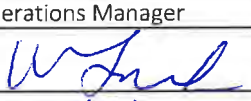
ASHTON COAL OPERATIONS LIMITED

2015 ANNUAL REVIEW

YANCOAL 兖煤澳大利亚有限公司

AshtonCoal
PART OF THE YANCOAL AUSTRALIA GROUP

Table 1 Title Block

Name of Operation	Ashton Coal
Name of Operator	Ashton Coal Operations Limited
Development consent number	DA No. 309-11-2001-i
Name of holder of development consent	White Mining Limited (ACN 009 713 893
Mining Lease number	ML 1529 ML 1533 ML 1623
Name of holder of mining lease	ML 1529 -Ashton Coal Mines Limited, ML 1533 - White Mining Limited (ACN 009713893), White Mining (NSW) Limited (ABN 19 089 414 595), ICRA Ashton Pty Ltd ACN 097 499 780, ML 1623 - White Mining (NSW) Limited (ACN 089 414 595) Austral-Asia Coal Holdings Pty Ltd (ACN 110 038 663) and ICRA Ashton Pty Ltd (ACN 097 499 780) *
Water Licence Number	See Section 7
Name of holder of water licence	Ashton Coal Mines Limited
MOP / RMP start date	28 March 2013
MOP / RMP end date	31 December 2017
Annual Review Start date	1 January 2015
Annual review end date	31 December 2015
I, William Farnsworth, certify that this Annual Review is a true and accurate record of the compliance status of Ashton Coal for the period 1 January 2015 to 31 December 2015 and that I am authorised to make this statement on behalf of Ashton Coal Operations Limited. Note: The Annual Review is an 'environmental audit' for the purposes of section 122B (2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion in) an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, $1 million and for an individual, $250,000. The Crimes Act 1900 contains other offences relating to false and misleading information: section 192G (Intention to defraud by false or misleading statement—maximum penalty 5 years imprisonment); sections 307A, 307B and 307C (False or misleading applications/information/documents—maximum penalty 2 years imprisonment or $22,000, or both).	
Name of Authorised reporting officer	William Farnsworth
Title of authorised reporting officer	Operations Manager
Signature of authorised reporting officer	
Date	22/3/2016

*As of 31 December 2015, the Leaseholder names are correct. During 2014 Ashton Coal has undergone some ownership changes, and applications have been submitted to DRE for title changes.

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1 Statement of Compliance

The Annual Review is required to incorporate a statement of compliance which includes a summary table that highlights the compliance status of the operation with its relevant approval conditions, as at the end of the reporting period. See Table 2

Table 2 Statement of Compliance, as at 31 December 2015

Were all conditions of the relevant approvals complied with?	
Development Consent 309-11-2001-i	yes
ML 1529	yes
ML 1533	yes
ML 1623	yes

Minor administrative non-compliances relating to implementation of Environmental Management Plans are discussed in Section 13.1

2 Introduction

The Ashton Coal Project (ACP) is located approximately 14 kilometres north-west of Singleton in the Upper Hunter Valley, New South Wales (NSW). The ACP is adjacent to the Open-Cut mines of Glendell (Glencore), Rixs Creek and Rixs Creek North (Bloomfield Group), Hunter Valley Operations (Rio Tinto) and Ravensworth Operations (Glencore). Adjacent Underground mines include Glennies Creek and Ravensworth Underground Mine (Glencore).

The ACP is operated by Ashton Coal Operations Limited (ACOL) and includes a decommissioned open cut coal mine, an underground coal mine, a Coal Handling and Preparation Plant and a rail siding. The Ashton Underground Coal Mine is approved to produce 5.45 Mtpa of coal. In 2015 1.38 Mtpa of high quality semi-soft coking coal was produced. This coal is predominantly exported through the Port of Newcastle, New South Wales.

Ashton Coal Operations Limited (ACOL) also have the South East Open Cut Project (SEOC), to the south east of current surface operations. This project was approved by the Planning Assessment Commission on the 4 October 2012, however was subsequently appealed. In 2014 the Land and Environment Court upheld the approval, subject to further conditions. The revised Development Consent was issued to Ashton Coal in April 2015. The SEOC approval has not been taken up and is not within the scope of this AEMR.

ACP and ACOL are wholly owned by the Yancoal Australia Group.

This Annual Review details the ACP's environmental and community performance for the period from 1 January 2015 to 31 December 2015. The operational area is shown in Figure 1.

This Annual Review is a statutory approval requirement and has been prepared in accordance with the Ashton Coal Mine Project Approval (DA No. 309-11-2001-i; as modified, condition 9.2) and the commitments outlined in the Mining Operations Plan. The AEMR is written in accordance with the NSW Government Annual Review Guideline published October 2015.

This report was prepared in consultation with the Department of Resources and Energy (DRE), Department of Planning and Environment (DPE), Environment Protection Authority (EPA) Department of Primary Industries – Water (DPI-Water) and Singleton Council (SC). No additional information was requested to be included in this report.

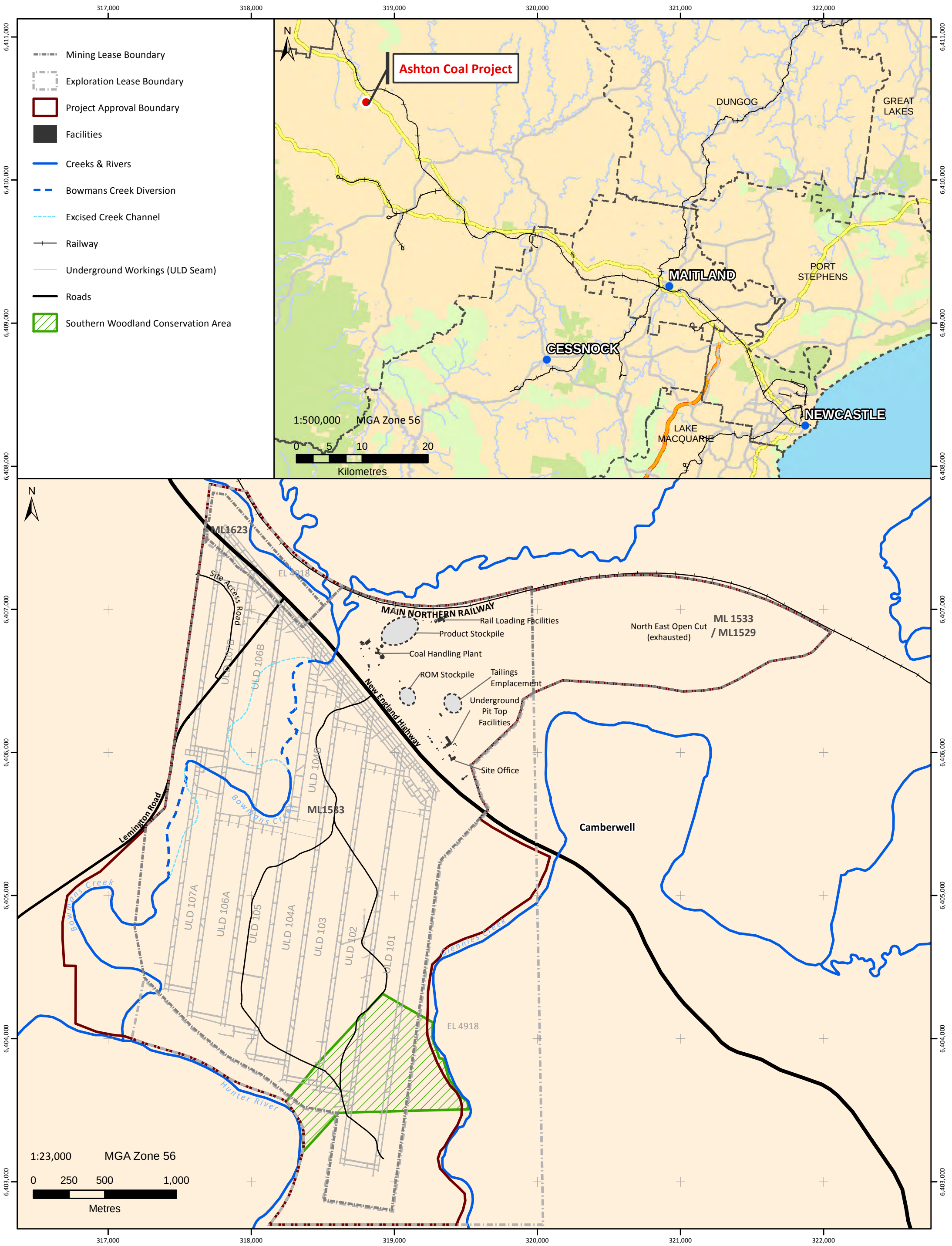


Figure 1 Regional site overview

Regional Site Overview

ACOL AEMR 2015 Period, Ashton Coal Project

Drawn: GW

8/03/2016

Map **C**

The AEMR is distributed to a range of stakeholders that include government authorities, the Community Consultative Committee (CCC), other mines and ACOL employees. The report is also available on the Ashton Coal website at http://www.ashtoncoal.com.au/

2.1 Mine Contacts

ACOL environment team contacts can be found in Table 3.

Table 3: ACOL management contact details

Name	Role	Phone contact details
William Farnsworth	Operations Manager	(02) 6570 9104
Digby Short	Environment and Community Relations Manager	(02) 6570 9219
Environmental Contact Line	n/a	1800 657 639

3 Approvals

The ACP has a number of statutory approvals that regulate activities on site. Details on Ashton Coal's existing statutory approvals as at 31 December 2015 are below. Water licences held by ACOL are discussed in Section 7.

During the reporting period a Mining Purposes Lease Application was submitted to DRE to cover the area of the ACOL tailings dam. Liaison with DRE to progress this lease is ongoing.

Table 4 ACOL's primary statutory approvals as at 31 December 2015

Approval	Description	Issue date	Expiry date
Development consents or project approvals issued by the DPE			
DA 309-11-2001-i	Development Consent for the ACP (as modified from time to time)	11/10/2002 Last modified 12/12/12	11/10/2023
Mining leases and exploration licences issued by the DRE			
ML 1533	Mining Lease	26/02/2003	26/02/2024
ML 1529	Mining Lease	10/09/2003	11/11/2021
ML 1623	Mining Lease	30/10/2008	30/10/2029
EL 5860*	Exploration Licence (EL)	21/05/2012	21/05/2015
EL 4918*	Exploration Licence	17/12/2010	17/12/2015
EPL issued by the EPA			
EPL 11879	Environment Protection Licence (EPL)	02/09 (anniversary date)	Not specified

* Renewals for exploration licences 5860 and 4918 were lodged on 15 May 2015 and 17 December 2015, respectively.

Table 5 ACOL's other statutory approvals as at 31 December 2015

Approval	Description	Expiry date
Radiation Management Licence		
RML5061098	Radiation Management Licence	06/04/16
Aboriginal heritage		
Section 90 Consent Permits AHIP 1131017 AHIMS Permit ID 3436	Longwalls 1-4: Salvage excavations. Community collection. Harm to certain Aboriginal objects through proposed works. Certain Aboriginal objects must not be harmed	23/12/21
Section 90 Consents Permits AHIP 1130976	Longwalls 5-8: Movement only of certain Aboriginal objects. Test excavations. Salvage excavations. Community collection. Harm to certain Aboriginal objects through	26/08/31

Approval	Description	Expiry date
	proposed works. Certain Aboriginal objects must not be harmed	
Voluntary Conservation Agreement		
Conservation Agreement	Conservation agreement over the southern conservation area. Agreement between The Minister administering the NPW Act 1974 and Ashton Coal Mines Limited for Ashton Coal Mine.	Perpetuity
Tailings Emplacement approval		
S126 Approval	Emplacement of carbonaceous materials Ashton North East Open Cut (NEOC) Issued 08/04/04	Perpetuity
S126 Approvals	Emplacement of carbonaceous materials Ravensworth Void 4 Issued 17/01/07	Perpetuity
S100 Approval	Emplacement of coarse rejects materials in the NEOC void Issued 01/03/12	Perpetuity
S100 Approval	Emplacement of fine rejects in the Ravensworth Void No 4 Issued 2/01/2007	Perpetuity

3.1 Mining Operations Plan

ACOL has an approved mining operations plan (MOP) in place that covers a five year period from 28 March 2013 to 31 December 2017.

The MOP satisfies the requirements of the Mining Operations guidelines (DRE), as well as the following management plans required by the Development consent: Land Management Plan, Landscape and Revegetation Management Plan, Rehabilitation Management Plan and Final Void Management Plan.

3.2 Environmental Management Plans

ACOL has developed a range of environmental management plans to meet the requirements of DA 309-11-2001-i and these are required to be reviewed and maintained regularly (Condition 1.21). A summary of the status of the management plans is provided in Table 6.

These plans are published on http://www.ashtoncoal.com.au.

Table 6 Status of environmental management plans as at 31 December 2015

Environmental management plan	Condition	Approval date
Environmental Management Strategy	3.3	19/08/2006
Noise	6.43	03/04/2014
Air Quality	6.10	03/04/2014
Lighting	6.56	21/09/2015
Waste	5.3	03/04/2014
Spontaneous Combustion	2.6	28/03/2014
Archaeology and Cultural Heritage	3.36	19/06/2015
Bushfire	3.57	09/12/2013
Flora and Fauna	3.46	31/07/2012
Water	4.7	14/5/2015

4 Operations summary

During the reporting period there were no material changes to operations at the Ashton Coal Project. Open cut mining ceased in September 2011, with remaining open cut rehabilitation works completed between 2011 and 2012. There has been no topsoil works or overburden movement since this time.

4.1 Exploration

No surface exploration projects were undertaken during the reporting period. No exploration activities were undertaken in the North East Open Cut (NEOC) area during the reporting period.

4.2 Construction

Construction of the fines plant adjacent to the Coal Handling and Preparation Plant was finalised in March 2015. Construction included a new filter housing within the CHPP as well as a steel structure with a concrete platform which houses four 40 cubic metre cells. Since commissioning in March 2015, the fines plant has been operational, and while minor adjustments are still being made to improve its performance, over 50,000 tonnes of product that would otherwise report to the tailings dam have been recovered. The fines plant has been constructed wholly within existing CHPP footprint.

During the reporting period, ACOL conducted mine infrastructure borehole drilling activities within the underground area, with two shallow pilot holes for raise bore construction (10m depth).

Rehabilitation of all drilling sites and completed boreholes, involving sealing or capping with gate valves was undertaken, with rehabilitated sites monitored in accordance with ACOL's procedures. Boreholes that are yet to be grouted or that require additional testing have been secured with borehole caps.

Two dewatering bores were constructed during 2015 (BH4a and BH5) to replace existing dewatering bores (BH2 and BH3).

During the reporting period there were no material variations from the MOP related to exploration activities.

4.3 Hours of operation

Under condition 2.8 of the Development consent DA 309-11-2001-i, Ashton Coal is permitted to undertake underground mining, train loading and CHPP operation 24 hours a day, 7 days a week. Gas well construction is permitted from 7am to 6pm Monday to Saturday, and 8am to 6pm Sundays and Public holidays. Three gas wells were constructed during 2015. Construction activities were undertaken on weekdays during approved operating hours. Limitations on work hours also apply to open cut mining, blasting and Bowmans Creek Diversion works, however none of these activities were undertaken during the reporting period. Ashton Coal complied with condition 2.8 during the reporting period.

4.4 Mining

The underground mine is approved to extract coal from the Pikes Gully (PG), Upper Liddell (ULD), Upper Lower Liddell (ULLD) and Lower Barrett (LB) coal seams. The underground mine utilises the longwall method of coal extraction, following continuous miner development of main headings and twin heading gate-roads. Seam thickness varies from about 1.8m to 2.8m high. All underground roadways will be driven at approximately 2.6 m mined height. The longwall has been designed to allow extraction of the full seam thickness. The expected underground mine life is until approximately 2027.

During the reporting period, coal was mined from the Upper Liddell coal seams (LW103 and 104). Approximately 3 million tonnes of run-of-mine coal was mined from the underground operations, which is very close to the 2.96 million tonnes projected in the MOP for 2015. Table 7 provides a summary of ACOL's mine performance figures for the reporting period.

Table 7 Mine performance data, 2015

Material	Approved Limit (DA 309-11-2001-i)	2014	2015 (this reporting period)	2016 (MOP forecast)
Topsoil stripped	-	0	0	0
Topsoil Spread	-	0	0	0
Overburden	-	0	0	0
ROM Coal	-	2,771,218	3,001,216	2,505,834
Coarse Reject	-	1,252,548	1,307,406	706,050
Tailings	-		290,243	
Product Coal	5.45 mtpa	1,336,092	1,375,405	1,329,084

4.4.1 Gas management

During the reporting period, ACOL conducted gas drainage borehole drilling activities within the underground area, specifically designed to provide longwall panel goaf gas drainage. Three longwall goaf large diameter gas drainage holes were completed.

4.5 Next Reporting Period

During 2016 Ashton Coal mining operations will continue as planned, with no significant changes to current operations. Mining will continue in LW104 until approximately April when it is planned to move to LW105 before moving to LW106A in approximately October.

Four piezometer open holes, one large diameter partly cored borehole for coal quality analyses and two large diameter longwall goaf gas drainage holes are planned to be drilled during the next reporting period.

5 Actions required from previous review

There are a number of actions resulting from the 2014 AEMR as discussed below.

A number of commitments were made in the 2014 AEMR by ACOL that were completed throughout 2015. Following the submission of the 2014 AEMR, the Department of Planning and Environment (DPE) and the Department of Resources and Energy (DRE) undertook a site inspection. The site inspection resulted in a number of actions that ACOL were required to address and report on in the 2015 Annual Review. These actions are documented in Table 8.

Table 8 Actions required from previous review

Action required from previous annual review	Source of Action	Action taken	Where discussed in annual review
Complete EPL variations, as discussed with EPA, and amend associated air quality and groundwater monitoring programs.	2014 AEMR	Not finalised. Awaiting consultation with the EPA regarding their proposed changes to the Air Quality Monitoring Programme. Will be completed in following reporting periods.	-
Obtain Mining Purposes Lease from the NSW Department of Energy and Resources for the Tailings Dam and associated infrastructure	2014 AEMR	The MPL application was lodged in first half of 2015 and ACOL is currently liaising with DRE to finalise the grant of the tenement.	-
Prepare, consult and lodge the Extraction Plan for the Upper Liddell Seams 105 - 107B for approval from the NSW DPE.	2014 AEMR	Complete. Lodged in 2nd half of 2015 and was approved on 22 January 2016.	-
Implement revised Water Management Plan, once approved by the DPE	2014 AEMR	Completed. Water Management Plan was approved in May 2015.	Section 7
Assess and commence remedial works as required in areas rehabilitated following the installation of pipework associated with boreholes and gas wells	2014 AEMR	Rehabilitation commenced and is progressive as more boreholes and pipes are constructed.	
Continue rehabilitation of the Bowmans Creek and the Bowmans Creek Diversion	2014 AEMR	Additional tree planting and rehabilitation maintenance was undertaken in both the Eastern and Western diversions during the reporting period.	Section 9.2
Recalibrate site water balance model	2014 AEMR	Site water balance model was recalibrated	Section 7
ACOL to commission an appropriately qualified geomorphologist to investigate the Western Diversion bed scour and recommend any remedial actions	2014 AEMR	This investigation was undertaken by appropriate geomorphologist in the second half of 2015. It is currently being peer reviewed prior to finalising recommendations in early 2016.	Section 9.2.2
Figures 3, 11, 13, 20 and 27 are not clear and legible. Please ensure all figures are clear and legible in next year's Annual Review.	DPE	Noted.	-
Further explanation is suggested in regard to Figure 5 whereby spillage from the PWD and Dam 56 is shown diagrammatically to spill to creeks. As this is a public document it is recommended that further explanation is contained in the report to explain what procedures are in place to prevent this.	DPE	Noted. Figure 10 has been updated this year to reflect the reasons for including spillways, which are required on all dams.	Figure 10
During the inspection, the Department observed that a large number of plastic tree guards remained around established trees in the creek diversion areas. These	DPE	Programme of tree guard removal commenced in 2015 and is ongoing as trees reach suitable height and health	Section 9.2

Action required from previous annual review	Source of Action	Action taken	Where discussed in annual review
plastic guards have the potential to be removed during flood events and may enter the stream environment. It is requested that the tree guards are removed and disposed of correctly.			
During the inspection of the Eastern Bowmans Creek Diversion it was noted that a large number of Casuarinas located in the diverted Bowmans Creek line were dying and, or of poor health. The Department requests that an investigation into the reason for the death and poor health of the trees be undertaken to identify the cause and recommend actions to be provided in a report to the Department by 31st January 2016.	DPE	Vegetation assessment was completed. Ashton vegetation assessment Bowmans Creek Woodland by PB and lodged with DPE.	Section 9.2.1
During a previous inspection with AGL Macquarie of the Ravensworth South Void it was noted that some spontaneous combustion was occurring within the area of responsibility of Ashton Coal's tailings facility. As discussed with Mr Peter Grey, the Department requests that a joint inspection of the area occurs between the Department and Ashton Coal to inspect the current remediation works prior to 30th September.	DPE	A number of attempts to set up this meeting were unsuccessful. The inspection occurred in the first quarter of 2016.	-
Efforts on the general tidiness and housekeeping of the site during longwall change out and washery shutdown maintenance are noted.	DPE	Noted	-
DRE observed that within the Eastern Bowmans Creek diversion that trees lining the creek are in a distressed condition. ACOL to undertake an investigation into the cause of the distressed vegetation within the BCD. A report outlining the findings of the investigation and proposed mitigation and management measures must be provided to DRE for consideration. (by 31 January 2016)	DRE	See above	Section 9.2.1

Action required from previous annual review	Source of Action	Action taken	Where discussed in annual review
DRE observed that plastic tubestock guards were in place around established trees within the Eastern BCD rehabilitation area. Plastic guards that are no longer in use should be removed.	DRE	As above	
Provide DRE with a summary of exploration undertaken on the mining leases and detail the rehabilitation status of these sites	DRE	Completed. No exploration completed during 2015.	
Maintenance of the contour bank located near Glennies Creek Road is required. General rehabilitation maintenance should be undertaken and summarised in the AEMR.	DRE	Maintenance has been completed. Additional topsoil and seed applied.	Section 9.5
Report on the rehabilitation of gas pipelines and gas wells that are undertaken within the reporting period	DRE	3 gas wells, and approximately 1940 metres of gas drainage pipeline installed in the reporting period. All pipeline area has been rehabilitated and maintenance including topsoil and weed management is ongoing. See Section 9.5 for further discussion.	Section 9.5
Provide details of the seed mix that is used in rehabilitation which includes the gas pipeline and gas well rehabilitation	DRE	The seed mix used on the gas pipeline and gas well rehabilitation is as follows: Rye Corn, Wimmera Rye, Seaton Park Clover, Haifa Clover, Aurora Lucerne, Vetch, Couch, Kikuyu No. 2, Croplift 15 fertilizer.	-
DRE encourages the use of nesting boxes within rehabilitated areas.	DRE	Noted.	-
DRE encourages the management of Rhodes Grass to prevent the species from becoming dominant in rehabilitation areas	DRE	A rehabilitation maintenance program of slashing NEOC rehabilitation to encourage species diversity was continued during 2015.	Section 9.5
DRE encourages the implementation of a grazing trial	DRE	Noted.	-
Tailings management: Active management of areas under spontaneous combustion must be implemented	DRE	There were two campaigns of earthworks at the tailings dam during 2015 to reduce spontaneous combustion in the area. Monitoring has indicated that the earthworks have proven largely successful. Ongoing monitoring and management will continue.	Table 9

6 Environmental Performance

Environmental performance is monitored closely at Ashton Mine to ensure standards are maintained or improved and compliance to Development consent, Environmental Protection Licence, environmental Management Plans and internal standards is maintained. Table 9 outlines the key performance or management issues and how they were addressed, as well as the implementation of any management measures from the reporting period and proposed improvements for following years. The environmental aspects covered require management plans under the current development consent, or are major environmental aspects covered by various procedures, plans and programmes.

Where practical, environmental management of the main environmental aspects at Ashton Coal have been discussed in Table 9. Where tabulating the information is not practical, further detail is included in the following sections of the report.

Table 9 Environmental Performance summary

Aspect	Approval criteria/ EIS prediction	Performance during the reporting period	Trend / key management implications	Implemented / proposed management actions.
Noise (Section 6.2)	See Table 11	Compliant with EPL and Development Consent conditions. For more detail, see Table 11. During the reporting period there were two minor non-compliances with the Noise Management Plan, as outlined in section 6.2.3 and section 12.	Noise monitoring results during the reporting period follow the trends of past years: Ashton Coal's operations are largely inaudible in the surrounding community and minimal noise complaints have occurred (no complaints received in 2015). Consistent with the development consent, the annual noise compliance report is included as Appendix 1.	The Noise Management Plan will be reviewed and updated if necessary to ensure best practice noise management techniques appropriate to the current operational status of the ACP.
Air Quality (Section 6.3)	See section 6.3.2 for detail on approval criteria and background levels.	Compliant with Development consent. There was one minor non-compliance with the Air Quality Management Plan during the reporting period as discussed in Section 6.3.2.3 and Section 12.	Site 8 HVAS data demonstrates that dust levels continue to fall, in part due to the decommissioning of the open cut operation, and also the high rainfall over the past few years. There were no air quality complaints or reportable incidents related to air quality in 2015.	The Air Quality Management plan and monitoring program will be updated during the next reporting period as required.
Visual Amenity and Lighting	6.54 All external lighting must comply with	Visual amenity and lighting management at ACOL are managed in accordance with the approved	There have been no lighting or visual amenity related incidents or	Lighting will continue to be managed to minimise

Aspect	Approval criteria/ EIS prediction	Performance during the reporting period	Trend / key management implications	Implemented / proposed management actions.
	Australian Standard AS4282 (INT) 1995. 6.55 Roads and areas where mobile equipment is used should be designed to minimise offsite impacts of lighting. A lighting Management Plan must be prepared in accordance with Section 6.56 of the development consent. 6.57 The effectiveness of lighting controls will be reported on in the AEMR.	Lighting Management Plan. Fixed lighting is utilised to illuminate the areas around the underground surface facilities, CHPP and open cut workshop. Earthen bunds are constructed and tree screens planted as a visual screen for infrastructure screening where possible. During the reporting period, earthen bunds and tree screens were inspected and maintained as required. Supplementary planting of tree screens to improve visual amenity along the New England Highway was undertaken.	complaints during the reporting period. ACOL will continue to effectively manage lighting and visual amenity according to the Lighting Management Plan and the Mining Operations Plan.	impacts on the local community and highway traffic while maintaining lighting levels necessary for operational and safety needs. Planned future works include maintenance of existing tree screens and the extension of tree screens where appropriate.
Waste and hydrocarbon management	5.3 A Waste management Plan must be maintained in accordance with section 5.3 of the development consent. Waste and hydrocarbon management must comply with the Protection of the Environment (Operations) Act	Waste continued to be managed in accordance with the Waste Management Plan. In 2015, the waste management service provider for Ashton Coal changed from Transpacific to JR & EG Richards Pty Ltd.	Waste Management followed similar trends to previous years, with no significant changes to waste volumes or management throughout the year. There were no reportable incidents or community complaints relating to waste, chemical or hydrocarbon management.	Waste management will continue to be managed in accordance with the waste management plan. The waste management plan will be reviewed and updated if necessary during 2016.
Spontaneous Combustion	Ashton Coal must have a Spontaneous Combustion Management Plan (condition 2.6), and manage overburden to prevent spontaneous combustion (condition 5.2).	During the reporting period there was no spontaneous combustion in the rehabilitation or the CHPP stockpile areas. Spontaneous combustion surrounding the Void 4 tailings storage facility was monitored and managed where possible. Earthworks were undertaken to excavate and cap areas to extinguish areas of spontaneous combustion. These works also	The nature of the loosely compacted overburden containing high levels of carbonaceous material indicates that ongoing management and maintenance of spontaneous combustion at the Void 4 tailings facility is required. New outbreaks are relatively	Ashton Coal will continue to monitor and manage spontaneous combustion according to its Spontaneous Combustion Management Plan and Tailings Emplacement Operations Plan. The

Aspect	Approval criteria/ EIS prediction	Performance during the reporting period	Trend / key management implications	Implemented / proposed management actions.
		'smoothed' the profile of the spoil to minimise the potential for air ingress. These areas will continue to be monitored to measure effectiveness, and ongoing management of spontaneous combustion will be undertaken.	common, and some areas may extinguish without any management works undertaken.	Spontaneous Combustion Management Plan will be reviewed in the next reporting period and updated if required.
Aboriginal Cultural Heritage	There are stringent requirements for the management of Aboriginal Cultural Heritage at Ashton Coal. Requirements of the development consent and AHIP 1131017 (Longwalls 1-4) and AHIP 1130976(Longwalls 5-8) are detailed in the Aboriginal Heritage Management Plan (ACHMP). Section Condition 3.35 calls for regular consultation with the aboriginal community consistent with appropriate guidelines. A Notice of Variation of AHIP 1130976 was issued in February 2015. The variation considered the long-term storage location(s) of artefacts. Storage location(s) now need to be agreed by RAP's prior to the conclusion of the AHIP (26 August 2031).	During the reporting period, minor salvage works were undertaken for the construction of the ULLD raised bore. Excavation pits and grader scrapes were undertaken, with one artefact retrieved. Salvage works (grader scrapes) also recommenced in the subsidence crack zone LW5-6. The works identified an additional area for salvage in LW6 which will be completed Q1 2016 prior to commencement of mining. Artefact analysis works were undertaken by archaeologists and the Aboriginal community for a total of eight weeks throughout the year. Skills developed with participants included artefact identification and recording techniques such as data entry, use of digital callipers and digital camera. Approximately 10,000 artefacts were recorded with the Aboriginal community representatives in the reporting period. There were two Aboriginal Community Consultation Forum (ACCF) meetings held during the reporting period. ACCF meetings discuss current mine operations, upcoming cultural heritage fieldwork, management of Cultural heritage, and gives the aboriginal community an opportunity to contribute to cultural heritage matters at ACOL.	As Ashton Coal is now predominantly mining under previously subsided land, the amount of cultural heritage fieldwork required is diminishing. ACOL is now focussing on the analysis of recovered artefacts and management of the Conservation Area and *in situ* archaeological sites in relation to Aboriginal Cultural Heritage Management	During the next reporting period, ACOL plans to: • Continue artefact analysis with archaeologists and the aboriginal community • Continue effective consultation with the aboriginal community through the ACCF • Continue to monitor and manage lands within the Conservation Area to preserve Aboriginal sites and flora and fauna of the area. • Conduct minor salvage works as required to meet operational requirements. • Commence salvage works along LW105, 016A, and LW201 planned subsidence zones, as required.

Aspect	Approval criteria/ EIS prediction	Performance during the reporting period	Trend / key management implications	Implemented / proposed management actions.
Bushfire	Bushfire at ACOL is managed in accordance with the Bushfire Management Plan which documents fire prevention and control measures to reduce the risk of and protect the operations and surrounding neighbours from bushfire.	During the reporting period, firebreaks were slashed around fence lines, pipelines and other infrastructure. There were no bushfires recorded on ACOL owned or neighbouring lands.	There have been no bushfires recorded at ACOL over the past year. This can be attributed to weather conditions less conducive to bushfire, as well as effective hazard management in accordance with the Bushfire Management Plan.	The prevention of bushfire on ACOL owned lands will continue to be actively managed in accordance with the Bushfire Management Plan.
Biodiversity (Flora and Fauna)(Section 6.4)	See Section 6.4	All required biodiversity monitoring was undertaken during the reporting period, with promising results. New threatened fauna species were identified on site, and the Bowmans Creek diversion rehabilitation monitoring is progressing well. Further information is included in Section 6.4	Consistent with previous years, the Bowmans Creek Diversion rehabilitation is progressing well. Weed management is important to ensure future rehabilitation success. Further information is included in Section 6.4	During the next reporting period the Flora and Fauna Management Plan (FFMP) will be reviewed and updated as required.
Bowmans Creek Diversion (Section 9.2)	See Section 9.2	Bowmans Creek Diversion is a major environmental aspect for ACOL. Performance during the reporting period is discussed in sections: • 6.4.2 Aquatic ecology – Bowmans and Glennies Creek, • 6.5 Pest Management, • 9.2 Bowmans Creek Diversion Management, • 9.1 Bowmans Creek Diversion Rehabilitation Monitoring Program, and • 9.5 Rehabilitation status.	See the following sections: • 6.4.2 Aquatic ecology – Bowmans and Glennies Creek, • 6.5 Pest Management, • 9.2 Bowmans Creek Diversion Management, • 9.1 Bowmans Creek Diversion Rehabilitation Monitoring Program, and • 9.5 Rehabilitation status.	Phase 2 of the BCD rehabilitation strategy will be implemented during the next reporting period. A focus on weed control is important for the ongoing success of the diversion rehabilitation.
Water – Surface water (Section 7)	See Section 7	Surface water quality trends indicate no adverse mining impacts on the water quality of the local waterways. The site water management plan was updated and approved during the reporting period.	There have been no reportable incidents or community complaints in relation to water quality during the reporting period. No TARPs under the Water Management Plan were triggered.	During the next reporting period, ACOL will continue to undertake monitoring and remedial works where required to commence the diversion

Aspect	Approval criteria/ EIS prediction	Performance during the reporting period	Trend / key management implications	Implemented / proposed management actions.
				of clean water off established rehabilitated areas, reducing the clean water diverted to in-pit storage.
Water – Groundwater (Section 7.4)	See Section 7	During the reporting period, the site water management plan and monitoring program was updated No unpredicted impacts to groundwater systems were identified. In accordance with condition 9.2 d) of the development consent, a Groundwater Management Report is included as Appendix 2.	There have been no reportable incidents or community complaints in relation to groundwater during the reporting period. No TARPs under the Water Management Plan were triggered.	Groundwater will continue to be managed in accordance with the Water Management Plan. The Water Management Plan will be reviewed and updated if required during the next reporting period.

6.1 Meteorological Data

Meteorological data is used at Ashton to interpret environmental impacts and to understand rehabilitation and land management outcomes. Ashton has two established meteorological monitoring stations: Monitoring Site 1 and the Repeater Station (**Figure 4**). A summary of meteorological data recorded at the Repeater monitoring station during the reporting period is provided in Table 10. Wind Roses are included in Figure 2 and rainfall at Figure 3.

Table 10: Summary of meteorological results from the Repeater monitoring station

Parameter	Units	2015	2014	2013
Total rainfall	mm	902	700	690
Maximum monthly rainfall	mm	270 (recorded in April)	157 (recorded in December)	175 (recorded in November)
Minimum monthly rainfall	mm	15 (recorded in September)	7 (recorded in January)	5 (recorded in October)
Maximum temperature	°C	39.3 (recorded in November)	43.9 (recorded in November)	44 (recorded in January)
Minimum temperature	°C	2.7 (recorded in July)	1.6 (recorded in May)	2 (recorded in August)

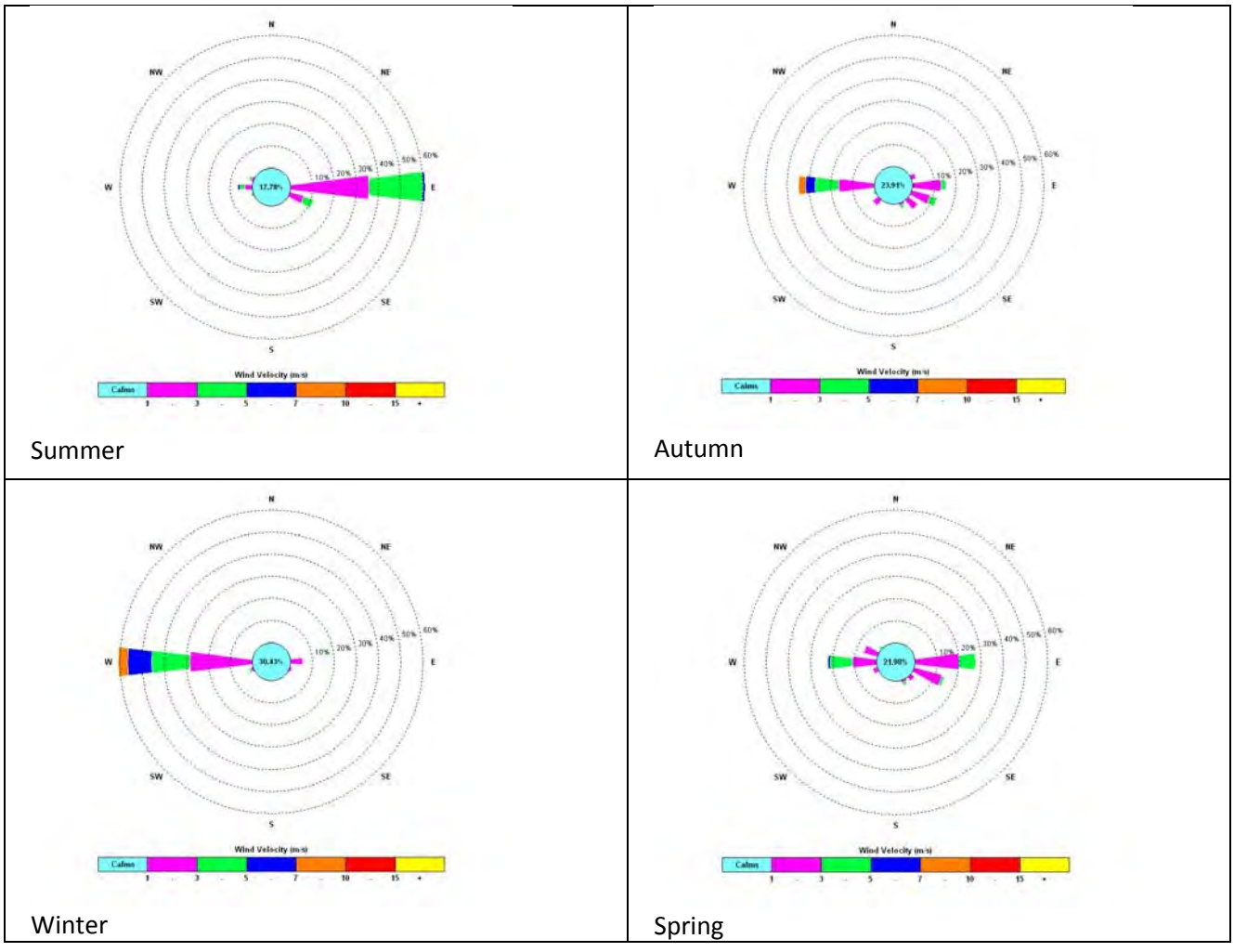


Figure 2 seasonal wind roses, Repeater Station

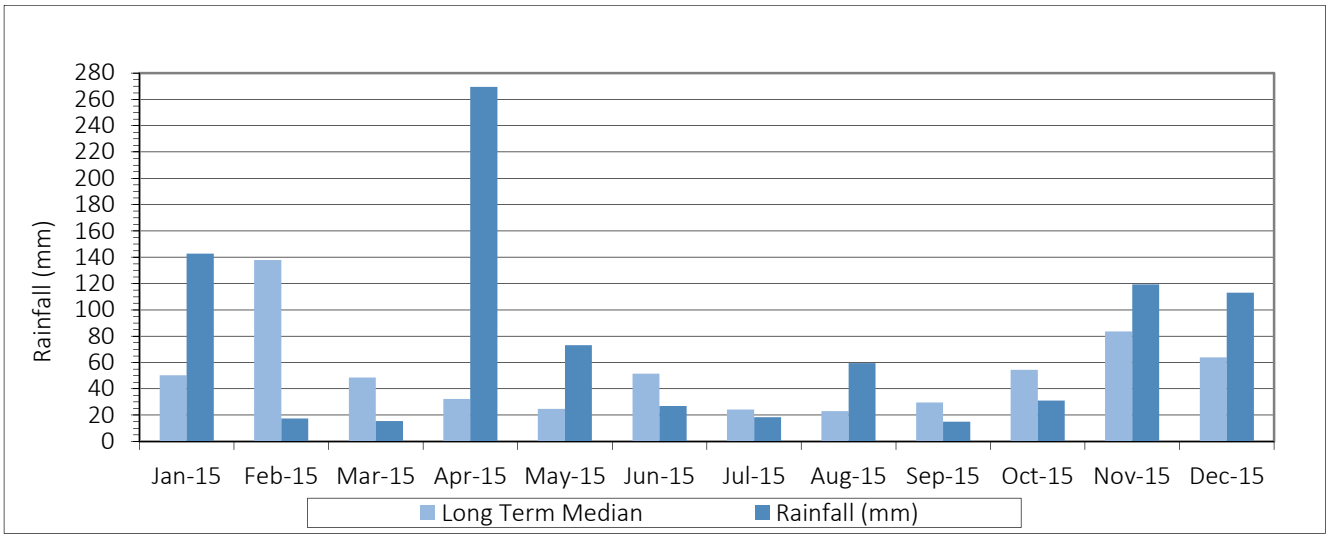


Figure 3 2015 Rainfall

6.2 Noise

6.2.1 Environmental Management

ACOL has a range of management strategies in place to limit impacts of noise. The operation's noise management plan details the relevant noise impact assessment criteria, compliance procedures and controls relating to mining activities.

Received levels from various noise sources are noted during attended monitoring and particular attention is paid to the extent of ACOL's contribution. During 2015, potential noise generating activities from ACOL included underground mine related activities, maintenance of equipment, operation of the CHPP, train loading and land management activities. Noise mitigation measures include properly maintaining mobile plant, CHPP and ventilation fans, limiting hours of mobile noise generation (such as rehabilitation works and drilling activities), permanent noise mitigating engineering controls at the CHPP, and pit top facilities located below natural surface level.

6.2.2 Environmental Performance

Noise generated by the ACP must not exceed the limits specified in Condition 6.34 of the development consent and condition L2.1 of the EPL.

At each of the three monitoring locations, the mine's average noise energy over a 15 minute period (LAeq (15min)), and the highest noise level generated for 0.6 seconds during one minute (LA1 (1min)) (in the absence of any other noise), is measured on a monthly basis. When ACOL was measurable and where meteorological conditions resulted in criteria applying (in accordance with the project approval), a low frequency assessment was conducted in accordance with the NSW Industrial Noise Policy.

An analysis of periodic attended noise monitoring results indicate ACOL's operations were not audible at any monitoring location during monitoring, with the exception of May 2016, where monitored results were high due to a measurable temperature inversion. Section 5.5E of the Noise Management Plan requires further monitoring to be undertaken if conditions were found to be unfavourable due to temperature inversion. Further monitoring was not undertaken in May, resulting in a minor non-compliance to Noise Management commitments.

Noise did not exceed the relevant L Aeq 15 min or L Aeq 1min criterion at any location at any other time, indicating nuisance and sleep disturbance noise generation was well within specified noise limits.

Analysis of all noise emissions from ACP showed that they complied with tonal, impulsive and low frequency modifying factor levels as per definitions in the NSW Industrial Noise Policy.

There were no noise complaints received during 2015.

A summary of results from ACOL's attended noise monitoring is provided in Table 11. The annual noise compliance report required by Development Consent condition 6.45 is attached as Appendix 1.

Table 11: Attended noise monitoring results

LAeq (15min)	N2	N3	N4
Noise impact criteria (Intrusive criteria) (LAeq (15min)) Night	36	36	36
Noise Impact criteria (LAeq (1min))Night	46	46	46
Predicted noise level for 2014 for each monitoring location (2002 EIS)	37	N/A	N/A
January	IA	IA	IA
February	IA	IA	IA
March	IA	IA	IA
April	IA	IA	IA
May*	39 (LAeq (15min)) 44 (LAeq (1min))	38 (LAeq (15min)) 43(LAeq (1min))	25(LAeq (15min) IA (LAeq (1min))
June	IA	IA	IA
July	IA	IA	IA
August	IA	IA	IA
September	IA	IA	IA
October	IA	IA	IA
November	IA	IA	IA
December	IA	IA	IA

IA – Ashton Coal's operations were inaudible.

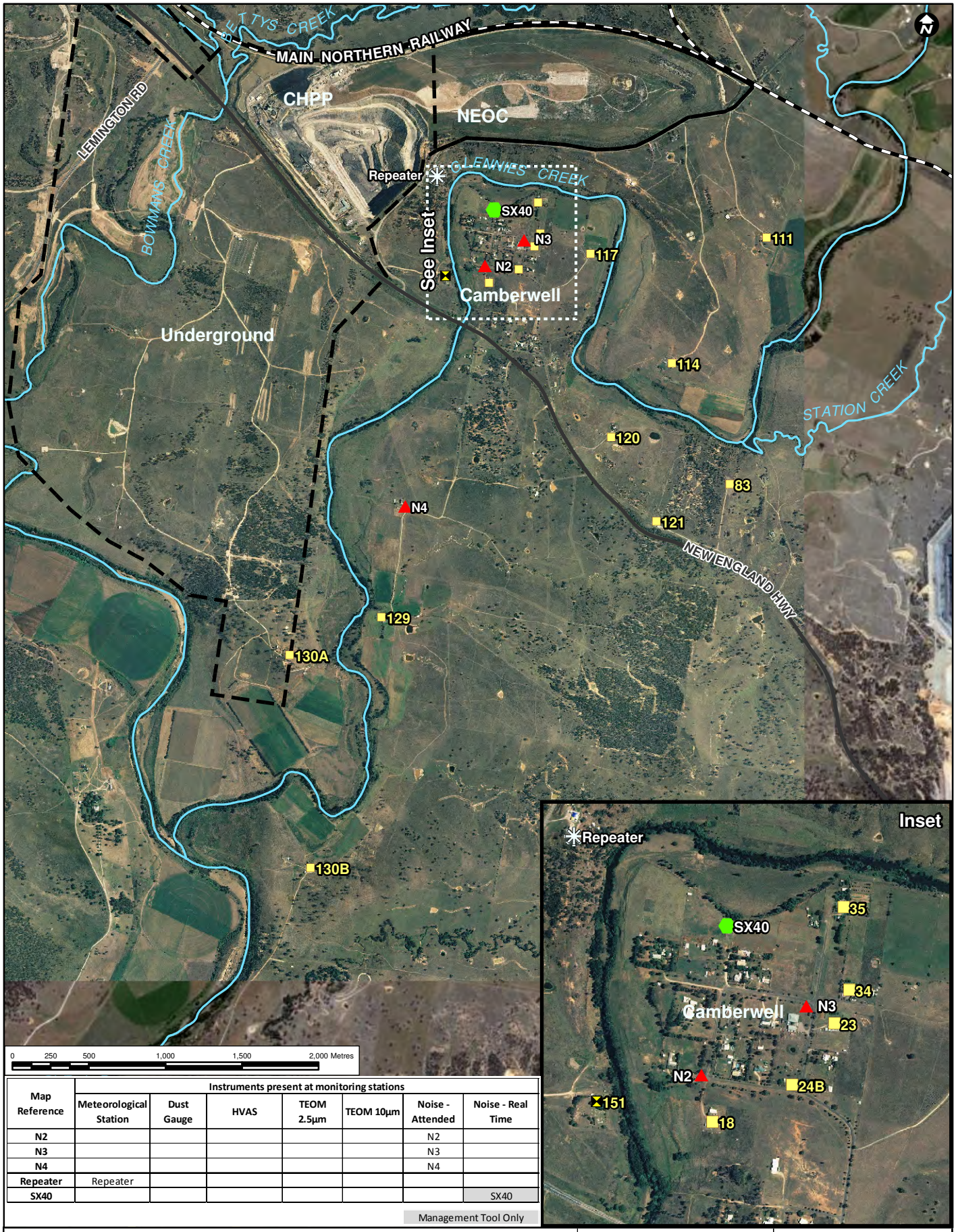
* During May, temperature inversion data showed that the noise measurements at N2 and N3 were made under non-compliant meteorological conditions and therefore the measured noise is not considered an exceedance of the noise goal.

