Appendix G

Surface Water Assessment

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Bloomfield Collieries Pty Ltd
17-Jan-2018

Surface Water Assessment

Bloomfield Colliery - Life of Mine Extension

Surface Water Assessment

Bloomfield Colliery - Life of Mine Extension

Client: Bloomfield Collieries Pty Ltd

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Prepared by

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Reviewed by Amanda Kerr

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Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
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B	15-Aug-2017	Final Draft	Amanda Kerr Associate Director	
0	17-Jan-2018	Final	Simon Murphy Project Manager	

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1.0 Introduction

1.1 Overview

The Bloomfield Colliery is an open cut mine is located south of East Maitland (refer to **Figure 1**) and is one of the Hunter Valley's oldest, continuously operating, open cut mines. The mine produces approximately 0.6 million tonnes per annum (Mtpa) (Bloomfield, 2017) of product coal from its existing operations. Bloomfield Collieries Pty Ltd ('Bloomfield') operates the site in accordance with Project Approval 07_0087 which was granted on 3 September 2009 under Part 3A (now repealed) of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Project Approval has since been modified on three separate occasions:

- Modification No. 1 – Amending overburden placement, rehabilitation works, constructing a new haul road and amending a powerline easement;
- Modification No. 2 – Seeking an extension of the date for the submission of certain management plans required by the Project Approval; and
- Modification No. 3 – Approval to modify approved vegetation clearing and biodiversity offset area.

Pursuant to Schedule 5, Condition 2 of the current Project Approval, mining may take place until 31 December 2021.

1.2 Proposed modification

Bloomfield is seeking approval for the following modifications to Project Approval 07_0087, as follows:

- Extension of mining operations up until to 31 December 2030; and
- Approval of an amended mine schedule to access previously unrecoverable resource and final landform.

Mine scheduling to support the Project Approval identified that the resource would be exhausted by the end of 2021. However, Bloomfield now predicts mining to extend beyond 2021 for the following reasons:

- Actual run of mine (ROM) production levels have been lower than the predicted ROM production rates of 1.3 Mtpa, over the life of the project to-date;
- Changes to the mine fleet which have allowed access to, and extraction of seams that were not previously considered to be a recoverable resource as part of the Environmental Assessment (Completion of Mining and Rehabilitation, Part 3A Environmental Assessment Project Application 07-0087, Volume 1, 2008); and
- Further exploration has identified other previously unrecoverable resources that the new fleet can now access.

Therefore, Bloomfield has identified up to 13 million tonnes of ROM coal remaining inside the approval area. Based on annual mining rates of approximately 1 million tonnes of ROM per year, mining will extend beyond 2021. The intention of the consent modification is to align the Bloomfield mining operations consent limit to coincide with the adjoining Abel Underground Mine ('Abel') consent limit of 31 December 2030. Rehabilitation will continue past this limit to allow for the rehabilitation of the tailings emplacement area. Maximum annual production levels will continue at 1.3 Mtpa ROM per year.

1.3 Purpose of this report

AECOM were engaged by Bloomfield to complete a surface water assessment for the project. The purpose of the assessment is to form part of an Environmental Assessment (EA) to support an application to the Department of Planning & Environment (DP&E) for modification of the Project Approval under the EP&A Act.

1.4 Consultation with DP&E and SEARs

Bloomfield wrote to DP&E on 9 November 2015, regarding the proposed life of mine extension for the project. DP&E issued the Secretary's Environmental Assessment Requirements (SEARs) on 22 March 2017. This report has been prepared to address the SEARs relevant to the management of soil and surface water. The general requirements and soil and water-specific requirements of the SEARs being:

- *The Department notes the existing approved coal extraction rate and extraction area is not proposed to change*
- *The Department considers, based on the information presented, that the proposed modification falls within the scope of a Section 75W modification*
- *The Department considers the environmental assessment for the S.75W should include the following requirements.*

Preliminary requirements

- *A clear description of the existing approval operation and the proposed development*
- *The likely interactions between the development and any other existing, approved or proposed developments in the vicinity of the site*
- *A list of any approvals that must be obtained before the development may commence*
- *An assessment of the likely impacts of the development on the environment, focussing on the specific issues identified below, including:*
  - *A description of the existing environment likely to be affected by the development, using sufficient baseline data*
  - *An assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice*
  - *A description of the measures that would be implemented to mitigate and/or offset the likely impacts of the development, and an assessment of:*
    - *Whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented;*
    - *The likely effectiveness of these measures*
    - *Whether contingency plans would be necessary to manage any residual risks*
  - *A description of any measures that would be implemented to monitor and report on the environmental performance of the development if it is approved*
- *Consideration of the development against all relevant environmental planning instruments (including Part 3 of the State Environmental Planning Policy (Mining, Petroleum Production Extractive Industries) 2007).*
- *The reasons why the modification should be approved having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development.*

Soil and Water

- *The EA will be required to demonstrate that the existing water management system is adequate in its existing, or in an upgraded form to accommodate the development. This should be in accordance with the Managing Urban Stormwater; Soils & Construction Guideline Volume 2E: Mines and Quarries. A new soil and water management plan may be required.*

Consultation

- *Finally, you should also consult with relevant local and State government authorities in particular, including Council, EPA, OEH, DRE and DoEE any local landholders and/or residences who may be affected by the proposal, and any interested community groups. The EA should report on this consultation.*

1.5 Methodology

The methodology applied for this assessment included the following tasks:

- Site inspection undertaken by AECOM on the 31 May 2017 to develop an appreciation of the site;
- Background review of existing documentation, including:
  - Environmental assessments, water management plans; and
  - Historical water quality monitoring data.
- Confirmation with site personnel aspects of current operations and water management on site;
- Review of existing legislative and policy requirements and documentation of potential impacts;
- Review of adequacy of existing soil and water management in context of current guidelines;
- Identify potential impacts of the proposed modification; and
- Develop recommendations for required mitigation measures, if appropriate.

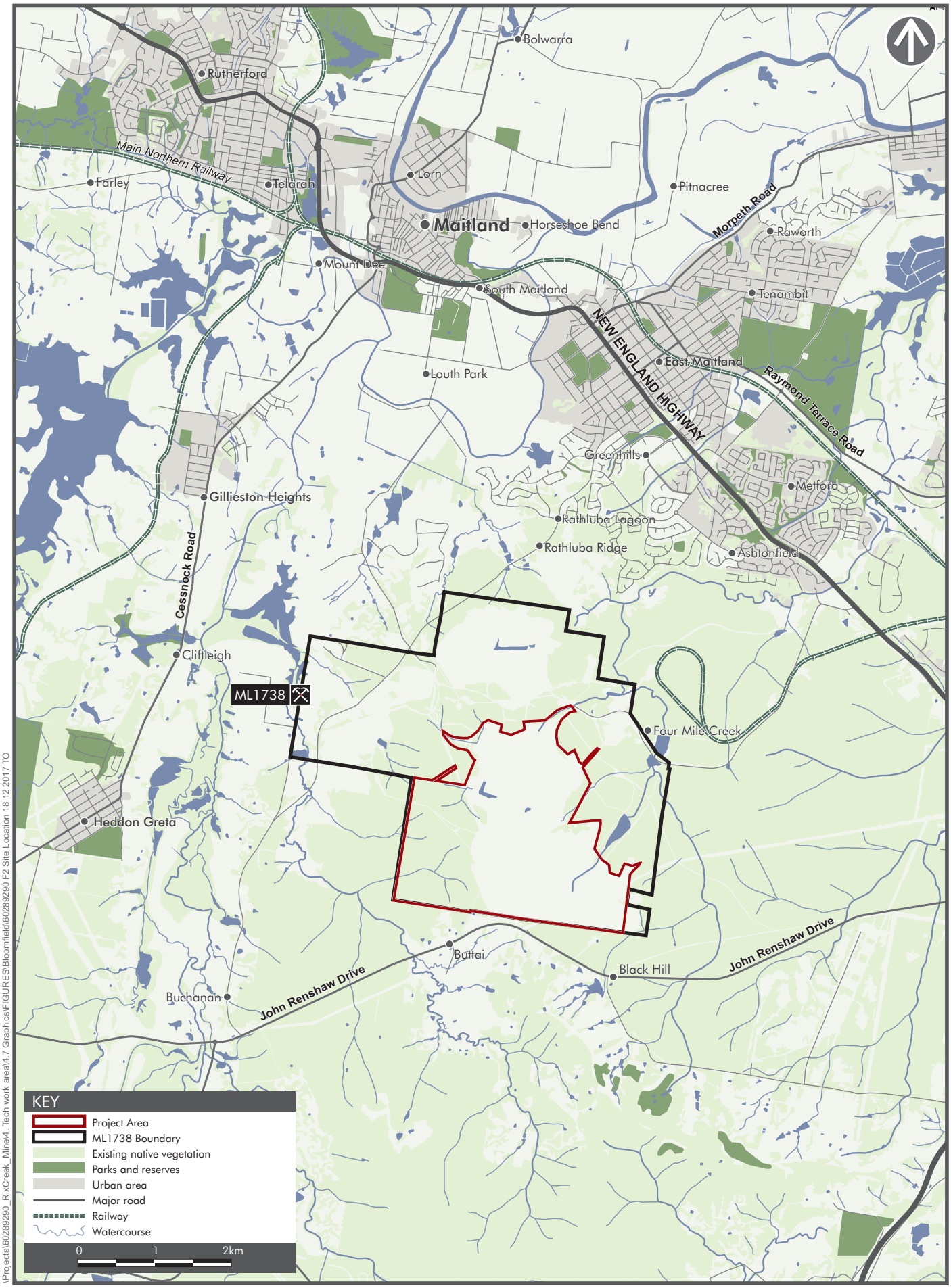
1.5.1 Background information review

The surface water system at Bloomfield is managed collaboratively with the Abel Underground Mine. Bloomfield and Abel operate the Coal Handling Preparation Plant (CHPP) in a cooperative manner, and the sites have a combined surface water management plan. Abel is currently in care and maintenance.

A ‘Surface Water Assessment for the Abel Upgrade Modification’ in 2012 for Donaldson Coal (Evans and Peck, 2012) superseded a previous study titled ‘Completion of Mining and Rehabilitation Project Surface Water Assessment (Evans and Peck, 2008).

