
ASHTON COAL PROJECT

UPPER LIDDELL SEAM EXTRACTION PLAN LW 105 - 107

Version December 2015

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Version History

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				Name/Position	Date
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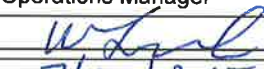
Abbreviations

ACHMP	Archaeology and Cultural Heritage Management Plan
ACOL	Ashton Coal Operations Pty. Limited
ACP	Ashton Coal Project
AEMR	Annual Environmental Management Report
CRRP	Coal Resource Recovery Plan
DPI Water	Department of Primary Industries Water (Previously NSW Office of Water)
DP&I	Department of Planning & Infrastructure
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	<i>Environmental Planning and Assessment Act 1979</i> (NSW)
EPL	Environmental Protection Licence
ERM	Environmental Resources Management (Australia) Pty Ltd
km	kilometres
LB	Lower Barrett Seam
LMP	Land Management Plan
LW	Longwall
m	metres
mm	millimetres
MOP	Mining Operations Plan
MPR	Marine Pollution Research Pty Ltd
Mtpa	million tonnes per annum
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
SCT	SCT Operations Pty Ltd
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 <i>Environmental Planning and Assessment Act 1979</i> 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.

Extraction Plan	
Name of Mine	Ashton Coal Mine
Name of Applicant	Ashton Coal Operations Pty Ltd
Development Consent Number	DA-309-11-2001-i
Mining Authorisations (Leases/Licence No.)	ML 1529, ML 1533 and ML 1623
Document Title	Extraction Plan LW 105 – 107
Document Reference Number	ExtPlan-EP Main Doc_ULDLW105-107_vDec Update vFinal.docx
Name of Person responsible for the Accuracy and Comprehensiveness of the Information Contained in this Plan	James Barben Environment and Community Coordinator
Signature	
Date	4/12/2015
Name of Representative(s) of the Authorisation Holder(s)	William Farnworth Operations Manager
Signature	
Date	2/12/2015

1 INTRODUCTION

1.1 OVERVIEW

This Extraction Plan (EP) details the monitoring, management and reporting activities to be undertaken in connection with secondary extraction of Longwalls (LW) 105 to 107 in the Upper Liddell (ULD) Seam. These longwall panels are located within the approved Ashton Coal Operations Pty Ltd (ACOL) underground mining area and are bound by the New England Highway to the north, the Hunter River to the south, Glennies Creek to the east and Ravensworth Operations to the west.

The ACP was granted consent on 11 October 2002 by the Minister of Planning pursuant to the provisions of the *Environmental Planning and Assessment Act 1979* (DA 309-11-2001-i). The mine is approved to produce up to 5.45 million tonnes per annum (Mtpa) of run of mine (ROM) coal and operate until 2023. The consolidated Development Consent has been modified on ten occasions, with the most recent on 12 December 2012.

The underground mine is approved for multiseam longwall extraction, targeting four coal seams in descending order (Pikes Gully (PG), Upper Liddell (ULD), Upper Lower Liddell (ULLD) and Lower Barrett (LB)). Development of the underground mine commenced in December 2005 and is accessed through the southern wall of the Arties Pit under the New England Highway.

An EP was prepared in August 2012, addressing a broader mine plan encompassing ULD LW101 to 108 (all eight proposed panels in the ULD Seam). Approval was ultimately only sought for LW101 to 104. As a result this EP has been prepared to cover a revised mine plan for LW 105 to 107.

Revised subsidence predictions (Strata Control Technology - SCT, 2015) have been prepared and a revised Hydrological Assessment (RPS, 2015) was undertaken in support of this EP. These assessments are based on comprehensive technical and environmental monitoring that has been ongoing since the commencement of ACOL operations, including multi seam operations.

Development of this EP has been based on a risk-based approach with a Risk Assessment Workshop conducted in 15 May 2014, attended by relevant ACOL personnel and technical specialists. A summary of the key potential consequences/hazards associated with LW 105 to 107, as identified in the risk workshop and technical assessments is provided in **Table 1**. The table also provides an overview of the associated management measures that have been developed to address each consequence.

Subsidence effects and potential environmental consequences will be monitored and managed in accordance with the performance measures specified under the Development Consent, and the individual management plans that form part of this document (refer to **Section 1.5**).

ACOL has prepared this EP (including component management plans and supporting technical assessments) to coincide with the scheduled progression of longwall mining within the ULD Seam. Pending approval of this EP, longwall extraction of ULD LW105 is scheduled to commence in June 2016.

1.2 UPDATE FOR SHORTENING OF LW 105

Since the first submission of the EP documentation for LW 105 to 107 (July 2015), the mining design for the Southern end of LW105 has been shortened by approximately 370 meters to avoid the impacts of localised faulting. This faulting was observed in the development gate roads and the overlying Pikes Gully Seam.