6.2.3 Trends and management measures

Noise monitoring results during the reporting period follow the trends of the past few years, where Ashton Coal's operations are largely inaudible in the surrounding community and minimal noise complaints have occurred. Noise generated by ACOL during the next reporting period are expected to remain consistent with the past two years, with no need to modify any management or acquisition zones under the development consent due to past or projected noise generation.

During the reporting period, there were a number of commitments noted in the Noise Management Plan that were not undertaken. These non-compliances are listed below:

- Section 5.5B requires a winter noise assessment that targets full production as well as weather conditions conducive to noise travelling. This was not undertaken in 2015.
- Section 5.5E requires replacement monitoring if noise levels exceeded consent conditions due to unfavourable weather conditions (i.e. Temperature inversions). This was not conducted in May 2015.



Map Reference	Instruments present at monitoring stations						
	Meteorological Station	Dust Gauge	HVAS	TEOM 2.5µm	TEOM 10µm	Noise - Attended	Noise - Real Time
N2						N2	
N3						N3	
N4						N4	
Repeater	Repeater						
SX40							SX40

Management Tool Only

Figure 4: Noise Monitoring Network

- ACOL Mining Lease Area
- Watercourses
- Private Receptors
- St Clements Church
- Meteorological Station
- Noise - Attended
- Noise - Real Time

AshtonCoal

Prepared by KLEINFELDER

Project Ref:	134660
Plot Date:	15/01/2014 16:33
Revision:	001 (gjoyce)

Map Projection:
GDA 1994 MGA Zone 56

Data Sources:
LPI - 2012
ACOL - 2013
Kleinfelder - 2013

Disclaimer:This is not an official or a legal map but is for informational use only. All data was compiled from the best sources available. All boundaries, scale and geographic points are approximate.

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These issues were identified as part of the internal compliance audit carried out as part of the Annual Review. An investigation was carried out and corrective actions assigned to ensure that the Noise Management Plan is complied with in future reporting periods.

6.3 Air Quality

6.3.1 Environmental Management

The air quality monitoring network consists of depositional dust gauges, fine particle monitors that operate on a set schedule and real-time fine particulate monitors that operate continuously. The coupling of operational procedures and monitoring allows ACOL to take a proactive approach to dust management where necessary.

Dust deposition gauges record dust fallout, which can be derived from mining or non-mining activities, and provide a useful measure of changing air quality over a long term. Depositional dust monitoring is carried out in accordance with *Australian Standard 3580.10.1:2003 Determination of particulates – Deposited matter – Gravimetric method* and analysed for insoluble solids and ash residue. Depositional dust samples are collected on a 30 day (plus or minus two days) basis from four depositional dust gauges surrounding Ashton Coal.

Total suspended particulates (TSP) are monitored using a high volume air sampler (HVAS). This monitor operates for 24-hours every six days in accordance with Australian Standard. HVAS measure cumulative dust levels from all sources.

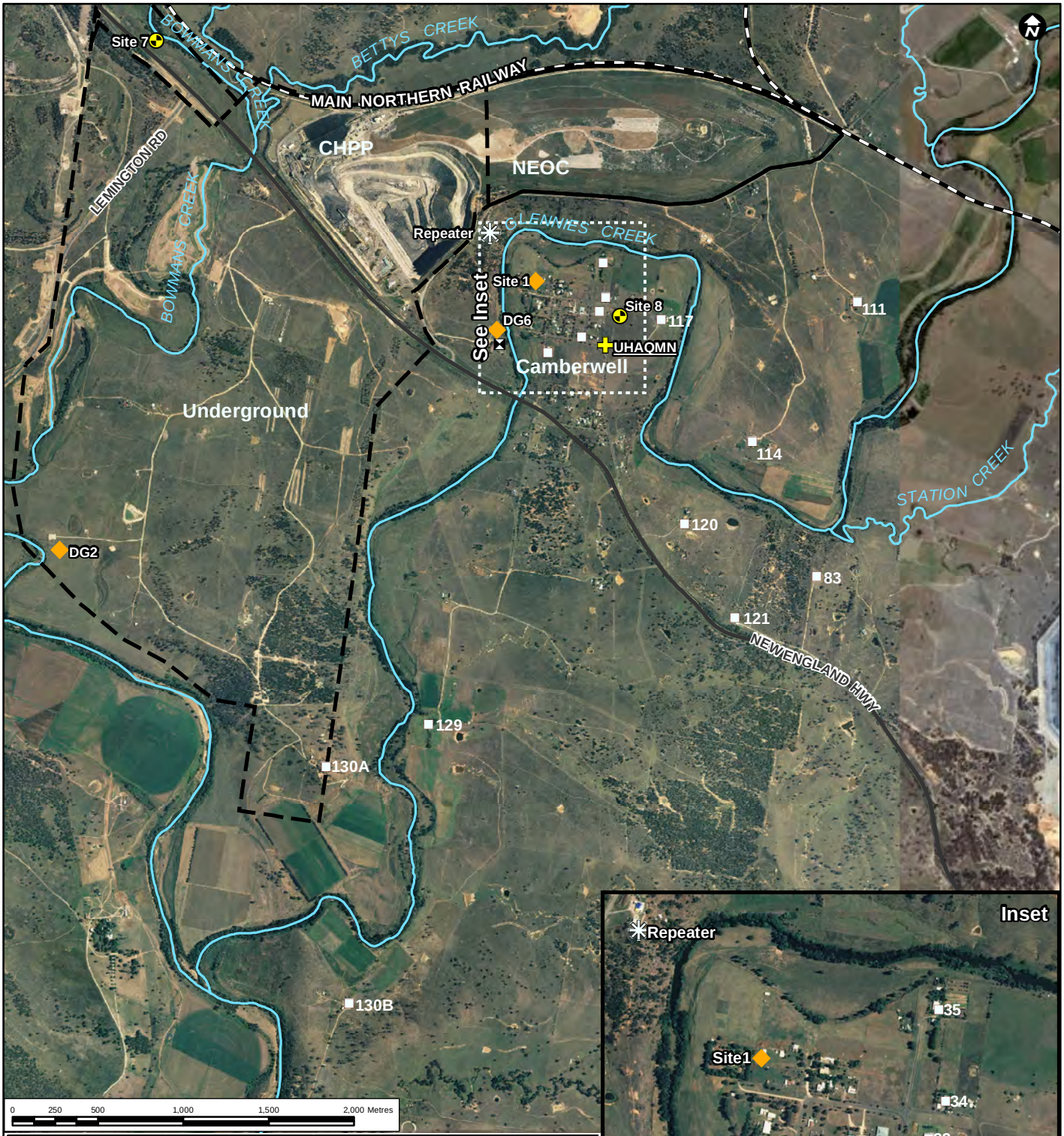
One statutory real-time tapered element oscillating microbalance sampler (TEOM) is used to record fine dust particles (i.e. particulate matter 10 microns and less (PM_{10})) on a continuous basis. There are also two TEOMs used for operational management purposes. One of these monitors is not reflective of impacts on sensitive receptors, and the other monitor is part of the Upper Hunter Air Quality Monitoring Network (UHAQMN). Delayed data from this monitor is available online to the public. As it is not available in real time or in a recordable format, it cannot be utilised as a statutory monitor. Using this site as part of the operational control monitoring network reflects ACOLs commitment to addressing cumulative impacts in collaboration with industry and regulators in the region.

ACOL's cumulative reduction protocol includes maintaining an open dialogue with neighbouring mining operations, sharing data and participating in the Upper Hunter Mining Dialogue Emissions and Air Quality working group.

The locations of air quality monitoring sites at Ashton Coal are shown in Figure 5.

Controls have been put in place in accordance with the management plan to reduce the potential for the generation and movement of dust from Ashton Coal's operation area. These controls are considered to have been adequate for the reporting period, and will continue to be applied during the next reporting period. The controls include:

- Large earth berms and tree plantations between the operations and the village have been constructed and trees established;
- At the closure of the mining operations in the NEOC, all available overburden dumps were bulk shaped and then rehabilitated during autumn 2012.
- Roads are clearly delineated and maintained and water carts utilised around the site to keep trafficked areas in a damp condition;
- All stockpiles are kept damp by the use of fixed or mobile water sprays under dry and windy conditions;
- All diesel equipment used on site is maintained properly and fitted with appropriate pollution control devices.



Map Reference	Instruments present at monitoring stations						
	Meteorological Station	Dust Gauge	HVAS	TEOM 2.5µm	TEOM 10µm	Noise - Attended	Noise - Real Time
Site1		DG7					
Site 7					Site 7		
Site8		DG14	HVAS 8		Site8		
DG2		DG2					
DG6		DG6					
Repeater	Repeater						
UHAQMN				2.5µm	10µm		

Management Tool Only (label underlined)

PM10: Particulate Matter smaller than 10µm

HVAS: High Volume Air Sampler (Samples 1 day every 6) *TEOM: Tapered Element Oscillating Micro-balance (Samples Real Time)*

TSP: Total Suspended Particulates *DG: Dust Gauge (Samples Monthly)* *UHAQMN: Upper Hunter Air Quality Monitoring Network*

Figure 5 : Air Quality Monitoring Network

- ACOL Mining Lease Area
- Watercourses
- Private Receptors
- St Clements Church
- Dust Deposition Gauge
- Meteorological Station
- Upper Hunter Air Quality Monitoring Network
- Monitoring Station
- Noise - Unattended
- Noise - Attended

AshtonCoal

Prepared by KLEINFELDER

Project Ref:	134660
Plot Date:	5/03/2014 11:26
Revision:	002 (gjoyce)

Map Projection:

GDA 1994 MGA Zone 56

Data Sources:

LPI - 2012
ACOL - 2013
Kleinfelder - 2013

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During the reporting period Ashton Coal continued to be a signatory to the Upper Hunter Air Quality Monitoring Network (UHAQMN). The network continuously measures dust particles in the air at up to 14 sites throughout the region. The collected data is provided to the community and industry through the Office of Environment and Heritage website.

6.3.2 Environmental Performance

6.3.2.1 Depositional Dust Gauges

Depositional dust gauge data capture rates for the reporting period were 100 per cent at all statutory sites, except for D2, which was owned and decommissioned by a neighbouring operation in April 2015 as it was in very close proximity to operations and could not be safely monitored.

In accordance with the project approval, the criterion for the maximum total deposited dust level is 4 grams per square metre per month (g/m2/month) over an annual averaging period. The criterion for the maximum increase in deposited dust levels due to ACOL's operations over an annual averaging period at any one dust gauge is 2 g/m2/month.

Table 12 shows the annual average insoluble solids for each gauge over the 2013 to 2015 reporting periods. There were no depositional dust gauges which exceeded the annual average of 4g/m²/month for the 2015 reporting period.

Table 12: Comparison of annual average deposited dust results

Site reference	Location	2015 annual average g/m2/month	2014 annual average g/m2/month	2013 annual average g/m2/month	Annual Average EIA Background Values g/m2/month
D2	Ravensworth property west of open cut	2.4*	3.66	5.16	3.5
D6	St Clements Church	3	3.59	4.13	1.5
D7	TEOM site 1 – Camberwell Village	3.2	3.03	3.30	N/A
D14	TEOM site 8 – Camberwell Village	1.9	2.56	2.91	N/A

* D2 was decommissioned by Glencore in April 2015. The average shown is for 4 months.

Contamination by bird droppings, insects and vegetation is a common issue for depositional dust monitoring systems. During this reporting period there was one contaminated result, recorded in February 2015 at D2. A depositional dust gauge is deemed contaminated by an independent monitoring contractor or a National Association of Testing Authority (NATA) accredited laboratory. Results found to be contaminated are excluded from the annual average calculation.

6.3.2.2 High Volume Air Samplers

A summary of the results from the statutory HVAS TSP monitoring site for the reporting period is provided in Table 13. HVAS data capture rate was 100 per cent for the reporting period. In accordance with the project approval, the long-term annual impact assessment criteria is 90 µg/m3 over an annual averaging period and there is no TSP short term 24-hour impact assessment criteria.

During the reporting period ACOL's statutory HVAS monitor remained below the long-term annual impact assessment criteria. The long term trends for HVAS results are presented in Figure 6 and indicate that the trends recorded from the HVAS site during 2015 remain below the long- term trends.

Table 13: Summary of HVAS TSP results

Site name	Site reference	Minimum 24-hour result µg/m^3	Maximum 24-hour result µg/m^3	Reporting period annual average µg/m^3	Long term (annual average) criteria µg/m^3
Camberwell village (east)	8	7	145	59	90

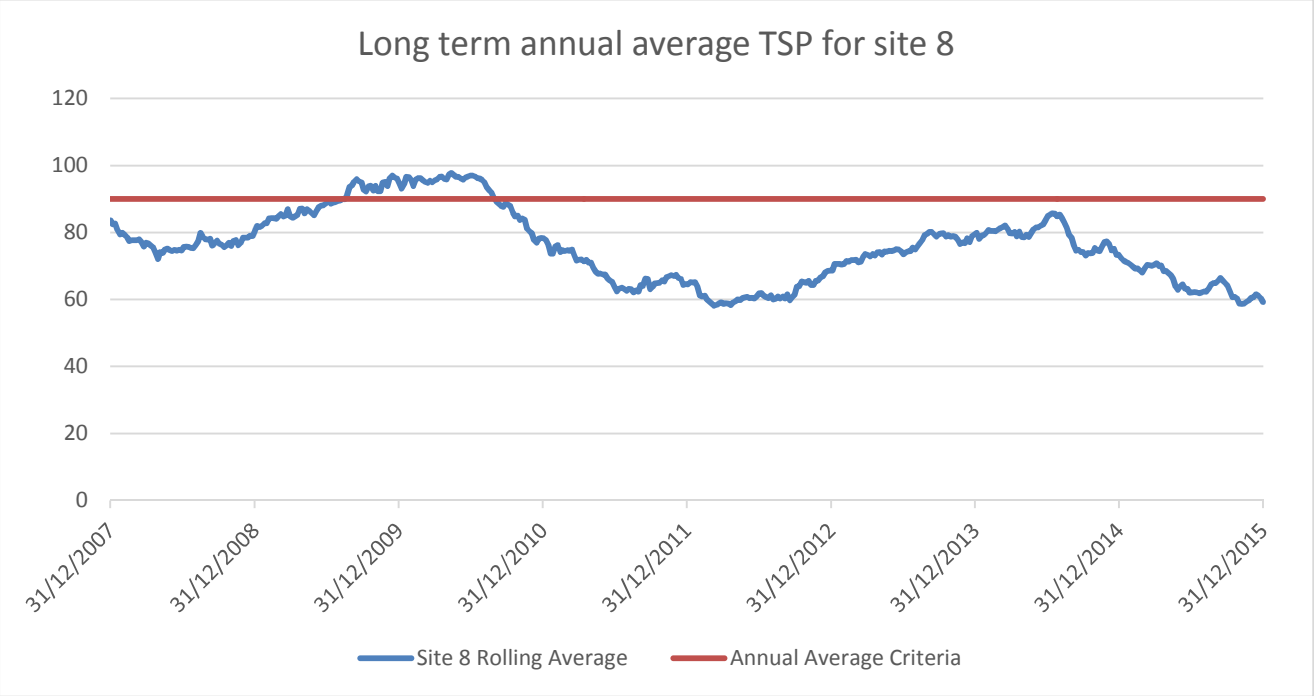


Figure 6: Long Term annual average TSP (HVAS) trends for site 8.

6.3.2.3 Tapered Element Oscillating Microbalance Samplers (TEOM)

There is one statutory PM_{10} TEOM monitoring station in operation for Ashton, as well as one operational TEOM and the local UHAQMN TEOM based in Camberwell village. Monitoring Location 7 is situated to the north of mining operations, immediately south of the Main Northern Railway and is intended to monitor the incoming concentrations of PM_{10} dust when the prevailing winds are from the northwest, which is the wind direction that presents the greatest risk of Ashton pit top facilities impacting the village of Camberwell.

Table 14: Locations and performance of TEOM sites.

Monitoring Station No	Particulates measured	Monitor Purpose	Location	Data capture (%)
7	PM_{10}	Background (upwind) Site (management tool)	Onsite at north-western end of rail siding	98
8	PM_{10}	Community Site - statutory	Camberwell village (east)	95
UHAQMN	PM_{10} and $PM_{2.5}$	Reference site	Camberwell Village	99 96

TEOM data capture rates were high at 95 per cent or above. Data outages were caused by power or circuit breaker trips.

A summary of the results from the statutory real-time PM_{10} TEOM monitoring site (Site 8) for the reporting period is provided in Table 15. During the reporting period the short term 24-hour impact assessment criteria of 50 µg/m^3 was exceeded four times at the community site, including air emissions from all sources. An

investigation into each of these events was undertaken, including using wind directional data to ascertain the operation's contribution, and assessing regional air quality trends and localised influences or events at the time. On all occasions, results of the investigation showed that ACOL's contribution was less than 50 µg/m3. The maximum value at site 8 occurred on the 11 December 2015 and was due to a house fire in Camberwell village. During the reporting period ACOL's statutory TEOM monitoring site remained below the long-term annual impact assessment criteria.

Table 15: Summary of TEOM PM_{10} results

Site reference	Minimum 24-hour result µg/m³	Maximum 24-hour result µg/m³	Short term Criteria µg/m³	Reporting period annual average µg/m³	Long term Criteria annual average µg/m³
7 (background upwind site)	3.0	66.5	50	20.8	30
8 (community site)	1.9	117.5		18.3	
Camberwell UHAQMN (PM10)	2.5	86.7		22	
Camberwell UHAQMN (PM2.5)	0.7	23.9	25*	7.2	8*

* Advisory reporting standards only

Under the Air Quality Management Plan (Condition 5.6C), a trial has been established requiring Ashton Coal to report to DPE all instances where the 24 hour average PM10 is above 50µg/m³ within three working days. Ashton Coal reported six instances of real time monitoring data exceeding the 24 hour average during the year. This is not consistent with the results above, which are recorded for the 24 hour period from 12:00am to 11:59pm, as the 24 hour rolling average is calculated hourly, and may be exceeded when the rolling average is split between days. There was one instance, on 6 May 2015 that was not reported to DPE within three working days. This represents an administrative non-compliance of management plan conditions. There were no adverse impacts as a result of this administrative non-compliance.

6.3.3 Trends and key management implications

Monitoring results indicate that Ashton Coal continues to meet the criteria set it the development consent in relation to air quality, indicating that current air quality management practices are effective.

There were no reportable incidents or community complaints relating to air quality during the reporting period.

6.3.3.1 Greenhouse gas reporting

Yancoal's Australian operations reported under the National Greenhouse and Energy Reporting Scheme for the 2014-15 financial year. Overall ACOL emitted 337,253 tCO_2-e, a 13% reduction when compared with the 2013-2014 data. A summary of results is discussed below:

- Gas drainage has contributed approximately 34,000 tCO_2-e less in 2014-15 compared with 2013-14, due to the commissioning of the central drainage plant in February 2014 that flares fugitive emissions. The underground area mined in 2014-2015 also had less in-situ gas when compared with the 2013-2014 mining area.
- Ventilation has contributed approximately 21,000 tCO_2-e less in 2014-15 compared with 2013-14, due to the underground area mined in 2014-2015 having less in-situ gas, when compared with the 2013-2014 mining area.
- Flaring increased 4-fold due to the commissioning of the central gas drainage plant that flares waste gas throughout the year.

6.4 Biodiversity (Flora and Fauna)

Each year Ashton Coal undertakes extensive terrestrial and aquatic flora and fauna monitoring to track progress against the management plan objectives. The monitoring program is aimed at tracking the condition of habitat areas over time and ensuring that the management plan's established performance indicators and project approval requirements are being met. The monitoring program includes terrestrial and aquatic monitoring, weed and vertebrate pest monitoring and associated management measures where required. This monitoring programme complements the rehabilitation monitoring of Bowmans Creek, North East Open Cut and the farmland over the ACOL underground mine which is discussed in Section 9. Monitoring includes areas within the Southern Conservation Area. A monitoring form requested by OEH is included as Appendix 3

6.4.1 Fauna Monitoring

Bi-annual Fauna Monitoring surveys were undertaken in October and December 2015. In total, eight survey sites were established in 2015 consisting of four sites that have been undermined in the past (impact) and four in remnant vegetation that have had no mining activities (control). Each site was systematically sampled using a variety of fauna survey methodologies including small and medium mammal trapping, mammal hair sampling, funnel trapping for reptiles, echolocation recording for microchiropteran bat species, remote cameras detection, call playback surveys for nocturnal birds/mammals and active searches (diurnal and nocturnal) for amphibians, reptiles, mammals and birds.

Two threatened species that had previously not been recorded within the Ashton Coal Project (ACP) site were identified during the 2015 monitoring surveys, being the masked owl (*Tyto novaehollandiae*) and the greater broad-nosed bat (*Scoteanax ruppellii*). Both of these species are listed as vulnerable under the NSW *Threatened Species Conservation Act 1995* (TSC Act). The masked owl responded to a call playback session on one occasion during the October survey and the greater broad-nosed bat was identified via analysis of the echolocation recordings.

A further four threatened species were identified during the surveys, being the grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*), squirrel glider (*Petaurus norfolcensis*), brush-tailed phascogale (*phascogale tapoatafa*) and the eastern bentwing bat (*Miniopterus schreibersii oceanensis*). Each of these species is listed as vulnerable under the TSC Act.

As documented in 2014, the grey-crowned babbler is utilising each of the woodland remnants in the ACP site with 44 observations of this species and 12 nests attributed to this species recorded during the 2015 survey period.

The squirrel glider was observed again in 2015 utilising the habitats within the Southern Open Cut woodland with a single sighting of one animal in each of the two survey periods.

The brush-tailed phascogale was captured at four of the eight transects and recorded on remote camera at an additional transect. This species was caught in a trap 17 times throughout the spring and summer surveys and was recorded on remote cameras on four different occasions. Although we cannot be certain on the size of the population within the ACP site, at least nine different individuals were either captured in a trap or recorded on a camera. This species is notoriously hard to capture and as such there have previously been very few records of this species in the local area. A review of the Atlas of NSW Wildlife (Bionet 2016) revealed only 15 previous documented sightings of this species within 10 kilometres of the ACP site. As such, the results from the 2015 monitoring surveys are of regional significance and highlight the importance of the remnant woodland patches within the ACP site and in particular the VCA.

Analysis of pooled species data demonstrated similar species diversity between the control (72) and impact (70) areas. Based on this similarity, there is little indication from fauna results that mining is having an adverse impact in the ACP site. Similarly, comparison among faunal groups indicates that species diversity was consistent.

6.4.2 Aquatic ecology – Bowmans and Glennies Creek

The large flood event in late April resulted in large scouring flood volumes through both the Bowmans Creek Diversion Channels (BCDs) and the excised creek channels.

Figure 7 Mid-stream of the Eastern Diversion Channel during April 21 flow event

Figure 8 Mid-stream of Eastern Diversion Channel under normal flow following flood events.

As the upper block banks are still low, a significant volume of the flood water was diverted through the old creek sections, with the result that there was little or no impact to the developing riparian habitats of the BCDs and no significant damage to the structure or form of the BCD channels. The flood volumes were sufficient to scour out or mobilise aquatic biota to the effect that following the floods the recolonisation of aquatic habitats would most likely have been initiated by opportunistic short-lived taxa with longer-lived taxa recolonisation taking longer. This results in higher swings in both diversity and macroinvertebrate stream health indices as they follow the rapid changes in the makeup of the assemblages immediately post-flood. These continuing post-flood effects on aquatic biota assemblages are the main basis for a number of low performance index results over the two sampling seasons this year.

The overall quality of the aquatic ecosystems within the diversion channels has continued to advance in 2015 with increased complexity and density of the riparian vegetation. The upper bank *Casuarina* woodland band plus the lower bank *Lomandra* sedge land are both maturing and producing valuable litter that is spreading down slope and deepening the soil/litter cover over the sloping riparian rock cobble banks encouraging new growth of grasses and herbs. Also notably, the density of *Casuarinas* and emergent sedges at and along the low flow riparian edge is starting to provide vital shade to the riparian shallows in a number of places. There has also

been a noticeable increase in complexity of emergent and submerged vegetation and of natural edge accumulated woody debris and vegetation litter plus there are some natural log jams occurring.

Comparisons of the macroinvertebrate biota data for the natural creek and diversion channel survey pools over autumn and spring 2015 indicate that the diversion channel sites are supporting a macroinvertebrate biodiversity and complexity consistent with that encountered within the range of monitoring sites located up and downstream in the retained Bowmans Creek sections (the in-line sections). The diversity and abundance of fish recorded from within the diversions channels in 2015 match the overall diversity and distribution of fish in natural in-line creek pools up- between and down-stream of the diversions. The fish results demonstrate that the diversion channels have continued to provide fish passage during periods of extended flow and provide refuge habitat during periods of low flow.

The river red gum population downstream of the BCD has been identified as a Groundwater Dependent ecosystem (GDE). Informal inspections of this GDE indicate that the GDE is in a healthy condition with no obvious impacts from mining operations.

6.5 Pest Management

Weed and pest management are undertaken at ACOL in accordance with the MOP, FFMP and good land management principles.

6.5.1 Weed Management

Weed control programs at Ashton Coal target weeds that are locally declared under the *Noxious Weeds Act 1993*, including African boxthorn, Mother-of-millions, various ground cactus species and St John's Wort and other environmental weeds. Weed control on site has been consistent over the last few years, targeting the larger populations of weeds, the more invasive species and the riparian zones.

Ashton Coal treated extensive areas of the site during the reporting period. Priority areas for treatment included the mine site boundary, Bowmans and Glennies Creeks, rehabilitation areas and selected offset and conservation areas.

In late June 2015, African Boxthorn was mulched along sections of Bowman's Creek using a Forestry Mulcher. This method of control was utilised due to the density and inaccessibility of the mature Boxthorn plants in these areas, which rendered other methods of control impractical and less likely to be effective. Once the Mulcher had completed each area the remaining stumps were then treated with garlon and diesel, using the basal bark spray method, in order to minimise regrowth. The plants were again treated by way of a follow-up foliar spray approximately eight weeks later.

The use of this method of control on the Boxthorn in these areas, and the follow-up treatments, was highly effective. This is depicted in the before and after photographs shown in Figure 9.

6.5.1 Vertebrate pest management

During the reporting period, ACOL continued an integrated Control Program to combat the presence of feral animals on ACOL property. Methods utilised during 2015 included site monitoring by means of Trail Cameras and Site Inspections, Soft Jaw and Cage Trapping and a 1080 Baiting Program. Results were variable between the various methods, as detailed below:

- Soft jaw trapping - one fox.
- Cage trapping – unsuccessful, recommendations below.
- Baiting – 44 fox takes, 10 wild dog takes, 1 feral pig take.

Results of the vertebrate pest management program were considered successful, with the following recommendations to improve the program in the next reporting period:

- Conduct future 1080 baiting programs
- Conduct trapping programs in association with MMS motion sensing trail cameras to reduce human interaction with trapping sites and target feral pigs.

Mulching Photo 1: Before Shot

Mulching Photo 1: After Shot

Mulching Photo 2: Before Shot

Mulching Photo 2: After Shot

Figure 9 African Boxthorn mulching

7 Water Management

Ashton Coal manages water through its Site Water Management Plan and associated surface and groundwater monitoring programs, issued on 14 May 2015. Ashton Coal is situated between Bettys Creek in the north, the Hunter River in the south, Glennies Creek in the east and Bowmans Creek and its associated floodplain in the west. Bowmans Creek and Glennies Creek are tributaries of the Hunter River, while Bettys Creek is a tributary of Bowmans Creek. ACOL's water management system includes monitoring surface and ground water sites according to an approved monitoring program.

7.1 Water Balance

ACOL regularly monitor the water balance for the operation to assist forecasting and modelling for different climatic and site scenarios. A series of flow meters and surveyed volumes are utilised to monitor the use and transfer of water between key water storages. Water storages are surveyed on a regular basis to ensure the accuracy of water volume data. A schematic overview of the site's water management system can be found in Figure 10.

The water balance is managed in accordance with the Mineral Council of Australia's Water Accounting Framework for the Minerals Industry (2012) (MCA WAF):

http://www.minerals.org.au/file_upload/files/resources/water_accounting/WAF_UserGuide_v1.2.pdf.

The MCA WAF allows sites to account for, report on and compare site water management practices in a rigorous, consistent and unambiguous manner that can easily be understood by non-experts. The MCA WAF focusses on the flows between the environment and the boundary of the operation i.e. the inputs, outputs and diversions.

7.1.1 Water Demands

Ashton Coal has three main water demands being Coal Handling and Preparation Plant (CHPP) supply, underground supply and above ground dust suppression. A total of 2.98 million tonnes (Mt) of coal was processed over the 2015 calendar year resulting in a CHPP demand of approximately 792 ML or 266 litres per feed tonne. Metered underground supply was 176 ML while dust suppression use over the 2015 calendar year was measured to be 41 ML.

7.1.2 Inputs and Outputs

Rainfall/runoff and aquifer interception are the principal water sources for Ashton Coal with approximately 274 hectares (ha) captured by the surface water management infrastructure on site. Over the 2015 calendar year, modelling indicates rainfall/runoff accounted for 46.9% of the total water inputs to the water management system while groundwater interception and extraction accounted for approximately 34.0%. Water sourced from the Hunter River and Glennies Creek accounted for 12.3% while water entrained in the feed coal accounted for 6.8% of the total water inputs. No water was sourced from the Glennies Creek Mine in 2015. Major outflows from Ashton Coal over the 2015 calendar year included evaporation (19.5%), entrainment in product coal and rejects (38.5%), loss from the underground (16.8%) and seepage (25.1%).

7.2 Water take

NSW Government requirements are for water take to be reported over a financial period (i.e. 1 July 2014 to 30 June 2015). Consequently, water take (section 7.2) is has been reported in a manner consistent with this requirements.

ACOL measures its water take in accordance with the approved Water Management Plan. Measured water take is partitioned in accordance with the predictions of the site Groundwater Model.

Water take at Ashton occurs via two separate methods: incidental (or passive) take and pumped surface water take. Incidental take occurs through mining induced fracturing of aquifers which report to the underground workings. This water is removed from the mine by a network of dewatering pumps. Pumped surface water take involves active pumping from Glennies Creek and the Hunter River to provide higher quality water for a variety of uses including irrigation of rehabilitation, use in equipment and as fire water at the mine.

During the 2014 – 2015 water year ACOL commenced a program to dewater underground workings. This water must be dewatered to mitigate the risk of safety issues associated with mining below it. The water is stored in the Pikes Gully seam which overlies the current extraction in the Upper Liddell Seam. The water has accumulated over a number of years and as such was effectively not taken during the 2014 – 2015 water year; however, it does inflate the apparent overall dewatering for the period. The total stored porous/hard rock water pumped from mine (not taken during 2014 – 2015 water year) was 111ML.

Table 16 Water Management Act 2000 Licences and associated water take for FY15.

Water Licence Number	NOW reference	Water sharing Plan, source and management zone	Entitlement	Passive take / inflows (ML	Active pumping (ML	Total (ML)
984	20AL201282	Hunter Regulated Water Sharing Plan, surface water, zone 3A (Glennies Creek)	9	0	0	0
997	20AL201311	Hunter Regulated Water Sharing Plan, surface water, zone 3A (Glennies Creek)	11	0	0	0
1120	20AL201624	Whole Water Source (Hunter Regulated River Water Source)	3	0	0	0
1121	20AL201625	Hunter Regulated Water Sharing Plan, surface water, zone 1B (Hunter River from	335	65	35	100

Water Licence Number	NOW reference	Water sharing Plan, source and management zone	Entitlement	Passive take / inflows (ML	Active pumping (ML	Total (ML)
		Goulburn River Junction to Glennies Cu Junction)				
1358	20AL203056	Hunter Regulated Water Sharing Plan, surface water, zone 3A (Glennies Creek)	4	0	0	0
6346	20AL203106	Hunter Regulated Water Sharing Plan, surface water, zone 1B (Hunter River from Goulburn River Junction to Glennies Creek Junction)	15.5	0	0	0
8404	20AL200491	Hunter Regulated Water Sharing Plan, surface water, zone 3A (Glennies Creek)	80	0	0	0
15583	20AL204249	Hunter Regulated Water Sharing Plan, surface water, zone 3A (Glennies Creek)	354	46	199	245
19510	20AL211015	Hunter Regulated Water Sharing Plan, surface water, zone 1B (Hunter River from Goulburn River Junction to Glennies Creek Junction)	130		0	
23912	20AL211423	Hunter Unregulated and Alluvial Water Sources 2009, surface water, Whole Water Source (Jerrys Water Source) (Bowmans Creek)	14	0	0	0
29566	20AL212287	Hunter Unregulated and Alluvial Water Sources 2009, Aquifer, Jerrys Management Zone (Jerrys Water Source)	358	23	0	23
36702	20AL212975	Hunter Unregulated and Alluvial Water Sources 2009, Surface water, Jerrys Management Zone (Jerrys Water Source) (Bowmans Creek)	116	0	0	0
36703	20AL212976	Hunter Unregulated and Alluvial Water Sources 2009, Surface water, Jerrys Management Zone (Jerrys Water Source) (Bowmans Creek)	150	45	0	45
TOTAL			**1579.5**	**179**	**234**	**413**

Table 17 Water Act 1912 Licences and associated water take

Water Licence Number	Water sharing Plan, source and management zone	Entitlement	Passive take / inflows	Active pumping	total
20BL169508	Water Act 1912 Groundwater Licence	100	0	0	0
20BL173716	Water Act 1912 Groundwater Licence	511	433	0	433
20BL173735	Water Act 1912 Groundwater Licence	Nil - Monitoring Only	-	-	-

No compensatory water has been required or provided in the reporting period.

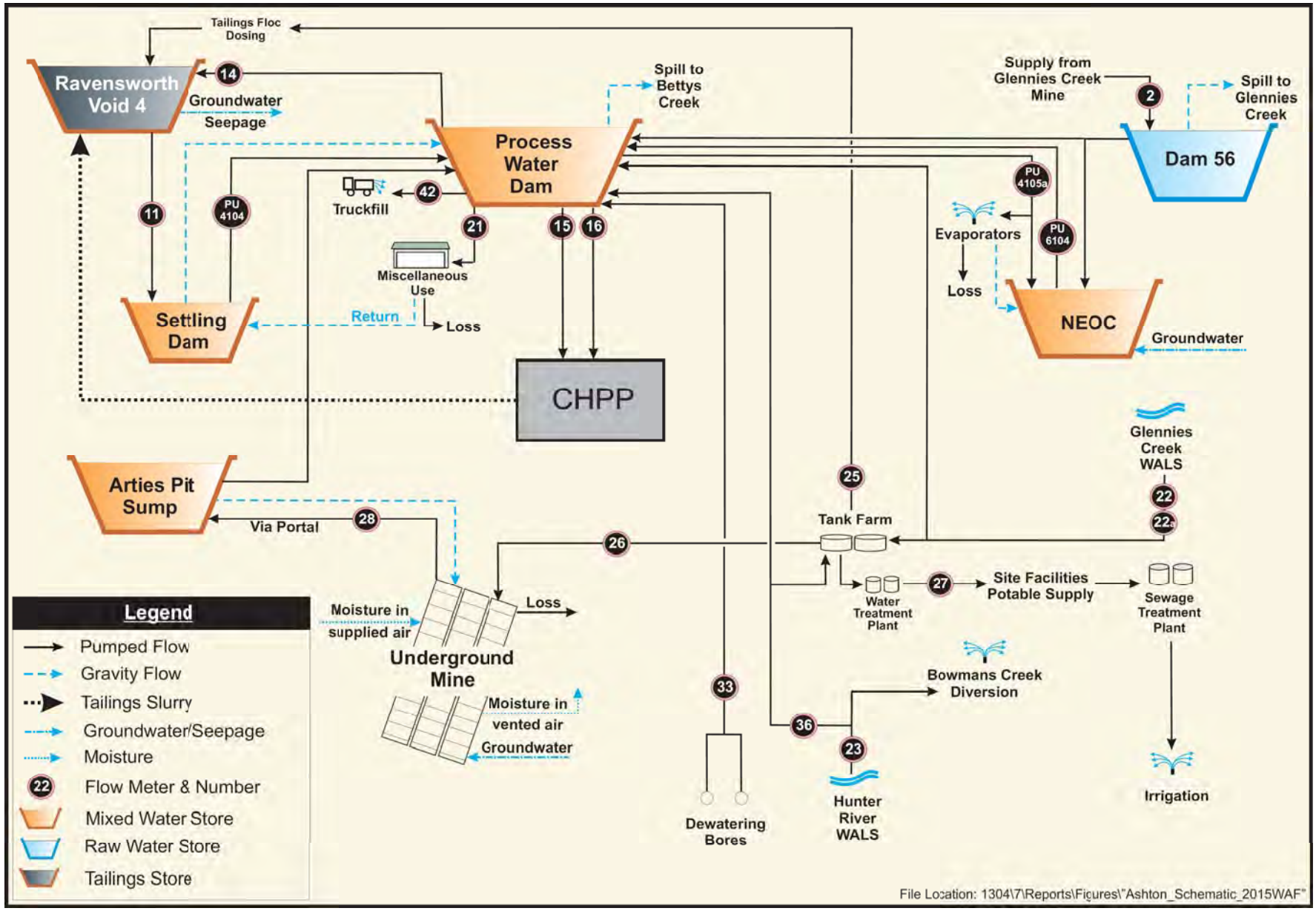


Figure 10 ACOL Water schematic*

*All dams must have spillways constructed to ensure dam wall stability. Dams at the ACP are managed to prevent spills occurring

7.3 Surface Water

7.3.1 Environmental Management

Surface water at ACOL is managed in accordance with the approved Site Water Management Plan. Controls have been put in place in accordance with this plan to control potential causes of water pollution. These controls are considered to have been adequate for the reporting period. Water quality for the creeks and rivers surrounding ACOL's operation is monitored by an independent consultant at 14 statutory monitoring sites. The location of the surface water monitoring sites is shown in Figure 11 and described in Table 18. Analysis of all water samples collected is undertaken by a NATA accredited laboratory. Monthly water samples were collected and analysed during the reporting period for pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Total Suspended Solids (TSS) Total Hardness ($CaCO_3$), and Oil and Grease (O&G).

ACOL's site water management plan aims to minimise any adverse impacts on receiving waters downstream of Ashton Coal; including Glennies Creek, Bettys Creek and Bowmans Creek, all of which drain into the Hunter River. The plan also outlines measures for managing water on site. ACOL's approved surface water monitoring program has established impact assessment criteria. Impact assessment criteria can be described as trigger values which, if activated, would lead to a response in terms of more intensive monitoring, investigation and if required, remedial action.

7.3.2 Environmental Performance

The location of surface water monitoring sites and data capture rates are provided in Table 18. SM1 and SM2 in Bettys Creek were dry, which is typical for this watercourse. A summary of the surface water quality data for statutory sites during the reporting period is provided in Table 19.

Table 18: Surface water monitoring locations and data capture rates

Monitoring Station	Stream	Location	Data capture rate %
SM 1	Bettys Creek	Glendell land upstream of Ashton	0*
SM 2	Bettys Creek	Just upstream of confluence with Bowmans Creek	0*
SM 3	Bowmans Creek	Water pool at north west corner of mine lease	100
SM 4	Bowmans Creek	Water pool immediately downstream of New England Highway	100
SM 4a	Bowmans Creek	Former channel	100
SM 5	Bowmans Creek	Halfway down Ashton property	75#
SM 6	Bowmans Creek	Just upstream of confluence with Hunter River	100
SM 7	Glennies Creek	Upstream of Ashton Mine	100
SM 8	Glennies Creek	Halfway down Ashton property	100
SM 9	Hunter River	Upstream of confluence with Bowmans Creek	100
SM10	Hunter River	Downstream of confluence with Bowmans Creek	92^
SM 11	Glennies Creek	Upstream of confluence with Hunter River	100
SM 12	Hunter River	Downstream of confluence with Glennies Creek	100
SM 13	Hunter River	Upstream of confluence with Glennies Creek midway between Bowmans Creek and Glennies Creek	100
SM 14	Hunter River	Directly upstream of confluence with Glennies Creek	100

*SM1 and SM2 in Betty's Creek were dry for the duration of the reporting period
Site SM5 was dry or too low to sample during January, March and April and

^SM10 had unsafe access in March.

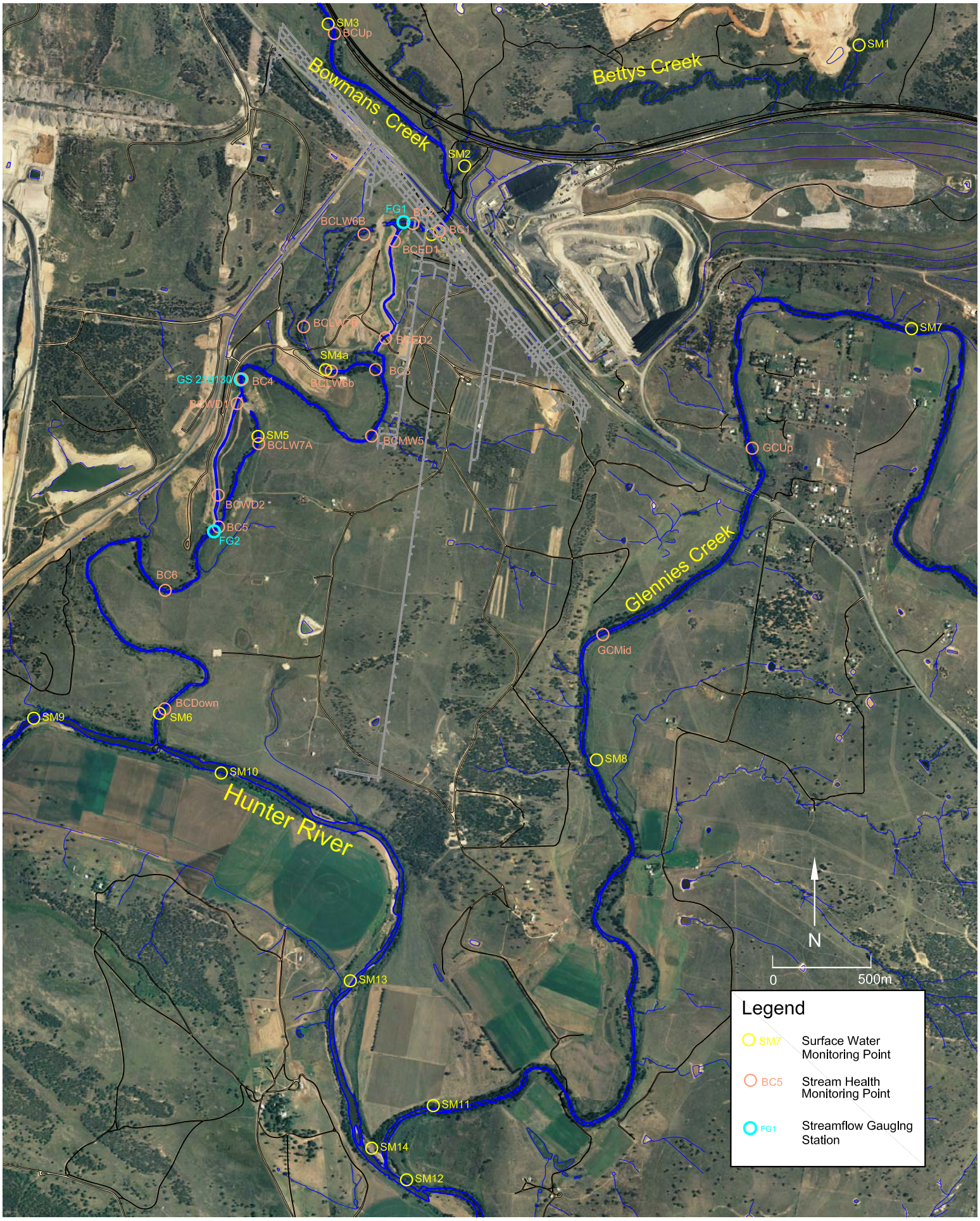


Figure 11 Surface Water Monitoring Sites

Table 19: Summary of surface water quality monitoring results

Creek System	2015	pH	EC µS/cm	TDS mg/L	TSS mg/L
Bettys Creek*	Minimum	-	-	-	-
	Maximum	-	-	-	-
	Average	-	-	-	-
Bowmans Creek	Minimum	6.9	805	494	2.0
	Maximum	8.3	2840	1740	255.0
	Average	7.7	1175	724	21.0
Glennies Creek	Minimum	7.5	326.0	185.0	1.0
	Maximum	8.3	3030.0	1690.0	19.0
	Average	7.9	882.1	520.6	8.5
Hunter River	Minimum	7.5	466.0	268.0	2.0
	Maximum	8.6	1216.0	724.0	46.0
	Average	8.3	851.8	498.1	17.8

*Bettys Creek was dry for the duration of the reporting period

7.3.2.1 pH

pH results were generally consistent with the past two year's results.

Surface water pH measured in Bowmans Creek (SM3, SM4, SM4a, SM5 and SM6) were neutral to slightly alkaline (ranging from 6.9 to 8.3) and remained within the acceptable pH range.

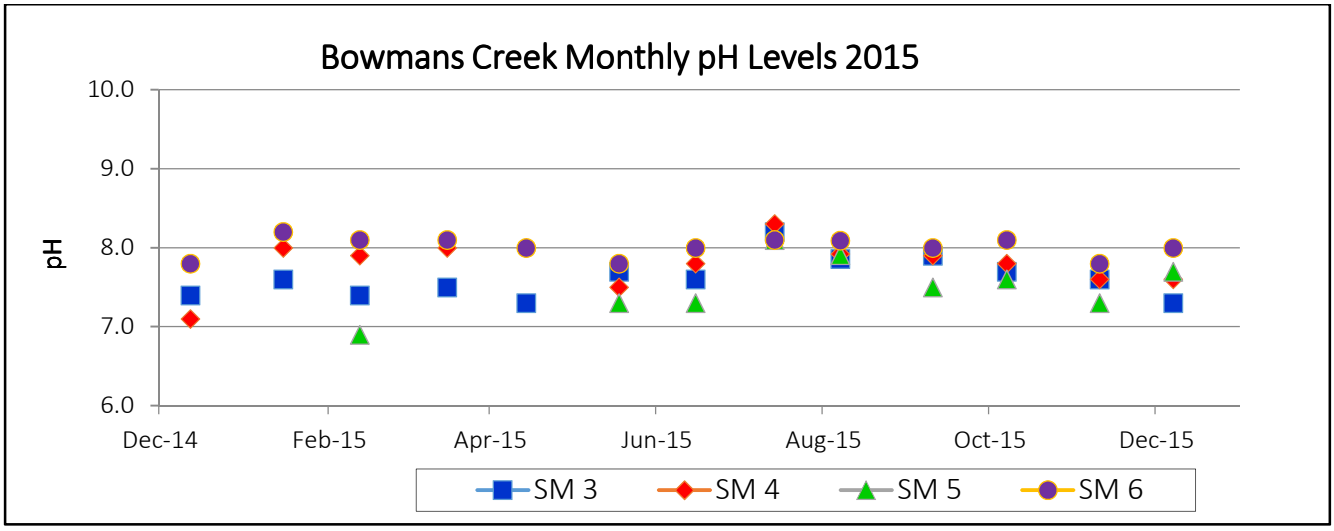


Figure 12: Bowmans Creek pH levels during 2015

Glennies Creek (SM7, SM8 and SM11) pH levels were neutral to slightly alkaline (ranging from 7.5 to 8.3) with throughout the year. The pH levels remained within the acceptable pH range.

