly Mine. However, as the median concentrations of the water quality parameters in the Charbon Colliery water are below the site specific guidelines values (SSGVs) for Airly Creek and Airly Mine's EPL 12374 concentration limits, the likelihood of potential off site discharges exceeding the SSGVs and EPL 12374 concentration limits will not increase as a result of the modification. With the implementation of the management controls for no discharge off site to Airly Creek, the likelihood of water sourced from Charbon Colliery directly entering the receiving environment without dilution is extremely low. Therefore, the potential impact to Airly Creek due to the modification is low. EPL 12374 specifies water quality limits in discharges, which Airly Mine is required to comply with at all times.

The aquatic ecology environment of Airly Creek is unlikely to be impacted given the low risk of potential impacts of the proposed modification and given that management controls will be implemented to avoid discharges off site.

Downstream licensed surface water users on Coco Creek are unlikely to be impacted as a result of the modification due to the low risk of potential impacts and the mitigation and management proposed to minimise off-site discharge volume and frequency.

7.3 Noise

7.3.1 Introduction

The modification is not proposing to increase the number of train movements included in SSD 5581, comprising maximum 5 days per day and average 2 trains per day over a calendar year. Neither is the modification proposing to increase noise emission sources at the pit top. The AMEP EIS assessed the impact of intrusiveness noise in accordance with the then in force *Industrial Noise Policy* (EPA, 2000) and rail noise in accordance with the *Rail Infrastructure Noise Guideline* (EPA, 2013).

The rail noise in the EIS assessed sections of the Wallerawang-Gwabegar Rail Line outside the Project Application Area boundary and south of the Airly rail loop entrance. The modification is proposing to operate one train per day from Charbon Colliery located north of Airly Mine. Rail noise due to trains arriving from the north to enter the Airly Rail Loop was not assessed in the Airly EIS. Water laden trains from Charbon will not be able to directly enter the Airly Rail Loop. Instead, they will travel past the Airly rail loop entry, and after stopping for a short duration, they will reverse into the

Airly rail loop. On the return trip to Charbon, the empty train will reverse out of the rail loop into the Wallerawang-Gwabegar Rail Line past the Airly rail loop entry, and after stopping for a short duration will travel back to Charbon Colliery.

Accordingly a noise assessment (SLR, 2019), appended as **Appendix D**, has been prepared to assess the impact of trains from Charbon Colliery, arriving on the Wallerawang-Gwabegar Rail Line from the north at the Airly pit top. The noise assessment assesses the impact of the noise associated with the change in direction of water trains on the Wallerawang-Gwabegar Rail Line as well as wagons bunching when reversing into the rail loop.

While the modification is not proposing to change any approved activities at the pit top with the potential to significantly increase noise emissions, the noise assessment (SLR, 2019) has established project trigger noise levels for the receptors assessed with reference to the now in force *Noise Policy for Industry* (EPA, 2017). It is noted that the modification is not seeking to increase approved noise levels above those already contained in SSD 5581.

7.3.2 Existing Environment

The Airly consent permits mining operations to be undertaken 24 hours per day, 7 days per week. Mining activities comprise underground mining, coal processing, train loading and other approved activities at the pit top.

Residential receptors assessed in the AMEP EIS considered sensitive receptors shown in **Figure 6**, and which are subject to the noise criteria in Condition 2 under Schedule 4 of SSD 5581, shown in **Figure 15**.

Noise is managed at the pit top in accordance with the *Airly Mine Noise Management Plan* (Centennial Coal, 2018f). Operator attended noise monitoring is conducted on an annual basis at locations representative of the nearest residential receivers surrounding Airly Mine. Noise monitoring indicates that operation of the existing Airly Mine complies with the SSD 5581 criteria. Furthermore, it is noted that Airly Mine noise emissions do not trigger any modifying factors as described by the former *Industrial Noise Policy* (EPA, 2000) and *Noise Policy for Industry* (EPA, 2017).

It is also noted that, to date, no complaints regarding noise emissions from Airly Mine have been received.

Noise Criteria

2. The Applicant must ensure that the noise generated by the development does not exceed the criteria in Table 4.

Table 4: Noise criteria dB(A)

Land	*Day* $L_{Aeq(15\ min)}$	*Evening* $L_{Aeq(15\ min)}$	*Night* $L_{Aeq(15\ min)}$	*Night* $L_{A\ (max)}$
Any residence on privately-owned land	35	35	35	52
	$L_{Aeq\ (period)}$			
R17 (camp ground)	50 (when in use)			N/A
R18 (Nissen Hut)	50 (when in use)			N/A

Note: To interpret the locations referred to in Table 4 see the applicable figure(s) in Appendix 7.

Noise generated by the development is to be measured in accordance with the relevant requirements of the *NSW Industrial Noise Policy*. Appendix 8 sets out the meteorological conditions under which these criteria apply and the requirements for evaluating compliance with these criteria.

However, these criteria do not apply if the Applicant has a negotiated agreement with the owner/s of the relevant residence or land to generate higher noise levels, and the Applicant has advised the Department in writing of the terms of this agreement.

Figure 15 – Noise Criteria in Airly Mine SSD 5581

7.3.3 Project Noise Impact Assessment Criteria

The noise assessment has been prepared with reference to Australian Standards (AS) 1055:1997 *Description and Measurement of Environmental Noise* Parts 1, 2 and 3 and in general accordance with the EPA's NSW *Noise Policy for Industry* (EPA, 2017) and *Rail Infrastructure Noise Guideline* (EPA, 2013).

7.3.3.1 Rail Traffic Noise

Given that the modification has the potential to impact on receptors R2 – R5 in the vicinity of the Airly rail loop entrance (**Figure 6**), relevant rail noise levels at these receptors have been established in accordance with the *Rail Infrastructure Noise Guideline* (EPA, 2013). The rail noise levels at these receptors are:

- daytime LAeq(15hour) – 65 dBA
- night-time LAeq(9hour) – 60 dBA
- passby LAmax – 85 dBA.

7.3.3.2 Project Trigger Noise Levels

Applicable project trigger noise levels (PTNL) for the assessed receptors R2 – R5 are included in **Table 19**. The rating background noise levels (RBLs) were taken from the EIS NIA. Given that no significant changes in the region have occurred, the RBLs are considered representative of the pre-mining acoustic environment.

The LAFmax sleep disturbance criteria at all receiver locations would be 52 dBA.

Table 19 – Project Trigger Noise Levels

Location ID	Period	Project Intrusive[1] dBA LAeq(15minute)	Project Amenity[2] LAeq(period)	Project Amenity[3] dBA LAeq(15minute)	Resulting PTNL[4] dBA LAeq(15minute)
R2-R5	Day	40	45	48	40
	Evening	35	40	43	35
	Night	35	35	38	35

1. Project Intrusive is the RBL plus 5 dB
2. Project amenity (period) noise level is the Amenity Criteria minus 5 dB.
3. Project amenity (15 minute) noise level is the Project Amenity (period) noise level plus 3 dB
4. Resulting PTNL is the lower of the project intrusive and the project amenity (15 minute) noise levels.

7.3.4 Impact Assessment

7.3.4.1 Rail Traffic Noise

Noise from offsite rail activities associated with the modification on the Wallerawang-Gwabegar Rail Line has been considered in the rail traffic noise impact assessment and assessed in accordance with the *Rail Infrastructure Noise Guideline* (EPA, 2013).

As the Wallerawang-Gwabegar Rail Line between Charbon Colliery and Airly pit top is operated infrequently and not to a fixed timetable, existing rail noise levels from this section of the rail line would be low.

The assessment has considered a single return rail movement (i.e one return movement resulting in two rail passbys) during either the day or night period. For receivers to the west of the Airly rail loop, identified as R2 – R5 in **Figure 6**, noise associated with the change of direction of water trains on the Wallerawang-Gwabegar rail line prior to entering and upon exiting the Airly rail loop has been considered.

To provide a worst case assessment of rail noise one locomotive (notch 2 setting - LAeq sound power level of 105 dBA) has been considered to be operating for up to 15 minutes during each direction change on the Wallerawang-Gwabegar Rail Line as well as wagons bunching generating a LAmax sound power level of 125 dBA.

Predicted rail traffic noise levels at receivers in the vicinity of the Airly rail loop entrance are provided in **Table 20**.

Table 20 – Predicted Rail Noise Levels at Airly Rail Loop Entrance

Receiver	Distance to Airly Rail Loop Entrance Stopping Area	Predicted Noise Levels in dBA			Trigger Levels in dBA		
		Day LAeq(15hour)	Night LAeq(9hour)	Passby LAmax	Day LAeq(15hour)	Night LAeq(9hour)	Passby LAmax
R2	650 m	<30	<30	30	65	60	85
R3	1050	<30	<30	<30	65	60	85
R4	1,500	<30	<30	<30	65	60	85
R5	1,200 m	<30	<30	<30	65	60	85

The nearest receiver to the Wallerawang-Gwabegar Rail Line between Airly and Charbon pit tops is located approximately 50 m from the centreline of the track in the township of Clandulla. Predicted rail noise levels at this offset distance for one train load per day (i.e two movements during the day or night period) are provided in **Table 21**.

Table 21 – Predicted Rail Noise Levels from Wallerawang-Gwabegar Rail Line between Airly and Charbon Pit Tops

Distance to Wallerawang-Gwabegar Rail Line	Predicted Noise Levels			Trigger Levels		
	Day LAeq(15hour)	Night LAeq(9hour)	Passby LAmax	Day LAeq(15hour)	Night LA60eq(9hour)	Passby LAmax
50 m	43	45	83	65	60	85

From **Table 20** and **Table 21**, rail noise levels from the modification are predicted to be below the trigger levels at all receiver locations.

7.3.4.2 Project Operational Noise Levels

No changes to the pit top activities are proposed, with the exception that one of the existing dam pumps will be upgraded. The proposed use of the Rail Loop by a water laden train would be comparable to the existing use of the Rail Loop by coal trains assessed in the AMEP EIS, with the exception that associated coal loading infrastructure would not be operational as the water will be

unloaded via gravity. Furthermore, as only one train would operate on the loop at any one time, the modification would not lead to an increase in onsite activities above those assessed in the EIS.

As such the modification is not predicted to increase offsite noise emissions, and it is expected that Airly Mine would continue to operate in compliance with SSD 5581 criteria at all receiver locations.

7.3.4.3 Construction Noise

Construction works are proposed to occur for six weeks. The construction hours will be restricted to recommended standard hours in DECCW (2009), as discussed in **Section 4.2.3.2**. Minor construction works will be required and will involve excavation works for the trenching of a replacement pipeline and the enlargement of the Train Loader Dam. Construction noise involved will not exceed the noise criteria in SSD 5581. Construction noise will be temporary.

7.3.5 Environmental Consequences

Given no new noise sources will be added to the approved noise emissions sources, there are no predicted consequences. No exceedances of the consent noise criteria are expected. No exceedances of the *Rail Infrastructure Noise Guideline* (EPA, 2013) trigger levels for rail noise for the day and night periods and passbys are predicted.

7.3.6 Management

Operational noise monitoring will continue to be undertaken in accordance with the *Airly Mine Noise Management Plan* (Centennial Coal, 2018f).

7.4 Other Environmental Aspects

An assessment of other environmental aspects, with no potential for significant impact, but relevant to the modification elements are provided in **Table 22**.

Table 22 – Other Environmental Aspects

Environmental Aspect	Assessment
Biodiversity	The amendments to the existing water management infrastructure proposed in **Section 4.2.2** will be undertaken entirely within already disturbed areas. Given the area of the proposed works is highly modified the area has no measurable ecological value. The upgrade works during the construction phase and the operation of the train water discharge system will unlikely alter the existing ecological value of the area and the immediate surroundings. The modification will not generate any measurable impacts on any threatened species, populations and ecological communities, and their habitats, listed under the BC Act or the EPBC Act.
Aboriginal heritage	The existence of any Aboriginal sites within the modification works site is highly improbable due to the highly disturbed nature of the area. Given the improbability of the existence of Aboriginal sites within the area proposed for upgrade works, it is unlikely the existing Aboriginal cultural heritage values of the area will be altered by the proposed modification. In the unlikely event that unexpected potential items of Aboriginal cultural heritage significance are discovered during construction works, the protocols for managing unexpected finds, set out in the *Western Region Aboriginal Cultural Heritage Management Plan* (Centennial Coal 2018d), will be followed. It is noted that Aboriginal heritage sites exist within the Project Application Area boundary and are listed in the *Western Region Aboriginal Cultural Heritage Management Plan* (Centennial Coal, 2018d), with no sites located in the vicinity of the proposed works. These existing items will continue to be monitored and managed in accordance with the protocols identified in the plan.
Historic	The existence of any Aboriginal sites within the modification works site is highly improbable

Environmental Aspect	Assessment
heritage	due to the highly disturbed nature of the area. Given the improbability of the existence of sites of archaeological significance within the area proposed for upgrade works, it is unlikely the existing historic cultural heritage values of the area will be altered by the proposed modification. Therefore, the modification is unlikely to alter the historic heritage value of the area. In the unlikely event that unexpected potential heritage items are discovered during construction works, the protocols for managing unexpected finds, set out in the *Western Region Historic Heritage Management Plan* (Centennial Coal, 2018e), will be followed. There are items of historic significance located within the Project Application Area boundary, however none are located at the pit top in the vicinity of the water management system or the rail loop. The items that exit within the Project Application Area boundary are listed in the *Western Region Historic Heritage Management Plan* (Centennial Coal, 2018e), and will continue to be managed in accordance with the monitoring programs included in the plan.
Train traffic	As discussed in **Section 4.2.1**, water laden trains from Charbon Colliery will arrive at the Airly pit top using the Wallerawang-Gwabegar Rail Line. Only some sections of Wallerawang-Gwabegar Rail Line remain open to rail traffic. It is reported that the section from Kandos to Torbane is currently unused, although there are plans to operate occasional tourist trains from Rylstone to Kandos and possibly onto Lithgow. The rail line is not operated to any fixed timetable. One train per day will be operated to transfer the maximum 170 ML/year water. The relevant section of the Wallerawang-Gwabegar Rail Line remains open but unused and surplus train paths exist. The addition of the one train per day is not expected to disadvantage any future rail users. Even should the planned weekend tourist trains on the section of line between Kandos and Rylstone become a regular occurrence, they are unlikely to interact with trains on the line south of Charbon rail loop junction. Given that this section of line has no passing loops, Centennial Coal will liaise with the rail operator John Holland Country Regional Network and the tourist train operator to ensure operations continue for all without undue delays or restrictions. Airly Mine is approved to operate an average of 2 coal trains per day in a calendar year (with a maximum daily rate of 5 trains), which enter the Gwabegar to Wallerawang Rail Line at Torbane just north of Capertee. Given that the water trains from Charbon Colliery will not overlap with Airly's coal trains on the main line, there will be no interaction between the two apart from at Torbane Junction. The addition of water trains on the Wallerawang-Gwabegar Rail Line, along the northern sections, between Airly Rail Loop Entrance and Charbon Colliery, is not expected to generate any inconveniences to any existing or expected future rail users. The modification is not proposing to increase the train movements above the approved limits in SSD 5581, comprising maximum 5 trains per day and an average of 2 trains per day in a calendar year.
Road traffic	Airly Mine has vehicle access from Glen Davis Road, off Castlereagh Highway, and a private access road (Mine Access Road) for employee, visitor and contractors. The modification will generate very little short-term construction traffic, consisting of a few trucks loads of pipes and fittings as well as construction staff. Six contractors will be required over a six week period (**Section 4.2.3**) to complete the upgrade works. Trains will be loaded by the train driver and trains will be operated by third party service providers. One or two operational staff is expected to be required to assist with the loading of the transfer system on site on the days that trains are required. The traffic generated during the construction will be short-term and will involve six personnel arriving at the site and will fall within the approved 155 FTE personnel approved on Airly Mine's consent (SSD 5581). Operational staff is not required to be increased as a result of modification and the vehicle movements assessed in the AMEP EIS will not increase. Therefore the modification will not affect the capacity, efficiency and safety of the local, sub-regional and regional road network over the life of the AMEP, as modified.
Air quality	Airly Mine operates in accordance with the *Airly Mine Air Quality and Greenhouse Gas Management Plan* (Centennial Coal, 2018g). The air quality criteria in this plan relating to dust deposition criteria of 4 g/m^2/month, total suspended dust concentration criteria of

Environmental Aspect	Assessment
	90 µg/m^3, 24-hour PM_{10} dust concentration criteria of 50 µg/m^3, and 12-month average PM_{10} dust concentration criteria of 30 µg/m^3 are not exceeded from the current operations. The modification will consist of minor works that have some potential to generate small volumes of dust, particularly the excavation of and refilling of the substitute pipeline trench and the expansion of the Train Loader Dam. However, the upgrade works are minimal and is expected to take less than six weeks, thus minimising the dust generation potential. Operations themselves will revolve around pumping water, and so no operational dust issues are predicted. No new air emissions sources would be added during the operational phase. Given that Mine operated within air quality criteria, the proposed modification is expected to have no measurable impact on the local air quality. The air quality at the site will continue to be managed in accordance with the *Airly Mine Air Quality and Greenhouse Gas Management Plan* (Centennial Coal, 2018g).
Greenhouse gas emissions	The greenhouse gas emissions (GHG) from the AMEP were assessed in the EIS (Golder Associates, 2014a) and assessed contributions from all activities that were approved for the project. Most of the contributions from the site operations were due to conveyor drives and the CHPP, with water pumps contributing little to the total emissions. Emissions of rail haulage of coal from Airly Mine pit top to off site locations (domestic and export markets) were included. Trains proposed to be utilised for transferring water from Charbon Colliery to Airly pit top are shorter trains with one locomotive. Longer trains with 4 locomotives for the coal haulage were assessed in the AMEP EIS to travel to Newcastle port. Given that water rail haulage will be only approximately 32 km from Charbon to Airly Mine pit top using one locomotive /15 wagon trains, which is significantly shorter distance assessed in the EIS between Airly pit top and to Newcastle port using longer trains, the modification will generate a small fraction of the previous rail haulage greenhouse gas emissions, compared to the approved levels. The GHG emissions from the upgraded pumps will not be significantly higher than the existing pumps. Airly Mine manages its GHG emissions in accordance with the *Airly Mine Air Quality and Greenhouse Gas Management Plan* (Centennial Coal, 2018g). Also, as part of Centennial Coal's Sustainability Strategy, the company has set its "Vision 2020", the platform to tangibly deliver the Company Vision and Values. Vision 2020 incorporates a target for GHG, being to reduce company greenhouse gas emissions by 25% by 2020. An action plan and roadmap are in place to deliver this goal.
Visual amenity	Given the minor nature of the upgrade works to the existing water management infrastructure, no impacts on visual amenity will occur due to the proposed modification.
Waste	The modification will generate a small volume of construction related waste materials (e.g. general waste, packaging material, off-cuts of cables and pipes etc.). These materials will be disposed of or recycled as per the current practice at the site. Any additional spoil generated during excavation works for trenching the larger diameter pipeline will be reused for the rehabilitation of the area once the pipeline has been buried.
Groundwater resources	There will be less reliance on groundwater use from the Production Bore to supplement the process water at the site. Mine inflows have been revised, and the maximum mine inflows during mining in the Panel and Pillar Zone is predicted to be significantly less than included in the AMEP. On this basis, the overall impact of Airly Mine on the local groundwater resources is likely to be less than assessed in the AMEP EIS.

8 STATEMENT OF COMMITMENTS

Centennial Airly is committed to the identification, mitigation and management of potential risks from the continued operations at the mine. Key environmental management plans are already well developed and in place to manage and monitor the performance of all activities currently undertaken.

The proposed modification is minor in nature. No new commitments are required to be included in the current *Statement of Commitments* for Airly Mine as a result of the proposed modification. The management measures and monitoring described in the Airly Mine management plans will continue to be implemented.

Following determination, the relevant management plans will be reviewed and updated as necessary in accordance with Condition 3 Schedule 6 of SSD 5581.

9 JUSTIFICATION AND CONCLUSION

9.1 Introduction

This chapter provides a justification for the proposed modification having regard to environmental considerations. It summarises the potential environmental impacts and considers the proposed modification against the principles of Ecologically Sustainable Development.

9.2 Substantially the Same Development

The proposed modification constitutes a minor change to an existing consent SSD 5581 for Airly Mine. The SSD 5581 Project Application Area boundary will remain unchanged and no major changes to the site will be required.

Hours of operations are not proposed to change from the approved 24 hours per day and seven days per week.

Environmental impact assessments (surface water, noise) undertaken in this SEE determined that the importation of up to 170 ML/year of surface water from Charbon Colliery and transfer to Airly Mine pit top using rail transport are not expected to be significant. Impacts have been assessed as minor to negligible and are generally consistent with the impacts assessed in the AMEP EIS (Golder Associates, 2014a).

Environmental impact assessments in this SEE have concluded the following.

1. **Surface water**. Water from Charbon Colliery has the potential to increase the electrical conductivity (EC), turbidity, the total suspended solid concentration, the total nitrogen and phosphorous concentrations and concentrations of dissolved and manganese in the water management system at Airly Mine. However, as the median concentrations of the water quality parameters in the Charbon Colliery water are below the site specific guidelines values (SSGVs) for Airly Creek and Airly Mine's EPL 12374 concentration limits, the likelihood of potential off site discharges exceeding the SSGVs and EPL 12374 concentration limits will not increase as a result of the modification. With the implementation of the management controls for no discharge off site to Airly Creek, the likelihood of water sourced from Charbon Colliery directly entering the receiving environment without dilution is extremely low. Therefore, the potential impact to Airly Creek due to the modification is low. EPL 12374 specifies water quality limits in discharges, which Airly Mine is required to comply with at all times.

   The aquatic ecology environment of Airly Creek is unlikely to be impacted given the low risk of potential impacts of the proposed modification and given that management controls will be implemented to avoid discharges off site.

   Downstream licensed surface water users on Coco Creek are unlikely to be impacted as a result of the modification due to the low risk of potential impacts and the mitigation and management proposed to minimise off-site discharge volume and frequency.

2. **Noise**. There are no expected exceedances of consented operational noise criteria or the trigger levels in *Rail Infrastructure Noise Guideline* (EPA, 2013). Construction noise will not exceed the consent noise criteria and will be temporary.

3. **Road and rail traffic**. There are no expected long term road traffic consequences due to the modification. Road traffic generated during construction phase will fall within the assessed road traffic and will be temporary. The operation of the one water laden train per day to the Wallerawang-Gwabegar Rail Line between Charbon Colliery and Airly pit top is not expected to generate any inconveniences to any existing or expected future rail users, as there are no current regular users and the modification would take up just one train path per day.

4. **Biodiversity**. The modification will not generate any impacts on any threatened species, populations and ecological communities, and their habitats, listed under the BC Act or the EPBC Act.
5. **Cultural heritage**. Past disturbance of the site intended for construction makes it improbable that Aboriginal sites or items of historic significance remain and accordingly, no impacts or consequences on the cultural heritage values of the site are predicted.
6. **Air quality and greenhouse gas emissions**. The modification activities are predicted to comply with all relevant air quality criteria. GHG emissions due to the modification will not increase the GHG emissions assessed in the AMEP EIS.
7. **Visual amenity**. No major change to the existing Airly pit top infrastructure is proposed in the modification, only upgrades to the existing water management infrastructure. The modification will have no consequences on the visual amenity to the site or region.
8. **Groundwater**. Given the reduced reliance on the groundwater from the Production Bore to supplement process water, impacts on groundwater resources, the local and regional aquifers are unlikely due to the modification. Mine inflows have been revised, and the maximum mine inflows during mining in the Panel and Pillar Zone is predicted to be significantly less than included in the AMEP EIS. On these bases, the overall impact of Airly Mine on the local groundwater resources is likely to be less than assessed in the AMEP EIS.

For reasons discussed above, the Airly Mine Extension Project (as to be modified) will remain substantially the same as the development that was originally approved as SSD 5581.

9.3 Environmental Impacts

The key environmental issues (surface water, noise) identified due the proposed modification were the subject of technical studies summarised in **Chapter 7.0**. Other environmental aspects have also been considered in **Section 7.4**.

Table 23 provides an overview of the key environmental issues discussed in this SEE. The impacts range from low risk to negligible and not predicted to be significant. Mitigation measures are proposed to be implemented as relevant for any potential adverse environmental impacts. The residual impacts of the modification are minimal and meet the objectives of the EP&A Act (**Section 5.3.1)**.

Table 23 – Summary of Environmental Impacts

Issue	Overview of Key Findings
Surface Water Resources	The Project will reduce reliance on groundwater extraction at Airly Mine. Modelling shows there will be no increase in the frequency or magnitude of offsite discharges due to the modification. Given that Centennial Airly will implement management measures for no offsite discharges, the potential impacts on Airly Creek water quality will not be significant. Downstream licensed surface water users on Coco Creek are unlikely to be impacted as a result of the modification due to the low risk of potential impacts and the management controls to be implemented to minimise offsite discharges. Given the low risk of discharge of water off site, the likelihood of impacts on the macroinvertebrates and fish in Airly Creek is low. Cumulative impacts with respect to surface water quality and quantity are not expected.
Noise	There are no expected exceedances of consented operational noise criteria or the trigger levels in *Rail Infrastructure Noise Guideline* (EPA, 2013) for the day and night periods and passbys.
Traffic and Transport	There are no expected road traffic consequences due to the modification. Upgrades of the existing infrastructure will require few delivery trucks while operations will require minimal staffing and consequently minimal vehicle movements. Total vehicle movements will fall within the levels assessed in the AMEP EIS.

Issue	Overview of Key Findings
	Train movements for the water transfer scheme will remain within the approved train movements in SSD 5581, except that the water laden trains will arrive at the pit top from the north on Wallerawang-Gwabegar Rail Line.
Biodiversity	No native vegetation clearing will occur during the upgrade activities. The modification will not generate any measurable impacts on any threatened species, populations and ecological communities, and their habitats, listed under the BC Act or the EPBC Act.
Air Quality	The limited construction proposed is not predicted to measurably change local air quality. Air quality monitoring is undertaken to ensure the site meets relevant air quality criteria in the consent.
Greenhouse Gas Emissions	The modification will generate GHG emissions, which will contribute to associated global environmental effects. However, the increase in GHG emissions resulting from the modification will not measurably increase the total Australian emissions and will be a small fraction of approved emissions assessed in the AMEP EIS.
Cultural Heritage	Given the minor new construction works will be restricted to already disturbed areas at the pit top, and that, no items of Aboriginal or historic cultural heritage significance exist within the works area, it is unlikely the existing cultural heritage values (Aboriginal, historic) of the site will be degraded due to the modification.
Visual Amenity	Given there will be only upgrade of the existing water management infrastructure at the pit top the modification will have no consequences on the visual amenity to the site or region.
Waste	The modification is not expected to affect the existing Airly Mine waste management strategy for residual waste and recyclable materials.
Groundwater Resources	Groundwater usage from the Production Bore will be reduced. Mine inflow predictions from the recalibrated Airly Mine groundwater model are significantly less than in approved in the AMEP EIS. On these bases, the impacts on the groundwater resources by Airly Mine are expected to be less than assessed in the AMEP EIS.

9.4 Alternatives to Proposed Modification

9.4.1 Do Nothing Option

In the 'Do Nothing' option Airly Mine will not be able to operate at the approved level. Airly Mine requires to extract the maximum 1.8 Mtpa of ROM coal approved in SSD 5581 to be an economically viable mine in the long term. As discussed in **Section 1.6**, sufficient volumes of water from the site sources are not available to meet the process water requirements for the mine to operate at the approved level. If the mine cannot operate at the approved level, the social and economic benefits included in the AMEP EIS will not be fully realised.

9.4.2 Water Transfer Options

The following alternatives to the proposed transfer of water from Charbon Colliey by rail transport were considered.

Road Haulage of Underground Water from Angus Place Colliery

Angus Place underground water has better water quality characteristics than Airly Creek and Airly's Production Bore water. However, water transfer from Angus Place pit top to Airly pit top can only be effected using road haulage on both public roads and private haul roads, as there is no rail connection between the sites. Road haulage was not considered a long term option due to the large numbers of trucks required to transfer 170 ML/year of water and the increase in road traffic on Glen Davis Road, which would have been difficult to mitigate. Given the potential environmental impacts with road haulage, this option would have most likely been unpopular with the local community including

sensitive receptors for noise impacts. Rail transport of water proposed in this modification has a lower environmental impact footprint.

Road Haulage of Surface Water from Charbon Colliery

Water from Charbon Colliery's onsite storage dams is of better quality than Airly Creek and Airly's Production Bore water. Road haulage of water of 170 ML/year from Charbon Colliery would have required a large number of trucks using Charbon Road, Bylong Valley Way via Cooper Drive (in the vicinity of Charbon Colliery) and Glen Davis Road to access Airly pit top. While Charbon Collier's consent allows road haulage of coal on Charbon Road and Bylong Valley Way (via Cooper Drive), road haulage of coal from the site has not occurred for at least 15 years. Reactivation of large numbers of trucks on Charbon Road (through Charbon village) and Bylong Valley Way (through Clandulla) would have most likely been unpopular with the local community including sensitive receptors for noise impacts. Rail transport of water from Charbon Colliery proposed in this modification has a lower environmental impact footprint than road haulage.

9.5 Ecologically Sustainable Development

Ecologically sustainable development (ESD) is a primary objective of environmental protection in NSW. The objects of the EP&A Act adopt the principles of ESD and it is defined under section 6(2) of the *Protection of the Environment Administration Act 1991* as:

> *6(2) For the purposes of subsection (1)(a), ecologically sustainable development requires the effective integration of economic and environmental considerations in decision-making processes. Ecologically sustainable development can be achieved through the implementation of the following principles and programs:*
>
> *(a) The precautionary principle – namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:*
>
> *(i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and*
>
> *(ii) an assessment of the risk-weighted consequences of various options,*
>
> *(b) inter-generational equity – namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations,*
>
> *(c) conservation of biological diversity and ecological integrity – namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration,*
>
> *(d) improved valuation, pricing and incentive mechanisms – namely, that environmental factors should be included in the valuation of assets and services, such as:*
>
> *(i) polluter pays – that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,*
>
> *(ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,*
>
> *(iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.*

The overall objectives of ESD are to use, conserve and enhance natural resources. This ensures that ecological processes are maintained facilitating improved quality of life, now and into the future.

Airly Mine is committed to the principles of ESD and understands that social, economic and environmental objectives are interdependent.

The company acknowledges that a well-designed and effectively managed operation will avoid significant and/or costly environmental impacts or degradation. Consideration has been given to appropriately identifying, avoiding, mitigating and managing environmental risk. This demonstrates environmental due diligence and will provide for on-going and adaptive monitoring and management of the operation in line with the ESD principles.

The consistency of the modification with each of the ESD principles noted above is discussed in sub-sections below.

9.5.1 The Precautionary Principle

This SEE has enabled an understanding of the potential impacts of the proposed modification on environmental factors. The environmental impact assessments were completed by suitably qualified and experienced specialist consultants, and who had been previously involved in similar assessments. The technical assessments were undertaken in accordance with current government policies and guidelines and relied on robust monitoring data acquired within Airly Mine's environmental monitoring framework.

Where applicable, environmental safeguards have been developed in the technical assessments to avoid or minimise any impact on the environment. Operational management controls have been devised to ensure no discharge of water will occur from Airly Mine. This will minimise the low risk assessed for the potential impacts on water quality and aquatic ecology in Airly Creek.

Following approval of the modification all relevant management plans will be reviewed and updated to ensure any potential impacts identified will be managed appropriately. On this basis, the proposed modification is consistent with the precautionary principle.

9.5.2 Intergenerational Equity

The principle of intergenerational equity is centred on the concept that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations. The potential impact of the proposed modification elements is not considered significant, and as a consequence has negligible potential to adversely affect the health, diversity or productivity of the environment.

Airly Mine undertakes environmental monitoring and implements ongoing mitigation measures to provide effective environmental management within the Project Application Area. This management is provided through planning, communication, documentation, review and feedback. These environmental management measures ensure that the health, diversity and productivity of the environment is maintained or enhanced for future generations.

The proposed modification will implement management controls that will ensure discharges to Airly Creek are avoided when the importation of water from Charbon Colliery commences. In this regard, the assessed low risk of impacts to water quality and aquatic ecology in Airly Creek will be mitigated.

9.5.3 Conservation of Biological Diversity and Ecological Integrity

The principle of conservation of biological diversity and ecological integrity holds that the conservation of biological diversity and ecological integrity should be a fundamental consideration for development proposals.

The potential environmental impacts of the proposed modification and measures to mitigate these potential impacts are detailed in the SEE. In particular, an aquatic ecology assessment was conducted

that considered the potential impacts of discharges of imported water on the existing aquatic ecology environment of Airly Creek. The proposed implementation of operational management controls to avoid discharges to Airly Creek will ensure any potential impacts due to the modification will be mitigated.

9.5.4 Improved Valuation, Pricing and Incentive Mechanisms

The principle of improved valuation, pricing and incentive mechanisms deems that environmental factors should be included in the valuation of assets and services. The cost associated with using or impacting upon an environmental resource is seen as a cost incurred to protect that resource.

The proposed modification will allow Airly Mine to operate at the approved level. In this regard, the social and economic benefits identified in the AMEP EIS will be fully realised. This will optimise the valuation and pricing of the coal resources across Centennial Coal's operations in the area.

The proposed modification meets the "polluter pays" principle as the cost of upgrade works at the site and for the hire of water trains will be borne by Centennial Airly. The users of the goods produced by Airly Mine, coal, will ultimately contribute to the costs incurred in the establishment of the water transfer scheme.

9.6 Section 4.15 of the EP&A Act

Section 4.15 (previous Section 79C) of the EP&A Act requires matters included in Section 4.15 (b) to (e) the consent authority considers as are of relevance to the development the subject of the development application:

> *(b) the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality,*
>
> *(c) the suitability of the site for the development,*
>
> *(d) any submissions made in accordance with this Act or the regulations,*
>
> *(e) the public interest.*

Section 4.15 (b) is addressed by this SEE generally. The matters in Section 4.15 (c)–(e) are addressed below.

9.6.1 Site Suitability

The imported water, up to 170 ML/year, will be stored within existing onsite storage dams at Airly pit top. Water will be imported on an as needs basis, and only when capacities of dams allow storage of the volume of water to be imported, without any risk of discharge. Airly Mine will have adequate control on management measures proposed to be implemented to avoid discharges off site to Airly Creek. In this regard, the Airly Mine pit top is a suitable site for the receipt of the up to 170 ML/year for storage, management and use as process water.

9.6.2 Submissions

This SEE for the proposed modification will be placed on public exhibition for a determined period of time. During this period the public will be invited to provide submissions which will be considered by the Minister, or his delegate, in determination of the proposed modification.

9.6.3 Public Interest

The proposed modification will allow Airly Mine to operate at the approved level in SSD 5581. The social and economic benefits identified in the AMEP EIS can only be fully realised if the modification is approved.

9.7 Conclusion

Centennial Airly is proposing a modification to Airly Mine's consent SSD 5581 to import up to 170 ML/year of surface water using rail wagons from Charbon Colliery. Minor upgrade works are required to facilitate the modification. It is proposed to operate one water laden train per day to transfer up to the 170 ML/year water from Charbon Colliery to Airly pit top on the Wallerawang-Gwabegar Rail Line. This one train per day will fall within the approved maximum 5 trains per day and an average of 2 trains per day in a calendar year, with the exception that the water laden train will arrive at the Airly pit top from the north.

The modification is a minor alteration of the approved AMEP, and is substantially the same development. The adverse environmental impacts of the proposed modification elements are predicted not to be significant and any potential impacts can be managed appropriately to minimise harm to the environment.

This SEE outlines the existing Airly Mine operations, describes the proposed modification, summarises the legislative and policy context, assesses the impacts of the proposed modification and determines that existing environmental management and monitoring are suitable. The proposed modification will not result in any significant impacts. The proposed modification will not significantly impact downstream water users.

The modification provides a substantial economic benefit to Airly Mine as then it can operate at the approved level. The modification elements can be implemented with little or no risk of adverse impacts on the receiving environment. The modification meets the relevant objects of the EP&A Act and is consistent with the four principles of the ecologically sustainable development. It meets all government policies. On these bases, the modification will meet environmental performance requirements to be considered for approval.

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11 ACRONYMS, UNITS AND ABBREVIATIONS

Acronyms, Units and Abbreviations	Definition
%	percent
%ile	Percentile
^{o}C	Degrees Celsius
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment Conservation Council
BOM	Bureau of Meteorology
CCC	Community Consultative Committee
CCL	Consolidated Coal Lease
CHPP	Coal Handling and Preparation Plant
CL	Coal Lease
cm	centimetre
dB(A)	Decibels, A weighted (a filter has been applied to the measured result to mimic the human response to noise)
DEE	Federal Department of the Environment and Energy
DECC	Department of Environment and Climate Change (NSW)
DECCW	(Former) Department of Environment, Climate Change and Water (NSW) (now known as Office of Environment and Heritage (OEH))
DGRs	Director General's Requirements, now SEARs
DPE	Department of Planning and Environment (NSW)
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EL	Exploration Licence
EMS	Environmental Management System
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPA	Environment Protection Authority
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EPL	Environment Protection Licence
FM Act	*Fisheries Management Act 1994* (NSW)
g	gram
GDE	Groundwater Dependent Ecosystem
GHD	GHD Pty Ltd
GHG	Greenhouse Gas
kL	kilolitre

Acronyms, Units and Abbreviations	Definition
km	kilometre
km^2	square kilometre
LCC	Lithgow City Council
LDP	Licensed Discharge Point
LEP	Local Environmental Plan
LGA	Local Government Area
m	metre
M	million
m/s	Metres per second
m^2	Square metre
m^3	Cubic metre
mg/L	Milligram per litre
ML	Megalitre or Mining Lease
MLA	Mining Lease Application
MNES	Matter of National Environmental Significance
mm	millimetre
mm/m	millimetre per metre
MOP	Mining Operations Plan
Mt	Million tonne
Mtpa	Million tonnes per annum
MWRC	Mid-Western Regional Council
NES	National Environmental Significance
NP&W Act	*National Parks and Wildlife Act 1974*
NPWS	National Parks and Wildlife Service
NSW	New South Wales
POEO Act	*Protection of the Environment Operations Act 1997*
RBL	Rated Background Level
ROM	Run of Mine
SAL	Strategic Agricultural Land
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SLR	SLR Consulting Australia Pty Ltd.
SoC	Statement of Commitments
TARP	Trigger Action Response Plan
TDS	Total Dissolved Solids

Acronyms, Units and Abbreviations	Definition
TEC	Threatened Ecological Community
t	Tonne
WM Act	*Water Management Act 2000*

APPENDIX A – SCHEDULE OF LANDS

Airly Mine Extension Project
Schedule of Land

Property ID	Lot/Section No./ Deposited Plan
1	1//1152312
2	4//1152312
3	2//1152312
4	3//1152312
5	5//1152312
6	3/1/758011
7	14//755757
8	1/1/758011
9	4/1/758011
10	154//722292
11	7020//1029319
12	13//755786
13	66//722329
14	68//722329
15	81//755757
16	117//755757
17	112//755757
18	124//755757
19	102//755757
20	94//755757
21	104//755757
22	105//755757
23	95//755757
24	33//755757
25	98//755757
26	91//755757
27	11/1/758011
28	7/3/758011
29	12//1118801
30	7026//1050399
31	7304//1130566
32	21//1118800
33	20//1118800
34	23//1118800
35	7//1118784
36	10//1118784
37	13//1118784
38	8//1118784
39	16//1118801
40	100//755757
41	7018//1051447
42	7014//1057712
43	83//755757
44	113//755757
45	121//755757
46	7022//1050402
47	67//722329
48	7016//1114802
49	7300//1130496
50	16/2/758011
51	6/2/758011
52	5/2/758011
53	8/1/758011
54	9/1/758011
55	5/3/758011
56	4/3/758011
57	8/3/758011
58	5//755766
59	7023//1050402
60	56//755786
61	3/2/758011
62	1//577478
63	4//755766
64	1//1007126
65	4/2/758011
66	1//755766
67	12//755786
68	3//755766
69	19//755766
70	5/1/758011
71	51//755786
72	2/1/758011
73	7021//1050431
74	7001//1057060
75	97//755757
76	119//755757
77	22//755786
78	116//755757
79	79//755757
80	109//755757
81	107//755757
82	90//755757
83	126//755757
84	120//755757
85	110//755757
86	108//755757
87	99//755757
88	115//755757
89	6/3/758011
90	1/2/758011
91	1/3/758011
92	2/3/758011
93	3/3/758011
94	9/3/758011
95	123//755757
96	34//755757
97	10//1118781
98	7303//1130566
99	18//1118800
100	19//1118800
101	22//1118800
102	11//1118784
103	14//1118784
104	13//1118801
105	14//1118801
106	15//1118801
107	24//1118800
108	9//1118784
109	12//1118784
110	101//755757
111	96//755757
112	106//755757
113	78//755757
114	89//755757
115	118//755757
116	82//755757
117	7001//1028024
118	7024//1050402
119	39//755786
120	125//755757
121	80//755757
122	42//755757
123	103//755757
124	7025//1050399

Airly Mine Extension Project
Schedule of Land

Property ID	Lot/Section No./ Deposited Plan
125	7031//1116097
126	7032//1116097
127	7034//1116073
128	7300//1130282
129	114//755757
130	28//755786
131	10/1/758011
132	17/2/758011
133	2/2/758011
134	15/2/758011
135	60//755757
136	6/1/758011
137	7/1/758011
138	701//1058328
139	4//577478
140	7018//1030008
141	71//755758
142	100//849168
143	7037//1065193
144	72//755758
145	7021//1030009
146	65//755786
147	3//577478
148	7017//1029387
149	701//1030007
150	703//1030007
151	701//1058325
152	70//755758
153	7036//1065193
154	63//755758
155	7027//1066212
156	89//755758
157	7016//1029387
158	7025//1066211
159	7014//1029387
160	9//655050
161	702//1058325
162	702//1058328
163	7024//1066211
164	7026//1066212
165	704//1030007
166	11//755757
167	702//1030007
168	2//577478
169	7015//1029387
170	54//755786
171	7300//1126380
172	7301//1126380
173	7023//1116918
174	7005//1116573
175	7006//1116573
176	7024//1116919
177	7303//1130728
178	7302//1130590
179	1//864999
180	7004//1029383
181	2//864999
182	10//755758
183	22//650039
184	7035//1117631
185	7033//1116073
186	7013//1057515
187	94//755758
188	93//755758
189	7020//1030008
190	7022//1029388
191	102//1079781
192	103//1079781
193	7013//1029386
194	111//755758
195	7001//1029380
196	13//755758
197	5//986083
198	17//244899
199	39//746912
200	10//132551
201	17//755758
202	2//131546
203	44//755758
204	28//755758
205	37//746912
206	25//755758
207	7002//1029380
208	A//349704
209	9//755758
210	1//346651
211	107//755758
212	36//755758
213	16//755758
214	41//755758
215	23//755758
216	6//131546
217	46//755758
218	38//746912
219	5//131546
220	18//244899
221	24//755758
222	8//755758
223	C//349704
224	1//119590
225	3//131546
226	45//755758
227	B//349704
228	1//1072590
229	32//755758
230	19//244899
231	14//244899
232	110//755758
233	20//244899
234	4//131546
235	78//755758
236	15//755758
237	15//244899
238	41//746912
239	55//755758
240	40//746912
241	1//131546
242	22//755758
243	16//244899
244	2//927952
245	1//927952
246	18//1106972
247	7010//1021311
248	1//1115443

Airly Mine Extension Project
Schedule of Land

Property ID	Lot/Section No./ Deposited Plan
249	1//122407
250	42//755758
251	112//755758
252	31//755758
253	26//755758
254	27//755758
255	29//755758
256	30//755758
257	7019//1030008
258	82//755758
259	1//197770
260	126//722134
261	7029//1065275
262	81//755758
263	153//257075
264	142//755757
265	7009//1029698
266	4//755757
267	67//755758
268	17//755757
269	92//755757
270	156//722330
271	102//610704
272	94//755778
273	13//244899
274	86//755757
275	51//755757
276	133//755757
277	85//755757
278	603//615881
279	101//610704

Property ID	Lot/Section No./ Deposited Plan
280	185//755778
281	164//48336
282	2//132549
283	2//379339
284	87//755757
285	35//755758
286	231//1012729
287	159//722293
288	77//755757
289	1//194534
290	2//813231
291	25//665681
292	601//615881
293	2//547497
294	128//755757
295	1//1070723
296	54//755757
297	163//48336
298	47//755758
299	77//755758
300	7015//1057714
301	3//792135
302	58//755757
303	1//132549
304	134//755757
305	1//564345
306	10//755757
307	49//755757
308	135//755757
309	75//755757
310	2//792135

Property ID	Lot/Section No./ Deposited Plan
311	3//709009
312	233//1012729
313	7008//1029698
314	111//755757
315	31//755757
316	55//755757
317	4//709009
318	48//755758
319	6//665679
320	79//755758
321	25//665682
322	141//755757
323	56//755757
324	40//755757
325	3//565109
326	7003//1056614
327	232//1012729
328	132//755757
329	59//755757
330	129//755757
331	4//792135
332	1//831104
333	1//195875
334	157//722330
335	7012//1056868
336	15//755757
337	7028//1029701
338	7029//1075846
339	83//755758
340	70//755757
341	43//755757

Property ID	Lot/Section No./ Deposited Plan
342	7038//1117632
343	158//722293
344	139//755757
345	93//755757
346	7037//1117633
347	7036//1117631
348	137//755757
349	13//755757
350	136//755757
351	20//755757
352	18//755757
353	27//755757
354	41//755757
355	26//755757
356	47//755757
357	24//755757
358	50//755757
359	7002//1058210
360	7302//1130728
361	7304//1130728
362	7028//1065275
363	21//755758
364	35//755786

APPENDIX B – STAKEHOLDER CONSULTATION OUTCOMES

Table B1 – Matters Raised during Consultation

Stakeholder	Matters raised	Comments and SEE Reference
Mid-Western Regional Council	Discrepancy between the volume of Reedy Creek Dam (220 ML) and the total volumetric entitlements on Charbon WALs of 336 ML/year	The Reedy Creek Dam volume is 220 ML. However, the total volumetric entitlement on WALs held by Charbon Colliery is 336 ML/year. It is possible to extract this volume of water given that there are environmental flows to the dam throughout the year. If the flows to the dam exceed capacity then overflows to Cumber Melon Creek occurs as discussed in Section 7.2.2.5 of the SEE for Charbon MOD 1 (Centennial Coal, 2019). However, to date, Charbon Colliery has extracted up to 185 ML/year in an average rainfall year, predicted in the Charbon Coal Project EA (Corkery, 2009).
	Towns that will be impacted by the reactivation of train movements to transport water on a regular basis	Residents in Clandulla will be impacted by the reactivation of train movements on the Wallerawang-Gwabegar Rail Line. A recent modelling undertaken for rail noise (SLR, 2019) showed that noise from the one water laden train on a receptor in Clandulla 50 m from the centreline of rail line for one train load per day (during the day or night period) will be within the trigger levels included in the *Rail Infrastructure Noise Guideline* (EPA, 2013), and very much less than the number of trains previously hauling coal from Charbon Colliery.
	Timing of exhibition of Charbon MOD 1 and Airly MOD 2 SEEs	Given the interrelationships between the two modifications, the SEEs supporting the modification applications will be submitted, exhibited and assessed concurrently.
	Consultation with government water agencies	Consultation with DoI – Land and Water was undertaken (refer **Section 6.3.3**).
	Consultation with the community	Consultation with local community has been undertaken and described in **Section 6.4**.
	Robustness of Airly Mine's recalibrated groundwater model to meet the government guidelines under which they should be developed	GHD's original groundwater model was developed in 2014 to inform the Groundwater Impact Assessment (GHD, 2014a) prepared for the Airly Mine Extension Project EIS. The calibration of the numerical model used monitoring data available at the time. The groundwater model and the groundwater impact assessment were both reviewed by a third party reviewer (Dr Noel Merrick) as required by the NSW *Aquifer Interference Policy* and *Australian Groundwater Modelling Guidelines*. The peer review report is available at the Department of Planning and Environment's website: https://majorprojects.accelo.com/public/19a9e0859370f35164b93b21e8895393/10.%20Airly%20MEP_%20Peer%20review%20of%20groundwater.pdf The predicted groundwater impacts were assessed against the minimal impact considerations for aquifer interference activities encapsulated in the NSW *Aquifer Interference Policy* the

Stakeholder	Matters raised	Comments and SEE Reference
		impacts were considered to be less than the Level 1 criteria and hence were acceptable. This conclusion of the Level 1 impact in terms of minimal harm considerations was endorsed by the third part reviewer. More recent groundwater data shows that there are no mine inflows that can be captured and reused as process water. The existing numerical groundwater model has recently been re-calibrated with the more recent monitoring data. The predictions from the re-calibrated model shows the mine inflows in the year of maximum inflows (2030) at 76 ML/year is significantly less than the maximum predictions in the EIS (183 ML/year) (Golder Associates, 2014a). The new prediction of 76 ML/ year in the year 2030 will be moisture entrained in product coal and will not be captured and reused as process. The mine cannot rely on mine inflows to act as a source of process water, as was assumed in the EIS when the site water balance was developed for the project. The Groundwater Assessment report (GHD, 2019b) included with the Surface Water Assessment (GHD, 2019a) for with mine inflows from the recalibrated groundwater model has been independently reviewed by Dr Noel Merrick in accordance with the government guidelines noted above.
Inglenook and Charbon CCC	Ongoing use of the Wallerawang- Gwabegar rail line is a positive for the area in that the line will remain open.	Noted.
	Concern regarding the transfer of water from the western catchment (Macquarie- Bogan catchment) to the eastern catchment (Hawkesbury-Nepean catchment) Imported water will not be discharged to Airly Creek and the Hawkesbury-Nepean catchment, and will be contained within the Airly Mine's pollution control network for use as process water.	The Surface Water Assessment supporting the Charbon MOD 1 SEE (GHD, 2019b) has assessed the impact of taking a maximum of 170 ML/year from Reedy Creek Dam on downstream water users and Windamere Dam. This volume of water is similar to volumes extracted from the dam when the mine was fully operational. The impact on flows and volumes in dams due to the proposed modification is considered negligible, as described in detail in Section 7.2.3.4 of the SEE for Charbon MOD 1 (Centennial Coal, 2019). A legal review on transfers between catchments was undertaken, and is discussed in detail in **Section 4.4**. Management controls will be implemented within the Airly pit top water management system to ensure no water will discharge under normal conditions. The Airly Mine MOD 2 SEE (Centennial Coal, 2019) describes the management controls that will be implemented. Airly Mine's Environment Protection Licence (EPL) 12374 allows discharge of water offsite

Stakeholder	Matters raised	Comments and SEE Reference
		through LDP001 on the 35 ML Discharge Dam for a five consecutive day rainfall totalling 44 mm (Condition L2.5 of EPL 12374). Water will only be transferred from Charbon to Airly if there is no risk of discharges as a result of this five day rainfall of 44 mm.
	Reduction in downstream flow into Cumber Melon Creek and Cudgegong River due to extraction of water from Reedy Creek Dam	The reduction in downstream flows is discussed in Section 7.2.3.4 of Charbon MOD 1 SEE (Centennial Coal, 2019). The reduction in flows is considered negligible.
	Question regarding whether the proposed importation of water at Airly Mine from Charbon Colliery was required to meet the future proposal to increase production from the approved 1.8 Mtpa to 3.0 Mtpa	The site water balance for Airly Mine discussed in the Airly MOD 2 SEE (Centennial Coal, 2019) was calculated for the approved 1.8 Mtpa and a workforce of 155 FTE personnel, not 3.0 Mtpa production rate. That site water balance was used to determine the deficits in the process water at Airly under wet, dry and average rainfall years. The dry year deficit was used to determine the volume of water that would be required to transfer to Airly Mine. The site water balance for Charbon Colliery, discussed in Section 7.2.3.1 of Charbon MOD 1 SEE (Centennial Coal, 2019), used that dry year deficit.
Airly CCC and personal communication	Compliance of Condition 11 under Schedule 4 of Airly Mine's consent SSD 5581 and the proposed Charbon MOD 1 and Airly MOD 2	The consent stipulates that Airly Mine should have sufficient water to operate the mine at approved limits. The current circumstances on the unavailability of water at Airly Mine, discussed in **Section 1.6** (no mine inflows for recapture and use, recent prolonged dry periods leading to lowering of water levels in onsite storages, unreliable yields from the Production Bore at that site) has lead to the identified shortfall in process water (approximately 170 ML/year in a dry year), Airly Mine sought reasonable and feasible options to address the issue. The option of importing water from an external source is the only sustainable option available to Airly for its life of mine operations. The transfer of water from Charbon Colliery and the receipt of that water by Airly Mine will only be allowed through modifications to the respective consents. Accordingly, Charbon Colliery is seeking a modification to its consent SSD 08_0211 to transfer up to 170 ML/year of surface water to Airly Mine by rail (Centennial Coal 2019). Airly Mine in this SEE is proposing to receive up to 170 ML/year of surface water from Charbon Colliery by rail. Once the modifications are approved Airly Mine will be have sufficient water to operate at the approved limits and will be complaint with this consent condition.
	Legislation under which transfer of water between catchments or Water Sharing Plans	Legal advice has been obtained by Centennial Coal on the legality of the proposed transfer of water between catchments / water sharing plans that would occur in the two modifications.

Stakeholder	Matters raised	Comments and SEE Reference
	are allowed	The legal advice considered the appropriate legislation, comprising the *Water Management Act 2000*, the *Water Management (General) Regulation 2018*, the Access Licence Dealing Principles Order 2004, the Regulated Water Sharing Plan (WSP), the Unregulated WSP and the Metropolitan WSP. The review of the legislation did not locate any provisions that prohibit the discharge of water from a water source governed by one water sharing plan into a water source governed by a different water sharing plan.
	An example of precedence of water transfers between catchments and Water Sharing Plans	Clarence Water Transfer Scheme which transfers water, via pump, from Main Dam at Clarence Colliery (located in the Hawkesbury and Lower Nepean Rivers Water Source) to Farmers Creek Dam (Lithgow Dam No.2), located in the Upper Nepean and Upstream Warragamba Water Source, is an example of permitted transfer of water between the two water sharing plans. Each of these water sources is within the same water sharing plan (*Greater Metropolitan Region Unregulated River Water Source*) however they are managed separately through different water management zoning. The water sharing plan rules, for both of these water sources is clearly relating to trading or transfer of allocation rights between sources. As both the Main Dam and Farmers Creek Dam have their own individual Water Access Licences within their respective sources, the transfer of bulk water across catchments can occur, up to the volume defined on the licence for each respective dam. The Clarence Water Transfer Scheme was approved for operation in 2014. In summary, the supply of water from Charbon to Airly is not the attempted trade of water allocation right from Charbon to Airly but it is the bulk transfer of water volumes from Charbon, that is approved to be extracted under existing held water access licences for the relevant source that the Charbon site is located within, to Airly site, to be used for the purpose defined by the access licence.
	Construction of a large dam at Airly pit top to address the identified water deficit at that mine, instead of transfer of water from Charbon Colliery	Under the *Water Management Act 2000*, Airly Mine has basic landholder rights (harvestable rights) to capture a portion of surface runoff from the pit top and store it in one or more dams. Airly may capture and use up to 10% of the average regional runoff for their property without requiring a licence under the WM Act. The maximum harvestable rights dam capacity (MHRDC) for the mine is 58 ML/year. The current water management captures 34 ML/year of the clean catchments run-off. A dam sized to capture an additional 24 ML/year (MHRDC minus existing surface run-off capture) will not meet the process water requirements as the deficit has been determined to be approximately 170 ML/year in a dry year.

Stakeholder	Matters raised	Comments and SEE Reference
		If the onsite dam capacities at Airly pit top are increased so that the entire identified deficit is obtained from the site through capture of surface runoff, then the MHRDC would be exceeded for the site. This would require licensing for the additional volume of water extracted from the surface water source exceeding the harvestable right, which may not be available within the water market. Increasing the capture capacity of site, would also reduce catchment contribution to Airly Creek which contributes to the Capertee Valley. While this option could work for Airly, the issue is that the local area does not have sufficient rainfall for surface water capture at the site to be a sustainable source for life of mine operations. This has been evidenced recently with prolonged dry periods resulting in low water levels in the onsite water storages at Airly pit top. The construction of a larger dam was considered when investigating whether the water from the site sources (surface water) could be increased to meet the identified process water deficit at Airly Mine, and was rejected for the above reasons.
	LD4 Discharge Dam water quality and provision of water quality data to the community	Water quality data were provided to the CCC members with the minutes of the CCC meeting held on 15 January 2019. Statistical summary of the water quality data are provided in Table 9 of the Charbon MOD 1 SEE (Centennial Coal, 2019) and **Table 16** of this SEE. Trends in the water quality data for the Charbon Colliery dams are discussed in Section 7.2.2.2 of the Charbon MOD 1 SEE (Centennial Coal, 2019)**.** Comparisons of the water quality data between the two sites are included in **Section 7.2.3.3.**
	EIS mine inflows and the site water balance were wrong.	GHD's groundwater and surface water modelling were both based on the monitoring data available at the time. The groundwater model and the groundwater impact assessment was reviewed by a third party reviewer (Dr Noel Merrick) as required by the NSW *Aquifer Interference Policy* and *Australian Groundwater Modelling Guidelines*. The peer review report is available at the Department of Planning and Environment's website: https://majorprojects.accelo.com/public/19a9e0859370f35164b93b21e8895393/10.%20Airly%20MEP_%20Peer%20review%20of%20groundwater.pdf The predicted groundwater impacts were assessed against the minimal impact considerations for aquifer interference activities encapsulated in the NSW *Aquifer Interference Policy* the impacts were considered to be less than the Level 1 criteria and hence were acceptable. This conclusion of the Level 1 impact in terms of minimal harm considerations was endorsed by the

Stakeholder	Matters raised	Comments and SEE Reference
		third part reviewer. Groundwater Modelling More recent groundwater data shows that there are no mine inflows that can be captured and reused as process water. The existing numerical groundwater model has recently been re-calibrated with the more recent monitoring data. The predictions from the re-calibrated model shows the mine inflows in the year of maximum inflows (2030) at 61 ML/year is significantly less than the maximum predictions in the EIS (183 ML/year). The new prediction of 61 ML/ year in the year 2030 will be moisture entrained in product coal and will not be captured and reused as process. The mine cannot rely on mine inflows to act as a source of process water, as was assumed in the EIS when the site water balance was developed for the project. Site Water Balance The site water balance for the EIS relied on the mine inflows, rainfall (and hence adequate water in onsite water storages), and water from the Production Bore. Water from these identified sources are no longer available at the volumes that were included in the site water balance that was approved in the EIS. Explanations are provided below. • **Mine Inflows** As discussed above mine inflows cannot be relied on to supplement process water. • **Surface water dams** Due to the recent prolonged drought the water levels in the onsite storages have been decreasing. The site water balance was reported for an average rainfall year (as required). The past year would not be classified as an average year. • **Production Bore** The Production Bore at Airly Mine is licensed at 158 ML/year. As explained at the Airly CCC meeting on 15 January 2019, the yield at the bore as been slowly decreasing and is significantly less than the 5 L/s on the water access licence. The yield is currently <1 L/s. This source water cannot be relied on for a sustainable supply of water at the site for life of mine operations. Additionally, the EC of the production bore is very high ~4500 µS/cm. The use of the production bore water in the last 2 years has resulted in the steady increase in the EC of the 109 ML Dam and the 35 ML Dam.
	Charbon consent modification to transfer water	Charbon Colliery's consent SSD 08_0211 is required to be modified to transfer water off site.

Stakeholder	Matters raised	Comments and SEE Reference
	to Airly Mine for life of mine operations	This SEE will support the modification application.
	Community's concern on extraction of water from Reedy Creek Dam and impact on the downstream Windamere Dam, which was built for irrigation purposes and is currently at 37%	The impact of extracting a maximum of 170 ML/year from Reedy Creek Dam on the downstream surface water users on Cumber Melon Creek and Lake Windamere has been assessed in the surface water assessment supporting this SEE (GHD, 2019a). This volume of water is similar to volumes extracted from the dam when the mine was fully operational. The impact on flows and volumes in dams due to the proposed modification is considered negligible, as described in detail in Section 7.2.3.4 in Charbon MOD 1 SEE (Centennial Coal, 2019). The volumes of water extracted from Reedy Creek Dam is expected to be lower than the 170 ML/year assessed as water from LDP4 Dam will also be extracted for the transfer scheme. Water from the LDP4 Dam will be extracted prior to extracting the additional volume from Reedy Creek Dam. This priority order will ensure that no discharges from LDP4 Dam occur via LDP4 discharges.
	Status of Charbon site rehabilitation works following cessation of mining	Progressive rehabilitation is being undertaken at Charbon Colliery in accordance with the two approved MOPs. The progress of the rehabilitation is reported is reported annually in the *Annual Return* submitted by Charbon Colliery by 31 March of each year, as required to meet the requirements of Condition 3 under Schedule 5 of SSD 08_0211, and in accordance with the *Post-approval requirements for State significant mining development – Annual Review Guideline* (DPE, 2015). The *Annual Review* is submitted to regulators, and it is made available to the community via Charbon Colliery's website.
	Condition of the coal stockpile areas and timing of rehabilitation works	The Product Coal Stockpile within the rail loop has some coal that is proposed to be blended with fine reject material as described in the MOP. The blended coal will be transported off site by rail, destined for export market. The coal stockpile area will be rehabilitated to a final landform with native vegetation, commensurate with the vegetation that occurs in the surrounding areas. In the current MOP this area is scheduled to be rehabilitated by 2021.
	Water transfer and effect on the rehabilitation of the Charbon site	The water being transferred to Airly is in excess to that required by Charbon for rehabilitation activities. Charbon has two large dams (LDP2 and LDP3) that supply water for rehabilitation

Stakeholder	Matters raised	Comments and SEE Reference
		activities, including dust suppression, as described in Section 3.3.8 of Charbon MOD 1 SEE (Centennial Coal, 2019). The planned rehabilitation at the site will not be impacted by the transfer of water to Airly Mine pit top. Progressive rehabilitation will continue in accordance with the MOPs.
	Alignment of the community consultation and submissions of Charbon MOD 1 and Airly MOD 2	Community consultation on the proposed modifications commenced last year. Community consultation will be ongoing while the modifications are assessed. Discussions on proposed modifications are discussed regularly in CCC meetings.
	Airly's proposal to increase coal production from 1.8 to 3.0 million tonnes per year. Concerns about water flow and quality. Dry mine and water requirements	Airly MOD 2 is not proposing to increase production from 1.8 Mtpa to 3.0 Mtpa. Airly Mine is considered "a dry mine" because there are no inflows from overlying aquifers during mining into the mine, and which would require management e.g. through pumping. As a result mine inflows are not available at Airly Mine for capture and reuse as process water. The lack of mine inflows is one of the three contributing factors for the identified deficit. There are not many discharges that occur from Airly's water management system via LDP001 to Airly Creek because the dams have sufficient freeboard not to discharge. In the future when water will be imported to the pit top a number of management controls will be implemented to ensure no discharges to Airly Creek will occur, including no transfer of water from Charbon if there is a risk that discharge will occur during rainfall periods. Details of the management controls that will be implemented at Airly pit top are included in this SEE in **Section 7.2.7**..
	Usage of water at Airly	The site water balance for Airly Mine for all approved activities is included in Airly MOD 2 SEE (Centennial Coal, 2019). Process water is one of the outputs and includes water for dust suppression (surface and underground) and water used in the onsite sewage treatment system and bathhouse use. Given that the washery is an approved activity, and Airly MOD 2 is not seeking to remove the construction of the washery and the reject emplacement area (REA) from the approved activities in the consent, water usage for these two activities is required to be included in the site water balance. Given the construction of the washery and the REA are not planned in the mine's current five year business plan, water at the pit top will not be used for those purposes. As noted in **Section 1.6**, water will be imported at Airly Mine on an as needs basis.
	Quality of imported water - will it be carrying	The water quality of water transported from Charbon is likely to be comparable to Airly quality in dams, and better than the Production Bore water. Water sourced from Charbon will be raw

Stakeholder	Matters raised	Comments and SEE Reference
	salts, heavy metals and coal sediments	water which has originated from catchment runoff and has flowed through a proportion of the site. The water quality: 1. is unlikely to contain coarse coal sediment or high sediment concentrations 2. will have metals that are naturally occurring from the coal seam. Water quality data from Reedy Creek Dam, LD4 Discharge Dam and LDP4 discharges are discussed in Section 7.2.2.2 of Charbon MOD 1 SEE (Centennial Coal, 2019). A detailed comparison of the water quality from Charbon against Airly water quality and how they compare against Airly's EPL 12374 are included in the Airly MOD 2 SEE (Centennial Coal, 2019). It is noted that regardless of the quality of imported water, Airly Mine will need to comply with the pollutant concentration limited included it is EPL 12374 for LDP001.
	Depletion of local groundwater levels in the Charbon/ Kandos area	No groundwater from Production Bores at Charbon Colliery will be used to transfer water to Airly Mine. The Production Bores are not currently used for any activities at Charbon Colliery. It is unlikely the groundwater levels in the Charbon / Kandos area will be depleted due to the proposed modification.
	Categorisation of the water transfer as "water sharing" and approval from the Office of Water for the transfer	Water take is permitted by existing Water Access Licences for Reedy Creek Dam catchment (**Section 4.4**, Section 7.2.3.7 of Charbon MOD 1 SEE (Centennial Coal, 2019)) at Charbon for purposes agreed by Department of Industry - Land and Water, and the Natural Resource Access Regulator (previously referred to as NSW Office of Water).
	Storage of imported water at Airly pit top	Water transferred from Charbon to Airly will be managed via a train unloading system that ultimately results in water being stored within the 109 ML Dirty Water Dam at Airly pit top. No water will be imported by Airly when the dams are 75% full or during heavy rainfall periods. Water will only be imported when dams are at well below the 75% capacity. These controls will ensure no water will discharge from the dams to Airly Creek.
	Runoff into the Capertee Valley	Management controls will be implemented to ensure no discharge occurs. In this regard the site will continue to be a zero discharge site under EPL 12374. Discharge is only permitted under wet conditions.
	Rail trips for transfer of water from Charbon to Airly	Charbon MOD 1 is seeking to use 1 water laden train per day (2 train movements) to transfer water from Charbon rail loop on the Wallerawang-Gwabegar Rail Line. This number of movements falls within the 8 train movements in the day period and 2 train movements in the

Stakeholder	Matters raised	Comments and SEE Reference
		night period assessed in the Charbon EA (Corkery, 2009). There is no proposal to increase trains at the Airly pit top in Airly MOD 2. The proposed one water laden train per day from Charbon Colliery arriving at Airly pit top will fall within the maximum 5 trains per day and average 2 trains per day in a calendar year approved in SSD 5581.
Rylstone District Environment Society	Justification for the transfer of surface water from Charbon to Airly instead of underground water from Angus Place	Water from Angus Place would have required the use of haulage trucks on public roads, as there is no rail loop and rail line connection between Angus Place and Airly pit top. Environmental impacts (traffic on public roads, road noise) are greater and a larger number of receptors would have been affected by the truck haulage than using rail from Charbon Colliery for the transfer of water.
	Low dam levels in the district and concerns around the proposed take of 170 ML/year of water from Reedy Creek Dam, and impacts on downstream surface water users, and spills over the dam	Figure 15 in Charbon MOD 1 SEE (Centennial Coal, 2019) shows the catchments of Reedy Creek and Windamere Dam, the largest water body in the vicinity of Charbon Colliery. Reedy Creek flows into Cumber Melon Creek, then Cudgegong River and finally to Lake Windamere. An assessment of downstream impacts for the extraction of 170 ML/year has been assessed in Section 7.2.1.4 of the Charbon MOD 1 SEE (Centennial Coal, 2019). Results show the take of this volume of water will result in a maximum reduction in flows in Cudgegong River at the confluence of Cumber Melon Creek of 1.6% and the reduction in flows to Lake Windamere would be 1%. These reductions in flows are conservative as water from LD4 Dam will be sourced for the transfer as well, so the full volume is unlikely to occur in a year. In addition, the transfer will occur on an as needs basis, and should there be sufficient water at Airly Mine then the transfer will not occur. In an average rainfall year the identified deficit is lower at 64 ML/year (Centennial Coal, 2019) and fewer trains per week will be operated to take water from Charbon to Airly. Figure 5-7 in the Surface Water Assessment (GHD, 2019c), appended as Appendix C in the Charbon MOD 1 SEE (Centennial Coal, 2019) shows three overflows would have occurred from Reedy Creek Dam to Cumber Melon Creek between 2015 (when Charbon Colliery ceased mining operations) and 2018, during heavy rainfall events.
	Adequacy of the Airly Mine water management system to avoid discharges under 1 in 1000 year (not 1 in 100 year) rainfall event	EPA regulates the discharge of water from scheduled activities. The surface water dams at Airly pit top and the associated licensed discharge points are included in Airly Mine's EPL 12374, and this licence is regulated by the EPA. EPL 12374 permits discharges under wet weather conditions. These wet weather conditions permitted are less than a 1 in 100 year or 1000 average recurrence interval rainfall event. Therefore discharges are likely to occur from

Stakeholder	Matters raised	Comments and SEE Reference
		the site in the rainfall conditions stated. Some operations do have EPL conditions which permit the surface water management system to not discharge in such rainfall condition as those stated, however, these are typically as a result of an identified elevated environmental risk (e.g. hazardous waste storages). At Airly, the environmental risks that warrant a condition as that discussed have not been identified and hence the EPL 12374 conditions reflect that.
	Additional water not identified by water studies conducted when applying for approval for Airly Mine extension.	GHD's groundwater and surface water modelling included in the *Airly Mine Extension Project EIS* were both based on the monitoring data available at the time. The groundwater model and the groundwater impact assessment was reviewed by a third party reviewer (Dr Noel Merrick) as required by the NSW *Aquifer Interference Policy* and *Australian Groundwater Modelling Guidelines*. The peer review report is available at the Department of Planning and Environment's website: https://majorprojects.accelo.com/public/19a9e0859370f35164b93b21e8895393/10.%20Airly%20MEP_%20Peer%20review%20of%20groundwater.pdf The predicted groundwater impacts were assessed against the minimal impact considerations for aquifer interference activities encapsulated in the NSW *Aquifer Interference Policy* the impacts were considered to be less than the Level 1 criteria and hence were acceptable. This conclusion of the Level 1 impact in terms of minimal harm considerations was endorsed by the third part reviewer. <u>Groundwater Modelling</u> More recent groundwater data shows that there are no mine inflows that can be captured and reused as process water. The existing numerical groundwater model has recently been re-calibrated with the more recent monitoring data. The predictions from the re-calibrated model shows the mine inflows in the year of maximum inflows (2030) at 61 ML/year is significantly less than the maximum predictions in the EIS (183 ML/year). The new prediction of 76 ML/ year in the year 2030 will be moisture entrained in product coal and will not be captured and reused as process. The mine cannot rely on mine inflows to act as a source of process water, as was assumed in the EIS when the site water balance was developed for the project. <u>Site Water Balance</u> The site water balance for the EIS relied on the mine inflows, rainfall (and hence adequate water in onsite water storages), and water from the Production Bore. Water from these

Stakeholder	Matters raised	Comments and SEE Reference
		identified sources is no longer available at the volumes that were included in the site water balance approved in the EIS. Explanations are provided below. • **Mine Inflows** As discussed above mine inflows cannot be relied on to supplement process water. • **Surface water dams** Due to the recent prolonged drought the water levels in the onsite storages have been decreasing. The site water balance was reported for an average rainfall year (as required). The past year would not be classified as an average year. • **Production Bore** The Production Bore at Airly Mine is licensed at 158 ML/year. As explained at the CCC meeting the yield at the bore as been slowly decreasing and is significantly less than the 5 L/s on the water access licence. The yield is currently <1 L/s. This source water cannot be relied on for a sustainable supply of water at the site for life of mine operations. Additionally, the EC of the production bore is very high ~4500 µS/cm. The use of the production bore water in the last 2 years has resulted in the steady increase in the EC of the 109 ML Dam and the 35 ML Dam.
	Quality of water to be transferred to Airly pit top	Water to be transferred to Airly will be sourced from LDP4 Dam and Reedy Creek Dam. The statistical summary of the water quality from these dams and the LD4 discharges are included in Table 9 of Charbon MOD 1 SEE (Centennial Coal, 2019). Discussions in trends in water quality of the noted parameters are included in Section 7.2.2.2 of Charbon MOD 1 SEE (Centennial Coal, 2019). Comparisons of water quality from the two sites are included in **Table 16** in this SEE.
	Charbon and Airly mines are in different catchments	This is correct. In relation to the transfer of water between catchments legal advice has been obtained by Centennial on the legality of the proposed transfer of water between catchments / water sharing plans that will occur in the two modifications. The legal advice considered the appropriate legislation, comprising the *Water Management Act 2000*, the *Water Management (General) Regulation 2018*, the Access Licence Dealing Principles Order 2004, the Regulated Water Sharing Plan (WSP), the Unregulated WSP and the Metropolitan WSP, to answer the question. The review of the legislation did not locate any provisions that prohibit the discharge of water from a water source governed by one water sharing plan into a water source

Stakeholder	Matters raised	Comments and SEE Reference
		governed by a different water sharing plan.
	Impact on aquatic ecology and the potential to introduce exotic and non-endemic species to Airly Creek.	An assessment of the impact of any discharge of Charbon water from the Airly pit top 35 ML Discharge Dam has been assessed in the Surface Water Assessment (GHD, 2019a) supporting the Airly MOD 2 SEE (Centennial Coal, 2019). This assessment concluded there is: • a low risk of impacts to macroinvertebrates in Airly Creek • no impact to native fish • a low likelihood of introducing non-endemic macroinvertebrates species to Airly Creek • no risk of spreading new invasive macroinvertebrates or fish species to Airly Creek. It is emphasized that operational safeguards will be implemented so that no discharge of water occurs through Airly LDP001 to Airly Creek.
	Take of water from Reedy Creek Dam and adverse impact on Cudgegong River, including unavailability of water to the environment and other users in the catchment	Impacts of take of 170 ML/year of water from Reddy Creek Dam on the surface water users in Cumber Melon Creek, impacts to flows in Cudgegong River and Windamere Dam are discussed in Section 7.2.3.4 of Charbon MOD 1 SEE (Centennial Coal, 2019).
	Impact of the operation of the train for the transfer of water	The one water train every day proposed for the transfer of water from Charbon Colliery to Airly pit top falls within the approved maximum 5 trains per day and an average 2 trains per day in a calendar year approved in Airly Mine's consent SSD 5581. The rail noise impacts of reversing the coal train into the Airly Rail Loop has been assessed in a noise impact assessment appended as **Appendix D** to this SEE, and discussed in **Section 7.3**. There are no expected exceedances of consented operational noise criteria or the trigger levels in *Rail Infrastructure Noise Guideline* (EPA, 2013) for the day and night periods and passbys. The impacts operating this one water laden train on rail noise, pit top intrusiveness noise, air quality and greenhouse has emissions is discussed in **Section 7.4**. No environmental impacts above that approved at Airly Mine will occur, and the mine will be in compliance with its consent conditions.

APPENDIX C – SURFACE WATER IMPACT ASSESSMENT

Centennial Airly Pty Ltd

Airly Mine Extension Project Modification 2
Surface Water Impact Assessment

April 2019

Executive summary

Airly Mine is an existing underground coal mine operated by Centennial Airly Pty Limited (Centennial Airly), a wholly owned subsidiary of Centennial Coal Company Limited (Centennial). It is located near Capertee village, approximately 40 km north-west of Lithgow on the Castlereagh Highway in the Western Coalfield of NSW.

The Airly Mine Extension Project (SSD_5581) was approved in December 2016 and allows Airly Mine to extract up to 1.8 million tonnes per annum of run of mine coal for a period of 20 years within the boundaries of Mining Lease 1331 and Authorisation 232. Centennial Airly proposes to modify SSD_5581 (Modification 2) to import up 170 ML/year of water to supply operations at the mine from nearby Charbon Colliery. A modification to the development consent for Charbon Colliery is currently underway in order to export the water proposed to be transferred to Airly Mine.

This Surface Water Impact Assessment has been prepared to inform the Statement of Environmental Effects for Modification 2 to SSD_5581. It assesses the impact of the proposed modification, relative to the conditions as currently approved at Airly Mine in terms of site water management, the site water and salt balance, water quality, downstream water users and aquatic ecology. The proposed transfer of 170 ML/year corresponds to the process water deficit identified by the site water balance in a dry year for all approved activities at Airly Mine. On average, the water deficit was forecast to be 64 ML/year, while no deficit was forecast for a 'wet' year. The transfer of water from Charbon Colliery to Airly Mine will occur on an as needs basis, to ensure water that is imported will not increase the likelihood of discharges to Airly Creek.

Water management at Airly Mine

The water management system at Airly Mine includes five dams and associated infrastructure that capture runoff from the surface facilities area and supply operations at the mine, along with a production bore that extracts groundwater. In 2018, the existing production bore only yielded about a quarter of the licence allocation, and the average yield continues to fall. Centennial requires an additional reliable source of water to supply approved operations and proposes to import water extracted from surface water storages at the nearby Charbon Colliery.

Unlike other underground coal mines in the Western Coalfield, groundwater inflows at Airly Mine are relatively minor and expected to be entirely entrained as coal moisture. No measurable groundwater inflows have been observed in the underground workings at Airly Mine. The groundwater inflow predictions have been recalibrated with monitoring data acquired since the numerical model was developed in 2014. The predicted inflows are significantly less (76 ML in 2030) than reported in the Airly Mine Extension Project EIS (approximately 180 ML in 2030).

Water balance

A site water and salt balance model has been developed for Airly Mine. Due to the revised groundwater inflow predictions, discharges from Airly Mine are only expected as result of rare rainfall events, which exceed the criteria specified in Airly Mine's Environment Protection Licence 12374 (EPL 12374). Water balance modelling indicates that no increase in the frequency or magnitude of off-site discharges are expected as a result of the proposal.

Surface water quality

Site-specific guidelines values (SSGVs) have been developed for Airly Creek, based on observed water quality. The importation of the water from Charbon Colliery has the potential to increase electrical conductivity, total suspended solids, turbidity, total nitrogen and phosphorous and dissolved manganese and nickel concentrations in the water management system at Airly Mine. However, as the median concentrations of water quality parameters at Charbon Colliery are below the SSGVs for Airly Creek and EPL 12374 limits at Airly Mine, the likelihood of potential off-site discharges exceeding the SSGVs and EPL limits will not increase as a result of the proposal.

With the adoption of proposed water management measures, the likelihood of water sourced from Charbon Colliery directly entering the receiving environment without dilution is extremely low. Therefore, the potential impact to Airly Creek is considered to be low. EPL 12374 specifies water quality limits, which Airly Mine is required to comply with at all times.

Downstream surface water users

There were three surface water users identified downstream of the Airly Mine surface facilities area. Based on the water and salt balance and surface water quality assessments, adverse impacts to downstream water users are unlikely to occur due to the low risk of potential impacts and the ephemeral nature of Airly Creek.

Aquatic ecology

The macroinvertebrate community of Airly Creek is comprised largely of pollution tolerant taxa due to poor water quality relating to the agricultural landuse, riparian zone clearing and water scarcity and the related influence of these factors on instream habitat.

It is unlikely that macroinvertebrates would survive transportation from Charbon Colliery to Airly Mine, due to damage during pumping, oxygen depletion during transport, changes in ionic composition and lack of habitat in the water management system at Airly Mine. Given these factors and the on-site water management measures, which will minimise the risk of discharge off-site, the risk of introducing non-endemic macroinvertebrate species to Airly Creek is considered to be low.

The invasive fish species *Gambusia holbrooki* has been observed at Reedy Creek Dam at Charbon Colliery and also been in Airly Creek in high numbers. Therefore, no impacts to native fish are expected within Airly Creek as a result of the Project.

Conclusion

The proposal is expected to reduce reliance on local and regional groundwater at Airly Mine, while no increase in the frequency or magnitude of off-site discharges are expected. Given the recommended mitigation and management measures, no measurable change in the potential impacts on Airly Creek, downstream water users, or broader cumulative impacts are expected with respect to surface water.

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Appendices

Appendix A – Hydrogeological model report

Appendix B – Supporting assessment requirements

Appendix C – Water and salt balance model

Appendix D – Historical water quality

Glossary

Australian Height Datum	A common national surface level datum approximately corresponding to mean sea level.
average recurrence interval	The average or expected value of the periods between exceedances of a given rainfall total accumulated over a given duration.
beneficiate	Treat, or wash, (a raw material) to improve its properties
box cut	Small open cut built to supply a secure and safe entrance as access to a slope to an underground mine
calibration	In computer modelling, the process of testing different model parameters for the fit of model results to observations
catchment	The land area draining through the main stream, as well as tributary streams, to a particular site
clean water	Waters within a site that have not come into physical contact with sediment, coal or mined carbonaceous material
coal fines	Fine material from coal
coal handling plant	A facility where coal is crushed and screened
coal moisture	The water within and entrained in coal
coal preparation plant	A facility where coal is beneficiated
coarse coal rejects	Waste material from a coal preparation plant that with relatively large particle size
confluence	The location where two streams meet and merge
design storm	A hypothetical rainfall event used for design purposes
dewatering	Transfer of water from underground workings to the surface
dirty water	Waters within a site that have come into contact with coal or mined carbonaceous material or otherwise contain an elevated sediment load
disturbed areas	Areas where vegetation is not present that are likely to generate sediment laden runoff
electrical conductivity	A measure of the concentration of dissolved salts in water
ephemeral	Stream that is usually dry, but may contain water for rare and irregular periods, usually after significant rain
evaporation	The process where liquid water turns into vapour in the air
fine coal rejects	Waste material from a coal preparation plant that with relatively small particle size
fresh water sources	Water on the land; not ocean water
groundwater	Subsurface water that occurs in soils and geological formations
in situ coal moisture	The moisture entrained in coal in the seam prior to extraction
licensed discharge points	A location where a licensed operation discharges water to the environment in accordance with conditions stipulated within the site environment protection licence
mass balance	A mathematical model that balances inflows and outflows in order to obey the law of conservation of mass
mean	The average, sum of values divided by the number of values
median	The middle value, such that there is an equal number of higher and lower values, also referred to as the 50th percentile
normalised root mean square error	A measure of goodness of fit, a small number indicates a better fit
perennial	A watercourse or part of a watercourse that has continuous flow throughout the year
process water	Water used for the operation of the mine

product coal	Coal that is transport off-site for sale
production bore	A bore used to extract water from the ground
Quaternary	The most recent geological period spanning from approximately 2.5 million years ago to present
rejects emplacement area	A facility for containing coal rejects
run of mine coal	Coal in its unprocessed state, following mining but before processing
runoff	The amount of rainfall which actually ends up as streamflow, also known as rainfall excess
sediment	Soil or other particles that settle to the bed of lakes, rivers, oceans and other waters
subsidence	The vertical difference between the pre-mining surface level and the post-mining surface level at a point
topography	The shape of the surface of the earth
train loader	A facility to load coal into rail wagons
Triassic	The geological period that spans between approximately 250 and 200 million years ago
wastewater	Liquid waste discharged by a community or industry

Abbreviations

AHD	Australian Height Datum
AMEP	Airly Mine Extension Project
BOM	Bureau of Meteorology
Centennial Airly	Centennial Airly Pty Limited
Centennial	Centennial Coal Company Limited
EC	electrical conductivity
EIS	environmental impact statement
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Act 1999*
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPL	environment protection licence
FTE	full time equivalent
CHP	coal handling plant
CPP	coal preparation plant
LDP	licensed discharge point
GHD	GHD Pty Ltd
GMRU WSP	Greater Metropolitan Region Unregulated River Water Sources Water Sharing Plan
GWIA	Groundwater Impact Assessment
ha	hectare
IESC	Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development
kL/day	kilolitre per day
km	kilometre
L/s	litre per second
m	metre
mg/L	milligram per litre
ML	megalitre (one million litres)
ML/year	megalitre per year
mm	millimetre
MNES	matters of national environmental significance
Mtpa	million tonne per annum
NTU	Nephelometric Turbidity Units, a measure of turbidity
NWQMS	National Water Quality Management Strategy
POEO Act	*Protection of Environment Operations Act 1997*
REA	rejects emplacement area
ROM	run of mine
SEE	statement of environmental effects
SILO	Scientific Information for Land Owners

SSGV	site-specific guideline values
SWIA	Surface Water Impact Assessment
TARP	trigger action response plan
WAL	water access licence
WM Act	*Water Management Act 2000*
WMP	water management plan
WSP	water sharing plan
µS/cm	microsiemens per centimetre

1. Introduction

GHD Pty Ltd (GHD) was commissioned by Centennial Airly Pty Limited (Centennial Airly), a wholly owned subsidiary of Centennial Coal Company Limited (Centennial), to prepare a Surface Water Impact Assessment (SWIA) for Modification 2 to State significant (SSD) consent SSD_5581 for Airly Mine (the Project). This assessment forms part of a Statement of Environmental Effects (SEE) to support a modification application under section 4.55 (2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

1.1 Background

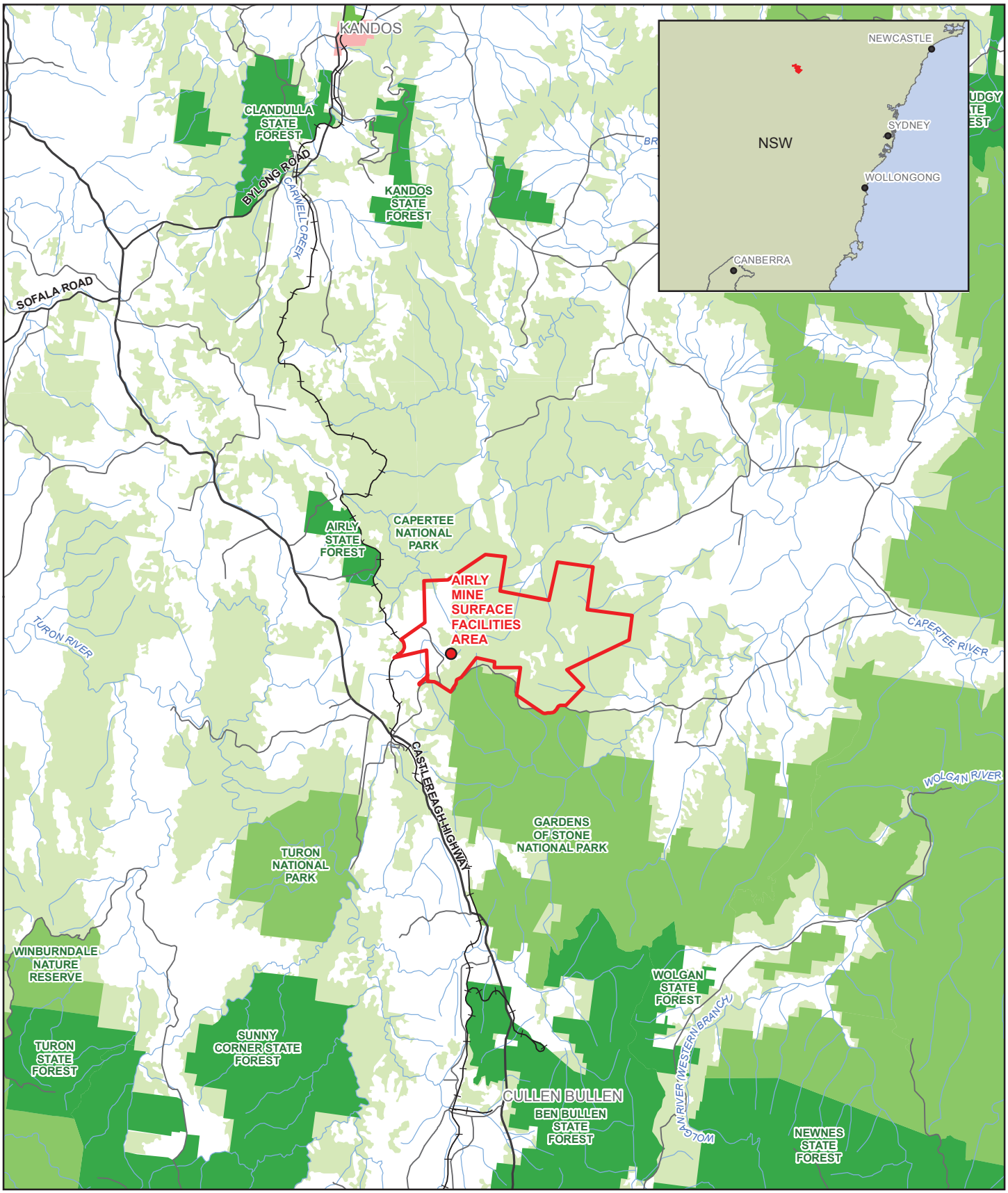
Airly Mine is an underground coal mine owned and operated by Centennial Airly. The mine is located near the village of Capertee, approximately 40 km north-west of Lithgow in the Western Coalfield. The location of the mine is shown in Figure 1-1.