Information on the currently approved Bloomfield water management system was incorporated and considered in the assessment of surface water impacts in the Abel Environmental Assessment (EA) (Evans and Peck, 2012). The Abel EA surface water assessment is therefore considered current and AECOM has taken the following approach to the background review:

- Adopted the results from the ‘Abel Upgrade Modification Surface Water Assessment’ (Evans and Peck, 2012) and Donaldson Coal ‘Abel Underground Mine, Water Management Plan’ (Evans and Peck 2014); and
- Referenced where necessary the ‘Completion of Mining and Rehabilitation Project Surface Water Assessment’ (Evans and Peck, 2008).



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SITE LOCATION
Bloomfield Project

FIGURE 1

2.0 Project overview

2.1 Site operation and ownership

Bloomfield Colliery is an existing open cut mining operation located to the north of John Renshaw Drive, Buttai, and east of Buchanan Road, Buchanan, approximately 20 km north-west of Newcastle (refer **Figure 1**).

Mining has occurred on the site for over 100 years. The open cut operations commenced in 1966 and the site produces mainly thermal coal with some semi-soft coking coal, principally for the Asian export market. In addition to the open cut operations, the site has also been subject to underground workings, which ceased in 1992.

The site is located within the Cessnock Local Government Area (LGA) and zoned 1(a) Rural 'A' under the Cessnock Local Environmental Plan 2011 (LEP). The project covers an area of approximately 317 hectares, with all land covered by the Project Approval being owned by Ashtonfields Pty Limited. The operator of the site and applicant for the consent modification is Bloomfield Collieries Pty Ltd, an Australian owned family company. Bloomfield is one of three open cut coal mines owned by its parent company, the Bloomfield Group.

Bloomfield Colliery is approved to operate 7 days per week, 24 hours per day. Mining is undertaken as a multi-seam truck and excavator or face shovel operation, conducted in sequential mining blocks. ROM coal is trucked to the ROM coal stockpile at the Bloomfield CHPP for processing, which occurs under the Abel Project Approval.

2.2 Integration with other mining operations

Mining operations in the vicinity of the project or integrated with part of the Bloomfield project include:

- Donaldson Open Cut Mine (former mine site, being rehabilitated);
- Abel Underground Mine (under care and maintenance since June 2016); and
- Tasman Underground Mine (former mine site, rehabilitated in 2014).

Aspects of Bloomfield's operations that are integrated with the above operations include:

- Bloomfield CHPP and associated facilities were approved under the Abel Project Approval;
- Delivery of coal from the various mines to the ROM coal stockpile areas adjacent to the CHPP;
- Water management system components are utilised by multiple operations, such as Bloomfield, Abel, and the Bloomfield CHPP, with open cut water management forming part of the overall integrated water balance;
- Provision of a final void that will be used for future management of CHPP reject and tailings;
- Integrated rehabilitation planning, considering the final land use proposed for multiple sites; and
- 'Integrated Environmental Monitoring Program' (GSS Environmental, 2007) developed for the integrated operations under the Abel Project Approval.

2.3 Proposed Extension of Mining

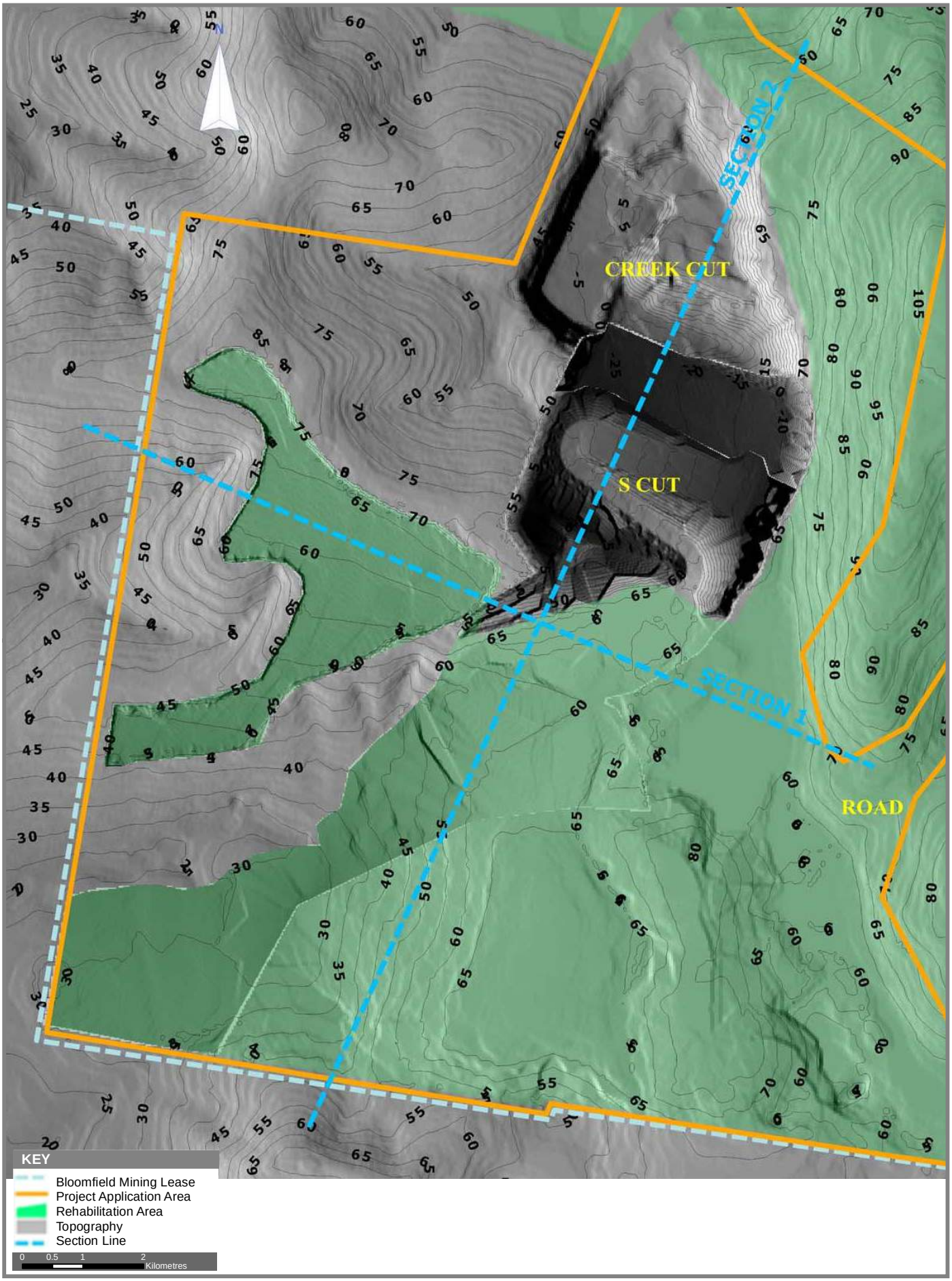
Bloomfield is seeking a consent modification to align the Bloomfield mining operations consent limit to coincide with the adjoining Abel consent limit of 31 December 2030. Maximum annual production levels from Bloomfield will continue at 1.3 Mtpa ROM per year.

2.4 Proposed final landform

The currently approved and proposed final landforms are shown in **Figure 2** and **Figure 3** respectively. The proposed final landform (subject of this application for consent modification) varies from the previously approved final landform, in which the void was placed approximately 200 m further to the east.

The following drainage characteristics are proposed for the final landform:

- The final void will operate as a water sink for 52 hectares of surface water drainage.
- Contour banks, channels and diversion drains will be constructed to direct water away from the final void and back into the existing water ways.
- The final eastern slopes of the overburden dump will drain east towards Four Mile Creek. The catchment area draining towards Four Mile Creek has increased by approximately 10 Ha from the currently approved final landform design; and the area draining to Buttai Creek will increase approximately 41 Ha.
- The proposed catchment area draining towards the final void is approximately 52 Ha, a decrease from the 103 Ha under the currently approved final landscape design.



AECOM GIS Printed:Date: 27/07/2017 \\AUNTL1FP001\Projects\60289290_RixCreek_Mine\4_Tech work areas\4.7 Graphics\GIS\Bloomfield\FIGURE 2.mxd

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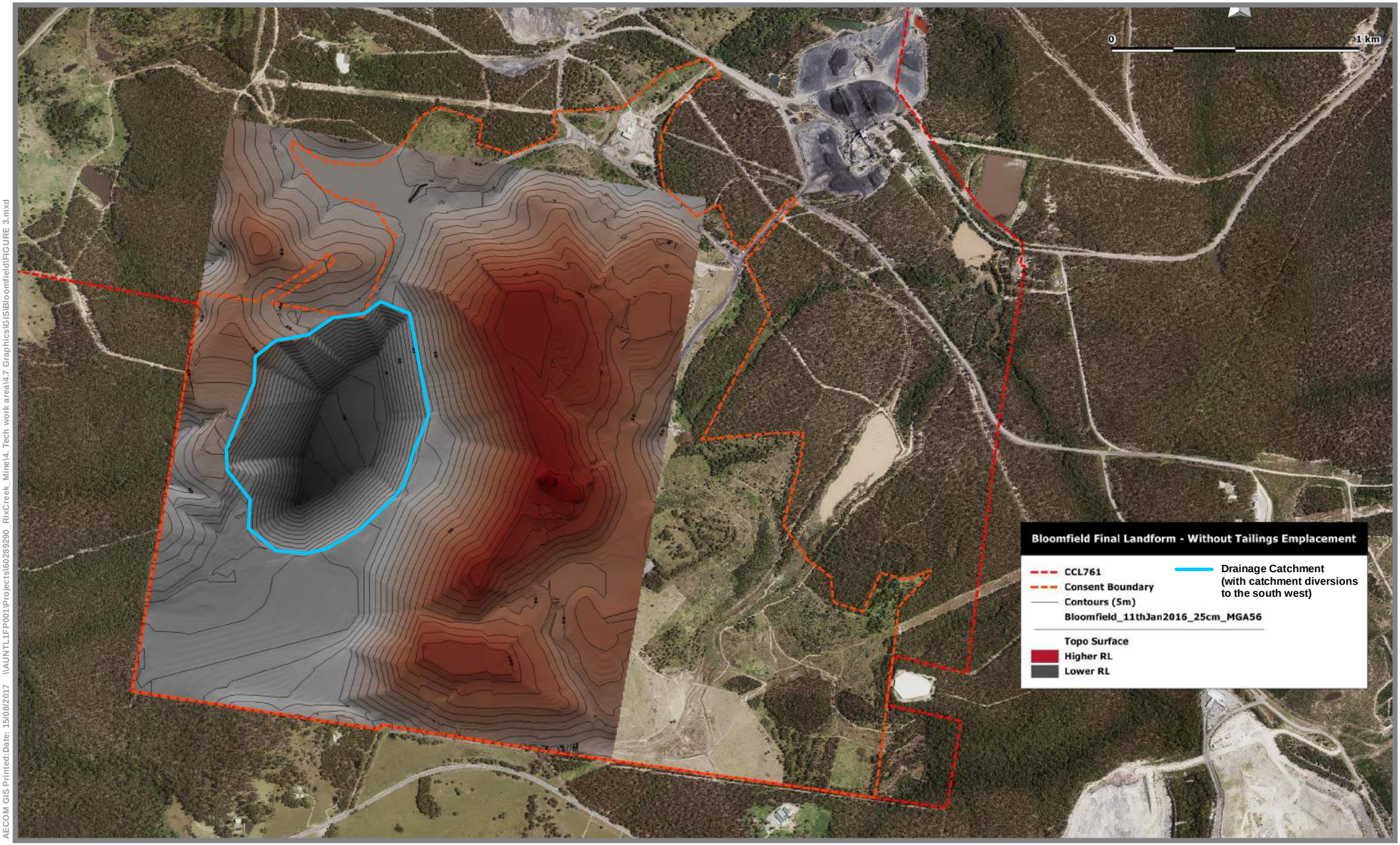
APPROVED FINAL LANDFORM
Bloomfield Project

FIGURE 2



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PROPOSED FINAL LANDFORM AND DRAINAGE CATCHMENT TO FINAL VOID

Bloomfield Project

FIGURE 3

3.0 Legislation, policy, and guidelines

This section outlines the legislation, policies and regulations relevant to the project for surface water management.