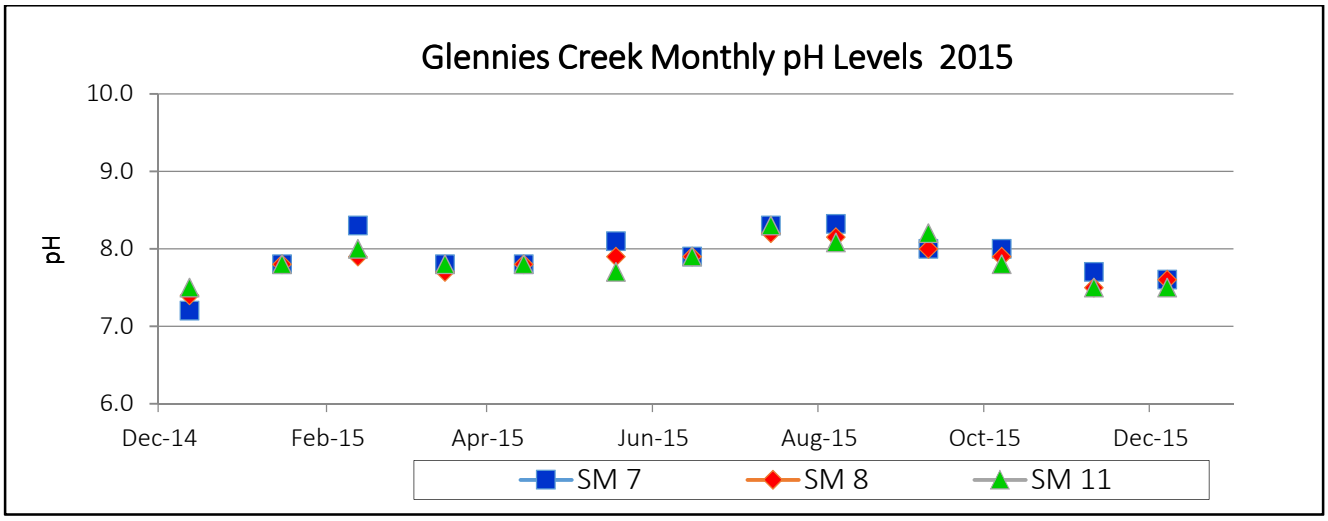


Figure 13: Glennies Creek pH levels during 2015

pH levels in the Hunter River (SM9, SM10, SM12, SM13 and SM14) were neutral to slightly alkaline (ranging from 7.5 to 8.6) with minimal variation between sites, and remained within the acceptable recommended pH range.

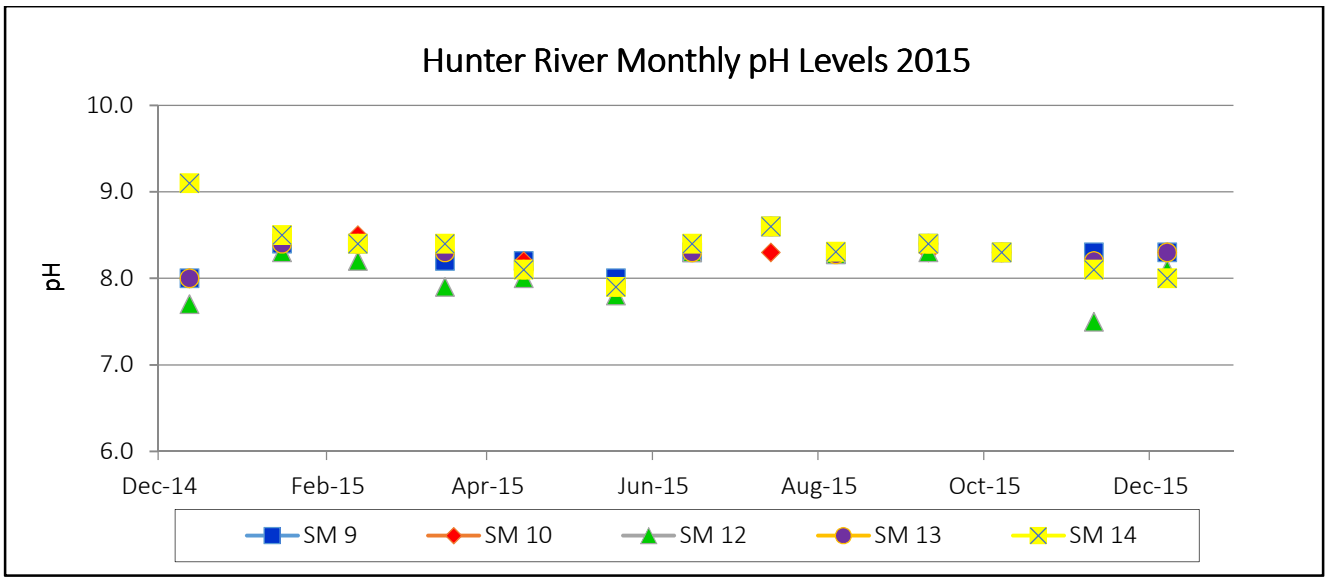


Figure 14: Hunter River pH levels during 2015

7.3.2.2 Electrical Conductivity (EC)

Surface water Electrical Conductivity (EC) results were generally consistent with results from 2013.

The EC trends in Bowmans Creek indicate there was pooling and little to no flow in February and March. Typical of previous years, Bowmans Creek sites (SM3, SM4, SM5 and SM6) generally experienced higher EC compared to other sites. This is due to a natural inflow of saline ground water which forms most of the flow during dry months and low surface flow periods, resulting in increased EC levels.

Bowmans Creek EC levels fluctuated between 805 - 2840µS/cm (Figure 15). Elevated levels of EC at SM4 have been observed previously and result from natural saline groundwater inflows to the pool. During periods of low flow in Bowmans Creek, the saline groundwater discharge becomes the dominant supply of water to the pool resulting in increasingly elevated EC levels. EC levels greater than 10,000 µS/cm have been historically observed at the site.

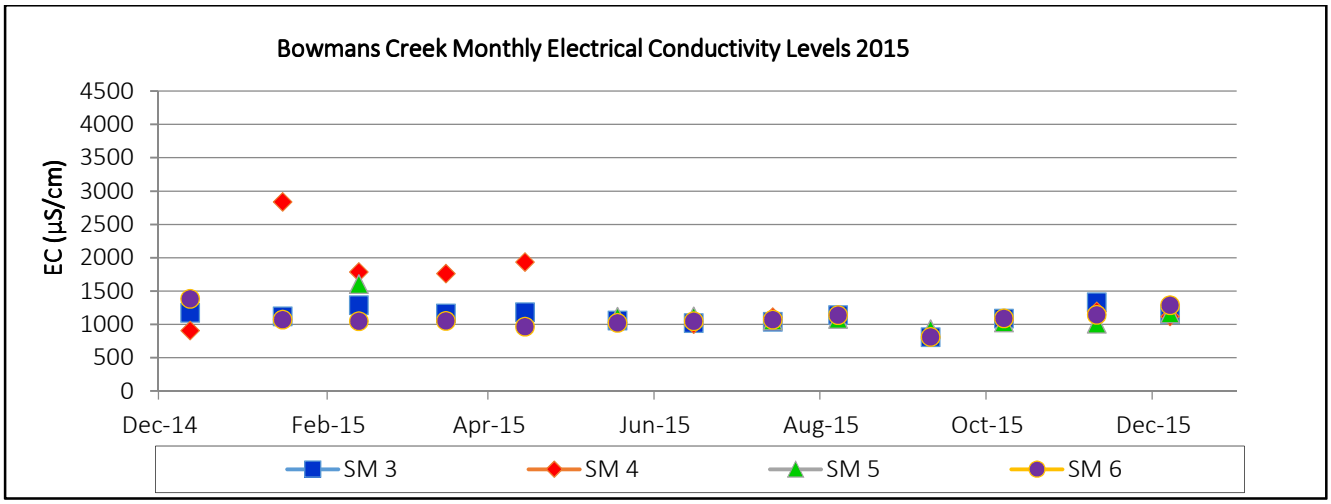


Figure 15: Bowmans Creek EC during 2015

Glennies Creek (SM7, SM8 and SM11) EC levels fluctuated throughout the year. EC ranged between 326 and 3030µS/cm.

In March 2015, an increase in EC was measured at the site upstream (SM7) of the mine only. In May and August, an increase in EC was again measured at the site upstream of Ashton Coal. However, on these occasions a higher EC value was also measured at either one or both of the monitoring points downstream of SM7. ACOLs internal investigations involved checking laboratory results, inspecting the monitoring locations and implementing a number of additional monitoring locations to try and isolate the source of the salinity anomalies. Investigations have been unable to identify the cause of the anomalous results. ACOL could not attribute any of the results to its own activities as there have been no discharges or unusual observations relating to Glennies Creek. ACOL will continue to monitor Glennies Creek in accordance with the approved Water Management Plan.

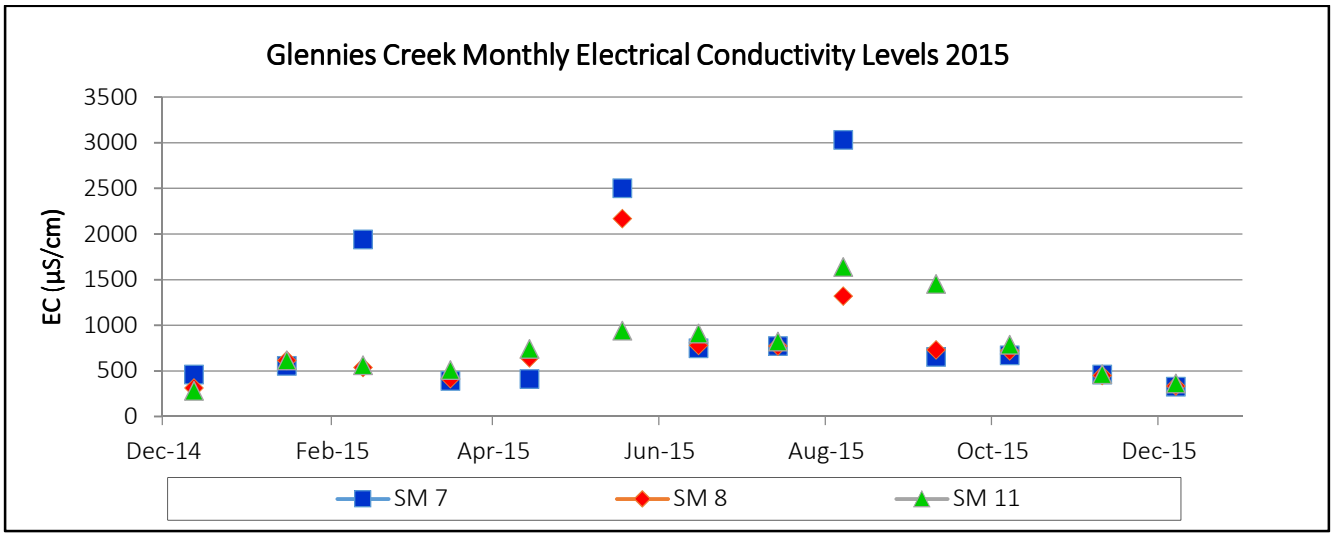


Figure 16: Glennies Creek EC during 2015

Hunter River (SM9, SM10, SM12, SM13 and SM14) EC levels were generally low throughout the year, as shown in Figure 17.

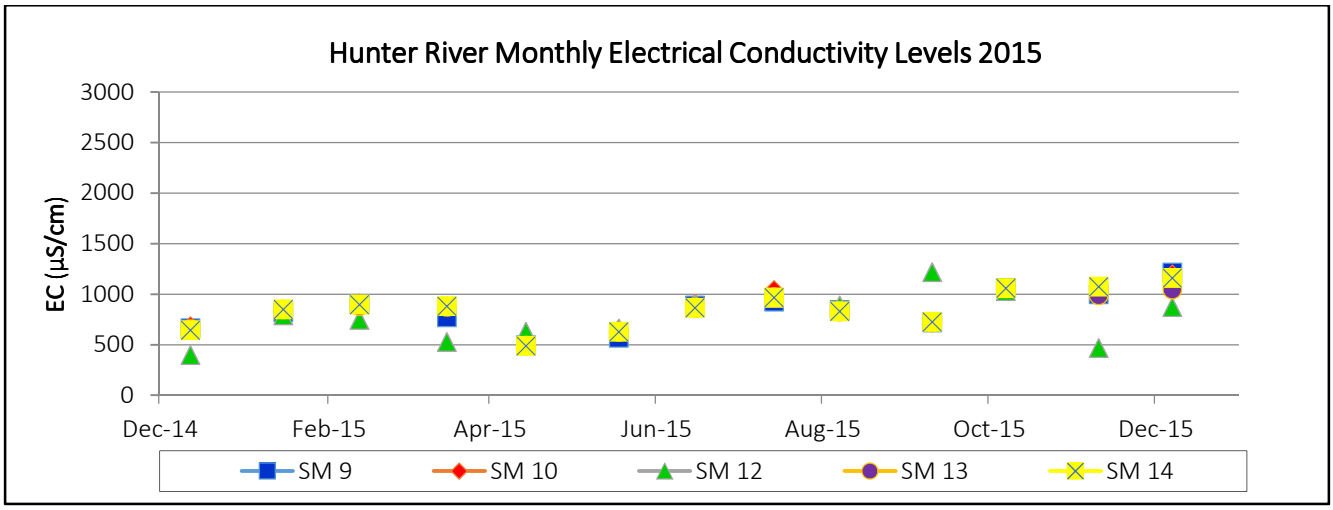


Figure 17: Hunter River EC during 2015

The monitoring data collected during the reporting period continued to indicate that there are no adverse impacts from mining on surface water quality around the mine site.

7.4 Groundwater

7.4.1 Environmental Management

The location of the groundwater monitoring sites is displayed in Figure 18. The monitoring network is spatially distributed across the underground mining area. Monitoring coverage is focussed in areas within and adjacent to the mining associated subsidence footprint, notably:

- Saturated quaternary sediments (alluvium) including Bowmans Creek Alluvium (BCA), Glennies Creek Alluvium (GCA) and Hunter River Alluvium (HRA).
- Shallow Permian sandstone and minor coal seams referred to in this report as coal measures overburden (CMOB).
- Permian coal measures of varying thickness targeted by mining.

ACOL's site water management plan aims to minimise any adverse impacts (other than those approved under the development consent) on aquifers in proximity to the operation, including the hard rock coal measures and the shallow alluvial deposits associated with the Hunter River, Glennies Creek and Bowmans Creek. The groundwater monitoring program includes groundwater level, piezometric pressure and field water quality parameters and has been carried out in accordance with the Ashton Coal Water Management Plan approved in May 2015 and the requirements detailed under the conditions of Development Consent DA No. 309-11-2001-i and Environmental Protection Licence 11879.

ACOL's approved groundwater monitoring program has established impact assessment criteria. Impact assessment criteria can be described as trigger values that, if exceeded, would lead to a response in terms of more intensive monitoring, investigation and ultimately if required remedial action.

Monitoring of water levels and water quality parameters is undertaken on a monthly basis at selected monitoring bores. Physical parameters – pH, EC and temperature are monitored quarterly and chemical speciation is undertaken on relevant bores annually.

Condition 9.2(d) of the development consent required the AEMR to contain a Groundwater Management Report. This is contained as Appendix 2 of this document, and details further information on Groundwater Management during the reporting period.

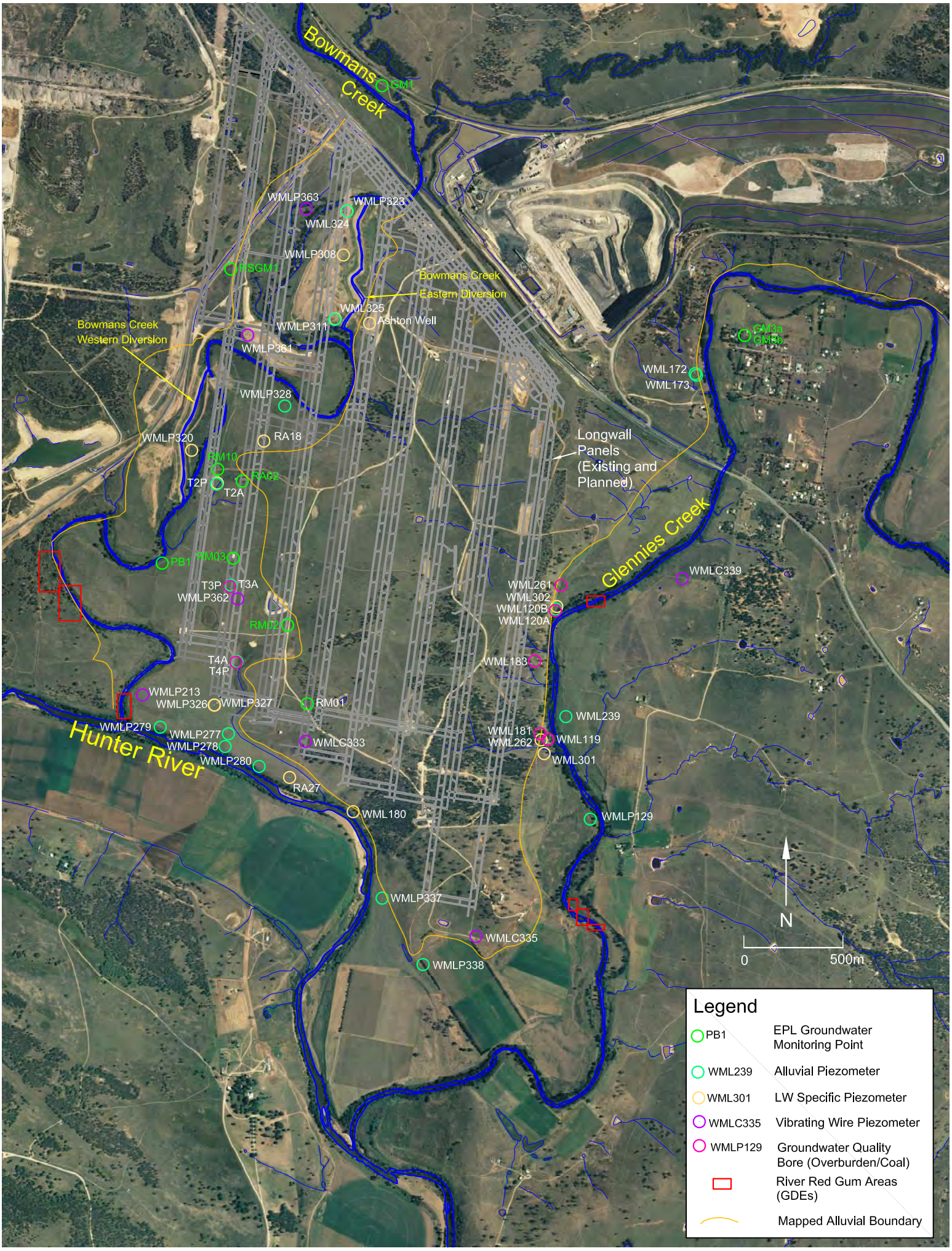


Figure 18 Groundwater Monitoring SItes

7.4.2 Environmental Performance Summary

The key points of the annual groundwater monitoring review can be summarised as follows:

- No groundwater level within the alluvium were recorded below trigger values;
- No exceedances of pH and EC trigger values were observed;
- Annual groundwater laboratory analysis results showed some minor exceedances of the ANZECC (2000) criteria for fluoride, dissolved iron and ammonia. These exceedances are not likely to be a result of mining related impacts;
- Direct rainfall recharge within the alluvium are observed on all the site, the overburden on the north east and the PG and Arties seams west of the underground;
- High level of inferred hydraulic connection between the Glennies Creek alluvium and Pikes Gully seam on the eastern part of the underground mine, which does not translate as observed inflows into the underground mine.
- Groundwater conditions to the east of LW01 have recovered from the impacts of underground mining. The stabilisation of the groundwater pressures between the GCA and the PG seam indicates that the groundwater gradient has returned to a pre-mining state;
- Groundwater level variation related to mining on the Upper Liddell seam on the whole area.

In conclusion, during 2015, there was no groundwater impact related to mining which exceeded impacts predicted in the Bowman's Creek Diversion Environmental Assessment.

Further data and analysis on the annual groundwater monitoring program is contained in Appendix 2.

8 Mine Subsidence

During the reporting period, mining operations occurred in Longwalls 103 and 104, both in the Upper Liddell Seam.

Mining height was nominally in the 2.3m to 2.6m range. The seam dipped to the southwest at a grade of up to 1 in 10. Overburden ranges in thickness from 210m near the start of the longwall panel to 110m at the take-off end. The final extraction void is nominally 216m wide. This includes the 5.5m width of development drivage either side of the longwall block. Maingate chain pillars are nominally at a centre to centre width and length of 30m and 150m respectively. Tailgate chain pillars are at a centre to centre width and length of 30m and 150m respectively.

Longwall 103 (LW103) began extraction on 21 August 2014, and extraction works were completed on 18 June 2015, with final supports removed on 5 July 2015. Longwall 103 is 2457m long and 205m wide. Overburden ranges in thickness from 2.3m to 2.6m. No unexpected impacts to the surface environment or infrastructure resulted from secondary extraction of LW103.

Longwall 104 (LW104) began extraction on 23 July 2015. LW104 is 2570m long and 205m wide. Overburden ranges in thickness from 180m near the start of the longwall panel to 110m at the take-off end. At the end of 2015, LW104 had been extracted to 1,428m chainage. This is equates to 1,032m extraction. There were no unexpected impacts to the environment or infrastructure during this reporting period.

The effects of subsidence were monitored in accordance with the document 'Ashton Coal Project Upper Liddell Seam Extraction Plan, Longwalls 1 to 8'; this included both regular survey monitoring and visual inspection of both environmental, land and infrastructure features.

Longwall operations at the Ashton Coal Project commenced in February 2007. Mining of the Pikes Gully seam and ULD seams LW101, LW102 and LW103 are completed. Operations are currently mining LW104. The progress of ULD longwall extraction is shown in Figure 19.

Fortnightly subsidence reports continued to be sent to key stakeholders during the reporting period in compliance with commitments set out in the approved extraction plans.

8.1 Subsidence Monitoring and Remediation

ACOL has monitored the subsidence movement on the surface during the extraction of all Longwalls using longitudinal subsidence lines. These are located over the start and finish of each panel, a main cross line extending over all seven southern panels and a dedicated cross line extending over Longwall 6B, 7B and 8. All panels have monitoring data from each start and end lines, and various cross lines relevant to panel, surface or strata features.

The subsidence monitoring lines relevant to LW103 are LW103-CL1, LW3-CL1, LW103-CL2 and XL5. Table 20 outlines the maximum subsidence parameters predicted and recorded during regular survey of subsidence lines as the longwalls passed each location. The frequency and results of monitoring have been maintained in accordance with 'Ashton Mine Subsidence Monitoring Programme Longwall 101 to 104'.

The latest subsidence monitoring survey of LW103 and LW104 indicate a maximum of 3.4m of subsidence has been measured which is less than predictions. The maximum measured values of tilt and strain are close to and only just greater than the predicted maxima at the completion of mining LW102. Estimation of tilts and strains was recognised as likely to be more uncertain due to the multi-seam subsidence effects and the lack of previous experience of monitoring subsidence above multi-seam extraction. For most of the panel, the maximum tilts and strains are much less than the maxima predicted, but the predictions were locally exceeded at the stacked geometry near the end of the panel. At this stacked location, the tilts and strains returned to only slightly above predicted values by the end of the panel.

Table 20 Subsidence of ULD Longwall Panel 101 - 104

	Maximum Subsidence (m)	Maximum Tilt (mm/m)	Maximum Strain (mm/m)
Longwall 101			
Predicted SMP/EP	4.40	235	94
PG LW1 CL1 Measured	2.76	60	49
PG LW1 CL2 Measured	2.91	110	38
XL1 Measured	2.49	42	23
XL5 Measured	3.23	101	20
XL8 Measured	2.78	136	28
Longwall 102			
Predicted SMP/EP	4.00	189	76
LW102CL1 Measured	3.20	38	12
LW102CL2 Measured	3.40	190	83
XL5 Measured	3.20	54	24
Longwall 103			
Predicted SMP/EP	4.00	162	65
LW103CL1 Measured	3.4	41	10

	Maximum Subsidence (m)	Maximum Tilt (mm/m)	Maximum Strain (mm/m)
LW103 CL2 Measured	3.4	145	58
XL5 Measured	3.4	61	25
Longwall 104			
Predicted SMP/EP	1.6	78	23
LW104CL1 Measured	2.3	35.9	27.3
XL5 Measured	3.139	59	16.6

The latest subsidence monitoring survey of LW103 and LW104 indicate a maximum of 3.4m of subsidence has been measured which is less than predictions. The maximum measured values of tilt and strain are close to and only just greater than the predicted maxima at the completion of mining LW102. Estimation of tilts and strains was recognised as likely to be more uncertain due to the multi-seam subsidence effects and the lack of previous experience of monitoring subsidence above multi-seam extraction. For most of the panel, the maximum tilts and strains are much less than the maxima predicted, but the predictions were locally exceeded at the stacked geometry near the end of the panel. At this stacked location, the tilts and strains returned to only slightly above predicted values by the end of the panel.

The maximum subsidence movements detected over Longwalls 102 and 103 are less than those predicted in the Subsidence Management Plan (SMP) for all centreline (CL) survey monitoring lines and cross lines. Horizontal movement has occurred in the coal seam up dip direction (East North -East) above each of the Longwall panels. This movement has predominantly occurred within the longwall panels with limited displacement detected outside the panel edge.

To manage subsidence impacts the 132kV power poles were reassessed and replaced with concrete poles prior to longwall extraction. The power lines have been fitted with rollers prior to longwall extraction. Visual and survey monitoring of the 132kV transmission line power poles was undertaken regularly whilst mining LW103 and LW104. Consistent with the 2014 AEMR, maximum subsidence of power poles was within predictions. There has been no adverse impacts on the power poles and the transmission line remains serviceable.

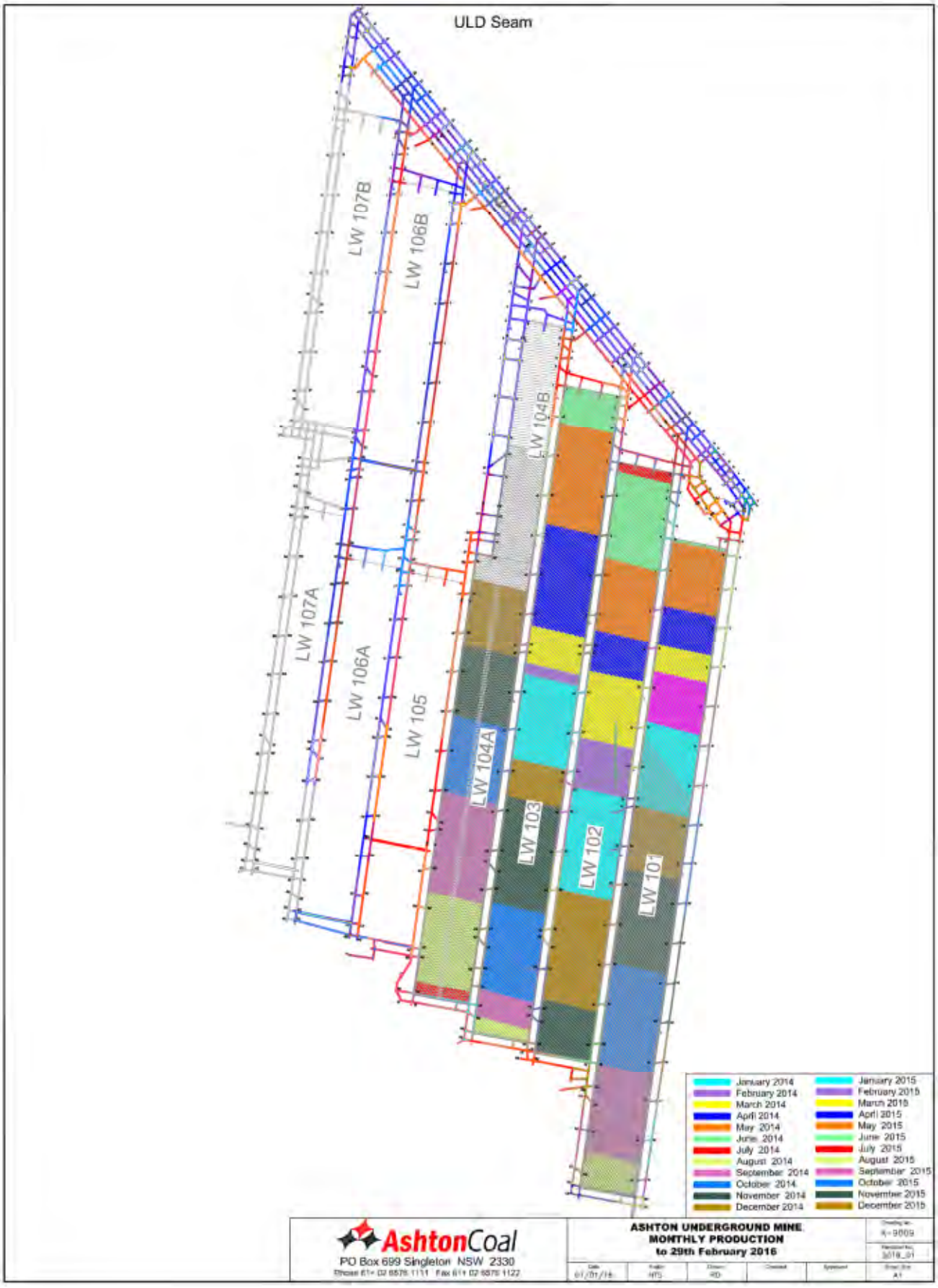


Figure 19 Progression of ULD mining as at 31 December 2015

A section of primary Right of Way (ROW) access to Property 130 was undermined by LW103 during the reporting period. This section of ROW traversing the active longwall panel was predicted to suffer perceptible subsidence impacts (e.g. surface cracking). This section of access road was closed off prior to undermining and an alternate access was adopted, with a suitable detour being activated. Remediation works were completed and the ROW reopened. No damage was observed to farm gates, grids or fences during the reporting period.

Rehabilitation of the surface cracks has been occurring as extraction continues with a small excavator smoothing cracks. Affected surface roads have been repaired to smooth compression humps and minor cracks.

Ponding has become evident in some subsided areas after rainfall events, typically in those areas which were flat pre-mining. Remediation is planned in consideration of the currently approved multi seam mining which will see the same area undermined for a further three seams. Presently, the ponding does not present a significant risk and serves as a water source for stock which graze over the lease.

In general, the maximum subsidence movements detected were less than those predicted. There is no indication of any significant lateral movement of the steep slope adjacent to Glennies Creek or of the New England Highway road cutting.

9 Rehabilitation and Land Management

Rehabilitation and land management activities undertaken at ACOL are outlined in the ACOL Mining Operations Plan (MOP), issued on 7 August 2014. There were no notable variations in activities at Ashton Coal when compared with the MOP.

During the reporting period, plantings in the Bowmans Creek Diversion rehabilitation area continued. Rehabilitation of gas drainage pipeline disturbance was undertaken. Following the success of previous years, slashing was undertaken on the North East Open Cut Rehabilitation to promote diversity of grass species.

Consistent with the MOP, there were no areas of rehabilitation relinquished or signed off by DRE during the reporting period.

During the next reporting period, rehabilitation will be monitored and maintenance conducted as required and gas drainage pipelines will continue to be rehabilitated.

During 2016, a project to gain approval to divert clean water off established rehabilitation into natural waterways will continue. It is hoped that with water quality testing and analysis and minor earthworks, clean water from the NEOC can be diverted offsite instead of reporting to industrial water storages. This will be reported on in the next annual review.

There are three main primary domains (or land management units) under active rehabilitation, monitoring and maintenance:

- Bowmans Creek Diversion – rehabilitation of the diverted creek sections is continuing in accordance with the commitments made in the Bowmans Creek Diversion Environmental Assessment, water management plan and MOP.
- Farmland above the underground mine – effective land management to ensure the land remains viable farmland is the focus over this area, which is managed in accordance with the MOP and the FFMP.

- North East Open Cut – rehabilitation has been completed in this area, monitoring and maintenance activities are ongoing.

The MOP defines rehabilitation phases for each domain, and the completion criteria for each phase. For each domain, specific performance indicators have been established main to allow the progress of rehabilitation to be measured. Consistent with MOP requirements, the performance indicators and current condition (measured during the 2015 rehabilitation monitoring) are described in Table 22 to Table 27.

Table 21 Revegetation species mix planted in the Bowmans Creek Diversion during February and March 2015.

Species	Number of seedlings
Ficus coranata	140
Melia azedarach	200
Brachychiton populeneus	800
Eucalyptus tereticornis	2500
Eucalyptus punctata	700
Eucalyptus crebra	1100
Corymbia maculata	1000

9.1 Bowmans Creek Diversion Rehabilitation Monitoring Program

Construction of the Bowmans Creek Diversion (BCD) was completed in November 2012, with revegetation plantings commencing that year to establish two vegetation communities (River Oak Forest and Red Gum Woodland) within the BCD rehabilitation area.

Rehabilitation monitoring is conducted twice a year to provide details of the current condition of planted trees and shrubs, total vegetation and weed coverage and extent of any erosion issues or concerns that may affect the success of the revegetation.

A combination of permanent monitoring quadrats and photographic points to track vegetation growth and coverage, erosion transects and Landscape Functional Analysis is used to determine the progress of revegetation and ecosystem function. Eleven monitoring quadrats have been established. Monitoring was performed in May and August 2015.

A total of 50 flora species have been recorded in the monitoring plots over the course of the surveys, consisting of 34 exotic species and 16 native species (several species of eucalypts may have been counted as one species due to the difficulties of identifying young eucalyptus trees). Thirty two species were common to both surveys with eight species recorded in the May survey only and 10 species in the August survey.

The most commonly recorded native species were the planted canopy and shrubs – although it should be noted that combining the juvenile Eucalypts has reduced the number of species recorded (see above). Ground cover stratum continues to be dominated by aggressive exotics such as *Chloris gayana* (Rhodes grass) and *Pennisetum clandestinum* (Kikuyu) which have served to stabilise the constructed banks, but have outcompeted other groundcover species as they have spread. Under the planting schedule native groundcovers or grasses are yet to be seeded into the two main communities. Excluding *Cynodon dactylon* (Common Couch), a total of seven native grasses and two native forbs have been recorded in the monitoring plots but their coverage is low and occurrence infrequent indicating the dominance of the exotics.

Canopy plantings have continued to increase in height, with *Casuarina cunninghamiana* trees in particular showing good growth with average heights ranging from over 3 m to over 5 m and maximum heights estimated to be approaching 6 m.

Survival of planted trees and shrubs appears to have stabilised. No further plantings of *C. cunninghamiana* are required at this stage. ACOL has recently undertaken a planting programme of the river Red Gum Woodland community that extends the area and number of individual trees and shrubs planted.

Only one exotic species listed as a noxious weed by the Upper Hunter County Council was identified during the survey, *Senecio madagascariensis* (Fireweed) - common throughout the BCD and uncontrollable due to its almost ubiquitous presence. Galenia (*Galenia pubescens*) – not a listed noxious weed - has increased.

Landscape Functional Analysis results shows this is still an immature, simplified landscape, which is to be expected as it is only in the first phase of a three phase rehabilitation program. Landscape Organisational Index (LOI) scores have decreased as the density of the River Oak Forest canopy has increased and begins to shade out the understorey. LOI scores in Forest Red Gum plots have decreased on the East Diversion as a result of slashing to grass species, which allows mid to upper storey species to out compete grasses. West Diversion lots remained largely unchanged showing the dominance of the ground cover strata. Stability and Infiltration/Runoff Indices did not record significant changes between the surveys. The Nutrient Cycling Index has improved in the River Oak Forest areas, but remained largely unchanged in the Forest Red Gum Woodland areas.

Recommendations arising from the monitoring surveys include:

- Cessation of planting of canopy species allowing for consolidation and continued growth;
- Continued irrigation of the new planting of Forest Red Gum Woodland plantings over the 2015/2016 summer period;
- Use the surviving *Acacia longifolia* shrubs on the West Diversion as indicator plants to determine if irrigation is required on the West Diversion, west bank areas;
- Begin planning for the augmentation of the native flora diversity for the 2016 autumn plantings as the Revegetation Plan progresses to Phase 2; and,
- Continued control of *Galenia pubescens*.

Table 22 is referenced from the Ashton Coal Mining Operations Plan – 2013 to 2017, Table 30 Ecosystem and Landuse Establishment - Performance Criteria, Measures and Indicators. Current status comments are based upon the data and observations made during the annual survey. BCD condition is based upon 11 monitoring plots (20m x 10m quadrats) located within the BCD itself. This report marks the progression from Phase 1 to Phase 2 of the rehabilitation of the BCD.

Table 22 Bowmans Creek Diversion Ecosystem and Landuse Sustainability Criteria, Measures and Indicators

Domain Objective	Performance Indicator	Performance Measure	Completion Criteria	Justification/Source	Current Status
Limit soil compaction and the spread of weeds by minimising site access by vehicles and stock	Fencing	Adequate fencing is installed and maintained	Vehicle access is restricted to nominated site access roads as far as practical.	ACOL Weed Management Plan Noxious Weeds Act 1993 Australian and NSW Weed Strategies TSC Act - Key Threatening Processes	Achieved Fencing is intact and in good condition restricting access to designated tracks Tracks are well delineated and maintained
			Stock is excluded.		Achieved Stock have been successfully excluded
Invasive species, weeds and feral animals are effectively controlled or eliminated from site.	Distribution and density of weeds.	Annual Weed Inspection and findings reported in AEMR.	Weeds and pest animal species, and abundance are comparable to analogue sites.		Partially Achieved - Ongoing Control efforts are being undertaken – weed control is and will be an on-going task African Boxthorn control efforts having a visible effect on this species occurrence Galenia has increased coverage both within and adjacent to the BCD
	Distribution and number of feral animals.	Annual vertebrate pest survey and findings reported in AEMR.		Rural Lands Protection Act 1998 FFMP	Ongoing See Section 6.5.1 for information on Pest management.
	Damage caused by feral animals.				Not Achieved Control efforts being undertaken
The rehabilitated landscape is enhanced using best available practices and materials.	Provision of nest boxes.	Installation of nest boxes reported in AEMR. Nest boxes monitored annually and results reported in AEMR.	Nest boxes established at a ratio of 1:3 in accordance with the FFMP. Nest boxes established are monitored and maintained.	FFMP	Nest box monitoring was undertaken during the reporting period (wholly within the VCA), with results indicating poor usage of nest boxes

Domain Objective	Performance Indicator	Performance Measure	Completion Criteria	Justification/Source	Current Status
Safety risks are eliminated as far as reasonably practicable.	Bushfire hazard.	Bushfire hazard reduction activities reported in AEMR.	Fire breaks and perimeter trails are maintained. The bushfire hazard is managed in accordance with the ACOL EMS.	Rural Fires Act 1997	Achieved Fire breaks and perimeter trails are adequately maintained
Establish vegetation profile consistent with the planned final land use.	Revegetation species mix applied in accordance with Table 22.	Rehabilitation/planting activities reported in AEMR including date of seeding and species mix used.	Species mix used aligns to the intended final land use.	Florabank Guidelines (1999)	Achieved Species that have been planted to date are in accordance with Table 22 of the MOP. Numbers and dates of plantings are listed in Table 21.
	Structural complexity scores.	Reporting and monitoring protocol as per the Bowmans Creek Diversion Rehabilitation Strategy (ACOL, e) employing a modified vegetation complexity assessment method (Newsome & Catling 1979).	Groundcover includes tussock grass clumps, areas of open ground and fallen timber.	Bowmans Creek Diversion Rehabilitation Strategy (ACOL, e)	Not Achieved as per Bowmans Creek Diversion Rehabilitation Strategy (ACOL, e) Groundcover still predominantly composed of exotic grasses and herbs
			Mid-stratum is very open to sparse, > 2 metres in height.		Partially Achieved Established mid-storey species are sparse, < 2m tall at this stage, but still relatively young in age Mid-stratum plantings are starting/plants on order
			Over-storey structure ranges from forest (i.e. riparian corridor) to woodland (i.e. floodplain areas), with a diverse yet clumped species composition		Partially Achieved Overstorey establishment has been largely successful River Oak Forest overstorey successful - **Achieved** Red Gum Woodland partially successful – new planting has extended the area of this vegetation

Domain Objective	Performance Indicator	Performance Measure	Completion Criteria	Justification/Source	Current Status
			that is consistent with reference sites.		community on the BCD. But this community is still young and requires time to mature – **Partially achieved**
			Structural complexity scores are broadly comparable to reference sites.		Not Achieved - Yet Revegetation is in Phase 1 (first 2-3 years) of a long term rehabilitation project Vegetation is still too young to be compared to mature reference sites. This measure cannot be achieved for several years to come

9.2 Bowmans Creek Diversion Management

The two reaches of the Bowmans Creek Diversion (BCD) (Eastern and Western) have been constructed in the underground mining area as shown in Figure 11. Construction commenced on the Eastern diversion in March 2011 and on the Western diversion in February 2012. Both were commissioned with direction of flow through each diversion in November 2012. Temporary low level block banks have been constructed across the original channel of Bowmans Creek, directing low flows into the diversion reaches. High (flood) flows are designed to overtop the temporary block banks in order that such flows not pass through the diversion until full vegetation establishment. The construction program has been completed (engineering sign off obtained) with the exception of permanent block banks which will be constructed 12 months prior to mining of the Upper Liddell Seam in LW106B.

The requirement for the diversions is to establish an ecologically healthy riparian corridor between the New England Highway and the Hunter River, on land owned by ACOL. Fulfilment of this requirement includes the construction, landscaping and ongoing monitoring and management which, compared to the characteristics and conditions of the pre-diverted creek, will provide:

- flow channels that mimic the hydraulic and geomorphic characteristics and provide similar resilience;
- for fish passage and a diversity of aquatic habitat;
- an enlarged area of ecologically diverse, naturally vegetated, riparian corridor; and
- a free draining floodplain that is vegetated to a standard consistent with the final intended land use.

In addition to general land management and environmental monitoring at ACOL, there are a number of rehabilitation and monitoring commitments specific to the BCD to be reported in this Annual review, as shown in Table 23.

Table 23 Bowmans Creek Diversion commitments

Commitment	Status	Further detail
Survey of bed and banks including bed samples at six months, one year, two years and at five yearly intervals, or after a flood with a peak flow of greater than 150m3/s. (Development consent, Schedule C, 7.1 and 7.2)	The last survey was carried out in 2014, and is next due in late 2017.	See section 9.2.2
Fish passage and aquatic ecology in stream diversions are monitored and remain within acceptable levels, or appropriate remedial measures considered.	Fish results in section 6.4.2 demonstrate that the diversion channels have continued to provide fish passage during periods of extended flow and provide refuge habitat during periods of low flow.	See section 6.4.2
Community structure in the diversion channels are monitored bi-annually to record growth rates, species abundance as well as percentage cover to determine a final structural complexity index.	Bi-annual monitoring is undertaken.	See section 9.1
From last year's AEMR inspection: During the inspection of the Eastern Bowmans Creek Diversion it was noted that a large number of Casuarinas located in the diverted Bowmans Creek line were dying and, or of poor health. The Department requests that an investigation into the reason	An investigation was undertaken and results are discussed below.	Section 8.1

Commitment	Status	Further detail
for the death and poor health of the trees be undertaken to identify the cause and recommend actions to be provided in a report to the Department by 31st January 2016.		
During the inspection, the Department observed that a large number of plastic tree guards remained around established trees in the creek diversion areas. These plastic guards have the potential to be removed during flood events and may enter the stream environment. It is requested that the tree guards are removed and disposed of correctly.	Programme of tree guard removal commenced in 2015 and is ongoing as trees reach suitable height and health	-

9.2.1 Dieback along diverted sections of Bowmans Creek

During the 2014 AEMR site inspection (undertaken 9 July 2015), officers from DRE and DPE noticed some dieback along sections of the excised Bowmans Creek. A field survey by qualified ecologists was undertaken in November 2015.

Results of the survey suggest that likely impacts associated with the poor tree health and canopy cover are not more broadly effecting the vegetation community assemblage, in particular the majority of understoreys species with shallow root zones and a principal reliance on surface water and rainfall are being maintained through the impact and control areas. This further supports that climatic influences are not the associated cause of individual poor tree health.

While there was observed foliage die back resulting from incidental spraying of woody weeds with the herbicide "Grazon DS®" at the impact and both control sites, it is unlikely that the increased poor tree health in the impact site can be directly attributed to this action. This conclusion is supported by the occurrences of stands of juvenile dead canopy trees in the impact site in areas where no woody weed treatment had occurred.

The noticeable increase in poor tree health as observed by NSW DPE and NSW DRE in July 2015 is most likely to be directly related to the close correlation of the approved area of dewatering from underground mining and to a lesser extent divergence of "low flow" regimes.

These impacts have resulted in a reduced availability of water resources for the large canopy trees dominated by the riparian specialist species, *Casuarina cunninghamii.* This species is directly associated with riparian vegetation in the locality and is largely restricted to the stream bank of riparian zones and alluvium where there is sufficient available water supply.

The approved Bowmans Creek Diversions Environmental Assessment (Evans and Peck 2009) identified potential impacts and mitigation measures for the existing riparian and aquatic ecosystems that were to be influenced by the creek diversions. The Environmental Assessment (Evans and Peck 2009) specifically identified that there would be a loss of some riparian fringing woodland habitat at the start and end of the diversion channels. The report also recognised that lowering of the water table would be expected to result in additional loss of trees around the exercised portions of the creek.

The observed poor tree health in the area of impact is therefore in accordance with the impacts assessed in the 2009 Environmental Assessment and has been adequately offset and mitigated through the substantial rehabilitation of riparian woodland along the diversions. This restoration has resulted an improvement in the net balance of riparian woodland habitat, as approved in the Environmental Assessment (Evans and Peck 2009).

While the observed poor health of the canopy trees are considered to be directly related to the approved impacts associated with the Bowmans Creek Diversions and dewatering associated with underground mining, it was recommended in the study report that Ashton Coal consider providing some supplementary canopy planting within the affected exercised creek section with species more tolerant of restricted water availability (suitable species could include, Grey Box (*Eucalyptus moluccana*) and or Ironbark (*Eucalyptus crebra*)) to maintain the connectivity values of the existing vegetation corridor along the excised creek section.

9.2.2 Geomorphology surveys of Bowmans Creek diversion

During the last reporting period, a geomorphology report on Bowmans Creek indicated there was some scour evident in the western diversion that required further investigation.

During this reporting period, further investigation was undertaken by a qualified geomorphologist, outlining the extent of the scour. The report identified that some remedial actions may be required to ensure the future sustainability of the diversion. The report is currently undergoing peer review by a geomorphologist in order to identify the most effective management practise for the diversion and maintenance of the scoured areas. Ongoing monitoring and remedial works will be reported in future annual reviews.

9.3 Farmland rehabilitation monitoring (pastures above underground mining)

Condition 9.2(I) of the Ashton Coal Project (ACP) development consent (DA No. 309 -11- 2001-I) requires the Annual Environmental Monitoring Report (AEMR) to include an assessment of any changes to agricultural land suitability resulting from the mining operations, including cumulative changes. Monitoring is undertaken in accordance with the performance and completion criteria specified in the Mining Operations Plan (MOP).

The farmland area over underground mining operations is stocked with agisted cattle. Cattle are managed in accordance with good land management practices. Creeks are fenced and stock excluded, and areas of subsidence resulting in ponding are utilized as stock watering points.

Overall the conclusion the data leads to is that underground mining is not having a measurable effect on the productivity of the pasture lands or the wooded areas at this stage.

For Domain 1 Pasture – Underground Mining variations in vegetative ground cover were strongly correlated to:

- The presence of canopy species, especially *Allocasuarina luehmannii* reduced cover;
- Disturbance associated with surface works, such as tracks and pipelines reduced cover;

There was also a weak correlation to elevation where higher areas with poorer soils had a lower percentage of ground cover, with lower areas such as the river flats near Bowmans Creek having 100% vegetative cover.