With the shortening of LW 105, the following EP documentation has been updated:

- Graphical Plans were updated as per the requirement of Section 7 of the Extraction Plan Guidelines (Version 5, 2015);
- The Subsidence Assessment (SCT) and Hydrological Assessment (RPS);
- The Extraction Plan Written Report (this document);
- The Built Features Management Plan;
- Figures for specific Asset Management Plans;
- Updates to Public Safety Management Plan; and
- Updates to Coal Resource Recovery Plan.

1.3 PROJECT AREA

The purpose of this EP is to manage subsidence induced impacts resulting from the secondary extraction of LW 105 - 107. It applies to the management of subsidence induced impacts to features within the LW 105 – 107 area (herein referred to as the Project Area).

The predicted subsidence footprint was calculated by SCT based on overburden depth (45° angle of draw equivalent) from the ULD Seam goaf except at the finishing end of the panel where the distance is reduced to half depth (26.5° angle of draw equivalent).

1.4 PURPOSE & SCOPE

This EP sets out the proposed monitoring, management, and reporting activities developed to address the predicted subsidence impacts from the secondary extraction of LW 105-107 in the ULD Seam at ACOL and has been prepared in accordance with Schedule 2 Condition 3.12 and 3.13 of the Development Consent and the EP Guidelines.

1.5 OBJECTIVES

The objective of this EP is to provide for the adequate protection of natural and built features from direct and indirect subsidence impacts of LW 105 to 107 in the ULD Seam. Subsidence performance measures are specified under Schedule 2 Conditions 3.9 and 3.10 of the Development Consent (see **Section 5.1**).

This objective will be achieved by:

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

1.6 DOCUMENT STRUCTURE

This EP provides an overview of the 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 summary of the existing environment affected under the scope of this plan;
- **Section 4** – Provides information of the results of subsidence monitoring completed (PG Seam LW 1 to 8 and ULD Seam LW 101 to 103) and comparison to former subsidence predictions, to confirm the accuracy of modelling conducted to-date. Outlines proposed subsidence predictions;
- **Section 5** – Outlines proposed subsidence monitoring;
- **Section 6** – Outlines the implementation of this plan and key roles and responsibilities; and
- **Section 7** – Outlines the consultation relating to the development of this plan.

1.6.1 Volume 1

The following reports and management sub-plans have been prepared in accordance with Schedule 2 Condition 3.12 of DA 309-11-2001-I and the EP Guidelines (Version 5 - 2015):

- **Appendix A** – *Coal Resource Recovery Plan*, providing detail on the mine plan and schedule, geology and overburden, resource recovery and justification for the proposal;
- **Appendix B** – *Subsidence Effects 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 C** – *Built Features Management Plan*, structured to include Asset Management Plans (AMPs) for each individual asset / landowner, detailing the consultation, monitoring, mitigation and remediation measures for affected surface infrastructure;
- **Appendix D** – *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 E** – *Water Management Plan*, was recently updated and approved for the entire operation and includes water management in the LW 105 to 107 area;
- **Appendix F** – *The Flora and Fauna (Biodiversity) Management Plan* covers the entire ACP operation and includes biodiversity management in the LW 105 to 107 area. The *Flora and Fauna (Biodiversity) Management Plan* outlines the monitoring and management of threatened species, terrestrial and aquatic ecosystems;
- **Appendix G** – *Archaeology and Cultural Heritage Management Plan* identifies potential impacts to Aboriginal cultural heritage and details their management and mitigation. This management plan covers the entire ACP operation, including the LW 105 to 107 area and;

- **Appendix H – Land Management Plan.** This is a requirement of the Extraction Plan Guidelines. A separate *Land Management Plan* was not prepared as this information is covered under the already approved *Flora and Fauna (Biodiversity) Management Plan* and approved MOP. A cross reference table was prepared demonstrating where requirements have already been met.

Note, the Development Consent outlines the requirement to prepare a Rehabilitation Management Plan. This is covered by the approved MOP for ACOL. The EP Guidelines outlines the requirement to prepare a Land Management Plan, with these requirements covered under the approved MOP and *Flora and Fauna (Biodiversity) Management Plan*. A gap analysis was undertaken comparing the EP 'component plan' requirements to existing management plans.

1.6.2 Volume 2

This EP is supported by technical reports including:

- Technical Report No. 1 – Subsidence Impact Assessment, SCT;
- Technical Report No.2 – Surface and Groundwater Impact Assessment, RPS Aquaterra;
- Risk Assessment Workshop – SLR Consulting.