3.1 Project approval

Bloomfield's Project Approval 07_0087 has the following conditions of consent that the site must comply with in relation to the management of surface water.

Water Management

Discharge

18. Except as may be expressly provided for by an EPL, or in accordance with section 120 of the Protection of the Environment Operations Act 1997, the Proponent shall not discharge any mine water from the site. However, water may be transferred between the site and the adjoining Donaldson Coal Mine and/or Abel Coal Mine, in accordance with any approved Water Management Plan (see below).

Water management plan

19. The Proponent shall prepare and implement a Water Management Plan for the project to the satisfaction of the Director-General. This plan must:

a. be prepared in consultation with OEH and NOW and be submitted to the Director-General for approval within 6 months of the date of this approval;

b. be prepared by suitably qualified expert/s whose appointment/s have been approved by the Director-General; and

c. include:

- *Site Water Balance;*
- *an Erosion and Sediment Control Plan;*
- *a Surface Water Monitoring Plan;*
- *a Ground Water Monitoring Program; and*
- *a Surface and Ground Water Response Plan.*

Site water balance

20. The Site Water Balance must:

- *include details of:*
  - *sources and security of water supply;*
  - *water use and management on site;*
  - *any off-site water transfers or discharges; and*
  - *reporting procedures; and*
  - *describe measures to minimise water use by the project.*

Erosion and sediment control

21. The Erosion and Sediment Control Plan must:

a. be consistent with the requirements of Managing Urban Stormwater: Soils and Construction (Volume 2E – Mines and Quarries) manual (OEH 2008), or its latest version;

b. identify activities that could cause soil erosion and generate sediment;

c. describe measures to minimise soil erosion and the potential for transport of sediment downstream;

d. describe the location, function and capacity of erosion and sediment control structures; and

e. *describe what measures would be implemented to maintain the structures over time.*

Surface water monitoring

22. The Surface Water Monitoring Program must include:

a. detailed baseline data on surface water flows and quality in creeks and other waterbodies that could potentially be affected by the project;

b. surface water and stream health impact assessment criteria;

c. a program to monitor the impact of the project on surface water flows, water quality and stream health; and

d. *reporting procedures for the results of the monitoring program.*

Surface and groundwater response plan

24. The Surface and Groundwater Response Plan must describe the measures and/or procedures that would be implemented to:

a. investigate, notify and mitigate any exceedances of the surface water, stream health and ground water impact assessment criteria;

b. compensate landowners of privately-owned land whose water supply is adversely affected by the project; and

c. mitigate and/or offset any adverse impacts on groundwater dependent ecosystems or riparian vegetation.

If the modification is approved, a review of the water management plan will be triggered, as per Schedule 5, Condition 4, of the Bloomfield's Project Approval 07-0087. This conditions requires that within three months of any modification of the conditions of the Project Approval (unless the conditions require otherwise), the Proponent shall review, and if necessary revise, the strategies, plans, and programs required under this approval to the satisfaction of the Director-General. This is to ensure the strategies, plans and programs are updated on a regular basis, and incorporate any recommended measures to improve the environmental performance of the project.

It is also noted that Project Approval (05_0136) for the Abel Underground Mine allows for the operation of the Bloomfield CHPP, Rail Loading Facility (RLF) and other related facilities required for the handling and processing of coal.

3.2 EPA licence conditions

Bloomfield is subject to an Environment Protection Licence (EPL) No 396 issued by the Environment Protection Authority (EPA) under the *Protection of the Environment Operations Act, 1997*.

The EPL conditions for the Bloomfield Open Cut relevant to this assessment are summarised in **Table 1** and **Table 2.**

Table 1 EPL 396 Condition P1.2 - water monitoring and discharge points

EPL Monitoring Point	Type of monitoring Point	Type of discharge point	Location description
1	• Discharge to water under wet weather conditions • Volume monitoring • Discharge quality monitoring	• Discharge to water under wet weather conditions * • Volume monitoring • Discharge quality monitoring	Lake Forster pipe outlet labelled as Discharge Point W001 on Bloomfield Colliery Water Management Plan dated 31/3/1999
2	• Ambient water quality monitoring		Four Mile Creek located 500m upstream of the current New England Highway culvert for Four Mile Creek.

* Discharge limits for wet weather conditions are defined as:

- Discharge for one day following rainfall of at least 10mm in 24 hours;
- Discharge for two days following rainfall of at least 15 mm in 24 hours; or
- Discharge for three days following rainfall of at least 20 mm in 24 hours.

Table 2 EPL 396 Condition L2.4 – surface water concentration and discharge limits

100th Percentile Concentration Limits				Volume
Electrical Conductivity (EC) (µS/cm)	pH	Total Suspended Solids (TSS) (mg/L)	Filterable Iron (mg/L)	Limit (ML/day)
6,000	6.5-8.5	30	1.0	40

3.3 Guidelines

The following guidelines have been received and referenced as part of this surface water assessment

- '*National Water Quality Management Strategy Australian Guidelines for Fresh and Marine Water Quality'* (ANZECC/ARMCANZ 2000) and the '*ANZECC Guidelines and Water Quality Objectives in NSW'* (DEC, 2006) with respect to defining the environmental values of receiving waters and the definition of protections levels based on ecosystem condition; and
- *Managing Urban Stormwater Soils and Construction – Volume 2E Mines and Quarrie*s, (DECC, 2008) and *Managing Urban Stormwater Soils and Construction – Volume 1* (Landcom, 2004) with respect to the design of erosion and sediment control measures.

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4.0 Existing water management system

4.1 Existing mine water management system

4.1.1 Overview

The main goals of the Bloomfield mine water management system are to:

- Divert natural catchment runoff (where possible) around the mine site;
- Maintain site workability by the capture and storage of pit seepage and disturbed area runoff; and
- Maximise the usage of stored mine water for process water supply at the Bloomfield CHPP, dust minimisation on haul roads, trafficable areas and stockpiles.

The water management system at Bloomfield has been developed to meet the demand for water at the Bloomfield CHPP. This has been undertaken in collaboration with neighbouring mine sites, in particular with Abel. The system incorporates:

- Removal of water from active pits;
- Storage of water in lakes and voids;
- Controlled discharge into Four Mile Creek in accordance with EPL requirements;
- Control of stormwater pollution from 'dirty catchments' such as the:
  - Overburden dumps;
  - Waste disposal areas utilised by the CHPP;
  - Stockpile areas; and
  - Workshop area.

An aerial photograph, noting the location of current water storage dams, tailings dam and future voids is provided in **Figure 4.**

4.1.2 Clean water

The major natural creek running through the site is Four Mile Creek. Most of the operational mining areas at Bloomfield are located within the catchment of Four Mile Creek. A series of drains and levees direct Four Mile Creek around Lake Foster (mine water storage) and into Possums Puddle (clean water storage). From Possums Puddle, clean water overflows, or is discharged, back into Four Mile Creek.

Runoff from undisturbed and rehabilitated areas is directed away from operational areas and mine water storages via diversion banks and channels (refer to **Figure 5**). These banks and channels direct runoff into clean water dams or natural watercourses.

The major clean water storage dam is Possums Puddle. Clean water is not accessed for operational purposes and these dams overflow into natural drainage systems. Further isolation of smaller rehabilitated catchment areas from the mine water system will continue as rehabilitation work progresses.

4.1.3 Mine water

Mine water is defined as pit water, mining water, water that collects in the Bloomfield S-cut (south) and Bloomfield Creek-cut (north) and which has been removed by water management methods to continue the operations of the mine. This water may have elevated total dissolved solids (TDS), above the values that represent fresh water as defined by ANZECC and ARMCANZ (2000).

Bloomfield has two major mine water storage facilities, referred to as Lake Kennerson and Lake Foster (refer to **Figure 4**). Water pumped from the open cuts (S-Cut and Creek Cut) reports via open drains to Lake Kennerson. Runoff from disturbed areas (i.e. high wall, haul roads, overburden dumps awaiting rehabilitation) which has the potential to carry suspended solids, is also directed to Lake Kennerson. Lake Kennerson dissipates velocity and allows the settlement of suspended solids.

Lake Kennerson has a valve-controlled pipe which, when opened, feeds to Lake Foster. Lake Foster also receives decant water from the tailings storage facility (U-Cut) and water from the stockpile dam, which collects the runoff from the CHPP and coal stockpile pads. Mine water is pumped, primarily from Lake Foster, to the CHPP for use in coal processing and for dust suppression purposes by spraying on the coal stockpile pads.

Mine water is discharged, via lockable valve pipes, into an open drain that flows to Four Mile Creek. Discharges are undertaken in accordance with the conditions of EPL 396. Water sampling is undertaken during discharge, and a monitoring station continuously monitors electrical conductivity (EC) and water level. Further discussion on water quality monitoring is provided in **Section 5.0**.

Currently, fine coal rejects (tailings) are transferred for disposal to a disused open cut pit (contiguous to the old underground workings) which forms a tailings dam to the north of the active mining area. Water from the historic underground workings is used in dust suppression and coal processing.