Landscape Functional Analysis (LFA) data obtained from LFA transects located along the primary monitoring transects were comparable to the LFA data obtained from the grassland analogue sites. For Domain 2 Trees over Grass – Underground Mining, the vegetative coverage, structure and LFA were comparable between the woodland analogue site and the established monitoring plot. Three areas of subsidence were observed on transects, with no visible effect upon vegetation.

Recommendations from farmland condition monitoring include:

- Continue efforts to eradicate African Boxthorn;
- Unassisted natural regeneration may result in a monoculture of *A. luehmannii* as observed in some areas of the regenerating woodland. Consider planting *E. crebra* and *E. moluccana* to establish the Central Hunter Grey Box - Ironbark Woodland in this area of the ACP;
- Extend Transect 2 from RDP 33 to the east to capture data from areas that are not, and will not be affected by subsidence.

Table 24 is taken from the MOP 2013 – 2017 (Table 30) and is based on the Trees over Grass – Underground Mining Area being in Phase 4 - Ecosystem and Landuse Establishment- Performance Criteria, Measures and Indicators of the Rehabilitation Phases plan.

Table 25 is taken from the MOP 2013 – 2017 (Table 31) and is based on the Pasture – Underground Mining Area being in Phase 5 - Ecosystem and Landuse Sustainability of the Rehabilitation Phases plan.

9.4 North East Open Cut rehabilitation monitoring program

The North East Open Cut (NEOC) rehabilitation program has been in place since 2007. Monitoring in conducted annually. Fieldwork was conducted during May 2015.

Open cut mining operations in the NEOC ceased in late 2011, with landform shaping and planting aspects of the rehabilitation completed in July 2012, excluding the void that remains in use. Maintenance of the rehabilitation is on-going.

The *Ashton Coal Mining Operations Plan 2013 – 2017* requires that monitoring occur within domains defined by land use and function and geophysical characteristics. The MOP defines two domains on the NEOC; **Pasture – NEOC** and **Trees over Grass – NEOC**. The objectives of these domains are set out within the MOP and include:

Pasture – NEOC

- Restored and maintained to the same or higher land capability and agricultural suitability than prior to mining.
- Final landform is sustainable and resilient to environmental pressures.

Trees over Grass – NEOC

- Ecological diversity will be maintained or enhanced.
- Ecosystem function is restored.

Pasture – NEOC area findings are summarised as follows:

A full floristic survey was conducted for the NEOC – Pasture areas. The findings are consistent with previous surveys – fewer species found on the pasture areas with exotic grass species *Chloris gayana* (Rhodes Grass), *Pennisetum clandestinum* (Kikuyu) and *Megathyrsus maximus* (formerly *Panicum maximum*- Guinea Grass) dominating the vegetative cover. Analogue plots had greater diversity and were dominated by native grasses.

The key performance indicators (KPIs) derived from the analogue plots and achievement for this survey were as follows:

- The performance measure of weed species abundance was achieved with the pasture plots having a similar abundance of listed and environmental weeds; and

Table 24 Trees over Grass – Underground Mining Area - Ecosystem and Landuse Establishment- Performance Criteria, Measures and Indicators

Domain Objective	Performance Indicator	Performance Measure	Completion Criteria	Justification/Source	Current Status
Invasive species, weeds and feral animals are effectively controlled or eliminated form site	Distribution and density of weeds	Annual Weed inspection and findings reported in AEMR	Weeds and pest animal species and abundance are comparable to analogue sites	ACOL Weed Management Plan Noxious Weeds Act 1993 Australian and NSW Weed Strategies TSC Act – Key Threatening Processes Rural Lands Protection Act 1998 FFMP	**Not Achieved** – African Boxthorn is widespread.
	Distribution and number of feral animals	Annual vertebrate pest survey and findings reported in AEMR			None observed – but not the focus of this survey
	Damage caused by feral animals				
Safety risks are eliminated as far as reasonably practicable	Bushfire hazard reduction works	Bushfire hazard reduction activities reported in AEMR	Bushfire management activities undertaken in accordance with the consent agreement	Rural Fires Act 1997	Not the focus of this survey
Establish a vegetation profile consistent with the planned final land use	Revegetation species mix applied in accordance with Table 22 (MOP Table 22)	Rehabilitation/planting activities reported in AEMR including date of seeding and species mix used.	Species mix used aligns to the intended final land use.	DA Schedule 2, Condition 3.49	**Partially achieved** – natural regeneration of some of the common canopy species is occurring

Table 25 Pasture – Underground Mining Area Phase 5 - Ecosystem and Landuse Sustainability Performance Criteria, Measures and Indicators

Domain Objective	Performance Indicator	Performance Measure	Completion Criteria	Justification/Source	Current Status
Restored and maintained to the same or higher land capability and agricultural suitability than prior to mining	LFA Organisation Index	Annual Rehabilitation Monitoring Report	Performance indicator is broadly comparable to that of analogue sites.	CSIRO Methodology for Ecosystem Function Analysis (Tongway, 2004) DA Schedule 2, Condition 3.55 DA Schedule 2, Condition 3.55	Achieved
	LFA Stability Index				Achieved
	LFA Infiltration Index				Achieved
	Land Capability Class		Field data results are used to define land capability and include: Climate Soil texture Position Slope Erosion pH Drainage Rock		Achieved
Final Landform is sustainable and resilient to environmental pressures	Weed species abundance and diversity		Performance indicator is broadly comparable to that of analogue sites		**Partially achieved -** African boxthorn and Galenia are common on both analogue and pasture areas
	Groundcover				Achieved

- Vegetative cover was partially achieved across the pasture areas. The northern slopes have improved coverage since the last survey, the southern slopes and cap areas have patchy coverage in places.

Landscape Functional Analysis (LFA) indices were recorded as follows:

- Landscape Organisation Index was partially achieved with patchy cover evident on the southern slopes and cap areas, but improving on the northern slopes;
- Stability Index scores followed the same pattern and were partially achieved;
- Infiltration/Runoff scores were achieved on the northern slopes, and were partially achieved on the southern and cap areas, giving an overall positive result.

Land Capability Class was assessed as being achieved as per objectives.

Trees over Grass (ToG) areas findings are summarised as follows:

- Foliage cover and Tree densities are partially achieved mainly due to denser seeding of midstorey and shrub species in the ToG areas, particularly on the sloping areas;
- Tree Diversity has been increased on the ToG areas with greater number of species compared to analogue plots- achieved; and
- Tree health and condition and observation of new growth both achieved with flower buds observed for the first time this survey.

LFA indices were achieved for the Landscape Organisational Index (LOI), but only partially achieved for the Stability Index due to differences between those ToG areas located on the cap (achieved) and the slopes (not achieved). Infiltration/Runoff Index was not achieved.

Recommendations for the management of the rehabilitated areas include:

- Better target weed monitoring efforts by undertaking weed mapping and a targeted weed control program (in particular African Boxthorn and cacti);
- Seed pasture legumes into the NEOC pasture areas, inoculated with commercially available microbial symbionts to both increase the sustainability of the pasture itself, but also to help counteract the alkalinity of the soil by introducing natural acidifying agents.
- Within the ToG areas of the NEOC, manually thin the mid-storey of *Acacias*, repair rilling, re-seed with shade tolerant grass species.

Table 26 is taken from the MOP 2013 – 2017 (Table 31) and is based on the Pasture – NEOC being in Phase 5 - Ecosystem and Landuse Sustainability - Performance Criteria, Measures and Indicators of the Rehabilitation Phases plan. Table 27 is taken from the MOP 2013 – 2017 (Table 31) and is based on the Trees over Grass – NEOC being in Phase 5 - Ecosystem and Landuse Sustainability - Performance Criteria, Measures and Indicators of the Rehabilitation Phases plan. Both tables show current performance against the performance and completion criteria detailed in the MOP.

Table 26 Pasture – NEOC - Ecosystem and Landuse Sustainability - Performance Criteria, Measures and Indicators

Domain Objective	Performance Indicator	Performance Measure	Completion Criteria	Justification/Source	Current Status
Restored and maintained to the same or higher land capability and agricultural suitability than prior to mining.	LFA Organisation Index	Annual Rehabilitation Monitoring Report	Performance indicator is broadly comparable to that of analogue sites.	CSIRO Methodology for Ecosystem Function Analysis (Tongway, 2004) DA Schedule 2, Condition 3.55	**Partially Achieved –** • Northern slopes have improved from last survey, with desirable grasses returning. • Southern slopes and cap areas have patchy ground cover in places. This can be attributed to seasonal factors.
	LFA Stability Index			DA Schedule 2, Condition 3.55	**Partially Achieved –** • Northern slopes have improved from last survey, southern slopes and cap areas not met KPI. • Some areas of patchiness contributing to non-achievement of KPI • This likely to be attributed to seasonal factors.
	LFA Infiltration Index				**Achieved -** all areas achieved KPI

Domain Objective	Performance Indicator	Performance Measure	Completion Criteria	Justification/Source	Current Status
	Land Capability Class		Field data results are used to define land capability and include: - Climate - Soil texture - Position - Slope - Erosion - pH - Drainage - Rock		**Achieved.**
Final Landform is sustainable and resilient to environmental pressures	Weed species abundance and diversity		Performance indicator is broadly comparable to that of analogue sites.		**Achieved** • Abundances and diversity comparable to analogue plots.
	Groundcover				**Partially Achieved** • Northern slopes have improved, while southern slopes and cap have some areas of patchy groundcover.

Table 27 Trees over Grass – NEOC - Ecosystem and Landuse Sustainability - Performance Criteria, Measures and Indicators

Domain Objective	Performance Indicator	Performance Measure	Completion Criteria	Justification/Source	Current Status
Ecological diversity will be maintained or enhanced	Foliage Cover	Annual Rehabilitation Monitoring Report	Vegetation structure and complexity is broadly comparable to that of analogue sites.	DA Schedule 2, Condition 3.55 CSIRO Methodology for Ecosystem Function Analysis (Tongway, 2004)	**Partially Achieved –** some areas have been over seeded with midstorey and shrub species. May require manual thinning to allow for greater ground cover.
	Tree Diversity		Diversity of maturing tree and shrub species is broadly comparable to that of analogue sites.		**Achieved.**
	Tree Density		Density of maturing tree and shrub species is broadly comparable to that of analogue sites.		**Partially Achieved** – midstorey and shrubs in higher density in parts of the ToG areas.
	Tree health/condition		Vegetation condition is broadly comparable to that of analogue sites.		**Achieved.**
	Flowers, fruit, new growth				**Achieved** – buds visible for the first time on canopy species.
Ecosystem function is restored	LFA Organisation Index		Index is broadly comparable to that of local remnant vegetation.		**Achieved.**
	LFA Stability Index				**Partially Achieved** Cap areas achieved this KPI, whereas Slope areas did not.
	LFA Infiltration Index				**Not Achieved** Bare soil areas due to shading and seasonality of grass covers.

9.4.1 NEOC water diversion project

The rehabilitated NEOC spoil emplacement at the Ashton Coal Mine is presently contributing runoff to the mine water management system and intercepting catchment that would otherwise report to surrounding streams and the Hunter River. ACOL are proposing to re-direct drainage from the rehabilitated spoil emplacement to the nearby Bettys/Bowmans and Glennies Creek catchments. Progressive rehabilitation and drainage off site is consistent with Condition 3.50, Schedule 2 of Development Consent DA 309/11. Drainage re-direction would involve on-site small scale earthworks and the use of detention basins at discharge points. The drainage concept is considered to provide a balance between earthworks (hence disturbance of the rehabilitated, stable landform) and catchment area directed off site.

The impact of the proposed drainage re-direction on the salinity of downstream creeks and the Hunter River has been simulated using recorded salinity data and available streamflow records. The average impact on the salinity in Bowmans Creek, over a 126 year simulation period using historical climate data, is for an increase of approximately 0.2%. The predicted increase varies over the flow regime with slightly greater increases at median and lower salinity (higher flows) and with decreases predicted at higher salinity (lower flows). The average impact on salinity in Glennies Creek is more uniform and, over a 60 year simulation period using historical streamflow data, is for an increase of approximately 0.4%. The average impact on salinity in the Hunter River over a 46 year simulation period using historical streamflow data, is for an increase of approximately 0.1%.

9.5 Rehabilitation status

During the reporting period approximately 1940 metres of gas drainage pipeline disturbance was rehabilitated, along with three gas boreholes. Rehabilitation included topsoiling and seeding areas over pipelines, with additional topsoiling, weed management and seeding being undertaken as required. No open cut rehabilitation was undertaken as it was completed in 2013. Rehabilitation maintenance was carried out on the NEOC rehabilitation to enhance species diversity. Maintenance activities included slashing to promote species diversity as well as maintenance of some contour banks through re-topsoiling and seeding where required. Rehabilitation status is outlined in Table 28.

During 2016 the following rehabilitation activities are planned:

- Maintenance focussing on weed management in the Bowmans Creek Diversion rehabilitated area
- Ongoing rehabilitation of pipelines and gas boreholes
- Works to divert water off NEOC rehabilitated areas into surrounding streams, if viable.

9.6 Research

No research was undertaken during the reporting period. ACOL, however during the period two ACARP proposals were lodged for proposed new research programs, one of which was successful and will commence in 2016. The successful research project is **C25031 Closure Criteria for River Diversions: An Alternative to Reference Sites.** Historical data collected by ACOL will be used in the research project, along with further monitoring to be undertaken along the stream diversion by researchers with the assistance of ACOL employees.

The broad aim of this research is to move from the use of reference sites in environmental assessment to a more pragmatic and robust methodology through designing realistic closure criteria based around the use of microbial communities as indicators of environmental condition. This is a two year project and updates will be provided over the next reporting period.

Table 28 Rehabilitation status

Mine area type	Previous Reporting Period (Actual) (ha)	This reporting period (Actual) (ha)	Next reporting period (Forecast) (ha)
	2014	2015	2016
Total mine footprint[1]	909.6	909.6	909.6
Total Active disturbance area[2]	177.3	177.3	177.3
Land being prepared for rehabilitation[3]	0	0	0
Land under active rehabilitation[4]	732.2	732.2	732.2
Completed rehabilitation[5]	0	0	0

Figure 20 NEOC rehabilitation

[1] Total Mine Footprint: includes all areas within a mining lease that either have at some point in time or continue to pose a rehabilitation liability due to mining and associated activities. As such it is the sum of total active disturbance, decommissioning, landform establishment, growth medium development, ecosystem establishment, ecosystem development and relinquished lands (as defined in the DRE MOP/RMP guidelines). Subsidence remediation areas are excluded.

[2] Total Active Disturbance includes all areas ultimately requiring rehabilitation such as: on-lease exploration areas, stripped areas ahead of mining, infrastructure areas, water management infrastructure, sewage treatment facilities, topsoil stockpile areas, access tracks and haul roads, active mining areas, waste emplacements (active/unshaped/ in or out of pit), and tailings dams (active/unshaped/uncapped).

[3] Land being prepared for rehabilitation – includes the sum of mine disturbed land that is under the following rehabilitation phases – decommissioning, landform establishment and growth medium development (as defined in the DRE MOP/ RMP guidelines)

[4] Land under active rehabilitation – includes areas under rehabilitation and being managed to achieve relinquishment – includes the following rehabilitation phases as described in the DRE MOP/RMP guidelines – 'ecosystem and land use establishment' (area seeded or surface developed in accordance with final use) and 'ecosystem and land use sustainability' (revegetation assessed as showing signs of trending towards relinquishment or infrastructure development).

[5] Completed rehabilitation – requires formal sign-off by DRE that the area has successfully met the rehabilitation land use objectives and completion criteria.

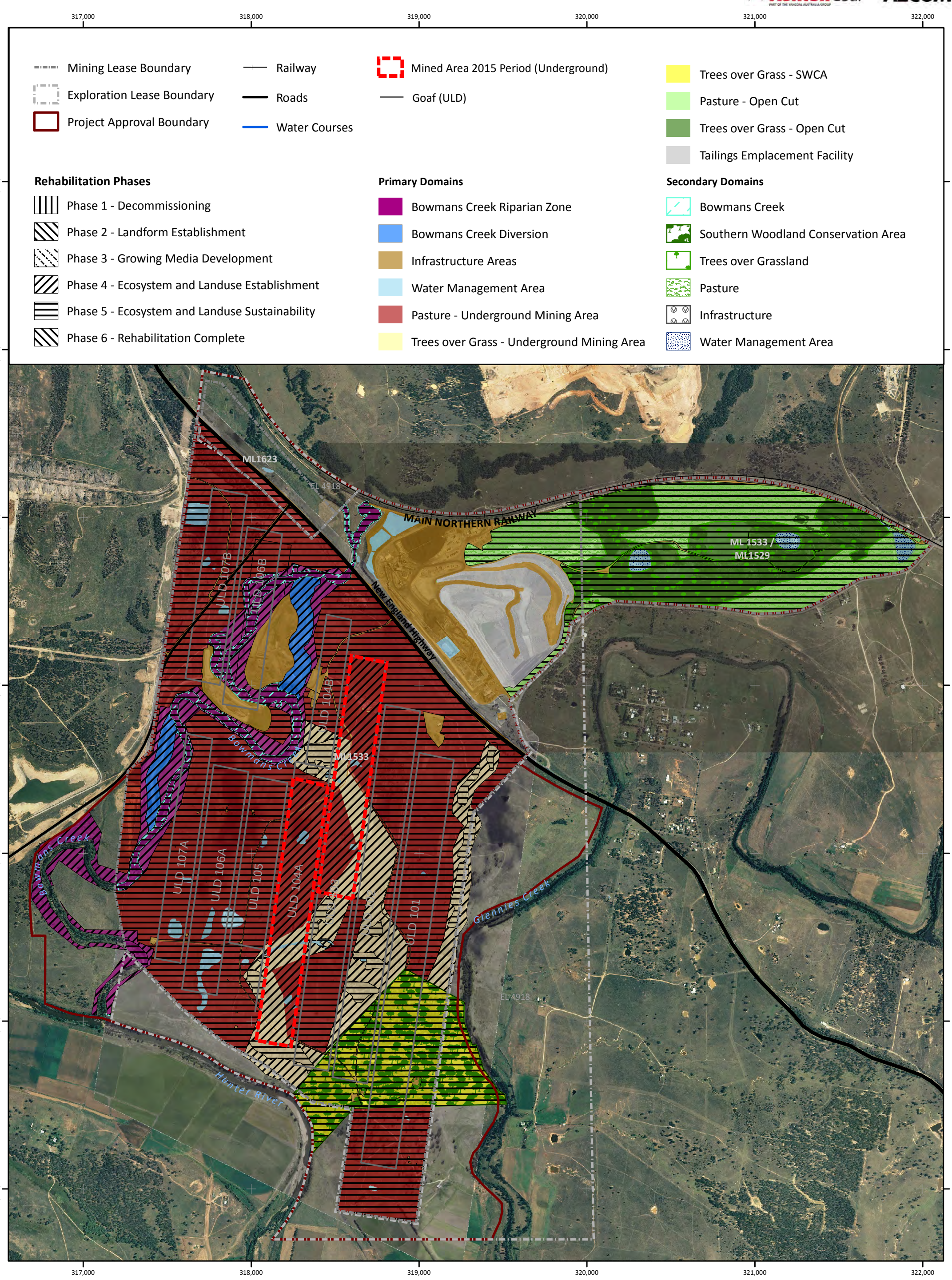


Figure 21 Rehabilitation status as at 31 December 2015.

Mining and Rehabilitation - 2015 Period

ACOL AEMR 2015 Period, Ashton Coal Project

Aerial Imagery Source: ACOL 2013

Drawn: GW

8/03/2016

Map **A**

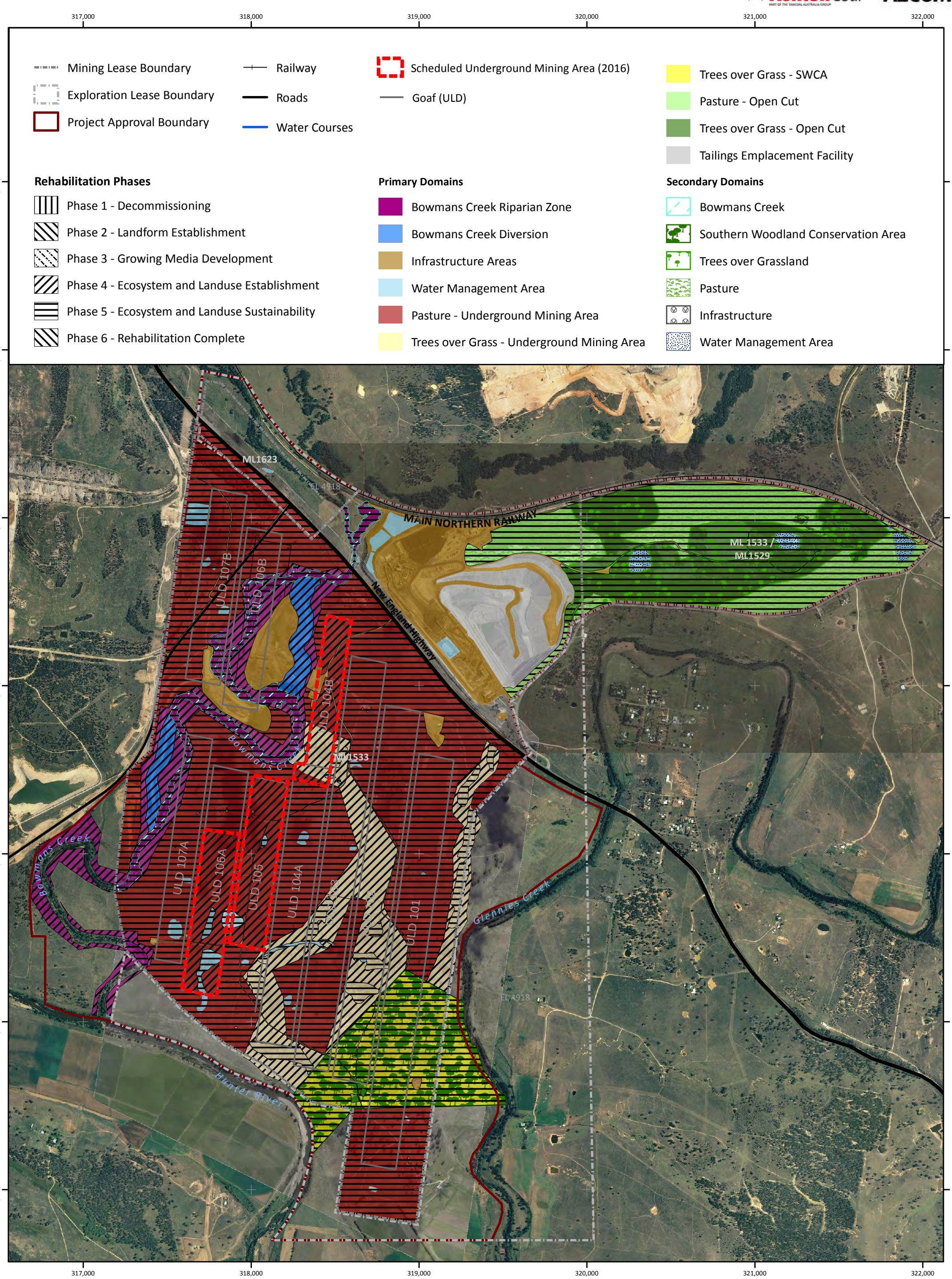


Figure 22 Planned rehabilitation status, 2016

Scheduled Mining and Rehabilitation - 2016 Period

ACOL AEMR 2015 Period, Ashton Coal Project

Aerial Imagery Source: ACOL 2013

Drawn: GW

8/03/2016

Map **B**

10 Community

ACOL is committed to minimising the impacts of its operations and is an active participant and contributor to community projects that benefit local people.

10.1 Complaints

There were no complaints received during 2015.

ACOL has a procedure for receiving, investigating, responding to and reporting complaints received from the community. The operation invites feedback about its activities through a free-call 24-hour Community Response Line (1800 657 639) which is advertised in the local phone directory and newspapers, and at www.ashtoncoal.com.au.

A comparison of complaints received during previous years is shown in Figure 23.

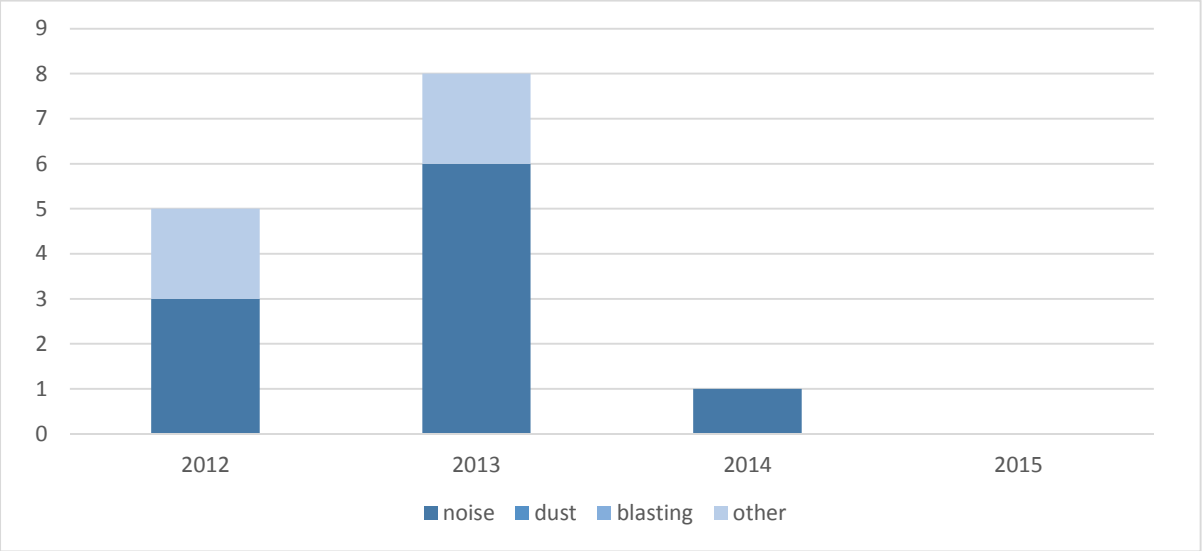


Figure 23: Comparison of complaints received during current and previous years

10.2 Community support program

Ashton Coal is committed to making a positive contribution in the areas in which it operates. To help facilitate this commitment, Ashton Coal has established the Community Support Program to provide assistance to local initiatives within the Singleton Local Government Area (LGA) and surrounding communities. The aim of the Community Support Program is to help benefit a wide range of community needs such as education, environment, health, infrastructure projects, arts, leisure and research. The following community groups / projects were supported by Ashton Coal in 2015:

- Cancer Council - Team McInerney
- Hunter region SLSA Helicopter Rescue Services
- Naidoc celebration week
- Northern Agricultural Association (Singleton Show)
- Pancar Foundation and the Calvary Mater Hospital
- Singleton Heights Public School
- Singleton Junior Rugby Club
- Singleton Mayoral Scholarship
- Singleton Public School
- Witmore Enterprises

Case Study: Wonnarua Mine Rehabilitation Pty Ltd continues to grow

Have you noticed the new greenhouses at the entrance to Camberwell Village?

In 2003, Ashton Coal signed an agreement with the Wonnarua Nation Aboriginal Corporation, enabling the Wonnarua Nation to withdraw their native title claim. In return, Ashton Coal agreed to promote and implement business opportunities for the Wonnarua People.

Since the agreement was signed, Ashton Coal has supported the Wonnarua Nation Aboriginal Corporation to establish the Wonnarua Mine Rehabilitation Pty Ltd. This has included financial support, engagement for site works, and leasing an Ashton Coal owned property to the business.

Wonnarua Mine Rehabilitation is a land management and nursery services company whose primary aim is to provide employment of Wonnarua and Aboriginal people in the Hunter Valley. Employees may have noticed the construction of two greenhouses as they pass through Camberwell. Ashton Coal supported Wonnarua Mine Rehabilitation to establish this nursery, which is now being used to supply seedlings to the broader industry.

10.3 Local neighbours

Ashton keeps in contact with local neighbours on an as-needed basis. Neighbours, particularly those that have the potential to be directly impacted by operations are kept up to date with operations and key projects through phone calls, regular emails and face to face meetings as required.

10.4 Website and community hotline

The broader community has access to information about the operation through its website, www.ashtoncoal.com.au. Included on the site are project approval documents, CCC meeting minutes, community complaint records, environmental monitoring information, environmental audits, environmental management plans and annual environmental management reports.

Ashton Coal's free-call 24-hour Community Response Line (1800 657 639) continued to operate during the reporting period to allow the community to contact the operation directly to ask questions or raise concerns about mining activities.

11 Independent audit

During 2013 an independent audit of Ashton's operations was undertaken against approval conditions. The actions resulting from this audit were presented in an Appendix of the 2013 AEMR. Thirty findings were identified in the audit, with 26 findings complete and closed, three findings commenced and one finding not applicable to current operations. All outstanding audit actions are administrative in nature and are detailed in Table 29. ACOL will continue to work with the relevant government departments to finalise outstanding actions prior to the 2016 independent audit.

The next three yearly independent compliance audit will be conducted during 2016.

Table 29 Independent Audit actions outstanding as at 31 December 2015

	Finding Summary	Proposed action	status
DA 309-11-2001-i Condition 3.46	The Flora and Fauna Management Plan (FFMP) was reviewed against the sub-requirements of this condition (a-t) a number of non-compliances.	Amend FFMP to address findings.	Partially complete. FFMP has been amended and comment made by DPE. ACOL need to resubmit to DPE for approval.
DA 309-11-2001-i Condition 8.2	The AQMP and WMP do not specify quality control or assurance measures for monitoring programs. The AQMP does not specify how laboratory analysis of dust samples should occur.	At the next revision ensure that the AQMP and the WMP specify quality control/assurance measures and specify which standards should be used to undertake laboratory analysis.	The AQMP and WMP have been revised. The WMP has been approved by DPE, the AQMP is pending.
EL 4918 and EL 5860 (Conditions 12)	ACOL are required to prepare a Groundwater Monitoring and Modelling Plan in consultation with NOW. The auditors found that the site's WMP covers the requirements for this plan and that ACOL undertakes regular consultation with NOW. The site's WMP does not cover the SEOC area and it is understood that EL's 5860 and 4915 at least partly cover this area. It is understood that a Draft Groundwater and Verification Monitoring Program has been prepared for the South East Open Cut and that it covers exploration activities, although this program was not viewed during the audit.	The WMP for the ACP covers most of the requirements of this condition. The draft SEOC Groundwater Monitoring and Verification Program will be lodged with DP&I and NOW which will satisfy the rest of the area covered by EL 4918 and EL 5860	In Progress - This administrative amendment will be incorporated into the WMP during the next review. The review is currently underway and is anticipated to be completed by the end of April 2016

12 Incidents and non-compliances during the reporting period

There were no reportable incidents during the reporting period. ACOL complied with the development consent and mining lease conditions throughout the reporting period.

Minor administrative non-compliances with management plan requirements are discussed within relevant sections of the report, and are summarised below.

- A worst-case scenario monitoring was not carried out during winter as required by Item 5.5B of the NMP. Winter monitoring was undertaken. No adverse impacts resulted from this minor non-compliance.
- Further monitoring was not carried out in May after weather conditions were identified to be unsuitable due to a temperature inversion. This is required by section 5.5E of the NMP. No adverse impacts resulted from this minor non-compliance.
- Section 5.6C of the AQMP requires ACOL to report all daily real time results exceeding 50µg/m^3 to DPE within three working days. ACOL reported six instances where the 24 hour rolling average exceeded this limit, however did not report on 6 May 2015 within three business days due to an oversight. No adverse impacts resulted from this non-compliance.

These administrative non-compliances were identified as part of the annual review process. They have been investigated to prevent recurrence.

13 Activities to be completed in the next reporting period

ACOL is committed to delivering a high standard of environmental and social performance into the future and has established targets for the next reporting period. These targets will be closely monitored and an update on the status of each will be reported in the next AEMR.

- Undertake an Independent Environmental Audit, as required by the development consent.
- Prepare, consult and lodge the Extraction Plan for the Upper Lower Liddell Seam 201 – 204
- Complete EPL variations, as discussed with the EPA, and amend associated air quality and groundwater monitoring programs.
- Facilitate the diversion of clean water runoff from the NEOC rehabilitated area.
- Recalibrate the Ashton Coal hydrogeological model.
- Continue maintenance program to remove green plastic tube stock guards around established trees within the Bowmans Creek Diversion.
- Review Fauna monitoring methodologies at Ashton Coal based on outcomes from the past 10 years of monitoring.

Appendix 1. Annual Noise Compliance Report

18 December 2015

Ref: 05148/6201

Ashton Coal Operations Limited
P.O. Box 699
Singleton NSW 2330

RE: 2015 ANNUAL NOISE MONITORING REPORT

This letter report presents a summary of the results of monthly noise compliance monitoring conducted for the Ashton Coal Project (ACP) each month in 2015.

The noise goal for mining operations at ACP is **38 dB(A) Leq (15 min)** for all operating times during the day and evening. At night the noise goal is **36 dB(A) Leq (15 min)**. In addition to the operational noise, the noise from ACP must not exceed 46 dB(A) L1 (1 min) between the hours of 10 pm and 7 am.

ACP environmental licence conditions indicate that compliance with noise emission criteria is not applicable under atmospheric conditions where winds speeds are higher than 3m/s and/or there is a temperature inversion of greater than +3° C/100m.

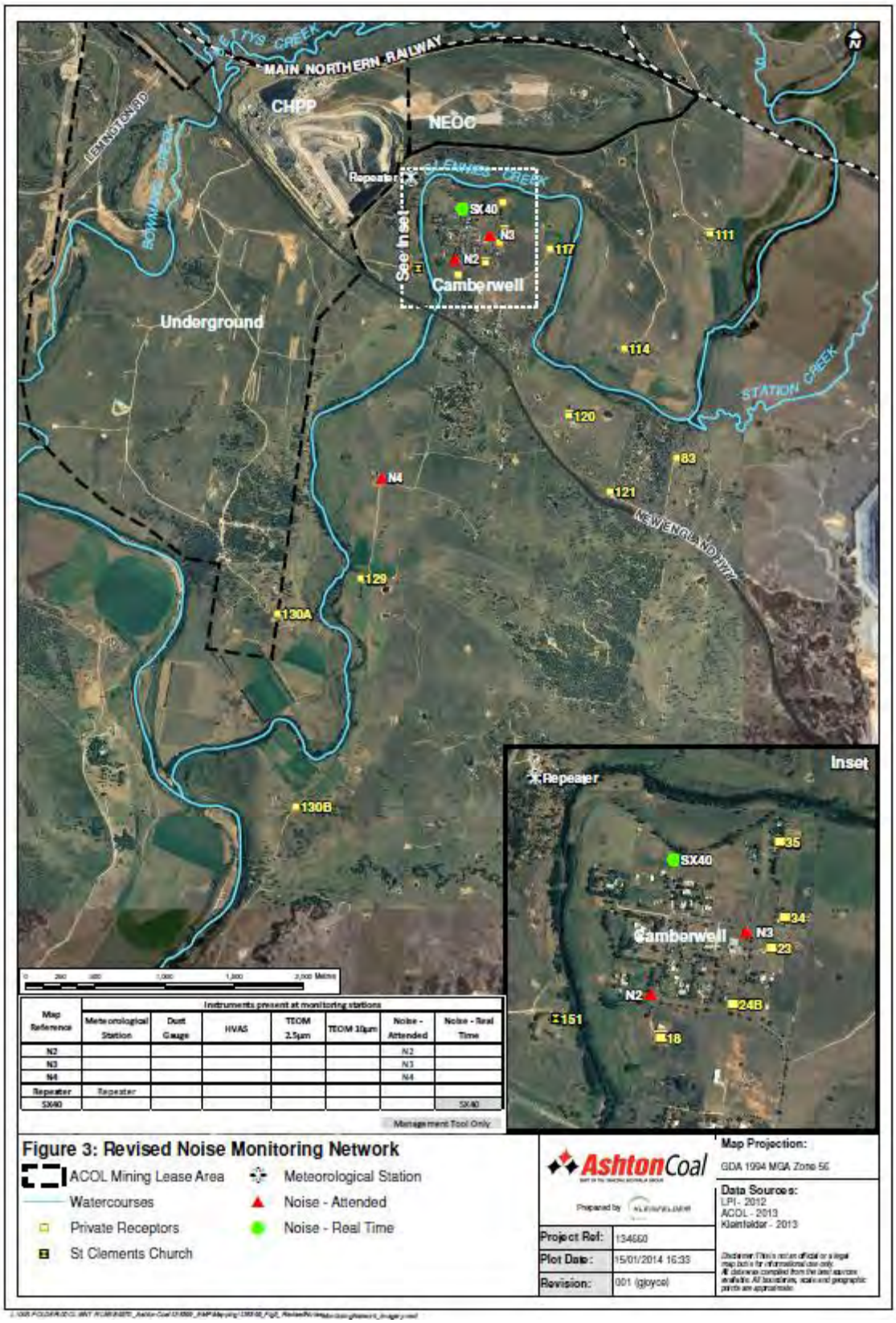
Noise measurements of fifteen minutes duration were taken in one third-octave bands at three representative receiver locations in the vicinity of the mine a shown in **Figure 1** and detailed below.

Location 1: N1
Location 2: N2
Location 3: N3

A summary of the results of the noise monitoring surveys are reproduced as an attachment to this letter. These results show that, under the atmospheric and operating conditions at the times of the monitoring, there was no exceedance of the relevant noise goals throughout the reporting periods.

Analysis of all noise emissions from ACP showed that they complied with tonal, impulsive and low frequency modifying factor levels as per definitions in the NSW Industrial Noise Policy.

The measured L1 (1 min) noise did not exceed the sleep disturbance criterion at any time or location.


MAIN NORTHERN RAILWAY
CHPP
NEOC
Repeater
See Inset
SX40
N3
N2
117
111
Camberwell
Underground
114
120
83
N4
121
129
130A
130B
STATION CREEK
Inset
35
34
23
24B
151
18
Instruments present at monitoring stations
Map Reference
Meteorological Station
Dust Gauge
HVAS
TEOM 2.5µm
TEOM 10µm
Noise - Attended
Noise - Real Time
Management Tool Only
Figure 3: Revised Noise Monitoring Network
ACOL Mining Lease Area
Watercourses
Private Receptors
St Clements Church
Meteorological Station
Noise - Attended
Noise - Real Time
AshtonCoal
Prepared by
Project Ref: 134660
Plot Date: 15/01/2014 16:33
Revision: 001 (gloyco)
Map Projection:
GDA 1994 MGA Zone 56
Data Sources:
LPI - 2012
ACOL - 2013
Klaintaldor - 2013

ATTACHMENT 1

MONTHLY NOISE MONITORING RESULTS

The following are a reproduction of the noise monitoring results for the 12 months of 2015.

Table 1 ACP Noise Monitoring Results – 30 January 2015 – Night						
Location	**Time**	**dB(A) Leq**	**Comments**	**WS (m/s)/ Direction**	**Inversion ^{o}C/ 100m**	**ACP Noise Sources**
N2	1:51 am	46	Traffic (44), frogs & insects (41), other mine (27), **ACP inaudible**	2.1/56	>3	n/a
N3	1:32 am	41	Traffic (38), frogs & insects (38), other mine (29), **ACP inaudible**	1.6/62	>3	n/a
N4	1:09 am	49	Frogs & insects (48), traffic (41), other mine faintly audible, **ACP inaudible**	1.8/66	>3	n/a

The results in Table 1 show that noise from ACP was inaudible at all of the three monitoring locations. The measured noise, therefore, did not exceed the relevant criterion at any location at any time during the January noise monitoring survey.

Mine noise was inaudible during the January night time survey and, thus, the measured L1 (1 min) noise did not exceed the sleep disturbance criterion at any time or location.

Table 2 ACP Noise Monitoring Results – 11 February 2015 – Night						
Location	**Time**	**dB(A) Leq**	**Comments**	**WS (m/s)/ Direction**	**Inversion ^{o}C/ 100m**	**ACP Noise Sources**
N2	11:49 pm	50	Traffic (49), frogs & insects (41), other mine (28), **ACP inaudible**	1.5/108	>3	n/a
N3	11:30 pm	42	Traffic (40), frogs & insects (38), other mine (26), **ACP inaudible**	2.8/134	>3	n/a
N4	11:10 pm	41	Traffic (39), frogs & insects (36), train (26), **ACP inaudible**	2.0/127	>3	n/a

The results in Table 2 show that noise from ACP was inaudible at all of the three monitoring locations. The measured noise, therefore, did not exceed the relevant criterion at any location at any time during the February noise monitoring survey.

Mine noise from ACP was inaudible during the February night time survey and, thus, the measured L1 (1 min) noise did not exceed the sleep disturbance criterion at any time or location.

Table 3 ACP Noise Monitoring Results – 3 March 2015 – Night						
Location	**Time**	**dB(A) Leq**	**Comments**	**WS (m/s)/ Direction**	**Inversion ^{o}C/ 100m**	**ACP Noise Sources**
N2	10:27 pm	48	Traffic (46), frogs & insects (43), other mine (28), train (27), **ACP inaudible**	2.8/115	>3	n/a
N3	10:02 pm	41	Frogs & insects (38), traffic (37), other mine (31), **ACP inaudible**	2.2/110	>3	n/a
N4	10:55 pm	43	Frogs & insects (42), traffic (36), other mine (26), **ACP inaudible**	2.4/115	>3	n/a

The results in Table 3 show that noise from ACP was inaudible at all of the three monitoring locations. The measured noise, therefore, did not exceed the relevant criterion at any location at any time during the March noise monitoring survey.

Mine noise from ACP was inaudible during the March night time survey and, thus, the measured L1 (1 min) noise did not exceed the sleep disturbance criterion at any time or location.

Table 4
ACP Noise Monitoring Results – 9/10 April 2015 – Night

Location	Time	dB(A) Leq	Comments	WS (m/s)/ Direction	Inversion ^{O}C/ 100m	ACP Noise Sources
N2	11:16 pm	49	Traffic (49), insects (38), **ACP inaudible**	0.9/70	>3	n/a
N3	10:55 pm	38	Traffic (35), insects (35), **ACP inaudible**	1.3/82	<3	n/a
N4	12:05 am	37	Traffic (36), frogs & insects (29), **ACP inaudible**	0.8/128	>3	n/a

The results in Table 4 show that noise from ACP was inaudible at all of the three monitoring locations. The measured noise, therefore, did not exceed the relevant criterion at any location at any time during the April noise monitoring survey.

Mine noise from ACP was inaudible during the April night time survey and, thus, the measured L1 (1 min) noise did not exceed the sleep disturbance criterion at any time or location.

Table 5
ACP Noise Monitoring Results – 19 May 2015 – Night

Location	Time	dB(A) Leq	Comments	WS (m/s)/ Direction	Inversion ^{O}C/ 100m	ACP Noise Sources
N2	11:58 pm	48	Traffic (47), **ACP (39)**, other mine (27), frogs (27)	2.1/281	>3	CHPP
N3	11:38 pm	46	Traffic (45), **ACP (38)**, other mine (28), frogs (27)	1.4/269	>3	CHPP
N4	11:04 pm	44	Traffic (44), frogs (31), other mine (28), **ACP (25)**	2.5/305	>3	CHPP

The results shown in Table 5 indicate that, under the operational and atmospheric conditions at the time, noise emissions from ACP was higher than the noise criterion of 36 dB(A) Leq at the N2 and N3 monitoring locations.

Temperature inversion data showed, however, that the noise measurements at N2 and N3 were made under non-compliant meteorological conditions (i.e. *temperature inversion of greater than 3°C/100 metres*). The measured noise, therefore, is not considered an exceedance of the noise goal. The noise from ACP was a relatively steady state hum from the direction of the CHPP.

The measured L1 (1 min) noise from ACP did not exceed the sleep disturbance criterion at any time or location. Mine noise from ACP was measured at 44 dB(A) L1 (1 min) at the N2 monitoring location and 43 dB(A) L1 (1 min) at the N3 monitoring location.

Table 6 ACP Noise Monitoring Results – 19 June 2015 – Night						
Location	**Time**	**dB(A) Leq**	**Comments**	**WS (m/s)/ Direction**	**Inversion ^{O}C/ 100m**	**ACP Noise Sources**
N2	10:40 pm	48	Traffic (48), trains (40), other mine (35), frogs (22), **ACP inaudible (<25)**	1.8/272	>+3	n/a
N3	10:23 pm	44	Traffic (41), trains (39), other mine (34), frogs (20), **ACP inaudible (<25)**	1.5/272	>+3	n/a
N4	10:03 pm	38	Traffic (37), frogs (30), other mine (25), **ACP inaudible (<20)**	1.2/261	>+3	n/a

The results shown in Table 6 indicate that, under the operational and atmospheric conditions at the time, noise emissions from ACP did not exceed the noise criterion at any monitoring location during the June noise monitoring survey.

The noise from ACP was inaudible during the June night time survey and, therefore, did not exceed the sleep disturbance criterion at any time or location.

Table 7 ACP Noise Monitoring Results – 16 July 2015 – Night						
Location	**Time**	**dB(A) Leq**	**Comments**	**WS (m/s)/ Direction**	**Inversion ^{O}C/ 100m**	**ACP Noise Sources**
N2	11:26 pm	46	Traffic (44), wind (40), plant (33), **ACP inaudible**	6.8/272	>+3	n/a
N3	11:05 pm	45	Wind (42), traffic (41), plant (31), frogs (28), **ACP inaudible**	7.0/271	<+3	n/a
N4	10:18 pm	45	Traffic (44), wind (38), **ACP inaudible**	5.0/268	<+3	n/a

The results shown in Table 7 indicate that, under the operational and atmospheric conditions at the time, noise emissions from ACP were inaudible and therefore, did not exceed the noise criterion at any monitoring location during the July noise monitoring survey.

The noise from ACP was inaudible during the July night time survey and, therefore, did not exceed the sleep disturbance criterion at any time or location.

Table 8 ACP Noise Monitoring Results – 18 August 2015 – Night						
Location	**Time**	**dB(A) Leq**	**Comments**	**WS (m/s)/ Direction**	**Inversion ^{O}C/ 100m**	**ACP Noise Sources**
N2	11:40 pm	52	Traffic (52), other mine (27), **ACP inaudible**	Calm	>+3	n/a
N3	11:22 pm	50	Traffic (50), other mine (37), **ACP inaudible**	Calm	>+3	n/a
N4	10:43 pm	50	Traffic (50), other mine (33), **ACP inaudible**	Calm	>+3	n/a

The results shown in Table 8 indicate that, under the operational and atmospheric conditions at the time, noise emissions from ACP were inaudible and therefore, did not exceed the noise criterion at any monitoring location during the August noise monitoring survey.

The noise from ACP was inaudible during the August night time survey and, therefore, did not exceed the sleep disturbance criterion at any time or location.

Table 9
ACP Noise Monitoring Results – 28 September 2015 – Night

Location	Time	dB(A) Leq	Comments	WS (m/s)/ Direction	Inversion ^{o}C/ 100m	ACP Noise Sources
N2	11:37 pm	47	Traffic (47), other mine (27), frogs (23), **ACP inaudible**	0.6/126	>+3	n/a
N3	11:18 pm	47	Traffic (47), frogs (29), other mine (28), **ACP inaudible**	1.1/131	>+3	n/a
N4	10:58 pm	40	Traffic (39), other mine (30), frogs (27), **ACP inaudible**	1.8/143	>+3	n/a

The results shown in Table 9 indicate that, under the operational and atmospheric conditions at the time, noise emissions from ACP were inaudible and therefore, did not exceed the noise criterion at any monitoring location during the September noise monitoring survey.

The noise from ACP was inaudible during the September night time survey and, therefore, did not exceed the sleep disturbance criterion at any time or location.