Airly Mine was first granted development consent DA162/91 for the development of an underground coal mine in April 1993. The Airly Mine Extension Project (AMEP) for the continuation of underground mining within the boundaries of Mining Lease 1331 and Authorisation 232 was submitted in September 2014. The AMEP was approved in December 2016 by the then NSW Planning Assessment Commission for a period of 20 years, with rehabilitation to be undertaken after this period. Airly Mine's development consent SSD_5581 provides approval to extract up to 1.8 million tonnes per annum (Mtpa) of run of mine (ROM) coal from the Lithgow Seam. Airly Mine is also approved to construct and operate a coal preparation plant (CPP) and reject emplacement area (REA) to beneficiate up to 1.8 Mtpa of ROM coal, however neither have been constructed to date. ROM and product coal is transported off-site by rail for the export and domestic markets.

1.2 Overview of site operations

Airly Mine comprises an underground mine and a surface facilities area. The development consent boundary, existing mining area and location of the surface facilities area (pit top) are shown in Figure 1-2. The features of the surface facilities area associated with operations at Airly Mine are provided in Figure 1-3 and include water management and pollution control infrastructure, underground mining access, a coal handling plant (CHP) (including a coal crusher), rail loop and train loader used to load coal for export from the site and workshop and administration infrastructure. Figure 1-3 also shows the concept design of the approved REA and the CPP.

The water management system at Airly Mine includes the collection of runoff from disturbed and undisturbed areas in dams and occasional discharges of water to Airly Creek through licensed discharge points (LDPs). Water used for activities associated with mining, including dust suppression, vehicle and plant washdown and underground mining, is currently sourced from the surface water catchment of the surface facilities area and a production bore. Water supply from clean water runoff and the production bore is minimised by reuse and recirculation of water on site.



LEGEND

- Project approval area SSD_5581
- Waterway
- Existing rail
- Built up area
- Recreation area
- Nature conservation
- State forest
- Forest or shrub
- Dual carriageway
- Principal road
- Secondary road
- Minor road

Paper Size A4

0 1 2 4 6 8

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Centennial Airly

Centennial Airly Pty Ltd
Airly Mine Extension Project - Modifcation 2
Surface Water Impact Assessment

Job Number 22-19275
Revision 0
Date 22 Jan 2019

Locality plan

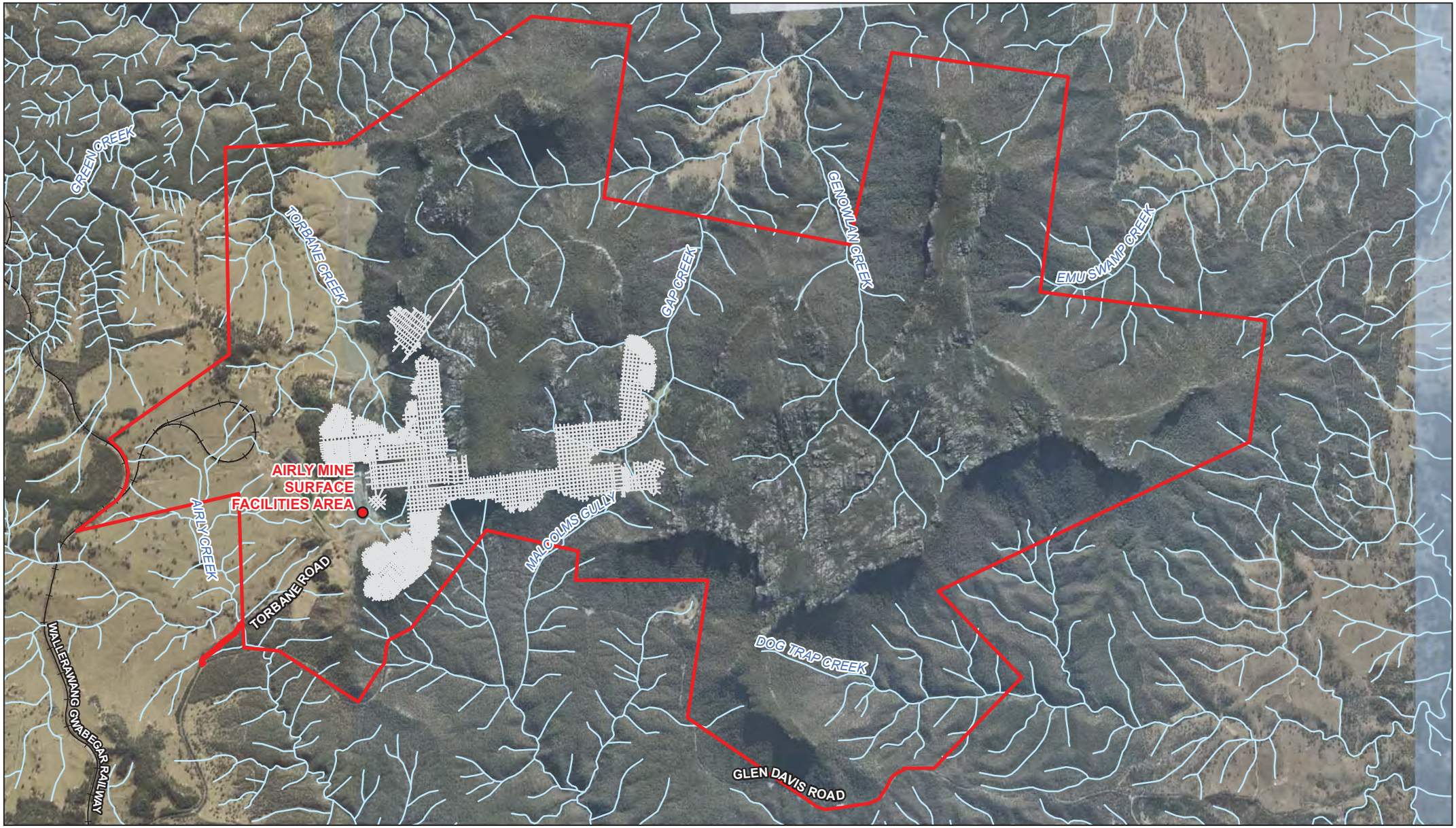
Figure 1-1

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\0105001\GIS\Maps\Deliverables\Western\Airly\2219275\SWIA\2219275_SWIA001_Locality_0.mxd

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Data source: @ Commonwealth of Australia (Geoscience Australia): 250K Topographic Data Series 3 2006; Centennial: Boundaries. Created by: smacdonald, kpsroba



Paper Size A4

0 375 750 1,125 1,500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Project approval area SSD_5581
- Existing workings
- Waterway
- Railway

GHD

Centennial Airly

Centennial Airly Pty Ltd
Airly Mine Extension Project - Modification 2
Surface Water Impact Assessment

Job Number 2219275
Revision 0
Date 22 Jan 2019

Site features

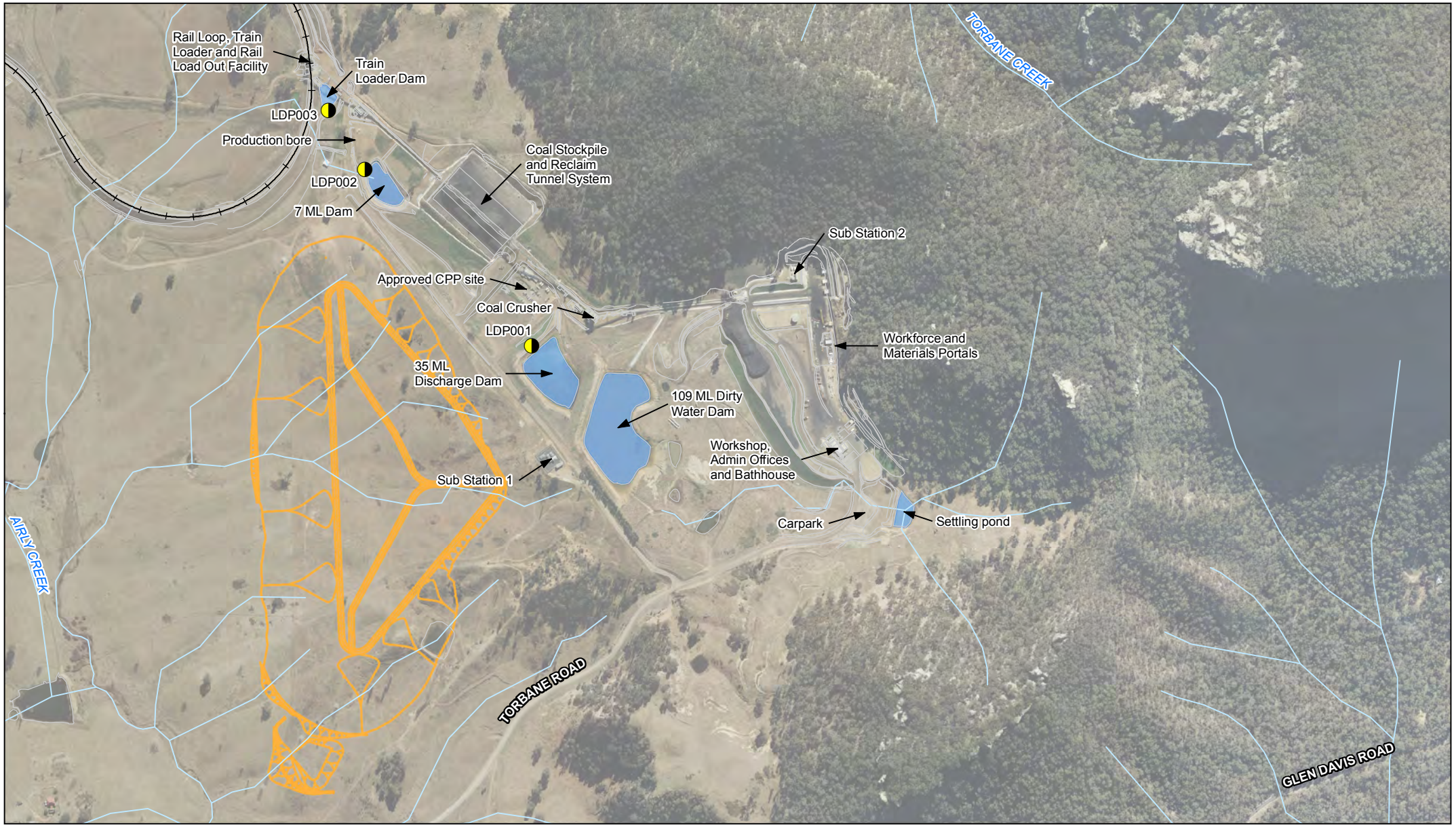
Figure 1-2

\\ghdnet\ghd\AU\Newcastle\Projects\22\0105001\GIS\Maps\Deliverables\Western\Airly\2219275\SWIA\2219275_SWIA002_SiteFeatures_0.mxd

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Data source: LPI: DTDB 2012; Centennial: Aerial Imagery, boundaries, 2013, Mine Workings, 2012. Created by: fmackay, kpsroba



Paper Size A4

0 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- LDP location
- Waterway
- Infrastructure
- Rail Loop
- Surface water storage
- Approved REA concept design

Centennial Airly Pty Ltd
Airly Mine Extension Project - Modification 2
Surface Water Impact Assessment

Job Number 2219275
Revision 0
Date 22 Jan 2019

Surface facilities area features

Figure 1-3

\\ghdnet\ghd\AU\Newcastle\Projects\22\0105001\GIS\Maps\Deliverables\Western\Airly\2219275\SWIA\2219275_SWIA003_SurfaceFacilitiesArea_0.mxd

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Data source: LPI: DTDB 2012; Centennial: Aerial Imagery, Infrastructure, 2013. Created by: fmackay, tmorton, kpsroba

1.3 Process water deficit

A recent review of the site water balance for Airly Mine has identified a deficit in process water supply as a result of:

- Revised groundwater inflow predictions being significantly less than included in the AMEP *Environmental Impact Statement* (EIS) (Golder Associates 2014).
- Current below average rainfall conditions limiting the surface water runoff captured on site.
- Reduced reliability of the production bore as a supplementary water supply.

1.3.1 Groundwater inflows

As noted above, the predictions of groundwater inflows into the underground workings that were included in the EIS for the AMEP, documented in within the *Groundwater Impact Assessment* (GHD 2014a), have recently been revised using additional monitoring data in accordance with the requirements of the site's *Water Management Plan* (WMP) (Centennial Coal 2018). Appendix A presents the results of the update and recalibration of the hydrogeological model for the mine using additional monitoring data collected since the AMEP was approved. The groundwater inflows predicted by the recalibrated hydrogeological model peak at 76 ML/year in 2030 (Scenario 2 option), which is significantly less than the maximum inflow of 183 ML/year predicted for the AMEP (GHD 2014a) that was used in the site water balance for the EIS for the AMEP (GHD 2014b).

The seepage of groundwater into the existing underground workings has been reported by Centennial Airly to be to be negligible and not sufficient to require regular mine dewatering. Monitoring results indicate that groundwater inflow volumes and process water used in underground operations is entrained in the ROM coal. As a result, all groundwater inflows and additional water is removed from the site as product coal moisture, with no water available to be reclaimed and reused as process water. Given the reduced groundwater inflows predicted by the recalibrated hydrogeological model, no mine inflows are expected to be able to be relied on for reuse as process water in the future.

1.3.2 Surface water runoff

Surface water runoff from across the site is captured within several dams and transferred to the main collection dam, the 109 ML Dirty Water Dam, prior to use in underground mining operations, dust suppression, machinery washdown and staff amenities. Harvested runoff is currently the primary water supply for operations at Airly Mine. A recent prolonged period of below average rainfall has reduced the volume of water stored on site, as the process water demand is currently greater than the rate of runoff harvested.

1.3.3 Production bore

Recent drought conditions at Airly Mine have increased reliance on the production bore to supplement process water supply. The volume of water extracted from the production bore is limited by water approvals to 5 L/s (158 ML/year), which is based on the sustainable yield of the bore calculated from the pumping tests undertaken at the time of installation. However, the current average yield is less than 0.8 L/s, with the flow rate continuing to decrease in during 2018 and early 2019. Investigations to assess the reliability of the production bore as a supplementary source of process water suggest that it is unlikely that flow rates will increase. Given the declining trend in yield, the Shoalhaven Group groundwater source is not currently considered to be a reliable source of water.

1.4 Project description

As part of the Project, up to 170 ML/year of water is proposed to be imported from Charbon Colliery using rail haulage to meet the deficit in process water supply at Airly Mine. Minor upgrades to the existing infrastructure at the surface facilities area is also proposed to allow for the transfer of water from train wagons to the 109 ML Dirty Water Dam.

The Project proposes:

- The importation of up to 170 ML/year of water from Charbon Colliery using rail haulage to meet the process water deficit forecast for Airly Mine.
- Minor upgrades to the existing surface infrastructure at the Airly Mine surface facilities area to allow transfer of imported water from the train wagons to the 109 ML Dirty Water Dam.

A modification to the development consent for Charbon Colliery is currently underway in order to export the water proposed to be transferred to Airly Mine.

1.5 Objectives and scope of work

The objective of the SWIA is to determine the potential impacts of the Project on the surface water environment within the vicinity of the Project and the broader regional environment. Since no change to the extent or rate of mining is proposed, the potential impacts of subsidence above mined areas are not expected to change as a result of the Project. Thus, the assessment of the potential impacts of the Project on surface water resources is limited to operations at the surface facilities area.

The scope of work for the SWIA includes:

- Review existing assessments and data relevant to the Project
- Review relevant statutory requirements
- Establish the baseline conditions for water management system
- Identify components of the Project with potential to affect the surface water environment
- Undertake an assessment of the potential impacts of the Project on:
  - Water and salt balance
  - Water quality
  - Downstream water users, including licensed water users and basic landholder rights
  - Aquatic ecology in Airly Creek
- Determine any licensing requirements for the Project
- Develop measures to avoid, minimise and mitigate potential impacts of the Project and recommend management, monitoring and reporting requirements

2. Regulatory context

2.1 Legislation

2.1.1 Environmental Planning and Assessment Act 1979

The EP&A Act is the core legislation relating to planning and development activities in NSW and provides the statutory framework under which development proposals are assessed. The EP&A Act aims to encourage the proper management, development and conservation of resources, environmental protection and ecologically sustainable development.

The SWIA forms part of a SEE to support an application to modify development consent SSD-5581 under section 4.55 (2) of the EP&A Act. The Minister for Planning (or delegate) is the determining authority for the Project.

2.1.2 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) is administered by the NSW Environment Protection Authority (EPA), which is an independent statutory authority and the primary environmental regulator for NSW. The objectives of the POEO Act are to protect, restore and enhance the quality of the environment. Some of the mechanisms that can be applied under the POEO Act to achieve these objectives include programs to reduce pollution at the source and monitoring and reporting on environmental quality. The POEO Act regulates and requires licensing for environmental protection, including for waste generation and disposal and for water, air, land and noise pollution.

Under the POEO Act, an environment protection licence (EPL) is required for premises at which a 'scheduled activity' is conducted. Schedule 1 of the POEO Act lists activities that are scheduled activities for the purpose of the Act. Licence conditions relate to pollution prevention and monitoring and can control the air, noise, water and waste impacts of an activity.

Currently, Centennial Airly holds EPL 12374 that authorises coal mining and coal works. Water is licensed to be discharged from the site through the following LDPs:

- LDP001 – discharge to Airly Creek via the 35 ML Discharge Dam
- LDP002 – discharge to Airly Creek via the 7 ML Dam
- LDP003 – discharge to Airly Creek via the Train Loader Dam

Water quality concentration limits for LDP001, LDP002 and LDP003 specified by EPL 12374 are provided in Table 2-1. No volumetric discharge limits at the LDPs are specified by EPL 12374.

Table 2-1 Water quality concentration limits for licensed discharge points

Parameter	Units	LDP001		LDP002 and LDP003
		90th percentile	100th percentile	100th percentile
Physicochemical parameters				
Electrical conductivity (EC)	µS/cm	2244		
pH	pH units		6.5–9.0	6.5–9.0
Total suspended solids (TSS)	mg/L		50	50
Turbidity	NTU		40	40
Nutrients				
Ammonia	mg/L		0.32	
Total nitrogen	mg/L	2		

Parameter	Units	LDP001		LDP002 and LDP003
		90th percentile	100th percentile	100th percentile
Total phosphorus	mg/L	0.5		
Dissolved metals				
Arsenic	mg/L		0.024	
Copper	mg/L		0.013	
Nickel	mg/L		0.1	
Zinc	mg/L		0.072	
Other parameters				
Oil and grease	mg/L		10	10

The water quality limits presented in Table 2-1 do not apply when the discharge for LDP001, LDP002 or LDP003 occurs solely as a result of rainfall measured at the site exceeding 44 mm over any consecutive five day period. A 44 mm rainfall depth is defined by *Managing Urban Stormwater: Soils and Construction Volume 1* (the 'Blue Book'; Landcom 2004) as the rainfall depth for a 95th percentile, five day rainfall event for the Central Tablelands consistent with the storage capacity (recommended minimum design criteria) for Type D sediment retention basins for mines (Landcom 2008).

Condition O4 of EPL 12374 requires the design storage capacity of the 35 ML Discharge Dam, 7 ML Dam and Train Loader Dam to be maintained by dewatering within 15 days (for the 35 ML Discharge Dam) or five days (for the 7 ML Dam and Train Loader Dam) following rainfall. Maintenance is required on all dams as necessary to retain the design storage capacity.

2.1.3 Water Management Act 2000

The *Water Act 1912* has historically been the main legislation for managing water resources in NSW, however is currently being progressively phased out and replaced by water sharing plans (WSPs) under the *Water Management Act 2000* (WM Act). Once a WSP commences, existing licences under the *Water Act 1912* are converted to water access licences (WALs), water supply works and use approvals under the WM Act.

The aim of the WM Act is to ensure that water resources are conserved and properly managed for sustainable use benefiting both present and future generations. It is also intended to provide formal means for the protection and enhancement of the environmental qualities of waterways and in-stream uses as well as to provide for protection of catchment conditions.

Water sharing plans

Fresh water sources throughout NSW are managed via WSPs under the WM Act. Provisions within WSPs provide water to support the ecological processes and environmental needs of groundwater dependent ecosystems and waterways. WSPs also regulate how the water available for extraction is shared between the environment, basic landholder rights, town water supplies and commercial uses. Key rules within the WSPs specify when licence holders can access water and how water can be traded.

The site is covered by two WSPs made under Section 50 of the WM Act, which are the Greater Metropolitan Region Unregulated River Water Sources WSP and the Greater Metropolitan Region Groundwater Sources WSP. Each WSP consists of several water sources that are regulated by a water extraction entitlement.

Airly Mine currently holds two WALs under the WM Act for the extraction of groundwater. A total of 278 ML/year is licensed for extraction from the Sydney Basin North groundwater source as part of the WSP for the Greater Metropolitan Region Groundwater Sources. WAL 24386 (158 ML/year) licenses the take of water from the production bore (water supply work approval 10WA112537), which is used to supplement water for use in mining activities. WAL 36565 (120 ML/year) licenses the extraction of water from the underground workings to the 109 ML Dirty Water Dam (miscellaneous works approval 10MW119324).

Basic landholder rights

Under the WM Act, extraction of water for basic landholder rights is protected by allocating and prioritising water for basic landholder rights. There are three types of basic landholder rights in NSW under the WM Act:

- Domestic and stock rights
- Native title rights
- Harvestable rights

Domestic and stock rights

Landholders are entitled to take water from a river, estuary or lake which fronts their land or from an aquifer which is underlying their land for domestic consumption and stock watering, without the need for a licence. However, a water supply work approval is required to construct a dam or a groundwater bore.

Native title rights

Anyone who holds native title with respect to water, as determined by the *Native Title Act 1993*, can take and use water for a range of purposes, including personal, domestic and non-commercial communal purposes.

Harvestable rights

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

The EIS for the AEMP (Golder Associates 2014) found that, based on the contiguous area of property under ownership of Centennial Airly at the Airly Mine site of 1710 ha, the maximum harvestable right for Airly Mine (10% of the average rainfall runoff of the total area) was 128 ML/year. The capacity of existing dams (excluding dams located in the surface facilities area, which are exempt) was estimated to be approximately 70 ML, and therefore, the remaining harvestable rights for the Project are 58 ML/year (45% of the total). The predicted volume of clean catchment runoff captured by the mine water management system was estimated to be 28 ML/year. As this volume is within the maximum harvestable rights, there is no requirement for licensing of clean catchment runoff by Centennial Airly under the WM Act.

2.1.4 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Commonwealth Department of the Environment and Energy and provides a legal framework to protect and manage nationally important flora, fauna, ecological communities and heritage places defined as 'matters of national environmental significance' (MNES). The EPBC Act identifies water resources, in relation to large coal mining development, as a MNES.

An action that 'has, will have or is likely to have a significant impact on a matter of national environmental significance' is deemed a 'controlled action' and may not be undertaken without prior approval from the Commonwealth Environment Minister. Approval under the EPBC Act is also required where actions are proposed on, or will effect, Commonwealth land and its environment.

The AMEP is a controlled action under the EPBC Act and the approval for referral 2013/7606 was granted on 18 May 2017. This approval has effect until 31 March 2047. The water resources trigger is one of the controlling provisions in this approval. The approval provides for Centennial Airly to carry out mining operations in accordance with development consent SSD_5581 with conditions relating to the protection of MNES.

The Project was determined, though an assessment of the Project against the significant impact criteria defined by the *Significant Impacts Guidelines 1.3* (DoE 2013a), as not likely to have a significant impact on any MNES listed under the EPBC Act (refer to Section 6.6) and consequently the Project is not required to be referred to the Commonwealth Department of Environment and Energy under the EPBC Act.

2.2 Guidelines

2.2.1 Significant impact guidelines

The significant impact guidelines provide over-arching advice on determining whether an action is likely to have a significant impact on a MNES protected by the EPBC Act and requires referral to the Commonwealth Department of the Environment and Energy for assessment and approval. Potential impacts on any MNES are subject to assessments of significance pursuant to the *Significant Impact Guidelines 1.1* (DoE 2013b). If a significant impact is considered likely, a referral under the EPBC Act must be submitted to the Commonwealth Environment Minister.

The *Significant Impact Guidelines 1.3* (DoE 2013a) includes significant impact criteria to assist in determining whether the impacts on a water resource from a proposed action associated with a coal seam gas or large coal mining development are likely to be significant, and therefore whether the action will require referral, assessment and approval. An action is likely to have a significant impact on a water resource if there is the possibility that it will directly or indirectly result in changes to the hydrology or water quality of a water resource.

The significant impact criteria defined by the *Significant Impact Guidelines 1.3* (DoE 2013a) are presented in Section 6.5, along with where each aspect has been assessed in the SWIA.

2.2.2 IESC information guidelines

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) is a statutory body established under the EPBC Act in 2012. The IESC provides independent scientific advice to Australian government regulators on proposed coal seam gas or large coal mining developments that are likely to have a significant impact on water resources. Information guidelines (IESC 2018) outline the information requirements of the IESC to adequately assess a proposal and provide scientific advice on the potential water-related impacts.

The SWIA has been undertaken based on the information guidelines specified by the IESC (2018). Appendix B presents the information requirements as well as where each requirement has been addressed in the SWIA.

2.2.3 Australian and New Zealand Guidelines for Fresh and Marine Water Quality

The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG 2018) provide guidance for assessing and managing ambient water quality in a wide range of water resource types and according to specified environmental values, such as aquatic ecosystems, primary industries, recreation and drinking water. A revised *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG 2018) was published in 2018 after a scientific review of the ANZECC (2000) guidelines. The Water Quality Management Framework (ANZG 2018) provides the key requirements for determining appropriate guideline values or performance criteria to evaluate the results of water quality monitoring programs.

The ANZG (2018) guideline adopts a risk-based approach to assessing ambient water quality by providing the framework to tailor water quality guidelines to local environmental conditions. Guideline values provided by ANZG (2018) can be modified into regional, local or site-specific guideline values (SSGVs) by taking into account factors such as the variability of the particular ecosystem, soil types, rainfall and level of exposure to contaminants. Guideline values are applied to the receiving environment at the edge of the mixing zone and do not apply to mine water at the point of discharge.

2.2.4 Managing Urban Stormwater: Soils and Construction

Managing Urban Stormwater: Soils and Construction – Volume 1 (Landcom 2004) outlines the basic principles for the design, construction and implementation of sediment and erosion control measures to improve stormwater management and mitigate the impacts of land disturbance activities on soils and receiving waters. This document relates particularly to urban development sites; however, it is relevant to the Project as it provides guidance on the configuration of erosion and sedimentation controls required during construction.

Additional guidelines on specific aspects of development and the application of erosion and sediment controls are also available. *Managing Urban Stormwater: Soils and Construction – Volume 2E Mines and Quarries* (DECC 2008) provides specific guidelines, principles and minimum design standards for good management practice in erosion and sediment control during the construction and operation of mines and quarries.

2.2.5 NSW Water Quality and River Flow Objectives

The *NSW Water Quality and River Flow Objectives* (DECCW 2006) are the agreed environmental values and long-term goals for each catchment in NSW. The objectives are intended to be considered in assessing and managing the potential impacts of activities on waterways.

The Project lies in the Hawkesbury-Nepean River catchment. There are no environmental objectives for the Hawkesbury-Nepean River, as, at the time of the objectives were approved, the Healthy Rivers Commission had completed a public enquiry and recommended water quality objectives for the catchment. These objectives were for nutrients, namely 0.035 mg/L for total phosphorus and 0.7 mg/L for total nitrogen. (NSW Government, 2001: Table 2, p. 22). These trigger levels are less stringent than the ANZG (2018) guideline levels for upland rivers (refer to Section 2.2.3).

3. Site description

3.1 Climate

A historical record of rainfall and evaporation data was obtained from the Scientific Information for Land Owners (SILO) database hosted by the Science Division of the Queensland Government's Department of Environment and Science. SILO point data consist of interpolated estimates based on historically observed data from Bureau of Meteorology (BOM) stations. For this assessment, SILO data was obtained for the grid point centred at -33.10N, 150.00E, which includes the Airly Mine surface facilities area.

Figure 3-1 presents the distribution of annual total rainfall and evaporation (Mortons lake evaporation) from the SILO dataset between January 1889 and December 2018. Figure 3-1 also compares SILO rainfall to site-based rainfall recorded between 2011 and 2018.

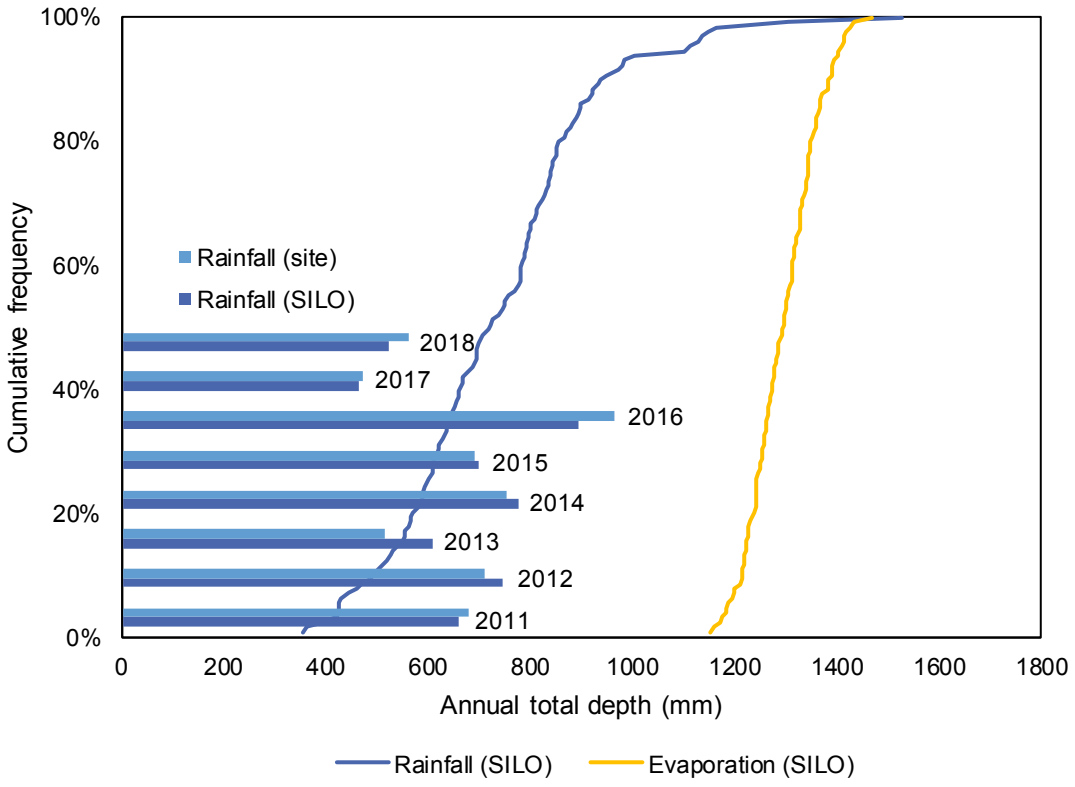


Figure 3-1 Annual rainfall and evaporation totals at Airly Mine

Figure 3-1 shows that annual rainfall totals have ranged from 347 mm (for 1982) to 1530 mm (for 1950), with a median of 721 mm and average of 731 mm. Annual evaporation totals have an average of 1296 mm, corresponding to an average annual moisture deficit (the difference between rainfall and evaporation) of 565 mm. The lower left corner of Figure 3-1 compares the annual rainfall totals observed at the site weather station against the SILO dataset. There is an adequate match between the site and SILO data (normalised root mean square error of 7%) indicating that the SILO dataset provides an adequate representation of the potential rainfall variability at the site. In recent years, both dry conditions (8th percentile in 2017) and wet conditions (91st percentile in 2016) have been experienced at the site.

Average monthly rainfall and evaporation totals were determined from the SILO dataset and are presented in Figure 3-2.

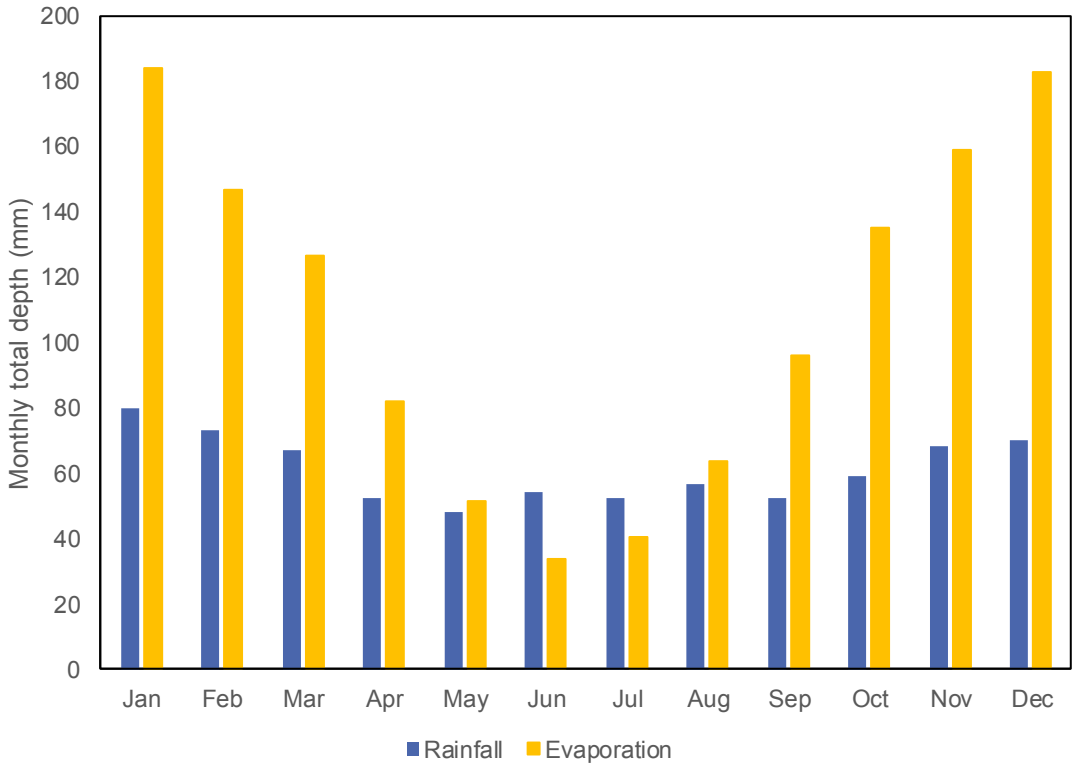


Figure 3-2 Average monthly rainfall and evaporation totals at Airly Mine

Figure 3-2 shows that evaporation varies seasonally, being higher in summer than in winter. There is also a similar, but less pronounced, seasonal variation in monthly rainfall totals. This seasonal variation is typical of the mild and cool temperature climate of the site.

3.2 Topography

Airly Mine is characterised by steep and rugged topography, as well as lower lying, undulating areas. The topography of the Project Application Area is dominated by Mount Airly to the west and Genowlan Mountain to the east. Site elevation varies from over 1000 m Australian Height Datum (AHD) to less than 750 m AHD in the south-eastern section of the site. The Airly Mine surface facilities area is located at the foot of Mount Airly at an elevation of about 780 m AHD.

3.3 Geology

Airly Mine is located within the southern part of the Western Coalfield of NSW, on the western edge of the Sydney Basin. The area is underlain by Triassic sandstone of the Narrabeen Group, which is underlain by the Illawarra Coal Measures.

The stratigraphy at Airly Mine is summarised in Table 3-1. This information has been sourced from the *Western Coalfield (south) Regional 1:100,000 Geology Map* (Yoo 1992) and exploration logs for Airly Mine. The outcrop geology in the vicinity of Airly Mine is shown in Figure 3-3.

Table 3-1 Stratigraphic sequence

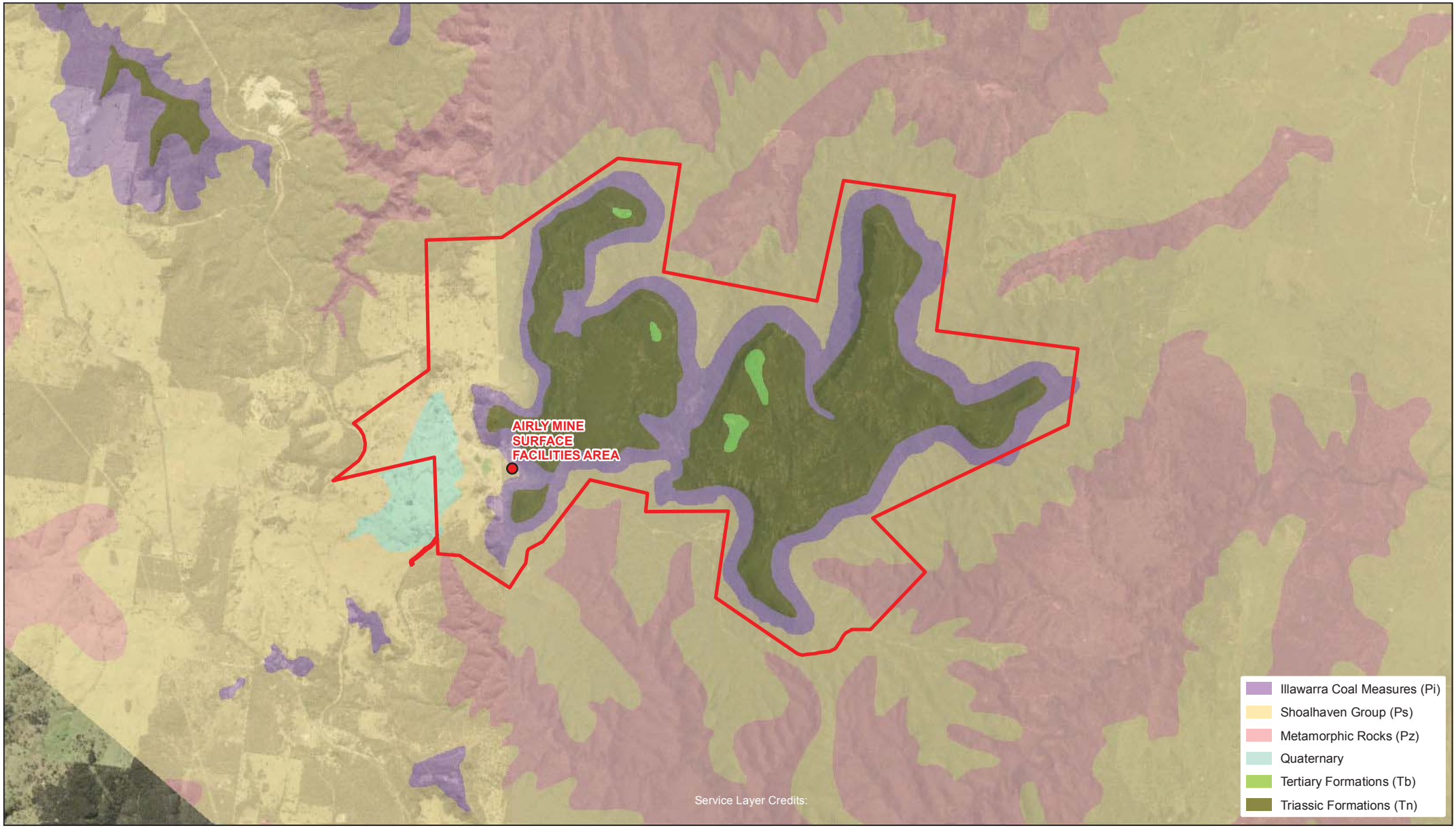
Period	Stratigraphy			Lithology
	Group	Subgroup	Formation	
Quaternary	Alluvium			Silt, clay, sand, gravel
Tertiary				Basalt, dolerite
Triassic	Narrabeen	Grose	Burra-Moko Head Sandstone	Quartz sandstone, red-brown claystone
			Caley Formation	Claystone, shale, quartz sandstone
Permian	Illawarra Coal Measures	Wallerawang	Middle River Coal Gap Sandstone	Coal, lithic sandstone, claystone
		Charbon	Glen Davis Formation Irondale Coal Long Swamp Formation	Sandstone, claystone, coal, mudstone
		Cullen Bullen	Lidsdale Seam Blackmans Flat Conglomerate Lithgow Seam Marrangaroo Formation	Coal, claystone, siltstone, mudstone, conglomerate
	Shoalhaven Group		Berry Siltstone	Siltstone, lithic sandstone conglomerate
Devonian	Metamorphic rocks			Quartzite, shale, sandstone, limestone, tuff

The Grose sandstone of the Triassic Narrabeen Group outcrops throughout the plateau and cliffs of Mount Airly and Genowlan Mountain, with small areas of Tertiary basalt outcrop at the higher elevations as shown in Figure 3-3. The Triassic strata are up to 200 m thick.

The Permian Illawarra Coal Measures outcrop around the Triassic formations at lower elevations, including the zone between Mount Airly and Genowlan Mountain. The Lithgow Seam within the lower Illawarra Coal Measures is the target coal seam at Airly Mine. The seam outcrops completely within the site boundary and is therefore disconnected to the areas of occurrence of this seam located several kilometres to the south and north-west. The thickness of the Lithgow Seam ranges between 3 m and 4 m with an average thickness of 3.4 m.

The depth of cover above the Lithgow Seam ranges from less than 20 m in areas of outcrop and in the Gap Creek area, up to approximately 310 m. The seam dips gradually to the east at around 1 degree. The average thickness of the Permian overburden is 105 m (Golder Associates 2013).

Interbedded siltstone and sandstone of the older Shoalhaven Group outcrop across the surface facilities area and beyond the Airly Mine boundary. Metamorphic rocks also outcrop beyond the site in areas of lower elevation.



Paper Size A4

0 625 1,250 1,875 2,500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Project approval area
SSD_5581

GHD

Centennial Airly

Centennial Airly Pty Ltd
Airly Mine Extension Project - Modification 2
Surface Water Impact Assessment

Job Number 22-19275
Revision 0
Date 22 Jan 2019

Geological map

Figure 3-3

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Data source: LPI: DTDB 2012; Aerial Imagery, 2015; Centennial: boundaries,2013; DPI: Geology, 2010. Created by: smacdonald, fmackay, kpsroba

3.4 Hydrology

Airly Mine lies within the Capertee River catchment, which is part of the Greater Hawkesbury/Nepean catchment. The Capertee River flows in a south-east direction to its confluence with the Wolgan River to form the Colo River, which ultimately contributes to the Hawkesbury River and Broken Bay.

There are four major creek systems located within the development consent boundary, as shown in Figure 1-2:

- Airly-Coco Creek (which includes Dog Trap Creek)
- Emu Swamp Creek
- Gap-Genowlan Creek
- Torbane-Oaky Creek

The Airly Creek system drains the southern sector of the site and joins Coco Creek within the Gardens of Stone National Park approximately 10 km south-east of the surface facilities area. Coco Creek flows out of the Gardens of Stone National Park for approximately 20 km before joining the Capertee River.

Surface runoff from a small area of the north-east of the site drains to Emu Swamp Creek, which flows in a north-east direction and joins the Capertee River approximately 10 km downstream.

Surface runoff from the northern sections of the site drains into Gap Creek and Genowlan Creek. The two creeks, which are groundwater fed in parts, drain northwards approximately 2 km before converging into the greater Genowlan Creek. Genowlan Creek continues to drain in a north-east direction until its confluence with the Capertee River approximately 8 km downstream. The Gap-Genowlan Creek sub-catchment occupies the largest portion of the site, with 1558 ha draining to the creek system.

The north-west section of the site area is drained by the Torbane-Oaky Creek system. Torbane Creek joins Oaky Creek approximately 2 km downstream of the site.

All of the watercourses draining the Airly Mine development consent boundary are ephemeral. Generally, these watercourses flow for relatively brief periods following significant rainfall events. Flows within Airly Creek, Oaky Creek, Coco Creek and Genowlan Creek become perennial outside the development consent boundary.

4. Methodology

4.1 Potential impacts

The objective of the SWIA is to identify and assess the significance of the potential impacts of the Project on the receiving surface water environment. The identification of potential impacts enables the development of measures to avoid or mitigate impacts. The following potential impacts to surface water systems as a result of the Project were identified:

- Changes to site water management
- Changes to the local water cycle
- Altered surface water quality downstream of the Project
- Altered availability of surface water to users downstream of the Project

4.2 Water and salt balance

A water and salt balance assessment was undertaken of the water management system for Airly Mine, including inflows, outflows and net change in storage. A site water and salt balance was previously developed in GoldSim for the AMEP (GHD 2014b), which is revised regularly to assist in the management and reporting of water use at the site. The changes to the site water and salt balance are described in Section 4.2.1 and are reflected in the existing conditions at the site in 2018 (described in Section 4.2.2).

Airly Mine does not currently operate at its approved production rate and not all approved activities are undertaken. For the purpose of the impact assessment, a baseline conditions scenario (described in Section 4.2.3) was established and used as the basis of comparison to the proposed conditions under the Project (described in Section 4.2.4).

4.2.1 Background

A site water and salt balance model was developed in GoldSim for the EIS for the AMEP *Surface Water Impact Assessment* (GHD 2014c). The results of this model are referred to as the approved (EIS) site water and salt balance and represent the AMEP approved in the EIS (Golder Associates 2014) based on the information available at that time. Since the time of the EIS, the site water and salt balance model has been updated to reflect:

- New site information, including dust suppression estimates, catchment and runoff model parameters. A summary of the changes to the current water and salt balance model compared to the model developed for the AMEP (GHD 2014b) is provided in Appendix C.
- The revised groundwater inflows into the underground workings predicted by the recalibrated hydrogeological modelling (refer Appendix A).
- The degrading reliability and average flow rates from the production bore. The average flow rate under existing conditions has continually reduced and the production bore is considered unreliable under the baseline and proposed conditions.

These updates to the site water and salt balance model are reflected in all scenarios considered in the assessment. Differences between the scenarios are described in the following sections.

4.2.2 Existing conditions

Airly Mine does not currently operate at its full approved production rate and not all approved activities are undertaken. The existing conditions site water and salt balance reflects the actual conditions experience in 2018, including:

- Observed rainfall at Airly Mine.
- Production of 906,308 t of ROM coal.
- Workforce of 125 fulltime equivalent (FTE) personnel.
- The average flow rate from production bore has reduced throughout the year to below 0.8 L/s. A total of 39 ML was extracted from the production bore in 2018.
- The approved CPP and REA were not included as they have not yet been constructed.

4.2.3 Baseline conditions

The water and salt balance model developed for the AEMP EIS (GHD 2014b) has been updated to reflect:

- Improved understanding of the water management system, including process water demands and catchment and runoff model parameters. A summary of the changes to the current water and salt balance model compared to the model developed for the AMEP (GHD 2014b) is provided in Appendix C.
- The revised groundwater inflows into the underground workings predicted by the recalibrated hydrogeological modelling (refer Appendix A).
- The exclusion of the production bore to supplement process water supply, which is not considered to be a reliable source of water due to decreasing yield from the bore.

The baseline conditions represent the scenario where all approved activities are undertaken, using the updated water and salt balance model. This effectively simulates a “do nothing” scenario for Airly Mine and is used to provide a comparison to the proposed conditions.

The baseline conditions site water and salt balance has assumed:

- The existing water management system and the approved operation of the CPP and REA. This includes the REA Dam at the toe of the REA and a planned LDP for potential discharges from the REA Dam (referred to as “planned REA LDP”).
- Approved maximum production rate of 1.8 Mtpa of ROM coal.
- Approved maximum workforce of 155 FTE personnel.

The CPP would require process water to operate, sourced from the existing water management system. Water for the CPP would be supplied by the 35 ML Discharge Dam via the Process Water Tank, with a water recycling system reducing the net demand of the CPP by returning approximately 80% of the water supplied to the 109 ML Dirty Water Dam.

The processing of ROM coal in the CPP is expected to produce approximately 20% waste reject material, consisting of both coarse and fine material that would be emplaced in the REA. Surface water runoff from the REA and contributing natural catchment would be collected by internal sediment collection storages and external sediment ponds before being recirculated in the surface water management system to the 109 ML Dirty Water Dam for reuse.

Due to the exclusion of the production bore to supplement process water supply, a deficit is modelled to exist under baseline conditions when process water demand exceeds harvested surface water runoff. To model this deficit, sufficient water to supply all approved operations was simulated to be available from Process Water Tank. The difference between water required (i.e. the outflows from the Process Water Tank) and the water available (i.e. the inflow to the Process Water Tank) was used to quantify the deficit for the site.

For the purpose of the salt balance, the EC of water supplied from the Process Water Tank was assumed to be equal to the median observed EC of the 35 ML Discharge Dam (which supplies the Process Water Tank). This EC was selected as it is the lowest reasonable representative value of process water at Airly Mine and therefore would show the greatest potential impact of the Project on the salt balance under proposed conditions.

4.2.4 Proposed conditions

Proposed conditions reflect the changes to the site water management system proposed as part of the Project. Therefore, proposed conditions were the same as the baseline conditions, but rather than simulating a process water deficit, the model simulated the transfer of up to 170 ML/year of water from Charbon Colliery to the Train Loader Dam. This transfer was modelled to occur as required when the surface water storages were simulated to be less than 75% full. The transfer of water was limited to up to one train per work day, with up to 30 containers of 26,000 L capacity each able to be delivered to Airly Mine.

The water from Charbon Colliery is proposed to be sourced from both Reedy Creek Dam (with median EC of 1485 µS/cm) and LDP4 Discharge Dam (with median EC of 1830 µS/cm), however the proportions of contributions from the water sources to be supplied to Airly Mine depends on day to day operational conditions. The median EC of LDP4 discharge is higher at 2320 µS/cm (as presented in Section 6.3.1) and therefore was adopted as the modelled EC of the transfer from Charbon Colliery. This was a conservative assumption for the purpose of assessing the potential impact of the Project on the site salt balance at Airly Mine.

4.2.5 Modelling methodology

The water management schematic for the water management system at Airly Mine is presented in Figure 4-1. The model represents the water and salt cycle as a series of elements, each containing pre-set rules and data, that are linked together to simulate the interaction of these elements within the water and salt cycle. The water and salt balance model was simulated over projected life of the mine, from existing conditions in 2018 until 2037, and selected outputs from the modelled system were statistically summarised.

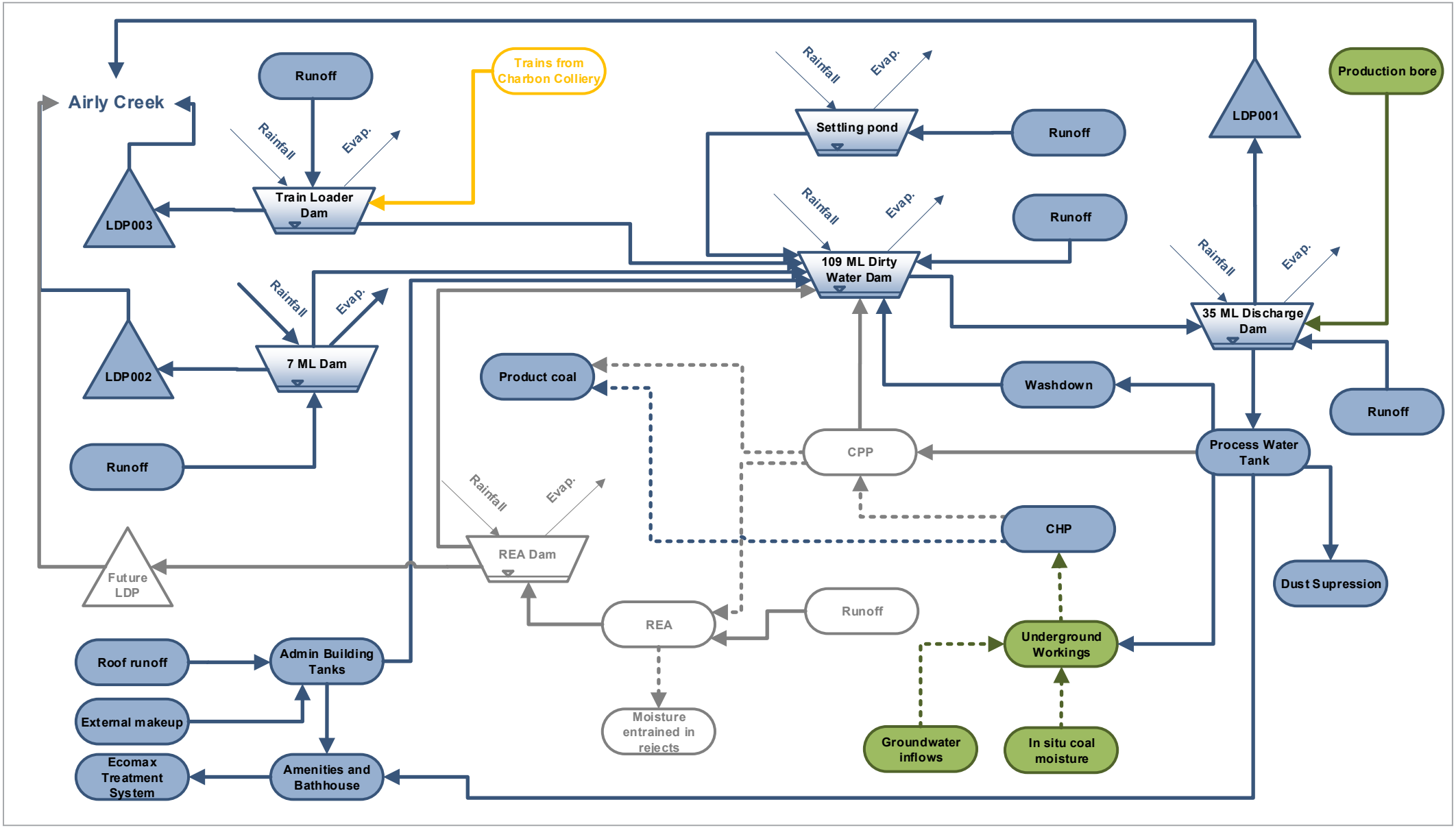
The salt balance model was developed as an extension of the water balance model, with expected concentrations of salt applied to water inflows into the system. Transfers of the resulting salt loads were modelled throughout the site. The mass and concentration of salt within particular storages was established such that a mass balance was achieved after allowing for salt discharged via extraction and overflows.

To assess the impact of rainfall on the site, modelling for the baseline conditions and proposed conditions was completed by using a historical time series of daily rainfall data extending over 130 years, from January 1889 to December 2018 (refer Section 3.1). A total of 130 simulations were applied, with each simulation modelling a different rainfall pattern from the record.

The results presented in this assessment include the average annual transfers between water management elements as well as the 10th percentile and 90th percentile values. The purpose of displaying the three results for each water transfer is to show the average transfer volume and an indication of the range of values expected due to possible variation in rainfall.

The 10th percentile represents the value at which 10% of the modelled outputs were less than this value. Similarly, the 90th percentile represents the value at which 90% of the modelled outputs were less than this value.

The 10th and 90th percentile results are not the same as the “dry” and “wet” year results presented in this assessment. The “dry” and “wet” year results are based on an equilibrium modelling approach with the driest and wettest rainfall year on record (347 mm in 1982 and 1530 mm in 1950 respectively; refer to Section 3.1) being repeated continuously as the simulated rainfall.



Legend

- Underground storage
- Underground process
- Surface storage
- Surface process
- Licensed discharge point
- Entrained moisture
- Surface water flow
- Groundwater flow
- Approved / baseline conditions
- Proposed conditions

Centennial Airly Pty Ltd
Airly Mine – Modification 2
Surface Water Impact Assessment

Water management schematic

Project No. 2219275
Revision No. 0
Date 29/03/2019

FIGURE 4-1

Created by: Tyler Tinkler

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Print date: 29/03/2019 13:08

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4.3 Water quality

A surface water quality assessment was undertaken to identify any potential impacts of water sourced from Charbon Colliery on the surface water management system at Airly Mine. The water quality assessment has been undertaken in accordance with the assessment framework and methodologies outlined by ANZG (2018).

Results have been compared to SSGVs derived for the Airly Creek catchment following the ANZECC (2000) methodology (Centennial Coal 2018) and concentration limits for LDP001 specified by EPL 12374. The ANZECC (2000) methodology has not changed in the updated Australian and New Zealand guidelines for fresh and marine water quality (ANZG 2018). The SSGVs for the Airly Creek catchment are presented in Table 4-1.

Table 4-1 Airly Creek catchment site-specific guideline values

Parameter	Units	EPL 12347 LDP001 limits		SSGV (Centennial Coal 2018)
		90th percentile	100th percentile	
Physicochemical parameters				
EC	µS/cm	2244		2709
pH	pH units		6.5–9.0	6.5–8.0
TSS	mg/L	50		25
Turbidity	NTU	40		25
Nutrients				
Ammonia	mg/L		0.32	0.32
Total nitrogen	mg/L	2		0.7
Total phosphorus	mg/L	0.5		0.056
Dissolved metals				
Aluminium	mg/L			0.027
Antimony	mg/L			0.001
Arsenic	mg/L		0.024	
Barium	mg/L			0.017
Beryllium	mg/L			0.001
Boron	mg/L			0.09
Cobalt	mg/L			0.001
Copper	mg/L		0.013	0.001
Iron	mg/L			0.3
Lead	mg/L			0.001
Manganese	mg/L			1.2
Molybdenum	mg/L			0.001
Nickel	mg/L		0.1	0.008
Silver	mg/L			0.001
Zinc	mg/L		0.072	0.0076
Other parameters				
Oil and grease	mg/L		10	5

SSGVs in Table 4-1 are presented for indicative purposes only as they are applied to the receiving environment at the edge of the mixing zone and do not apply to mine water discharges via LDPs.

The water quality assessment considered data from the following locations for Airly Mine:

- Airly Creek Upstream – located on Airly Creek upstream of Airly Mine surface facilities area.
- Airly Creek – located downstream of Airly Creek Upstream monitoring site and the Airly Mine surface facilities area.
- 35 ML Discharge Dam – the main clean water storage for Airly Mine surface facilities area. Overflows from the dam discharge through LDP001 to Airly Creek.

As presented in GHD (2019a), the monitoring locations at Charbon Colliery used for comparison are:

- LDP4 discharge – discharge from the LDP4 Discharge Dam into Reedy Creek upstream of Reedy Creek Dam.
- LDP4 Discharge Dam – receives runoff from the coal handling and preparation plant and stockpile areas as well as seepage and runoff from the REA and overflows from the Mine Washery Dams. Overflows from the dam discharge through LDP4 to Reedy Creek.
- Reedy Creek Dam – the main clean water storage for Charbon Colliery. Overflows from the dam occur downstream of the site into Cumber Melon Creek.

Monitoring locations are shown in Figure 4-2 and Figure 4-3 for Airly Mine and Charbon Colliery respectively.

The period of data reviewed for each location is provided in Table 4-2.

Table 4-2 Period of surface water quality data assessed

Location	Period from	Period to	Count
Airly Creek Upstream	April 2014	October 2018	23–25
Airly Creek	January 2010	October 2018	43–71
35 ML Discharge Dam	January 2010	October 2018	103–77
LDP4 discharge	January 2013	September 2018	1–47
LDP4 Discharge Dam	October 2013	September 2018	1–28
Reedy Creek Dam	January 2010	January 2018	1–43

4.4 Downstream water users

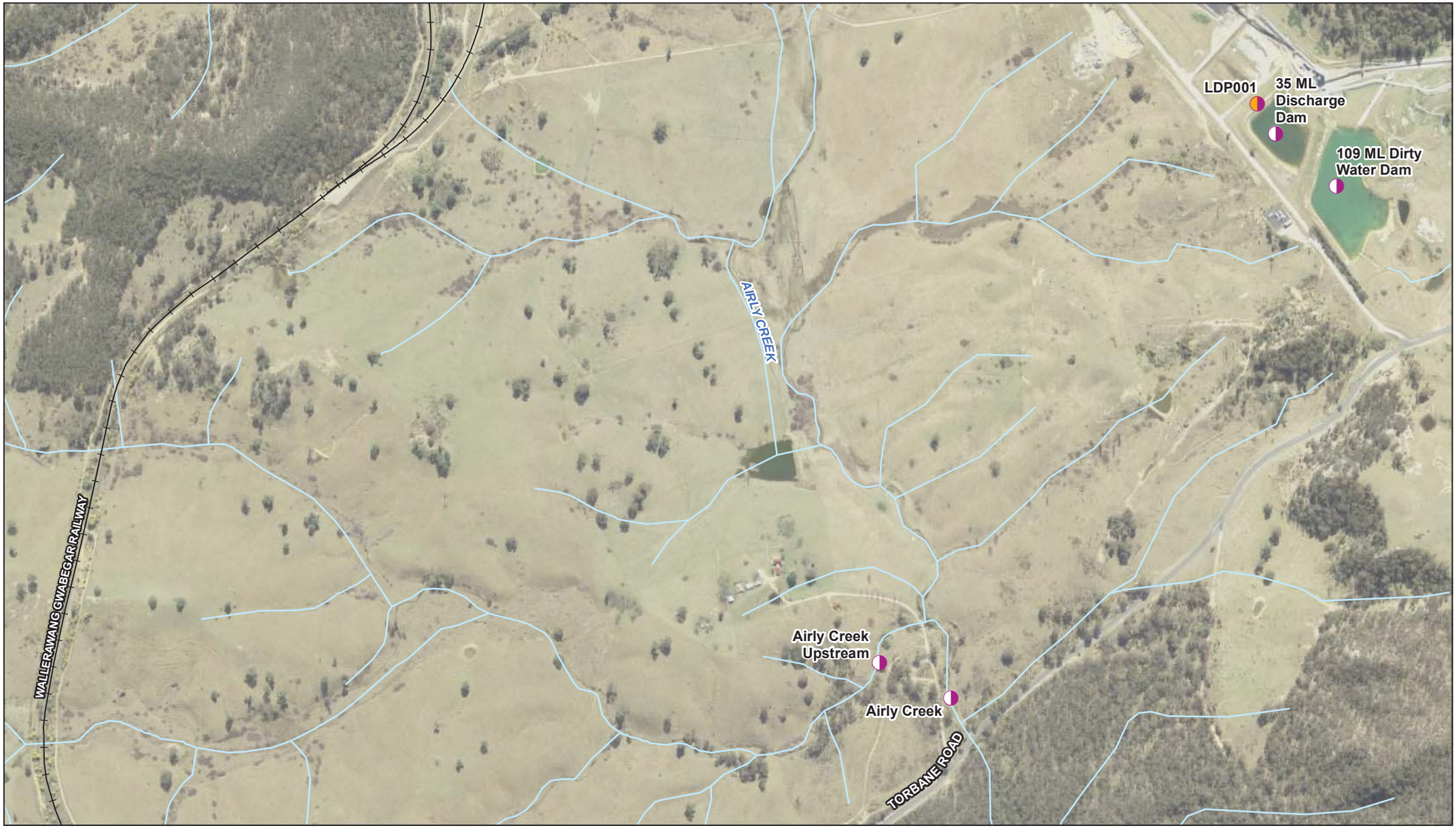
The potential impacts of the Project on downstream water users were assessed by identifying water users within the potential area of impact. This area was estimated conservatively based on potential discharges from Airly Mine surface facilities area, which would enter Airly Creek, then Coco Creek, before joining the Capertee River. At its confluence with Coco Creek, the Capertee River is a major watercourse with a catchment area of about 800 km^2, or about 500 times the catchment area of the Airly Mine surface facilities area. Therefore no potential impacts are expected in the Capertee River with respect to water quantity.

The assessment area was limited to within 2 km of Airly Creek and Coco Creek. Lots in this area were searched for works approvals using the *NSW Water Register* (WaterNSW 2019), to identify licensed water users and domestic and stock rights users with a water supply works approval.

4.5 Aquatic ecology

Aquatic ecology monitoring was undertaken in Airly Creek and other waterways relevant to Airly Mine operations as part of the EIS for the AMEP over three sampling events (Cardno 2014). Macroinvertebrates, fish and habitat condition was monitored during each sampling event.

Routine (post-EIS) aquatic ecology monitoring is conducted biannually in Airly Creek with seven monitoring rounds completed between spring 2015 and spring 2018. Macroinvertebrates, water quality and habitat condition are monitored during each sampling event.



Paper Size A4

0 80 160 240 320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Waterway
- Railway
- Existing workings
- Approved project extension workings
- Flow monitoring
- Flow and water quality monitoring
- Water quality monitoring

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Surface Water Impact Assessment

Job Number 22-18803
Revision 0
Date 22 Jan 2019

Surface water monitoring locations Airly Mine

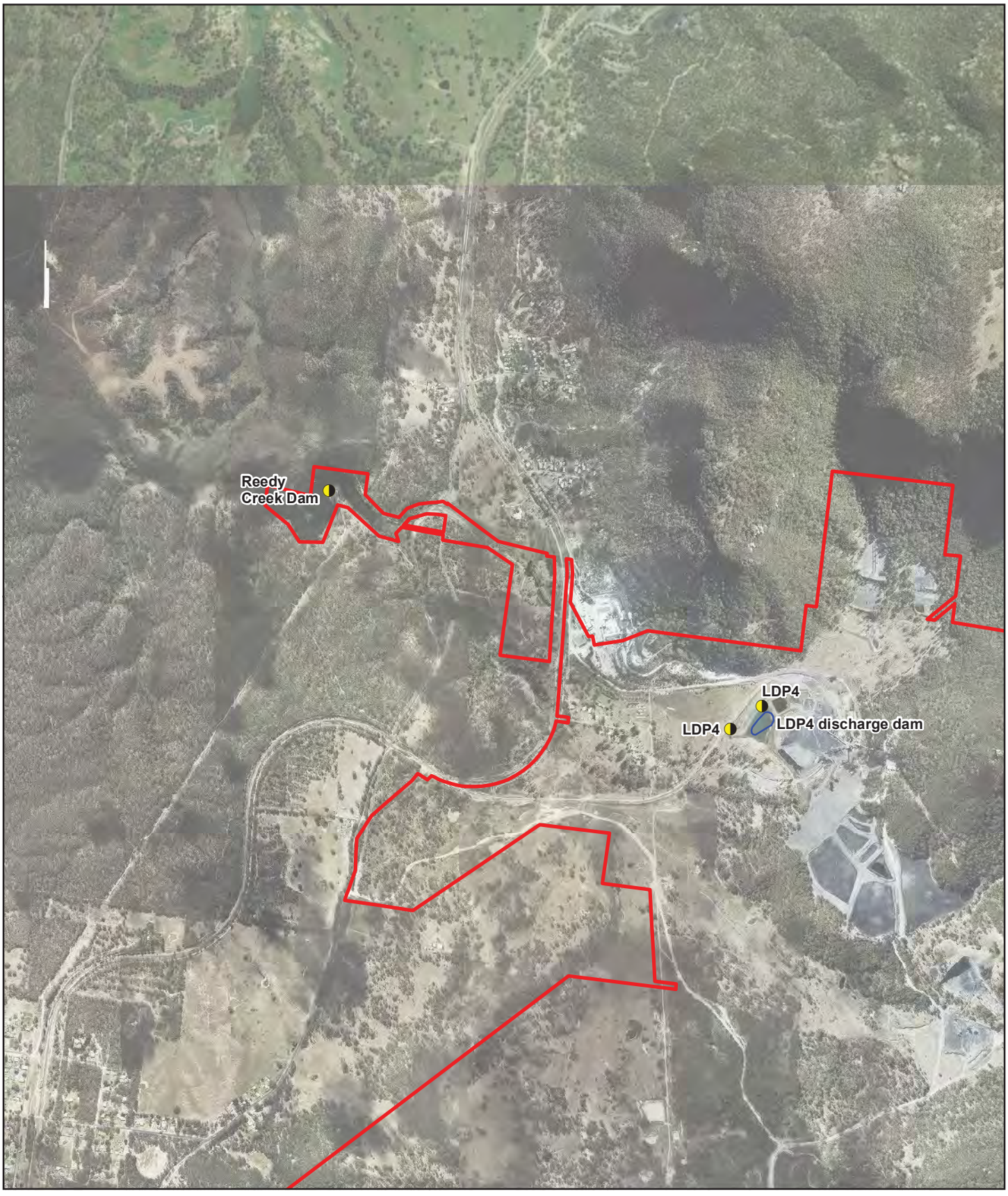
Figure 4-2

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Data source: LPI: DTDB 2012; Centennial: Aerial Imagery, boundaries, 2013, Monitoring Locations, 2017. Created by: fmackay, kpsroba



LEGEND

- Project Site Boundary
- Monitoring location
- Production Bore

Paper Size A4

0 0.1 0.2 0.3 0.4 0.5

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Centennial Airly

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Airly Mine Extension Project - Modification 2
Surface Water Impact Assessment

Surface water quality monitoring locations
Charbon Colliery

Job Number	22-19275
Revision	0
Date	22 Jan 2019

Figure 4-3

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Data source: Centennial: Boundaries, 2013: Aerial imagery, 2016. LPI: DCDB/DTDB, 2015. Created by: smacdonald, tmorton, kpsroba

5. Existing environment

5.1 Water management

The water management system at Airly Mine is comprised of clean surface, dirty surface, amenities, waste and underground water elements. Sources of water at the site include:

- Direct rainfall onto storages
- Catchment runoff
- External water supply (for bathhouse and amenities)
- Groundwater inflows to the underground workings

The primary water demands are for underground mining operations, surface dust suppression, machinery washdown, fire-fighting storage and staff amenities.

The layout of the existing surface water management system at the surface facilities area is shown in Figure 5-1, including the catchment of the approved REA, based on the concept design. A schematic of the overall water cycle is provided in Figure 5-2.

5.1.1 Clean surface water management system

Surface water runoff from areas where there is no coal storage, transportation, handling or processing or any disturbance is considered to be clean water, as it is unlikely to be contaminated with coal fines or sediment. Runoff is diverted around dirty water and coal-contact catchments to avoid mixing. The clean surface water management system diverts runoff from natural (undisturbed) and impervious catchments, such as areas of vegetation, sealed roads and sealed car parks.

The 35 ML Discharge Dam is the main clean water storage at Airly Mine. The dam receives surface water runoff from the northern perimeter clean water drainage system and piped transfers and overflows from the 109 ML Dirty Water Dam. Water is supplied to the Process Water Tank from the 35 ML Discharge Dam. Overflows from the dam discharge through LDP001 to Airly Creek.

5.1.2 Dirty surface water management system

Dirty water is runoff from disturbed areas and areas likely to contain suspended sediment, oils, grease and hydrocarbons. This typically includes workshop and fuel storage areas. Coal-contact water is runoff from catchments where coal storage, transportation, handling or processing occurs and is managed within the dirty water management system.

The dirty water management structures at Airly Mine form the basis of sediment control at the site. Dirty water runoff (coal-contact and sediment-laden water) is managed by a number of dirty water storages which enable suspended solids to settle out of the water column. Small primary dams trap coarse sediment, which overflow into the 109 ML Dirty Water Dam where fine sediments settle. The dirty water management structures are regularly de-silted to maximise available storage capacity.

Sediment-laden water from the eastern hardstand area is directed via diversion bunds to an active filter pond, where it is managed and released to the 109 ML Dirty Water Dam if capacity is available.

Settling Pond

The Settling Pond receives surface water runoff from contributing catchments east of the surface facilities area. Overflows from the Settling Pond are directed to the 109 ML Dirty Water Dam.

7 ML Dam

The 7 ML Dam receives surface water runoff from the conveyor and stockpile areas. The water level in the dam is maintained low by pumping water to the 109 ML Dirty Water Dam. During high rainfall events, overflows from the 7 ML Dam discharge through LDP002 into Airly Creek.

Train Loader Dam

The Train Loader Dam receives surface water runoff from the train loading area. The water level in the dam is maintained low by pumping water to the 109 ML Dirty Water Dam. During high rainfall events, overflows from the Train Loader Dam discharge through LDP003 into Airly Creek.

109 ML Dirty Water Dam

The 109 ML Dirty Water Dam receives surface water runoff from the eastern hardstand area, including the mine entrance area and emergency stockpile, and from the northern perimeter clean water drainage system. Overflows from the Settling Pond and Administration Buildings Tanks, water pumped from the 7 ML Dam and Train Loader Dam and extractions from the production bore are also directed into the 109 ML Dirty Water Dam.

Water is supplied from the 109 ML Dirty Water Dam to the 35 ML Discharge Dam via a pontoon mounted pipe, with water drawn from the surface of the dam. Overflows are also directed to the 35 ML Discharge Dam.

5.1.3 Underground water management system

The underground water management system at Airly Mine consists of the underground mine workings and groundwater extraction through a production bore. Mining operations are supplied water by the Process Water Tank (part of the dirty surface water management system).

Groundwater inflows

As discussed in Section 1.3.1, the seepage of groundwater into the underground workings has been reported by Centennial Airly to be negligible and not sufficient to require regular mine dewatering. Monitoring data indicates that all groundwater inflows and additional process water used in underground operations is entrained in ROM coal. As a result, no groundwater inflows are available to be reclaimed and reused as process water.

Production bore

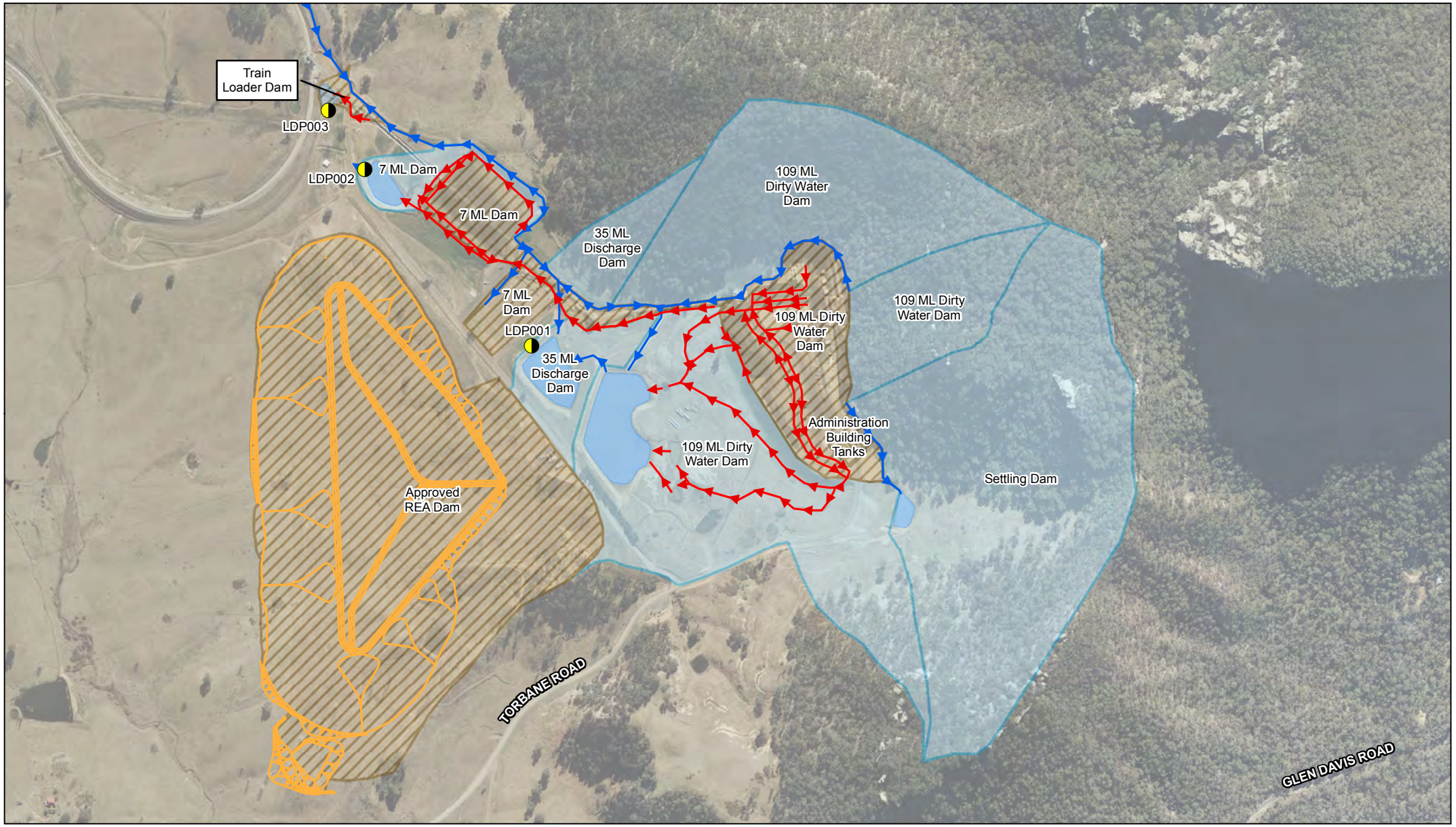
Airly Mine was granted approval for groundwater extraction through the production bore (WAL 24386 and water supply works approval 10WA112537) in 2011. As discussed in Section 1.3.3, below average rainfall conditions at Airly Mine have increased reliance on the production bore to supplement process water supply. Extraction from the production bore, other than for monitoring purposes, commenced in 2017, with approximately 21 ML extracted during the latter part of 2017. In 2018, the maximum actual extraction rate achieved from the production bore has been limited to 2 L/s, with a total of 39 ML extracted through the year, however the average flow rate has reduced to below 0.8 L/s in late 2018, and continues to decrease over time. The actual extraction rates achieved are considerably less than the sustainable yield of the bore calculated from the pumping tests undertaken at the time of installation, which are the basis for the water supply works approval limit of 5 L/s and by the WAL of 158 ML/year.

Investigations to assess the reliability of the production bore as a supplementary source of process water suggest that it is unlikely that flow rates will increase and be sustained for the life of mine operations (refer to Appendix A). Given the declining trend in yield, the Shoalhaven Group groundwater source is not currently considered to be a reliable source of water.

The water quality of the production bore is poor compared to the surface water at Airly Mine, with higher EC (median of 4920 µS/cm) and elevated dissolved nickel concentrations (median of 0.28 mg/L). Prolonged use of the production bore is expected to result in an increase in EC and dissolved nickel concentrations in the 35 ML Discharge Dam at Airly Mine, as has begun to be observed during 2018 (refer to Section 5.4).

5.1.4 Amenities and wastewater management system

As Airly Mine is not connected to a municipal water supply, drinking water is supplied by bottled water. Water for amenities is harvested from the rooftops of the administration and facilities buildings and supplemented by trucked water. Wastewater from the administration buildings and bathhouse is directed to the Ecomax effluent treatment system for disposal via soil infiltration.



Paper Size A4

0 90 180 270 360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- LDP location
- Surface water storage
- Clean Water Diversion
- Dirty Water Diversion
- Clean water catchment
- Dirty water catchment
- Approved REA concept design

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Surface Water Impact Assessment

Job Number 2219275
Revision 0
Date 22 Jan 2019

Layout of surface water management system

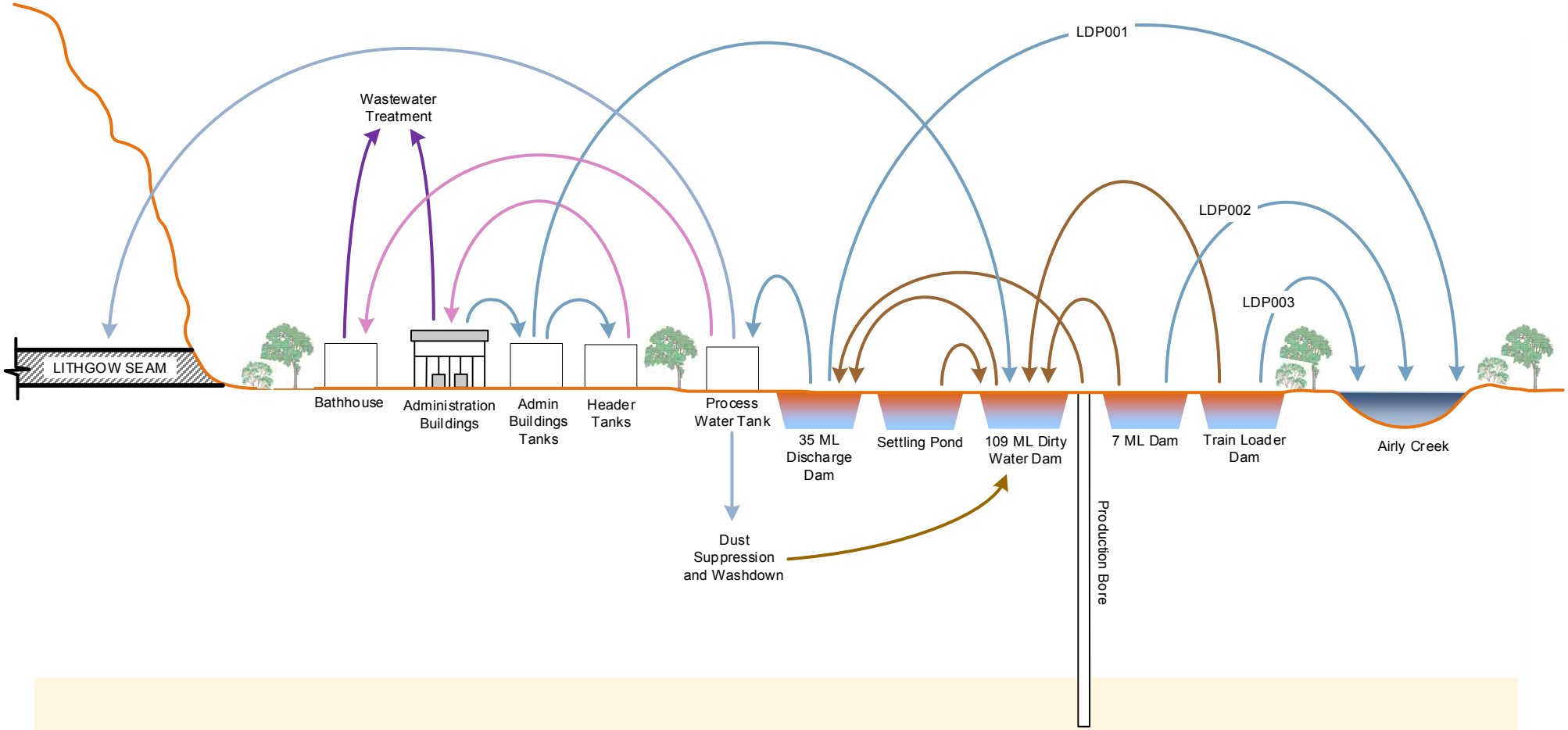
Figure 5-1

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

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Data source: LPI: DTDB 2012; Centennial: Aerial Imagery, Infrastructure, 2013. Created by: fmackay, tmorton, kpsroba



LEGEND

- Clean Water
- Underground Water
- Dirty Water
- Wastewater
- Amenities Water

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LOCATION	Airly
SEAM	Lithgow
DRAWN	SM
CHECKED	TD
APPROVED	SG
SCALE	NTS

Centennial Airly Pty Ltd
Airly Mine Extension Project – Modification 2
Surface Water Impact Assessment

Water cycle schematic
Existing conditions

Centennial Airly

DATE 15/01/2019

Figure 5-2

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5.2 Water and salt balance – existing conditions

5.2.1 Water balance

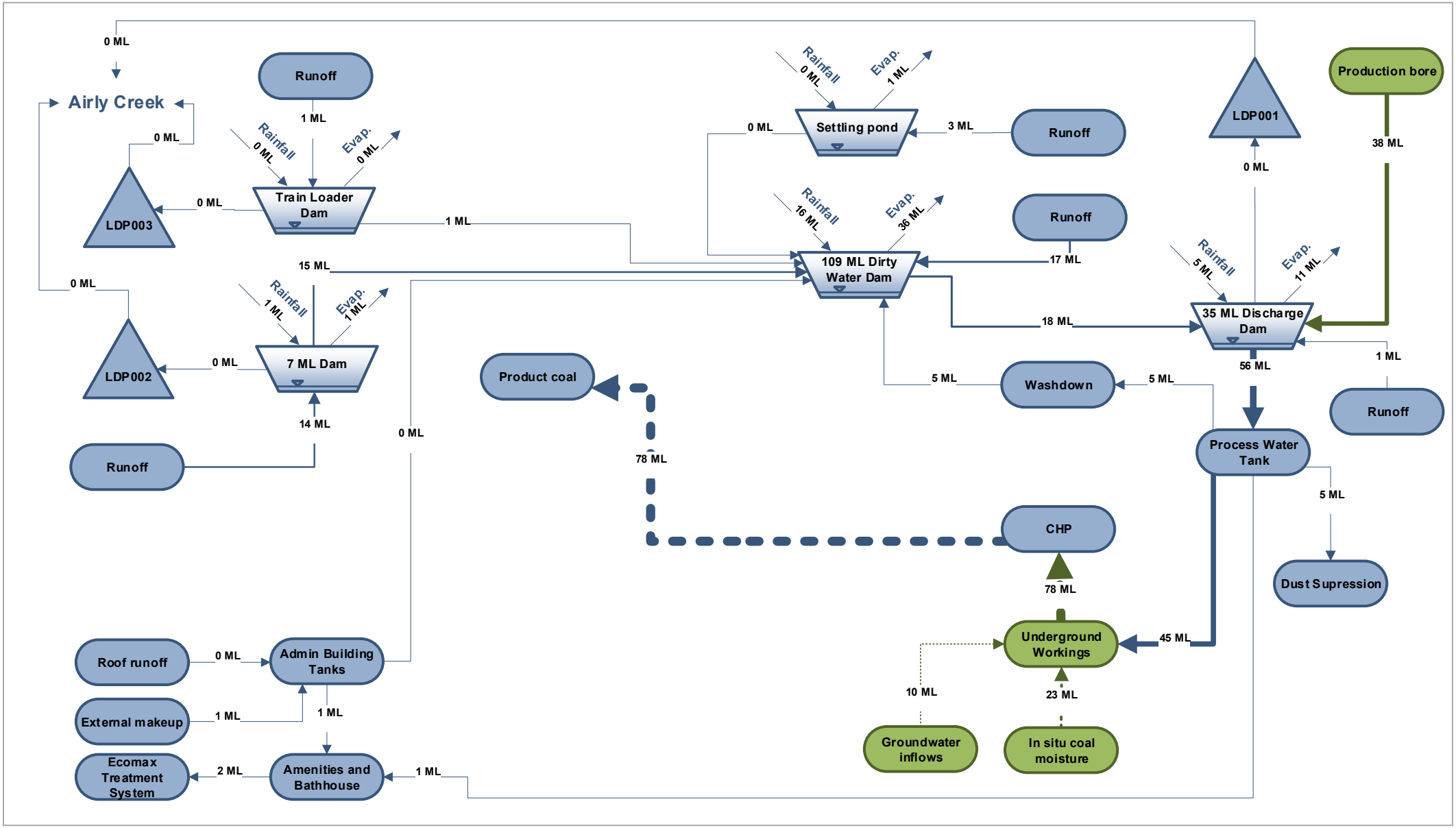
The water and salt balance at Airly Mine was simulated based on the observed data in 2018 (refer to Section 4.2.2). The annual water balance for existing conditions during 2018 is shown in Figure 5-3 and summarised in Table 5-1. The results shown are modelled results (rounded to 1 ML/year), based on the available site observations and modelled estimates where flows could not be directly measured.