1.6.3 Volume 3

This contains the Plans in accordance with the EP Guideline, including:

PLAN 1A	Extraction Area Boundary – Proposed
PLAN 1B	Aerial Photography and Proposed Extraction Boundary
PLAN 2	Surface Features
PLAN 3	Geological Data – Seam Thickness and Depth of Cover Contours
PLAN 4A	Pikes Gully Seam Thickness & Depth of Cover Contours
PLAN 4B	Upper Lower Liddell Seam Thickness and Depth of Cover Contours
PLAN 4C	Lower Barrett Seam Thickness and Depth of Cover Contours
PLAN 5	Mining Titles and Land Ownership
PLAN 6	Geological Strata Sections
PLAN 7	APPROVED PLAN

1.7 RISK MANAGEMENT

A risk assessment was conducted on 15 May 2014 to review and identify the subsidence-related hazards that may affect the environment and community as a result of the secondary extraction of the EP Area. The risk assessment team assessed four panels (LW 105-108), with the impact area reducing to three panels (LW 105-107) since the risk assessment was undertaken. The shortening of LW 105 results in a slightly reduced subsidence risks profile.

Risks were identified and assessed through the review of known surface and sub-surface features within the EP Area. For each specific risk/hazard identified in the risk assessment, controls that are already in place were identified. The risk assessment team assigned a risk ranking to each hazard using the risk matrix. The risk ranking (low, moderate, high or extreme) assigned to each risk/hazard was determined on the basis of group consensus. Where appropriate, additional controls were identified and recorded on the risk register. The outcome of the risk assessment forms the basis for this EP.

The risk assessment was facilitated by Andrew Hutton from SLR Consulting who is an experienced facilitator and has qualifications in risk management. The risk assessment was attended by:

- James Barben (ACOL);
- Aaron McGuigan (ACOL);
- Jeff Peck (ACOL);
- Alan Tight (ACOL);
- Andrew Hutton (SLR Consulting);
- Chris Jones (SLR Consulting);
- Ken Mills (SCT – Subsidence Specialist);
- Brad Woods (RPS – Hydrology); and
- Greg Shepard (RPS - Hydrology).

The risk assessment identified a total of:

- 27 low risks;
- 14 moderate risks;
- 2 high risks; and
- 0 extreme risks.

Only one risk was classified as high relating to built features. This related to Lemington Road, with the consequence relating to *'Lemington Road – loss of access or damage due to flooding which is caused by mine subsidence'*. Controls to manage the impact of subsidence on Lemington Road are outlined in the Lemington Road Subsidence Deed. The key controls are summarised in the Glencore AMP and the Singleton Shire Council AMP. Subsequent studies have identified that Lemington Road is above the 1 in 100 year flood level, even with predicted subsidence impacts.

The other high risk related to groundwater, with the consequence being, *Hard Rock ground water level and quality changes due to mine subsidence greater than predicted (including the cumulative subsidence impacts) - some unknowns in the structures and what the contributions could be*. A Hydrogeological Assessment was undertaken following the risk assessment. Water management controls for the site are outlined in the *ACOL Water Management Plan (Appendix E)* which covers the entire ACOL operations.

The risk assessment is included in **Volume 2**.

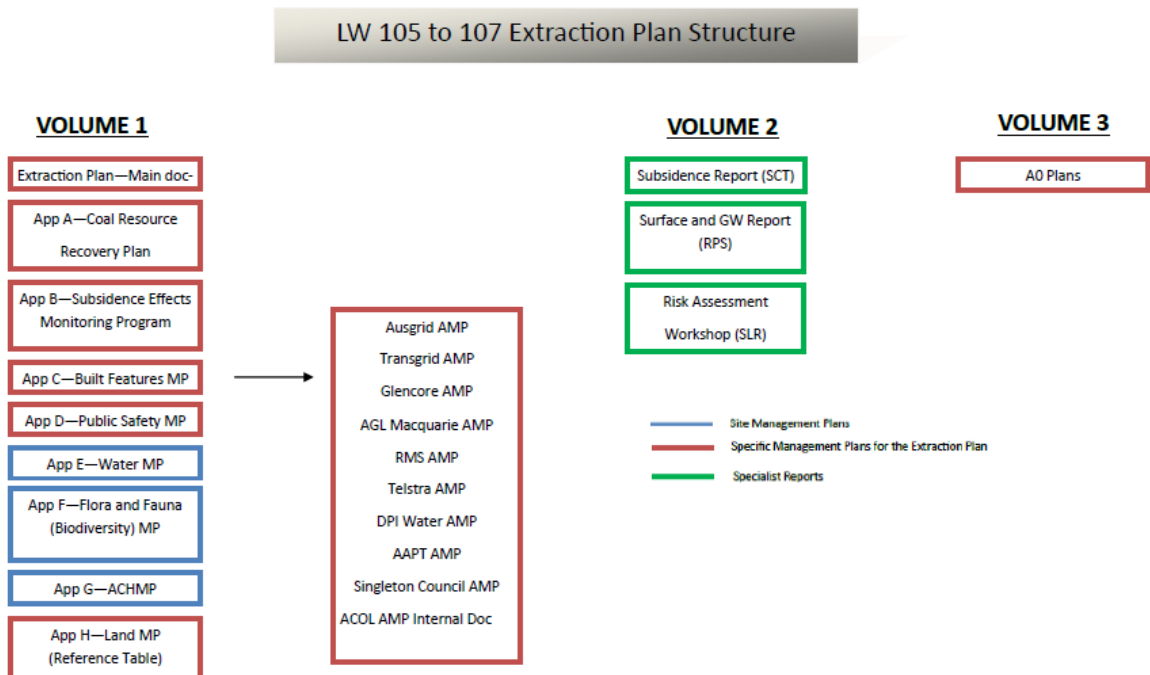


Figure 1 EP Structure

As previously outlined, information relating to rehabilitation is outlined in the approved MOP. Information relating the Land Management Plan (requirement of EP Guidelines) is covered by the *Flora and Fauna (Biodiversity) Management Plan* and the MOP.