Table 10
ACP Noise Monitoring Results – 20 October 2015 – Night

Location	Time	dB(A) Leq	Comments	WS (m/s)/ Direction	Inversion ^{o}C/ 100m	ACP Noise Sources
N2	11:38 pm	40	Traffic (39), frogs & insects (31), other mine (24), **ACP inaudible**	1.7/30	>+3	n/a
N3	11:20 pm	40	Traffic (39), frogs & insects (33), **ACP inaudible**	2.4/35	>+3	n/a
N4	10:40 pm	42	Frogs & insects (41), traffic (35), other mine (25), **ACP inaudible**	1.1/56	>+3	n/a

The results shown in Table 10 indicate that, under the operational and atmospheric conditions at the time, noise emissions from ACP were inaudible and therefore, did not exceed the noise criterion at any monitoring location during the October noise monitoring survey.

The noise from ACP was inaudible during the October night time survey and, therefore, did not exceed the sleep disturbance criterion at any time or location.

Table 11
ACP Noise Monitoring Results – 23 November 2015 – Night

Location	Time	dB(A) Leq	Comments	WS (m/s)/ Direction	Inversion ^{o}C/ 100m	ACP Noise Sources
N2	11:30 pm	38	Traffic (37), frogs & insects (31), **ACP inaudible**	3.2/91	<+3	n/a
N3	11:11 pm	42	Frogs & insects (40), traffic (37), other mine (28), **ACP inaudible**	3.0/89	<+3	n/a
N4	11:52 pm	43	Traffic (41), frogs & insects (38), **ACP inaudible**	3.3/98	<+3	n/a

The results shown in Table 11 indicate that, under the operational and atmospheric conditions at the time, noise emissions from ACP were inaudible and therefore, did not exceed the noise criterion at any monitoring location during the November noise monitoring survey.

The noise from ACP was inaudible during the November night time survey and, therefore, did not exceed the sleep disturbance criterion at any time or location.

Table 12
ACP Noise Monitoring Results – 14 December 2015 – Night

Location	Time	dB(A) Leq	Comments	WS (m/s)/ Direction	Inversion ^{o}C/ 100m	ACP Noise Sources
N2	11:38 pm	52	Insects (52), traffic (43), **ACP inaudible**	3.2/91	<+3	n/a
N3	10:49 pm	44	Traffic (43), insects (38), **ACP inaudible**	3.0/89	<+3	n/a
N4	11:16 pm	36	Traffic (34), insects (34), other mine barely audible, **ACP inaudible**	3.3/98	<+3	n/a

The results shown in Table 12 indicate that, under the operational and atmospheric conditions at the time, noise emissions from ACP were inaudible and therefore, did not exceed the noise criterion at any monitoring location during the December noise monitoring survey.

The noise from ACP was inaudible during the December night time survey and, therefore, did not exceed the sleep disturbance criterion at any time or location.

Appendix 2. Groundwater Management Report

Australasian
Groundwater
and Environmental
Consultants Pty Ltd
(AGE)

Report on

Ashton Coal Project

Groundwater Monitoring Review for AEMR 2015

Prepared for

Ashton Coal Operations Ltd

Project No. G1758H March 2016
www.ageconsultants.com.au ABN 64 080 238 642

Document details and history

Document details

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Final	Issued to client	AV	CC	10/03/2016

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Appendix B Summary of Groundwater Analysis

Report on

Ashton Coal Project
Groundwater Monitoring Review for AEMR 2015

1 Introduction

The Ashton Coal Project (ACP) is located 14 km west of Singleton in the Hunter Valley region of New South Wales (NSW). The ACP consists of open cut and underground mining to access a series of coal seams within the Permian Foybrook Formation. Ashton Coal Operations Ltd (ACOL) is wholly owned and operated by Yancoal Australia Limited (Yancoal).

Mining commenced at the north east open cut mine (NEOC) in 2003 and coal was recovered from eleven seams of varying thickness, down to and including the Lower Barrett Seam. Open cut mine ceased in 2011.

The underground mine development commenced in July 2006 with the extraction of the first longwall panel (LW1) in the Pikes Gully seam (PG) commencing on 12 March 2007. Currently, ACOL extracts coal solely from the Upper Liddell seam (ULD) underground workings. To manage surface water mining impacts and to minimise effects on underground mining, Bowmans Creek, which overlies the western area of underground workings, has been diverted into two excavated and lined channels. The channels have re-routed Bowmans Creek above abandoned longwall panels.

The Water Management Plan (WMP) was reviewed and updated by Gilbert & Associates Pty Ltd and Australasian Groundwater and Environmental (AGE) on behalf of ACOL and approved by the NSW Department of Planning & Environment (DPE) on 27 October 2015. The groundwater monitoring program was changed and came into force the 1st November 2015.

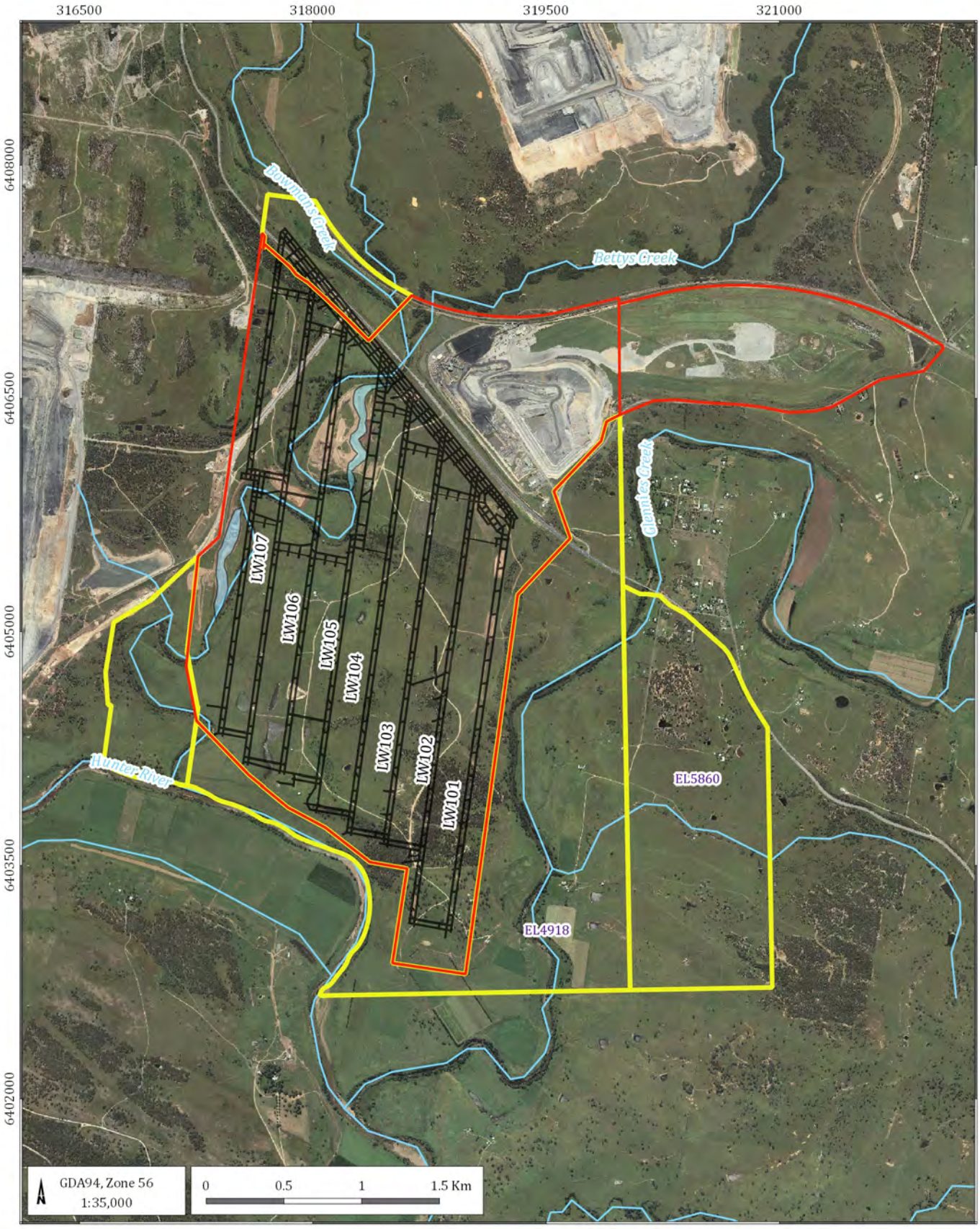
This report provides a review of the groundwater monitoring undertaken during 2015 (01 January 2015 to 31 December 2015) and was prepared by AGE at the request of ACOL.

2 Project settings

2.1 Mining

The Ashton underground mine is located south of the New England Highway, bounded by the Hunter River to the south and two Hunter River tributaries - Bowmans Creek and Glennies Creek to the east and west, respectively (refer to Figure 2-1). Underground operations intend extracting four coal seams, Pikes Gully (PG), Upper Liddell (ULD), Upper Lower Liddell (ULLD) and Lower Barrett (LB), via a longwall arrangement.

The first series of underground workings (LW1 to LW8) extracted coal from the PG seam. LW1 is located in the east of the mining lease (ML) close to the PG subcrop, Glennies Creek and the Glennies Creek alluvium. The final LW panel within the PG (LW8) is located down dip in the western portion of the ML. Currently; longwall mining is taking place within the ULD, which underlies the PG. Gate road development has commenced within the Lower Liddell seam (LLD). LW panels within the ULD are denominated LW101, LW102, etc.; and panels within the LLD are denominated LW201, LW202, etc.



LEGEND

- ULD longwall panels
- Surface water
- Lease boundaries
- Coal title boundaries

Yancoal Ashton - AERM (G1758H)

Site location

DATE 02/02/2016

FIGURE No: **2-1**

Generally, the western half of the underground workings (LW5 to LW8, LW105 to LW107) are located below areas of Bowmans Creek alluvium, the creek itself and two sections of creek diversions. LW6B is an area of historically, elevated groundwater inflows and is located in the north western section of the underground mine area. The overburden thickness above LW5 to LW8 varies due to the west-south-westerly dip of the coal seams. Cover to the PG workings ranges between approximately 100 m over the northern end of LW6B, and approximately 200m over the southern end of LW7A.

Timing of longwall panel coal extraction to date is summarised in Table 2-1.

Table 2-1 Longwall panel schedule

Longwall panel	Mined seam	Start date	End date
LW1	Pike's Gully	12/03/2007	15/10/2007
LW2	Pike's Gully	9/11/2007	22/07/2008
LW3	Pike's Gully	20/08/2008	4/03/2009
LW4	Pike's Gully	2/04/2009	15/10/2009
LW5	Pike's Gully	4/01/2010	4/06/2010
LW6A	Pike's Gully	8/07/2010	23/11/2010
LW7A	Pike's Gully	22/03/2011	8/08/2011
LW7B	Pike's Gully	28/09/2011	17/01/2012
LW8	Pike's Gully	27/02/2012	6/06/2012
LW101	Upper Liddell	31/07/2012	14/06/2013
LW6B	Pike's Gully	14/07/2013	10/10/2013
LW102	Upper Liddell	10/11/2013	24/07/2014
LW103	Upper Liddell	21/08/2014	21/06/2015
LW104A	Upper Liddell	27/07/2015	mid-Jan 2015

Mining of LW103 in the ULD commenced on 22 August 2014 and was completed mid-July 2015. LW103 is the third panel to recover coal from the ULD. LW103 underlies the previously mined PG LW3. The longwall panels accessing the ULD are offset 60 m to the west of the overlying PG goaf. This offset is designed to reduce the resulting subsidence and associated impacts to the surrounding environment. ACP is currently mining the LW105.

2.2 Climate and rainfall

Based on the updated Köppen-Geiger climatic classification (Peel *et al.,* 2007), the climate of the Ashton area is characterised as 'temperate without a dry season and hot summers'.

The temperature statistics for 2015 are summarised in Table 2-2. The 2015 daily temperature minima and maxima are presented graphically in Figure 2-2.

Table 2-2 2015 Temperature statistics

Period	April - September (cooler months)		January - March October - December (warmer months)	
Statistics	Minima	Maxima	Minima	Maxima
Lowest	2.7	11.0	9.6	17.8
Highest	18.7	31.3	23.0	39.3
Mean	9.4	19.2	16.6	29.2
Median	9.4	18.5	16.8	29.4

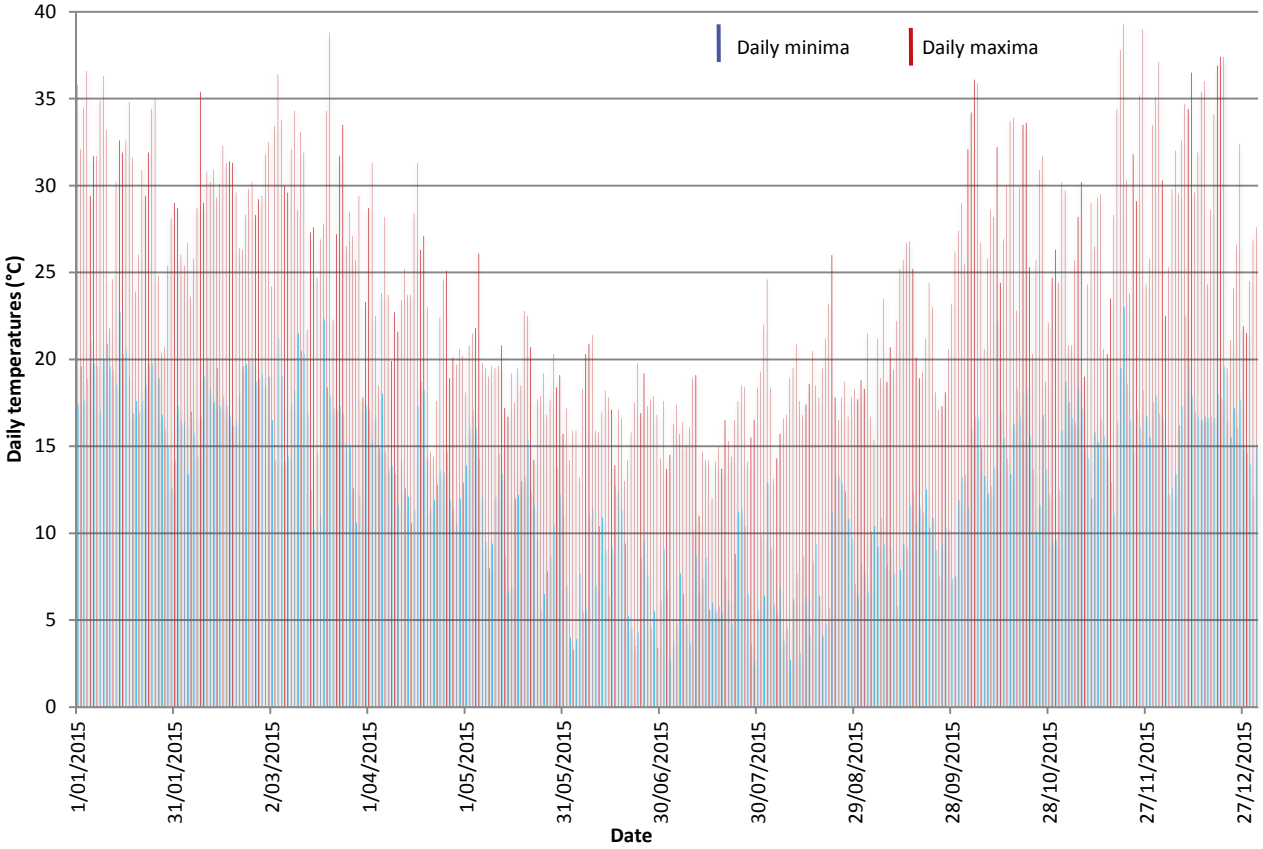


Figure 2-2 Average temperature between January and December 2015

The 2015 and long-term average monthly rainfall is summarised in Table 2-3 and presented graphically in Figure 2-3. The data in Table 2-3 is a composite of data from the:

- Ashton Weather Station for the period 1 July 2006 to 31 December 2015; and
- SILO database (QLD government, 2015) for the periods of 1 January 1889 to 30 June 2006, and 2 February 2015 to 1 March 2015.

The SILO data was assessed for a representative area located approximately 9 km south of Ashton (coordinates: latitude -32.45°, longitude: 151.50°).

Precipitation is predominant in October and February; whereas, the winter months are generally drier with a slight rainfall increase in June and July. The long-term annual average rainfall over 126 years (1889 – 2015) is **647 mm/year**.

An evapotranspiration (EVT) rate of 765 mm/year was sourced from the Bureau of Meteorology (BOM) database for the Ashton area.

Table 2-3 Long-term average (1889-2015) and total monthly rainfall (2015)

Monthly rainfall (mm)	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Average (1889-2015)	76	73	63	48	42	50	42	37	40	50	59	67	647
Monthly totals (2015)	142.8	17.4	15.6	269.6	73.2	27	18.2	59.6	15	31	0	0	669.4

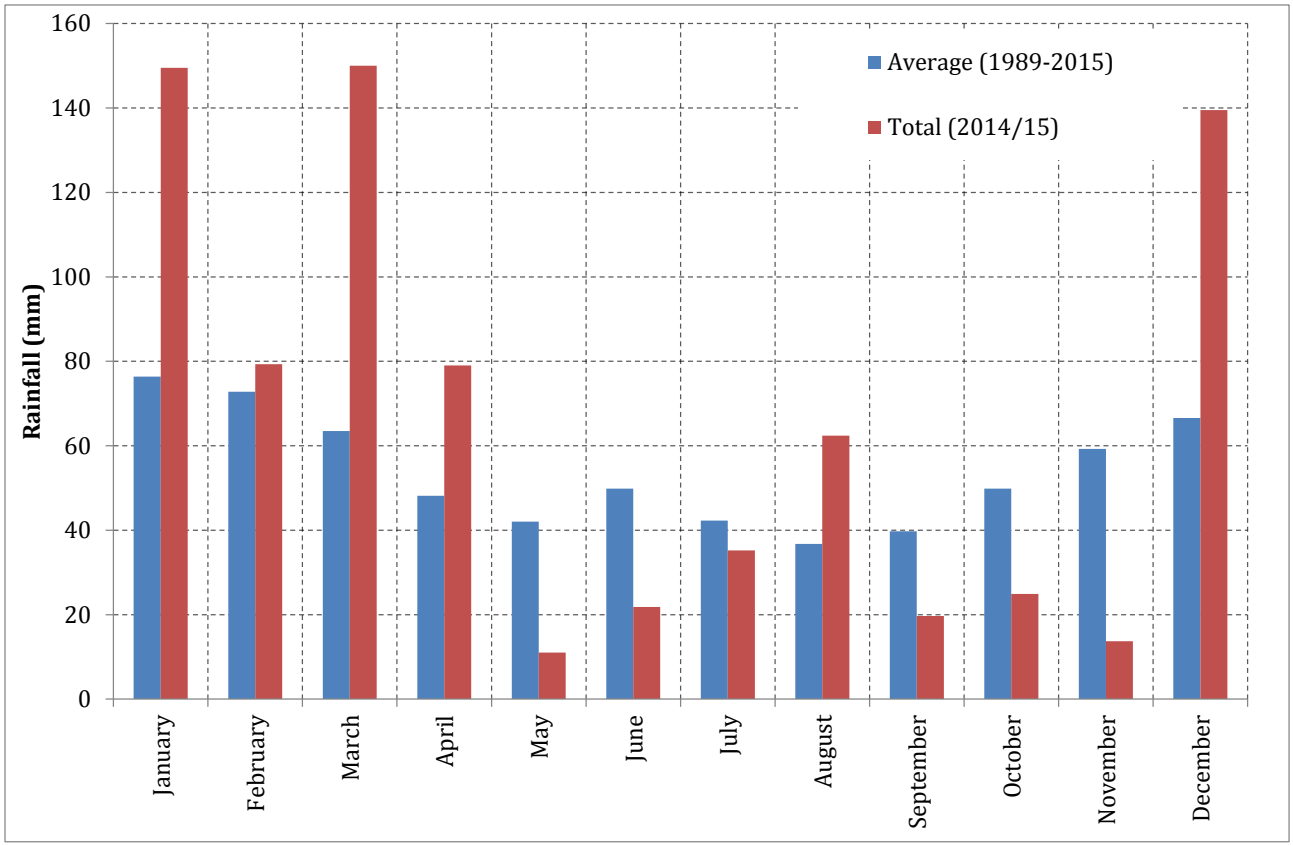


Figure 2-3 Comparison of 2014/15 monthly rainfall and long-term average

Long-term rainfall trends can be characterised using the Cumulative Rainfall Departure (CRD) method (Bredenkamp *et al.*, 1995). CRD shows trends in rainfall relative to the long-term monthly average and provides a historical record of wetter and drier periods. A rising trend in slope in the CRD plot indicates periods of above average rainfall, while a declining slope indicates periods of below average rainfall. CRD has been used in this study to give context to variations in groundwater levels and chemistry. The CRD and monthly rainfalls between 2005 and 2015 are graphed in Figure 2-4. Two main CRD trends were observed:

- average rainfall between mid-2005 and mid-2009, except the summer 2006-2007 which was drier;
- rainfall predominantly below average between mid-2009 and mid-2015. Specifically, the area is noted to have periods of prolonged below average rainfall between mid-2009 and mid-2011, and between mid-2012 and mid-2015.

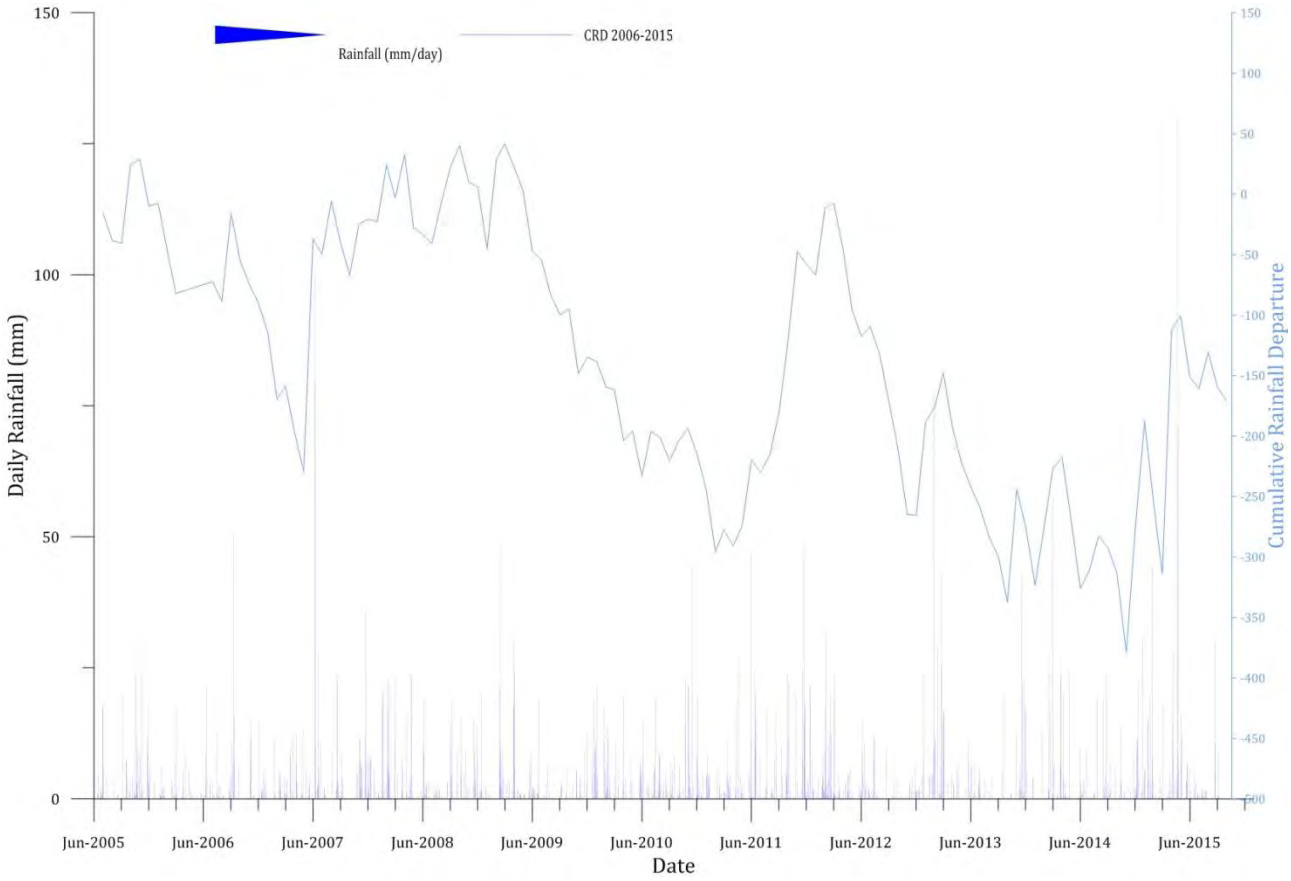


Figure 2-4 Comparison of monthly rainfall and CRD

2.3 Surface water

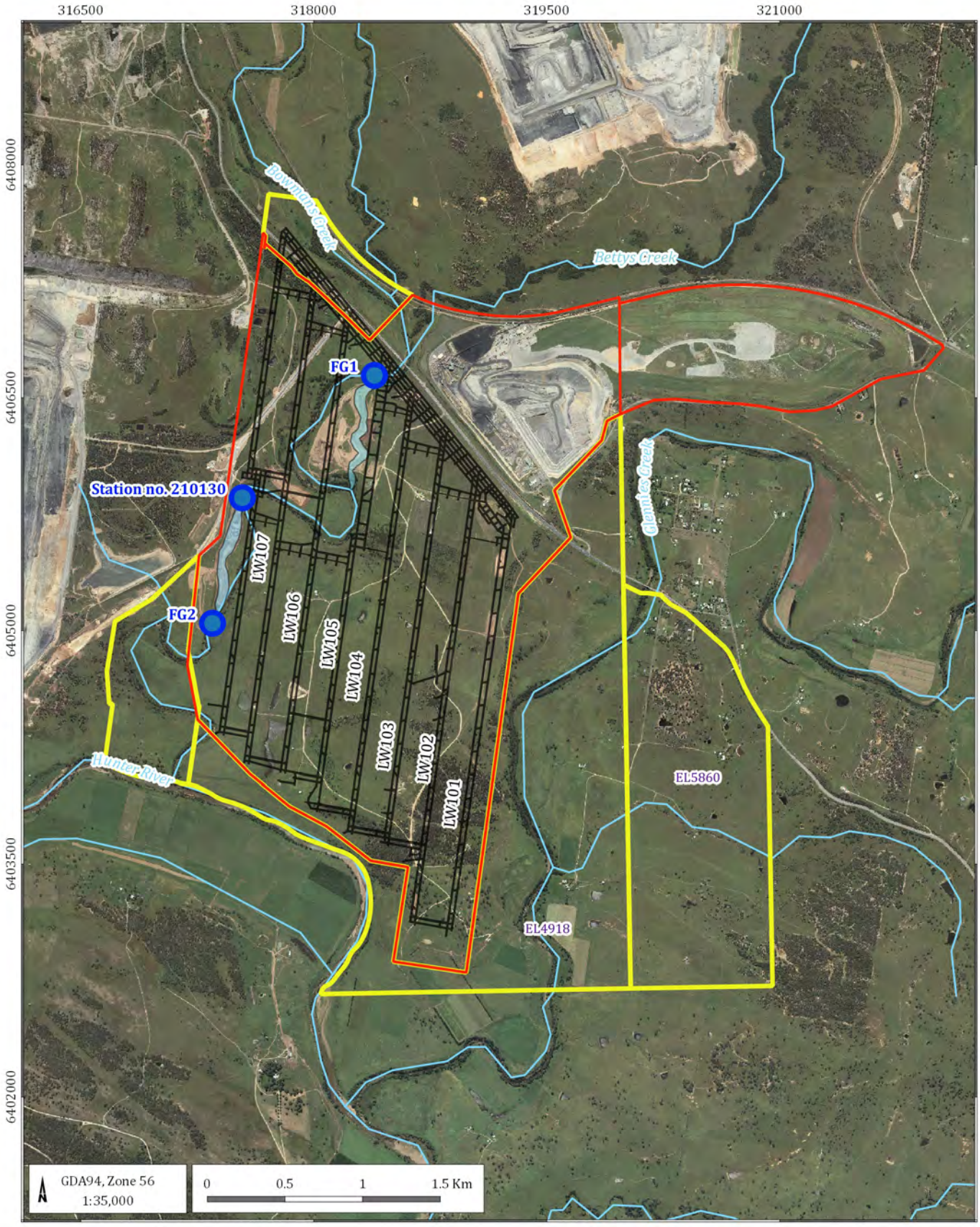
Ashton lease is bounded by Bowmans Creek on the west, Bettys Creek (tributary of Bowmans creek) on the north, Glennies Creek on the west side and Hunter River on the south. Both Bowmans and Glennies Creeks are an affluent of Hunter River. The three main water courses are shown on Figure 2-5 and described below:

- Hunter River is the main surface water body with a catchment area at Bowmans Creek of 13,590 km^2. The flow is regulated by Glenbawn dam and by other licensed extractions and releases.
- Glennies Creek and its associated alluvium are located to the east of the underground workings and the Pike's Gully sub-crop area. The catchment area is approximately 600 km^2 and up to half of the Glennies Creek catchment feeds into Lake St. Claire, located within the far north eastern section of the catchment. Water from Lake St. Claire discharges into Glennies Creek under controlled release.
- Bowmans Creek natural channel is above the longwall panel LW6B and its associated alluvium are over LW5 to LW8. It is the main water course over the underground working area. Bowmans creek was diverted in two locations to minimise the impact of mining on the creek and the potential inflows to the underground workings. The construction of the eastern diversion commenced in March 2011 and the western diversion commenced in February 2012. Both diversions were commissioned in November 2012 and are within the Bowmans Creek Alluvium (BCA). The diversions were designed to replicate the natural creek setting in terms of channel cross sectional variability in bed level and ecological features (i.e. resting pools). There were lined with a geosynthetic clay liner in order to minimise leakage from the creek.

  Bowmans Creek flow is not regulated and is monitored following the WMP. The stream flow gauging station no. 210130, from the NSW Office of Water, was installed in October 1993 and is used as a flow baseline for Bowmans creek with a catchment area of 240 km^2. This station is localised in the middle section of the creek on the mining lease, upstream to the western diversion. The annual discharges for the last ten years are summarized in Table 2-4. Following the two diversions, ACOL installed two stream flow gauging stations in 2012, named FG1 and FG2, located upstream and downstream of the Bowmans Creek Diversion (BCD) and longwall mining area. The catchment area of Bowmans Creek at Hunter River is approximately 300 km^2.

Table 2-4 Bowmans Creek annual discharge (Station no. 210130)

Year	Total discharge (ML)
1995	6,102
1996	6,006
1997	Not available
1998	82,489
1999	23,520
2000	Not available
2001	Not available
2002	1,559
2003	3,034
2004	410
2005	1,497
2006	Not available
2007	55,132
2008	Not available
2009	13,368
2010	10,767
2011	Not available
2012	17,667
2013	30,468
2014	656
2015	Not available
Average	**18,048**
Median	**8,435**
Minimum	**410**
Maximum	**82,489**



LEGEND

- Surface water
- ULD longwall panels
- Bowman Creek Diversions
- Flow gauging stations
- Lease boundaries
- Coal title boundaries

Yancoal Ashton - AERM (G1758H)

Surface water

DATE 02/02/2016

FIGURE No: **2-5**

2.4 Geology

The stratigraphic sequence in the region comprises two distinct units, Quaternary alluvium and Permian sediments.

- The **Permian sediments** comprise of coal seam sequences with overburden and interburden consisting of sandstone, siltstone, tuffaceous mudstone, and conglomerate. The Middle Permian strata form a regular layered sedimentary sequence, with the Whittingham Coal Measures containing the main economic coal seams. Ashton is located in the central Hunter Valley of NSW where the lower sequences of the Whittingham Coal Measures (Singleton Supergroup) sub-crop. The underground operations target seams between the Pikes Gully and Lower Barrett. The stratigraphic sequence of the Permian coal measures in the Hunter Valley is shown in Figure 2-6.
- The **Quaternary alluvium** unconformably overlies the Permian sediments and consists of silt, sand and gravel in the alluvial floodplains of the Hunter River, Bowmans Creek and Bowmans Creek. The Bowmans and Glennies Creek alluvium are likely to be in direct connection to the Hunter River alluvium. Figure 2-7shows the extents of the Quaternary alluvium. It is important to note that the mapping of the alluvium does not accurately define the extent of alluvium, as large-scale mapping often incorporates desktop assessment with limited ground truthing. The alluvium extents were sources from the Aquifer Interference Policy (2012) and the 1:25,000 Singleton Geological Map (McIlveen, 1984).

The 1:100,000 Hunter Valley Coalfields geological map shows that the major structural features within the Ashton area include the Rix's Creek Syncline and the Bayswater Syncline, which bound the mine site to the east and west, respectively. These two structures have caused the geology to dip uniformly to the west-southwest. The area is also bound to the north by the Hebden thrust fault.

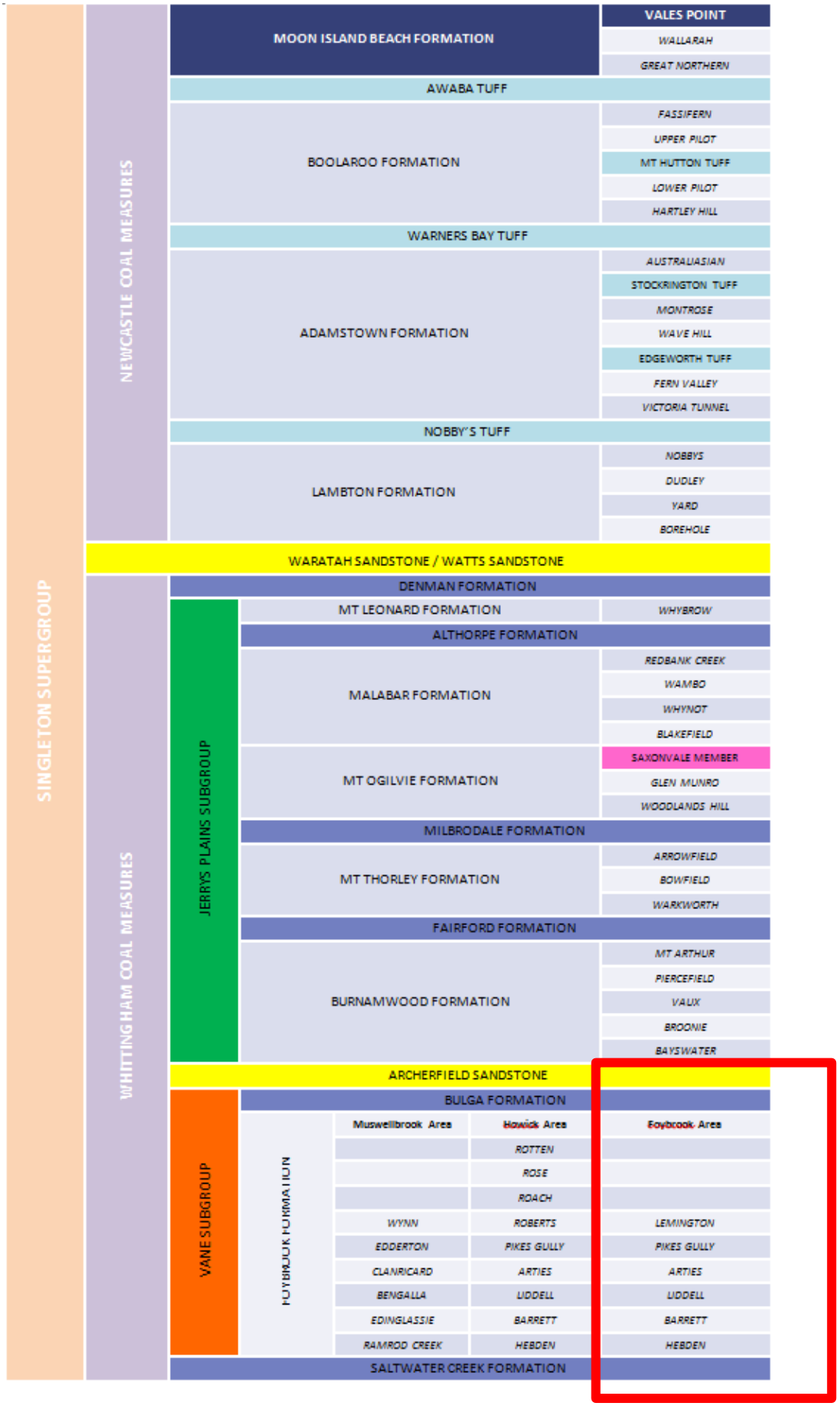
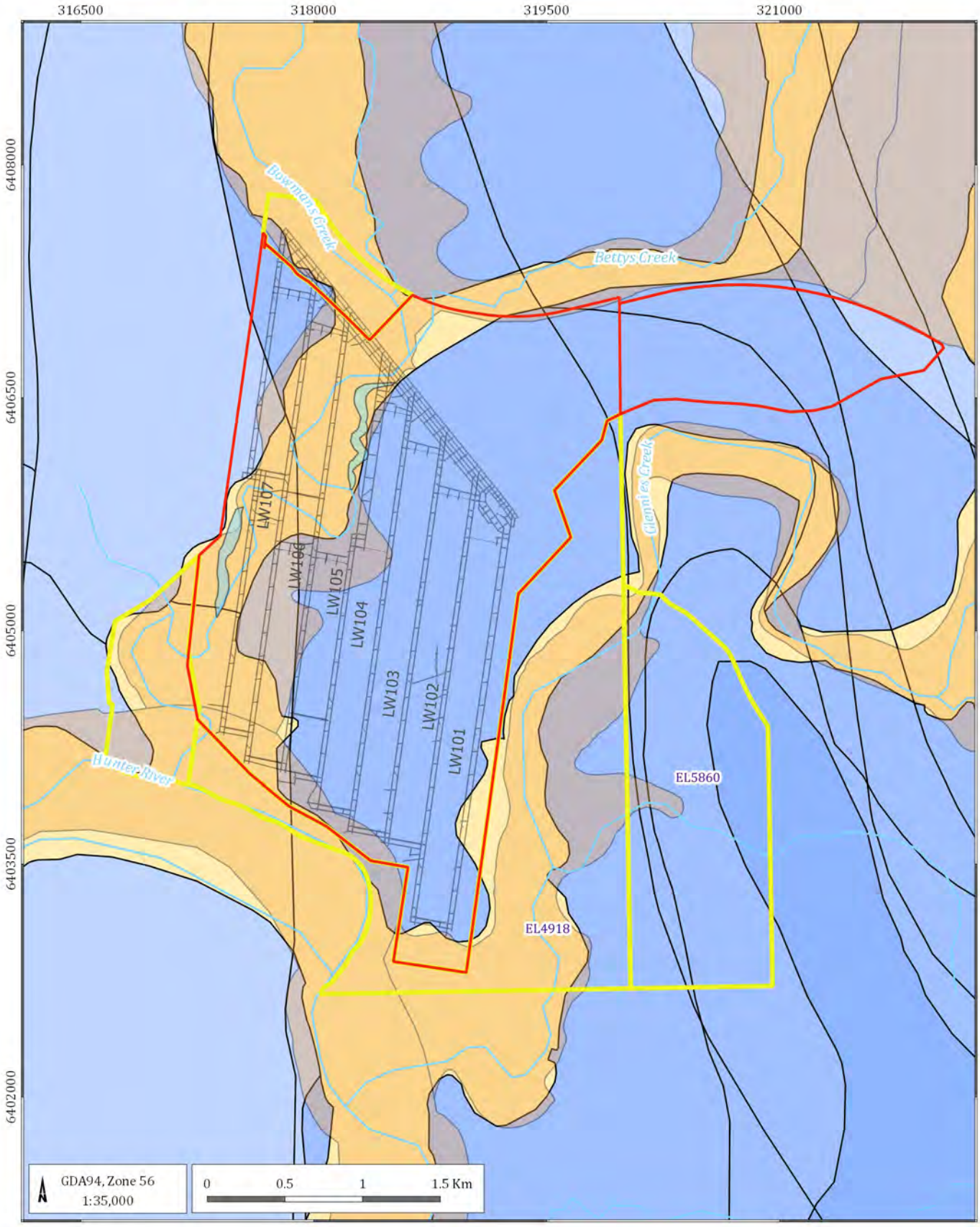


Figure 2-6 Stratigraphy of the Singleton Supergroup



LEGEND

- Coal title boundaries
- Lease boundaries
- ULD longwall panels
- Surface water

Regional geology

- Qa - Quaternary Alluvium
- Pswj - Derman Formation, Jerry's Plains Subgroup
- Pswv - Archerfield Sandstone, Vane Subgroup

Alluvium (AIP)

- Highly

Yancoal Ashton - AERM (G1758H)

Regional Geology

DATE 02/02/2016

FIGURE No: **2-7**

2.5 Hydrogeology

2.5.1 Aquifer systems

The two main water bearing systems within the Ashton area are the fractured Permian coal measures and the unconsolidated alluvial sediments of the Hunter River, Glennies Creek and Bowmans Creek.

2.5.1.1 Permian coal measures

The hydraulic conductivity and storativity of the Permian coal measures is variable. The Permian coal measures can be categorised into the following hydrogeological units:

- **Coal Measures (CM)**. Coal seams are the prime water bearing strata within the Permian coal measures, typically ranging in thickness from 0.5 m to 10 m. It is low to moderately permeable with recorded horizontal hydraulic conductivity (Kxy) values in the Singleton area between 0.6 m/d ($7x10^{-6}$ m/s) and $4.0x10^{-3}$ m/d ($5x10^{-8}$ m/s) (Rust PPK, 1997 and MER, 2005). The coal seams form a series of aquifers alternated by aquitard (interburden).
- **Regolith** or **Coal measures overburden (CMOB)**. It is defined as hydrogeologically "tight" and hence very low yielding sandstone, siltstone and conglomerate that comprise the majority of the Permian interburden/overburden. From previous studies (Rust PPK, 1997, MER, 2005 and AGE, 2010), the hydraulic conductivity of the low yielding interburden/overburden has been recorded between $1x10^{-4}$ m/d ($1x10^{-9}$ m/s) and $1x10^{-5}$ m/d ($1x10^{-10}$ m/s). However, as presented by Kendorski (1993), longwall extraction results in collapse of the overlying rock strata. A previous AGE report (AGE, 2015) discuss about the disturbance zones and highlights the potential extent of the caved, fractured, dilated and constrained zones within the overburden above Pikes Gully seam and the Upper Liddell seam. This subsidence might increase the aquifer properties of the overburden and potential connection between the different aquifers (between the coal seams and alluviums) in post-mining. Site permeability testing was carried out by SCT in 2009 to assess the permeability of the overburden material pre and post longwall mining. The pre-mining test results ranged between $1x10^{-11}$ m/s and $1.5 x 10^{-7}$ m/s. Only three tests were able to be repeated post mining due to drilling difficulties related to loss of drilling fluids; however, of these tests, permeability increased by at least one order of magnitude in the deeper tests (SCT, 2009).

2.5.1.2 Quaternary alluvium

The unconsolidated alluvium aquifers system associated with the Quaternary alluvium of Hunter River and its tributaries is generally 10 m to 15 m thick, thinning to 0 m to 5 m towards the edges of the alluvial plain. There are three main alluvial deposits in Ashton area:

- **Bowmans Creek alluvium (BCA)** is located on the west part of the underground workings, primarily over LW5 to LW8. They are the main alluvium formation over Ashton area and have been investigated in 2008 by Aquaterra (renamed later RPS). The current channel over the mine can be divided into three portions, northern, central and southern. The northern portion (over LW6B) has the greatest median thickness of saturated alluvium (3.6 m) and the greatest hydraulic conductivity of 4.45 m/d ($5 x10^{-5}$ m/s). Oppositely, the southern portion extends to the Hunter River alluvium and has the lower median saturated thickness (2.3 m) with lower hydraulic conductivity of 0.75 m/d ($9 x10^{-6}$ m/s). The hydraulic conductivity repartition along the creek illustrates coarser grained material at the upper portion and finer material near the **Hunter River alluvium.**

  Bettys Creek alluvium are localised on the north edge of the open pit (NEOC) and joins Bowmans Creek on the north west of the pit.

- **Glennies Creek alluvium (GCA)** is situated within a small alluvial floodplain immediately east of the underground mine. It is adjacent to the LW101 and joins the Hunter River alluvium on the south part of the longwall.
- **Hunter River alluvium (HRA)** is located on the south edge of the underground mine.

2.5.2 Recharge

Groundwater recharge at the site primarily occurs as result of rainfall infiltration at outcrop of the coal measures and the alluvium and lateral flow through from the alluvium to the coal measures (Aquaterra, 2009). The Whittingham Coal Measures are known to subcrop below the Hunter River and the BCA and GCA, the hydraulic connectivity between the Whittingham Coal Measures and the alluvium is not precisely understood. However, it is likely that this geological contact is a source of recharge to the underlying coal measures.

Additionally, localised recharge to the Bowmans and Glennies creeks alluvium via lateral seepage from the Hunter River occurs during periods of high flows.

3 Monitoring program

3.1 Groundwater monitoring network

The ACOL groundwater monitoring network consists of more than 100 monitoring bores, of which 49 are monitored as part of the water management plan (WMP), including longwall panel specific monitoring bores and vibrating wire piezometer (VWP). The WMP outlines a monitoring plan and key monitoring locations in areas which are potentially sensitive to mining impacts.

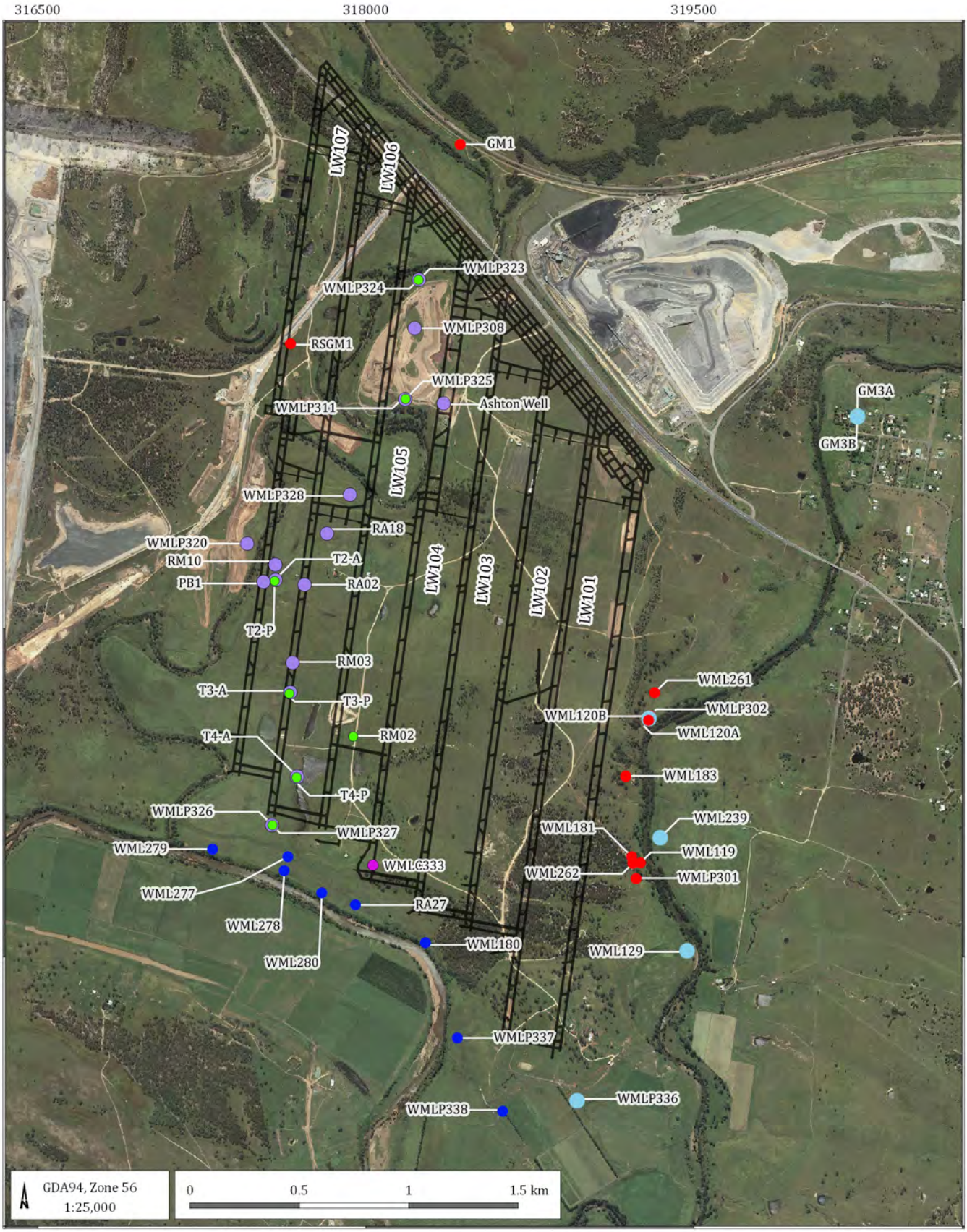
The WMP monitoring locations and respective monitoring targets are presented in Figure 3-1. Detail of the groundwater monitoring plan, including monitoring parameters and frequency, is summarised in Appendix A.