4.1.4 Wastewater

Wastewater generated on site, consisting of domestic waste from bathhouses, administration offices and associated amenity areas, passes through a Cessnock City Council approved anaerobic wastewater treatment system.

4.1.5 Bloomfield CHPP and stockpile area

The approval for the Abel Project included expansion of the Bloomfield CHPP and associated stockpile area to accept up to 6.1 Mtpa of ROM coal (Donaldson, 2014) from the Abel Underground Mine in addition to the 1.3 Mtpa of ROM coal approved for Bloomfield.

Due to current coal market conditions, the Bloomfield CHPP currently receives approximately 1.1 Mtpa of ROM coal from Bloomfield Colliery, and Abel is currently in ‘care and maintenance’.

Surface water runoff from the stockpile areas are directed to the Stockpile Dam where is it transferred to Lake Foster (refer to **Figure 6**).

Water supply to the CHPP

The current water supply to the Bloomfield CHPP involves a series of storages and interconnecting pipelines:

- Lake Kennerson (200 ML capacity) receives all the dirty water from the pit, except the drain at the northern end of the cut which goes directly to Lake Foster. The dirty water is pumped / drained to Lake Kennerson. From Lake Kennerson it is either discharged off-site via a clean water diversion drain in accordance with EPL 396, or sent to Lake Foster if required for use in the Bloomfield CHPP or for dust suppression. There are two clean water diversions that flank Lake Kennerson and discharge to Four Mile Creek. A pipeline connects the “Big Kahuna”, the main water storage for Abel, to Lake Kennerson;
- Lake Foster (45 ML capacity) receives all other dirty water from site, the tailings return water, CHPP stockpile runoff dams, and the one dirty water drain from the open cut (seen at the northern end of the cut). Lake Foster feeds the Bloomfield CHPP and water cart for dust suppression; and
- Stockpile Dam (22 ML capacity) collects runoff from the stockpile near the CHPP and is transferred to Lake Foster for use in the CHPP.

The main access road between Creek Cut, S-Cut North and the ROM coal stockpile forms the southern boundary of the workshop area. This road is drained, via a table drain, to a low (vegetated) detention basin on the southern side of road. This detention basin acts as a sediment control pond. Once the basin is sufficiently full, water overflows through a culvert under the access road and discharges into the drainage line that flows along the western side of the workshop area and eventually becomes Elwells Creek a tributary of Four Mile Creek.

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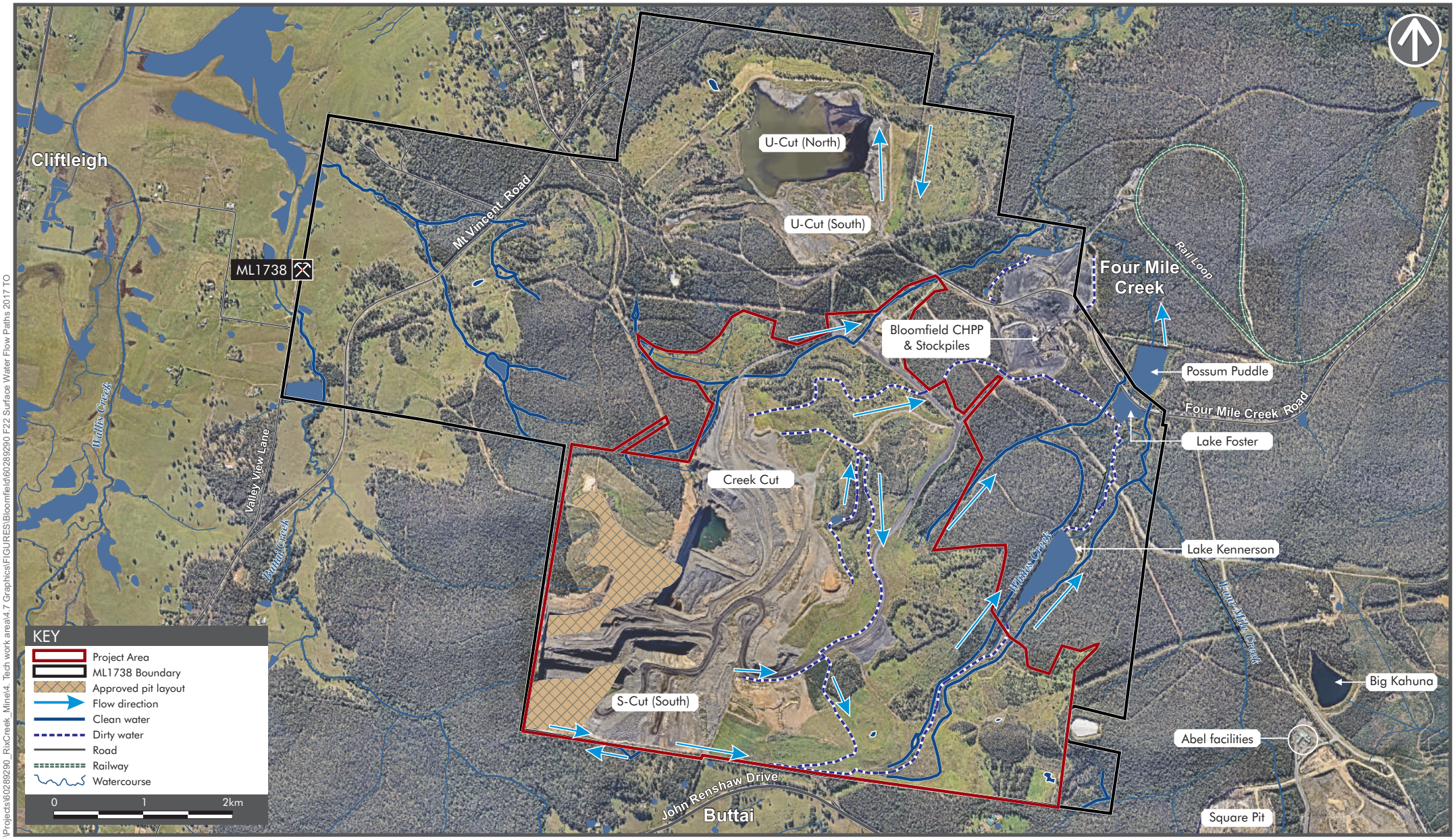
LOCATION OF CURRENT WATER STORAGE DAMS, TAILINGS DAMS AND FUTURE VOIDS

Bloomfield Project

FIGURE 4



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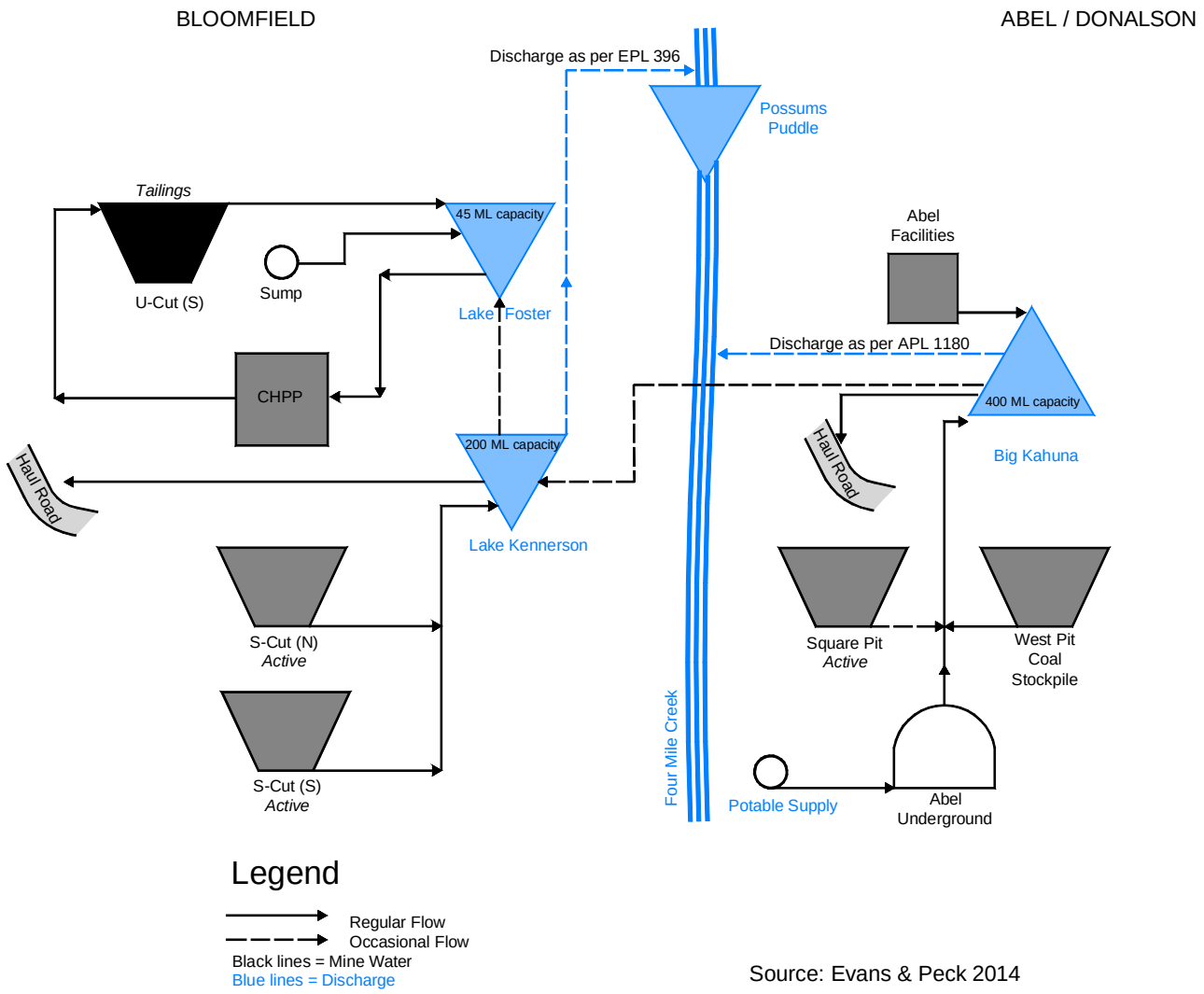
SURFACE WATER FLOW PATHS

Bloomfield Project

FIGURE 5



Source: Evans & Peck 2014

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EXISTING WATER AMANGEMENT ARRANGEMENT
Bloomfield Project

Figure 6

4.1.6 Erosion and sediment management

'Sediment affected water' is runoff that does not come in contact with coal, it is surface water runoff from disturbed areas, pit overburden and haul roads. This runoff is managed to ensure that downstream water quality is within the adopted water quality compliance criteria and EPL water quality limits.