2 STATUTORY REQUIREMENTS

2.1 DEVELOPMENT CONSENT

This document has been prepared in accordance with Schedule 2 Conditions 3.12 and 3.13 of the Development Consent. The Development Consent requirements and relevant reference within the EP is provided in **Table 1**.

Table 1 Development Consent – EP Document Reference

Condition Number	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.	EP 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 by the DP&E on 12 June 2014.
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.	EP and Appendices
3.12(d)	Detailed performance indicators for each of the performance measures in Tables 1 and 2 [DA 309-11-2001-i MOD 7 Conditions 3.9 and 3.10].	Specific management plans
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.	Volume 2 – Subsidence Assessment and Technical Reports
3.12(f)	Describe measures that would be implemented to ensure compliance with the performance measures in Tables 1 and 2 and remediate any predicted impacts and/or environmental consequences.	AMPs and Site Environmental Management Plans
3.12(g)	Include the following to the satisfaction of DRE:	
	A Coal Resource Recovery Plan	Appendix A
	A Subsidence Monitoring Program	Appendix B
	A Built Features Management Plan	Appendix C
	A Public Safety Management Plan	Appendix D
	Appropriate revisions to the Rehabilitation Management Plan required under Condition 3.51	Covered under the approved MOP
3.12(h)	Water Management Plan	Appendix E
	Biodiversity Management Plan	Appendix F - Flora and Fauna (Biodiversity) Management Plan
	Land Management Plan	Covered under the approved <i>Flora and Fauna (Biodiversity) Management Plan</i> and MOP. A cross reference table has been prepared (Appendix H)
	Heritage Management Plan	Appendix G – Archaeological and Cultural Heritage Management Plan
3.12(i)	Program to collect sufficient baseline data for future Extraction Plans.	Appendix B – <i>Subsidence Effects Monitoring Program</i>

Condition Number	Condition	EP Reference
3.13(a)	Assessment of the potential environmental consequences of the Extraction Plan, incorporating any relevant information that has been obtained since this approval.	Volume 2
3.13(b)	Detailed description of the measures that would be implemented to remediate predicted impacts.	Volume 2
3.13(c)	Contingency plan that expressly provides for adaptive management.	Section 6.1

2.1.1 Mining Lease

Specific mining lease conditions relating to subsidence are outlined in **Table 2** below:

Table 2 Key Mining Lease Conditions

Condition	Mining Lease Requirement	Comment / Reference
Mining Lease 1529		
18	The lease holder shall not interfere in any way with fences on or adjacent to the subject area unless the prior written approval of the owner thereof or the Minister and subject to such conditions as the Minister may stipulate.	Built Features MP
19	The lease holder shall observe any instruction given or which may be given by the Minister with a view to minimising or preventing public inconvenience or damage to public or private property.	Public Safety MP
20	Where required to do so by the Minister and within such time as may be stipulated by the Minister the lease holder shall carry out to the satisfaction of the Minister surveys of structures, buildings and pipelines on adjacent landholdings to determine the effect of operations on any such structures, buildings and pipelines.	Subsidence Assessment (SCT, 2015) undertaken. Specific AMP's prepared.
21	If so directed by the Minister the lease holder shall rehabilitate to the satisfaction of the Minister any ands within the subject area which may have been disturbed by the lease holder.	Covered under the MOP.
30	The lease holder shall conduct operations in such a manner as not to cause or aggravate soil erosion and the lease holder shall observe and perform any instructions given or which may be given by the Minister with a view to minimising or preventing soil erosion.	Covered under the MOP and Water Management Plan.
31	The lease holder shall pay to Singleton Council, Department of Land and Water Conservation or the Chief Executive, Roads and Traffic Authority the cost incurred by such Council or Department or Chief Executive of making good any damage caused by operations carried on by or under the authority of the lease holder to any road adjoining or traversing the surface or the excepted surface, as the case may be of the subject area. Provided however that the amount to be paid by the lease holder as aforesaid shall be reduced by such sum of money if any as may be paid to the said Council, the Department of Land and Water Conservation of the Chief Executive, Roads and Traffic Authority as the case may be from the Mine subsidence Compensation Fund	All management of built features covered under specific AMP's.
32	In the event of operations being conducted on the surface of any road, track or firetrail traversing the subject area or in the event of the operations causing damage to or interference with any such road, track or firetrail the lease holder, at his own expense, shall if directed to do so by the Minister provide to the satisfaction of the Minister an alternate road, track or firetrail in a position as required by the Minister and shall allow free and uninterrupted access along	Covered under Built Features MP and specific AMP's.