Table 5-1 Annual water balance – existing conditions (2018)

	Volume (ML/year)
INPUTS	
Direct rainfall onto storages and catchment runoff	57
External potable water supply	1
Groundwater inflows into underground workings	10
Extraction from production bore	38
In situ coal moisture	23
TOTAL INPUTS	**129**
OUTPUTS	
Evaporation	49
Dust suppression	5
Sewage to Ecomax effluent treatment system	2
Discharge through LDP001	0
Discharge through LDP002	0
Discharge through LDP003	0
Product coal moisture	78
TOTAL OUTPUTS	**134**
CHANGE IN STORAGE	
Surface water storages	-5
Underground workings	0
TOTAL CHANGE IN STORAGE	**-5**
BALANCE	
Inputs – outputs – change in storage	0

Table 5-1 shows that during 2018, direct rainfall onto storages and catchment runoff was the largest input at Airly Mine while product coal moisture was the largest output. Figure 5-3 shows that product coal moisture includes groundwater inflows and in situ coal moisture that reported as ROM coal moisture and cannot be recovered. The balance of product coal moisture was from underground mining. This water was sourced from the production bore, direct rainfall and catchment runoff, after allowing for evaporation losses and dust suppression usage. Some water was lost as sewage, which includes external makeup to the administration building tanks.

Table 5-1 shows that during 2018, water storage volumes at Airly Mine fell by about 4 ML, despite extractions from production bore being at the highest achievable rates throughout the year (due to rounding, modelled extractions were about 1% lower than observed). This drop in storage volumes reflects the below average rainfall, lower than predicted groundwater inflows and degrading reliability of the production bore described in Section 1.3.



Legend

- Underground storage
- Underground process
- Surface storage
- Surface process
- Licensed discharge point
- Entrained moisture
- Surface water flow
- Groundwater flow
- X (X, X) — Mean (10^{th} percentile, 90^{th} percentile)

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Centennial Airly Pty Ltd
Airly Mine – Modification 2
Surface Water Impact Assessment

Water management schematic
Annual water transfers
Existing conditions (2018)

Project No. 2219275
Revision No. 0
Date 29/03/2019

FIGURE 5-3

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5.2.2 Salt balance

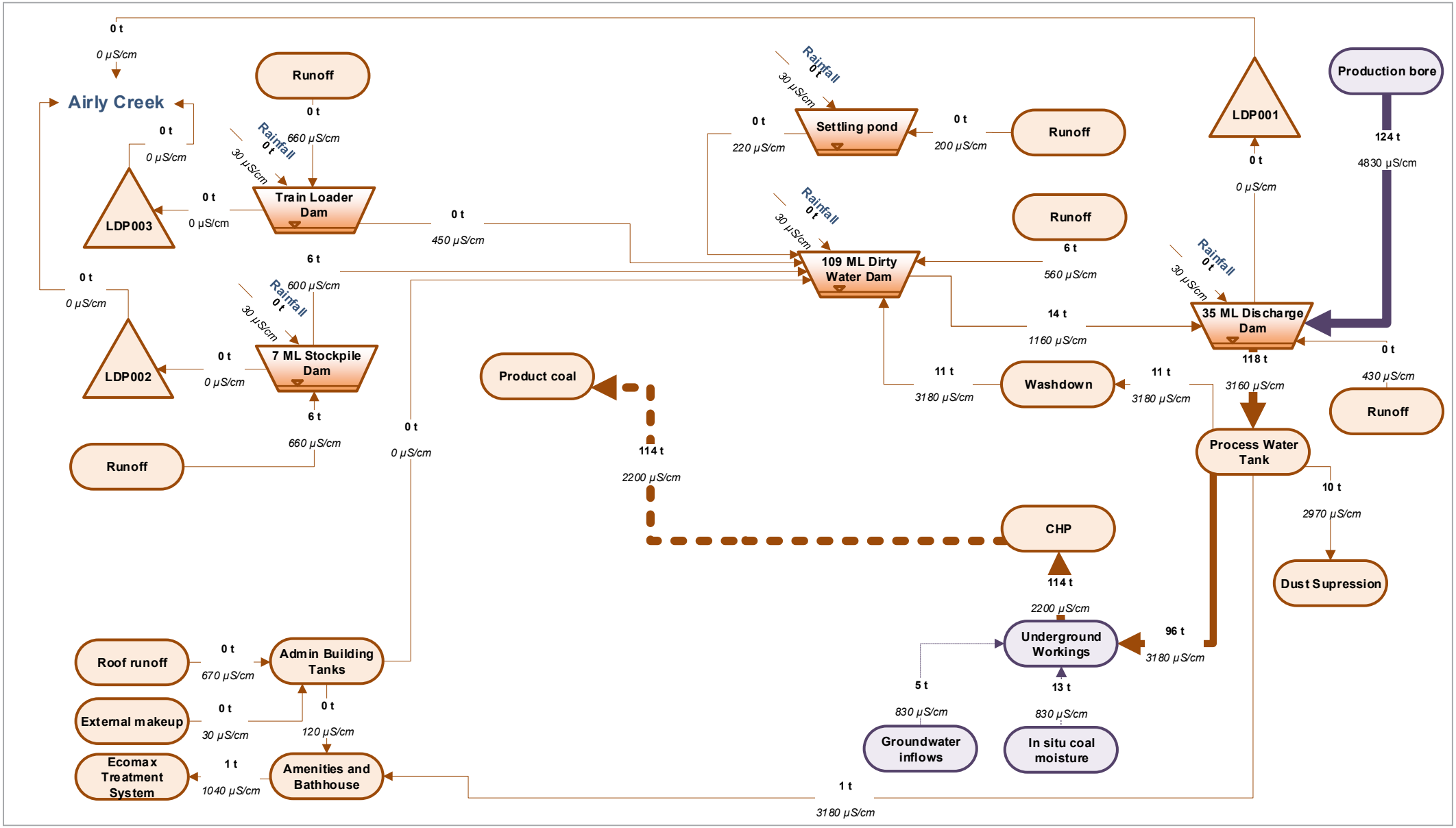
The annual salt balance for existing conditions during 2018 is shown in Figure 5-4 and summarised in Table 5-2. The results shown are modelled results (rounded to 1 tonne/year), based on the available site observations and modelled estimates where flows could not be directly measured.

Table 5-2 Annual salt balance – existing conditions (2018)

	Mass (tonne/year)
INPUTS	
Direct rainfall onto storages and catchment runoff	14
External water supply	0
Groundwater inflows into underground workings	5
Extraction from production bore	124
In situ coal moisture	13
TOTAL INPUTS	**154**
OUTPUTS	
Evaporation	0
Dust suppression	10
Sewage to Ecomax effluent treatment system	1
Discharge through LDP001	0
Discharge through LDP002	0
Discharge through LDP003	0
Product coal moisture	114
TOTAL OUTPUTS	**125**
CHANGE IN STORAGE	
Surface water storages	31
Underground workings	0
TOTAL CHANGE IN STORAGE	**31**
BALANCE	
Inputs – outputs – change in storage	0

Table 5-2 shows that during 2018, extraction from the production bore was the largest input of salt at Airly Mine and product coal moisture the largest output. Figure 5-4 shows that the salt in product coal moisture includes salt in groundwater inflows and in situ coal moisture that report in ROM coal moisture. The balance of salt in product coal moisture was from the production bore, direct rainfall and catchment runoff, after allowing for dust suppression usage. Relatively minor amounts were lost as sewage, which includes external makeup to the administration building tanks.

Table 5-1 shows that, overall during 2018, the salt balance estimates that salt in water storages at Airly Mine increased by about 30 tonne. This is largely attributable to the below average rainfall conditions and the use of the production bore. This increasing trend in salt in storages is reflected in the trends in water quality discussed in Section 5.4.



Legend

- Underground storage
- Underground process
- Surface storage
- Surface process
- Licensed discharge point
- Entrained moisture
- Surface water flow
- Groundwater flow

Centennial Airly Pty Ltd
Airly Mine – Modification 2
Surface Water Impact Assessment

Water management schematic
Annual salt transfers
Existing conditions (2018)

Project No. 2219275
Revision No. 0
Date 29/03/2019

FIGURE 5-4

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5.3 Water and salt balance – approved conditions

The water and salt balance model (refer to Section 4.2) was used to estimate the annual transfers between the water cycle components under baseline conditions. As discussed in Section 4.2.3, the baseline conditions modelling assumed production at the maximum approved rate of 1.8 Mtpa of ROM coal and construction of the approved CPP and REA. The baseline conditions modelling was used to quantify the simulated deficit in process water at Airly Mine.

The water management system for Airly Mine was modelled using a historical time series of daily rainfall data extending over 130 years, from January 1889 to December 2018 (refer Section 3.1). A total of 130 simulations were applied, with each simulation modelling a different rainfall pattern from the record.

The results presented in this section include the average annual transfers between water management elements as well as the 10th percentile and 90th percentile values. The purpose of displaying the three results for each water transfer is to show the average transfer volume and an indication of the range of values expected due to possible variation in rainfall.

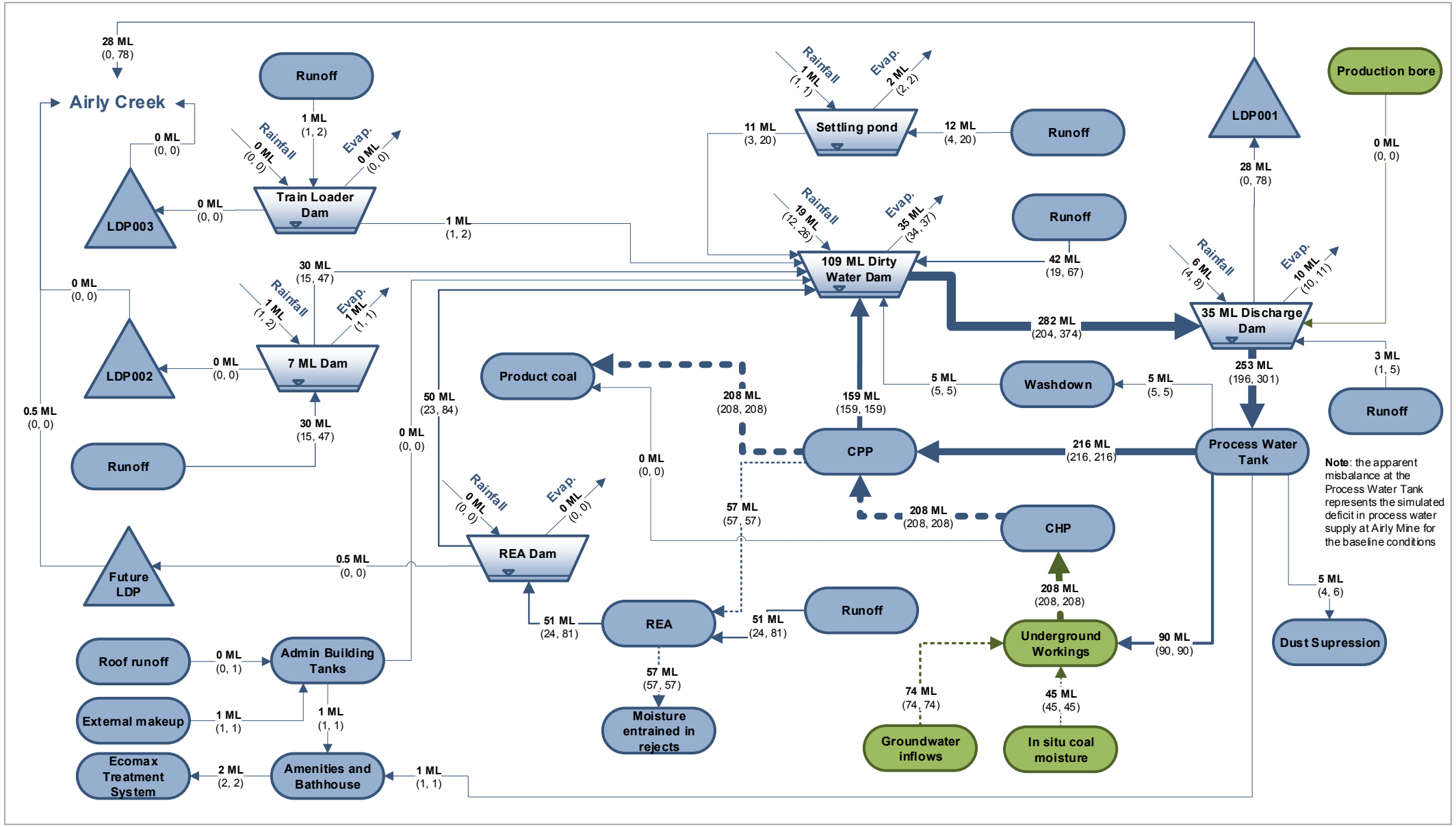
The 10th percentile represents the value at which 10% of the modelled outputs were less than this value. Similarly, the 90th percentile represents the value at which 90% of the modelled outputs were less than this value.

The 10th and 90th percentile results are not the same as the “dry” and “wet” year results presented in this section. The “dry” and “wet” year results are based on an equilibrium modelling approach with the driest and wettest rainfall year on record (347 mm in 1982 and 1530 mm in 1950 respectively; refer to Section 3.1) being repeated continuously as the simulated rainfall.

The results presented are based on the predicted site conditions in 2030. This year was chosen as it is when groundwater inflows into the underground workings are predicted to peak and it therefore most comparable to the approved conditions from the AMEP EIS (GHD 2014b).

5.3.1 Water balance

A summary of the annual water balance results is provided in Figure 5-5. The results for the baseline conditions in Table 5-3 are compared against the approved results as presented in the AMEP EIS (GHD 2014b). Results are rounded to the nearest 1 ML/year, except for discharges via the planned REA LDP, for consistency with the EIS.



Legend

- Underground storage
- Underground process
- Surface storage
- Surface process
- Licensed discharge point
- Entrained moisture
- Surface water flow
- Groundwater flow
- X (X, X) Mean (10^{th} percentile, 90^{th} percentile)

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Centennial Airly Pty Ltd
Airly Mine – Modification 2
Surface Water Impact Assessment

Water management schematic
Annual water transfers
Baseline conditions (2030)

Project No. 2219275
Revision No. 0
Date 09/04/2019

FIGURE 5-5

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Table 5-3 Annual water balance – approved conditions and baseline conditions (2030)

Water management element	Approved conditions (ML/year)	Baseline conditions (ML/year)		
	Average (mean)	Average (mean)	"Dry" year	"Wet" year
INPUTS				
Direct rainfall onto storages and catchment runoff	195	165	34	724
External potable water supply	1	1	1	0
Groundwater inflows into underground workings	180	74	74	74
Extraction from production bore	1	0	0	0
In situ coal moisture	45	45	45	45
TOTAL INPUTS	**422**	**285**	**154**	**843**
OUTPUTS				
Evaporation	45	49	49	54
Dust suppression	100	5	6	4
Sewage to Ecomax effluent treatment system	2	2	2	2
Discharge through LDP001	76	28	0	517
Discharge through LDP002	0	0	0	0
Discharge through LDP003	0	0	0	0
Discharge through planned REA LDP	0.5	0.5	0	0
Product coal moisture	142	208	208	208
Moisture retained in rejects	57	57	57	57
TOTAL OUTPUTS	**422**	**349**	**322**	**843**
CHANGE IN STORAGE				
Surface water storages	0	0	0	0
Underground water storages	0	0	0	0
TOTAL CHANGE IN STORAGE	**0**	**0**	**0**	**0**
BALANCE				
Deficit	0	64	168	0
Inputs – outputs – change in storage + deficit	0	0	0	0

Table 5-3 shows that for the baseline conditions, without the production bore as a reliable source of water, there is insufficient water at Airly Mine to operate at the approved production rate and approved activities (including the approved CPP and REA). This is unlike the approved conditions from the AMEP EIS (GHD 2014b), where groundwater inflows were expected to report as free water and be recovered for reuse and the production bore was expected to supply up to 158 ML/year, based on pumping tests at the time of installation. The water shortfall quantified by the water balance model (refer to Section 4.2.3) for the baseline conditions is reported as a deficit in Table 5-3 and as the apparent misbalance of inflows and outflows of the Process Water Tank in Figure 5-5.

Direct rainfall onto storages and catchment runoff

Table 5-3 shows that, on average, the largest source of water into the Airly Mine water management system in 2030 was predicted to be direct rainfall and catchment runoff for both the baseline conditions and approved conditions. Compared to the 2014 EIS predictions (GHD 2014b), the baseline conditions has lower estimated direct rainfall onto storages and catchment runoff, due to the refinement in catchment areas, runoff parameters and water storage geometry based on operational data. Under the “dry” year and “wet” scenarios, rainfall and runoff are substantially lower and higher respectively.

External potable water supply and sewage to Ecomax treatment system

No changes in site personnel between baseline conditions and approved conditions are proposed. As a result, no significant changes to the external potable water demand or the sewage treated on site by the Ecomax effluent treatment system were predicted by the water balance modelling. In the “wet” year, roof runoff collected is forecast to be sufficient to reduce the requirement for external potable water makeup.

Groundwater inflows into underground workings

Groundwater inflows into the underground workings are now expected to be significantly less than predicted under approved conditions. As discussed in Section 1.3.1, this is a result of the recent recalibration of the hydrogeological model for the mine using additional monitoring data collected since the AMEP. Groundwater inflows are expected to be unchanged with rainfall conditions.

Extraction from production bore

As discussed in Section 1.3.3, the production bore is not currently considered a reliable source of water and was not modelled to supply process water to Airly Mine for the baseline conditions.

In situ coal moisture

In situ coal moisture was modelled to contribute 45 ML/year to the water management system in 2030, unchanged from approved conditions to the baseline conditions. This is a result of no changes to the maximum mining rate of 1.8 Mtpa or the assumed moisture rate of 2.5%.

Evaporation

Evaporation from the surface of water storages was modelled to result in the loss of about 50 ML/year under approved conditions and the baseline conditions. The baseline conditions differs slightly from approved conditions due to refinements in modelled storage geometry and differences in modelled operating water levels. Evaporation is expected to be slightly higher in the “wet” year, as the surface water storages are expected to be slightly fuller and have a greater surface area on average.

Dust suppression

Dust suppression was modelled under the baseline conditions to demand 5 ML/year of water. The revised dust suppression demand reflects site observations of dust suppression usage since 2014, which is less conservative than the demand of 100 ML/year assumed by the water balance model under approved conditions.

Discharge through LDP001

On average, discharges through LDP001 to Airly Creek were modelled to be lower under the baseline conditions than the approved conditions. This reflects the reduction in predicted groundwater inflows into underground workings, which at the time of AMEP EIS (GHD 2014b) were expected to be transferred to the surface water system for reuse and discharge through LDP001. In the baseline conditions, any groundwater inflows are expected to report only a product coal moisture and therefore discharges via LDP001 are only expected due to rare rainfall events. Discharges via LDP001 are expected to higher in the “wet” year and no discharges are predicted in the “dry” year.

Discharge through LDP002, LDP003 and planned REA LDP

No discharges through LDP002 or LDP003 occur in the approved conditions or for the baseline conditions.

The REA Dam was designed to capture the 1% annual exceedance probability, 72 hour rainfall event (GHD 2014d). Therefore, discharges through the planned REA LDP are expected to occur only as a result of rainfall that exceeds this criteria. One overflow from the REA Dam of approximately 31 ML was modelled to occur in response to a large rainfall event in the historical rainfall dataset, which recorded over 270 mm over five consecutive days in March 1926. This discharge event is reflected in the 0.5 ML/year discharge on average for the approved and baseline conditions presented in Table 5-3. No discharges from the REA Dam were predicted to occur for the “wet” year, as these results were based on the wettest rainfall year on record (1530 mm in 1950; refer to Section 3.1), which did not record any rainfall events over the design criteria for the REA Dam.

Product coal moisture and moisture retained in rejects

Water associated with the product coal moisture was forecast to be the largest output from the site, on average. This volume is an increase compared to approved conditions, as all groundwater inflows are now expected to report as product coal moisture and not be able to be recovered and reused under the baseline conditions. Moisture retained in rejects was unchanged, and both are expected to be insensitive to rainfall conditions.

Daily results

Figure 5-6 presents the percentiles of the daily flow rates predicted to discharge through LDP001 under existing conditions for all 130 historical rainfall patterns modelled. For clarity, the results are shown with a logarithmic vertical axis and therefore values of 0 ML/day are not plotted.

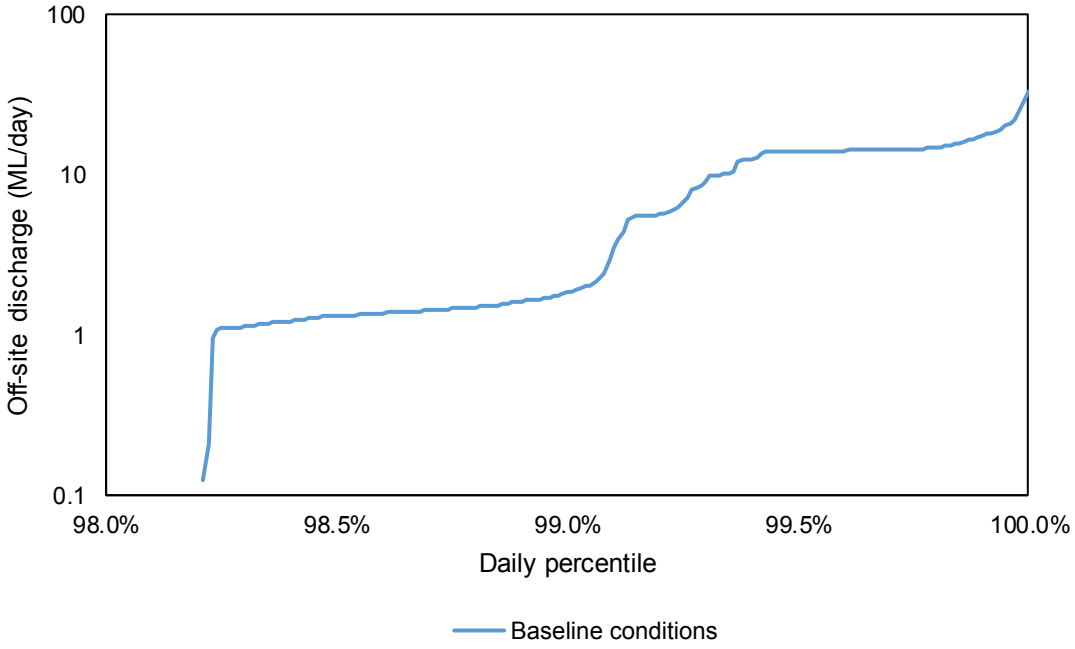
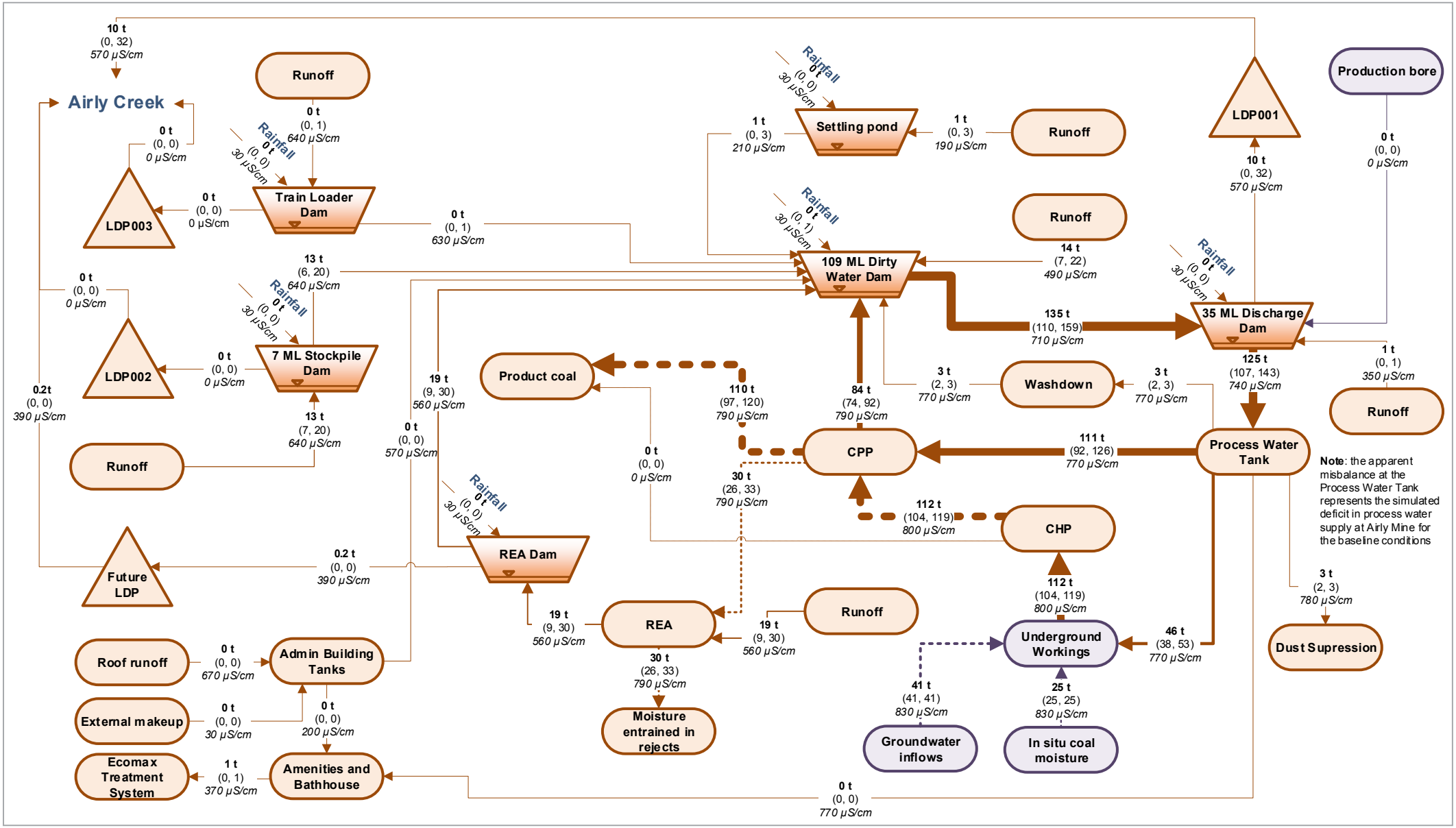


Figure 5-6 Predicted daily LDP001 discharges – baseline conditions

Discharges off-site through LDP001 to Airly Creek are expected to occur only due to rare rainfall events. All discharges modelled under existing conditions were predicted to occur as a result of rainfall events exceeding 44 mm over five days, which is the rainfall depth for a 95th percentile, five day rainfall event design criteria for the 35 ML Discharge Dam (refer Section 2.1.2). Discharges were predicted to occur on less than 2% of days modelled, with the maximum daily discharge estimated to be about 30 ML/day.

5.3.2 Salt balance

As discussed in Section 4.2, the salt balance model was developed as an extension of the water balance model with expected concentrations of salt applied to water inflows into the system. From the results shown in Figure 5-7, inputs and outputs for the salt balance under the baseline conditions in 2030 are summarised in Table 5-4. Results are rounded to the nearest 1 tonne/year, except for discharges via the planned REA LDP, for consistency with the EIS.



Legend

- Underground storage
- Underground process
- Surface storage
- Surface process
- Licensed discharge point
- Entrained moisture
- Surface water flow
- Groundwater flow
- X / (X, X) / XX — Mean (10th percentile, 90th percentile) Mean EC

Centennial Airly Pty Ltd
Airly Mine – Modification 2
Surface Water Impact Assessment

Water management schematic Annual salt transfers Baseline conditions (2030)

Project No. 2219275
Revision No. 0
Date 09/04/2019

FIGURE 5-6

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Table 5-4 Annual salt balance - approved conditions and baseline conditions (2030)

Water management element	Approved conditions (tonne/year)	Baseline conditions (tonne/year)		
	Average (mean)	Average (mean)	"Dry" year	"Wet" year
INPUTS				
Direct rainfall onto storages and catchment runoff	58	49	10	179
External potable water supply	0	0	0	0
Groundwater inflows into underground workings	109	41	41	41
Extraction from production bore	3	0	0	0
In situ coal moisture	28	25	25	25
TOTAL INPUTS	**198**	**115**	**76**	**245**
OUTPUTS				
Evaporation	0	0	0	0
Dust suppression	53	3	4	1
Sewage to Ecomax effluent treatment system	0	1	1	1
Discharge through LDP001	35	10	0	147
Discharge through LDP002	0	0	0	0
Discharge through LDP003	0	0	0	0
Discharge through planned REA LDP	0.2	0.2	0	0
Product coal moisture	78	110	135	76
Moisture retained in rejects	31	30	37	21
TOTAL OUTPUTS	**198**	**153**	**176**	**245**
CHANGE IN STORAGE				
Surface water storages	0	0	0	0
Underground water storages	0	0	0	0
TOTAL CHANGE IN STORAGE	**0**	**0**	**0**	**0**
BALANCE				
Deficit	0	38	100	0
Inputs – outputs – change in storage + deficit	0	0	0	0

Table 5-4 shows that the sources and sinks for the salt balance at Airly Mine are broadly similar to the water balance shown in Table 5-3. In order to maintain a mass balance, it was necessary in the modelling to assign a salinity to the deficit quantified in Section 5.3.1, based on the median EC of the 35 ML Discharge Dam (refer to Section 4.2.3). The salt associated with the deficit for the baseline conditions is reported as a deficit in Table 5-4 and as the apparent misbalance of inflows and outflows of the Process Water Tank in Figure 5-7.

Direct rainfall onto storages and catchment runoff

On average, the largest source of salt into the water management system for the baseline conditions is direct rainfall onto storages and catchment runoff. This is lower and higher in the "dry" year and "wet" year case respectively, in proportion with rainfall. The result for the baseline conditions is lower than the approved conditions, on average, approximately proportional to the difference in water flows shown in Table 5-3.

External potable water supply and sewage to Ecomax treatment system

In all cases, the salt in external potable water supply is less than 0.5 tonne/year and relatively minor. In all cases, the salt lost in sewage was relatively minor, with a slight difference between approved conditions and the baseline conditions due to slight differences in the modelling and rounding.

Groundwater inflows into underground workings

The salt associated with groundwater inflows is the second largest input into the water management system, and is independent of rainfall conditions. The salt flux for the baseline conditions is lower than for approved conditions, approximately proportional to the difference in water flows shown in Table 5-3 and due to refined estimates of groundwater salinity based on site observations.

Extraction from production bore

In the baseline conditions, the production bore is not considered a reliable source of water and therefore no inputs to the water management system are modelled. Therefore, unlike approved conditions, the production bore does not contribute any salt to the site salt balance under the baseline conditions.

In situ coal moisture

Salt associated with in situ coal moisture is very similar in all cases, being slightly lower in the baseline conditions compared to approved conditions, reflecting refinement in the model based on site observations of groundwater salinity.

Evaporation

In all cases, no salt was modelled to be lost via evaporation.

Dust suppression

In the baseline conditions, salt lost via dust suppression was relatively minor, in the “dry” year, the mass lost was slightly higher, due to less dilution by rainfall and catchment runoff, and slightly lower in the “wet” year, due to greater dilution. The salt lost in approved conditions was significantly greater, approximately proportional to the difference in water flows shown in Table 5-3.

Discharge through LDP001

In the baseline conditions, some salt is discharged via LDP001 on average, however this is significantly less than under approved conditions, as the reduction in predicted groundwater inflows means that discharges are only expected due to rare rainfall events. In the “wet” year, the mass of salt discharged is higher than the average, however this is less than proportional to difference in water flows shown in Table 5-3, due to dilution within the water management system. No discharges were simulated in the “dry” year.

Discharge through LDP002, LDP003 and planned REA LDP

In all cases, no discharges were simulated via LDP002 or LDP003. The mass of salt discharged via the planned REA LDP from the REA Dam was about 0.2 tonne/year on average under both approved and baseline conditions.

Product coal moisture and moisture retained in rejects

Salt associated with the product coal moisture was forecast to be the largest output from the site. On average, this mass is an increase compared to approved conditions, as all groundwater inflows are now expected to report as ROM coal moisture and not be able to be recovered and reused under the baseline conditions. Moisture retained in rejects was slightly lower, due to differences in the simulated salt inflows to the site. Both product coal moisture and moisture retained in rejects are expected to be higher for the “dry” year due to less dilution by rainfall and catchment runoff, and slightly lower in the “wet” year, due to greater dilution.

Daily results

Figure 5-8 presents the percentiles of the EC corresponding to the daily volume of water predicted to be discharged through LDP001 into Airly Creek for 2030 under baseline conditions (as shown in Figure 5-6). EC was modelled to range from approximately 300 µS/cm up to a maximum of about 850 µS/cm.

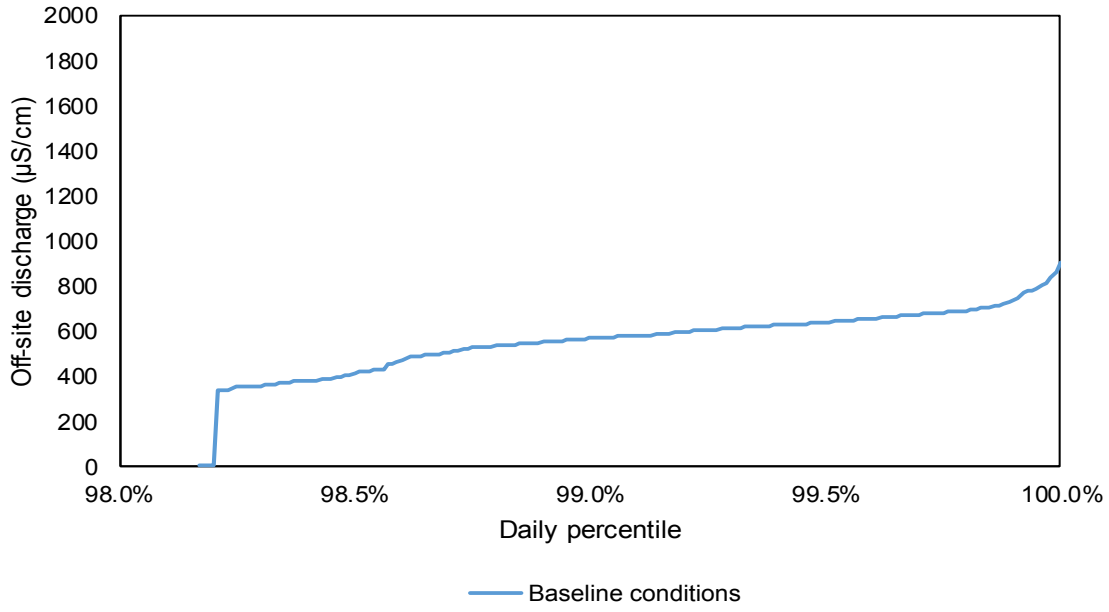


Figure 5-8 Predicted electrical conductivity of daily LDP001 discharges – baseline conditions

5.3.3 Summary

The water and salt balance modelling has shown that without the water from groundwater inflows and a reliable production bore that was expected at the time of the 2014 EIS (GHD 2014b), Airly Mine has insufficient reliable water to operate at the approved production rate and workforce with the approved CPP and REA under all rainfall conditions that are reasonably foreseeable based on the historical rainfall record.

5.4 Water quality

A statistical summary of water quality and time series graphs for selected parameters monitored at Airly Creek Upstream, Airly Creek and the 35 ML Discharge Dam are provided in Appendix D. Where the analytical result was below the limit of reporting (LOR) for a parameter, then the detection limit was used in its place. Median water quality results are provided in Table 5-5 and are representative of the ambient water conditions.

The concentration limits for LDP001 discharges specified by EPL 12374 and the SSGVs for the Airly Creek catchment (Centennial Coal 2018) (as presented in Table 4-1) are also provided in Table 5-5 for comparative purposes. Exceedances of the LDP001 limits or SSGVs are highlighted in orange.

Table 5-5 Summary of existing water quality at Airly Mine

Parameter	Units	EPL 12374 LDP001 limits		SSGVs	Airly Creek Upstream		Airly Creek		35 ML Discharge Dam	
		90th percentile	100th percentile		Count	Median	Count	Median	Count	Median
Physicochemical parameters										
EC	µS/cm	2244		2709	25	**2710**	71	**2390**	103	900
pH	pH units		6.5–9.0	6.5–8.0	25	7.5	71	7.4	103	**8.4**
TSS	mg/L	50		25	25	2	71	4	103	2
Turbidity	NTU	40		25	24	1.9	45	2.0	78	1.5
Nutrients										
Ammonia	mg/L		0.32	0.32	25	0.01	45	0.02	80	0.01
Total nitrogen	mg/L	2		0.7	25	0.4	45	0.5	80	0.3
Total phosphorus	mg/L	0.5		0.056	25	0.01	45	0.02	80	0.01
Dissolved metals										
Aluminium	mg/L			0.027	25	0.01	46	0.01	81	0.01
Antimony	mg/L			0.001	24	0.001	45	0.001	80	0.001
Arsenic	mg/L		0.024		25	0.001	46	0.001	81	0.001
Barium	mg/L			0.017	25	0.015	46	0.016	81	**0.048**
Beryllium	mg/L			0.001	25	0.001	46	0.001	81	0.001
Boron	mg/L			0.09	25	0.05	45	0.05	81	0.05
Cadmium	mg/L				25	0.0001	46	0.0001	81	0.0001
Chromium	mg/L				25	0.001	46	0.001	81	0.001
Cobalt	mg/L			0.001	25	0.001	46	0.001	81	0.001
Copper	mg/L		0.013	0.001	25	0.001	46	0.001	81	0.001
Iron	mg/L			0.3	25	0.07	67	0.05	102	0.05
Lead	mg/L			0.001	25	0.001	47	0.001	82	0.001
Manganese	mg/L			1.2	25	0.126	68	0.157	102	0.014
Mercury	mg/L				23	0.0001	45	0.0001	81	0.0001
Molybdenum	mg/L			0.001	25	0.001	46	0.001	81	0.001

Parameter	Units	EPL 12374 LDP001 limits		SSGVs	Airly Creek Upstream		Airly Creek		35 ML Discharge Dam	
		90th percentile	100th percentile		Count	Median	Count	Median	Count	Median
Nickel	mg/L		0.1	0.008	25	0.005	46	0.006	81	0.002
Selenium	mg/L				25	0.01	46	0.01	81	0.01
Silver	mg/L			0.001	24	0.001	45	0.001	80	0.001
Zinc	mg/L		0.072	0.0076	25	0.005	46	0.006	81	0.005
Other parameters										
Oil and grease	mg/L		10	5	25	5	70	5	103	5

5.4.1 Physicochemical parameters

EC recorded at Airly Mine was generally between 1300 µS/cm and 3300 µS/cm at Airly Creek Upstream and Airly Creek monitoring sites. The Airly Creek catchment has been observed to be naturally brackish and is closely related to the geology of the catchment, having the same water type as found in the underlying Shoalhaven Group aquifer. The median EC result for both Airly Creek catchment sites was found to exceed the EPL 12374 limit for LDP001 discharge of 2244 µS/cm.

The 35 ML Discharge Dam has reported a lower EC level, typically between 500 µS/cm and 1000 µS/cm. An increasing trend in EC within the 35 ML Discharge Dam has been observed over the previous 12 months, with a maximum EC recording of 3120 µS/cm in October 2018. This is attributable to the increased use of groundwater from the production bore since 2017, which has a median concentration of 4830 µS/cm based on 71 samples collected between July 2012 and October 2018.

The pH levels for both Airly Creek monitoring sites were found to range between 6.5 and 8.5, indicating slightly acidic to slightly alkaline water. Observations from the 35 ML Discharge Dam are more alkaline, with pH recorded between 7.5 and 9.5. The median pH level at the 35 ML Discharge Dam of 8.4 exceeded the upper SSGV of 8.0 but is within the EPL 12374 limits.

Results for TSS were generally below 25 mg/L at both Airly Creek monitoring sites and the 35 ML Discharge Dam. In general, concentrations of TSS recorded at the Airly Creek site were elevated compared to the upstream site. The Airly Creek site had a 90th percentile concentration of 74 mg/L compared to 5 mg/L for the Airly Creek Upstream site and 8 mg/L for the 35 ML Discharge Dam.

The majority of turbidity results have been below 10 NTU for Airly Creek monitoring sites and the 35 ML Discharge Dam. Monitoring results for Airly Creek were found to vary up to a maximum of 262 NTU in 2013 and 2014; however results have been less than 50 NTU for all sites since mid-2014.

5.4.2 Nutrients

Ammonia concentration results have generally been below 0.1 mg/L for all monitoring sites, with similar results for the Airly Creek catchment sites and the 35 ML Discharge Dam. No exceedances of the EPL 12374 concentration limit and SSGV of 0.32 mg/L were observed.

The majority of total nitrogen concentration results have ranged between the LOR of 0.1 mg/L and 1 mg/L, with the Airly Creek monitoring sites generally slightly elevated compared to the 35 ML Discharge Dam.

Observed total phosphorus was typically below 0.05 mg/L for Airly Creek Upstream and the 35 ML Discharge Dam. Results for the Airly Creek monitoring site were slightly elevated by comparison, with a median concentration of 0.02 mg/L for Airly Creek and 0.01 mg/L for both Airly Creek Upstream and the 35 ML Discharge Dam.

5.4.3 Dissolved metals

Dissolved metals monitored at the Airly Mine sites were generally at or below the LOR for the majority of parameters, with the exception of results for dissolved cobalt, copper, iron, manganese, nickel and zinc.

Results for dissolved aluminium at Airly Creek Upstream, Airly Creek and 35 ML Discharge Dam generally ranged between the LOR of 0.01 mg/L and 0.02 mg/L, with all results since 2015 found to be below the SSGV of 0.027 mg/L.

All dissolved antimony results for Airly Creek Upstream, Airly Creek and the 35 ML Discharge Dam were less than the LOR and SSGV of 0.001 mg/L.

Dissolved arsenic results were generally reported to be less than the LOR of 0.001 mg/L for all Airly Mine monitoring sites, with the exception of one result of 0.002 mg/L reported for the 35 ML Discharge Dam in December 2016. All observed results were less than the EPL 12374 dissolved arsenic limit of 0.024 mg/L for LDP001 discharge.

The concentration of dissolved barium recorded at the Airly Creek Upstream and Airly Creek monitoring sites were similar, with median results of 0.015 mg/L and 0.016 mg/L respectively. Results for the 35 ML Discharge Dam were generally higher, with all observations found to exceed the SSGV of 0.017 mg/L.

Dissolved beryllium results were below the LOR of 0.001 mg/L for all monitoring sites, with the exception of two results of 0.003 mg/L at the 35 ML Discharge Dam.

The majority of observed dissolved boron results were found to be below the LOR of 0.05 mg/L for all monitoring sites. One recorded sample of 0.13 mg/L in January 2014 at the 35 ML Discharge Dam was found to exceed the SSGV of 0.09 mg/L.

Results for dissolved cadmium were below the LOR of 0.0001 mg/L for all monitoring sites, with the exception of one sample of 0.0003 mg/L recorded in October 2012 at both Airly Creek site and the 35 ML Discharge Dam.

All dissolved chromium results for Airly Creek Upstream, Airly Creek and the 35 ML Discharge Dam were less than the LOR and SSGV of 0.001 mg/L.

Dissolved cobalt was observed to generally be below the LOR of 0.001 mg/L for the Airly Creek Upstream site and the 35 ML Discharge Dam. Results for the Airly Creek site were elevated by comparison, with several results above the SSGV of 0.001 mg/L. A maximum dissolved cobalt concentration of 0.02 mg/L was observed at the Airly Creek monitoring site in July 2017.

The majority of dissolved copper results for Airly Mine ranged between the LOR of 0.001 mg/L and 0.004 mg/L, with an outlier maximum result of 0.02 mg/L reported for Airly Creek in May 2014. Approximately 40% of LDP4 discharge results exceeded the Airly Creek SSGV of 0.001 mg/L. Two results for the Airly Creek monitoring site were found to exceed the EPL 12374 limit for LDP001 of 0.013 mg/L.

Dissolved iron concentrations at the Airly Creek Upstream and Airly Creek sites were found to range between the LOR of 0.05 mg/L and 0.2 mg/L in general. A maximum of 0.7 mg/L has been recorded at the Airly Creek monitoring site in December 2014. Results for the 35 ML Discharge Dam at Airly Mine were generally below the LOR.

Dissolved lead concentrations at all Airly Mine monitoring sites have consistently been reported below the LOR and SSGV of 0.001 mg/L, with the exception of one observation of 0.002 mg/L in the 35 ML Discharge Dam in April 2012.

Reported dissolved manganese concentrations for Airly Mine monitoring locations were found to range between 0.03 mg/L and 0.89 mg/L. The 35 ML Discharge Dam was found to be slightly lower than the Airly Creek sites, with a median value of 0.014 mg/L for the 35 ML Discharge Dam compared to 0.126 mg/L for Airly Creek Upstream and 0.157 for Airly Creek. All results for the Airly Creek Upstream site and the 35 ML Discharge Dam were below the SSGV of 1.2 mg/L; however several results recorded at Airly Creek were exceeded the SSGV.

All Airly Mine monitoring sites have consistently reported dissolved mercury concentrations below the LOR of 0.0001 mg/L.

The majority of dissolved molybdenum results were found to be below the LOR and SSGV of 0.001 mg/L. Several results for Airly Creek and the 35 ML Discharge Dam exceeded this value.

Concentrations of dissolved nickel generally varied from 0.002 mg/L to 0.012 mg/L at the Airly Mine monitoring sites. Results for the 35 ML Discharge Dam were generally slightly less than for the Airly Creek catchment monitoring sites, with a median value of 0.002 mg/L. All results for all three monitoring sites were below the EPL 12374 limit for LDP001 discharge of 0.1 mg/L; however several results for Airly Creek Upstream and Airly Creek were found to exceed the SSGV of 0.008 mg/L.

Dissolved selenium concentrations at all Airly Mine monitoring sites have consistently been reported below the LOR and SSGV of 0.01 mg/L, with the exception of one observation of 0.02 mg/L at the Airly Creek Upstream site in September 2015.

Results for dissolved silver have been reported to be below the LOR and SSGV of 0.001 mg/L for all monitoring sites, with the exception of one observation of 0.003 mg/L in the 35 ML Discharge Dam in June 2014.

Dissolved zinc concentrations were found to typically vary between the LOR of 0.005 mg/L and 0.008 mg/L for the Airly Creek Upstream site and the 35 ML Discharge Dam. Results for the Airly Creek monitoring site were elevated compared to the Airly Creek Upstream site and the 35 ML Discharge Dam, generally ranging between the LOR and 0.021 mg/L. All results for the Airly Creek Upstream, Airly Creek and 35 ML Discharge Dam sites were below the EPL 12374 limit of 0.072 mg/L for LDP001 discharge. However, the SSGV of 0.0076 mg/L was exceeded on occasion at all three monitoring sites, with over 30% of results for Airly Creek exceeding the SSGV.

5.5 Downstream water users

As discussed in Section 3.4, watercourses within the Airly Mine development consent boundary, including Airly Creek are ephemeral with periods of limited or no flow. Ephemeral watercourses are unreliable sources of water and it is unlikely that any downstream water users rely on flows in Airly Creek.

Figure 5-9 presents the identified surface water users in the area of potential impact (refer to Section 4.4). Three lots with approvals for surface water diversion works (pumps), licensed to extract from the Hawkesbury and Lower Nepean River Water Source were identified. These users are located on Coco Creek, approximately 20 km downstream of the Airly Mine surface facilities area. Available information on the approvals and associated WALs for these three lots is provided in Table 5-6.

5.6 Aquatic ecology

5.6.1 Macroinvertebrate monitoring

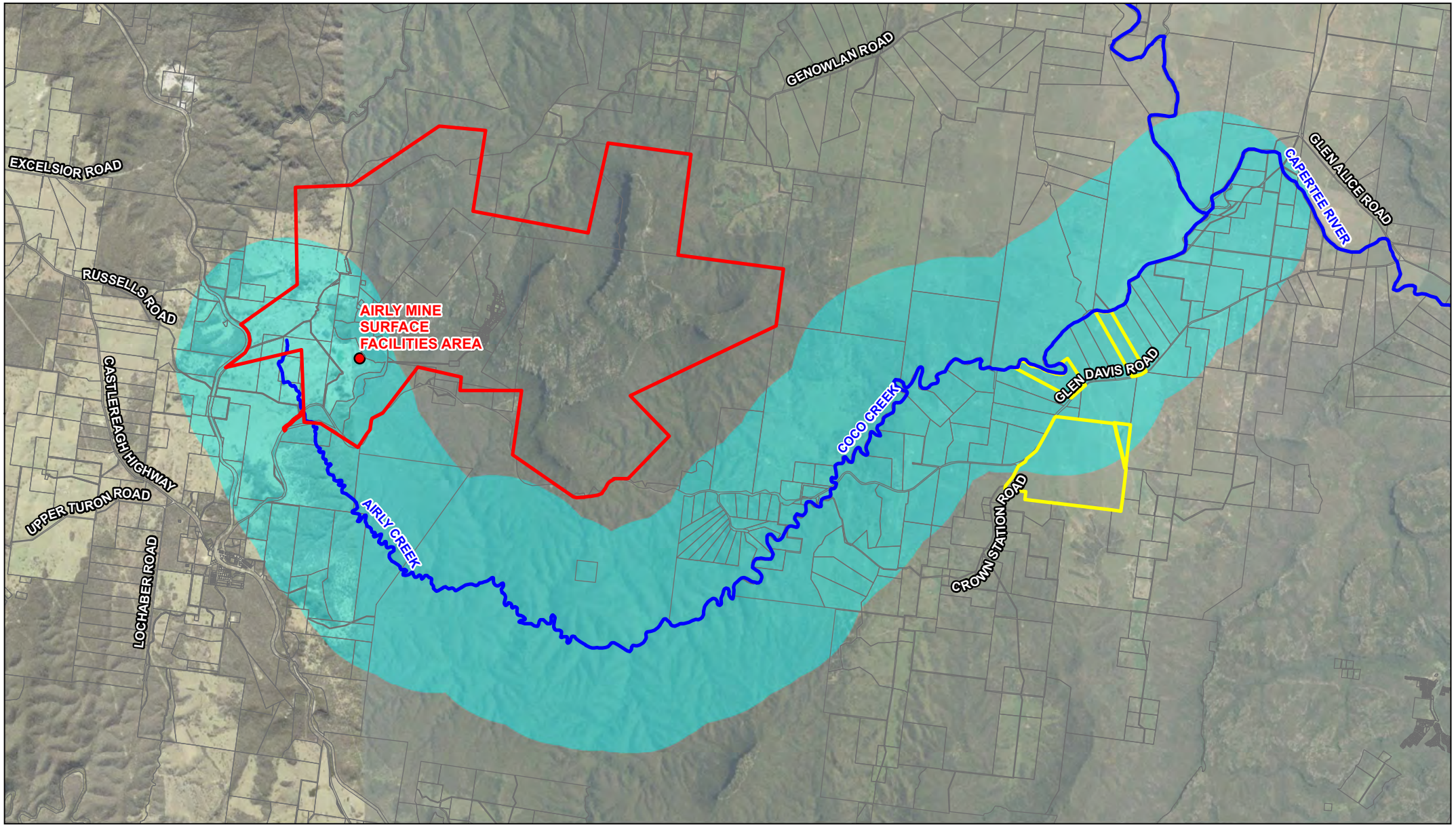
Cardno (2014) identified that the macroinvertebrate community of Airly Creek was impaired due to historical clearing of the riparian vegetation, agricultural, historical mining and the ephemeral nature of the waterway. Cardno conducted three fish surveys of Airly Creek using backpack electrofishing and identified one fish species, the invasive *Gambusia holbrooki* (Plague minnow), as occurring in Airly Creek (Cardno 2014).

The results of routine (post-EIS) monitoring program have confirmed the findings of Cardno (2014) in regards to the macroinvertebrate community. The macroinvertebrate community of Airly Creek is comprised largely of pollution tolerant taxa due to poor water quality relating to the agricultural landuse, riparian zone clearing and water scarcity and the related influence of these factors on instream habitat (GHD 2019b).

5.6.2 Exotic species

A Department of the Environment and Energy EPBC Act Protected Matters Report (DEE 2019) search was undertaken. The search did not identify any invasive species as occurring in the Reedy Creek catchment at Charbon Colliery, although the invasive fish species *Gambusia holbrooki* has been collected (opportunistically) during macroinvertebrate monitoring (Z Lagerroth 2019, pers. comm., 4 February 2019). Predation by *Gambusia holbrooki* is a Key Threatening Process (KTP) listed under the *Fisheries Management Act 1994* (FM Act). *Gambusia holbrooki* has also been recorded as occurring in Airly Creek (Cardno 2014).

No invasive macroinvertebrate species were identified in the Protected Matters Report (DEE 2019) as likely to occur at Charbon Colliery.



Paper Size A4

0 875 1,750 2,625 3,500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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LEGEND

- Project approval area SSD_5581
- Downstream watercourse
- Works approval search area
- Surface water, licensed

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Centennial Airly Pty Ltd
Airly Mine Extension Project - Modification 2
Surface Water Impact Assessment

Job Number 2219275
Revision 0
Date 22 Jan 2019

Downstream water users

Figure 5-9

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

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Data source: LPI: DTDB 2012; Centennial: Aerial Imagery, boundaries, 2013, Mine Workings, 2012. Created by: fmackay, kpsroba

Table 5-6 Details of downstream licensed surface water users

Lot/DP	Approval number	Kind of approval	Work type	Use purpose	WAL number	WAL share components	Category
Lot 10, DP 247318	10CA104429	Water supply works and water use	Diversion works – pumps	Irrigation	26541	12.00 ML/year	Unregulated river
Lot 4, DP 866875	10CA105445	Water supply works and water use	Diversion works – pumps Storages	Irrigation	25906	5.00 ML/year	Domestic and stock
					26039	42.50 ML/year	Unregulated river
Lot 42, DP 751640	10CA105144	Water supply works and water use	Diversion works – pumps Storages	Irrigation	26728	4.00 ML/year	Domestic and stock (stock)
					26601	45.00 ML/year	Unregulated river

6. Impact assessment

6.1 Water management system

As part of the Project, up to 170 ML/year of water is proposed to be imported from Charbon Colliery using rail haulage to meet the deficit in process water supply at Airly Mine. Minor upgrades to the existing infrastructure at the surface facilities area is also proposed to allow for the transfer of water from train wagons to the 109 ML Dirty Water Dam.

Water from the trains is proposed to be discharged using flexible hoses into an existing drainage line adjacent to the embankment of the rail loop which flows under gravity to the Train Loader Dam. Water from this dam will continue to be pumped using the existing pipeline to the 109 ML Dirty Water Dam for storage and settlement of suspended material, prior to being transferred to the 35 ML Discharge Dam for use as process water. The pump at the Train Loader Dam would be upgraded to rapidly transfer water to the 109 ML Dirty Water Dam to minimise the potential for off-site discharges.

6.2 Water and salt balance

The water and salt balance model (refer to Section 4.2) was used to estimate the annual transfers between the water cycle components under the baseline conditions and proposed conditions. Section 5.3 identifies that, under the baseline conditions if all approved production and activities (the approved CPP and REA) are undertaken, there is a process water deficit at Airly Mine of up to 168 ML/year (for the “dry” year case) and 64 ML/year on average. In proposed conditions, the transfer of up to 170 ML/year of water from Charbon Colliery was simulated to be available to supply operations at Airly Mine.

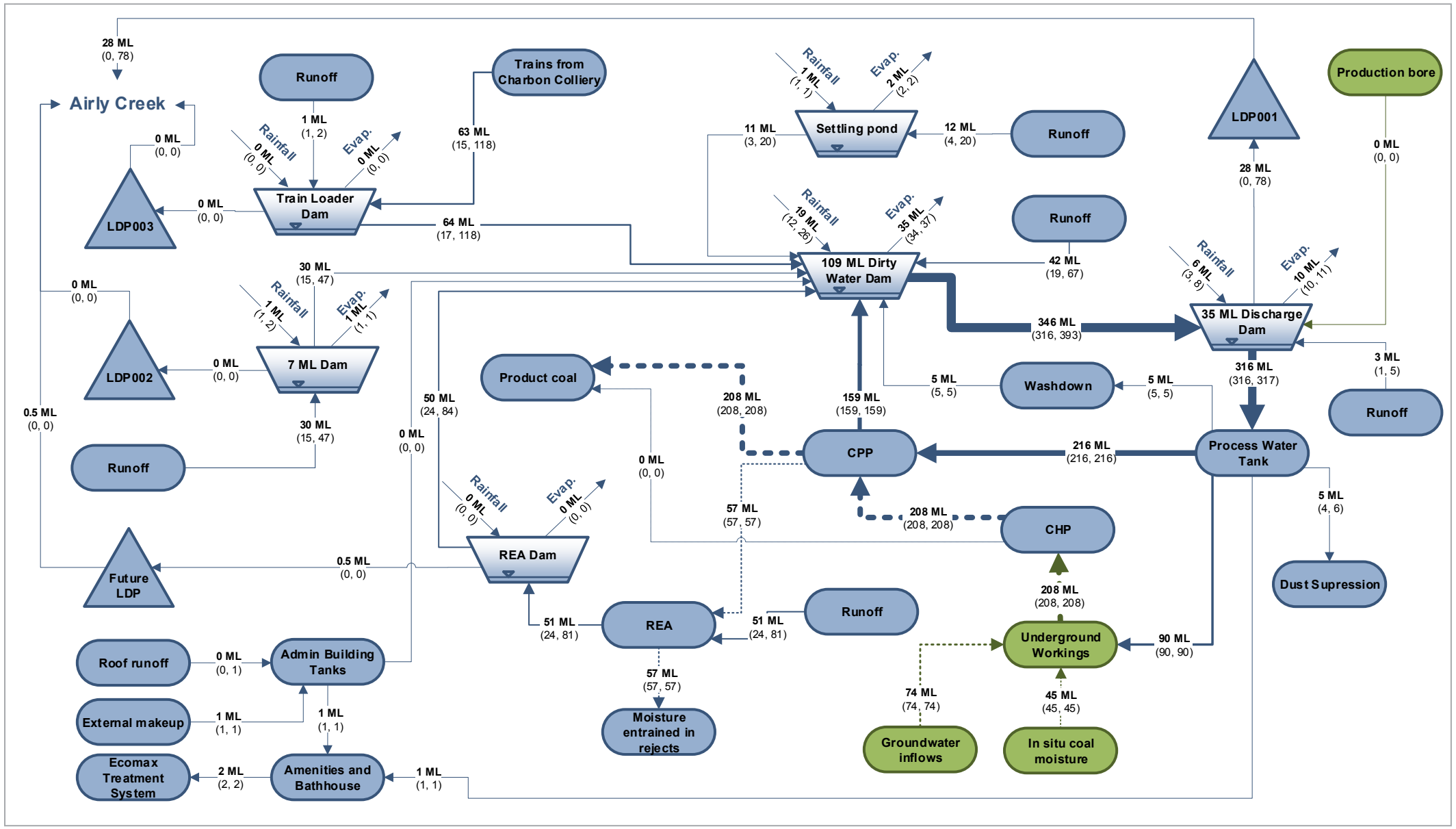
The water management system for Airly Mine was modelled using a historical time series of daily rainfall data extending over 130 years, from January 1889 to December 2018 (refer Section 3.1). A total of 130 simulations were applied, with each simulation modelling a different rainfall pattern from the record.

The results presented in this assessment include the average annual transfers between water management elements as well as the 10th percentile and 90th percentile values. The purpose of displaying the three results for each water transfer is to show the average transfer volume and an indication of the range of values expected due to possible variation in rainfall. The 10th percentile represents the value at which 10% of the modelled outputs were less than this value. Similarly, the 90th percentile represents the value at which 90% of the modelled outputs were less than this value. The 10th and 90th percentile results are not the same as the “dry” and “wet” year results presented in this assessment. The “dry” and “wet” year results are based on an equilibrium modelling approach with the driest and wettest rainfall year on record (347 mm in 1982 and 1530 mm in 1950 respectively; refer to Section 3.1) being repeated continuously as the simulated rainfall.

The results presented are based on the predicted site conditions in 2030. This year was chosen as it is when groundwater inflows into the underground workings are predicted to peak.

6.2.1 Water balance

The forecast annual water transfers for proposed conditions are presented in Figure 6-1, which may be compared to the baseline conditions results shown in Figure 5-5. The average annual inputs and outputs for the water balance for the baseline conditions and proposed conditions are summarised in Table 6-1. Results are rounded to the nearest 1 ML/year, except for discharges via the planned REA LDP, for consistency with the EIS.



Legend

- Underground storage
- Underground process
- Surface storage
- Surface process
- Licensed discharge point
- Entrained moisture
- Surface water flow
- Groundwater flow
- X (X, X) — Mean (10th percentile, 90th percentile)

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Airly Mine – Modification 2
Surface Water Impact Assessment

Water management schematic Annual water transfers Proposed conditions (2030)

Project No. 2219275
Revision No. 0
Date 09/04/2019

FIGURE 6-1

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Table 6-1 Average annual water balance – baseline conditions and proposed conditions (2030)

Water management element	Baseline conditions (ML/year)	Proposed conditions (ML/year)	Baseline conditions (ML/year)	Proposed conditions (ML/year)	Baseline conditions (ML/year)	Proposed conditions (ML/year)
	Average (mean)		"Dry" year		"Wet" year	
INPUTS						
Direct rainfall and catchment runoff	165	165	34	34	724	724
External potable water supply	1	1	1	1	0	0
Groundwater inflows	74	74	74	74	74	74
Extraction from production bore	0	0	0	0	0	0
In situ coal moisture	45	45	45	45	45	45
Transfer from Charbon Colliery	0	63	0	168	0	0
TOTAL INPUTS	**285**	**349**	**154**	**322**	**843**	**843**
OUTPUTS						
Evaporation	49	48	49	49	54	54
Dust suppression	5	5	6	6	4	4
Sewage to Ecomax system	2	2	2	2	2	2
Discharge through LDP001	28	28	0	0	517	517
Discharge through LDP002	0	0	0	0	0	0
Discharge through LDP003	0	0	0	0	0	0
Discharge through planned REA LDP	0.5	0.5	0	0	0	0
Product coal moisture	208	208	208	208	208	208
Moisture retained in rejects	57	57	57	57	57	57
TOTAL OUTPUTS	**349**	**349**	**322**	**322**	**843**	**843**
CHANGE IN STORAGE						
Surface water storages	0	0	0	0	0	0
Underground water storages	0	0	0	0	0	0
TOTAL CHANGE IN STORAGE	**0**	**0**	**0**	**0**	**0**	**0**
BALANCE						
Deficit	64	0	168	0	0	0
Inputs – outputs – change + deficit	0	0	0	0	0	0

Table 6-1 shows that only difference between the baseline conditions and the proposed case is that the forecast process water deficit is supplied by water imported from Charbon Colliery. The results of the “dry” year indicate that proposed transfer rate of 170 ML/year is sufficient to supply the approved production and activities (including the approved CPP and REA) at Airly Mine in all rainfall conditions that could reasonably be expected based on the historical rainfall record. In the “wet” year, no transfer from Charbon Colliery is expected to be required and therefore the site water balance would be unchanged by the Project.

Daily results

Figure 6-2 presents the daily LDP001 discharges predicted for the baseline conditions and proposed conditions for all 130 historical rainfall patterns modelled. For clarity, the results are shown with a logarithmic vertical axis and therefore values of 0 ML/day are not plotted.

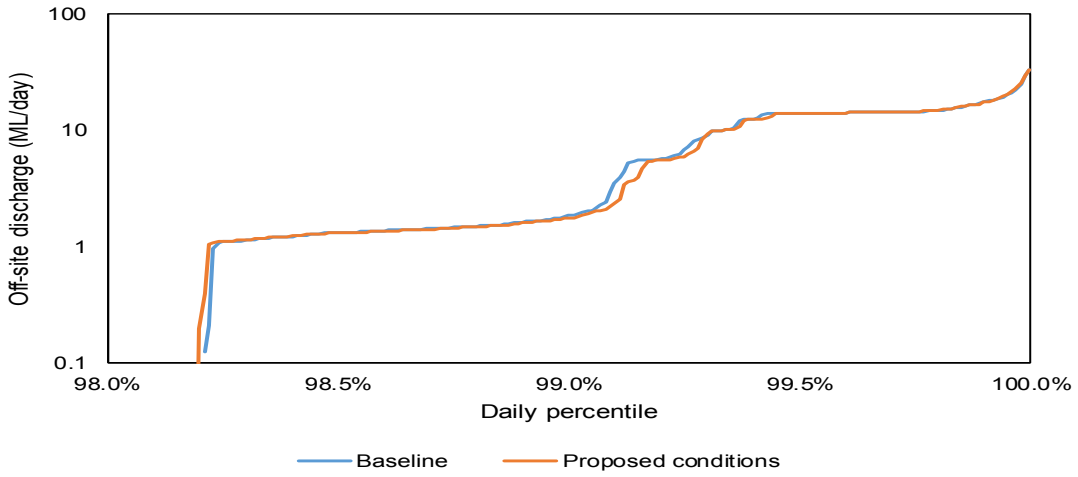


Figure 6-2 Impact on predicted daily LDP001 discharges

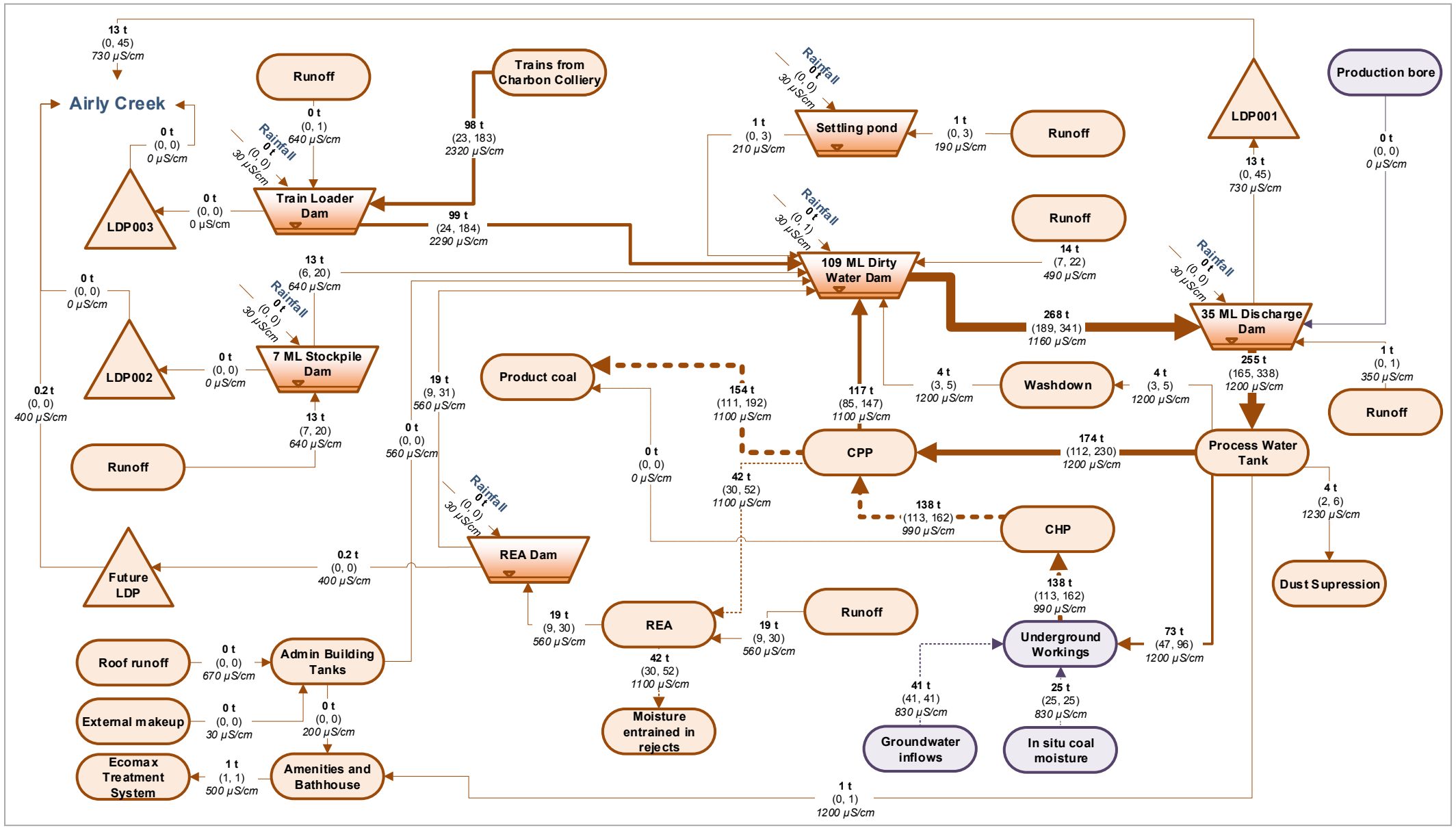
Figure 6-2 shows negligible differences between baseline conditions and proposed conditions, due to differences in modelling implementations between the different scenarios. This demonstrates that there is no increase in likelihood of discharges due to the Project, since discharges are only expected to due rainfall events.

Discharges off-site through LDP001 to Airly Creek occur due to rare rainfall events for the baseline conditions and proposed conditions. All discharges modelled were predicted to occur as a result of rainfall events exceeding 44 mm over five days, which is the rainfall depth for a 95th percentile, five day rainfall event design criteria for the 35 ML Discharge Dam (refer Section 2.1.2). Discharges were predicted to occur on less than 2% of days modelled, with the maximum daily discharge estimated to be about 30 ML/day for the baseline conditions and proposed conditions.

The water balance model results did not forecast transfers from Charbon Colliery (for the proposed conditions) at the same time as discharges through LDP001, since discharges would occur only when the site water storages were filled by rainfall runoff, in which case water transfers from Charbon Colliery would not occur, as the storages would be more than 75% full.

6.2.2 Salt balance

The predicted annual salt transfers for the proposed conditions are presented in Figure 6-3, which may be compared to Figure 5-7 for the baseline conditions. The average annual inputs and outputs for the salt balance for the baseline conditions and proposed conditions are compared in Table 6-2, for the year 2030, consistent with the water balance results presented in Section 6.2.1. Results are rounded to the nearest 1 tonne/year, except for discharges via the planned REA LDP, for consistency with the EIS.



Legend

- Underground storage
- Underground process
- Surface storage
- Surface process
- Licensed discharge point
- Entrained moisture
- Surface water flow
- Groundwater flow
- X (X, X) XX — Mean (10th percentile, 90th percentile) Mean EC

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Surface Water Impact Assessment

Water management schematic
Annual salt transfers
Proposed conditions (2030)

Project No. 2219275
Revision No. 0
Date 09/04/2019

FIGURE 6-4

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Table 6-2 Average annual salt balance – baseline conditions and proposed conditions (2030)

Water management element	Baseline conditions (tonne/year)	Proposed conditions (tonne/year)	Baseline conditions (tonne/year)	Proposed conditions (tonne/year)	Baseline conditions (tonne/year)	Proposed conditions (tonne/year)
	Average (mean)		"Dry" year		"Wet" year	
INPUTS						
Direct rainfall and catchment runoff	49	49	10	10	179	179
External potable water supply	0	0	0	0	0	0
Groundwater inflows	41	41	41	41	41	41
Extraction from production bore	0	0	0	0	0	0
In situ coal moisture	25	25	25	25	25	25
Transfer from Charbon Colliery	0	98	0	260	0	0
TOTAL INPUTS	**115**	**213**	**76**	**336**	**245**	**245**
OUTPUTS						
Evaporation	0	0	0	0	0	0
Dust suppression	3	4	4	9	1	1
Sewage to Ecomax system	1	1	1	1	1	1
Discharge through LDP001	10	13	0	0	147	147
Discharge through LDP002	0	0	0	0	0	0
Discharge through LDP003	0	0	0	0	0	0
Discharge through planned REA LDP	0.2	0.2	0	0	0	0
Product coal moisture	110	154	135	254	76	76
Moisture retained in rejects	30	42	37	71	21	21
TOTAL OUTPUTS	**153**	**213**	**176**	**335**	**245**	**245**
CHANGE IN STORAGE						
Surface water storages	0	0	0	0	0	0
Underground water storages	0	0	0	0	0	0
TOTAL CHANGE IN STORAGE	**0**	**0**	**0**	**0**	**0**	**0**
BALANCE						
Deficit	38	0	100	0	0	0
Inputs – outputs – change + deficit	0	0	0	0	0	0

As discussed in Section 4.2.3, in order to maintain a mass balance, it was necessary in the modelling to assign a salinity to the deficit quantified in Section 5.3.1, based on the median EC of the 35 ML Discharge Dam (refer to Section 4.2.3). The salt associated with the deficit for the baseline conditions is reported as a deficit for the baseline conditions in Table 6-2. The EC of the water transferred from Charbon Colliery was modelled to be 2320 µS/cm, equivalent to the median EC of the LDP4 Discharge at Charbon Colliery (refer to Section 6.3.1). As noted in Section 4.2.3, the assumption of the EC of the imported water is conservative, given that water from Charbon Colliery will be sourced from LDP4 Dam as well as Reedy Creek. The EC of the water actually transferred from Charbon Colliery is likely to be lower than the modelled EC of 2320 µS/cm.

Table 6-2 shows the key difference between the baseline conditions and proposed conditions is that the salt modelled to be imported in the water from Charbon Colliery is greater than was modelled for the deficit in the baseline conditions. Therefore the outputs of salt in the average and “dry” year case are proportionally higher. The significance of this result is discussed below. In the “wet” year, no transfer from Charbon Colliery is expected to be required and therefore the site salt balance is unchanged by the Project.

Daily results

Figure 6-4 presents the percentiles of the EC corresponding to the daily volume of water predicted to be discharged through LDP001 into Airly Creek for the baseline conditions and proposed conditions (as shown in Figure 6-2). EC was modelled to range up to approximately 800 µS/cm for the baseline conditions and 1700 µS/cm for the proposed conditions. These maximum concentrations are generally lower than the EC presented in Section 6.3, since some dilution of water at Airly Mine would occur due to rainfall before any discharges occurred.

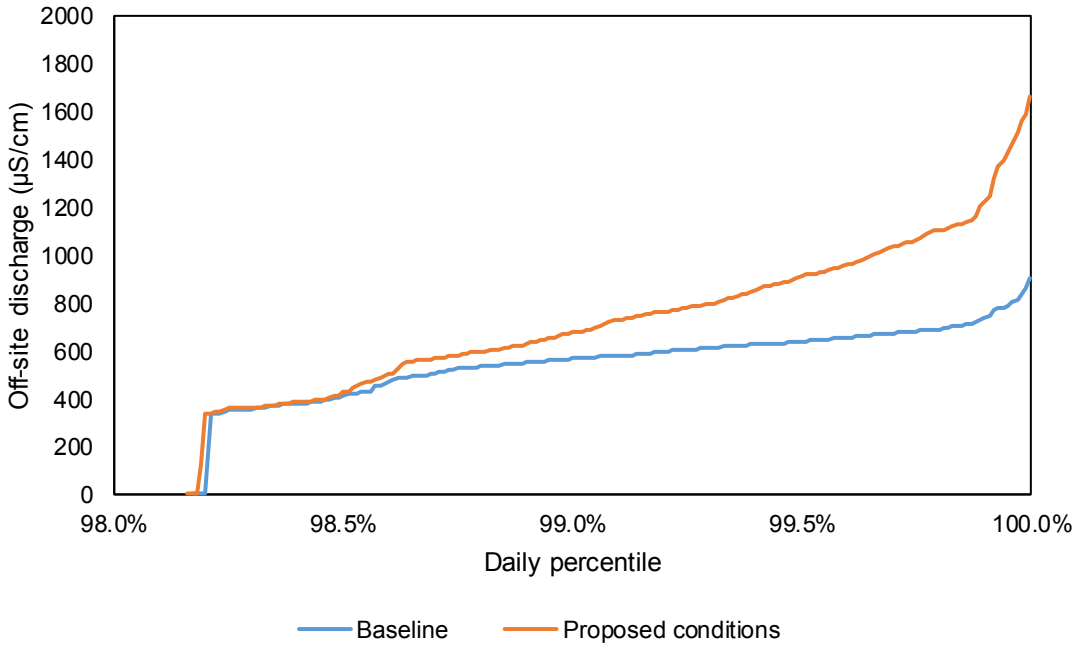


Figure 6-4 Impact on predicted electrical conductivity of daily LDP001 discharges

The difference in salt discharged via LDP001 and Table 6-2 and difference in EC in Figure 6-4 between the baseline conditions and proposed conditions, reflects the difference in the modelled EC of the process water deficit and the transfers from Charbon Colliery. These modelled EC were necessarily artificial and deliberately conservative, in order to identify the potential impact on the site salt balance, and, therefore, these results only indicate that this is a potential impact on discharge water quality at Airly Mine as a result of the Project. As noted in Section 4.2.3, the assumption of the EC of the imported water is conservative, given that water from Charbon Colliery will be sourced from LDP4 Discharge Dam as well as Reedy Creek Dam. The EC of the water actually transferred from Charbon Colliery is likely to be lower than the modelled EC of 2320 µS/cm and therefore the EC of potential discharges is likely to be lower. This potential impact identified by the site salt balance is considered in detail in Section 6.3, which includes a wide range of water quality parameters, including EC.

6.3 Water quality

The introduction of water from Charbon Colliery to Airly Mine has the potential to effect the water quality of the water management system and potential discharges to Airly Creek. The median water quality results for the relevant sites at Airly Mine and Charbon Colliery are provided in Table 6-3. The concentration limits for LDP001 discharges specified by EPL 12374 and the SSGVs for the Airly Creek catchment (Centennial Coal 2018) (as presented in Table 4-1) are also provided in Table 6-3 for comparative purposes. Exceedances of the LDP001 limits or SSGVs are highlighted in orange.

A statistical summary of water quality and time series graphs for selected parameters are provided in Appendix D. Where the analytical result was below the LOR for a parameter, then the detection limit was used in its place.

The following sections provide comparisons of the water quality parameters between the imported Charbon Colliery water and the water quality of Airly Mine water. Direct comparisons are made between water quality data from the two mine sites. Water quality from the Charbon Colliery water sources are also directly compared with Airly Mine's EPL 12374 limits for LDP001 and Airly Creek SSGVs. These comparisons should be considered conservative since water from Charbon Colliery sources will be blended from the LDP4 Discharge Dam and Reedy Creek Dam and the blending volume ratio depends on operational conditions. Water quality of the blended water may not necessarily reflect the water quality of any one source dam at Charbon Colliery.

The imported water will be blended with water in Airly Mine dams. Given that the blending ratio in the water management system will not be known when the water importation commences, the water quality of the Airly Mine water management system and any potential discharges via LDP001 are not able to be predicted until the water quality monitoring has been undertaken over a period of time.

Table 6-3 Comparison of water quality at Airly Mine and Charbon Colliery

Parameter	Units	EPL 12374 LDP001 limits		SSGVs	Airly Creek Upstream		Airly Creek		35 ML Discharge Dam		LDP4 discharge		LDP4 Discharge Dam		Reedy Creek Dam	
		90 %ile	100 %ile		Count	Median	Count	Median	Count	Median	Count	Median	Count	Median	Count	Median
Physicochemical parameters																
EC	µS/cm	2244		2709	25	**2710**	71	**2390**	103	900	47	1830	16	**2320**	42	1485
pH	pH units		6.5–9.0	6.5–8.0	25	7.5	71	7.4	103	**8.4**	47	7.8	28	8.0	44	8.0
TSS	mg/L	50		25	25	2	71	4	103	2	47	6	25	8	44	2
Turbidity	NTU	40		25	24	1.9	45	2.0	78	1.5	46	4.7	25	3.9	6	6.1
Nutrients																
Ammonia	mg/L		0.32	0.32	25	0.01	45	0.02	80	0.01	1	0.01	6	0.01	1	0.01
Total nitrogen	mg/L	2		0.7	25	0.4	45	0.5	80	0.3	1	0.4	6	0.2	1	0.4
Total phosphorus	mg/L	0.5		0.056	25	0.01	45	0.02	80	0.01	1	0.05	6	0.02	1	0.01
Dissolved metals																
Aluminium	mg/L			0.027	25	0.01	46	0.01	81	0.01					1	0.01
Antimony	mg/L			0.001	24	0.001	45	0.001	80	0.001					1	0.001
Arsenic	mg/L		0.024		25	0.001	46	0.001	81	0.001	7	0.001	1	0.001	4	0.001
Barium	mg/L			0.017	25	0.015	46	0.016	81	**0.048**						
Beryllium	mg/L			0.001	25	0.001	46	0.001	81	0.001						
Boron	mg/L			0.09	25	0.05	45	0.05	81	0.05	1	0.05				
Cadmium	mg/L				25	0.0001	46	0.0001	81	0.0001	7	0.0001	1	0.0001	4	0.0001
Chromium	mg/L				25	0.001	46	0.001	81	0.001	7	0.001	7	0.001	4	0.001
Cobalt	mg/L			0.001	25	0.001	46	0.001	81	0.001	1	0.001				
Copper	mg/L		0.013	0.001	25	0.001	46	0.001	81	0.001	7	0.001	1	0.001	13	0.001
Iron	mg/L			0.3	25	0.07	67	0.05	102	0.05					10	0.05
Lead	mg/L			0.001	25	0.001	47	0.001	82	0.001	6	0.001	1	0.001	4	0.001
Manganese	mg/L			1.2	25	0.126	68	0.157	102	0.014	1	0.05			10	0.194
Mercury	mg/L				23	0.0001	45	0.0001	81	0.0001	7	0.0001	1	0.0001	4	0.0001

Parameter	Units	EPL 12374 LDP001 limits		SSGVs	Airly Creek Upstream		Airly Creek		35 ML Discharge Dam		LDP4 discharge		LDP4 Discharge Dam		Reedy Creek Dam	
		90 %ile	100 %ile		Count	Median	Count	Median	Count	Median	Count	Median	Count	Median	Count	Median
Molybdenum	mg/L			0.001	25	0.001	46	0.001	81	0.001						
Nickel	mg/L		0.1	0.008	25	0.005	46	0.006	81	0.002	7	0.008	1	0.002	4	0.003
Selenium	mg/L				25	0.01	46	0.01	81	0.01	2	0.01			2	0.01
Silver	mg/L			0.001	24	0.001	45	0.001	80	0.001					1	0.001
Zinc	mg/L		0.072	0.0076	25	0.005	46	0.006	81	0.005	7	0.005	1	0.005	13	0.005
Other parameters																
Oil and grease	mg/L		10	5	25	5	70	5	103	5	47	2	11	2	42	2

6.3.1 Physiochemical parameter

EC recorded at Charbon Colliery generally ranged between 1300 µS/cm and 2500 µS/cm for LDP4 discharge and the LDP4 Discharge Dam. Results for Reedy Creek Dam were typically lower, with a median value of 1485 µS/cm compared to median values of 1830 µS/cm for LDP4 discharge and 2320 µS/cm for the LDP4 Discharge Dam. All results for EC at Charbon Colliery were less than the SSGV for the Airly Creek catchment, however results for LDP4 discharge and the LDP4 Discharge Dam has exceeded the EPL 12374 limit for LDP001 discharge since 2017. Generally, the EC reported for Charbon Colliery water sources was found to be less than the EC observed at the Airly Creek Upstream and Airly Creek monitoring sites.

The pH results for Charbon Colliery indicate slightly alkaline water, with pH typically ranging from 7.5 to 8.5. All results were within the EPL 12374 limits for LDP001 discharge; however a number of results exceeded the upper SSGV of 8.0 for LDP4 discharge, LDP4 Discharge Dam and Reedy Creek Dam. The median pH of the water at Charbon Colliery varies between 7.8 and 8.0 and falls within the EPL 12374 100th percentile pH range.

TSS concentrations were generally below the SSGV of 25 mg/L, with all results below the EPL 12374 limit for LDP001 discharge of 50 mg/L. Occasional results reported for Charbon Colliery monitoring sites were found to be elevated compared to Airly Mine monitoring sites.

Turbidity results for Charbon Colliery monitoring sites were found to be below the EPL 12374 limit for LDP001 discharge, with the exception of one sample at 63 NTU in March 2017. The majority of results were below the SSGV of 25 NTU, with the median results for LDP discharge, LDP4 Discharge Dam and Reedy Creek Dam below 7 NTU. The results for Charbon Colliery were generally elevated compared to Airly Mine monitoring sites, with median values below 2 NTU for the Airly Creek Upstream, Airly Creek and 35 ML Discharge Dam sites.

6.3.2 Nutrients

Limited results are available for nutrients from Charbon Colliery sites. Relatively low concentrations of ammonia, total nitrogen and total phosphorus have been observed, with all results below relevant SSGVs and EPL 12374 limits for LDP001 discharge. Similar results are observed at both Airly Mine and Charbon Colliery monitoring sites.

6.3.3 Dissolved metals

All results for dissolved aluminium, antimony, arsenic, boron, cadmium, cobalt, lead, selenium and silver were found to be below the relevant LOR for LDP4 discharge, LDP4 Discharge Dam and Reedy Creek Dam. No results for dissolved barium, beryllium and molybdenum were available from Charbon Colliery monitoring sites. Dissolved metals monitored at the Airly Mine sites were generally at or below the LOR for the majority of parameters, with the exception of results for dissolved iron, manganese, nickel and zinc.

Results for dissolved chromium at Charbon Colliery monitoring sites were below the LOR of 0.001 mg/L, with the exception of one results reported for the LDP4 discharge of 0.004 mg/L in January 2018. All dissolved chromium results for Airly Mine monitoring sites were also below the LOR.

Dissolved copper results for LDP4 Discharge Dam and Reedy Creek Dam were reported to be below the LOR of 0.001 mg/L. Dissolved copper has been observed above the LOR on four occasions within samples from the LDP4 discharge, with three exceedances of the SSGV of 0.001 mg/L. All results were below the EPL 12374 limit of 0.013 mg/L for LDP001 discharge. Results for Charbon Colliery were similar to those for Airly Mine monitoring sites, with a median value of 0.001 mg/L for all sites.

