# Bloomfield Colliery Continuation Project

## Groundwater Impact Assessment

Bloomfield Collieries Pty Ltd

19 February 2025

→ **The Power of Commitment**

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# 1. Introduction

The Bloomfield Colliery (the Colliery) is an existing open cut mining operation located approximately 20 kilometres (km) north-west of Newcastle, as shown by Figure 1.1. The Colliery is operated by Bloomfield Collieries Pty Limited (Bloomfield), part of the Bloomfield Group of companies. The Colliery currently operates in accordance with Project Approval (PA) 07_0087 and subsequent modifications, with approved production levels of a maximum of 1.3 million tonnes per annum (Mtpa) of Run of Mine (ROM) coal. Mining operations under the existing approval may take place until 31 December 2030.

Based on current annual mining rates and estimated remaining coal reserves, Bloomfield proposes to continue mining operations further north of the existing approved project area within Mining Lease (ML) 1738 within the existing Creek Cut area and an additional area known as the Workshop Cut (Modification 5). Existing mining methods would continue to be employed with production levels to be reduced below the currently approved 1.3 Mtpa of ROM coal to 0.9 Mtpa. This continuation would extend the life of the operation until 31 December 2035. The proposed extension is to occur in two individual areas known as:

– Creek Cut
– Workshop Cut

## 1.1 Site details

### 1.1.1 Project site

The ML and proposed project area are shown in Figure 1.2, while the approved and proposed project areas are compared in Figure 1.3.

The Colliery is centrally located between the suburbs of Kurri Kurri, East Maitland and Beresfield. The Colliery is situated north of John Renshaw Drive, Buttai and east of Buchanan Road, Buchanan.

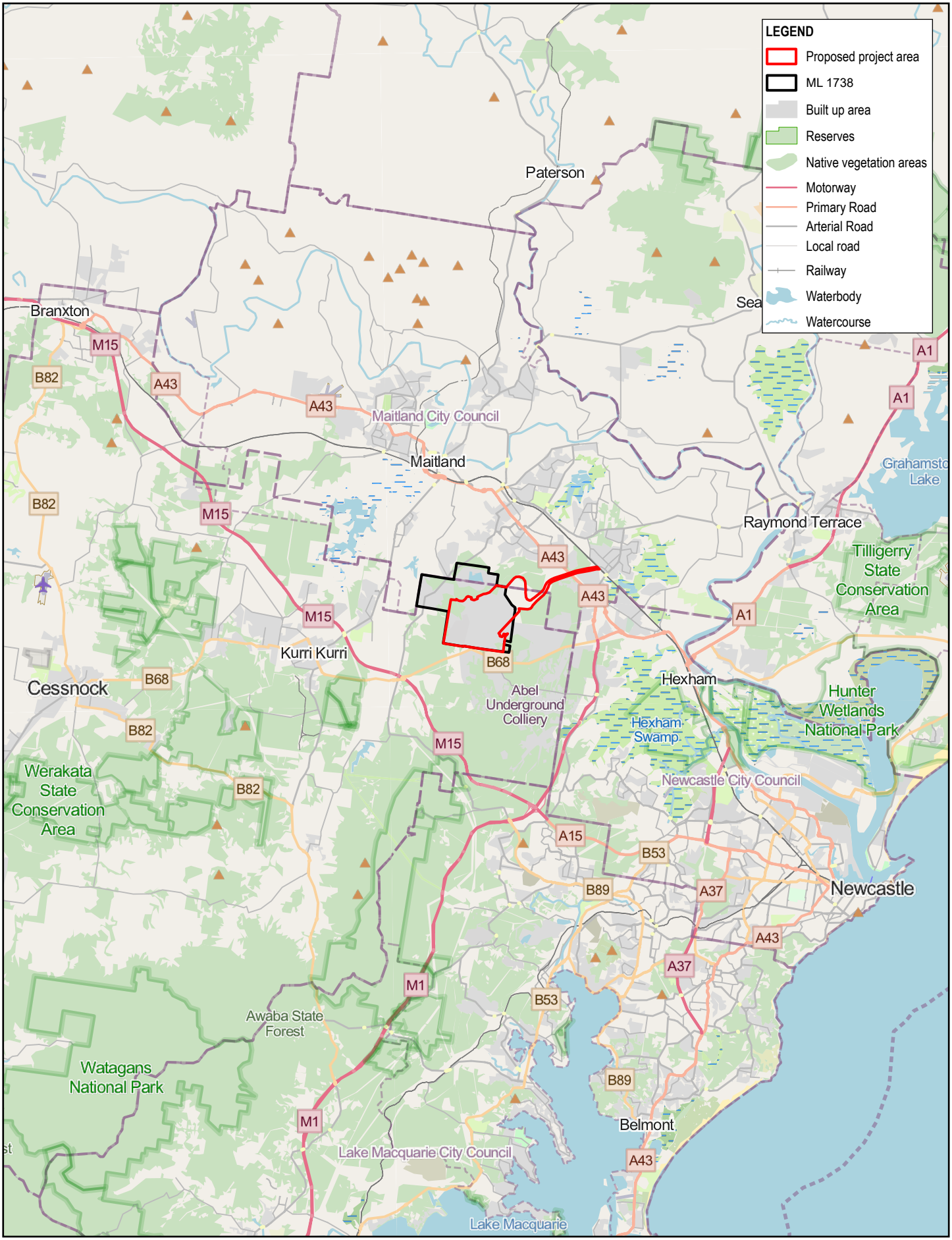
Land use in the surrounding locality is a mixture of:

– North – rehabilitated grazing land post mining.
– South – rural residential properties, John Renshaw Drive.
– East – rehabilitated grazing land post mining.
– West – open forest and residential properties located adjacent to Buchanan Road and to the northwest at Louth Park.

The nearest urban residential area is Ashtonfield, approximately 2.25 km north-east of the Workshop Cut (refer Figure 1.3). The nearest residence to the approved project area that is not owned by Bloomfield is located approximately 600 metres south of the southern boundary of the currently approved project area.

Mining operations in the vicinity of the approved project area include:

– Abel Underground Mine, located to the south-east of the Colliery (in care and maintenance since June 2016).
– Donaldson Open Cut Mine, located to the east of the Colliery (in care and maintenance since June 2016).
– Tasman Underground Mine, located to the south of the Colliery (closed, rehabilitation completed in 2014).
– Bloomfield Coal Handling & Preparation Plant (CHPP) and rail loading facility approved as part of the Abel Project Approval (PA) 05_0136.

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Kilometres

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

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GHD

**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Mine Continuation**
**Groundwater Impact Assessment**

Project No. **12597478**
Revision No. **0**
Date **04/07/2024**

## Regional context

# FIGURE 1.1

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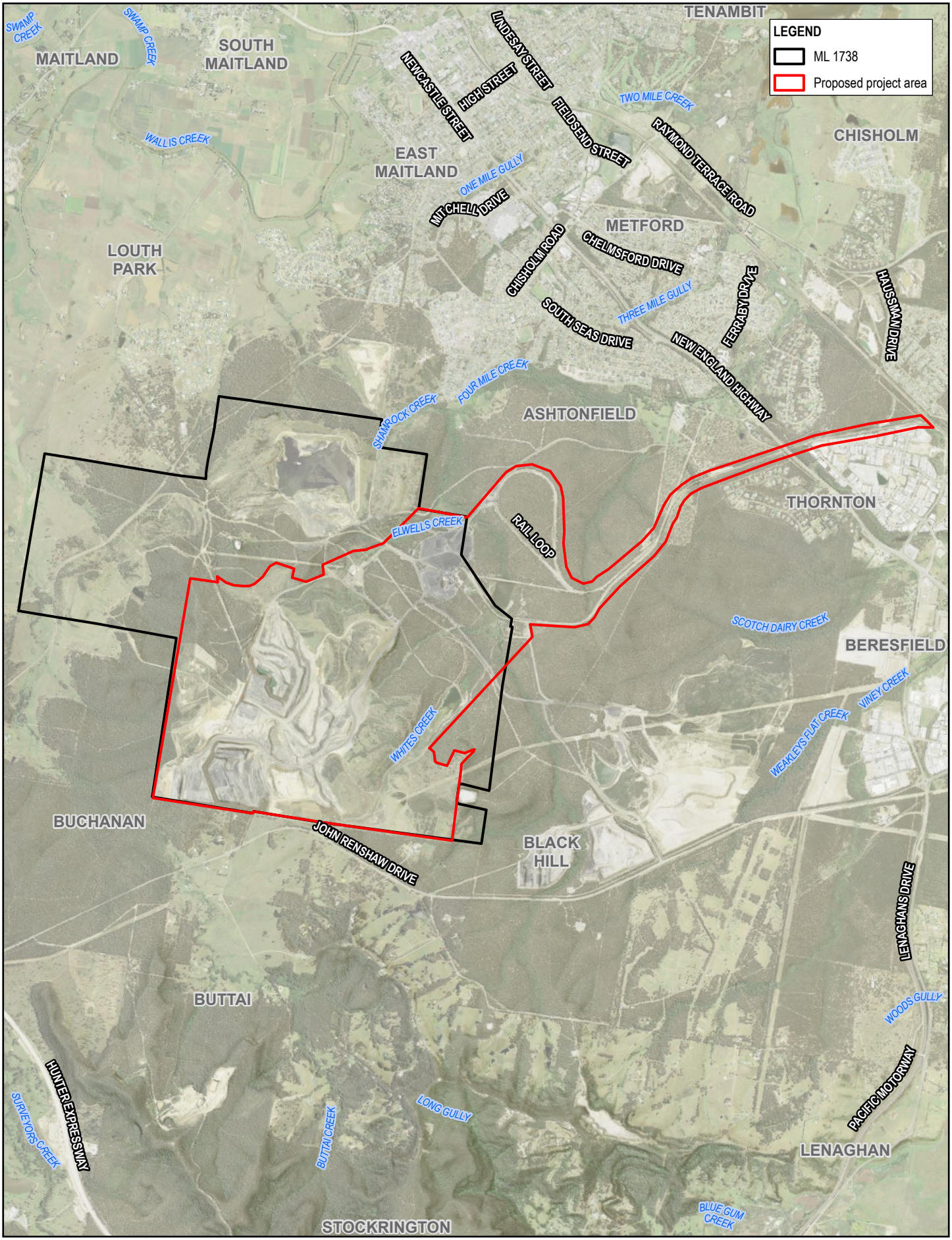


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**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Mine Continuation**
**Groundwater Impact Assessment**

**Proposed project area**

Project No. **12597478**
Revision No. **0**
Date **04/07/2024**

# FIGURE 1.2

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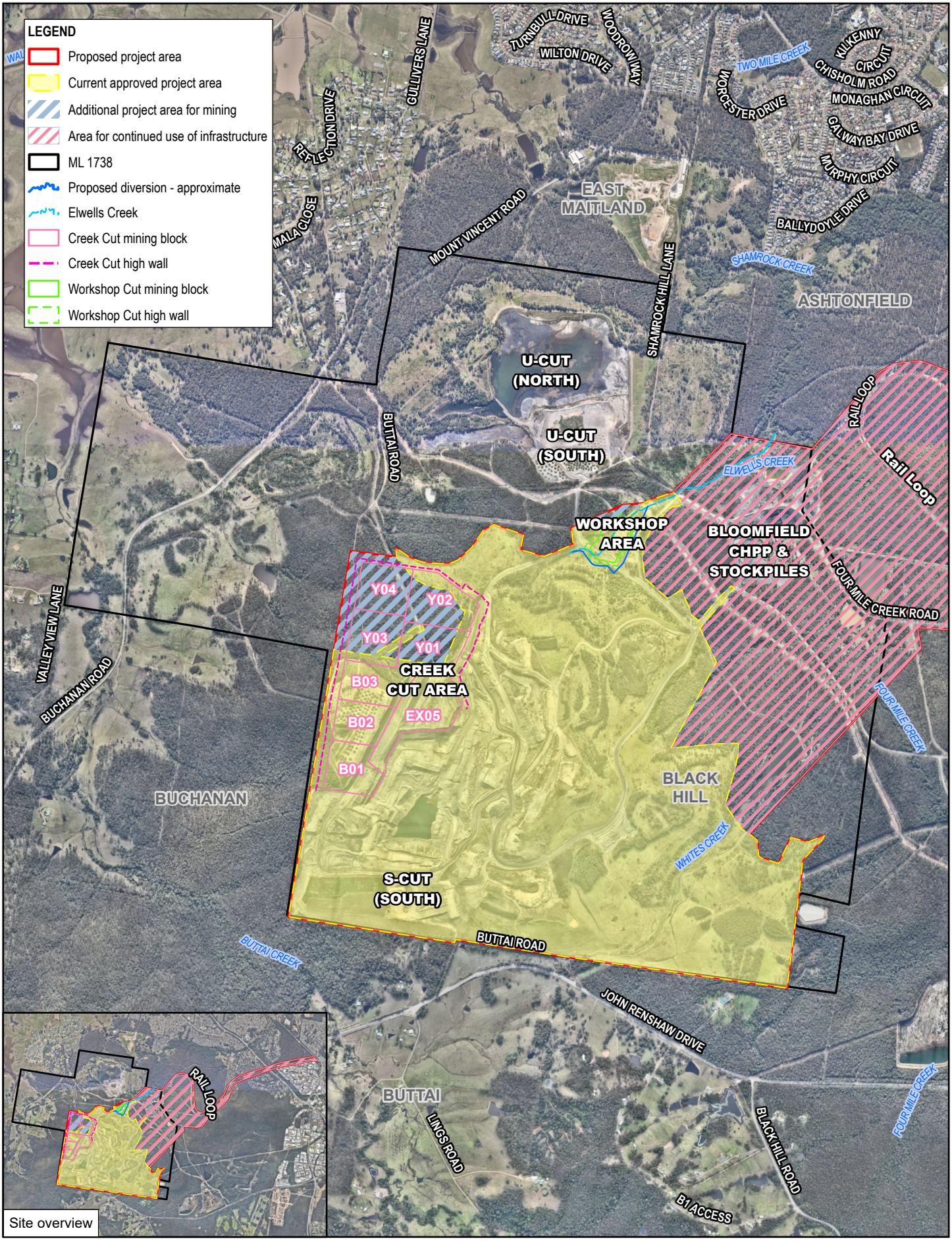
Data source: LPI: DCDB, 2019. Bloomfield Colliery: Project area/Mine lease, 2023. sixmaps/LPI_Imagery_Best: © Department of Customer Service 2020
World Hillshade: Esri, Geoscience Australia, NASA, NGA, USGS.
Created by: tmorton

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**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Mine Continuation**
**Groundwater Impact Assessment**

Project No. **12597478**
Revision No. **0**
Date **04/07/2024**

## Mine continuation plan

# FIGURE 1.3

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Data source: LPI: DCDB, 2019. Bloomfield Colliery: Project area/Mine lease, 2023. World Hillshade: Esri, Geoscience Australia, NASA, NGA, USGS
Nearmap WMS Server: – Imagery (Date extracted: 04/07/2024).
Created by: tmorton

### 1.1.2 Project history and current operations

Coal has been mined at the Colliery for approximately 170 years. The open cut, which has been operating since 1966, is approved to produce a maximum of 1.3 Mtpa of ROM coal. Product coal is predominantly thermal coal with some semi-soft coking coal for the Asian export market. Currently the Colliery is operated under Project Approval (PA) 07_0087, with open cut mining operations currently located in the southern portion of the approved project area within the S-Cut and Creek Cut open cut pits. Underground mining operations ceased in 1992.

The Colliery is a multi-seam, multi bench system, mining up to 13 seams or splits. Coal is extracted from seams within the Tomago Coal Measures, including the Buttai, A, B and C, Whites Creek, Elwells Creek, Donaldson and Big Ben seams. Heavy earth moving equipment delivers the ROM coal to the onsite CHPP via internal haul roads. ROM coal is processed at the CHPP including size reduction, washing and screening. Product coal is stockpiled adjacent to the CHPP before being loaded into rail wagons at the Bloomfield rail loading facility and transported by rail to the Port of Newcastle or to other domestic customers.

The Colliery has approval to operate 24 hours per day, seven days per week, and employs 93 personnel over 15 shifts a week across its operations, including the mining, administration and maintenance areas.

The following land uses are located within the approved project area:

– Current active open cut coal mining areas.
– Unshaped and shaped overburden dump areas.
– Progressively rehabilitated areas some of which are actively grazed by cattle.
– Workshop and surrounding area used for maintenance and fuel storage.
– Road linking the current coal mining areas with the ROM coal stockpiles adjacent to the CHPP.
– Road linking the current and proposed coal mining areas to the workshop.
– Areas of completed rehabilitation which are actively grazed by cattle.

## 1.2 Purpose of this report

This Groundwater Impact Assessment (GIA) report has been prepared to provide an assessment of the potential groundwater impacts related to the construction and operation of the proposed project (Modification 5). Details of the proposed project are outlined in Section 2. This report has been independently peer reviewed by Dr Noel Merrick (HydroAlgorithmics, 2024). The peer review report is included in Appendix E.

## 1.3 Scope and limitations

The scope of this GIA is as follows:

– Review updated groundwater monitoring data and summarise existing information on the hydrogeological environment, including the existing conceptual model.
– Undertake searches of the registered groundwater bore and Groundwater Dependent Ecosystem (GDE) online databases and identify groundwater receptors.
– Review of the relevant Water Sharing Plans (WSPs) and classification of the groundwater source under the NSW Aquifer Interference Policy.
– Approximate the rate of groundwater inflow and radius of drawdown during the proposed operations and post mining phases based on the conceptual model, previous numerical groundwater modelling, available monitoring data and appropriate analytical methods where required.
– Assess potential impacts (quantity and quality) on identified groundwater receptors, including assessment of impacts against the relevant level and quality criteria in the NSW Aquifer Interference Policy.
– Identify groundwater licensing requirements under the relevant WSPs, including an assessment of market depth should an additional Water Access Licence (WAL) be required.
– Identify ongoing groundwater monitoring requirements.
– Document the findings of the above in a Groundwater Impact Assessment report.

This report has been prepared by GHD for *Bloomfield Collieries Pty Ltd* and may only be used and relied on by *Bloomfield Collieries Pty Ltd* for the purpose agreed between GHD and *Bloomfield Collieries Pty Ltd* as set out in Section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than *Bloomfield Collieries Pty Ltd* arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer Section 1.4 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

## 1.4 Assumptions

The following assumptions apply to this assessment:

– Continued use of the existing infrastructure approved as part of the “Bloomfield Site” in the Abel project approval PA 05_0136 such as the CHPP, train load out, rail loop and water management. This continued use of the existing infrastructure until 31 December 2035 for mining purposes will not result in any additional impact to groundwater.
– Assessment of groundwater impacts associated with mine workings approved under the Abel project approval PA 05_0136, or from the continued transfer of water from Abel Mine to Bloomfield Colliery, is beyond the scope of this GIA.

# 2. Project description

## 2.1 Description of the project

### 2.1.1 Proposed mining

The proposed project includes:

- Extending mining of the Creek Cut and mining of the Workshop Cut, which is an additional 39 ha area.
- Extraction of seams from below the Buttai seam in the Creek Cut area.
- Extraction of an additional 5.8 Mt ROM coal.
- Reducing the annual maximum production level to 0.9 Mt ROM.
- Extending the date of the project approval to allow mining operations to continue until 31 December 2035.
- Proposed changes to rehabilitation and final landform including a decreased size of the final void and reduced size of the slope angles of the rehabilitated landform, improving post mining land use options including agricultural grazing.
- Continued use of infrastructure approved as part of the "Bloomfield Site" in the Abel project approval PA 05_0136 including the CHPP, train load out, rail loop and water management structures until 31 December 2035.
- Continued use of the tailings storage facilities at U-Cut and S-Cut South Void (as originally approved by Abel project approval PA 05_0136) until 31 December 2035.

#### 2.1.1.1 Mining area

The proposed modification includes the continuation of mining operations towards the north of the existing approved project into two additional areas known as the Creek Cut area and the Workshop Cut area, mining all seams from surface down to and including the Big Ben seam. The proposal also includes mining of existing blocks B01, B02 and B03 of the Creek Cut area down to and including the Big Ben seam in areas where mining of the upper Buttai Seams has already occurred (refer Figure 1.3).

#### 2.1.1.2 Mining method

No changes to the mining method currently used at the Colliery is proposed.

The Colliery would continue to use existing mining methods, both within the currently approved project area and into the proposed project area. The Colliery currently uses multi-seam bench open cut techniques to extract coal from a variety of seams within the Tomago Coal Measures. The mining process at the Colliery generally comprises vegetation stripping, removal and stockpiling of topsoil, drilling and blasting of overburden, removal and emplacement of overburden, and extraction of coal. Coal is transported by truck to the ROM coal stockpile via internal haul roads and overburden emplacement areas are reshaped and rehabilitated to create the final landform.

No changes to equipment, mining or blasting method, rejects and approved tailings disposal methods are proposed as a result of the modification. Once the U-Cut tailings disposal area is exhausted, the tailings will be disposed to a tailings emplacement void at S-Cut previously approved by Modification 3 of the Abel project approval PA 05_0136.

No change to the site access or water management are proposed.

No change is proposed to the operational workforce, hours of operation or the management of mining waste.

### 2.1.2 Surface infrastructure

Surface infrastructure at the Colliery is comprised of administration, office buildings, the workshop and the CHPP complex owned by Bloomfield. This infrastructure is inclusive of infrastructure approved under Abel project approval PA 05_0136 which consists of:

– The Bloomfield CHPP.
– The Bloomfield Rail Loading Facility, Rail Loop and Rail Spur.
– Bloomfield Colliery open-cut pits which are used to emplace coal reject and tailings from the Bloomfield Open Cut Project as well as the Abel Mine.
– Water management structures.

The term of the Abel project approval is to December 2030.

This proposed modification therefore seeks the continued use of the “Bloomfield Site” infrastructure for the processing, handling and railing of coal and tailings and water management until the end of the mine life of the modification, being 31 December 2035.

When mining occurs in the Workshop Cut, the existing workshop would require demolition and remediation. The workshop activities would be moved to existing facilities in the CHPP area. Current office buildings are relocatable and will be removed from site and re-used at the CHPP or relocated offsite. No other changes are proposed to surface infrastructure.

### 2.1.3 Coal reject management

Fine tailings process waste from the CHPP, would continue to be disposed into the existing tailings emplacement area (U-Cut North), until a new tailings emplacement area is established in S-Cut South. Coarse reject would continue to be disposed within the existing open cut voids with overburden.

The management and disposal of tailings into the existing tailings emplacement area is approved under the Abel consent. Modification 3 of the Abel project approval PA 05_0136 also approves the establishment of a tailings disposal area in S-Cut South Void. As part of this proposed modification (MOD 5 PA 07_0087), Bloomfield would require continued use of this tailings area for the remaining life of the mine until 2035. Both U-Cut North and S-Cut South void tailings areas have been approved previously and therefore this modification only seeks the continued use of the tailings storage facilities at U-Cut North and S-Cut South Void.

### 2.1.4 Overburden emplacement

Overburden is the strata between the surface and the upper-most coal seam and is removed prior to accessing the coal. For the purpose of this GIA, management of overburden also includes the management of interburden which is the non-resource material located between coal seams.

Overburden is placed in progressive spoil emplacement areas which are subsequently reshaped to re-establish a landscape that blends with the surrounding undisturbed topography. Overburden emplacement areas are typically reshaped to about 10 degrees with a maximum slope of 18 degrees for the final void. Where steep slopes are constructed, suitable erosion and sediment control banks are incorporated to provide stability.

Reshaping of overburden emplacement areas is undertaken in accordance with the procedures documented in the current Rehabilitation Management Plan prepared for the Colliery which would be updated to accommodate the changes that would result from the modification.

### 2.1.5 Water management

The current mine water management system is part of an integrated system involving the management of surface runoff and groundwater sources associated with Bloomfield Colliery and neighbouring Abel and Donaldson mines. This ensures a continuous supply of water to the Bloomfield CHPP and minimises impacts to the surrounding waterways including Four Mile Creek, Buttai Creek and associated tributaries.

The Colliery's water management system includes removal of water from active pits, storage of water in dams and voids, controlled discharge into Four Mile Creek in accordance with EPL 396 and control of storm water pollution from overburden emplacement areas, stockpile areas and the Workshop Cut.

No significant changes to the Colliery's surface water management system are proposed. The current system integrates water management approved for the Colliery under its project approval as well as water management approvals for infrastructure managed under the Abel project approval PA 05_0136. Infrastructure approved under Abel project approval PA 05_0136 includes the CHPP, train load out, rail loop and water management structures. As noted previously, this modification seeks to have this infrastructure included in PA 07_0087.

The current Water Management Plan for Bloomfield Mine incorporates the water management structures for the "Bloomfield Site" approved under the Abel project approval. The modification would continue to operate under the current Water Management Plan which includes:

– A site water balance.
– An erosion and sediment control plan.
– Surface water monitoring plan.
– Groundwater monitoring.
– Surface and groundwater response plan.

Elwells Creek, an ephemeral creek line which runs through the current workshop area, will require temporary realignment during mining of the Workshop Cut. Following completion of mining in the Workshop Cut, Elwells Creek will be relocated back to its original location. Surface water impacts associated with the relocation of Elwells Creek during and post mining are assessed in GHD (2024).

## 2.1.6 Dangerous goods management

The transportation, handling and storage of all dangerous goods for the project would not change as a result of the proposed modification and be undertaken in accordance with the requirements of the NSW *Work Health and Safety Act* (WHS Act), NSW *Work Health and Safety Regulation 2017* (WHS Regulation), NSW *Dangerous Goods (Road and Rail Transport) Act 2008*, and NSW *Dangerous Goods (Road and Rail Transport) Regulation 2014*.

The dangerous goods stored for the project would typically include compressed gases, flammable and combustible liquids, explosives and corrosive substances. Based on the quantities proposed to be stored, it is not anticipated that a Dangerous Goods Licence would be required for the project.

## 2.1.7 Rehabilitation

This modification would allow for the rehabilitation of the areas disturbed by mining activities in addition to current rehabilitation commitments at the Colliery under the relevant regulatory requirements and planning considerations. Ongoing liaison with local landholders and community would continue to address community concerns resulting from the proposed modification are addressed, where practicable in the design and operation of mining activities.

The proposed modification does not include any changes to the proposed final land use. The proposed modification would, however, result in changes to the final landform, which are expected to have a beneficial impact through a reduction in the size and depth of the final void, reduction of final rehabilitated slope angles supportive of the final land use and removal of shallow underground workings where surface potholing is known to occur.

Rehabilitation works are currently closely integrated with mine production and are undertaken progressively as mining proceeds in accordance with the Rehabilitation Management Plan and Annual Forward Program.

### 2.1.7.1 Subsidence monitoring, management and remediation

The proposed modification includes improved long term stability benefits from mining the shallow underground workings at the Workshop Cut which would remove the potential for continuing sink hole issues caused by underground mine subsidence.

Subsidence monitoring, management and remediation would be undertaken throughout the life of the project in consultation with the relevant authorities, land and infrastructure owners, and other relevant stakeholders. Further details regarding proposed monitoring, management and remediation of subsidence impacts from the project are presented in the EIS.

## 2.2 Relationship of the project to existing approved operations

The modification would represent no change from how the Colliery currently interacts with existing approved operations, and instead represents a continuation of the use of infrastructure approved under Abel project approval PA 05_0136.

The Abel project approval PA 05_0136 ceases in 2030. This approval currently provides for the use of infrastructure such as the CHPP, train load out, rail loop and tailings and water management structures. This infrastructure is part of the “Bloomfield Site” but does not currently form part of the Bloomfield project approval. The proposed modification would allow for this infrastructure to continue to be used past 2030 by including the use and area of this infrastructure in the Bloomfield project approval.

# 3. Potential groundwater impacts

The proposed project has the potential to cause impacts to groundwater, arising from:

– Groundwater interception by open cuts pits within the extended Creek Cut and Workshop Cut areas and dewatering of these open cut pits, resulting in groundwater drawdown and potential impacts on groundwater receptors including registered bores, GDEs and watercourses.
– Groundwater take from the fractured rock groundwater source due to interception by open cut pits within the extended Creek Cut and Workshop Cut areas.
– Groundwater take from the alluvial groundwater sources due to interception by open cut pits within the extended Creek Cut and Workshop Cut areas.
– Groundwater quality impacts associated with groundwater drawdown from mining of open cut pits within the extended Creek Cut and Workshop Cut areas.
– Groundwater quality impacts associated with continued use of the tailings storage facilities at U-Cut and S-Cut South Void, currently approved by Abel project approval PA 05_0136 until December 2030.
– Additional drawdown of groundwater post-mining as the final void water level recovers, resulting in potential impacts to groundwater receptors including registered bores, GDEs and watercourses.
– Potential for leaks and spills (such as diesel tanks, chemical tanks, potentially contaminated water) during construction and operations, resulting in groundwater quality impacts.
– Higher than predicted water levels within the final void and migration of polluted water from the final void to groundwater, resulting in potential impacts to groundwater quality and beneficial use.

# 4. Legislation and policy

## 4.1 Legislation

### 4.1.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979 (EP&A Act)* and the Environmental Planning and Assessment Regulation 2021 (EP&A Regulation) provide the framework for environmental planning in NSW and include provisions to ensure that proposals that have the potential to impact on the environment are subject to detailed assessment and provide opportunity for public involvement.

The Colliery was originally approved under Part 3A (now repealed) of the EP&A Act, with subsequent modifications considered under (now repealed) section 75W of the EP&A Act. Projects, such as the proposed modification, are now considered to be State Significant Development (SSD) and modifications to be considered under section 4.55 of the EP&A Act.

It is noted that NSW Department of Planning has not issued secretary's environmental assessment requirements (SEARs) for the EIS for this modification and this GIA has been undertaken with direct reference to the scoping document for the Bloomfield Continuation Project and applicable assessment guidelines.

### 4.1.2 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) 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). Part 9 of the EPBC Act provides that an action that has, will have or is likely to have a significant impact on MNES may not be undertaken without prior approval from the Commonwealth Environment Minister. Approval under the EPBC Act is also required for actions carried out by Commonwealth agencies or impacting on Commonwealth land.

In accordance with section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)., the proposed modification has been referred to the Department of Climate Change, Energy, the Environment and Water (DCCEEW). The proposed modification was referred as EPBC Act referral 2024/09978.

It was determined on 13 December 2024 that the proposed modification is a controlled action and, therefore, requires assessment and approval under the EPBC Act.

### 4.1.3 Protection of the Environment Operations Act 1997

The objectives of the POEO Act are to protect, restore and enhance the quality of the environment. Under the POEO Act, an Environmental Protection Licence (EPL) is required for premises at which a 'scheduled activity' is conducted. Scheduled activities that occur at the Colliery are classified as coal works and mining for coal.

The EPL under the POEO Act relevant to the Colliery is EPL 396, which licenses water to be discharged through the licensed discharge points (LDPs). No specific groundwater monitoring is required under EPL 396.

### 4.1.4 Water Management Act 2000

The WM Act is the main legislation for water licences and approvals, replacing the Water Act 1912. The aim of the WM Act is to ensure that water resources are conserved and properly managed for sustainable use. 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.

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. Registered groundwater users identified for this assessment are listed in Section 5.5.1.

The WM Act defines certain licences and approvals:

– An access licence entitles its holder:
    a. To specified shares in the available water within a specified water management area or from a specified water source (the share component).
    b. To take water:
        (i) At specified times, at specified rates or in specified circumstances, or in any combination of these.
        (ii) In specified areas or from specified locations, (the extraction component).
– A water use approval confers a right on its holder to use water for a particular purpose at a particular location.
– A water supply work approval (as a specific type of water management work approval) authorises its holder to construct and use a specified water supply work at a specified location.

The WM Act defines the various offences for taking and using water from water sources other than in accordance with the relevant approvals.

#### 4.1.4.1 Water sharing plans

Water sources in 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.

WALs entitle licence holders to specified share components in the available water that may be sustainably extracted from a particular water source. The actual volume of water available to be extracted may vary, dependent on available water determinations made under the WM Act. Available water determinations are made for each WAL category in each water source and are generally made at the start of a water year, although may be altered at any time.

Groundwater within the proposed project area is regulated by the *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2022* (Hunter Unregulated WSP) and the *Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016* (Sydney Basin – North Coast Groundwater Source).

Groundwater is managed under WAL 41506 which licenses the extraction of 500 share components from the Sydney Basin-North Coast Groundwater Source. Bloomfield does not currently hold any surface water WALs for the Project.

#### 4.1.4.2 Water Management (General) Regulation (2018)

The Water Management (General) Regulation 2018 (WM Regulations) outline the procedures, technical requirements, licensing requirements, and water supply authority powers under the WM Act. The WM Regulations define the overall conditions governing water access licences, approvals and exemptions that are relevant to this assessment.

Under the WM Regulations, certain structures may be excluded from licencing requirements. Excluded works, or those exempt from licensing are defined by Schedule 1 of the WM Regulations. Relevant excluded works for the Project include:

– Dams solely for the control or prevention of soil erosion that are located on a minor stream.
– Dams solely for the capture, containment and recirculation of drainage and/or effluent, consistent with best management practice or required by a public authority to prevent the contamination of a water source, that are located on a minor stream.
– Rainwater tanks collecting water from roofs only.

None of the proposed water storages for the Project site are proposed to be constructed on any major streams.

#### 4.1.4.3 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 (not relevant to this GIA)

**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 generally required to construct a dam, or a groundwater bore, unless an exemption applies.

**Native title rights**

Anyone who holds native title with respect to water, as determined by the *Native Title Act 1993* (NT Act), can take and use water for a range of purposes, including personal, domestic and non-commercial communal purposes. There are currently no determinations under the NT Act in any of the WSPs relevant to this assessment.

#### 4.1.4.4 Controlled activity approvals

Any works proposed within the defined riparian zone of a creek are to be carried out in accordance with the WM Act. Works undertaken on waterfront land (i.e., near a river, lake or estuary) require a controlled activity approval, unless defined as exempt. SSDs and activities within a mining lease do not require controlled activity approvals. As the Project is proposed as an SSD and is carried out in accordance with a Mining Lease under the *Mining Act 1992*, no controlled activity approvals are required.

## 4.2 Policy and guidelines

### 4.2.1 NSW State Groundwater Policy

The objective of the NSW State Groundwater Policy Framework Document (NSW Government 1997) is to manage the State's groundwater resources so that they can sustain their environmental, social and economic uses. The policy has three component parts:

– NSW Groundwater Quantity Protection Policy.
– NSW Groundwater Quality Protection Policy.
– NSW Groundwater Dependent Ecosystems Policy.

***NSW Groundwater Quantity Protection Policy***

The principles of this policy include:

– Maintain total groundwater use within the sustainable yield of the aquifer from which it is withdrawn.
– Groundwater extraction shall be managed to prevent unacceptable local impacts.
– All groundwater extraction for water supply is to be licensed. Transfers of licensed entitlements may be allowed depending on the physical constraints of the groundwater system.

***NSW Groundwater Quality Protection Policy***

The objective of this policy is the ecologically sustainable management of the State's groundwater resources to:

– Slow and halt or reverse any degradation in groundwater resources.
– Direct potentially polluting activities to the most appropriate local geological setting so as to minimise the risk to groundwater.

– Establish a methodology for reviewing new developments with respect to their potential impact on water resources that will provide protection to the resource commensurate with both the threat that the development poses and the value of the resource.
– Establish triggers for the use of more advanced groundwater protection tools such as groundwater vulnerability maps or groundwater protection zones.

***NSW Groundwater Dependent Ecosystems Policy***

This policy was designed to protect ecosystems that rely on groundwater for survival so that, wherever possible, the ecological processes and biodiversity of these dependent ecosystems are maintained or restored for the benefit of present and future generations.

### 4.2.2 NSW Aquifer Interference Policy

The NSW Aquifer Interference Policy (AIP) outlines the water licensing requirements under the *Water Act 1912* and WM Act. A water licence is required whether water is taken for consumptive use or whether it is taken incidentally by the aquifer interference activity (such as dewatering) even where that water is not being used consumptively as part of the activity's operation.

Under the WM Act, a WAL gives its holder a share of the total entitlement available for extraction from the groundwater source. The WAL(s) held by the person undertaking the extraction must cover a sufficient share component and water allocation to account for the take of water from the relevant water source at all times. Sufficient access licences must be held to account for all water taken from a groundwater or surface water source as a result of an aquifer interference activity, both for the life of the activity and after the activity has ceased.

The NSW AIP requires that potential impacts on groundwater sources, including their users and GDEs, be assessed against minimal impact considerations, outlined in Table 1 of the AIP. If the predicted impacts meet the Level 1 minimal impact considerations, then these impacts will be considered acceptable. The minimal impact considerations relevant to this GIA are outlined in Section 8.3.1.

### 4.2.3 Groundwater Assessment Toolbox for Projects in NSW

The Groundwater Assessment Toolbox for Projects in NSW (DPE, 2022a) is a technical guideline to provide a collaborative and transparent document for the preparation and reviewing of groundwater assessments in NSW for major projects. The three main objectives of the toolbox are as follows:

– Provide a framework to investigate, assess the impacts on, manage and monitor groundwater resources and their interaction with surface water resources within the footprint of a major project.
– Clarify minimum requirements from groundwater documentation including groundwater modelling that is prepared for major projects and used to support and inform impact assessments.
– To identify practical approaches for the assessment of cumulative groundwater impacts.