The groundwater monitoring program includes the monitoring of:

- groundwater (piezometric) pressures;
- field water quality parameters – pH and electrical conductivity (EC);
- groundwater sampling for comprehensive chemical analysis; and
- monitoring of groundwater level and EC as required by Environmental Protection Licence 11879 (EPL 11879).

Monitoring frequency is as follows:

- monthly monitoring at selected alluvial piezometers for water level and field water quality;
- monthly monitoring of water level and piezometric pressure in longwall-specific piezometers during active extraction at relevant longwalls;
- quarterly monitoring at selected piezometers for water level, piezometric pressure and field water quality;
- six-monthly for bores specified by EPL 11879; and
- annual sampling at selected piezometers for comprehensive chemical analysis.



LEGEND

ULD longwall panels

Monitoring bores November 2015

- BCA - Bowman's Creek alluvium
- HRA - Hunter River alluvium
- GCA - Glennies Creek alluvium
- CMOB (Regolith) - Coal measure overburden
- Coal measures

VWP

- WMLC333 (Lem, Art, LD, Bar)

Yancoal Ashton - AERM (G1758H)

WMP groundwater monitoring network

DATE 02/02/2016

FIGURE No: 3-1

3.2 Trigger values of groundwater management plan

Triggers for groundwater level and water quality (EC and pH) have been developed for monitoring bores in the Bowmans Creek Alluvium (BCA), Glennies Creek Alluvium (GCA) and the Hunter River Alluvium (HRA). These triggers have been included in the last water management plan, in May 2015 and have been updated in November 2015 based on the current observations.

Groundwater level trigger were established based on the predicted mining related drawdowns at the alluvial monitored bores and on the observed natural variations (RPS 2014). Since the validation of the WMP in May 2015 and until the end of mining in the ULD, a recorded water level below the defined trigger level at a monitoring bore, sustained for three consecutive months, would trigger a response under the WMP. Groundwater elevation trigger levels are summarised in Table 3-1.

Table 3-1 Groundwater elevation trigger levels for alluvial monitoring bores

Aquifer	Monitoring bore	Interpolated base of alluvium (mAHD)	Assigned trigger value end of mining Upper Liddel Seam (mAHD)
BCA	WMLP323	57.7	58.4
	WMLP311	54.9	56.2
	T2A	51.8	52.5
	WMLP328	54.7	55.2
GCA	WML120B	50	51.7
	WML129	45	50.4
	WML239	45.4	50.8
HRA	WMLP279	37.4	49
	WMLP280	43.3	48.8
	WMLP337	45.6	47.8

As for the groundwater levels, triggers values for EC and pH have been developed in the last WMP based on the 20th and 80th percentile of the historical data for all the bores in the alluvium. A response would be triggered if recorded values of pH or EC are outside the allocated triggers for a period of three consecutive monthly measurements. Additionally, if a recorded value at a monitoring bore is extremely different than the previous three readings without any unusual event that could have caused the change, a response would be triggered. The triggers values allocated for pH and EC are in Table 3-2.

Table 3-2 Groundwater quality trigger levels for alluvial monitoring bores

Aquifer	pH trigger	EC trigger
BCA	< 6.5 or > 8.0	> 2,000 µS/cm
GCA	< 6.2 or > 8.0	> 2,000 µS/cm
HRA	< 6.2 or > 8.0	> 3,100 µS/cm**

Note: *** > 3,000 µS/cm before 1st November 2015*

4 Groundwater quality

4.1 Field quality

Five main monitoring bore locations were chosen to observe potential mining impacts related on groundwater quality (pH and EC). Groundwater monitoring data trends were graphed per locations, grouping monitoring bores screened in different lithology:

- Group 1 and Group 2: they are situated at the east of the groundwater workings. The monitoring bores are screened within Glennies Creek alluvium and different coal seams.
- Group 3: it is located on the south of the longwall 101, downstream of Hunter River. The monitoring bores are in the alluvium.
- Group 4: it is situated on the south part of the longwall 104-106. The bores are screened in the alluvium and Permian overburden.
- Group 5: it is located over the longwall 105, on the Bowmans Creek eastern diversion. The monitoring bores are screened in the alluvium and Permian overburden.

The triggers values for pH and EC for the alluvium are included in the graphs to verify the compliance with the WMP. Additionally, the CRN and daily rainfall are graphed to identify any variation of concentration related to rainfall compare to mining.

The monitoring location groups are illustrated on Figure 4-1 and are discussed in the following sections.

LEGEND

ULD longwall panels

Monitoring bores AEMR groups

- BCA - Bowman's Creek alluvium
- CMOB (Regolith) - Coal measure overburden
- Coal measures
- GCA - Glennies Creek alluvium
- HRA - Hunter River alluvium

VWP

- WMLC333 (Lem, Art, LD, Bar)

Yancoal Ashton - AERM (G1758H)

WMP groundwater monitoring network and AEMR monitoring groups

DATE 03/02/2016

FIGURE No: **4-1**

4.1.1 pH

pH is generally a good indicator of water quality and to identify the groundwater source. From the monthly monitoring program during 2015, pH trend is highly variable and ranges between 6.5 and 9.5. As mentioned previously, the graphs are realized per group of monitoring bores and are illustrated in Figure 4-2 to Figure 4-6.

- **Group 1 monitoring location**: Pikes Gully seam and Glennies Creek alluvium have similar pH trends. There are not enough data available for the bore screened in the Arties seam to assess any pH trend connection with the alluvium.
- **Group 2 monitoring location**: Upper Liddell and Pikes Gully seams have comparable pH behaviour along the Year 2015. Additionally the Arties seam and the Glennies Creek alluvium have similar pH trend.
- **Group 3 monitoring location**: the bore WMLP337 (Hunter River alluvium) has comparable variation than the Pikes Gully seam and other monitoring bores in the alluvium highlighted in groups 1 and 2.
- **Group 4 monitoring location**: the bore WMLP326 in the alluvium has similar pH variation than the previous groups observed. However the bore WMLP327, in the overburden, seems having different variation than the other monitoring bores.
- **Group 5 monitoring location**: the bores WMLP325 and WMLP311, respectively screened in the overburden and in the Bowmans Creek alluvium, have similar pH variation.

Overall, the main observations are:

- bores screened in GCA, BCA, HR and various coal seams tend generally to have similar pH variation;
- there are no reportable exceedances of the WMP trigger values;
- pH is highly variable and the trends generally match seasonal variation. Periods of low rainfall are characterised by low pH (< 7 pH units) and vice versa for periods of elevated rainfall; and
- there are no obvious impacts from mining to the pH measured on these monitoring bores during the Year 2015.

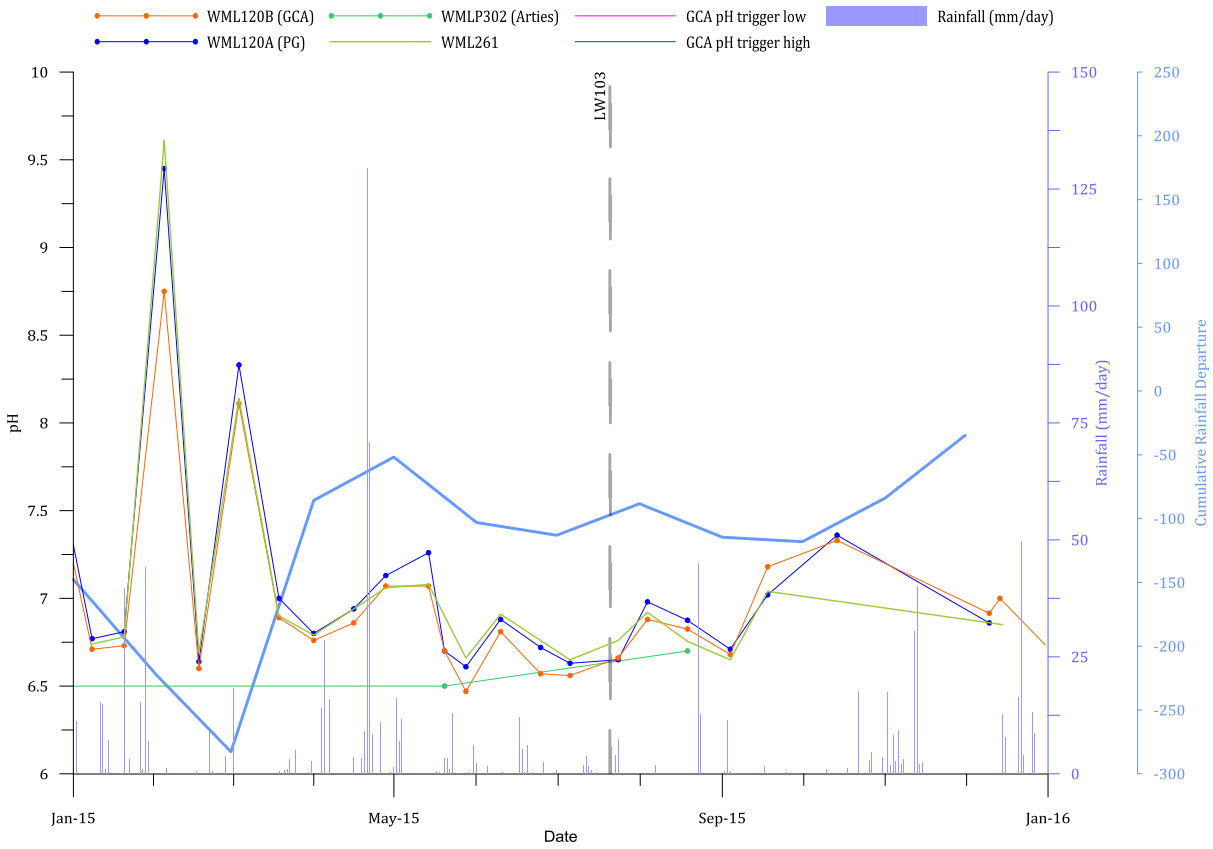


Figure 4-2 Group 1 bores - pH trends

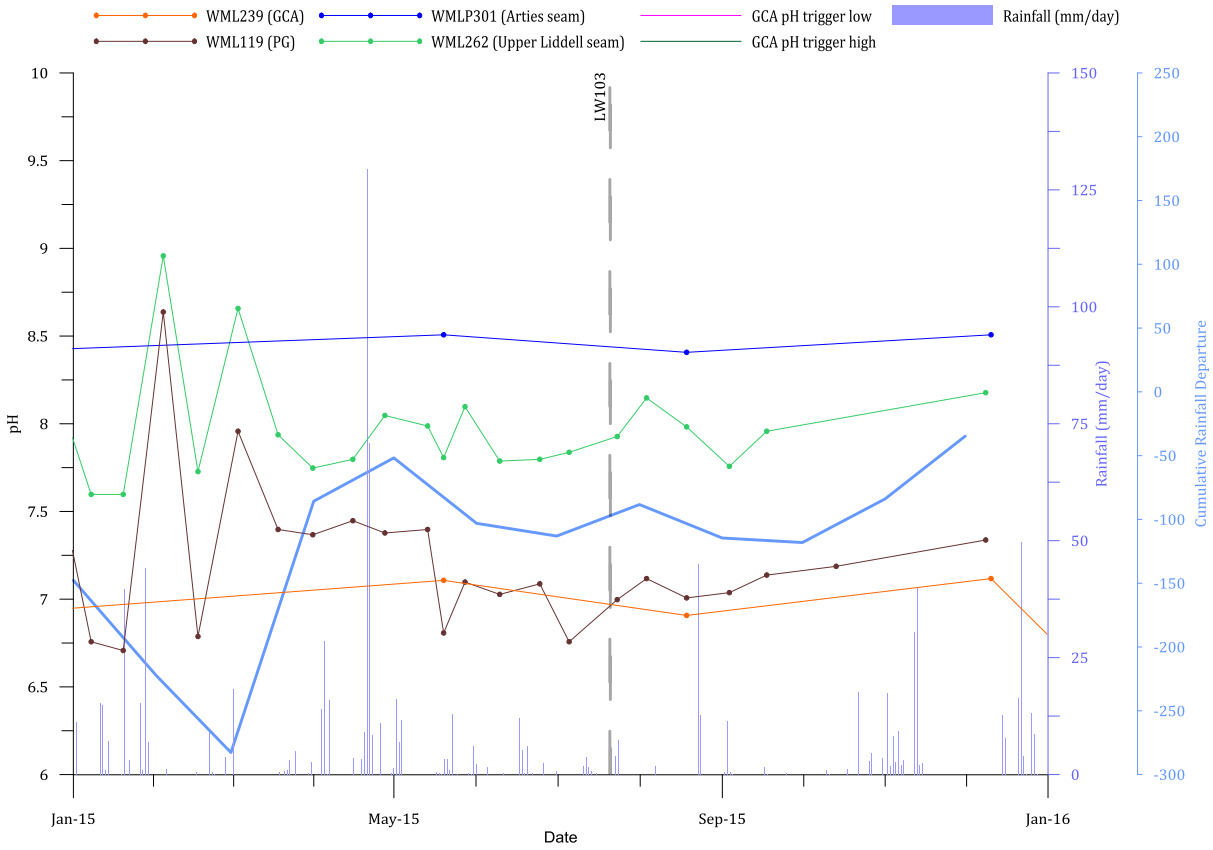


Figure 4-3 Group 2 bores - pH trends

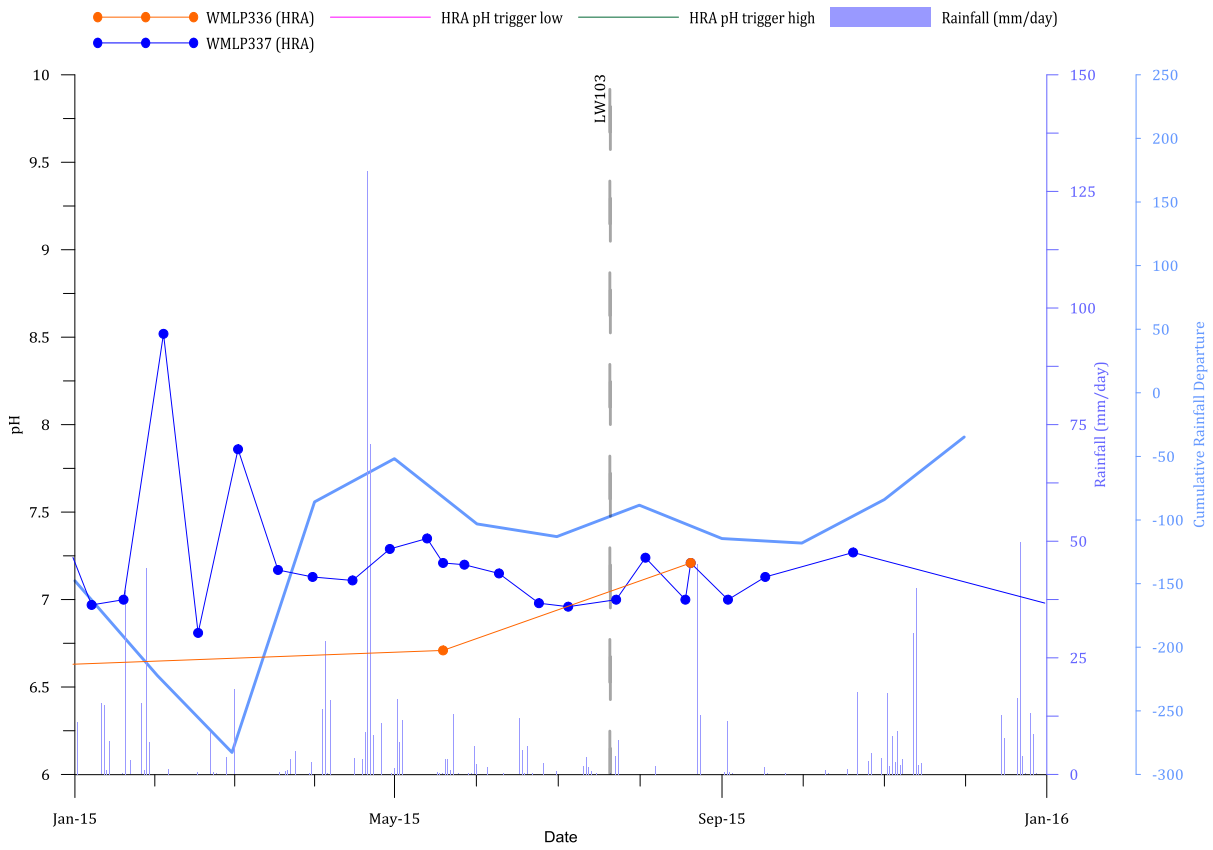


Figure 4-4 Group 3 bores - pH trends

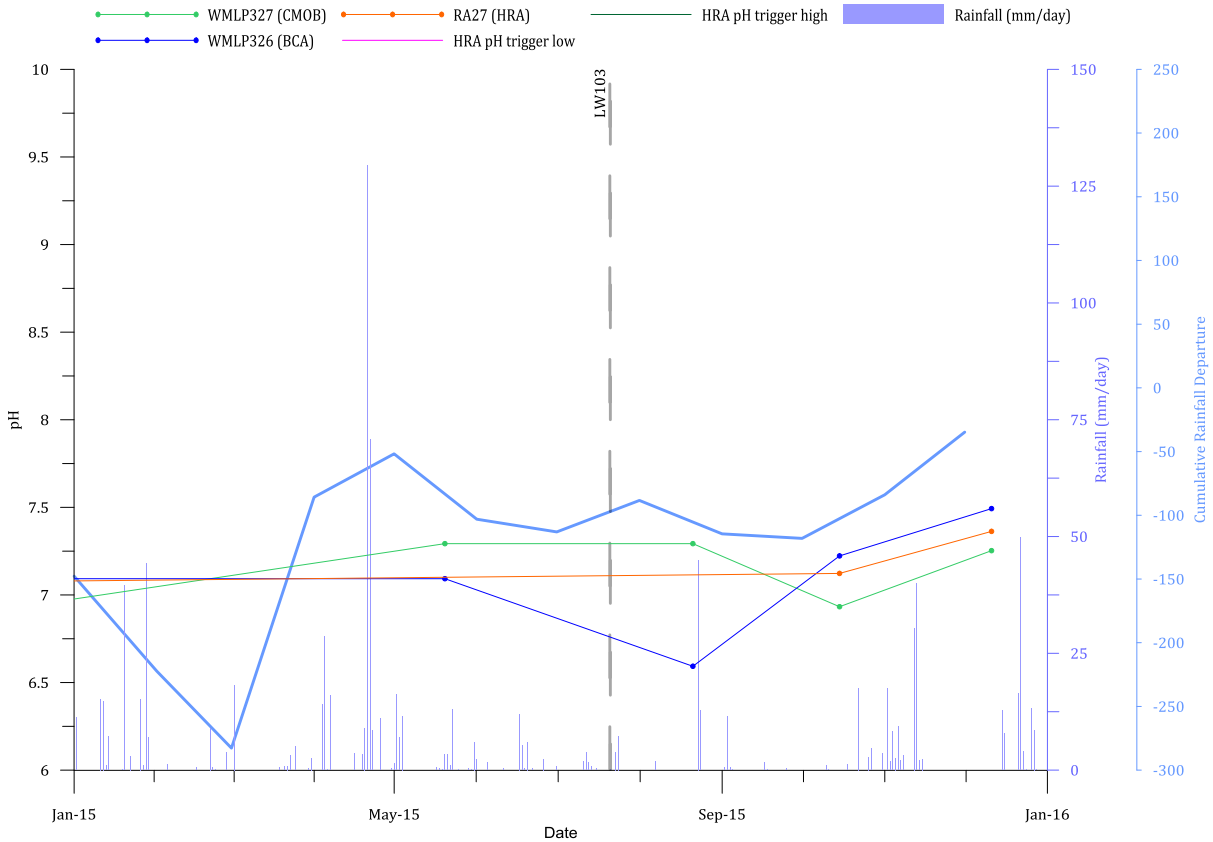


Figure 4-5 Group 4 bores - pH trends

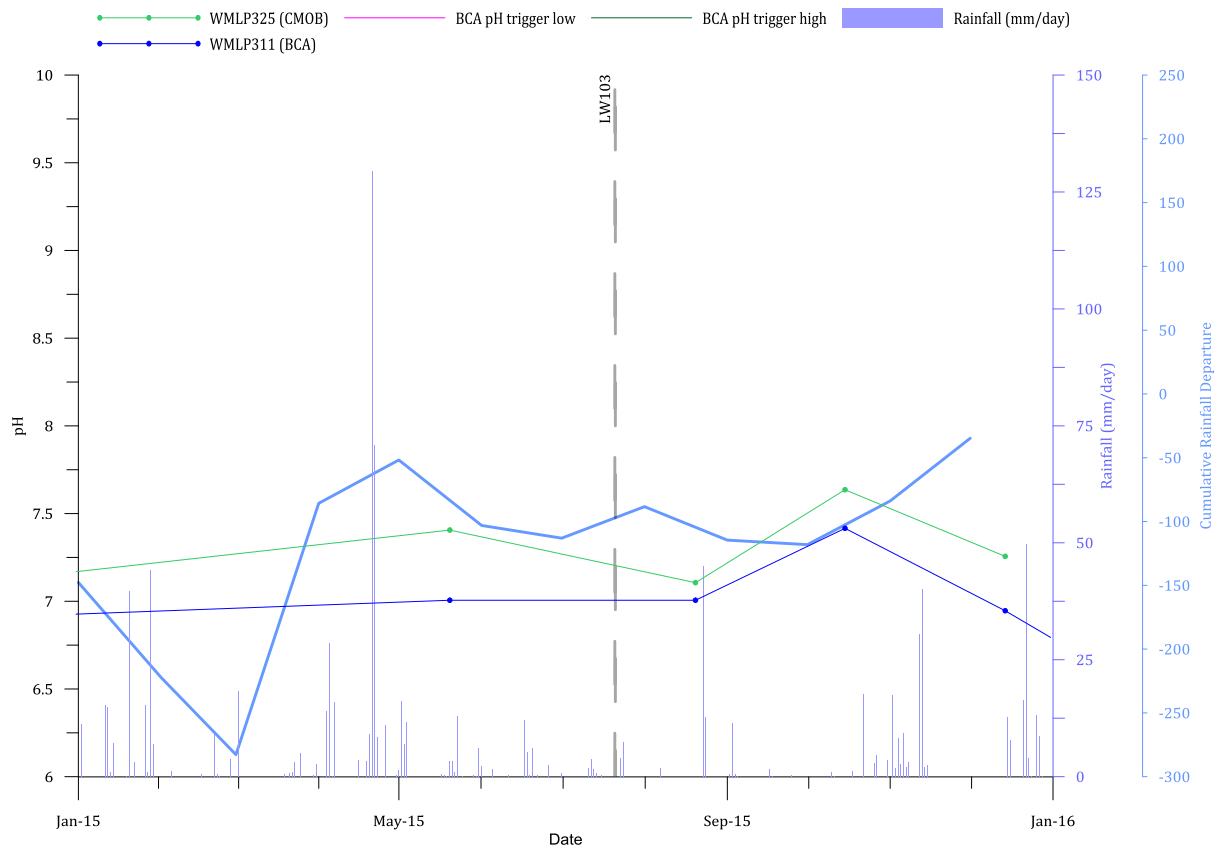


Figure 4-6 Group 5 bores - pH trends

4.1.2 Electrical conductivity

The groundwater at Ashton Coal has distinctive EC ranges. In the alluvium the values are generally below 2000 µS/cm with higher value, around 3000 µS/cm, for the Hunter River at the south of the first panel (LW101). EC values in Coal Measures are mostly higher. The electrical conductivities are analysed by the same five groups of monitoring location than the pH trends. The EC trends are illustrated in Figure 4-7 to Figure 4-11.

- **Group 1 monitoring bores**: The Glennies Creek alluvium (WML120B) and the Pikes Gully seam (WML120A) have comparable EC trends during the Year 2015 and seem merging from May 2015. GCA and PG appear be previously hydraulically connected and the connections have been increased in May 2015. EC concentration for GCA and PG are mostly constant during the year, with a value averaging 600 µS/cm. The Arties seam (WMLP 302) has higher EC value, around 1000 µS/cm and fluctuates differently than the alluvium.
- **Group 2 monitoring bores**: As observed in the group 1, the monitoring bores screened in the PG and GCA appear hydraulically connected. However the Arties and the Upper Liddell seams have different EC concentration and fluctuations than the alluvium with EC concentration ranging between 6000 and 8000 µS/cm.
- **Group 3 monitoring bores**: the two bores screened in the Hunter River alluvium have different EC values, 3000 µS/cm for WMLP337 and 600 µS/cm for WMLP336.

- **Group 4 monitoring bores**: the bores are screened in the BCA, HRA and CMOB and all have similar EC fluctuation with concentration between 1500 and 2000 µS/cm. The overburden has been probably hydraulically connected with the alluvium during mining but no obvious EC variation related to mining has been observed in 2015.
- **Group 5 monitoring bores**: both bores, in the alluvium and overburden have similar EC fluctuation with values below 2000 µS/cm.

Overall the general trends observation for EC for the different geological formations and locations are:

- The exceedance protocol for EC was not triggered at all during 2015.
- The BCA and the CMOB appear to be naturally hydraulically connected locally and the GCA and the PG seam also appear to be naturally hydraulically connected in given locations. This hydraulic connection does not appear to have been impacted by mining in 2015.
- The Arties and Upper Liddell seams do not appear to be hydraulically connect the any of the alluvium deposits (BCA, GCA and the HRA) that overlie the site.
- The stabilisation of the EC between WML120A and WML120B indicates a return to equilibrium in the area between the GCA and the PG seam aquifers.
- There are no visible EC variations related to mining activity during 2015.

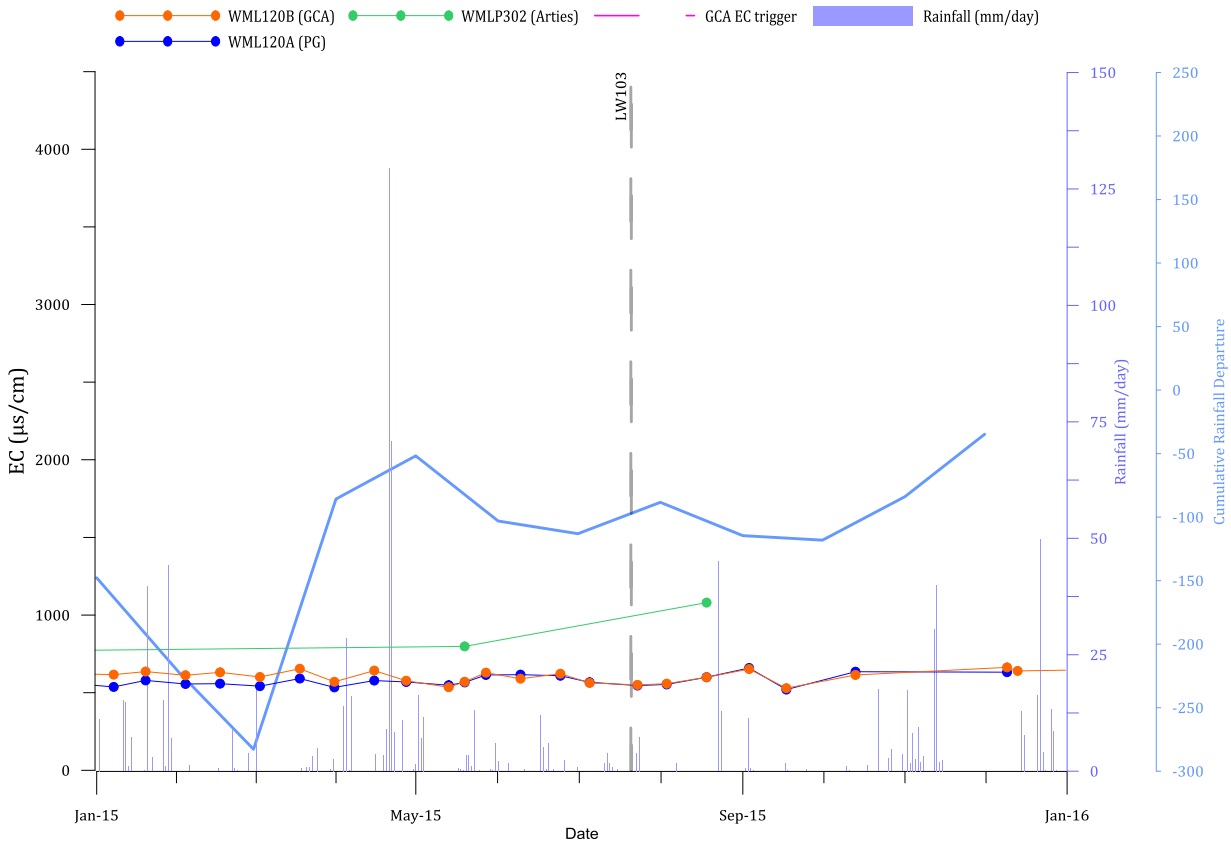


Figure 4-7 Group 1 bores - EC trends

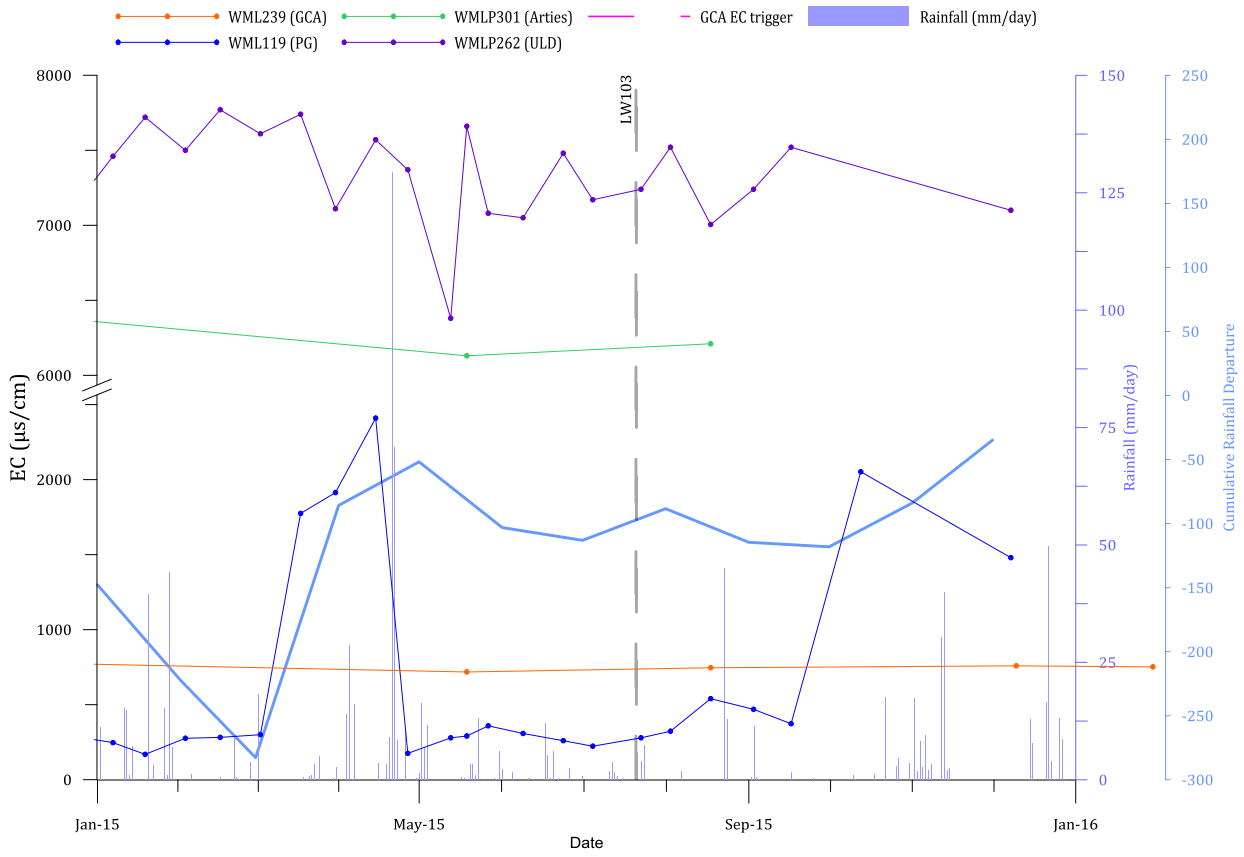


Figure 4-8 Group 2 bores - EC trends

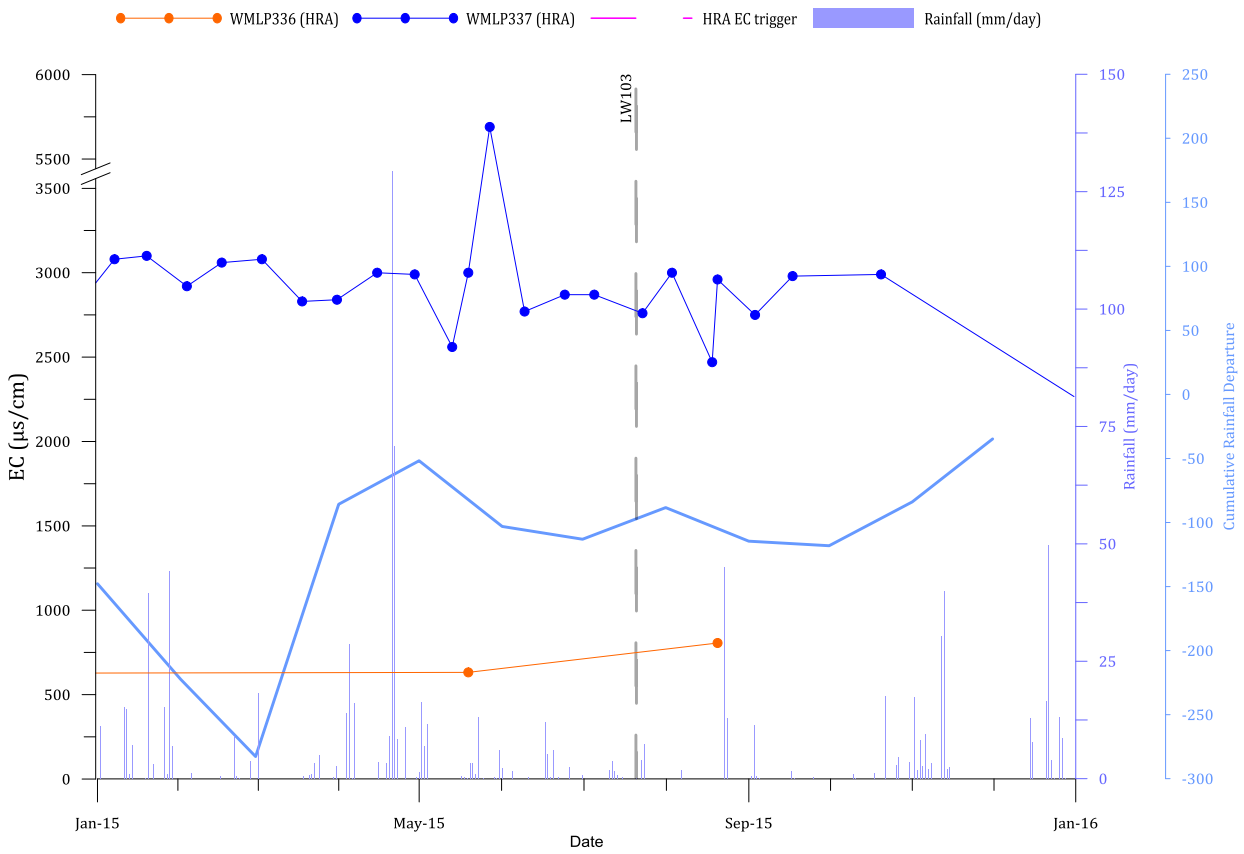


Figure 4-9 Group 3 bores - EC trends

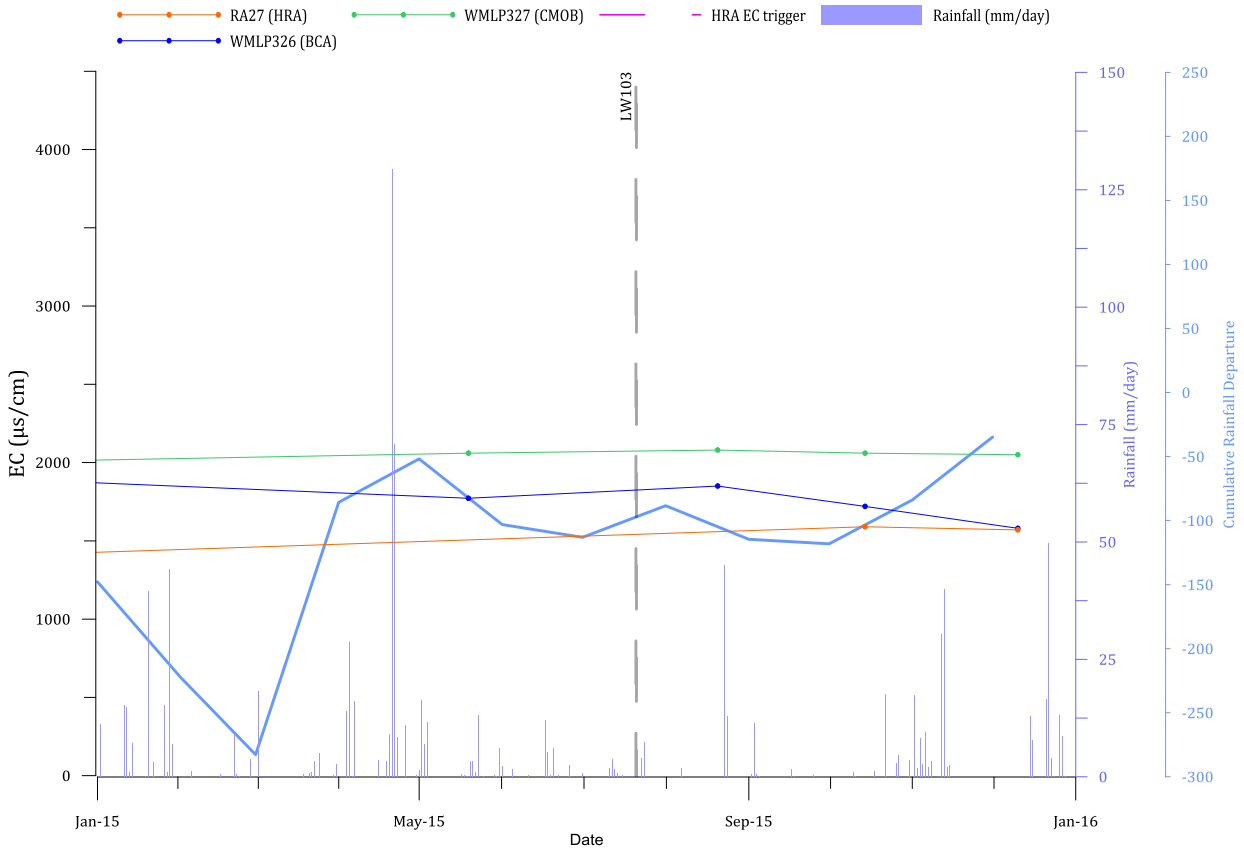


Figure 4-10 Group 4 bores - EC trends

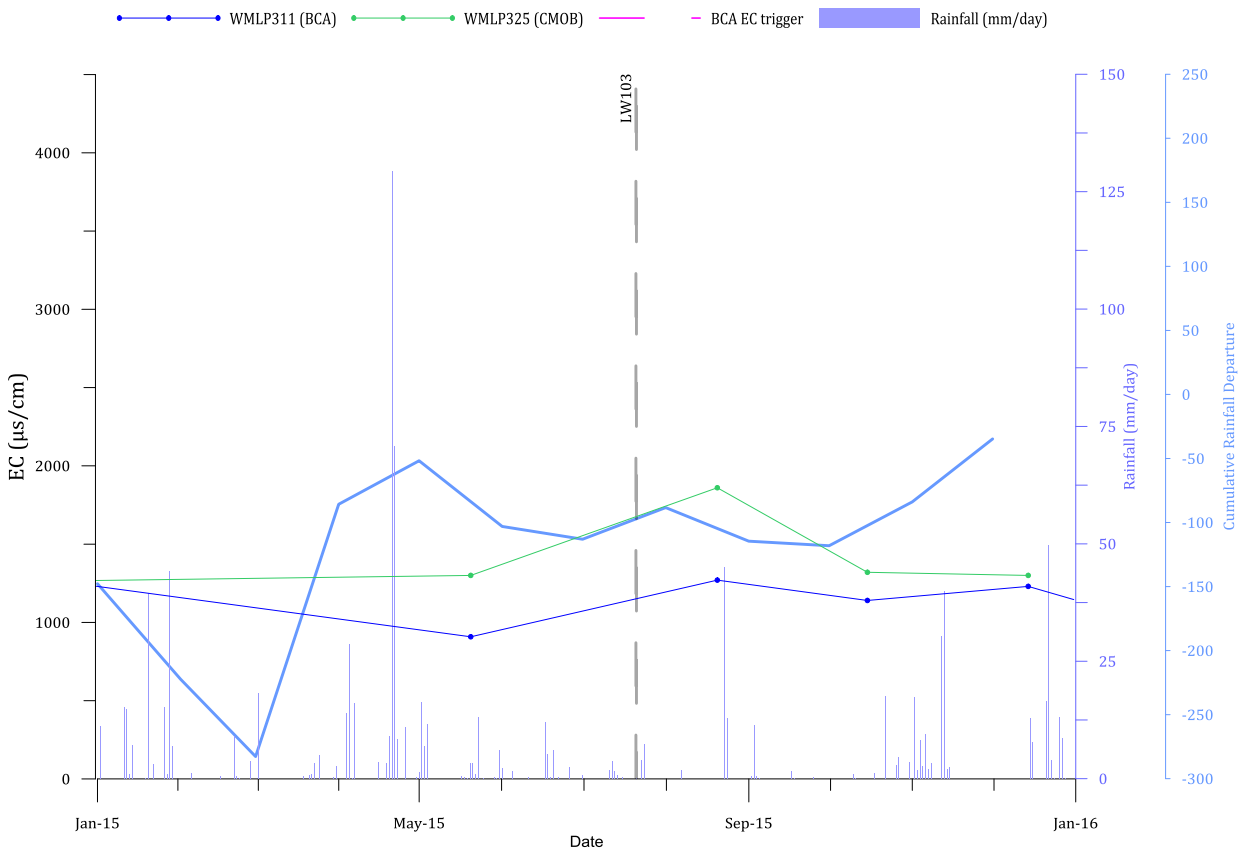


Figure 4-11 Group 5 bores - EC trends

4.2 Laboratory analysis

Selected monitoring bores are sampled annually for NATA accredited laboratory analysis. The site WMP highlights 43 bores for annual comprehensive analysis and these bores were sampled between August and October 2015. The list of analytes are summarised in Table 4-1.

Table 4-1 Summary of laboratory analytes

Analysis type	Parameter
Physical parameters	• pH • Electrical conductivity (EC) • Field temperature • Total dissolved solids (TDS) • Turbidity
Cations/Anions/Alkalinity	• Sodium • Magnesium • Potassium • Calcium • Fluoride • Chloride • Sulphate • Total alkalinity • Hardness/alkalinity as HCO^3
Nutrients	• Nitrate • Nitrite • Total nitrogen • Total phosphorous
Metals	• Copper • Lead • Zinc • Nickel • Iron • Manganese • Arsenic • Selenium • Cadmium • Chromium

The laboratory results were compared with the ANZECC Guidelines 2000 for recreational use, livestock and short term irrigation guideline values. The guideline value exceedances are summarised in Table 4-2 and the analysis results are attached in Appendix B.

Table 4-2 ANZECC guideline exceedance summary

Bore ID	Target	Fluoride	Iron - Filtered	Ammonia as N
ANZECC recreational			200	10
ANZECC irrigation			**20**	
ANZECC livestock		2	*5*	
WML112C	Bowman's Ck Alluvium		**11.2**	145
WML262	Upper Lower Liddell Seam	*2.8*		
WMLP336	Hunter River Alluvium		**32.1**	
WMLP338	Hunter River Alluvium		**17.4**	

The groundwater types (cation/anion ratios) are plotted as a piper plot in Figure 4-12.

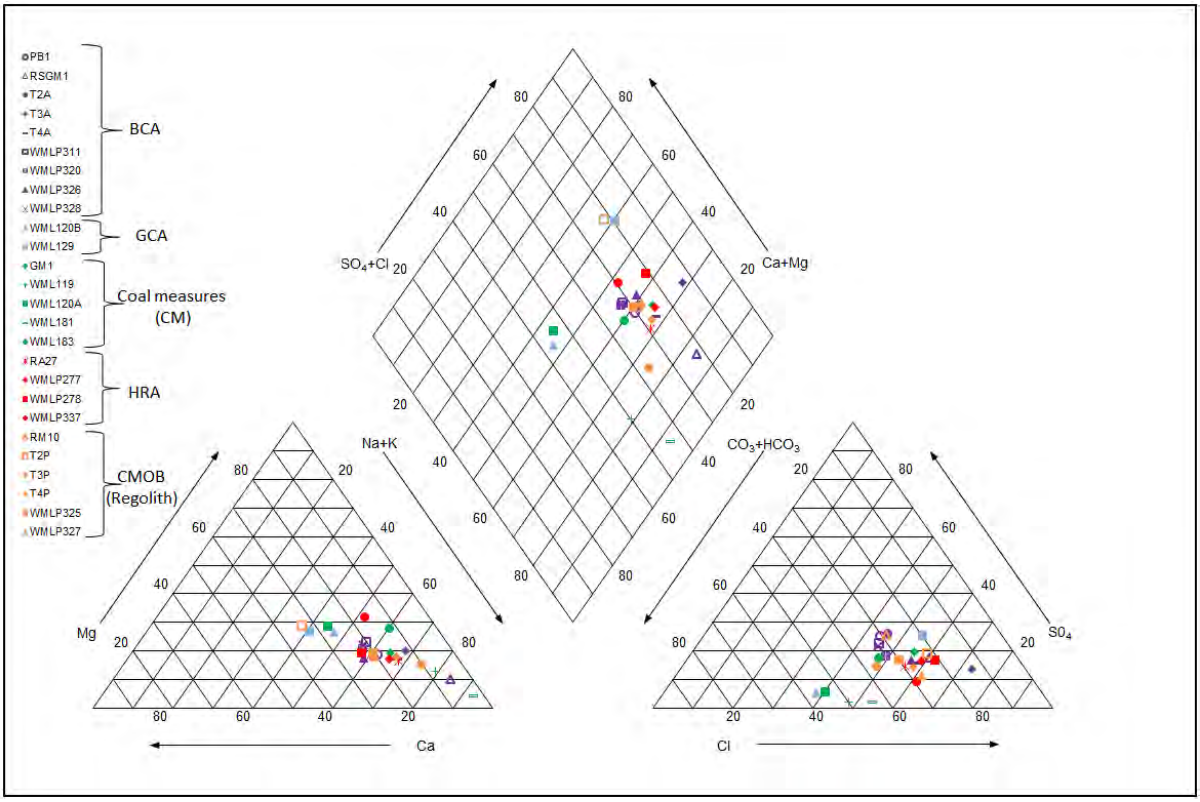


Figure 4-12 Piper plot - Year 2015

The groundwater quality observations can be summarised as follows:

- WML120A and WML120B are screened in the GCA and PG, respectively and have similar chemical composition but differ from the general results from the other monitoring bores. This indicates that, locally, the alluvium and PG are naturally hydraulically connected.
- The BCA bores and the regolith bores are located in the area; however, the groundwater composition is slightly different between the two series of bores. The regolith bores appear to be slightly more Na-Cl water type than the BCA bores. This shows that the BCA bores are recharged predominantly by rainfall and surface runoff, whereas the regolith bores are recharged also from underground sources.
- Overall, monitoring bores within HRA, BCA, CMOB (regolith) and two coal measures have similar water composition (Na-Cl water types) which indicate that there is some mixing of water between the alluvium and the other groundwater bearing units, with the exception of:
    - CMOB (regolith): T4P;
    - Coal Measure: RSGM1 (Bayswater seam beneath BCA), WML181 and WML119 both monitoring bores below the GCA, near the LW101; and
    - BCA: T3A.