Limited observations for dissolved iron have been undertaken at Charbon Colliery. The majority of samples from Reedy Creek Dam have been below the LOR of 0.05 mg/L, with the exception of one result for 0.22 mg/L reported in March 2012. Results indicate that dissolved iron concentrations were generally lower in Reedy Creek Dam than at the Airly Creek monitoring sites.

Concentrations of dissolved manganese at Charbon Colliery monitoring sites were found to range between 0.05 mg/L and 0.4 mg/L, which is elevated compared to the Airly Mine monitoring sites. The median dissolved manganese result for Reedy Creek Dam of 0.194 mg/L is higher than the median results for all three Airly Mine monitoring sites. However, all results for LDP4 discharge and Reedy Creek Dam were below the SSGV of 1.2 mg/L.

Dissolved mercury has been detected a total of three times at the Charbon Colliery monitoring sites analysed, with a maximum of 0.0013 mg/L reported for Reedy Creek Dam in January 2018. However, this result is considered to be erroneous as the total mercury result from the same sample was less than the LOR of 0.0001 mg/L. All results at the Airly Mine monitoring sites were found to be below the LOR.

The majority of dissolved nickel results for LDP4 discharge, LDP4 Discharge Dam and Reedy Creek Dam varied between 0.002 mg/L and 0.009 mg/L. Two results for LDP4 discharge were found to exceed the SSGV of 0.008 mg/L; however all results were below the EPL 12374 limit for LDP001 discharge of 0.1 mg/L. Median results were similar to the values for the Airly Creek monitoring sites.

Dissolved zinc concentrations were observed at the Charbon Colliery monitoring sites to generally range between the LOR of 0.005 mg/L and 0.02 mg/L. Occasional results for LDP4 discharge and Reedy Creek Dam were found to exceed the SSGV of 0.0076 mg/L; however all results were below the EPL 12374 limit for LDP001 discharge of 0.072 mg/L. Results were similar at the monitoring sites at Airly Mine and Charbon Colliery.

6.3.4 Summary

The quality of the water proposed to be imported from Charbon Colliery is comparable to the water quality of Airly Creek and the 35 ML Discharge Dam, however EC, TSS, turbidity, total nitrogen and phosphorous and dissolved manganese and nickel concentrations were found to be slightly elevated at Charbon Colliery in comparison to Airly Mine. It is possible that the importation of water from Charbon Colliery for use during dry periods may result in an increase in these concentration within the water management system at Airly Mine. However, as the median water quality at Charbon Colliery is below the SSGVs for Airly Creek and EPL limits at Airly Mine, it is expected that the likelihood of potential off site discharges exceeding the SSGVs and EPL limits will not increase as a result of the Project.

The water and salt balance modelling presented in Section 6.2 predicted that discharges from the 35 ML Discharge Dam would occur due to overflows of the dam under high rainfall events and prolonged wet periods and therefore discharge would be highly unlikely occur under zero or low flow conditions in Airly Creek. Based on the salt balance modelling, the flow weighted average EC of off-site discharges through LDP001 under proposed conditions is predicted to be approximately 750 µS/cm, which is within the historical range observed in Airly Creek and below the SSGV of 2709 µS/cm.

On-site water management measures, discussed in Section 7, would minimise the risk of discharge off-site. As water sourced from Charbon Colliery would only be used during periods of low rainfall, the risk of this water directly entering the receiving environment without dilution and causing environmental harm is extremely low. Therefore the potential impact to Airly Creek as a result of the Project is considered to be low.

6.4 Downstream water users

The results of the water and salt balance impact assessment (refer Section 6.2) and water quality impact assessment (refer Section 6.3) indicate that no adverse change to the frequency or water quality of potential discharges from Airly Mine are expected as a result of the Project. Adverse impacts to downstream water users are unlikely to occur as a result of the Project due to the low risk of potential impacts and the mitigation and management proposed in Section 7 to minimise off-site discharge volume and frequency.

6.5 Aquatic ecology

As identified in Section 6.3, it is possible that the importation of water from Charbon Colliery for use during dry periods may result in an increase in the concentration of dissolved manganese and nickel in the water management system at Airly Mine. Given the pollution tolerant nature of the macroinvertebrate community observed in Airly Creek, and that the median concentrations of these metals are below the SSGVs for Airly Creek, there is a low risk of impacts to the macroinvertebrate community of Airly Creek. No fish were observed in Airly Creek other than the invasive *Gambusia holbrooki.* Therefore, no impacts to native fish are expected within Airly Creek as a result of the Project.

In the unlikely event that discharges of the water imported from Charbon Colliery did occur, there is a low likelihood of introducing non-endemic macroinvertebrate species to Airly Creek as some macroinvertebrate taxa collected in Reedy Creek Dam have not previously been observed in Airly Creek during routine monitoring. Such an introduction has the potential to influence the macroinvertebrate community by altering the population dynamics (e.g. the balance between predators and grazers) or increasing competition for endemic species. However, it is likely that macroinvertebrates would not survive the transportation from Charbon Colliery to Airly Mine, due to damage during pumping, oxygen depletion during transport, changes in ionic composition and lack of habitat in the water management system at Airly Mine. Given these factors and the on-site water management measures, which will minimise the risk of discharge off-site, the risk of introducing non-endemic macroinvertebrate species to Airly Creek is considered to be low.

The invasive fish species *Gambusia holbrooki* has been collected (opportunistically) from Reedy Creek Dam at Charbon Colliery during macroinvertebrate monitoring. Predation by *Gambusia holbrooki* on native fish species is a KTP under the FM Act. However, as *Gambusia holbrooki* has also been observed to occur in Airly Creek in high numbers (Cardno 2014), there is no risk of increasing the range of this invasive fish in the Airly Creek catchment or further downstream.

6.6 Significant impact criteria

The significant impact criteria defined by the *Significant Impact Guidelines 1.3* (DoE 2013a) are presented in

Table 6-4, along with where each aspect has been assessed in the SWIA. The SWIA has been undertaken based on the information guidelines specified by the IESC (2018). Appendix B presents the information requirements as well as where each requirement has been addressed in the SWIA.

Table 6-4 Significant impact criteria

Impact criteria	Comment
Hydrological characteristics	
Changes in the water quantity, including the timing of variations in water quantity.	No impact. No change to extraction from water resources is proposed (refer to Section 6.1). The proposal is not expected to have any measurable increase in off-site discharge (refer to Section 6.2.1).

Impact criteria	Comment
Changes in the integrity of hydrological or hydrogeological connections, including substantial structural damage.	No impact. No change to extent of the underground or surface parts of the site are proposed (refer to Section 1.3).
Changes in the area or extent of a water resource.	No impact. No change to the approved surface water catchments of the surface facilities area are proposed (refer to Section 1.3).
Water quality	
Substantially reduces the amount of water available for human consumptive uses or for other uses, including environmental uses, which are dependent on water of the appropriate quality.	No changes to water extraction at Airly Mine are proposed. No change to off-site discharges quantities are expected.
Creates risk to human or animal health or to the condition of the natural environment as a result of the change in water quality.	The importation of the water from Charbon Colliery has the potential to increase EC, TSS, turbidity, total nitrogen and phosphorous and dissolved manganese and nickel concentrations in the water management system at Airly Mine. However, as the median concentrations of water quality parameters at Charbon Colliery are below the SSGVs for Airly Creek and EPL limits at Airly Mine, the likelihood of potential off-site discharges exceeding the SSGVs and EPL limits will not increase as a result of the Project. With the adoption of proposed water management measures, the likelihood of water sourced from Charbon Colliery directly entering the receiving environmental without dilution is extremely low. Therefore, the potential impact to Airly Creek is considered to be low.
Causes persistent organic chemicals, heavy metals, salt or other potentially harmful substances to accumulate in the environment.	
There is a significant worsening of local water quality (where current local water quality is superior to local or regional water quality objectives).	
Seriously affects the habitat or lifestyle of a native species dependent on a water resource.	No impact. Given the pollution tolerant nature of the macroinvertebrate community observed in Airly Creek, and that the median concentrations of these metals have been recorded below the SSGVs for Airly Creek, there is a low risk of impacts to the macroinvertebrate community of Airly Creek. No fish were observed in Airly Creek other than the invasive *Gambusia holbrooki.* Therefore, no impacts to native fish are expected within Airly Creek as a result of the Project (refer to Section 6.5).
Causes the establishment of an invasive species (or the spread of an existing invasive species) that is harmful to the ecosystem function of the water resource.	No impact. No invasive macroinvertebrate species were identified in the Protected Matters Report (DEE 2019) as likely to occur at Charbon Colliery. The invasive fish species *Gambusia holbrooki* has been observed at Reedy Creek Dam at Charbon Colliery and also been in Airly Creek in high numbers. Therefore, there is no risk of spreading this invasive fish species to the Airly Creek catchment (refer to Section 6.5).
High quality water is released into an ecosystem which is adapted to a lower water quality.	Not applicable. No changes to the frequency or magnitude of potential off-site discharges are expected (refer to Section 6.2.1). The quality of water in the water management system at Airly Mine and Charbon Colliery is not considered high (refer to Section 5.4).

6.7 Cumulative impacts

As the Project is not expected to result in any measurable impacts to water quantity or quality downstream of Airly Mine, and given that there are no other developments in the vicinity of Airly Mine, cumulative impacts are unlikely to occur as a result of the Project.

7. Mitigation, management and licensing

7.1 Discharge avoidance

The following management measures will be implemented to minimise the risk of discharge to Airly Creek:

- The importation of water from Charbon Colliery will only be undertaken as required when surface water storages are less than 75% full at Airly Mine, such that 25% freeboard is maintained at all times at Airly Mine.
- The water level in surface water storages will be continuously monitored.
- The water level in surface water storages will be maintained with sufficient freeboard to contain the 95th percentile, five day rainfall event of 44 mm.

A review of the size of surface water storages and transfer systems (pipelines and pumps) will be undertaken to ensure that the surface water management system is sufficient to capture the 95th percentile, five day rainfall event without uncontrolled discharges off-site.

7.2 Inspections

Centennial Airly undertake site inspections of the water management structures at the surface facilities area weekly as a minimum. The surface water storages are inspected for capacity, structural integrity and effectiveness. Maintenance of any erosion and sediment control structures will be implemented when visual defects are observed. Sediment accumulated within storages will be removed as required to maintain water storage capacity.

7.3 Licensing

The Project proposes to transfer up to 170 ML/year from Charbon Colliery and no other changes to extraction or use of water at Airly Mine are proposed. Therefore no changes to any licences held for Airly Mine are required by the Project. Charbon Colliery hold sufficient licences for the transfer (GHD 2019a).

7.4 Water management plans

A regional water management plan (Centennial Coal 2016) provides an overview of the water management requirements across Centennial's operations in the Western Coalfield. A site-specific water management plan for Airly Mine (Centennial Coal 2018) has also been developed to address the specific water management requirements for the mine. An extraction plan (including a water management plan) is also required for specific mine workings prior to extraction.

The water management plans ensure that the operation of the mine, with respect to water, meets all relevant regulatory requirements. The regional and site-specific water management plans are reviewed every three years or as a result of any regulatory requirements, any significant changes to water management practices or the development of new mining areas. Following approval of the Project, the site-specific water management plan will be updated to include the new water management strategy.

Trigger action response plans (TARPs) are provided in the site-specific water management plan. These TARPs provide guidance on the immediate actions that should be taken in response to any impacts of the Project identified as part of the monitoring program. Generally, responses include investigation and monitoring, determination of the risk of impact and remedial measures to be implemented. The TARPs also include reporting, training and personnel responsibilities. A review of the TARPs within the water management plans for Airly Mine and Charbon Colliery will be undertaken, including those associated with water quality on site and dewatering of sediment basins.

7.5 Monitoring

7.5.1 Water quality

A comprehensive surface water monitoring program has been developed by Airly Mine. The water management plan (Centennial Coal 2018) provides the details of the surface water monitoring program. Monitoring includes water quality and level of water storages at the surface facilities area and water quality, flow and stability of watercourses surrounding the surface facilities area. The main objective of monitoring is to ensure that the implemented water management measures function as designed. Observations from the surface water monitoring will be used to report on the site water balance for each calendar year as part of the annual review.

It is recommended that the surface water monitoring program from Charbon Colliery be amended such that the monitoring of the sources of water transferred to Airly Mine (LDP4 Discharge Dam and Reedy Creek Dam) is consistent with the monitoring of the 35 ML Discharge Dam at Airly Mine. The recommended changes to the surface water quality monitoring are summarised in Table 7-1. It is recommended that the current monitoring program at Airly Mine continue and the results used to identify any changes to surface water quality at Airly Mine due to the importation of water from Charbon Colliery.

Table 7-1 Surface water quality monitoring frequency and parameters

Location	Frequency	Parameters
LDP4 Discharge Dam, Reedy Creek Dam	Monthly	**Physicochemical parameters:** biochemical oxygen demand (BOD), dissolved oxygen (DO), EC, pH, TDS, TSS, turbidity. **Nutrients:** ammonia, nitrate, nitrite, nitrate + nitrite, total Kjeldahl nitrogen, total nitrogen, total organic carbon, total phosphorus. **Major ions:** alkalinity, calcium, chloride, magnesium, potassium, sodium, sulfate. **Metals (dissolved):** aluminium, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, cerium, chromium, cobalt, copper, erbium, gallium, iron, lead, lithium, manganese, mercury, molybdenum, nickel, rubidium, selenium, silver, strontium, thallium, thorium, tin, titanium, uranium, zinc. **Metals (total):** aluminium, arsenic, barium, boron, cadmium, cobalt, iron, lead, manganese, mercury, nickel, selenium, silver, zinc. **Other parameters:** bromine, chlorine (free and total residual), E. coli detection, faecal coliforms, fluoride, iodine, oil and grease, silica, silicon, total cyanide.

7.5.2 Aquatic ecology

Biannual aquatic ecology monitoring will be continued in Airly Creek in order to identify any changes that occur in the event of a discharge from Airly Mine. The aquatic ecology monitoring program design and methodology is outlined in the Airly Mine water management plan (Centennial Coal 2018).

8. Summary

The SWIA considers the overall water management system associated with Airly Mine and the potential impacts of the Project on the surface water environment under proposed conditions. The assessment of potential impacts of the proposed importation of water from Charbon Colliery considered the water and salt balance, surface water quality and downstream water users. A summary of the existing/approved conditions and potential impacts under proposed conditions is provided in Table 8-1.

Table 8-1 Summary of potential impacts

Component	Existing/approved conditions	Potential impacts
Water balance	• Airly Mine has a process water deficit, due to groundwater inflows being lower than predicted and the existing production bore becoming unreliable. • Off-site discharges are only expected as a result of rare rainfall events in excess of the 95th percentile, five day event (44 mm of rainfall in 5 days).	• No increase in the likelihood of potential off-site discharges, compared to the baseline conditions. • Reduced reliance on local and regional groundwater sources at Airly Mine.
Salt balance	• The main salt influx at Airly Mine is forecast to be direct rainfall and catchment runoff. • The main outflow of salt from Airly Mine, on average, is forecast to be salt within the moisture entrained in product coal.	• The results of the salt balance model indicate a potential increase in the salinity of the off-site discharges, however the more detailed assessment of water quality (shown below) found that the potential impact is low.
Water quality	• Airly Creek is categorised as brackish with EC in the range of 1300 µS/cm to 3300 µS/cm. Similar EC is observed at Charbon Colliery, with EC generally recorded between 1300 µS/cm and 2500 µS/cm. • The pH of Charbon Colliery source water is typically within from 7.5 to 8.5, a range that is within the range of Airly Creek. • Historical range of TSS, turbidity and nutrients at Charbon Colliery comparable to Airly Creek catchment. • Concentrations of dissolved manganese and nickel found to be elevated at Charbon Colliery.	• The importation of the water from Charbon Colliery has the potential to increase EC, TSS, turbidity, total nitrogen and phosphorous and dissolved manganese and nickel concentrations in the water management system at Airly Mine. • However, as the median concentrations of water quality parameters at Charbon Colliery are below the SSGVs for Airly Creek and EPL limits at Airly Mine, the likelihood of potential off site discharges exceeding the SSGVs and EPL limits will not increase as a result of the Project. • With the adoption of proposed water management measures, the likelihood of water sourced from Charbon Colliery directly entering the receiving environmental without dilution is extremely low. • Therefore, the potential impact to Airly Creek is considered to be low.
Downstream water users	• Total of three lots identified as licensed for surface water use downstream of the Airly Mine surface facilities area.	• Adverse impacts to downstream water users are unlikely to occur due to the low risk of potential impacts and the ephemeral nature of Airly Creek.

Component	Existing/approved conditions	Potential impacts
Aquatic ecology	• The macroinvertebrate community of Airly Creek is mainly pollution tolerant taxa due to poor water quality because of agricultural landuse and riparian zone clearing. • The invasive *Gambusia holbrooki* (Plague minnow) is already present in Airly Creek and Reedy Creek Dam at Charbon Colliery. • No invasive macroinvertebrate species were identified in the Protected Matters Report as likely to occur at Charbon Colliery.	• Given the low risk of discharge, there is a low risk of impacts to macroinvertebrates and native fish in Airly Creek. • There is a low likelihood of introducing non-endemic macroinvertebrate species to Airly Creek, as it is unlikely that they would survive in the water management system. • No new invasive macroinvertebrates or fish species that could be spread to Airly Creek have been identified at Charbon Colliery.

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Appendices

Appendix A – Hydrogeological model report

10 April 2019

Nagindar Singh
Approvals Coordinator
Centennial Airly Pty Ltd
1384 Castlereagh Highway
Lidsdale NSW 2790

Our ref: 2219275-95876
Your ref:

Dear Nagindar

Airly Mine Mod 2
Hydrogeological Model Report

1 Introduction

This letter details the recalibration of the existing numerical hydrogeological model, originally developed to inform the Groundwater Impact Assessment (GIA) for the Airly Mine Extension Project (SSD 5581). The numerical model has been recalibrated to reflect additional groundwater monitoring data collected since the Airly Mine Extension Project was assessed in 2014. The predictions of the recalibrated model have been used to inform the site water balance for the Surface Water Impact Assessment (SWIA) for Airly Mine Extension Project Modification 2.

1.1 History of model development

The chronology of the development of the groundwater model for Airly Mine is as follows:

- The original model was developed by GHD in 2013 to inform the GIA for the Airly Mine Extension Project.
- An independent peer review of the original groundwater model was undertaken in 2014 by Dr Noel Merrick (Hydro Algorithmics, 2014).
- Comments from the independent peer review were addressed by GHD and incorporated into the final version of the Hydrogeological Model Report (GHD, 2014).
- The original model was found to over-predict groundwater inflows into the mine workings between 2015 and 2017 and was therefore updated by GHD in 2017 using additional monitoring data collected since the original model to better predict observed flows and drawdown (GHD, 2017).
- Additional groundwater monitoring locations were installed at Airly Mine in late 2016 and January 2017. Monitoring of these locations commenced in 2017
- An independent peer review of the recalibrated model was undertaken in 2018 by Dr Noel Merrick (Hydro Algorithmics, 2018).
- The recalibrated model was updated to address comments from the independent model review (Hydro Algorithmics, 2018) and incorporate data from groundwater monitoring locations installed in late 2016 and January 2017.

- An independent peer review of this report was undertaken by Dr Noel Merrick (Appendix E). All outstanding comments from the review have been addressed in this report.

1.2 Assumptions

The report relies on a combination of existing data and site-specific data supplied by the client specifically for the Project including but not limited to:

- Surfaces from the mine geological model.
- Borehole logs and other relevant geological data.
- Bore/piezometer construction details and depth.
- Piezometric head measurements.
- Hydraulic testing data.
- Hydrological (surface water level) data.
- Topographical data.

A numerical groundwater model is a mathematical representation of a complex natural environment where parameters and processes can only be inferred from a finite number of measurements. Simplifications and assumptions are necessary in modelling. Efforts have been made to provide clarity on the data used to support the modelling and associated limitations. Findings presented in this report should be considered in this context.

2 Hydrological conceptualisation and model calibration

The original conceptual model is outlined in Section 4 of GHD (2014) with a schematic representation of the local hydrogeology provided in Figure 4-2 of that report. Further details are provided in Section A.1 of Appendix A.

As discussed in Section 1, the existing hydrogeological model was developed by GHD and reported in GHD (2014). Work undertaken as part of the update and recalibration of the hydrogeological model is discussed in Section A.2 of Appendix A.

As required by the NSW Aquifer Interference Policy (DPI, 2012), Dr Noel Merrick (HydroSimulations) is the third party reviewer for the recalibration of the numerical model and the predictive simulations (Section 3) including the uncertainty analysis (Section 3.3.1).

3 Predictive simulations

3.1 Predictive modelling approach

The recalibrated model was run for predictive simulations to update estimates of the potential future groundwater inflow rates into the mine and to update predictions for the potential magnitude and extent of drawdown.

As per model calibration, the proposed mining of the Lithgow Seam was simulated by extending drain cells throughout Layer 8 of the model as per the mining schedule. The mining schedule is as per the 1.8 Mtpa mine plan approved as per SSD_5581.

The best fit model parameters from transient calibration (Table A-5, Appendix A) were adopted for predictive modelling.

The general layout of the five mining zones approved under Airly Mine's consent SSD 5581, including areas approved for Panel and Pillar mining, is shown in Appendix F. In addition to the approved subsidence limits included in the Airly Mine Extension Project EIS, the consent SSD 5581 includes restrictions on mining as per Condition 1 under Schedule 3.

3.2 Prediction scenarios

Two scenarios were modelled. These scenarios are discussed below, including any differences between scenarios adopted for this assessment, and those adopted in GHD (2014):

- **Scenario 1** assumes that the vertical and horizontal hydraulic conductivity will increase up to a height of approximately 23 m above the panel and pillar mining zone. It is noted that a zero height of fracturing was adopted for Scenario 1 in GHD (2014). However, it was considered by Airly Mine that a height of six times the height of the mine workings is more realistic for a minimum height of fracturing. A height of six times the height of the mine workings (average 3 m) equals 18 m. Due to the thicknesses of the layers in the model, fracturing was modelled to the top of layer 5. This corresponds to a height of 23 m above the mine workings.
- **Scenario 2** assumes that the vertical and horizontal hydraulic conductivity will increase up to a height of 75 m above the panel and pillar mining zone, which is the maximum height of the fracture zone predicted by Golder Associates (2013).

For both Scenario 1 and Scenario 2 the bulk horizontal and vertical hydraulic conductivities within the fracture zone (i.e. Layers 5-7 for Scenario 1 and 3–7 for Scenario 2) have been established in accordance with GHD (2014). Hydraulic conductivity values of 0.41 m/day (horizontal) and 1.6×10^{-4} m/day (vertical) were adopted for the fracture zone as per GHD (2014). Note that fracturing applies above the panel and pillar mining zone only.

3.3 Groundwater inflows

Predicted groundwater inflow rates into the underground workings are presented in Figure 3-1. Groundwater inflow rates have been presented for Scenario 1 and Scenario 2 outlined in Section 3.2. Predicted groundwater inflows presented as part of the Airly Mine Extension Project (GHD, 2014a) have

been included for comparison, and showed a peak of 183 ML/year for the year 2030. It is noted that these mine inflows were used in the site water and salt balance for the proposed scenario in the surface water assessment (GHD, 2014b) for the Airly Mine Extension Project.

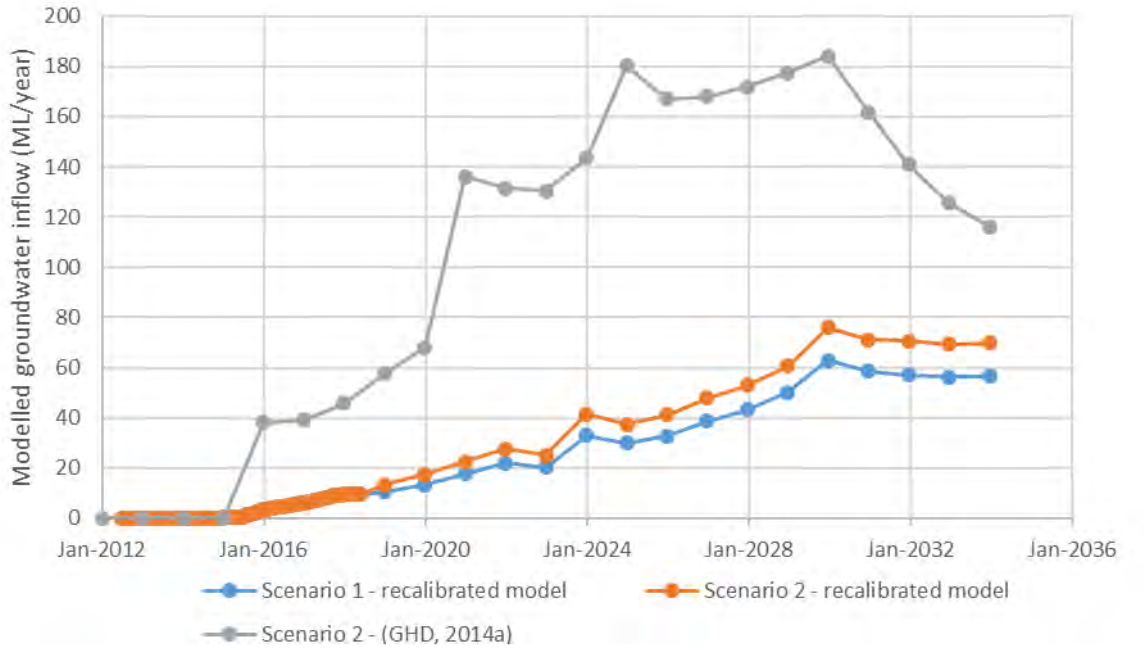


Figure 3-1 Modelled groundwater inflows into mine workings

Under Scenario 1 the modelled groundwater inflow rate (using the recalibrated model) increases over time to a peak of 61 ML/year in 2030, before gradually decreasing to 56.4 ML/year in 2033, the final year of mining. Under Scenario 2, the inflow rate increases over time to a peak of 76 ML/year in 2030, before gradually decreasing to 70 ML/year in 2033.

Groundwater inflows for Scenario 2 are recommended to be adopted for the water balance assessment as the height of fracturing adopted for this model is more conservative and closer to the 60 m estimate reported recently by Strata2 (2019). With the Scenario 2 predictions, the modelled inflow rate is likely to be greater than the actual inflow rates given that the 75 m height of fracturing over the panel and pillar zone (with void widths of 61 m and inter-panel pillar widths of 35 m) is conservative (David King, pers comm). However, in both scenarios, the peak inflows are so low that it considered that any groundwater inflows will report only as moisture in run of mine coal, and will be able to be captured and reused as process water. Therefore, the site water balance is expected to be independent of the actual groundwater inflows, in terms of process water demand and off-site discharges.

Since there have been no changes to the mine design or mining rate, differences in modelled inflows between the recalibrated model developed as part of this report and the Airly Mine Extension Project (GHD, 2014a) are due to the recalibration of the hydrogeological model utilising increased monitoring data since 2014.

3.3.1 Lineaments

Assessment of fracturing and its influence on groundwater is an information requirement in IESC (2018a). Additionally, the Independent Expert Scientific Committee (IESC) recommended that additional assessment of fault zones and their potential impacts on aquifer connectivity and groundwater flow be undertaken as part of the Airly Mine Extension Project (GHD, 2015). While this recommendation of IESC was addressed by GHD (2015), observed drawdown at ARP04 had not yet occurred (refer Appendix A and Appendix B) and therefore an investigation was undertaken as part of this assessment to determine whether the drawdown at ARP04 may be attributable to lineaments that extend from the Devonian basement geology to the surface. ARP04 is located near a lineament identified in the geological structural review for Airly Mine (SRK, 2018). The location of the lineament is shown as Domain D in Figure 3-2.

This lineament has been considered as potentially forming a zone of enhanced hydraulic conductivity or alternatively as a horizontal flow barrier to groundwater flow due to potential discontinuities in geological formations.

To investigate the impact of these alternative conceptualisations on transient calibration, two alternative scenarios were considered for comparison with the best fit model run:

- Area of enhanced hydraulic conductivity from surface (Layer 1) to the Marrangaroo Formation (Layer 9). Horizontal hydraulic conductivities were increased 10 times relative to the best fit model run and vertical hydraulic conductivities were increased 20 times relative to the best fit model run.
- Horizontal low flow boundary from surface (Layer 1) to the Marrangaroo Formation (Layer 9). Horizontal hydraulic conductivities were divided by 100 across the low flow boundary.

The model cells where hydraulic conductivity was enhanced and the horizontal low flow boundary was applied are shown in Figure 3-3. The lineament was modelled at cells shown in orange.

Model results for the best fit transient model run have been compared with model results for the lineament scenarios described above. Observed and modelled groundwater levels at ARP04 are shown in Figure 3-4 and Figure 3-5.

The results indicate that there is negligible difference to modelled groundwater levels at ARP04 or modelled mine inflows due to the inclusion of lineaments. This is shown in Figure 3-4 and Figure 3-5 where model results for the best fit transient model run and for the lineament scenarios described above show the same modelled groundwater level at ARP04. Therefore lineaments were not considered further as part of the assessment.

The lack of difference in modelled groundwater levels between the base case scenario (best fit transient model run) and the two lineament scenarios is likely due to the low groundwater pressure in the Lithgow Seam and the Marrangaroo Formation at Airly, including at ARP04, which is attributable to the extensive groundwater seepage areas along the slopes of Mount Airly and Genowlan Mountain as well as the network of fractures and joints that direct groundwater flow to these areas of outcrop. This process likely dominates the local hydrogeological flow system and, as a result, the majority of local groundwater flow reports to these areas of seepage rather than flowing into mine workings.

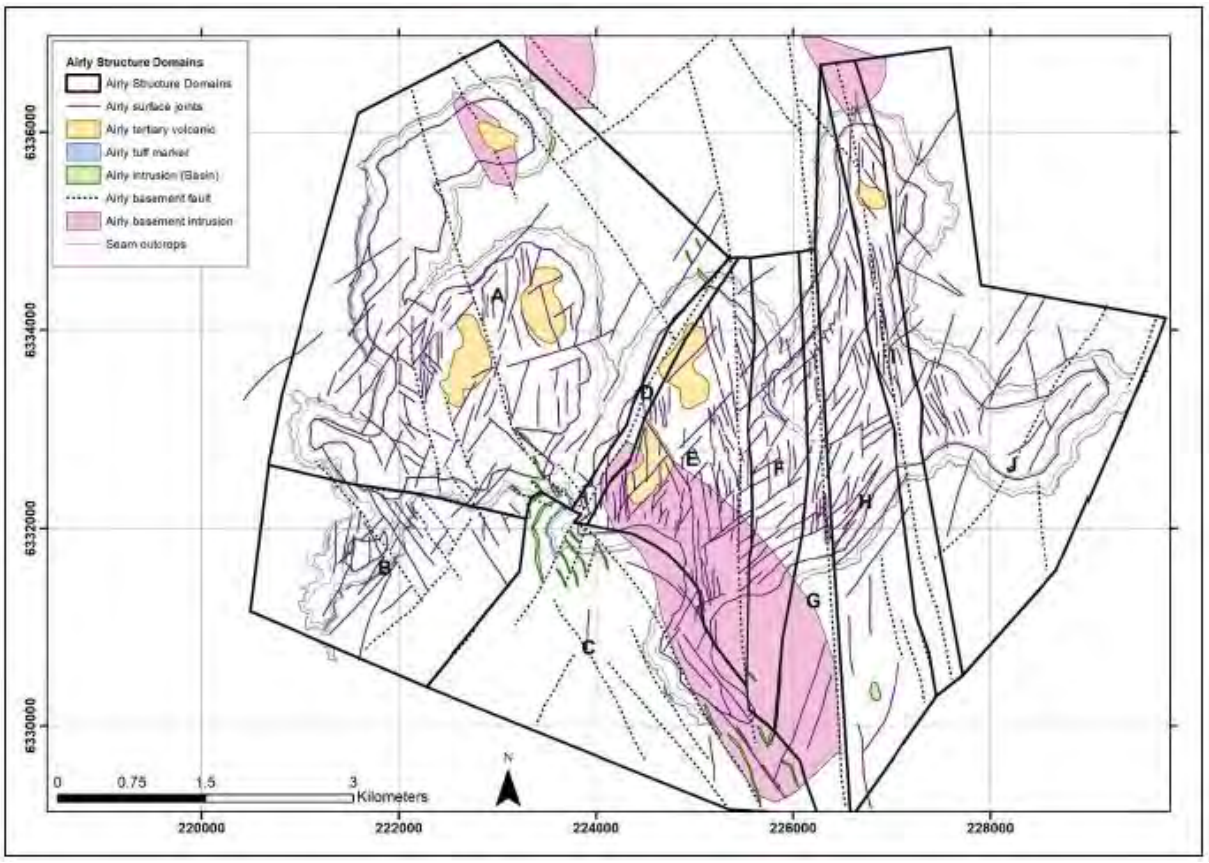


Figure 3-2 Structural interpretation of basement and surface faults and joints for Airly Mine with seam level structural domains (SRK, 2018)

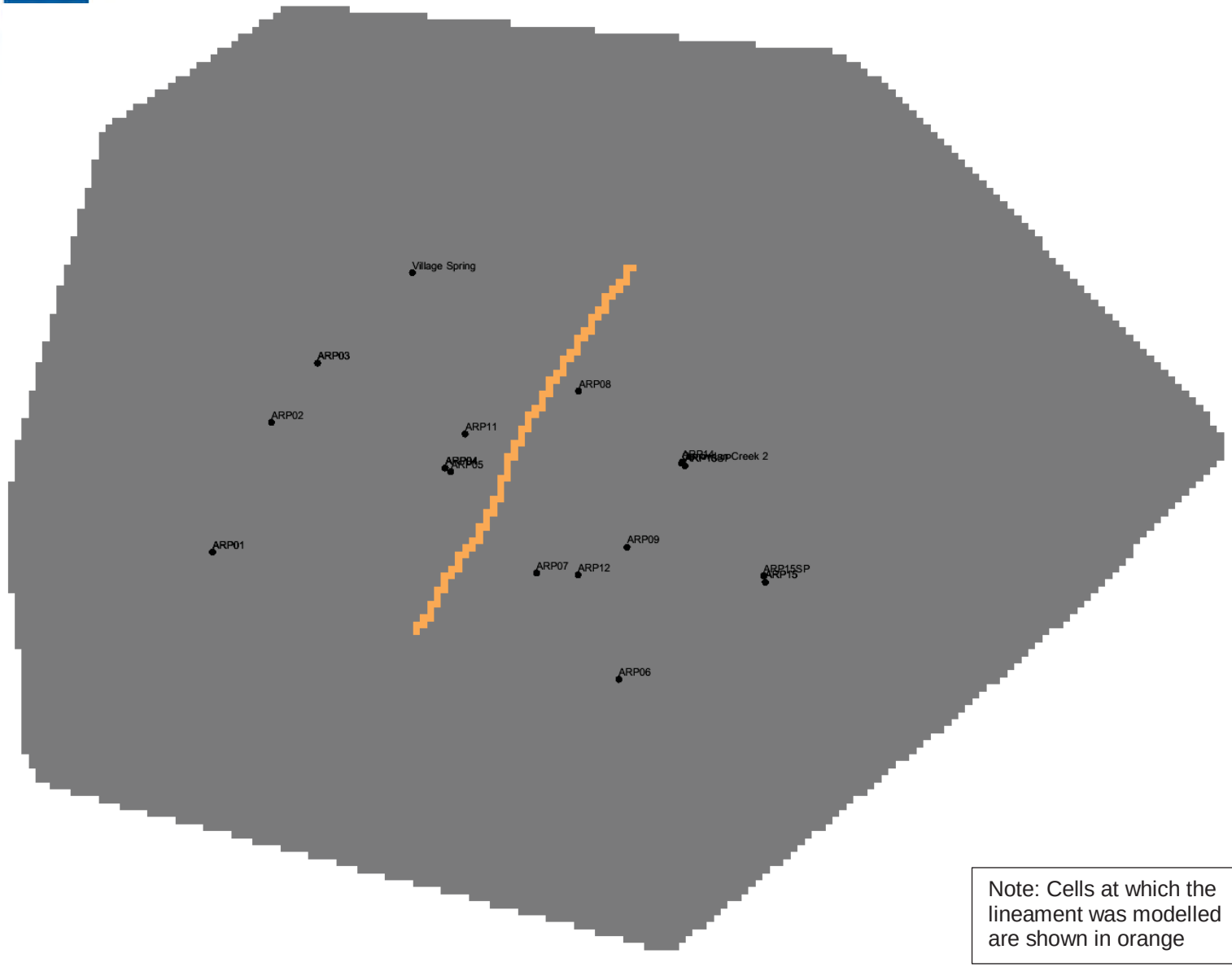


Figure 3-3 Modelled lineaments zone and groundwater monitoring locations

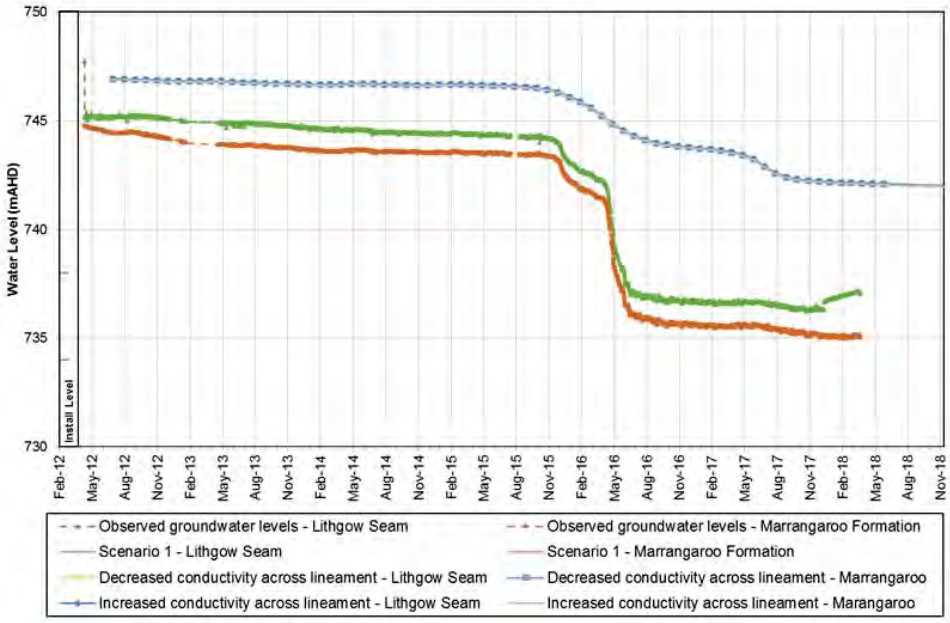


Figure 3-4 Modelled and observed groundwater levels – ARP04 Lithgow Seam and Marrangaroo Formation – lineaments scenario

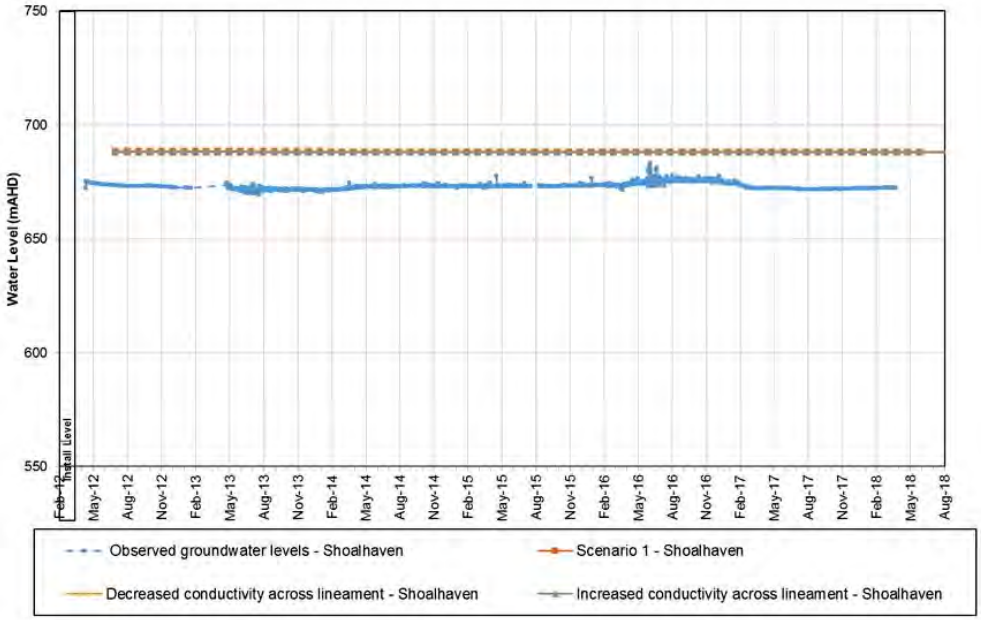


Figure 3-5 Modelled and observed groundwater levels – ARP04 Shoalhaven Group – lineaments scenario

3.3.2 Uncertainty analysis

Uncertainty analysis for hydrogeological model predictions has been undertaken with reference to the requirements of the *Information guidelines for proponents preparing coal seam gas and large coal mining development proposals* (IESC, 2018a) and the *Explanatory Note on Uncertainty Analysis in Groundwater Modelling* (IESC, 2018b).

IESC (2018b) outlines three general approaches to uncertainty analysis with respect to groundwater modelling and these, in order of increasing complexity and computational resource requirements, are: *'(1) scenario analysis with subjective probability, (2) deterministic modelling with linear probability quantification and (3) stochastic modelling with Bayesian probability'*.

The adopted approach for uncertainty analysis was 'scenario analysis with subjective probability'. The approach has been selected based on the outcomes of a risk assessment undertaken on the groundwater environment for Airly Mine facilitated by Centennial Airly in 2018. The risk of impact on the local and regional groundwater environment due to operation of Airly Mine is considered to be generally low as was also concluded in GHD (2014a). This assessment is based on the limited number of receptors (GDEs and landholder bores), the low connectivity between shallow alluvial groundwater environment and the coal seam and the adopted mining method (GHD, 2014a) and naturally low pressure heads and minimal mine inflow to date.

Based on the adopted methodology, five scenarios were considered as part of uncertainty analysis. In each of these scenarios, model parameters were varied. The hydrogeological model was run for each scenario under steady state and transient conditions. Parameters varied in each scenario are summarised below:

- Uncertainty run 1: rainfall recharge multiplied by 2. Rainfall recharge for this scenario was 6.58×10^{-5} m/day.
- Uncertainty run 2: hydraulic conductivity of coal and Marrangaroo multiplied by 2.
- Uncertainty run 3: hydraulic conductivity of Marrangaroo multiplied by 2, rainfall recharge increased to 1.7% of 90th percentile annual rainfall to 4.34×10^{-5} m/day, hydraulic conductivity of Lithgow Seam (Layer 8) coal increased by 4.
- Uncertainty run 4: model storage increased ×10, Scenario 2 fracture height, increased vertical and horizontal hydraulic conductivity of fracture area, increased rainfall recharge.
- Uncertainty run 5: model storage decreased ×10, Scenario 1 fracture height, reduced vertical and horizontal hydraulic conductivity of fracture area, reduced rainfall recharge.

Note that fracture height was maintained at the Scenario 1 level for uncertainty runs 1, 2 and 3. Rainfall recharge for the best fit model run and for uncertainty runs 2, 4 and 5 was 3.29×10^{-5} m/day.

Parameters to modify as part of the uncertainty analysis were selected with consideration of the likely sensitive model parameters. These parameters were determined based on experience and were subject to critique by the third party peer reviewer, as required by the NSW Aquifer Interference Policy (DPI, 2012). Model parameters were increased or decreased to provide a range of estimated groundwater inflows.

Model results were analysed to identify potential changes to predicted groundwater inflows. Calibration statistics were reviewed for each scenario. Calibration statistics were used to identify the likelihood of the selected parameters of each scenario occurring. Model calibration statistics are summarised in Table 3-1.

Table 3-1 Uncertainty analysis – model calibration statistics

Model run	Steady state calibration – Scaled Root Mean Squared Error	Transient calibration – Root Mean Squared Error (m)	Transient calibration – Scaled Root Mean Squared Error
Best fit model run	5.3%	10.5	4.1%
Uncertainty run 1	8.1%	21.7	8.4%
Uncertainty run 2	5.3%	11.2	4.3%
Uncertainty run 3	5.7%	12.4	4.8%
Uncertainty run 4	8.1%	21.8	8.4%
Uncertainty run 5	7.6%	16.52	6.2%

Uncertainty runs that include changing rainfall recharge and storage (run 1, run 4 and run 5) result in large changes in calibration statistics. The poor fit between model results and observed groundwater levels (indicated by the increased calibration error) as shown in Table 3-1, indicates that these parameters and associated groundwater inflow predictions are not realistic and are unlikely to occur.

Uncertainty runs that include modifying hydraulic conductivities (run 2 and run 3) result in calibration statistics that are similar to the best fit model run. The reasonable fit between model results and observed groundwater levels indicates that these model runs may provide a reasonable prediction of groundwater inflows from mining.

The modelled groundwater inflows for each of the uncertainty analysis runs have been compared with modelled groundwater inflows for the best fit model scenario and are shown in Figure 3-6. While run 1 and run 4 result in increased modelled groundwater inflows, the poor calibration statistics indicate parameters associated with these scenarios are not likely to occur.

As panel and pillar mining has not yet commenced at Airly Mine, it is difficult to verify the hydraulic properties of goaf areas. Continued monitoring of groundwater levels and mine inflows following the commencement of panel and pillar mining will provide monitoring data estimating hydraulic properties of goaf areas. Monitoring of the fracture height will be reviewed following extraction of the first four panels within the panel and pillar zone. Further recalibration of the model will be undertaken if required following review of this data.

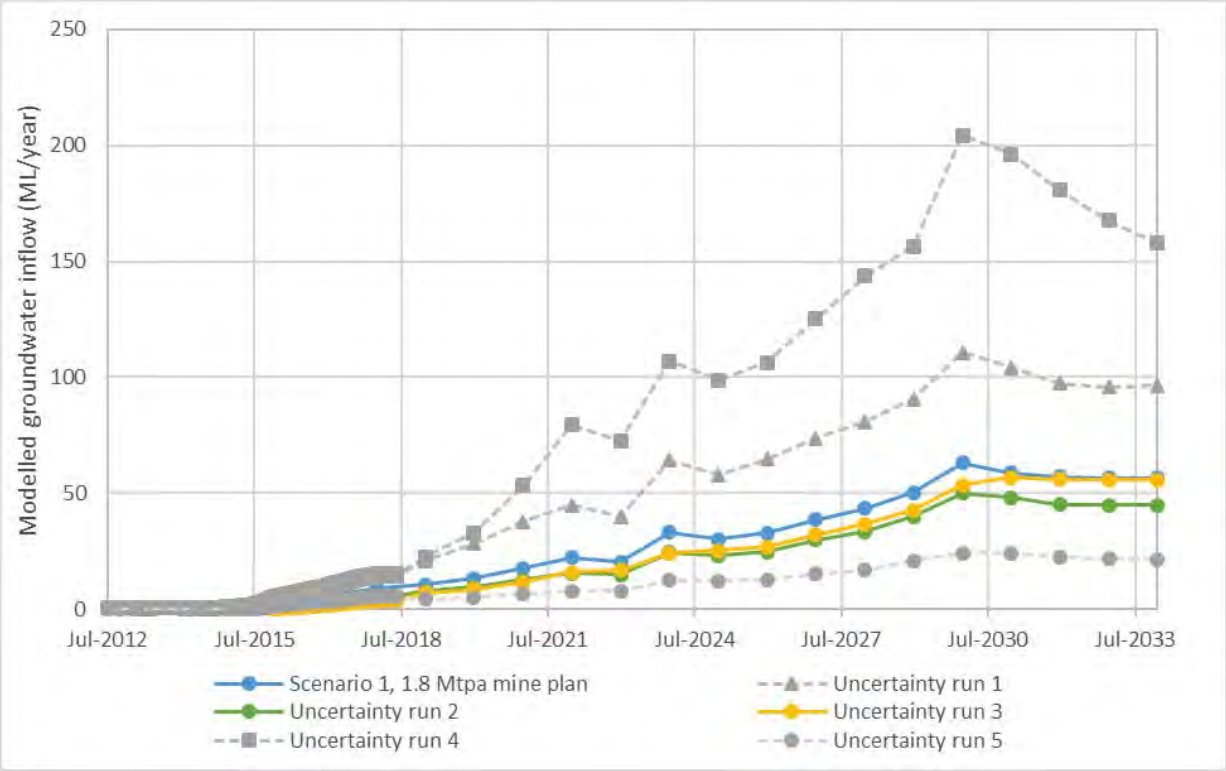


Figure 3-6 Modelled mine inflows – uncertainty analysis

3.4 Flow budget and inter-aquifer flow

The flow budget at final year of mining (year 2033) and the average flow budget over the period of mining (2014 to 2033) is presented in Table 3-2. The transient flow budget applies to Scenario 1 (best fit model).

Table 3-2 Transient flow budget

Condition	Zone	Inputs (ML/year)					Outputs (ML/year)				
		Recharge	GHB	Storage	Other zones	Total	Drains*	GHB	Storage	Other zones	Total
Average	All zones	503.5	226.9	26.6	–	756.9	440.8	315.7	4.1	–	760.6
	Alluvium	146.7	0.0	5.6	294.2	446.5	395.5	0.0	1.6	49.4	446.4
	Rock	356.8	226.9	21.0	49.4	654.0	45.3**	315.7	2.5	294.2	657.8
End of mining	All zones	503.5	227.0	48.2	–	778.7	462.3	315.5	0.9	–	778.7
	Alluvium	146.7	0.0	12.2	280.8	439.7	389.1	0.0	0.8	49.8	439.7
	Rock	356.8	227.0	36.0	49.8	669.6	73.2***	315.5	0.1	280.8	669.6

Note:
*Outputs from alluvium via drains is seepage to surface and baseflow. Outputs from rock via drains includes mine dewatering and baseflow/seepage to surface.
**Of average transfers from rock aquifers to drains, 28.5 ML/year is mine dewatering and 16.8 ML/year is baseflow.
***Of transfers from rock aquifers to drains, 56.4 ML/year is mine dewatering and 16.8 ML/year is baseflow.

4 Production bore

The Airly Mine Production bore (AM2B-1) was installed in 2009 within sandstone and siltstone of the Shoalhaven Group and granted approval for groundwater extraction through the production bore (WAL 24386 and water supply works approval 10WA112537) in 2011. An approval for an extraction rate of 158 ML/year or 5 L/s is based on a sustainable yield of the bore calculated from the pumping tests undertaken at the time of installation.

Recent drought conditions at Airly Mine and lower than predicted groundwater inflows into mine workings has increased reliance on the production bore to supplement process water supply. The volume of water extracted from the production bore is limited by water approvals to 5 L/s (158 ML/year), which is based on an ongoing extraction rate below the sustainable yield of the bore calculated from the pumping tests undertaken at the time of installation. However, the current average yield is less than 0.8 L/s, with the flow rate decreasing further over time. Due to the likely discontinuous nature of fracturing within the Shoalhaven geology group aquifer, it is likely that the existing location of the production bore intercepts a higher yielding, localised storage of groundwater. As this localised storage of groundwater formed over a considerable period, production bore use has incrementally reduced this localised storage. The reduced yield now experienced from the production bore is likely to be representative of the regional yield.

It is noted the utilisation of the production bore water to supplement Airly Mine's process water first commenced in 2017 when the water storage levels in onsite dams started to drop due to the onset of the current drought being experienced. In 2017, approximately 21.6 ML of water was extracted from the production bore. In 2018, approximately 38.6 ML of water was extracted from the production bore.

Investigations to assess the reliability of the production bore as a supplementary source of process water suggest that it is unlikely that flow rates will increase to a point that was nominated on the water supply works approval 10WA112537. Given the declining trend in yield, the Shoalhaven Group groundwater source is not currently considered to be a reliable source of water.

5 Conclusions and recommendations

A three-dimensional numerical groundwater flow model of Airly Mine has been developed using industry standard MODFLOW-NWT code. The model has been updated and recalibrated to include additional monitoring data collected at the site since the previous model revision. The model simulates the essential features of the hydrogeological system of the mine including the key hydrostratigraphic units, recharge and discharge mechanisms and spatial and temporal distribution of piezometric heads. The calibrated model parameters are generally consistent with packer testing and falling head testing undertaken at the site and with other sites at within the Lithgow region.

The calibrated model is considered to have the characteristics predominantly of Class 2 confidence level (i.e. moderate confidence), with elements of Classes 1 and 3, in accordance with the confidence level classification of the Australian Groundwater Modelling guidelines (AGMG) (Barnett et al, 2012). A comparison of the calibrated model and the AGMG confidence level classifications is shown in Appendix D. This level of confidence is considered to be appropriate based on the low level of risk of impact of Airly Mine operations to the local and regional groundwater environment. Specific indicators of Class 2 confidence level includes future mining (predictive) period (14 years) of no greater than 10 times the calibration period (6 years). Model confidence would be lower in areas where model calibration would be considered deficient and for predictions of far future conditions post-mining, where the groundwater system slowly recovers towards a new dynamic equilibrium over potentially many tens to hundreds of years. While the existing mining at Airly Mine has provided transient data that provides a sensible basis for projecting potential future effects of mining, there are potential unknowns regarding potential changes of hydrogeological parameters of strata above the panel mining area.

The confidence in model predictions would be improved by ongoing data collection and revision of the numerical model. Predictions of mining-induced effects depend on the monitoring network capturing the stress-response relationship.

It is recommended that surface water and groundwater monitoring continues at Airly Mine. It is recommended that monitoring data continues to be reviewed. Review of monitoring data will allow opportunities to verify model predictions. Model recalibration may be required if observations vary significantly from model predictions.

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Sincerely
GHD

Stuart Gray
Senior Hydrogeologist
+61 2 4979 9017

Appendix A

Hydrological conceptualisation and model calibration

A.1 Hydrological conceptualisation

Rainfall

Daily rainfall data were obtained as SILO Patched Point Data from the Queensland Climate Change Centre of Excellence. SILO Patched Point Data is based on historical data from a particular Bureau of Meteorology (BOM) station with missing data 'patched in' by interpolating with data from nearby stations.

For this assessment, SILO data was obtained for BOM Ilford (Warrangunyah) Station (station number 62031), which is located approximately 29 km north-west of Airly Mine. This station was chosen based on the length and quality of the data record and proximity to the site.

The period of rainfall data used for this assessment extended from January 1901 to May 2018 and is summarised as annual totals in Figure A-1.

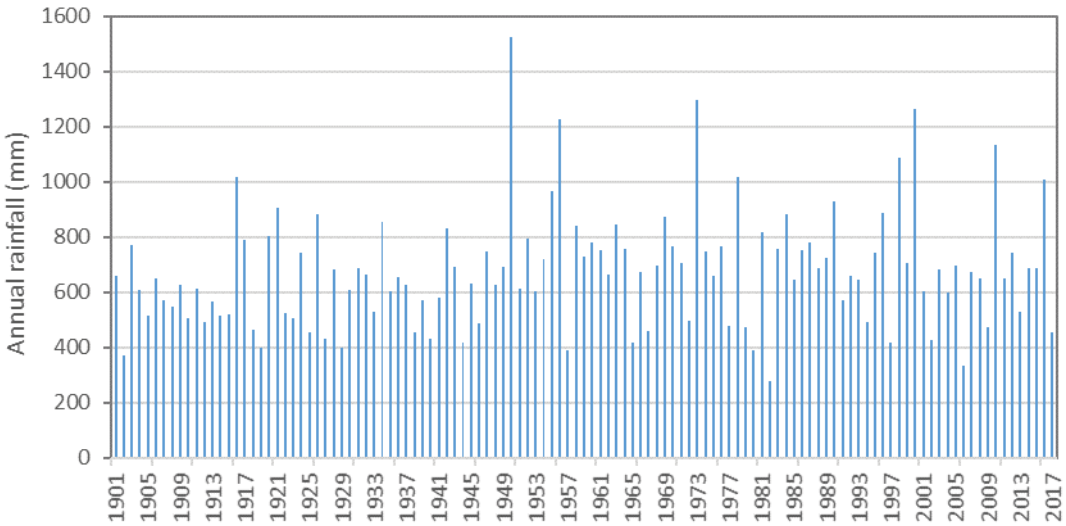


Figure A-1 Annual rainfall recorded at Illford (Warrangunyah) Station

The SILO dataset from the BOM Ilford (Warrangunyah) Station was also used to generate a cumulative rainfall departure (CRD) curve over the period from 1901 to 2018. A portion of the CRD curve, from the year 2000 to 2018, is presented in Figure A-2. A CRD curve is the monthly accumulation of the difference between the observed monthly rainfall and long-term average monthly rainfall. Any increase in the CRD curve reflects above average rainfall while a decrease in CRD curve reflects below average rainfall. The CRD curve only deviates from zero due to atypical (above and below average) rainfall. The CRD curve was generally reducing between 2012 and 2015 with CRD generally increasing during 2016 and again reducing since 2017.

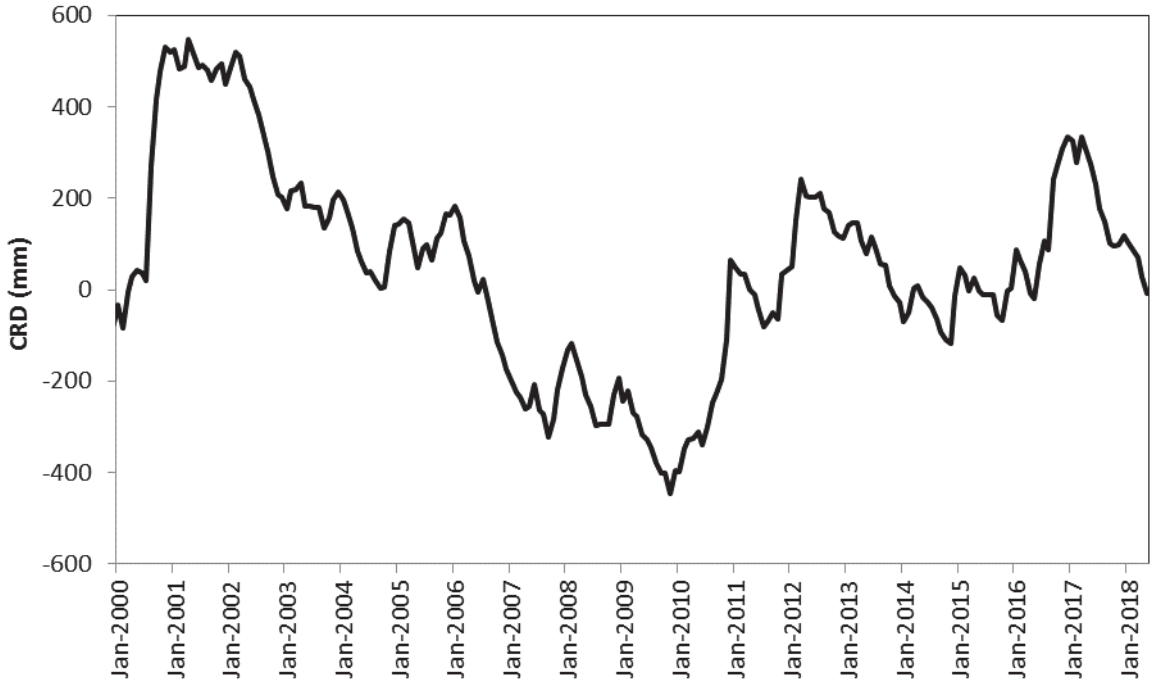


Figure A-2 Cumulative rainfall departure curve

Hydrology

Watercourses within and in the vicinity of the Development Consent Area include four major sub-catchment areas:

- The Torbane-Oaky Creek sub-catchment.
- The Airly-Coco Creek sub-catchment.
- The Emu Swamp Creek sub-catchment.
- The Gap-Genowlan Creek sub-catchment.

All sub-catchments drain into the Capertee River which flows in a south-easterly direction and is a tributary of the Colo River, which ultimately flows into the Hawkesbury River and Broken Bay.

The Gap-Genowlan Creek sub-catchment occupies the largest portion of the Development Consent Area with 1,558 ha draining to the creek system.

Figure A-3 and Figure A-4 presents hydrographs of surface water depth at Gap Creek and Genowlan Creek respectively. The hydrographs indicate a behaviour typical of ephemeral creek systems, with the surface water level increasing following episodic rainfall events and effectively falling to zero during dry periods when there is insufficient rainfall and runoff to maintain surface water flow.

The streamflow data do not show any continuous baseflow from a permanent water table but rather indicates that baseflow would generally be short in duration following rainfall events and characteristic of unsaturated, perched flow conditions.

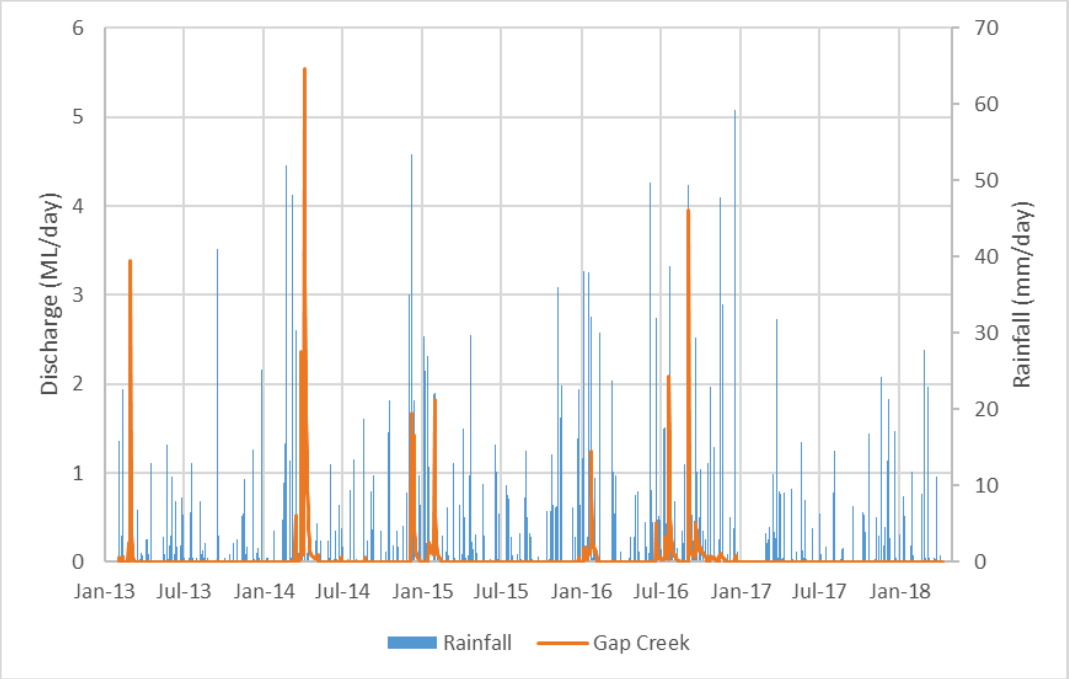


Figure A-3 Rainfall and streamflow data for Gap Creek

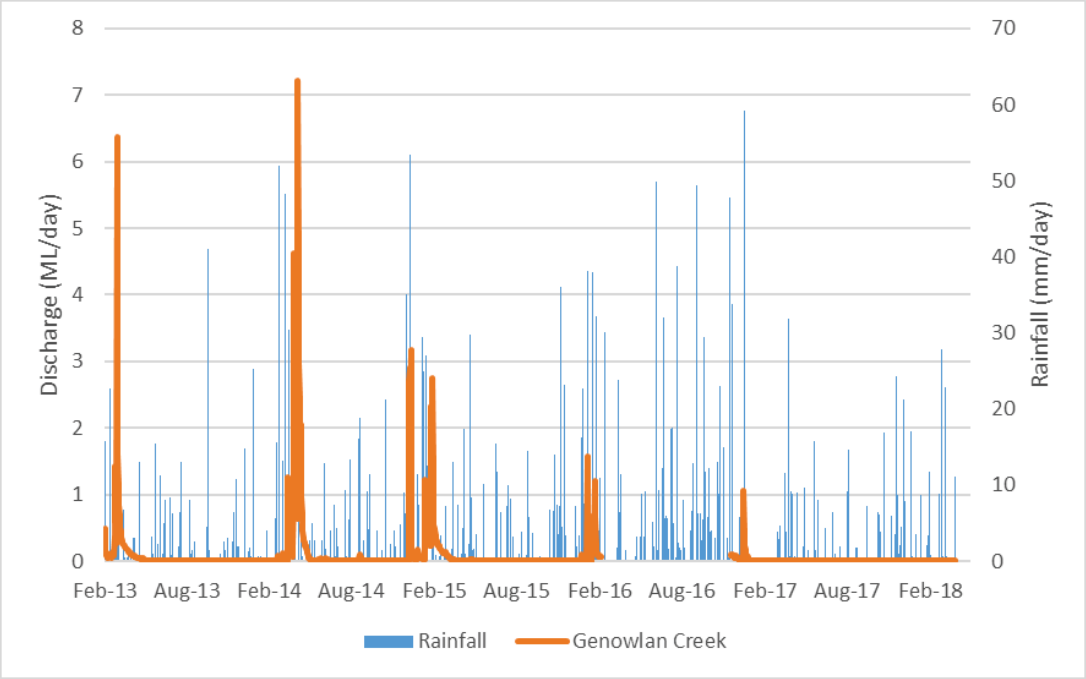


Figure A-4 Rainfall and streamflow data for Genowlan Creek

Hydraulic properties

Results of Packer testing and falling head testing reported by RPS (2013) indicate the following hydraulic conductivities:

- Narrabeen Sandstone: 0.002–0.15 m/day (based on two packer tests at ARP01, one packer test at ARP02A and one falling head test at ARP03A).
- Lithgow Seam: 0.02–0.08 m/day (based on packer tests at ARP01 and ARP04 and falling head tests at ARP02A and APR03A).

Packer testing reported by GHD (2014) indicates the following hydraulic conductivities:

- Narrabeen Sandstone: 0.00015 m/day (ARP06).
- Lithgow Seam: 0.07 m/day (ARP06).

Additional packer testing undertaken by Highland Drilling and GHD in December 2016 and reported in GHD (2016) indicated the following hydraulic conductivities:

- Marrangaroo Formation: 0.027 m/day (ARP13).
- Upper Shoalhaven Group: 0.0027 m/day (ARP13).

No field testing to estimate aquifer storage properties has been undertaken.

Groundwater flow systems

The groundwater monitoring network at Airly Mine primarily targets the localised low yielding groundwater sources within the Quaternary alluvium, weathered and/or fractured sandstone and coal seams that occur within Mount Airly and Genowlan Mountain above the target seam. Some monitoring of the regional groundwater system beyond the outcrop of the target seam is undertaken.

Groundwater monitoring network

Groundwater level data are available from standpipe monitoring bores and vibrating wire piezometers (VWPs) constructed at Airly Mine. Existing groundwater monitoring location details are summarised in Table A-1 and locations are shown in Figure A-5.

Table A-1 Groundwater monitoring locations

Monitoring type	Location name	Period of data	Ground level (m AHD)	Lithology
VWP	ARP01	June 2012–present Data logger stopped recording values for the Narrabeen Sandstone in December 2015	1027.96	Narrabeen Sandstone (74 m bgl)
				Irondale Seam (238.5 m bgl)
				Lithgow Seam (260 m bgl)

Monitoring type	Location name	Period of data	Ground level (m AHD)	Lithology
				Marrangaroo Formation (263 m bgl)
	ARP02A	May 2012–present	1022.68	Narrabeen Sandstone (65 m bgl)
				Irondale Seam (243 m bgl)
				Lithgow Seam (266 m bgl)
				Marrangaroo Formation (270 m bgl)
	ARP03A	July 2012–present	1001.66	Narrabeen Sandstone (136 m bgl)
				Middle River Seam (165 m bgl)
				Lithgow Seam (252 m bgl)
				Marrangaroo Formation (257 m bgl)
	ARP04	April 2012–present	762.66	Lithgow Seam (25 m bgl)
				Marrangaroo Formation (28.5 m bgl)
				Shoalhaven Siltstone (210.3 m bgl)
	ARP06	June 2013–present	1028.5	Narrabeen Sandstone (230 m bgl)
				Irondale Seam (252 m bgl)
				Lithgow Seam (288 m bgl)

Monitoring type	Location name	Period of data	Ground level (m AHD)	Lithology
				Marrangaroo Formation (295 m bgl)
	ARP07	July 2013–present	992.6	Middle River Seam (168 m bgl)
				Lithgow Seam (252 m bgl)
	ARP08	September 2013–present	1027.7	Narrabeen Sandstone (183 m bgl)
				Irondale Seam (282.5 m bgl)
	ARP13	December 2016–present [1]	785.6	Shoalhaven Group (120 m bgl)
				Devonian strata (280 m bgl)
	ARP15	January 2017– present [1]	846.7	Lithgow Seam (125 m bgl)
				Shoalhaven Group (200 m bgl)
				Devonian strata (365 m bgl)
Bore/standpipe	AM2B-1	2009–present (quality only)	Unknown	Shoalhaven Group (38–87 m bgl)
	ARP05	August 2012–present	757.22	Gap Creek alluvium (8–11 m bgl)
	ARP07	July 2013–present (dry)	992.6	Narrabeen Sandstone (110–119 m bgl)
	ARP08	September 2013–present	1027.7	Lithgow Seam (301–305 m bgl)

Monitoring type	Location name	Period of data	Ground level (m AHD)	Lithology
	ARP09	June 2013–present (mostly dry)	856.86	Genowlan Creek alluvium (3–4 m bgl)
	ARP11	January 2017– present	750.92*	Permian strata (1.25–15.3 m bgl)
	ARP12	January 2017– present	895.185*	Genowlan Creek alluvium (0.5–2.6 m bgl)
	ARP13SP	January 2017– present	785.74*	Lithgow Seam (67.5–70.5 m bgl)
	ARP14	January 2017– present	783.944*	Genowlan Creek alluvium (0.5–2.3 m bgl)
	ARP15SP	January 2017– present	847.525*	Narrabeen Sandstone (10–16 m bgl)
	Nioka	2013, January 2018 – present (quality only)	Unknown	Permian strata
Seepage	Village Spring	February 2011–present	Unknown	Permian Siltstone
	Mine workings	December 2009–present	N/A	Lithgow Seam

*Elevation for ARP11, ARP12, ARP13SP, ARP14 and ARP15SP is the top of casing elevation

Vibrating wire piezometers

Piezometric head data for VWPs for selected hydrographs utilised as part of model recalibration are shown in Appendix B. Only those VWPs recording positive pressure have been plotted. Generally there is minimal variability in piezometric head over the monitoring period. Groundwater monitoring data for all VWPs and standpipe monitoring bores is shown in Appendix C. Where mining has approached certain monitoring locations, this has been indicated on the hydrographs.

Piezometric pressure is generally low and stable at the existing VWP monitoring locations, generally ranging from 0 m to 10 m above the measuring point elevation. The low piezometric pressure is considered to reflect the extensive groundwater seepage/drainage area across the slopes of Mount Airly and Genowlan Mountain.

Decreasing piezometric pressure associated with mining in the Lithgow Seam was observed within the Lithgow Seam and the Marrangaroo Formation at one location (ARP04) during late 2015 and during 2016 (GHD, 2017). Piezometric pressure was observed to fall approximately 7 m at ARP04 in the Lithgow Seam and the Marrangaroo Formation between December 2015 and May 2016. Observed drawdown within Permian strata is consistent with EIS predictions (GHD, 2014). No other groundwater drawdown attributable to mining operations has been observed.

Standpipe monitoring bores

Groundwater hydrographs utilised as part of transient calibration are presented in Appendix B. Groundwater hydrographs for all VWPs and standpipe monitoring bores are presented in Appendix C. Groundwater hydrographs presented in Appendix C have been plotted with the rainfall CRD curve.

Groundwater hydrographs indicate that ARP05 installed in the Gap Creek Alluvium, and ARP09 and ARP12 installed within the Genowlan Creek alluvium are generally dry. Groundwater levels at these alluvial monitoring bores show response to periods of above average rainfall.

Review of groundwater levels at ARP05 indicates a generally decreasing trend between the commencement of monitoring in 2012 and 2016. Mining at Airly Mine under the Gap Creek catchment commenced in 2015. Statistical analysis indicated that the decreasing trend in groundwater level at ARP05 commenced prior to mining in the Gap Creek catchment commencing. Therefore, although the decreasing trend in groundwater level at ARP05 may have some contribution from mining, it is also a continuation of pre-mining trends.

Groundwater levels at ARP14, installed in the Genowlan Creek alluvium, have remained relatively constant over the period of monitoring.

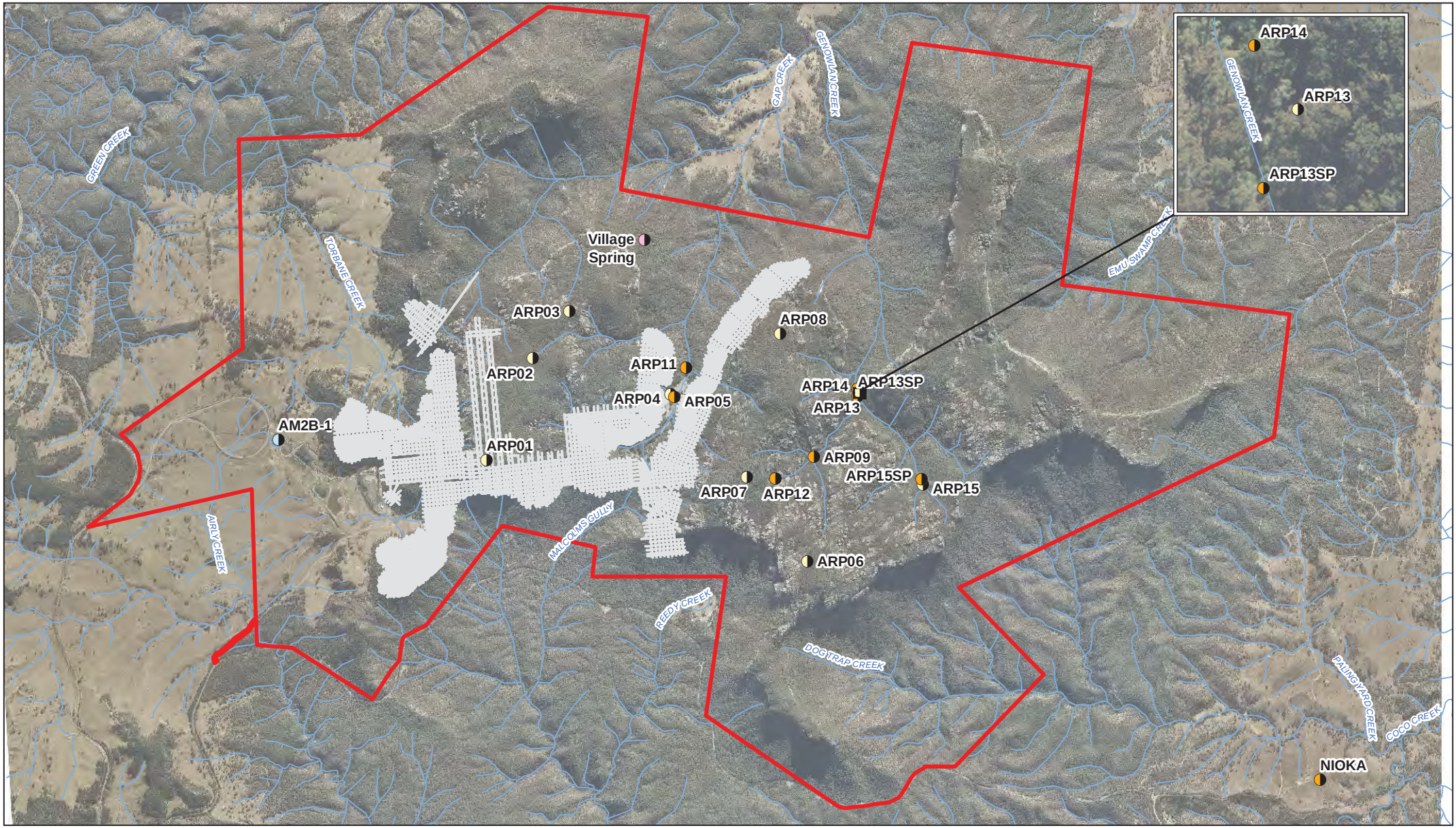
Groundwater levels at ARP11, installed in the shallow strata near the Gap Creek alluvium shows a generally decreasing trend throughout 2017 and early 2018. This decreasing trend is potentially related to generally below average rainfall over the monitoring period. Groundwater levels at ARP11 appear to generally fluctuate by up to 0.1 m following rainfall events, with a fluctuation in groundwater level of approximately 0.5 m following rainfall in February 2017.

Groundwater levels at ARP13SP, installed in the Lithgow Seam, have been very constant over the monitoring period. Groundwater levels at ARP15SP, installed in the Narrabeen Sandstone, were generally decreasing between the commencement of monitoring in January 2017 and November 2017. Groundwater levels at ARP15SP displayed a response to rainfall with groundwater levels varying up to approximately 2.5 m during late 2017 and during 2018.

Groundwater flow directions

Groundwater flow directions in the area of Airly Mine have been interpreted from contours of piezometric heads presented in Figure A-6, Figure A-7 and Figure A-8. The contours are presented separately for the Lithgow Seam, Marrangaroo Formation and the Shoalhaven Group using monitoring data from standpipe bores and VWPs installed in each of these formations. The groundwater level data from 2017 have been used to generate the contours to take advantage of data collected from monitoring locations installed in late 2016 and early 2017. The figures can be considered an approximately synchronous dataset, providing a snapshot of the piezometric surface in 2017.

The contours of the piezometric surface indicate that the groundwater flow direction within the Lithgow Seam, Marrangaroo Formation and Shoalhaven Group is from the west to the east. It should be noted that the eastern extent of the localised groundwater sources within the Lithgow Seam and Marrangaroo Formation is bound by the seepage areas in the vicinity of the seam outcrop. Hence, groundwater within these formations is not hydraulically connected to the regional groundwater to the east of the Development Consent boundary utilised by private landholders.



Paper Size A4

0 200 400 800 1,200 1,600

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Groundwater seepage
- Production bore
- Standpipe monitoring bore
- Vibrating wire piezometer
- Existing workings
- Project Approval Area SSD_5581
- Waterway

Airly Mine
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Groundwater monitoring network

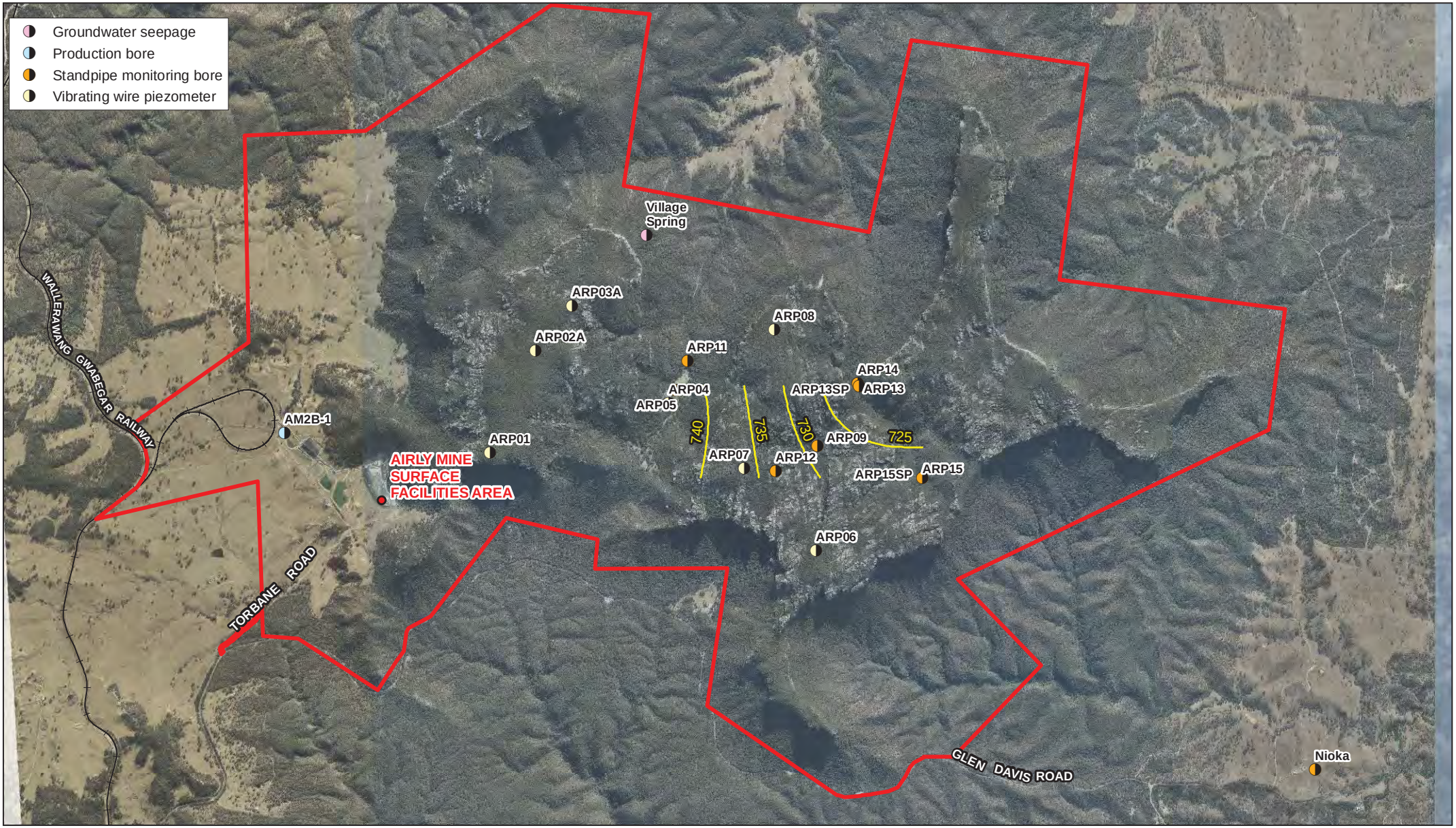
Figure A-5

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Airly Surface Facilities Area
- Railway
- Measured Piezometric Contour (m AHD)
- Project Approval Area_SSD_5581

Centennial Airly

Airly Mine
Airly Mine Mod 2
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Date 10 Apr 2019

Measured Piezometric Contours Lithgow Seam

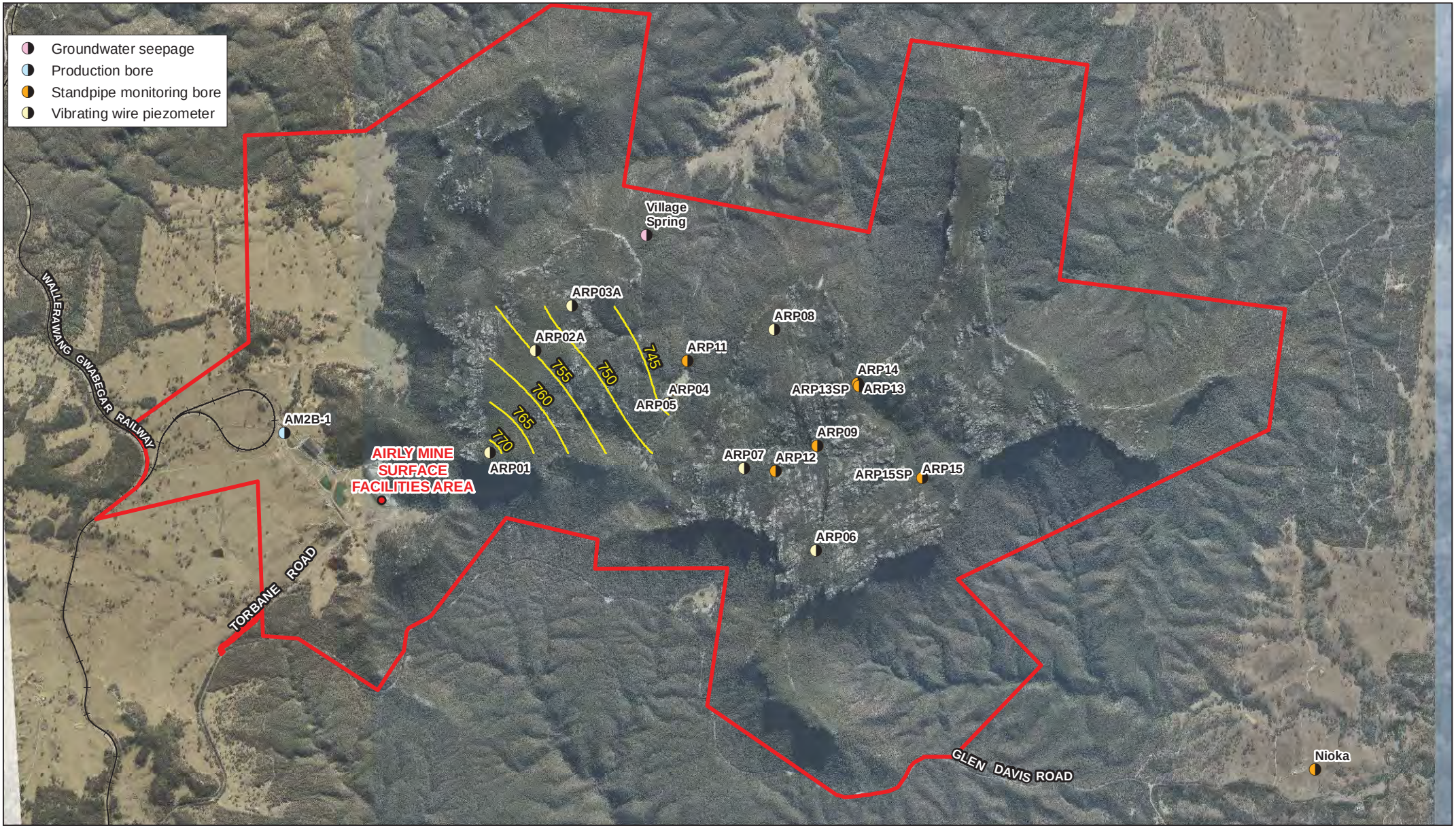
Figure A-6

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Data source: LPI: DTDB 2012; Centennial: Aerial Imagery, boundaries, 2013, GHD: groundwater contours, 2017. Created by: igilmore



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Airly Surface Facilities Area
- Railway
- Project Approval Area_SSD_5581

Centennial Airly

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Measured Piezometric Contours Marrangaroo Formation

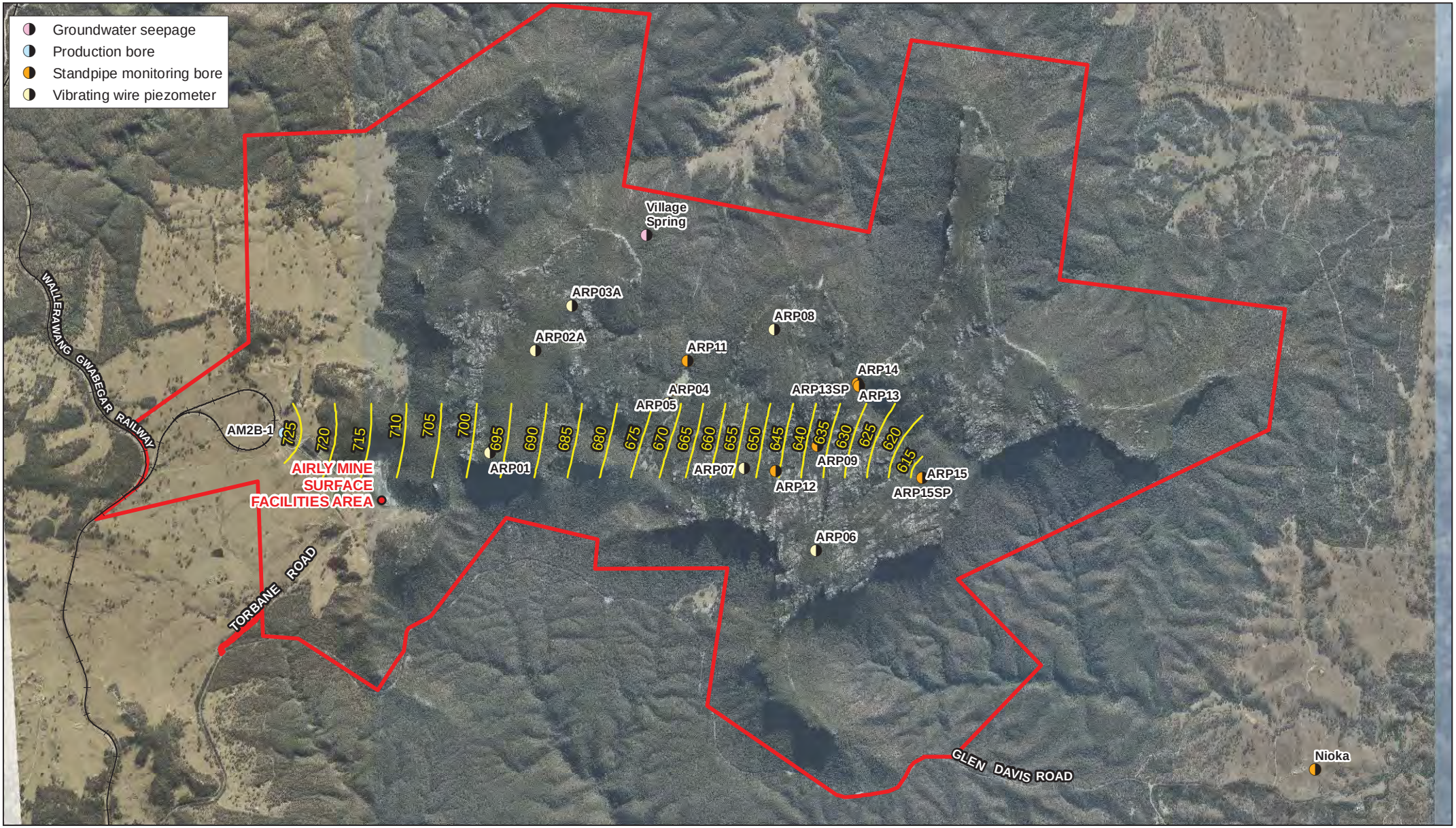
Figure A-7

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Data source: LPI: DTDB 2012; Centennial: Aerial Imagery, boundaries, 2013, GHD: groundwater contours, 2017. Created by: igilmore



Paper Size A4

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Airly Surface Facilities Area
- Railway
- Measured Piezometric Contour (m AHD)
- Project Approval Area_SSD_5581

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Revision 0
Date 10 Apr 2019

Measured Piezometric Contours Shoalhaven Group

Figure A-8

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Data source: LPI: DTDB 2012; Centennial: Aerial Imagery, boundaries, 2013, GHD: groundwater contours, 2017. Created by: igilmore

Groundwater seepage

The rate of seepage of groundwater from the Permian strata at Village Spring has been monitored since February 2011. A plot of the daily flow rate at Village Spring is shown in Figure A-9. It is reported by Centennial Airly that the seep at Village Spring is fed by drainage from the old shale workings.