The toolbox comprises of five elements containing a general overview, guidelines for major projects, minimum requirements for groundwater modelling, information on cumulative groundwater impact assessment and aquifer interference policy (based on the *NSW Aquifer Interference Policy 2012).* This GIA has been prepared with reference to this guideline.

### 4.2.4 Cumulative Impact Assessment Guidelines for State Significant Projects

The Guidelines (DPE 2022b) were developed for strategic assessment and management of cumulative impacts, as facilitated by the ecologically sustainable development objectives of the EP&A Act. The guidelines aim to strengthen Project-level Cumulative Impact Assessment (CIA) for State Significant Projects in NSW. CIA types include issue-specific CIA, where the cumulative impacts of the Project on key matters are assessed with other relevant future Projects and combined CIA, where the combined effect of the different cumulative impacts of the Project on key matters, sensitive receptors or important features are considered with other relevant future Projects. Relevant future Projects may be identified via the NSW Major Projects website. The assessment should consider:

– The government's strategic planning framework for the area, having regard to any relevant legislation, plans, policies or guidelines.
– The Project and other potentially relevant future Projects that may be developed over the same time period or similar timeframes as the Project.
– Potential material impacts on features including National Parks and other protected areas, environmentally sensitive areas, threatened species and ecological communities, important natural resources, culturally significant resources, key infrastructure and industries, sensitive land use zones, population centres, settlements and residential areas (key matters).
– The likely scale and nature of the cumulative impacts of these Projects.

# 5. Site description

## 5.1 Climate

Climate data were obtained as SILO Patched Point Data from the Science Division of the Queensland Government's Department of Environment and Science. 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 were obtained for the East Maitland Bowling Club (station 61034), located approximately 7 km north of the Colliery for the period of 1 January 1889 to 1 January 2024. This station was selected for the length and continuity of the dataset.

The historical SILO rainfall data between 1889 and 2024 are shown in Figure 5.1.

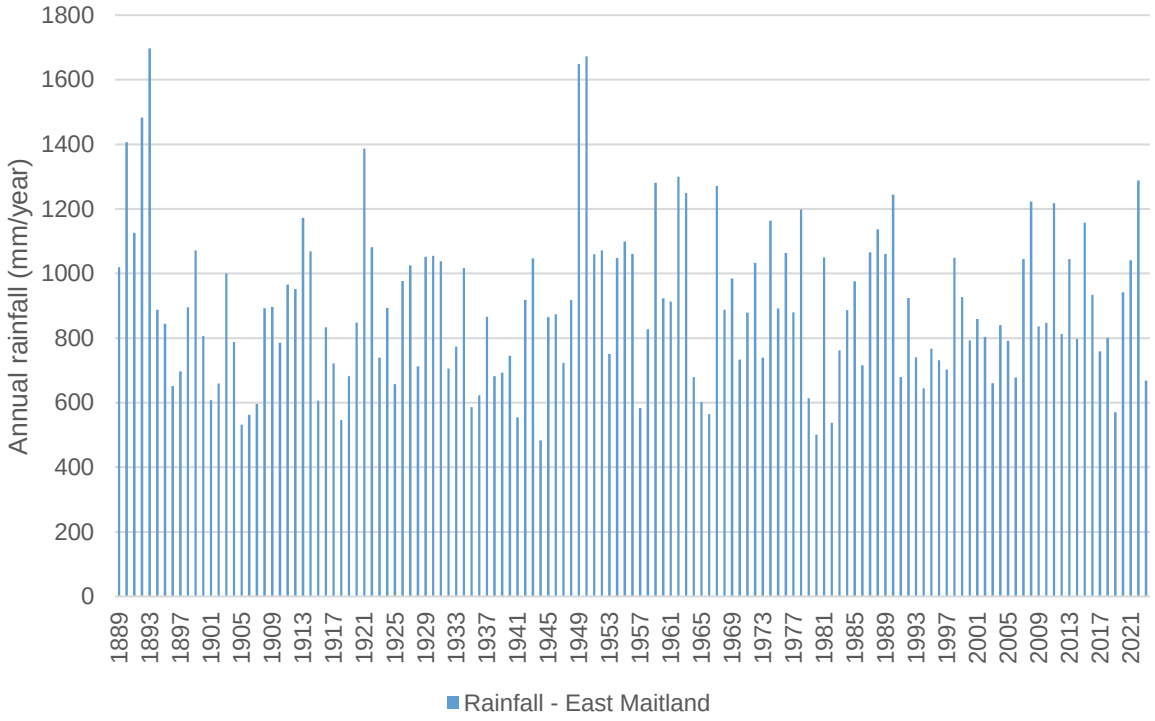



***Figure 5.1 Annual rainfall depths***

The statistics of the annual rainfall totals within the grid point dataset were:

– Minimum rainfall: 478 mm in 1980
– Median rainfall: 894 mm
– Average rainfall: 930 mm
– Maximum rainfall: 1697 mm in 1893

Annual rainfall was above average in recent years (2020 – 2022), and below average in 2023.

The SILO dataset was used to generate a Cumulative Rainfall Departure (CRD) curve. CRD is the monthly accumulation of the difference between the observed monthly rainfall and the long term average monthly rainfall. Any increase in the CRD reflects above average rainfall while a decrease in CRD reflects below average rainfall. The CRD curve only deviates from zero due to atypical (above and below average) rainfall. The CRD over the period 1900 to 2023 is shown in Figure 5.2.


*Figure 5.2 Cumulative rainfall departure curve*

Since open cut mining commenced in 1966, there has been a general increasing trend in CRD. However, over this time, there have been periods of several years of both above average and below average rainfall. In recent years, above average rainfall was recorded between 2016 and 2017, as well as an additional increase in late 2021 through to 2023.

Climate change influence on rainfall has not been considered for this GIA due to the relatively short timeframe of the proposed project. Climate change considerations for assessment of the final void are discussed in the Surface Water Impact Assessment report (GHD, 2024).

Annual average evaporation totals near the Colliery are 1439 mm, corresponding to an average annual moisture deficit (the difference between rainfall and evaporation) of 509 mm.

A plot of average monthly evaporation in comparison to average monthly rainfall is shown in Figure 5.3. This graph shows strong seasonality in average monthly evaporation, with higher evaporation recorded in summer months compared to winter. There is limited seasonality in average rainfall totals. There is an average monthly net rainfall deficit in all months of the year, except for June, returning higher rainfall (mm/day) compared to evaporation.

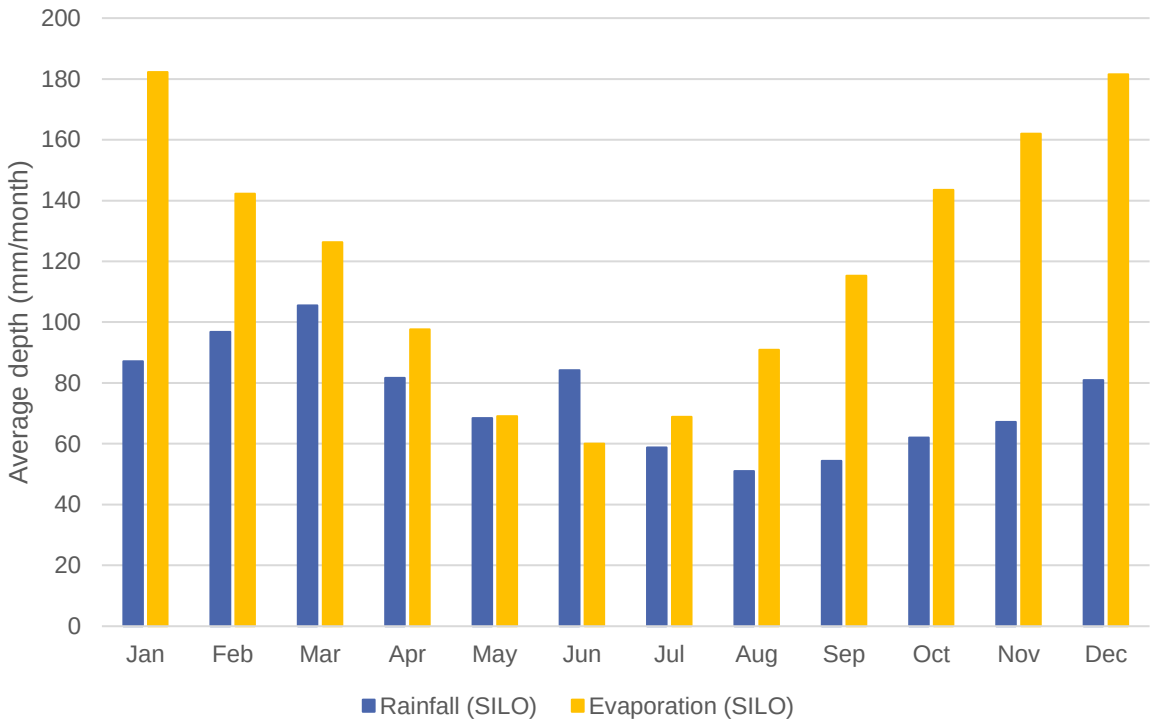



*Figure 5.3* ***Average monthly evaporation and rainfall recorded at BOM station East Maitland Bowling Club***

## 5.2 Topography

The elevation throughout the Colliery ranges from over 100 m Australian Height Datum (AHD) in the south to 10 m AHD in the west. The landscape has been heavily modified by open cut mining methods which has formed large excavations to elevations less than -50 m AHD. Topographic maps are provided in Appendix A for the Creek Cut and Workshop Cut areas along with cross-sections.

The existing elevations within the Creek Cut mining block area ranges between approximately 25 to 85 m AHD. The southern four mining blocks (B01, B02, B03, EX05) pre-mining landform has been altered by mining disturbance whilst the northern four blocks (Y01 to Y04) appear largely undisturbed. Generally, local relief for the western portion of mining blocks B01, B02, B03, Y03, Y04 fall downslope to the west while the remainder slopes south easterly towards existing Colliery open cut operations.

The topography in the existing Workshop Cut mining area generally slopes in a north east direction. In the vicinity of the proposed Workshop Cut mining area, the existing topography ranges from approximately 40 m AHD to 30 m AHD. North west of the proposed Workshop Cut is a ridgeline with maximum elevation of 87 m AHD. A localised high point is located south west of the proposed Workshop Cut mining area at a maximum elevation of approximately 110 m AHD.

## 5.3 Hydrology

Regionally, the Colliery is located within the catchment of the Hunter River adjacent to two third order watercourses, Buttai Creek and Four Mile Creek. A number of mapped first, second and third order watercourses intersect the ML. Buttai Creek is located in the western portion of the ML, with a number of first and second order tributaries flowing west off site to join the main third order channel of Buttai Creek. A small western portion of the ML is intersected by the main channel of Buttai Creek. In the eastern portion of the ML, Four Mile Creek flows generally north-west. A number of named and unnamed first order tributaries flow north east to join Four Mile Creek within the ML.

The southernmost first order watercourse of Whites Creek is diverted around Lake Kennerson to maintain clean water flow where it intersects the third order stream of Four Mile Creek about 200 m south of Lake Foster. Four Mile Creek bypasses Lake Foster to the east and discharges into Possum Puddle which then discharges via a spillway back into Four Mile Creek.

Discharges from the licenced discharge point (EPA ID1) occur from Lake Kennerson and bypasses Lake Foster. Elwells Creek, a first order tributary is located immediately to the west of the Bloomfield workshop and flows in a north easterly direction, meeting Four Mile Creek north of the coal stockpile area. In the centre of the ML there are two mapped first and second order creeks under the NSW Hydroline spatial dataset which are unnamed. It is likely that these creeks would have once been connected to the first order unnamed tributary situated between Whites Creek and Elwells Creek but no longer exist due to augmentation during mining. The regional hydrology is shown in Figure 5.4.

## 5.4 Geology

The Colliery is located within the Four Mile Creek Formation of the Permian Tomago Coal Measures. A map of the surface geology in the vicinity of the Colliery area is shown in Figure 5.5, with the Tomago Coal Measures represented in Figure 5.5 by the unit Pto. The Tomago Coal Measures generally dip to the south with coal seam subcrops occurring to the north and west of the proposed project area.

Quaternary alluvial deposits of clay, silt, sand, and gravel originating from Wallis Creek overlay the Tomago Coal Measures to the west of the Colliery. Alluvium associated with Buttai Creek intersects a small area of the western portion of the ML. At the eastern side of the Colliery, Quaternary sediments are present, associated with the Hunter River floodplain. A small area of Four Mile Creek alluvium intersects the proposed project area. The alluvium in the vicinity of the Colliery is represented in Figure 5.5 by the unit Q_av.

The coal bearing stratum of the mine consists of sandstone, shale, mudstone, tuff and coal. Sediments above and below the coal predominantly comprise of interbedded mudstone, siltstone and sandstone. The coal seams that have been mined at the Colliery, from shallow to deep, are:

– Buttai seams
– A, B and C seams
– Whites Creek seam
– Elwells Creek seam
– Donaldson seam
– Big Ben seam
– Rathluba seam

The Newcastle Coal Measures outcrop to the south of the Colliery and are represented by the unit Pnbm in Figure 5.5. The Tomago Coal Measures are underlain by marine sedimentary rocks of the Maitland Group.

The seams targeted by the proposed project include all the seams listed above from surface to the Big Ben seam. Open cut workings currently exist within each of these seams, while underground workings exist within the Donaldson, Big Ben and Rathluba seams. The Big Ben seam subcrops to the north and west of the proposed project area. To the west, the subcrop underlies to the Buttai Creek alluvium, approximately 1.5 km to the west of the proposed Creek Cut area.

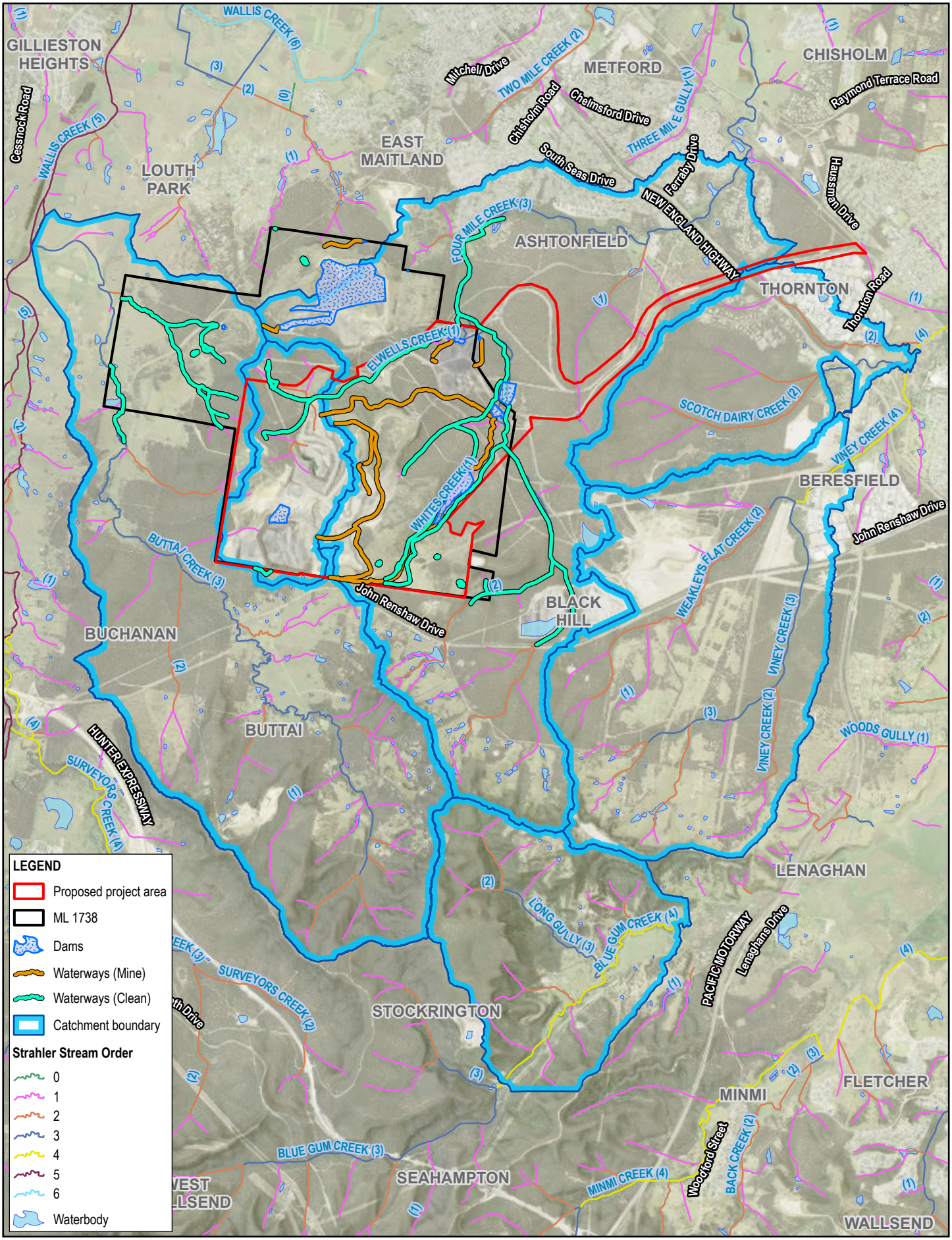
Historical underground workings exist within the Rathluba seam, within the Wallis Creek Formation, which underlies the Big Ben seam. No further mining of the Rathluba seam is proposed. Approximate depths to the Big Ben and Rathluba seams are shown by the cross sections presented in Section 7.

## 5.5 Hydrogeology

Groundwater at the Colliery occurs within the fractured rock of the Four Mile Creek Formation of the Tomago Coal Measures. The groundwater source is generally low yielding and brackish to saline and is regulated by the Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016. The majority of groundwater flow is conceptualised to occur within the cleats and fractures of the coal seams.

Groundwater within the Quaternary alluvial sediments located near the Colliery is regulated by the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2022. Groundwater flow within the alluvium is conceptualised to follow changes in topography. Alluvium associated with Buttai Creek is located a few kilometres to the west of the proposed project area. Alluvial clay extends to approximately -10 m AHD. The alluvium is also low yielding, being dominated by clay.

Further details on groundwater level, flow and quality are presented in Section 6, while a conceptual groundwater model is presented in Section 7.




Paper Size ISO A4

0 0.5 1 1.5 2

Kilometres

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

N

GHD

**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Mine Continuation**
**Groundwater Impact Assessment**

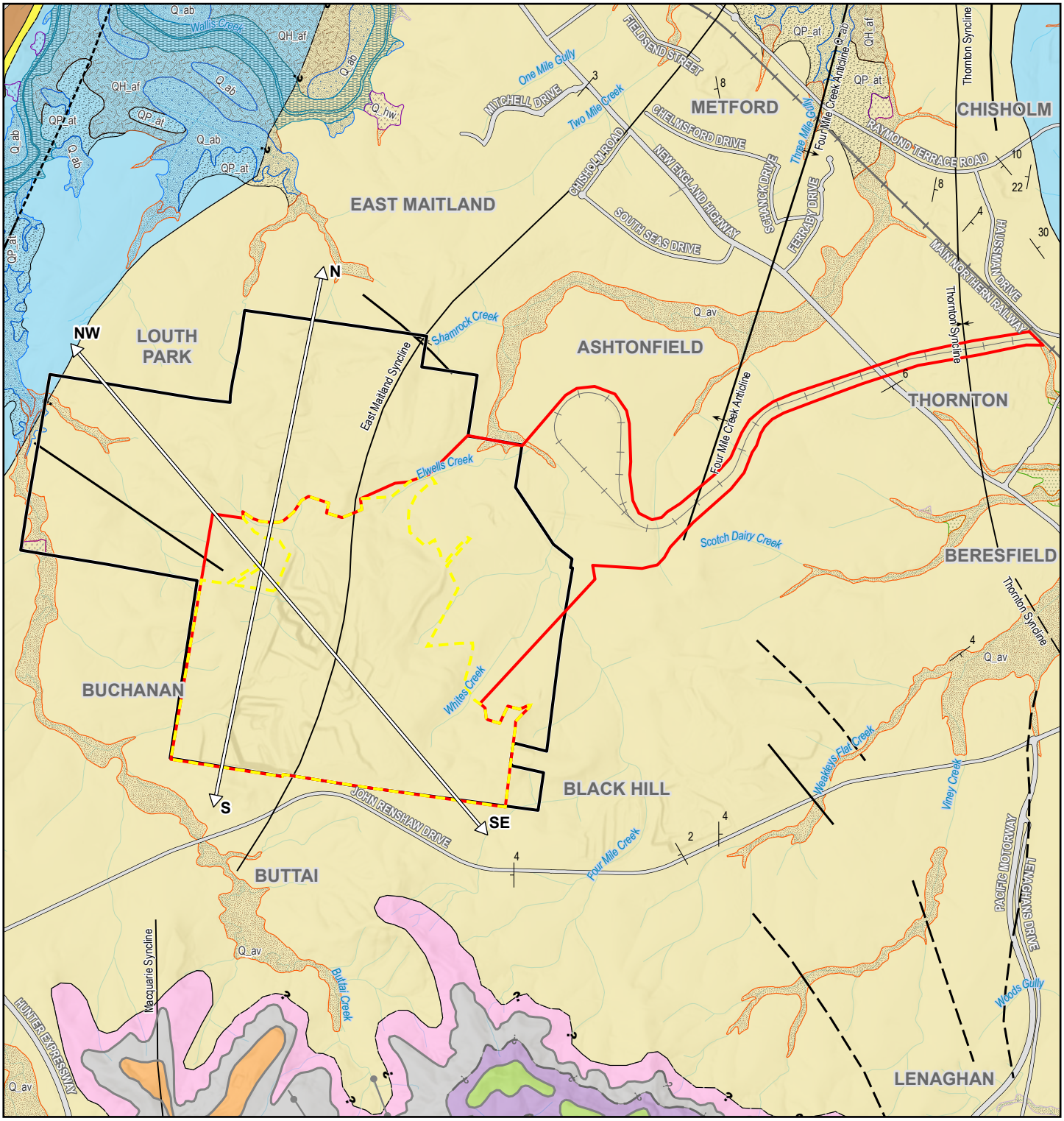
Project No. **12597478**
Revision No. **0**
Date **04/07/2024**

## Regional hydrology

# FIGURE 5.4

N:\AU\Newcastle\Projects\22\12597478\GIS\Maps\Deliverables\12597478_GW_ImpactAssess.aprx
Print date: 04 Jul 2024 - 12:04

Data source: LPI: DCDB, 2019. Bloomfield Colliery: Project area/Mine lease, 2023. sixmaps/LPI_Imagery_Best: © Department of Finance, Services & Innovation 2018
World Hillshade: Esri, Geoscience Australia, NASA, NGA, USGS.
Created by: tmorton




**LEGEND**

- ML 1738
- Proposed project area
- Current approved project area
- Cross-sections
- Watercourse
- Railway
- Road

**Geology**

- QH_af - Alluvial floodplain deposits
- QP_at - Alluvial terrace deposits
- Q_ab - Alluvial backswamp deposits
- Q_acw - Alluvial channel deposits
- Q_al - Alluvial levee/overbank deposits
- Q_at - Alluvial terrace deposits
- Q_av - Alluvial valley deposits
- Q_avf - Alluvial fan deposits
- Q_hw - Anthropogenic stored water
- Pmtb - Branxton Formation
- Pmtm - Mulbring Siltstone
- Pmtu - Muree Sandstone
- Pndg - Glebe Formation
- Pndo - Kotara Formation
- Pndt - Tickhole Formation
- Pnew - Waratah Sandstone
- Pnls - Shepherds Hill Formation
- Pto - Tomago Coal Measures

**Geological boundaries**

- Coal seam outcrop, inferred
- Coal seam outcrop
- Geological boundary, inferred
- Geological boundary, position accurate
- Geological boundary, position approximate
- Dyke or Vein
- Strike of strata, dip not determined
- Strike and dip of bedding
- Fault, concealed
- Fault, position accurate
- Fault, position approximate
- Anticline, position accurate
- Syncline, position accurate
- Syncline, position approximate

Paper Size ISO A4

0 0.5 1 1.5

Kilometres

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

N

GHD

**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Continuation Project**
**Groundwater Impact Assessment**

Project No. **12597478**
Revision No. **0**
Date **10/07/2024**

## Surface geology

# FIGURE 5.5

N:\AU\Newcastle\Projects\22\12597478\GIS\Maps\Deliverables\12597478_GW_ImpactAssess.aprx
Print date: 10 Jul 2024 - 16:24

Data source: LPI: DCDB, 2019. Bloomfield Colliery: Project area/Mine lease, 2023. DPIE: Geology, 10/07/2024 World Hillshade: Esri, Geoscience Australia, NASA, NGA, USGS.
Created by: tmorton

### 5.5.1 Groundwater use

A search of the Australian Groundwater Explorer (BOM 2023) and Water NSW (2023) undertaken in 2023 identified 13 registered bores within an approximate five-kilometre radius of the proposed project area. Of the registered bores, five were registered as monitoring bores and two were registered for water supply including stock and domestic stock. The remainder of bores have an unknown purpose.

Bore details are provided in Table 5.1. A map of the locations is shown in Figure 5.6. The majority of bores are relatively deep, having an installed depth over 20 m, and assumed to be in the fractured rock groundwater source. Reported yields are less than 1 L/s. There are no registered bores within the Buttai Creek alluvium adjacent to the ML.

There are no registered bores located within the proposed project area. The closest bore to the proposed project area is GW080034, located approximately 500 m to the north of the Creek Cut Area. No details for this bore were found in the registered bore search, however it is likely to correspond with Bloomfield's groundwater monitoring bore Site 2.

Overall, the search of registered bore databases suggests that groundwater use in the vicinity of the proposed project area is limited.

***Table 5.1 Registered bores***

| Bore ID | Purpose | Easting | Northing | Drilled Depth (m) | Standing water level (m) | Yield (L/s) | Lithology |
|---|---|---|---|---|---|---|---|
| GW051353 | Stock, domestic | 365986 | 6365810 | 49.7 | 15.2 | 0.2 | Sandstone, shale |
| GW051647 | Stock | 362896 | 6373006 | 12 | Unknown | Unknown | Clay, sand, sandstone |
| GW053411 | Irrigation | 361215 | 6366699 | 20 | Unknown | 0.32 | Sand, clay, shale |
| GW053412 | Irrigation | 361240 | 6366730 | 7.9 | 1.6 | 0.06 | Clay, sandstone, shale |
| GW078046 | Monitoring bore | 368651 | 6368741 | 30.4 | 13.6 | Unknown | Siltstone |
| GW078121 | Monitoring bore | 368619 | 6367262 | 43 | 22.3 | Unknown | Siltstone, sandstone |
| GW078122 | Monitoring bore | 368666 | 6367663 | 35.4 | 23.1 | Unknown | Sandstone, siltstone |
| GW078123 | Unknown | 369309 | 6368165 | 33 | 24.4 | Unknown | Sandstone, siltstone |
| GW078124 | Monitoring bore | 369883 | 6368018 | 40 | 18.6 | Unknown | Sandstone, siltstone, mudstone |
| GW078127 | Monitoring bore | 369073 | 6366406 | 30 | 16.6 | Unknown | Siltstone, mudstone |
| GW079892 | Unknown | 366598 | 6372257 | Unknown | Unknown | Unknown | Unknown |
| GW080034 | Unknown | 365222 | 6370959 | Unknown | Unknown | Unknown | Unknown |
| GW205425 | Unknown | 364086 | 6372118 | 50 | Unknown | Unknown | Unknown |

### 5.5.2 Groundwater dependent ecosystems

The *Probable Vegetation Groundwater Dependent Ecosystems – Hunter/Central Rivers* dataset (DPE Water 2022) was reviewed to identify potential groundwater dependent ecosystems (GDEs) in the vicinity of the proposed project area. The dataset developed by DPE Water identifies vegetation communities that have a probability of being a groundwater dependent ecosystem within NSW. The dataset has been divided into catchment management areas. For this project, the Hunter-Central Rivers dataset was used.

The dataset indicates that the majority of existing vegetation within and adjacent to the proposed project area has the potential to be a terrestrial GDE, as shown in Figure 5.7. As discussed further in Sections 7 and 8, based on the groundwater drawdown from current mining operations at Bloomfield, as well as historical mining operations, it is unlikely that these terrestrial ecosystems are supported by groundwater under current conditions.

The background documents for the groundwater WSPs relevant to the proposed project (*Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2022* and the *Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016)* refer to the High Priority Groundwater Dependent Ecosystem Map which was reviewed to identify any high priority GDEs that may be impacted by the proposed project. It is noted that there are no high-priority GDEs listed in the relevant WSPs that have the potential to be impacted by the proposed project.

## 5.6 Existing mining operations

Coal has been mined within and surrounding the Colliery for approximately 170 years via both open cut and underground methods in multiple seams in both the Four Mile Creek Formation and the underlying Wallis Creek Formation of the Tomago Coal Measures resulting in a disturbed groundwater regime. Open cut operations commenced in 1966 while underground mining ceased in 1992.

Coal is currently extracted via open cut methods within the Creek Cut and S-Cut areas within the approved project area (see Figure 1.3). The depth of excavation currently extends to approximately -40 to -50 m AHD. Existing and historical open cut mining areas at the Colliery (excluding Donaldson open cut mine) are shown in Figure 5.8. Historical underground mining areas at the Colliery (excluding Abel and Tasman underground mines) are shown in Figure 5.9.

Three recent mines adjoin the Colliery, all of which have previously extracted coal from the Tomago Coal Measures:

– Donaldson open cut mine, located to the east of the proposed project area (currently in care and maintenance).
– Abel underground mine, located to the immediate south of the proposed project area (currently in care and maintenance).
– Tasman underground mine, located further to the south of the proposed project area (closed).

Existing and historical mines at the Colliery, as well as the three recent mines adjoining the Colliery, have been incorporated into the existing groundwater model for the area (HydroSimulations, 2017). Further details of this model are provided in Section 6.4.

As stated in Section 2.1.5, the water management system at the Colliery is integrated with Donaldson open cut mine and Abel underground mine. The Colliery receives mine water from Donaldson and Abel via a transfer from the Big Kahuna Dam to Lake Kennerson. This transfer equated to 535 ML in 2022-23.


Paper Size ISO A4

0 0.5 1 1.5 2

Kilometres

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

N

GHD

**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Continuation Project**
**Groundwater Impact Assessment**

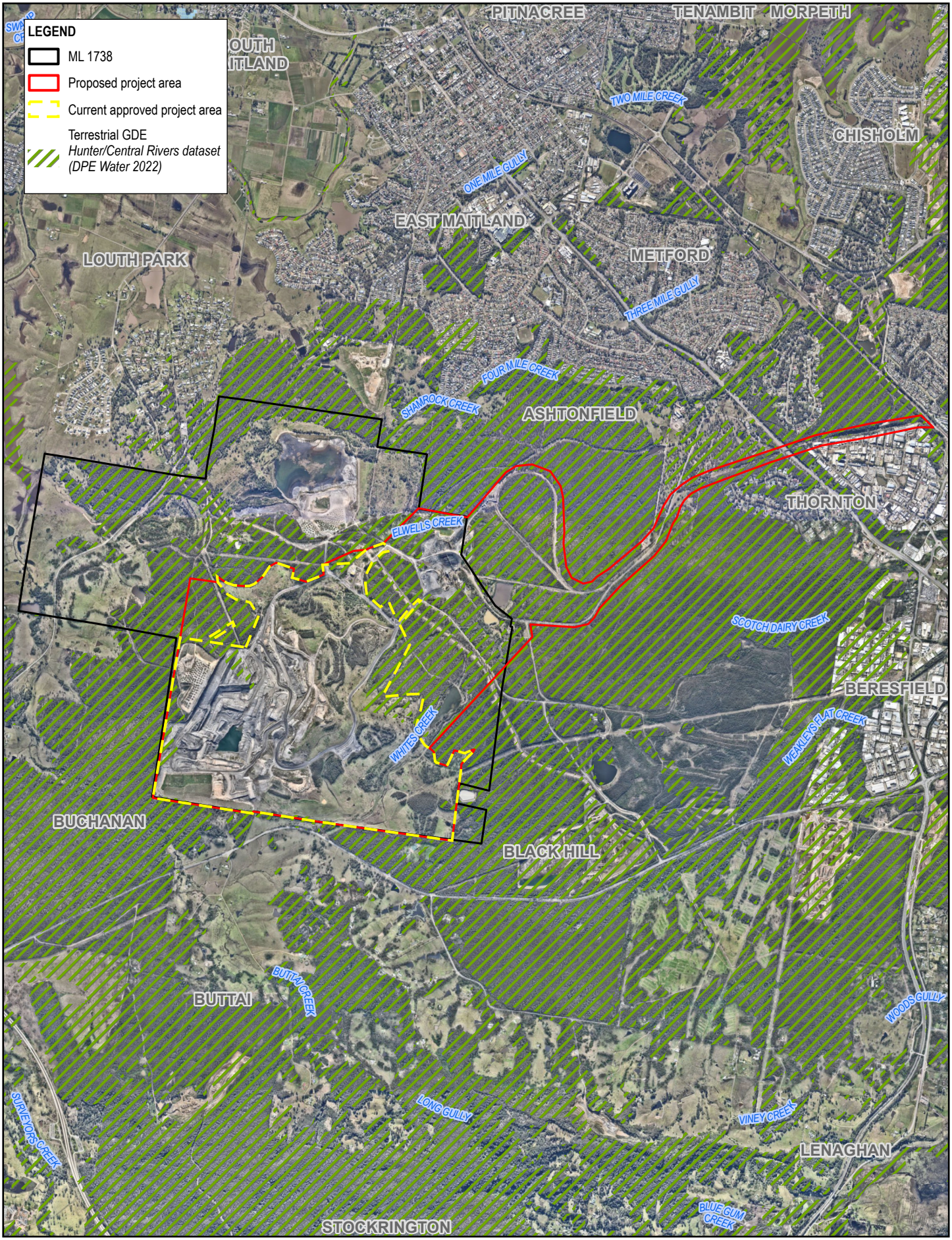
Project No. **12597478**
Revision No. **0**
Date **04/07/2024**

## Registered bore locations

# FIGURE 5.6

N:\AU\Newcastle\Projects\22\12597478\GIS\Maps\Deliverables\12597478_GW_ImpactAssess.aprx
Print date: 04 Jul 2024 - 12:03

Data source: LPI: DCDB, 2019. Bloomfield Colliery: Project area/Mine lease/Creek cut data, 2023. Nearmap WMS Server: – Imagery (Date extracted: 04/07/2024).
Created by: tmorton

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Kilometres

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

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**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Continuation Project**
**Groundwater Impact Assessment**

Project No. **12597478**
Revision No. **0**
Date **04/07/2024**

## Groundwater Dependent Ecosystems

# FIGURE 5.7

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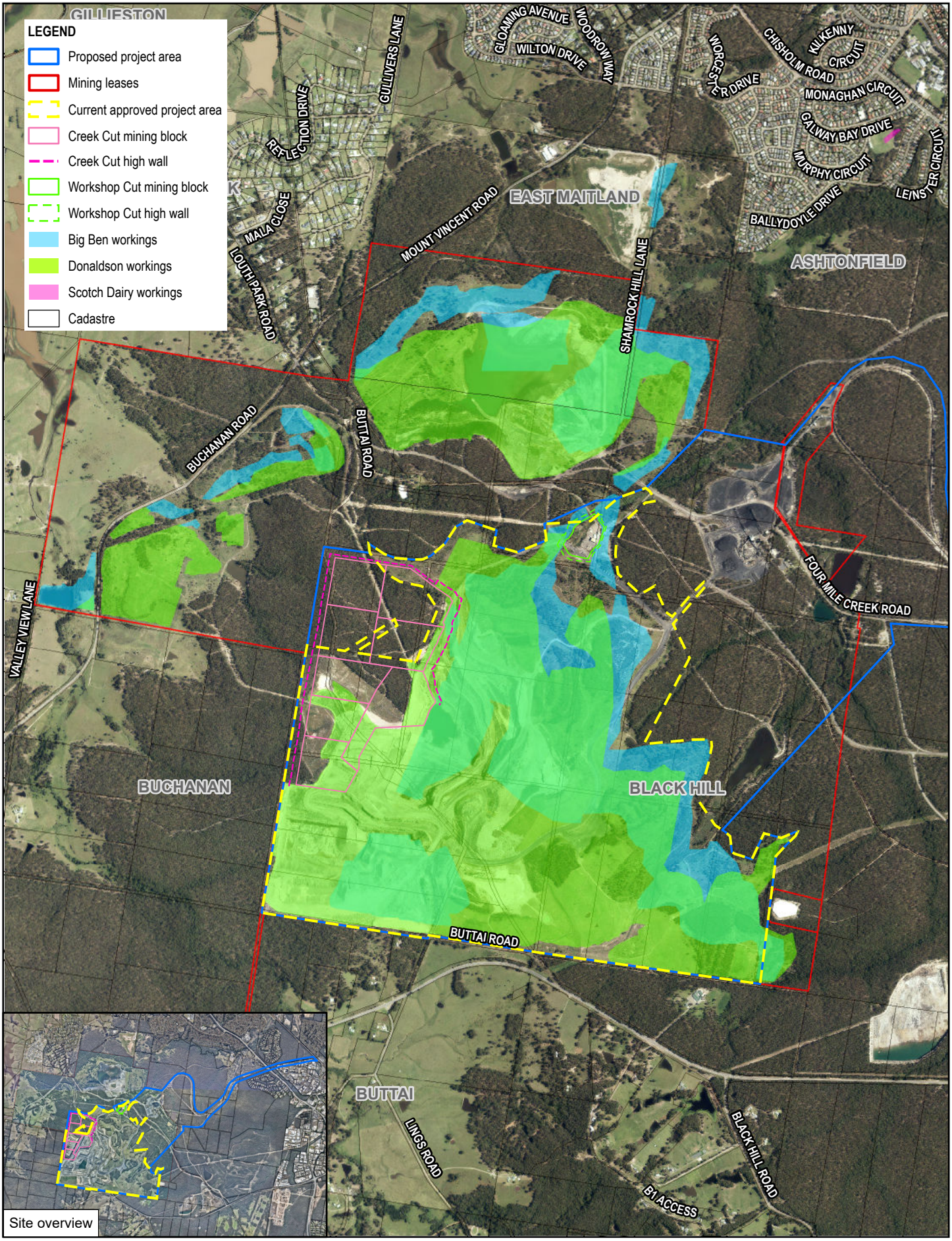
Print date: 04 Jul 2024 - 12:03