2.1.2 Extraction Plan Team

In accordance with Schedule 2 Condition 3.12(a) of the Development Consent, the appointment of the below team of suitably qualified and experienced experts was endorsed by a delegate of the Secretary for DP&E on 12 June 2014. A summary of the project team is outlined in **Table 3**.

Table 3 Summary of Project Team

Name	Company	Area of Expertise
Aaron McGuigan	ACOL	Technical Services
Digby Short	ACOL	Environment and Community
James Barben	ACOL	Environment and Community
Jeff Peck	ACOL	Mine Surveyor
Andrew Hutton	SLR	Risk Assessment/Subsidence Management
Chris Jones	SLR	Environmental/Subsidence Management
Ken Mills	SCT	Subsidence Assessment
Brad Woods	RPS	Surface water/ Groundwater
Greg Sheppard	RPS	Surface water/ Groundwater

3 MINE PLAN

3.1 MINE PLAN AND DESIGN

With increased understanding of the groundwater and surface water systems and their response to mining (gained since the ACP was first approved), ACOL has developed an underground mine plan for the extraction of the ULD Seam that will result in acceptable environmental impacts whilst optimising resource extraction. The mine plan has also been developed to reduce potential impacts to built features and natural features within the area.

The vertical alignment of LW 105 to 107 in the ULD Seam is horizontally offset from the overlying PG Seam mine workings by approximately 60m to the west. The ULD mine plan for LW 105 to 107 has been based on detailed analysis of the predicted subsidence behaviour and groundwater impacts to Glennies Creek and Bowmans Creek alluvium. LW 108 will no longer be mined, LW 107B has been widened and LW 107A has been extended to the south.

The ACOL longwall panels are located within Mining Lease 1533 and lie south of the New England Highway. Longwall panels are generally oriented in a north south direction, bounded by Glennies Creek to the east, the Hunter River alluvium to the south, the New England Highway to the north, Ravensworth Mine to the west and partially overlain by Bowmans Creek in the west.

Mining is currently occurring within ULD Seam in LW 104. Mining was previously completed within the PG Seam for LW 1-8. The scope of this EP includes secondary extraction of LW 105 to 107 within the ULD Seam, only. Additional detail on the proposed workings, including dimensions, overburden depth, and mining schedule are contained within the EP. It should be noted that the Southern end of LW105 has been shortened by approximately 370 meters to avoid the impacts of localised faulting. This faulting was observed in the development gateroads and the overlying Pikes Gully Seam.

The key natural and built features of the EP Area are shown in **Figure 2** and key dimensions summarised in **Table 4**.

Table 4 Approximate ULD Longwall Panel Dimensions

Panel	Nominal Gateroad Width (m)	TG Pillar Width Rib to Rib (m)	LW Void Width (m)	LW Length (m)
LW105	5.4	25	216	1021
LW106A	5.4	25	216	1354
LW106B	5.4	25	216	1063
LW107A	5.4	N/A	161	1351
LW107B	5.4	N/A	216	1145

A full description of the site conditions, depth of cover, mining and resource recovery methods are provided in the Coal Resource Recovery Plan (**Appendix A**).

