ASHTON COAL PROJECT
PIKES GULLY LONGWALL 6B
EXTRACTION PLAN

30/05/2013

Ashton Coal Operations Pty Limited

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Version History

Version	Status	Details	Prepared By	Authorised/Approved for Issue	
				Name/Position	Date
A	Draft	For Consultation	P. Fletcher & AECOM	P. Fletcher, Technical Services Manager	June 2011
B	Draft	For Consultation	P. Fletcher & AECOM	P. Fletcher, Technical Services Manager	December 2011
6/11/2012	Final	For Consultation & Approval	M. Moore & AECOM	M. Moore, Approvals Manager	6/11/2012
30/05/2013	Final	Approved	M. Moore & AECOM	M. Moore, Approvals Manager	30/05/2013

EXECUTIVE SUMMARY

Project Description

This Extraction Plan (including component management plans) details the monitoring, management and reporting activities associated with secondary extraction of longwall 6B (LW6B) in the Pikes Gully Seam at the Ashton Coal Project.

LW6B is located within the north western part of the underground mining area and will undermine an excised section of Bowmans Creek made redundant by the approved eastern creek diversion. It will also undermine saturated alluvium and a small section of the recently realigned Lemington Road. Consequently the timing of LW6B extraction is contingent on the timing of creek flow being diverted down the constructed diversion channel.

The extents, predicted impacts and consequences of secondary extraction for LW6B proposed under this Extraction Plan are completely consistent with that assessed in the Bowmans Creek Diversion Environmental Assessment and approved by development consent modification application DA 309-11-2001-i MOD 6.

While all other longwall panels within the Pikes Gully Seam have been mined (under approved Subsidence Management Plans), approval for extraction of LW6B has not been previously requested. As the intention has been to eventually extract LW6B the effects of LW6B on surrounding and overlying features and on public safety have been considered as part of previous Subsidence Management Plan applications for adjacent panels. **Figure A** provides a flow chart / document structure to illustrate the approvals granted to date and elements of this Extraction Plan that have been previously approved under the development consent or former Subsidence Management Plan approvals.

Subject to approval of this Extraction Plan, it is planned that LW6B will be extracted following completion of LW1 and prior to extraction of LW2 in the Upper Liddell Seam.

Subsidence Predictions

Multi-seam subsidence impacts for Pikes Gully Seam LW 5 - 8 (inclusive) were previously considered in the Bowmans Creek Diversion Environmental Assessment. Notwithstanding, subsidence estimates for LW 6B - 8 have since been revised to account for changes that were made to the mine plan prior to the approval of the Bowmans Creek Diversion development consent modification application. This included setting back longwall voids by 40m (horizontally) from the high bank of Bowmans Creek[1] and removal of three miniwalls under the creek.

The estimated maximum subsidence values for the revised assessment are consistent with that previously presented in the Bowmans Creek Diversion Environmental Assessment (**Table A**).

[1] except for those creek sections made redundant by the creek diversion

Table A: Summary of Predicted Subsidence – PG Seam LW6B

Panel	Maximum Subsidence (m)	Maximum Tilt (mm/m)	Maximum Strain (mm/m)	Source
LW6B	1.6	70	30	Subsidence Assessment for Longwalls 6B to 8 (SCT, 2011)
	1.6	70	30	Bowmans Creek Diversion EA (Evans and Peck, 2009)

Subsidence Impacts and Management

Subsidence impacts associated with extraction of LW6B are predicted to be minimal, including negligible impacts to the recently constructed Bowmans creek diversions.

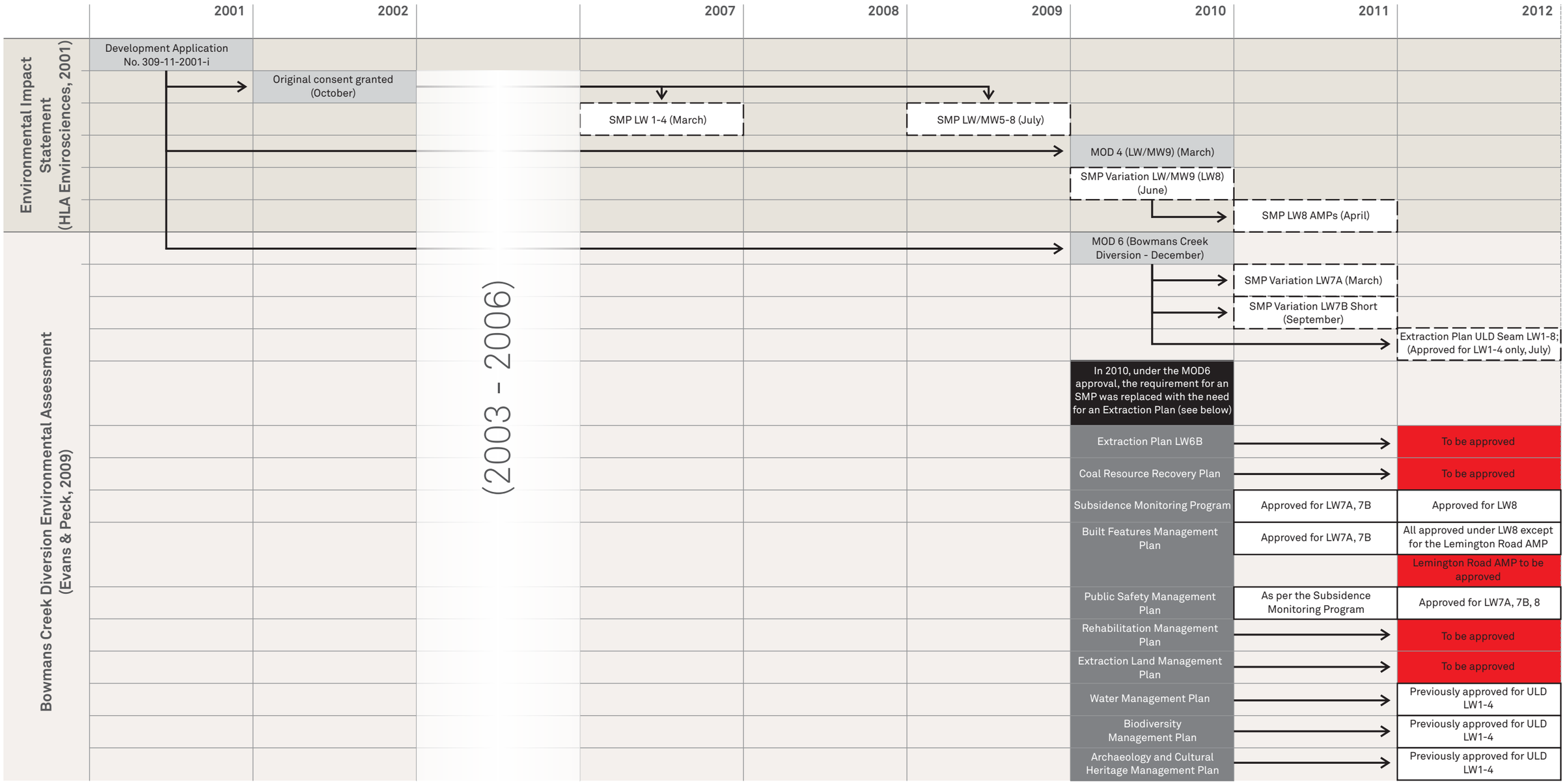
The associated consequences of subsidence are predicted to be minor and readily managed using the proposed controls and measures. Some non-critical infrastructure (e.g. fences) is unlikely to remain serviceable at the predicted strains and tilts for LW6B. It will however be possible to relocate or apply mitigation measures to all affected infrastructure.

Subsidence effects and potential environmental consequences will be monitored and managed in accordance with the performance measures specified in the development consent, and the individual management plans that form part of this Extraction Plan.

Potentially affected features are shown in **Figure B** and a summary of the key potential subsidence effects and monitoring and management actions is provided in **Table B**.

Figure A

Approvals Pathway Overview



Approved Subsidence Management Plans and Extraction Plans

Approved Management Plans

Development Consent and Modifications*

Managment Plan/ Extraction Plan title

Managment Plans yet to be approved

* Only those modifications relevant to the Extraction Plan Approvals Pathway are shown

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Ref. No.	Feature
1a	Bowmans Creek Diversion
1b	Excised section of Bowman's Creek
2	Bowman's Creek Floodplain
3	Groundwater Alluvium
4	Clean Water Drainage (MacGen)
5	Lemington Road
6	Telecommunications Lines
7	ACOL Water Pipelines
8	Prescribed Dam Notification Area
9	ACOL Goaf Gas Drainage BH
10	Proposed Gas Pipeline and Easement (MacGen)
11	Biodiversity
12	ACOL Fences and Gates

Legend

- Ashton Mining Leases
- First Workings (PG Seam)
- PG LW6B Second Workings
- Pond / Dam
- Dam Notification Area
- New England Highway
- Lemington Road Alignment
- TEL — Telstra U/G Cable
- Polyethylene Water Pipe
- Existing Clean Water Drainage
- GAS — Gas Pipeline (Approved but not Developed)
- Gas Pipeline Easement
- GW04 — ACOL Goaf Gas Drainage BH (PG)
- Bowmans Creek Diversion And Drainage
- Excised Creek Section
- Fences
- Optic Fibre
- Buildings
- Saturated Alluvium

0 100 200 250m

1 : 10000 (A3) 1 : 5000 (A1)

VOID 5 DAM NOTIFICATION AREA

NEW ENGLAND HIGHWAY

LEMINGTON ROAD

NARAMA DAM NOTIFICATION AREA

EASTERN DIVERSION

GW17 GW15 GW08

LW8 LW7B LW6B LW7A LW6A LW5 LW4B

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Extraction Plan
Pikes Gully Seam LW6B

Figure B
Overview of Key Features

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Table B: Summary of Key Potential Subsidence Effects and Monitoring and Management Actions - LW6B (PG Seam)

ITEM # (REFER FIGURE A)	NATURAL / BUILT FEATURE	POTENTIAL SUBSIDENCE EFFECT / CONSEQUENCES	MONITORING AND MANAGEMENT ACTIONS	MANAGEMENT PLAN REFERENCE
1a	Bowmans Creek and diversions	Generally beyond the limits of subsidence for LW6B. However, block banks and land areas adjacent to the high bank of the constructed diversion channel are expected to experience vertical subsidence generally under 20mm although up to 0.1m in some locations (SCT 2011). Hence there is potential for minor tensile cracking to occur in these areas as a result of subsidence movements. No environmental consequences predicted.	Detailed management of the diversions and retained creek sections via the Water Management Plan, inclusive of the Bowmans Creek Diversion Management Plan which includes survey monitoring, visual inspections, surface water quality monitoring, and monitoring program for aquatic ecology condition. Detailed survey methods for monitoring of the Bowmans Creek high bank and block banks is provided in the Subsidence Monitoring Program.	Bowmans Creek Diversion Completion Criteria (see BCD Construction MOP, Feb 2011) Mine Design complies with Condition 1.18 of DA 309-11-2001 *"LW... voids ...not...closer than 40 metres from any point vertically beneath the high bank…"* Subsidence Monitoring Program (**Appendix C**) Built Feature Management Plan (**Appendix D**) Asset Management Plan (ACOL) Water Management Plan (**Appendix G**)
1b	Excised section of Bowmans Creek	Surface ponding	Surface ponding in the excised section of Bowmans Creek will be allowed to remain above LW6B to form additional aquatic habitat To avoid unnecessary disturbance surface ponding within the excised creek channel will be remediated only as a result of increased mine inflows and/or mine safety risks.	Water Management Plan (**Appendix G**). Trigger Action Response Plan (**Section 6.3**, **Table 11**) Extraction Land Management Plan (**Appendix I**)
		Potential for surface cracking of excised creek banks or creek bed.	Visual inspection of the area immediately behind the longwall face. Mapping of cracking to be monitored and recorded using GNNS. Remediation of cracking post-subsidence in accordance with the Extraction Land Management Plan.	

ITEM # (REFER FIGURE A)	NATURAL / BUILT FEATURE	POTENTIAL SUBSIDENCE EFFECT / CONSEQUENCES	MONITORING AND MANAGEMENT ACTIONS	MANAGEMENT PLAN REFERENCE
		Potential for localised bank instability of excised channel (due to local ground movement tilts and strains).	Weekly visual inspection of affected reach, noting any areas of recent bank collapse, erosion or instability. Remediation of erosion points as required.	
		Potential for erosion and bed scour (due to local ground movement tilts and strains). High flow events that overtop the block bank could lead to head cut at erosion points in the channel bed.	Visual inspection of excised creek channel following rainfall event greater than 50mm in 24 hours or when block bank is overtopped. Remediation of erosion points as required.	Water Management Plan (**Appendix G**). Trigger Action Response Plan (**Section 6.3**, **Table 11**) Extraction Land Management Plan (**Appendix I**)
2	Bowmans Creek floodplain	Surface ponding	Monitoring and remediation of ponding (to provide a nominally free-draining landform) at completion of longwall panel (except in the excised creek channel).	Extraction Land Management Plan (**Appendix I**)
		Surface cracking	Cracking repaired at completion of longwall subsidence by filling or ripping, and revegetated to prevent erosion and reduce potential safety risks to people and livestock. (Note, area remains free of stock).	
		Enhanced erosion of drainage lines.	Monitoring of affected areas and where identified, install temporary sediment controls (i.e. install sediment fence immediately downslope) until stabilisation or reshaping works to prevent ongoing erosion until remediation can be completed.	
3	Groundwater – alluvium	Potential drawdown of alluvial aquifer.	Water level monitoring in relevant piezometers - fortnightly during extraction.	Development Consent DA 309-11-2001-i Water Management Plan (**Appendix G**)
		Changes in ground water quality.	Water quality sampling of groundwater bores on a quarterly basis.	
		Increased inflows to underground mine.	Routine monitoring of inflows reporting to the underground workings as an indicator of changed geological conditions and possible interaction with overlying alluvial aquifers.	

ITEM # (REFER FIGURE A)	NATURAL / BUILT FEATURE	POTENTIAL SUBSIDENCE EFFECT / CONSEQUENCES	MONITORING AND MANAGEMENT ACTIONS	MANAGEMENT PLAN REFERENCE
4	Clean water drainage (Macquarie Generation)	Surface cracking and ponding.	Maintain existing clean water drainage from Macquarie Generation sedimentation basins to Bowmans Creek.	Asset Management Plan (Macquarie Generation)
5	Lemington Road	Subsidence and surface cracking.	Temporary speed and traffic control is likely to be necessary during the period of active mining. Repair and maintenance of the road surface is likely to be required at the completion of LW6B. Conditions 45 and 46 of the Ravensworth Operations Project (PA 09_0176) require Ravensworth Operations Pty Ltd to construct the Lemington Road realignment in a manner that can reasonably withstand the subsidence impacts resulting from the Ashton underground coal mine and to pay ACOL's reasonable costs associated with the monitoring and management of subsidence related impacts on the realigned road. (Note MSB has approved the road for extraction of Pikes Gully Seam).	Built Feature Management Plan (**Appendix D**) Asset Management Plan (Macquarie Generation) Asset Management Plan (Xstrata – Ravensworth Operations) Asset Management Plan (Lemington Road)
6	Telecommunications lines	Strain on buried Telstra telecommunications cables. A PowerTel (AAPT) fibre optic cable is located over the main headings and is predicted not to experience any vertical subsidence or differential movements.	Telstra and AAPT cables are expected to remain serviceable throughout mining activities associated with LW6B. Monitoring and ongoing liaison with potentially affected stakeholders will assist to identify any subsidence-induced damage to the Telstra cables and highlight if any repairs are required.	Built Feature Management Plan (**Appendix D**) Asset Management Plan (Telstra) Asset Management Plan (PowerTel)
7	ACOL tailings/water pipelines	A small section of tailings and reclaim water pipeline is located within the 20mm subsidence line and is unlikely to be adversely affected (based on previous experience of undermining these pipelines).	Visual inspection of pipeline. Continuous flow monitoring to identify pipeline leakage via CHPP control room. Repair as required.	Built Feature Management Plan (**Appendix D**) Asset Management Plan (ACOL)