Data source: LPI: DCDB, 2019. Bloomfield Colliery: Project area/Mine lease, 2023. BOM: GDEs, 2024. Nearmap WMS Server: Imagery (Date extracted: 04/07/2024).
Created by: tmorton




Paper Size ISO A4

0 0.2 0.4 0.6 0.8 1

Kilometres

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

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GHD

**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Continuation Project**
**Groundwater Impact Assessment**

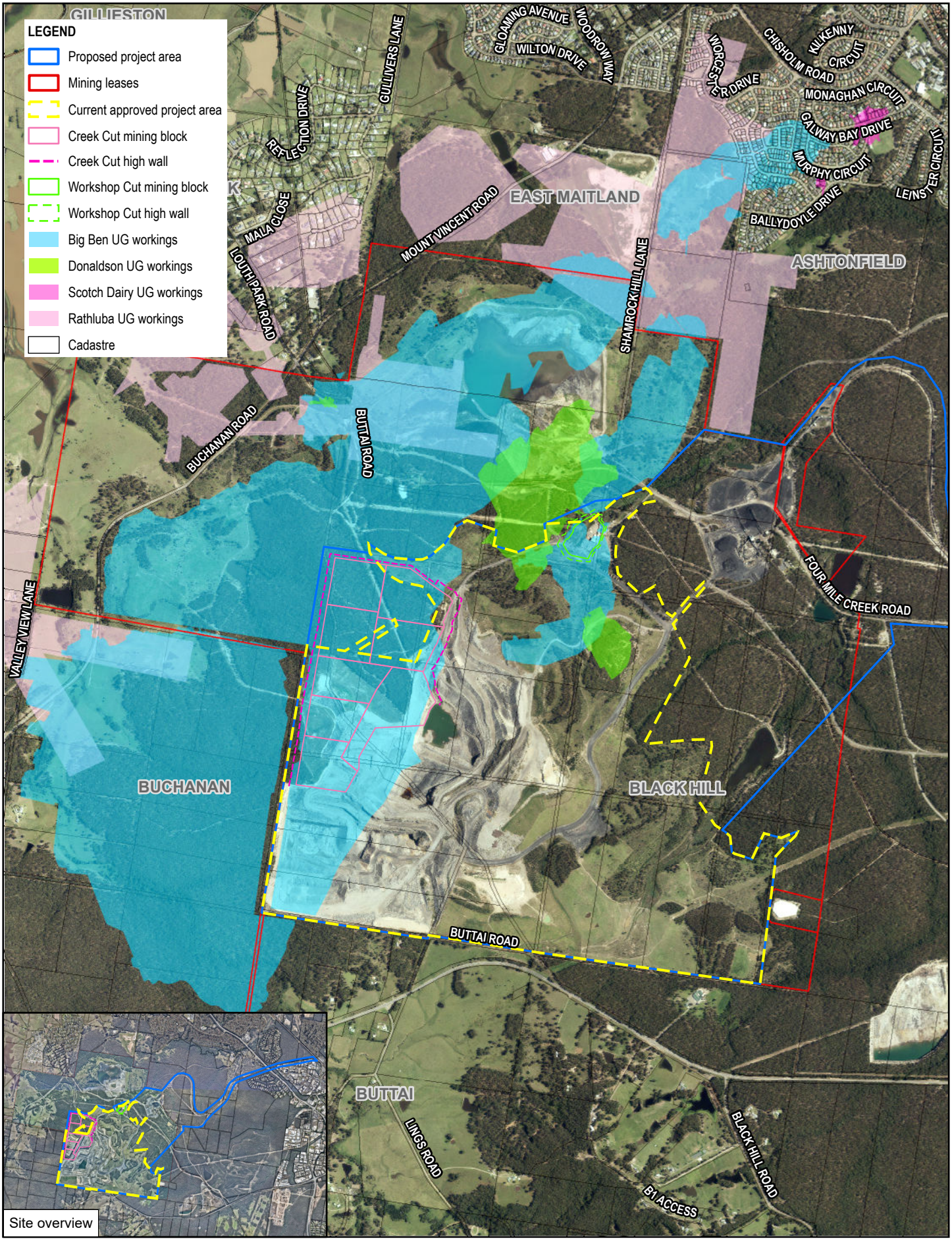
Project No. **12597478**
Revision No. **0**
Date **04/07/2024**

## Existing Open Cut Workings

# FIGURE 5.8

N:\AU\Newcastle\Projects\22\12597478\GIS\Maps\Deliverables\12597478_GW_ImpactAssess.aprx
Print date: 04 Jul 2024 - 12:04

Data source: LPI: DCDB, 2019. Bloomfield Colliery: Project area/Mine lease/Background open cut workings image, 2023. Nearmap WMS Server: Imagery (Date extracted: 04/07/2024).
Created by: tmorton




Paper Size ISO A4

0 0.2 0.4 0.6 0.8 1

Kilometres

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

N

GHD

**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Continuation Project**
**Groundwater Impact Assessment**

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Revision No. **0**
Date **04/07/2024**

## Existing Underground Workings

# FIGURE 5.9

N:\AU\Newcastle\Projects\22\12597478\GIS\Maps\Deliverables\12597478_GW_ImpactAssess.aprx
Print date: 04 Jul 2024 - 12:03

Data source: LPI: DCDB, 2019. Bloomfield Colliery: Project area/Mine lease/Background open cut workings image, 2023. Nearmap WMS Server: Imagery (Date extracted: 04/07/2024).
Created by: tmorton

# 6. Groundwater management and monitoring

## 6.1 Groundwater management overview

Groundwater at the Colliery is managed in accordance with the Bloomfield Mining Operations Water Management Plan (WMP) (AECOM, 2020), which includes a Groundwater Management Plan and Groundwater Response Plan. The WMP outlines groundwater monitoring requirements, groundwater impact assessment criteria/triggers and reporting requirements. This section provides details of the existing groundwater monitoring program, baseline groundwater data, the existing numerical groundwater model and the current groundwater impact assessment criteria and trigger values.

## 6.2 Groundwater extraction

Groundwater is extracted from the existing open cut pits at S-Cut and Creek Cut and transferred to Lake Kennerson where it is reused in coal processing or discharged off site. The volume of groundwater taken from the fractured rock groundwater source during the water year 1 July 2022 to 30 June 2023 was 332 ML, which is within the allocated limit under WAL 41506 of 500 share components from the Sydney Basin-North Coast Groundwater Source.

There is also groundwater pumping from the historical Rathluba seam underground workings to the north west of the proposed project area (24 ML/year on average) and transfer to Loader Main Dam to manage potential seepage of groundwater to Buttai Creek. There is no other dewatering of the historical underground workings.

## 6.3 Groundwater monitoring program

Groundwater monitoring has been undertaken by Bloomfield since 2007 at seven standpipe monitoring bores and 17 vibrating wire piezometers at eight sites. Bore network details are provided in Table 6.1 and locations are shown in Figure 6.1.

***Table 6.1 Summary of groundwater monitoring bores***

| Location | Monitoring point | Depth (m) | Surface RL (m AHD) | Screened lithology | Monitoring record |
|---|---|---|---|---|---|
| Site 1 | VW171 | 171 | 24.6 | Rathluba seam | April 2007-present |
| | VW46 | 46 | 24.6 | Big Ben seam | April 2007-present |
| | VW35 | 35 | 24.6 | Donaldson seam | April 2007-present |
| Site 2 | Standpipe (SP2-1) | 65 | 79 | Donaldson seam | April 2007-present |
| | Standpipe (SP2-2) | 85 | 79 | Big Ben seam | April 2007-present |
| | VW190 | 190 | 79 | Rathluba seam | April 2007-present |
| Site 3 | Standpipe (SP3-1) | 14 | 30 | Donaldson seam | May 2007-present |
| | VW131 | 131 | 30 | Rathluba seam | May 2007-present |
| Site 4 | Standpipe (SP4-2) | 9.4 | 26.5 | Alluvium/weathered Permian | April 2007-present |
| | Standpipe (SP4-1) | 78.4 | 26.5 | Rathluba seam | April 2007-January 2012 |
| Site 5 | VW90 | 89.5 | 60.7 | Big Ben seam | April 2007-present |
| | VW71 | 71 | 60.7 | Donaldson seam | April 2007-present |
| | VW62 | 62 | 60.7 | Whites Creek seam | April 2007-present |
| Site 6 | VW128 | 128 | 53.6 | Big Ben seam | April 2007-August 2009 |
| | VW114 | 114 | 53.6 | Donaldson seam | April 2007-August 2009 |
| | VW96 | 96 | 53.6 | Whites Creek seam | April 2007-present |

| Location | Monitoring point | Depth (m) | Surface RL (m AHD) | Screened lithology | Monitoring record |
|---|---|---|---|---|---|
| Site 7 | VW107 | 107 | 26.8 | Big Ben seam | April 2007-present |
| | VW95 | 95 | 26.8 | Donaldson seam | May 2007-present |
| | VW70 | 70 | 26.8 | Whites Creek seam | April 2007-present |
| | Standpipe (SP7-1) | 11.2 | 26.8 | Alluvium/weathered Permian | May 2007-August 2015 |
| Site 8 | VW238 | 238 | 24 | Rathluba seam | April 2007-present |
| | VW97 | 97 | 24 | Big Ben seam | April 2007-present |
| | VW83 | 83 | 24 | Donaldson seam | April 2007-present |
| | Standpipe (SP8-1) | 9.9 | 22.5 | Alluvium/weathered Permian | April 2007-February 2008 |

Monitoring bores are screened in alluvium and coal seams. Groundwater levels are monitored quarterly at both standpipes and vibrating wire piezometers. Groundwater quality is sampled from standpipe monitoring bores every quarter for physio chemical parameters (pH and electrical conductivity (EC)) and major ions, with limited observations of dissolved metals.

## 6.3.1 Baseline monitoring results

Since mining at the Colliery pre-dates the commencement of groundwater monitoring in 2007, there are no pre-mining groundwater monitoring data available.

### 6.3.1.1 Groundwater levels

Groundwater levels have been plotted for all monitoring sites from data ranging April 2007 to August 2023 and hydrographs are presented in Appendix B. The CRD curve has been added to the hydrographs as recommended by the peer reviewer (HydroAlgorithmics, 2024).

Alluvial/shallow groundwater has been monitored at Sites 3, 4, 7 and 8. Shallow groundwater at Site 3 occurs within the Donaldson seam, whereas shallow groundwater at Sites 4, 7 and 8 is recorded to occur within alluvium or weathered Permian. It is noted that Site 4 is likely to be located within Four Mile Creek alluvium, and Sites 7 and 8 are likely within the Buttai Creek alluvium.

Sites 3 and 4 are located at the north-eastern portion of the ML. Depth to shallow groundwater ranges from less than 2 m below ground level (bgl) to approximately 6 m at these locations. There is minimal response to rainfall evident at Site 3. This may be partly attributable to the monitoring frequency being quarterly. There is some evidence of shallow groundwater level response to rainfall at Site 4 based on the comparison between the hydrograph and CRD, particularly between 2007 and 2016 during which time there was a general increase in CRD and this corresponded with a general increase in groundwater level. However, the decreasing trend in CRD between 2016 and 2019 did not appear to result in a decreasing trend in groundwater level.

Drawdown of shallow groundwater is not evident at Sites 3 and 4 over the monitoring period, despite Site 3 being above historical underground workings in the Big Ben and Rathluba seams and adjacent to historical open cut workings in the Big Ben and Donaldson seams. It is noted that these historical workings are outside of the current approval area and would have been mined many years ago.

Shallow groundwater at Sites 7 and 8 is no longer monitored. These standpipes have gone dry, likely due to groundwater drawdown attributable to current open cut mining operations at S-Cut and Creek Cut. There is some evidence of shallow groundwater level response to rainfall at Site 7 based on similar trends in groundwater level and CRD.

Groundwater levels within the Big Ben, Donaldson and/or Rathluba seams are monitored at all sites. Current depth to groundwater (August 2023) ranges from approximately 35 m bgl at Site 1 to 70 m bgl at Site 7. Depth to groundwater exceeded 100 m at Site 6 in 2009 before going dry.

The groundwater elevation within the Big Ben and Donaldson seams at Site 2 to the north of the proposed project area has been generally consistent over the monitoring period ranging from approximately 15 to 30 m AHD. There appears to be a groundwater level response to rainfall (including in the underlying Rathluba seam), based on a visual comparison between the hydrographs and CRD curve. The magnitude and timing of groundwater drawdown observed at other locations (discussed below) was not evident at Site 2.

Groundwater elevations within the Big Ben and Donaldson seams at Sites 1, 5, 6, 7 and 8 show some drawdown over the monitoring period which can be attributable to mining (most likely open cut mining operations at S-Cut and Creek Cut within the Big Ben and Donaldson seams). The groundwater elevation at Site 1 has reduced by approximately 10 m over the monitoring period from 0 m AHD to -10 m AHD, although some rainfall response (approximately 5 m) is evident during 2021 and 2022 due to above average rainfall. Likewise, groundwater drawdown of up to 10 m is evident at Site 5, located a similar distance from the S-Cut and Creek Cut area as Site 1. A groundwater level response to rainfall is also evident at this location, particularly prior to 2010. A minor recovery in groundwater level is evident in recent years likely due to above average rainfall.

The groundwater levels at monitoring locations along the southern boundary of the ML are likely to be influenced by dewatering of mine workings at the adjoining Donaldson and Abel mines as well as from mining operations at the Colliery. Full depressurisation occurred at Site 6 in 2009 and no recovery has been observed since this time. Over 60 m of groundwater drawdown has been recorded in the Big Ben and Donaldson seams at Site 7 over the monitoring period, with some recovery occurring in recent years. The groundwater elevation within the Big Ben and Donaldson seams at Site 8 has reduced by approximately 20 m over the monitoring period from approximately -5 m AHD to -25 m AHD. Groundwater levels at these sites appear to be dominated by mining operations with minimal rainfall influence evident.

Groundwater contours have been generated using the groundwater elevation data reporting in August 2023 for the Big Ben and Donaldson seams. Contours are presented in Figure 6.2 (Big Ben seam) and Figure 6.3 (Donaldson seam). The maximum groundwater elevation across the Colliery is in the range 20 – 30 m AHD and occurs at the north eastern portion of the ML. Groundwater flow is generally towards the S-Cut and Creek Cut area at the southern portion of the ML as a result of current mining operations, with the groundwater elevation in this area being approximately -40 m AHD. Outside the area of mining influence at the northern portion of the ML, there is groundwater flow from east to west following topography towards Buttai Creek. There is also a vertical gradient with depth, which is typical for the coal measures, with groundwater pressure reducing with depth.

Based on the groundwater contours, the current groundwater elevation in the proposed Creek Cut area is interpreted to be approximately -10 to -20 m AHD with a depth to the water table of up to 80 m. The current groundwater elevation in the proposed Workshop Cut area is interpreted to be approximately 0 to 10 m AHD with depth to the water table approximately 40 m.

#### 6.3.1.2 Groundwater quality

Groundwater quality monitoring has been undertaken at six standpipe monitoring bores over the monitoring period. A summary of the standpipes and median electrical conductivity (EC) at each location is provided in Table 6.2. Time series groundwater quality plots are included in Appendix C. A piper diagram of major ion chemistry at each location is shown in Figure 6.4.

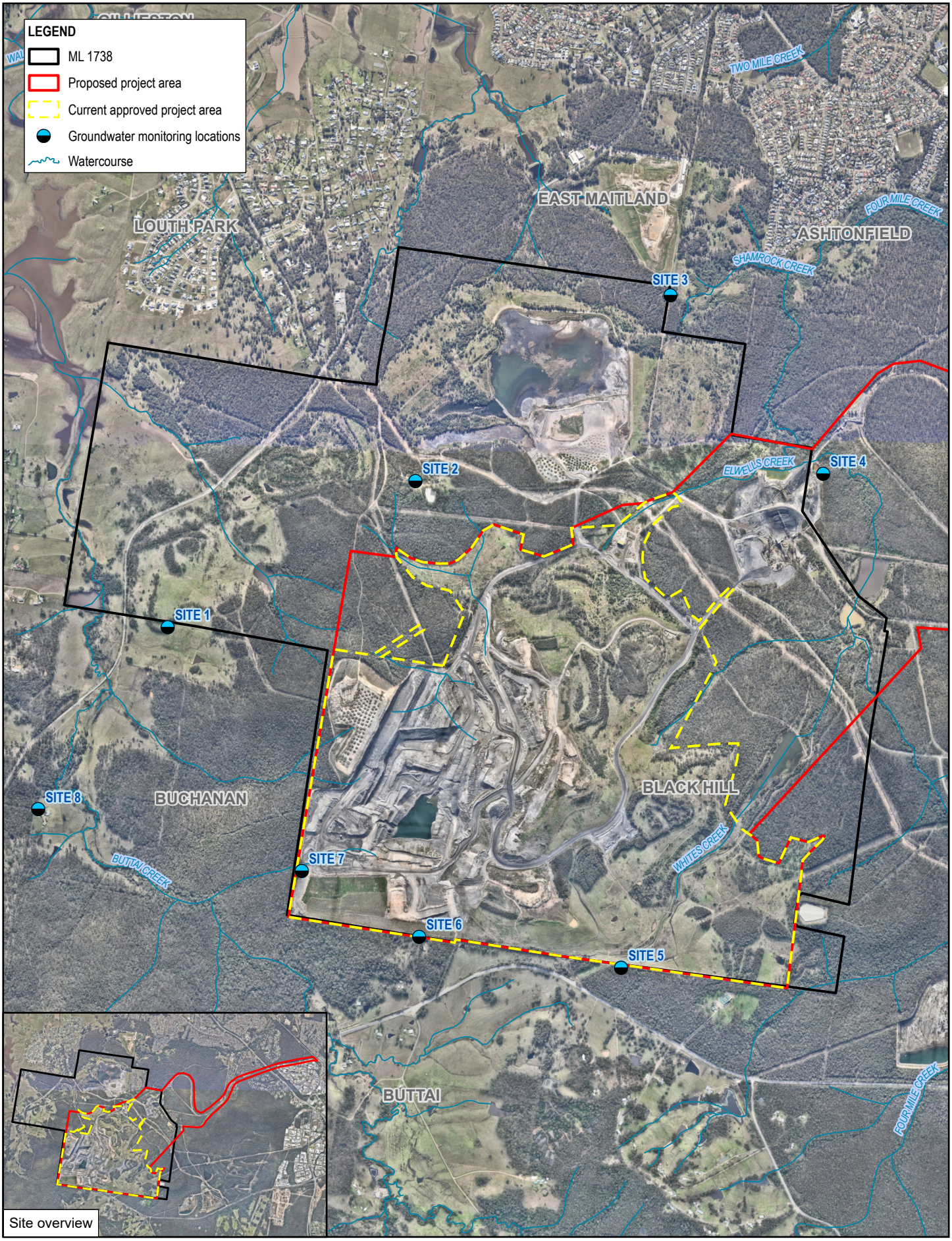
***Table 6.2 Groundwater median EC***

| Location | Name | Hole Depth (m) | Lithology | Median electrical conductivity (µS/cm) | Description |
|---|---|---|---|---|---|
| Site 2 | PD2.1 (SP2-1) | 65 | Donaldson Seam (55.5 - 61.4 m) | 5630 | Fractured rock groundwater near proposed Creek Cut area. |
| | PD2.2 (SP2-2) | 85 | Big Ben Seam (79.0 - 94.0 m) | 5850 | Fractured rock groundwater near proposed Creek Cut area. |
| Site 3 | PD3 (SP3) | 14 | Donaldson Seam | 5890 | Shallow groundwater near tailings dam. |
| Site 4 | PD4.1 (SP4-1) | 78 | Rathluba Seam (75.4 - 77.4 m) | 9690 | Fractured rock groundwater outside mining footprint. Monitoring discontinued. |

| Location | Name | Hole Depth (m) | Lithology | Median electrical conductivity (µS/cm) | Description |
|---|---|---|---|---|---|
| | PD4.2 (SP4-2) | 9 | Alluvium/weathered Permian | 7290 | Alluvial groundwater outside mining footprint. |
| Site 7 | PD7.1 (SP7-1) | 11 | Alluvium/weathered Permian | 5060 | Alluvial groundwater near current S-Cut. Monitoring discontinued. |

Groundwater (both shallow and deeper fractured rock) is generally slightly acidic and saline. Shallow groundwater near the existing S-Cut (Site 7) is generally sodium chloride type water. However, the shallow groundwater towards the north of the ML has a larger sulfate dominance. Shallow groundwater at Sites 3 and 4 are sulfate dominant with more of a mixed cation chemistry. The sulfate dominance at Site 3 may be attributable to interaction with seepage from the tailings dam. Deeper groundwater from the Big Ben, Donaldson and Rathluba seams are generally sodium chloride type.

Overall, the review of groundwater quality suggests that beneficial use is limited due to the saline conditions.




Paper Size ISO A4

0 0.25 0.5 0.75 1

Kilometres

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

N

GHD

**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Continuation Project**
**Groundwater Impact Assessment**

Project No. **12597478**
Revision No. **0**
Date **04/07/2024**

## Groundwater monitoring locations

# FIGURE 6.1

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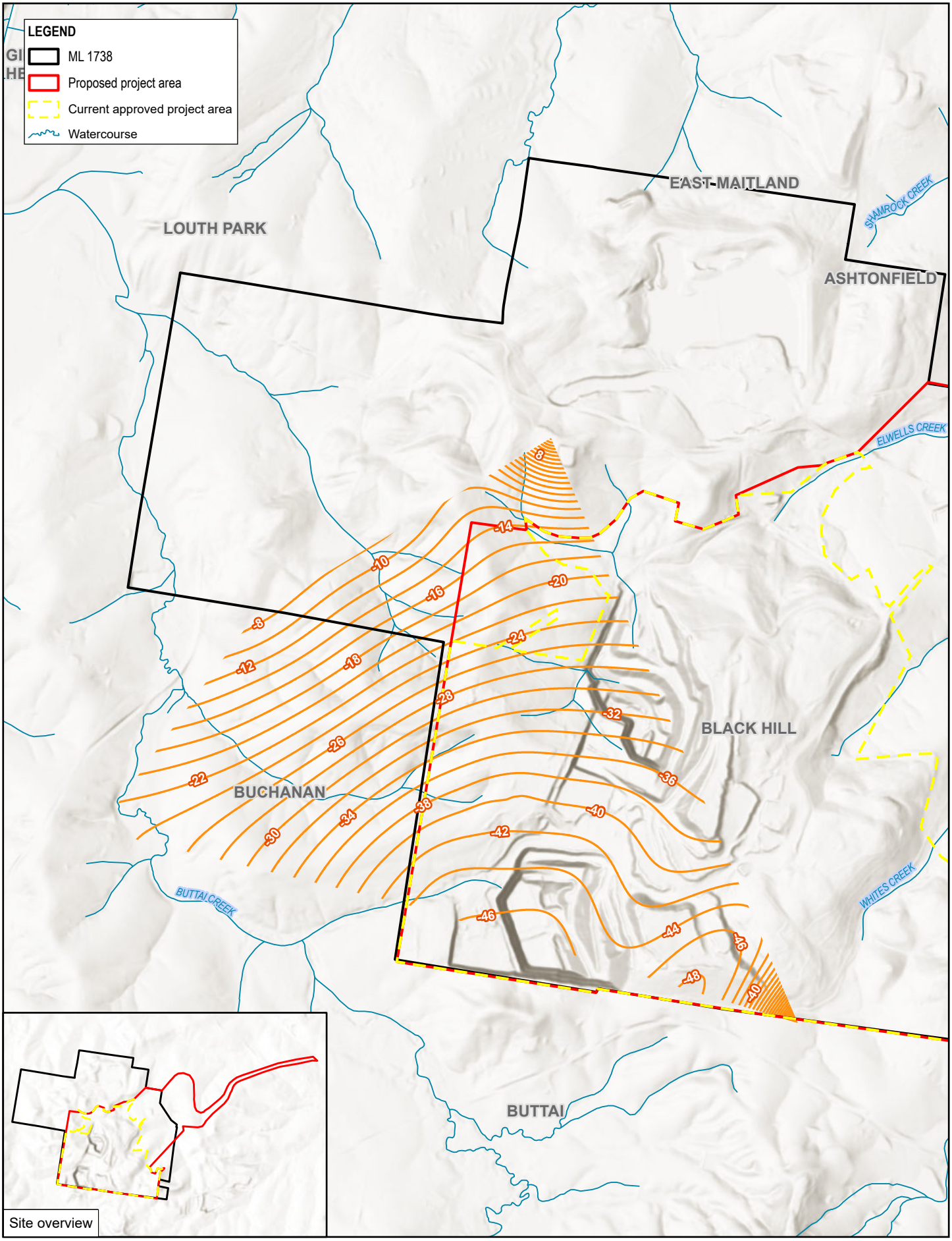
Print date: 04 Jul 2024 - 12:04

Data source: LPI: DCDB, 2019. Bloomfield Colliery: Project area/Mine lease/Creek cut data, 2023. World Hillshade: Esri, Geoscience Australia, NASA, NGA, USGS
Nearmap WMS Server: .
Created by: tmorton

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Kilometres

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

N

GHD

**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Continuation Project**
**Groundwater Impact Assessment**

## Groundwater flow contours – Big Ben seam

Project No. **12597478**
Revision No. **0**
Date **04/07/2024**

# FIGURE 6.2

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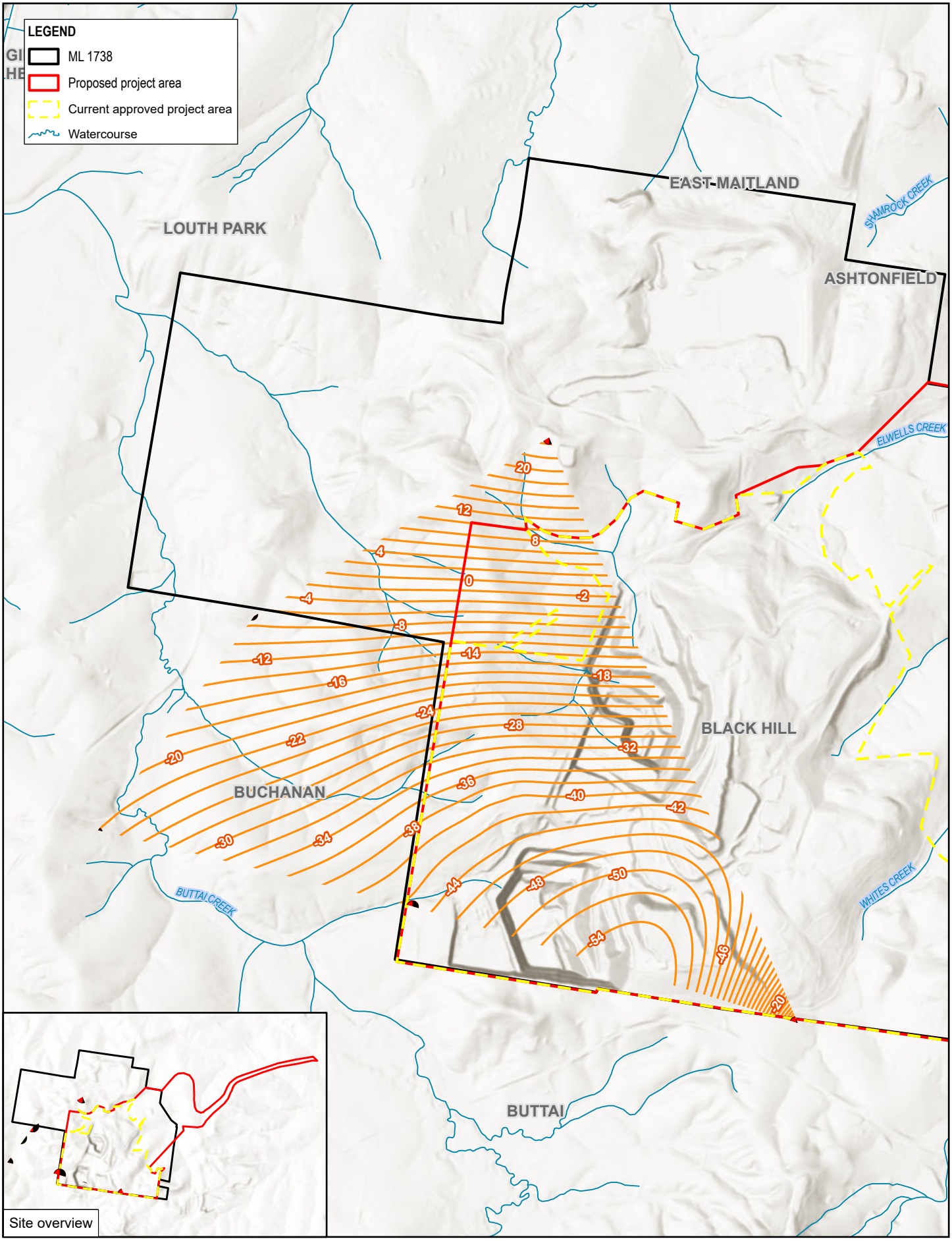
Data source: LPI: DCDB, 2019. Bloomfield Colliery: Project area/Mine lease/Creek cut data, 2023. World Hillshade: Esri, Geoscience Australia, NASA, NGA, USGS.
Created by: tmorton




Paper Size ISO A4

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Kilometres

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

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GHD

**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Continuation Project**
**Groundwater Impact Assessment**

## Groundwater flow contours – Donaldson seam

Project No. **12597478**
Revision No. **0**
Date **04/07/2024**

# FIGURE 6.3

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Data source: LPI: DCDB, 2019. Bloomfield Colliery: Project area/Mine lease/Creek cut data, 2023. World Hillshade: Esri, Geoscience Australia, NASA, NGA, USGS.
Created by: tmorton

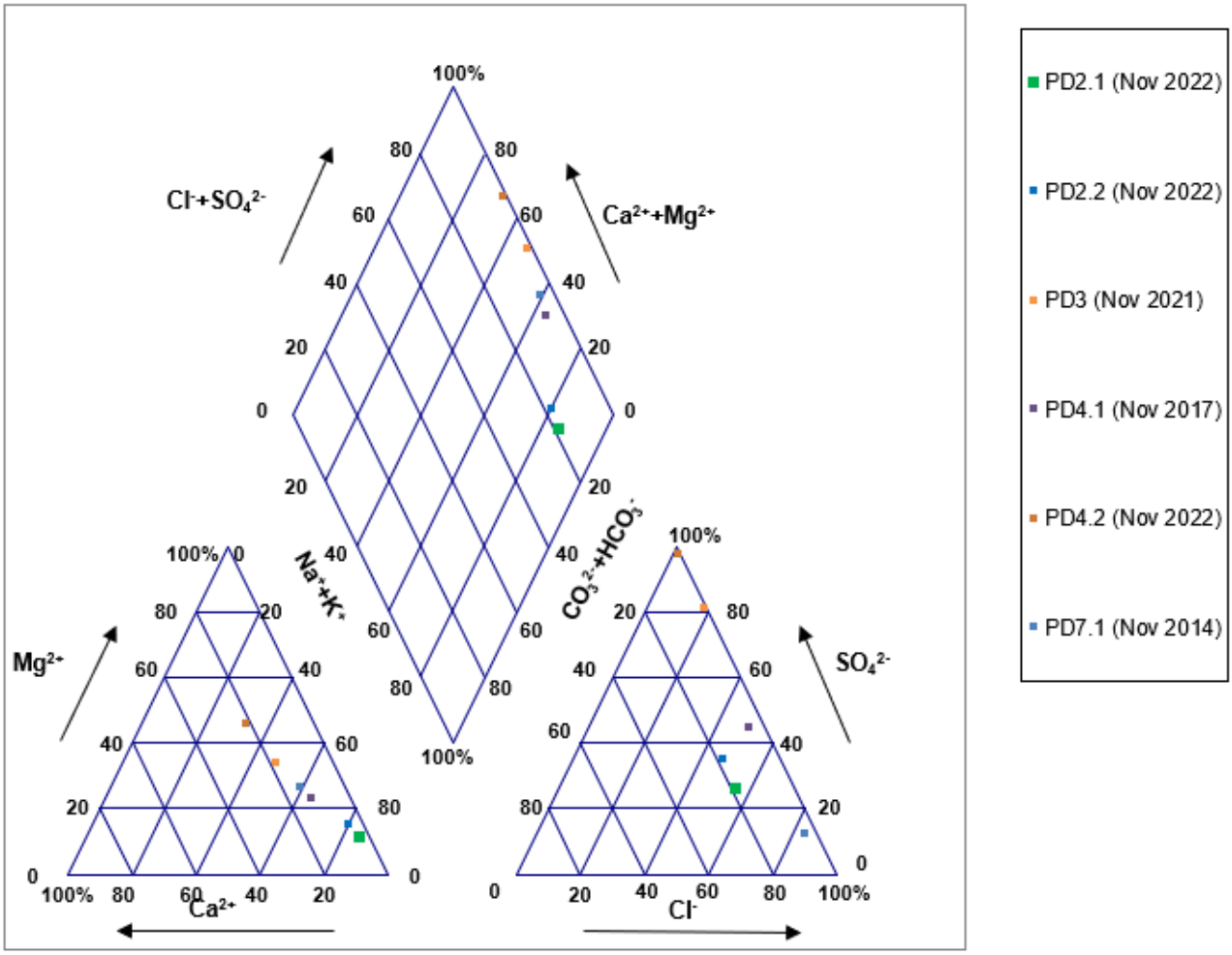



*Figure 6.4 Piper diagram - groundwater*

# 6.4 Numerical groundwater model

A three-dimensional numerical groundwater model was developed for the Colliery by Aquaterra (2008) as part of the Environmental Assessment for project approval PA 07_0087. This model was updated by Aquaterra (2013) and HydroSimulations (2015) to incorporate Donaldson, Abel and Tasman mines.

HydroSimulations (2017) further updated the regional model to assess groundwater impacts from Modification 4 of the Bloomfield Colliery project approval PA 07_0087. The HydroSimulations (2017) model uses MODFLOW-SURFACT with a structured grid, which allows for modelling of variably saturated flow. Modelling was undertaken using the Groundwater Vistas Graphical User Interface.

Key features of the model are as follows:

– Model area extends 16.6 km south to north and 23 km west to east, with a total area of 380 km$^2$.
– 20 model layers from alluvium/regolith in Layer 1, down through Tomago Coal Measures to Wallis Creek Subgroup as the basement.
– Grid size ranges from 50 x 50 m to 100 x 100 m, with a total of 1.46 million cells.
– Incorporates the Time-varying Material Property (TMP) facility to represent changes in aquifer properties from backfill and underground fracturing.
– Calibration model 2006 – 2017, followed by the prediction model to 2031 and then recovery model for 100 years.
– The model was calibrated against groundwater level observations only, with no groundwater inflow observations readily available for calibration.

### 6.4.1 Model predictions and impact assessment criteria

The HydroSimulations (2017) model predicts groundwater inflows into the S-Cut and Creek Cut pits from the fractured rock groundwater source between 2006 and 2025. Predicted inflows range from 253 ML/year (in 2023) to 572 ML/year (in 2013). The predicted inflow for year 2025 is 367 ML/year. HydroSimulations (2017) regarded these as conservative estimates of actual groundwater inflow because they do not take into account evaporative losses within the pit.

HydroSimulations (2017) modelled the final void to remain a groundwater sink over the 100 year post mining period, with groundwater levels only predicted to recover 15 m after 100 years, with a void water surface of -40 m AHD. It is considered that further recovery would occur beyond 100 years post mining at the Colliery and adjacent mines.

Groundwater drawdown as a result of mining activities at the Colliery was predicted to reach at maximum in year 2025. Drawdown of up to 100 m (compared to a no mining base case) was predicted within the approved project area. Groundwater drawdown beyond the ML (attributable to the modification) was predicted to be less than 0.5 m, with the exception of the south-west corner where the 2 m groundwater drawdown contour extends beyond the ML by 600 m and extends below Buttai Creek. No registered bores are within the zone of groundwater drawdown exceeding 2 m.