These bores are likely not in direct connection with alluvium recharge sources (RSGM1, WML181 and WML119) or close to coal seam groundwater sources (T3A and T4P).

5 Groundwater levels

Groundwater levels in key monitoring bores in the BCA, GCA, HRA and fractured rock monitoring locations have been measured manually and using automated data loggers. In order to assess mining related impacts on groundwater levels within the Ashton area, hydrographs have been prepared using data from monitoring bores in discrete areas around the underground footprint. Each hydrograph presents data from alluvium bores, fractured rock bores and vibrating wire piezometers (VWP). As for the field parameters (EC and pH), five areas surrounding the underground footprint were selected (refer Figure 4-1). The water levels monitored were plotted against time and compared to CRD. The hydrograph are illustrated from Figure 5-1 to Figure 5-6.

Therefore, to compare the groundwater levels with the triggers defined in WMP, hydrographs per alluvium formation and the longwall specific groundwater monitoring program were prepared (from Figure 5-7 to Figure 5-10).

5.1 Group 1 monitoring locations

Group 1 comprises three monitoring bores screened in the Glennies Creek Alluvium, Pikes Gully and Arties seams. The water levels observations during 2015 are the following:

- Water levels within the Glennies Creek alluvium, Pikes Gully and Arties seams have similar fluctuations. As mentioned in the EC trends graph, the PG and GCA are highly connected at this location (East of the underground mine) with similar groundwater elevation.
- Water levels in WML120A and WML120B a near identical indicating a state of equilibrium between the alluvium and the PG seam.
- All of the monitoring bores plotted in the Group1 hydrograph vary after a high rainfall event (April 2015).
- No related mining impact has been observed in the Group 1 monitoring bores during 2015.

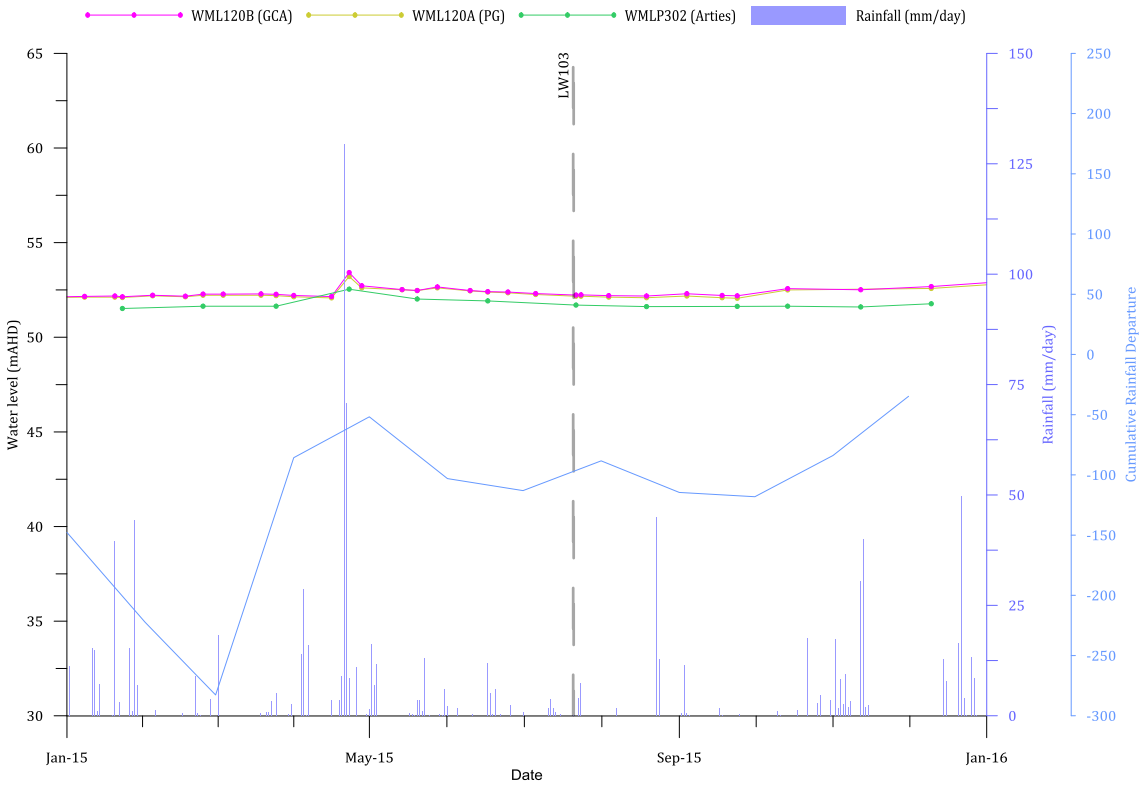


Figure 5-1 Hydrograph – Group 1 monitoring bores

5.2 Group 2 monitoring locations

There are four monitoring bores at this location, screened in the GCA, PG, Arties and ULD. The water levels observations during 2015 are the following:

- Water levels in GCA and Arties seams are generally constant during the year 2015. Some minor rainfall influence is visible.
- Water level in the ULD is constantly decreasing due to the dewatering in this coal seam. During 2015, the water elevation in this bore has decreased from 33.56 mAHD (8 Jan) to 32.32 mAHD (9 Dec).
- WML119 was seen to react to a significant rainfall event in April 2015 and has presented an elevated groundwater elevation between October and December 2015. This latter period coincides with an increase in groundwater EC. The most likely explanation of this increase in groundwater elevation and EC is a change in sampling procedure and contractor. This bore is subject to surface water infiltration (as can be noted from the very low historical EC measurement), as such the elevated groundwater level may also be a reflection of the infiltration from the surface.

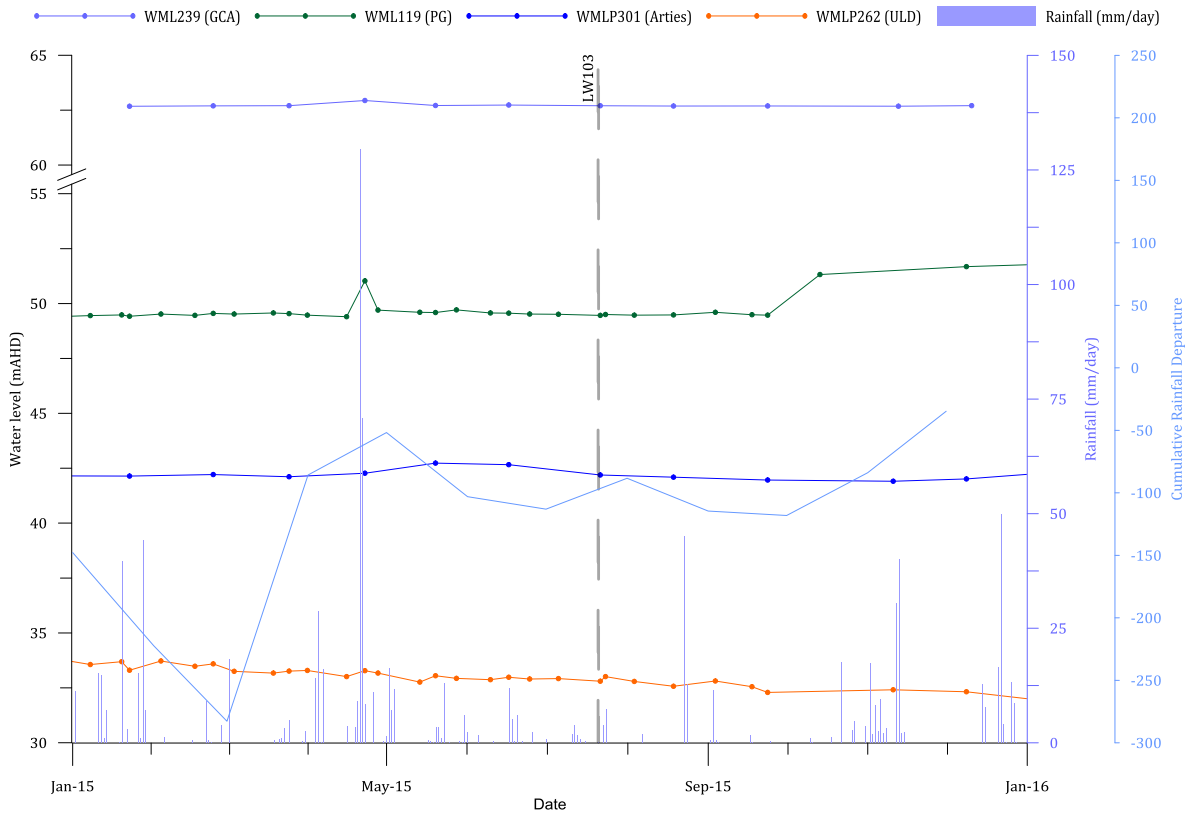


Figure 5-2 Hydrograph - Group 2 monitoring bores

5.3 Group 3 monitoring locations

The Group 3 monitoring locations include two VWP installations screened in Lemington, PG, Arties, ULD, Lower Liddell, Upper Barrett and lower Barrett seams and two monitoring bores in the HRA. Due to the number of water level represented, the hydrograph was divided in two series Figure 5-3 and Figure 5-4. The observations of the water levels during the year 2015 are the following:

- Groundwater levels in the HRA to Lemington 17 seam and Upper and Lower Barrett, are generally constant during the year and do not seem affected by the mine.
- Groundwater levels from the Lemington 19 seam to the Upper Liddell seam are constantly decreasing due to the dewatering in the ULD.
- The groundwater levels in the Lower Liddell seam are variable between the VWP WMLC334 and WMLC335. In the WMLC334, the water level appears to be affected by the dewatering, with similar elevation than the Upper Liddell seam, with high variation in February and mid-June. However, in the WMLC335, the groundwater level is not affected by the dewatering and the water elevation is above the Lemington seam, around 45 m AHD.
- There is no water variation related to rainfall in the fractured rock, however groundwater variation is observed in the HRA after the rainfall event in April 2015.

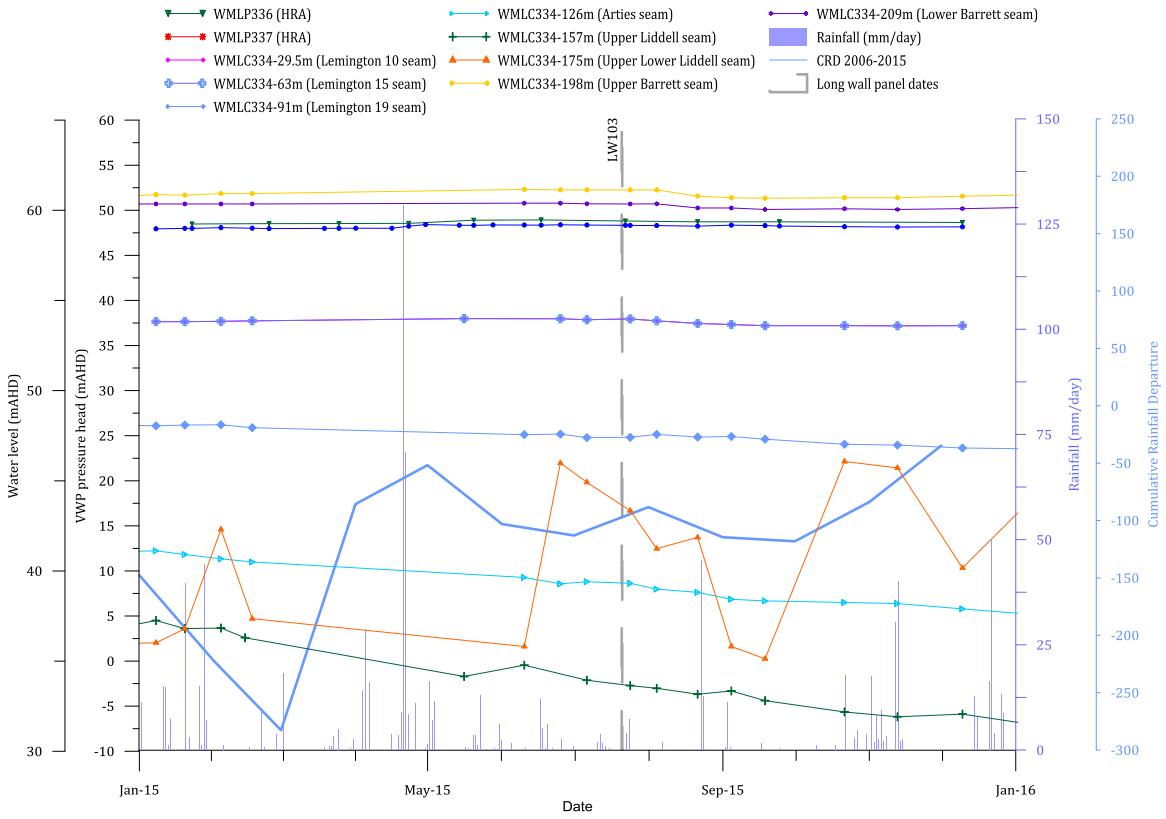


Figure 5-3 Hydrograph - Group 3-1 monitoring locations (VWP - WMLP334 and bores - WMLP336/WMLP337)

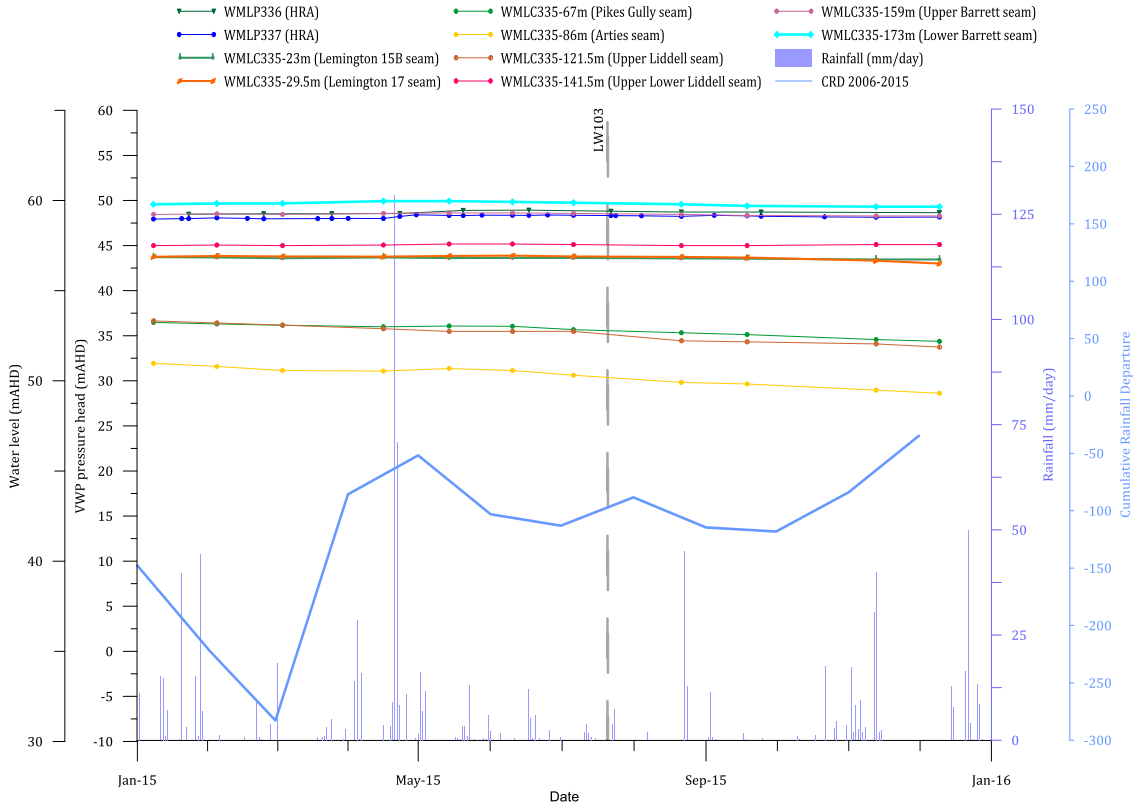


Figure 5-4 Hydrograph - Group 3-2 monitoring locations (VWP - WMLP335 and bores - WMLP336/WMLP337)

5.4 Group 4 monitoring locations

Group 4 comprises three monitoring bores screened in the alluvium and in the overburden. Additionally, one VWP was downloaded but stopped working in August 2015. The main observations during 2015 are the following:

- HRA, BCA and CMOB have similar water level fluctuation and elevation. The bores do not appear to be impacted by mining activity.
- The pore pressure head in Lemington 15 and 19 seam plies are impacted by mining in the ULD and the sensors have likely stopped working due to subsidence.
- The Arties seam sensor is damaged and is giving erroneous readings.
- No groundwater level variation related to rainfall is evident in any of the locations.

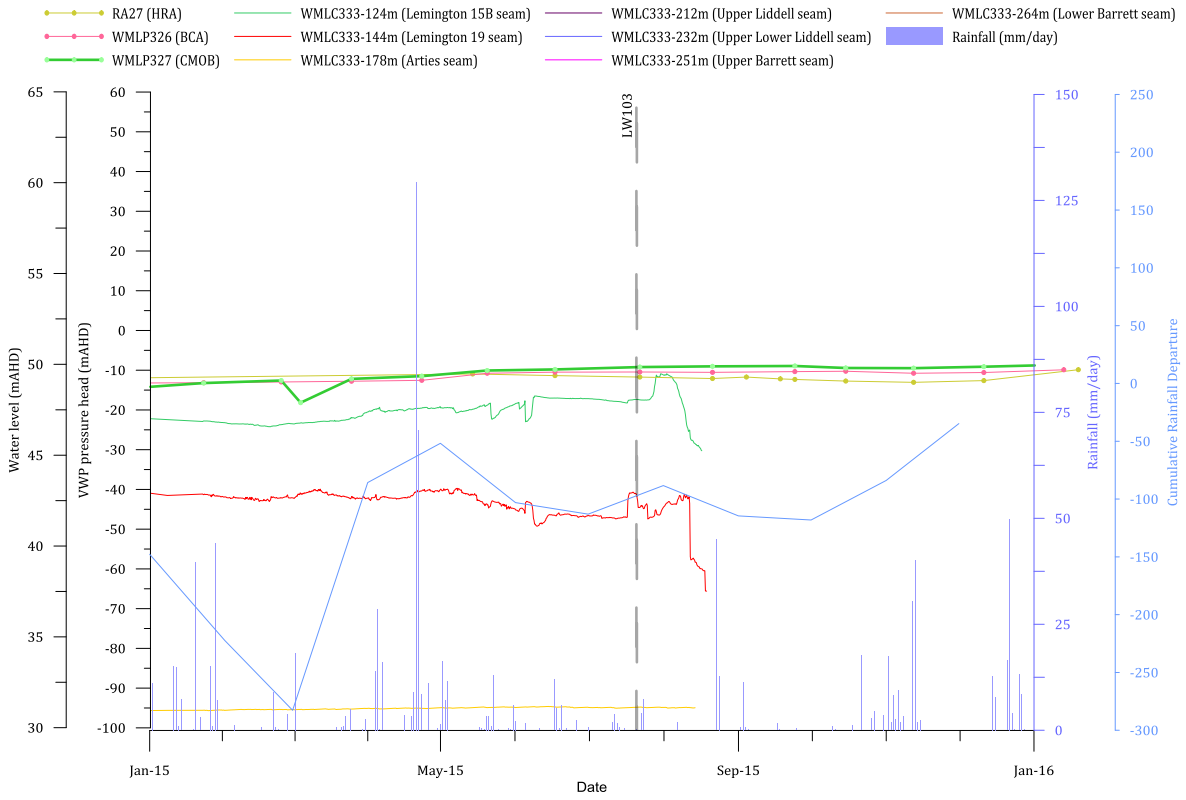


Figure 5-5 Hydrograph - Group 4 monitoring bores

5.5 Group 5 monitoring locations

Group 5 monitoring bores comprise three monitoring bores screened within the BCA (Ashton Well and WMLP311) and CMOB (WMLP325). The main observations are as follows:

- The three monitoring bores have similar water level fluctuations and do not appear to be impacted by mining activity.
- Groundwater levels in the three monitoring bores were markedly impacted by the rainfall event in April 2015. The groundwater levels have remained relatively constant since April 2015.

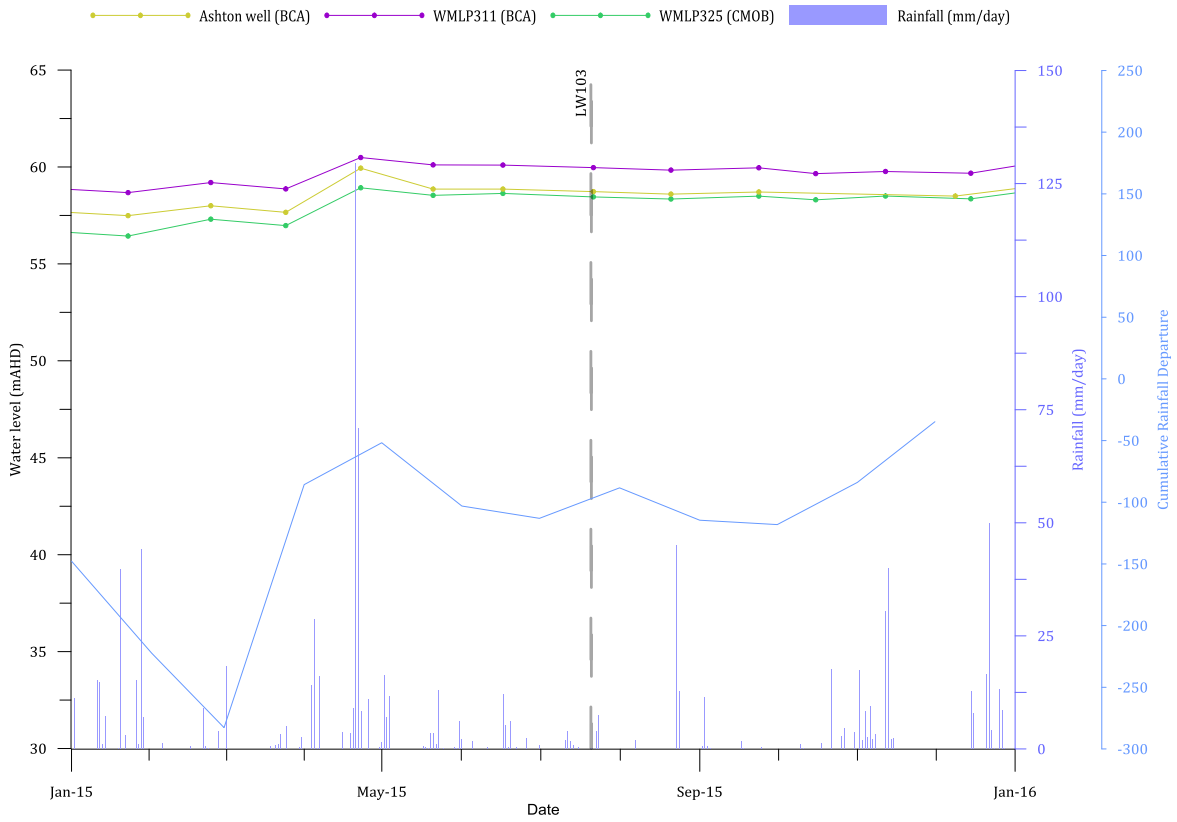


Figure 5-6 Hydrograph - Group 5 monitoring bores

5.6 Alluvial compliance bores

Groundwater levels in key monitoring bores have been measured both manually and using automated pressure transducers. The groundwater level trends and trigger levels for the BCA, GCA and HRA monitoring bores are presented graphically in Figure 5-7, Figure 5-8 and Figure 5-9, respectively. Longwall specific water level measurements are presented graphically in Figure 5-10. Daily rainfall measurements have also been plotted and used to compare water level trends.

Figure 5-7 presents the pressure transducer data as a continuous line and manual measurements for the same locations as points of the same colour.

Figure 5-8 and Figure 5-9 present manual measurements only, as no pressure transducers were deployed in these monitoring bores.

The following observations can be noted for January 2015:

- No exceedances have been noted that require the groundwater management protocol to be enacted.
- All BCA monitoring bore water levels increase throughout December and January. A marked response to rainfall events can be seen in all bores, most notably in early January. WMLP311 data shows two distinct spikes in groundwater level on 22 and 28 December; these are likely caused by localised, rainfall run-off.
- All GCA, HRA and longwall specific monitoring bore groundwater levels continued to rise throughout December and January and the likely cause is the above average rainfall in December and January.
- No mining related impact has been observed on the alluvial aquifers

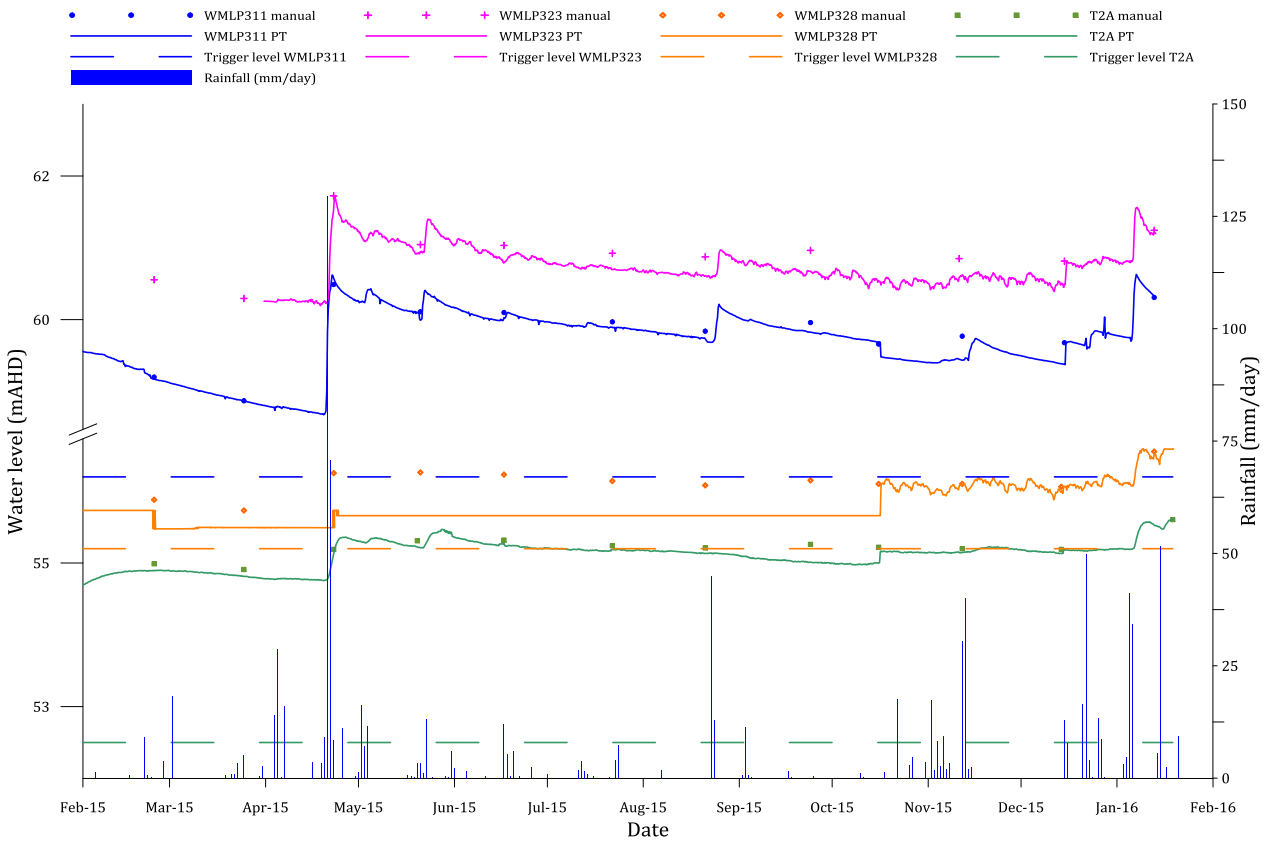


Figure 5-7 Bowmans Creek alluvium (BCA) hydrograph

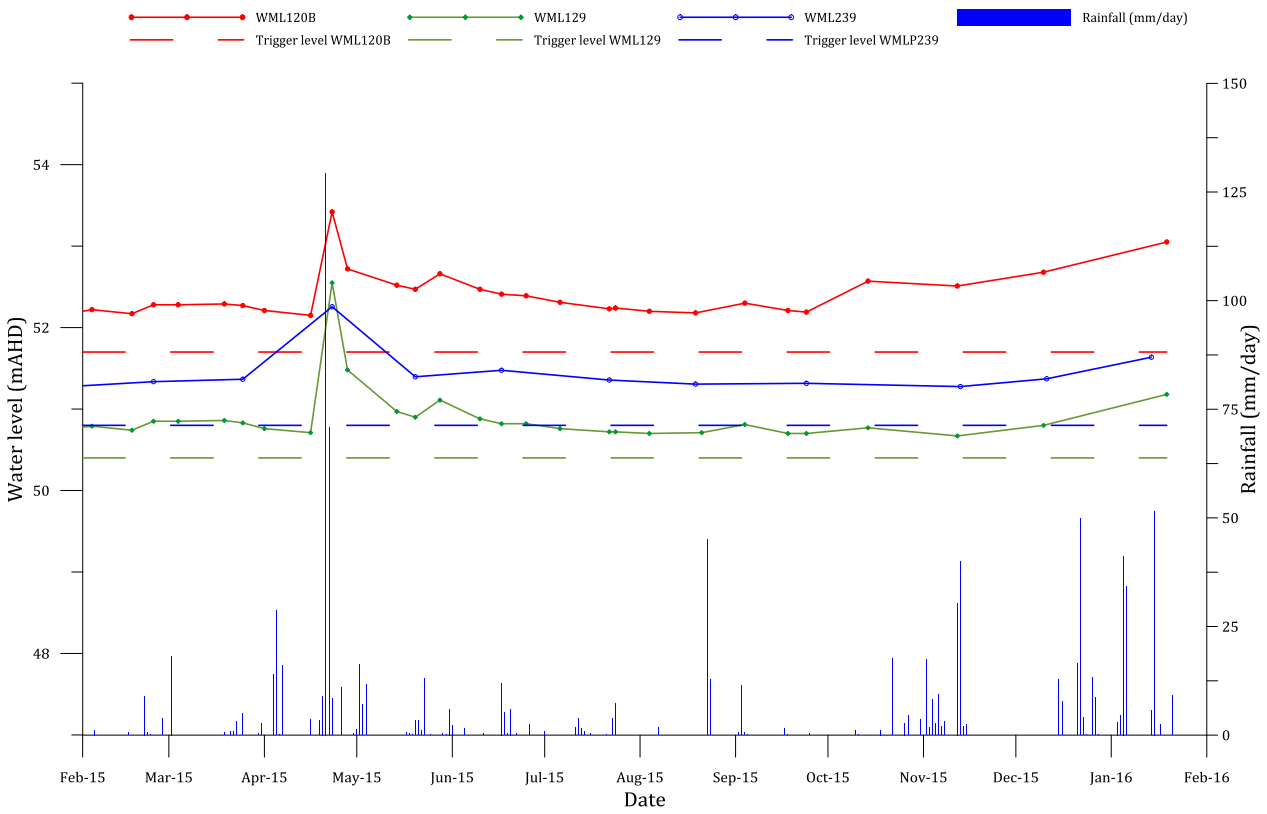


Figure 5-8 Glennies Creek alluvium (GCA) hydrograph

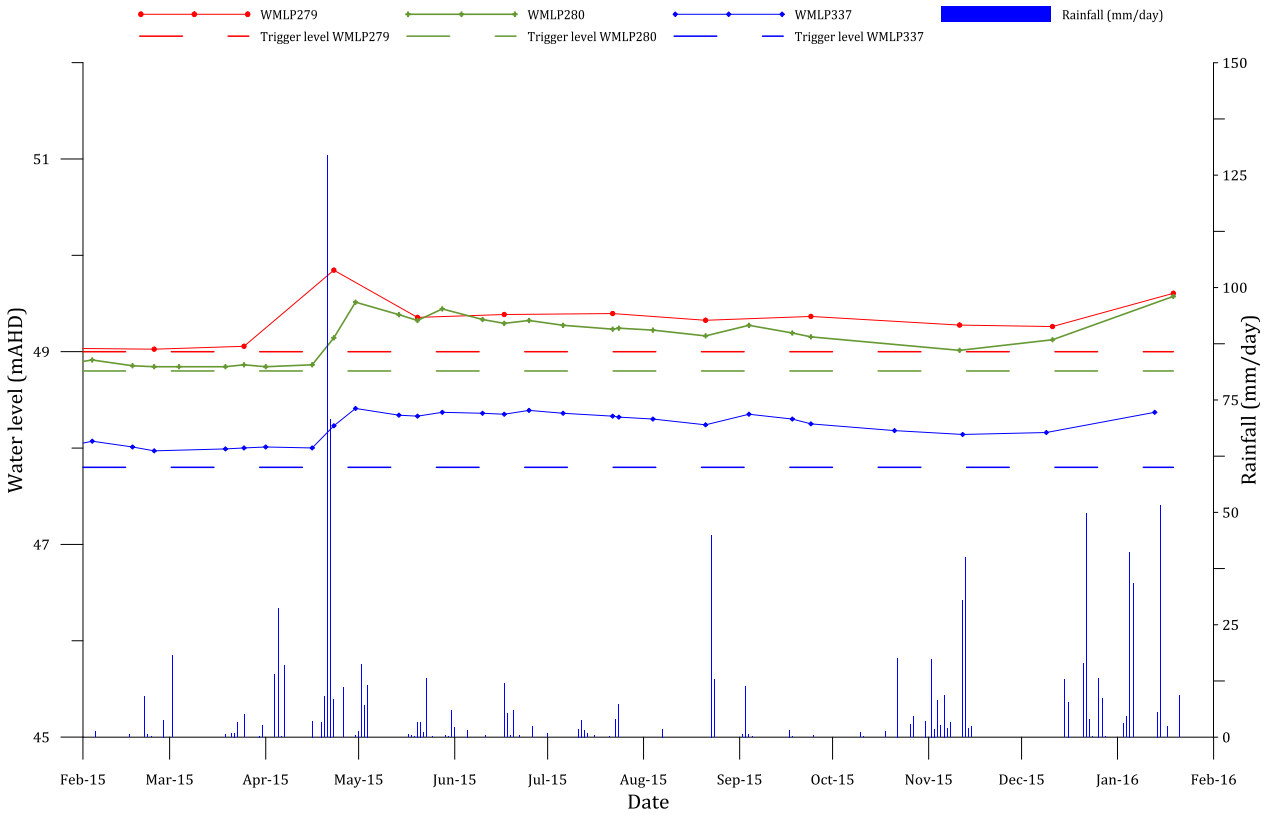


Figure 5-9 Hunter River alluvium (HRA) hydrograph

5.7 Longwall specific bores

Longwall-specific monitoring bores are used to assess any potential groundwater level response relative to the longwall panel extraction. LW103 and LW104 were mined in 2015. The groundwater levels of the longwall-specific monitoring bores are plotted in Figure 5-10.

The main observations are as follows:

- there are no obvious mining related impacts to groundwater levels; and
- the monitoring bores screened within the alluvium have water levels that are impacted by major rainfall events (eg April and December 2015).

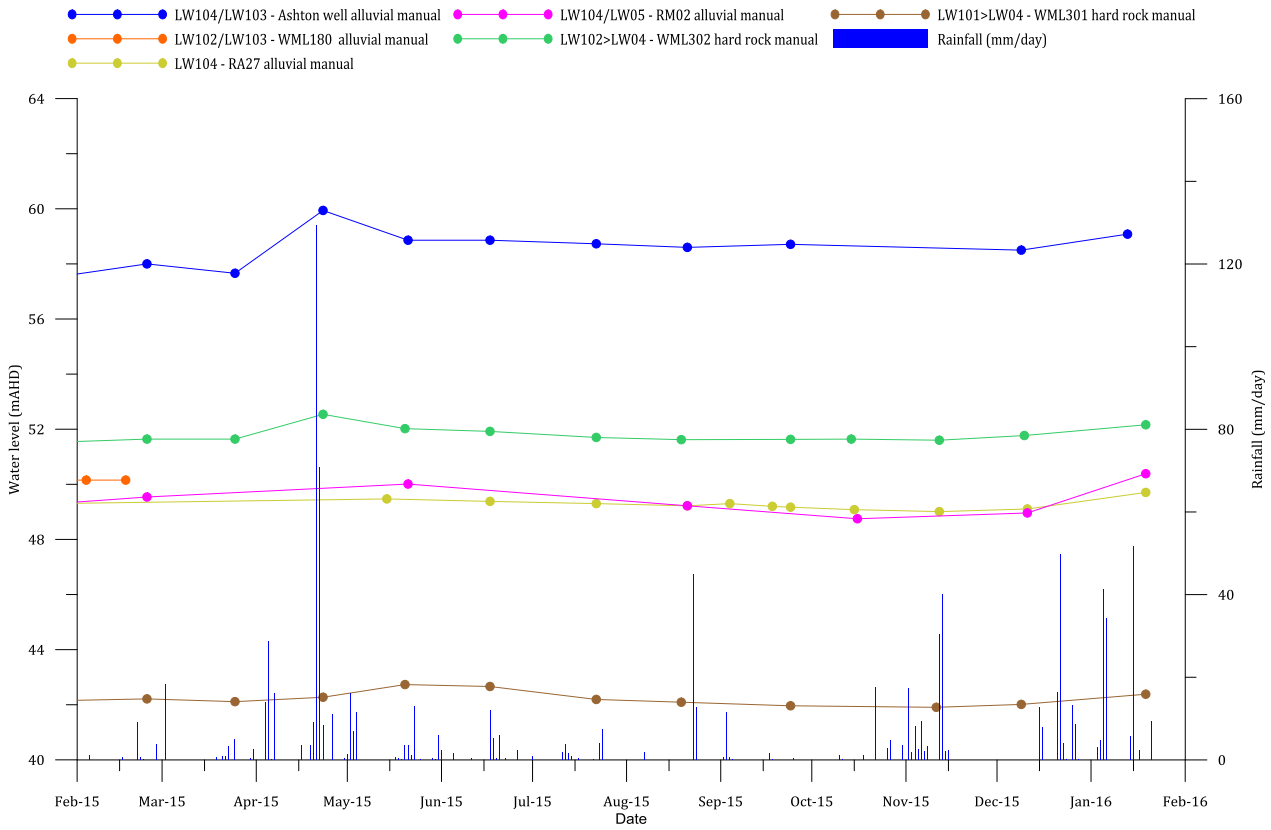


Figure 5-10 Longwall specific monitoring bore hydrographs (LW103-LW104)

6 Mine inflow

Ashton underground mine inflows are calculated through a review of dewatering abstraction volumes and a water balance assessment. The water balance assessment is the most appropriate tool to assess mine inflows as the volume of abstracted water comprises water from a number of sources, including but not limited to groundwater, surface water, incidental take and groundwater transitioning from the point of entry to the abstraction point. The transition time of this "stored" water is assumed to be in the order of years and therefore is not considered inflow that has occurred in 2015. It is considered that the stored water is largely from the groundwater sources (predominantly hardrock) rather than surface water. For the purposes of the water balance, the stored water volume has been deducted from hardrock groundwater take only.

Data utilised in the assessment includes:

- metered water volumes pumped to the mine from the various sources;
- metered water abstracted from the mine;
- partitioned water takes from the surface water sources and the separate groundwater sources; and
- estimate of stored water pumped from the mine.

These volumes are summarised in Table 6-1. In 2015, Ashton pumped a total of 632 ML of incidental water take, of this volume 356 ML are considered to have entered the mine from the groundwater source. This equates to an average groundwater inflow of 11.6 L/s, which is slightly below the modelled inflow of 13 L/sec.

Table 6-1 Breakdown of abstracted water volumes

Water source			Volume (ML)		
Total water abstracted from mine	Mine water input		176		808
	Abstracted groundwater (Total Incidental Water Take)	Estimated volume of abstracted "stored" water in goaf and old workings	**276**	**632**	
		Estimated groundwater inflow	**356**		

7 Conclusions

The key points of the annual groundwater monitoring review can be summarised as follows:

- No groundwater level within the alluvium was recorded below the triggers value.
- No exceedances of pH and EC trigger values were observed.
- Annual groundwater laboratory analysis results showed some minor exceedances of the ANZECC (2000) criteria for fluoride, dissolved iron and ammonia. These exceedances are not likely to be a result of mining related impacts.
- Direct rainfall recharge within the alluvium are observed on all the sites, the overburden on the north east and the PG and Arties seams west of the underground.
- High level of inferred hydraulic connection between the Glennies Creek alluvium and Pikes Gully seam on the eastern part of the underground mine, which does not translate as observed inflows into the underground mine.
- Groundwater conditions to the east of LW01 have recovered from the impacts of underground mining. The stabilisation of the groundwater pressures between the GCA and the PG seam indicates that the groundwater gradient has returned to a pre-mining state.
- Groundwater level variation related to mining from Lemington 19 to Upper Liddell seams on the south side of the underground working area.
- Groundwater level variation related to mining on the Upper Liddell seam on the whole area.
- Estimated groundwater inflows are slightly below the modelled inflow.

In conclusion, during the year 2015, there was no groundwater impact related to mining exceeding the predicted impacts from the Bowman's Creek Diversion Environmental Assessment (BCD EA). The BCD EA is key to the requirement of the DA Condition. The impact of the pumping and ground subsidence related to mining in the ULD extends to the Lemington seam plies in the south part of the mine.