ITEM # (REFER FIGURE A)	NATURAL / BUILT FEATURE	POTENTIAL SUBSIDENCE EFFECT / CONSEQUENCES	MONITORING AND MANAGEMENT ACTIONS	MANAGEMENT PLAN REFERENCE
8	Prescribed dams	No subsidence impact. Narama Dam is located 430m to the south west of LW6B.	Narama Dam managed according to Dam Safety Committee recommendations for a notifiable dam. (The Dam Safety Committee has recently revised the Narama Dam notification area to be outside the Ashton underground mine extraction footprint).	Built Feature Management Plan (**Appendix D**) Asset Management Plan (Xstrata – Ravensworth Operations) Dam Safety Committee recommendations as approved by DRE
9	ACOL goaf gas drainage infrastructure	No subsidence impact.	ACOL goaf gas drainage boreholes will be designed to accommodate subsidence impacts and will not be significantly affected by mining of LW6B.	Built Feature Management Plan (**Appendix D**) Asset Management Plan (ACOL)
10	Proposed Macquarie Generation gas pipeline and easement	No subsidence impact.	Macquarie Generation has indicated that it has no immediate plans to construct this pipeline. Therefore it will not be impacted by subsidence from mining of LW6B in the PG Seam. The easement will remain in place.	Built Feature Management Plan (**Appendix D**) Asset Management Plan (Macquarie Generation)
11	Biodiversity	No significant impact predicted. Minor potential for deterioration or degradation in habitat quality as a result of surface cracking, ponding and changes in drainage patterns and nutrient flow.	Fauna, riparian vegetation and aquatic ecology surveys as per methodology in Flora and Fauna (Biodiversity) Management Plan, including targeted searches for threatened species and habitat diversity assessment.	Flora and Fauna (Biodiversity) Management Plan (**Appendix H**)
12	ACOL Fences and gates	Ground tilt and strain.	Visual inspection / monitoring of gates and fences. Repairs to fences and gates as required.	Asset Management Plan (ACOL, Macquarie Generation)
-	Archaeology	No impact predicted to known sites. The aboriginal archaeological water hole site is located outside of the LW6B subsidence impact area and will not be impacted by secondary extraction of LW6B. (There are no known Aboriginal cultural heritage sites within LW6B extraction area).	Assess / salvage / manage any additional identified sites in accordance with protocols approved under AHIP #1130976.	Aboriginal Archaeological & Cultural Heritage Management Plan (ACHMP) (**Appendix J**)

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PLAN 4A	Upper Liddell Seam Thickness & Depth of Cover Contours
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PLAN 6	Geological Strata Sections

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Abbreviations

ACHMP	Archaeology and Cultural Heritage Management Plan
ACOL	Ashton Coal Operations Pty. Limited
ACP	Ashton Coal Project
AEMR	Annual Environmental Management Report
ARI	Average Recurrence Interval
AXYS	AXYS Consulting Pty Ltd
BCD	Bowmans Creek Diversion
CRRP	Coal Resource Recovery Plan
DP&I	Department of Planning & Infrastructure (formerly the Department of Planning DoP)
DPI	Department of Primary Industries (part of DTIRIS)
DRE	Division of Resources & Energy (a division of DTIRIS)
DTIRIS	Department of Trade and Investment, Regional Infrastructure and Services (formerly the Department of Industry & Investment – I&I)
EA	Environmental Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EMS	Environmental Management Strategy
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPL	Environmental Protection Licence
ERM	Environmental Resources Management (Australia) Pty Ltd
GDE	Groundwater Dependent Ecosystems
km	Kilometres
LB	Lower Barrett Seam
LMP	Land Management Plan
LW	Longwall (e.g. LW4)
m	Metres
MG	maingate (i.e. MG1 = maingate 1)
mm	Millimetres
ML	Mining Lease
MOP	Mining Operations Plan
MPR	Marine Pollution Research Pty Ltd
Mtpa	million tonnes per annum
MW	miniwall
NoW	NSW Office of Water (a division of DTIRIS)
OEH	Office of Environment and Heritage (formerly Department of Environment, Climate Change and Water - DECCW)
PG	Pikes Gully Seam
PSE	Principle Subsidence Engineer
RMS	Roads and Maritime Services (formerly the Roads and Traffic Authority)
ROM	Run of mine
RUM	Ravensworth Underground Mine
SCT	SCT Operations Pty Ltd
SEMP	Subsidence Environmental Management Plan

SHECM	Safety Health Environment and Community Management System
SMP	Subsidence Management Plan
TARP	Trigger Action Response Plan
TG	tailgate (i.e. TG1 = tailgate 1)
ULD	Upper Liddell Seam
ULLD	Upper Lower Liddell Seam

Glossary

Note: Terms in bold are defined in the development consent, the majority of the remaining definitions are adopted from the SMP Guidelines.

Angle of Draw	The angle between the vertical and the line joining the edge of the mining void with the limit of vertical subsidence, usually taken as 20 mm.
Cover depth	The depth of coal seam from the ground surface (metres).
Cumulative subsidence	The total subsidence effects resulting from all seams mined (within this Extraction plan: up to and including the Upper Liddell Seam).
Environmental consequences	Environmental consequences of Subsidence Impacts, including: damage to infrastructure, buildings and residential dwellings; loss of surface flows to the subsurface; loss of standing pools; adverse water quality impacts; development of iron bacterial mats; cliff falls; rock falls, damage to Aboriginal heritage sites; impacts on aquatic ecology; ponding; etc.
Far-field subsidence	Mining-induced movements of the ground surface in areas where vertical subsidence is less than 20 mm.
First workings	Workings which establish access to the coal resource area and which do not result in surface subsidence. First workings do not include longwall extraction of coal.
Goaf	The mined-out area into which the immediate roof strata break.
Incremental subsidence	The subsidence effects resulting from mining in the Upper Liddell Seam only (i.e. not including for any subsidence already completed as a result of mining in the Pikes Gully Seam).
Development Consent	Development consent (DA 309-11-2001-i) issued on 11 October 2002 under Section 80 of the *Environmental Planning and Assessment Act 1979* by the Minister for Planning (and as modified).
Mitigation Measures	Subsidence management measures which aim to reduce subsidence impacts, usually implemented prior to or during mining.
Remediation Measures	Subsidence management measures which aim to repair any adverse effects of subsidence, usually implemented after mining.
Second Workings	Extraction of coal by longwall mining or pillar extraction that may result in surface subsidence.
Subsidence or subsidence effects	Deformation of the ground mass due to mining, including all mining-induced ground movements, including both vertical and horizontal displacement, tilt, strain and curvature.
Subsidence impacts	Physical changes to the ground and its surface caused by subsidence effects, including tensile and shear cracking of the rock mass, localised buckling of strata caused by valley closure and upsidence and surface depressions or troughs.

Upsidence	Relative vertical upward movements of the ground surface associated with subsidence.
Vertical subsidence	Vertical downward movements of the ground surface caused by underground coal mining.

1 INTRODUCTION

The Ashton Coal Project (ACP) is located approximately 14km northwest of Singleton in the Hunter Valley region of New South Wales (refer to **Figure 1**) and is managed on behalf of the Ashton Joint-Venture by Ashton Coal Operations Pty Limited (ACOL). The project (as approved) includes an open cut mine, an underground mine, a Coal Handling and Preparation Plant, rail siding and associated mine support infrastructure.

Development consent (DA 309-11-2001-i) for the ACP was granted in October 2002 and authorises longwall coal extraction from the Pikes Gully (PG), Upper Liddell (ULD), Upper Lower Liddell (ULLD) and Lower Barrett (LB) coal seams. DA 309-11-2001-i (as modified) approves the general layout of the underground mine (**Figure 2**) and authorises and sets limits on impacts to natural and built features associated with the longwall mine.

All other longwall panels approved for extraction within the PG Seam have been extracted in accordance with previously approved SMPs. While secondary (i.e. longwall) extraction of LW6B has not been considered previously in any prior SMP (or EP) applications, the component management plans approved for adjacent extracted panels included measures to manage the effect of LW6B on surrounding natural and built features. (**Figure A** provides a flow chart / document structure to illustrate the approvals granted to date and elements of this EP that have been previously approved under the development consent or former SMP approvals.)

LW6B is located within the north-western part of the underground mining area, and will undermine an excised section of Bowmans Creek (made redundant by the approved creek diversion) associated alluvium and a small section of the recently realigned Lemington Road. The layout for this longwall panel, as defined by the approved first workings, includes prescribed setbacks (i.e. 40m horizontally from the high bank) from retained and diverted sections of Bowmans Creek (to the south and east respectively), as well as a suitable setback from the New England Highway (to the north). The western extent of the panel is defined by the previously mined LW7B. The proposed area of LW6B extraction is 1034m (long) by 215m (wide). The extents of secondary extraction for LW6B proposed under this EP are completely consistent with that assessed in the Bowmans Creek Diversion (BCD) Environmental Assessment (EA).

LW6B will be the first panel to undermine an excised section of Bowmans Creek, hence its commencement is contingent on the completion of the eastern creek diversion and subsequent diversion of creek flow. The construction of the eastern creek diversion was completed in October 2012, with water diverted into the constructed channel in early November 2012[2]. Pending EP (and SMP) approval, LW6B extraction is currently scheduled to commence in June 2013, following completion of LW1 in the ULD Seam.

As described in the BCD EA, the impacts associated with LW6B are predicted to be minimal. The consequences of these potential impacts are expected to be manageable and consistent with those previously identified and approved for the ACP. This is supported by comprehensive monitoring data collected since prior to commencement of ACP operations, including monitoring of subsidence effects from all other PG Seam longwall panels.

With the exception of Lemington Road, the subsidence effects and environmental impacts of LW6B were fully described and considered in the EA for the BCD development consent

[2] Officers from the NSW Department of Planning and Infrastructure and the NSW Office of Water inspected the completed diversions on 31 January 2013 and an as executed engineers report was provided to the regulators on 5 March 2013.

modification application (DA 309-11-2001-i MOD 6), which was approved on 24 December 2010. (Note Lemington Road has been relocated to the Brunkers Lane alignment, which was a private access road at the time the BCD EA was prepared, assessed and approved).

Notwithstanding, the subsidence effects and potential consequences of LW6B will be monitored and managed according to the programs and measures described in the individual management plans (accompanying this EP) to ensure the performance measures specified in conditions 3.9 and 3.10 to Schedule 2 of DA 309-11-2001-i are complied with.

Approval of this LW6B Extraction Plan (EP) is required prior to longwall coal extraction (i.e. second workings). Note that an Extraction Plan now replaces the previous development consent requirement for a Subsidence Management Plan (SMP) and Subsidence Environmental Management Plan (SEMP), although in this case SMP approval is still required as a condition to the mining lease for the ACP underground mine.

This EP (including component management plans) details the proposed monitoring, management, and reporting activities that have been developed to address the predicted subsidence impacts associated with extraction of longwall panel 6B (LW6B) in the PG Seam in the context of overall mine operations.

1.1 MINE DEVELOPMENT

The underground mine is located south of New England Highway, and is accessed from the northern side of the highway via a portal in the Arties pit. Underground mine development commenced in July 2006, with extraction of the first PG Seam longwall panel (LW1) commencing in March 2007. The subsidence effects associated with mining the first four longwall panels (LW1 – 4) were managed in accordance with an approved SMP and SEMP.

Monitoring conducted during the mining of these first longwall panels combined with detailed site investigations led to the proposal of an alternate mine plan for the next four panels (LW5 – 8). This alternate plan included two shortened longwall panels (LW5 – 6) and two full length miniwall (MW), narrower panels (MW7 – 8) which were proposed to avoid or minimise impacts to Bowmans Creek and areas of associated saturated alluvium. Notwithstanding, the proposed layout included MWs that undermined Bowmans Creek, SMP approval for LW5 – 6 and MW7 – 8 (LW/MW5 – 8) was granted in July 2009[3].

Following further detailed site investigations, approval was sought to divert two sections of Bowmans Creek to allow for the development of an alternate underground mine plan, using full width longwall panels. Approval for the creek diversions and revised mine plan was granted in December 2010. This removed certain technical and economic constraints manifest in the LW/MW layout; provided for the maintenance of Bowmans Creek stream flow; and authorised hydraulic interaction between the longwall mine and Bowmans Creek alluvial aquifer (should this occur).

The underground mine plan must now ensure that longwall voids are set back by at least 40m from any point vertically beneath the high bank of Bowmans Creek, except those sections of the creek made redundant by the diversions (condition 3.14 to schedule 2 of DA 309-11-2001-i). (Note ACOL is also required to hold appropriate water licence entitlements to account for any reduction in alluvial groundwater levels caused by the mine).

[3] Longwall Miniwall 5-9 was the name of the document submitted to DRE for approval as an SMP. The subsequent SMP approval was titled LW/MW5 – 8 as LW/MW9 was awaiting a development consent modification (MOD 4). Subsequently SMP approval for LW/MW5 – 8 was modified over time to include LW/MW 9, then LW7A and LW7B(short).

Secondary extraction of PG LWs 5, 6A, 7A, 7B and 8 has now been carried out under the approved LW/MW5 – 8 SMP, with approved variations to this SMP enabling full width panel extraction of LWs 7A, 7B(short) and 8. Updated management plans detailing the monitoring and management of subsidence for built features and public safety inclusive of LW6B, 7B and 8 were included in and approved through this SMP variation process.

ACOL has since sought and gained EP and SMP approval for LW1 – 4 in the ULD Seam. These approvals were granted in August 2012. This has enabled progression of longwall extraction in the ULD Seam and continuity of mining while construction of the Bowmans Creek diversions is being completed. Extraction of ULD LW101 commenced in August 2012. It is anticipated that PG LW6B will be extracted following completion of ULD LW101 and prior to ULD LW102 (refer to **Section 3.2**).

This EP complies with condition 3.12 to schedule 2 of DA 309-11-2001-i and replaces the requirement for the preparation, approval and implementation of a SMP.

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MAIN NORTHERN RAILWAY
LAKE LIDDELL
LIDDEL
MT OWEN
RAVENSWORTH EAST
CUMNOCK
CREEK
SWAMP
HVO WEST
CREEK
GLENDELL OPEN CUT
CREEK
INTEGRA UNDERGROUND
BETTYS
CREEK
NARAMA
BAYSWATER
RAVENSWORTH UNDERGROUND
ASHTON COAL PROJECT
GLENNIES
INTEGRA OPENCUT
HVO NORTH
NEW
RIVER
ENGLAND
RIXS CREEK
HUNTER
HIGHWAY
HVO SOUTH
RIXS CREEK
SINGLETON
LEMINGTON

LOCALITY PLAN
N
Muswellbrook
Singleton
Maitland
PACIFIC
Ashton Coal Project
NEWCASTLE
South
Pacific
Ocean
SYDNEY

N
W
E
S
0 1.0 2.0 3.0 4.0km

CAD REF:\\AUNTL\PP00\PROJECTS\60099483_ASHTON_SMAR\5 CAD\5.3 WORKING\AUTOCAD\FIGURES\EXTRACTION PLAN\0_MAIN REPORT\EP - ASHTON WHOLE SITE.DWG
LAST MODIFIED:12/19/2011 2:50 PM

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Extraction Plan
Pikes Gully Seam LW6B

Figure 1
Location of the Ashton Coal Project

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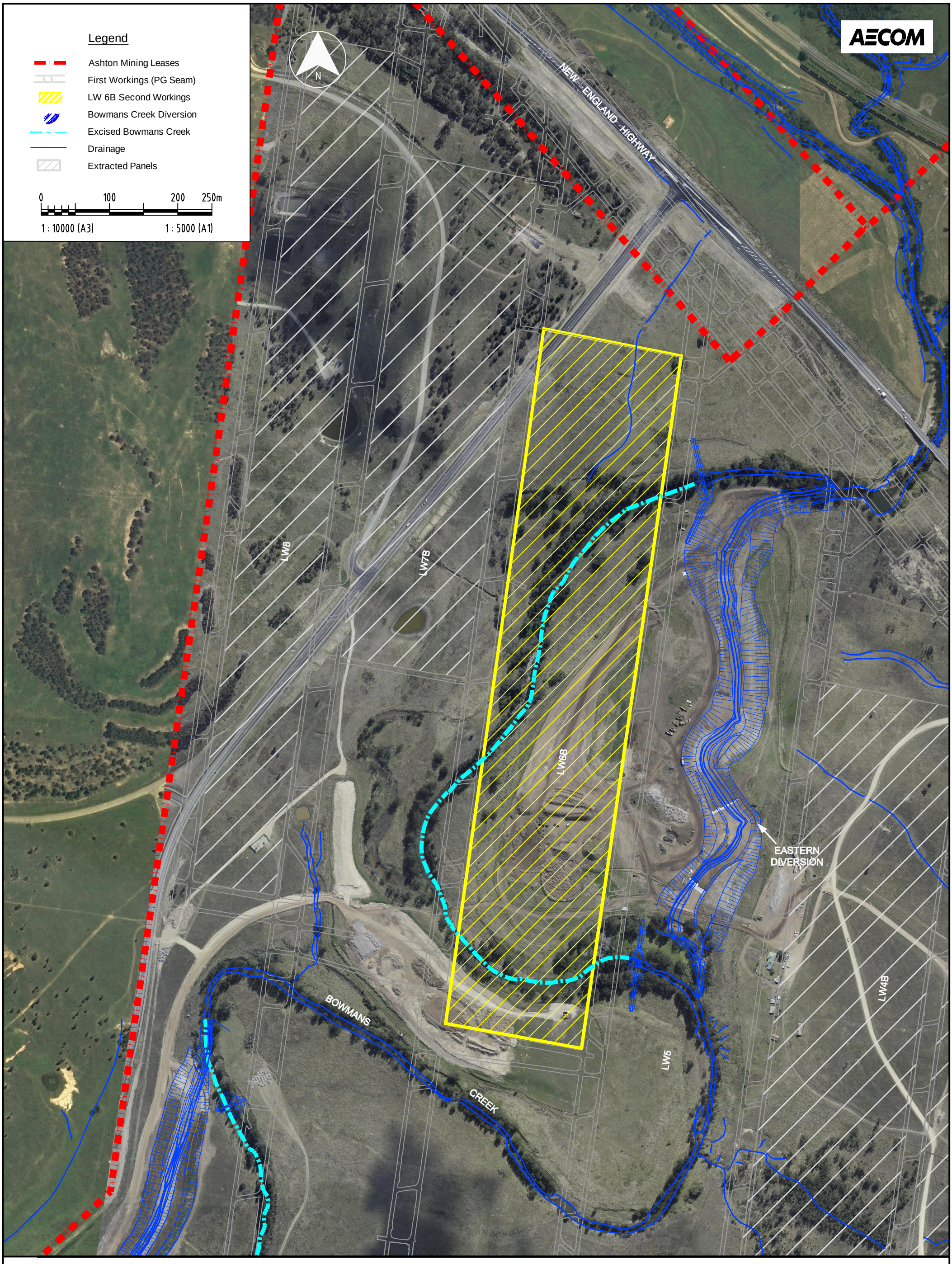

AshtonCoal

Extraction Plan
Pikes Gully Seam LW6B

Figure 2
Extraction Plan Area and
Updated Mine Plan

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1.2 PURPOSE & SCOPE

This EP sets out the proposed monitoring, management, and reporting activities developed to address the predicted subsidence impacts from the extraction of LW6B in the PG Seam at the Ashton Underground Mine and has been prepared in accordance with condition 3.12 and 3.13 to Schedule 2 of DA 309-11-2001-i. All other panels and first workings in the PG Seam are covered by previous SMP Approvals.