Erosion and sedimentation control is an integral part of the site's water management system. The design of rehabilitated areas incorporates water management structures to effectively shed run-off water, whilst minimising erosion and sediment load. Progressive rehabilitation of disturbed areas as soon as is practicable, also reduces the potential for erosion and downstream sedimentation. There are a number of sediment basins around the site that are positioned to intercept runoff from other disturbed areas on-site, such as from haul roads, stockpile pads, infrastructure areas, and recently rehabilitated areas.

Silt traps along the edges of haul roads and hardstand areas are cleaned at regular intervals. They have been designed to capture surface runoff during rain events and allow sediment to settle. All silt traps, dams, drains, bunds, lines, valves and other infrastructure used to manage runoff are inspected on a quarterly basis as part of the site Environmental Management System (EMS) (Bloomfield, 2017).

4.1.7 Tailings management

Arrangements for disposal of coarse rejects and fine tailings from the CHPP to the S-Cut following the completion of resources extraction from that cut, have been approved as part of the Abel Project Approval.

The size of the void storage required on the Bloomfield site is subject to tailings production from Abel, which is currently in care and maintenance.

The latest estimate of the tailings storage required for disposal comes from the Abel Modification Tailings Disposal Option by Evans and Peck, 2012 (Evans and Peck 2012 b), that states that the 2011 survey data from Bloomfield provides the best available basis for estimating future requirements for storage of tailings (0.17 m^3/tonne of ROM coal). Therefore, of the 1 million tonnes of ROM coal per annum 0.83 million tonnes is product and solid refuse (chitter) with 0.17 million tonnes of tailings reject material.

4.1.8 Groundwater – surface water interaction

Groundwater in the alluvium associated with Wallis Creek and the Hunter River floodplain is believed to be in direct hydraulic connection with the surface water in these wetland areas, based on close correlation between the surface water and groundwater levels (Aquaterra, 2008). Similar conditions are expected to occur in the lower reaches of the major tributary streams. There is believed to be relatively free interchange of water between the alluvium and the surface water bodies, with the groundwater discharging to the surface water at most times, and possibly flowing in the reverse direction for short periods following periods of heavy rainfall.

The limited occurrences of localised surficial groundwater in the colluvium / weathered bedrock are believed to be in reasonable hydraulic connection with the high-level streams, and there is expected to be some interchange of water between the creek-beds and the shallow weathered bedrock beneath. These localised occurrences of surficial groundwater do not represent a significant or regionally extensive aquifer system, and should really be considered to be part of the surface water flow system.

On the other hand, there is believed to be minimal interaction between the surface drainage system (including the alluvial and other surficial groundwater), and the deeper groundwater within the coal measures. Likewise, there is believed to be limited interaction between groundwater in the alluvium and deeper groundwater in the coal measures (Aquaterra, 2008).

Potential groundwater impacts associated with the proposed extension of the Bloomfield Colliery mine life and amended final landform are assessed separately (refer to *Groundwater Impact Assessment, Bloomfield Life of Mine Extension,* AECOM 2018)**.**

4.2 Water balance

4.2.1 Bloomfield Colliery

A site water balance was developed by Evans and Peck (2012) for the Abel EA. As the two sites operate collaboratively with respect to water management and the CHPP operations, the assessment included Bloomfield's water system as part of the water balance modelling. The site water balance described:

- Sources and security of water supply;
- Water use and management on site;
- Off-site water transfers or discharges;
- Reporting procedures; and
- Measures to minimise water use by the project.

The site water balance model indicates that the Bloomfield project is capable of meeting all water needs for dust suppression from the groundwater inflows and surface runoff into the mine pits, and typically generates a net surplus of water that can contribute to the water supply required for operation of the Bloomfield CHPP.

The site water balance reporting from the Bloomfield Annual Environmental Management Reports for 2012 to 2016 are summarised in **Table 3.**

Table 3 Bloomfield Colliery stored water 2012 - 2016

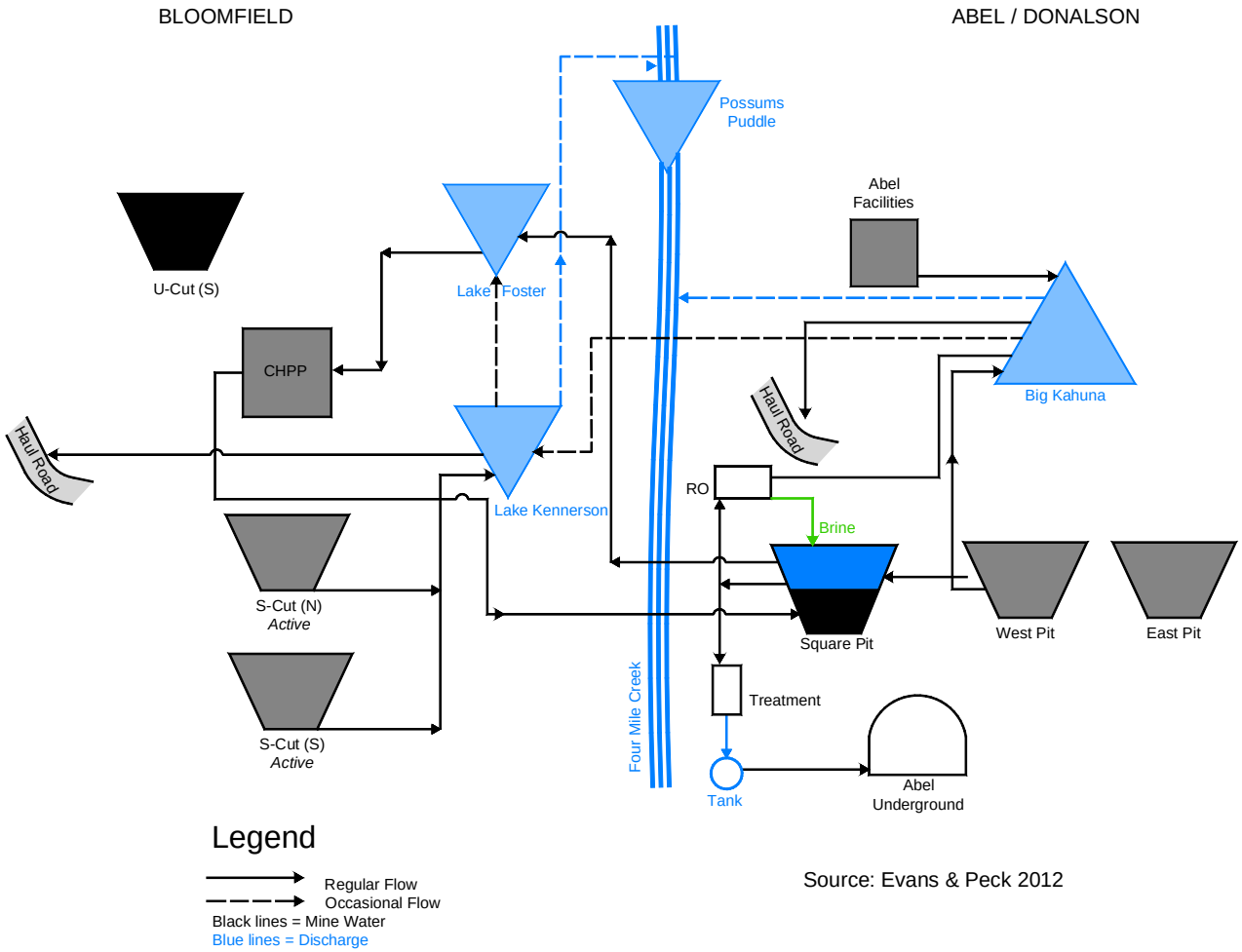
Storage	Stored water volumes (m^3) held by Bloomfield Colliery					
	2016	2015	2014	2013	2012	Storage capacity
Clean water						
Possums Puddle	90	90	90	90	90	90
Mine water						
Lake Kennerson	100	100	130	120	60	190
Lake Foster	20	20	20	20	20	45
Tailings Dam	150	350	400	400	400	600
S Cut (S-Cut South)	NIL	NIL	NIL (operational pit)	NIL (operational pit)	NIL (operational pit)	NIL (operational pit)
Creek Cut (S cut north)	440	650	NIL (operational pit)	NIL (operational pit)	NIL (operational pit)	NIL (operational pit)
Controlled discharge volumes						
EPL 396 Point 1	<40ML/day	<40ML/day	<40ML/day	<40ML/day	<40ML/day	-
Annual Volume	1792ML	1625ML	990ML	1680ML	1400ML	

Source: Bloomfield Annual Environmental Reports

4.2.2 Abel Underground Mine

The surface water impact assessment undertaken for Abel (Evans and Peck, 2012), assessed the operation of both Bloomfield and Abel over the life of the Abel project (up to and including 2030). The water balance model considered both mines as the water management is integrated across both sites. There are formal agreements in place between Abel and Bloomfield including protocols relating to the transfer of water from Abel to Bloomfield.

A schematic of the water management system is provided in **Figure 7.**



Source: Evans & Peck 2012

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SCHEMATIC DIAGRAM OF INDICATIVE WATER MANAGEMENT SYSTEM IN 2015
Bloomfield Project

FIGURE 7

The Abel Upgrade Modification Surface Water Assessment (Evans and Peck 2012) staged the impact assessment of surface water management for the Abel project into two stages:

Stage 1: 2013 - 2018

- Use of the Donaldson Square Pit to store the higher salinity water expected from the Abel Underground Mine as well as tailings from the Bloomfield CHPP when required;
- Use of spare capacity in the Donaldson Square Pit for storage of tailings; and
- Treatment of mine water (i.e. using a reverse osmosis [RO] plant) to a standard suitable for discharge to Four Mile Creek.

Stage 2: 2019 - 2030

- Transfer of water from Abel Underground Mine to Lake Foster for use in the Bloomfield CHPP;
- Placement of tailings in one of the major Bloomfield Colliery voids (S-Cut [South] and Creek-Cut [North]) as they become available; and
- Placement of any excess mine water in one of the major Bloomfield Colliery voids as required.

The Abel project includes the construction of a reverse osmosis (RO) treatment plant in the future. The intention of the RO plant will be to treat surplus mine water and enable discharge to Four Mile Creek, via the Big Kahuna. In order to ensure opportunities for licensed discharge can be compliant with water quality limits, the salinity in the Big Kahuna needs to be maintained below 2,000 µS/cm.