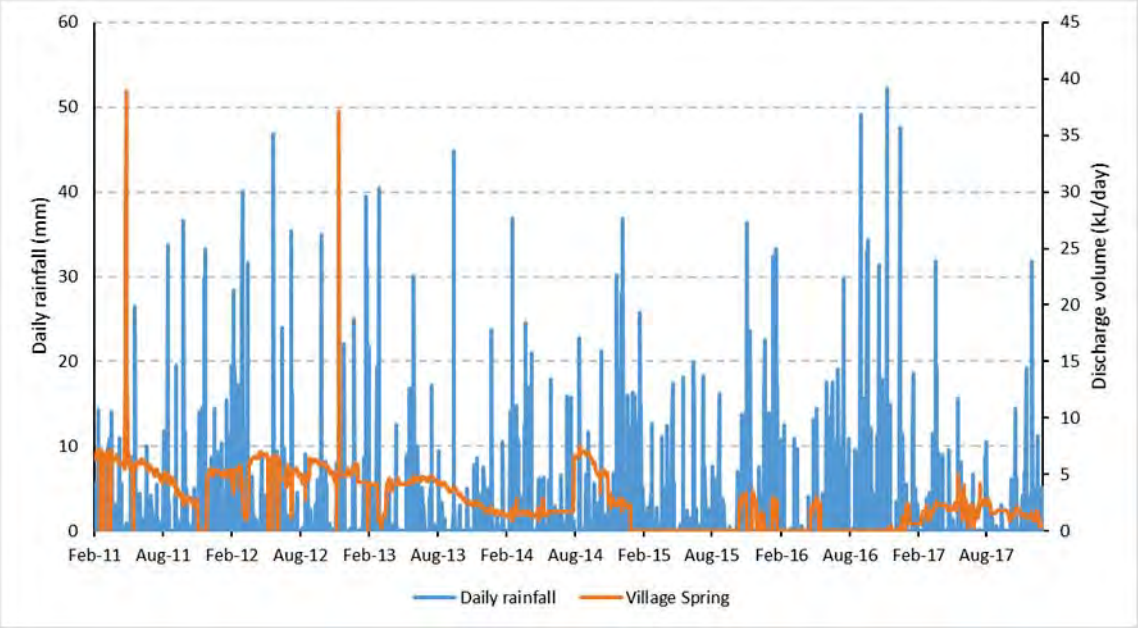


Figure A-9 Recorded flows at Village Spring

A.2 Model recalibration

Model construction

Model construction details for the original model are outlined in Section 5 of GHD (2014). The original model included 10 layers. As part of the previous model update undertaken in 2017 (refer to Section 1), layer 10 (Shoalhaven Group) was split into three layers (equal thickness through each column of the grid) to improve the fit between observed and modelled levels for the Shoalhaven Group and Devonian strata.

Model layers and top and base elevations are outlined in Table A-2. The elevation of layers in the model is based on geological data provided by Centennial Airly.

Table A-2 Model layers

Layer	Description	Top	Base
1	Shallow zone/alluvium	Topographic contours	Topographic contours – 10 m
2	Narrabeen Sandstone	Topographic contours – 10 m	Lithgow Seam roof + 75 m
3	Permian Interburden	Lithgow Seam roof + 75 m	Lithgow Seam roof + 25 m
4	Irondale Seam	Lithgow Seam roof + 25 m	Lithgow Seam roof + 23 m
5	Permian Interburden	Lithgow Seam roof + 23 m	Lithgow Seam roof + 3 m
6	Irondale Seam	Lithgow Seam roof + 3 m	Lithgow Seam roof + 1 m
7	Permian Interburden	Lithgow Seam roof + 1 m	Lithgow Seam roof elevation data
8	Lithgow Seam	Seam elevation data	Seam elevation data
9	Marrangaroo Formation	Lithgow Seam floor elevation data	Lithgow Seam floor – 5 m
10-12	Shoalhaven Group	Lithgow Seam floor – 5 m	450 m AHD

Model recalibration

Model calibration involves changing the values of model parameters within realistic bounds until the model outputs fit historical measurements, such that the model can be accepted as a reasonable representation of the physical system of interest (Barnett et al. 2012). Recalibration of the hydrogeological model was initially undertaken manually under steady state conditions.

The primary calibration targets are observed groundwater levels (heads). Calculated water levels from VWPs with negative water pressures were not used in calibration.

The calibrated steady state heads were used to define the initial conditions for the transient model.

Steady state recalibration results

Steady state recalibration was undertaken through trial and error. Approximately 50 runs have been undertaken as part of this assessment and in GHD (2017).

The lowest scaled root mean square error (SRMSE) obtained (using realistic material properties) for a converging steady state run was 5.3%. The RMS for this model run was 13.6 m. Hydrogeological properties from the best fit steady state run are summarised in Table A-3. These hydraulic conductivity values are generally in the range of or similar order of magnitude to the field measured values outlined in Section A.1.

Parameters that required the most changes during calibration were GHBs and hydraulic conductivity of the Shoalhaven Group, and hydraulic conductivity of the Marrangaroo Formation and Narrabeen Sandstone. GHBs were assigned with Layer 10, 11 and 12 of the model based on groundwater levels at the production bore and groundwater level data from the monitoring bores. GHBs were varied (both up and down) during recalibration.

Table A-3 Hydrogeological properties after steady state calibration

Hydrogeological unit	Model layers	Horizontal hydraulic conductivity (K_h) (m/day)	Vertical hydraulic conductivity (K_v) (m/day)
Shallow zone	Layer 1	0.0548	0.00548
Alluvium	Layer 1	2	0.2
Narrabeen Sandstone	Layer 2	0.0011	0.00011
Coal seams	Layer 4, 6 and 8	0.0548	0.00548
Permian siltstone	Layer 3, 5 and 7	0.00019	0.000019
Marrangaroo Formation	Layer 9	0.0137	0.00137
Shoalhaven Group	Layer 10 and 11	0.00137	0.000137
Deep Shoalhaven Group	Layer 12	0.0548	0.00548

A scatterplot of modelled groundwater levels (best fit steady state run) versus observed levels is shown in Figure A-10. Locations that are dry or have negative water pressure were not utilised in model recalibration and therefore have not been included in the plot.

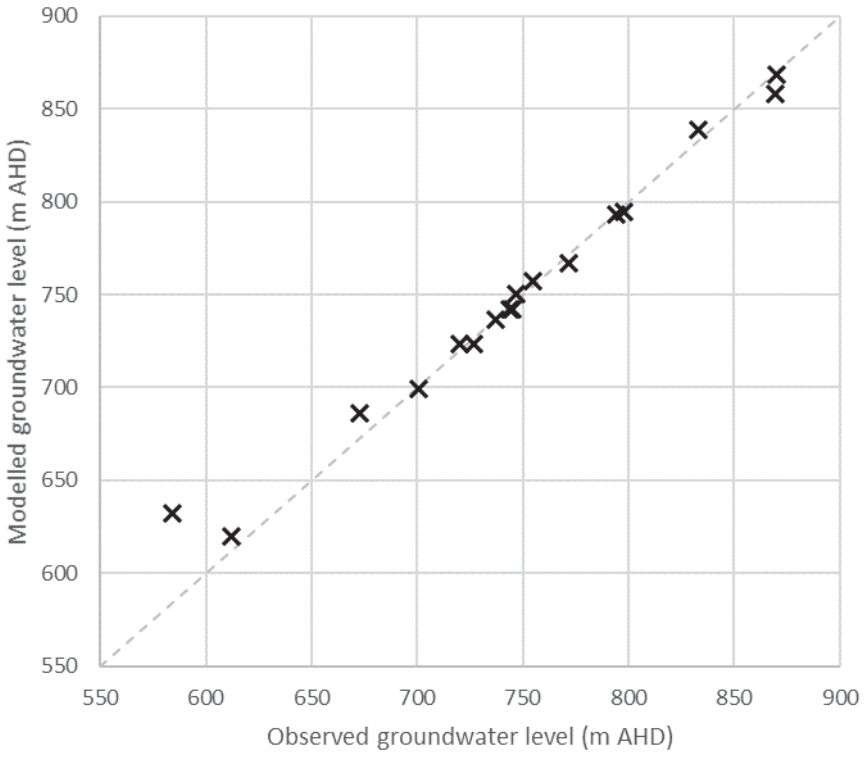


Figure A-10 Steady state calibration scatterplot

The outlier shown in Figure A-10 occurs at ARP13 in the Devonian strata. Modelled groundwater levels in the Devonian are partially controlled by GHB values. GHB values in the Devonian have been set with reference to GHB values in the overlying Shoalhaven group and with reference to observed levels at installations in the Devonian (ARP13 and ARP15). It was not possible to achieve a reasonable fit at both ARP13 and ARP15 without having GHB values that did not match the conceptual model. Therefore GHB values were maintained within the range of expected values which resulted in the poor fit at ARP13 in the Devonian strata.

Steady state flow budget and inter-aquifer flow

The steady state flow budget is shown in Table A-4. Flow budgets have been calculated for the entire model domain (all zones), alluvium and for the porous and fractured rock aquifers only. The model indicates that there is a net inflow of groundwater from the porous and fractured rock aquifer to the alluvium of approximately 188 ML/year under steady state conditions.

Table A-4 Steady state flow budget

Model zone	Inputs (ML/year)				Outputs (ML/year)			
	Net Recharge	GHB*	Other Zones	Total	Seepage to surface	GHB*	Other Zones	Total
All zones	503.5	132.3	–	635.8	421.5	214.5	–	636.0
Alluvium	146.7	113.3	259.6	519.6	415.2	34.2	71.2	520.6
Porous and fractured rock	356.8	19.0	71.2	447.1	6.3	180.3	259.6	446.2

***** General head boundary

Transient model setup and calibration

The steady state model was converted into a transient model and was initially run from 2011 to 2018 using monthly stress periods and actual rainfall data. The modelled best fit steady state groundwater levels were used as the starting head levels for the transient model. Drain cells were established within Layer 8 to coincide with the development of existing workings within the Lithgow Seam between 2011 and 2018. It is noted that panel extraction has not yet commenced at Airly Mine and therefore no fracturing was applied during the calibration period.

Storage parameters, hydraulic conductivity values and the net recharge coefficient were varied to achieve a best fit between observed hydrographs and modelled groundwater levels. Groundwater inflows into the existing workings (low and not measureable to date) were also considered a calibration target. Calibrated hydrogeological model properties are presented in Table A-5. Spatially uniform values for storage parameters and hydraulic conductivity were applied throughout the model. Rainfall recharge was applied uniformly across Layer 1 of the model. Best fit hydraulic conductivity values from transient calibration are generally the same as for steady state calibration with the exception of the value for the deep Shoalhaven Group.

The lowest SRMSE obtained (using realistic material properties) for a converging transient run was 4.1%. The RMS for this run was 10.5 m.

Drain conductance for drains simulating the mine workings was required to be lowered to improve the fit between modelled and observed groundwater inflow into the mine workings. Drain conductance was lowered to 0.02 m^2/day.

A scatterplot of modelled groundwater levels (best fit transient run) versus observed levels is shown in Figure A-11. Locations that are dry or have negative water pressure were not utilised in model recalibration and therefore have not been included in the plot.

A total of 580 calibration targets were used. Transient calibration targets included monthly monitoring data from four standpipe monitoring bores and 13 VWPs at seven locations. Between 10 and 68 data points were used as transient calibration targets at each monitoring point depending on the length of the monitoring dataset available.

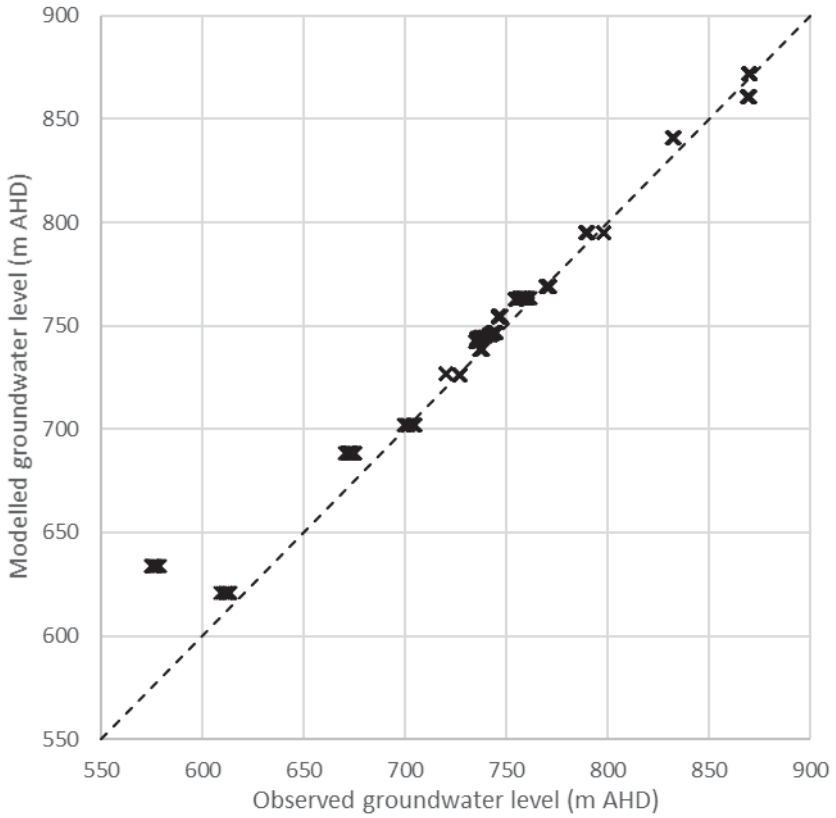


Figure A-11 Transient calibration scatterplot

The transient calibration scatterplot indicates that the fit between modelled and observed levels at ARP13 in the Devonian strata continue to be an outlier. At the majority of bores the model tends to slightly overestimate groundwater levels.

Table A-5 Calibrated model properties

Hydrogeological unit	Model layer	Horizontal hydraulic conductivity (K_h) (m/day)	Vertical hydraulic conductivity (K_v) (m/day)	Specific yield (unitless)	Specific storage (1/m)
Shallow zone	Layer 1	0.05479	0.005479	0.05	–
Alluvium	Layer 1	2	0.2	0.2	–
Narrabeen Sandstone	Layer 2	0.0011	0.00011	0.2	0.0001
Coal seams	Layer 4, 6 and 8	0.0548	0.00548	0.001	0.00001

Hydrogeological unit	Model layer	Horizontal hydraulic conductivity (K_h) (m/day)	Vertical hydraulic conductivity (K_v) (m/day)	Specific yield (unitless)	Specific storage (1/m)
Permian siltstone	Layer 3, 5 and 7	0.00019	0.000019	0.001	0.00001
Marrangaroo Formation	Layer 9	0.0137	0.00137	0.001	0.00001
Shoalhaven Group	Layer 10 and 11	0.00137	0.00003	0.001	0.00001
Deep Shoalhaven Group	Layer 12	0.0137	0.0003	0.001	0.00001

Calibration hydrographs for selected monitoring locations are presented in Appendix B. Hydrographs indicate the model is slightly underestimating drawdown due to mining at ARP04 (in terms of magnitude and rate) within the Lithgow Seam and the Marrangaroo Formation. The modelled levels at ARP04 depressurise over approximately 18 months compared to the relatively sudden observed depressurisation at ARP04. It should be noted that the drawdown observed at ARP04 is within predicted levels approved under development consent SSD_5581.

Updates to the model as part of recalibration included modifying hydraulic conductivity of alluvium and varying rainfall recharge in the alluvium. The model had issues with convergence when rainfall recharge to the alluvium was varied to match the extremes in rainfall (long dry periods followed by short, intense wet events). The model currently underestimates the decreasing trend at ARP11 and does not replicate the short term variation in groundwater level at ARP15 following above average rainfall events as shown in Appendix B.

To investigate the cause of the modelled decreasing trend in groundwater levels at ARP11, a no mining model run was undertaken for the calibration period. As shown in Appendix B, modelled groundwater levels at ARP11 over the calibration period were the same for the mining and no mining scenarios. This shows that the modelled decreasing trend at ARP11 is not attributable to mining and is due to rainfall recharge.

Parameter sensitivity

Key findings from the calibration process are as follows:

- The model is sensitive to adjustment of the specific yield. It was found that the specific yield needed to be reduced to match the drawdown observed at ARP04 and maintain a low groundwater inflow. The modelled drawdown in the Lithgow Seam and Marrangaroo Formation at ARP04 is similar to the observed magnitude, although there is a difference in the rate of drawdown due to the model being based on monthly stress periods and time steps.
- The model is also sensitive to the vertical hydraulic conductivity of the Shoalhaven Group (layers 10-12 of the updated model). In order to reduce the modelled groundwater pressure within the

Shoalhaven Group (to better simulate observed pressures), it was necessary to reduce the vertical hydraulic conductivity.

- Modelled groundwater inflows were sensitive to drain conductance. Observed groundwater inflows have been low (not measureable) to date. Drain conductance was lowered to improve the fit between modelled and observed inflows.

Appendix B

Calibration hydrographs

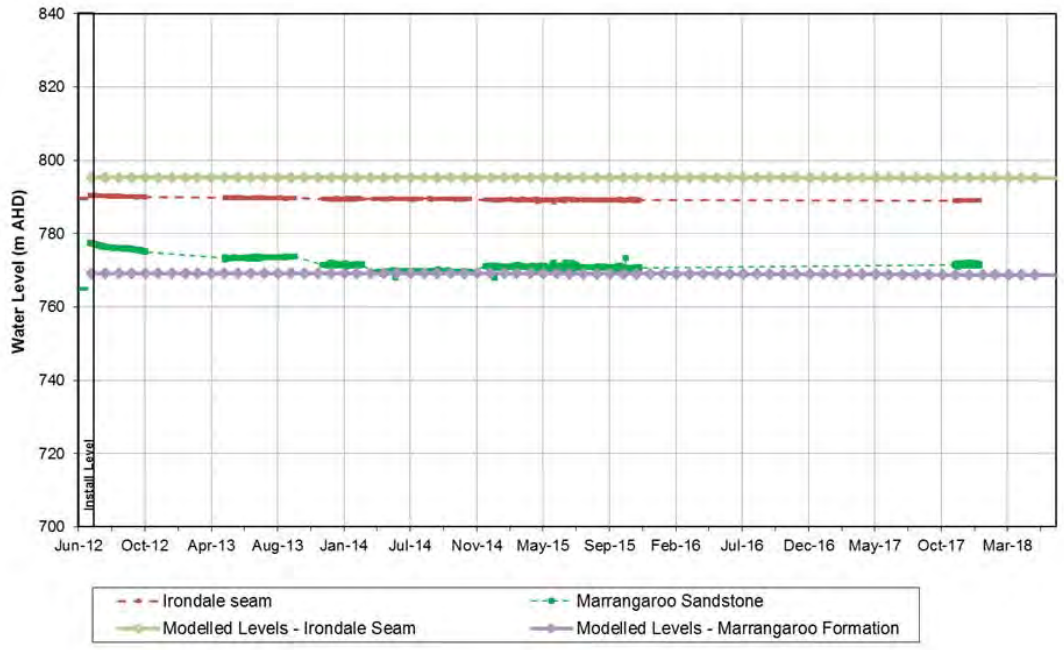


Figure B-1 Modelled and observed hydrographs – ARP01

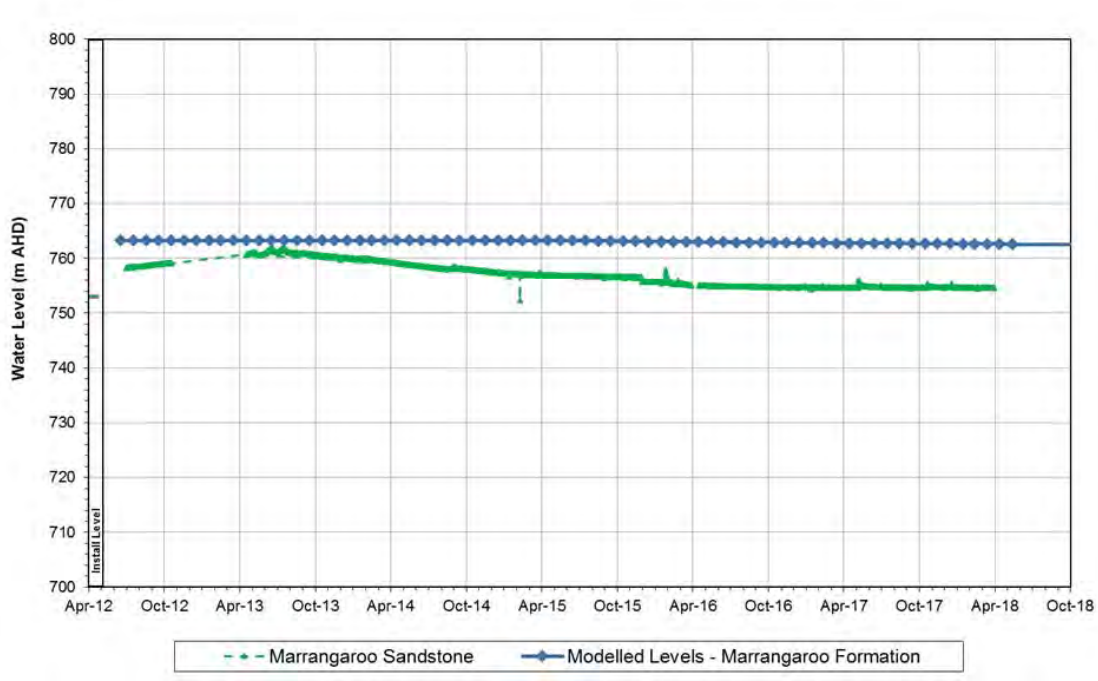


Figure B-2 Modelled and observed hydrographs – ARP02

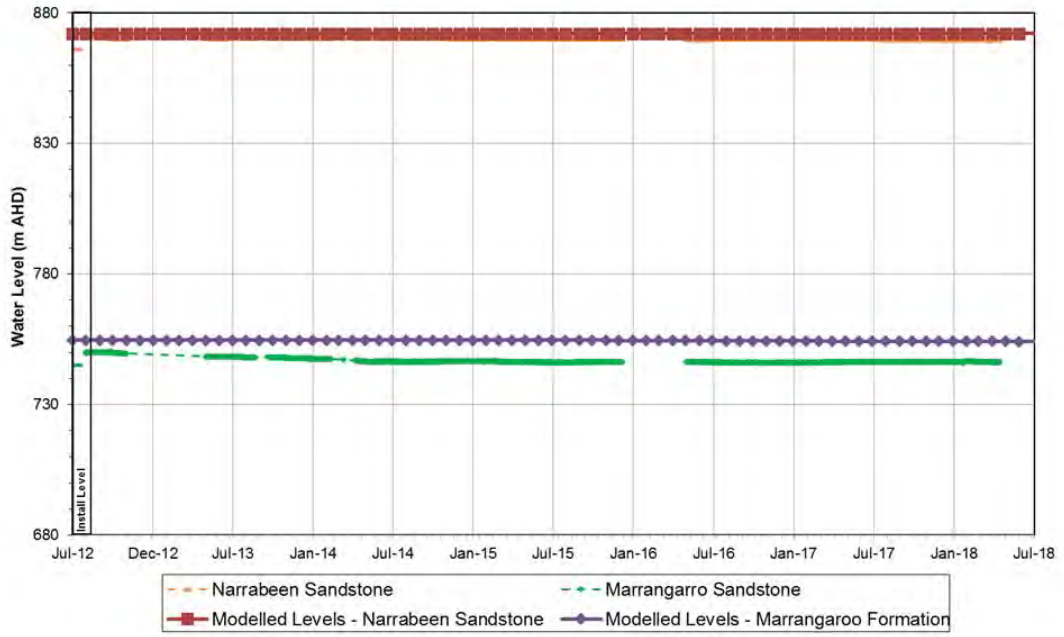


Figure B-3 Modelled and observed hydrographs – ARP03

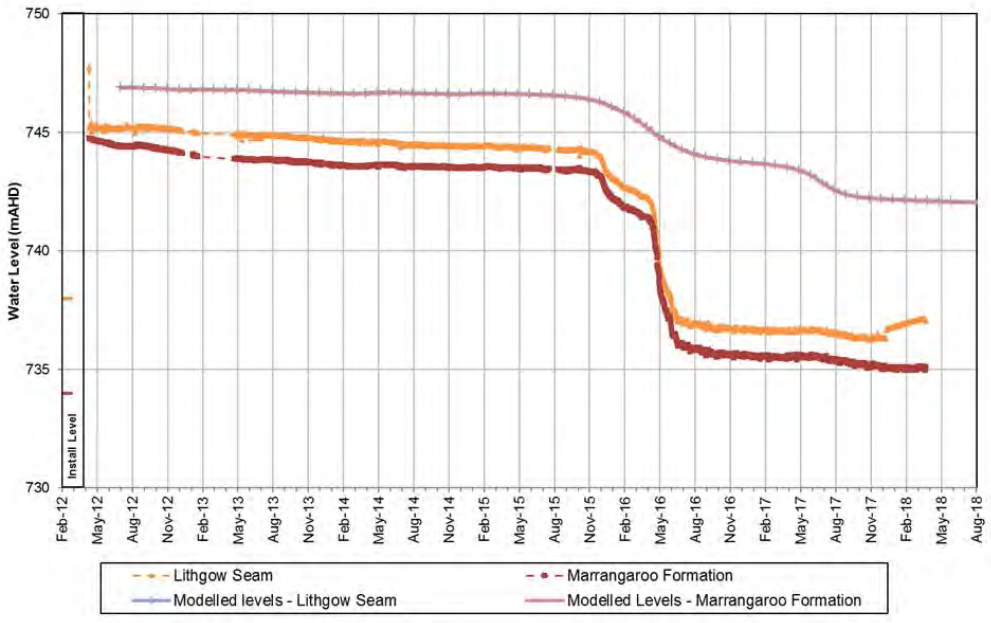


Figure B-4 Modelled and observed hydrographs – ARP04 Lithgow Seam and Marrangaroo Formation

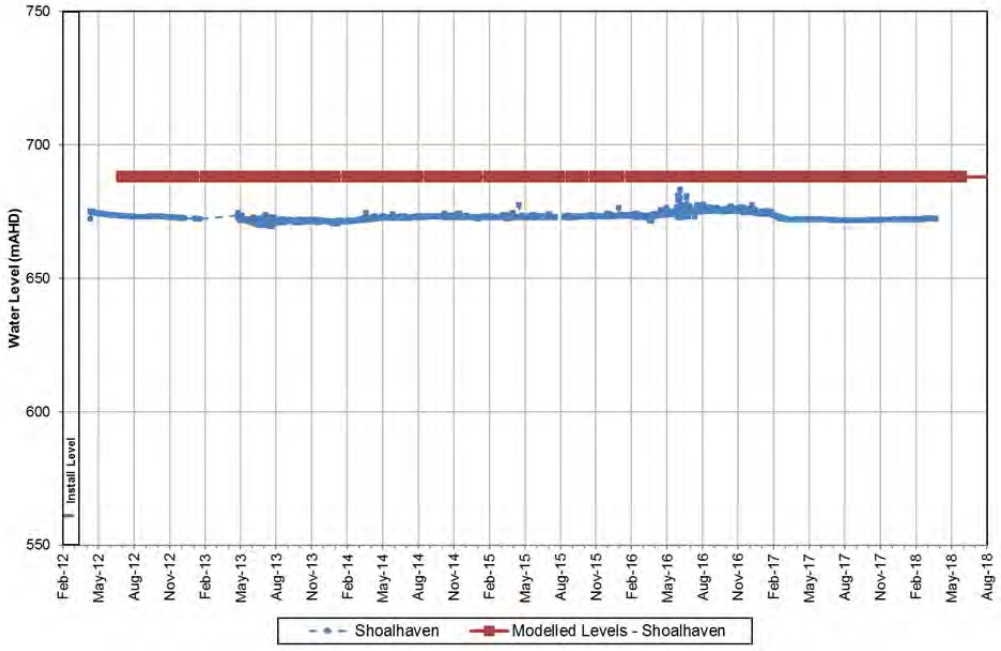


Figure B-5 Modelled and observed hydrographs – ARP04 Shoalhaven Group

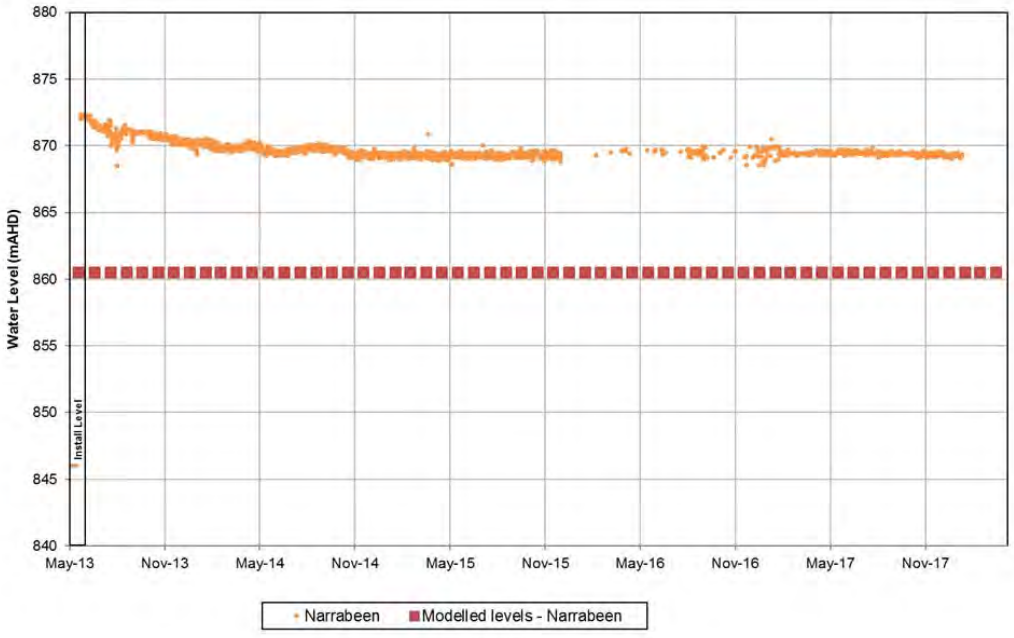


Figure B-6 Modelled and observed hydrographs – ARP06

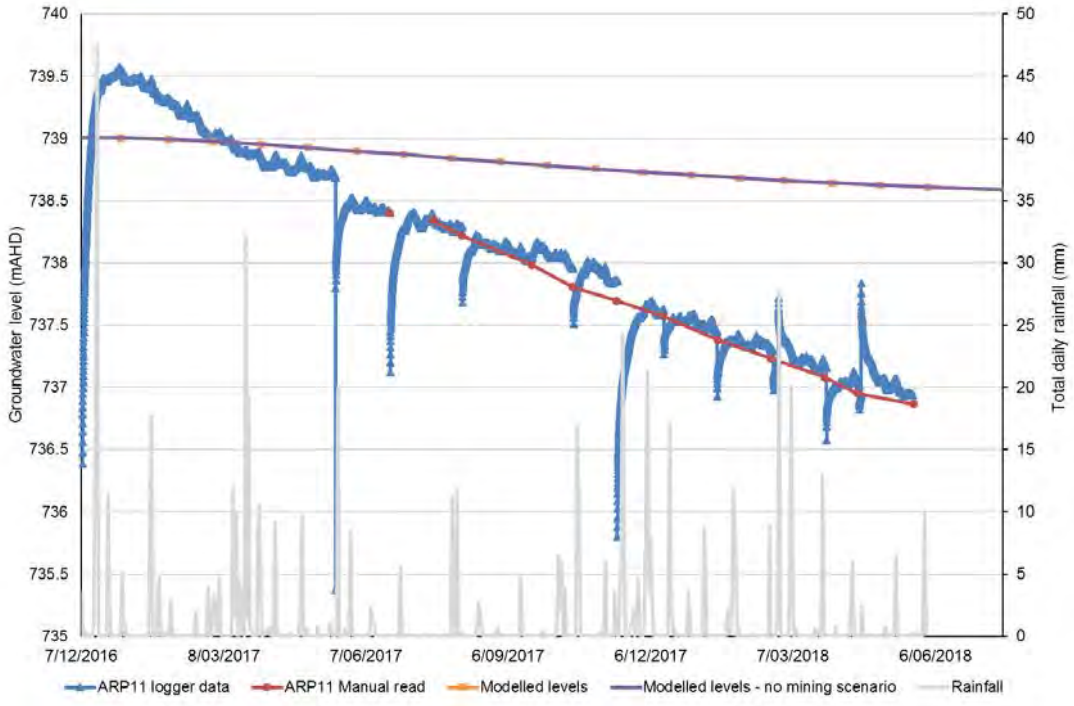


Figure B-7 Modelled and observed hydrographs – ARP11

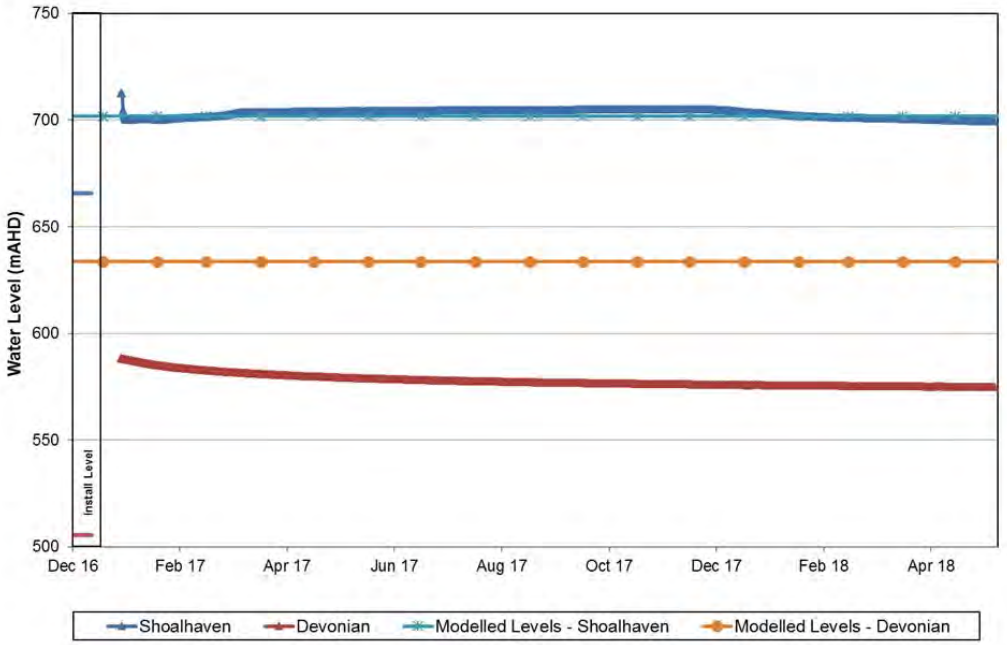


Figure B-8 Modelled and observed hydrographs – ARP13

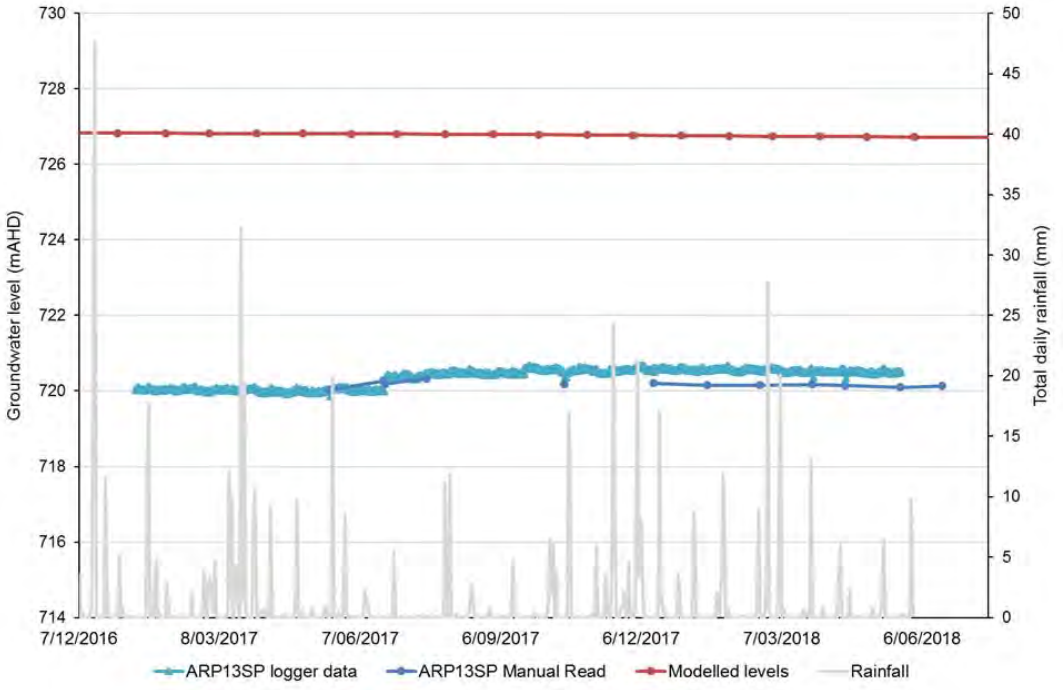


Figure B-9 Modelled and observed hydrographs – ARP13SP

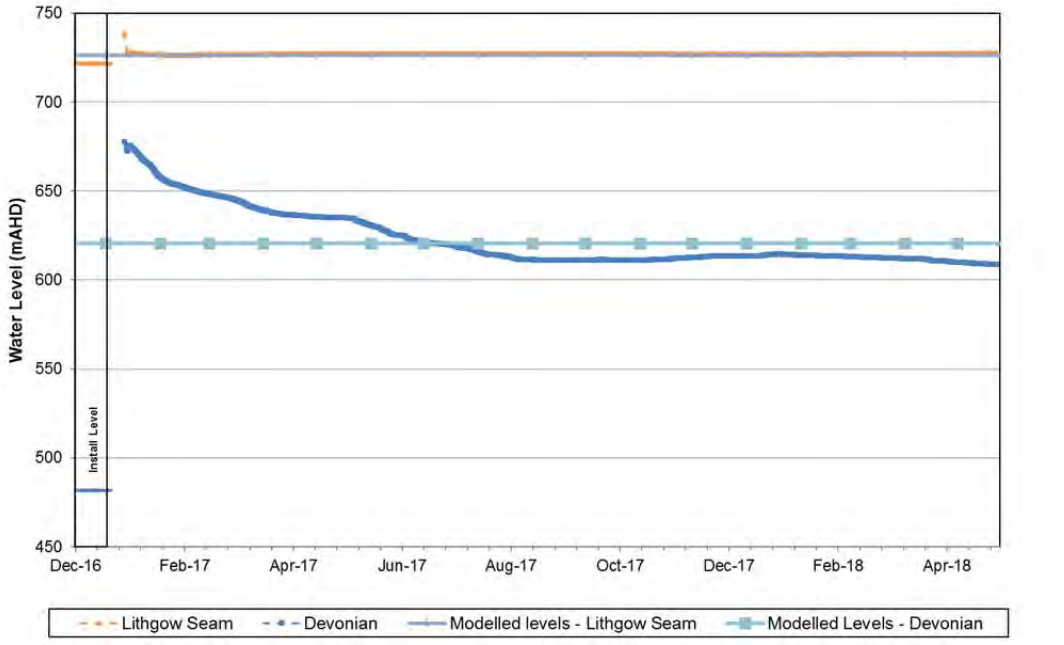


Figure B-10 Modelled and observed hydrographs – ARP15

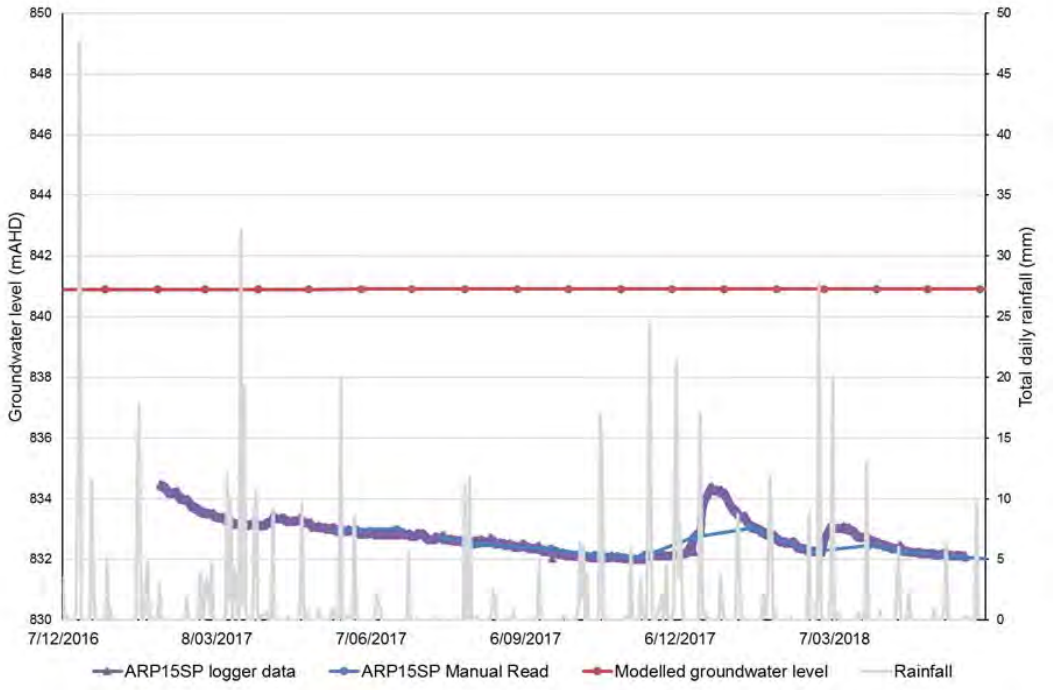


Figure B-11 Modelled and observed hydrographs – ARP15SP

Appendix C

Groundwater hydrographs

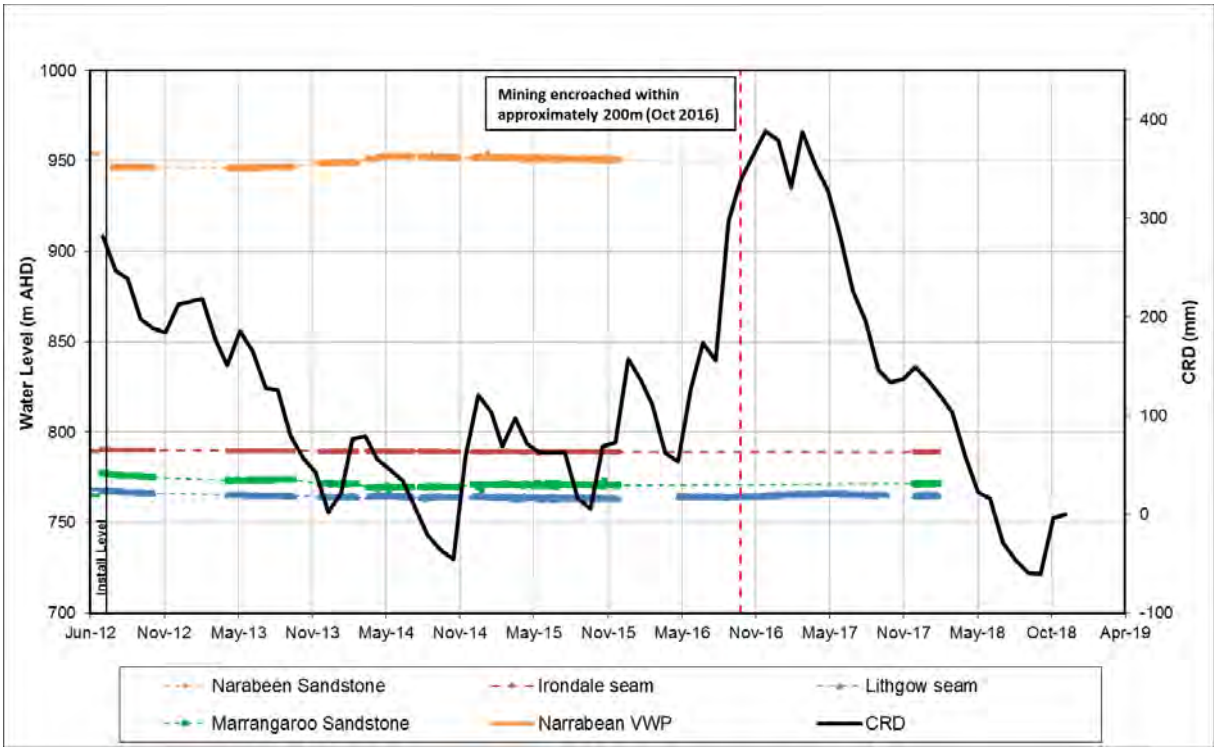


Figure C-1 Observed hydrographs – ARP01

Pressure constantly negative in Narrabeen Sandstone and Lithgow Seam. VWP pressure consistently negative in the Irondale Seam since October 2014.

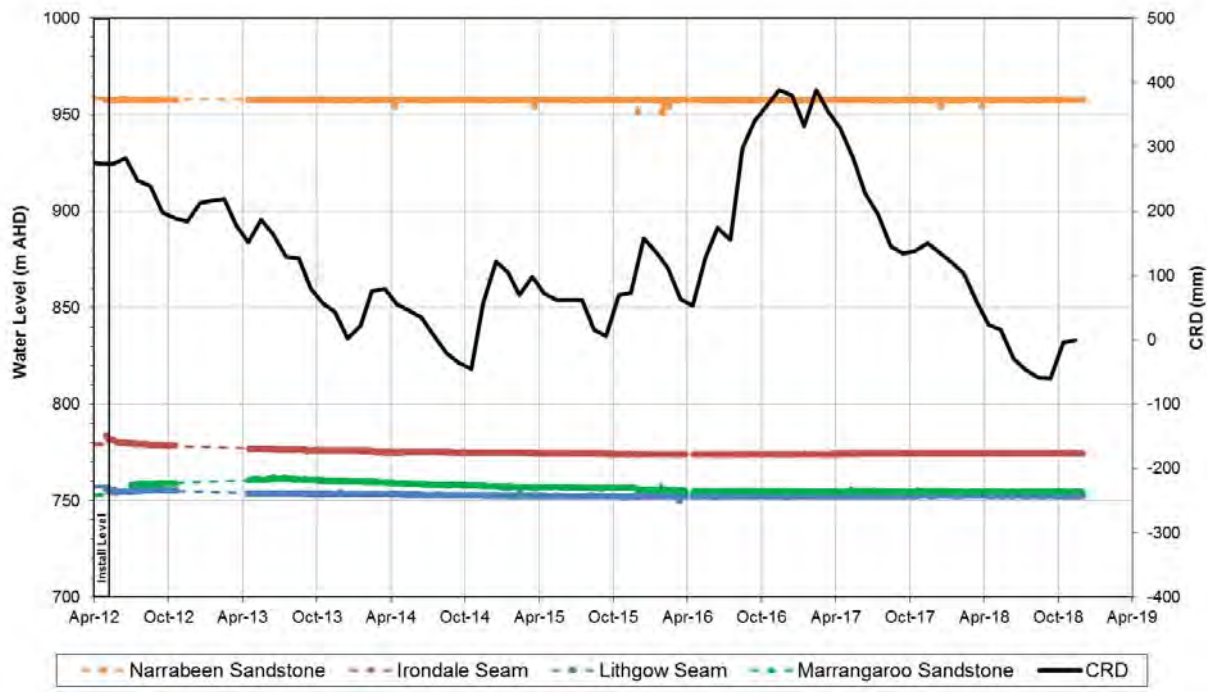


Figure C-2 Observed hydrographs – ARP02

Pressure has been negative at the VWP installed in the Narrabeen Sandstone and Lithgow Seam since installation. Pressure has been negative in the Irondale Seam since July 2012 (two months after installation).

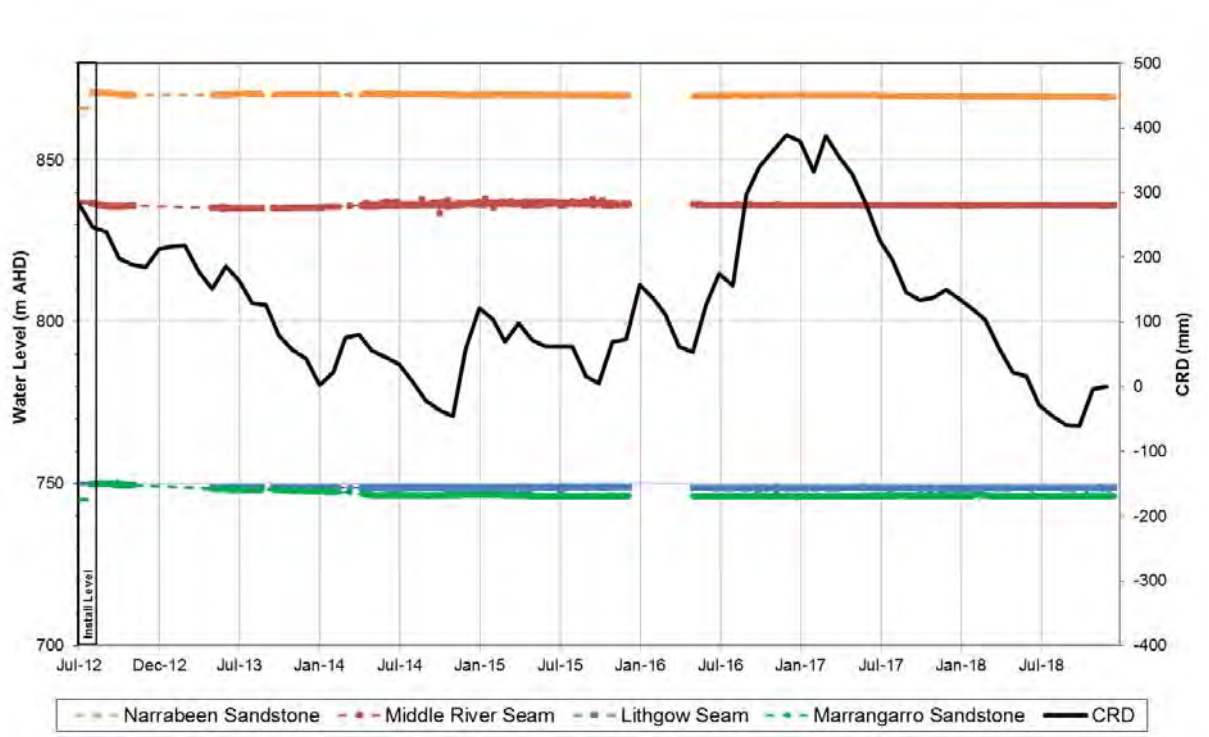


Figure C-3 Observed hydrographs – ARP03

Pressure has typically been negative in the Middle River Seam**.** Pressure has been negative in the Lithgow Seam since October 2012.

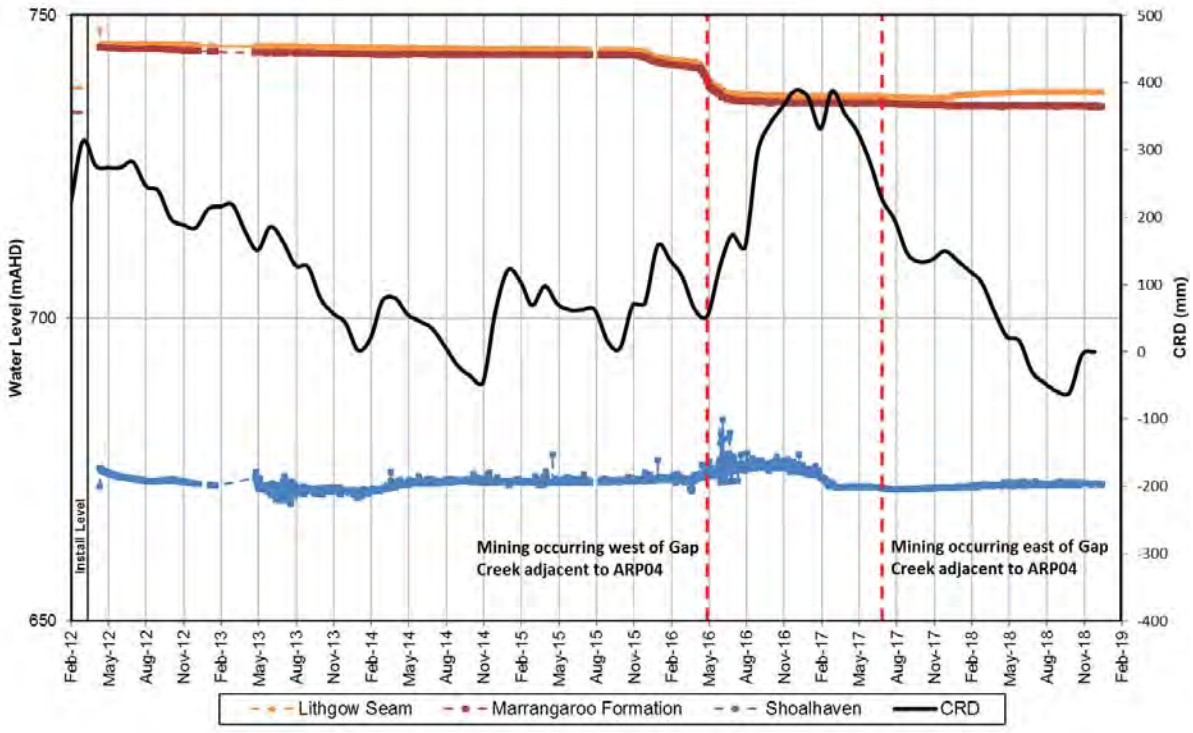


Figure C-4 Observed hydrographs – ARP04

Pressure has been negative in the Lithgow Seam at ARP04 since June 2016.

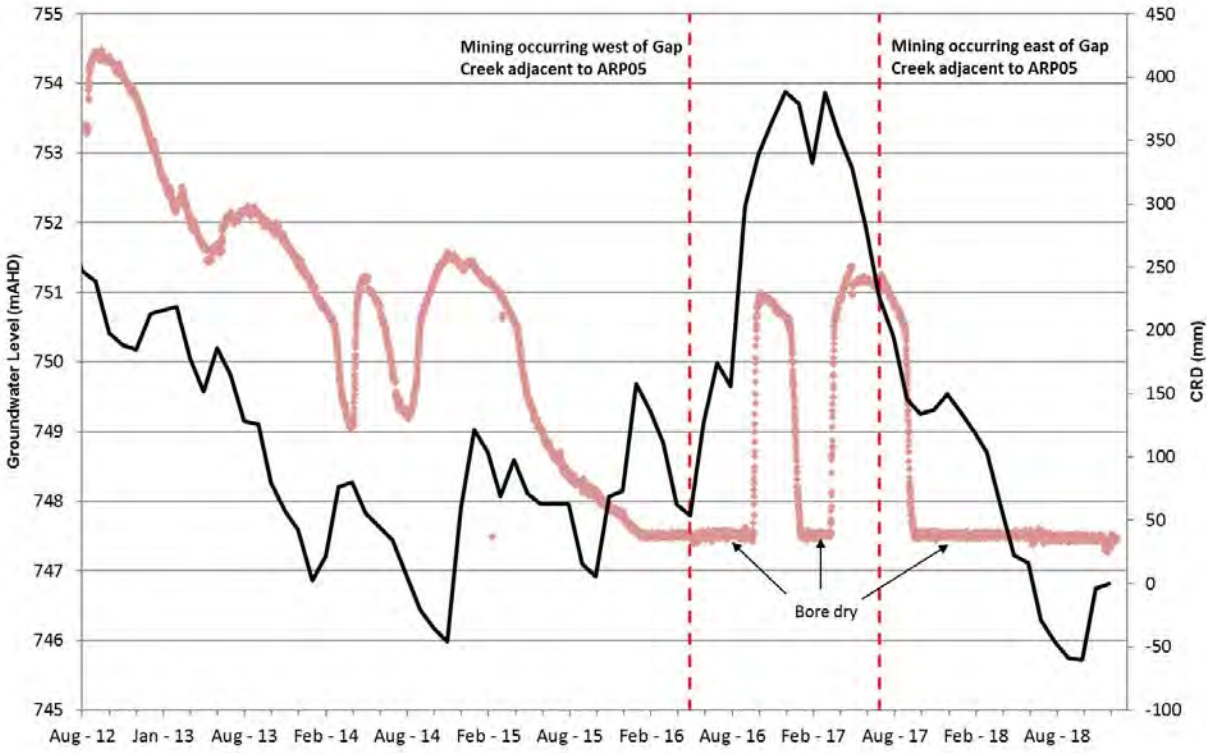


Figure C-5 Observed hydrographs – ARP05

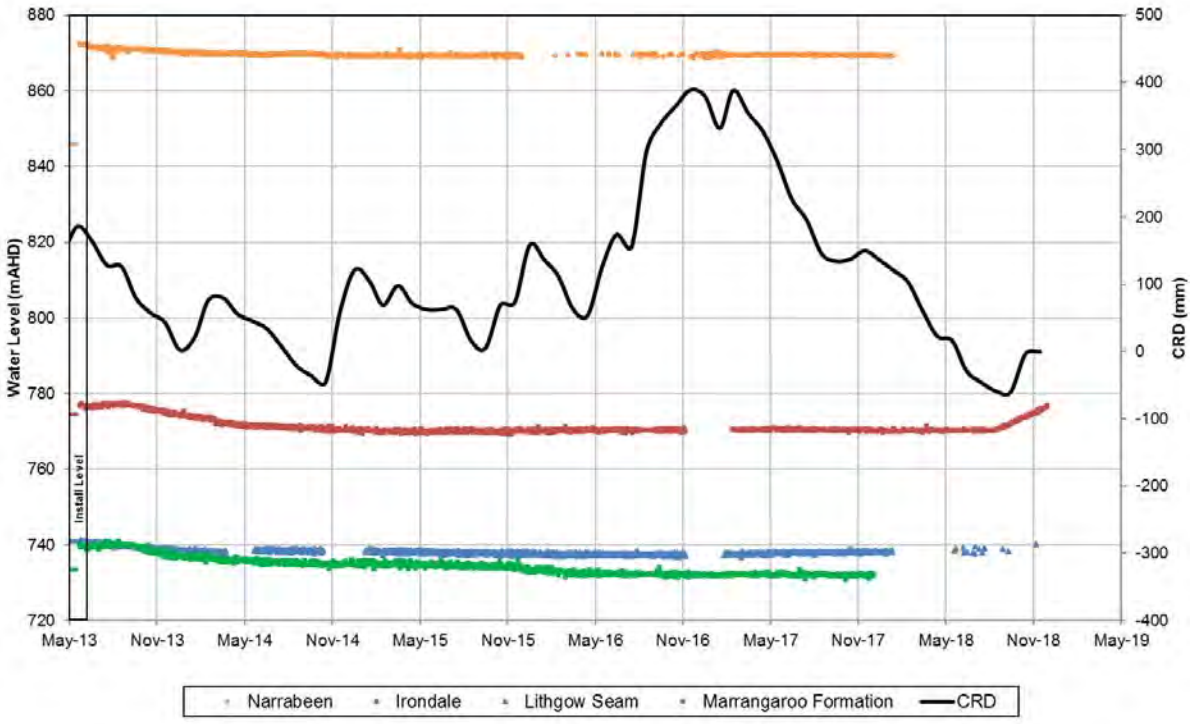


Figure C-6 Observed hydrographs – ARP06

Pressure consistently negative at ARP06 in the Lithgow Seam, in the Irondale Seam since December 2013 and in the Marrangaroo Formation since December 2015.

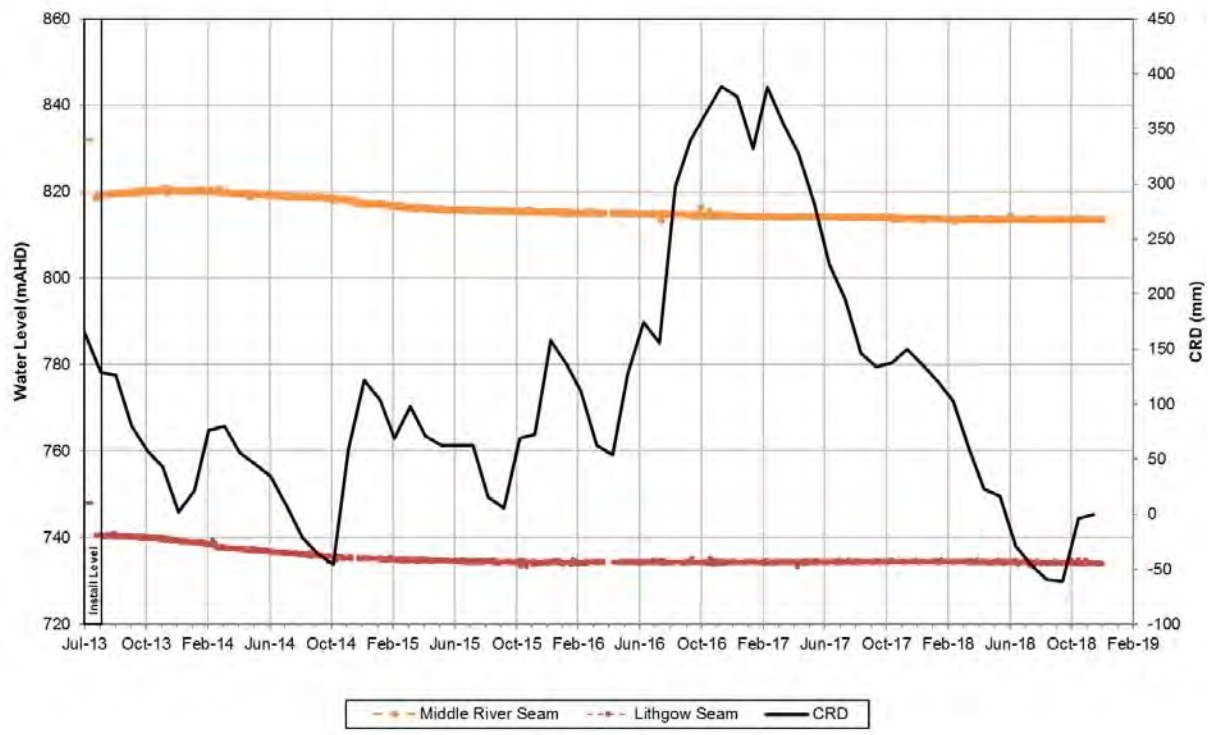


Figure C-7 Observed hydrographs – ARP07

Pressure consistently negative at VWPs installed at ARP07.



Figure C-8 Observed hydrographs – ARP08

Pressures have been negative at ARP08 in the Narrabeen Sandstone since May 2016 and in the Lower Irondale Seam since November 2016.

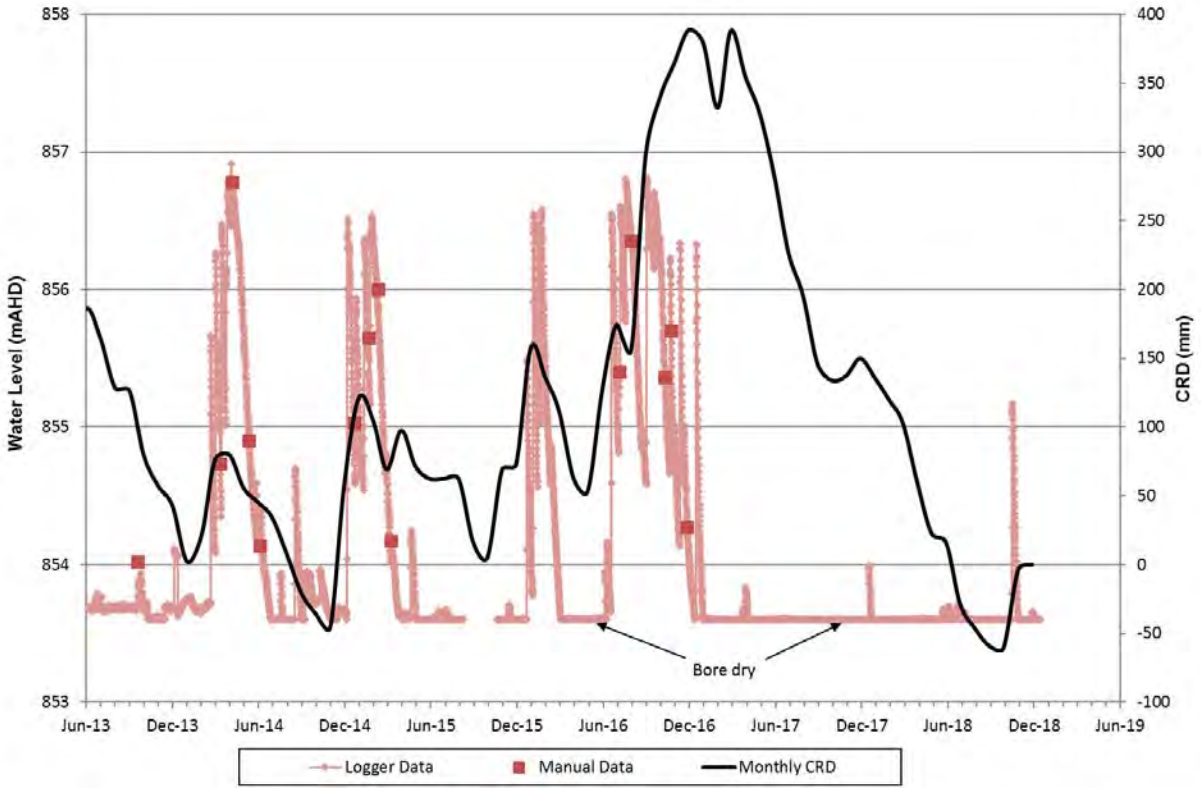


Figure C-9 Observed hydrographs – ARP09

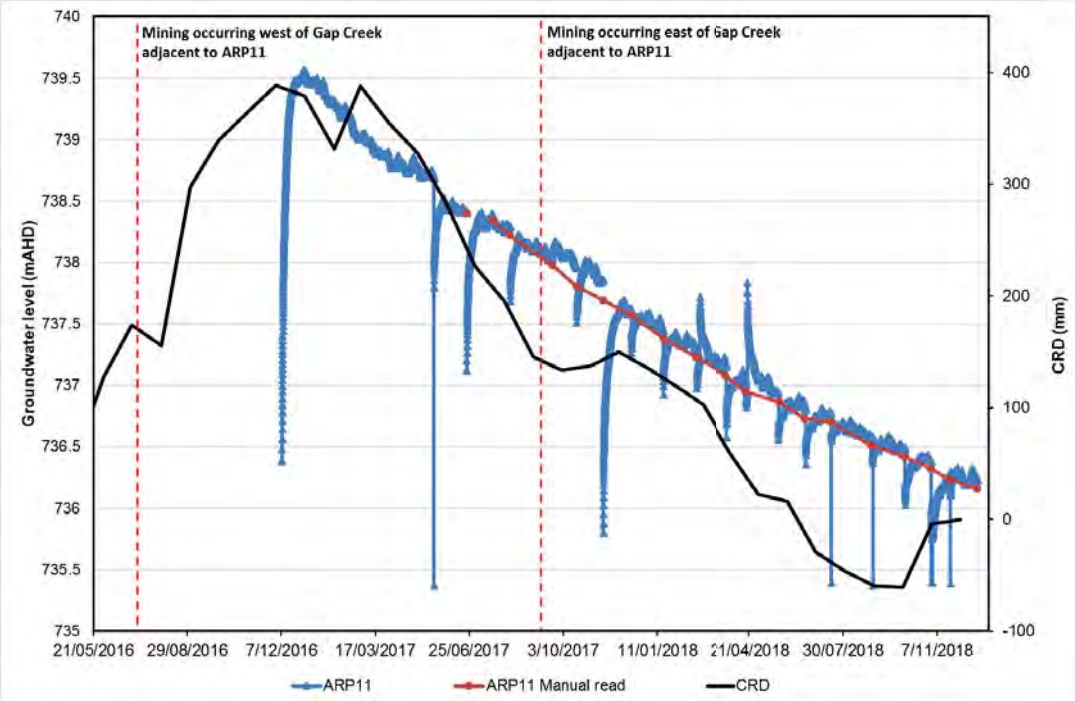


Figure C-10 Observed hydrographs – ARP11

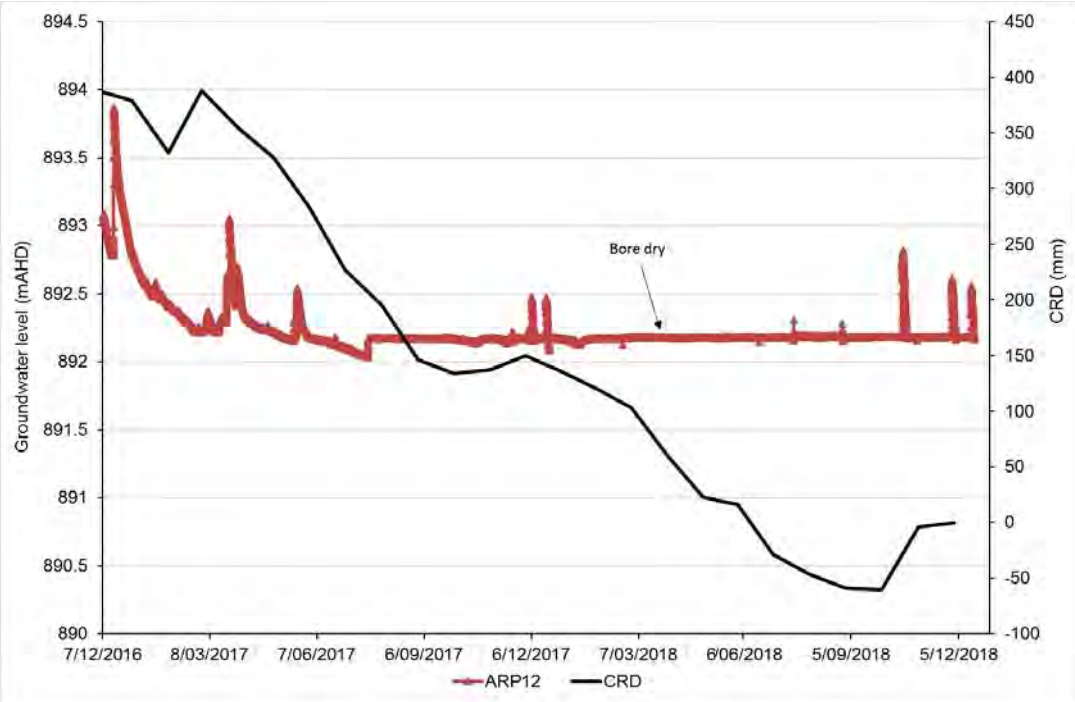


Figure C-11 Observed hydrographs – ARP12

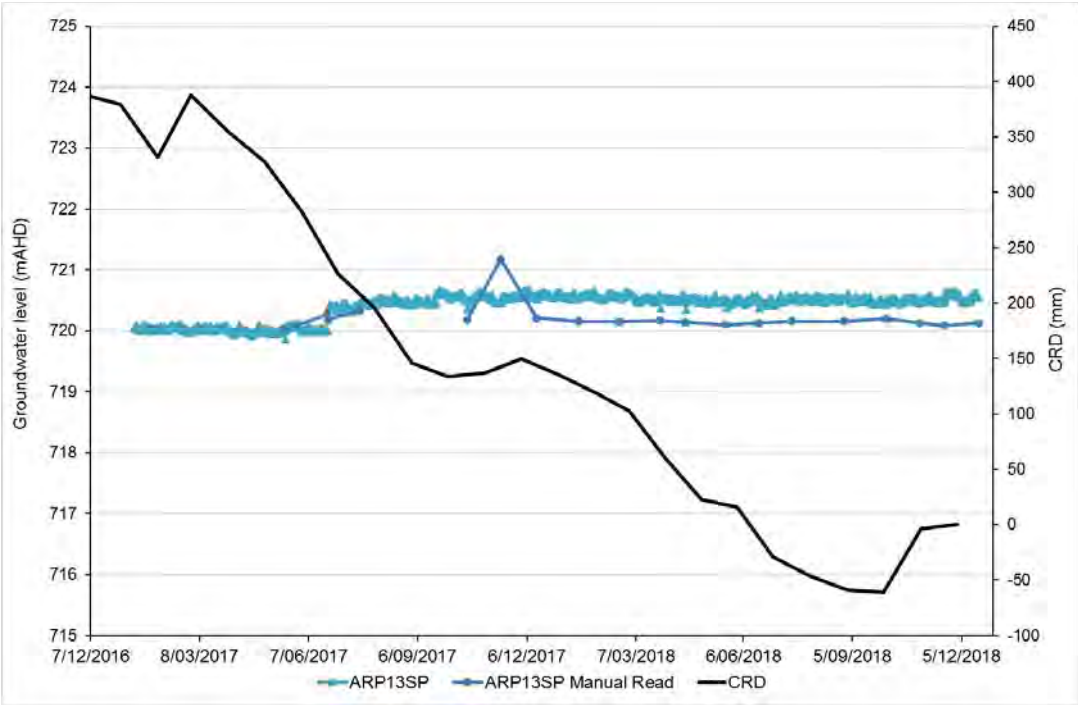


Figure C-12 Observed hydrographs – ARP13SP

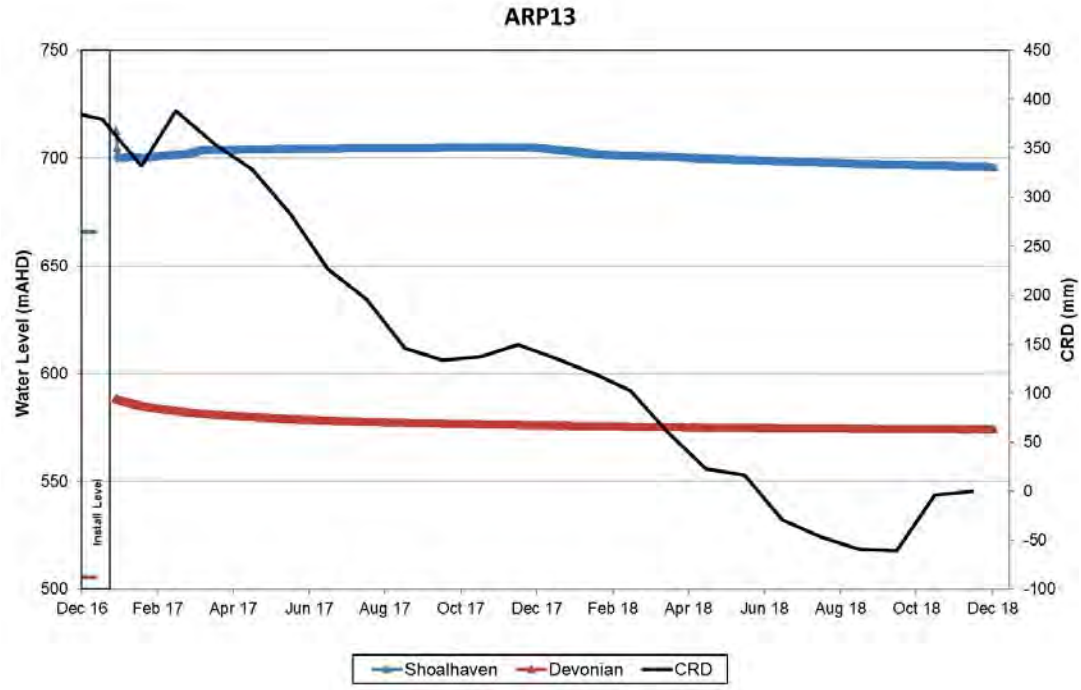


Figure C-13 Observed hydrographs – ARP13

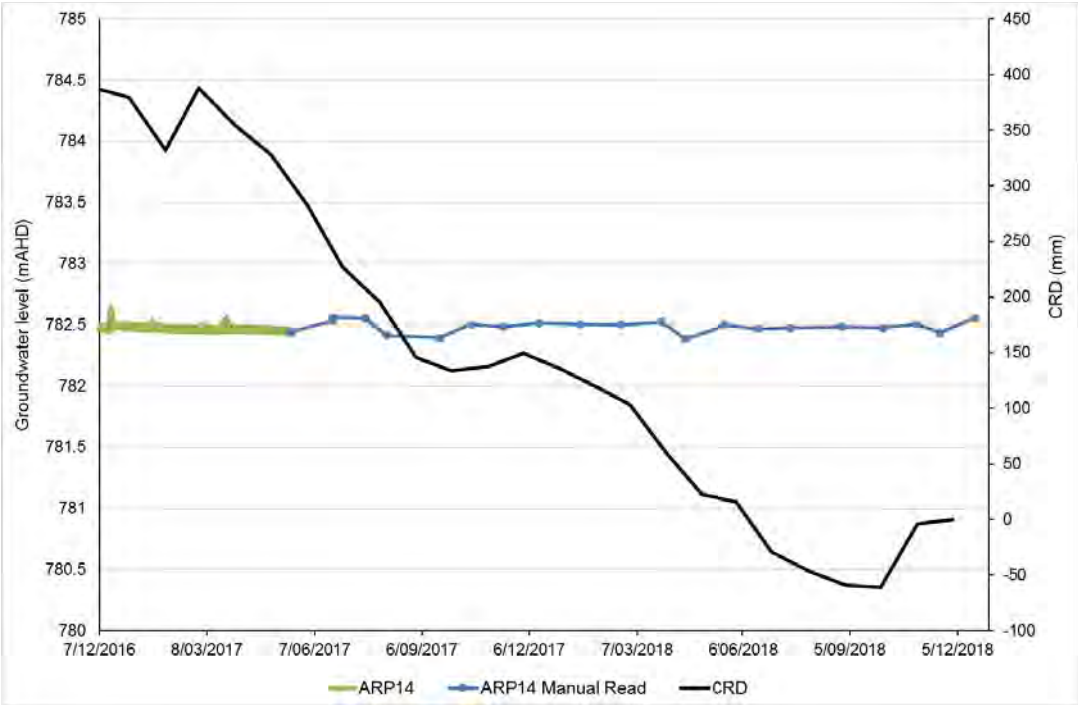


Figure C-14 Observed hydrographs – ARP14

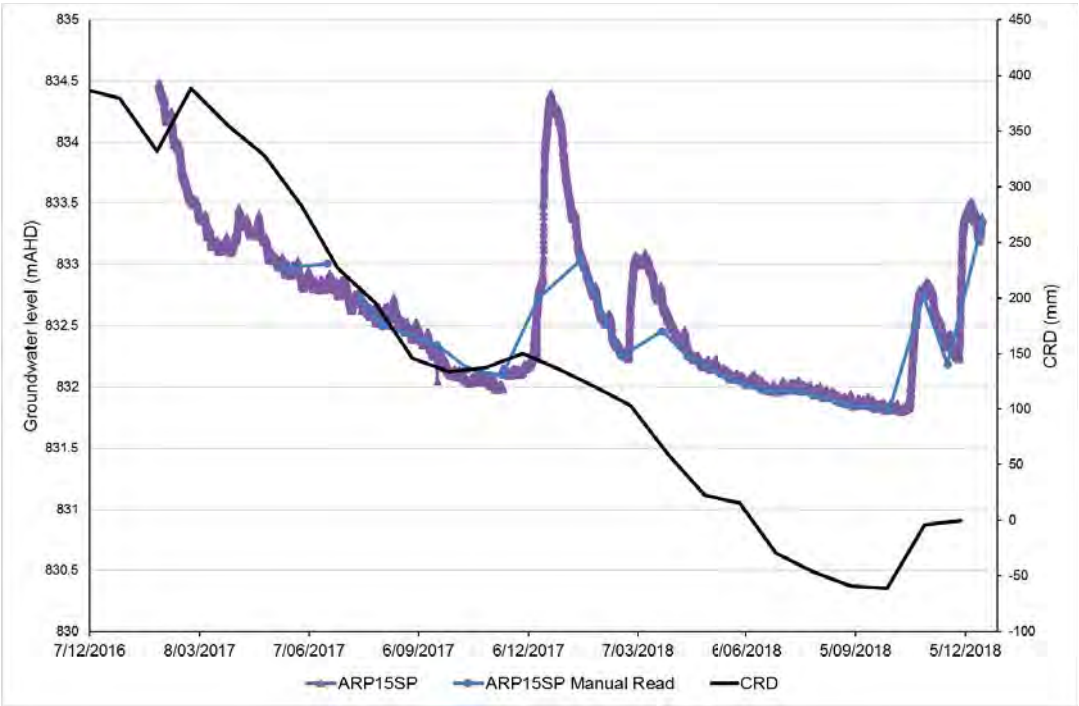


Figure C-15 Observed hydrographs – ARP15SP

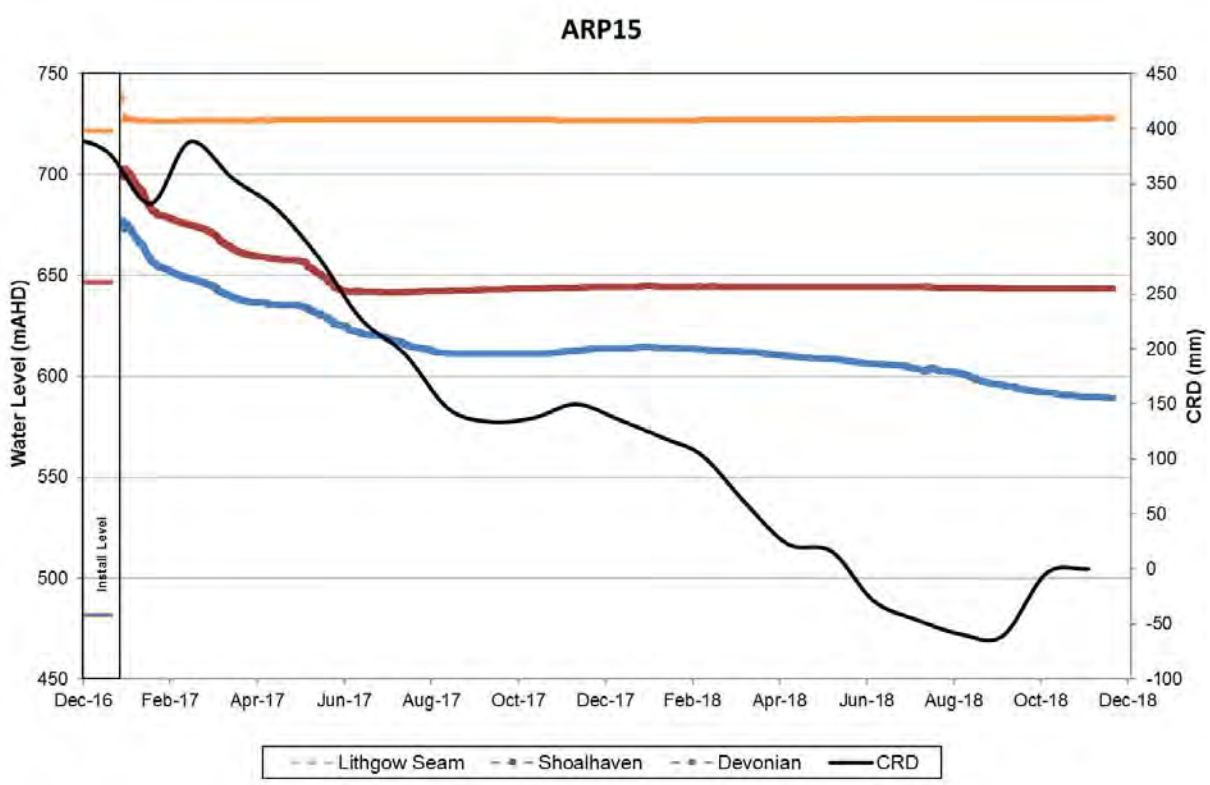


Figure C-16 Observed hydrographs – ARP15

Pressures have been negative at ARP15 in the Shoalhaven Group since June 2017.