This EP forms part of ACOL's Environmental Management Strategy (EMS) for the ACP. The EMS includes a suite of environmental management plans required under condition 3.6 to Schedule 2 of DA 309-11-2001-i, as well as the Mining Operations Plan (MOP) required as a condition to Mining Leases (ML) 1533, 1623, and 1529. The relationship of this EP to the ACP EMS and previous SMPs is shown on **Figure 3**.

1.3 OBJECTIVES

The objective of this EP is to provide for the adequate protection of important natural and built features from direct and indirect subsidence impacts associated with the extraction of LW6B in the PG Seam and to ensure that the subsidence management performance measures prescribed by conditions 3.9 and 3.10 to schedule 2 of DA 309-11-2001-i are met.

This objective will be achieved by:

- Identifying and implementing as appropriate, a monitoring and management regime to reduce the effects of subsidence on natural and built features; and
- Implementing a review and auditing process to provide feedback on the implemented monitoring and management regime and to ensure continual improvement.

1.4 SUPPORTING TECHNICAL ASSESSMENTS

The BCD EA (Evans and Peck, 2009) and associated documentation submitted and approved under DA 309-11-2001-i MOD 6 was based on a suite of detailed specialist environmental assessments which considered the potential impacts of the new mine plan. More recent assessment of subsidence impacts to infrastructure (**Appendix A**) and Aboriginal archaeology (see **Section 5.2**) have been used to inform development of this EP.

Copies of the EA and relevant technical reports used to support this EP are provided on CD attached to this report.

1.5 DOCUMENT STRUCTURE

This EP provides a brief overview of the approved mine plan, associated subsidence and resulting environmental consequences. It also briefly outlines the monitoring and management regime proposed to be implemented for the underground mine, which is detailed further in the component management plans appended to this EP. In summary, this plan includes the following information:

- **Section 2** – Summarises the relevant statutory requirements for the preparation of this document and the management of subsidence impacts, providing cross-referencing to the appropriate section or appendices where each requirement is addressed;
- **Section 3** – Provides a description of the proposed mine plan and schedule;

- **Section 4** – Provides the results of subsidence monitoring completed (LW1 – 7B & 8) and comparison to former subsidence predictions, to confirm the accuracy of modelling conducted to-date;
- **Section 5** – Summarises the results of recent subsidence modelling and estimation for the approved mine plan for LW6B and outlines the predicted environmental consequences;
- **Section 6** – Outlines the performance measures, management and monitoring activities that are proposed to mitigate predicted subsidence impacts and confirm that subsidence and its consequences are within predicted ranges. The section also sets out the proposed contingency response in the event that subsidence impacts exceed (or are considered likely to exceed) the adopted performance indicator; and
- **Section 7** – Details the responsibilities of ACOL personnel under this EP and sets out the reporting, auditing and review requirements.

The following reports and management sub-plans have been prepared in accordance with condition 3.12 to Schedule 2 of DA 309-11-2001-i:

- **Appendix A** –Presents revised subsidence predictions for Longwalls 6B to 8 (by SCT Operations Pty Ltd) prepared to address minor alterations made to the mine plan prior to the approval of the development consent modification for the BCD;
- **Appendix B** – Coal Resource Recovery Plan, providing detail on the mine plan and schedule, geology and overburden, resource recovery and justification for the proposal;
- **Appendix C** – Subsidence Monitoring Program, detailing the proposed survey monitoring that will be conducted to confirm subsidence behaviour, and summarising the monitoring of impacts to built and natural features (contained in other sub-plans);
- **Appendix D** – Built Features Management Plan (BFMP), structured to include Asset Management Plans (AMPs) for each individual asset / landowner, detailing the consultation, monitoring, mitigation and remediation measures for affected surface infrastructure. (Note plans for LW 6B, 7B (short) and 8, approved under previous SMP applications and variations are included for completeness);
- **Appendix E** – Public Safety Management Plan, listing potential risks associated with subsidence of the surface, and avoidance measures that will be implemented to prevent personal injuries;
- **Appendix F** – A rehabilitation summary providing a discussion of the current Rehabilitation Strategy which was approved as part of the BCD EA. A Rehabilitation Management Plan is currently under preparation in accordance with the amended development consent;
- **Appendix G** – A summary of the revised site wide Water Management Plan previously approved including monitoring and management practices relevant to secondary extraction of PG LW6B at the ACP;
- **Appendix H** – A summary of the revised Flora and Fauna (Biodiversity) Management Plan as relevant to PG LW6B, for the site-wide monitoring and management of threatened species, terrestrial and aquatic ecosystems;
- **Appendix I** – Extraction Land Management Plan, addressing monitoring and remediation of subsidence impacts resulting from LW6B, not specifically addressed by the site-wide Land Management Plan;
- **Appendix J** – A summary of the previously approved Archaeology and Cultural Heritage Management Plan; which consolidates the management strategies

developed in consultation with the Aboriginal Community and documented within previous management plans and the requirements of associated AHIPs;

- **Appendix K** – Legislative Requirements – provides a reference list of where requirements under the development consent, SMP Guidelines (DMR 2003) and ACOL's statement of commitments have been met for PG LW6B; and
- **Appendix L** – Risk Assessment - based on a risk assessment workshop conducted for LW6B – 8 in accordance with the SMP Guidelines (DMR, 2003).

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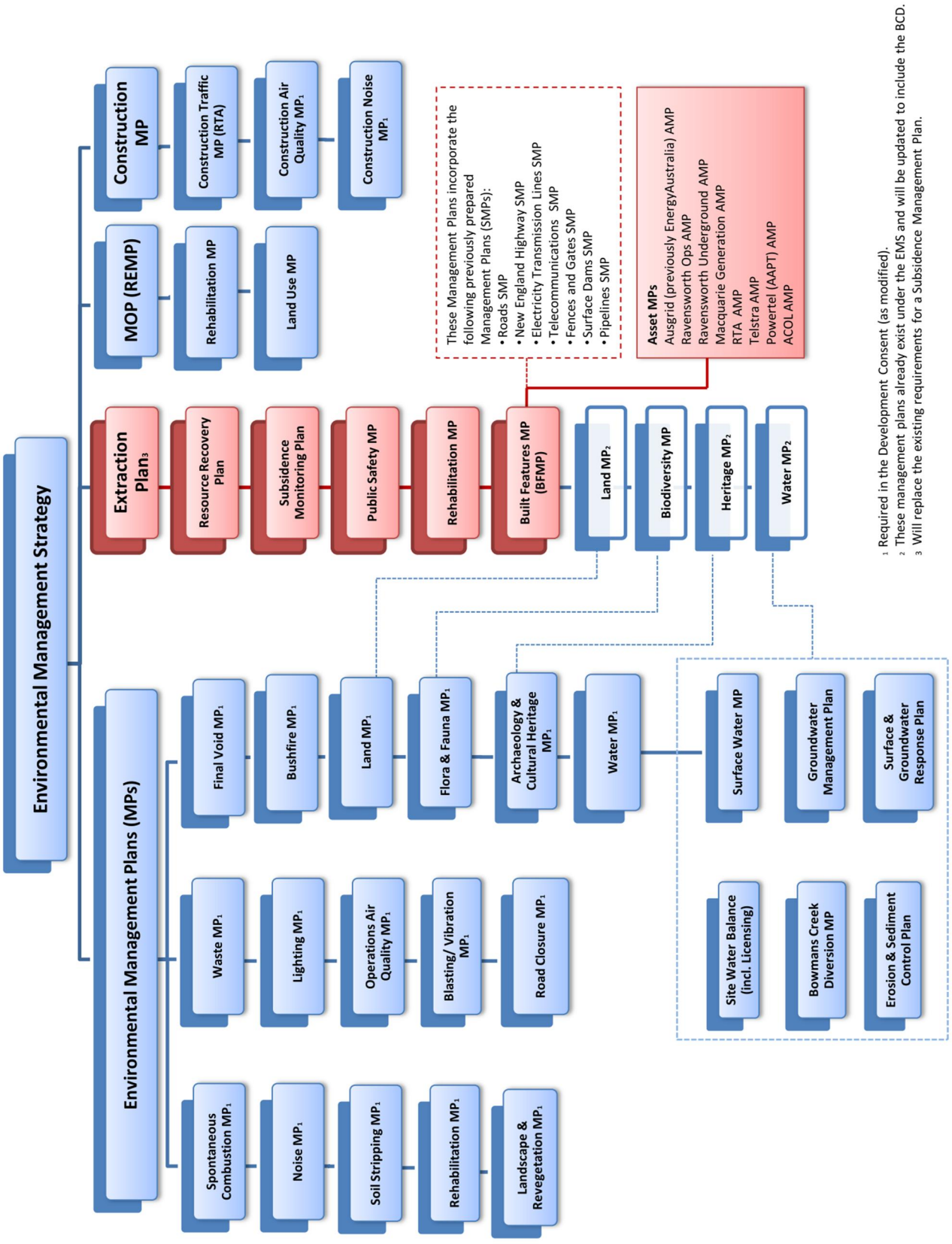
Figure 3 Ashton Coal Environmental Management Strategy



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2 STATUTORY REQUIREMENTS

2.1 DEVELOPMENT CONSENT

The ACP was granted development consent on 11 October 2002 (DA 309-11-2001-i) by the Minister for Planning under the State Significant and Integrated Development provisions of Part 4 of the *Environmental Planning and Assessment Act 1979*, and has since been modified to enable (inter alia) changes to the general underground mine layout (as previously described).

This document has been prepared in accordance with conditions 3.12 and 3.13 to Schedule 2 of DA 309-11-2001-i, as modified. The development consent condition requirements and relevant reference for this information within the EP is provided in **Table 1**.

Table 1 Development Consent – EP Document Reference

CONSENT REF	CONDITION	EP REFERENCE
3.12	The Applicant shall prepare and implement an Extraction Plan for the second workings within each seam to be mined to the satisfaction of the Director-General.	Extraction Plan and Appendices
3.12(a)	Be prepared by a team of suitably qualified and experienced persons whose appointment has been endorsed by the Director-General	Endorsement provided on 3 June 2011
3.12(b)	Be approved by the Director-General before the Applicant carries out any of the second workings covered by the plan;	This Application
3.12(c)	Detailed plans of existing and proposed first and second workings and any associated surface development.	Extraction Plan and Appendices
3.12(d)	Detailed performance indicators for each of the performance measures in Tables 1 and 2 (DA 309-11-2001-i conditions 3.9 and 3.10).	Appendices D, G, H and J
3.12(e)	Provide revised predictions of the potential subsidence effects, subsidence impacts and environmental consequences of the proposed second workings, incorporating any relevant information obtained since this approval.	Appendix A
3.12(f)	Describe measures that would be implemented to ensure compliance with the performance measures in Tables 1 and 2 (DA 309-11-2001-i MOD 6 conditions 3.9 and 3.10), and remediate any predicted impacts and/or environmental consequences.	Appendices D - G
3.12(g)	Coal Resource Recovery Plan	Appendix B
	Subsidence Monitoring Program	Appendix C
	Built Features Management Plan	Appendix D
	Public Safety Management Plan	Appendix E
	Rehabilitation Management Plan (as required under condition 3.51)	Appendix F
3.12(h)	Water Management Plan	Appendix G
	Biodiversity Management Plan	Appendix H
	Land Management Plan	Appendix I
	Heritage Management Plan	Appendix J
3.12(i)	Program to collect sufficient baseline data for future Extraction Plans.	Appendix C

CONSENT REF	CONDITION	EP REFERENCE
3.13	Plans under condition 3.12(h) must include the following:	
3.13(a)	Assessment of the potential environmental consequences of the Extraction Plan, incorporating any relevant information that has been obtained since this approval.	Appendix A and refer to Bowmans Creek Diversion EA
3.13(b)	Detailed description of the measures that would be implemented to remediate predicted impacts.	Appendices D and F-J
3.13(c)	Contingency plan that expressly provides for adaptive management.	Section 6.4 and 7.1

In addition to the requirements for the preparation of this EP discussed above, **Appendix K** sets out other relevant development consent conditions and statements of commitments relating to the management of subsidence impacts at the ACP. A document reference providing further detail of how each condition is being met is also provided.

This EP and supporting documents have been prepared with assistance from a suitably qualified and experienced project team (as listed in **Table 2**). In accordance with condition 3.12(a) to Schedule 2 of DA 309-11-2001-i, the appointment of the below team of suitably qualified and experienced experts was endorsed by a delegate of the Director-General of the Department of Planning and Infrastructure (DP&I) on 3 June 2011.

Table 2 Summary of Project Team

NAME	COMPANY	AREA OF EXPERTISE
Amanda Kerr	AECOM	Environmental/Subsidence Management
Peter Horn	AECOM	Environmental/Subsidence Management
Ken Mills	SCT	Subsidence Modelling
Paul Anink	Marine Pollution Research	Aquatic Ecology
Angela Besant	Insite Heritage	Archaeology
Peter Dundon; Craig Schulz	RPS Aquaterra	Ground and Surface Water
John Paul King	Pea Consulting	Terrestrial Ecology

2.1.1 Mining Lease

Submission and approval of SMPs is a requirement of the ML. Preparation of SMPs is guided by the Division of Resources and Energy (DRE) document "*Guidelines for Applications for Subsidence Management Plan Approvals*" (DMR, 2003).

Where not addressed by the existing relevant planning approval documents, this EP has also been prepared to enable ACOL to comply with the SMP guidelines. A reference table outlining the SMP Guidelines requirements with the content of this EP is provided as **Appendix K**.

The ML includes a number of specific requirements of relevance to the management of impacts to roads, transmission lines, communications and pipelines. These are also discussed in **Appendix K**.

3 MINE PLAN

3.1 MINE PLAN

LW6B is one of 10 individual longwall panels (LWs 1 – 5, 6A and B, 7A and B and 8) designated for extraction from the PG, ULD, ULLD and LB coal seams within the currently approved underground mine plan. The LW6B EP area and mine plan is shown in **Figure 2**.

The mine plan has been designed to minimise surface subsidence effects on overlying natural and built features, as far as practically possible. This includes the diversion of Bowmans Creek and adherence to a 40 m horizontal setback between the high bank of the creek (in its diverted form) and the projected vertical edge of the longwall void.

Other general features of the approved mine plan in the vicinity of Bowmans Creek include:

- Division of LW6 and LW7 panels into two sections (A and B) with a panel of coal retained between the two sections to provide a stable platform for, and protection (from subsidence) of an east-west section of Bowmans Creek commonly referred to as the “oxbow section”, between the two diversions;
- Offsetting the location of ULD Seam gateroads from that of the overlying PG Seam gateroads, with the exception of LW7A and LW8 main gateroads; and
- Variable width panels to accommodate the offset ULD Seam arrangement.

A description and assessment of the interaction of the approved mine plan with surrounding and overlying environmental features is provided in the BCD EA (Evans and Peck, 2009). (Note the approved mine plan is included as Schedule B to DA 309-11-2001-i).

Key dimensions of LW6B include:

- 5.4m wide gate roads (nominal width).
- 25m wide tailgate pillar (rib-to-rib).
- 30m wide maingate pillar (rib-to-rib).
- 216m wide longwall void.
- 1034m long longwall panel.

A full description of the site conditions, depth of cover, mining and resource recovery methods are provided in the Coal Resource Recovery Plan (**Appendix B**). Land ownership is shown in **Figure 4**.

3.2 MINE SCHEDULE

The ACP underground mine operates seven days a week, 24 hours a day on a rotating shift basis, with production primarily on a five day roster.

At the date of this report, extraction of PG LWs 1 – 6A (inclusive), 7A, 7B (short) and 8 is complete, with extraction progressing in LW1 of the ULD Seam.

LW6B is currently planned to be mined following completion of ULD LW1 and prior to ULD LW2. Currently proposed commencement and completion dates for LW6B are summarised in **Table 3**. This out-of-sequence mine schedule was required to enable construction of the Bowmans Creek eastern diversion to be completed and subsequent diversion of creek flow into the constructed channel prior to LW6B extraction.