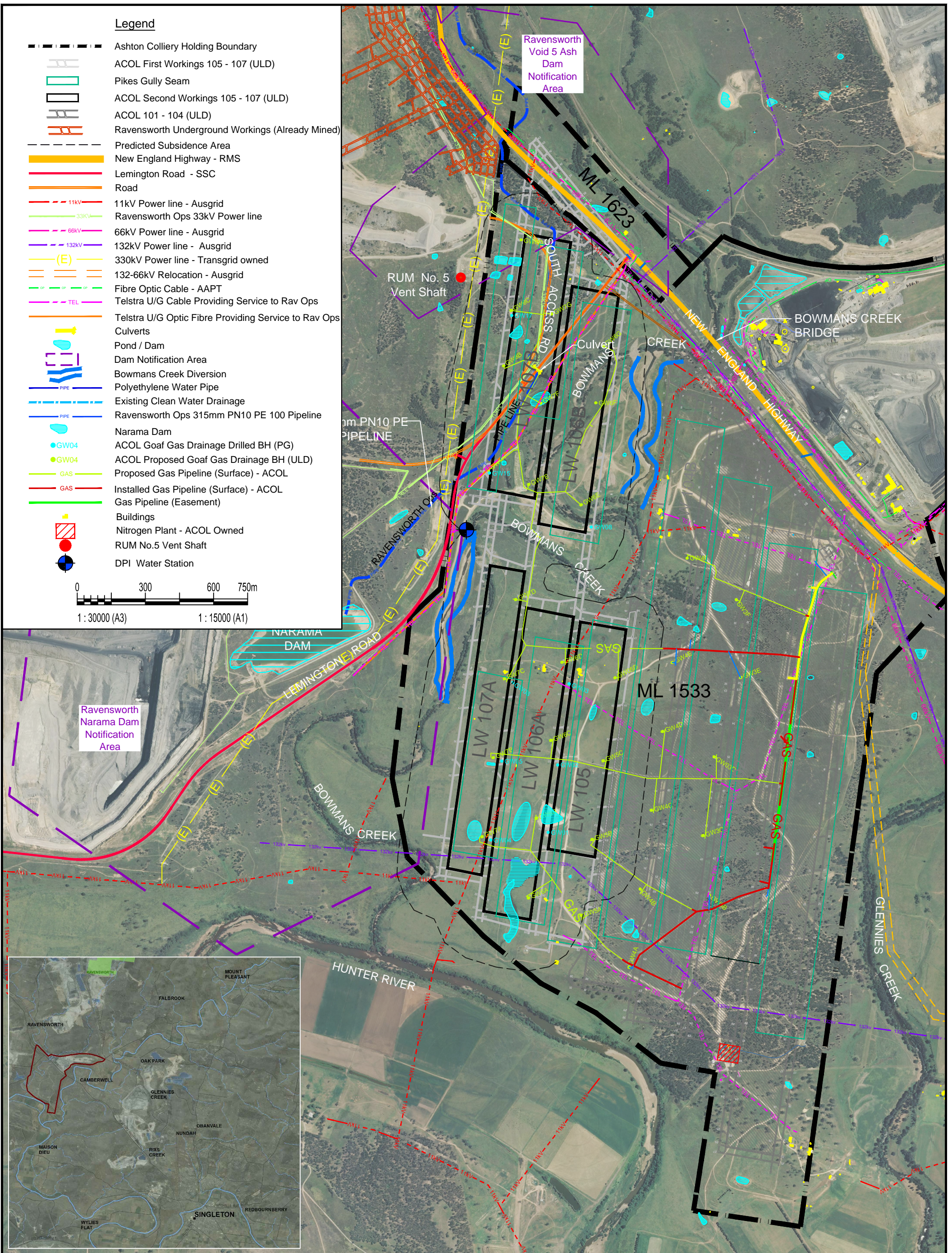
3.2 MINE SCHEDULE

ACOL's underground mine operates seven days per week, 24 hours per day on a rotating shift basis. At the date of this report, extraction of ULD 103 has been completed, with extraction of LW 105 to 107 proposed to commence in June 2016.

The proposed sequence of mining under this EP and anticipated start and completion dates are summarised in **Table 5** dependent on relevant mining constraints.

Table 5 Approximate Mining Schedule (Secondary Extraction for Remaining ULD Seam Longwalls)

Longwall				
Panel	Float (weeks)	Start	End	Days of no coal
ULD				
LW103	0	21/08/2014	19/06/2015	39
LW104A	0	27/07/2015	31/12/2015	24
LW104B	0	24/01/2016	28/04/2016	39
LW105	42.4	6/06/2016	25/09/2016	40
LW106A	13.7	3/11/2016	23/03/2017	33
LW106B	39.4	26/04/2017	19/08/2017	39
LW107A	46.2	26/09/2017	29/01/2018	27
LW107B	69.5	25/02/2018	30/06/2018	40



Legend

- Ashton Colliery Holding Boundary
- ACOL First Workings 105 - 107 (ULD)
- Pikes Gully Seam
- ACOL Second Workings 105 - 107 (ULD)
- ACOL 101 - 104 (ULD)
- Ravensworth Underground Workings (Already Mined)
- Predicted Subsidence Area
- New England Highway - RMS
- Lemington Road - SSC
- Road
- 11kV Power line - Ausgrid
- Ravensworth Ops 33kV Power line
- 66kV Power line - Ausgrid
- 132kV Power line - Ausgrid
- 330kV Power line - Transgrid owned
- 132-66kV Relocation - Ausgrid
- Fibre Optic Cable - AAPT
- Telstra U/G Cable Providing Service to Rav Ops
- Telstra U/G Optic Fibre Providing Service to Rav Ops
- Culverts
- Pond / Dam
- Dam Notification Area
- Bowmans Creek Diversion
- Polyethylene Water Pipe
- Existing Clean Water Drainage
- Ravensworth Ops 315mm PN10 PE 100 Pipeline
- Narama Dam
- ACOL Goaf Gas Drainage Drilled BH (PG)
- ACOL Proposed Goaf Gas Drainage BH (ULD)
- Proposed Gas Pipeline (Surface) - ACOL
- Installed Gas Pipeline (Surface) - ACOL
- Gas Pipeline (Easement)
- Buildings
- Nitrogen Plant - ACOL Owned
- RUM No.5 Vent Shaft
- DPI Water Station

0 300 600 750m
 1 : 30000 (A3) 1 : 15000 (A1)



LAST MODIFIED: 11/02/2015 12:10 PM CAD REF: G:\DRAFTING\630_10823 ASHTON SMP EXTRACTION PLAN EP - BUILT FEATURES EXTRACTION PLAN BASE_03.DWG

4 SUBSIDENCE ASSESSMENT

Predicted subsidence effects and impacts associated with secondary extraction in the ULD Seam are described in **Section 5.1**, whilst associated environmental consequences are summarised in **Section 5.2**. As previously outlined, SCT (2015) completed the subsidence assessment for LW 105 to 107.