8 References

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Ashton Coal, "*Water Management Plan, HSEC Management System-Plan*", Doc No. 3.4.1.8, November 2015

Australasian Groundwater and Environmental Consultants Pty Ltd, "*Groundwater Inflow Assessment and Monitoring Network Review*", Project No. G1738, June 2015

Australasian Groundwater and Environmental Consultants Pty Ltd, "*Ashton End of Panel Report _LW103",* Project No. G1738, October 2015

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RPS, "*Ashton Coal Groundwater Model update*", May 2014

Office of Water NSW, Real-time data, Rivers and Streams
http://realtimedata.water.nsw.gov.au/water.stm?ppbm=DAILY_REPORTS&dr&3&drkd_url

Appendix A Summary of Water Management Plan - Monitoring Locations

Client sample ID (Primary)	Sample Number. Note. All measurements in mg/L unless specified	Sample Date	pH Value (Lab) pH units	Electrical Conductivity @ 25°C (Lab) uS/cm	Total Dissolved Solids (TDS) at 180 C mg/L	Calcium	Magnesium	Sodium	Potassium	Chloride	Hydroxide Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as CaCO3	Total Alkalinity	Sulfate as SO4	Fluoride	Arsenic - Filtered	Cadmium - Filtered	Chromium - Filtered	Copper - Filtered	Lead - Filtered	Manganese - Filtered	Nickel - Filtered	Selenium - Filtered	Zinc - Filtered	Iron - Filtered	Nitrite as N	Nitrate as N	Nitrite + Nitrate as N	Total Phosphorus as P	Total Anions meq/L	Total Cations meq/L	Ionic Balance %	Total Cyanide	Turbidity (NTU)	Total Kjeldahl Nitrogen as N	Total Nitrogen as N
ANZECC irrigation (short term use) (mg/L)																	2	0.05	1	5	5	10	2	0.05	5	10											
ANZECC livestock (mg/L)				4000		1000									1000	2	0.5	0.01	1	1	0.1		1	0.02	20		30	1500									
WML120A	ES1533606001	14/10/2015	7.36	635	325.00	31	20	58	0.05	88	0.05	0.05	167	167	17	0.4	0.0005	0.00005	0.0005	0.0005	0.0005	0.578	0.0005	0.005	0.008	2.11	0.005	0.005	0.005	0.09	6.17	5.72	3.86	0.002	10.90	0.05	0.05
WML120B	ES1533606002	14/10/2015	7.33	614	282.00	31	19	63	0.05	79	0.05	0.05	166	166	16	0.4	0.0005	0.00005	0.0005	0.002	0.0005	0.002	0.0005	0.005	0.006	0.0025	0.005	0.05	0.05	0.04	5.88	5.85	0.25	0.002	1.00	0.05	0.05
WML183	ES1533606003	14/10/2015	7.58	4530	2520.00	110	157	633	9	805	0.05	0.05	824	824	407	0.5	0.0005	0.00005	0.0005	0.0005	0.0005	0.233	0.001	0.005	0.016	0.11	0.005	0.005	0.005	0.04	47.6	46.2	1.59	0.002	240.00	1.30	1.30
WML181	ES1533606004	14/10/2015	7.72	3980	2000.00	18	19	738	4	757	0.05	0.05	873	873	40	1.4	0.0005	0.00005	0.0005	0.0005	0.0005	0.028	0.0005	0.005	0.00025	0.05	0.005	0.005	0.005	0.09	39.6	34.7	6.72	0.002	107.00	1.80	1.80
WML119	ES1533606005	14/10/2015	7.52	2020	920.00	31	30	347	5	349	0.05	0.05	512	512	23	0.5	0.0005	0.00005	0.0005	0.0005	0.0005	0.068	0.0005	0.005	0.00025	0.07	0.005	0.005	0.005	0.19	20.6	19.2	3.34	0.002	34.30	1.90	1.90
WML129	ES1533606006	14/10/2015	7.10	1080	573.00	63	32	88	4	208	0.05	0.05	105	105	132	0.1	0.0005	0.00005	0.0005	0.0005	0.0005	0.34	0.003	0.005	0.02	0.53	0.005	0.04	0.04	0.04	10.7	9.71	4.92	0.002	66.20	0.40	0.40
RA27	ES1533719001	15/10/2015	7.13	1590	1160	43	28	220	0.05	297	0.05	0.05	220	220	108	0.4	0.0005	0.00005	0.0005	0.0005	0.0005	0.170	0.001	0.005	0.00025	0.0025	0.005	0.64	0.64	2.20	15.0	14.0	3.47	0.002	1240	1.4	2.0
WMLP277	ES1533719002	15/10/2015	6.98	1760	996	60	37	263	0.05	368	0.05	0.05	217	217	139	0.5	0.002	0.00005	0.0005	0.001	0.0005	0.254	0.002	0.005	0.013	0.59	0.005	0.37	0.37	0.11	17.6	17.5	0.39	0.002	5.1	0.05	0.4
WMLP278	ES1533719003	15/10/2015	6.91	1780	968	78	40	222	0.05	391	0.05	0.05	187	187	146	0.3	0.002	0.00005	0.0005	0.0005	0.0005	0.177	0.001	0.005	0.010	0.75	0.005	0.94	0.94	0.10	17.8	16.8	2.79	0.002	5.0	0.2	1.1
WMLP326	ES1533719004	15/10/2015	7.23	1720	906	78	36	224	2	350	0.05	0.05	236	236	143	0.4	0.009	0.00005	0.0005	0.003	0.0005	0.517	0.003	0.005	0.008	0.67	0.01	0.80	0.81	1.02	17.6	16.6	2.68	0.002	217	9.8	10.6
WMLP327	ES1533719005	15/10/2015	6.94	2060	1100	85	46	292	4	455	0.05	0.05	282	282	116	0.3	0.001	0.00005	0.0005	0.0005	0.0005	0.161	0.014	0.005	0.021	2.14	0.005	0.02	0.02	0.12	20.9	20.8	0.14	0.002	34.1	0.2	0.2
T4A	ES1533719006	15/10/2015	7.05	1780	888	50	35	257	0.05	365	0.05	0.05	229	229	136	0.6	0.0005	0.00005	0.0005	0.0005	0.0005	0.006	0.011	0.005	0.019	0.0025	0.005	0.61	0.61	0.09	17.7	16.6	3.37	0.002	30.3	0.1	0.7
T4P	ES1533719007	15/10/2015	7.43	2090	1140	61	44	308	3	433	0.05	0.05	290	290	146	0.5	0.0005	0.00005	0.0005	0.0005	0.0005	0.045	0.0005	0.005	0.00025	0.33	0.005	0.005	0.005	0.06	21.0	20.1	2.22	0.002	9.8	0.8	0.8
POND	ES1533719009	15/10/2015	8.41	285	206	17	10	19	16	19	0.05	0.05	96	96	0.05	0.5	0.002	0.00005	0.0005	0.004	0.0005	0.075	0.010	0.005	0.007	0.26	0.005	0.005	0.005	0.22	2.45	2.91	----	0.002	39.4	2.4	2.4
T3P	ES1533719010	15/10/2015	7.7	1650	796	34	31	283	3	280	0.05	0.05	299	299	115	0.6	0.0005	0.00005	0.020	0.0005	0.0005	0.020	0.002	0.005	0.00025	0.23	0.005	0.01	0.01	0.05	16.3	16.6	1.09	0.002	24.5	1.0	1.0
GM1	ES1533719011	15/10/2015	7.38	2160	1190	65	48	301	3	426	0.05	0.05	268	268	206	0.3	0.0005	0.00005	0.0005	0.0005	0.0005	0.416	0.0005	0.005	0.00025	0.0025	0.005	0.005	0.005	0.02	21.7	20.4	3.10	0.002	23.4	0.3	0.3
T3A	ES1533827001	16/10/2015	7.3	2180	1430	46	47	303	0.05	492	0.05	0.05	128	128	126	0.5	0.0005	0.00005	0.0005	0.0005	0.0005	0.124	0.006	0.005	0.026	0.0025	0.005	1.71	1.71	1.42	19.0	19.3	0.72	0.002	1610	2.2	3.9
RM10	ES1533827002	16/10/2015	7.54	1120	536	45	24	153	2	164	0.05	0.05	146	146	125	0.4	0.002	0.00005	0.0005	0.002	0.0005	0.072	0.0005	0.005	0.014	0.0025	0.005	0.44	0.44	0.11	10.1	10.9	3.69	0.002	57.7	0.9	1.3
T2A	ES1533827003	16/10/2015	7.51	1120	704	45	24	152	2	168	0.05	0.05	146	146	131	0.3	0.0005	0.00005	0.0005	0.0005	0.0005	0.002	0.0005	0.005	0.013	0.0025	0.005	0.44	0.44	0.13	10.4	10.9	2.34	0.002	149	0.3	0.7
T2P	ES1533827004	16/10/2015	7.13	1100	778	67	35	86	2	213	0.05	0.05	110	110	92	0.2	0.005	0.00005	0.0005	0.0005	0.0005	0.357	0.0005	0.005	0.019	3.91	0.005	0.04	0.04	0.01	10.1	10.0	0.52	0.002	4.4	0.05	0.05
WMLP320	ES1533827005	16/10/2015	7.36	1240	610	54	31	158	2	203	0.05	0.05	190	190	103	0.2	0.0005	0.00005	0.0005	0.0005	0.0005	0.007	0.0005	0.005	0.011	0.06	0.005	0.28	0.28	0.02	11.7	12.2	2.10	0.002	1.6	0.2	0.5
WMLP328	ES1533827006	16/10/2015	7.52	1050	530	45	28	135	2	156	0.05	0.05	158	158	101	0.2	0.0005	0.00005	0.0005	0.0005	0.0005	0.006	0.0005	0.005	0.010	0.0025	0.005	0.12	0.12	0.02	9.66	10.5	4.02	0.002	10.3	0.1	0.2
WMLP311	ES1533827007	16/10/2015	7.41	1140	686	45	31	144	2	171	0.05	0.05	170	170	116	0.3	0.0005	0.00005	0.0005	0.0005	0.0005	0.002	0.002	0.005	0.010	0.0025	0.005	0.24	0.24	0.04	10.6	11.1	2.18	0.002	5.4	0.2	0.4
WMLP325	ES1533827008	16/10/2015	7.63	1320	739	52	30	175	2	234	0.05	0.05	186	186	101	0.5	0.0005	0.00005	0.0005	0.0005	0.0005	0.331	0.0005	0.005	0.008	0.85	0.005	0.05	0.05	0.08	12.4	12.7	1.21	0.002	5.8	0.3	0.4
PB1	ES1533827009	16/10/2015	7.63	1130	660	43	25	155	2	163	0.05	0.05	157	157	125	0.3	0.0005	0.00005	0.0005	0.0005	0.0005	0.003	0.0005	0.005	0.008	0.0025	0.005	0.40	0.40	0.05	10.3	11.0	3.07	0.002	1.1	0.1	0.5
WMLP337	ES1534160001	21/10/2015	7.26	2990	1810	92	111	339	5	608	0.05	0.05	414	414	126	0.4	0.001	0.00005	0.0005	0.075	0.0005	0.412	0.006	0.005	0.019	0.08	0.01	0.43	0.44	1.18	28.0	28.6	0.96	0.002	5550	2.0	2.4
RSGM1	ES1534160002	21/10/2015	7.32	3670	2190	37	43	664	1	716	0.05	0.05	369	369	282	0.8	0.013	0.00005	0.0005	0.049	0.0005	0.013	0.008	0.02	0.016	0.0025	0.005	0.42	0.42	0.40	33.4	34.3	1.23	0.002	774	0.7	1.1

Appendix B **Summary of Groundwater Analysis**

Bore ID	Target	Sample Number	Sample Date	pH Value (field) pH units	pH Value (Lab) pH units	cumulative pH (retain excel formula)	Electrical Conductivity (field) uS/cm	Electrical Conductivity @ 25°C (Lab) uS/cm	cumulative EC uS/cm (retain excel formula)	Total Dissolved Solids (TDS) at 180 C mg/L	Total Suspended Solids (TSS) mg/L	Total Hardness as CaCO3 mg/L	Calcium	Magnesium	Sodium	Potassium	Chloride	Hydroxide Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as CaCO3	Total Alkalinity	Sulfate as SO4	Silica	Fluoride
ANZECC recreational										1 000 000		50 0000												
ANZECC irrigation																								
ANZECC livestock									*4000*				*1000*	*2000*								*1000*		*2*
GM1	Upper Lower Liddell Seam	H1521757	19/08/2015		7.2	7.2		2160	2160	1300	22	355	62	49	336	4.0	420			312	312	172		0.24
GM3A	Glennies Ck Alluvium			DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
GM3B	Coal Measures Overburden (regolith)			DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
RA10	Bowman's Ck Alluvium	H1521810	21/08/2015		6.8	6.8		1490	1490	874														
RA18	Bowman's Ck Alluvium	H1521811	21/08/2015		7.1	7.1		1080	1080	616														
RA27	Hunter River Alluvium	ES1533719001	15/10/2015	6.66	7.13	7.13	1550	1590	1590	1160			43	28	220	0.1	297	0.05	0.05	220	220	108		0.4
RM02	Coal Measures Overburden (regolith)	H1521759	21/08/2015		7	7		2130	2130	2590														
RM03	Bowman's Ck Alluvium			DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
RM10	Bowman's Ck Alluvium/Coal Measures Overburden (regolith)	ES1533827002	16/10/2015	6.79	7.54	7.54	1094	1120	1120	536			45	24	153	2.0	164	0.05	0.05	146	146	125		0.4
RSGM1	Bayswater Seam	ES1534160002	21/10/2015		7.32	7.32				2190			37	43	664	1.0	716	0.05	0.05	369	369	282		0.8
T2A	Bowman's Ck Alluvium	ES1533827003	16/10/2015	6.65	7.51	7.51	1103	1120	1120	704			45	24	152	2.0	168	0.05	0.05	146	146	131		0.3
T2P	Coal Measures Overburden (regolith)	ES1533827004	16/10/2015	6.44	7.13	7.13	1088	1100	1100	778			67	35	86	2.0	213	0.05	0.05	110	110	92		0.2
T3A	Bowman's Ck Alluvium	ES1533827001	16/10/2015	6.62	7.3	7.3	**2130**	**2180**	**2180**	1430			46	47	303	0.1	492	0.05	0.05	128	128	126		0.5
T3P	Coal Measures Overburden (regolith)	ES1533719010	15/10/2015	7.23	7.7	7.7	1526	1650	1650	796			34	31	283	3.0	280	0.05	0.05	299	299	115		0.6

Bore ID	Target	Sample Number	Sample Date	pH Value (field) pH units	pH Value (Lab) pH units	cumulative pH (retain excel formula)	Electrical Conductivity (field) uS/cm	Electrical Conductivity @ 25°C (Lab) uS/cm	cumulative EC uS/cm (retain excel formula)	Total Dissolved Solids (TDS) at 180 C mg/L	Total Suspended Solids (TSS) mg/L	Total Hardness as CaCO3 mg/L	Calcium	Magnesium	Sodium	Potassium	Chloride	Hydroxide Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as CaCO3	Total Alkalinity	Sulfate as SO4	Silica	Fluoride
T4A	Bowman's Ck Alluvium	ES1533719006	15/10/2015	6.74	7.05	7.05	1761	1780	1780	888			50	35	257	0.1	365	0.05	0.05	229	229	136		0.6
T4P	Coal Measures Overburden (regolith)	ES1533719007	15/10/2015	7.23	7.43	7.43	2114	2090	2090	1140			61	44	308	3.0	433	0.05	0.05	290	290	146		0.5
T4Pduplicate	Coal Measures Overburden (regolith)	ES1533719008	15/10/2015		7.44	7.44		2090	2090	1080			60	41	296	3.0	429	0.05	0.05	290	290	146		0.5
T5	Bowman's Ck Alluvium	H1521817	21/08/2015		7	7		795	795	449														
WML112C	Bowman's Ck Alluvium	H1521761	21/08/2015		8	8		**2410**	**2410**	722	56	109	5	24	223	33.5	244			880	880	2		0.1
WML119	Pike's Gully Seam	ES1533606005	14/10/2015	6.84	7.52	7.52	2085	2020	2020	920			31	30	347	5.0	349	0.05	0.05	512	512	23		0.5
WML120A	Pike's Gully Seam	ES1533606001	14/10/2015		7.36	7.36		635	635	325			31	20	58	0.1	88	0.05	0.05	167	167	17		0.4
WML120B	Glennies Ck Alluvium	ES1533606002	14/10/2015		7.33	7.33		614	614	282			31	19	63	0.1	79	0.05	0.05	166	166	16		0.4
WML129	Glennies Ck Alluvium	ES1533606006	14/10/2015		7.10	7.1		1080	1080	573			63	32	88	4.0	208	0.05	0.05	105	105	132		0.1
WML181	Pike's Gully Seam	ES1533606004	14/10/2015	7.08	7.72	7.72	3914	3980	3980	2000			18	19	738	4.0	757	0.05	0.05	873	873	40		1.4
WML183	Pike's Gully Seam	ES1533606003	14/10/2015	6.75	7.58	7.58	4383	4530	4530	2520			110	157	633	9.0	805	0.05	0.05	824	824	407		0.5
WML239	Glennies Ck Alluvium	H1521771	19/08/2015		6.9	6.9		746	746	426	72	179	41	19	76	1.6	132			166	166	22		0.26
WML261	Upper Lower Liddell Seam	H1521779	19/08/2015		6.9	6.9		1300	1300	678	14	216	31	34	194	2.6	248			260	260	41		0.32
WML262	Upper Lower Liddell Seam	H1521780	19/08/2015		8	8		*7540*	7540	3820	12	37	7	5	1620	7.8	2010			930	930	<2		*2.8*
WMLP277	Hunter River Alluvium	ES1533719002	15/10/2015	6.66	6.98	6.98	1757	1760	1760	996			60	37	263	0.1	368	0.05	0.05	217	217	139		0.5
WMLP278	Hunter River Alluvium	ES1533719003	15/10/2015	6.66	6.91	6.91	1766	1780	1780	968			78	40	222	0.1	391	0.05	0.05	187	187	146		0.3
WMLP279	Hunter River Alluvium	H1521783	21/08/2015		7	7		937	937	521	164	248	51	29	94	2.4	166			210	210	29		0.18
WMLP280	Hunter River Alluvium	H1521784	21/08/2015		7.1	7.1		1900	1900	1030	104	378	74	47	260	1.8	392			270	270	113		0.32
WMLP301	Arties Seam	H1521785	19/08/2015		8.4	8.4		*6210*	*6210*	3270	92	53	7	9	1410	6.6	1420			1220	1220	11		1.4

Bore ID	Target	Sample Number	Sample Date	pH Value (field) pH units	pH Value (Lab) pH units	cumulative pH (retain excel formula)	Electrical Conductivity (field) uS/cm	Electrical Conductivity @ 25°C (Lab) uS/cm	cumulative EC uS/cm (retain excel formula)	Total Dissolved Solids (TDS) at 180 C mg/L	Total Suspended Solids (TSS) mg/L	Total Hardness as CaCO3 mg/L	Calcium	Magnesium	Sodium	Potassium	Chloride	Hydroxide Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as CaCO3	Total Alkalinity	Sulfate as SO4	Silica	Fluoride
WMLP302	Arties Seam	H1521786	19/08/2015		6.7	6.7		1080	1080	634	14	197	26	32	152	3.0	194			250	250	34		0.27
WMLP311	Bowman's Ck Alluvium	ES1533827007	16/10/2015		7.41	7.41		1140	1140	686			45	31	144	2.0	171	0.05	0.05	170	170	116		0.3
WMLP323	Bowman's Ck Alluvium	H1521789	21/08/2015		7.4	7.4		1140	1140	553														
WMLP324	Coal Measures Overburden (regolith)	H1521790	21/08/2015		7.2	7.2		1330	1330	635														
WMLP325	Coal Measures Overburden (regolith)	ES1533827008	16/10/2015		7.63	7.63		1320	1320	739			52	30	175	2.0	234	0.05	0.05	186	186	101		0.5
WMLP326	Bowman's Ck Alluvium	ES1533719004	15/10/2015		7.23	7.23		1720	1720	906			78	36	224	2.0	350	0.05	0.05	236	236	143		0.4
WMLP327	Coal Measures Overburden (regolith)	ES1533719005	15/10/2015	6.61	6.94	6.94	2062	2060	2060	1100			85	46	292	4.0	455	0.05	0.05	282	282	116		0.3
WMLP328	Bowman's Ck Alluvium	ES1533827006	16/10/2015	6.72	7.52	7.52	1038	1050	1050	530			45	28	135	2.0	156	0.05	0.05	158	158	101		0.2
WMLP336	Hunter River Alluvium	H1521795	21/08/2015		7.2	7.2		806	806	431	560	240	53	26	74	3.2	108			210	210	41		0.18
WMLP337	Hunter River Alluvium	ES1534160001	21/10/2015		7.26	7.26		2990	2990	1810			92	111	339	5.0	608	0.05	0.05	414	414	126		0.4
WMLP338	Hunter River Alluvium	H1521797	21/08/2015		6.8	6.8		1590	1590	889	164	389	70	52	197	1.9	290			330	330	66		0.52

Bore ID	Target	Sample Number	Sample Date	Aluminum	Arsenic - Filtered	Barium - Filtered	Boron - Filtered	Cadmium - Filtered	Chromium - Filtered	Copper - Filtered	Lead - Filtered	Manganese - Filtered	Nickel - Filtered	Selenium - Filtered	Zinc - Filtered	Iron - Filtered	Mercury - Filtered	Ammonia as N	Nitrite as N	Nitrate as N	Nitrite + Nitrate as N	Total Phosphorus as P
ANZECC recreational				200		1000	1000	5	50	1000	50	100	100	10	5000	300	1	10	1000	10000		
ANZECC irrigation				**20**	**2**		_	**0.05**	**1**	**5**	**5**	**10**	**2**	**0.05**	**5**	**10**	**0.002**					
ANZECC livestock				*5*	*0.5*		*5*	*0.01*	*1*	*1 **	*0.1*	*-*	*1*	*0.02*	*20*	*-*	*0.002*		*30*	*1500*		
GM1	Upper Lower Liddell Seam	H1521757	19/08/2015	0.088	0.0012			<0.0002	0.0003	0.0005	0.0003	0.507	0.0006	<0.0002	0.004	1.2	<0.0005	0.12	0.07	0.24	0.31	0.06
GM3A	Glennies Ck Alluvium			DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
GM3B	Coal Measures Overburden (regolith)			DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
RA10	Bowman's Ck Alluvium	H1521810	21/08/2015																			
RA18	Bowman's Ck Alluvium	H1521811	21/08/2015																			
RA27	Hunter River Alluvium	ES1533719001	15/10/2015		0.0005			0.00005	0.0005	0.0005	0.0005	0.17	0.001	0.005	0.0003	0.003			0.005	0.64	0.64	2.2
RM02	Coal Measures Overburden (regolith)	H1521759	21/08/2015																			
RM03	Bowman's Ck Alluvium			DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
RM10	Bowman's Ck Alluvium/Coal Measures Overburden (regolith)	ES1533827002	16/10/2015		0.002			0.00005	0.0005	0.002	0.0005	0.072	0.0005	0.005	0.014	0.003			0.005	0.44	0.44	0.11
RSGM1	Bayswater Seam	ES1534160002	21/10/2015		0.013			0.00005	0.0005	0.049	0.0005	0.013	0.008	0.02	0.016	0.003			0.005	0.42	0.42	0.4
T2A	Bowman's Ck Alluvium	ES1533827003	16/10/2015		0.0005			0.00005	0.0005	0.0005	0.0005	0.002	0.0005	0.005	0.013	0.003			0.005	0.44	0.44	0.13
T2P	Coal Measures Overburden (regolith)	ES1533827004	16/10/2015		0.005			0.00005	0.0005	0.0005	0.0005	0.357	0.0005	0.005	0.019	3.91			0.005	0.04	0.04	0.01
T3A	Bowman's Ck Alluvium	ES1533827001	16/10/2015		0.0005			0.00005	0.0005	0.0005	0.0005	0.124	0.006	0.005	0.026	0.003			0.005	1.71	1.71	1.42
T3P	Coal Measures Overburden (regolith)	ES1533719010	15/10/2015		0.0005			0.00005	0.02	0.0005	0.0005	0.02	0.002	0.005	0.0003	0.23			0.005	0.01	0.01	0.05
T4A	Bowman's Ck Alluvium	ES1533719006	15/10/2015		0.0005			0.00005	0.0005	0.0005	0.0005	0.006	0.011	0.005	0.019	0.003			0.005	0.61	0.61	0.09

Bore ID	Target	Sample Number	Sample Date	Aluminum	Arsenic - Filtered	Barium - Filtered	Boron - Filtered	Cadmium - Filtered	Chromium - Filtered	Copper - Filtered	Lead - Filtered	Manganese - Filtered	Nickel - Filtered	Selenium - Filtered	Zinc - Filtered	Iron - Filtered	Mercury - Filtered	Ammonia as N	Nitrite as N	Nitrate as N	Nitrite + Nitrate as N	Total Phosphorus as P
T4P	Coal Measures Overburden (regolith)	ES1533719007	15/10/2015		0.0005			0.00005	0.0005	0.0005	0.0005	0.045	0.0005	0.005	0.0003	0.33			0.005	0.005	0.005	0.06
T4Pduplicate	Coal Measures Overburden (regolith)	ES1533719008	15/10/2015		0.0005			0.00005	0.0005	0.0005	0.0005	0.05	0.0005	0.005	0.0003	0.3			0.005	0.005	0.005	0.05
T5	Bowman's Ck Alluvium	H1521817	21/08/2015																			
WML112C	Bowman's Ck Alluvium	H1521761	21/08/2015	0.047	0.0004			<0.0002	<0.0002	0.005	<0.0002	0.034	0.0048	<0.0002	0.011	11.2	<0.0005	145	<0.03	0.14	0.14	0.69
WML119	Pike's Gully Seam	ES1533606005	14/10/2015		0.0005			0.00005	0.0005	0.0005	0.0005	0.068	0.0005	0.005	0.0003	0.07			0.005	0.005	0.005	0.19
WML120A	Pike's Gully Seam	ES1533606001	14/10/2015		0.0005			0.00005	0.0005	0.0005	0.0005	0.578	0.0005	0.005	0.008	2.11			0.005	0.005	0.005	0.09
WML120B	Glennies Ck Alluvium	ES1533606002	14/10/2015		0.0005			0.00005	0.0005	0.002	0.0005	0.002	0.0005	0.005	0.006	0.003			0.005	0.05	0.05	0.04
WML129	Glennies Ck Alluvium	ES1533606006	14/10/2015		0.0005			0.00005	0.0005	0.0005	0.0005	0.34	0.003	0.005	0.02	0.53			0.005	0.04	0.04	0.04
WML181	Pike's Gully Seam	ES1533606004	14/10/2015		0.0005			0.00005	0.0005	0.0005	0.0005	0.028	0.0005	0.005	0.0003	0.05			0.005	0.005	0.005	0.09
WML183	Pike's Gully Seam	ES1533606003	14/10/2015		0.0005			0.00005	0.0005	0.0005	0.0005	0.233	0.001	0.005	0.016	0.11			0.005	0.005	0.005	0.04
WML239	Glennies Ck Alluvium	H1521771	19/08/2015	0.263	0.0004			<0.0002	0.0008	0.0013	0.0008	0.0346	0.0009	<0.0002	0.02	0.52	<0.0005	<0.05	<0.03	0.26	0.26	0.09
WML261	Upper Lower Liddell Seam	H1521779	19/08/2015	0.147	0.001			<0.0002	0.0002	0.0006	0.0008	0.172	0.0008	<0.0002	0.032	0.96	<0.0005	<0.05	0.03	0.1	0.13	0.06
WML262	Upper Lower Liddell Seam	H1521780	19/08/2015	0.256	0.0036			<0.0002	0.0004	0.0009	0.0017	0.0911	0.0009	<0.0002	0.019	1.2	<0.0005	0.54	<0.03	<0.05	<0.05	0.4
WMLP277	Hunter River Alluvium	ES1533719002	15/10/2015		0.002			0.00005	0.0005	0.001	0.0005	0.254	0.002	0.005	0.013	0.59			0.005	0.37	0.37	0.11
WMLP278	Hunter River Alluvium	ES1533719003	15/10/2015		0.002			0.00005	0.0005	0.0005	0.0005	0.177	0.001	0.005	0.01	0.75			0.005	0.94	0.94	0.1
WMLP279	Hunter River Alluvium	H1521783	21/08/2015	2.02	0.001			<0.0002	0.0029	0.0029	0.0014	0.296	0.003	<0.0002	0.014	4.9	<0.0005	<0.05	<0.03	0.11	0.11	0.22
WMLP280	Hunter River Alluvium	H1521784	21/08/2015	0.506	0.0009			<0.0002	0.0008	0.0034	0.0004	1.03	0.0017	0.0004	0.008	3.7	<0.0005	<0.05	<0.03	0.05	0.05	0.21
WMLP301	Arties Seam	H1521785	19/08/2015	0.19	0.0021			<0.0002	0.0004	0.0006	0.001	0.058	0.0005	<0.0002	0.01	0.57	<0.0005	0.73	<0.03	<0.05	<0.05	0.27
WMLP302	Arties Seam	H1521786	19/08/2015	0.198	0.0019			<0.0002	0.0007	0.0106	0.0013	0.0429	0.0007	<0.0002	0.033	3.8	<0.0005	0.53	<0.03	0.08	0.08	0.27
WMLP311	Bowman's Ck Alluvium	ES1533827007	16/10/2015		0.0005			0.00005	0.0005	0.0005	0.0005	0.002	0.002	0.005	0.01	0.003			0.005	0.24	0.24	0.04
WMLP323	Bowman's Ck Alluvium	H1521789	21/08/2015																			

Bore ID	Target	Sample Number	Sample Date	Aluminum	Arsenic - Filtered	Barium - Filtered	Boron - Filtered	Cadmium - Filtered	Chromium - Filtered	Copper - Filtered	Lead - Filtered	Manganese - Filtered	Nickel - Filtered	Selenium - Filtered	Zinc - Filtered	Iron - Filtered	Mercury - Filtered	Ammonia as N	Nitrite as N	Nitrate as N	Nitrite + Nitrate as N	Total Phosphorus as P
WMLP324	Coal Measures Overburden (regolith)	H1521790	21/08/2015																			
WMLP325	Coal Measures Overburden (regolith)	ES1533827008	16/10/2015		0.0005			0.00005	0.0005	0.0005	0.0005	0.331	0.0005	0.005	0.008	0.85			0.005	0.05	0.05	0.08
WMLP326	Bowman's Ck Alluvium	ES1533719004	15/10/2015		0.009			0.00005	0.0005	0.003	0.0005	0.517	0.003	0.005	0.008	0.67			0.01	0.8	0.81	1.02
WMLP327	Coal Measures Overburden (regolith)	ES1533719005	15/10/2015		0.001			0.00005	0.0005	0.0005	0.0005	0.161	0.014	0.005	0.021	2.14			0.005	0.02	0.02	0.12
WMLP328	Bowman's Ck Alluvium	ES1533827006	16/10/2015		0.0005			0.00005	0.0005	0.0005	0.0005	0.006	0.0005	0.005	0.01	0.003			0.005	0.12	0.12	0.02
WMLP336	Hunter River Alluvium	H1521795	21/08/2015	***20.4***	0.0062			<0.0002	0.0192	0.0288	0.0108	0.848	0.024	0.0018	0.175	**32.1**	<0.0005	<0.05	<0.03	6.5	6.5	1.2
WMLP337	Hunter River Alluvium	ES1534160001	21/10/2015		0.001			0.00005	0.0005	0.075	0.0005	0.412	0.006	0.005	0.019	0.08			0.01	0.43	0.44	1.18
WMLP338	Hunter River Alluvium	H1521797	21/08/2015	2.18	0.0105			<0.0002	0.0045	0.0036	0.0094	1.52	0.0048	0.0004	0.028	**17.4**	<0.0005	0.06	<0.03	0.24	0.24	0.47

Bore ID	Target	Sample Number	Sample Date	Total Anions meq/L	Total Cations meq/L	Ionic Balance %	Oil and Grease	Total Cyanide	Turbidity (NTU)	Total Kjeldahl Nitrogen as N	Total Nitrogen as N
ANZECC recreational								100			
ANZECC irrigation											
ANZECC livestock											
GM1	Upper Lower Liddell Seam	H1521757	19/08/2015					<0.004	18		
GM3A	Glennies Ck Alluvium			DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
GM3B	Coal Measures Overburden (regolith)			DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
RA10	Bowman's Ck Alluvium	H1521810	21/08/2015								
RA18	Bowman's Ck Alluvium	H1521811	21/08/2015								
RA27	Hunter River Alluvium	ES1533719001	15/10/2015	15	14	3.47		0.002	1240	1.4	2
RM02	Coal Measures Overburden (regolith)	H1521759	21/08/2015								
RM03	Bowman's Ck Alluvium			DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
RM10	Bowman's Ck Alluvium/Coal Measures Overburden (regolith)	ES1533827002	16/10/2015	10.1	10.9	3.69		0.002	57.7	0.9	1.3
RSGM1	Bayswater Seam	ES1534160002	21/10/2015	33.4	34.3	1.23		0.002	774	0.7	1.1
T2A	Bowman's Ck Alluvium	ES1533827003	16/10/2015	10.4	10.9	2.34		0.002	149	0.3	0.7
T2P	Coal Measures Overburden (regolith)	ES1533827004	16/10/2015	10.1	10	0.52		0.002	4.4	0.05	0.05
T3A	Bowman's Ck Alluvium	ES1533827001	16/10/2015	19	19.3	0.72		0.002	1610	2.2	3.9
T3P	Coal Measures Overburden (regolith)	ES1533719010	15/10/2015	16.3	16.6	1.09		0.002	24.5	1	1
T4A	Bowman's Ck Alluvium	ES1533719006	15/10/2015	17.7	16.6	3.37		0.002	30.3	0.1	0.7
T4P	Coal Measures Overburden (regolith)	ES1533719007	15/10/2015	21	20.1	2.22		0.002	9.8	0.8	0.8
T4Pduplicate	Coal Measures Overburden (regolith)	ES1533719008	15/10/2015	20.9	19.3	4.03		0.002	9.4	0.8	0.8
T5	Bowman's Ck Alluvium	H1521817	21/08/2015								
WML112C	Bowman's Ck Alluvium	H1521761	21/08/2015					<0.004	37		

Bore ID	Target	Sample Number	Sample Date	Total Anions meq/L	Total Cations meq/L	Ionic Balance %	Oil and Grease	Total Cyanide	Turbidity (NTU)	Total Kjeldahl Nitrogen as N	Total Nitrogen as N
WML119	Pike's Gully Seam	ES1533606005	14/10/2015	20.6	19.2	3.34		0.002	34.30	1.90	1.90
WML120A	Pike's Gully Seam	ES1533606001	14/10/2015	6.17	5.72	3.86		0.002	10.90	0.05	0.05
WML120B	Glennies Ck Alluvium	ES1533606002	14/10/2015	5.88	5.85	0.25		0.002	1.00	0.05	0.05
WML129	Glennies Ck Alluvium	ES1533606006	14/10/2015	10.7	9.71	4.92		0.002	66.20	0.40	0.40
WML181	Pike's Gully Seam	ES1533606004	14/10/2015	39.6	34.7	6.72		0.002	107.00	1.80	1.80
WML183	Pike's Gully Seam	ES1533606003	14/10/2015	47.6	46.2	1.59		0.002	240.00	1.30	1.30
WML239	Glennies Ck Alluvium	H1521771	19/08/2015					<0.004	18		
WML261	Upper Lower Liddell Seam	H1521779	19/08/2015					<0.004	6.9		
WML262	Upper Lower Liddell Seam	H1521780	19/08/2015					<0.004	10.4		
WMLP277	Hunter River Alluvium	ES1533719002	15/10/2015	17.6	17.5	0.39		0.002	5.1	0.05	0.4
WMLP278	Hunter River Alluvium	ES1533719003	15/10/2015	17.8	16.8	2.79		0.002	5	0.2	1.1
WMLP279	Hunter River Alluvium	H1521783	21/08/2015					<0.004	90		
WMLP280	Hunter River Alluvium	H1521784	21/08/2015					<0.004	38		
WMLP301	Arties Seam	H1521785	19/08/2015					<0.004	8.1		
WMLP302	Arties Seam	H1521786	19/08/2015					<0.004	8.5		
WMLP311	Bowman's Ck Alluvium	ES1533827007	16/10/2015	10.6	11.1	2.18		0.002	5.4	0.2	0.4
WMLP323	Bowman's Ck Alluvium	H1521789	21/08/2015								
WMLP324	Coal Measures Overburden (regolith)	H1521790	21/08/2015								
WMLP325	Coal Measures Overburden (regolith)	ES1533827008	16/10/2015	12.4	12.7	1.21		0.002	5.8	0.3	0.4
WMLP326	Bowman's Ck Alluvium	ES1533719004	15/10/2015	17.6	16.6	2.68		0.002	217	9.8	10.6
WMLP327	Coal Measures Overburden (regolith)	ES1533719005	15/10/2015	20.9	20.8	0.14		0.002	34.1	0.2	0.2
WMLP328	Bowman's Ck Alluvium	ES1533827006	16/10/2015	9.66	10.5	4.02		0.002	10.3	0.1	0.2

Bore ID	Target	Sample Number	Sample Date	Total Anions meq/L	Total Cations meq/L	Ionic Balance %	Oil and Grease	Total Cyanide	Turbidity (NTU)	Total Kjeldahl Nitrogen as N	Total Nitrogen as N
WMLP336	Hunter River Alluvium	H1521795	21/08/2015					<0.004	1100		
WMLP337	Hunter River Alluvium	ES1534160001	21/10/2015	28	28.6	0.96		0.002	5550	2	2.4
WMLP338	Hunter River Alluvium	H1521797	21/08/2015					<0.004	400		

Appendix 3. OEH Conservation Area Monitoring Form

MONITORING REPORT FORM

This form is being completed for the following reason:

- ☐ **Annual Report by landholder (self reporting)**
- ☐ Routine visit by OEH with landholder
- ☐ Compliance visit by OEH with landholder
- ☐ Change of ownership visit by OEH with landholder
- ☐ Conservation Agreement
- ☐ Wildlife Refuge
- ☐ Property Agreement

Please make three copies of the completed form and any additional information. One to be retained by the landowner, one for the local Area office of NPWS and the third to go to Conservation Partnerships Delivery Unit, OEH, PO Box A290, Sydney South NSW 1232.

A LANDOWNER AND PROPERTY DETAILS

Property Owner	Ashton Coal Operations Pty Ltd
Property Name	Southern Woodland Conservation Area
Property Address	New England Highway, Camberwell
CA number	
Area (ha)	65 ha
CMA Region	Hunter
Agreement signed	
Date of last monitoring visit	18 December 2015 (Umwelt)
Date of visit	
Officer undertaking visit	

B LANDHOLDER OVERVIEW SINCE LAST VISIT

1 LANDHOLDER EXPERIENCES RELATING TO THE IMPLEMENTATION OF THE CONSERVATION AGREEMENT /WILDLIFE REFUGE

Points to note	***Comments***

☐ **Please place an X in this box if new issue(s)/problem(s) require management help**

2 WORKS UNDERTAKEN SINCE LAST VISIT

Description of work undertaken	***Source of funding and amount***	***Date completed***
Repairs to subsidence cracking Wild dog control Weed control		Ongoing

3 FIRE HISTORY MONITORING

Date of fire	*Area burnt (% of c.a./approx ha)*	*Reason (hazard red./wild)*	*Intensity (low/medium/high)*
N/A			

4 VISITATION

Average No. of Visitors per year	*Purpose of Visitation*	*Visitation effects*	*Strategies to overcome effects*
N/A			

5 COMMUNITY CONSULTATION AND INPUT INTO DECISION MAKING

Type of Involvement	*Numbers involved*	*Outcomes*
N/A		

C CONSERVATION VALUES

	Conservation Values noted in Agreement and its significance	**Current condition ** (I = improving M= maintain D= declining)** *Anecdotal evidence only available at present*	**Current and emerging threats**	**Level (*severe, high, moderate or low*) and extent (*throughout, widespread, scattered or localised*) of threats**	**New findings; any other relevant information.**
Landscape/ Catchment - World/national heritage listings - Landscape & scenic values					
Biological - Vegetation Communities - Flora - Fauna & habitat - Water bodies	Woodland birds EEC vegetation Brush tailed Phascogale habitat Barking Owl		Weeds and pests such as Cactus spp and dog, fox and cat.	Moderate – manageable but requires ongoing works to control	
Geological					
Cultural Heritage - Aboriginal - Historic					
Research/ education					
Other					

**** Current Condition: determine change by comparison with previous Condition Assessments (Pages 5 to 8). Carry out new assessment if not done previously. Biometric can also be used.**

D MANAGEMENT ISSUES

	Describe the Issue (short description of current extent of impacts, new sightings and any other relevant information	**Description of planning and implementation of control measures being and to be undertaken, and duration**
Weeds (where applicable, infestation can be given as a % of total vegetation)	Low level weeds are present, density is not a level where impacts on fauna are being found in monitoring.	Weed management is an important part of the land management plan. Weed management is ongoing commitment onsite.
Pest Animals - Feral - Domestic - Native	Feral animals are controlled by a combination of baiting and habitat management.	1080 baiting program and removal of grazing.
Fire Management		Firebreaks are maintained around the property that contains the conservation area.
Threatened species; endangered ecological communities etc		
Cultural Heritage Management		Cultural Heritage Management Plan is implemented.
Visitor Impact Management		
Community Consultation and input into decision making.		
Research/ Education programs		
Other permitted uses -vehicle access - use of timber -seed collection - etc	Underground mining results in minor subsidence impacts that need to be remediated from time to time.	Subsidence repair with small earthmoving equipment.

E WORKPLAN TO ADDRESS MANAGEMENT ISSUES (in priority order)

Action to be completed or ongoing action (discuss on site and where necessary confirm details later)	*Cost and possible funding sources*	*Completion Date*	*Responsibility (landholder, OEH, other)*
Ongoing weed control and pest management as required	Owner funded	Ongoing	landholder

F ATTACHMENTS

- Map showing location of activities referred to above eg weed infestations; fire; location of past and future management actions.

List further attachments if relevant:

- Photos from previously/new identified photopoints
- Rapid Assessment Sheets for previous/new sites.
- Other Monitoring results.

I/we confirm a field inspection has been undertaken and this form is a summary of the conservation values and management issues discussed.

Signature Landowner representative: 

Date report completed: 18 December 2015

Level of threat definition

Table 4 Description of the level of impact categories (adapted from State of the Parks 2007 Guidelines)

Impact of the threat	Description of category
Severe	The threat will lead to loss of property value(s) in the foreseeable future if it continues to operate at current levels
High	The threat will lead to a significant reduction of property e values(s) if it continues to operate at current levels.
Moderate	The threat is having a detectable impact on reserve values(s) but damage is not considered significant.
Mild	The threat is having minor or barely detectable impact on property value(s).

Extent of threat definition For cultural heritage places, sites and objects, classify the extent the impact is having on the place/site/object itself.

Table 5: Description of the extent categories (adapted from State of the Parks 2007 Guidelines)

Extent of the threat	Description of category
Throughout	The impact is occurring in 50% or more of property area/cultural place/site/object.
Widespread	The impact is occurring in more than 15% but less than 50% of reserve area/cultural place/site/object.
Scattered	The impact is occurring in between 5 and 15% of reserve area/cultural place/site/object.
Localised	The impact is occurring is less than 5% of reserve area/cultural place/site/object.

CONDITION ASSESSMENT NATIVE VEGETATION

For native bushland and grassland sites and paddocks containing scattered shade trees

Site number or name:	**Southern Woodland Conservation Area**	
Monitoring date:	**December 2015**	
Assessment questions		**Answer Yes, No or N/A**
1.	Is the area fenced to manage stock access and grazing? *Healthy bush should be rested for long periods to allow regeneration. To achieve this, it should be fenced off.*	Yes
2.	Is there regeneration of native trees and shrubs, or if in grassland, regular germination of native herbs eg perennials such as lilies or orchids and annuals such as daisies? *Regeneration of trees and shrubs is necessary for the bush to maintain health, diversity and a range of habitats. An understorey of shrubs encourages small insect eating birds and other native animals.*	Yes
3.	Is there a diverse range of tree and shrub species present, eg more than 20 (coast), 15 (tablelands), 10 (western slopes and plains)? (Note: healthy river red gum forest may have only one tree and 5-10 shrub species present). *Diversity encourages a range of native animals and helps the bush withstand attacks of insects and other adverse conditions.*	Yes
4.	If grassland, is there a diverse range of grasses and broad leaf herbs present?	N/A
5.	Is there adequate ground cover, eg leaves, bark and twigs, or litter (dead grasses)? *Ground cover indicates whether the area is being disturbed by stock and is a measure of tree canopy density and the domination of exotic grasses and weeds.*	Yes
6.	Are mosses or lichens on rocks, fallen branches and the ground surface, or are these species, along with liverworts, forming a crust on bare soil?	Yes
7.	Are weeds uncommon, sparsely scattered, absent, or mainly around edges of the area? *The understorey may have exotic weeds present. Too many are undesirable and you may need a management plan for their control. Weeds compete with native plants for light, space, water and nutrients.*	No
8.	Is there a very low incidence of pest animals, eg foxes and rabbits? *Remnant bush can be a refuge for pest animals as well as natives. The feral animals should be controlled.*	Yes
9.	Is the patch shape a block or part of a corridor more than 30 metres wide rather than a thin strip? *Blocks of native vegetation have less edge area than strips, so they are less influenced by changes in levels of weeds, predators, noise and climatic effects.*	Yes
10.	Is the area greater than 1 ha (coast), 5 ha (tablelands), 10 ha (western slopes), 20 ha (plains), 50 ha (Western Division)?	Yes
11.	Is the remnant linked to other remnants by corridors, eg. roadside vegetation, or scattered trees no more than 50 m apart ? *Corridors provide shelter and pathways for native organisms (other than birds) to move over the landscape for feeding, breeding, roosting and expanding territory*.	Yes
12.	Is there a mix of tree ages present, ie saplings through to old growth with hollows? *A range of ages and conditions means the bush is regenerating itself and each stage of growth is suitable habitat for native organisms.*	Yes, but no hollows
13.	If trees are present is an understorey also present? *An understorey of shrubs encourages small insect eating birds and other native animals.*	Yes
14.	Is the understorey mostly comprised of native shrubs and / or grasses and broad leaf	Yes

herbs?	
15. Area there standing trees (alive or dead) with hollows, present in the remnant or paddock ? *Dead trees with hollows are essential for roosting and nesting of a large range of native birds such as parrots and of bats.*	No
16. Are the trees mainly healthy, with little or no dieback? *Dieback is apparent if there are bare twigs at the outer part of the tree canopy. It is usually a sign of severe insect attack.*	Yes
17. Are there less than 20 % of trees affected by mistletoe? *Mistletoe is a parasite that invades trees and causes them to lose vigour. Where many trees in an area are affected it is likely to indicate that the area of vegetation is under severe stress.*	Yes
18. Are there logs and fallen timber on the ground? *Logs and dead material are essential habitat for smaller native organisms. But they can also be a harbour for pest animals.*	Yes
19. If scattered paddock trees are unfenced, are stock camps absent? *Bare ground, bare tree roots or the movement of soil all can indicate erosion which needs to be managed and controlled.*	N/A
20. If scattered paddock trees are unfenced, is evidence of stock ringbarking or rubbing absent?	N/A
21. Is the area free of herbicide, insecticide or fertiliser overspray from adjoining areas? *Herbicides and insecticides can kill native plants and small organisms. Fertiliser encourages exotic species by raising nutrient levels.*	Yes
22. Is the area free from the threat of salinity and / or high water tables?	Yes
23. Are patches of vegetation left unburnt as wildlife breeding habitat?	Yes
Total number of 'yes' answers	16

Condition rating - native vegetation

Number of 'yes' answers			**Vegetation condition rating**	**Need for management attention**
Remnant bushland	**Remnant grassland**	**Scattered paddock trees**		
15 +	10 +	13 +	Healthy	Maintain current management
9 - 14	6 - 9	8 - 12	Good	Needs some management attention
5 - 8	3 - 5	5 - 7	Fair	Needs a significant level of management attention
0 - 4	0 - 2	0 - 4	Poor	Urgent management necessary if you wish to retain area as stock shelter

CONDITION ASSESSMENT - WATER BODIES

For creeks, rivers, farm dams and natural or artificial wetlands

Site number or name: N/A	**Monitoring date:**
Assessment questions	**Answer Yes, No or N/A**
1. Is all or part of the site fenced to control stock access?	
2. Is there a diverse range of native tree and shrub species present upslope of the dam or wetland, or along the creek?	
3. Are there any standing trees (dead or alive), with hollows near to, or within the dam or wetland, or along the creek?	
4. Is the site linked to remnant vegetation by corridors, eg. roadside or scattered trees no more than 50m apart?	
5. Is the site free of herbicide, insecticide or fertiliser overspray or run off?	
6. Are weeds uncommon, sparsely scattered or absent from the site?	
7. Is there an earthen or floating island within the dam?	
8. Does the dam have an irregular margin?	
9. Does 50% of the dam edge have a gentle slope?	
10. Is 50% of the dam less than 800mm deep when the dam's full?	
11. Are there any native fish species present in the dam or creek?	
12. Are introduced fish species (eg. carp) absent from the dam or creek?	
13. Are there hollow logs, rocks and litter around the dam or along the creek?	
14. Is more than 50% of the creek corridor vegetated with native species?	
15. Are the creek banks stabilised by vegetation?	
16. Are there wider patches of native vegetation along the creek corridor eg 20-30m wide?	
17. Is the area immediately adjacent to the creek free from cultivation?	
18. Are aquatic insects present under small to medium rocks or logs within the creek?	
19. Is the creek's water free from regular algal blooms?	
20. Does foliage of trees or shrubs hang over the creek, dam or wetland?	
21. Is there any regeneration of reeds and rushes upslope of the dam or wetland?	
22. Is there a buffer zone of ungrazed vegetation around the wetland?	
23. Is the area free of irrigation tailwater or polluted stormwater?	
24. Is the area free of fire during bird breeding seasons?	
25 Are patches of vegetation left unburnt as wildlife breeding habitat?	
26 If the area has original vegetation, has the water regime remained largely unmodified?	
27. Does the water level fluctuate regularly (seasonally)?	
Totals number of 'yes' answers	

Condition rating - water bodies

Number of 'yes' answers			Water resource condition rating	Need for management attention
Dam	**Creek**	**Wetland**		
11 +	13 +	10 +	Healthy	Maintain current management
7 – 10	9 - 12	7 - 9	Good	Needs some management attention
4 – 6	5 - 8	4 - 6	Fair	Needs a significant level of management attention
0 – 3	0 - 4	0 - 3	Poor	Urgent management required to improve the resource condition

- MONITORING POINT LOCATIONS AND CORRESPONDING VEGETATION COMMUNITIES REPRESENTED AS AT MAY 2015

Photo Point	Quadrat N0	Easting/Northing GDA 94 MGA 56	Photo bearing degrees	Vegetation Community Represented
LFA Transect	RWood03	56318438E 6403732N		Central Hunter Ironbark – Box Woodland (Peake, 2007)
Vegetation Transect				Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter (PCT ID1603; BVTID HU817)
Reverse angle of Vegetation Transect				

BIOMETRIC VEGETATION TYPE BENCHMARKS AND BASELINE QUADRAT SCORES AS AT 2015

Photo Point	Quadrat N0	Native species richness	Overstorey cover %pfc	Mid-storey cover %pfc	Ground cover – grasses %pfc	Ground cover – shrubs %pfc	Ground cover – other %pfc	Proportion oversotrey regen.	Exotic cover
Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter (PCT ID1603; BVTID HU817)									
Insert Benchmark values		41	15-40	5-20	30-50	5-10	20-40	Not measured	

Monitoring Data Sheet

Monitoring Point Number	RWood03	**Date**	19/05/2015
Vegetation Community	Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter		
1. Site Photo(s)Taken	Yes		

2. Floristic BioMetric attributes	
Native cover	
Overstorey:	60
Midstorey:	15
Groundcover(grass):	75
Groundcover (shrub):	15
Groundcover (other):	10
Native species richness:	23
Proportion of canopy species regenerating	100
Exotic cover	10

3. Observations	**GPS coordinates**	**Photo number**	**Observations**
Natural regeneration of disturbed areas			Area is older re-growth. No hollows are present, but there are a range of ages present
Threatened species sightings			Nil
Fire event/fuel			No evidence of recent fire, low-moderate fuel abundance
Weeds			Low abundance
Pest animals			nil
Visitor impact/vehicles			low
Rubbish dumping			Nil