Table 3 Proposed Mining Schedule (Secondary Extraction)

PANEL	START DATE	DURATION	COMPLETED DATE
ULD LW1	August 2012	10 months	May 2013
PG LW6B	June 2013	4 months	October 2013
ULD LW2	November 2013	6 months	May 2014

3.3 CREEK DIVERSION CONSTRUCTION SCHEDULE

Construction of the eastern creek diversion (adjacent to and east of LW6B) was completed in October 2012. Creek flow was then successfully diverted into the constructed creek channel in November 2012 with the completion of the upstream block bank (required to divert water into the constructed diversion channel) to its initial approved temporary design height. Consequently the natural channel of Bowmans Creek above LW6B has now been excised with flows diverted to the east of and away from the subsidence footprint of LW6B into the constructed diversion channel.

The approved diversion design required the upstream block bank to be constructed to an initial temporary height equivalent to the six month average recurrence interval (ARI) flood level. This enables creek flows up to the six month ARI level and fish passage to be diverted into the diversion channel.

The upstream block bank is not required to be raised to its full height until just prior to mining of ULD LW6B, two to three years post completion of the diversion. This provides adequate time for critical bank stabilising vegetation to be established along the length of the diversion prior to directing full bank flow into the constructed channel. Until this time, the temporary block bank will be overtopped during events less frequent than the 6 month ARI, with resulting flows entering areas of the excised creek channel affected by subsidence above LW6B. This will minimise the potential for damage to the newly constructed channel from higher flood flow events (i.e. less frequent than a six month ARI).

The upstream temporary block bank includes a clay core which has been keyed into the bed of the creek, while both upstream and downstream sides of the block bank have been armoured with suitably sized rip-rap, in accordance with the approved design.

A downstream block bank will be established at the same time as the full height upstream block bank is established. The primary purpose of the downstream block bank is to prevent backwater flooding of the excised section of the creek under flood flow events, once subsidence occurs. The downstream block bank has been designed to allow drainage from the excised section of the creek but prevent backwater flow into the excised section of the creek.

Notwithstanding, the upstream and downstream block banks will be immediately constructed to their full design heights if PG LW6B subsidence impacts lead to significant mine inflows from pooled water in the overlying excised creek channel. This was described in the EA and in the BCDMP and an additional section has now been added to the EP to reflect the construction scheduling of the full height block banks.

The eastern diversion (including its upstream temporary block bank) has been designed and constructed to generally lie beyond the limits of subsidence for PG LW6B (as described in the EP). Modelling indicates less than 20mm subsidence as a result of PG LW6B is expected to occur at the location of both upstream and downstream block banks and along the length of the channel and its bank (SCT, 2011). The Subsidence Monitoring Program (**Appendix C**) includes specific monitoring activities to verify the integrity of the constructed

temporary height upstream block bank, including survey line and visual monitoring whilst the Built Features Management Plan (**Appendix D**) provides for repair/remediation of any damage caused by subsidence.

The diversion was inspected by officers of DP&I and NoW on 31 January 2013. An as-executed engineers report was subsequently submitted to DP&I, NoW and DRE on 5 March 2013 (in fulfilment of condition 4.6 to schedule 2 of DA 309-11-2001-i). Rehabilitation and revegetation of the adjoining riparian and terrestrial zones will continue for the remaining life of the mine according to the rehabilitation strategy (**Appendix G**).

The diversion is not a hard engineered channel but rather has been designed and constructed to mimic the behaviour of the pre-diverted creek. Hence it is expected that the channel will dynamically respond to flow events in a similar manner to the behaviour of the natural creek. This is incorporated in the performance criteria for the diversion and requires an adaptive approach to the management and remediation of the diversion channel, particularly in the initial period of bank stabilisation. In accordance with condition 4.5 to Schedule 2 of DA 309-11-2001-i the creek diversion, inclusive of block banks, must be constructed, managed and maintained to the satisfaction of the Director-General of DP&I.

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Legend

- Ashton Mining Leases
- EL Boundaries
- Ashton Coal Mines Limited (ACML)
- Glendell Land Leased to ACML
- Savage Mineral Ltd & Enex Foydell Ltd
- Glendell Tenements PTY Ltd
- Macquarie Generation
- Renison Ltd - Ravensworth Operations PTY Ltd
- Crown Land
- Freehold Land
- Singleton Council
- ACOL First Workings (PG Seam)
- Bowmans Creek Diversion
- Bowmans Creek
- Excised Bowmans Creek
- LW 6B Second Workings (PG)

0 100 200 300 400 500m

1 : 10000 (A3)

AECOM

NEW ENGLAND HIGHWAY

LW8

LW7B short

LW6B

EASTERN DIVERSION

BOWMANS CREEK

LW4B

HIGHWAY

WESTERN DIVERSION

BOWMANS CREEK

LW7A

LW6A

LW5

LW4A

LW3

LW2

LW1

CAD REF:P:\MTL\6129842_EXTRACTION_PLAYS.CADD\S3 WORKING\DRG\PIKES GULLY FIGURES\EP - FIGURE 4 - LAND OWNERSHIP20120229(1).DWG

LAST MODIFIED:11/8/2012 8:29 AM

AshtonCoal

Extraction Plan
Pikes Gully Seam LW 6B

Figure 4
Land Ownership

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4 SUMMARY OF PREVIOUS SUBSIDENCE MONITORING

Subsidence monitoring has been undertaken at the ACP since the commencement of longwall operations in early 2007 and allows for comparison against subsidence predictions which informed both the BCD EA for LW5-8 and the various SMPs approved for all currently extracted longwall panels in the PG Seam.

The BCD EA considered multiseam subsidence movements on a seam basis. Maximum predicted subsidence values for supercritical width panels in the PG Seam, as presented in the BCD EA, are summarised in **Table 4**.

Table 4 Expected Subsidence Movements presented in the BCD EA – PG Seam (SCT 2009)

SUBSIDENCE MOVEMENT	MAXIMUM PREDICTED
Vertical Subsidence (mm)	1600
Tilt (mm/m)	70
Tensile strain (mm/m)	30

Subsidence behaviour observed to date is consistent with supercritical width subsidence and the predicted subsidence behaviour (SCT, 2011).

Revised predictions have been established progressively for longwall panels in the PG Seam through a series of detailed technical investigations undertaken by SCT. These revised predictions informed the various approved SMPs for extraction of longwall panels in the PG Seam. A comparison of the predicted and maximum observed subsidence parameters is presented in **Table 5**. The location of the subsidence monitoring lines and detailed discussion of the results of the previous monitoring is provided in the Subsidence Monitoring Program (**Appendix C**).

As described by SCT (2011), the maximum vertical subsidence observed to date has been less than the 1.6 to 1.8 m predicted to occur as a result of extraction of supercritical width panels (LW 1 – 5, 6A, 7A and 7B). SCT (2008, 2009) note that maximum subsidence predictions for subcritical width panels (LW8) tend to be sensitive to the nature of the overburden strata and in situ stress conditions, and so are difficult to predict with a high level of certainty. The mine geometry of LW8 is constrained by the ACOL lease boundary and is the only subcritical width panel in the PG Seam. Maximum vertical subsidence recorded for LW8 has remained below predictions put forward in the 2010 LW/MW 9 SMP variation[4].

Tilt and strain values recorded to date are generally within the range predicted in the respective SMP for these panels, although there are several locations where locally higher strains and tilts have been observed. These anomalies are a consequence of ground movements, particularly horizontal ground movements that are not possible to predict by conventional subsidence estimation techniques.

Subsidence investigations at the ACP show that angle of draw generally increases with overburden depth. The maximum angle of draw measured for LW7B (which is adjacent to LW6B) is 23° at a depth of 154 m. The maximum overburden depth for LW6B is 145 m, hence the angle of draw for LW6B is expected to be within this range. Notwithstanding, as described by SCT (2011), the maximum angle of draw for the PG Seam is expected to be generally in the order of 26.5°.

[4] LW9 now referred to as LW8

Table 5 Subsidence Monitoring Results (PG Seam)

PANEL	PREDICTED SUBSIDENCE SMP	MAXIMUM MEASURED			
North End of LW1			**CL2**	**XL8**	
Subsidence (mm)	1800	-	1528	1500	-
Tilt (mm/m)	244	-	100	103	-
Horizontal movement (mm)	-	-	476	500	-
Tensile strain (mm/m)	73	-	40	15	-
Compressive strain (mm/m)	98	-	28	27	-
Remainder of LW1		**CL1**		**XL5**	
Subsidence (mm)	1700	1318	-	1436	-
Tilt (mm/m)	141	60	-	75	-
Horizontal movement (mm)	-	480	-	503	-
Tensile strain (mm/m)	42	19	-	17	-
Compressive strain (mm/m)	56	23	-	24	-
LW2		**CL1**	**CL2**	**XL5**	
Subsidence (mm)	1600	1296	1513	1266	-
Tilt (mm/m)	102	40	82	78	-
Horizontal movement (mm)	-	440	298	390	-
Tensile strain (mm/m)	30	17	16	11	-
Compressive strain (mm/m)	41	16	32	28	-
LW3		**CL1**	**CL2**	**XL5**	
Subsidence (mm)	1600	1420	1354	1429	-
Tilt (mm/m)	78	41	48	97	-
Horizontal movement (mm)	-	463	345	394	-
Tensile strain (mm/m)	23	10	17	22	-
Compressive strain (mm/m)	31	7	18	24	-
LW4		**CL1**	**CL2**	**XL5**	**XL10[1]**
Subsidence (mm)	1600	1397	1194	1546	1263
Tilt (mm/m)	78	36	40	53	33
Horizontal movement (mm)	-	230	560	360	258[1]
Tensile strain (mm/m)	23	10	18	9	6
Compressive strain (mm/m)	31	9	67	9	10
LW5		**CL1**	**CL2**	**XL5**	
Subsidence (mm)	1600	1266	1326	1376	-
Tilt (mm/m)	67	23	29	35	-
Horizontal movement (mm)	-	399	339[2]	360	-
Tensile strain (mm/m)	20	21	6	5	-
Compressive strain (mm/m)	27	-9	-8	-17	-
LW6A		**CL1**	**CL2**	**XL5**	
Subsidence (mm)	1600	1400	1280	1360	
Tilt (mm/m)	57	18	25	39	
Horizontal movement (mm)	-	280	250	320	
Tensile strain (mm/m)	17	7	4	8	
Compressive strain (mm/m)	23	7	9	9	
LW7A		**CL1**	**CL2**	**XL5**	
Subsidence (mm)	1600	1415	>860	1391	
Tilt (mm/m)	70	24	13	23	
Horizontal movement (mm)	-	338	118	365	

PANEL	PREDICTED SUBSIDENCE SMP	MAXIMUM MEASURED			
Tensile strain (mm/m)	30	7.6	2.4	10	
Compressive strain (mm/m)	-	9.6	>3.8	12.1	
LW7B		**CL3**	**CL4**	**XL13**	
Subsidence (mm)	1600	1.375	1.235	1.37	
Tilt (mm/m)	70	30.4	20.4	28.5	
Horizontal movement (mm)	-	321	203	415	
Tensile strain (mm/m)	30	10.5	3.3	11.7	
Compressive strain (mm/m)	-	6.9	5.8	6.0	
LW8		**CL1**	**CL2**	**XL13**	**XL14**
Subsidence (mm)	1200	0.550	0.730	0.569	0.870
Tilt (mm/m)	50	8.0	10.4	12.2	21.0
Horizontal movement (mm)	-	90	83	218	244
Tensile strain (mm/m)	15	0.8	2.4	6.1	6.3
Compressive strain (mm/m)	20	1.0	2.4	10.6	12.7

[1] *XL10 was installed after some of the horizontal movement associated with the previous longwall may already have occurred so not all horizontal movements may have been measured.*

[2] *Maximum measured at end of line so actual maximum expected to be greater.*

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5 SUBSIDENCE ASSESSMENT

Subsidence or subsidence effects, subsidence impacts, and environmental consequences are defined under the ACP development consent as follows:

Subsidence or subsidence effects	Deformation of the ground mass due to mining, including all mining-induced ground movements, including both vertical and horizontal displacement, tilt, strain and curvature.
Subsidence impacts	Physical changes to the ground and its surface caused by subsidence effects, including tensile and shear cracking of the rock mass, localised buckling of strata caused by valley closure and upsidence and surface depressions or troughs.
Environmental consequences	The environmental consequences of subsidence impacts, including: damage to infrastructure, buildings and residential dwellings; loss of surface flows to the subsurface; loss of standing pools; adverse water quality impacts; development of iron bacterial mats; cliff falls; rock falls; damage to Aboriginal heritage sites; impacts on aquatic ecology; ponding; etc.

Predicted subsidence effects and impacts associated with LW6B are described in **Section 5.1**, while associated environmental consequences are summarised in **Section 5.2**.

5.1 REVISED SUBSIDENCE PREDICTIONS

Subsidence impacts were originally assessed as part of the Environmental Impact Statement (EIS) for the entire ACP (HLA, 2001), and have since been revised during preparation of previous SMP applications and more recently in the BCD EA (Evans and Peck, 2009).

Revised subsidence estimates for LW6B – 8 have been prepared to address minor alterations made to the mine plan since the development consent modification for the BCD was approved. These minor alterations included the omission of MWs 6 and 7 underlying Bowmans Creek and minor changes to gateroad/panel widths within the mine plan design. The results of the updated Subsidence Impact Assessment (SCT, 2011) are summarised below. The full report is included in **Appendix A**.

The subsidence contours that are expected at the completion of mining LW6B are presented in **Figure 5**. As described by SCT (2011), the contour intervals are variable for clarity and simplicity of presentation and it should be recognised that the maximum vertical subsidence is naturally variable by about 15% for any given panel geometry and overburden depth.

The average maximum subsidence parameters expected at the completion of LW6B are summarised in **Table 6**. Maximum subsidence is expected over the central part of the panel. In general, the tilts and strains are also likely to be greater toward the centre. These estimates are consistent with those presented in the BCD EA (SCT, 2009).

Surface cracks associated with LW6B extraction are expected to be generally less than 100 mm wide and generally adjacent to, and parallel with the goaf edge, within the panel footprint (SCT, 2011).

Surface infrastructure impacted by secondary extraction of LW6B is summarised in **Section 6**. Although some surface infrastructure is unlikely to remain serviceable at these strains and tilt levels, relocation or temporary mitigation measures are possible for the

majority of infrastructure as detailed within the Built Features Management Plan (**Appendix D**).

Table 6 Summary of Predicted Subsidence – PG Seam LW6B

MAXIMUM SUBSIDENCE (m)	MAXIMUM TILT (mm/m)	MAXIMUM STRAIN (mm/m)	SOURCE
1.6	70	30	Subsidence Assessment for Longwalls 6B to 8 (SCT 2011)
1.6	70	30	Bowmans Creek Diversion EA (Evans and Peck, 2009)

LW6B is of supercritical width for mining in the PG Seam. In supercritical width panels, the central part of the surface above each panel is resting fully on the goaf, so the magnitude of maximum subsidence is a function of the seam thickness mined and the bulking characteristics of the overburden strata. Maximum subsidence is typically in the range 55-65% of seam thickness mined. For a 2.4 m mining section, maximum subsidence is therefore estimated to be 1.6 m (SCT, 2011).

Subsidence over the chain pillars is controlled by the elastic compression of the strata above and below the chain pillar as well as a small amount of compression of the coal in the chain pillar itself. At 150 m deep, the elastic compression usually causes less than 200 mm of surface subsidence in total when both adjacent panels have been mined. The chain pillars are typically large enough to prevent pillar instability that might cause additional subsidence and the 25-35 m wide pillars (measured rib-to-rib) are expected to remain stable in the long term (SCT, 2011).

The revised subsidence estimates for the longwall panels in the PG Seam are considered by SCT (2011) to be reliable and are based on the previous experience of monitoring the PG seam at the ACP (refer to **Section 4**).

The revised assessment indicates that the maximum subsidence values are consistent with the EA predictions. There have been some reductions to the extent of subsidence presented in the EA as a result of alterations to the mine plan (i.e. removal of miniwalls beneath Bowmans Creek and shortening of LW7A and 7B).

5.2 POTENTIAL ENVIRONMENTAL CONSEQUENCES

Identification of surface and subsurface features and environmental consequences to natural features of mining were considered in detail in the BCD EA (Evans and Peck, 2009). As determined by SCT (2011), there has been no significant change to predicted subsidence since the development consent modification (MOD6) was approved.

Therefore, a revised assessment of environmental consequences resulting from secondary extraction of LW6B has not been prepared for this EP. Potential impacts to built features were assessed by SCT (2010, 2011, 2012). Potential environmental consequences and impacts to surface and subsurface features are summarised below whilst appropriate management measures are described in **Section 6** of this EP.

The subsidence effects and potential environmental consequences resulting from LW6B extraction will be monitored and managed in accordance with the performance measures specified in the development consent (DA 309-11-2001-i), and the individual management plans that form part of this EP. A summary of predicted subsidence impacts and

environmental consequences relevant to the features, sites and values to be managed under this EP (including component plans) is provided in **Table 7**.