4.1 SUMMARY OF PREVIOUS SUBSIDENCE MONITORING

Subsidence monitoring has been undertaken at the ACP since the commencement of longwall operations in early 2007. This section provides a summary of the previous subsidence monitoring, with detailed analysis provided in Section 3.1 of the SCT Subsidence Assessment (2015).

The subsidence behaviour observed in the PG Seam has been consistent with supercritical width subsidence and with the subsidence behaviour expected.

Subsidence monitoring above LW 101 and 102 has provided insight into the mechanics of multi-seam subsidence.

Table 6 presents a summary of the subsidence movements measured above LW 101 and 102 and a comparison with the estimates for maximum incremental subsidence based on 85% of the second seam mining height and for maximum subsidence of 75% of the combined mining height for both seams.

Multi-seam subsidence presents a number of additional challenges for describing the subsidence behaviour. In a single seam mining environment, the subsidence behaviour is consistent with and largely controlled by the mining geometry in the seam that has been mined. In a multi-seam mining environment, the presence of previous mining in an overlying seam means that the starting point for subsidence estimation for the second seam is not necessarily zero and the subsidence behaviour is no longer simply a geometrical function of the seam being mined, but rather a complex interaction of the geometries in both seams.

The subsidence monitoring above LW 101 and 102 indicated that for an offset mining geometry, the maximum subsidence can be estimated with reasonable confidence and the subsidence profile is also relatively predictable although the specific mechanics of the interaction of the two seams needs to be recognised. Where panels in the two seams overlap in an offset geometry, maximum cumulative subsidence from mining both seams is in the order of 62-72% of the combined thickness of both seams (compared to 50-60% for the first seam mined) and incremental subsidence is in the order of 73-80% of the height of the second seam mined. For the purposes of prediction, values for maximum incremental subsidence of 85% of second seam mining height and maximum cumulative subsidence of 75% of combined seam height appear reasonably conservative.

Table 6 outlines the current subsidence monitoring results for LW 101 and 102 are outlined below. This illustrates the combined PG and ULD Seam results.

Table 6 Measured Subsidence Results (LW 101 and 102)

Location	Incremental Subsidence ULD Seam (m)	Max Incremental Tilt (mm/m)	Max Incremental Strain (mm/m)	Maximum Subsidence (m)	Max Tilt (mm/m)	Max Strain (mm/m)
Measured During Mining in PG Seam	-	-	-	1.5	100	40
Predicted Based on Combined Seam Height of 5.2m (2.6m & 2.6m)	2.2 (85% T ₂)	120	46	3.9 75% (T ₁ +T ₂)	205	82
Measured on LW102CL1	2.1	33	14	3.2	38	12
Measured on XL5	2.3	66	18	3.2	54	24
Measured on LW102CL2 background	2.1	27	5	3.2	33	4
Measured on LW102CL2 stacked	2.1	87	65	3.4	193	107
Measured on LW102CL2 10-30m undercut	2.1	136	80	3.4	243	122
Measured at completion of LW102CL2	2.1	77	45	3.4	190	83

Locally, the incremental subsidence can be higher when subsidence that would otherwise have occurred during mining in the first seam except for the presence of a chain pillar is recovered during mining in the second seam when the chain pillar is destabilised.

Maximum values of subsidence parameters such as strain and tilt are typically of a similar or lower magnitude to the subsidence parameters measured in the first seam mined despite the greater subsidence. The maximum values of tilt and strain are typically less than 50% of the maximum calculated assuming single seam mining conditions but occasionally increase to the same magnitude as parameters measured during mining in the PG Seam.

However, a difference in behaviour is observed in areas where overlying goaf edges interact to form a stacked goaf edge. Where the lower seam is mined out into solid from below an existing goaf in the upper seam a double goaf edge referred to as a stacked goaf edge is created. The maximum tilt in these areas is double the background levels and horizontal strains increase up to about four times background peaks elsewhere along the panel. The strains and tilts reach a maximum when the lower seam has mined past the upper seam goaf edge by a distance of about equal to the separation between the two seams i.e. about 30m for the ULD and PG Seams.