Abel has been in 'care and maintenance' since June 2016. The 'Abel Underground Mine, Water Management Plan' (Donaldson Coal, 2014), notes the following key aspects of mine water management since the 2012 Project Approval:

- The use of the Donaldson Square Pit no longer considered viable (see Stage 1 above);
- Since August 2013, some areas of old underground workings have been allowed to progressively fill with groundwater – only inflow from localised areas has been transferred to the Big Kahuna;
- Water for underground operational purposes is drawn from the Hunter Water potable supply;
- Water from the Big Kahuna is used for on-site operational purposes, principally dust suppression;
- Water is periodically transferred from the Big Kahuna (Abel) to Lake Kennerson (Bloomfield) via a pipeline, which has a capacity of 8 ML/day; and
- When conditions permit under Abel's EPL, water is discharged to Four Mile Creek from the Big Kahuna Dam.

Figure 6 provides the existing water management system as it existed in 2014, and as it operates today.

To date, the Abel mine water make has shown significant variation. Whilst surface runoff from surface operations at Abel also provide a source of water, mine water is a dominant factor in the overall site water balance and ensures security of supply for the water needed for the Abel and Bloomfield CHPP mine operations.

Mine water make to date has been significantly less than the annual rates predicted by Aquaterra (2012). This is due to the:

- Lower rates of production and care and maintenance periods due to market conditions; and
- Practice of allowing water to accumulate in parts of worked-out areas of the mine (Abel Panels 1-9 and the East Mains).

Once the underground water storage capacity is filled (390ML), the outflow from the underground workings will continue to be pumped to the surface.

Due to subsequent changes in Abel's operations since the original Project Approval, "Stage 1" of the surface water assessment is likely to extend well beyond 2018, and the need for the construction of an RO plant has not yet been triggered. Evans & Peck (2012) concluded that "*Notwithstanding some*

uncertainty about the volume of water retained in the deposited tailings, the total volume of water required to make up for losses in the tailings and by evaporation is reported to be significantly less than the volume of runoff and groundwater seepage into the currently operating pits at Bloomfield. Accordingly, Bloomfield is self-sufficient (i.e. does not require any water to be transferred from the Abel Underground Mine for operational purposes)."

Therefore, the changes to Abel's mine water make and water budget compared to the 2012 projections have not been an impediment to the ongoing operation of Bloomfield.

4.2.3 'Stage 1' water management

The Evans and Peck (2012) Surface Water Assessment provides a proposed water management system for the Abel Modification that integrates the Bloomfield Colliery, the Bloomfield CHPP and Abel Underground. Currently Abel is in a care and maintenance phase. However the amount of water required by Bloomfield can be provided by the Bloomfield operation itself.

Evans and Peck (2012) note the followings key aspects of the Stage 1 (refer **Figure 7**) water management:

- Bloomfield Colliery would operate with modest transfers of water from the Big Kahuna to Bloomfield, when conditions permitted;
- That tailings from the Bloomfield CHPP would be placed in the Donaldson Square Pit, however as noted in **Section 4.2.2**, this is longer a viable option; and
- Water from the Big Kahuna would be used for dust suppression, discharged in accordance with Donaldson Coals licence conditions (EPL 11080) and to Bloomfield where possible.

4.2.4 Proposed Water Management 2019 – 2030

Evans and Peck (2012) provided a proposed water management model from 2019 to 2030, in which it was assumed that mining would be completed in S-Cut (South) by the end of 2018, followed by Creek-Cut (North) in 2022, with over 20,000 ML of storage for tailings.

With this proposed modification the Bloomfield mine will extend mining operations out to 2030 to be in line with Abel's consent. Based on this extended extraction at Bloomfield, and the lower rate of extraction from Abel to date, the proposed water management arrangement for 2019 - 2030 is not fully representative of proposed operations.

When Abel returns to full operation (timing for return to full operation is currently unknown), the site water management plan and site balance should be updated to reflect the amended program of extraction and project the future water needs and tailings storage requirements of both sites.

4.2.5 Water balance and Salinity Accounting Methodology

Evans and Peck (2012) incorporated an assessment of the performance of the water management system under different climate sequences, representing the full range of wet and dry climate drawn from local historic climate records.

The water balance for the 2013 to 2018 period focused on the Abel / Donaldson water management system and represented the daily inflows and outflows and associated salinity for the elements of the water management system depicted in **Figure 7.**

This mine water balance accounted for the storage of tailings in the Donaldson Square Pit from mid-2015, however the Abel Underground Mine Water Management Plan (Donaldson 2014) notes that this is no longer a viable option.

4.2.6 Catchments and storages

The catchments and storages used for the water balance are stated in **Table 4**. Where relevant to the particular stage or climate scenario, the catchments and water storages or voids set out in **Table 4** are included in the model.

Table 4 Catchment areas, storages and voids

Catchments	Area (ha)	Storage volume (ML)
West Pit	28.7	-
Abel Mine Facilities	2.1	-
Storage/Voids		
Big Kahuna	4.9	400
Donaldson Square Pit	21	2,900
S-Cut (South) and catchment	55	10,000
Creek-Cut (S-Cut North) and catchment	68	10,000

Source: Evans and Peck 2012

4.2.7 Water demands

Water requirements for mine operations comprise water use for dust suppression on haul roads, work areas and stockpiles, with the largest water requirement for the Bloomfield CHPP.

4.2.8 Assumed water transfers and storage operating rules

The adopted water transfers and storage operating rules were modelled by Evans and Peck (2012) and stated as follows:

- Discharge from Big Kahuna to Four Mile Creek is modelled to occur at a rate of 8 ML/day for 5 days following any day over 10 mm of rainfall;
- Transfer from Big Kahuna to Lake Kennerson occurs at a rate of 8 ML/day, after 3-4 days following discharge to Four Mile Creek;
- The RO plant is assumed to have an inflow of 4 ML/day with the waste brine (assumed to be 25% of the inflow) returned to the Donaldson Square Pit. The output of the RO plant is assumed to have a salinity of 150 mg/L (250 µS/cm); and
- 'Top-up' supply to account for the assumed 10% loss from water supplied for the underground operations is assumed to be taken from the Donaldson Square Pit.

4.2.9 Water Balance and Salinity Results 2013-2019

The water balance by Evans and Peck (2012) noted that the overall water balance is dominated by the groundwater inflow to Abel underground. The effect of climate on water use for dust suppression and the number of opportunities for discharge to Four Mile Creek are secondary factors in the overall site water balance.

The water balance assumed that Bloomfield S-Cut (South) would be available for storage of tailings and water from the end of 2018. However, Abel has been in care and maintenance since June 2016. Lower extraction rates and ability to store water in Abel's unused underground workings has resulted in less mine water make than previously projected. The availability of the Bloomfield S-Cut south for tailings does not impede operations for tailings and water storage with Abel in care and maintenance.

The Evans and Peck (2012) water balance has noted for the period between 2015 and 2019 that in the worst case wet climate scenario that the maximum additional storage for the Abel Underground in addition to the Big Kahuna and the Donaldson Square pit is approximately 400 ML. The report also notes that:

- If required, this additional storage requirement (about 400 ML) would be made available by either constructing an embankment around the western edge of the Donaldson Square Pit within the existing disturbance area (an embankment about 2.5 m high would be sufficient to hold an

additional 500 ML of water) or creating additional storage in the Donaldson West Pit (e.g. by modifying the existing sump within the approved disturbance area);

- While these additional storage options would resolve the water storage issue until the Bloomfield S-Cut (South) void became available, alternative storage would also need to be provided for tailings storage (estimated as being approximately 2.4 million m³ based on the 2012 tailings production schedule). Options for this storage of these tailings include:
    - Creating additional storage in the Donaldson Square Pit with the construction of the embankment around the Donaldson Square Pit;
    - Storage of tailings in the S-Cut South interim storage; and
    - Transferring groundwater inflows from the Abel Underground Mine to the sump in the Donaldson West Pit (creating additional storage capacity for tailings in the Donaldson Square Pit).

The Evans and Peck (2012) water balance and tailings storage analysis assumes that all the contributing mines provide ROM coal to the CHPP at maximum scheduled rates.

As Abel is in care and maintenance mode, and the ROM coal to the CHPP is significantly below the maximum approved capacity, the need for creating additional storage for tailings is not required in the interim. Currently the U-Cut pit is being used for tailings, at current production rates this tailings emplacement will reach capacity in 2019. Bloomfield has an approved (Dam Safety Committee) augmentation plan to increase the capacity of this tailings facility if required.

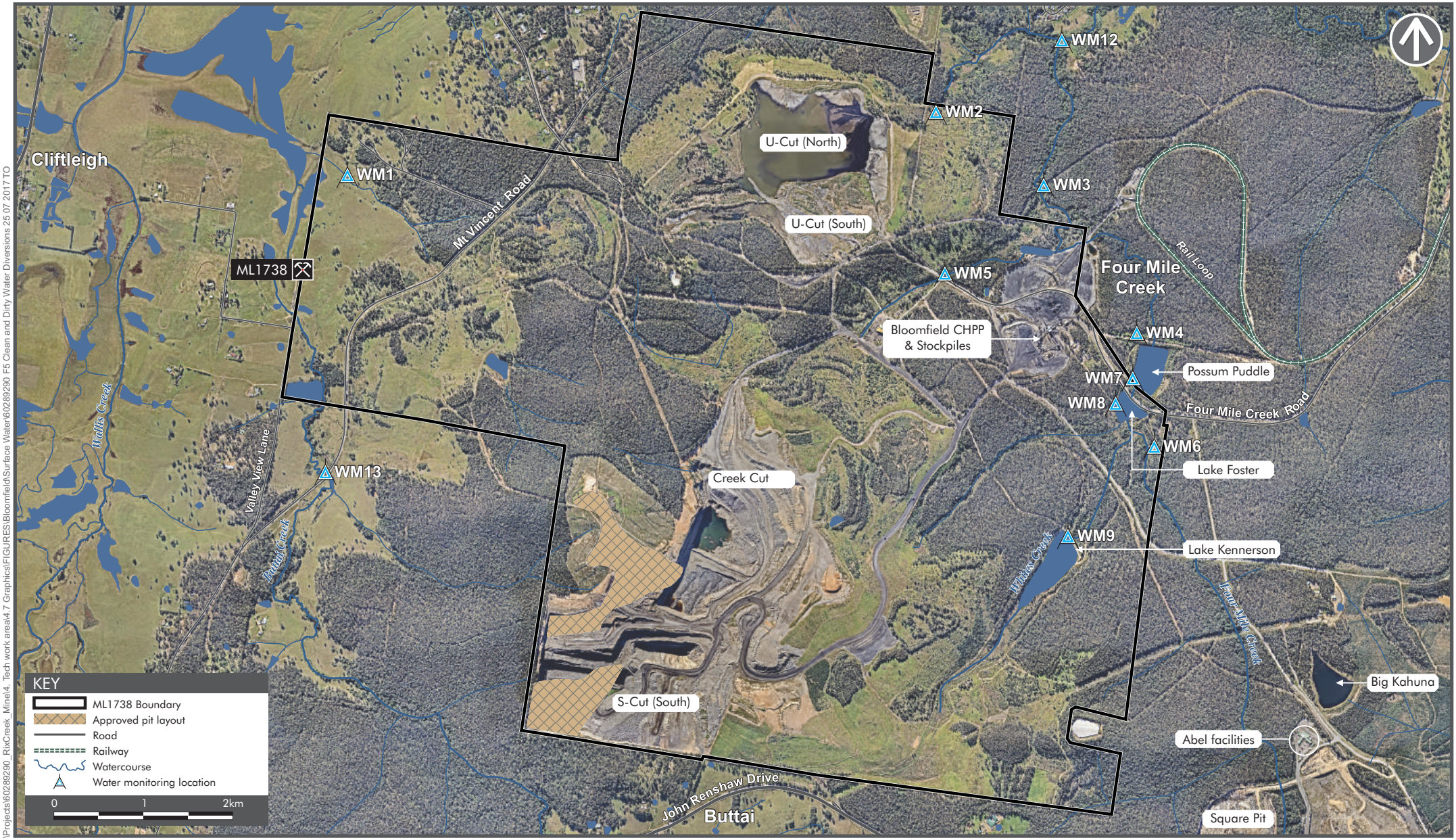
Based on this review of the existing water balance, the water management system has the flexibility to manage the change in production rates and schedules. The Bloomfield site is largely self-sufficient for water supply and both sites have the ability to manage surplus water within their licensed discharge limits. In summary, this can be achieved by:

- Transfer of water between the two sites;
- Discharge of surplus water within the limits of the EPL;
- Installation and operation of an RO plant by Abel (if Bloomfield are unable to take surplus from Abel); and
- Storage of mine water in underground voids (Abel).

5.0 Existing surface water quality

Routine monthly ambient water quality monitoring is carried out at thirteen locations within and around the Bloomfield site shown in **Figure 8.**

Water samples are analysed for a wide variety of parameters including pH, EC, total suspended solids (TSS), TDS, dissolved oxygen (DO), plant nutrients anions, cations and metals. Water quality monitoring data has been collected since 1996. Water quality data collected along Four Mile Creek and its tributaries (upstream to downstream) is summarised in **Table 5.** **Table 6** summarises the monitoring sites within and around the Bloomfield site.



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WATER MONITORING LOCATIONS
Bloomfield Project

FIGURE 8

Table 5 Summary of water quality data in Four Mile Creek

Location	Four Mile Creek @ John Renshaw Drive	Four Mile Creek U/S Possums Puddle	Four Mile Creek @ Possums Puddle discharge	Elwells Creek @ haul road	Elwells Creek / Four Mile Creek Junction	Shamrock Creek @ Shamrock Hill Lane	Shamrock Creek / Four Mile Creek Junction	Four Mile Creek U/S New England Highway
Designation	WM 10	WM 6	WM 4	WM 5	WM 3	WM 2	WM 12	WM 11
pH								
Mean	7.0	7.0	7.5	6.7	7.3	6.3	7.4	7.3
Minimum	5.7	5.5	5.5	3.4	4.2	3.9	4.1	5.7
10 percentile	6.4	6.5	6.9	5.2	6.7	4.9	6.8	6.8
90 percentile	7.5	7.7	8.2	7.8	7.9	7.6	8.1	7.9
Maximum	8.7	9.1	9.3	8.5	8.9	8.4	8.7	8.7
EC (µS/cm)								
Mean	414	230	1178	1892	1555	1144	2177	2223
Minimum	50	100	70	9	193	180	200	189
10 percentile	182	135	195	430	370	330	550	671
90 percentile	649	313	3215	3950	3426	2422	4830	4700
Maximum	4900	2780	7360	8010	6080	5900	8260	8070
TDS (mg/l)								
Mean	320	164	604	1042	934	808	1628	1518
Minimum	130	20	8	100	120	46	126	0
10 percentile	180	80	106	228	206	243	316	310
90 percentile	418	255	1750	2082	2476	2083	3915	3570
Maximum	3390	1760	5660	6110	5070	3980	7015	6555
TSS (mg/l)								
Mean	24	30	24	58	23	49	31	18
Minimum	2	1	1	1	1	4	1	0
10 percentile	6	4	1	4	2	8	5	3
90 percentile	50	70	46	131	53	111	73	40
Maximum	180	370	627	1001	370	340	270	150
DO (mg/L)								
Mean	5.7	6.6	8.5	8.3	7.7	6.4	7.1	6.0
Minimum	0.3	2.2	3.6	3.7	3.2	3.1	3.0	0.5
10 percentile	2.0	3.1	6.1	5.9	5.3	4.0	4.6	3.2
90 percentile	9.6	10.5	10.6	11.0	9.9	9.0	9.8	9.5
Maximum	13.2	13.0	13.2	11.4	11.1	11.4	11.4	12.5

Water quality data from the other monitoring sites within and around the Bloomfield site is summarised in **Table 6.**

Table 6 Summary of water quality data for other locations

Location	Adjacent Rathluba Colliery	Buttai Ceek @ Buchanan Road	Possums Puddle	Lake Foster	Lake Foster discharge pipe outlet
Designation	**WM 1**	**WM 13**	**WM 7**	**WM 8**	**EPL 1**
pH					
Mean	4.4	7.3	7.2	8.0	8.2
Minimum	2.7	6.1	5.9	5.9	5.6
10 percentile	2.8	6.7	6.6	7.6	7.9
90 percentile	6.7	7.8	8.0	8.3	8.6
Maximum	8.0	8.5	9.3	8.9	10.0
EC (µS/cm)					
Mean	3044	754	434	5125	4898
Minimum	116	135	9	260	300
10 percentile	993	388	180	3499	2628
90 percentile	7411	1100	960	6330	6350
Maximum	14400	1600	4960	9700	9000
TDS (mg/l)					
Mean	1475	501	281	3677	3080
Minimum	86	204	40	110	450
10 percentile	280	315	110	2171	1500
90 percentile	3951	773	308	5044	4576
Maximum	5825	1020	3580	6200	5500
TSS (mg/l)					
Mean	54	19	18	11	20
Minimum	1	2	1	1	1
10 percentile	2	5	2	2	4
90 percentile	74	39	45	23	37
Maximum	1272	74	250	68	294
DO (mg/L)					
Mean	6.5	5.8	7.5	8.3	9.6
Minimum	1.8	2.0	3.1	3.1	4.2
10 percentile	3.6	3.2	4.2	5.5	6.3
90 percentile	9.2	9.2	10.1	10.5	12.7
Maximum	9.2	12.1	13.0	13.1	14.5

Event-based samples of any discharge from Bloomfield Colliery are collected and analysed for EC, pH, TSS and filterable iron, as required by the EPL conditions. Water samples during a discharge event are taken from EPL Point 1 (Lake Foster discharge pipe outlet) and at EPL Point 2 (Four Mile Creek U/S New England Highway) downstream of the discharge point. A summary of annual discharges from Lake Kennerson and associated water quality is provided in **Table 7** and respectively. The water management system is designed so that uncontrolled discharges should not occur. Should an uncontrolled discharge occur, a grab sample would be taken and analysed for the same suite of pollutants as for a controlled discharge event.

Table 7 Summary of annual discharges

Year	No. of discharge events	Daily discharge (ML)			Lake Kennerson	Annual	Annual
		Min	Max	Average	Annual discharge volume (ML)	Salt load (t)	Rainfall (mm)
1999	42	14	40	38	915	3,108	997
2000	61	0.6	40	36	2,201	7,176	912
2001	31	15	40	36	1,126	3,439	941
2002	17	40	40	40	680	1,824	856
2003	6	40	40	40	240	1,014	701
2004	20	5	40	34	670	2,572	769
2005	9	25	40	35	319	1,367	775
2006	0	-	-	-	-	0	635
2007	26	10	40	37	955	3,030	1150
2008	30	20	40	37	1,100	3,116	1184
2009	18	30	40	39	699	2,184	943
2010	9	25	40	38	345	1,002	826
2011	47	20	40	39.57	1,860	6,694	1182
2012	35	40	40	40	1,400	4,997	915
2013	43	20	40	39	1,680	5,909	1147
2014	35	5	40	28	990	4,069	844
2015	53	10	40	31	1,625	6,214	1378
2016	57	2	40	31	1,792	7,897	1041
2017	30	5	40	22	670	2,192	586

Table 8 Summary of water quality data for discharges

Parameter	EPL 1 Lake Foster discharge pipe outlet	EPL 2 Four Mile Creek U/S New England Highway
pH		
Mean	8.0	7.6
Minimum	6.7	6.0
10%Percentile	7.7	7.0
90% Percentile	8.3	8.2
Maximum	8.9	8.5
EC (µS/cm)		
Mean	4683	2941
Minimum	860	283
10%Percentile	3182	818
90% Percentile	5710	4972
Maximum	6975	5930
TDS (mg/l)		
Mean	3553	2270
Minimum	588	44
10%Percentile	2152	606
90% Percentile	4680	4024
Maximum	5510	5470
TSS (mg/l)		
Mean	11.6	39.9
Minimum	0.0	1.0
10%Percentile	2.0	8.0
90% Percentile	19.0	100
Maximum	350.0	360

6.0 Surface water assessment and impacts

6.1 Mine Water Management

6.1.1 Potential Impacts

Due to lower production rates at both Bloomfield and Abel's operations since the most recent Bloomfield Modification and Abel's 2012 Project Approval, the basis and assumptions previously applied for the surface water assessment for 'Stage 1' is likely to extend well beyond 2018, and therefore the need for an RO plant or other measures has not yet been triggered. Evans and Peck (2012) concluded that "*Notwithstanding some uncertainty about the volume of water retained in the deposited tailings, the total volume of water required to make up for losses in the tailings and by evaporation is reported to be significantly less than the volume of runoff and groundwater seepage into the currently operating pits at Bloomfield. Accordingly, Bloomfield is self-sufficient (i.e. does not require any water to be transferred from the Abel Underground Mine for operational purposes)*."