Table 7 Summary of Predicted Subsidence Effects and Potential Consequences

FEATURE	PREDICTED SUBSIDENCE EFFECT	POTENTIAL CONSEQUENCE	COMMENT
Natural Features			
Bowmans Creek and creek diversion	Generally beyond the limits of subsidence for LW6B. However, block banks and land areas adjacent to the high bank of the constructed diversion channel are expected to experience vertical subsidence generally under 20mm although up to 0.1m in some locations (SCT 2011).	Potential for minor tensile cracking to occur in these areas as a result of subsidence movements. No environmental consequences predicted.	Separation of at least 40m horizontally between the longwall void and the highbank of the creek section (not including section made redundant by the diversion). Majority of creek diversion is beyond the 20mm subsidence line. Detailed survey methods for monitoring of the Bowmans Creek high bank and block banks is provided in the Subsidence Monitoring Program whilst management and repair activities are detailed in the ACOL AMP. Any damage to the block banks observed during weekly monitoring activities will be repaired.
Excised section of Bowmans Creek (made redundant by the creek diversion)	Up to 1.6m of subsidence. Ground tilt and strain. Surface cracking generally less than 100mm wide (SCT 2011).	Pooling of water in subsided excised channel during and post flood events (above height of block banks). Potential localised bank instability and increased bank erosion. Potential cracking of creek bed. Potential bed scour and head cut in excised creek channel.	Surface cracking is generally restricted to areas of maximum strain above the goaf edge. Remediation of cracking and erosion points will be carried out in accordance with the Water Management Plan (**Appendix G**) and the Extraction Land Management Plan (**Appendix I**).
Bowmans Creek floodplain	Up to 1.6m of subsidence. Ground tilt and strain. Surface cracking generally less than 100mm wide.	Ponding of water in subsided areas during flood events (that over top creek/diversion high bank). Surface cracking. Enhanced erosion of drainage lines.	Surface cracking is generally restricted to areas of maximum strain above the goaf edge. ACOL remain committed to maintaining a free draining landscape (with the exception of the excised sections of the creek channel) in accordance with the Extraction Land Management Plan (**Appendix I**).

FEATURE	PREDICTED SUBSIDENCE EFFECT	POTENTIAL CONSEQUENCE	COMMENT
Bowmans Creek floodplain alluvial aquifer and groundwater resource	Up to 1.6m of subsidence. Cracking of underlying bedrock.	Temporary localised lowering of watertable due to subsided landform. Lowering of watertable due to subsurface cracking and potential interconnection with goaf. Increased inflows to underground mine.	Monitoring of alluvial groundwater levels and quality in previously undermined areas (i.e. LW6A, 7A and 7B Short) shows no adverse impact on alluvial groundwater as a result of PG LW extraction.
Built Features			
Clean water drain(Macquarie Generation)	Up to 1m of subsidence (in the area overlying LW6B). Surface cracking generally less than 100mm wide.	Ponding of water within the drainage channel. Enhanced alluvium recharge (due to surface cracking).	A clean water drain connects Macquarie Generation sediment dams with the excised portion of Bowmans Creek. The corridor terminates approximately above the LW6B goaf edge. The general function of the drain (i.e.to transport water across Macquarie Generation and ACOL owned land from sediment basins to the excised creek channel) will remain unaffected.
Lemington Road	Up to 0.2m - 0.3m of subsidence with 50 – 100mm more subsidence on the southbound lane. Tensile strains to a maximum of 5mm/m with maximum tilts along and across the road occurring 290m – 320m from the intersection with the NE Hwy. Minor subsidence movements of up to 60mm are expected on the road between 180m - 280m and 370m – 800m from the NE Hwy intersection.	Surface cracking up to approximately 30mm may occur between 290m – 320m from the intersection with the NE Hwy. Surface cracks of up to 50 – 100mm may occur on land adjacent to the southern side of the road (i.e. potential future road reserve) between 280m – 380m from the NE Hwy Intersection. Reduced ride quality due to troughs and humps in pavement. Increased pavement wear. Increased traffic and public safety risk.	Conditions 45 and 46 of the Ravensworth Operations Project (PA 09_0176) required Ravensworth Operations Pty Ltd to construct the Lemington Road realignment in a manner that can reasonably withstand the subsidence impacts resulting from the Ashton underground coal mine. The constructed road also has MSB approval for Pikes Gully longwall extraction.
New England Highway	None.	None.	The highway and road reserve lie above the main headings outside the 26.5° angle of draw for the proposed mining in the PG Seam (SCT 2011). Detailed subsidence monitoring of the New England Highway and associated infrastructure is detailed within the RMS AMP.
Bowmans Creek Bridge	Minor valley closure of around 10 – 11mm.	None, the potenital impact of minor valley closure is not expected to be perceptible.	
New England Highway / Lemington Road Intersection	None (the intersection lies outside the 26.5° angle of draw for the proposed mining in the PG Seam).	None.	

FEATURE	PREDICTED SUBSIDENCE EFFECT	POTENTIAL CONSEQUENCE	COMMENT
Telecommunications lines (copper - Telstra; fibre optic - AAPT)	The PowerTel (AAPT) fibre optic cable is located over the main headings and is unlikely to experience any vertical subsidence or differential movements. A single Telstra cable crossing the north west corner of LW6B may experience vertical subsidence in the range of 1m.	No impacts to the PowerTel (AAPT) fibre optic cable are predicted as a result of LW6B subsidence impacts. The Telstra cable will experience strains relative to its proximity with the goaf.	Telstra and AAPT cables are expected to remain serviceable throughout mining activities associated with LW6B. SCT (2011) note that buried multi-core cables can generally accommodate strains up to about 20mm/m. Whilst subsidence associated with mining the PG Seam completed to date has resulted in strains in exceedance of this tolerance threshold; mining has not impacted the serviceability of the Telstra cables previously affected by ACOL's operations. Therefore Telstra cables are considered likely to remain serviceable.
ACOL tailings pipelines and spill management containment structures	Up to 20mm of subsidence where pipelines cross the north east corner of LW6B.	Nil expected.	Buried sections of pipeline potentially impacted by LW6B are located beyond the longwall block extents. Based on experience over previous longwall panels (LW7B and 8) the pipelines are unlikely to be adversely affected as a result of mine subsidence. Whilst the predicted strains may exceed the 5-10mm/m working strains of polyethylene, it is not expected that contact between the pipe and ground would be sufficiently tight to transfer all of the ground strain to the pipe.
Prescribed dams	Nil	Nil	Narama Dam is located approximately 430m southwest of LW6B and is outside the DSC Notification Area.
ACOL goaf gas drainage infrastructure	A single goaf gas drainage borehole will be located in the south east corner of the LW6B subsidence impact area. Subsidence in this area is expected to reach approximately 0.5m to 1m.	Nil	ACOL goaf gas drainage boreholes have been designed to accommodate subsidence impacts and will not be significantly affected by mining of LW6B.
Proposed Macquarie Generation gas pipeline and easement	Nil	Nil	Macquarie Generation has indicated that it has no immediate plans to construct this pipeline. Therefore it will not be impacted by subsidence from mining of LW6B in the PG Seam. The easement will remain in place.

FEATURE	PREDICTED SUBSIDENCE EFFECT	POTENTIAL CONSEQUENCE	COMMENT
Biodiversity	Up to 1.6m of subsidence, ground tilt and strain and surface cracking generally less than 100mm wide on existing habitat areas.	No significant impacts predicted. Minor potential for deterioration or degradation in habitat quality as a result of surface cracking, ponding and changes in drainage patterns.	The excised section of Bowmans Creek located over LW6B currently provides aquatic habitat for plants and invertebrates and some limited fish passage. The fringing riparian woodland habitat is narrow and fragmented but provides potential foraging ,feeding and roosting resources for terrestrial animals. The Bowmans Creek Diversion Management Plan includes an intensive monitoring regime in the natural and diverted creek areas. The plan also includes extensive natural environment restoration and enhancement.
Archaeology	Nil	Nil	An area previously identified as a Potential Archaeological Deposit (PAD) in the vicinity of Lemington Road (AHIMS No. 37-3-0496) was re-assessed as part of prior site works and was determined not to be PAD. Two previously identified and recorded Aboriginal artefact sites (AHIMS No. 37-3-1015 and 37-3-1016) located within the potential subsidence zone associated with LW6B have been salvaged as part of the Bowmans Creek Diversion Project (AHIP 1130976). There are currently no known items or areas of Aboriginal heritage significance within the LW6B subsidence impact area. The aboriginal archaeological water hole site is located outside of the LW6B subsidence impact area and will not be impacted by secondary extraction of LW6B.
ACOL fences and gates	Ground tilt and strain.	Some fences may become ineffective and require repair.	The potentially effected land is currently unstocked.

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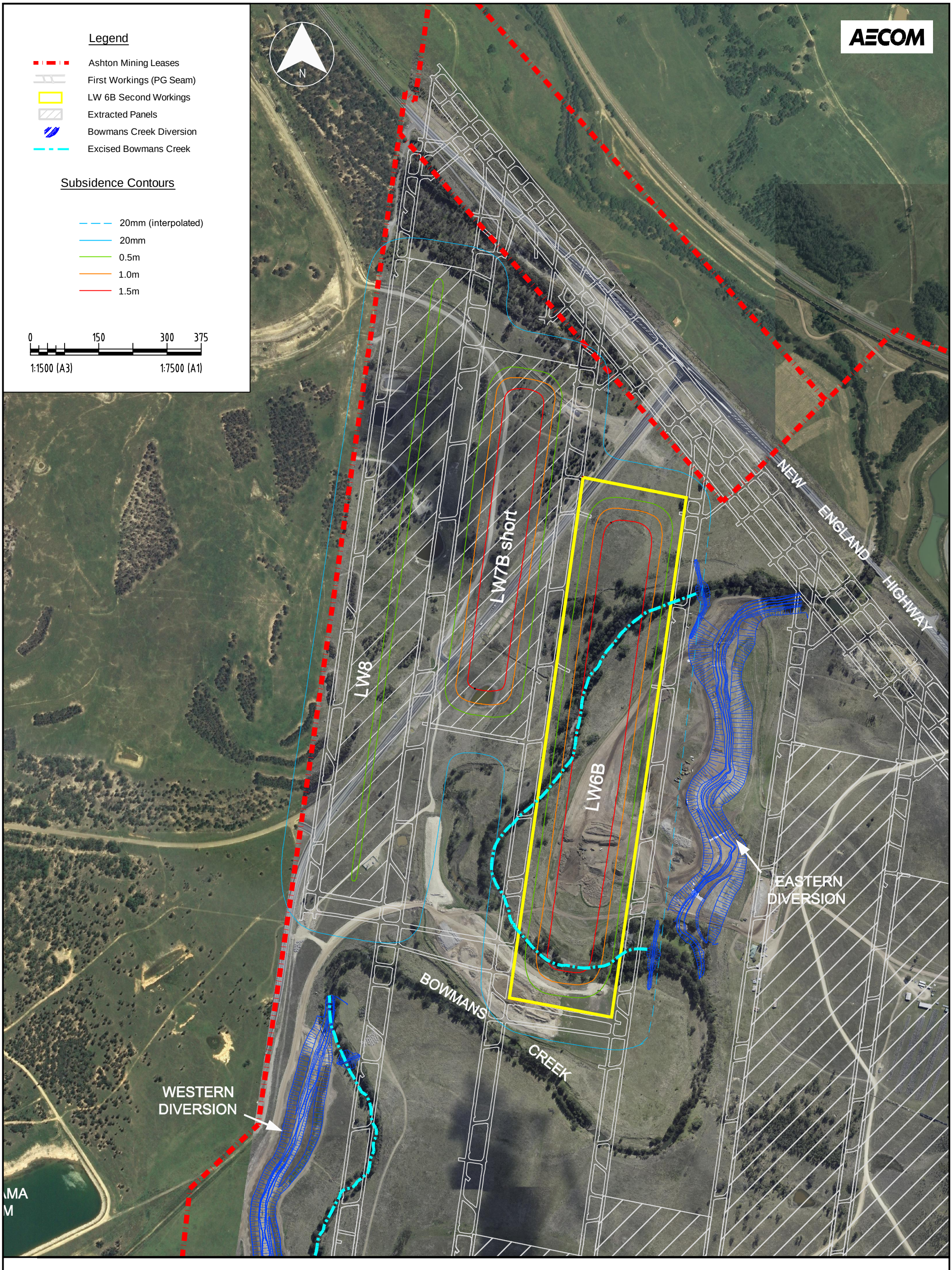

AshtonCoal

Extraction Plan
Pikes Gully Seam LW6B

Figure 5
Predicted Combined Subsidence Contours for LW6B, 7B (short) and 8

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6 SUBSIDENCE MONITORING AND MANAGEMENT

6.1 SUBSIDENCE PERFORMANCE MEASURES

Subsidence performance measures are specified under conditions 3.9 and 3.10 to Schedule 2 of DA 309-11-2001-i:

3.9 The Applicant shall ensure that underground mining does not cause any exceedances of the performance measures in Table 1, to the satisfaction of the Director-General.

Table 1: Subsidence Impact Performance Measures

Watercourses	
Bowmans Creek	No greater subsidence impact or environmental consequences than predicted in the documents referred to in condition 1.2 ac)
Bowmans Creek – Eastern and Western Diversions	Hydraulically and geomorphologically stable
Bowmans Creek alluvium	No greater subsidence impact or environmental consequences than predicted in the documents referred to in condition 1.2 ac)
Biodiversity	
Threatened species, threatened populations, or endangered ecological communities	Negligible impact or environmental consequences
Aboriginal heritage features	
Waterhole Site	Negligible impact or environmental consequence
Other Aboriginal heritage sites	No greater subsidence impact or environmental consequences than approved under a permit issued under section 90 of the *National Parks and Wildlife Act 1974*

Notes:
1) The Applicant will be required to define more detailed performance indicators for each of these performance measures in the various management plans that are required under this consent (see condition 3.12 below).
2) The requirements of this condition only apply to the impacts and consequences of mining operations undertaken following the date of approval of modification 6.

3.10 The Applicant shall ensure that underground mining does not cause any exceedances of the performance measures in Table 2, to the satisfaction of the Director-General of DRE.

Table 2: Subsidence Impact Performance Measures

Built features	
New England Highway, including the bridge over Bowmans Creek	Always safe and serviceable. Damage that does not affect safety or serviceability must be fully repairable, and must be fully repaired.
Brunkers Lane	In accordance with recommendations of the report prepared under condition 7.14.
Other built features, including other public infrastructure	Always safe. Serviceability should be maintained wherever practicable. Loss of serviceability must be fully compensated. Damage must be fully repaired or replaced, or else fully compensated.
Public safety	
Public safety	No additional risk.

Notes:
1) The Applicant will be required to define more detailed performance indicators for each of these performance measures in Built Features Management Plans (see condition 3.12 below).

2) *The requirements of this condition only apply to the impacts and consequences of mining operations undertaken following the date of modification 6.*
3) *Requirements regarding "safe" or "serviceable" do not prevent preventative or mitigatory actions being taken prior to or during mining in order to achieve or maintain these outcomes.*
4) *Compensation required under this condition includes any compensation payable under the Mine Subsidence Compensation Act 1961 and/or the Mining Act 1992.*

3.11 Any dispute between the Applicant and the owner of any built feature over the interpretation, application or implementation of the performance measures in Table 2 is to be settled by the Director-General of DRE. The Director-General of DRE may seek the advice of the MSB on the matter. Any decision by the Director-General of DRE shall be final and not subject to further dispute resolution under this consent.

More detailed subsidence performance measures and indicators have been specified within relevant management plans compiled in support of this EP. A summary, including a reference to where each performance measure and indicator is addressed, is provided in **Table 8**.

Table 8 Summary of Performance Measures and Indicators

ITEM	SUB-ITEM	PERFORMANCE MEASURE	PERFORMANCE INDICATOR	DOCUMENT REFERENCE
Watercourses	Bowmans Creek	No greater subsidence impact or environmental consequences than predicted in the documents referred to in condition 1.2ac to schedule 2 of DA 309-11-2001-i.	A (minimum) 40m setback between the underground workings and any point vertically beneath the high bank of the active Bowmans Creek is maintained.	Section 1 & Table 7
			Subsidence observations are within the revised predictions and predicted area of impact.	Table 7 & Section 5.1
			Monitoring indicates that surface water quality indicators are below trigger values identified in the WMP (refer Section 7).	Water Management Plan (Appendix G)
	Bowmans Creek Diversions	Hydraulically and geomorphologically stable	As executed report certified by a practising engineer submitted to the Director-General (DP&I) and NOW within six months of completing construction of the diversions.	As Executed Report
			Construction Inspections undertaken and certifications acquired in accordance with Table 4 of the Bowmans Creek Diversion Management Plan.	Bowmans Creek Diversion Management Plan - Refer Water Management Plan (Appendix G)
			Construction standards completion criteria identified in Table 3 of the Bowmans Creek Diversion Construction Mining Operations Plan.	Bowmans Creek Diversion Construction Mining Operations Plan - Refer Water Management Plan (Appendix G)
			Geomorphology and stream health completion criteria identified in Table 7 of the Bowmans Creek Diversion Construction Mining Operations Plan.	Bowmans Creek Diversion Construction Mining Operations Plan - Refer Water Management Plan (Appendix G)

ITEM	SUB-ITEM	PERFORMANCE MEASURE	PERFORMANCE INDICATOR	DOCUMENT REFERENCE
	Bowmans Creek alluvium	No greater subsidence impact or environmental consequences than predicted in the documents referred to in condition 1. 2ac to schedule 2 of DA 309-11-2001-i.	Baseflow monitoring results indicate impacts to baseflows are below or equivalent to predictions approved by the BCD EA and described in the WMP.	Water Management Plan (Appendix G)
			Reductions of groundwater contributions to the alluvium and baseflow are accounted for under existing Water Access Licences	
			In any licensing period enough water has been allocated to all relevant water licence accounts to cater for seepage inflows to the underground workings and consequential direct or indirect take from overlying water sources.	
			Internal underground water seepage is properly accounted for within the ACOL balance sheet for licensed water draw from the Hunter Regulated and Unregulated River System.	
			Monitoring indicates that mine inflows are below or equivalent to predictions approved by the BCD EA and described in the WMP.	
Biodiversity	Endangered populations	The overall River Red Gum Population to be managed so that the long term viability of the local population is not directly impacted by mining.	Established area of planted River Red Gum to achieve a co-dominant status in regeneration areas as outlined in the rehabilitation strategy to an area equalling 10.48ha.	Flora and Fauna (Biodiversity) Management Plan (Appendix H)
		The health of established River Red Gum individuals will be maintained until project completion.	Comparative health assessments indicate that compared to a reference site, no overall decline in tree health is observed. Recruitment of juveniles and seed bank establishment is improved above pre-mining conditions.	
	Threatened species	Threatened fauna species and their habitats are not adversely impacted.	Terrestrial fauna and habitat monitoring shows that the numbers of threatened species and the health (including recruitment) of significant populations are not declining and results are comparable or improved from the baseline surveys.	
			Monitoring shows that individuals are progressively expanding into new home ranges.	