# 7. Conceptual groundwater model

A conceptual groundwater model has been developed for the Colliery based on the available assessments and monitoring undertaken to date.

## 7.1 Overview

Groundwater at the Colliery occurs within shallow low yielding water bearing units composed of unconfined alluvium and/or weathered Permian strata, as well as in deeper low yielding fractured rock and coal seams. The coal seams, which may be semi-confined, are considered to be the main water bearing units within the fractured rock groundwater source.

No aquifer testing data is available so there is limited information regarding the hydraulic conductivity and storage properties of the water bearing units. HydroSimulations (2017) calibrated the hydraulic conductivities (horizontal) of the coal seams to range from $1 \times 10^{-4}$ m/day to $5 \times 10^{-2}$ m/day.

Recharge to the groundwater system occurs primarily via rainfall to the shallow water bearing units (alluvium and weathered zones) and coal seam outcrop areas. River leakage is also an input, particularly due to the depressurised groundwater system. There would also be some vertical leakage through the stratified Permian profile to deeper units.

Groundwater discharge occurs primarily by:

– Evapotranspiration within the shallow water bearing units.
– Baseflow to rivers and creeks.
– Inflow into mine workings (both open cut and underground).
– Groundwater extraction via bores and mine shafts.

Major cation analysis (refer Figure 6.4) indicates differing groundwater chemistry between shallow and deeper groundwater, suggesting minimal connection between these sources. The shallow groundwater sources in the vicinity of the proposed project area are not considered to be extensive due to drawdown from historical open cut mining operations.

The potentiometric surface generally reflects the natural and altered topography. As such, groundwater flow is towards mine workings and larger watercourses.

The environmental sensitivity of the groundwater system at the Colliery is considered to be low based on the low yielding aquifer and limited productive use, limited receptors and limited connectivity between groundwater and potential GDEs.

## 7.2 Existing mining

A conceptual groundwater model that represents existing conditions at the Colliery is shown in Figure 7.1 and Figure 7.2. The first cross section is north to south (Figure 7.1, vertical exaggeration approximately 10 times) and the second is west to east (Figure 7.2, vertical exaggeration approximately 3 times). The cross section alignments are shown on the plans in Appendix A.

The hydrogeological setting is characterised by a highly disturbed area with open cut mining operations occurring adjacent to old underground workings and backfilled open cut areas. In the vicinity of the approved project area, groundwater flows from recharge areas at the north towards the south towards the existing S-Cut and Creek Cut open cut pits, where there is groundwater take within these pits. A primary pathway for groundwater flow is via existing underground workings and areas of backfill. The depth to groundwater is approximately 80-100 m below natural surface in the area of the existing and proposed open cut areas. Groundwater continues to flow to the south of the approved project area due to ongoing dewatering of adjacent mines.

To the north of the approved project area, there is groundwater flow from recharge areas in the eastern portion of the approved project area west towards Buttai Creek via underground workings and areas of backfill.

## 7.3 Proposed mining

A conceptual groundwater model that represents proposed conditions at the Colliery is shown in Figure 7.3 and Figure 7.4. The first cross section is north to south (Figure 7.3, vertical exaggeration approximately 10 times), and the second is west to east (Figure 7.4, vertical exaggeration approximately 3 times). The cross section alignments are shown on the plans in Appendix A.

Proposed mining includes an extension of the Creek Cut to the north of the approved project area and additional open cut mining at the Workshop Cut. The design contours for 2035 (refer Appendix A) reflects the deepest extent of mining within the proposed Creek Cut and Workshop Cut and this landform has been adopted in Figure 7.3 and Figure 7.4. The lowest elevation of the proposed Creek Cut is approximately -10 m AHD, while the lowest elevation of the proposed Workshop Cut (located further to the east of the west-east cross section alignment) is approximately 7.5 m AHD. Existing open cut workings at the S-Cut and Creek Cut will be backfilled to elevations of approximately 20 to 30 m AHD.

Backfilling of the existing S-Cut and Creek Cut may result in some groundwater recovery after 2030, however based on modelling undertaken by HydroSimulations (2017) groundwater recovery is likely to be minimal (15 m in 100 years) and it is unlikely that there will be groundwater interception by the proposed Creek Cut and Workshop Cut.

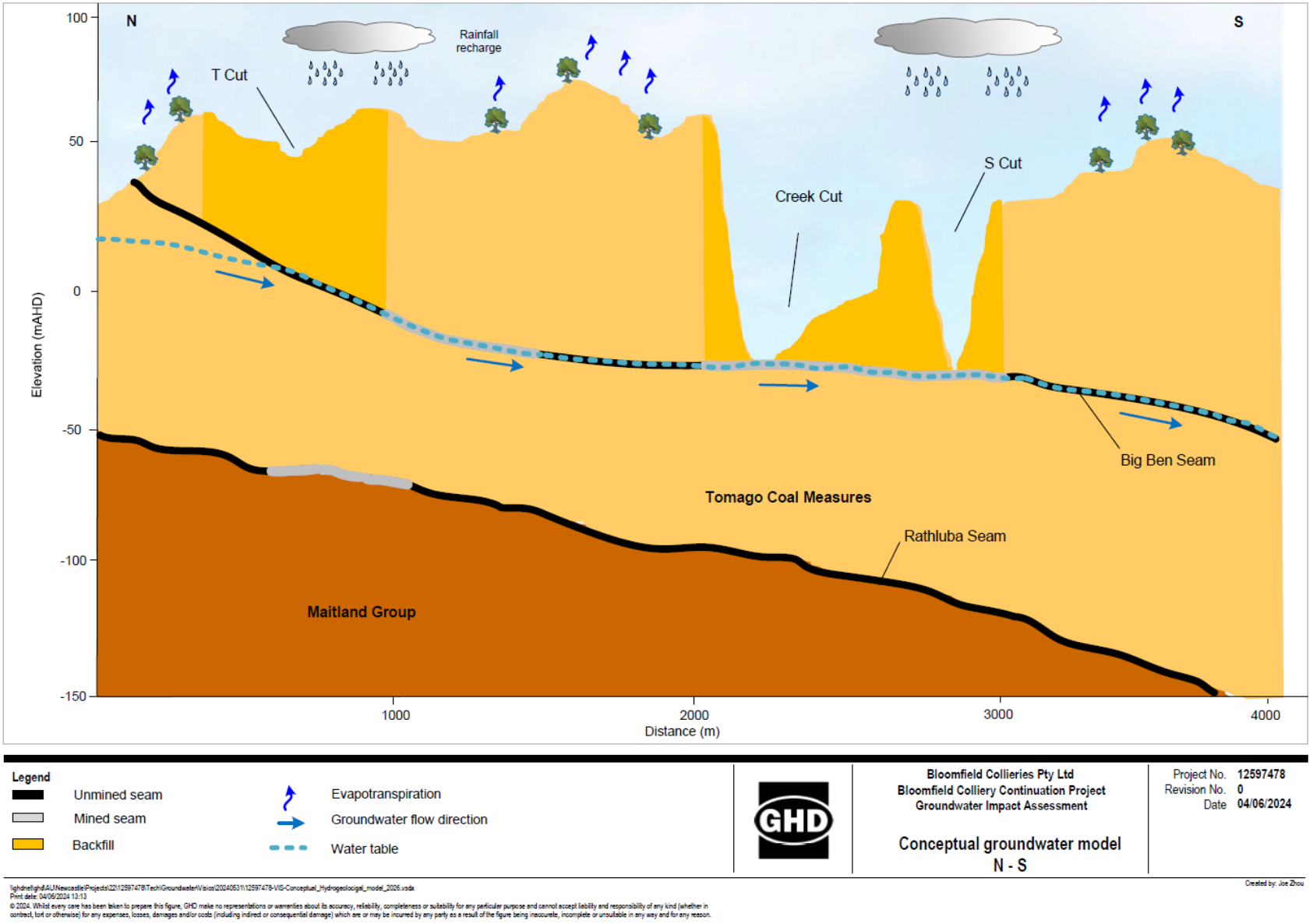





*Figure 7.1 Conceptual groundwater model – existing conditions (N - S)*

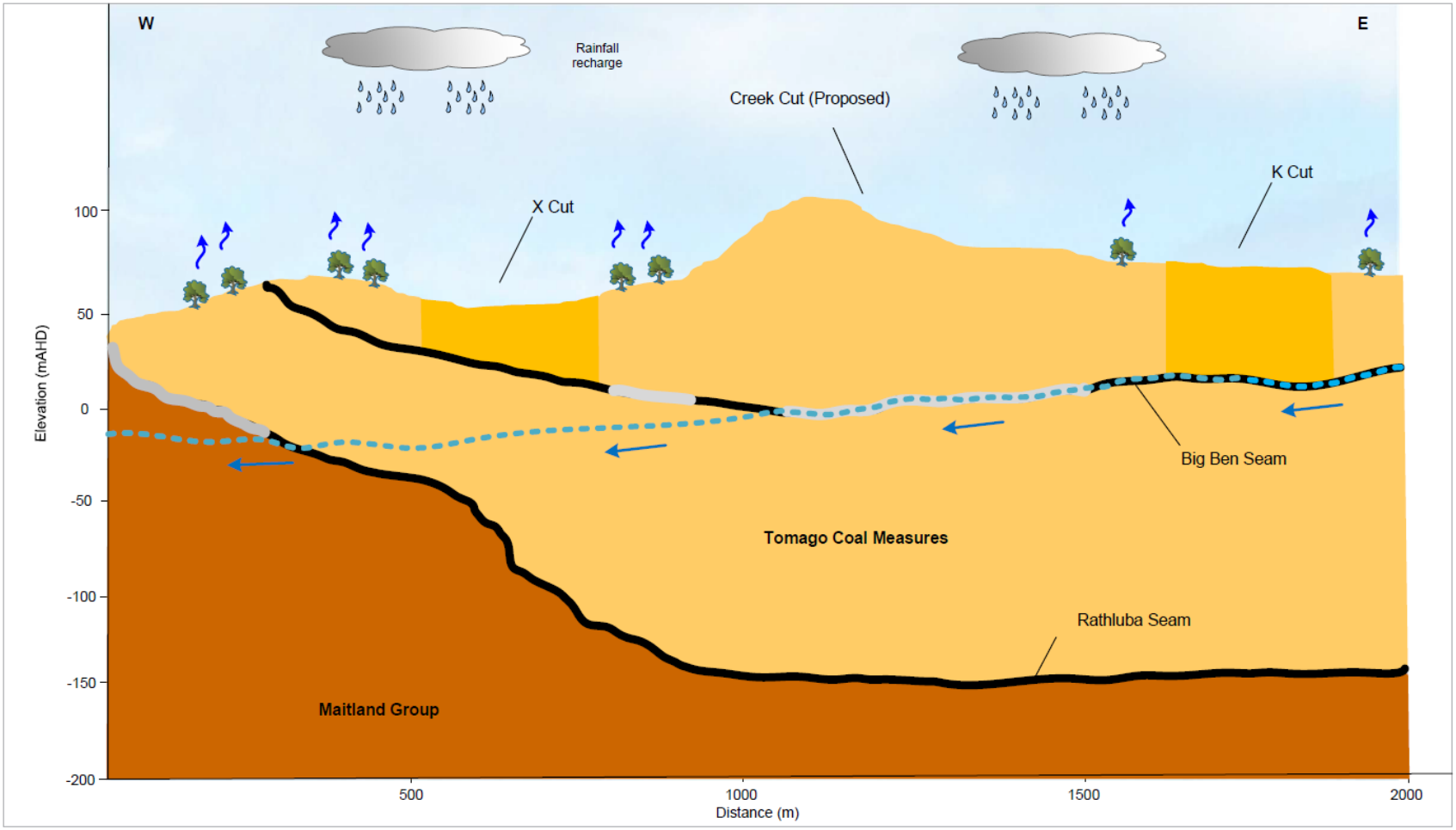



*Figure 7.2 Groundwater conceptual model – existing conditions (W - E)*

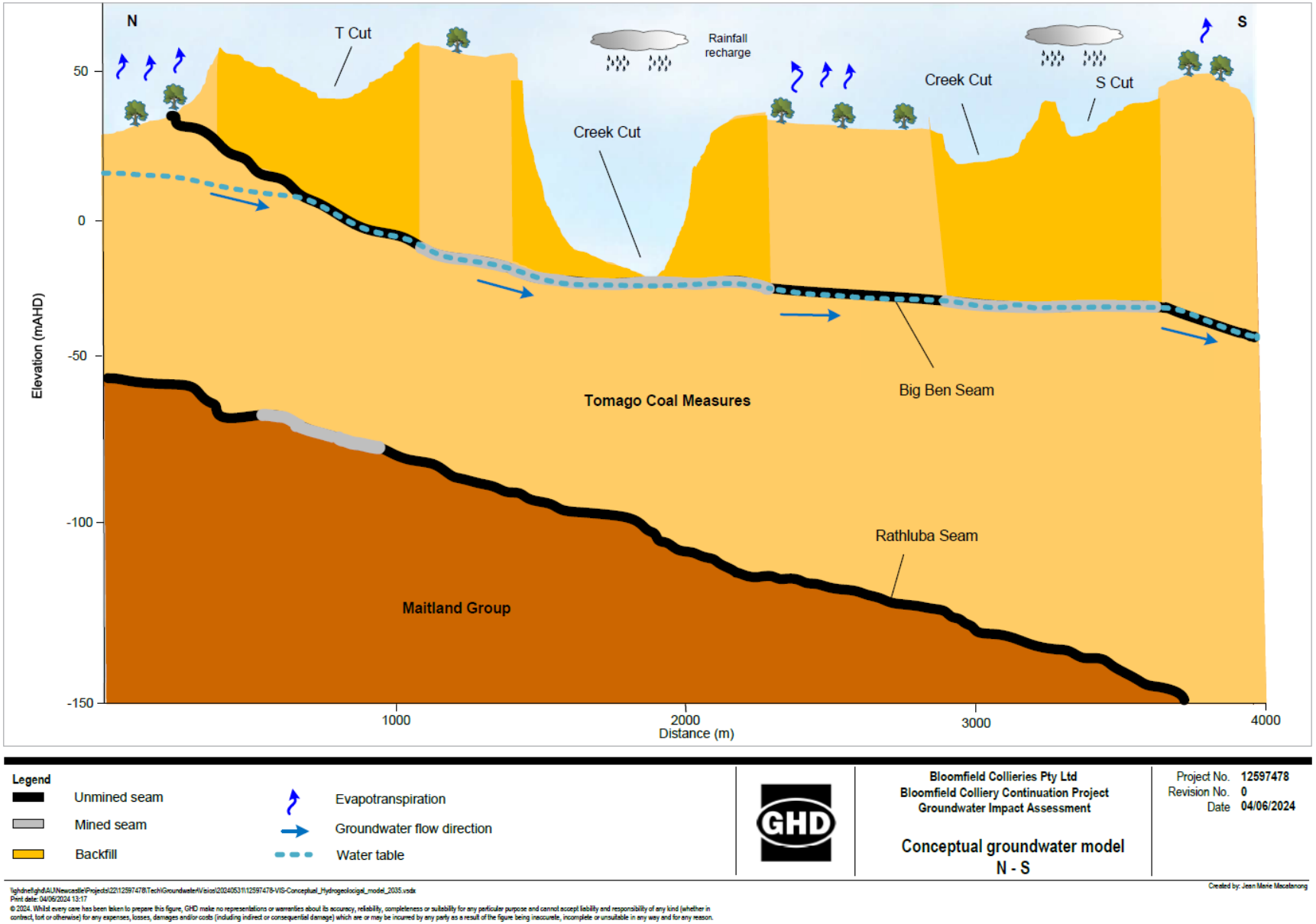



*Figure 7.3 Conceptual groundwater model – proposed conditions (N - S)*

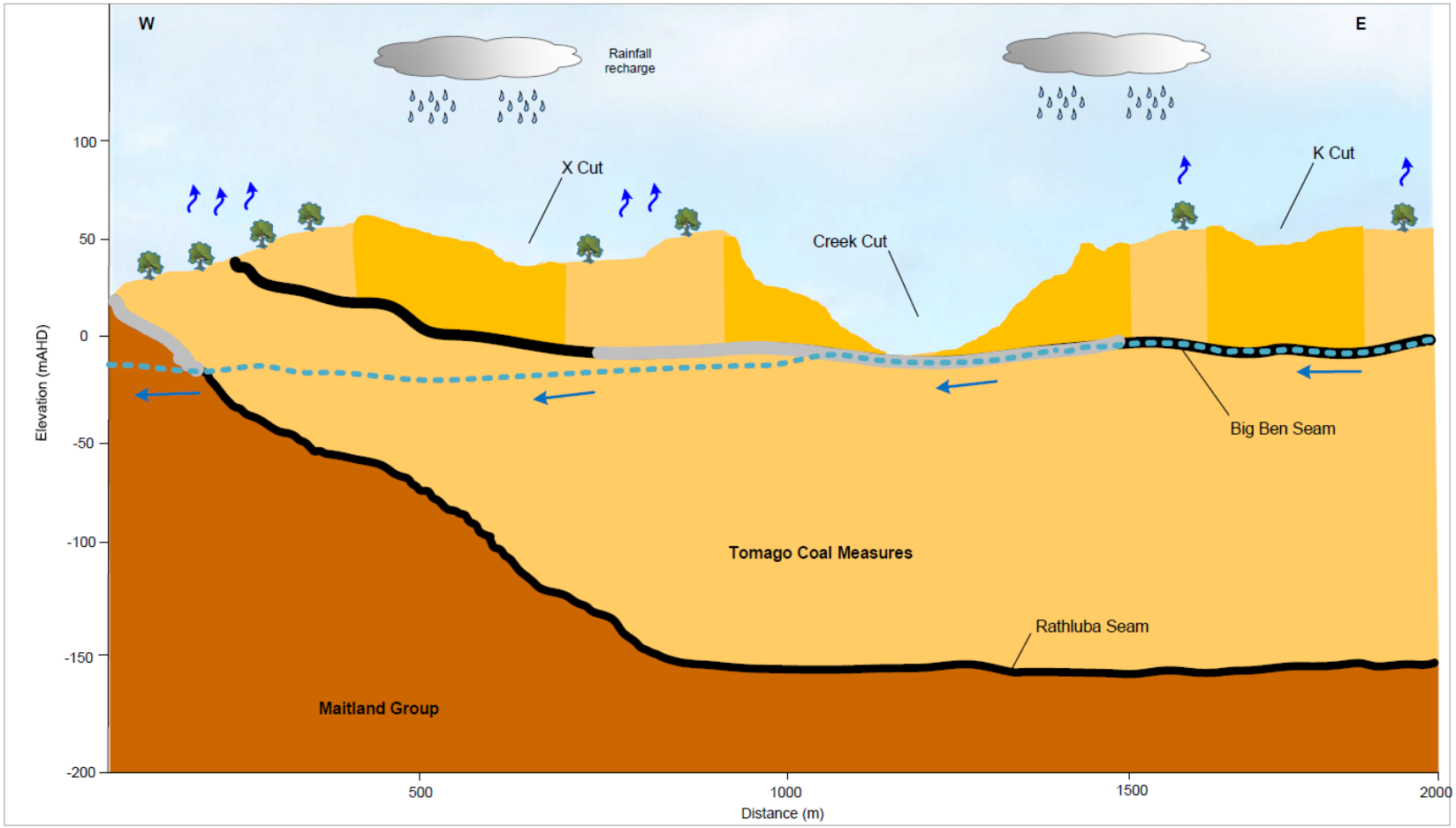





*Figure 7.4 Conceptual groundwater model – proposed conditions (W - E)*

# 8. Impact assessment

## 8.1 Method

The conceptual groundwater model presented in Section 7 forms the basis for the groundwater impact assessment.

The current groundwater elevation in the proposed Creek Cut area is well below pre-mining conditions. The level is interpreted to be approximately -10 to -20 m AHD, approximately at the level of the Big Ben seam, with a depth to the water table of up to 80 m below ground surface. The deepest extent of mining within the proposed Creek Cut is approximately -10 m AHD which suggests that groundwater interception would be minimal, if any. The current groundwater elevation in the proposed Workshop Cut area is interpreted to be approximately 0 to 10 m AHD with depth to the water table approximately 40 m. The deepest extent of mining within the Workshop Cut is approximately 7.5 m AHD, which again suggests that groundwater interception would be minimal, if any.

Due to the minimal groundwater interception by the proposed project, it is considered that a mathematical model (numerical or analytical) is not required to quantify groundwater impacts (changes to levels and flows) due to the proposed project. Groundwater impacts are expected to be within the range previously observed and/or predicted and therefore it is sufficient to rely on existing groundwater monitoring data and groundwater modelling predictions to assess the groundwater impacts of the proposed project.

To confirm that a conceptual groundwater model was an appropriate approach, NSW DCCEEW (formerly DPE-Water) were consulted. This consultation included the following:

– Provision of a letter and email on 27/11/2023 detailing the proposed groundwater modelling approach.
– A meeting was held on 11/12/2023 presenting the modelling approach and initial findings.
– Provision of further information on 06/03/2024 with justification for the proposed modelling approach in response to questions from the meeting held on 11/12/2023.

NSW DCCEEW have not yet provided a formal response however indicated the conceptual modelling approach was acceptable during the meeting held on 11/12/2023, subject to reviewing the final GIA. Bloomfield committed to providing detailed results as part of the GIA and also having the GIA and methodology peer reviewed by an independent specialist.

The GIA has been independently peer reviewed by Dr Noel Merrick (HydroAlgorithmics, 2024), which supported that the methodology and approach was an appropriate level of assessment (see Appendix E). The peer review also made some recommendations for improvement, which have been incorporated into the GIA.

## 8.2 Impact prediction

### 8.2.1 Groundwater inflows

Metered groundwater inflows into the S-Cut and Creek Cut over the past four water years is as follows:

– 1 July 2022 to 30 June 2023: 332 ML/year
– 1 July 2021 to 30 June 2022: 361 ML/year
– 1 July 2020 to 30 June 2021: 274 ML/year
– 1 July 2019 to 30 June 2020: 260 ML/year

Predicted groundwater inflow at year 2025, based on HydroSimulations (2017), is 367 ML/year. Since the proposed Creek Cut and Workshop Cut excavations are smaller and shallower than the existing and approved S-Cut and Creek Cut, it is likely that groundwater inflows attributable to the project will be less than those reported in recent years. Inflows may be negligible or zero if there is no groundwater interception. As groundwater recovers post mining, there will be groundwater inflows into the proposed Creek Cut (final void), however these are likely to be less than the inflows reported in recent years due to the shallower depth of excavation.

### 8.2.2 Groundwater depressurisation and drawdown

Since the proposed Creek Cut and Workshop Cut excavations are smaller and shallower than the existing and approved S-Cut and Creek Cut, it follows that any incremental groundwater depressurisation and drawdown as a result of the proposed project will be less than existing. If there is no groundwater interception there will be no additional drawdown.

Although there is substantial groundwater drawdown from existing, historical and adjoining mining activities, the incremental drawdown attributable to the proposed project is expected to be negligible and not extend beyond the ML.

## 8.3 Impact assessment

### 8.3.1 Impact assessment criteria

The potential impacts have been assessed in accordance with the NSW AIP. The AIP requires that potential impacts on groundwater sources, including their users and GDEs, be assessed against minimal impact considerations, outlined in Table 1 of the policy. If the predicted impacts meet the Level 1 Minimal Impact Considerations, then these impacts will be considered as acceptable.

The NSW AIP divides groundwater into “highly productive” and “less productive” groundwater sources. Highly productive groundwater is defined in this policy as having:

– Total dissolved solids of less than 1,500 mg/L.
– Contains water supply works that can yield water at a rate greater than 5 L/sec.

Based on the reported yields for the registered bores outlined in Section 5.5.1 as well as the groundwater salinity observed at monitoring bores, groundwater yields are less than 5 L/s and total dissolved solids exceeds 1,500 mg/L. Groundwater at the project is therefore defined as “less productive” as per the NSW AIP.

Level 1 minimal impact considerations for Less Productive Groundwater Sources – Porous and Fractured Rock Water Sources have therefore been adopted for the GIA and are defined as follows:

– Water table:
  - Less than or equal to 10% cumulative variation in the water table, allowing for typical climatic ‘post-water sharing plan’ variations, at a distance of 40 m from any high priority GDE or high priority culturally significant site listed in the schedule of the relevant WSP. A maximum of a 2 m water table decline cumulatively at any water supply work.
  - If more than 10% cumulative variation in the water table, allowing for typical climatic ‘post-water sharing plan’ variations, 40 m from any high priority GDE; or high priority culturally significant site; listed in the schedule of the relevant WSP then appropriate studies will need to demonstrate to the Minister’s satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or significant site. If more than 2 m decline cumulatively at any water supply work, then make good provisions should apply.
– Water pressure:
  - A cumulative pressure head decline of not more than a 2 m decline at any water supply work.
  - If the predicted pressure head decline is greater than the requirement above, then appropriate studies are required to demonstrate to the Minister’s satisfaction that the decline will not prevent the long-term viability of the affected water supply works unless make good provisions apply.
– Water quality:
  - Any change in groundwater quality should not lower the beneficial use category of the groundwater source, beyond 40 m from the activity.
  - If the above condition is not met then appropriate studies will need to demonstrate to the Minister’s satisfaction that the change in groundwater quality will not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply work.

### 8.3.2 Impact to existing groundwater users

Incremental drawdown attributable to the project is expected to be negligible and/or not extend beyond the ML boundary. Since there are no registered bores within the ML (with the exception of Bloomfield Colliery groundwater monitoring bores), there is no drawdown expected to occur at any registered bore.

The impact of the project therefore meets the NSW AIP Level 1 Minimal Impact Considerations for Landholder Bores.

### 8.3.3 Impact to GDEs

Due to the groundwater drawdown from current and historical mining operations at Bloomfield, it is unlikely that the terrestrial ecosystems identified in Section 5.5.2 are supported by groundwater under current conditions. In addition, there are no high-priority GDEs listed in the relevant WSPs that have the potential to be impacted by the proposed project.

Therefore, the impact of the project meets the NSW AIP Level 1 Minimal Impact Considerations for GDEs.

### 8.3.4 Impact to groundwater quality

The project is not expected to cause any significant change in groundwater quality or in the beneficial use of the groundwater. Groundwater at the Colliery is saline and of negligible beneficial use.

It is not expected that the project will result in the interaction between fresh and saline groundwater sources (since all groundwater sources in the vicinity of the proposed project area are saline). Due to the negligible groundwater interception expected, it is not expected that the project will result in the generation of acid in groundwater.

Continued use of the tailings storage facilities at U-Cut and S-Cut South Void may result in some continued localised interaction between tailings water and groundwater, however it is expected to be of similar extent and impact as current conditions. There is evidence of tailings water influence on shallow groundwater in the vicinity of U-Cut, based on elevated sulfate concentrations at groundwater monitoring location Site 3. However, the groundwater EC at Site 3 is similar to that at other monitoring sites and it is considered that the beneficial use of this groundwater has not reduced. Since S-Cut is currently a groundwater sink, local groundwater flow direction will be towards the S-Cut. Tailings water will be contained within the pit for several hundred years until groundwater levels recover. At that time, there may be groundwater flow through the void, where it is expected that any interaction between tailings water and groundwater will result in similar changes to local groundwater chemistry as for current conditions at U-Cut and will not reduce the beneficial use of the groundwater.

The impact of the project therefore meets the NSW AIP Level 1 Minimal Impact Considerations for Groundwater Quality.

### 8.3.5 Impacts post closure

HydroSimulations (2017) modelled the final void to remain a groundwater sink over the 100 year post mining period, with groundwater levels only predicted to recover 15 m after 100 years, with a void water surface of -40 m AHD. It is likely that groundwater levels would continue to recover beyond 100 years post mining.

Under the proposed project, the location of the final void moves to the north to correspond with the proposed Creek Cut, with a base elevation of -10 m AHD.

As groundwater levels recover post mining there will be groundwater inflow into the final void. During this time the final void may act as a groundwater sink (assuming groundwater to the south of the final void has recovered) or will be a flow through void with groundwater flow to the south.

Long term (several hundred years), it is expected that groundwater levels adjacent to the final void will recover to a level of around 20 m AHD. This is based on interpretation of groundwater level data and the conceptual model of groundwater flow under pre-mining conditions. Recovered groundwater level of 20 m AHD is below the spill level of the final void of approximately 40 m AHD.

Water levels within the final void are assessed within the Surface Water Impact Assessment (GHD, 2024). The Surface Water Impact Assessment (GHD, 2024) identified that the void is unlikely to discharge into surface water environments. Depending on rainfall and evaporation, there may be periods when the final void is a groundwater sink (when water levels in the void are lower) or a groundwater source (when water levels in the void rise). Due to the poor groundwater quality, it is unlikely that there will be reductions in beneficial use of groundwater associated with these fluctuations in void water level.

### 8.3.6 Cumulative impacts

HydroSimulations (2017) developed a regional groundwater model that incorporates the mine workings of Bloomfield Colliery and the adjoining Donaldson open cut mine, Abel underground mine and Tasman underground mine. Groundwater inflow and drawdown predictions therefore account for the operation of each of these sites concurrently (in accordance with approvals) and therefore assess the cumulative impacts. This groundwater impact assessment is based on the predictions from HydroSimulations (2017).

## 8.4 Water sharing plan licensing requirements

Any interference or extraction of groundwater at the project requires a WAL under the WM Act. Groundwater at the Colliery is managed under WAL 41506 which licenses the extraction of 500 share components from the Sydney Basin-North Coast Groundwater Source.

Groundwater take is expected to remain below 500 ML/year and therefore no additional licence allocations are required.

# 9. Mitigation

## 9.1 Monitoring

The spatial distribution of the existing groundwater monitoring network outlined in Table 6.1 and shown in Figure 6.1 is both within and beyond the extent of predicted groundwater drawdown during mining operations. Therefore, it is considered that the existing groundwater monitoring network is sufficient to detect groundwater drawdown and quality impacts during mining operations and provide observation data for validation of the groundwater model.

The monitoring program will be reviewed annually and additional monitoring bores added as required.

It is recommended that the existing groundwater monitoring program be continued. It is recommended that groundwater be monitored to:

– Measure dewatering performance.
– Assess potential impacts to groundwater levels and quality on other groundwater users in the vicinity.
– Identify groundwater issues such as potential large drawdowns at receptors as early as possible.
– Provide data which can be used to update the groundwater model.
– Measure groundwater level recovery post closure and provide data which can be used to predict how long a WAL may be required after the project is completed.

It is considered that the existing Groundwater Management Plan within the WMP, including the TARP, is sufficient to monitor and manage impacts to groundwater from the project.

Groundwater monitoring requirements post closure should be reviewed as part of closure planning with a focus on understanding the impacts of groundwater recharge from a recovering final void on the local groundwater system. Groundwater should continue to be monitored in the post closure phase until groundwater levels stabilise and/or regulation requirements are met.

## 9.2 Reporting and reviewing

Results from the groundwater monitoring program will be reported annually in the Annual Review. Changes to the monitoring program, TARP or update of the groundwater model will be undertaken based on the results of the monitoring.

# 10. Summary

This GIA has been prepared to provide an assessment of the potential groundwater impacts related to the construction and operation of the proposed project (Modification 5). The GIA has focused on incremental groundwater impacts associated with the extended Creek Cut and additional Workshop Cut. The GIA has been informed by groundwater monitoring between 2007 and 2023 and by a three dimensional numerical groundwater model for the Colliery (HydroSimulations 2017).

Groundwater at the Colliery occurs within shallow low yielding water bearing units composed of unconfined alluvium and/or weathered Permian strata, as well as in deeper low yielding fractured rock and coal seams of the Tomago Coal Measures. The groundwater sources are generally low yielding and saline with limited beneficial use. It is unlikely that terrestrial ecosystems at the Colliery are supported by groundwater under current conditions and it is noted that there are no high-priority GDEs listed in the relevant WSPs that have the potential to be impacted by the proposed project.

The hydrogeological setting is characterised by a highly disturbed area with open cut mining operations occurring adjacent to old underground workings and backfilled open cut areas. In the vicinity of the approved project area, groundwater flows from recharge areas at the north to south towards the existing S-Cut and Creek Cut open cut pits, where there is groundwater take within these pits. A primary pathway for groundwater flow is via existing underground workings and areas of backfill. To the north of the approved project area, there is groundwater flow from recharge areas in the eastern portion of the approved project area west towards Buttai Creek via underground workings and areas of backfill.

The conceptual groundwater model presented in Section 7 forms the basis for the groundwater impact assessment. Review of existing groundwater levels and proposed open cut mining indicates it is unlikely there will be groundwater interception by the proposed Creek Cut and Workshop Cut. Groundwater impacts are expected to be within the range previously observed and/or predicted and therefore it is sufficient to rely on existing groundwater monitoring data and groundwater modelling predictions to assess the groundwater impacts of the proposed project.

Groundwater inflows into the proposed open cut workings, if any, are expected to be less than those reported in recent years and within the 500 ML/year licence allocation under WAL 41506.

Although there is substantial groundwater drawdown from existing, historical and adjoining mining activities, the incremental drawdown attributable to the proposed project is expected to be negligible and not extend beyond the ML. Review of the project against the NSW AIP indicates that:

– The impact of the project meets the NSW AIP Level 1 Minimal Impact Considerations for Landholder Bores.
– The impact of the project meets the NSW AIP Level 1 Minimal Impact Considerations for GDEs.
– The impact of the project meets the NSW AIP Level 1 Minimal Impact Considerations for Groundwater Quality.

# 11. References


AECOM (2020) Bloomfield Mine Operations Water Management Plan.

BOM (2023) *Australian Groundwater Explorer*, Australian Government Bureau of Meteorology, viewed online from http://www.bom.gov.au/water/groundwater/explorer/map.shtml.

Aquaterra Consulting Pty Ltd (2008) Bloomfield Completion of Mining and Rehabilitation Groundwater Impact Assessment. Report to Peter Dundon and Associates Pty Ltd. September 2008.

DPE (2022a) Groundwater assessment toolbox for major projects in NSW - Overview document. Technical guideline prepared for the Water group, NSW Department of Planning and Environment.

DPE (2022b) Cumulative Impact Assessment Guidelines For State Significant Projects, NSW Department of Planning and Environment.

DPE Water (2022) Probable Vegetation Groundwater Dependent Ecosystems – Hunter/Central Rivers. Retrieved from https://datasets.seed.nsw.gov.au/dataset/probable-vegetation-gde-hunter-central-rivers.

GHD (2022) Bloomfield Mine Closure: Groundwater Assessment.

GHD (2024) Bloomfield Colliery Continuation Project: Surface Water Impact Assessment.

HydroAlgorithmics (2024) Bloomfield Colliery Continuation Project: Groundwater Peer Review.

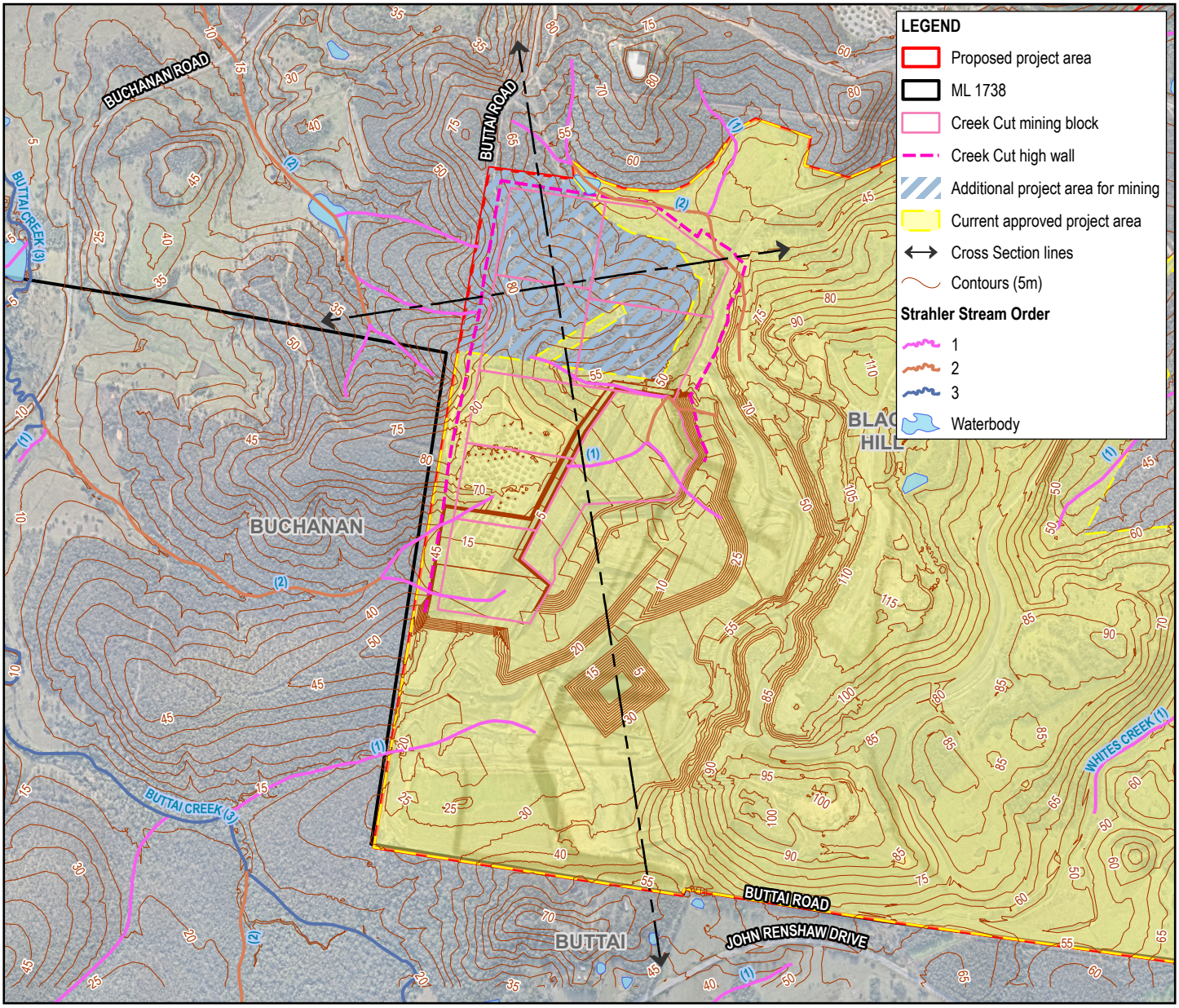
HydroSimulations (2017) Bloomfield Colliery Extension: Groundwater Modelling Assessment.