Appendix D

Australian Groundwater Modelling Guidelines confidence level assessment

Table D-1 Assessment of model confidence level against Australian Groundwater Model Guidelines (Barnett et al, 2012)

Class	Data		Calibration		Prediction		Quantitative indicators	
1 (simple)	✗	Not much	✗	Not possible	✗	Timeframe >> calibration	✗	Timeframe > 10x
	✗	Sparse coverage	✗	Large error statistic	✗	Long stress periods	~	Stresses > 5x
	✗	No metered usage	✗	Inadequate data spread	✓	Poor/no validation	✓	Mass balance > 1% (or one-off 5%)
	✗	Low resolution					✓	Properties < > field values
	✗	Poor aquifer geometry	✗	Targets incompatible with model purpose	✗	Transient prediction but steady-state calibration	✗	No review by Hydro/ Modeller
	✗	Basic / initial conceptualisation						
2 (impact assessment)	✓	Some	✓	Partial performance	✓	Timeframe > calibration	✓	Time frame = 3–10x
	✓	Ok coverage	✓	Some long term trends wrong	✗	Long stress periods	~	Stresses = 2–5x
	✓	Some data usage / low volumes	✓	Short term record	✗	Ok validation	✗	Mass balance <1%
	~	Baseflow estimates Some K & S measurements	✓	Weak seasonal match	✓	Transient calibration and prediction	✓	Some properties < > field values Review by hydrogeologist
	✓	Some high resolution topographic DEM &/or some aquifer geometry	✗	No use of targets compatible with model purpose (heads & fluxes)	✓	New stresses not in calibration	✗	Some coarse discretisation in key areas of grid or at key times
	✗	Lots, with good coverage	✗	Good performance stats	✗	Timeframe ~ calibration	✗	Timeframe <3x

Class	Data		Calibration		Prediction		Quantitative indicators	
3 (complex simulator)	✗	Good metered usage info	✗	Most long term trends matched	✓	Similar stress periods	✗	Stresses <2x
	✓	Local climate data	✗	Most seasonal matches ok	✗	Good validation	✗	Mass balance <0.5%
	✗	Kh, Kv and Sy measurements from a range of tests	✓	Present day data targets	✓	Calibration & prediction consistent (transient or steady state)	✗	Properties ~ field measurements
	✗	High resolution DEM all areas	✓	Head & flux targets used to constrain calibration	✗	Similar stresses to those in calibration	✓	No coarse discretisation in key areas (grid or time)
	✗	Good aquifer geometry					✓	Review by experienced modeller

Note: achieved attributes are shown with a tick, partially achieved attributes are shown with a tilde and not achieved attributes are shown with a cross.

Appendix E

Independent peer review

HydroAlgorithmics Pty Ltd ● ABN 25 163 284 991
PO Box 241, Gerringong NSW 2534. Phone: (+61 2) 4234 3802

noel.merrick@hydroalgorithmics.com

DATE: 9 April 2019

TO: Nagindar Singh
Approvals Coordinator
Centennial Coal Company Limited
1384 Castlereagh Highway
Lidsdale NSW 2790
Tel: (02) 6355 9814

FROM: Dr Noel Merrick

RE: Airly Mine Modification MOD2 –
Groundwater Assessment Peer Review

YOUR REF: Email 27 February 2019

OUR REF: HA2019/04

1. Introduction

This report provides a peer review of Modification MOD2 for the Airly Mine. MOD2 deals with transportation of water from Charbon to Airly to meet an identified process water deficit, with production remaining at 1.8 Mtpa.

An earlier interim review dated 19 March 2019 provided comments and notes to allow the groundwater assessment report to be modified to be more complete and more informative. Apart from a few instances noted below, the previous review comments have been addressed satisfactorily.

2. Documentation

The peer review is based on the following report:

1. GHD, 2019, Airly Mine Mod 2 Hydrogeological Model Report. Letter report 2219275/2219275-LET-AirlyMod2_HMR to Nagindar Singh, Centennial Airly Pty Ltd, 2 April 2019. 63p including 4 Appendices.

Of the Appendices in Document #1, the following has additional detail on hydrogeological conceptualisation and groundwater model calibration:

2. [Doc #1] Appendix A. Hydrological Conceptualisation and Model Calibration. Report 22\16787\WP\102849 prepared for Centennial Airly Pty Ltd., 2 April 2019, 22p.

The earlier EIS groundwater assessment was documented in:

3. GHD, 2014, Airly Mine Extension Project Groundwater Impact Assessment. Report 22\16787\WP\102849 prepared for Centennial Airly Pty Ltd. Revision 1 (August 2014), 66p + 3 Appendices.

This report was peer reviewed in:

4. HydroAlgorithmics, 2014, Airly Mine Extension Project - Groundwater Model Review. Report HA2014/9 prepared for Centennial Airly Pty Ltd. 11p.

Document #1 comprises the groundwater impact assessment for the Modification. It has the following sections:

1. Introduction
2. Hydrological conceptualisation and model calibration
3. Predictive simulations
4. Production bore
5. Conclusions and recommendations
6. References.

The Appendices are:

A. Hydrological conceptualisation and model calibration
B. Calibration hydrographs
C. Groundwater hydrographs
D. Australian Groundwater Modelling Guidelines confidence level assessment

Document #2 has the following sections:

1. Hydrological conceptualisation
2. Model recalibration

3. Review Methodology

While there are no standard procedures for peer reviews of entire groundwater assessments, there are guidelines for the numerical modelling that underpins the assessment.

There are two accepted guides to the review of groundwater models: (A) the Murray-Darling Basin Commission (**MDBC**) Groundwater Flow Modelling Guideline[1], issued in 2001, and (B) guidelines issued by the National Water Commission (**NWC**) in June 2012 (Barnett et al., 2012[2]). The NWC national guidelines were built upon the original MDBC guide, with substantial consistency in the model conceptualisation, design, construction and calibration principles, and the performance and review criteria, although there are differences in details.

The NWC guide promotes the concept of "model confidence level", which is defined using a number of criteria that relate to data availability, calibration, and prediction scenarios. The NWC guide is almost silent on coal mine modelling and offers no direction on best practice methodology for such applications. There is, however, an expectation of more effort in uncertainty analysis, although the guide is not prescriptive as to which methodology should be adopted.

Guidelines on uncertainty analysis for groundwater models were issued by the Independent Expert Scientific Committee (**IESC**) on Coal Seam Gas and Large Coal Mining Development in February

[1] MDBC (2001). Groundwater flow modelling guideline. Murray-Darling Basin Commission. URL: www.mdbc.gov.au/nrm/water_management/groundwater/groundwater_guides

[2] Barnett, B, Townley, L.R., Post, V., Evans, R.E., Hunt, R.J., Peeters, L., Richardson, S., Werner, A.D., Knapton, A. and Boronkay, A. (2012). *Australian Groundwater Modelling Guidelines*. Waterlines report 82, National Water Commission, Canberra.

2018 in draft form and finalised in December 2018[3].

The groundwater guides include useful checklists for peer review. Only the modelling components of the 2-page Model Appraisal checklist[4] in MDBC (2001) have been used for this peer review, namely sections (1) Report, (5) Calibration, (7) Prediction, (8) Sensitivity Analysis and (9) Uncertainty Analysis.

The detailed assessment of the groundwater modelling is recorded in the peer review checklist in **Table 1**. Supplementary comment is offered in the following sections of this review.

4. Report Matters

Document #1 is a brief letter report in support of a Modification that deals with provision of water to Airly Mine from an external water source. This activity will not interfere with the groundwater system. The reason for a groundwater assessment is to provide an update of predicted mine inflows for approved mining using a recalibrated model with the benefit of a longer monitoring record and the augmentation of the groundwater monitoring network. The earlier EIS model of 2014 was found to overestimate the inflows recorded from 2015 onwards.

Given the purpose of the report, much of the detail in the EIS report is omitted. Attention is focussed on model calibration and prediction. A full peer review of the EIS report Document #3 can be found in Document #4.

A full set of monitoring bore groundwater hydrographs is provided at Appendix C of Document #1, with comparison against the rainfall trend in the form of a cumulative rainfall departure curve.

Most mining has been and will be conducted using the bord and pillar technique, with consequent minimal fracturing and subsidence. There is to be some panel mining, but the width of 61m is narrower than in most other longwall mining operations in NSW. This limits the height of fracturing and consequent impacts. It is not obvious to the reader where the panel mining is planned, but parallel panels can be identified on Figure A-5 to the immediate north of Bore ARP01.

The locations of Bores ARP04 and ARP05 differ on Figures 3-3 and A-5.

On page 38 of Document #2, there is still a reference to annual stress periods instead of monthly stress periods.

On page 26 of Document #2, there is a stated belief that the “decreasing trend in groundwater level at ARP05 during mining is a continuation of pre-mining trends”. This is not correct. Figure 1 (of this review report) illustrates likely mining effects recorded at ARP05 that are coincident with definite mining effects at ARP04.

Unfortunately, there is no indication of mining sequence on the mine plan of Figure A-5, or time markers on the groundwater hydrograph plots. This prevents the reader from verifying potential mining effects on hydrographs. However, the mining effect at ARP04 (Figure 1) is obvious, and the separate mining effects are probably due to westerly mining followed by easterly mining close to the bore. The observed declining trend at ARP11 could have been interpreted as a mining effect, being situated between proximal western and eastern mining, but a null-mining run proves conclusively that the response is due entirely to rainfall reduction.

[3] Middlemis H and Peeters LJM (2018) *Uncertainty analysis—Guidance for groundwater modelling within a risk management framework*. A report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of the Environment and Energy, Commonwealth of Australia 2018.

[4] The new guidelines include a more detailed checklist but they do not offer the graded assessments of the 2001 checklist, which this reviewer regards as more informative for readers.

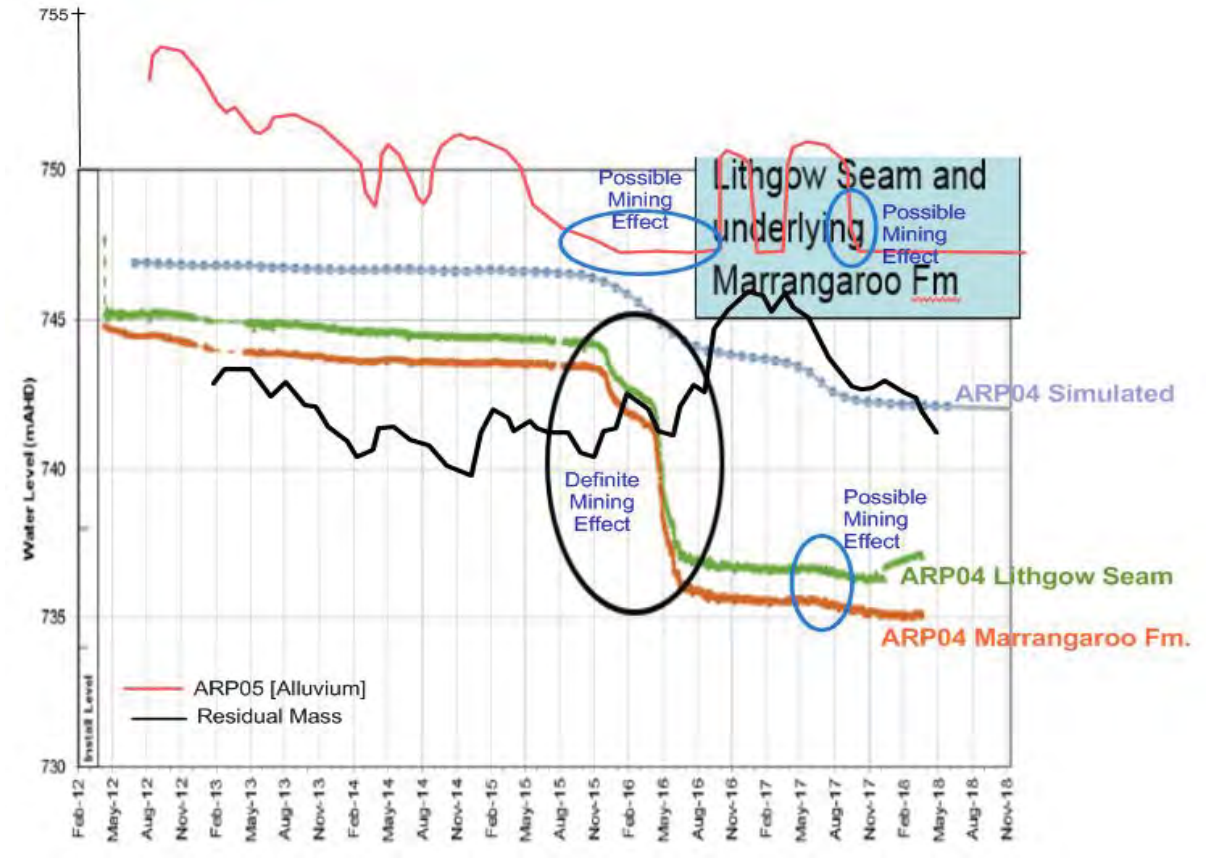


Figure 1. Mining effects evident on hydrographs for Bores ARP04 and ARP05.

5. Model Matters

The model update has achieved better model calibration than recorded in Document #3 for the previous EIS model. Calibration statistics are satisfactory, being 5.3 %RMS and 14 mRMS for steady-state, and 4.1 %RMS and 11 mRMS for transient calibration. However, the number of transient calibration targets is not stated, and only half of the simulated hydrographs are compared with observations in Appendix B.

A non-quantitative control on calibration was the observation of mine inflows too low to be measurable. This is consistent with simulated inflows of about 0.03 ML/day at 2018 and less than 0.2 ML/day during the prediction period.

Of the two fracture height scenarios, Scenario 2 (with fracturing to 75m altitude) is considered more appropriate. Independent calculations by the reviewer suggest a likely height of about 50m to 70m.

The model is said “to have the characteristics of class 1 and 2 confidence level”. In fact, counts of the attributes marked in Appendix D indicate that the model is 14% Class 1, 57% Class 2, and 29% Class 3. The model is mostly Class 2, with elements of the other two classes.

Two lineament simulations, for alternative conduit and barrier fault conceptualisations, demonstrated no evident effects on the hydrograph at ARP04. As noted on Figures 3-2 and 3-3, ARP04 appears to be about 400m west of the lineament. Nearby bores ARP05 and ARP11 are each about 350m west of the fault, and ARP08 is about 200m east of the fault. If the lineament is having any effect, it is not observable at the locations of the installed monitoring bores.

An IESC-compliant uncertainty analysis has been undertaken that accords with the simplest advocated approach using scenario analysis for six model variants. This suggests a narrow range

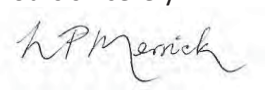
in predicted mine inflows. The simplified approach precludes any estimate of probabilities of occurrence.

6. Conclusion

The degree of model complexity and modelling effort for this Modification for Airly Mine are considered to be appropriate, as the project is clearly low risk. The geometry of the target coal seam within a truncated topography has resulted in naturally low-pressure heads, and the advent of mining causes only minimal further reduction. Mining to date has demonstrated very low inflows of a magnitude too low to be measurable. The numerical model can be regarded as a reliable predictor of future inflows remaining low.

The reviewer regards this model as being *fit for purpose*, where the purpose is jointly estimation of water take and reduction in groundwater pressure heads.

Yours sincerely



Dr Noel Merrick

Table 1. MODEL APPRAISAL: **Airly Groundwater Model** [Documents #1, #2]

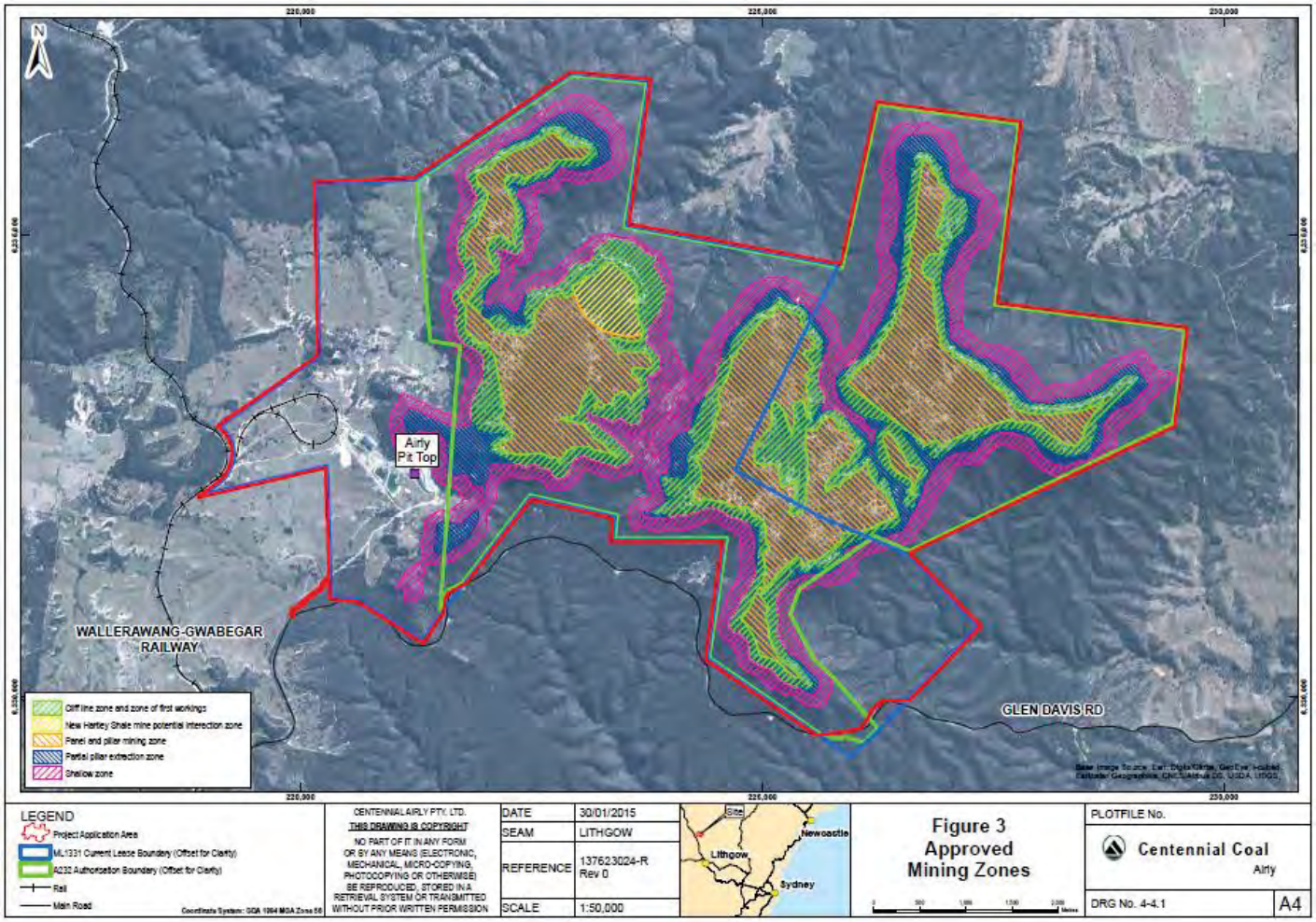
Q.	QUESTION	Not Applicable or Unknown	Score 0	Score 1	Score 3	Score 5	Score	Max. Score (0, 3, 5)	COMMENT
1.0	THE REPORT								
1.1	Is there a clear statement of project objectives in the modelling report?		Missing	Deficient	Adequate	Very Good			Section 1 [Doc#1].
1.2	Is the level of model complexity clear or acknowledged?		Missing	No	Yes				Reference to NWC national guidelines. Class 1-2 confidence classification substantiated in Appendix D. Appropriate.
1.3	Is a water or mass balance reported?		Missing	Deficient	Adequate	Very Good			Tables of all recharge/discharge components for whole model for steady-state and transient calibration.
1.4	Has the modelling study satisfied project objectives?		Missing	Deficient	Adequate	Very Good			
1.5	Are the model results of any practical use?			No	Maybe	Yes			The impact assessment is based on a transient calibrated model with plausible model properties. Impacts are believed to be very minor due to naturally low-pressure heads resulting from coal seam daylighting at western and eastern edges, facilitating drainage.
5.0	CALIBRATION								
5.1	Is there sufficient evidence provided for model calibration?		Missing	Deficient	Adequate	Very Good			Steady-state and transient calibration with groundwater level targets, and knowledge of mine inflows too low to be measurable. RMS and %RMS performance statistics and scattergrams for steady-state and transient.
5.2	Is the model sufficiently calibrated against spatial observations?		Missing	Deficient	Adequate	Very Good			Can infer only from scattergrams. Predicted contours are not compared with observed gradients in Figures A-6 to A-8. Simulated vertical head differences are reproduced reasonably at most sites.

5.3	Is the model sufficiently calibrated against temporal observations?		Missing	Deficient	Adequate	Very Good			Observed mining effects are evident only at ARP04 and ARP05. A reasonable match to declining trends is achieved at ARP04. The simulation at ARP05 is not shown.
5.4	Are calibrated parameter distributions and ranges plausible?		Missing	No	Maybe	Yes			K, Ss and Sy values are reasonable. Fractured zone Kh and Kv are not knowable in advance of panel mining; the adopted values do not decline with altitude, as would be expected.
5.5	Does the calibration statistic satisfy agreed performance criteria?		Missing	Deficient	Adequate	Very Good			Steady-state model: 5.3 %RMS, 14 mRMS. Transient model: 4.1 %RMS, 11 mRMS
5.6	Are there good reasons for not meeting agreed performance criteria?	N/A	Missing	Deficient	Adequate	Very Good			
7.0	PREDICTION								
7.1	Have multiple scenarios been run for climate variability?		Missing	Deficient	Adequate	Very Good			A single average climate has been used. Naturally low-pressure heads suggest low response to climate variations.
7.2	Have multiple scenarios been run for operational /management alternatives?		Missing	Deficient	Adequate	Very Good			One mine plan. There are no nearby neighbouring mines requiring cumulative impact assessment.
7.3	Is the time horizon for prediction comparable with the length of the calibration / verification period?		Missing	No	Maybe	Yes			Calibration period 8 years (2011-2018). Prediction period 15 years (2019-2033).
7.4	Are the model predictions plausible?			No	Maybe	Yes			Closed basin would constrain drawdown to the mining lease. Drawdown maps are not presented; the focus is on water make.
8.0	SENSITIVITY ANALYSIS								
8.1	Is the sensitivity analysis sufficiently intensive for key parameters?		Missing	Deficient	Adequate	Very Good			Investigated for (1) a lineament – no effect; (2) fracturing height – minor effect.
8.2	Are sensitivity results used to qualify the reliability of model calibration?		Missing	Deficient	Adequate	Very Good			RMS statistics for 6 model variants.
8.3	Are sensitivity results used to qualify the accuracy of model prediction?		Missing	Deficient	Adequate	Very Good			For mine inflow predictions only.

9.0	UNCERTAINTY ANALYSIS								
9.1	If required by the project brief, is uncertainty quantified in any way?		Missing	No	Maybe	Yes			Investigation for 6 model variants by scenario analysis [IESC method 1 for low-risk projects}. Appropriate approach. Three realisations decalibrate the model, so are not reliable predictors.

Appendix F

General layout of mining zones at Airly Mine


220,000
225,000
230,000
N
Airly
Pit Top
WALLERAWANG-GWABEGAR
RAILWAY
GLEN DAVIS RD
Cliff line zone and zone of first workings
New Hartley Shale mine potential interaction zone
Panel and pillar mining zone
Partial pillar extraction zone
Shallow zone
LEGEND
Project Application Area
ML1331 Current Lease Boundary (Offset for Clarity)
A232 Authorisation Boundary (Offset for Clarity)
Rail
Main Road
Coordinate System: GDA 1994 MGA Zone 56
CENTENNIAL AIRLY PTY. LTD.
THIS DRAWING IS COPYRIGHT
NO PART OF IT IN ANY FORM OR BY ANY MEANS (ELECTRONIC, MECHANICAL, MICRO-COPYING, PHOTOCOPYING OR OTHERWISE) BE REPRODUCED, STORED IN A RETRIEVAL SYSTEM OR TRANSMITTED WITHOUT PRIOR WRITTEN PERMISSION
DATE 30/01/2015
SEAM LITHGOW
REFERENCE 137623024-R Rev 0
SCALE 1:50,000
Site
Newcastle
Lithgow
Sydney
Figure 3
Approved
Mining Zones
PLOTFILE No.
Centennial Coal
Airly
DRG No. 4-4.1
A4

Appendix B – Supporting assessment requirements

IESC information requirements (IESC 2018)

Assessment requirement	Where addressed
Surface water	
Context and conceptualisation	
Describe the hydrological regime of all watercourses, standing waters and springs across the site including: • geomorphology, including drainage patterns, sediment regime and floodplain features; • spatial, temporal and seasonal trends in streamflow and/or standing water levels; • spatial, temporal and seasonal trends in water quality data (such as turbidity, acidity, salinity, relevant organic chemicals, metals, metalloids and radionuclides); and, • current stressors on watercourses, including impacts from any currently approved projects.	Section 3.4
Describe the existing flood regime, including flood volume, depth, duration, extent and velocity for a range of annual exceedance probabilities. Provide flood hydrographs and maps identifying peak flood extent, depth and velocity. This assessment should be informed by topographic data that has been acquired using lidar or other reliable survey methods with accuracy stated.	Not relevant.
Provide an assessment of the frequency, volume, seasonal variability and direction of interactions between water resources, including surface water/ groundwater connectivity and connectivity with sea water.	Not relevant.
Analytical and numerical modelling	
Provide conceptual models at an appropriate scale, including water quality, stores, flows and use of water by ecosystems.	Section 4.2.
Describe and justify model assumptions and limitations, and calibrate with appropriate surface water monitoring data.	Section 4.2.
Use methods in accordance with the most recent publication of Australian Rainfall and Runoff (Ball et al. 2016).	Not relevant.
Provide an assessment of the risks and uncertainty inherent in the data used in the modelling, particularly with respect to predicted scenarios.	Section 4.2.
Develop and describe a program for review and update of the models as more data and information becomes available.	Section 7.
Provide a detailed description of any methods and evidence (e.g. expert opinion, analogue sites) employed in addition to modelling.	Not relevant.
Impacts to water resources and water-dependent assets	
Describe all potential impacts of the proposed project on surface waters. Include a clear description of the impact to the resource, the resultant impact to any assets dependent on the resource (including water-dependent ecosystems such as riparian zones and floodplains), and the consequence or significance of the impact. Consider: • Impacts on streamflow under the full range of flow conditions. • Impacts associated with surface water diversions. • Impacts to water quality, including consideration of mixing zones. • The quality, quantity and ecotoxicological effects of operational discharges of water (including saline water), including potential emergency discharges, and the likely impacts on water resources and water-dependent assets. • Landscape modifications such as subsidence, voids, post rehabilitation landform collapses, on-site earthworks (including disturbance of acid-forming or sodic soils, roadway and pipeline networks) and how these could affect surface water flow, surface water quality, erosion, sedimentation and habitat fragmentation of water-dependent species and communities.	Section 4.1.

Assessment requirement	Where addressed
Discuss existing water quality guidelines, environmental flow objectives and requirements for the surface water catchment(s) within which the development proposal is based.	Section 2.
Identify processes to determine surface water quality guidelines and quantity thresholds which incorporate seasonal variation but provide early indication of potential impacts to assets.	Not relevant. SSGVs already defined. Refer to Section 4.3
Propose mitigation actions for each identified significant impact.	Section 7.
Describe the adequacy of proposed measures to prevent or minimise impacts on water resources and water-dependent assets.	Section 7.
Describe the cumulative impact of the proposal on surface water resources and water-dependent assets when all developments (past, present and reasonably foreseeable) are considered in combination.	Not relevant.
Provide an assessment of the risks of flooding (including channel form and stability, water level, depth, extent, velocity, shear stress and stream power), and impacts to ecosystems, project infrastructure and the final project landform.	Not relevant.
Data and monitoring	
Identify monitoring sites representative of the diversity of potentially affected water-dependent assets and the nature and scale of potential impacts, and match with suitable replicated control and reference sites (BACI design) to enable detection and monitoring of potential impacts.	Not relevant, no change to existing monitoring program proposed or required.
Develop and describe a surface water monitoring program that will collect sufficient data to detect and identify the cause of any changes from established baseline conditions, and assess the effectiveness of mitigation and management measures. The program will: • include baseline monitoring data for physico-chemical parameters, as well as contaminants (e.g. metals); • comparison of physico-chemical data to national/regional guidelines or to site-specific guidelines derived from reference condition monitoring if available; and, • identify baseline contaminant concentrations and compare these to national guidelines, allowing for local background correction if required.	
Ensure water quality monitoring complies with relevant National Water Quality Management Strategy (NWQMS) guidelines (ANZECC/ARMCANZ 2000) and relevant legislated state protocols (e.g. QLD Government 2013).	
Describe the rationale for selected monitoring parameters, duration, frequency and methods, including the use of satellite or aerial imagery to identify and monitor large-scale impacts.	
Identify data sources, including streamflow data, proximity to rainfall stations, data record duration and describe data methods, including whether missing data have been patched.	
Develop and describe a plan for ongoing ecotoxicological monitoring, including direct toxicity assessment of discharges to surface waters where appropriate.	
Identify dedicated sites to monitor hydrology, water quality, and channel and floodplain geomorphology throughout the life of the proposed project and beyond.	
Water and salt balance, and water quality	
Provide a quantitative site water balance model describing the total water supply and demand under a range of rainfall conditions and allocation of water for mining activities (e.g. dust suppression, coal washing etc.), including all sources and uses.	Section 5.3 and Section 6.2

Assessment requirement	Where addressed
Provide estimates of the quality and quantity of operational discharges under dry, median and wet conditions, potential emergency discharges due to unusual events and the likely impacts on water-dependent assets.	
Describe the water requirements and on-site water management infrastructure, including modelling to demonstrate adequacy under a range of potential climatic conditions.	
Provide salt balance modelling that includes stores and the movement of salt between stores, and takes into account seasonal and long-term variation.	
Cumulative impacts	
Context and conceptualisation	
Provide cumulative impact analysis with sufficient geographic and temporal boundaries to include all potentially significant water-related impacts.	Not applicate. No significant cumulative impact identified.
Consider all past, present and reasonably foreseeable actions, including development proposals, programs and policies that are likely to impact on the water resources of concern in the cumulative impact analysis. Where a proposed project is located within the area of a bioregional assessment consider the results of the bioregional assessment.	Not applicate. No significant cumulative impact identified.
Impacts	
Provide an assessment of the condition of affected water resources which includes: • identification of all water resources likely to be cumulatively impacted by the proposed development; • a description of the current condition and quality of water resources and information on condition trends; • identification of ecological characteristics, processes, conditions, trends and values of water resources; • adequate water and salt balances; and, • identification of potential thresholds for each water resource and its likely response to change and capacity to withstand adverse impacts (e.g. altered water quality, drawdown).	Not applicate. No significant cumulative impact identified.
Assess the cumulative impacts to water resources considering: • the full extent of potential impacts from the proposed project, (including whether there are alternative options for infrastructure and mine configurations which could reduce impacts), and encompassing all linkages, including both direct and indirect links, operating upstream, downstream, vertically and laterally; • all stages of the development, including exploration, operations and post closure/decommissioning; • appropriately robust, repeatable and transparent methods; • the likely spatial magnitude and timeframe over which impacts will occur, and significance of cumulative impacts; and, • opportunities to work with other water users to avoid, minimise or mitigate potential cumulative impacts.	Not applicate. No significant cumulative impact identified.
Mitigation, monitoring and management	
Identify modifications or alternatives to avoid, minimise or mitigate potential cumulative impacts. Evidence of the likely success of these measures (e.g. case studies) should be provided.	Not applicate. No significant
Identify cumulative impact environmental objectives.	

Assessment requirement	Where addressed
Identify measures to detect and monitor cumulative impacts, pre and post development, and assess the success of mitigation strategies.	cumulative impact identified.
Describe appropriate reporting mechanisms.	
Propose adaptive management measures and management responses.	
Final landform and voids – coal mines	
Identify and consider landscape modifications (e.g. voids, on-site earthworks, and roadway and pipeline networks) and their potential effects on surface water flow, erosion, sedimentation and habitat fragmentation of water-dependent species and communities.	Not applicable. No final void proposed.
Provide an assessment of the long-term impacts to water resources and water-dependent assets posed by various options for the final landform design, including complete or partial backfilling of mining voids. Assessment of the final landform for which approval is being sought should consider: • groundwater behaviour – sink or lateral flow from void. • water level recovery – rate, depth, and stabilisation point (e.g. timeframe and level in relation to existing groundwater level, surface elevation). • seepage – geochemistry and potential impacts. • long-term water quality, including salinity, pH, metals and toxicity. • measures to prevent migration of void water off-site. For other final landform options considered sufficient detail of potential impacts should be provided to clearly justify the proposed option.	
Assess the adequacy of modelling, including surface water and groundwater quantity and quality, lake behaviour, timeframes and calibration.	
Provide an evaluation of stability of void slopes where failure during extreme events or over the long term (for example due to aquifer recovery causing geological heave and landform failure) may have implications for water quality.	
Evaluate mitigating inflows of saline groundwater by planning for partial backfilling of final voids.	
Assess the probability of overtopping of final voids with variable climate extremes, and management mitigations.	

Appendix C – Water and salt balance model

Since the 2014 EIS, the site water and salt balance model has been regularly updated to reflect improved site information. In particular, the following changes to the model have occurred:

- Adoption of groundwater inflow predictions from revised hydrogeological modelling
- Recognition that reduced predicted groundwater inflows are likely to report only as ROM coal moisture and not require dewatering from the underground to the surface
- The production bore contributes to 35 ML Discharge Dam, rather than the 109 ML Dirty Water Dam
- Reduction in the production bore extraction rate
- Reduction in dust suppression demands to match actual site usage
- Detailed stage storage relationships for surface water storages based on bathymetry and survey
- Adjustments to catchment areas and land use to reflect improved survey and aerial imagery as well as changes in site water management system (in particular the 7 ML Dam catchment)
- Updates to salinity (EC) parameters based on observed monitoring data

The modelling parameters are compared in Table B-1, the changes to storage geometry and catchment areas are summarised in Table B-2 and Table B-3 respectively. Changes to the runoff model parameters are summarised in Table B-4.

Table C-1 Modelling parameters

Category	Parameter	Original model (proposed conditions in GHD 2014)	Current model
Production	ROM extraction rate	1.8 Mtpa	1.8 Mtpa
	Site personnel	155 FTE	155 FTE
Amenities	Drinking water usage	2.2 L/day/FTE	2.2 L/day/FTE
	Shower usage	11.3 L/day/FTE	11.3 L/day/FTE
	Toilet usage	26.5 L/day/FTE	26.5 L/day/FTE
Mining support operations	Underground mining operations	80 L/tonne ROM coal	50 L/tonne ROM coal
	CPP water demand (gross)	120 L/tonne ROM coal	120 L/tonne ROM coal
	Dust suppression	100 ML/year	5 ML/year
	Washdown	5 ML/year	5 ML/year
Coal moisture	In situ coal moisture	2.5%	2.5%
	ROM coal moisture	8%	Varies with groundwater inflows
	Beneficiated coal moisture	9%	Varies with groundwater inflows
	Coarse rejects moisture	9%	9%
	Fine rejects moisture	26%	26%
Coal processing	Product coal mass fraction	80%	80%
	Coarse rejects mass fraction	15%	15%
	Fine rejects mass fraction	5%	5%

Category	Parameter	Original model (proposed conditions in GHD 2014)	Current model
Maximum transfer rates	Train Loader Dam to 109 ML Dirty Water Dam	5 L/s	5 L/s (existing conditions/baseline conditions) 100 L/s (proposed conditions)
	7 ML Dam to 109 ML Dirty Water Dam	48 L/s	48 L/s
	Production bore extraction	9 L/s up to 278 ML/year	5 L/s up to 158 ML/year
	REA Dam to 109 ML Dirty Water Dam	25 L/s	20 L/s
Salinity data	Rainfall	20 µS/cm	30 µS/cm
	Clean catchment runoff	185 µS/cm	120 µS/cm
	Coal-contact runoff	653 µS/cm	450 µS/cm
	Groundwater inflows into underground workings	900 µS/cm	830 µS/cm
	Groundwater extracted from production bore	4626 µS/cm	4830 µS/cm

Table C-2 Storage capacities

Storage	Original model (GHD 2014)	Current model
7 ML Dam	7 ML	7.24 ML
Train Loader Dam	0.78 ML	0.71 ML
Settling Pond	3 ML	3 ML
109 ML Dirty Water Dam	109 ML	98.08 ML
35 ML Discharge Dam	35 ML	22.88 ML
Process Water Tank	0.746 ML	0.746 ML
Administration Buildings Tank	0.14 ML	0.19 ML
Header Tanks	0.04 ML	0.04 ML
REA Dam	52.4 ML	52.4 ML

Table C-3 Catchment area data

Storage	Original model (GHD 2014)				Revised model			
	Catchment area (ha)	Vegetated catchment (%)	Impervious catchment (%)	Disturbed/ compacted catchment (%)	Catchment area (ha)	Vegetated catchment (%)	Impervious catchment (%)	Disturbed/ compacted catchment (%)
7 ML Dam – without CPP	5.7	29	71	0	14.1	38	62	0
7 ML Dam – with CPP	7.2	23	77	0	14.1	38	62	0
Train Loader Dam	0.4	0	100	0	0.5	36	64	0
Settling Pond	32.8	86	14	0	33.0	99	1	0
109 ML Dirty Water Dam	53.1	75	25	0	56.8	85	15	0
35 ML Discharge Dam	5.9	90	10	0	6.7	95	5	0
Administration Buildings Tank	0.2	0	100	0	0.1	0	100	0
REA Dam	45.0	40	0	60	46.6	71	1	28

Table C-4 AWBM parameters

Parameter	Original model (GHD 2014)			Revised model		
	Vegetated catchment	Impervious catchment	Disturbed/ compacted catchment	Vegetated catchment	Impervious catchment	Disturbed/ compacted catchment
A_1, A_2, A_3	0.134, 0.433, 0.433	1.0, 0.0, 0.0	0.134, 0.433, 0.433	0.134, 0.433, 0.433	1.0, 0.0, 0.0	0.134, 0.433, 0.433
C_1, C_2, C_3	18.0, 182.88, 365.76 ($C_{average}$ = 240)	7.0, 0.0, 0.0	7.0, 14.0, 30.0	18.0, 182.9, 365.8 ($C_{average}$ = 240)	7.0, 0.0, 0.0	0.7, 7.6, 15.2 ($C_{average}$ = 10)
BFI	0.0	0.0	0.0	0.3	0.0	0.3
K_b	0.813	0.813	0.813	0.98	0.0	0.98
K_s	0.5	0.0	0.5			

Appendix D – Historical water quality

D.1 Airly Mine

D.1.1 Statistical summary

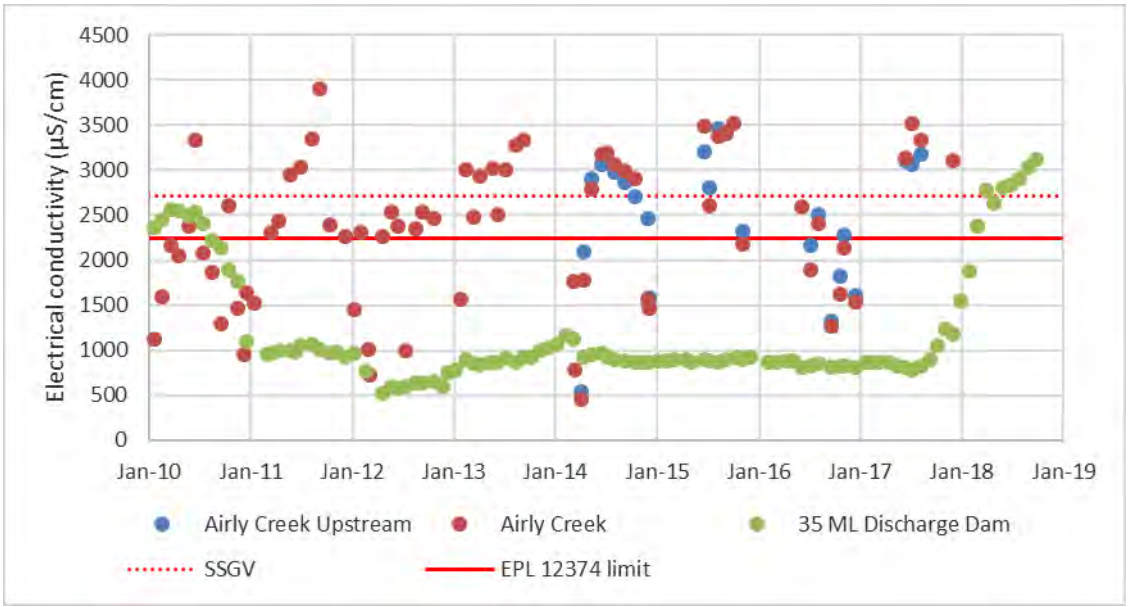
Parameter	Units	Airly Creek Upstream				Airly Creek				35 ML Discharge Dam			
		Count	10th percentile	Median	90th percentile	Count	10th percentile	Median	90th percentile	Count	10th percentile	Median	90th percentile
Physicochemical parameters													
EC	µS/cm	25	1580	2710	3194	71	1270	2390	3340	103	780	900	2482
pH	pH units	25	7.3	7.5	7.9	71	7.0	7.4	7.8	103	8.1	8.4	9.0
TSS	mg/L	25	1	2	5	71	2	4	74	103	1	2	8
Turbidity	NTU	24	0.8	1.9	6.2	45	0.4	2.0	79.3	78	0.7	1.5	4.8
Nutrients													
Ammonia	mg/L	25	0.01	0.01	0.04	45	0.01	0.02	0.06	80	0.01	0.01	0.04
Nitrate	mg/L	25	0.01	0.01	0.07	45	0.01	0.01	0.06	80	0.01	0.01	0.04
Nitrite	mg/L	25	0.01	0.01	0.01	45	0.01	0.01	0.01	80	0.01	0.01	0.01
Nitrate + nitrite	mg/L	25	0.01	0.01	0.07	45	0.01	0.01	0.06	80	0.01	0.01	0.04
Total Kjeldahl nitrogen	mg/L	25	0.1	0.4	0.7	45	0.2	0.4	1.5	80	0.1	0.3	0.4
Total nitrogen	mg/L	25	0.1	0.4	0.7	45	0.2	0.5	1.6	80	0.1	0.3	0.5
Total phosphorus	mg/L	25	0.01	0.01	0.09	45	0.01	0.02	0.22	80	0.01	0.01	0.04
Major ions													
Bicarbonate alkalinity	mg/L	25	79	142	188	46	60	127	218	80	69	91	119
Carbonate alkalinity	mg/L	25	1	1	1	46	1	1	1	80	1	1	8
Hydroxide alkalinity	mg/L	25	1	1	1	46	1	1	1	80	1	1	1
Total alkalinity	mg/L	25	79	142	188	46	60	127	218	80	76	94	120
Calcium	mg/L	25	123	252	301	46	119	255	320	80	42	52	159
Chloride	mg/L	25	29	48	69	46	28	64	111	80	30	47	100

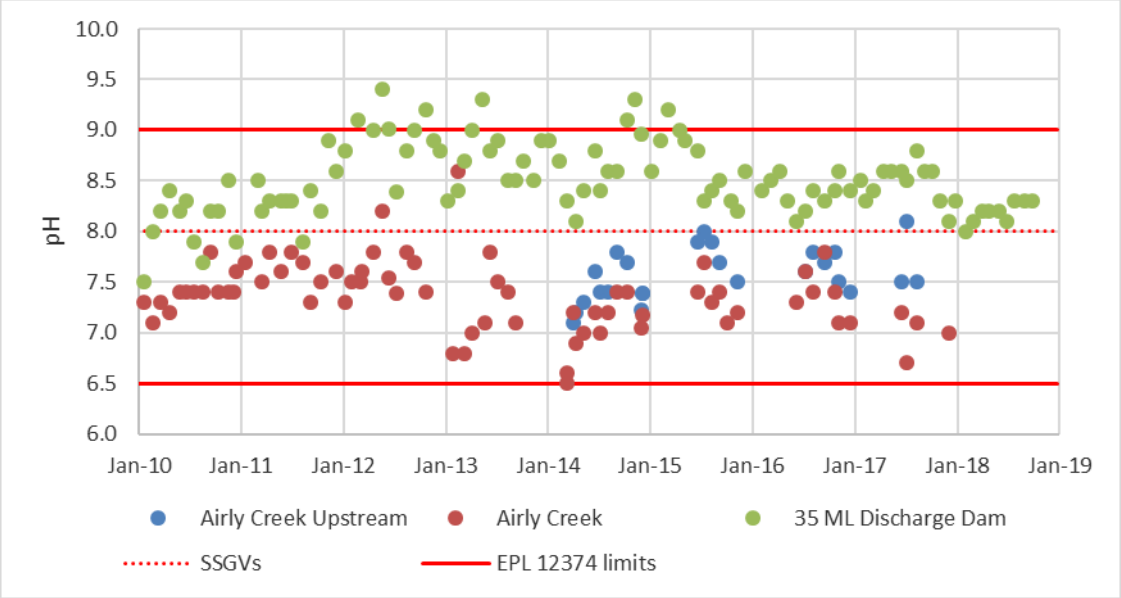
Parameter	Units	Airly Creek Upstream				Airly Creek				35 ML Discharge Dam			
		Count	10th percentile	Median	90th percentile	Count	10th percentile	Median	90th percentile	Count	10th percentile	Median	90th percentile
Magnesium	mg/L	25	107	228	273	46	103	238	302	80	47	55	169
Potassium	mg/L	25	4	5	7	46	4	6	9	80	6	8	10
Sodium	mg/L	25	40	80	91	46	41	89	119	80	34	45	89
Sulfate	mg/L	25	79	1380	1770	46	723	1460	1885	80	222	283	910
Dissolved metals													
Aluminium	mg/L	25	0.01	0.01	0.02	46	0.01	0.01	0.01	81	0.01	0.01	0.02
Antimony	mg/L	24	0.001	0.001	0.001	45	0.001	0.001	0.001	80	0.001	0.001	0.001
Arsenic	mg/L	25	0.001	0.001	0.001	46	0.001	0.001	0.001	81	0.001	0.001	0.001
Barium	mg/L	25	0.011	0.015	0.018	46	0.011	0.016	0.027	81	0.035	0.048	0.068
Beryllium	mg/L	25	0.001	0.001	0.001	46	0.001	0.001	0.001	81	0.001	0.001	0.001
Boron	mg/L	25	0.05	0.05	0.05	45	0.05	0.05	0.05	81	0.05	0.05	0.05
Cadmium	mg/L	25	0.0001	0.0001	0.0001	46	0.0001	0.0001	0.0001	81	0.0001	0.0001	0.0001
Chromium	mg/L	25	0.001	0.001	0.001	46	0.001	0.001	0.001	81	0.001	0.001	0.001
Cobalt	mg/L	25	0.001	0.001	0.001	46	0.001	0.001	0.003	81	0.001	0.001	0.001
Copper	mg/L	25	0.001	0.001	0.002	46	0.001	0.001	0.003	81	0.001	0.001	0.001
Iron	mg/L	25	0.05	0.07	0.16	67	0.05	0.05	0.20	102	0.05	0.05	0.05
Lead	mg/L	25	0.001	0.001	0.001	47	0.001	0.001	0.001	82	0.001	0.001	0.001
Manganese	mg/L	25	0.053	0.126	0.461	68	0.026	0.157	0.892	102	0.012	0.040	0.128
Mercury	mg/L	23	0.0001	0.0001	0.0001	45	0.0001	0.0001	0.0001	81	0.0001	0.0001	0.0001
Molybdenum	mg/L	25	0.001	0.001	0.001	46	0.001	0.001	0.001	81	0.001	0.001	0.001
Nickel	mg/L	25	0.004	0.005	0.009	46	0.003	0.006	0.012	81	0.002	0.002	0.004
Selenium	mg/L	25	0.01	0.01	0.01	46	0.01	0.01	0.01	81	0.01	0.01	0.01
Silver	mg/L	24	0.001	0.001	0.001	45	0.001	0.001	0.001	80	0.001	0.001	0.001
Zinc	mg/L	25	0.005	0.005	0.009	46	0.005	0.006	0.021	81	0.005	0.005	0.008
Total metals													
Aluminium	mg/L	25	0.01	0.01	0.07	46	0.01	0.03	0.57	81	0.02	0.03	0.09
Arsenic	mg/L	25	0.001	0.001	0.001	46	0.001	0.001	0.003	81	0.001	0.001	0.001
Barium	mg/L	25	0.012	0.016	0.020	46	0.011	0.017	0.049	81	0.037	0.050	0.067

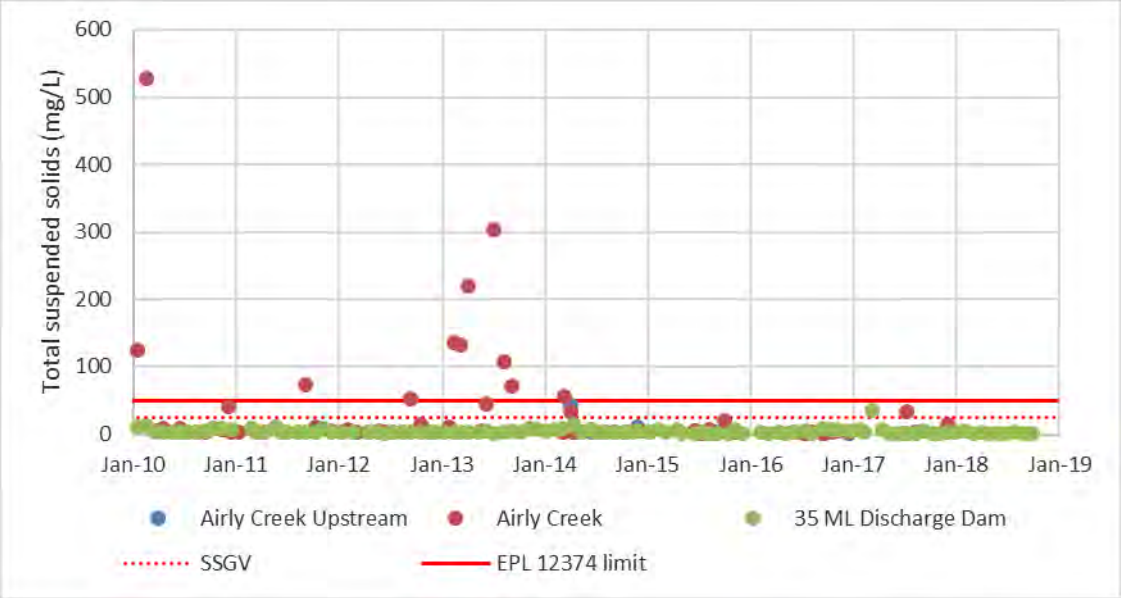
Parameter	Units	Airly Creek Upstream				Airly Creek				35 ML Discharge Dam			
		Count	10th percentile	Median	90th percentile	Count	10th percentile	Median	90th percentile	Count	10th percentile	Median	90th percentile
Boron	mg/L	25	0.05	0.05	0.05	46	0.05	0.05	0.05	81	0.05	0.05	0.05
Cadmium	mg/L	25	0.0001	0.0001	0.0001	46	0.0001	0.0001	0.0001	81	0.0001	0.0001	0.0001
Cobalt	mg/L	25	0.001	0.001	0.001	46	0.001	0.001	0.023	81	0.001	0.001	0.001
Iron	mg/L	25	0.05	0.07	0.16	68	0.09	0.38	8.85	103	0.05	0.08	0.22
Lead	mg/L	25	0.001	0.001	0.001	46	0.001	0.001	0.002	82	0.001	0.001	0.001
Manganese	mg/L	25	0.052	0.153	0.487	68	0.041	0.339	6.84	102	0.012	0.040	0.128
Mercury	mg/L	25	0.0001	0.0001	0.0001	46	0.0001	0.0001	0.0001	81	0.0001	0.0001	0.0001
Nickel	mg/L	25	0.003	0.005	0.009	46	0.004	0.007	0.014	81	0.002	0.002	0.004
Selenium	mg/L	25	0.01	0.01	0.01	46	0.01	0.01	0.01	81	0.01	0.01	0.01
Silver	mg/L	24	0.001	0.001	0.001	45	0.001	0.001	0.001	80	0.001	0.001	0.001
Zinc	mg/L	25	0.005	0.005	0.011	46	0.005	0.009	0.054	81	0.005	0.005	0.007
Other parameters													
Cyanide (total)	mg/L	25	0.004	0.004	0.004	44	0.004	0.004	0.004	79	0.004	0.004	0.004
Fluoride	mg/L	24	0.2	0.2	0.3	44	0.1	0.2	0.3	79	0.2	0.2	0.3
Oil and grease	mg/L	25	5	5	5	70	2	5	5	103	2	5	5

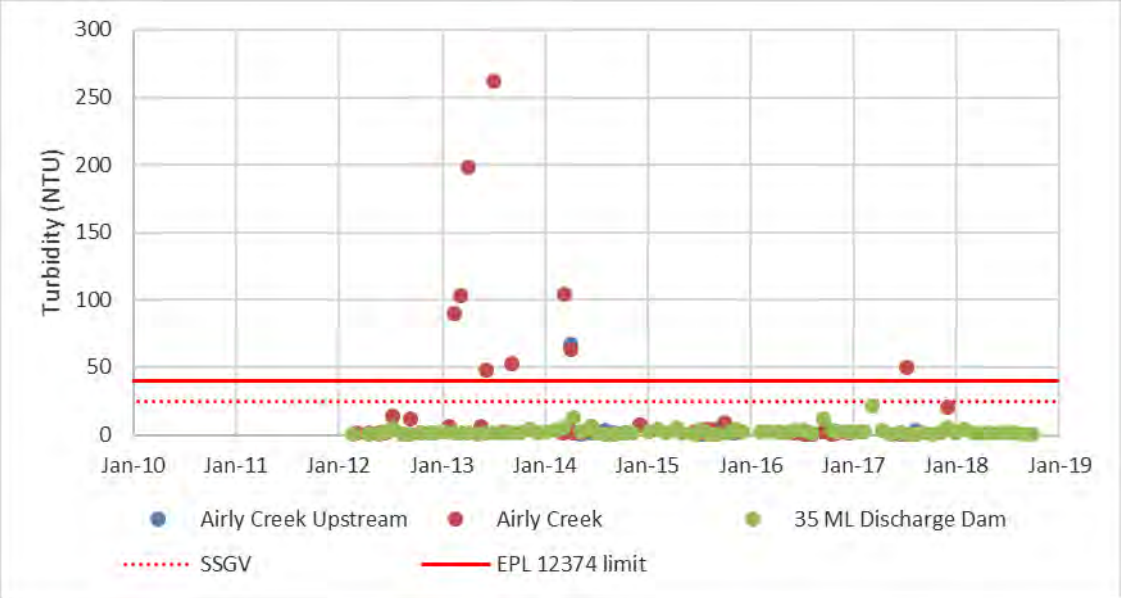
D.1.2 Time series graphs

Physicochemical parameters

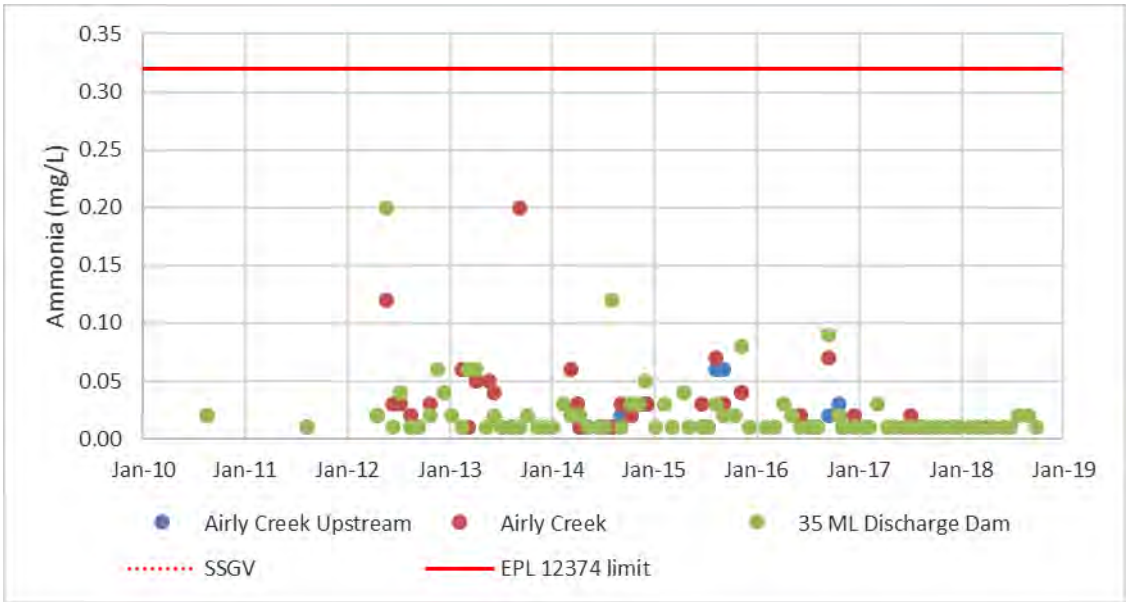


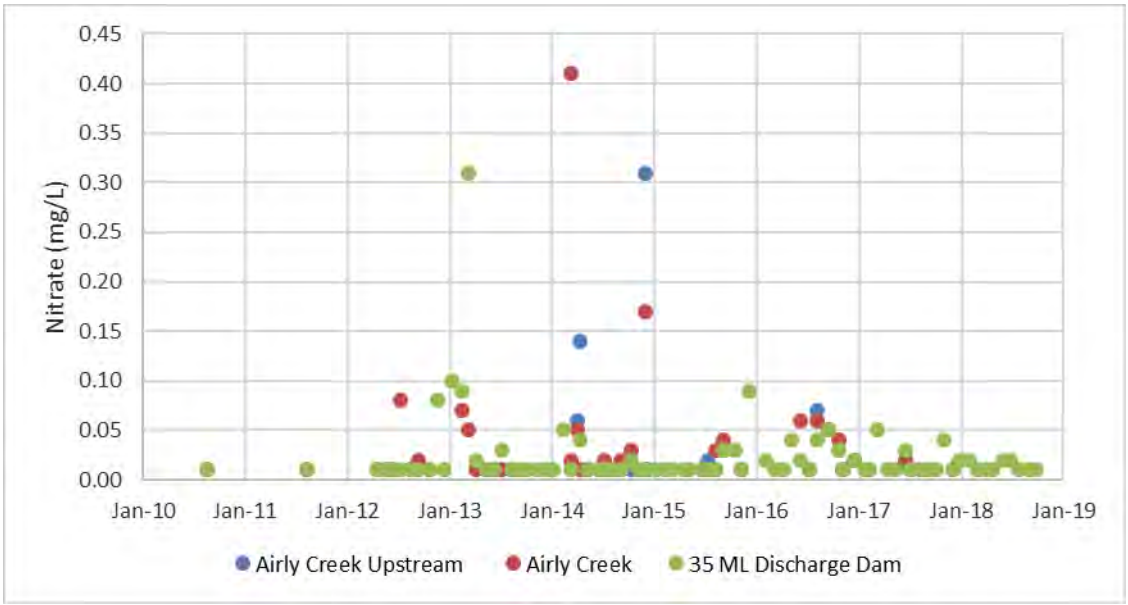


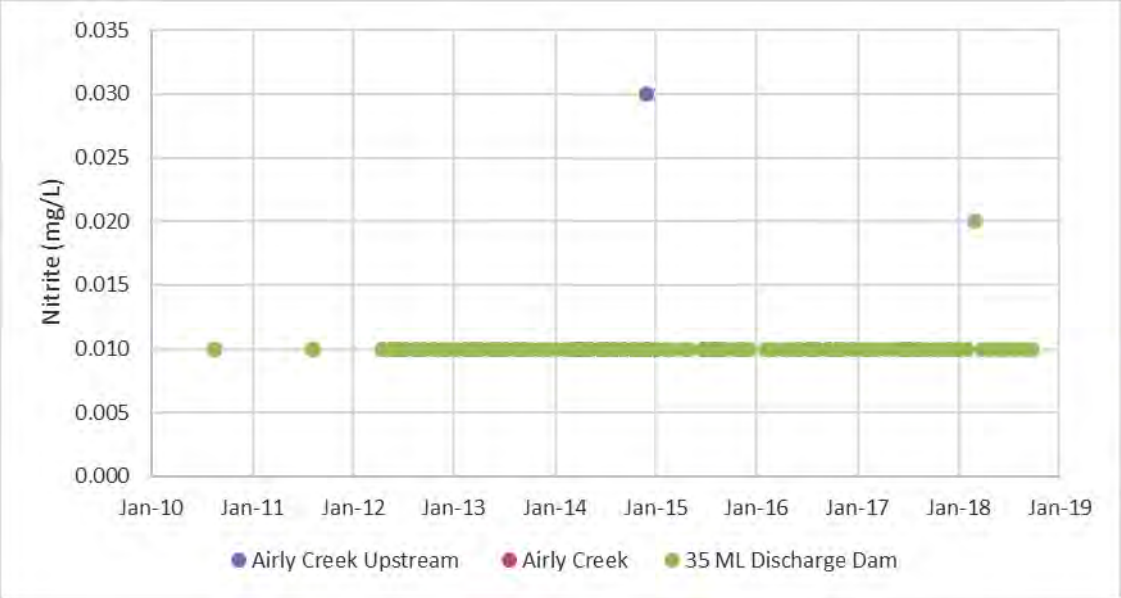

Total suspended solids (mg/L)
600
500
400
300
200
100
0
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam
SSGV
EPL 12374 limit

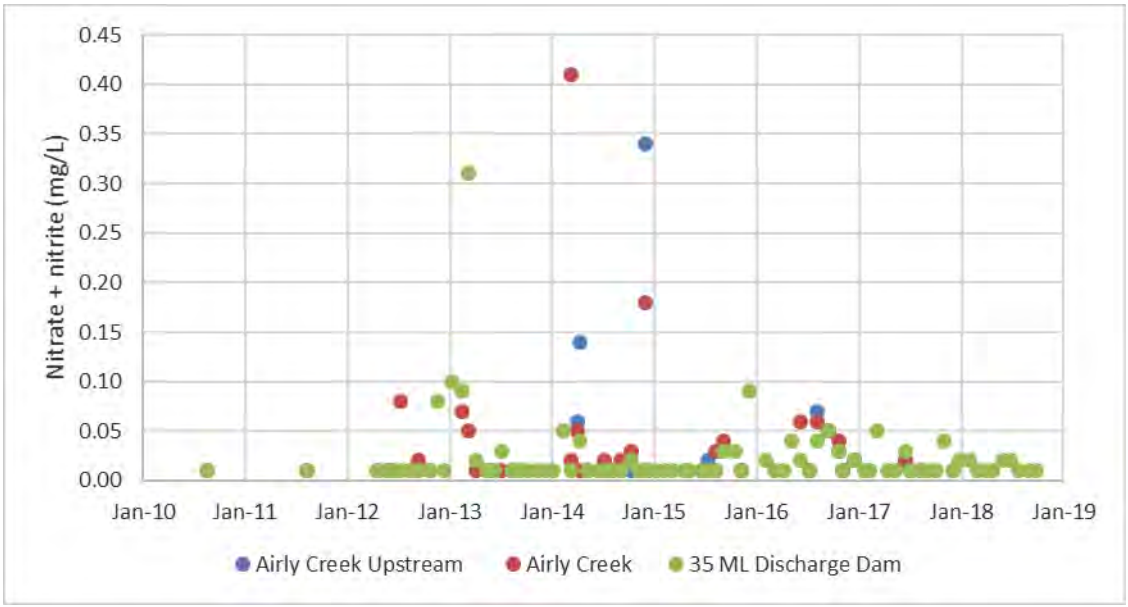

Turbidity (NTU)
300
250
200
150
100
50
0
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam
SSGV
EPL 12374 limit

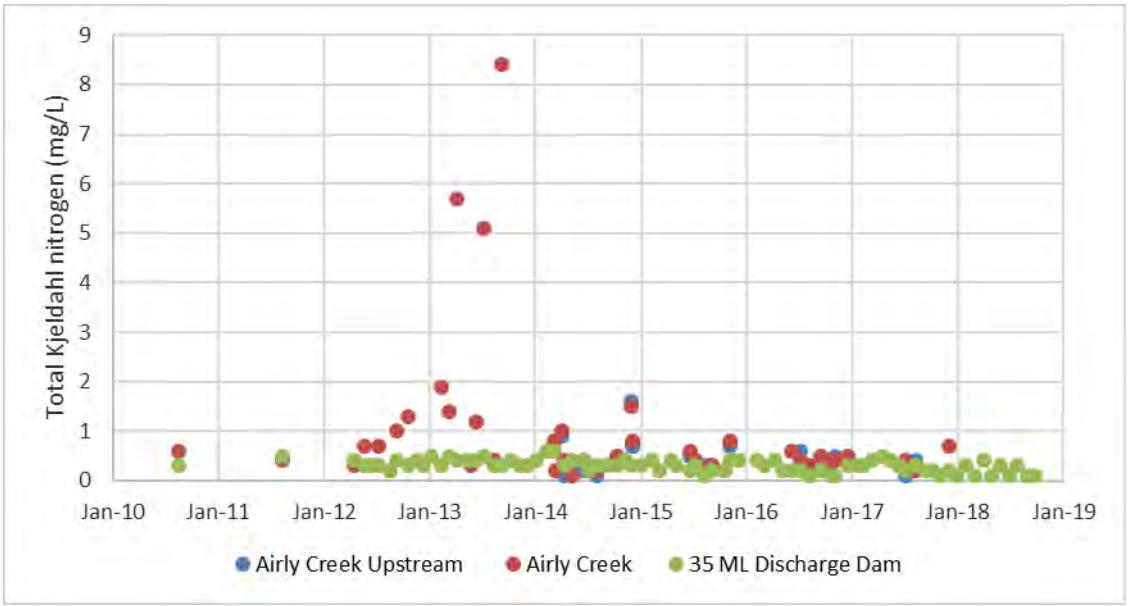
Nutrients

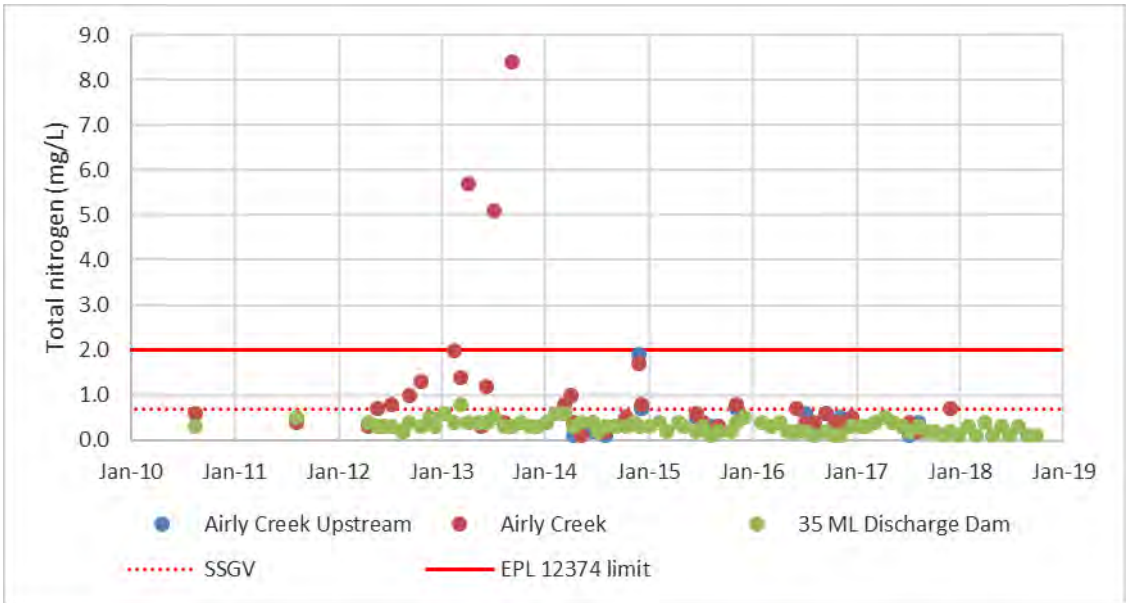

Ammonia (mg/L)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam
SSGV
EPL 12374 limit

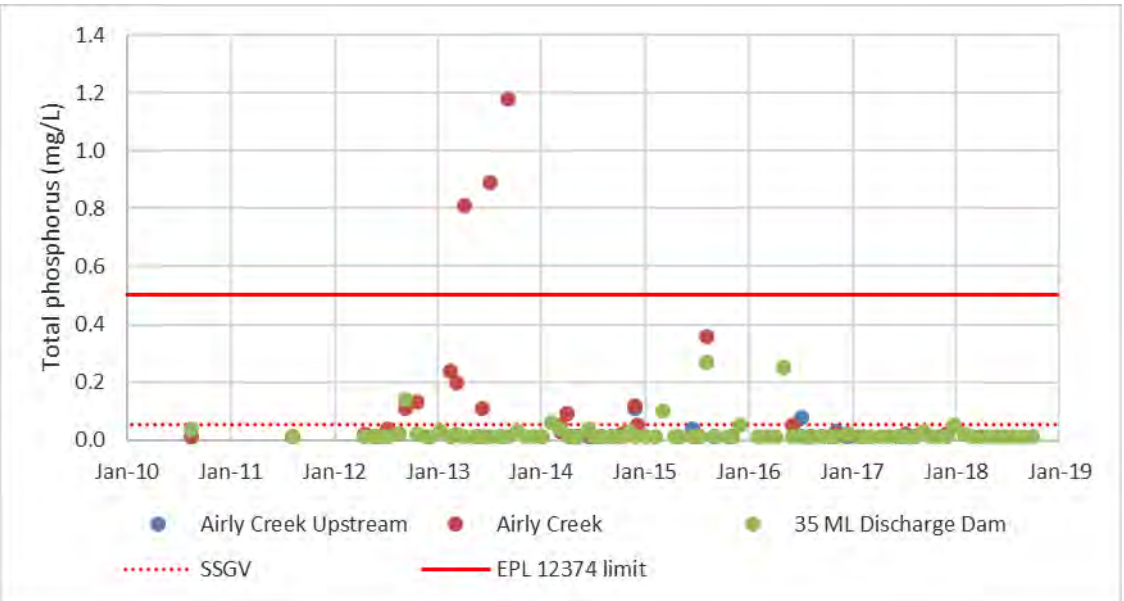

0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Nitrate (mg/L)
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam


0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
Nitrite (mg/L)
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam

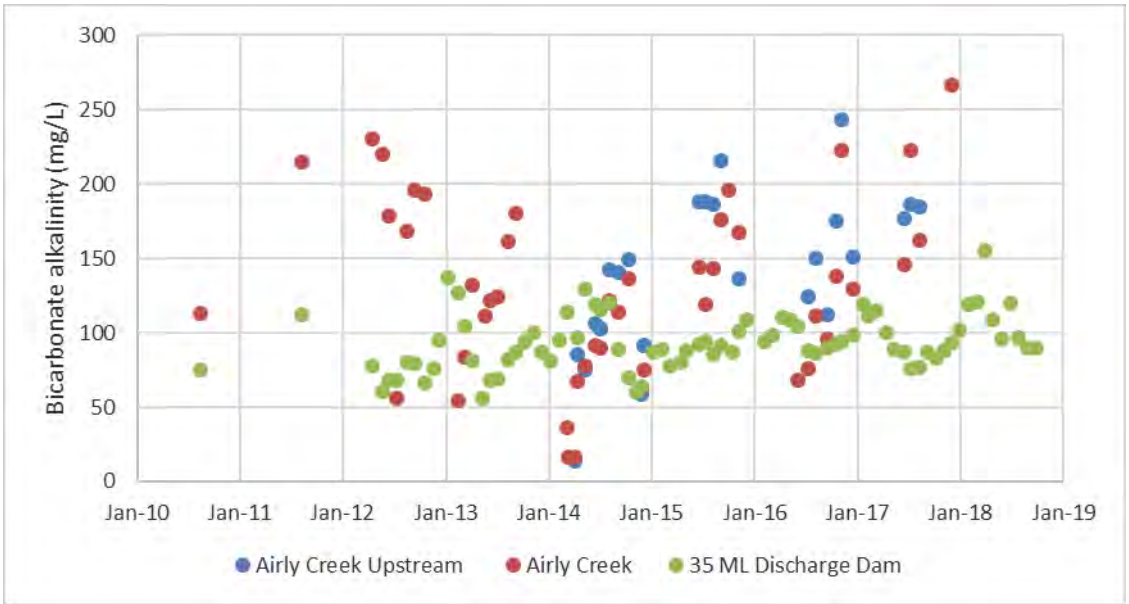

0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Nitrate + nitrite (mg/L)
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam

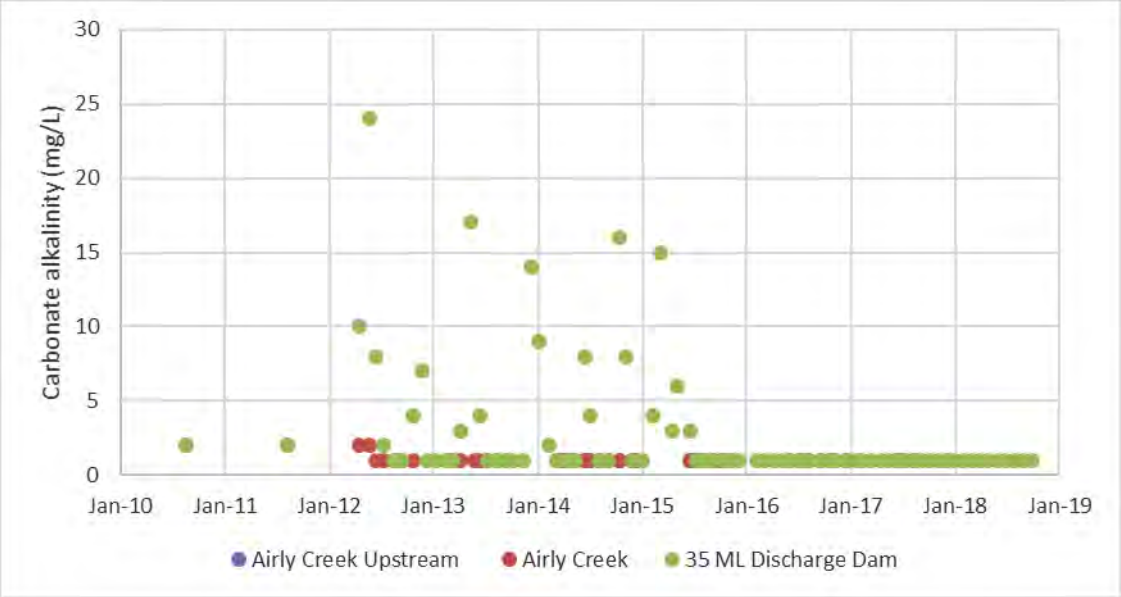

Total Kjeldahl nitrogen (mg/L)
9
8
7
6
5
4
3
2
1
0
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam

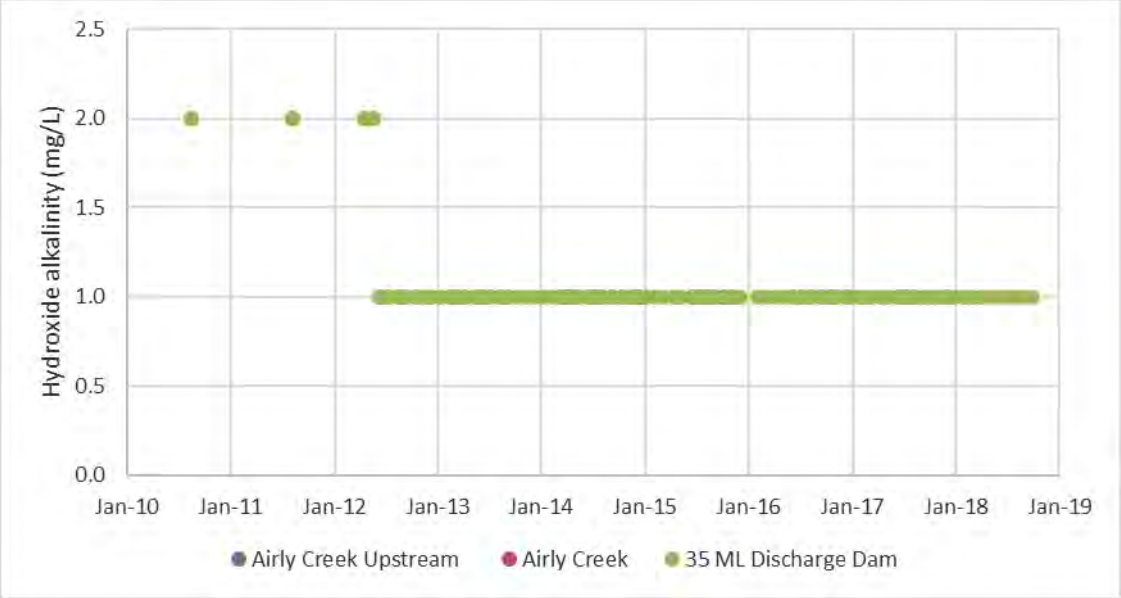

Total nitrogen (mg/L)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam
SSGV
EPL 12374 limit

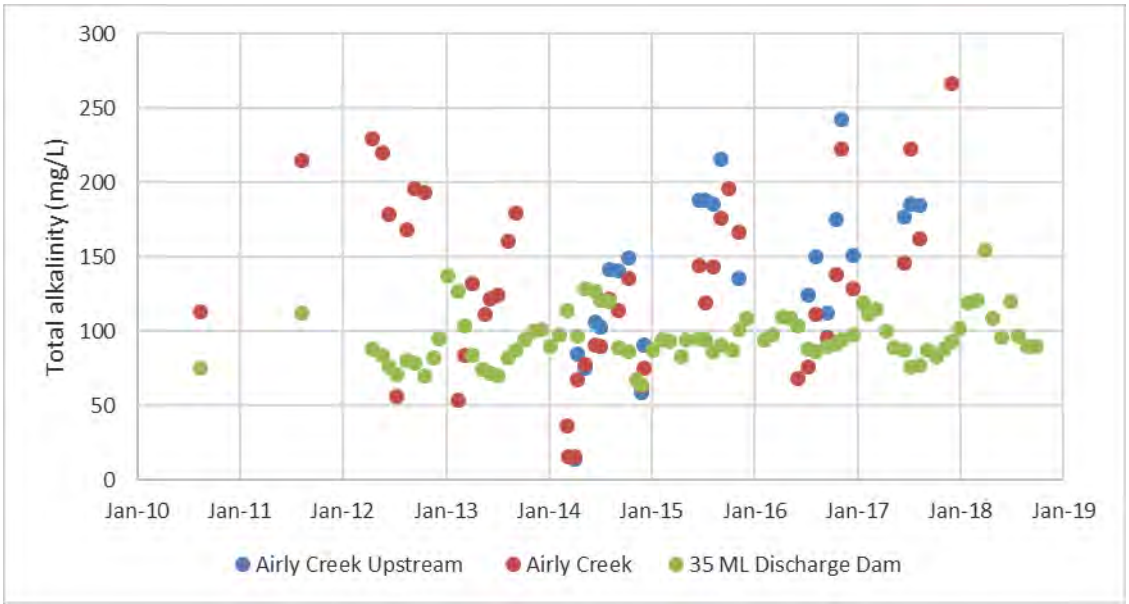

Total phosphorus (mg/L)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam
SSGV
EPL 12374 limit

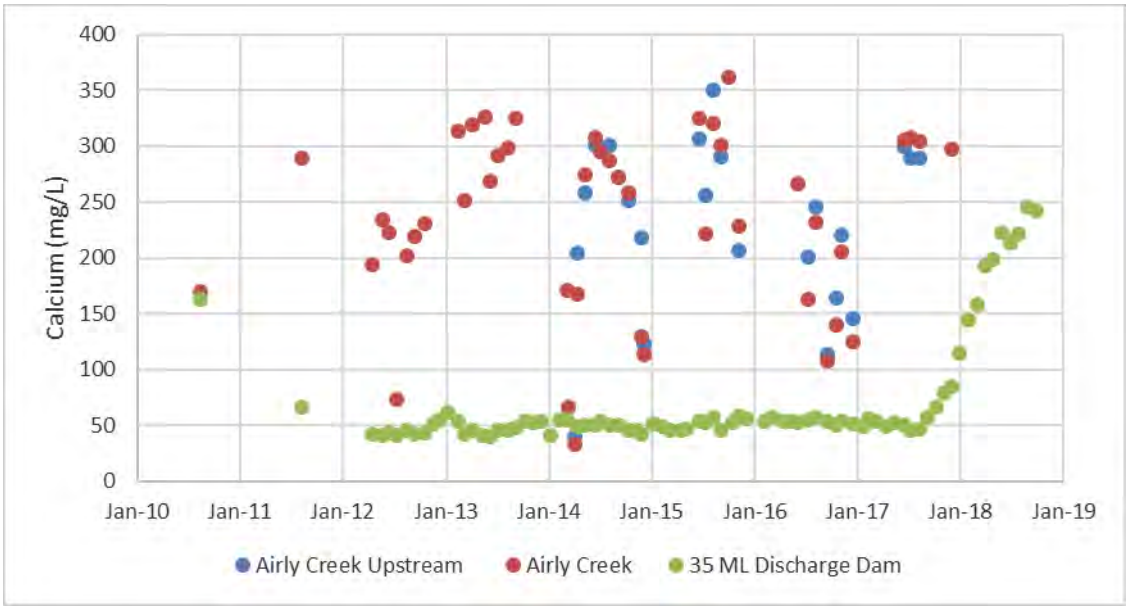
Major ions

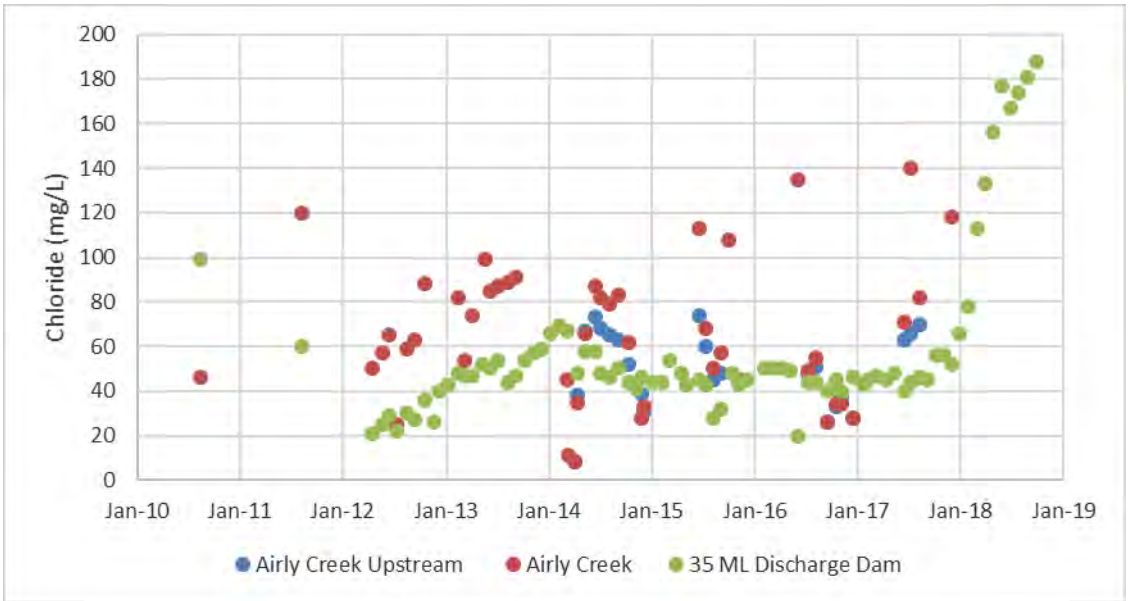

Bicarbonate alkalinity (mg/L)
300
250
200
150
100
50
0
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam

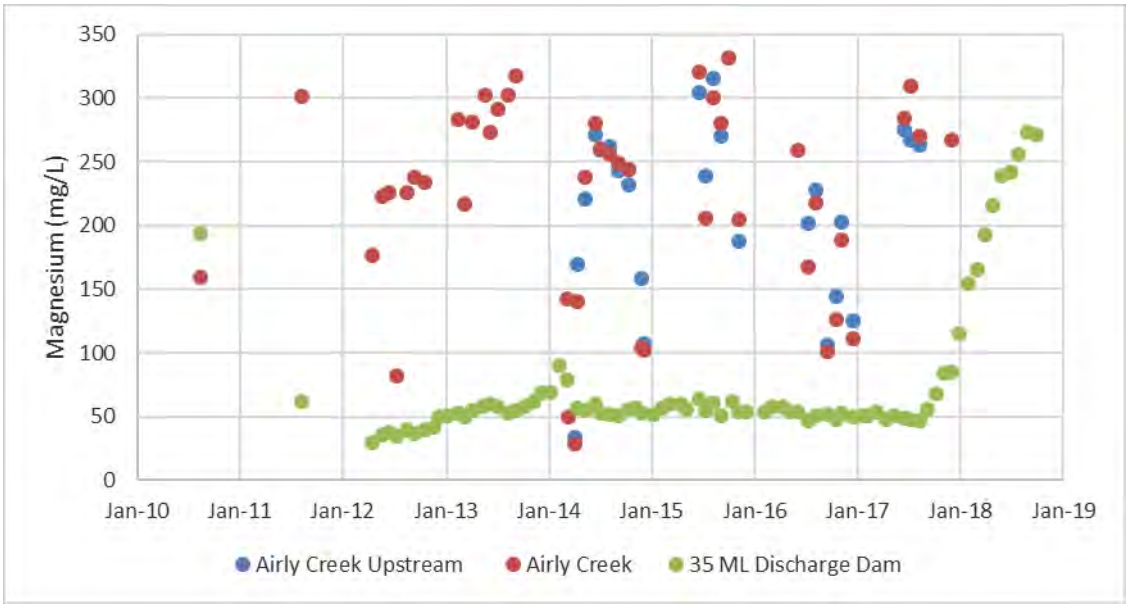

Carbonate alkalinity (mg/L)
30
25
20
15
10
5
0
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam

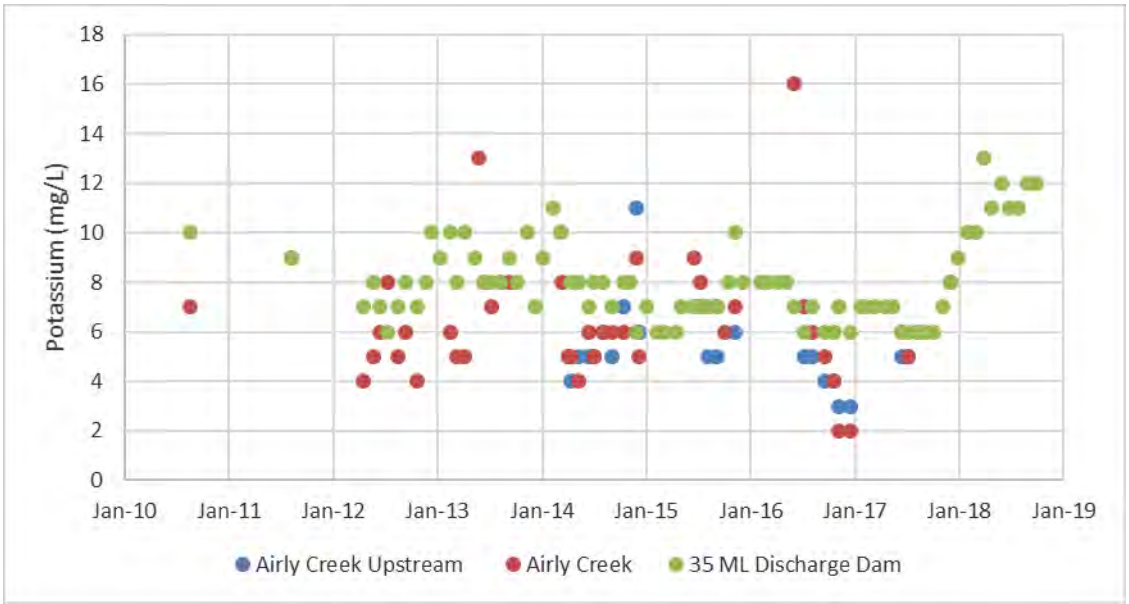

Hydroxide alkalinity (mg/L)
2.5
2.0
1.5
1.0
0.5
0.0
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam

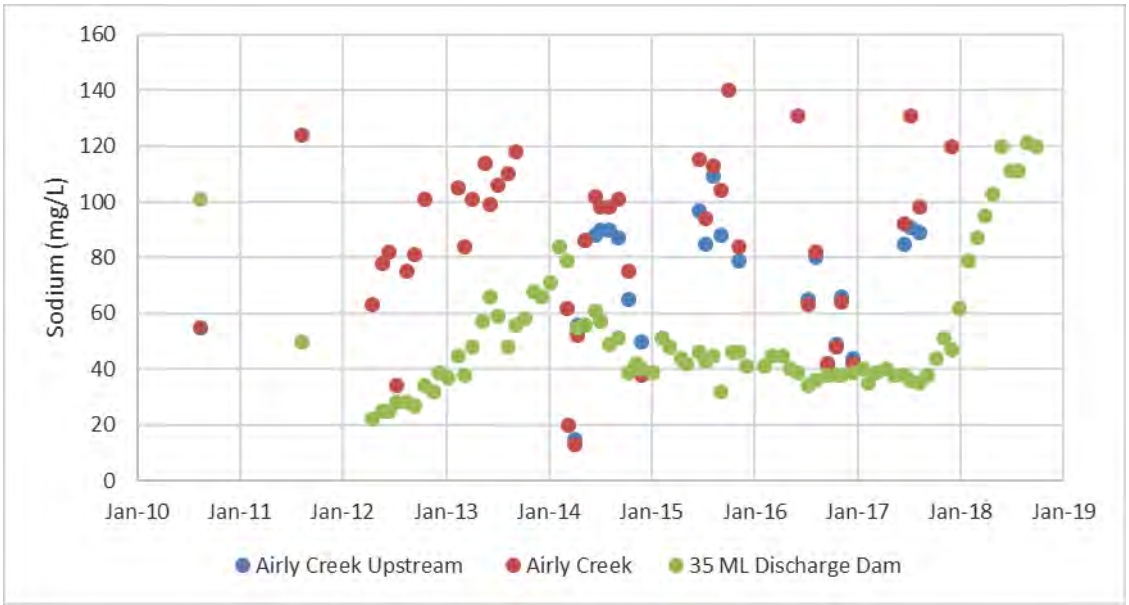

Total alkalinity (mg/L)
300
250
200
150
100
50
0
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam

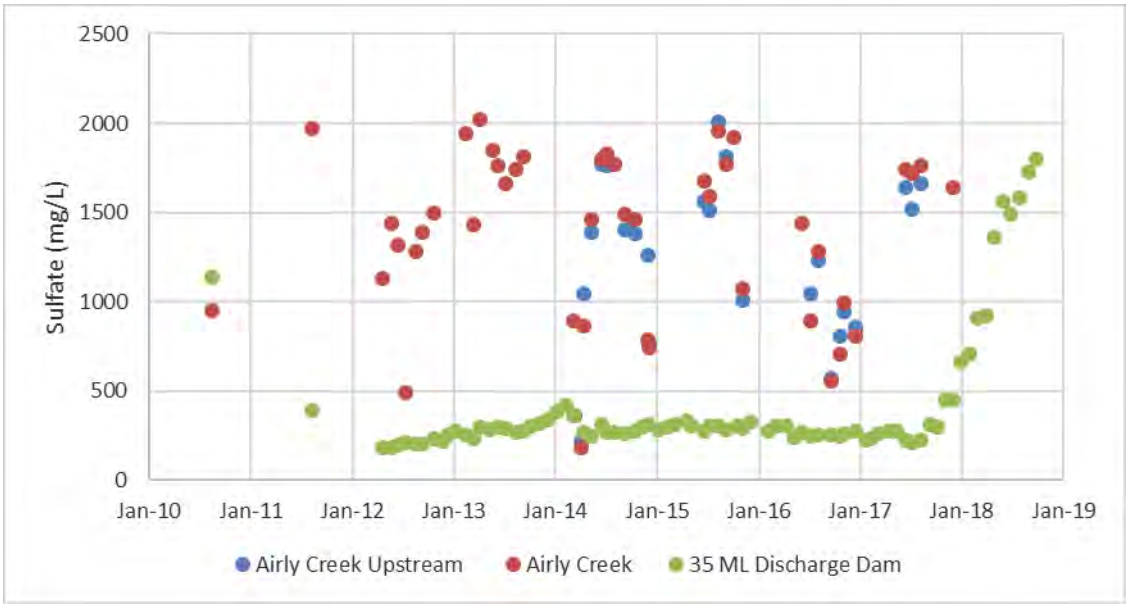

Calcium (mg/L)
400
350
300
250
200
150
100
50
0
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam


Chloride (mg/L)
200
180
160
140
120
100
80
60
40
20
0
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam

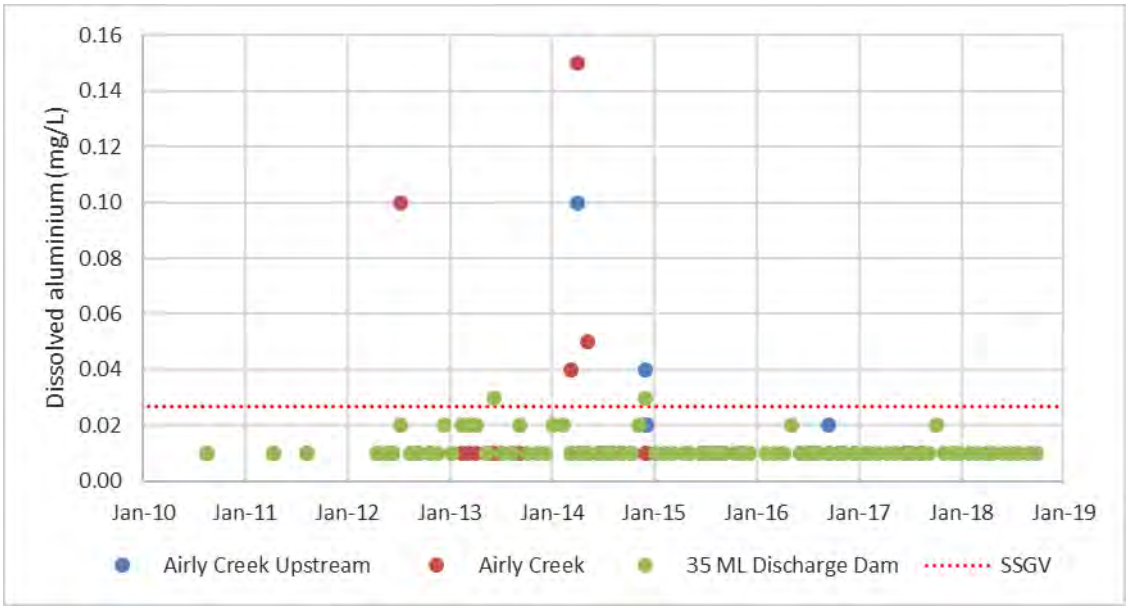

Magnesium (mg/L)
350
300
250
200
150
100
50
0
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam

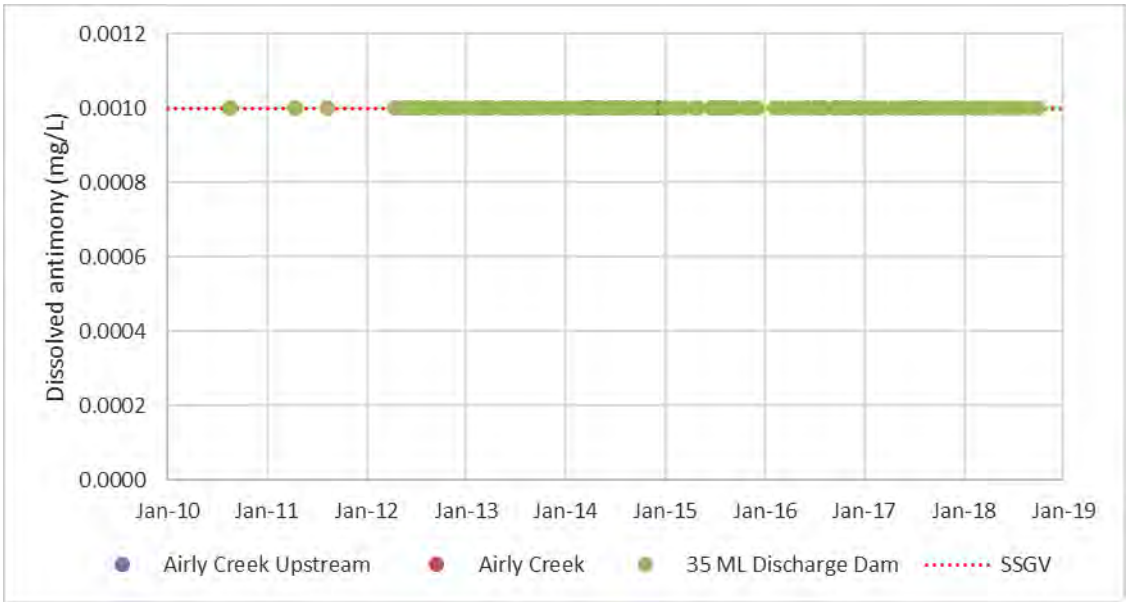

Potassium (mg/L)
18
16
14
12
10
8
6
4
2
0
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam

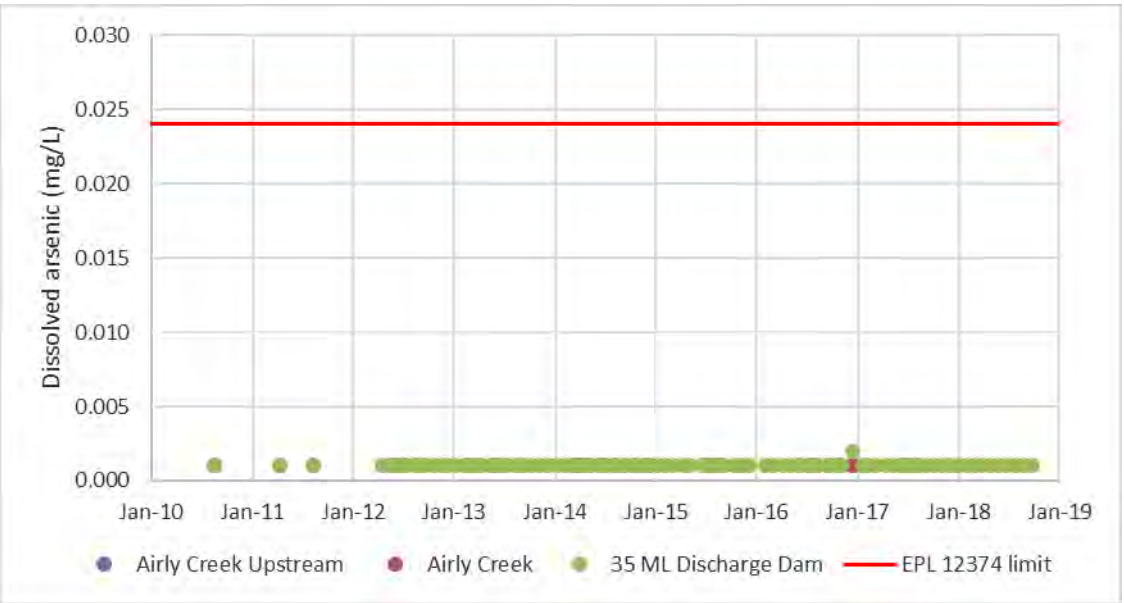

Sodium (mg/L)
160
140
120
100
80
60
40
20
0
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam

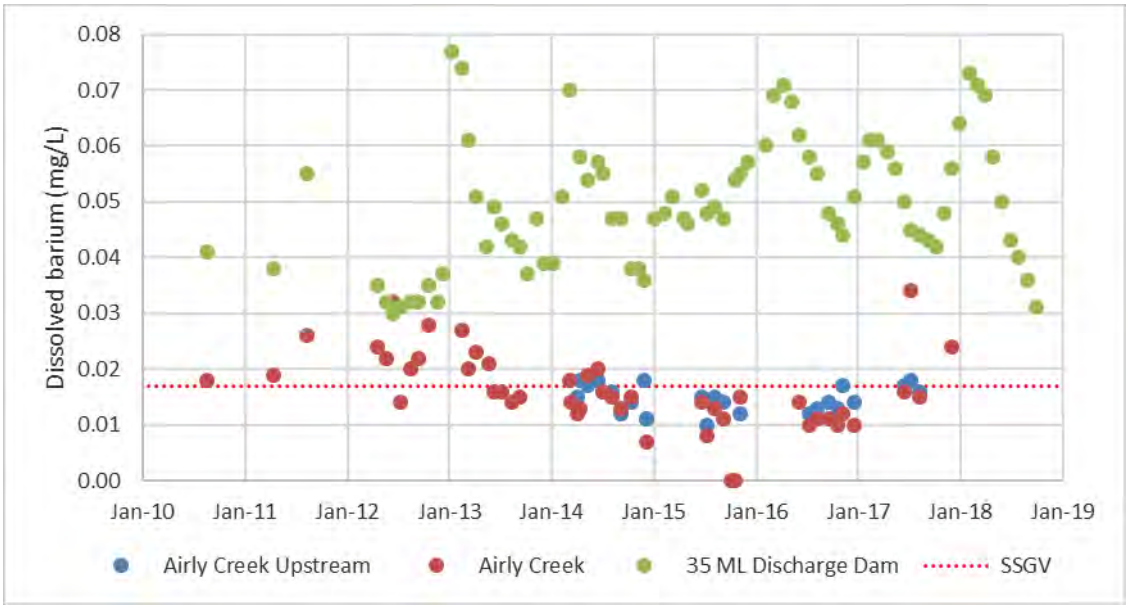


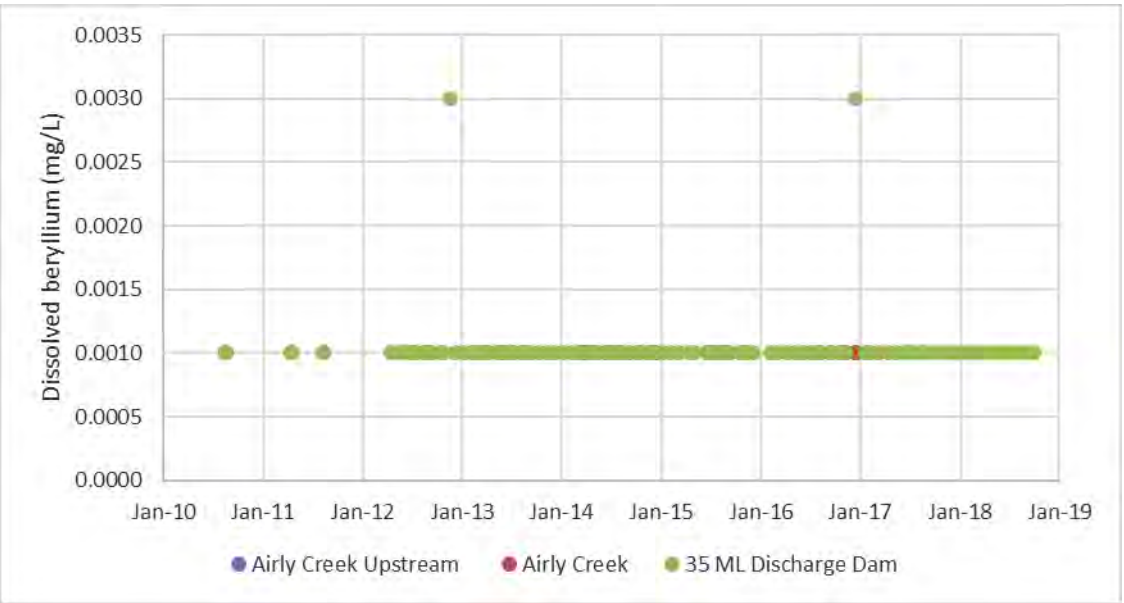
Dissolved metals

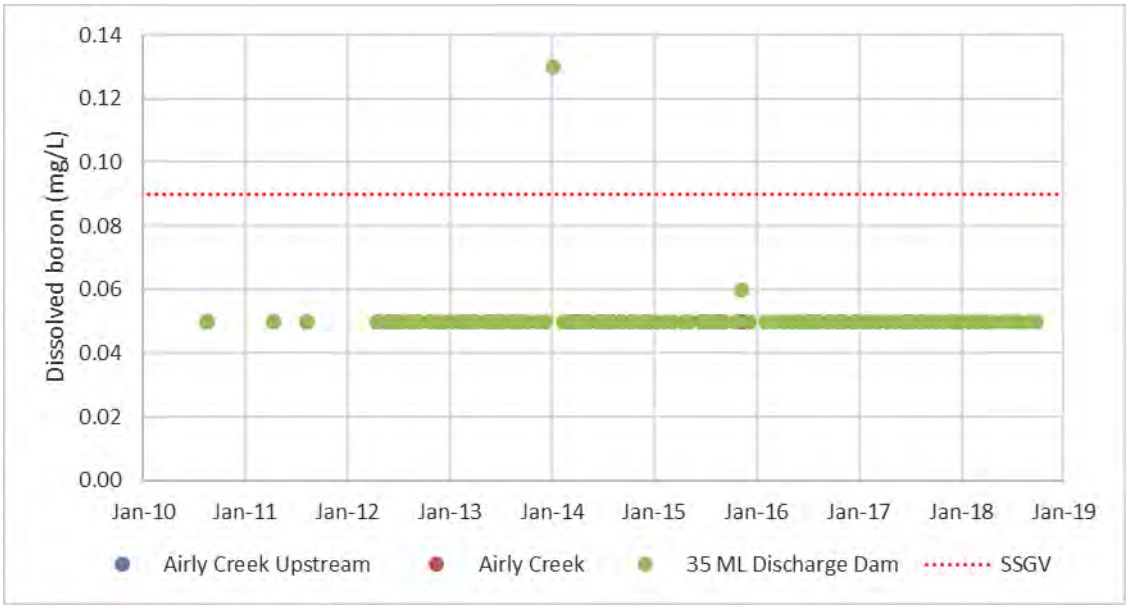


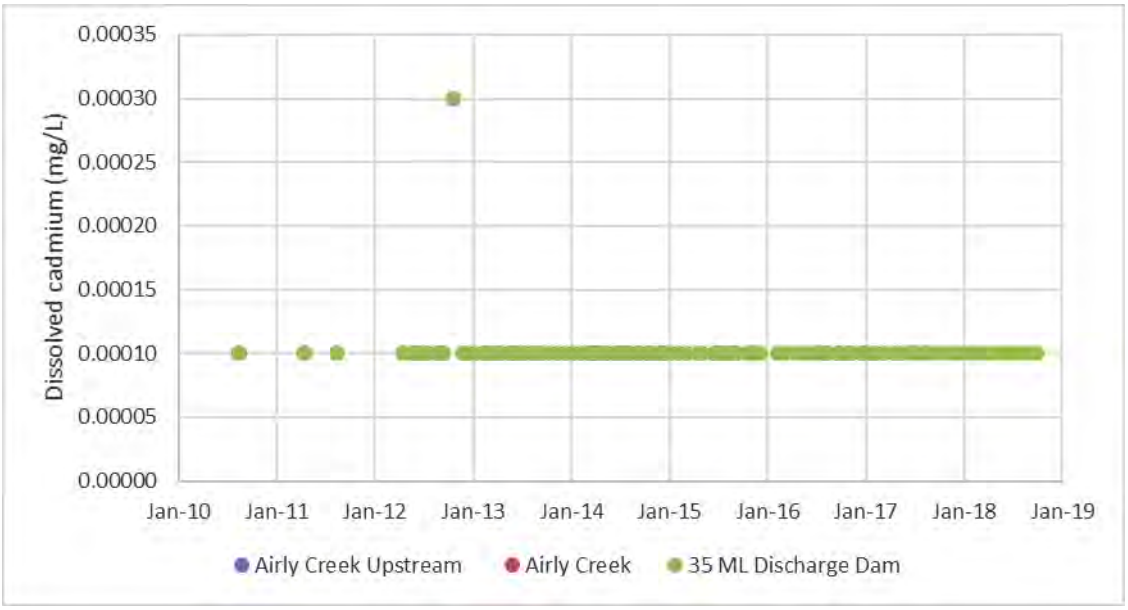


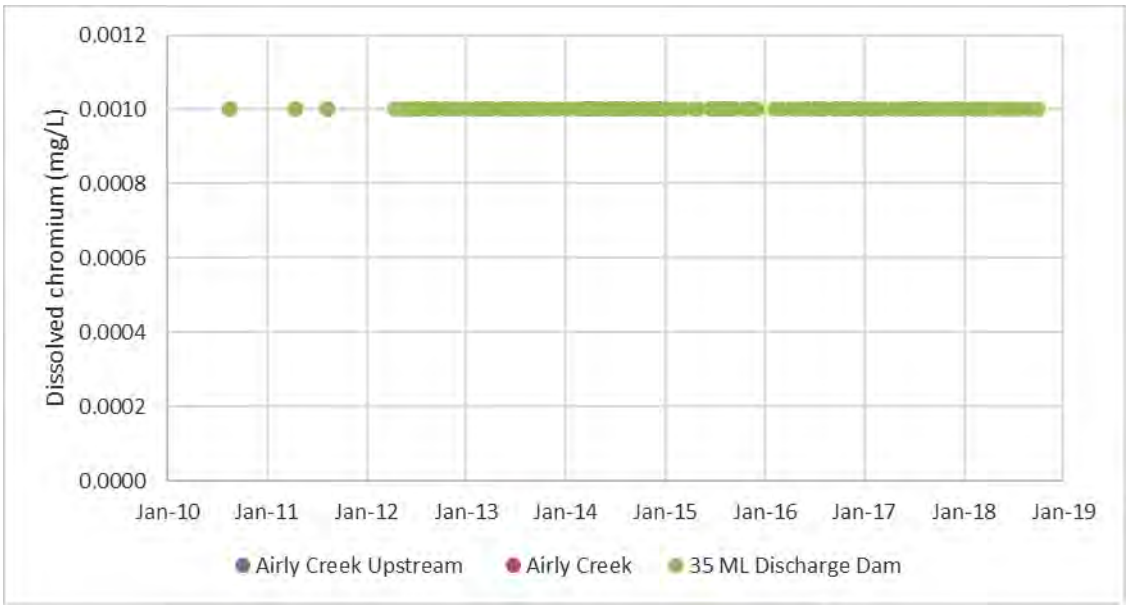

0.030
0.025
0.020
0.015
0.010
0.005
0.000
Dissolved arsenic (mg/L)
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam
EPL 12374 limit

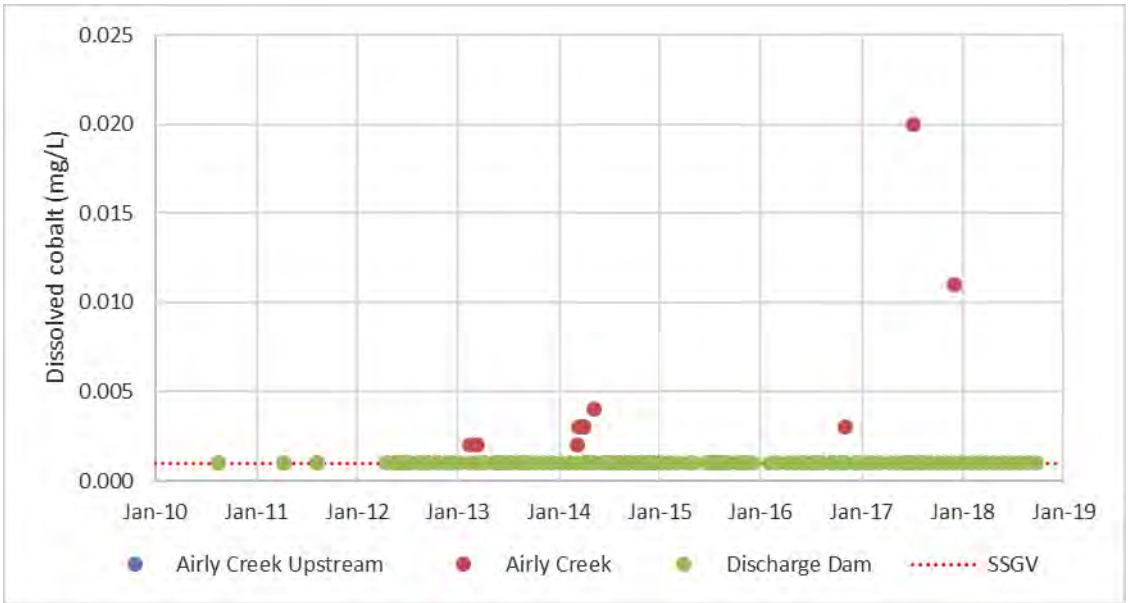

0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Dissolved barium (mg/L)
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam
SSGV

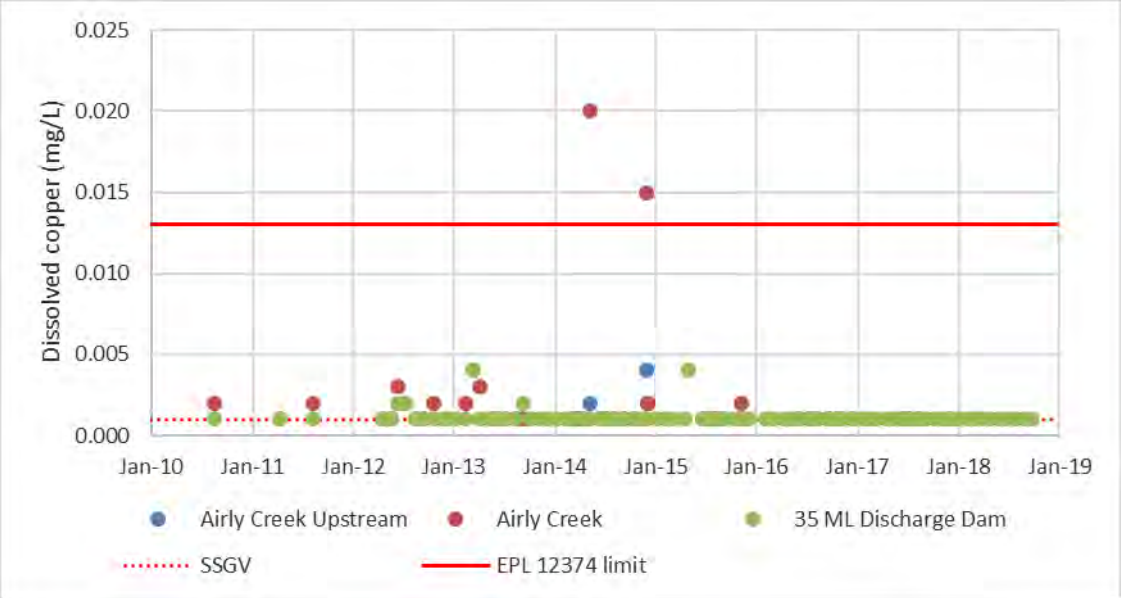

0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
Dissolved beryllium (mg/L)
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam

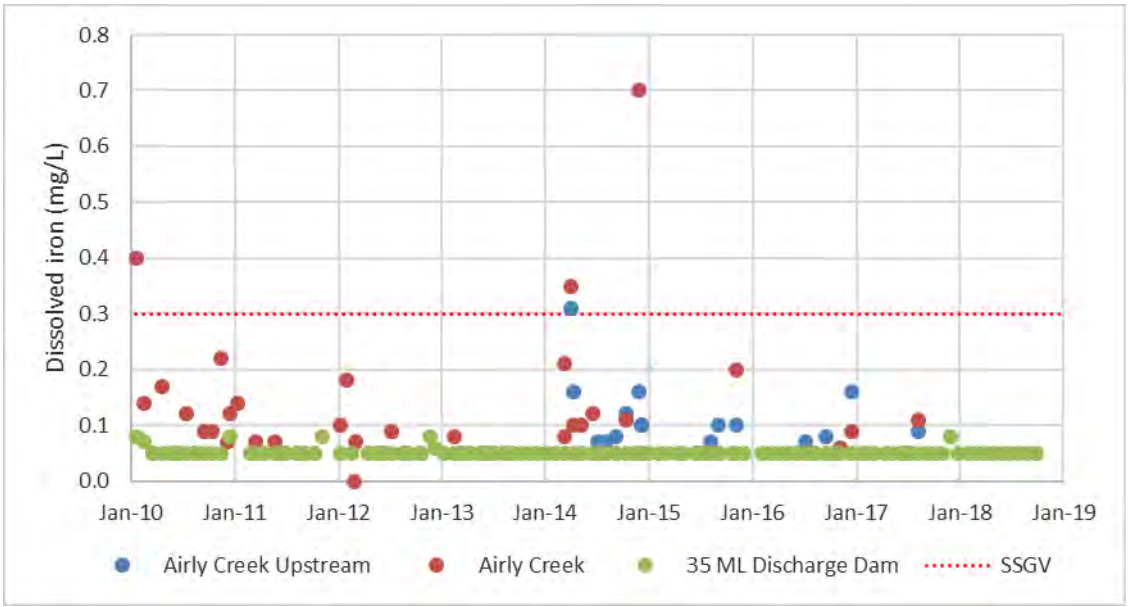

0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Dissolved boron (mg/L)
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam
SSGV

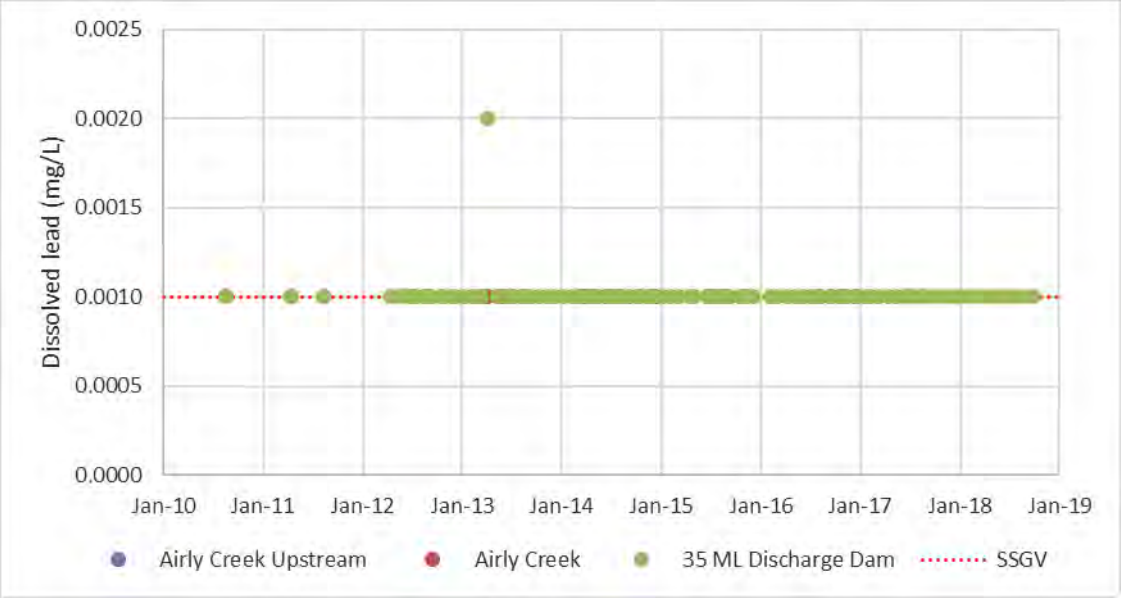

0.00035
0.00030
0.00025
0.00020
0.00015
0.00010
0.00005
0.00000
Dissolved cadmium (mg/L)
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam

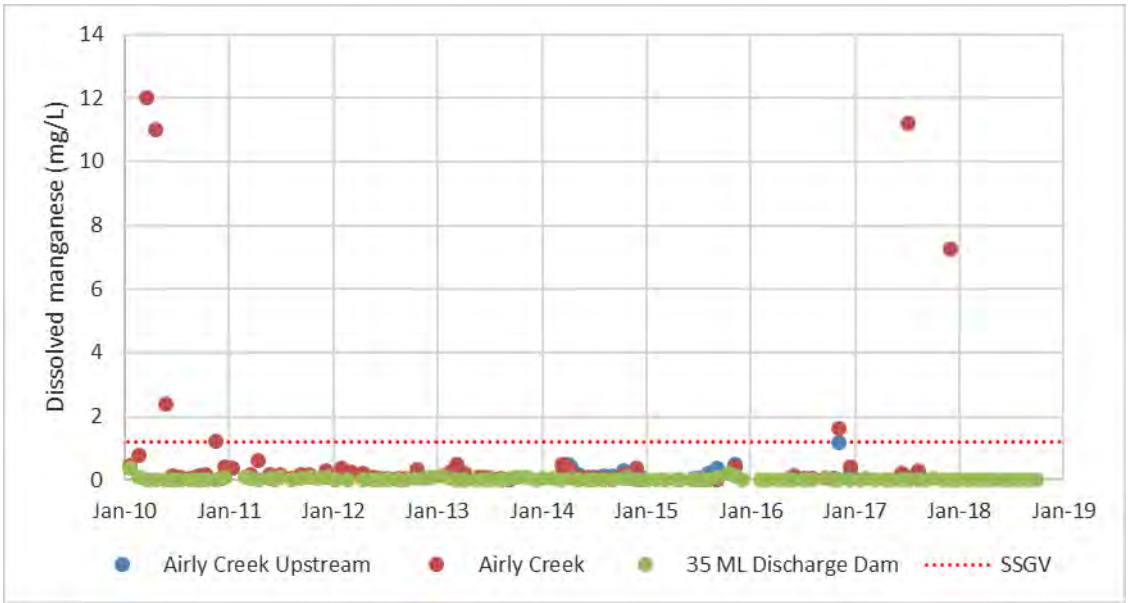

0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
Dissolved chromium (mg/L)
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam

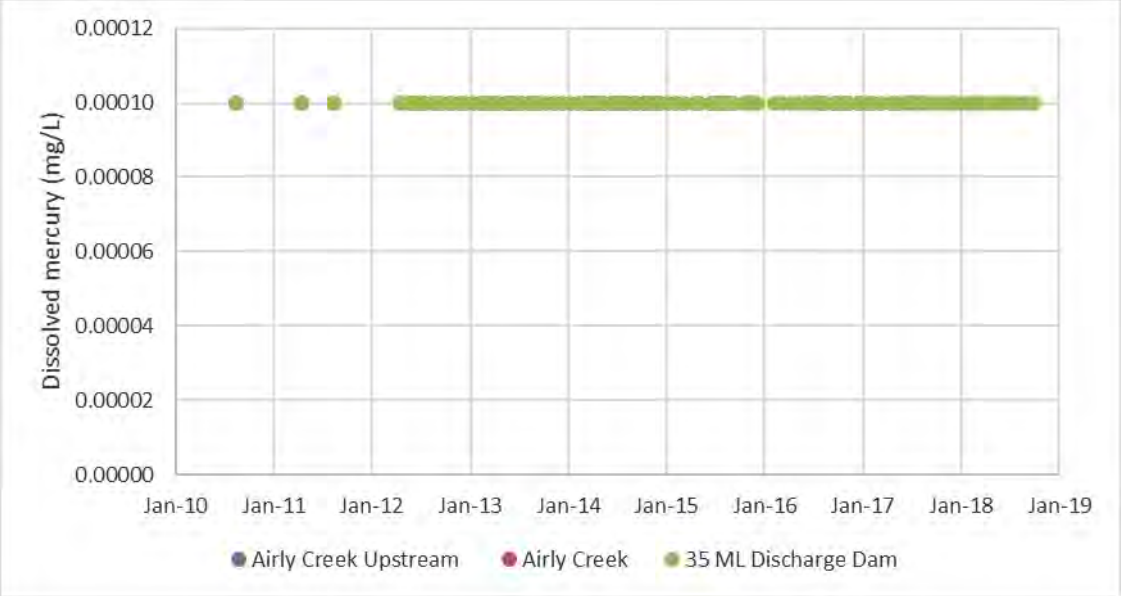

0.025
0.020
0.015
0.010
0.005
0.000
Dissolved cobalt (mg/L)
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
Discharge Dam
SSGV

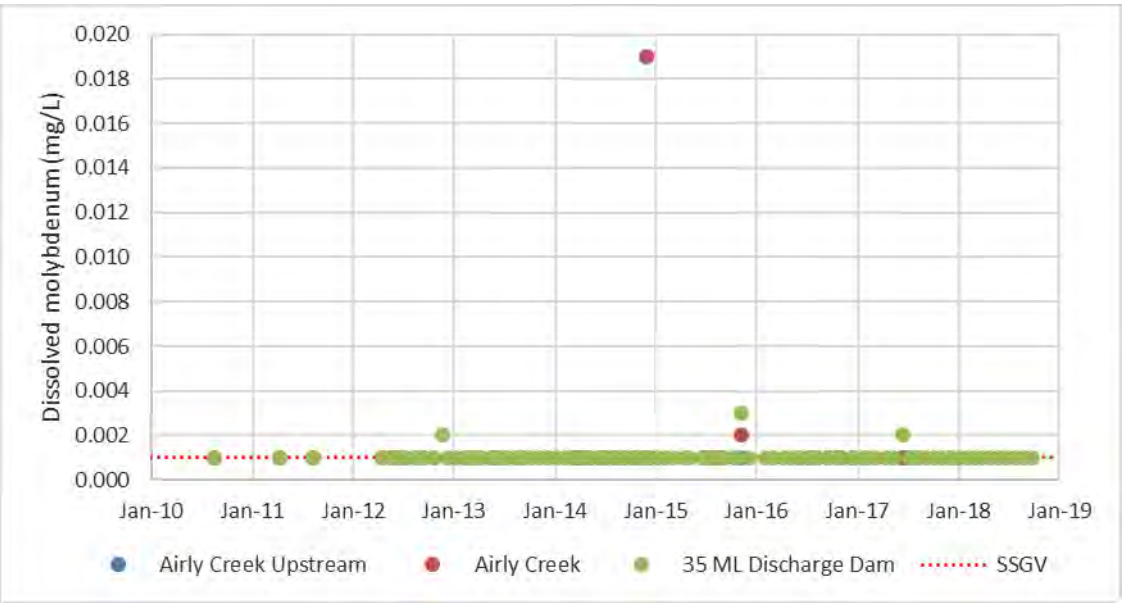

0.025
0.020
0.015
0.010
0.005
0.000
Dissolved copper (mg/L)
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam
SSGV
EPL 12374 limit

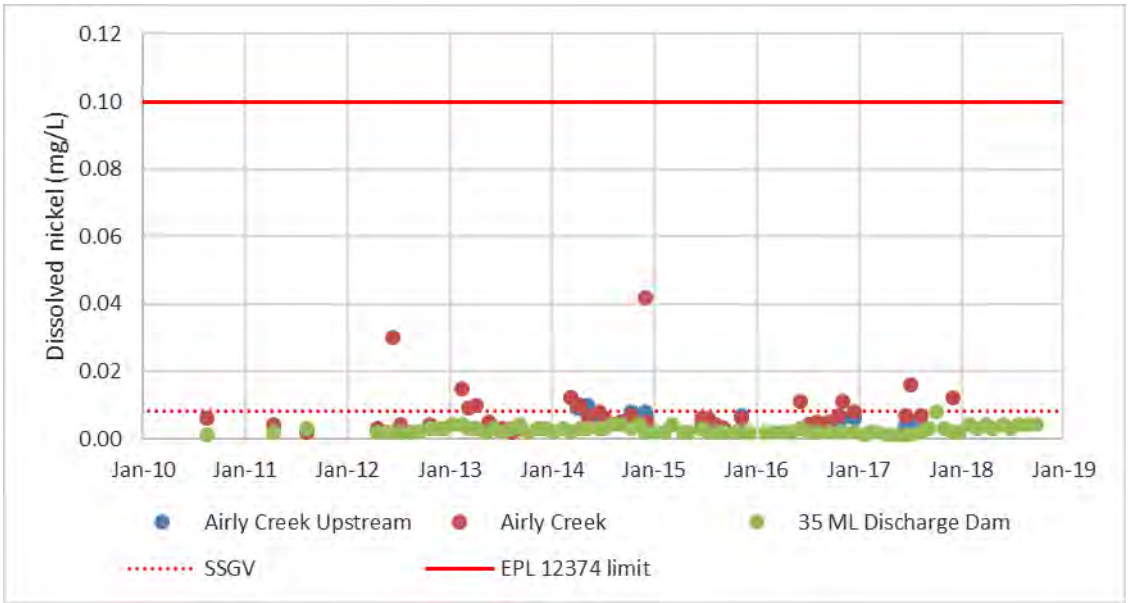

0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Dissolved iron (mg/L)
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam
SSGV

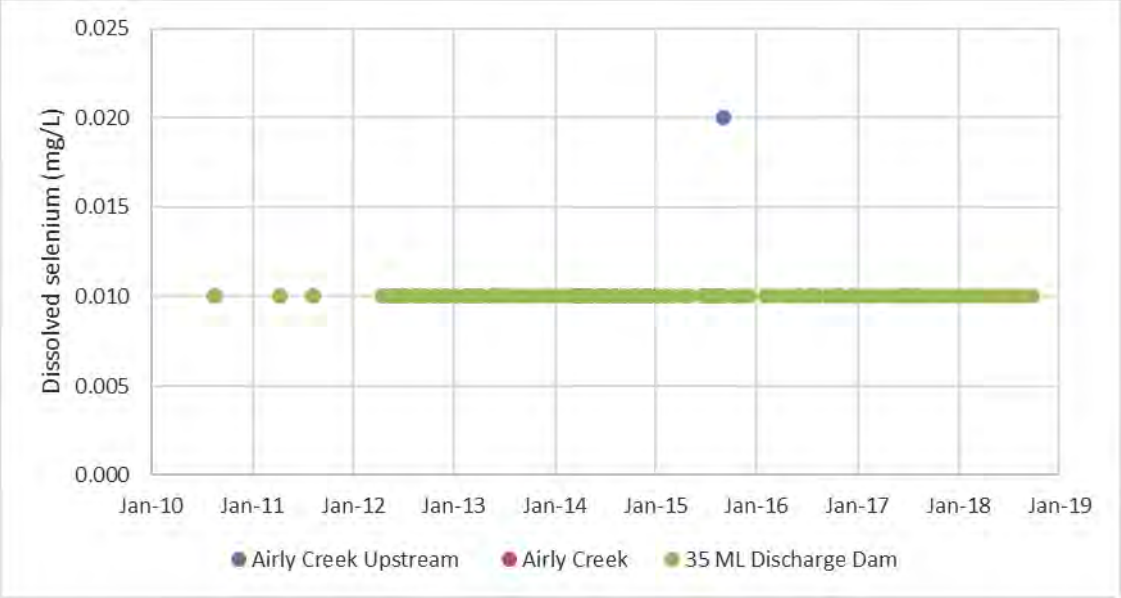

0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
Dissolved lead (mg/L)
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam
SSGV

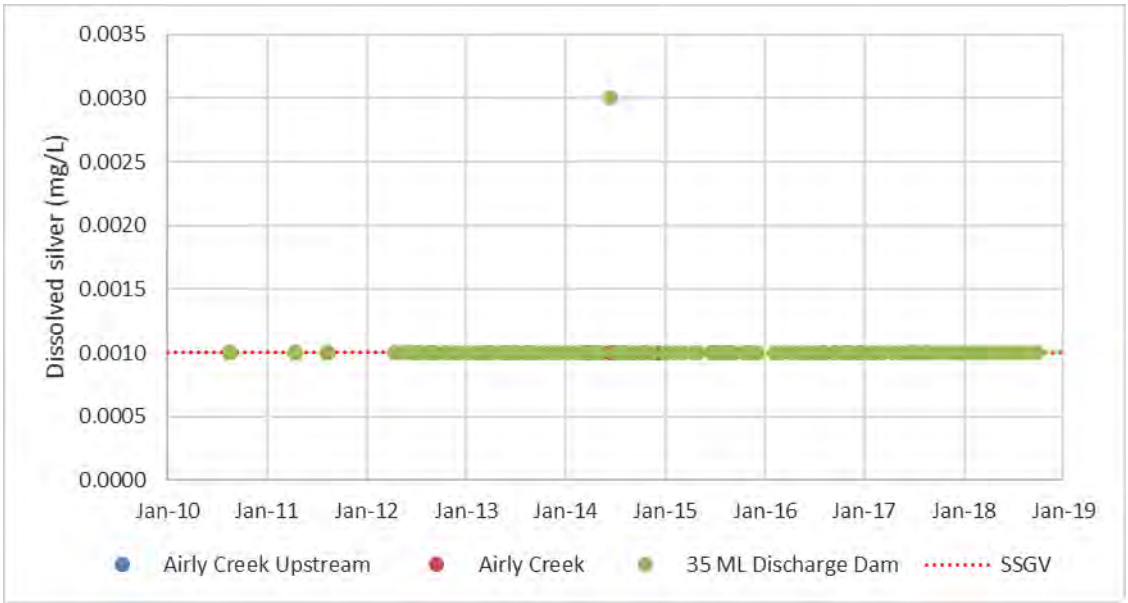

14
12
10
8
6
4
2
0
Dissolved manganese (mg/L)
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam
SSGV

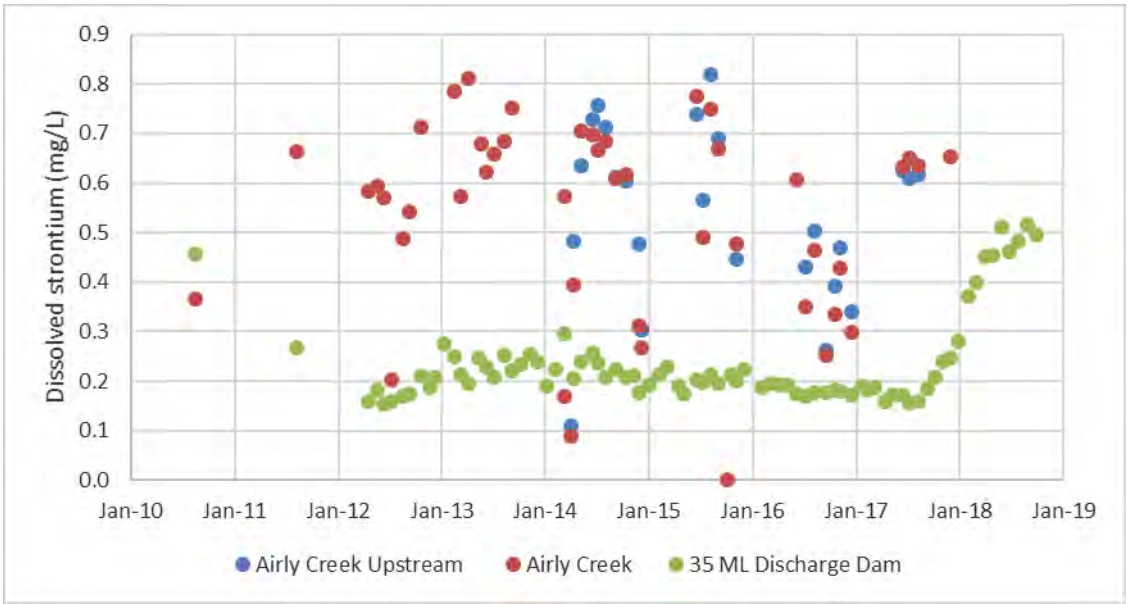

0.00012
0.00010
0.00008
0.00006
0.00004
0.00002
0.00000
Dissolved mercury (mg/L)
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam

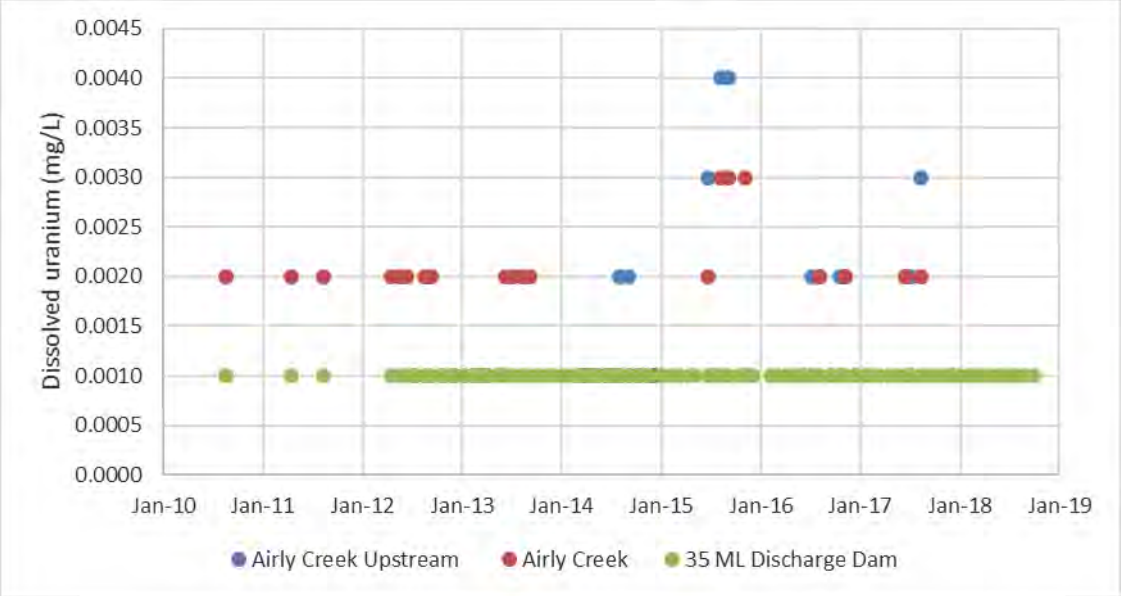

Dissolved molybdenum (mg/L)
0.020
0.018
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam
SSGV

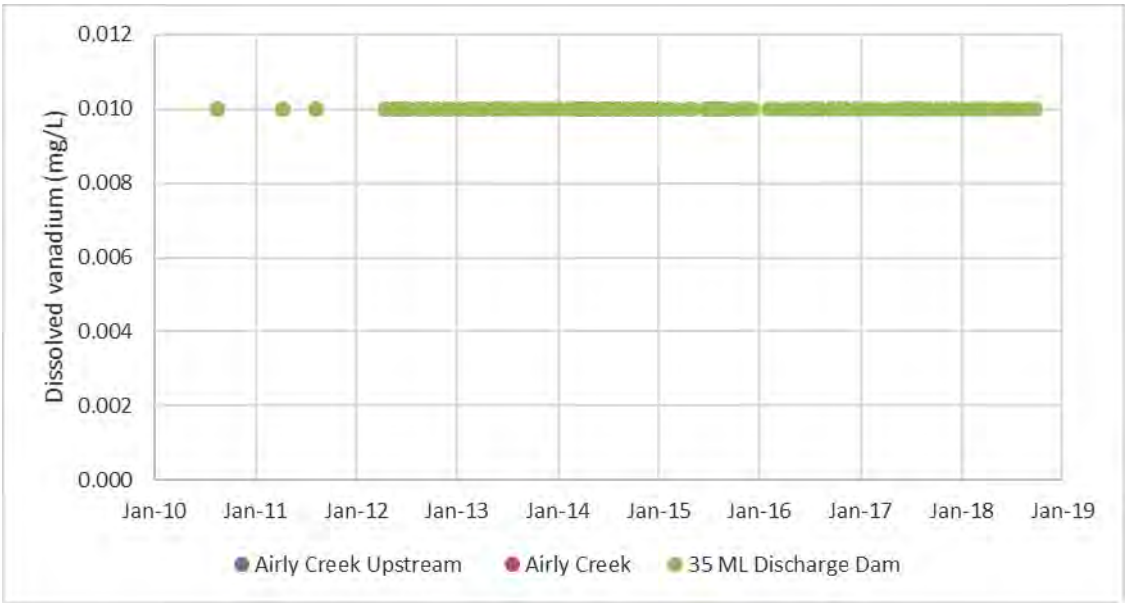

Dissolved nickel (mg/L)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam
SSGV
EPL 12374 limit

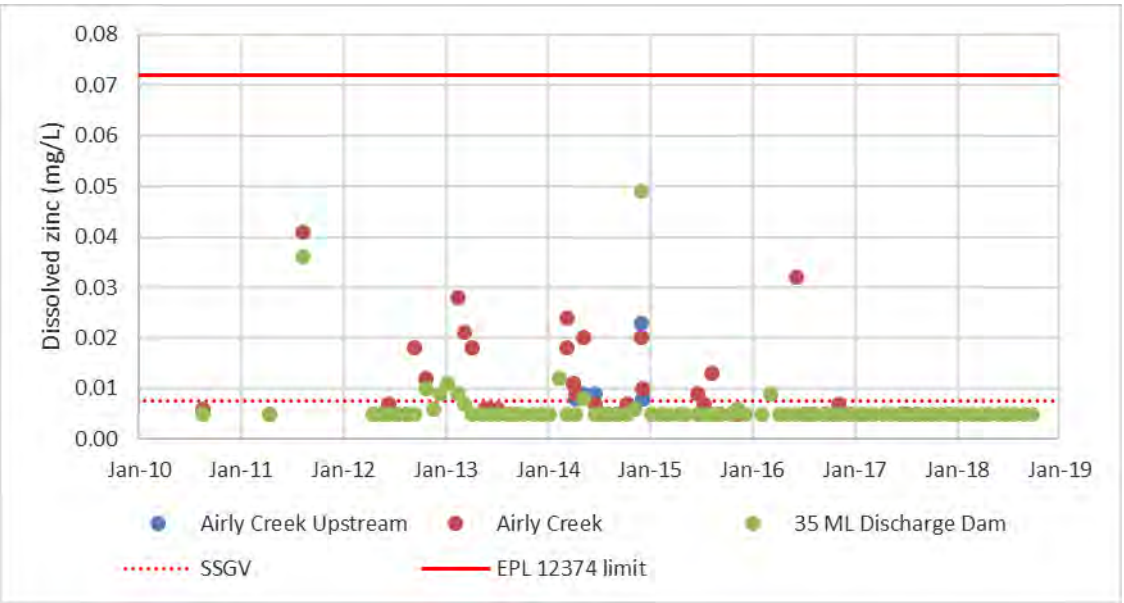

Dissolved selenium (mg/L)
0.025
0.020
0.015
0.010
0.005
0.000
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam


Dissolved silver (mg/L)
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam
SSGV

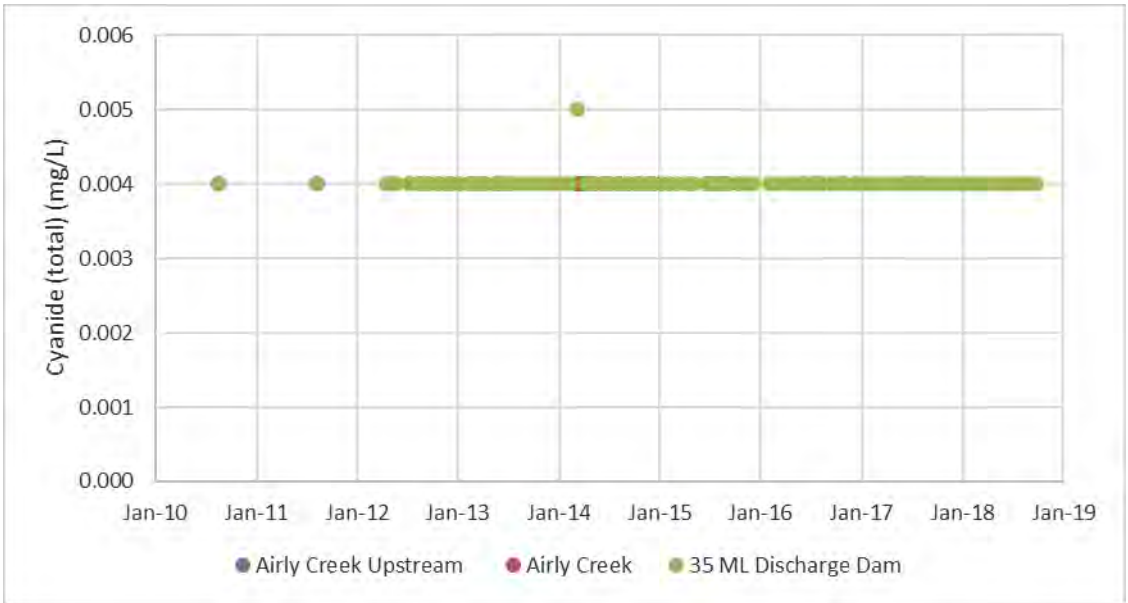

Dissolved strontium (mg/L)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam

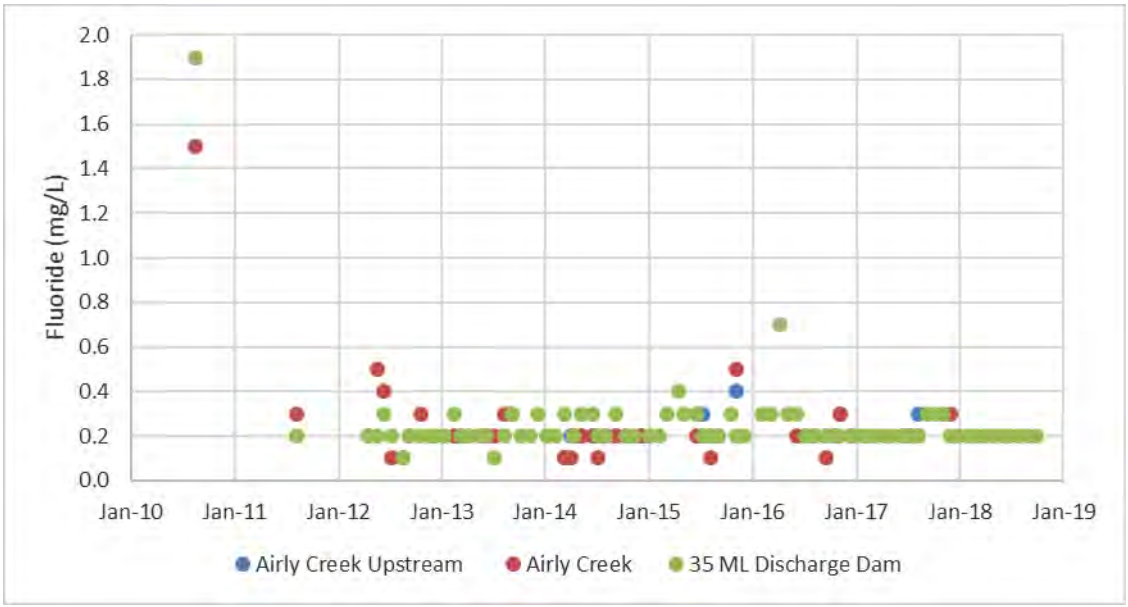

Dissolved uranium (mg/L)
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam

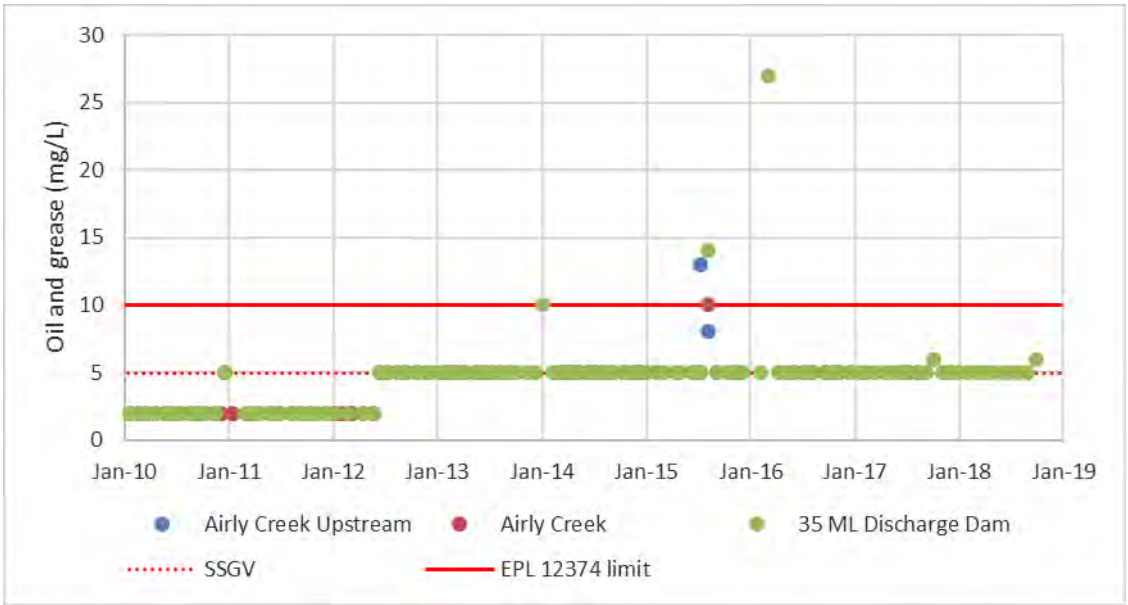




Other parameters




Fluoride (mg/L)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam


Oil and grease (mg/L)
30
25
20
15
10
5
0
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Airly Creek Upstream
Airly Creek
35 ML Discharge Dam
SSGV
EPL 12374 limit

D.2 Charbon Colliery

D.2.1 Statistical summary

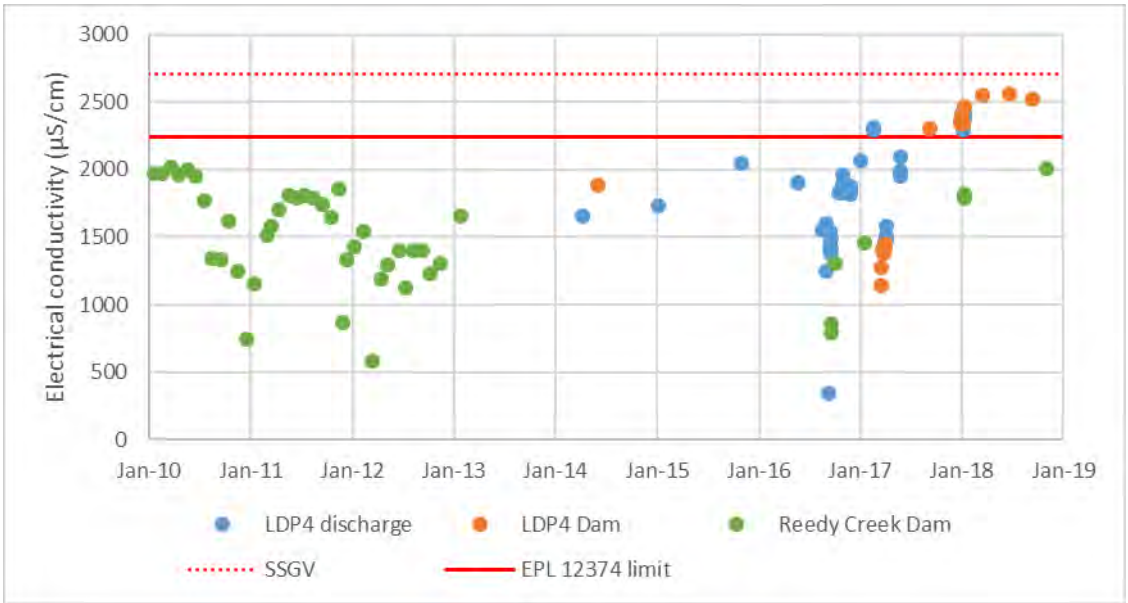
Parameter	Units	LDP4 discharge				LDP4 Discharge Dam				Reedy Creek Dam			
		Count	10th percentile	Median	90th percentile	Count	10th percentile	Median	90th percentile	Count	10th percentile	Median	90th percentile
Physicochemical parameters													
EC	µS/cm	47	1406	1830	2304	16	1330	2320	2535	42	891	1485	1969
pH	pH units	47	7.7	7.8	8.1	28	7.8	8.0	8.2	44	7.7	8.0	8.4
TSS	mg/L	47	3	6	10	25	2	8	34	44	2	2	7
Turbidity	NTU	46	1.5	4.7	12.3	25	1.3	3.9	8.3	6	0.9	6.1	7.2
Nutrients													
Ammonia	mg/L	1	0.01	0.01	0.01	6	0.01	0.01	0.02	1	0.01	0.01	0.01
Nitrate	mg/L									1	0.01	0.01	0.01
Nitrite	mg/L									1	0.01	0.01	0.01
Total Kjeldahl nitrogen	mg/L					1	0.2	0.2	0.2	1	0.4	0.4	0.4
Total nitrogen	mg/L	1	0.4	0.4	0.4	6	0.1	0.2	0.3	1	0.4	0.4	0.4
Total phosphorus	mg/L	1	0.05	0.05	0.05	6	0.01	0.02	0.03	1	0.01	0.01	0.01
Major ions													
Calcium	mg/L									10	93	133	160
Chloride	mg/L									10	40	62	67
Magnesium	mg/L									10	58	89	113
Potassium	mg/L									10	12	14	14
Sodium	mg/L									10	29	44	58
Sulfate	mg/L									10	335	545	730
Dissolved metals													
Aluminium	mg/L									1	0.01	0.01	0.01

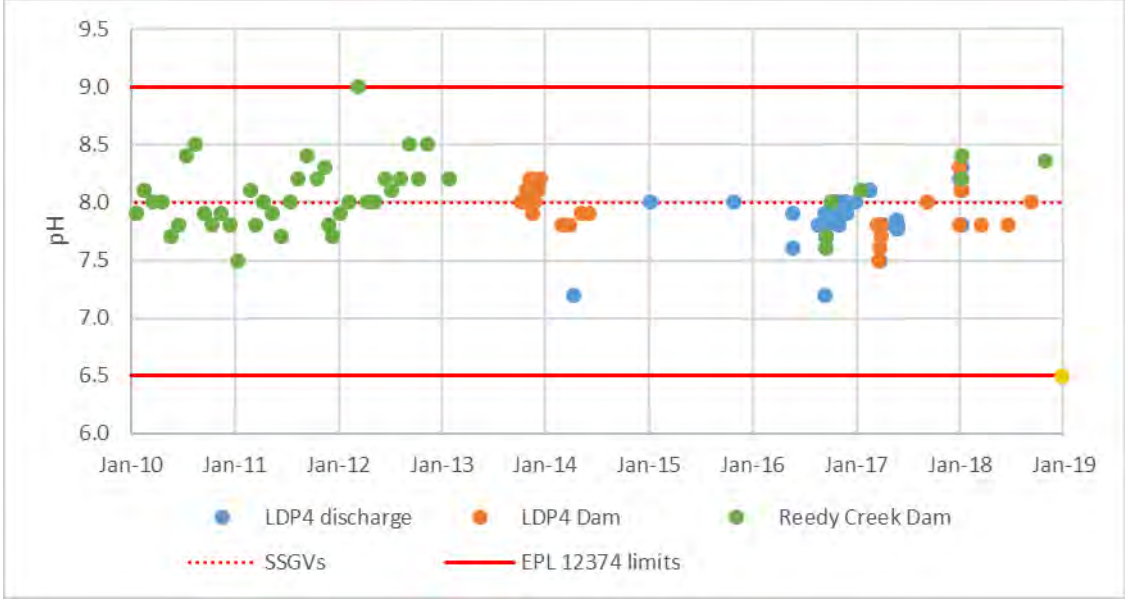
Parameter	Units	LDP4 discharge				LDP4 Discharge Dam				Reedy Creek Dam			
		Count	10th percentile	Median	90th percentile	Count	10th percentile	Median	90th percentile	Count	10th percentile	Median	90th percentile
Antimony	mg/L									1	0.001	0.001	0.001
Arsenic	mg/L	7	0.001	0.001	0.001	1	0.001	0.001	0.001	4	0.001	0.001	0.001
Boron	mg/L	1	0.05	0.05	0.05								
Cadmium	mg/L	7	0.0001	0.0001	0.0001	1	0.0001	0.0001	0.0001	4	0.0001	0.0001	0.0001
Chromium	mg/L	7	0.001	0.001	0.002	7	0.001	0.001	0.001	4	0.001	0.001	0.001
Cobalt	mg/L	1	0.001	0.001	0.001								
Copper	mg/L	7	0.001	0.001	0.004	1	0.001	0.001	0.001	13	0.001	0.001	0.001
Iron	mg/L									10	0.05	0.05	0.07
Lead	mg/L	6	0.001	0.001	0.001	1	0.001	0.001	0.001	4	0.001	0.001	0.001
Manganese	mg/L	1	0.05	0.05	0.05					10	0.109	0.194	0.354
Mercury	mg/L	7	0.0001	0.0001	0.0003	1	0.0001	0.0001	0.0001	4	0.0001	0.0001	0.0009
Nickel	mg/L	7	0.005	0.008	0.011	1	0.002	0.002	0.002	4	0.002	0.003	0.004
Selenium	mg/L	2	0.01	0.01	0.01					2	0.01	0.01	0.01
Silver	mg/L									1	0.001	0.001	0.001
Zinc	mg/L	7	0.005	0.005	0.015	1	0.005	0.005	0.005	13	0.005	0.005	0.020
Total metals													
Aluminium	mg/L									1	0.01	0.01	0.01
Antimony	mg/L									1	0.001	0.001	0.001
Arsenic	mg/L	2	0.001	0.001	0.001	6	0.001	0.001	0.001	3	0.001	0.001	0.001
Boron	mg/L					6	0.05	0.05	0.05				
Cadmium	mg/L	2	0.0001	0.0001	0.0001	6	0.0001	0.0001	0.0001	3	0.0001	0.0001	0.0001
Chromium	mg/L	3	0.001	0.001	0.001	6	0.001	0.001	0.001	3	0.001	0.001	0.001
Cobalt	mg/L					6	0.002	0.006	0.009				
Copper	mg/L	2	0.001	0.001	0.001	6	0.001	0.001	0.002	12	0.001	0.001	0.009
Iron	mg/L									10	0.05	0.05	0.88
Lead	mg/L	3	0.001	0.001	0.002	6	0.001	0.001	0.002	3	0.001	0.001	0.002
Manganese	mg/L					6	0.239	0.278	0.397	10	0.1758	0.219	0.433
Mercury	mg/L	1	0.0001	0.0001	0.0001	6	0.0001	0.0001	0.0001	2	0.0001	0.0001	0.0001

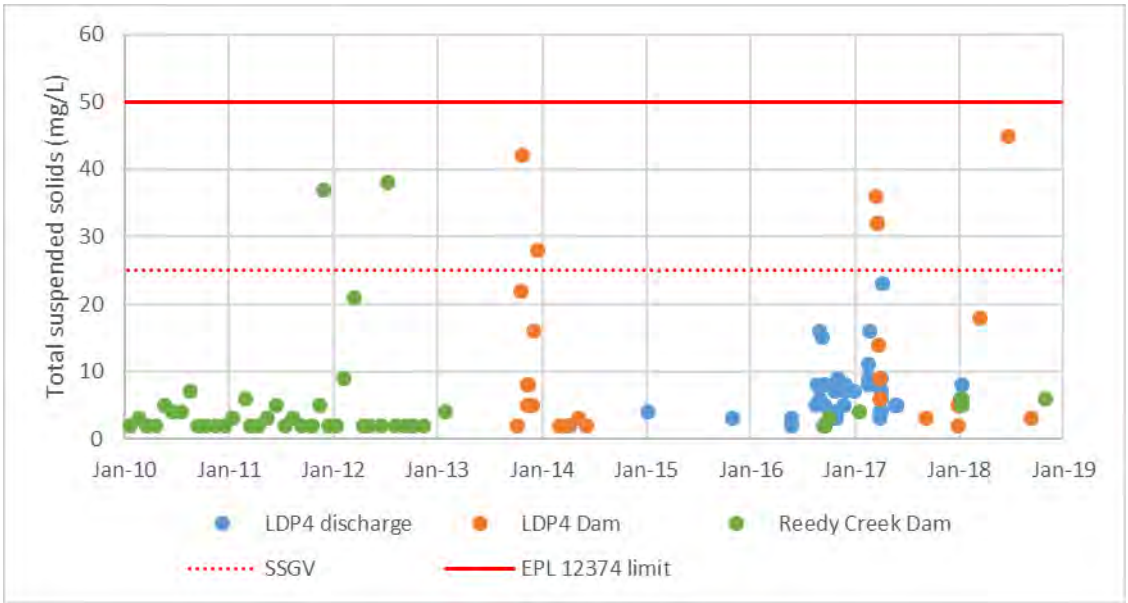
Parameter	Units	LDP4 discharge				LDP4 Discharge Dam				Reedy Creek Dam			
		Count	10th percentile	Median	90th percentile	Count	10th percentile	Median	90th percentile	Count	10th percentile	Median	90th percentile
Nickel	mg/L	2	0.011	0.013	0.016	6	0.008	0.023	0.030	3	0.002	0.002	0.004
Selenium	mg/L	1	0.01	0.01	0.01	6	0.01	0.01	0.01	2	0.01	0.01	0.01
Zinc	mg/L	2	0.008	0.009	0.010	6	0.007	0.013	0.023	12	0.005	0.007	0.048
Other parameters													
Cyanide	mg/L	1	0.004	0.004	0.004	6	0.004	0.004	0.004				
Fluoride	mg/L	1	0.1	0.1	0.1	6	0.2	0.4	0.5				
Oil and grease	mg/L	47	2	2	5	11	2	2	5	42	2	2	5

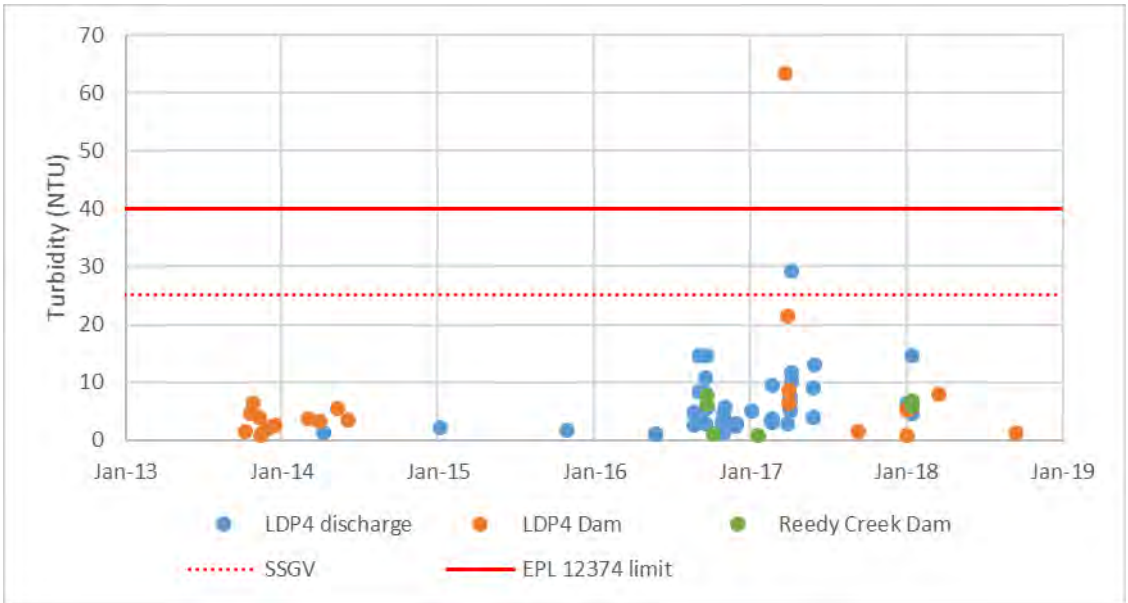
D.2.2 Time series graphs

Physicochemical parameters

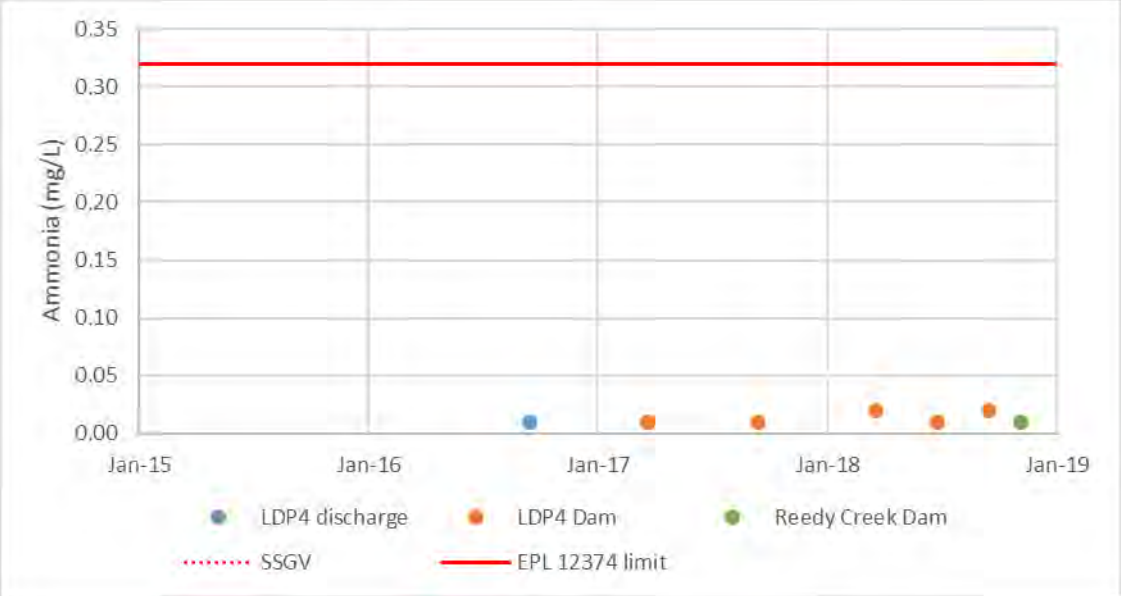


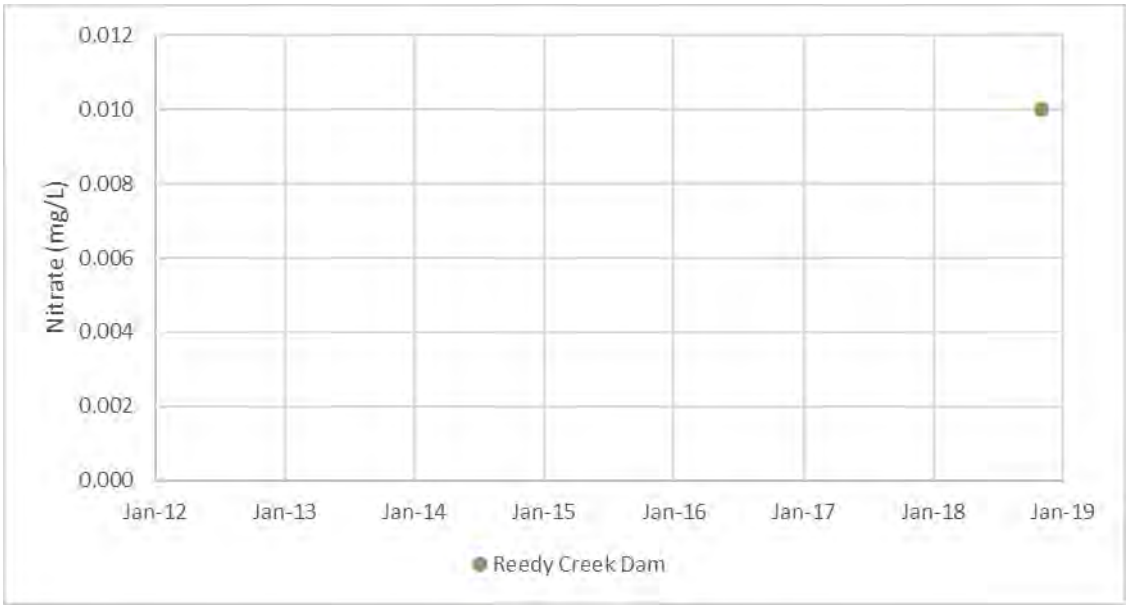


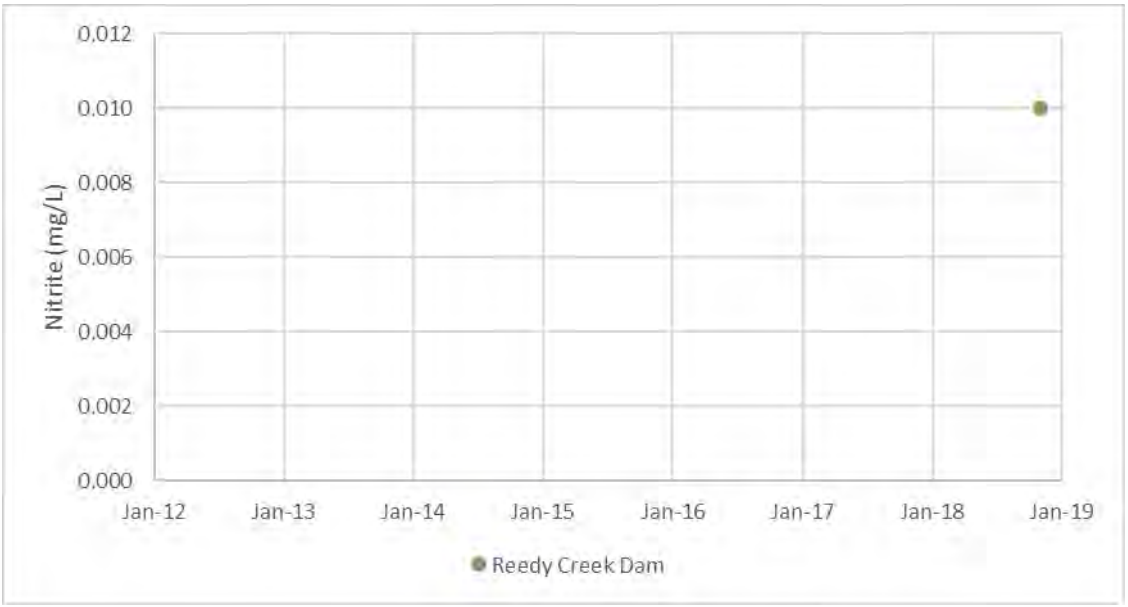

Total suspended solids (mg/L)
60
50
40
30
20
10
0
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
LDP4 discharge
LDP4 Dam
Reedy Creek Dam
SSGV
EPL 12374 limit

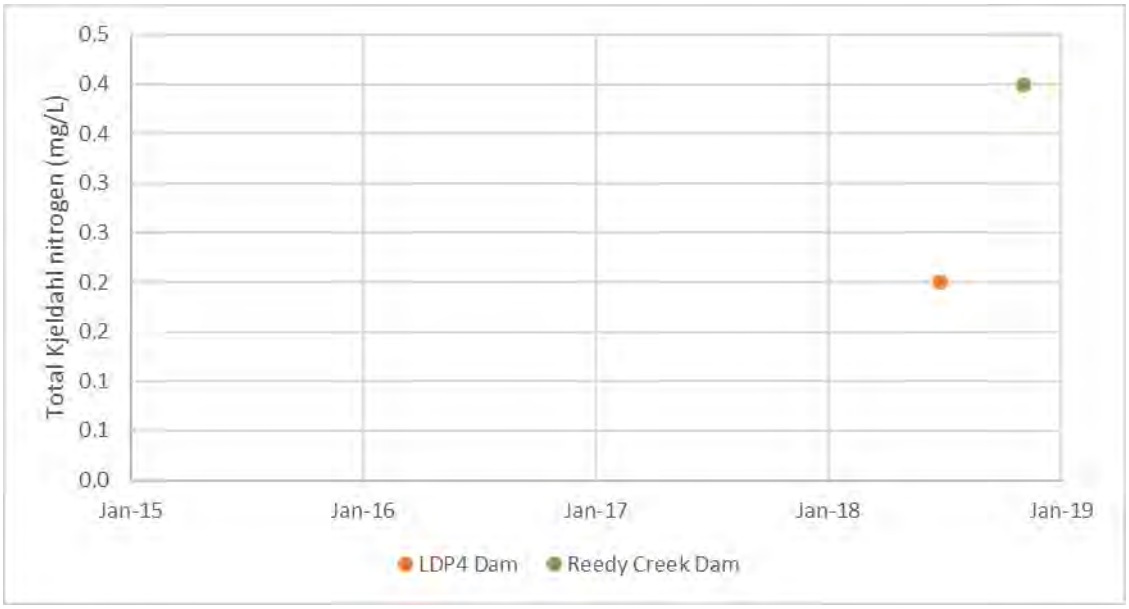

Turbidity (NTU)
70
60
50
40
30
20
10
0
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
LDP4 discharge
LDP4 Dam
Reedy Creek Dam
SSGV
EPL 12374 limit