ITEM	SUB-ITEM	PERFORMANCE MEASURE	PERFORMANCE INDICATOR	DOCUMENT REFERENCE
			Monitoring shows that key habitat features (foraging, nesting, refuge habitat) and structural complexity within remnant and rehabilitated/ compensatory habitat areas are not declining and results are comparable with the pre-mining surveys.	
		Ensure that any threatened fauna or flora that have not been identified in the EIS, but which may inhabit the site, are identified as early as practicable.	New listings and new threatened species identified during the bi-annual monitoring program are assessed for impacts and any management recommendations are incorporated into future relevant management plans.	
Aboriginal Heritage Features	Waterhole Site	Negligible impact or environmental consequence.	This site should not be impacted by the life of mine activities. The indicator of success is the retention of the Waterhole site in a stable condition upon completion of mining.	ACHMP Appendix J
	Other Aboriginal Heritage Sites over the underground mining area	Managed according to the methodology prescribed in the relevant AHIP and ACHMP.	Sites managed in accordance with the relevant AHIPs over the life of the mine.	
Built Features	Xstrata owned Assets	General	All existing infrastructure is assessed in consultation with Ravensworth Operations and any required mitigation / relocation works are carried out prior to undermining.	BFMP Appendix D
	Water Utilities	To ensure unplanned disruptions to water supply do not occur as a result of subsidence related damage to pipelines.	No unplanned interruptions to water supply occur due to subsidence induced damage to pipelines.	
	Telstra Infrastructure	To minimise telecommunications disruptions to local residents, companies or the wider community.	No loss of service. Damage to underground Telstra cables is repaired following subsidence.	

ITEM	SUB-ITEM	PERFORMANCE MEASURE	PERFORMANCE INDICATOR	DOCUMENT REFERENCE
	AAPT Fibre Optic	To maintain serviceability at all times.	No subsidence at or around the fibre optic cable.	
			No damage to the fibre optic cable.	
	ACOL Infrastructure	To ensure unplanned disruptions to ACOL operations do not occur as a result of subsidence related damage to roads, water storages, pipelines, buildings and/or power lines.	All infrastructure is assessed regularly and any required mitigation / relocation works are carried out prior to undermining.	
		To avoid public safety hazards from damaged infrastructure.	No disruptions occur due to subsidence induced damage to infrastructure.	
	New England Highway	To prevent damage to the New England Highway.	Mine plan is designed to provide sufficient barriers and controls to prevent subsidence related impacts to the New England Highway.	
		To prevent public safety hazards resulting from subsidence damage to the New England Highway.	First workings are designed to remain long-term stable.	
		To ensure the New England Highway is maintained as safe and serviceable (as it relates to impacts from subsidence).	Subsidence monitoring of the New England Highway to confirm negligible subsidence related movement.	
		To monitor and remediate subsidence induced impacts to roads.	No road hazards or disruptions to traffic occur as a result of subsidence impacts.	
			All subsidence related damage is identified and remediated as soon as practicable.	
	Lemington Road (previously referred to as Brunkers Lane)	To prevent public safety hazards resulting from subsidence damage to Lemington Road.	ACOL will implement adequate controls to ensure road traffic safety.	
		To consult with relevant stakeholders so that access along Lemington Road is not disrupted as a result of subsidence.	ACOL will continue to consult with Ravensworth (and MSB) so that all subsidence related damage is identified and remediated as soon as practicable to prevent public safety hazards resulting from subsidence damage to Lemington Road.	

ITEM	SUB-ITEM	PERFORMANCE MEASURE	PERFORMANCE INDICATOR	DOCUMENT REFERENCE
Public Safety	General	No additional (safety) risk (per condition. 3.10 Table 2 to schedule 2 of DA 309-11-2001-i).	No risk to public safety as a result of mining operations.	Public Safety Management Plan Appendix E
		To prevent personal injury as a result of subsidence impacts.	No injuries or accidents occur as a result of subsidence impacts or subsidence damage.	
			All identified public safety risks are managed quickly and appropriately to avoid injury.	
			Safety incidents recorded within the ACOL SCHECM system.	

6.2 SUBSIDENCE MONITORING

The purpose of the Subsidence Monitoring Program is to set the location and frequency of monitoring to enable subsidence effects to be detected and quantified (i.e. vertical movements, ground tilts and strains), and to trigger a management response where required.

Subsidence monitoring for LW6B was included in the Subsidence Monitoring Program for PG LW6B, 7B(Short) and 8, which was approved by DRE on 30 August 2011 as part of the SMP variation application for LW7B(Short) and 8 (see **Figure A**). This monitoring program has since been updated to provide additional monitoring arrangements specific to LW6B. The updated Subsidence Monitoring Program is provided in **Appendix C**.

The surface survey monitoring program for LW6B is generally consistent with that previously established and monitored during longwall extraction of previous PG Seam longwalls and incorporates the following:

- Centrelines to identify centreline subsidence, travelling abutment subsidence rate and residual strains and tilts at abutment; and
- Cross lines to measure subsidence, pillar compression and residual strains and tilts, assist with refinement of visualisation model, and monitor effects of adjacent longwall on creeks (natural and manmade).

Survey monitoring is also proposed for significant surface infrastructure that may be sensitive to LW6B subsidence effects, such as (but not limited to):

- Bowmans Creek Diversion – areas of the eastern diversion high bank adjacent to LW6B potentially impacted by subsidence (i.e. within the angle of draw).
- Lemington Road - this road will be directly undermined in part by LW6B.
- New England Highway, including Bowmans Creek Bridge, Lemington Road intersection and road culverts – the highway, bridge, intersection and culverts will not be undermined and are located outside the angle of draw for LW6B; and
- Narama Dam - the dam is located well beyond (approximately 430m) the extraction footprint for LW6B and outside the dam notification area.

The Subsidence Monitoring Program also summarises the monitoring of environmental and built features (as documented in other sub-plans – **Appendices D-J**).

6.3 SUBSIDENCE MANAGEMENT

Surface and sub-surface features addressed within the EP are listed in **Table 9** and **Table 10**. These features may be potentially impacted by the secondary extraction of LW6B. The location of built features is shown in **Figure 6** and environmental features are shown in **Figure 7**. Detailed descriptions of each of these features are contained within the BCD EA and also within each referenced management plan**.**

Revised subsidence predictions and impacts to these surface and sub-surface features have been provided in **Appendix A**. Management and monitoring actions for each feature are included in each of the management plans, as indicated in **Table 9** and **Table 10** below. A Trigger Action Response Plan (TARP) is provided in **Table 11**. Note colour coding of trigger criteria is described in **Table 12** (**Section 6.4**).

Table 9 Surface and Sub-Surface Features (LW6B)

FEATURE	REFERENCE
Natural Features	
Bowmans Creek and Bowmans Creek diversion	Water Management Plan (Appendix G)
Bowmans Creek floodplain	Extraction Land Management Plan (Appendix I)
Groundwater resources	Water Management Plan (Appendix G)
Threatened flora and fauna	Flora and Fauna (Biodiversity) Management Plan (Appendix H)
Public Utilities	
Relocation of Lemington Road (to be dedicated as a public road)	Built Features Management Plan (Appendix D)
Telecommunications lines	Built Features Management Plan (Appendix D)
New England Highway	Built Features Management Plan (Appendix D)
Farm Land and Facilities	
Fences and gates	Built Features Management Plan (Appendix D)
Mine Infrastructure	
Prescribed Dam Notification Area – Narama Dam	Built Features Management Plan (Appendix D)
Gas drainage infrastructure – ACOL Owned	Built Features Management Plan (Appendix D)

Table 10 Built Features by Asset Owner (LW6B)

ASSET	BRIEF DESCRIPTION	BUILT FEATURES MP - SUB-PLAN REFERENCE
Xstrata (Ravensworth Operations)		
Prescribed dam	Narama Dam (Note the DSC has recently revised the dam notification area to be outside the Ashton underground mine footprint).	Appendix D (Ravensworth Operations) Appendix K (Lemington Road)
Public Roads	Relocation of Lemington Road (to be dedicated as a public road at which time Singleton Council will become the asset owner).	
Macquarie Generation		
Private roads	Site Access Roads.	Appendix F (Macquarie Generation)
Fences	Boundary fencing, internal fencing and gates.	
Sedimentation basins	Very minor impacts to drainage line.	
Roads and Maritime Services (formerly Roads and Traffic Authority)		
Public roads	New England Highway.	Appendix G (Roads and Maritime Services)
Telstra		
Telecommunication lines	Telstra cables.	Appendix H (Telstra)
Powertel (AAPT)		
Telecommunication lines	Sydney to Brisbane fibre optic cable.	Appendix I (Powertel)
ACOL		
Proposed Goaf Gas Drainage Boreholes	Located across on Macquarie Generation and ACOL owned land.	Appendix F (Macquarie Generation) & J (ACOL)
Fences	Boundary fencing, internal fencing, gates and cattle grids.	Appendix J (ACOL)
Pipelines	Tailings Pipelines.	

Note: Additional information regarding the assets described in **Table 10** is provided within the BFMP (**Appendix D**).

Table 11 Trigger Action Response Plan (LW6B)

Aspect	Method /Parameters / Frequency	Purpose	Trigger	Response (in accordance with Table 12 - Contingency Plan and Responsibilities)	Responsibility	
					Accountable	Monitoring
Subsidence parameters						
Subsidence parameters	Refer to Subsidence Monitoring program - include vertical subsidence, tilts and strains.	To obtain additional subsidence data and verify subsidence modelling at ACP.	Subsidence observations exceed predicted values.	Refer to Table 12.	TSM	TSM
Built Features						
New England Highway	Detailed highway monitoring program as per Built Features Management Plan.	To verify no subsidence impacts experienced to New England Highway infrastructure and to ensure highway remains safe and serviceable.	Impacts observed to New England Highway, Bowmans Creek bridge, road culverts or Lemington Road intersection.	Refer to Built Features Management Plan - Roads & Maritime Services Asset Management Plan.	TSM	TSM
Floodplain						
Surface Ponding	Visual inspection of low lying areas following heavy rainfall (> 50mm in 24 hours).	To identify areas of ponding as a result of local runoff or catchment flood flows.	Formation of surface ponding on floodplain / overbank areas following local rainfall - no correlated increase in mine inflows following formation of surface ponding.	Continue to monitor and undertake remediation of ponding (to provide free-draining landform) at completion of longwall panel. Refer to Extraction Land Management Plan. Immediately remediate where risk to people, surface infrastructure or livestock is identified.	ME	ECRC
Alluvial material stockpiles (as a result of the creek diversion construction)	Visual inspections following heavy rainfall (>50mm in 24 hours) and weekly during active subsidence.	To ensure adequate vegetative cover and integrity of clean water diversion bunds and erosion controls.	Damage to bunds, damaged or limited sediment capacity remaining behind sediment fences, loss of vegetative cover over area (>10m^2) over alluvial stockpiles or bund walls.	Repair bund and revegetate. Reinstate sediment fence. Remove captured sediment from behind sediment fence and dispose of appropriately (e.g. within surface operations). Revegetate disturbed areas of stockpile with similar grass species.	ME ME ECRC	ECRC
Surface cracking (land surface generally)	Weekly visual inspection of the area immediately behind the longwall face. Mapping of cracking to be monitored and recorded using GNSS.	To identify areas of subsidence cracking that require remediation, therefore reducing risk of erosion and enhanced infiltration of surface water runoff.	Persistent surface cracking (i.e. have not closed within one month of longwall pass)	Persistent cracking repaired after development of full subsidence for given longwall by filling or ripping, and revegetated to prevent erosion and reduce potential safety risks to people and livestock. Temporary fencing may be implemented if necessary during the interim period between the longwall face passing and when remediation measures are undertaken (refer to Land Management Plan and Public Safety Management Plan).	ME ME	ECRC
Bowmans Creek (Excised Channel)						
Surface cracking of excised creek banks or creek bed	Visual inspection, where possible, of the area immediately behind the longwall face. Mapping of cracking to be monitored and recorded using GNSS.	To identify areas of subsidence cracking that require remediation, therefore reducing risk of erosion and reducing infiltration of surface water flows/ ponding in excised channel.	Persistent surface cracking (i.e. have not closed within one month of longwall pass).	Maintain stockpile of suitable materials (e.g. clay / alluvial material) for repairing cracking in excised creek bed. Repair cracking of creek banks or creek bed as follows: • Assess and install sediment and erosion controls as appropriate to the location of cracking (i.e. sediment fences, silt curtain / floating boom, coffer dam or temporary water diversion). • By hand and light machinery, fill cracks with clay and compact, and provide surface layer of alluvial material (i.e. gravel - cobbles size rock). • Remove erosion and sediment controls. Inspect weekly for a period of 2 months to ensure no ongoing erosion or further cracking - if any noted, repeat process. Subsequent management as per Extraction Land Management Plan.	ME ME then ECRC	ECRC

Aspect	Method /Parameters / Frequency	Purpose	Trigger	Response (in accordance with Table 12 - Contingency Plan and Responsibilities)	Responsibility	
					Accountable	Monitoring
Erosion - drainage lines	Visual inspections following heavy rainfall (>50mm in 24 hours) and weekly during active subsidence.	To identify changes to the surface (erosion, development of nick points) which require remediation to prevent ongoing erosion.	Nick points or active erosion observed during routine inspections.	Implement temporary sediment controls (i.e. install sediment fence immediately downslope). Assess site, and once active subsidence is considered complete, undertake stabilisation / reshaping works to prevent ongoing erosion, and stabilise with vegetation or erosion control product. Inspect monthly until adequate soil coverage and vegetation establishment has been achieved. If ongoing erosion is noted, reassess and implement additional or alternate remediation.	ME	ECRC
Bank and bed stability	Weekly visual inspection noting any areas of recent bank collapse, erosion or instability.	To identify changes to the surface (erosion, development of nick points or head cut) which require remediation to prevent ongoing erosion.	Observation of bank slump or erosion. Observation of bed head cut.	Undertake assessment of site, with assistance of appropriately qualified person. Install temporary sediment and erosion controls as appropriate. Review options for longer term stabilisation and revegetation or remediation of affected area.	ECRC	ECRC
Pools within excised creek channels	Installation of depth markers in pools above LW6B and one control site for recording of water depth during weekly visual inspections.	To establish a pre-subsidence baseline and monitor depth of water in surface pools to identifying potential increase in surface water loss due to surface or sub-surface cracking.	Observed water level drop at impacted markers drop by 10% or greater over a 1 week period compared to control pool outside impact zone or consistent downward trend in water level not relative to observations at control site over time.	Increase water level monitoring frequency to daily. Site inspection by aquatic ecologist and assessment of potential mitigation actions to minimise impact to aquatic fauna, may include trapping and relocation of large invertebrates, or additional monitoring of aquatic health at pool location. Review of potential groundwater implications by hydrogeologist, including, as appropriate: review of groundwater monitoring data (i.e. alluvial water levels, mine water inflows, water quality parameters) and confirmation that groundwater monitoring observations are within predicted limits (refer to Water Management Plan TARP). Develop recommendations for any additional groundwater investigation / monitoring that may be required or possible mitigation options. Undertake site inspection to identify any surface cracking within creek bed and remediate as per above Trigger (after any relocation of fauna has been completed).	ME	ECRM
Bowmans Creek (diverted sections)						
Diversion channel banks and block banks	Detailed survey monitoring as described in the Built Features Management Plan (ACOL AMP).	To establish a pre-subsidence baseline and monitor the stability of the western high bank, banks of the diverted channel (eastern diversion) and installed block banks.	Subsidence observations exceed predicted values.	Refer to Built Features Management Plan - ACOL Asset Management Plan.	ECRC	ECRC
Surface Water						
Surface water quality	Routine surface water monitoring is undertaken in accordance with Table 9.2 of the WMP. This includes (but is not limited to): • Monthly monitoring – water quality screening analysis, observable water quality issues. • Annual – comprehensive water quality analysis. • Flood event - Field analysis of EC and pH (1:20 yr and/or 1:100yr event). • Sampling locations – SM3 and SM4 upstream, and SM5 – downstream.	To monitor surface water quality parameters and identify if degradation of water quality is occurring as a result of subsidence and associated environmental consequences.	Monitoring results outside of the impact assessment criteria stated in Section 7.2.2 of the Water Management Plan, with reference to background water quality levels.	Investigate potential causes: • Conduct visual inspection to ascertain if any obvious causes are visible (e.g. broken pipe, discharge from dam etc.). • If cause identified implement immediate repairs. If no obvious visible cause then: • Engage a Hydrologist to undertake a preliminary investigation and report on any identified changes if required. • Confirm trends or anomalies by repeating water quality and sampling of impacted streams as required. • Compare exceedance with climatic conditions. Where investigations determine that impacts are the result of ACOL operations and may potentially impact down stream surface water users, implement actions as per Section 10.1 of the Water Management Plan	ECRC	ECRC