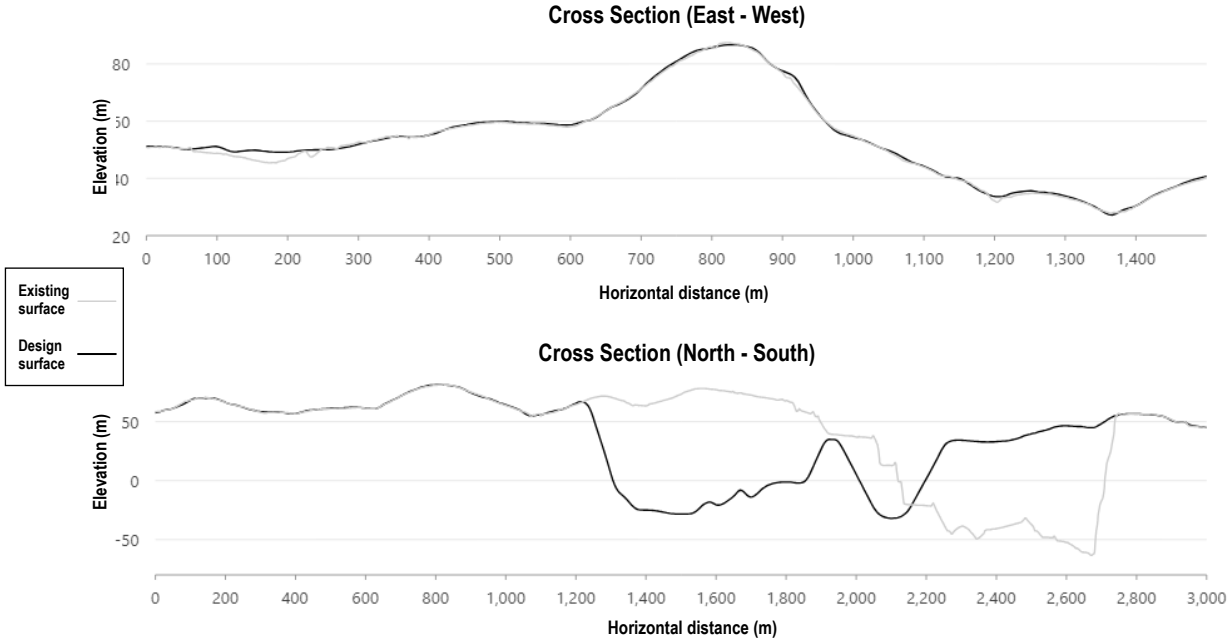
Water NSW (2022) *Real Time Data*, viewed online from https://realtimedata.waternsw.com.au/water.stm

# Appendices

# Appendix A

## Design contours: 2026 to 2035

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Grid: GDA 1994 MGA Zone 56

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GHD

**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Mine Continuation**
**Groundwater Impact Assessment**

**Creek Cut Area**
**topography and hydrology - 2026**

Project No. **12597478**
Revision No. **0**
Date **10/07/2024**

# FIGURE A.1

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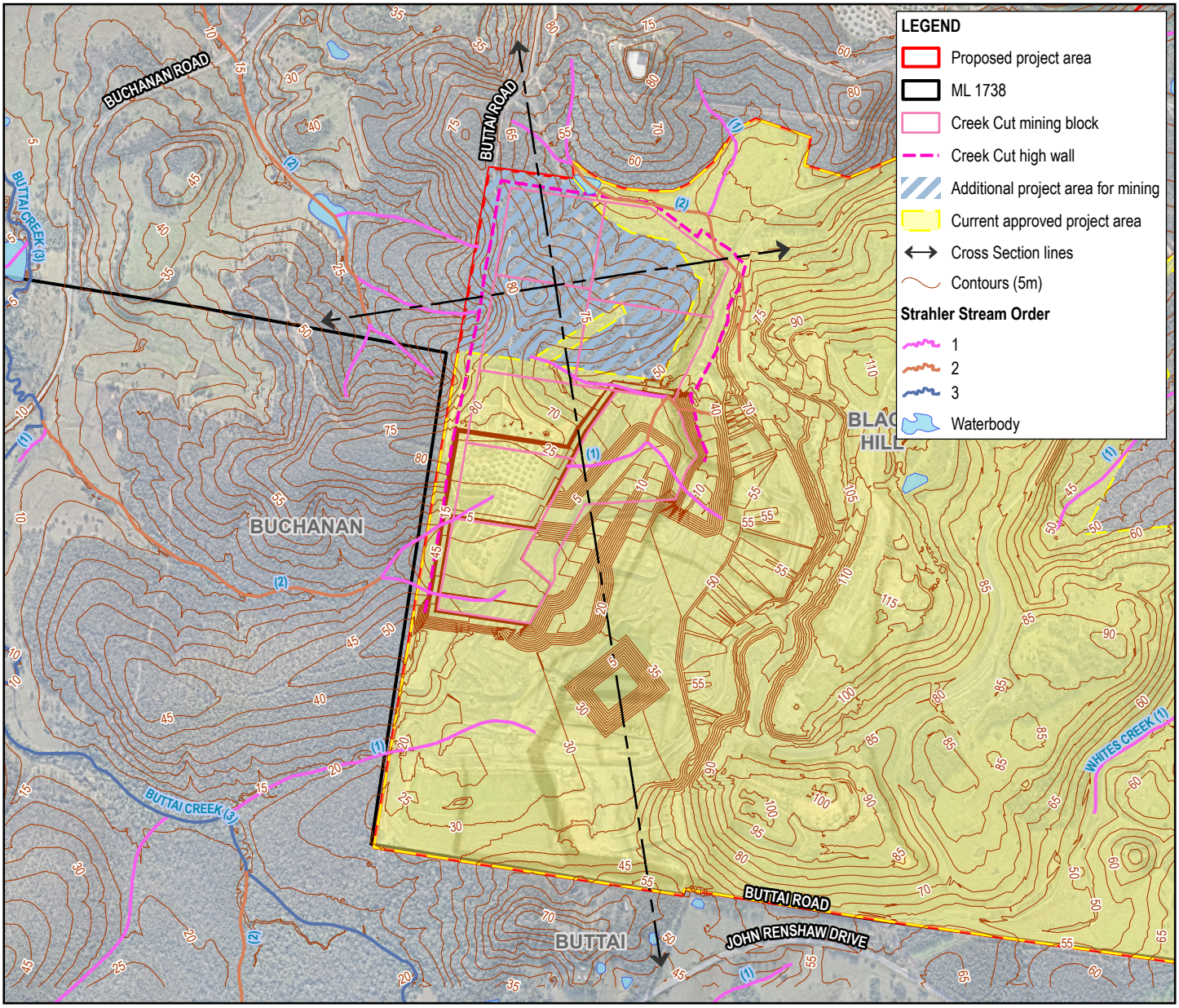


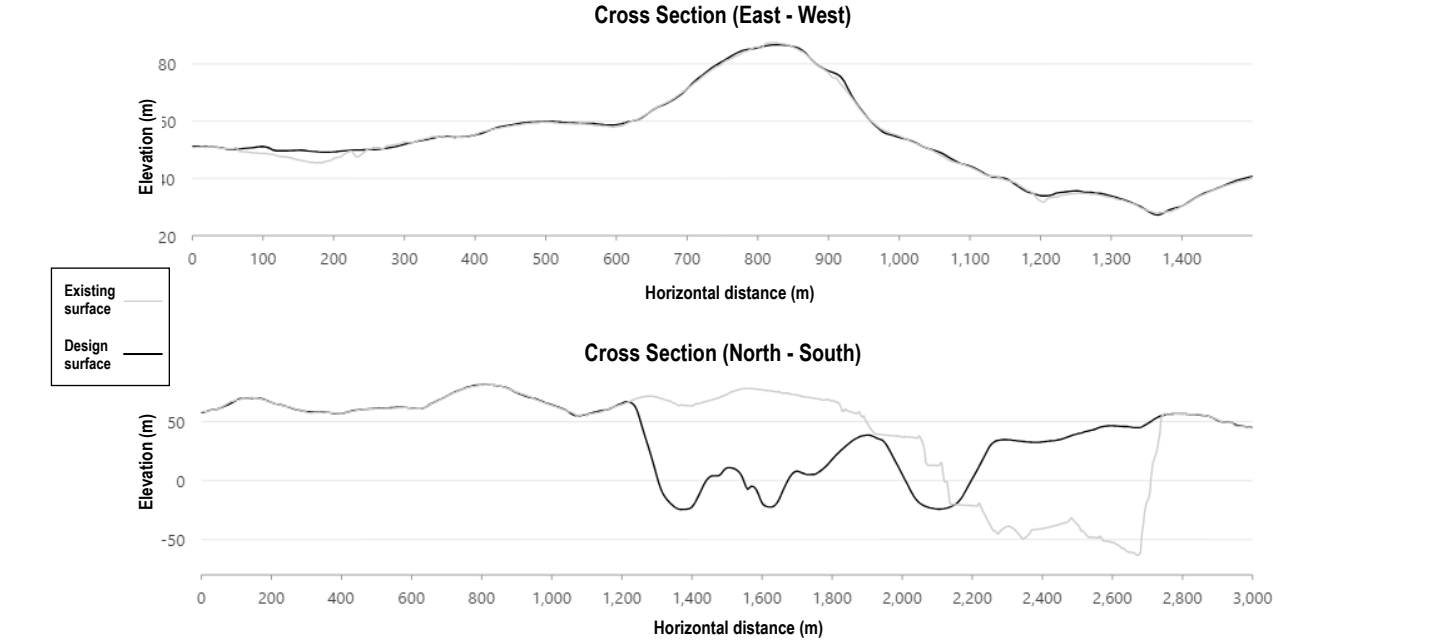


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Kilometres

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Grid: GDA 1994 MGA Zone 56

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GHD

**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Mine Continuation**
**Groundwater Impact Assessment**

**Creek Cut Area**
**topography and hydrology - 2027**

Project No. **12597478**
Revision No. **0**
Date **10/07/2024**

# FIGURE A.2

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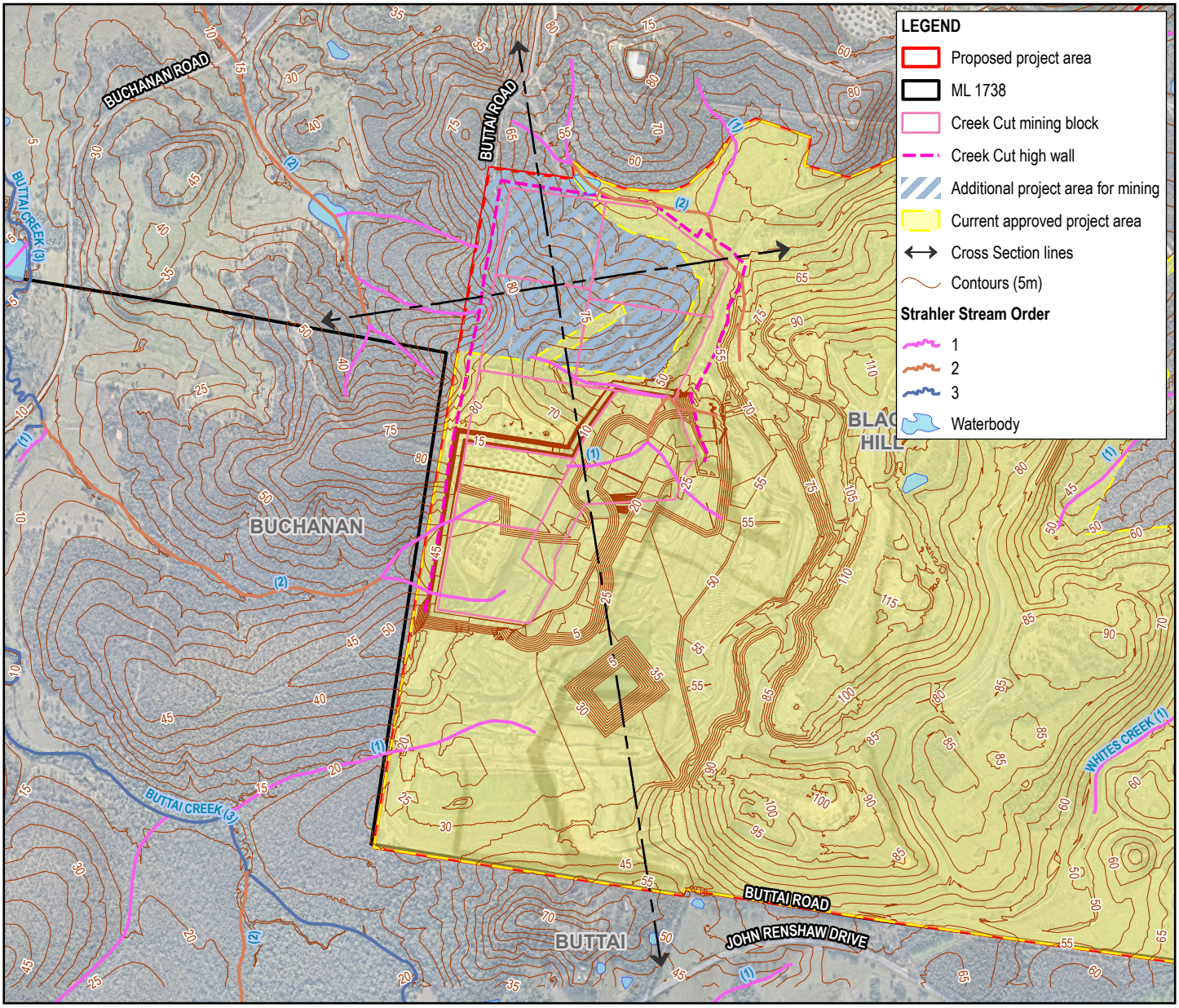


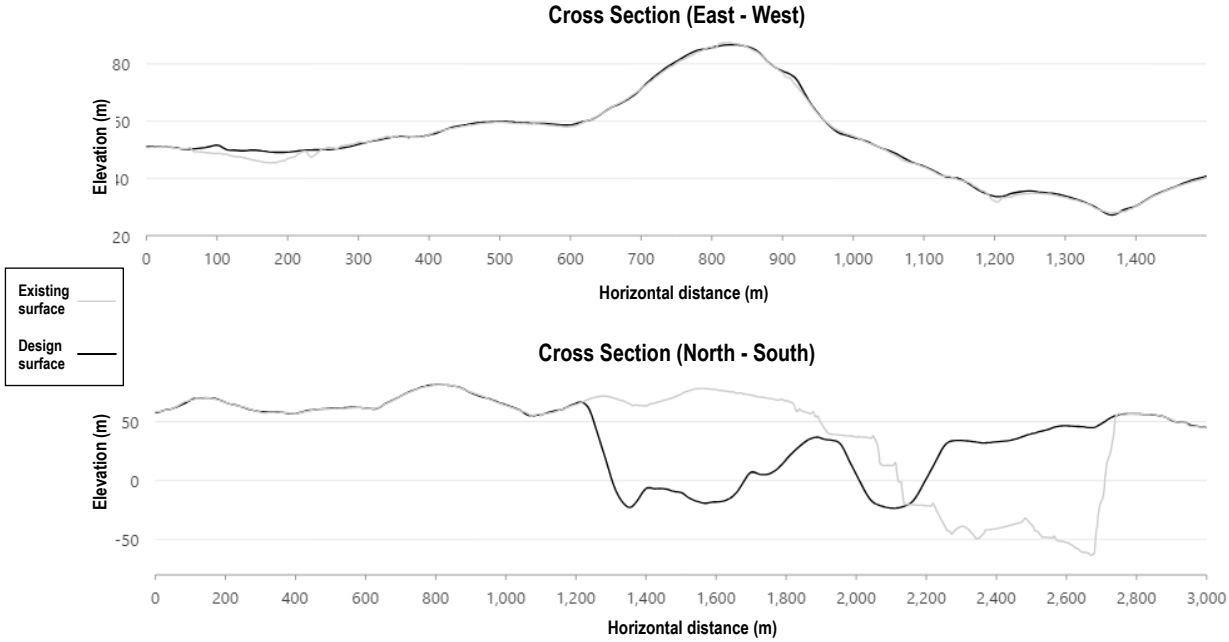


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GHD

**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Mine Continuation**
**Groundwater Impact Assessment**

**Creek Cut Area**
**topography and hydrology - 2028**

Project No. **12597478**
Revision No. **0**
Date **10/07/2024**

# FIGURE A.3

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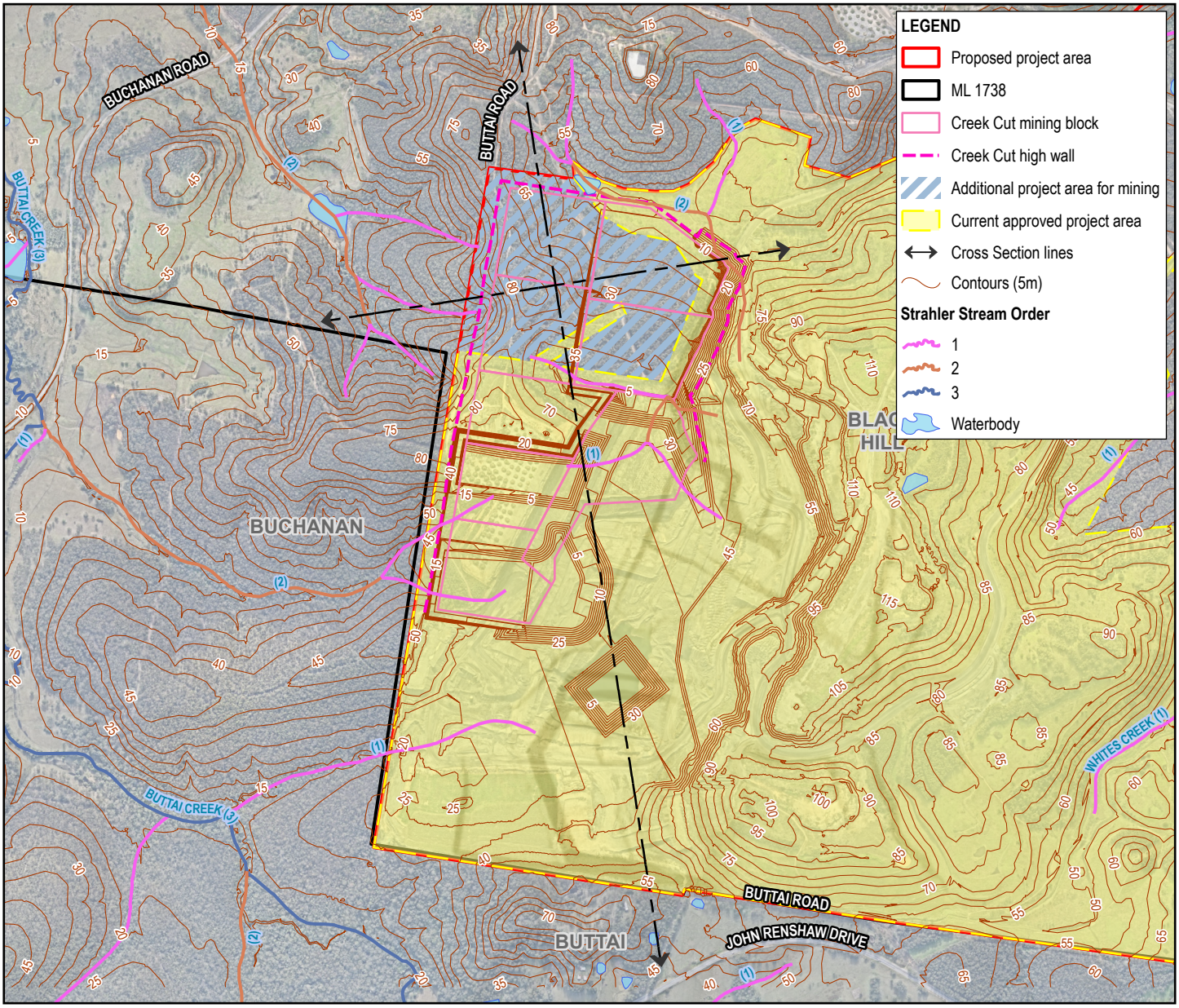


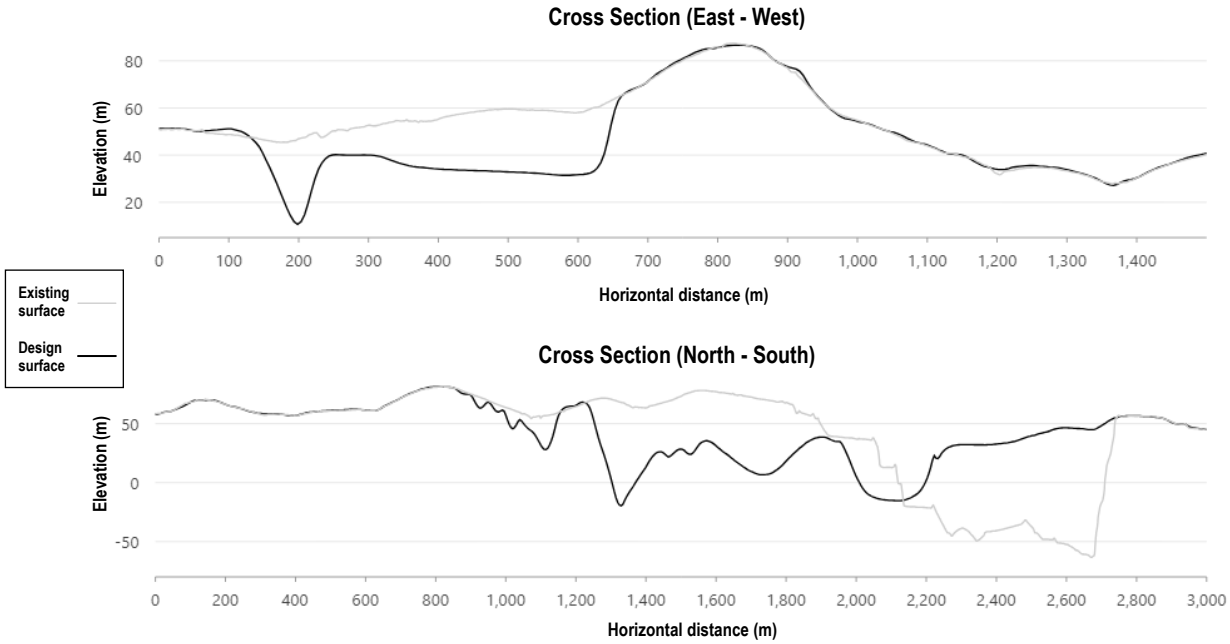


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GHD

**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Mine Continuation**
**Groundwater Impact Assessment**

## Creek Cut Area topography and hydrology - 2029

Project No. **12597478**
Revision No. **0**
Date **10/07/2024**

# FIGURE A.4

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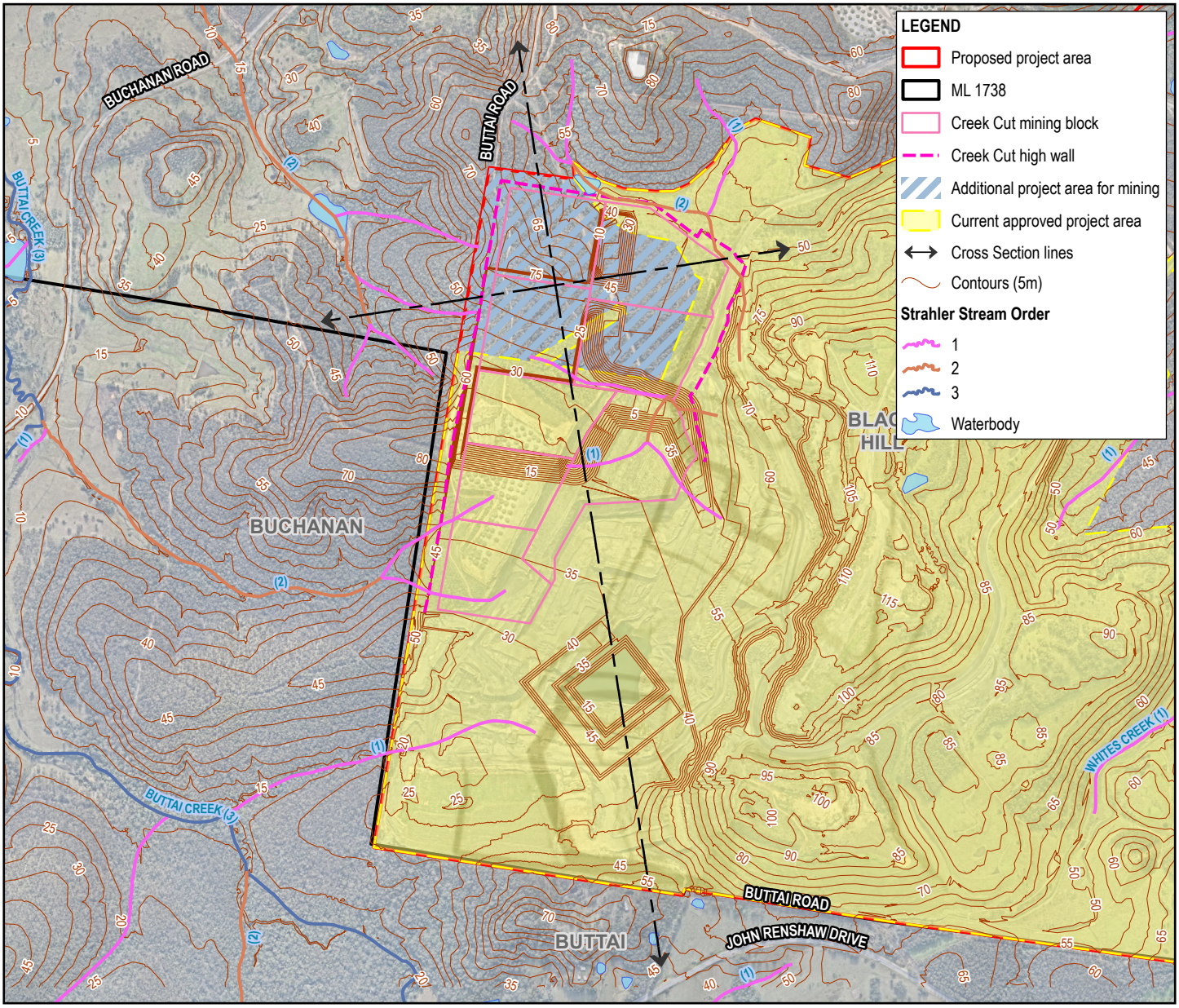


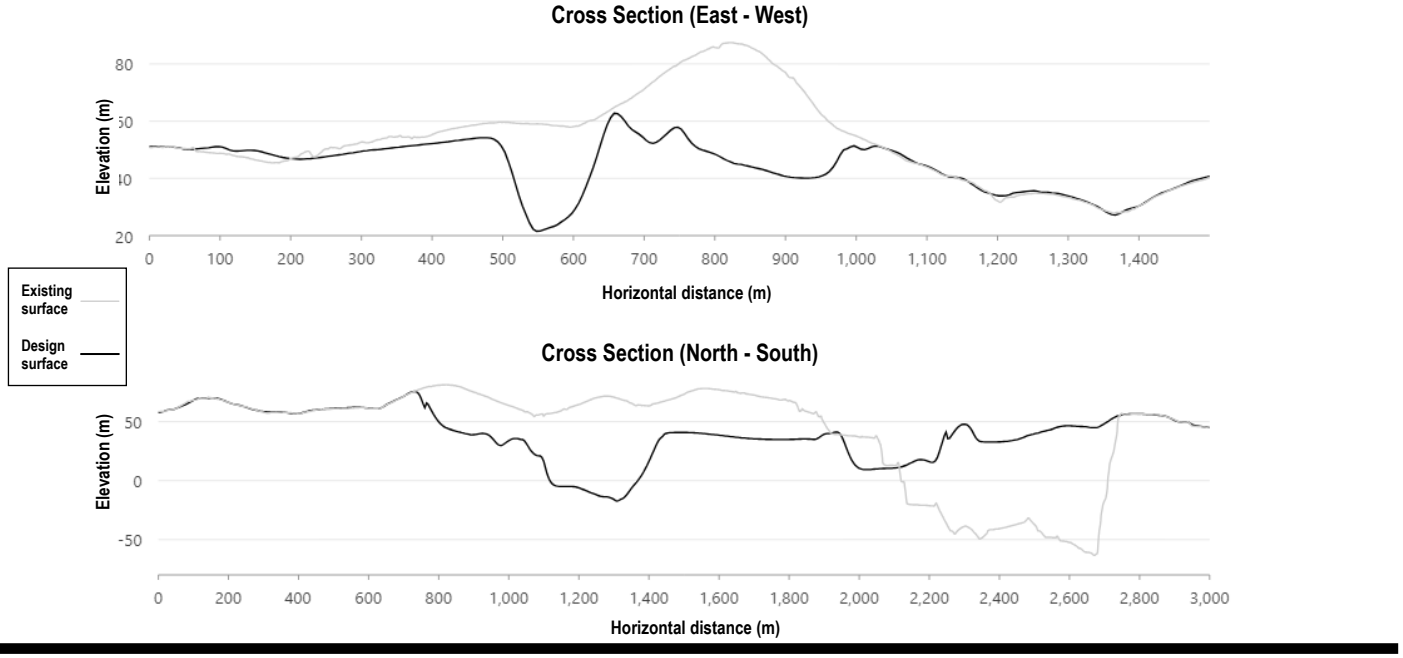


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GHD

**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Mine Continuation**
**Groundwater Impact Assessment**

**Creek Cut Area**
**topography and hydrology - 2032**

Project No. **12597478**
Revision No. **0**
Date **10/07/2024**

# FIGURE A.5

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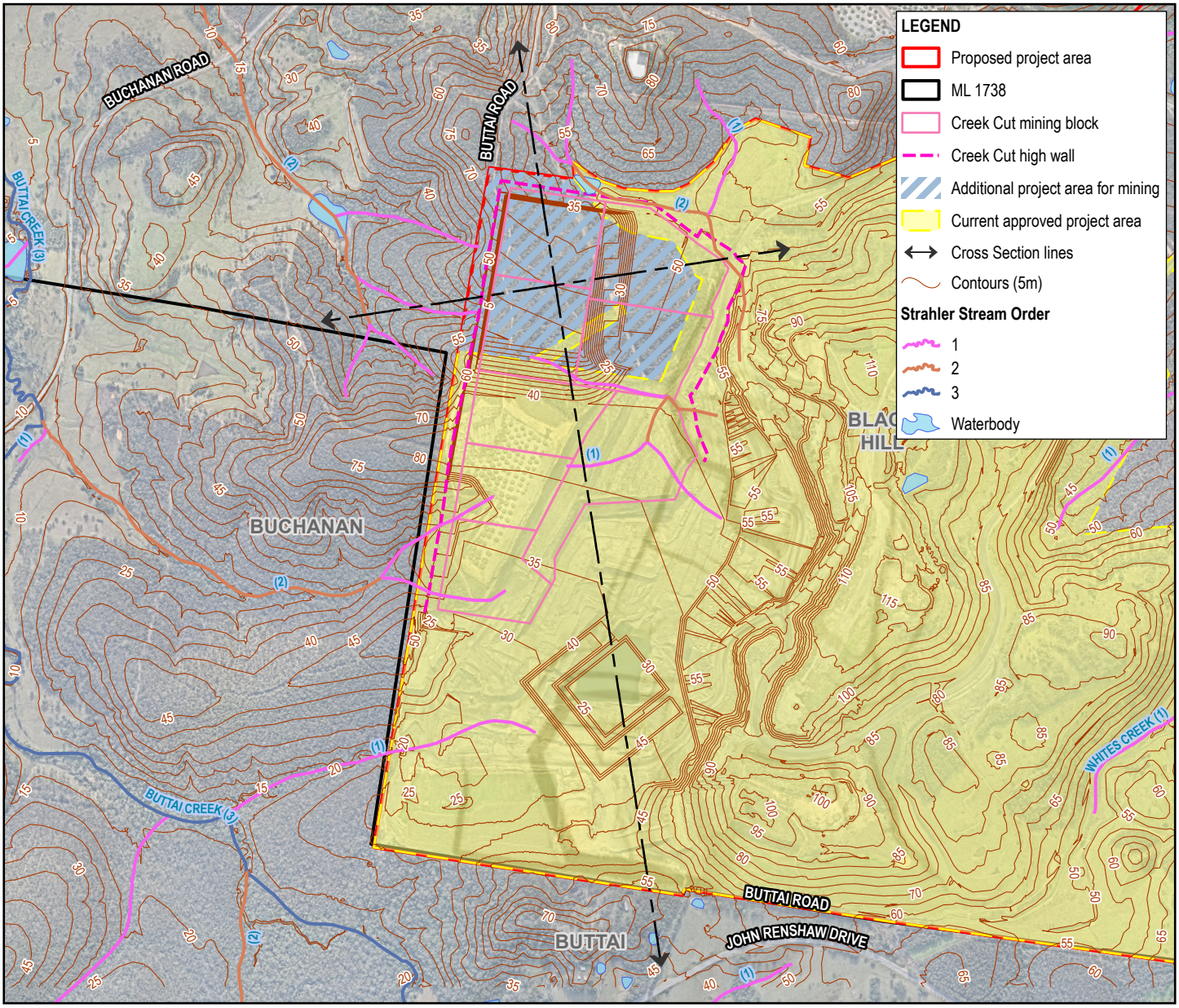


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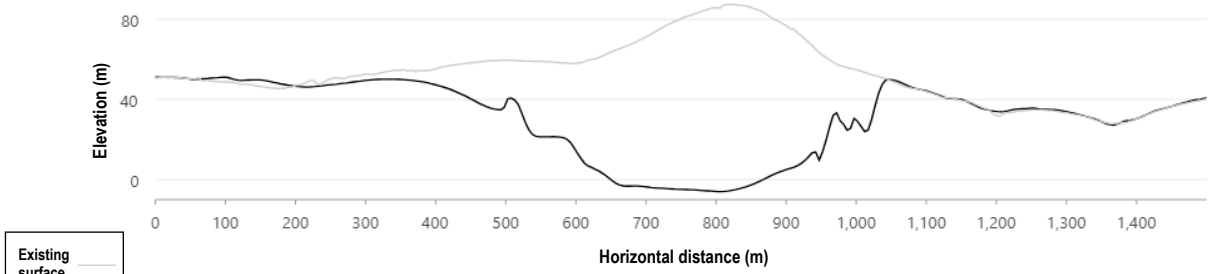


Existing surface

Design surface

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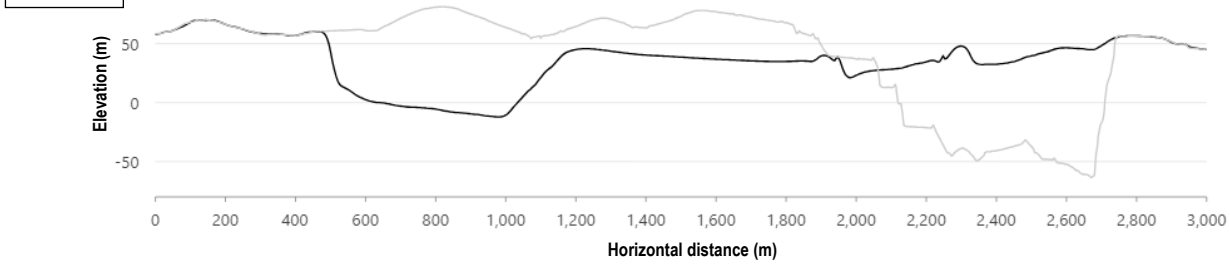