Recent departures of Abel's mine water make, water budget and projections of tailings production (compared to the 2012 projections) are not an impediment to the ongoing operations of Bloomfield through to 2030. Abel's Project Approval includes an allowance for disposal of surplus water to Bloomfield voids in future years, and that if Bloomfield is still operational, appropriate means are available to dispose of surplus water (if that were to occur) via an RO plant if necessary and modifications to the Donaldson Square Pit, which could then be discharged to Four Mile Creek under appropriate conditions.

With Abel in care and maintenance mode, and the volume ROM coal processed by the CHPP well below maximum approved rates, the need for creating additional storage for tailings is, for the interim, not required. Currently the tailings pit is being used for disposal of tailings and is projected to have sufficient capacity up until 2019 and beyond if the augmentation is carried out.

The proposed modification for the extension of mining is not predicted to have significant impacts on water supply or demand, or offsite water quality impacts. Current management on site is consistent with current guidelines, in that:

- Natural catchments are managed to divert clean water;
- Mine water and runoff from disturbed areas is captured and stored on site; and
- Mine water is reused on site for CHPP operations and dust suppression to minimise the use of higher quality water.

The design and operation of the existing water management system allows a high degree of flexibility in and significant capacity to account for variations in climatic conditions and production rates. No further impacts to surface water management, beyond that approved under the current Project Approval are predicted.

6.1.2 Mitigation Measures

There is a current, submitted Water Management Plan in place that outlines the principles of water management across both Bloomfield and Abel.

As per the conditions of consent under the Project Approval, the Water Management Plan, inclusive of a site water balance, requires review and revision in response to specific triggers. This includes completion of an annual review, submission of an incident report, and any modifications to the conditions of the approval.

Future reviews and updates to the Water Management Plan will therefore ensure that the management of soil and water on site continues to:

- Stay current and consistent with current guidelines and best practice;
- Account for projected changes in operation; and
- Update water balance modelling and projections on the basis of observed results (i.e. variations in mine water make, groundwater monitoring).

At such time that Abel returns to production, reconsideration of the water balance, as part of the above review process, will enable and support appropriate planning to ensure mine water and tailings can continue to be contained on site.

6.2 Catchments

6.2.1 Potential Impacts

The amended final landform will result in the following changes to the existing approved design:

- The final eastern slopes of the overburden dump will drain east towards Four Mile Creek. The catchment area draining towards Four Mile Creek has increased by approximately 10 Ha from the currently approved final landform design; and
- The proposed catchment area draining towards the final void is approximately 52 Ha, a decrease from the 103 Ha under the currently approved final landscape design. This increases the catchment to Buttai Creek by 41 hectares.

A potential negative impact of this final landform amendment will be an increased risk of sediment laden water draining off site to Four Mile Creek and Buttai Creek whilst the catchment is being revegetated and stabilised.

A reduced catchment draining to the final void will have a positive effect on Four Mile Creek and Buttai Creek and its tributaries, as it results in less water being removed from the natural catchment hydrology in the post-mining phase, and less water draining to the final mining void.

6.2.2 Mitigation Measures

Rehabilitated catchments will continue to be managed as per the current Water Management Plan and Rehabilitation Management Plan. These principles include that:

- Rehabilitated landform is progressively rehabilitated;
- Runoff from areas undergoing rehabilitation is managed with appropriately designed water and sediment management structures (contour banks, drains, and drop structures); and
- Ongoing monitoring of the landform is carried out to repair and restore areas of erosion or instability.

Discharge of water from the final landform will not occur to Four Mile Creek or Buttai Creek and its tributaries until the catchment is considered ‘rehabilitated’ in accordance with the Rehabilitation Monitoring Plan and associated regulator sign-off and approvals.

6.3 Surface water quality impacts

The potential impacts of Bloomfield’s current and future operations relate to the risks of contamination from disturbed catchments, mine water, and process water being released off site to natural waterbodies.

Discharges to Four Mile Creek from Bloomfield occur from Lake Foster discharge pipe outlet and are monitored and reported in accordance with EPL 396. Since the approval of the Project there have been four unplanned discharges as a result of large rainfall events or pipe failure which resulted in water overflowing from storage dams and leaving the site. These incidents were reported to the EPA in accordance with Project Approval and EPL requirements. Of the planned discharges, there have been a small number of isolated incidents where water quality was outside of EPL compliance limits.

The proposed modification being sought by Bloomfield will not increase or decrease the probability of unplanned discharges, or water quality risks, from Bloomfield’s operations. However these risks will continue to exist up until the end of extraction (2030) and until such time as the site is rehabilitated noting that risks would decrease with the progressive rehabilitation of post mining areas across the life of the project.

6.3.1 Mitigation Measures

By implementing an effective mine water management system, the project will continue to mitigate potential adverse impacts on receiving waters. The key elements include:

- Runoff from undisturbed and rehabilitated areas is directed away from operational areas and mine water storages via diversion banks and channels; and
- Collection of mine and sediment water for treatment before discharge via Lake Kennerson, Lake Foster and sediment basins to intercept runoff from disturbed areas.

Surface water monitoring will continue to be undertaken in accordance with Bloomfield's EPL 396. The existing monitoring program is subject to periodic review to ensure it continues to be adequate and consistent with current guidelines and policy requirements.

6.4 Soil – erosion and sediment control

6.4.1 Potential impacts

The extension of mining to 2030 is considered to have negligible potential impact to soil. The proposed extension of mining will not result in the expansion of disturbed areas beyond that approved under the current consent. The mining operations will continue to extract within previously nominated pit limits, as the new mining fleet is capable of extracting coal that was previously considered unrecoverable.

The amended final landform will result in an increased proportion of the rehabilitated catchment areas draining to Four Mile Creek, Buttai Creek and its tributaries as opposed to the final void. These potential impacts will be mitigated through current site practices, as outlined in site environmental management plans, for example: the design and operation of drainage lines, sediment basins and erosion and sedimentation controls.

6.4.2 Mitigation measures

To ensure that the discharge of all water from the site is managed and meets appropriate quality standards, the key elements of the erosion and sediment control plan include:

- Coordination of mining to minimise exposure to disturbed soils;
- Separation or diversion of clean water catchments from disturbed areas to minimise sediment laden and mine water volumes for management;
- Collection and management of runoff sediment control devices;
- Appropriate storage and handling of topsoil materials;
- Revegetation of disturbed areas following site disturbance; and
- Effective maintenance program.

6.5 Cumulative impacts

The Abel and Bloomfield existing operations have a cumulative impact on the local soil and water environment. The sites are operating within their approved limits, and will continue to do so up until the approved limit of mining in 2030.

There are minor additional impacts related to soil, water quality and surface water as a result of the proposed modification. These can be addressed by the mitigation measures above. Therefore, no additional impacts are predicted when considering other projects within the region.

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7.0 Conclusions and Recommendations

Bloomfield is seeking approval for modifications to Project Approval 07_0087, for the extension of mining operations up until 31 December 2030 and a revised final landform.

Mine scheduling to support the Project Approval identified that the resource would be exhausted by the end of 2021. However, Bloomfield now predicts mining to extend beyond 2021 due to:

- Actual run of mine (ROM) production levels have been lower than the predicted ROM production rates of 1.3 Mtpa, over the life of the project to-date;
- Changes to the mine fleet have allowed access to, and extraction of seams that were not previously considered to be a recoverable resource as part of the Environmental Assessment (Completion of Mining and Rehabilitation, Part 3A Environmental Assessment Project Application 07-0087, Volume 1, 2008); and
- Further exploration has identified other previously unrecoverable resources that the new fleet can now access.

Bloomfield has identified up to 13 million tonnes of ROM coal remaining inside the approval area. Based on current annual mining rates of approximately 1 million tonnes of ROM per year, mining will extend beyond 2021. The intention of this consent modification is to align the Bloomfield mining operations consent limit to coincide with the adjoining Abel Underground Mine consent limit of 31 December 2030. Maximum annual production levels will continue at 1.3 Mtpa ROM per year.

Due to the subsequent changes in Abel's operations since the original Project Approval, the surface water assessment for 'Stage 1' is likely to extend well beyond 2018. Evans and Peck (2012) concluded that "*Notwithstanding some uncertainty about the volume of water retained in the deposited tailings, the total volume of water required to make up for losses in the tailings and by evaporation is reported to be significantly less than the volume of runoff and groundwater seepage into the currently operating pits at Bloomfield. Accordingly, Bloomfield is self-sufficient (i.e. does not require any water to be transferred from the Abel Underground Mine for operational purposes).*"

Recent departures of Abel's mine water make, water budget and projections of tailings production (compared to the 2012 projections) are not an impediment to the ongoing operations of Bloomfield through to 2030.

The design and operation of the existing water management system allows a high degree of flexibility in and significant capacity to account for variations in climatic conditions and production rates. No further impacts to surface water management, beyond that approved under the current Project Approval are predicted.

Future reviews and updates to the Water Management Plan will ensure that the management of soil and water on site continues. At such time that Abel returns to production, reconsideration of the water balance will enable and support appropriate planning to ensure mine water and tailings can continue to be contained on site.

The amended final landform has decreased the catchment area to the final void. This has increased the catchment area that will ultimately drain towards Four Mile Creek by approximately 10 Ha, and increased the catchment to Buttai Creek and its tributaries by 41 Ha, as compared to the currently approved landform.

The proposed final landform will increase the risk of sediment-laden water draining off-site to Four Mile Creek and Buttai Creek and its tributaries during the rehabilitation phase, whilst the area is being revegetated and stabilised. These potential impacts will be mitigated through current site practices, as outlined in site environmental management plans, for example: the design and operation of drainage lines, sediment basins and erosion and sedimentation controls (refer to **Section 6.4.2**).

The reduction in catchment area draining to the final void will have a positive long-term effect on Four Mile Creek and Buttai Creek and its tributaries, as it will result in less water being removed from the natural catchment hydrology in the post-mining phase, and less water draining to the final mining void.

The proposed modification being sought by Bloomfield will not increase or decrease the probability of unplanned discharges, or water quality risks, from Bloomfield's operations. However, these risks will continue to exist up until the end of extraction (2030) and until such time as the site is rehabilitated.

The project will continue to mitigate potential adverse impacts on receiving waters. Surface water monitoring will continue to be undertaken in accordance with Bloomfield's EPL 396. The existing monitoring program is subject to periodic review to ensure it continues to be adequate and consistent with current guidelines and policy requirements.

The proposed extension of mining will not result in the expansion of disturbed areas beyond that approved under the current consent. The mining operations will continue to extract within previously nominated pit limits, as the new mining fleet is capable of extracting coal that was previously considered unrecoverable.

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