Aspect	Method /Parameters / Frequency	Purpose	Trigger	Response (in accordance with Table 12 - Contingency Plan and Responsibilities)	Responsibility	
					Accountable	Monitoring
Surface water flows (Bowmans Creek)	Routine surface water monitoring is undertaken in accordance with Table 9.2 of the WMP. This includes (but is not limited to): • Monthly water level monitoring, or immediately following a flow event in Bowmans Creek of greater than 150m^3/s. • Visual observation of changes to stream banks and surrounding areas - monthly. • Observable water quality issues - monthly. • Water quality screening analysis - monthly. Water quality comprehensive analysis – annually.	To identify any stream flow impact due to mining.	Observation of variation in flow within Bowmans Creek (unexpected change in relative flow quantities or depths of water) between successive monitoring sites.	Actions as per Water Management Plan including assessment by hydrogeologist/hydrologist to undertake a preliminary investigation, confirm trends and report on any identified changes. Immediately repair any visual subsidence cracks across water ways and drainage lines. If there is any indication that significant drainage of the alluvium is occurring, or there is a loss of stream flow, due to cracking, the full height block banks will be constructed immediately (if not already complete).	ECRC	ECRC
Mine inflow	Routine underground mine flow monitoring is undertaken in accordance with Table 9.4 of the WMP. This includes (but is not limited to): • Daily inspection by mining supervisors. • Monthly collection of flow rate data from pumping stations. • Fortnightly water quality samples for on-site screening (quarterly or following a sudden increase in flow rate or discolouration of the water). • Water quality comprehensive analysis – annually. • Review BOM Forecasts and flood warnings daily during wet weather.	To evaluate/identify potential operational risk that is posed by increased ponding or flow in the excised creek channel and entering the mine workings via connective cracking above LW6B. Identify trends in bulk water salinity as a means of identifying new sources of mine seepage inflows as mining progresses.	Increase in mine inflows of 40% above normal flow rates (as predicted in Section 7.3.5 of the Water Management Plan) AND identification of surface ponding.	Provide surface diesel pump and associated equipment on standby. Continue to monitor and undertake remediation of ponding (to provide free-draining landform) at completion of longwall panel. Increase block banks to full height.	ME	ECRC (TSM)
			Observed mine inflows of 50% above normal flow rates sustained for three consecutive months (as per Section 7.3.5 of the Water Management Plan) AND identification of surface ponding. OR Sudden inrush that is outside of the anticipated trend OR Sudden decrease in TDS	Actions as per Inrush Management Plan. Evacuate underground workings if significant inrush of water occurs underground or appears likely to occur. Undertake assessment to reduce volume of overland ponding post-flooding as soon as practicable, including: • Employ diesel pump to reduce volume of water ponded on surface by pumping downstream to Bowmans Creek. • Undertake temporary drainage works using dozer or similar to prevent impoundment / assist discharge to Bowmans Creek (any such works to incorporate appropriate erosion controls in accordance with the Erosion and Sediment Control Plan or as determined by appropriate specialist). (Note: water is considered to be clean catchment runoff that would otherwise drain to Bowmans Creek – therefore, is considered that no licence is required to discharge this water). As per Extraction Land Management Plan and Water Management Plan, priority is given to rapid identification of subsidence cracks, ripping, backfilling and compaction of subsidence troughs and addressing the drainage of ponded water to achieve a free draining landform, and reduce ponding, and therefore mine infiltration. Continue to monitor and undertake remediation of ponding (to provide free-draining landform) at completion of longwall panel.	ME	TSM (ECRC)
			Increase in mine inflows of 50% above normal flow rates sustained for three consecutive months (as per Section 7.3.5 of the Water Management Plan) AND **NO** identification of surface pond. OR Sudden inrush that is outside of the anticipated trend. OR Sudden decrease in TDS.	Actions as per Water Management Plan including assessment by hydrogeologist/hydrologist to undertake a preliminary investigation and report on any identified changes. Actions as per Inrush Management Plan. Evacuate underground workings if significant inrush of water occurs underground or appears likely to occur. Where investigations determine that impacts are the result of ACOL operations and may potentially impact on adjacent bores or surface water users, implement actions as per Section 10.1 of the Water Management Plan.	ME	ECRC

Aspect	Method /Parameters / Frequency	Purpose	Trigger	Response (in accordance with Table 12 - Contingency Plan and Responsibilities)	Responsibility	
					Accountable	Monitoring
Groundwater						
Groundwater level	Water level monitoring in relevant piezometers. Two weeks prior to and fortnightly during mining of LW6B.	To identify any groundwater level impact due to mining and to evaluate potential operational risk that is posed by flows entering the excised creek channel and entering the mine workings via connective cracking above LW6B. To identify the extent of vertical cracking from the goaf to the ground surface.	Observed variation in measured groundwater levels outside predicted levels or climatic variation. OR Consistent trend in water level over time (using at least 3 months data) that indicates trigger may be reached during the mining period. OR Sudden drawdown in measured groundwater levels (100% of the predicted drawdown). OR Significant increased flow reporting to UG (>25%).	Refer to Water Management Plan Review by hydrogeologist of observed data, prevailing climatic conditions and preparation of preliminary report and recommendations including: ▪ Identify cause/source. ▪ Identify implications (operations, licensing, environmental impacts, surface capacity). ▪ Repeat sampling to confirm exceedance or anomaly. ▪ Increase frequency of monitoring to identify if exceedance is an isolated event or ongoing trend. Where investigations determine that impacts are the result of LW6B operations, implement actions as per Section 10.1 of the Water Management Plan.	ECRC	ECRC
Groundwater quality	Water quality sampling of groundwater bores on a quarterly (screening analysis) and annual (comprehensive analysis) basis.	To identify and confirm trends versus predicted impacts and to identify physical and/or chemical water quality impacts related to mining.	Changing trend in measured parameters by outside limits of baseline levels (as per Section 7.3.3 of the Water Management Plan).	Refer to Water Management Plan. Review by hydrogeologist of observed data, prevailing climatic conditions and preparation of preliminary report and recommendations including: ▪ Identify cause/source ▪ Identify implications (operations, licensing, environmental impacts, surface capacity) ▪ Repeat sampling to confirm exceedance or anomaly; ▪ Increase frequency of monitoring to identify if exceedance is an isolated event or ongoing trend. Where investigations determine that impacts are the result of ACOL operations and may potentially impact on adjacent bores or surface water users, implement actions as per Section 10.1 of the Water Management Plan.	ECRC	ECRC
Biodiversity						
Riparian vegetation	Biannual monitoring of transects and quadrats along Bowmans Creek (includes both control and impact sites), noting dominant and sub-dominant species, percentage cover of each structural layer, level of disturbance and condition rating, evidence of regeneration, and targeted searches for threatened flora species. Each site to be also monitored via photographic record.	To identify changes in vegetation composition and structure occurring along Bowmans Creek over time.	Dieback or loss of small number of riparian trees (<10%).	Consider leaving in place (as roosts or perches for bats / birds of prey) or use of stags for use in diversions (e.g. to create woody debris) or within revegetation area as habitat for small ground-dwelling mammals and reptiles. Plant replacement trees of same species (or alternate species selection in keeping with longer-term rehabilitation objectives / plans).	ECRC (ME)	ECRC
			Decline in species diversity or condition, relative to a control site, over time (e.g. foliage cover and species number at any key strata level no longer broadly comparable to a control site or pre-mining condition).	Investigate site specific changes against upstream and downstream reference sites. If changes mirrored in reference sites, investigate possible regional, climatic or seasonal basis for deterioration based in the first instance. Compare observations to predicted impacts in EA (i.e. some change in riparian vegetation is anticipated following construction of diversion). If within predictions, or a result of regional, seasonal or climatic conditions - no further action other than reporting in biannual reports and AEMR. If site specific deterioration is not able to be linked to other site changes (i.e. not regional, seasonal, climatic), and outside that predicted in the EA, investigate links between site changes, water quality and habitat quality changes and check against groundwater monitoring trends. Reference should be made to the key considerations in Table 1 of the Biodiversity Management Plan. If causes determined to be site specific initiate reporting procedures. Investigate possible links with mining then develop mitigation measures and/or action plan as necessary.	ECRC	ECRC

Aspect	Method /Parameters / Frequency	Purpose	Trigger	Response (in accordance with Table 12 - Contingency Plan and Responsibilities)	Responsibility	
					Accountable	Monitoring
Terrestrial fauna and habitat	Fauna surveys as per methodology in Biodiversity Management Plan, including targeted searches for threatened species. Biannually in spring and summer. Amphibian surveys - concurrent with surveys above, or if no rainfall has been recorded for the season, the amphibian survey must take place in the last week of the season.	To assess the continued survival and management of the native flora and fauna within the study area.	Terrestrial fauna and habitat monitoring shows that the numbers of threatened species and the health (including recruitment) of significant populations are declining and results are not comparable or improved from the baseline surveys. Monitoring shows that key habitat features (foraging, nesting, refuge habitat) and structural complexity within remnant and rehabilitated/ compensatory habitat areas are declining and are not comparable or improved from the baseline surveys. Where overall monitoring trends indicate a negative impact to species diversity or abundance.	Investigate in accordance with the key considerations in Table 1 of the Flora and Fauna (Biodiversity) Management Plan. Develop strategy to ensure viability of local population is maintained or enhanced (may include provision of additional habitat resources i.e. nest boxes, ground logs/hollows, and additional habitat planting).	ECRC	ECRC
Riparian habitat condition & diversity	Site habitat diversity assessment using RCE/ AusRivAS protocols with site SIGNAL indices & site photo referencing photos. Fish sampling using overnight bait traps. Biannual surveys (spring and autumn) at both short and long term sites. Short term sites to be sampled at same time as long-term sites: at least once prior to LW6B and at least twice following completion of LW6B.	To identify any potential mining-related impact. To monitor long-term seasonal and site related changes/trends pre, during and post mining, to aid in identifying any impacts related to mining.	Significant deterioration or continuing downward trend in target species diversity or site SIGNAL compared to pre-mining conditions, with regard to seasonal, climatic baseline variations. Trigger is individual Site Diversity or SIGNAL value below the lower value of: Standard Deviation of the mean Site Diversity or SIGNAL value obtained from previous sampling.	Investigate site specific changes against upstream and downstream reference sites. If changes mirrored in reference sites, investigate possible regional, climatic or seasonal basis for deterioration based in the first instance. If regional, seasonal or climatic - no further action other than reporting in biannual reports and AEMR. If site specific deterioration is not able to be linked to other site changes (i.e. not regional, seasonal, climatic), investigate links between site changes, water quality and habitat quality changes and check against groundwater monitoring trends. Reference should be made to the key considerations in Table 1 of the Flora and Fauna (Biodiversity) Management Plan. If causes determined to be site specific initiate reporting procedures. Investigate possible links with mining then develop mitigation measures and/or action plan as necessary. Continue to monitor short-term sampling sites biannually until evidence of mining-related impact has been remediated / mitigation measures have been proven to be effective.	ECRC	ECRC
Archaeology						
Unknown archaeological sites	Opportunistic observation.	To ensure Aboriginal heritage is managed in accordance with the approved ACHMP and AHIP 1130976.	The discovery of any previously unrecorded Aboriginal heritage sites or discovery of skeletal remains.	Surface works will cease in the immediate area immediately and the area secured. Assessment of the site/object/remains and subsequent management of the site will be carried out in accordance with the protocols provided in the Site ACHMP and AHIP 1130976.	ECRC	ECRC

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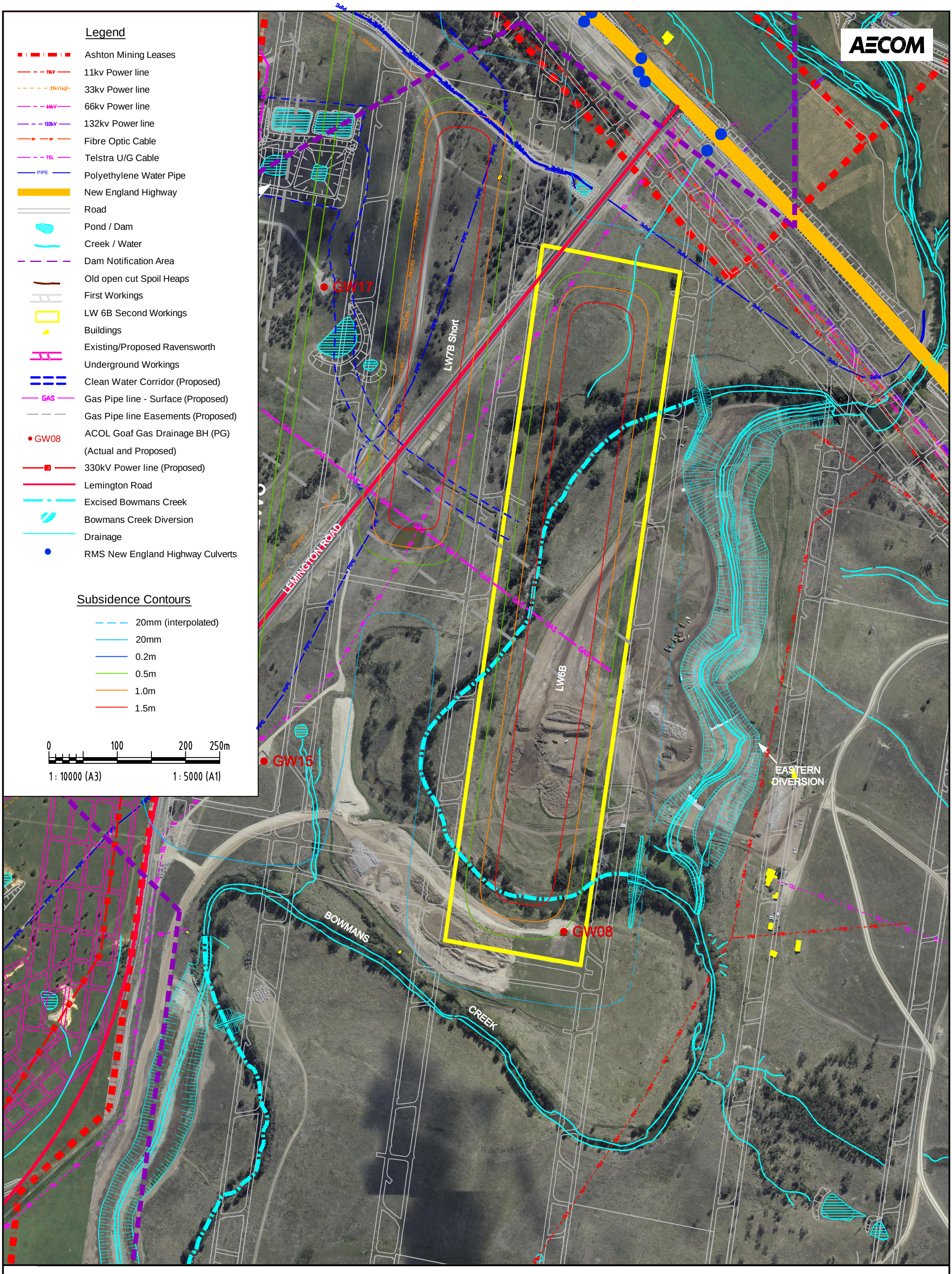

AshtonCoal

Extraction Plan
Pikes Gully Seam LW6B

Figure 6
Location of Existing &
Proposed Built Features

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Legend

- Ashton Mining Leases
- Pikes Gully First Workings
- Grey-Crowned Babbler
- Squirrel Glider
- *Acacia pendula*
- LW 6B Second Workings (PG)
- AHIP Boundary - 1130976
- AHIP Boundary - 1131017
- Saturated Alluvium
- Excised Bowmans Creek
- Bowmans Creek Diversion
- Drainage
- AHIMS Site

Subsidence Contours

- 20mm (interpolated)
- 20mm
- 0.5m
- 1.0m
- 1.5m

0 150 300 375

1:1500 (A3) 1:7500 (A1)

AECOM

0798 1014 1015 1016 0496 0499 1017 0495 0542 1018 0556 0543 0558 1147 0514 1148 0547 0512 05 1141 055 0006 051 0581 0502 0501 0511 0503 1153 0535 1059

LW8 LW7B LW6B LW4B LW6A LW5 LW4A LW3

NEW ENGLAND HIGHWAY

EASTERN DIVERSION

WESTERN DIVERSION

BOWMANS CREEK

AshtonCoal

Extraction Plan
Pikes Gully Seam LW6B

Figure 7
Environmental Features

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6.4 CONTINGENCY RESPONSE

In the event that observed subsidence impacts exceed the performance measures identified in **Section 6.1** (and relevant management plans), the following process and actions will be implemented (as further detailed in **Table 12**):

- The observation will be reported to the Technical Services Manager (Underground) or Environment and Community Relations Manager as soon as practicable, ideally within 24 hours.
- The observation will be recorded for the purposes of the SMP Status Report (provided to DRE, refer to Section 7.5).
- **Assess** public safety and where applicable, implement safety measures in accordance with the Public Safety Management Plan or as otherwise necessary to prevent injury or harm to any person.
- **Immediately report** any pollution incident that has caused or is threatening to cause material harm to the environment to the EPA and other authorities as required under the Protection of the Environment Operations Act 1994.
- **Report** any other incident to the relevant stakeholders (as identified in each sub-plan to this EP) as soon as practicable after ACOL becomes aware of the occurrence.
- **Investigate** in consultation with affected stakeholders (where appropriate) to evaluate the contributing factors to the exceedance. The investigation may include (where applicable) for example:
    - Re-survey of the relevant subsidence monitoring lines;
    - Re-sampling or re-surveying of the applicable environmental monitoring locations (i.e. groundwater bores, surface water monitoring sites);
    - Review measured subsidence parameters against the observed impact, and latest subsidence predictions; and
    - Determine appropriate remedial response.
- **Implement** remedial action and/or adaptive management measures, dependent on the outcomes of the above investigation. Any such measures will be undertaken in consultation with the relevant stakeholder and/or to the satisfaction of the appropriate government agency and DP&I.
- **Review** the subsidence management and subsidence monitoring program, where appropriate to reduce the risk of future incidents; and
- Revise future plans and implement change where required.