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GHD

**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Mine Continuation**
**Groundwater Impact Assessment**

**Creek Cut Area**
**topography and hydrology - 2035**

Project No. **12597478**
Revision No. **0**
Date **10/07/2024**

# FIGURE A.6

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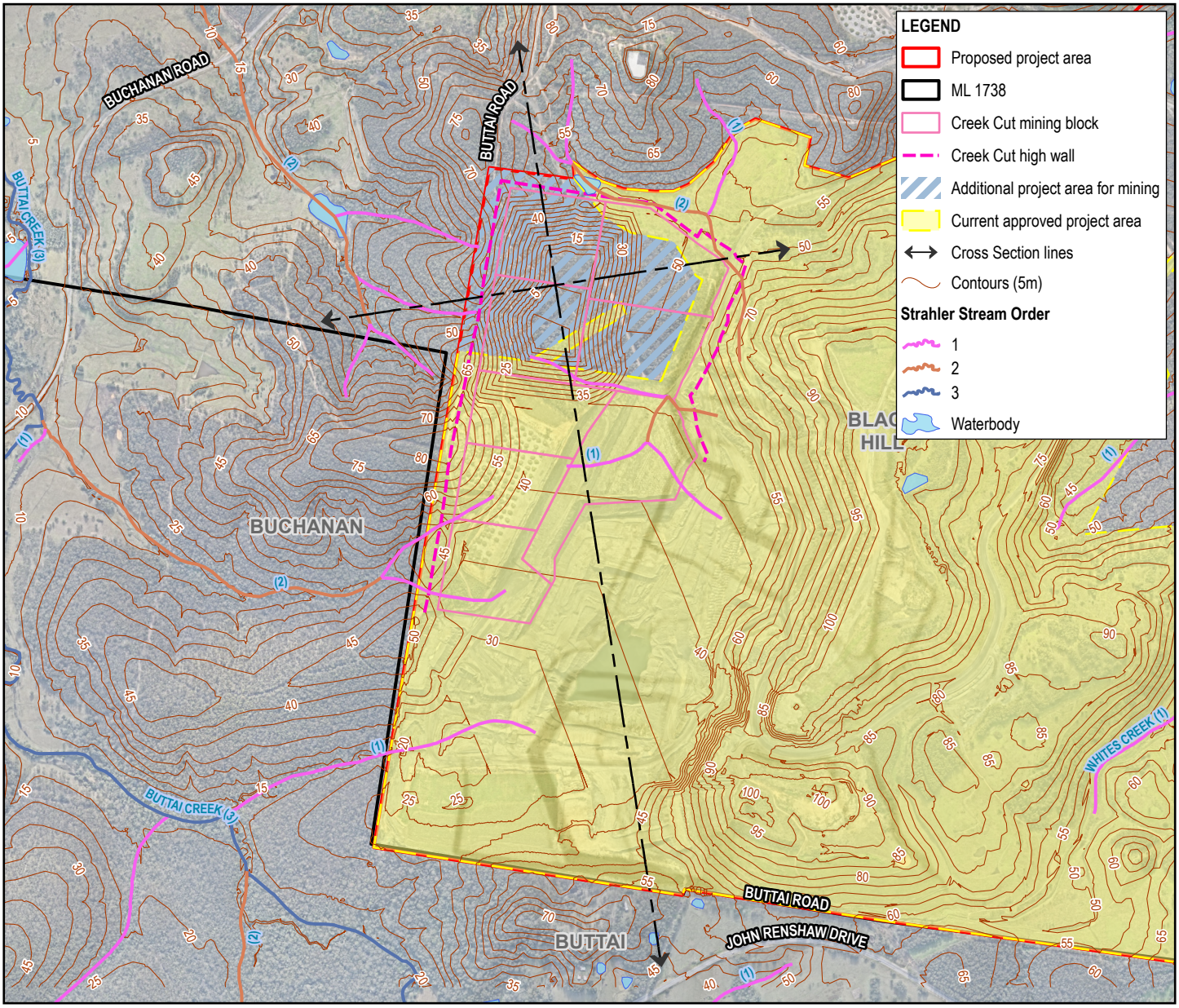


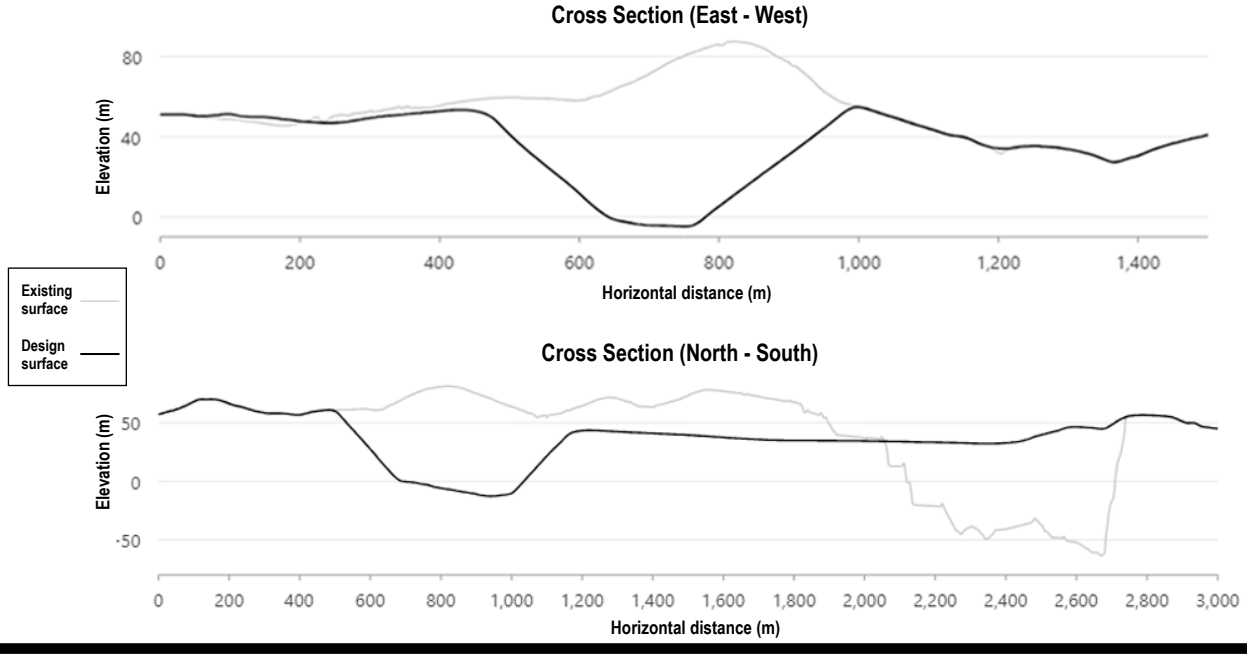


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**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Mine Continuation**
**Groundwater Impact Assessment**

**Creek Cut Area**
**topography and hydrology - Final**

Project No. **12597478**
Revision No. **0**
Date **10/07/2024**

# FIGURE A.7

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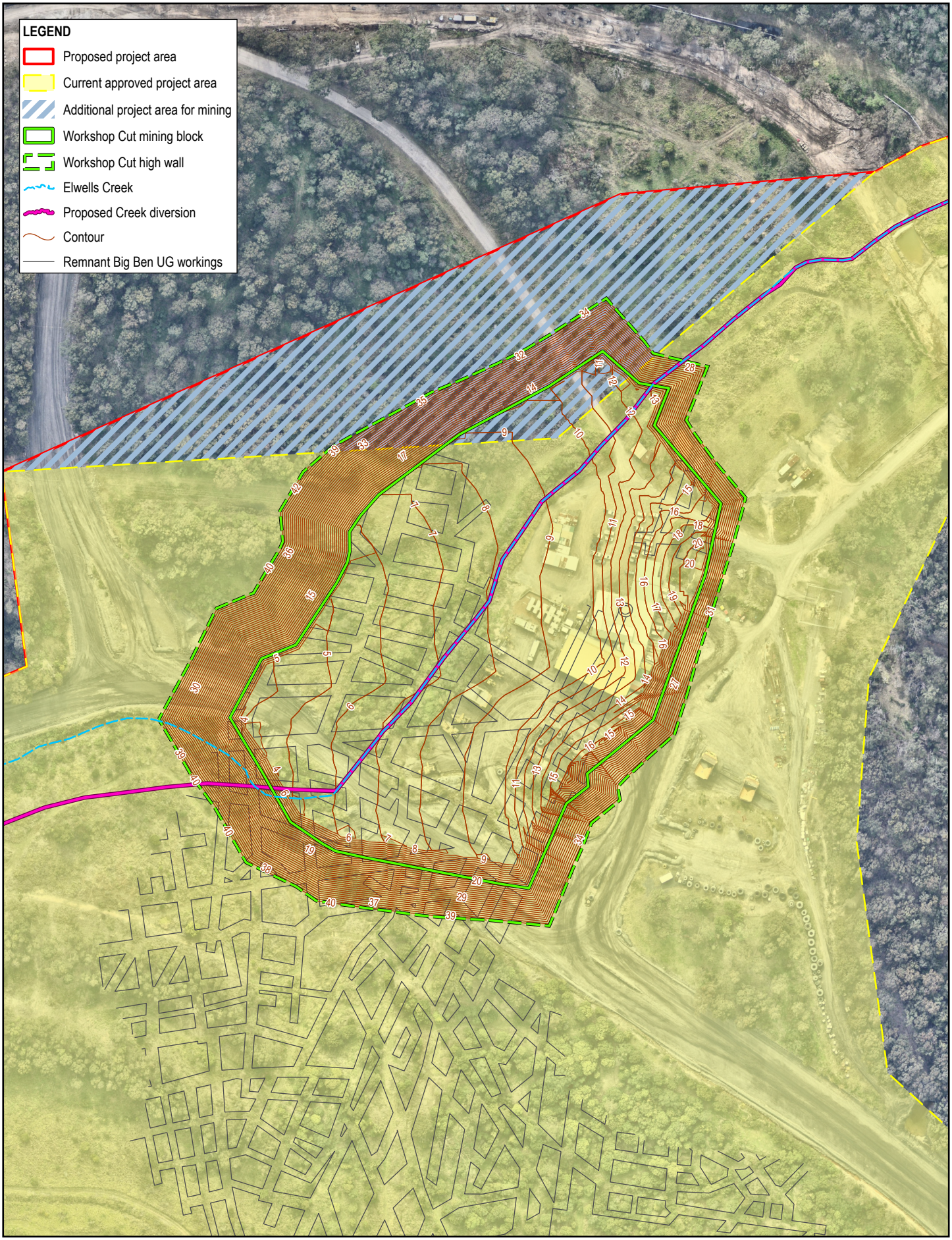


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**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Mine Continuation**
**Groundwater Impact Assessment**

## Workshop Cut Area topography and hydrology - Base

Project No. **12597478**
Revision No. **0**
Date **03/07/2024**

# FIGURE A.8

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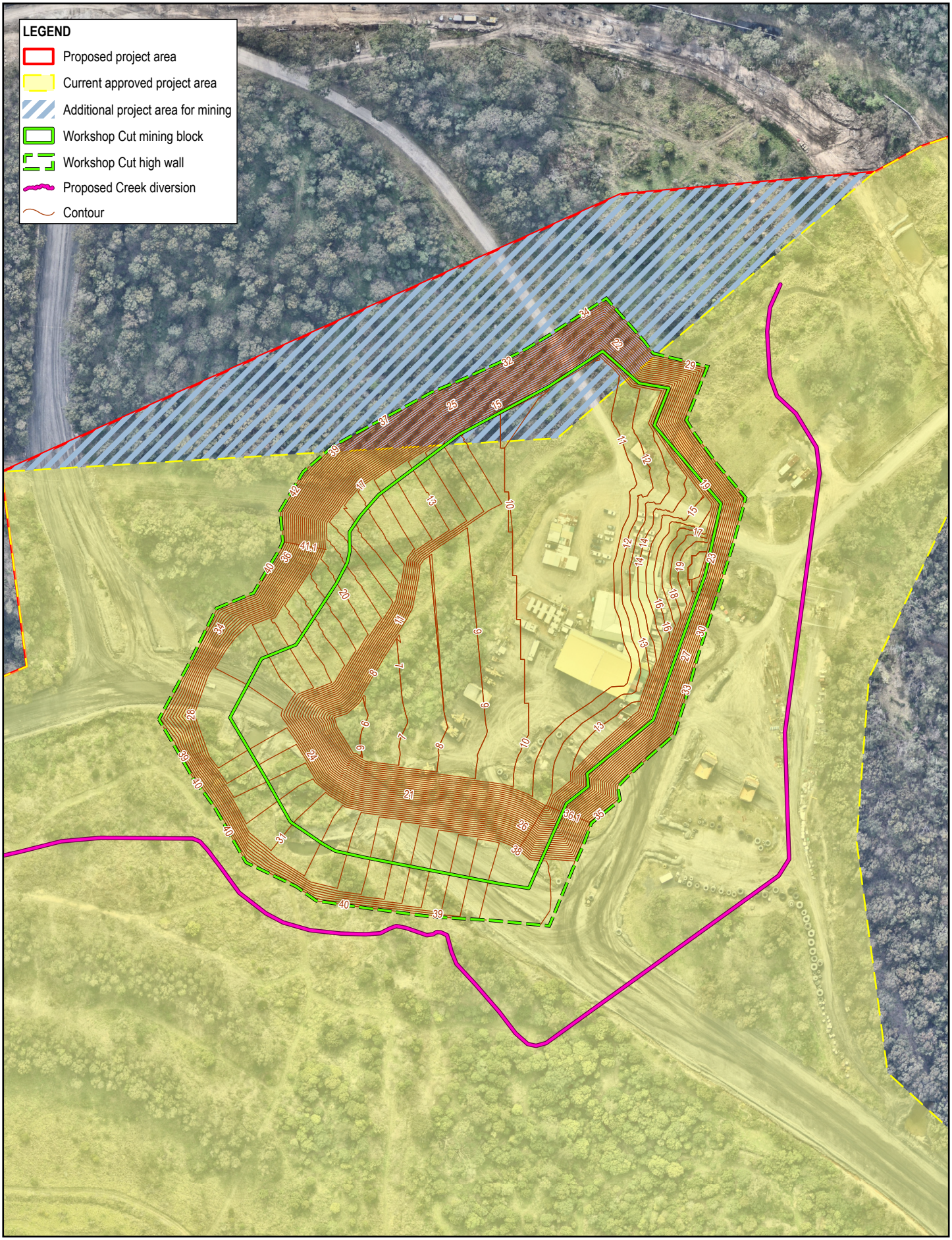


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GHD

**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Mine Continuation**
**Groundwater Impact Assessment**

## Workshop Cut Area
## topography and hydrology - Stage 1

Project No. **12597478**
Revision No. **0**
Date **03/07/2024**

# FIGURE A.9

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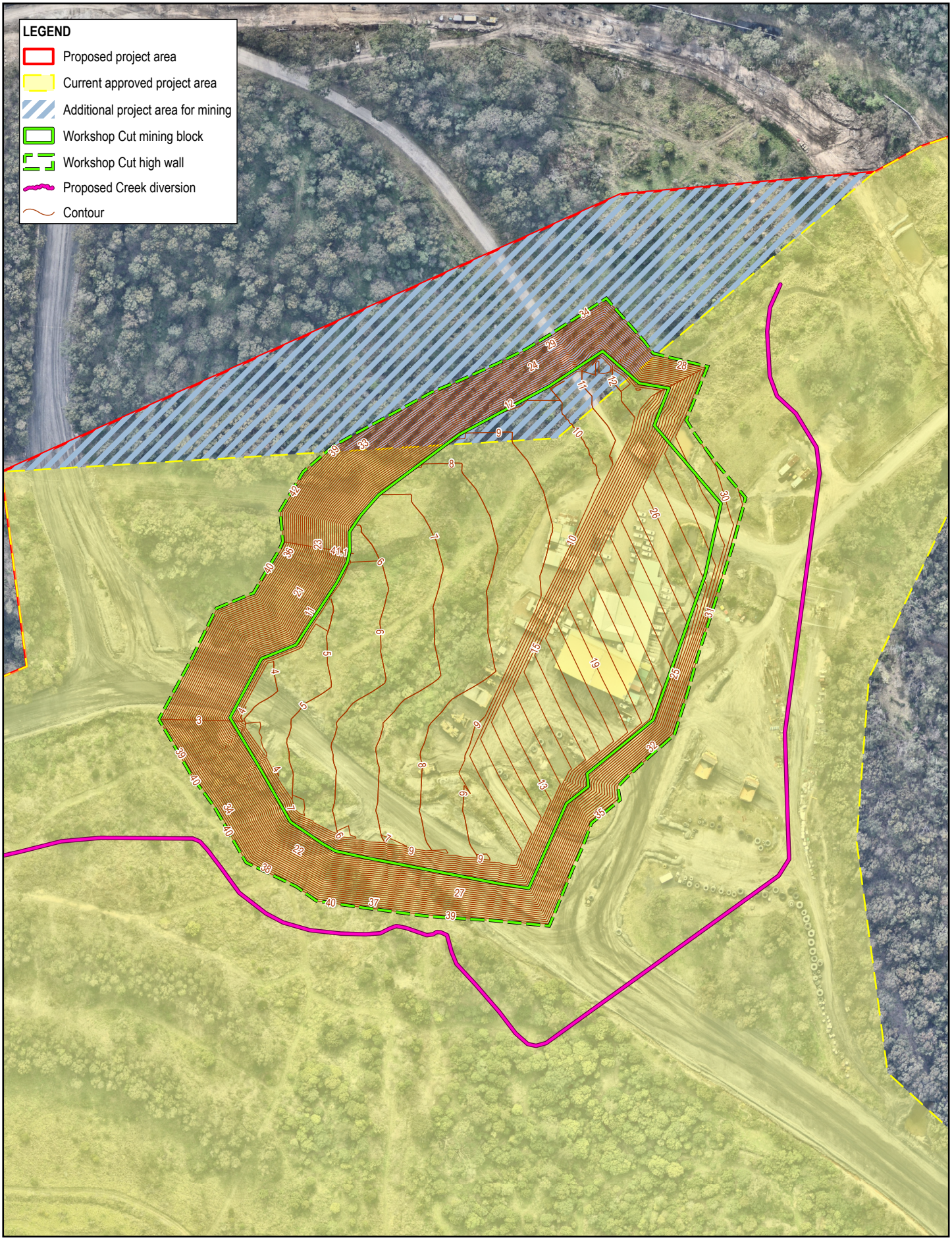


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N

GHD

**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Mine Continuation**
**Groundwater Impact Assessment**

## Workshop Cut Area
## topography and hydrology - Stage 2

Project No. **12597478**
Revision No. **0**
Date **03/07/2024**

# FIGURE A.10

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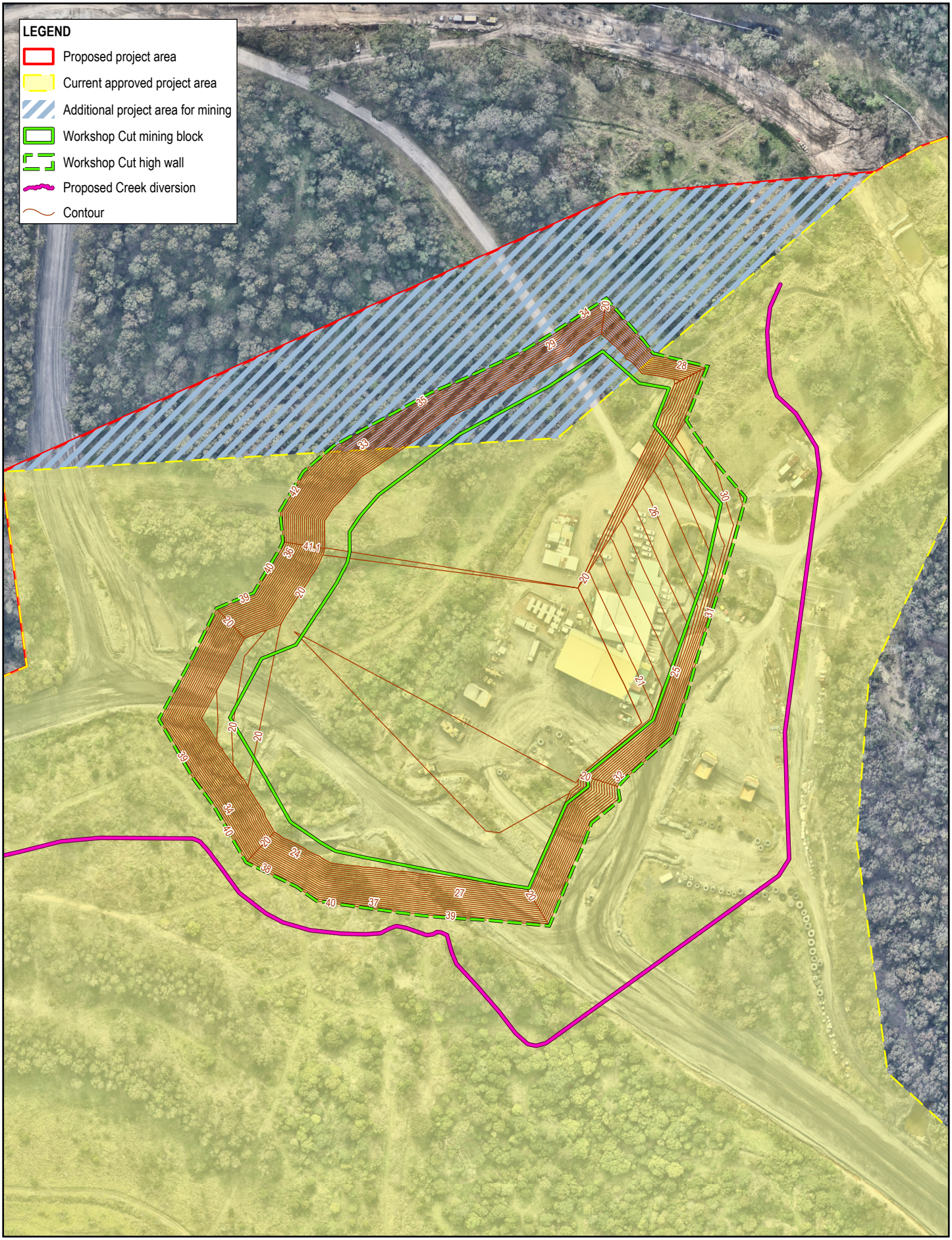


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GHD

**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Mine Continuation**
**Groundwater Impact Assessment**

## Workshop Cut Area topography and hydrology - Stage 3

Project No. **12597478**
Revision No. **0**
Date **03/07/2024**

# FIGURE A.11

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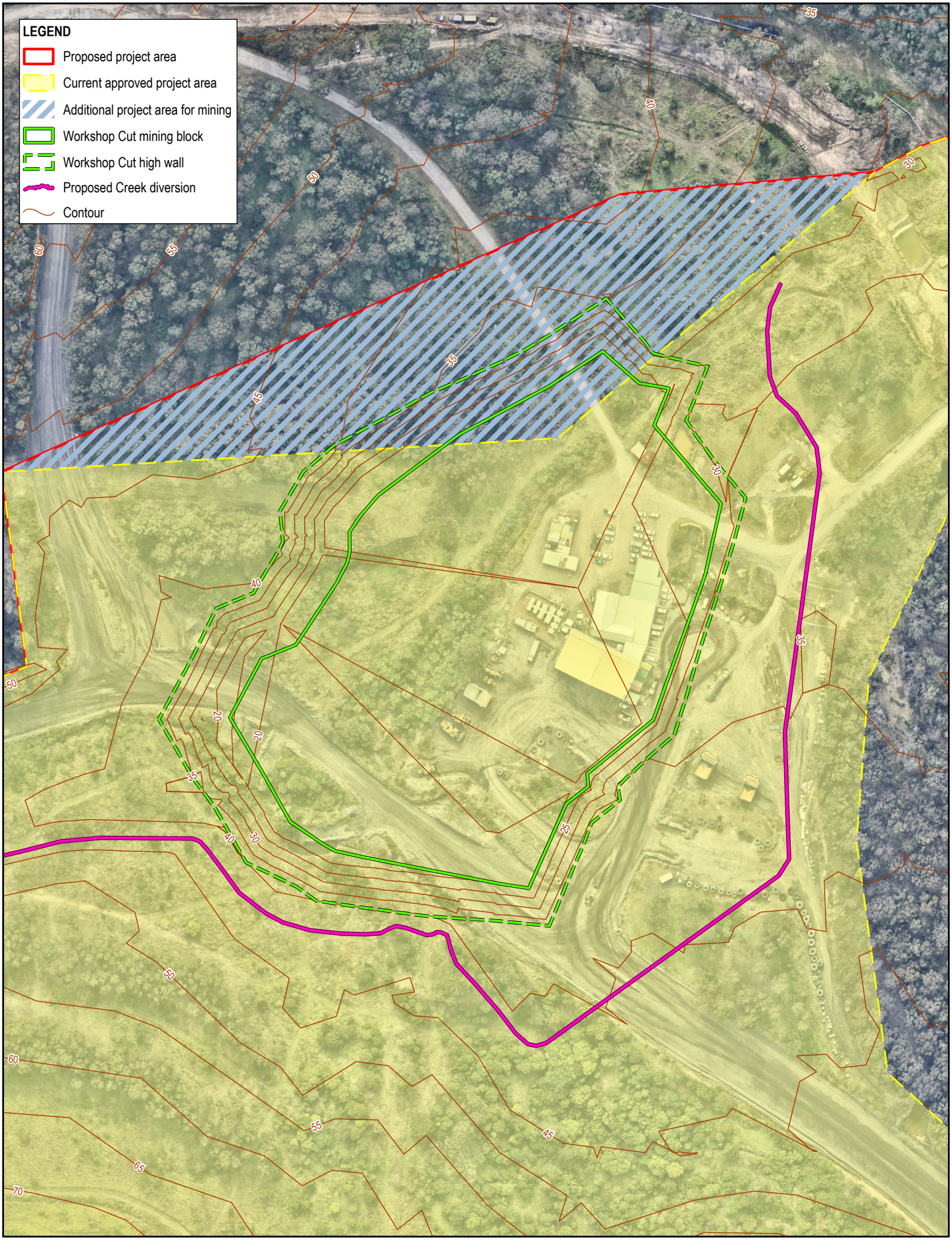


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GHD

**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Mine Continuation**
**Groundwater Impact Assessment**

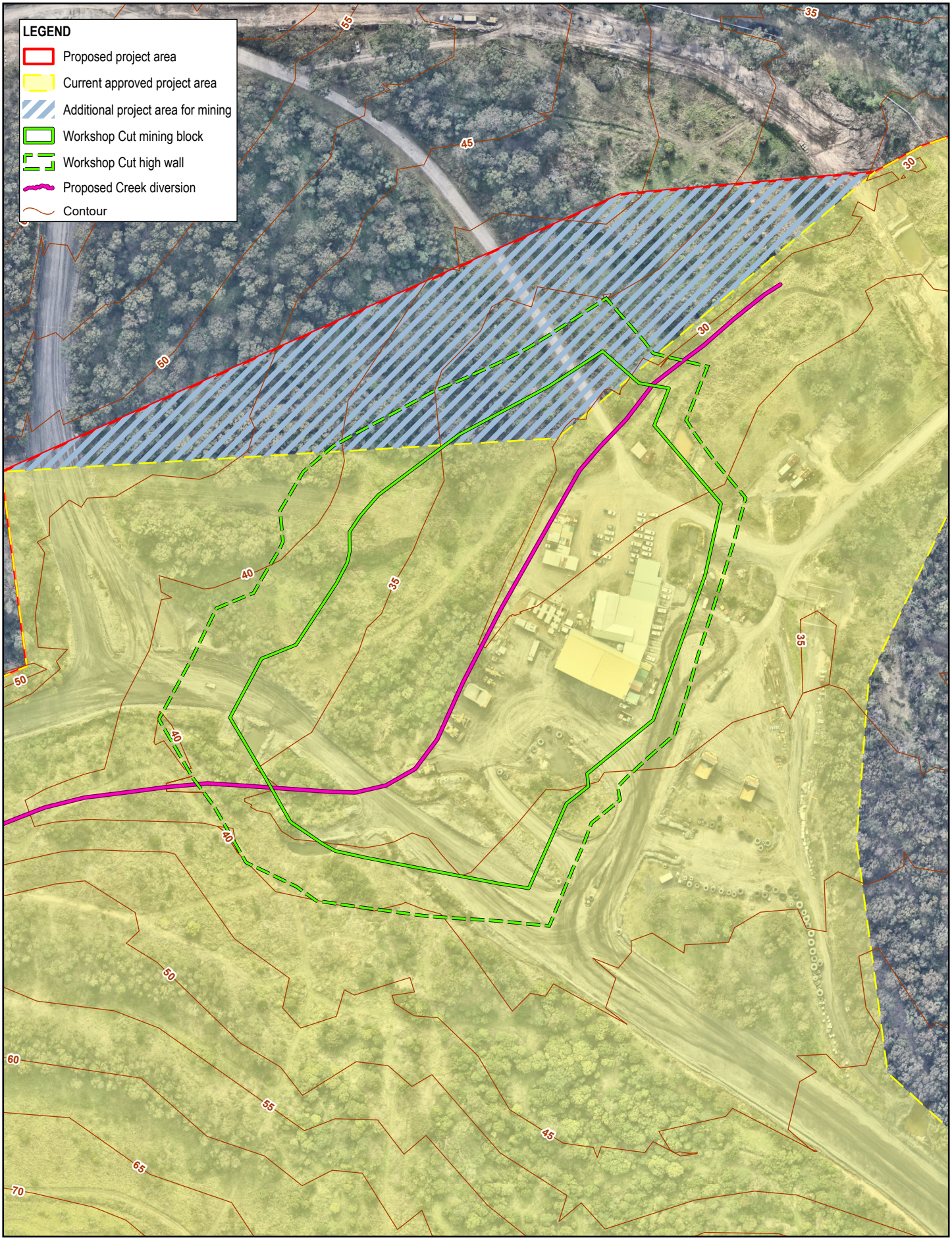
## Workshop Cut Area topography and hydrology - 2035

Project No. **12597478**
Revision No. **0**
Date **03/07/2024**

# FIGURE A.12

N:\AU\Newcastle\Projects\22\12597478\GIS\Maps\Deliverables\12597478_SWIA.aprx
Print date: 03 Jul 2024 - 13:35

Data source: LPI: DCDB, 2019. Bloomfield Colliery: Project area/Mine lease/Creek cut/Workshop/Mine workings data, 2023/2024. Nearmap WMS Server: World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community – Imagery (Date extracted: 03/07/2024).




Paper Size ISO A4

0 20 40 60 80 100

Metres

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

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GHD

**Bloomfield Collieries Pty Limited**
**Bloomfield Colliery Mine Continuation**
**Groundwater Impact Assessment**

## Workshop Cut Area topography and hydrology - Final

Project No. **12597478**
Revision No. **0**
Date **03/07/2024**

# FIGURE A.13

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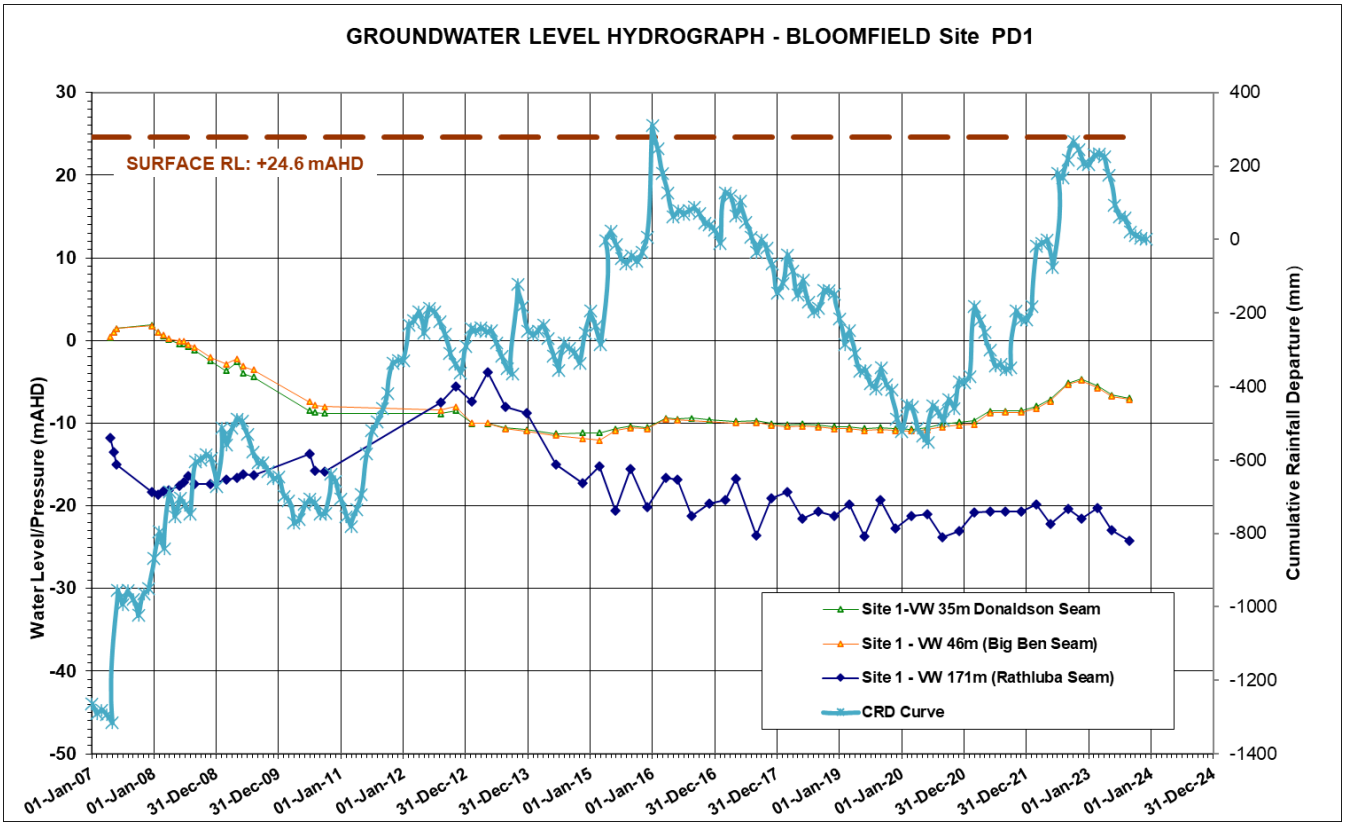
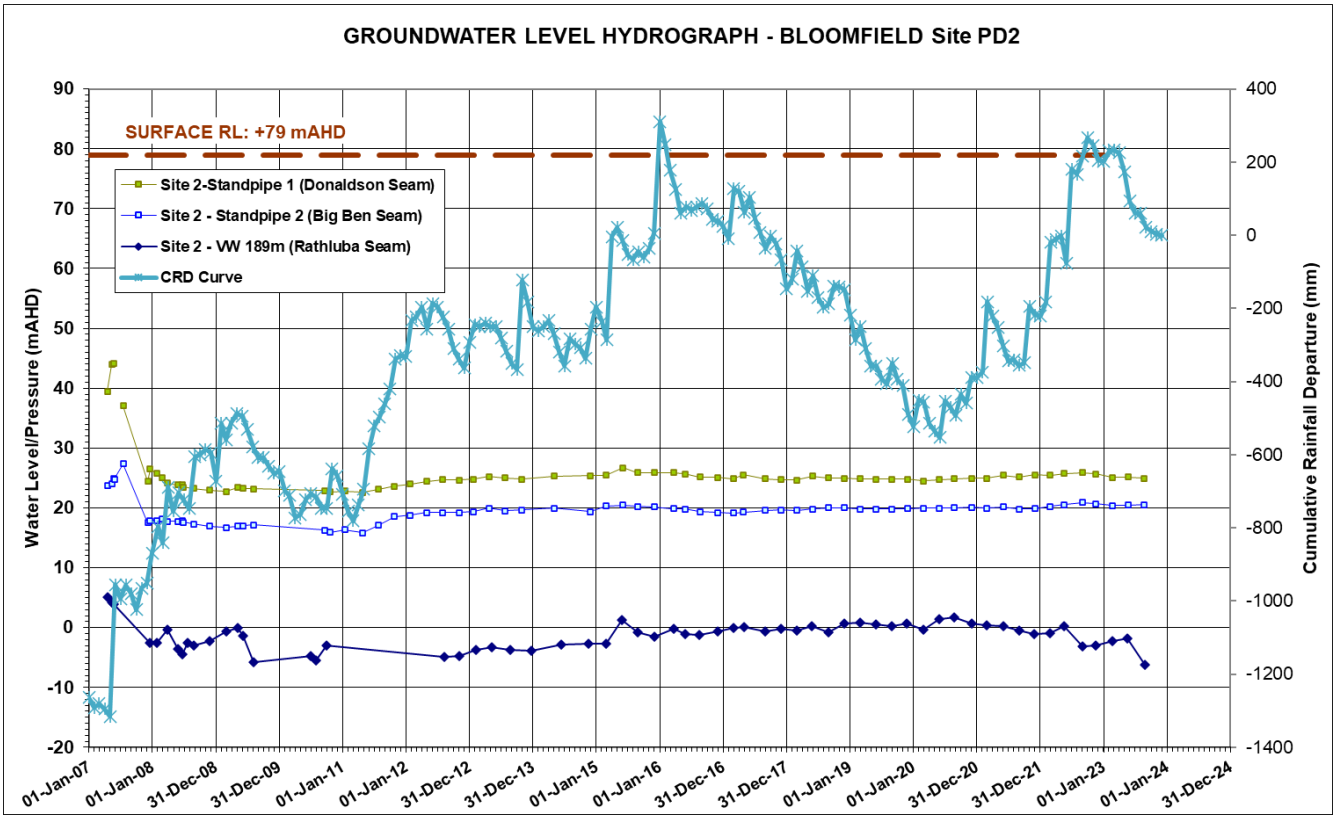
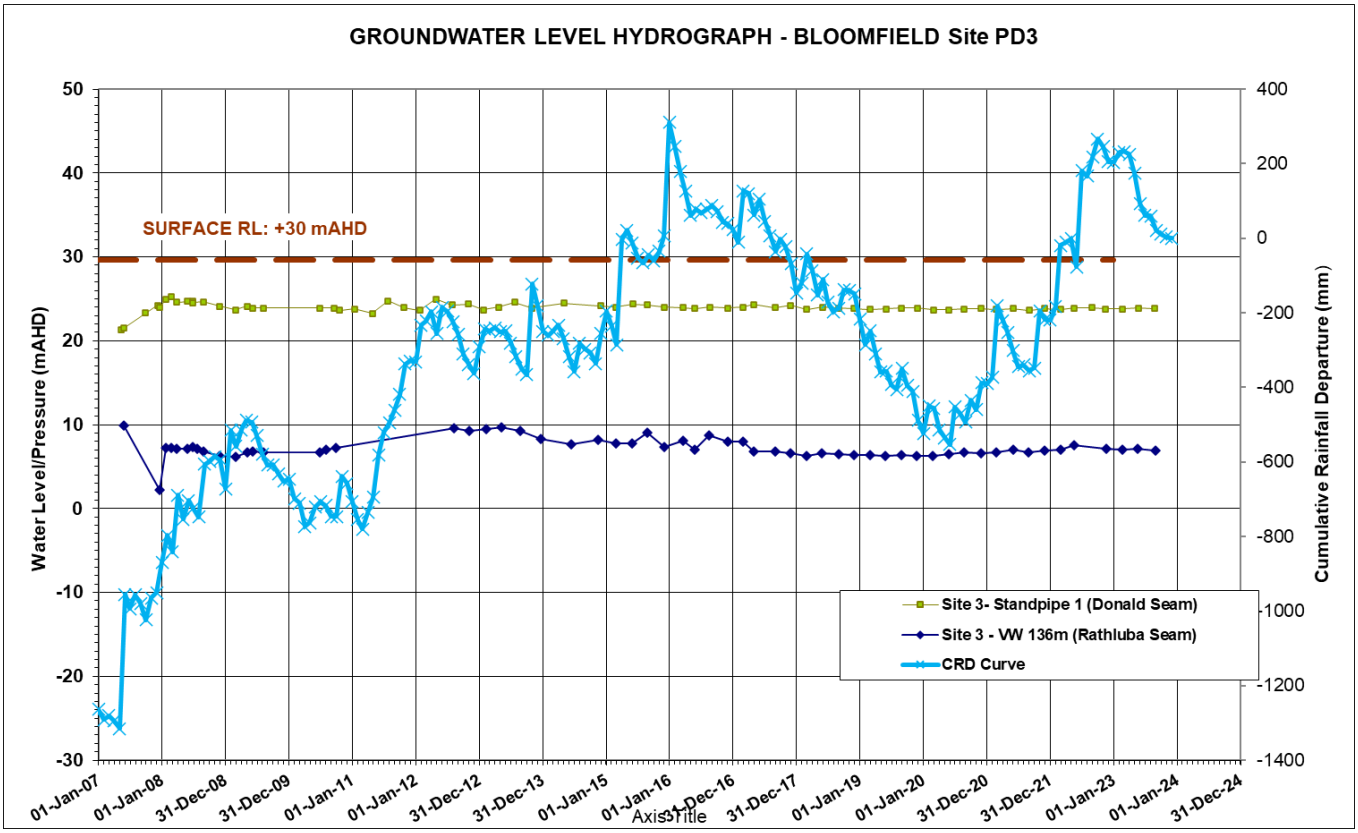
Data source: LPI: DCDB, 2019. Bloomfield Colliery: Project area/Mine lease/Creek cut/Workshop/Mine workings data, 2023/2024. Nearmap WMS Server: World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community – Imagery (Date extracted: 03/07/2024).