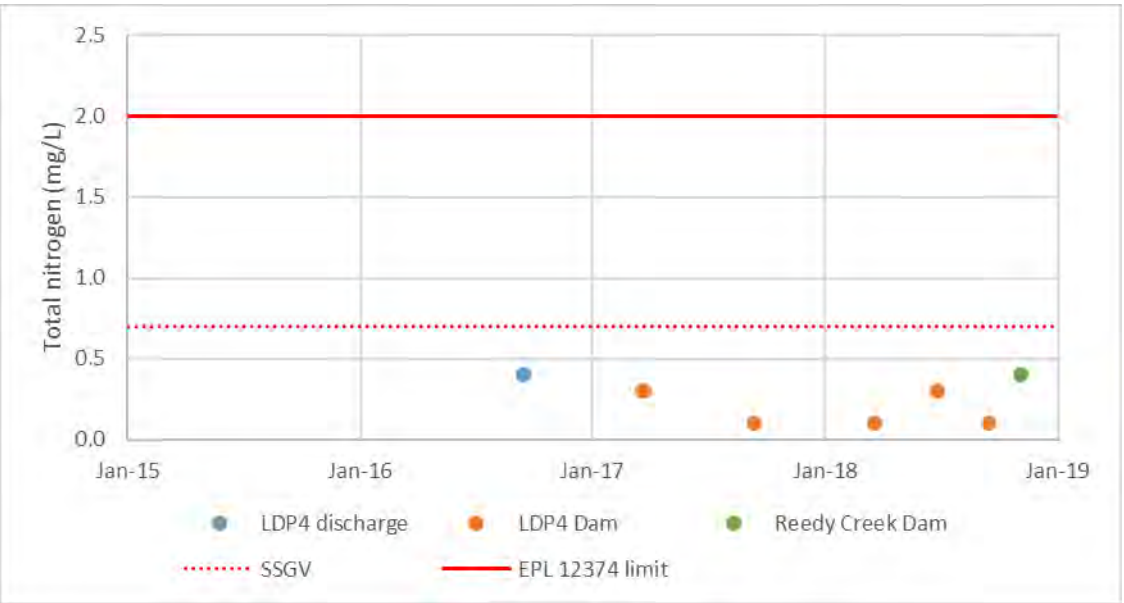
Nutrients

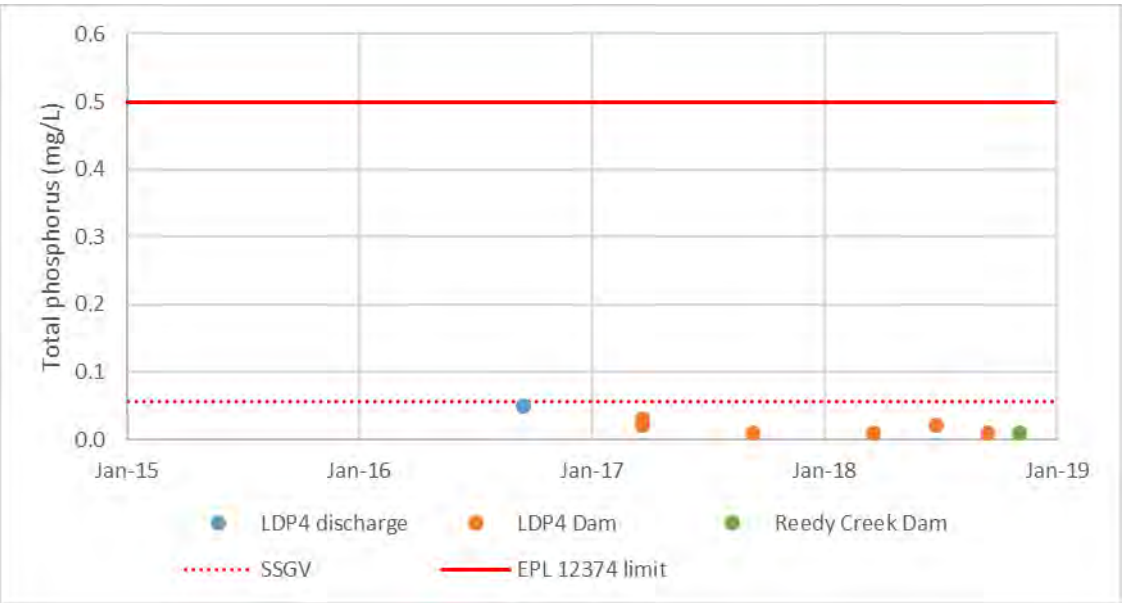

Ammonia (mg/L)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
LDP4 discharge
LDP4 Dam
Reedy Creek Dam
SSGV
EPL 12374 limit


0.012
0.010
0.008
0.006
0.004
0.002
0.000
Nitrate (mg/L)
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Reedy Creek Dam

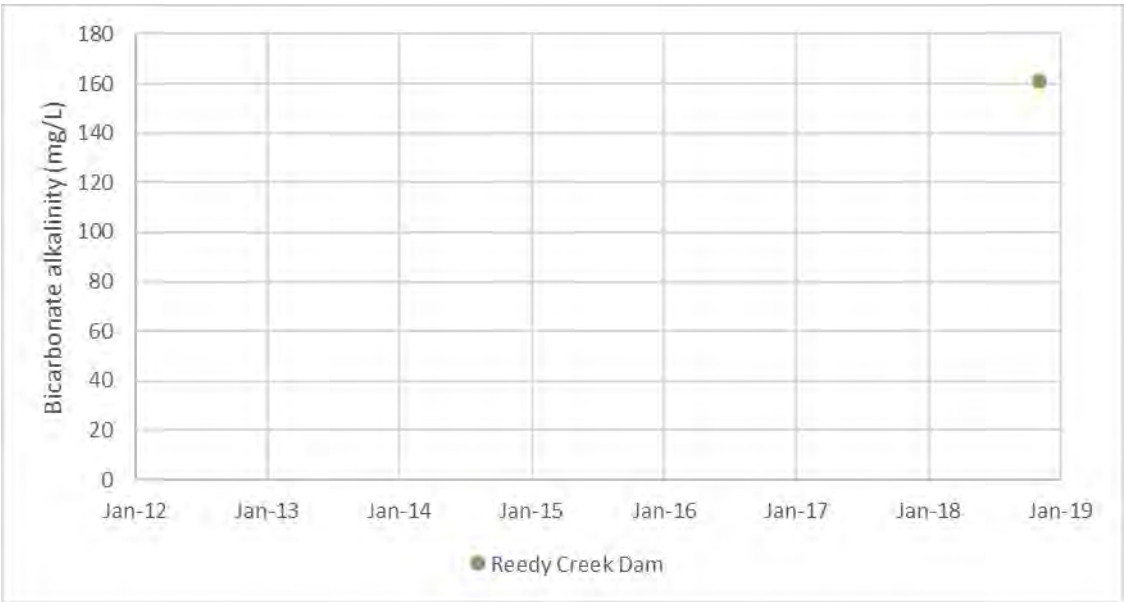

0.012
0.010
0.008
0.006
0.004
0.002
0.000
Nitrite (mg/L)
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Reedy Creek Dam

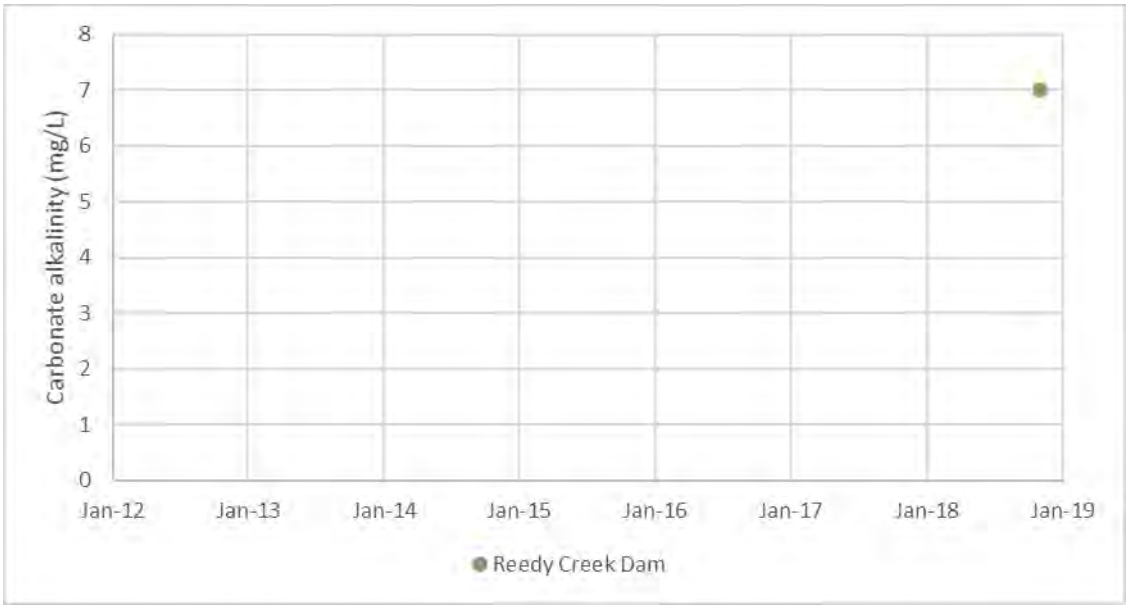

0.5
0.4
0.4
0.3
0.3
0.2
0.2
0.1
0.1
0.0
Total Kjeldahl nitrogen (mg/L)
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
LDP4 Dam
Reedy Creek Dam

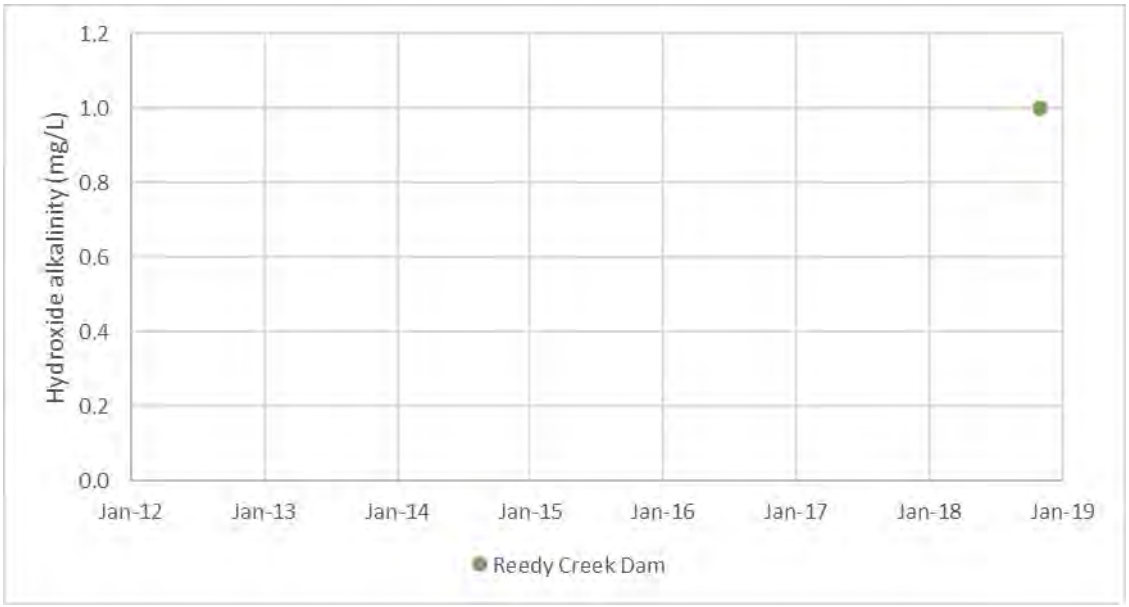

Total nitrogen (mg/L)
2.5
2.0
1.5
1.0
0.5
0.0
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
LDP4 discharge
LDP4 Dam
Reedy Creek Dam
SSGV
EPL 12374 limit

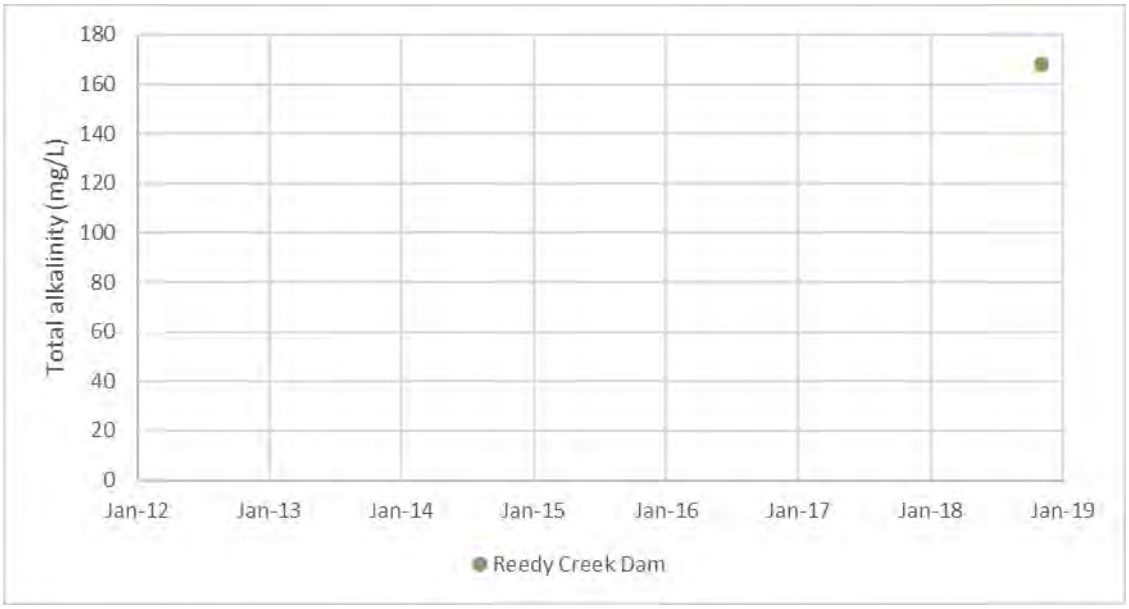

Total phosphorus (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
LDP4 discharge
LDP4 Dam
Reedy Creek Dam
SSGV
EPL 12374 limit

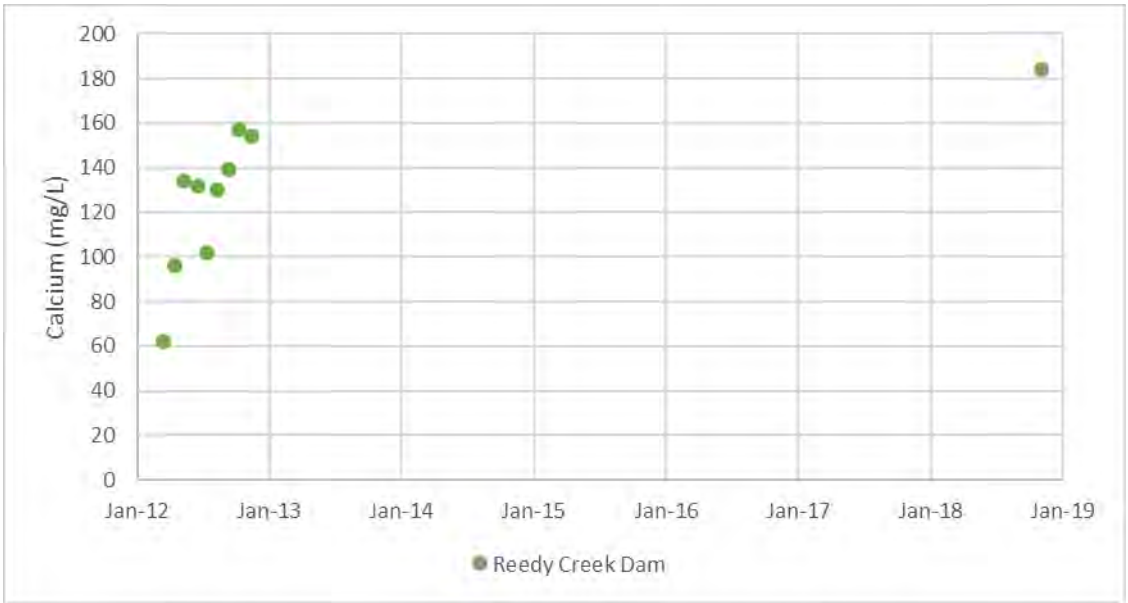
Major ions

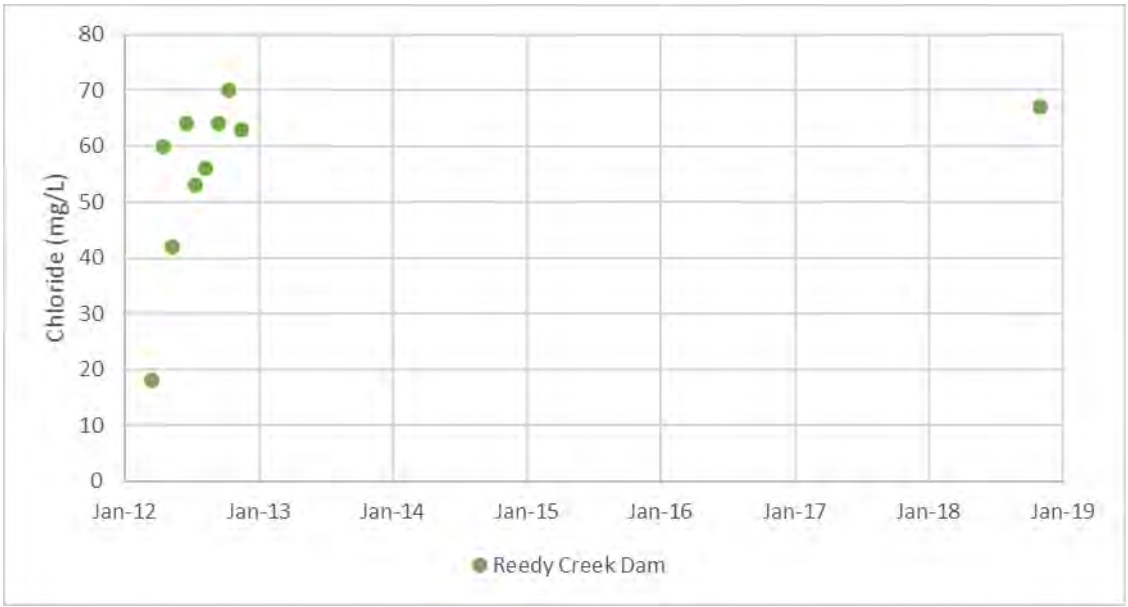

Bicarbonate alkalinity (mg/L)
180
160
140
120
100
80
60
40
20
0
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Reedy Creek Dam

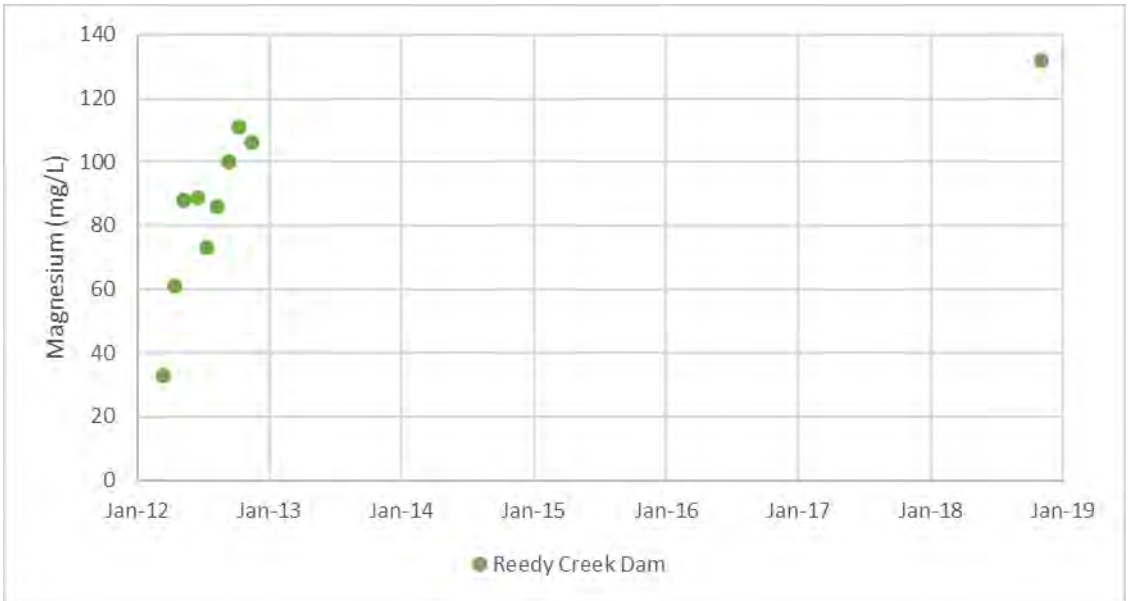

Carbonate alkalinity (mg/L)
8
7
6
5
4
3
2
1
0
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Reedy Creek Dam

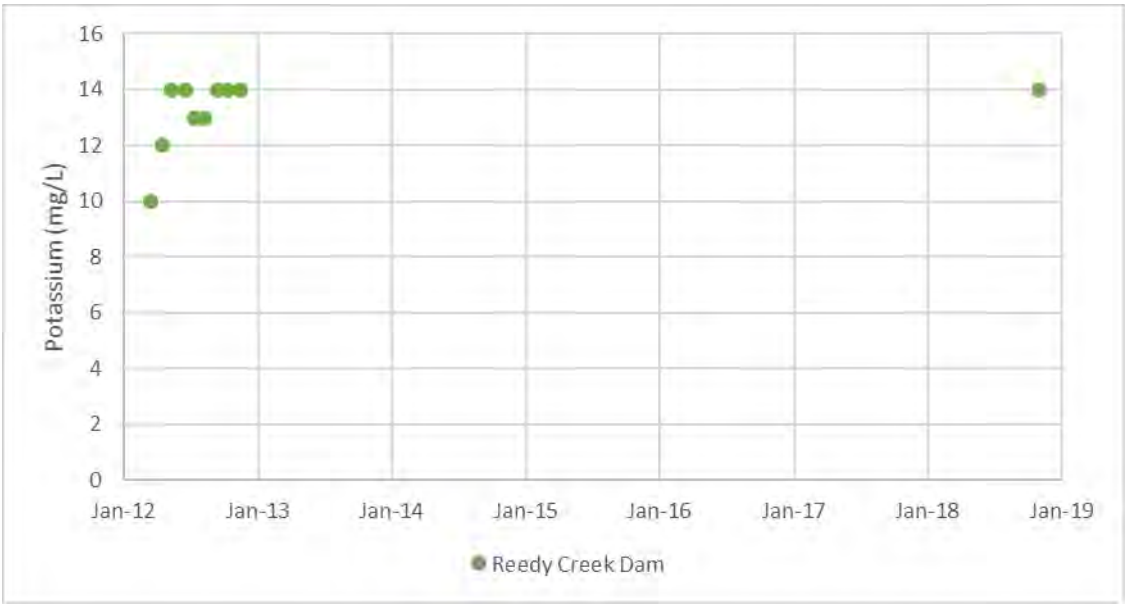

Hydroxide alkalinity (mg/L)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Reedy Creek Dam

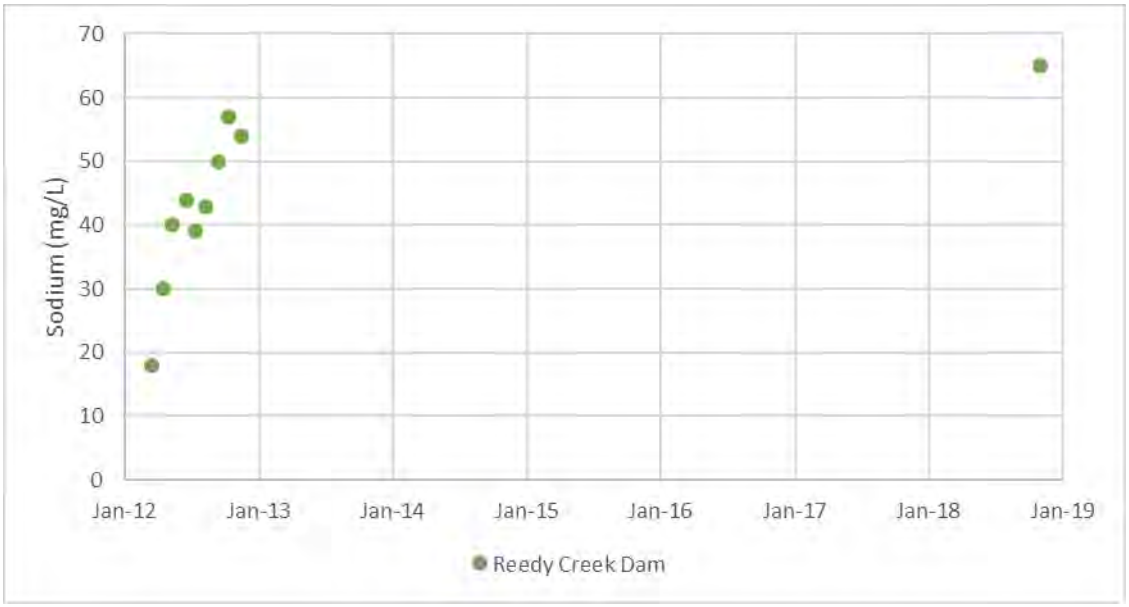

Total alkalinity (mg/L)
180
160
140
120
100
80
60
40
20
0
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Reedy Creek Dam

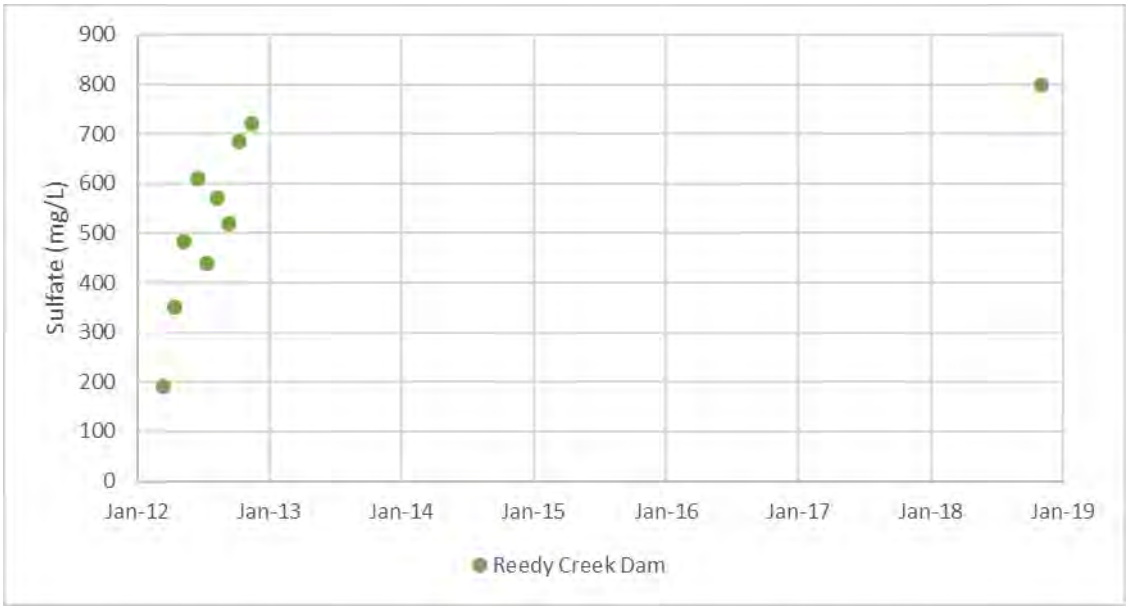

Calcium (mg/L)
200
180
160
140
120
100
80
60
40
20
0
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Reedy Creek Dam


Chloride (mg/L)
80
70
60
50
40
30
20
10
0
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Reedy Creek Dam

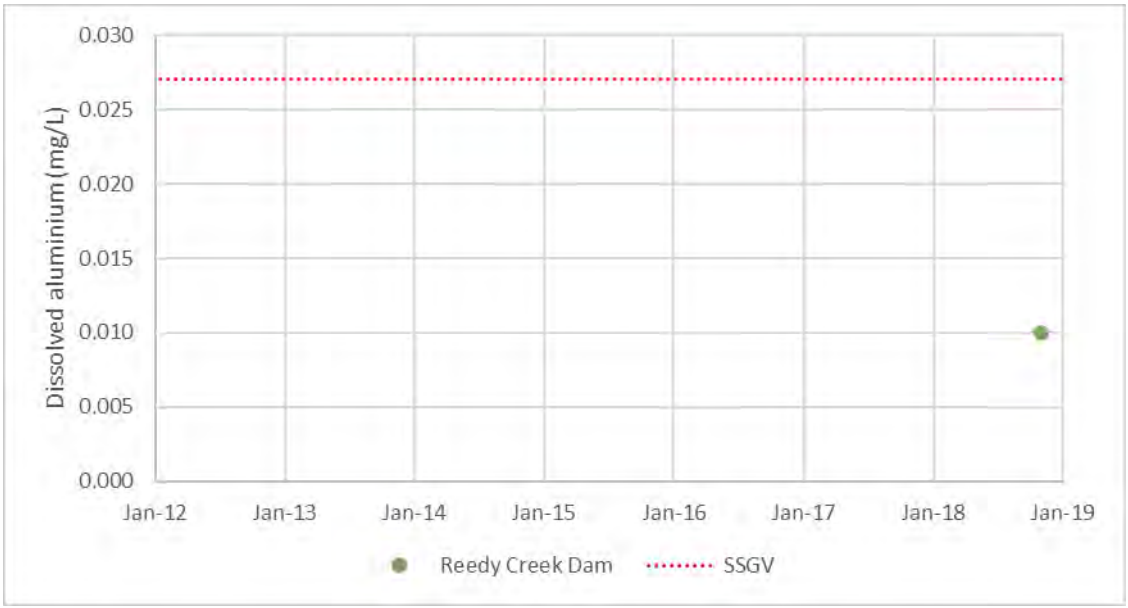

Magnesium (mg/L)
140
120
100
80
60
40
20
0
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Reedy Creek Dam

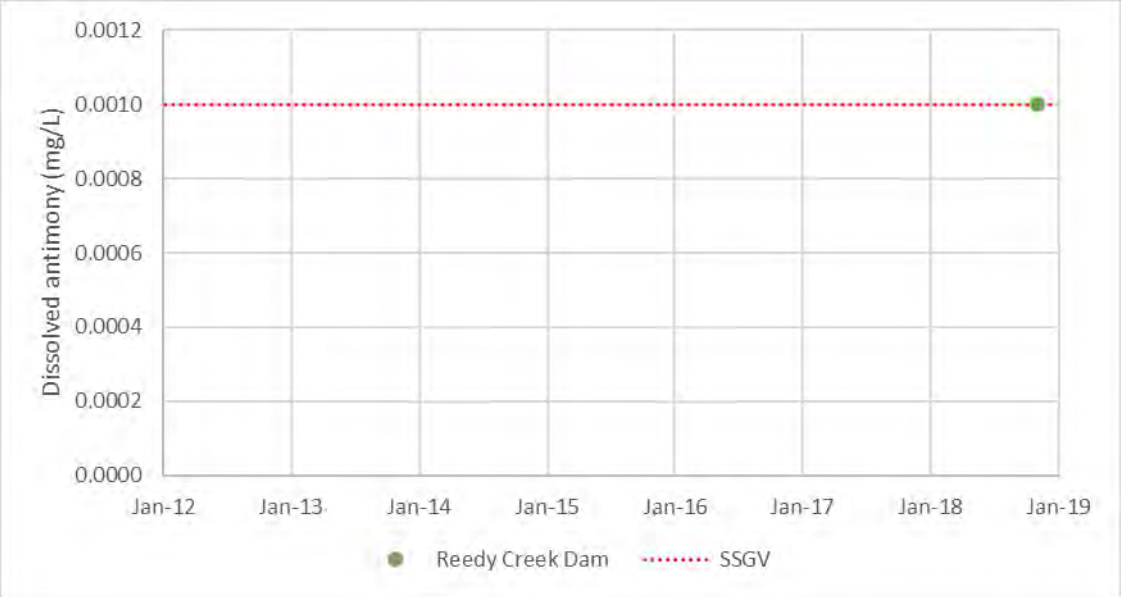

Potassium (mg/L)
16
14
12
10
8
6
4
2
0
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Reedy Creek Dam

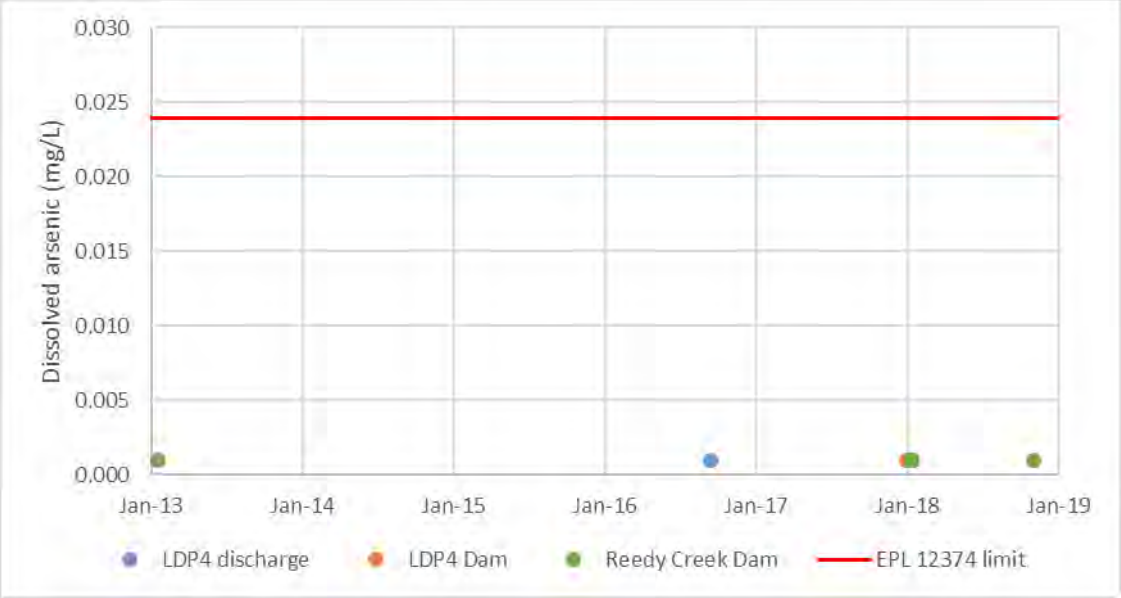

Sodium (mg/L)
70
60
50
40
30
20
10
0
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Reedy Creek Dam


Sulfate (mg/L)
900
800
700
600
500
400
300
200
100
0
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Reedy Creek Dam

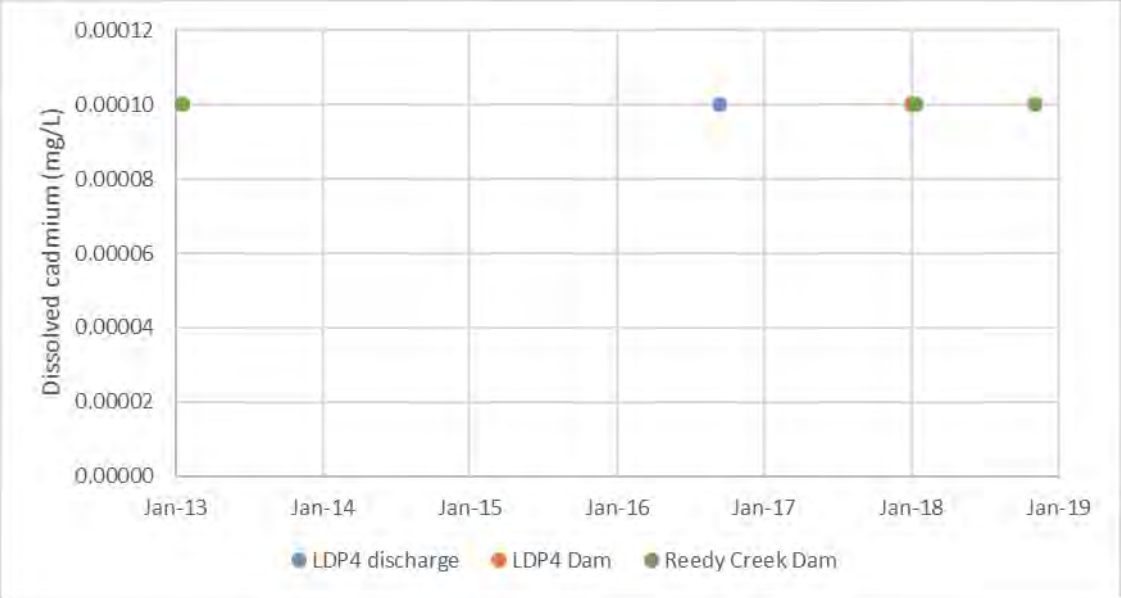
Dissolved metals

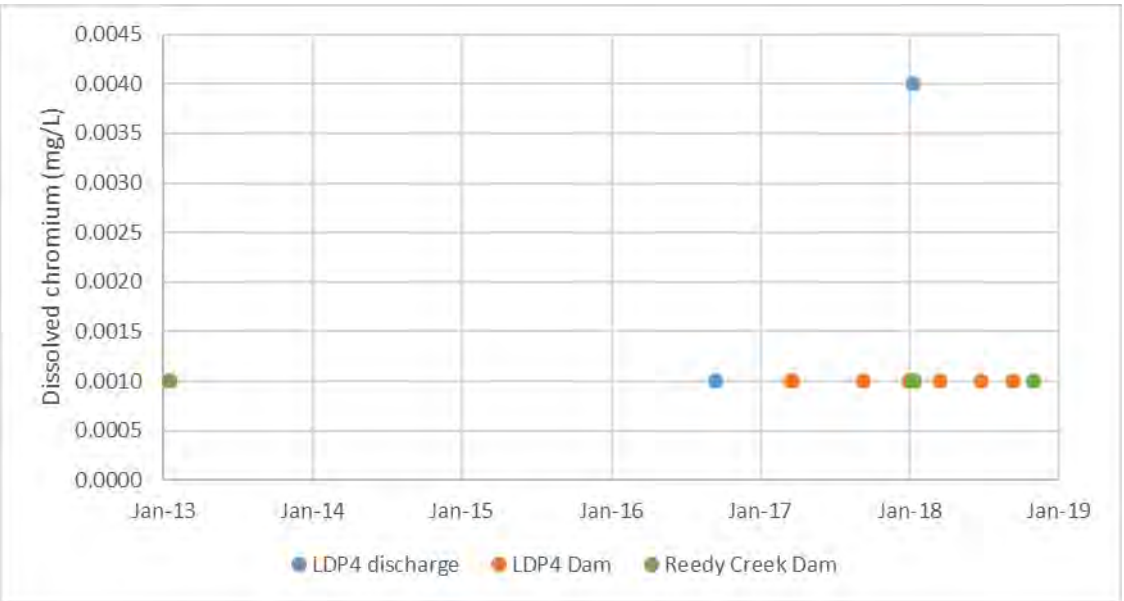


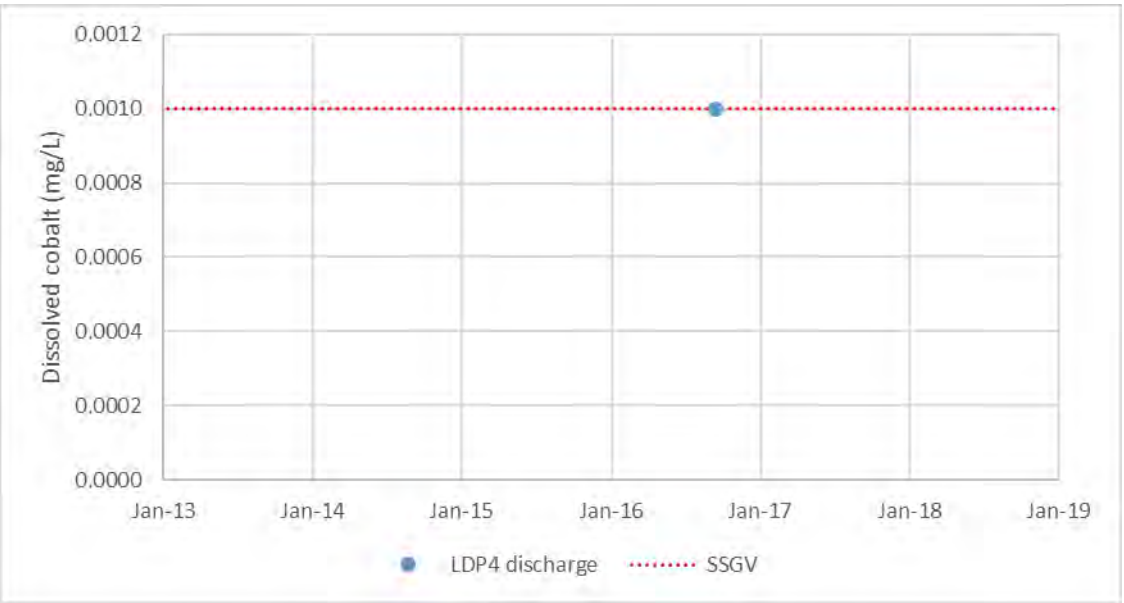


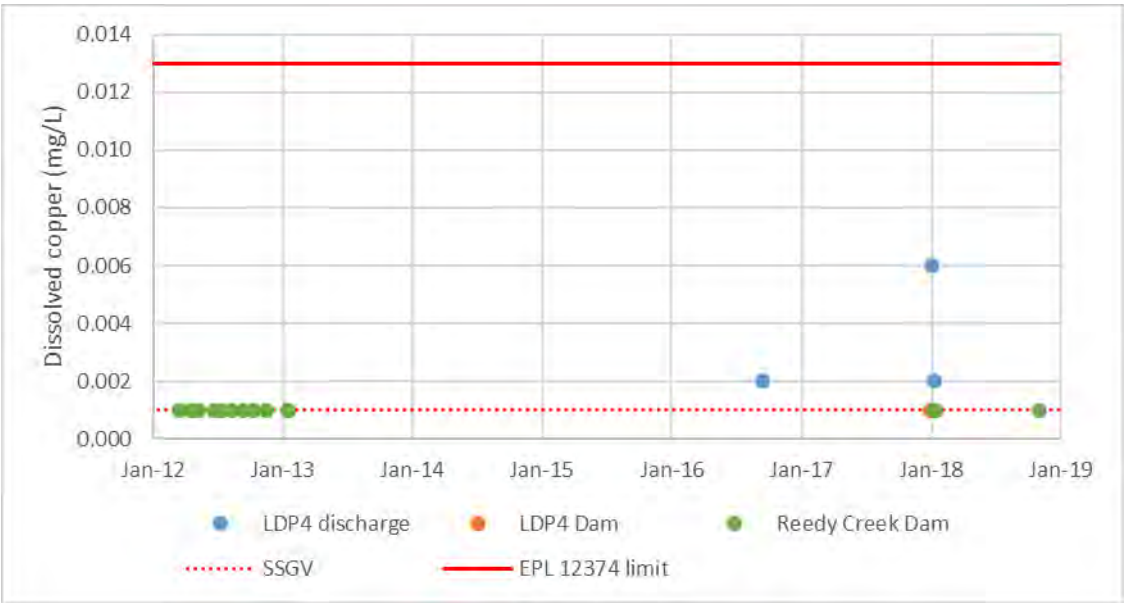


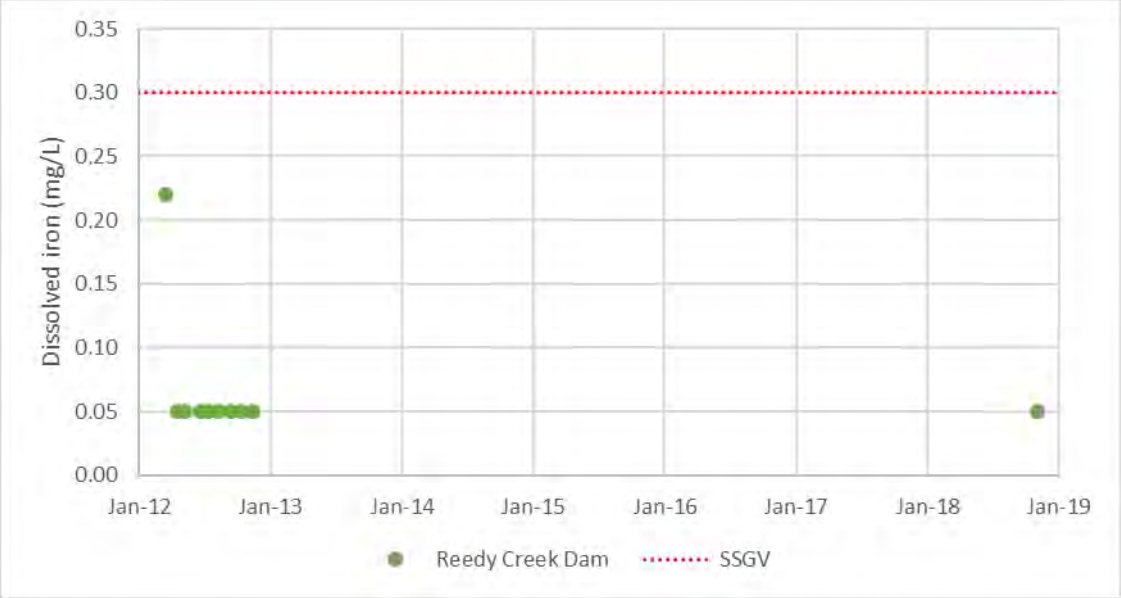

0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Dissolved boron (mg/L)
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
LDP4 discharge
SSGV

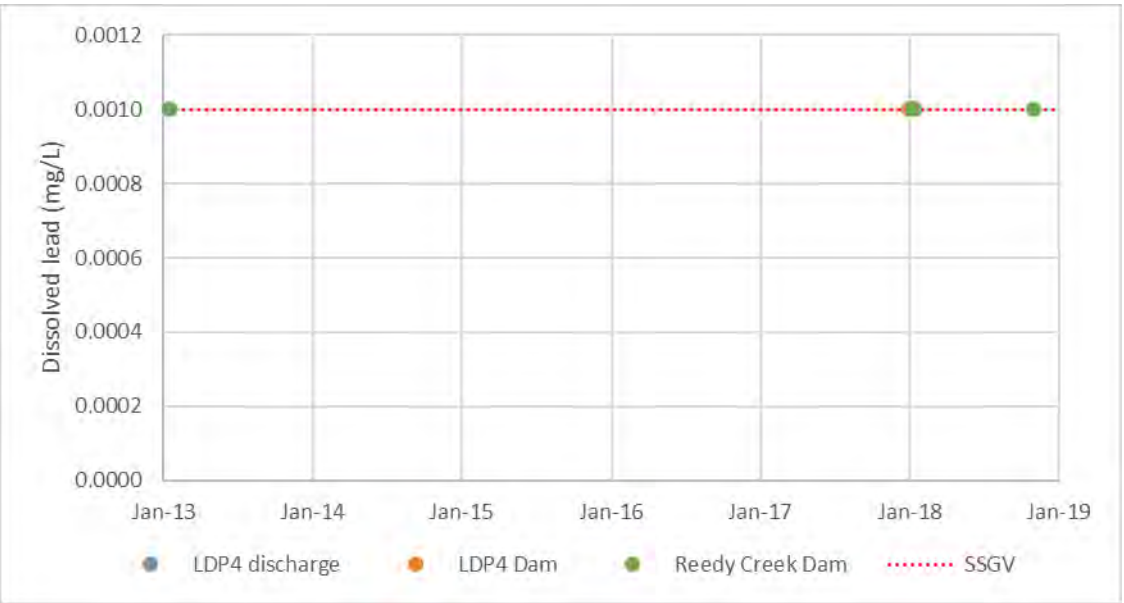

0.00012
0.00010
0.00008
0.00006
0.00004
0.00002
0.00000
Dissolved cadmium (mg/L)
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
LDP4 discharge
LDP4 Dam
Reedy Creek Dam

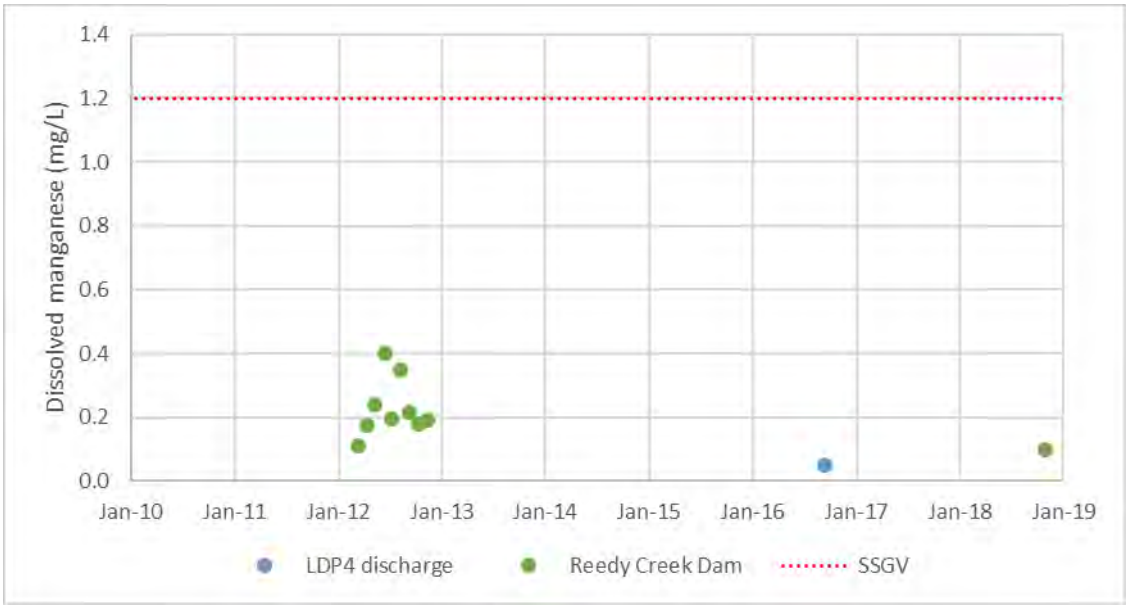

0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
Dissolved chromium (mg/L)
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
LDP4 discharge
LDP4 Dam
Reedy Creek Dam

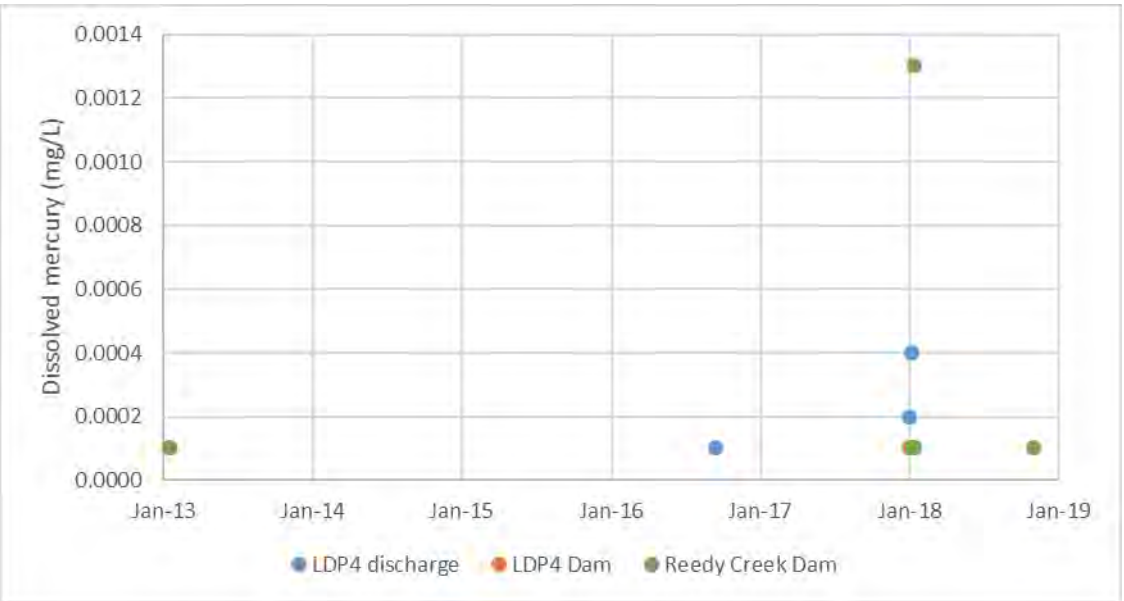

0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
Dissolved cobalt (mg/L)
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
LDP4 discharge
SSGV

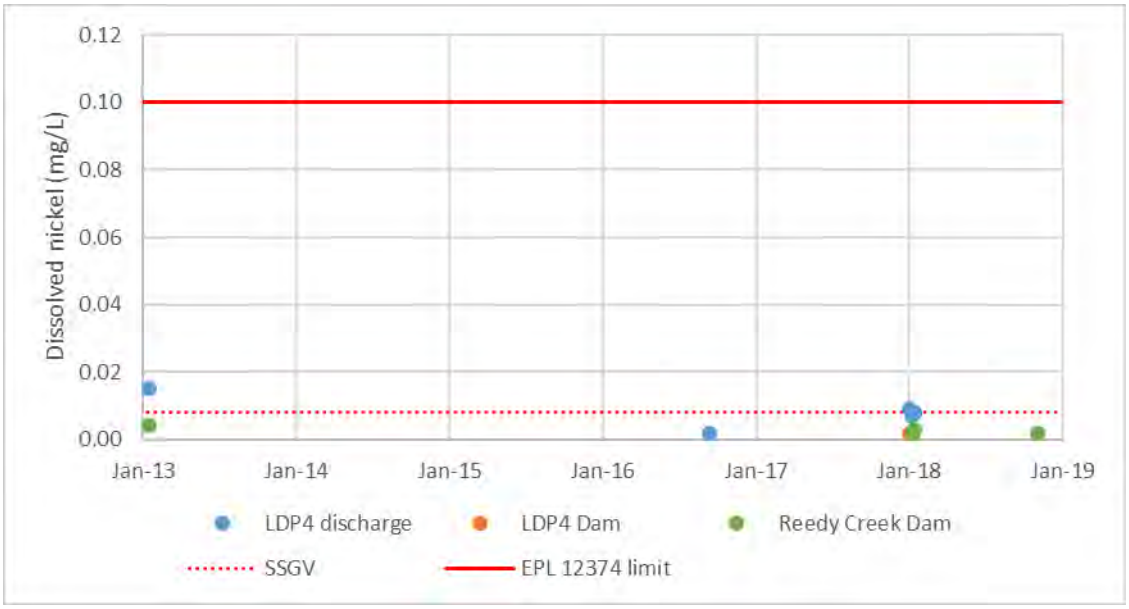

0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
Dissolved copper (mg/L)
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
LDP4 discharge
LDP4 Dam
Reedy Creek Dam
SSGV
EPL 12374 limit

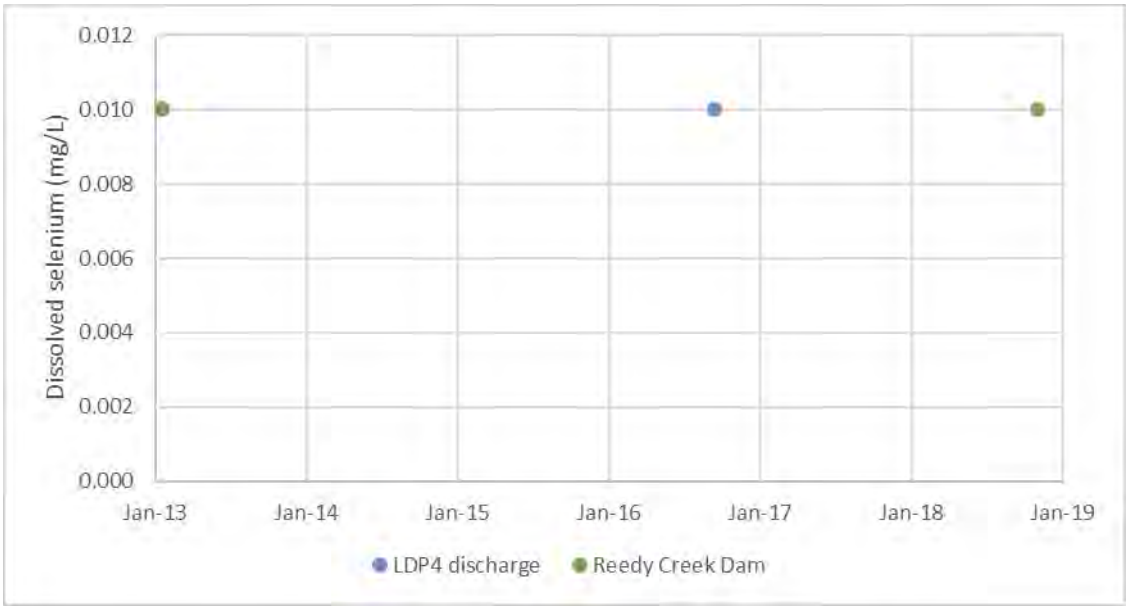

0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Dissolved iron (mg/L)
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Reedy Creek Dam
SSGV

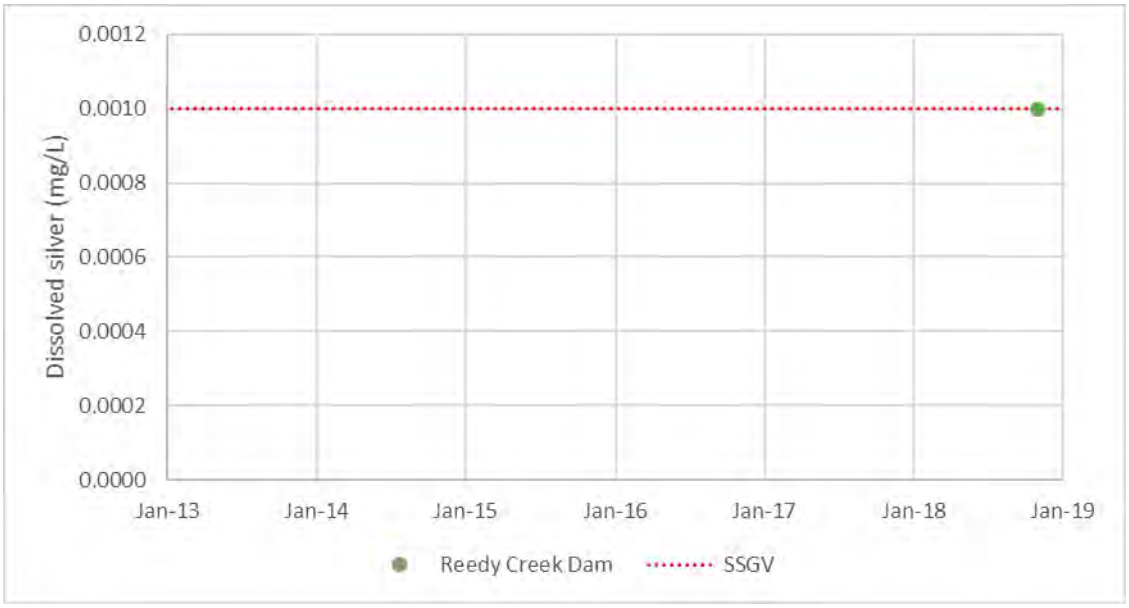

0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
Dissolved lead (mg/L)
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
LDP4 discharge
LDP4 Dam
Reedy Creek Dam
SSGV

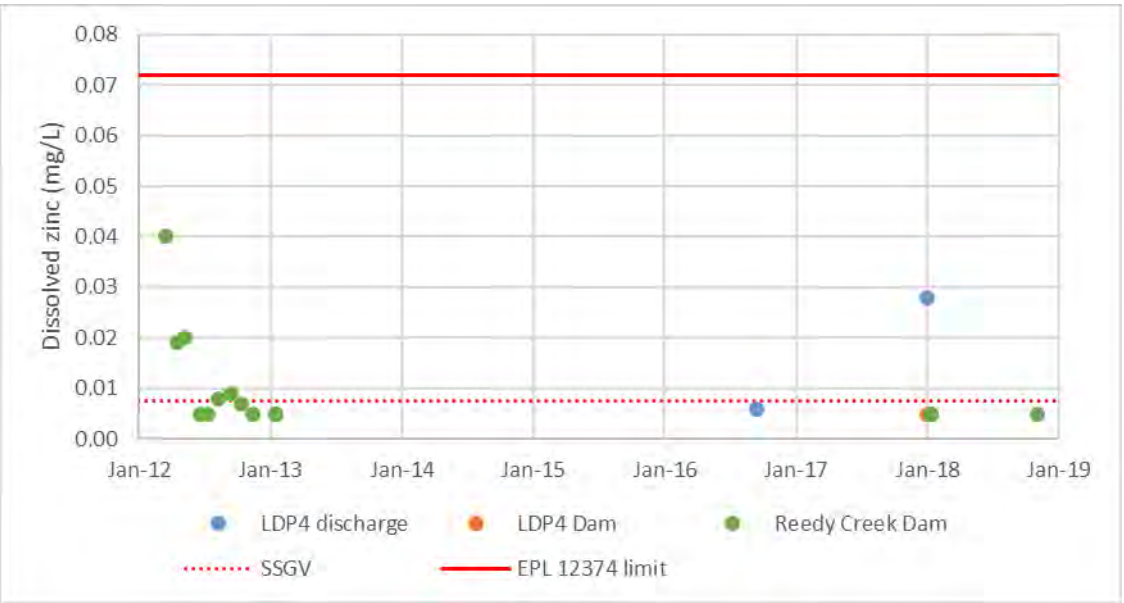

1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Dissolved manganese (mg/L)
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
LDP4 discharge
Reedy Creek Dam
SSGV


0.0014
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
Dissolved mercury (mg/L)
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
LDP4 discharge
LDP4 Dam
Reedy Creek Dam

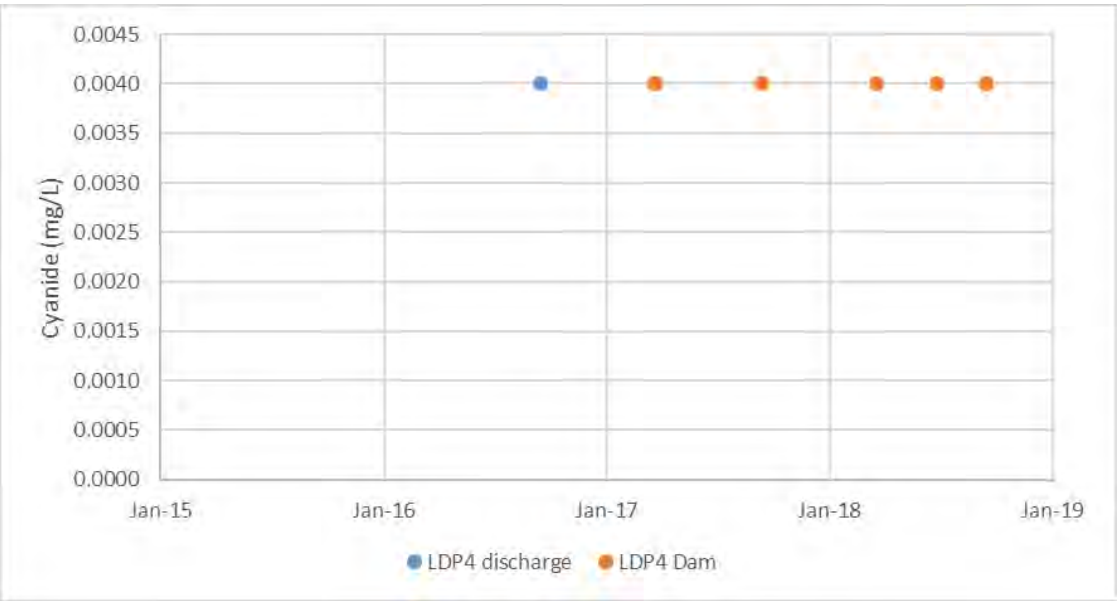

0.12
0.10
0.08
0.06
0.04
0.02
0.00
Dissolved nickel (mg/L)
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
LDP4 discharge
LDP4 Dam
Reedy Creek Dam
SSGV
EPL 12374 limit

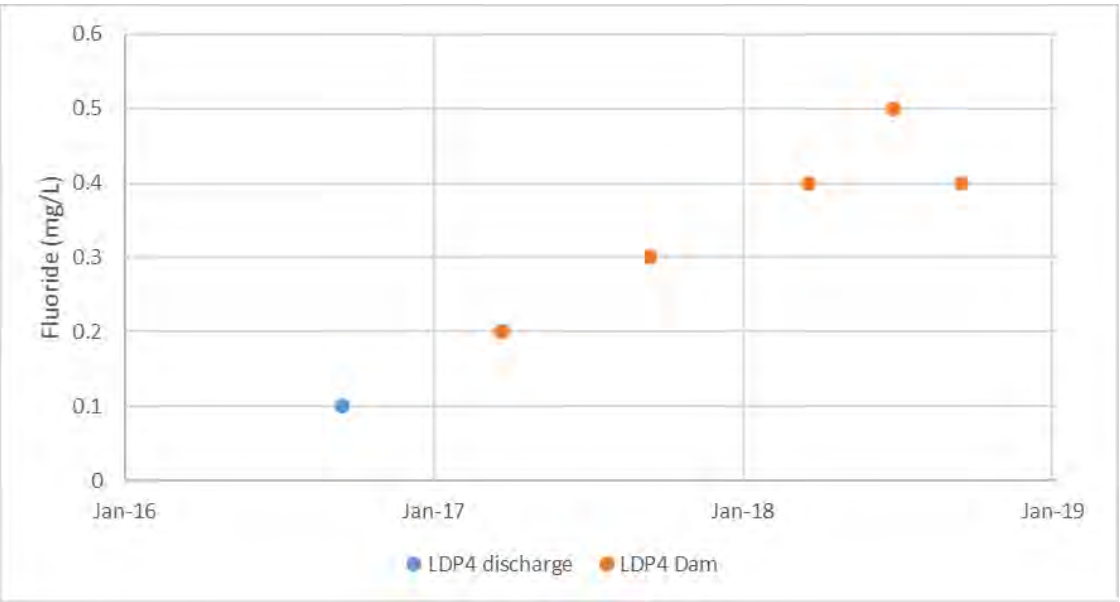

0.012
0.010
0.008
0.006
0.004
0.002
0.000
Dissolved selenium (mg/L)
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
LDP4 discharge
Reedy Creek Dam

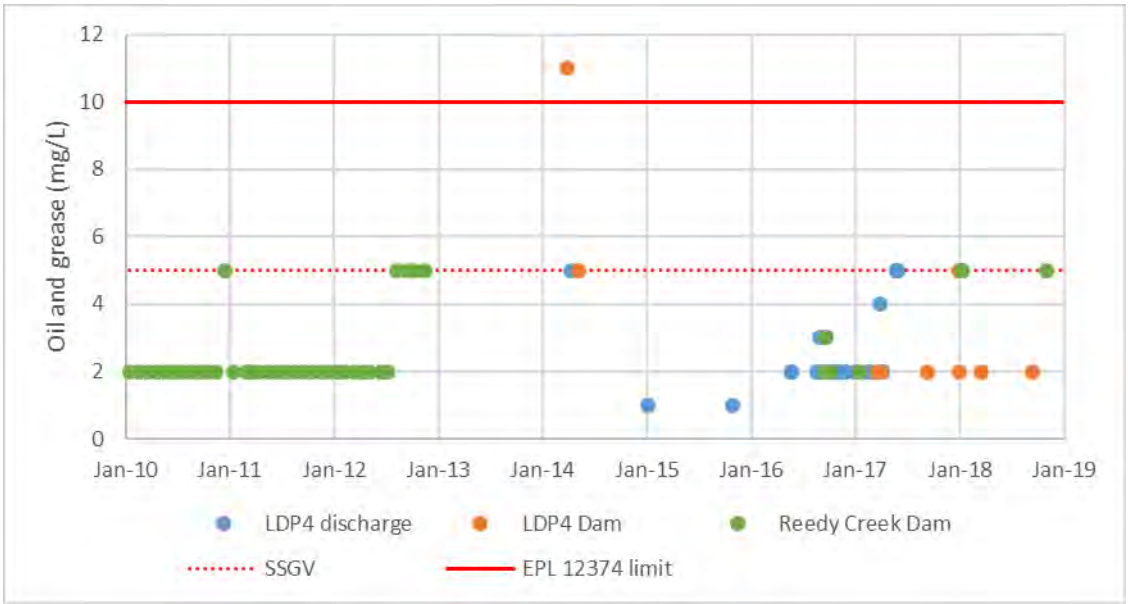

0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
Dissolved silver (mg/L)
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Reedy Creek Dam
SSGV



Other parameters






Oil and grease (mg/L)
12
10
8
6
4
2
0
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
LDP4 discharge
LDP4 Dam
Reedy Creek Dam
SSGV
EPL 12374 limit

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GHD
Level 3 GHD Tower 24 Honeysuckle Drive Newcastle NSW 2300
PO BOX 5403 Hunter Region Mail Centre NSW 2310
T: 61 2 4979 9999 F: 61 2 4979 9988 E: ntlmail@ghd.com

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2219275-47150/https://projects.ghd.com/oc/newcastle1/airlyminemod1groundw/Delivery/Documents/2219275-REP-SWIA-AirlyMod2.docx
Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	T Davies T Tinkler	S Gray		S Gray		10/04/2019

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APPENDIX D – NOISE IMPACT ASSESSMENT

4 April 2019

630.12598-L01-v2.0.docx

Centennial Airly Pty Limited
PO BOX 1000
TORONTO NSW 2283

Attention: Nagindar Singh

Dear Nagindar

Airly Coal Mine - Modification 2
Noise and Vibration Impact Assessment

1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Centennial Airly Pty Ltd, the operator of Airly Mine to undertake a Noise and Vibration Impact Assessment for the proposed modification of consent SSD 5581 to allow receipt of up to 170 ML/year of water from Charbon Colliery (the Project).

The NIA has been prepared with reference to Australian Standards (AS) 1055:1997 *Description and Measurement of Environmental Noise* Parts 1, 2 and 3 and in general accordance with the Environment Protection Authority's (EPA) NSW *Noise Policy for Industry* (NPfI) and *Rail Infrastructure Noise Guideline* (RING).

This NIA also makes reference to SLR report 630.10123.03010R1R1 *Airly Mine Extension Project - Noise and Vibration Impact Assessment* dated 24 March 2014 (EIS -NIA).

2 Project Overview

2.1 Project Description

The Project elements comprise:

- The importation of mine water from Charbon Colliery (up to 170 ML/year) using rail haulage to meet the process water deficit predicted for the site.
- Minor upgrades to the existing surface infrastructure at the Airly pit top to allow transfer of imported water from the train wagons to the site's 109 ML Dam.

Centennial Airly is seeking approval to operate 1 train per day from Charbon Colliery to allow the 170 ML/year of water to the Airly pit top. The train movement could occur either in the day or the night period.

The rolling stock and locos are to be provided by Centennial Airly Pty Ltd specifically for the transfer of water from Charbon to Airly and will be available on an as needs basis. The Wallerawang- Gwabegar rail line between Charbon and Airly pit tops does not operate passenger or other services on a fixed timetable and as such, project trains could be scheduled as required to transport water to Airly.

For the purpose of this assessment, it is proposed that trains will operate with one locomotive and 15 wagons. Each wagon will be retrofitted with two ISO containers, each with a 26,000 L capacity. Each train will therefore carry up to 780 kL of water at a time.

It is important to note that there is no proposal to increase the number of train movements that are currently approved under SSD 5581 due to the importation of the water. The total number of train movements required for the receipt of water at the Airly and the existing transportation of up to 1.8 Mtpa of coal off site will fall within the approved maximum 5 trains per day and an average 2 trains per day over any calendar year.

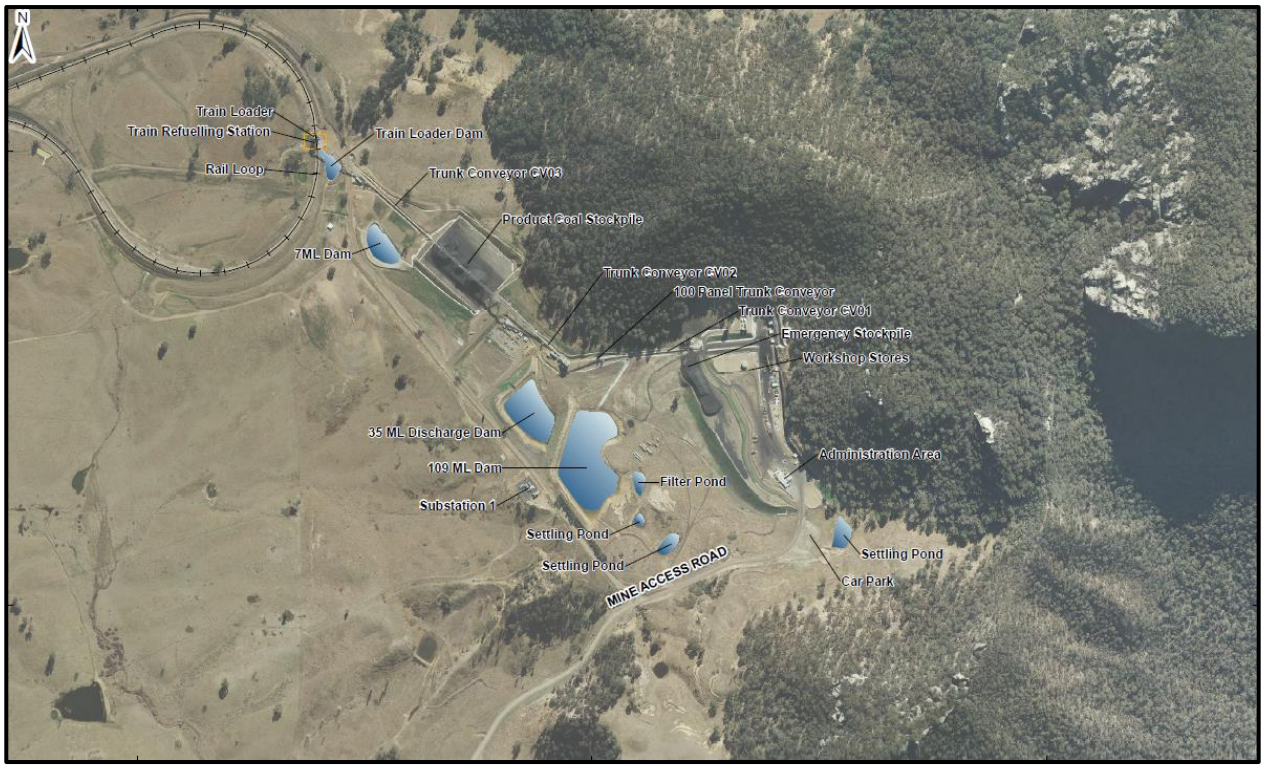
A water laden train from Charbon travelling south along the Wallerawang-Gwabegar line will not be able to directly enter the Airly rail loop. Instead it will travel past the Airly rail loop entry, and after stopping for a short duration, it will reverse into the Airly rail loop.

Water from the trains will be discharged using flexible hoses into an existing drainage line which runs to the rail embankment and flows by gravity into the Train Loader Dam. Collected water in the Train Loader Dam will be pumped to the 109 ML Dam using an existing pipeline for settlement and storage. Following settlement, water will be pumped to the 35 ML Discharge Dam for use as process water under the existing water management system.

On the return trip to Charbon, the empty train will reverse out of the rail loop into the Wallerawang-Gwabegar rail line past the Airly rail loop entry, and after stopping for a short duration will travel back to Charbon.

Figure 1 shows the existing water management infrastructure including the three dams previously discussed.

Figure 1 Existing Surface Water Management Infrastructure



2.2 Existing Approval and Consent Conditions

Schedule 4 Condition 2 of SSD 5581 provides noise criteria relevant to the current Airly Mine operation and is shown in **Figure 2**.

Figure 2 Noise Criteria - SSD 5581

Noise Criteria

2. The Applicant must ensure that the noise generated by the development does not exceed the criteria in Table 4.

Table 4: Noise criteria dB(A)

Land	*Day* $L_{Aeq(15\ min)}$	*Evening* $L_{Aeq(15\ min)}$	*Night* $L_{Aeq(15\ min)}$	*Night* $L_{A\ (max)}$
Any residence on privately-owned land	35	35	35	52
	$L_{Aeq\ (period)}$			
R17 (camp ground)	50 (when in use)			N/A
R18 (Nissen Hut)	50 (when in use)			N/A

Note: To interpret the locations referred to in Table 4 see the applicable figure(s) in Appendix 7.

Noise generated by the development is to be measured in accordance with the relevant requirements of the *NSW Industrial Noise Policy*. Appendix 8 sets out the meteorological conditions under which these criteria apply and the requirements for evaluating compliance with these criteria.

However, these criteria do not apply if the Applicant has a negotiated agreement with the owner/s of the relevant residence or land to generate higher noise levels, and the Applicant has advised the Department in writing of the terms of this agreement.

2.3 Sensitive Receptors

There are a number of rural/residential properties in the vicinity of the Project. Centennial maintains a substantial holding of land in the vicinity of Airly Mine.

The closest effected residential receivers to the Project will be receivers located to the west of the existing rail loop. Receivers considered in this NVIA are shown in **Table 1** and **Figure 3**.

Table 1 Nearest Sensitive Receptors

Receptor ID	Receptor	Easting	Northing
R2	Residential	218907	6332949
R3	Residential	218648	6333227
R4	Residential	218292	6333516
R5	Residential	217893	6332797

218000
219000
220000
6333000
6332000

R4
R3
R2
R5
RUSSELLS ROAD
Heavy Rail
Rail Loop
Train Loader
Rail Entrance

LEGEND
Project Application Area
Residential Receptor
Road
Railway

0 100 200 300 400 m

Scale:1:8,000
GDA 1994 MGA Zone 56

07-Mar-2019
630.12598

H:\Projects-SLR\630-SnWNTL\630-NTL\630.12598 Airly Coal Mine - MOD2 NA\06 SLR Data\01 CAD\GIS\ArcGIS\SLR630125 98_F03_SensitiveReceptors_01.mxd

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Nearest Sensitive Receptors

FIGURE 3

3 Project Noise Impact Assessment Criteria

3.1 NPfI Trigger Noise Levels

The EPA has regulatory responsibility for the control of noise from 'scheduled premises' under the *Protection of the Environment Operations Act 1997*. In implementing the Noise Policy for Industry (NPfI), the EPA has two broad objectives:

- Controlling intrusive noise levels in the short term.
- Maintaining noise amenity levels for particular land uses over the medium to long-term.

In general terms, the NPfI sets out procedures for establishing the project intrusiveness $L_{Aeq(15minute)}$ and project amenity $L_{Aeq(period)}$ noise levels, with a view to determining the lower (that is, the more stringent) being the Project Trigger Noise Level (PTNL), NPfI Section 2.1 states:

> *The project intrusiveness noise level aims to protect against significant changes in noise levels, whilst the project amenity noise level seeks to protect against cumulative noise impacts from industry and maintain amenity for particular land uses. Applying the most stringent requirement as the project noise trigger level ensures that both intrusive noise is limited and amenity is protected and that no single industry can unacceptably change the noise level of an area.*

For assessing intrusiveness, the existing background noise generally needs to be measured. The intrusiveness trigger level essentially means that the equivalent continuous noise level (L_{Aeq}) of the source should not be more than 5 dBA above the measured (or default) Rating Background Level (RBL).

The amenity assessment is based on amenity noise levels specific to the land use and associated activities. The project amenity noise levels are shown in **Table 2** and relate only to industrial-type noise and do not include road, rail or community-related noise. Based on the NPfI land use descriptions residences surrounding the development have been classified for the purposes of this noise assessment as 'rural residential'.

Table 2 Amenity Criteria - Recommended Amenity Noise Levels

Type of Receiver	Noise Amenity Area	Time of Day	Recommended $L_{Aeq(Period)}$ Noise Level, dBA
Residential	Rural	Day	50
		Evening	45
		Night	40

The PTNLs are then determined in accordance with NPfI Section 2.1 *Project Noise Trigger Level* by identifying the lower of the project amenity or project intrusive noise levels (following conversion of the $L_{Aeq(period)}$ project amenity noise level to an equivalent $L_{Aeq(15minute)}$ value for comparison with the $L_{Aeq(15minute)}$ project intrusive noise level). NPfI Section 2.2 *Noise Descriptors* assumes a default conversion factor of +3 dB for the conversion of $L_{Aeq(period)}$ noise levels to $L_{Aeq(15minute)}$ noise levels.

In addition to the PTNLs, NPfI provides guidance in relation to the assessment of sleep disturbance. Specifically, the NPfI states:

Where the subject development/premises night-time noise levels at a residential location exceed:

- *$L_{Aeq(15minute)}$ 40 dBA or the prevailing RBL plus 5 dB, whichever is the greater, and/or*
- *L_{AFmax} 52 dBA or the prevailing RBL plus 15 dB, whichever is the greater,*

a detailed maximum noise level assessment should be undertaken.

Where those trigger levels are not met, it is appropriate to consider any effect of the noise with regard to:

- The extent to which the maximum noise level exceeds the rating background noise level
- How often high noise events will occur
- The distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the subject development
- Whether there are times of day when there is a clear change in the noise environment (such as during early-morning shoulder periods)
- Current scientific literature available at the time of the assessment regarding the impact of maximum noise level events at night.

3.2 Rail Traffic Noise

The EPA released *Rail Infrastructure Noise Guideline* (RING) in May 2013. The Guideline provides requirements in Appendix 2 for rail traffic-generating developments and are reproduced as follows:

Land-use developments other than rail projects that are likely to generate additional rail traffic on an existing rail network should be assessed against the following requirements:

- *Identify the typical offset distance/s of sensitive receivers from the rail line/s that are likely to be affected by increased rail movements.*
- *Quantify the existing level of rail noise at the offset distance/s identified above using the noise descriptors $L_{Aeq,15/9hr}$ and L_{Amax} (95th percentile) dB(A).*
- *Predict the cumulative rail noise level (i.e. from the existing and proposed rail movements) using a calibrated noise model (based on predicted increased rail movements) at the offset distances identified above.*
- *Compare the cumulative noise level with the rail noise assessment trigger levels: $L_{Aeq,15hr}$ 65 dB(A), $L_{Aeq,9hr}$ 60 dB(A), and L_{Amax} (95th percentile) 85 dB(A).*
- *Implement all feasible and reasonable noise mitigation measures where the cumulative noise level exceeds the noise assessment trigger levels and project-related noise increases are predicted.*
- *Where the L_{Aeq} noise level increases are more than 2 dB(A), which is equivalent to approximately 60 per cent of the total line or corridor rail traffic, and exceeds the relevant noise assessment trigger level, strong justification should be provided as to why it is not feasible or reasonable to reduce the increase.*

Notes

1 A project-related noise increase is an increase of more than 0.5 dB over the day or night periods.

2 *The geographical extent of the rail noise assessment ideally should be where project-related rail noise increases are less than 0.5 dB. This roughly equates to where project-related rail traffic represents less than 10 per cent of the total line or corridor rail traffic.*

3.3 Project Trigger Noise Levels

Applicable PTNLs for all receiver areas surrounding the Project have been established with reference to the NPfI and are contained in **Table 3**. The rating background noise levels (RBLs) were taken from the EIS NIA. Given that no significant changes in the region have occurred, the RBLs are considered representative of the pre-mining acoustic environment.

Table 3 Project Trigger Noise Levels

Location ID	Period	Project Intrusive[1] dBA $L_{Aeq(15minute)}$	Project Amenity[2] $L_{Aeq(period)}$	Project Amenity[3] dBA $L_{Aeq(15minute)}$	Resulting PTNL[4] dBA $L_{Aeq(15minute)}$
R2-R5	Day	40	45	48	40
	Evening	35	40	43	35
	Night	35	35	38	35

1. Project Intrusive is the RBL plus 5 dB
2. Project amenity (period) noise level is the Amenity Criteria minus 5 dB.
3. Project amenity (15 minute) noise level is the Project Amenity (period) noise level plus 3 dB
4. Resulting PTNL is the lower of the project intrusive and the project amenity (15 minute) noise levels

The L_{AFmax} sleep disturbance criteria at all receiver locations would be 52 dBA.

It is noted that Airly Mine, as part of this Project is not seeking to increase approved noise levels above those already contained in SSD 5581.

3.4 Annual Compliance Noise Monitoring and Operational Performance

A requirement of the approved project Noise Management Plan (NMP), operator attended noise monitoring is conducted on an annual basis at locations representative of the nearest residential receivers surrounding Airly Mine. Noise monitoring indicates that operation of the existing Airly Coal mine complies with the SSD 5581 criteria. Furthermore it is noted that Airly Mine noise emissions do not trigger any modifying factors as described by the NSW *Industrial Noise Policy* and NPfI.

It is also noted that, to date, no complaints regarding noise emissions from Airly Mine have been received.

4 Project Operational Noise Assessment

No changes to the pit top activities are proposed; with the exception that one of the existing dam pumps will be upgraded. The proposed use of the rail loop by a water laden train would be comparable to the existing use of the rail loop by coal trains assessed in the EIS NIA, with the exception that associated coal loading infrastructure would not be operational as the water is unloaded via gravity. Furthermore, as only one (1) train would operate on the loop at any one time, the modification would not lead to an increase in onsite activities above those assessed in the EIS NIA.

As such the Project is not predicted to increase offsite noise emissions, and it is expected that Airly Mine would continue to operate in compliance with SSD 5581 criteria at all receiver locations.

5 Rail Traffic Noise Impact Assessment

Noise from offsite rail activities associated with the Project on the Wallerawang-Gwabegar rail line has been considered as part of the rail traffic noise impact assessment and assessed in accordance with RING.

As the Wallerawang - Gwabegar rail line between Charbon and Airly pit is operated infrequently and not to a fixed timetable, existing rail noise levels would be low across the project area.

The assessment has considered a single return rail movement (i.e one return movement resulting in two rail passbys) during either the Day or Night period. For receivers to the west of the Airly rail loop, noise associated with the change of direction of water trains on the Wallerawang-Gwabegar rail line prior to entering and upon exiting the Airly rail loop has been considered.

To provide a worst case assessment of rail noise one locomotive (notch 2 setting - L_{Aeq} sound power level of 105 dBA) has been considered to be operating for up to 15 minutes during each direction change on the Wallerawang-Gwabegar rail line as well as wagons bunching generating a L_{Amax} sound power level of 125 dBA.

Predicted rail traffic noise levels at receivers in the vicinity of the Airly rail loop entrance are provided in **Table 4**.

Table 4 Predicted Rail Noise Levels - Airly Rail Loop Entrance

Receiver	Distance to Airly Rail Loop Entrance Stopping Area	Predicted Noise Levels			Trigger Levels		
		Day $L_{Aeq(15hour)}$	Night $L_{Aeq(9hour)}$	Passby L_{Amax}	Day $L_{Aeq(15hour)}$	Night $L_{A60eq(9hour)}$	Passby L_{Amax}
R2	650 m	<30	<30	30	65	60	85
R3	1050	<30	<30	<30	65	60	85
R4	1,500	<30	<30	<30	65	60	85
R5	1,200 m	<30	<30	<30	65	60	85

The nearest receiver to the Wallerawang-Gwabegar rail line between Airly and Charbon Pit tops is located approximately 50 m from the centreline of the track in the township of Clandulla. Predicted rail noise levels at this offset distance for one train load per day (i.e two movements during the day or night period) are provided in **Table 5**.

Table 5 Predicted Rail Traffic Noise Levels - Wallerawang-Gwabegar between Airly and Charbon

Distance to Wallerawang-Gwabegar rail line	Predicted Noise Levels			Trigger Levels		
	Day $L_{Aeq(15hour)}$	Night $L_{Aeq(9hour)}$	Passby L_{Amax}	Day $L_{Aeq(15hour)}$	Night $L_{A60eq(9hour)}$	Passby L_{Amax}
50 m	43	45	83	65	60	85

Rail noise levels from the Project are predicted to be below the trigger levels at all receiver locations.

6 Vibration

Given the separation distance between the Project site and the nearest potentially affected residential locations (greater than 650 m) vibration levels from activities at the Project site are predicted to be negligible and below levels of human perception at the nearest residences.

7 Conclusion

The Project is not predicted to increase offsite noise emissions, and it is expected that Airly Mine would continue to operate in compliance with SSD 5581 and NPfI criteria at all receiver locations. Rail noise levels from the Project are predicted to be below the trigger levels at all receiver locations.

I trust the above meets your current requirements. If you have any questions or require any further information please do not hesitate to contact me on 02 4907 3200 or email mdavenport@slrconsulting.com.

Yours sincerely



MARTIN DAVENPORT
Associate - Acoustics & Vibration

Checked/
Authorised by: MR