Table 12 Contingency Plan and Responsibilities

	Normal Subsidence and associated consequences within predicted limits.	**Level 1** Subsidence and associated consequences considered likely to exceed predictions *or* Minor incident / exceedance observed.	**Level 2** Subsidence and associated consequences considered likely to significantly exceed predictions *or* Major incident / exceedance observed.
PERSON RESPONSIBLE	⇩	⇩	⇩
SURVEYOR	Work to continue as normal and in accordance with development consent and mining / environmental management plans.	– Report to TSM and ME. – Additional survey of surface area to confirm subsidence impacts and effects, where required.	– As per Level 1 but respond **immediately**.
MINING ENGINEER (ME)		– Investigate area and advise of additional works or remediation, where required. – Increase monitoring frequency in immediate vicinity, where required. – Consult with external expert for advice where appropriate. – Report findings and recommendations to TSM. – Report incident / response in SMP Status Report.	– As per Level 1; and – **Immediately** report findings and recommendations to TSM (this may include recommendations to temporarily halt longwall extraction).
TECHNICAL SERVICES MANAGER (TSM)		– Review investigation(s). – Review information, and **approve** and instruct implementation of remediation / corrective action / or compensation, if necessary. – Report findings and recommendations to MM and/or ECRM and/or GM, where required.	– As per Level 1 but respond **immediately**; and – In making recommendations review need to halt longwall extraction; – Consult with external expert for advice where appropriate; – As soon as practical notify DRE, MSB and PSE on corrective actions; – As soon as practical notify relevant stakeholders, including infrastructure owners, of impacts.
ENVIRONMENT & COMMUNITY RELATIONS COORDINATOR (ECRC)		– Investigate area and advise of additional works or remediation where required. – Increase monitoring frequency in immediate vicinity, where required. – Consult with external expert for advice where appropriate. – Review information, and **approve** and instruct implementation of remediation / corrective action / or compensation, if necessary. – Report findings and recommendations to TSM and/or MM and/or GM where required. – Report incident and response in AEMR, where required.	– As per Level 1 but respond **immediately**; and – As soon as practicable, notify DP&I and relevant agency of impacts where required (e.g. OEH, DRE, NOW) and report on corrective actions.
MINE MANAGER (MM)		– Ensure adequate resources are available for implementation of remediation / correct actions. – Report to GM, where required.	– As per Level 1 but respond **immediately**.
GENERAL MANAGER (GM)		– Review information, and **approve** and instruct implementation of remediation / corrective action / or compensation, if necessary.	– As per Level 1 but respond **immediately**.

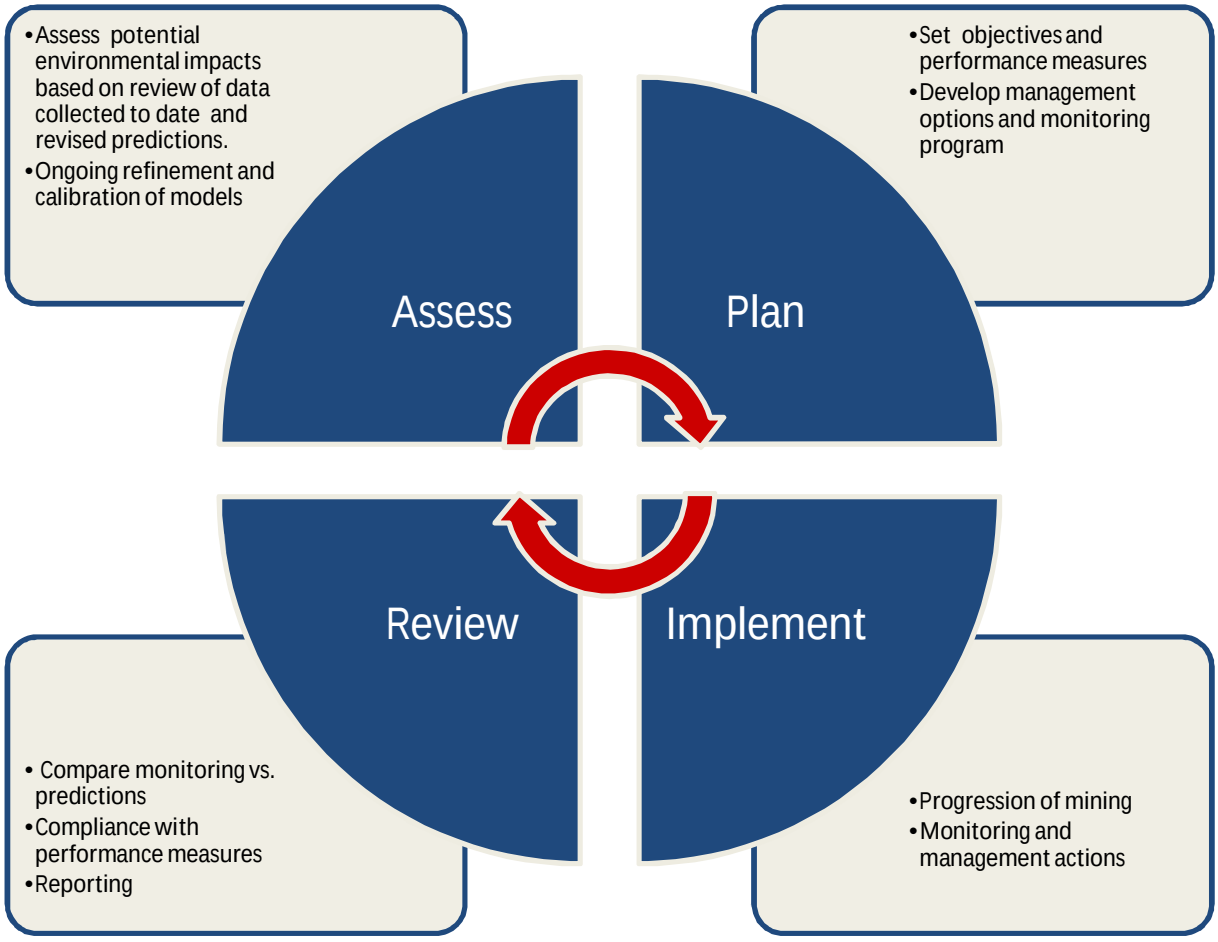
7 IMPLEMENTATION

7.1 ADAPTIVE MANAGEMENT

ACOL's approach to managing subsidence and environmental impacts at the ACP includes using past performance to guide and improve future monitoring and management actions.

Monitoring of the environment, geological conditions and the subsequent response to mining has been in place at ACOL since prior to mining and has led to an improved understanding of the environment and site-specific subsidence behaviour. Updated information is then incorporated into ACOL's management plans through each phase of mine planning (e.g. EPs) and reviewed when required. This adaptive management approach is illustrated in **Figure 8**.

Figure 8 Adaptive Management Loop



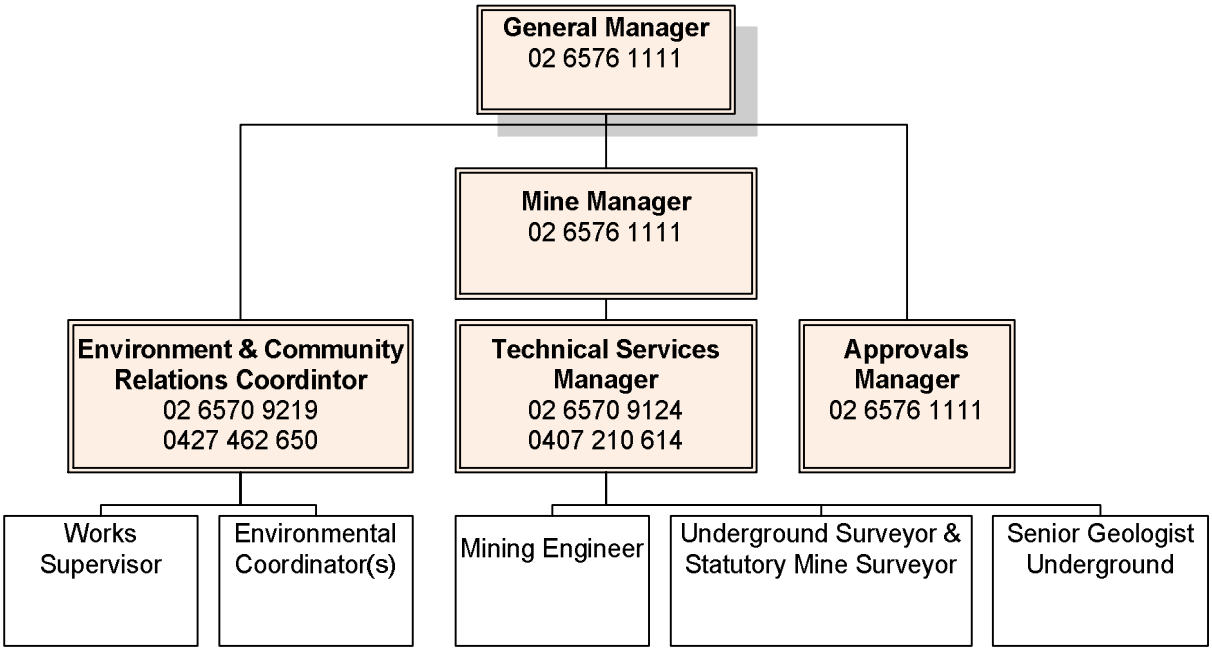
7.2 RESPONSIBILITIES AND RESOURCES

Table 13 Roles and Responsibilities

ROLE	RESPONSIBILITIES
General Manager	▪ Ensure all ACOL personnel are committed to implementing the monitoring and management regime described in the EP. ▪ Ensure that adequate resources are available to ACOL personnel to facilitate the completion of their responsibilities under this EP.
Underground Mine Manager	▪ Ensure the Subsidence Monitoring Program, Built Features Management Plan and Public Safety Management Plan are adhered to.
	▪ Ensure that adequate resources are available to ACOL personnel to facilitate the completion of their responsibilities under the Built Features Management Plan and Public Safety Management Plan.
Environment and Community Relations Manager	▪ Ensure that all environmental monitoring and reporting is undertaken in accordance with the relevant environmental management plans and various approval requirements, and is checked, processed, filed and appropriately reported.
	▪ Ensure that the ongoing community consultation processes detailed in the Built Features Management Plan are carried out.
	▪ Prepare and maintain a stakeholder contact register.
	▪ Ensure that audits and reviews are carried out as detailed in the Plans.
Technical Services Manager	▪ Ensure that all monitoring and reporting is carried out within the timeframes specified, checked, processed and filed and appropriately reported.
	▪ Liaise with stakeholders regarding subsidence impact management.
Underground Surveyor and Statutory Mine Surveyor	▪ Ensure that all subsidence monitoring is carried out to the accuracy required within specified timeframes and are checked, processed, filed and appropriately reported.

The ACOL organisation chart, as relevant to this EP is provided in **Figure 9**. The full organisation structure for the underground mine is contained within ACOL's Site Safety Standards "Structure and Responsibility Charts".

Figure 9 Organisation Chart



7.3 COMMUNICATIONS

Each of the detailed environmental and infrastructure management plans (see Appendices) include communications protocols and notification schedules with affected landowners, infrastructure owners, government agencies and the community, along with responsibilities for undertaking those tasks.

Any major amendments to the individual management plans will be completed in consultation with the relevant stakeholders and in accordance with the development consent requirements.

7.4 REVIEW

The following reporting and review processes will be implemented in accordance with ACOL's EMS to ensure that the performance of this EP and sub-plans is monitored and to indicate whether improvements to subsidence monitoring or management are required.

7.4.1 Audits and Reviews

An internal review of the EP and/or associated sub plans may be conducted if:

- An incident is recorded as a result of subsidence (refer to **Section 6.4**);
- There is a significant change in operation that may affect the environment or the community;
- Required to do so by any statutory requirements or directions/conditions of approvals; or
- Recommended as a result of internal or external audits.

This EP may also be audited (where required) under the scope of any external environmental compliance audits.

Consideration will be given to updating this plan, or sub-plans, as a result of audits/ reviews, on in response to feedback on the following reports.

7.5 REPORTS

A copy of the approved EP will be placed on the ACOL website for public information.

In addition to the EP reporting requirements other reports are required under various conditions of consent and other statutory obligations. This includes:

- Annual Environmental Management Report (AEMR);
- End of Panel Reports;
- SMP Status Reports ; and
- Reporting required for any monitoring undertaken (includes water and groundwater quality, heritage, land and flora and fauna monitoring).

7.5.1 Annual Environmental Management Report

The Annual Environmental Management Report (AEMR) is the primary reporting tool for performance at ACOL. The AEMR is required to be prepared under the development consent and its purpose is to review the performance of the mine against the EMS and the relevant MOPs, the conditions of this consent, and other licences and approvals relating to the mine. The AEMR is required to include:

- An annual compliance audit of the performance of the project against conditions of the consent and statutory approvals; and
- Assess the development against the predictions made in the EIS and the terms and commitments.

Once finalised and approved, the AEMR will be made available on the ACOL website.

7.5.2 End of Panel Report

ACOL has also committed to the ongoing preparation of End of Panel reports at the completion of each longwall under the development consent (a typical condition of a Subsidence Management approval under the ML). End of Panel reports will include:

- Summary of the subsidence monitoring results for the applicable longwall panel;
- Analysis of the monitoring results against the impact assessment criteria, predictions in the EA/EIS and monitoring results from previous panels;
- Discussion of any trends in the monitoring results over the life of the mine; and
- Description of actions taken to ensure adequate management of any subsidence impacts due to longwall mining.

End of Panel reports will be submitted to DP&I, DTIRIS and NoW.

7.5.3 Subsidence Management Plan Status Reports

ACOL will prepare and maintain a SMP Status Report which will include a summary of any:

- Subsidence management actions undertaken in the period;
- Comments, advice and feedback from consultation with stakeholders in relation to subsidence management undertaken in the reporting period and a summary of ACOL's responses;

- Observed and/or reported subsidence impacts, incidents, service difficulties, community complaints, and any other relevant information reported to ACOL in the reporting period and a summary of ACOL's response to these issues;
- Subsidence development based on monitoring information compared with any defined triggers and/or the predicted subsidence (to facilitate early detection of potential subsidence impacts);
- Adequacy, quality and effectiveness of the implemented management processes based on the monitoring and consultation information summarised above; and
- A statement regarding any additional and/or outstanding management actions to be undertaken or the need for early response or emergency procedures to ensure adequate management of any potential subsidence impacts due to longwall mining.

The SMP Status Report will be updated at least every 14 days and regularly submitted to the Principal Subsidence Engineer (DRE) and the owners of affected infrastructure. The status report will also be available upon request to the Mine Subsidence Board, Director of Environmental Sustainability (DRE), Principal Subsidence Engineer (DRE) and owners/operators of any affected infrastructure.

7.6 DOCUMENT CONTROL AND QUALITY ASSURANCE

This EP and supporting documents will be controlled as part of the ACOL Safety Health Environment and Community Management (SHECM) Document Control System. This system provides for all SHECM documents to be available via an electronic control system to personnel whose activities are dependent upon them. Furthermore, all documents and data must be:

- Prepared, reviewed and revised to determine adequacy, by authorised personnel;
- Dated, with revision status indicated;
- Legible, and maintained in an orderly manner; and
- Retained for specific periods.

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