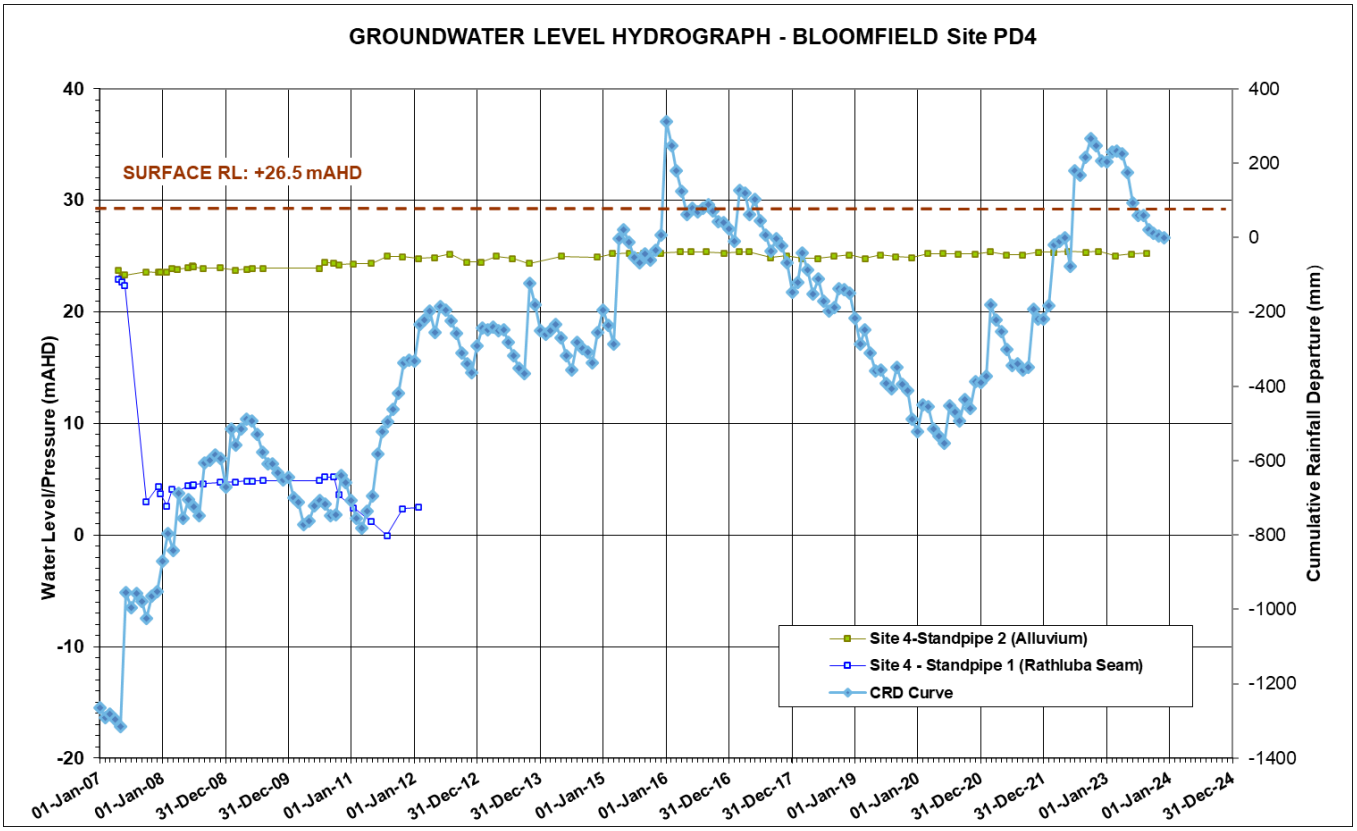
# Appendix B

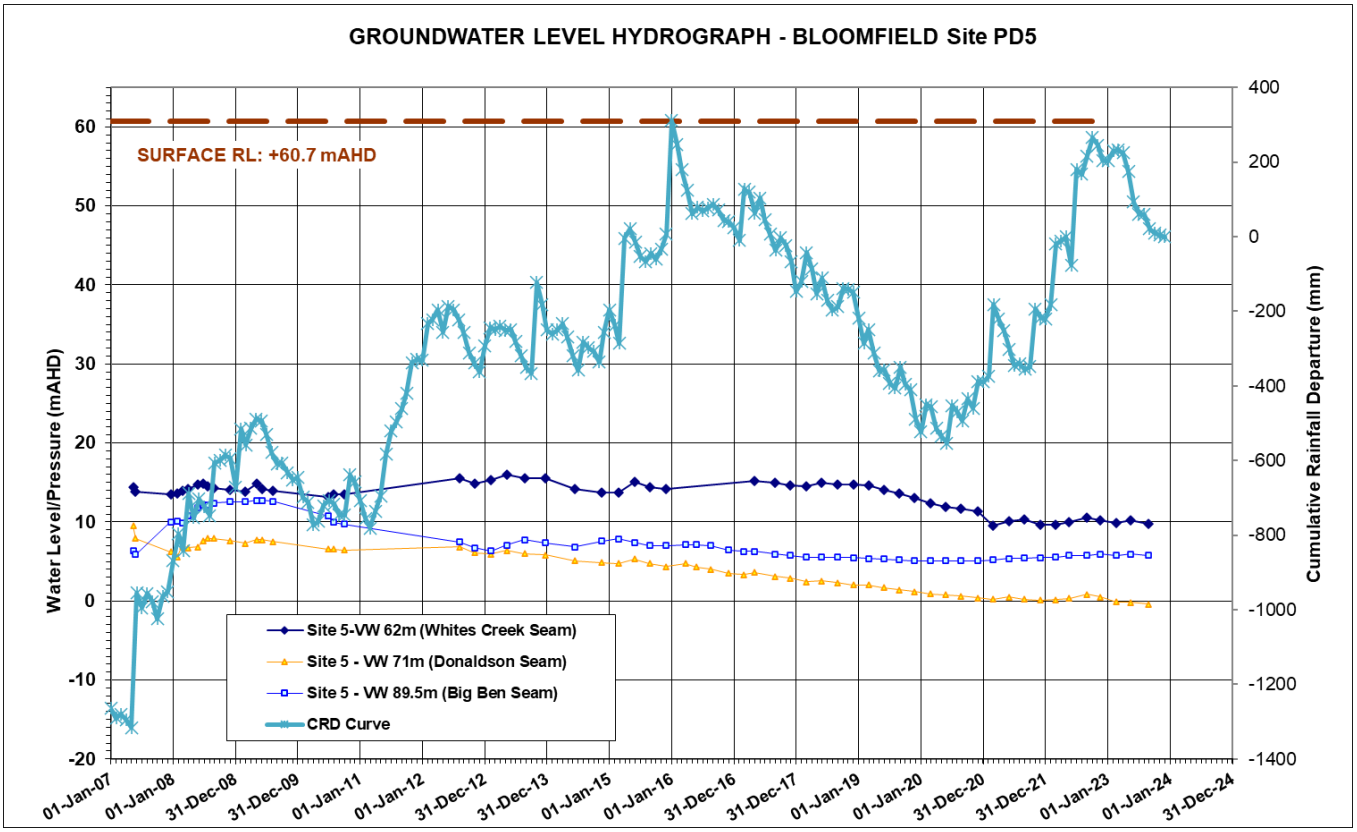
## Groundwater levels

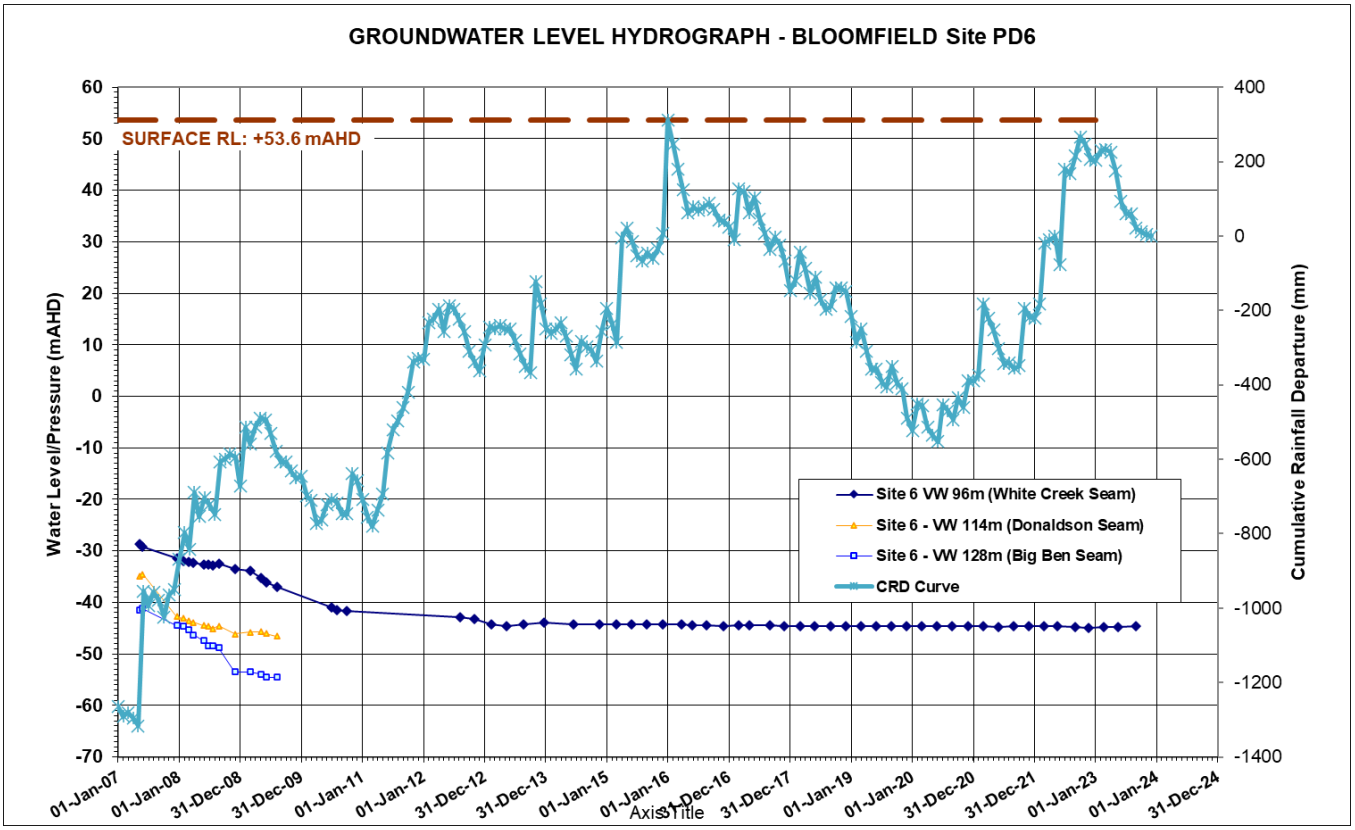

GROUNDWATER LEVEL HYDROGRAPH - BLOOMFIELD Site PD1
SURFACE RL: +24.6 mAHD
Water Level/Pressure (mAHD)
Cumulative Rainfall Departure (mm)
Site 1-VW 35m Donaldson Seam
Site 1 - VW 46m (Big Ben Seam)
Site 1 - VW 171m (Rathluba Seam)
CRD Curve

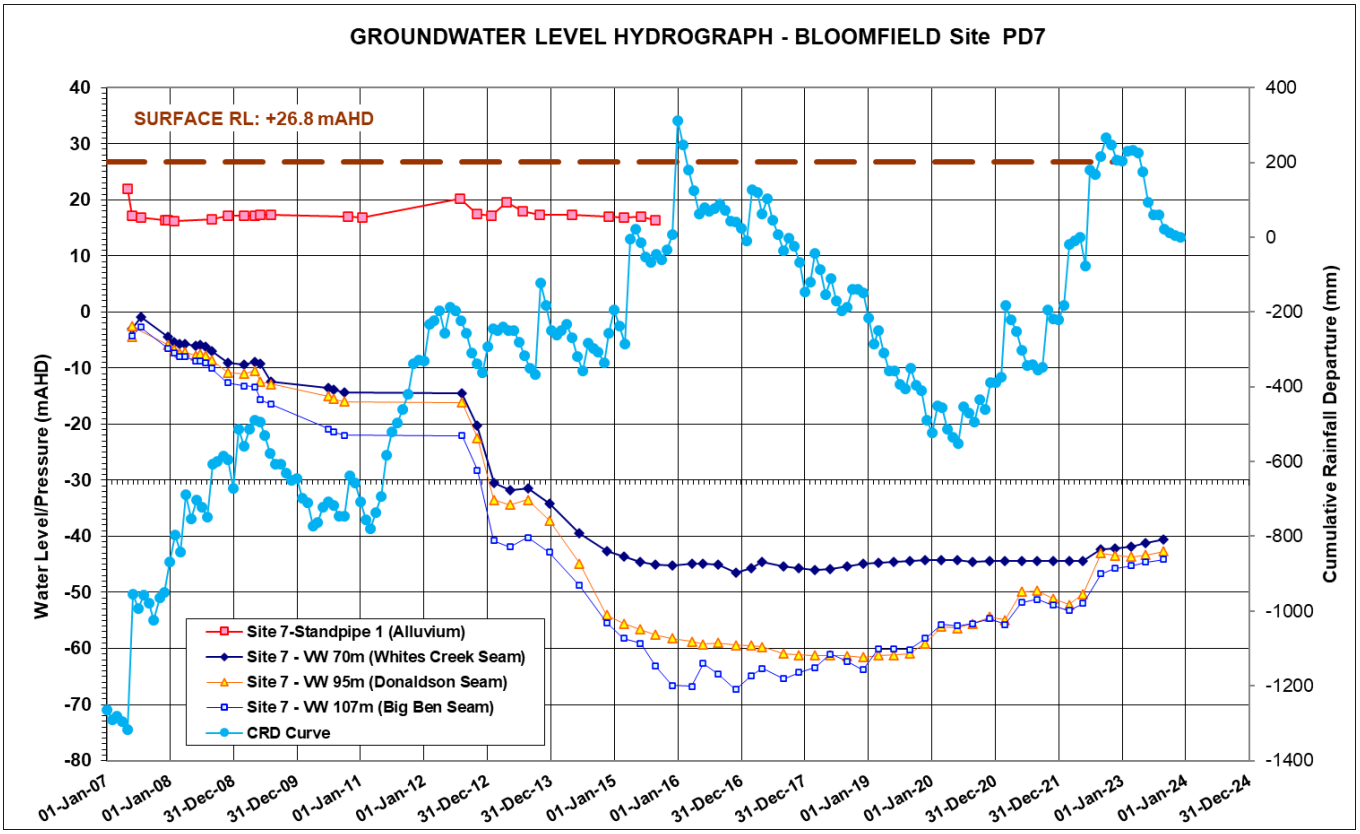

GROUNDWATER LEVEL HYDROGRAPH - BLOOMFIELD Site PD2
SURFACE RL: +79 mAHD
Water Level/Pressure (mAHD)
Cumulative Rainfall Departure (mm)
Site 2-Standpipe 1 (Donaldson Seam)
Site 2 - Standpipe 2 (Big Ben Seam)
Site 2 - VW 189m (Rathluba Seam)
CRD Curve

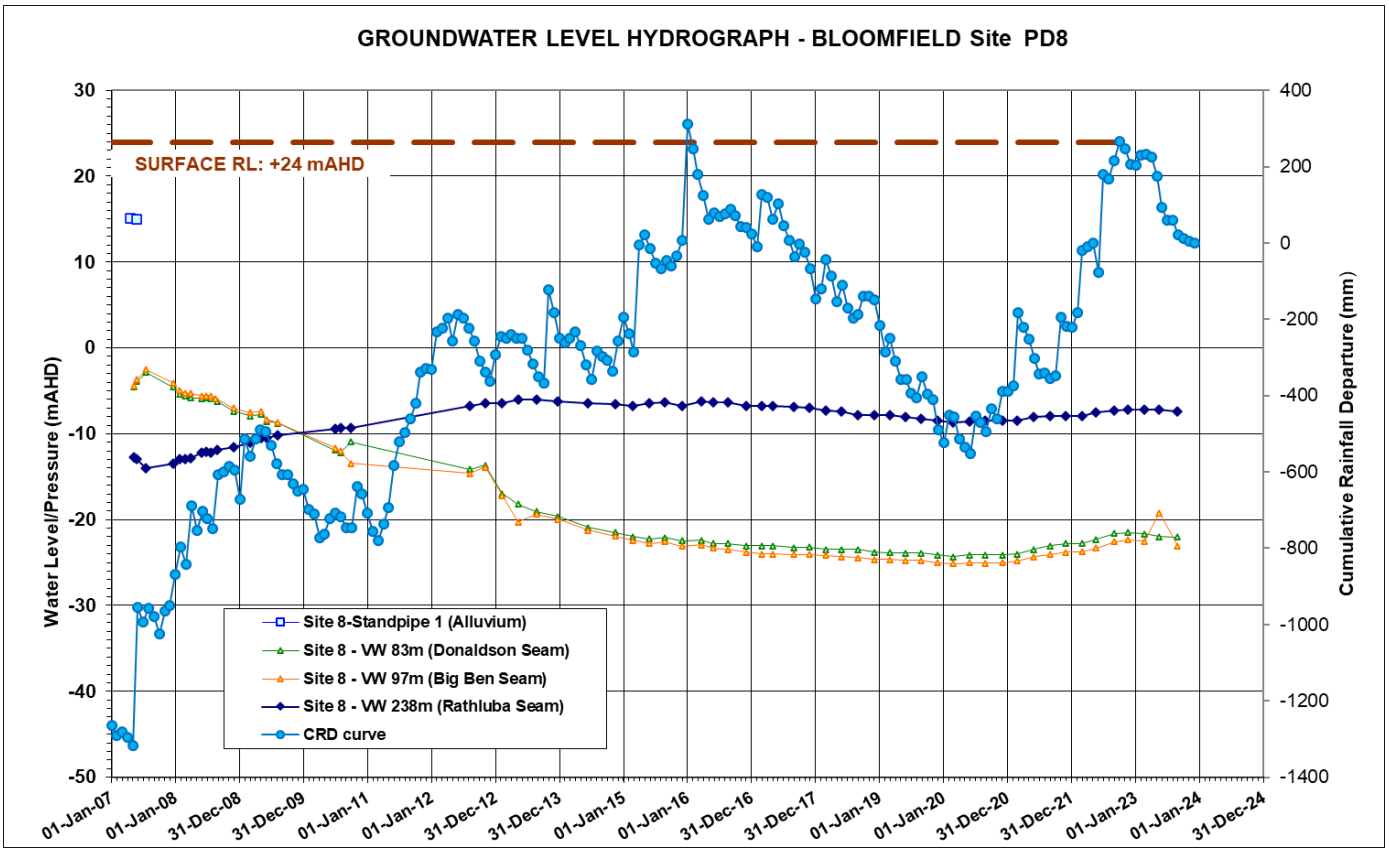

GROUNDWATER LEVEL HYDROGRAPH - BLOOMFIELD Site PD3
SURFACE RL: +30 mAHD
Water Level/Pressure (mAHD)
Cumulative Rainfall Departure (mm)
Site 3- Standpipe 1 (Donald Seam)
Site 3 - VW 136m (Rathluba Seam)
CRD Curve
Axis Title


GROUNDWATER LEVEL HYDROGRAPH - BLOOMFIELD Site PD4
SURFACE RL: +26.5 mAHD
Water Level/Pressure (mAHD)
Cumulative Rainfall Departure (mm)
Site 4-Standpipe 2 (Alluvium)
Site 4 - Standpipe 1 (Rathluba Seam)
CRD Curve


GROUNDWATER LEVEL HYDROGRAPH - BLOOMFIELD Site PD5
SURFACE RL: +60.7 mAHD
Water Level/Pressure (mAHD)
Cumulative Rainfall Departure (mm)
Site 5-VW 62m (Whites Creek Seam)
Site 5 - VW 71m (Donaldson Seam)
Site 5 - VW 89.5m (Big Ben Seam)
CRD Curve


GROUNDWATER LEVEL HYDROGRAPH - BLOOMFIELD Site PD6
SURFACE RL: +53.6 mAHD
Water Level/Pressure (mAHD)
Cumulative Rainfall Departure (mm)
Site 6 VW 96m (White Creek Seam)
Site 6 - VW 114m (Donaldson Seam)
Site 6 - VW 128m (Big Ben Seam)
CRD Curve
Axis Title

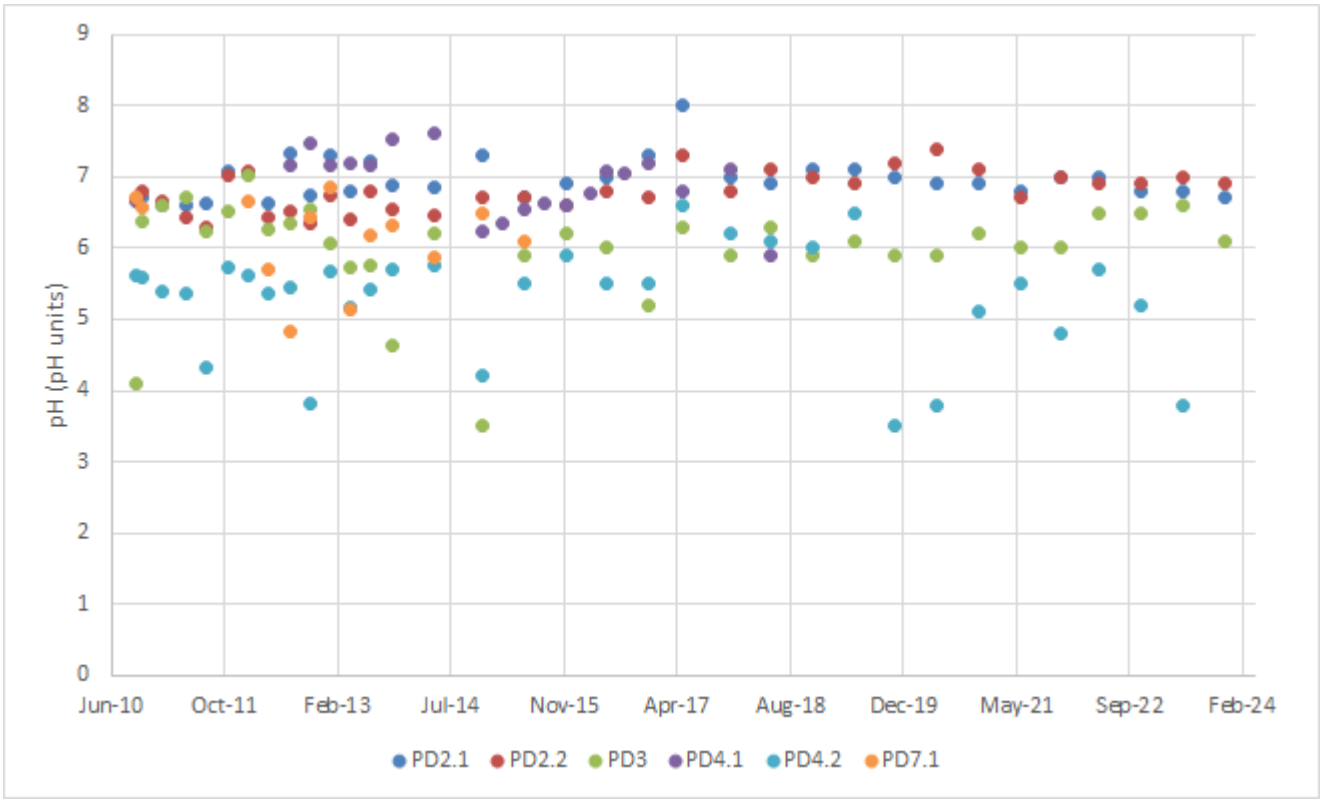

GROUNDWATER LEVEL HYDROGRAPH - BLOOMFIELD Site PD7
SURFACE RL: +26.8 mAHD
Water Level/Pressure (mAHD)
Cumulative Rainfall Departure (mm)
Site 7-Standpipe 1 (Alluvium)
Site 7 - VW 70m (Whites Creek Seam)
Site 7 - VW 95m (Donaldson Seam)
Site 7 - VW 107m (Big Ben Seam)
CRD Curve

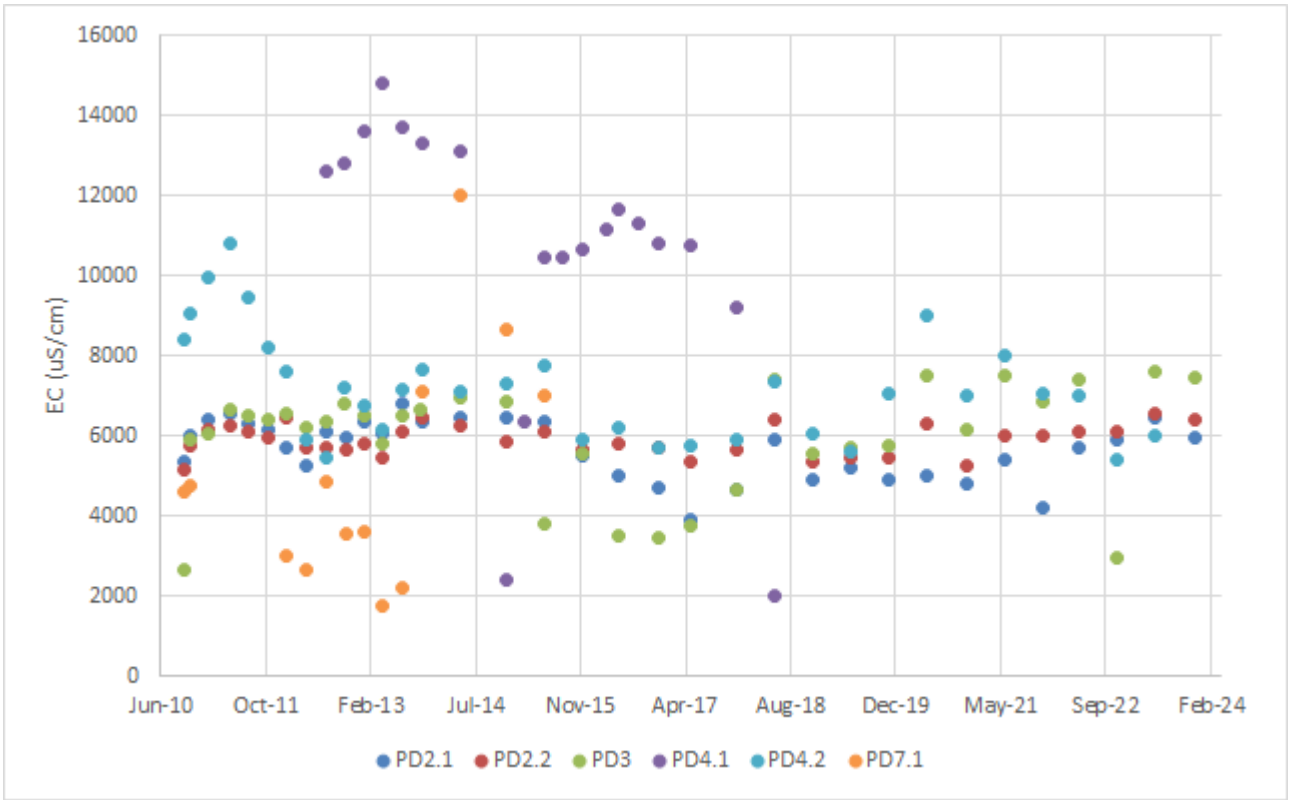

GROUNDWATER LEVEL HYDROGRAPH - BLOOMFIELD Site PD8
SURFACE RL: +24 mAHD
Water Level/Pressure (mAHD)
Cumulative Rainfall Departure (mm)
Site 8-Standpipe 1 (Alluvium)
Site 8 - VW 83m (Donaldson Seam)
Site 8 - VW 97m (Big Ben Seam)
Site 8 - VW 238m (Rathluba Seam)
CRD curve

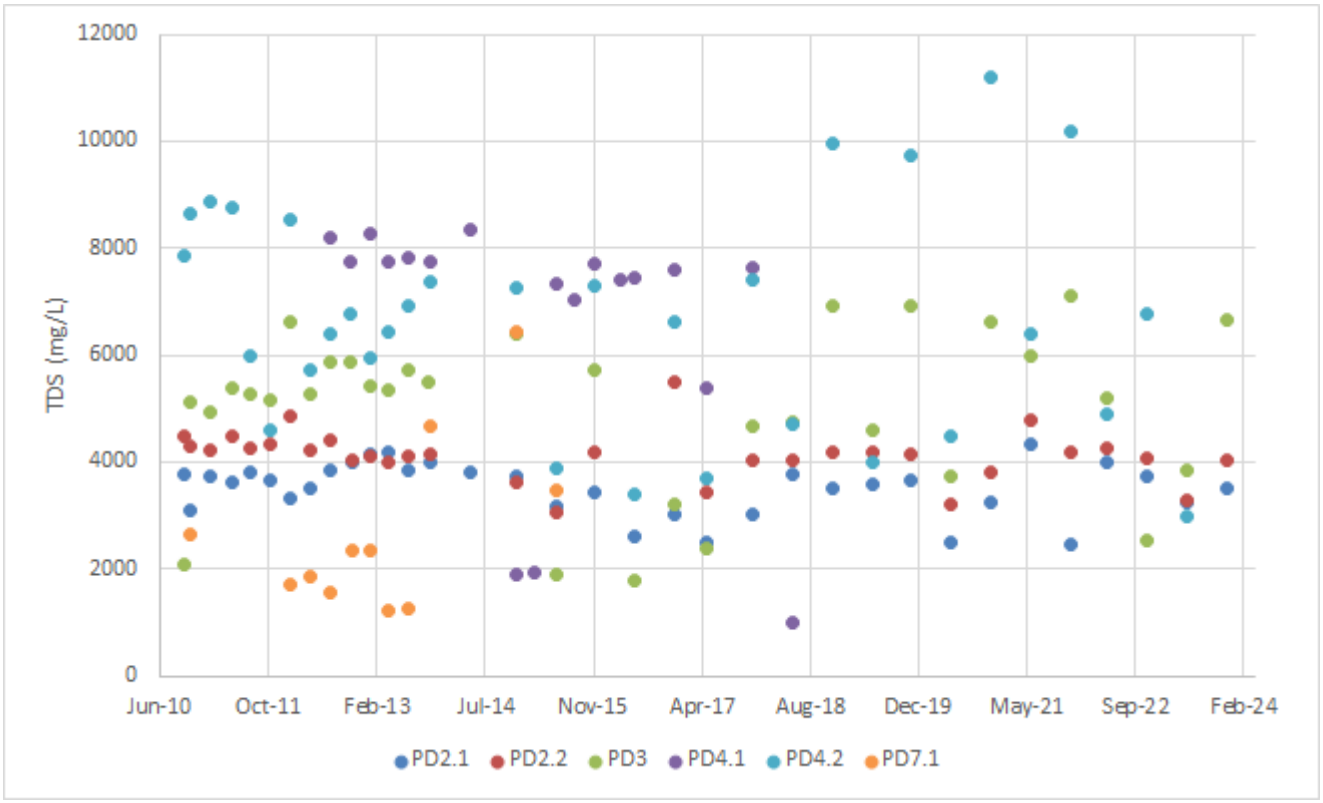
# Appendix C

## Groundwater quality graphs

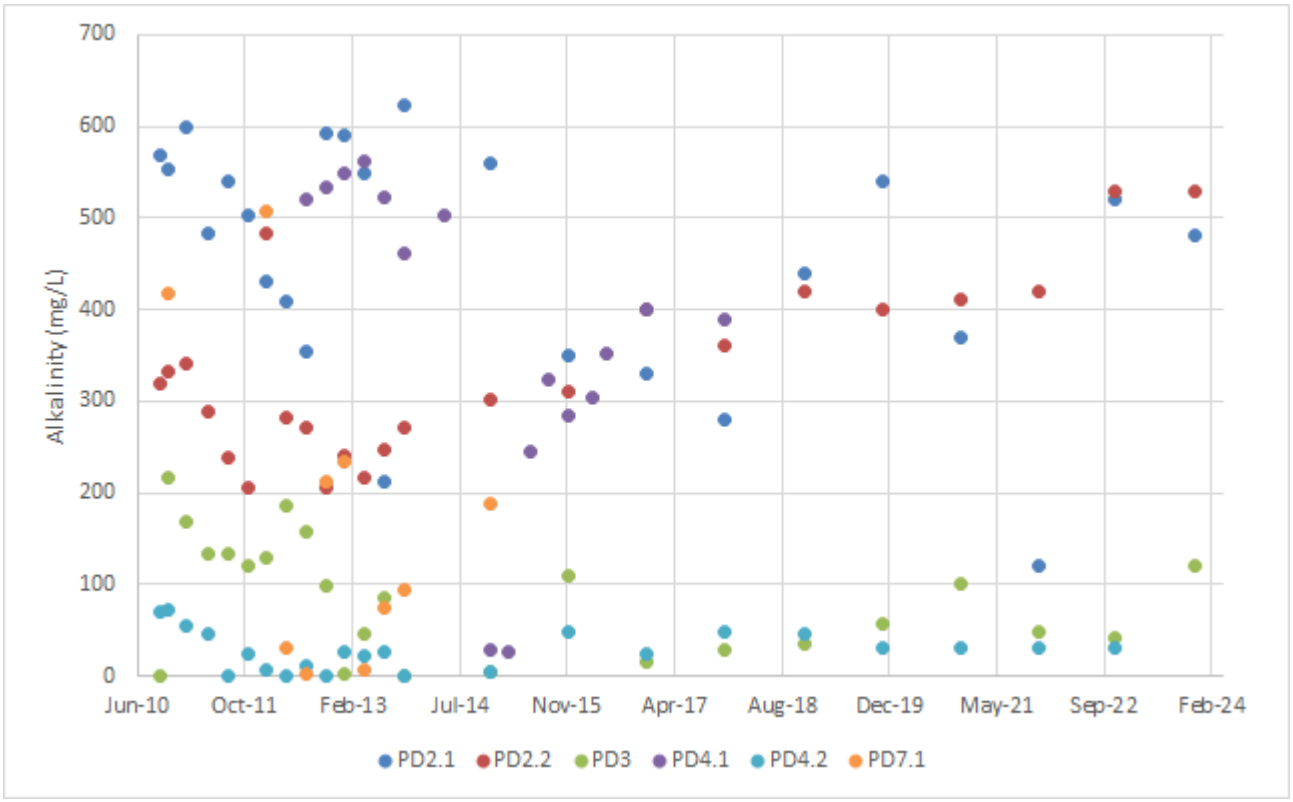
# C-1 Physiochemical parameters

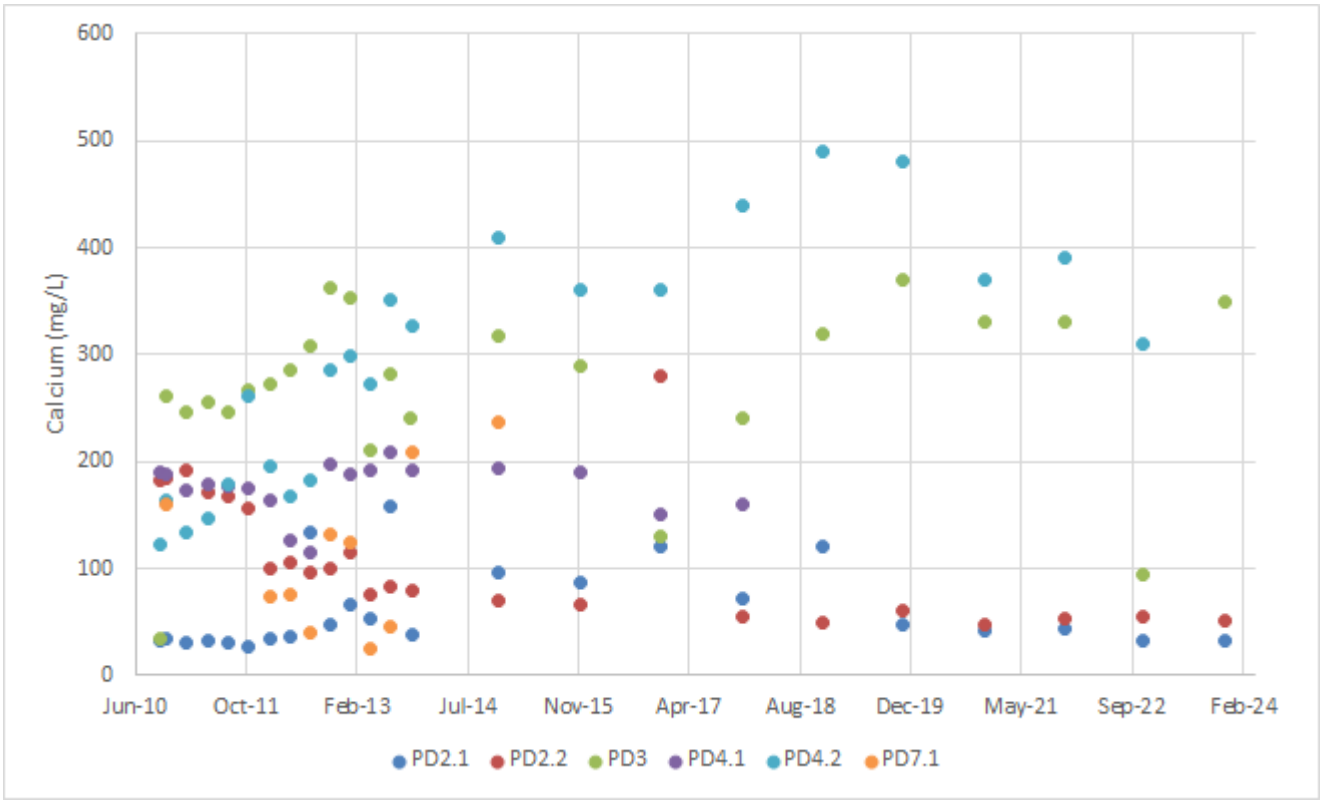


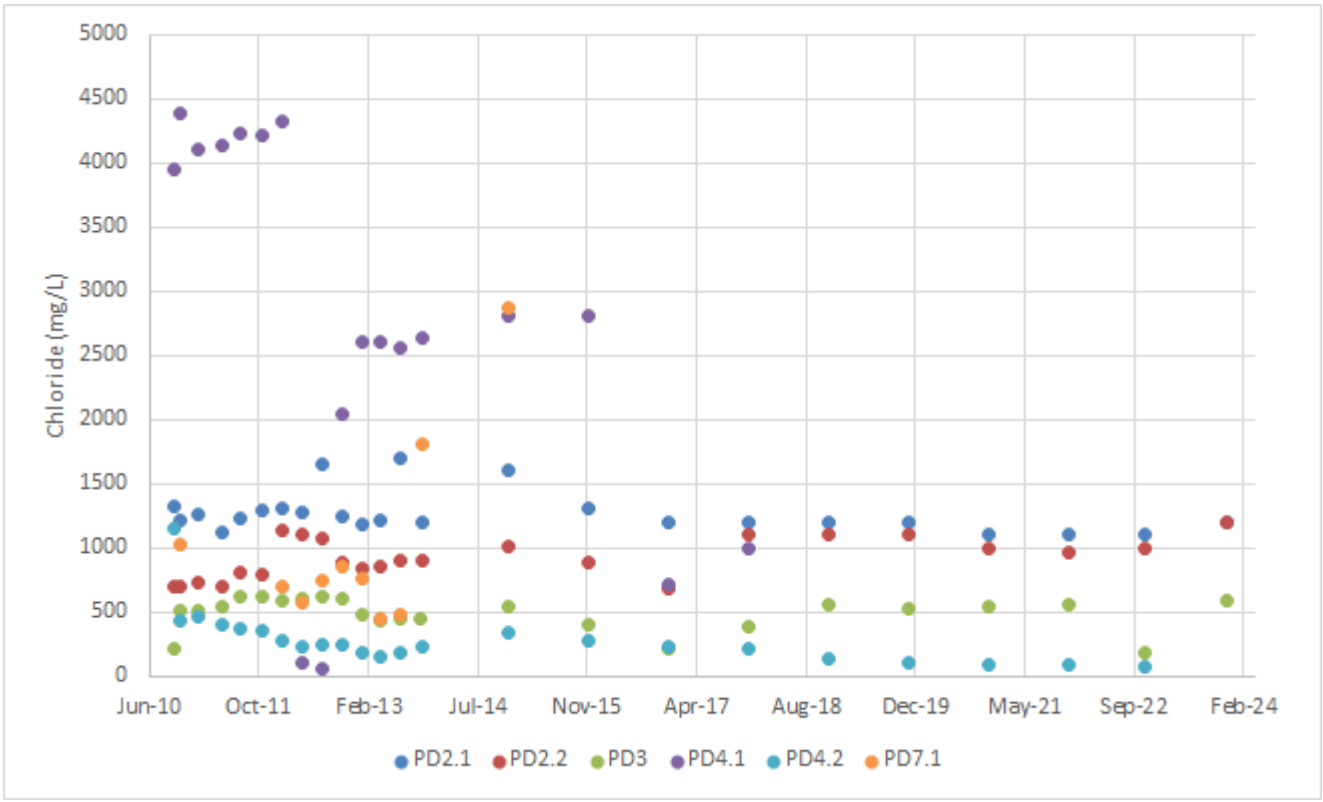



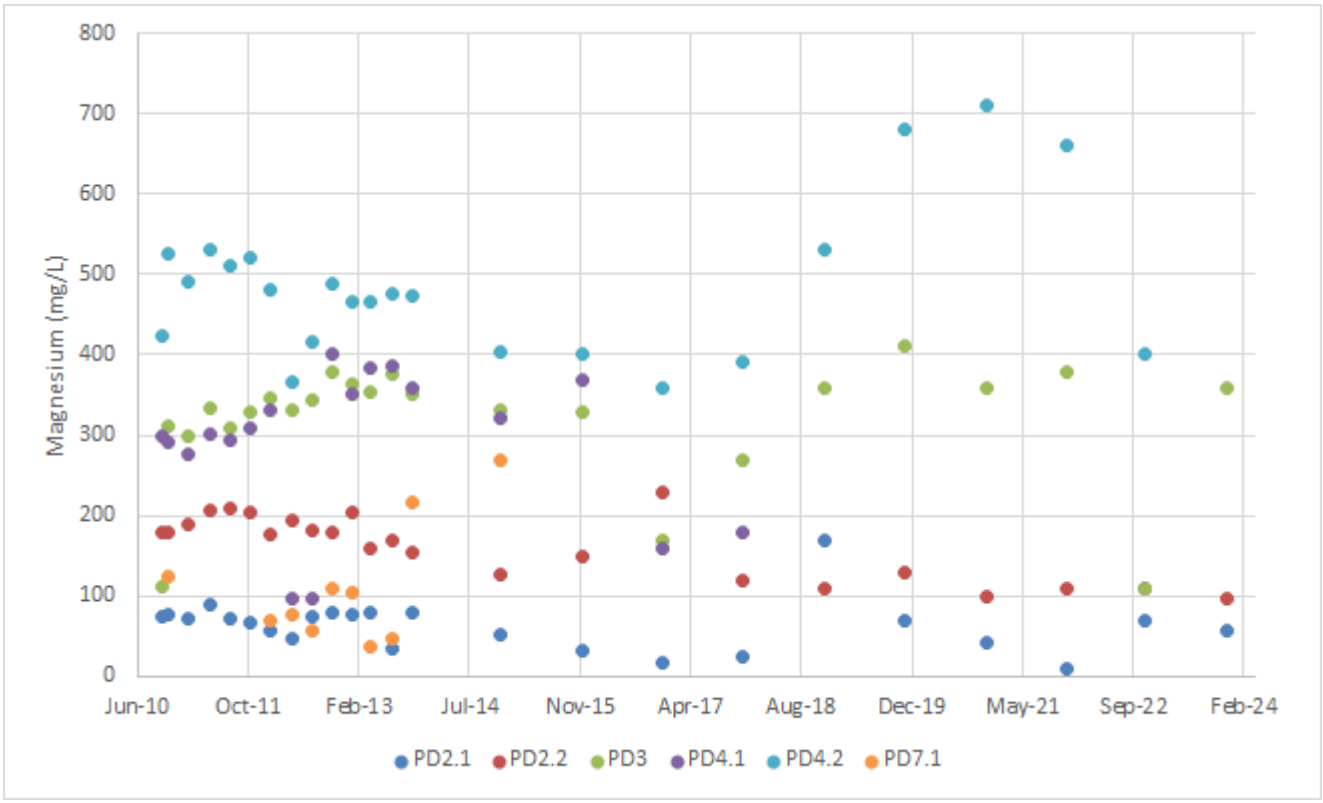


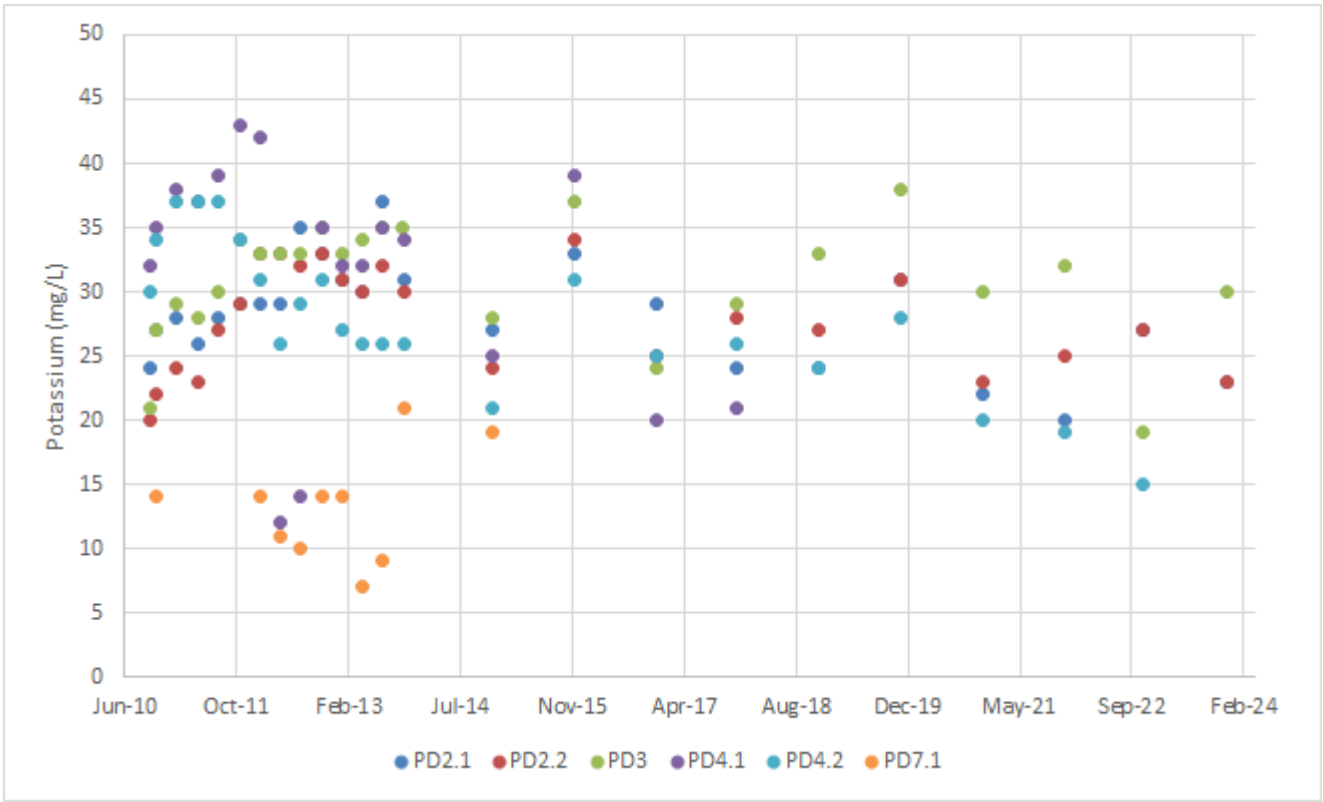

# C-2 Major cations and anions

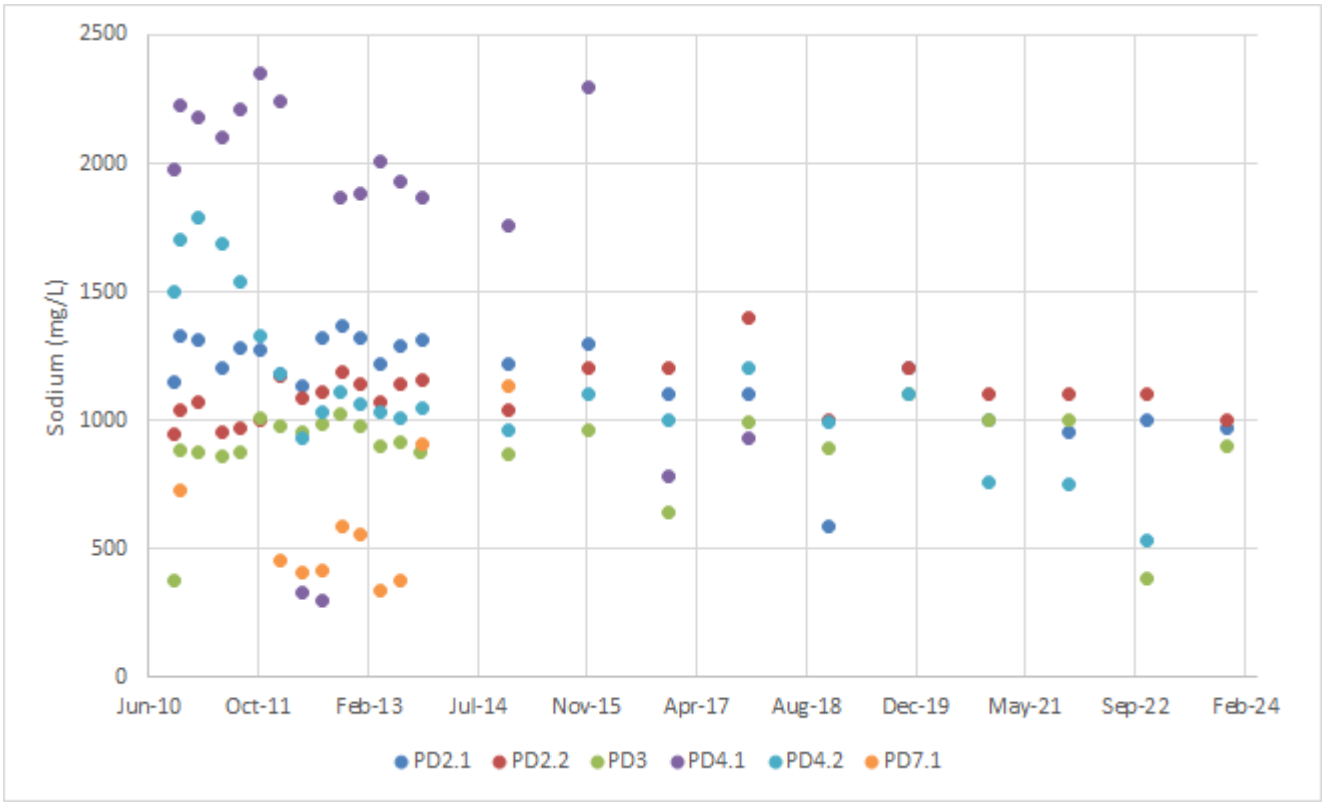


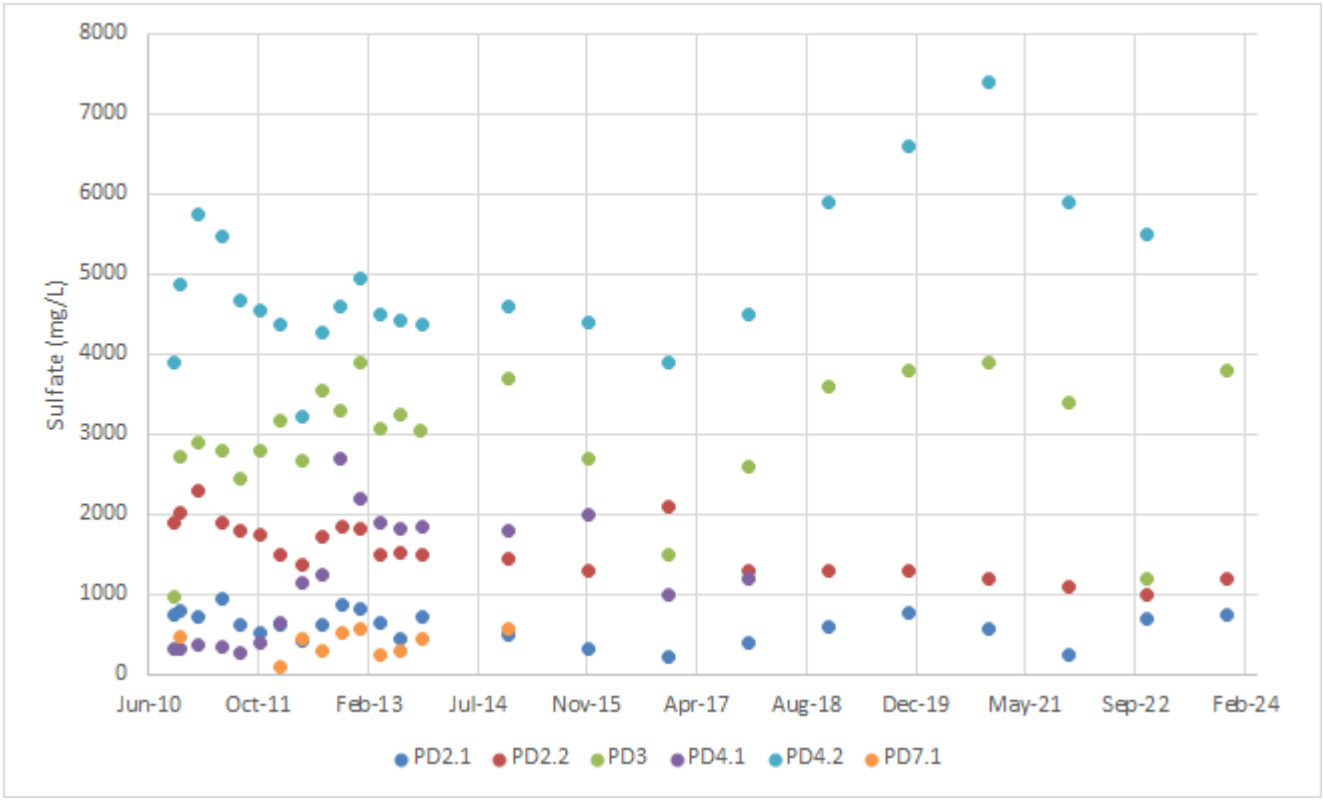

600
500
400
300
200
100
0
Calcium (mg/L)
Jun-10
Oct-11
Feb-13
Jul-14
Nov-15
Apr-17
Aug-18
Dec-19
May-21
Sep-22
Feb-24
PD2.1
PD2.2
PD3
PD4.1
PD4.2
PD7.1


5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Chloride (mg/L)
Jun-10
Oct-11
Feb-13
Jul-14
Nov-15
Apr-17
Aug-18
Dec-19
May-21
Sep-22
Feb-24
PD2.1
PD2.2
PD3
PD4.1
PD4.2
PD7.1

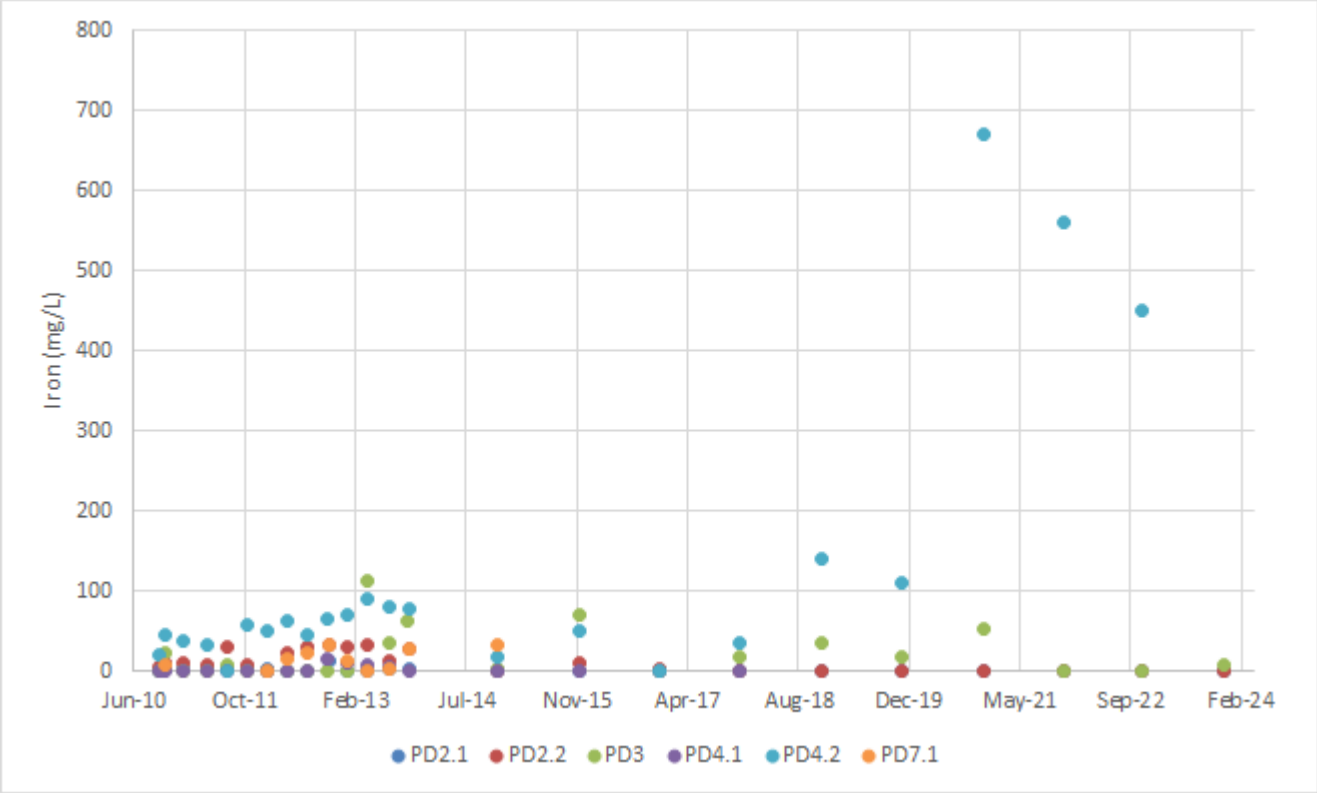

Magnesium (mg/L)
800
700
600
500
400
300
200
100
0
Jun-10
Oct-11
Feb-13
Jul-14
Nov-15
Apr-17
Aug-18
Dec-19
May-21
Sep-22
Feb-24
PD2.1
PD2.2
PD3
PD4.1
PD4.2
PD7.1


Potassium (mg/L)
50
45
40
35
30
25
20
15
10
5
0
Jun-10
Oct-11
Feb-13
Jul-14
Nov-15
Apr-17
Aug-18
Dec-19
May-21
Sep-22
Feb-24
PD2.1
PD2.2
PD3
PD4.1
PD4.2
PD7.1


Sodium (mg/L)
2500
2000
1500
1000
500
0
Jun-10
Oct-11
Feb-13
Jul-14
Nov-15
Apr-17
Aug-18
Dec-19
May-21
Sep-22
Feb-24
PD2.1
PD2.2
PD3
PD4.1
PD4.2
PD7.1


Sulfate (mg/L)
8000
7000
6000
5000
4000
3000
2000
1000
0
Jun-10
Oct-11
Feb-13
Jul-14
Nov-15
Apr-17
Aug-18
Dec-19
May-21
Sep-22
Feb-24
PD2.1
PD2.2
PD3
PD4.1
PD4.2
PD7.1

# C-3 Dissolved metals



# Appendix D

## Groundwater quality table

Maximum water quality observations for each monitoring location as shown below.

| Parameter | Units | PD2.1 | PD2.2 | PD3 | PD4.1 | PD4.2 | PD7.1 |
|---|---|---|---|---|---|---|---|
| Physiochemical | | | | | | | |
| pH | pH units | 8 | 7.4 | 7.03 | 7.61 | 6.6 | 6.86 |
| EC | uS/cm | 6,820 | 6,580 | 7,600 | 14,800 | 10,800 | 12,000 |
| TDS | mg/L | 4,320 | 5,510 | 7,100 | 8,340 | 11,200 | 6,420 |
| TSS | mg/L | 25,000 | 414 | 184 | 130 | 542 | 30,900 |
| Nutrients | | | | | | | |
| Alkalinity | mg/L | 622 | 530 | 217 | 561 | 73 | 508 |
| Sulfate | mg/L | 953 | 2,300 | 3,900 | 2,680 | 7,400 | 562 |
| Chloride | mg/L | 1,700 | 1,200 | 622 | 4,390 | 1,150 | 2,870 |
| Calcium | mg/L | 159 | 280 | 370 | 209 | 490 | 237 |
| Magnesium | mg/L | 170 | 230 | 410 | 402 | 710 | 270 |
| Sodium | mg/L | 1,370 | 1,400 | 1,100 | 2,350 | 1,790 | 1,130 |
| Potassium | mg/L | 37 | 34 | 38 | 43 | 37 | 21 |
| Dissolved metals | | | | | | | |
| Iron | mg/L | 11.4 | 32.9 | 113 | 14.8 | 670 | 32 |

# Appendix E

## Hydro algorithmics review

**HydroAlgorithmics Pty Ltd** ● ABN 25 163 284 991
PO Box 241, Gerringong NSW 2534. Phone: +61(0)424 183 495

noel.merrick@hydroalgorithmics.com

DATE: 23 July 2024

TO: Dr Stuart Gray
Technical Director – Water Resources
GHD Pty Ltd
Level 4, 24 Honeysuckle Drive
Newcastle NSW 2300

FROM: Dr Noel Merrick

RE: Bloomfield Colliery Continuation Project – Groundwater Peer Review

OUR REF: HA2024/10

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## 1. Introduction

This report provides a peer review of the Groundwater Impact Assessment (GIA) for the Bloomfield Colliery Continuation Project (the Project). The GIA has been prepared by GHD Pty Ltd (Newcastle) for the client Bloomfield Collieries Pty Limited (Bloomfield).

The Colliery operates under Project Approval (PA) 07_0087 and subsequent Modifications (1 to 4). Bloomfield is seeking approval for Modification 5 that would involve continuation of open cut mining to the north in the existing Creek Cut area, and in the north-east in the Workshop Cut area. Mine life would extend to the end of December 2035.

The Colliery is located approximately 30 km north-west of Newcastle, NSW, where coal has been mined for about 170 years from the Tomago Coal Measures. To the south and south-east are the Abel, Donaldson and Tasman coal mines, all of which are either closed or in care and maintenance. These mines have contributed to regional depressurisation of the Permian formations that host the coal.

The main elements of the Project that are relevant to groundwater assessment are:

- An additional 39 hectares (ha) of excavation.
- Mining of coal seams lower than the Buttai Seam down to and including the Big Ben Seam.
- Mining in the Creek Cut area to an elevation of approximately -10 mAHD.
- Mining in the Workshop Cut area to an elevation of approximately 7.5 mAHD.
- Migration of the final void northwards with floor level raised from approximately -60 mAHD to -10 mAHD.

## 2. Documentation

This review is based on the following report:

- GHD, 2024. Bloomfield Colliery Continuation Project Groundwater Impact Assessment. Report 12597478 prepared for Bloomfield Collieries Pty Ltd, Revision B, 12 July 2024. 51p + 4 Appendices.

This GIA document has the following major sections:

1. Introduction
2. Project description
3. Potential groundwater impacts
4. Legislation and policy
5. Site description
6. Groundwater management and monitoring
7. Conceptual groundwater model
8. Impact assessment
9. Mitigation
10. Summary
11. References

The Appendices are:

A. Design contours: 2026 to 2035
B. Groundwater levels
C. Groundwater quality graphs
D. Groundwater quality table

## 3. Assessment Approach

The groundwater impact assessment in GHD (2024) is based on historical data assessment and conceptual modelling rather than numerical groundwater modelling. The rationale for this simplified approach is that the changes sought for approval are minor in form and their effects can be anticipated without additional quantitative modelling. However, expectations of the effects due to the changes are informed reliably by an existing numerical groundwater model of regional mining in the subject area, as documented in a report by HydroSimulations (2017) in which this reviewer was the lead author. This report has the following major sections:

1. Introduction
2. Hydrogeological analysis
3. Groundwater simulation model
4. Model calibration
5. Predictive modelling
6. Limitations
7. References

The Appendices are:

A. Mining progression
B. Groundwater level hydrographs
C. Simulated groundwater level maps
D. Predicted groundwater drawdown maps

In the groundwater modelling guideline issued by the National Water Commission (Barnett *et al.*, 2012), one of the checklist questions is:

- *Is a groundwater model the best option to address the project and model objectives?*

In this case, a groundwater model is considered to be an unnecessary option. The findings from the existing groundwater model are a sufficient guide to the likely groundwater-related impacts of the Project.

## 4. Project Objectives and Findings

The GIA report states the purpose of the study as being "to provide an assessment of the potential groundwater impacts related to the construction and operation of the proposed project (Modification 5)". Detailed objectives are listed in the form of a scope of work [Section 1.3].

Incremental impacts are assessed for:

- Pit inflows [licensed take].
- Existing groundwater users.
- Groundwater dependent ecosystems [GDEs].
- Groundwater quality.
- Post closure.

### a. Groundwater levels

GHD (2024) presents groundwater hydrographs in Appendix B for all 24 sensors (standpipes or vibrating wire piezometers) at eight sites (Site 1 to Site 8). Measurements range in time from 2007 to early 2024.

Apart from Site 3, the most northerly site, there are evident mining effects on groundwater levels. It is of interest that the shallowest standpipes at Sites 7 and 8 (depths about 11 m and 10 m respectively) have gone dry in an area where the HydroSimulations (2017) model predicted shallow drawdown effects in excess of 2 m.

There is also a rainfall recharge signature, in the form of correlation with Cumulative Rainfall Departure [CRD], at most sites, even for deep sensors. At two sites GHD (2024) notes "some rainfall response" and "minimal response to rainfall", but this reviewer is of the view that the response to rainfall is more widespread than has been reported. The hydrographs in Appendix B would have benefitted by co-plotting with a portion of the CRD curve presented at Figure 5.2.

### b. Conceptual model

Conceptual groundwater model diagrams are presented in Figures 7.1 to 7.4 for west-east and north-south sections before and after the Project. These schematics give an adequate picture of the key processes acting on the groundwater system. They give a visual impression of the significant depth to water as a consequence of historical mining. This is an important observation relevant to the Project, as the planned depths of excavation might not intercept groundwater, in which case groundwater impacts are expected to be nil or minor.

One criticism is that the west-east section in Figure 7.2 does not match the topographic levels of the reversed east-west section in Appendix A, although they are supposed to relate to the same transect.

### c. Groundwater take

In Section 8.2.1, GHD (2024) reports metered groundwater inflows for the past four water years since July 2019. The average over this period was 332 ML/year, compared to the predicted average take of 448 ML/year in the HydroSimulations (2017) model, which did not have the benefit of metered flows as a constraint on model calibration. Furthermore, the model prediction was said to be conservative, as "*These rates do not account for evaporative losses from the floor and walls of the pits*". The good agreement between predicted and actual inflows gives confidence in the model as a reliable predictor of groundwater impacts.

GHD (2024) makes the valid inference that the "groundwater inflows attributable to the project will be less than those reported in recent years" because the proposed Project excavations would be "smaller and shallower". Furthermore: "Inflows may be negligible or zero if there is no groundwater interception". It

follows that drawdowns in response to mining would also be “negligible or zero” if no groundwater is encountered during mining, or of limited magnitude and extent if groundwater is intercepted.

### d. Other impacts

Groundwater quality is assessed in numerous ways:

- by means of a Piper Diagram, which indicates spatial variability in sulphate levels (attributed to distance from tailings);
- by median electrical conductivity in Table 6.2, which indicates moderately high salinity; and
- by time-series charts of key analytes in Appendix C.

The site-by-site summary in Appendix D has the wrong units (“NTU”) for TDS, and some TSS values that are inconsistent with the corresponding TDS values.

Due to extant depressurisation, and the limited depths of extraction of the two continuation areas, GHD (2024) concludes correctly that negligible impacts are to be expected at private landowner bores and GDEs, and no additional water quality impacts are to be expected.

There will be some change to post-closure effects as foreshadowed in HydroSimulations (2017), as the final void is to be shallower than modelled and moved northwards. GHD (2024) assumes there would be groundwater inflows into the elevated void, but it is possible that a pit lake might not form. Water levels in the final void are assessed in a Surface Water Impact Assessment that this reviewer has not seen.

## 5. Conclusion

The geology is reasonably well known as the result of many decades of coal mining. Analysis of geological and hydrogeological data has led to a robust conceptual model that is illustrated in Figures 7.1 to 7.4 of the GIA report. This indicates an effect on the water table from already-completed mining and regional depressurisation due to adjacent historical mining. The key processes are captured in these diagrams.

GHD (2024) assesses each of the minimal harm considerations of the Aquifer Interference Policy in Section 8.3. In each case, a defensible Level 1 standing is put forward. GHD (2024) summarises the findings of the groundwater impact assessment in Section 10 of the GIA report. This reviewer concurs with the conclusions.

It is evident that the proposed changes in this Project are minor in form and would not lead to any significant incremental impacts from what has already been approved. In addition, the predicted take is well below the currently-held water access licence for the Sydney Basin-North Coast Groundwater Source.

## 6. References

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.

GHD, 2024. Bloomfield Colliery Continuation Project Groundwater Impact Assessment. Report 12597478 prepared for Bloomfield Collieries Pty Ltd, Revision B, 12 July 2024. 51p + 4 Appendices.

HydroSimulations, 2017. Bloomfield Colliery Extension Groundwater Modelling Assessment. Report HC2017/39 for AECOM and The Bloomfield Group, October 2021. 72p.

ghd.com

The Power of Commitment