The magnitude, direction, and form of the total horizontal movement from LW 102 is consistent with the cross-panel horizontal movement observed during mining of the PG Seam. Horizontal subsidence movements measured above LW 102 are typically in the range of 20-30% of the vertical subsidence. There is a strong similarity in the characteristics and distribution of horizontal subsidence movements between LW 101 and 102 indicating a consistent mechanism driving the horizontal movements and a strong influence of strata dilation in this process.

4.2 SUBSIDENCE PREDICTIONS FOR LW 105 TO 107

Subsidence behaviour resulting from extraction of the ULD Seam is variable based on the width of the panel, overburden depth, chain pillar barrier widths and the presence of prior workings in the PG Seam.

This EP main document focuses on potential subsidence impacts associated with secondary extraction of the ULD Seam LW 105 to 107.

In this section, the subsidence estimates for mining in the ULD Seam (LW 105-107) are presented in the form of incremental subsidence contours i.e. the subsidence that is expected for mining in the ULD Seam, above that which has already occurred in the PG Seam. The changes in landform during the construction of Lemington Road add to the complexity of presenting contours of cumulative subsidence, although estimates are provided for the purposes of providing an indication of the magnitude of lowering of the surface around the BCD and the general landform.

It should be noted that Lemington Road was constructed after subsidence in the PG Seam was substantially complete, hence should only receive impacts from mining of the ULD Seam. The changes in landform during the construction of Lemington Road add to the complexity of presenting contours of cumulative subsidence, although estimates are provided for the purposes of providing an indication of the magnitude of lowering of the surface and the general landform.

The predicted subsidence footprint was calculated by SCT based on overburden depth (45° angle of draw equivalent) from the ULD Seam goaf except at the finishing end of the panel where the distance is reduced to half depth (26.5° angle of draw equivalent).

These predictions are based on a conservative empirical approach and are presented in **Table 7**.

The subsidence predictions estimate the incremental and cumulative subsidence parameters for each of the proposed longwall panels.

Table 7 Incremental and Cumulative Subsidence Parameters Predicted for the Revised Layout of ULD Seam Longwall Panels – LW 105 to 107 – Compared to Subsidence Parameters Predicted for the Approved Stacked Layout

ULD Seam Longwall Panels and Depth (m) and Depth Range (in brackets)	Revised Layout					Approved Layout			
	ULD Subs (m)	ULD Tilt (mm/m)		ULD Strain (mm/m)		Subs (m)	Tilt (mm/m)	Strain (mm/m)	
	Normal and Stacked Edges	Normal	Stacked Edges ¹	Normal	Stacked Edges ¹				
Incremental Subsidence Parameters									
LW105 170 (155-195)	2.1	49	99	12	49	2.1	80	40	
LW106A 175 (170-210)	2.1	48	96	12	48	2.1	80	40	
LW106B 150 (140-180)	2.5	67	133	17	67	2.1	80	40	
LW107A 190 (185-220)	2.1	44	88	11	44	2.1	80	40	
LW107B 170 (165-200)	2.7	64	127	16	64	2.1	80	40	
Cumulative Subsidence Parameters									
LW105 170 (155-200)	3.8	89	179	22	89	3.7	150	70	
LW106A 175 (170-210)	3.8	87	174	22	87	3.7	150	70	
LW106B 150 (140-180)	4	107	213	27	107	3.7	150	70	
LW107A 190 (185-220)	3.8	80	160	20	80	3.7	150	70	
LW107B 170 (165-200)	4	94	188	24	94	3.7	150	70	

Note: ¹ The stacked edges occur where the ULD Seam is mined from under the PG Seam goaf into a solid abutment with peak values occurring when the PG Seam goaf edge is undermined by about 20-30 m.

Maximum incremental subsidence has been estimated as 85% of the nominal combined extraction heights of the ULD Seam and cumulative subsidence has been estimated based on 75% of the combined thickness of both seams. The ULD seam thicknesses planned to be mined have been assumed to be 2.5m for LW 105, 106A, and 107A, and 2.8m and 3.0m respectively for LW 106B and 107B. Variations in the cutting height that may occur for a range of reasons are expected to proportionally influence the maximum subsidence and other subsidence parameters.

Figure 3 and 4 shows a summary of the areas where stacked geometries and higher strains and tilts are likely to occur. The areas where greater impacts are expected are likely to be at stacked goaf edges such as the start of LW 105, 106A, and 106B, the finish of LW 105, 106B, and 107B, the western side of LW107A and the northern edges of LW 6A and 7A in the PG Seam.

Figure 5 shows a cross-section of the subsidence along the line of subsidence line XL13 over the central part of the northern longwall panels. Profiles of the incremental subsidence, cumulative subsidence, and previously approved subsidence are shown. The figure illustrates the general characteristics of the subsidence predicted for the EP and the subsidence for the previously approved geometry.

The only substantive changes in terms of subsidence impacts as a result of the revised layout (shortening of LW 105) are that the area of ponding has been reduced and several of the poles on the 132 kV power lines (Ausgrid owned) that traverse the southern part of the longwall panels will no longer be directly mined under.

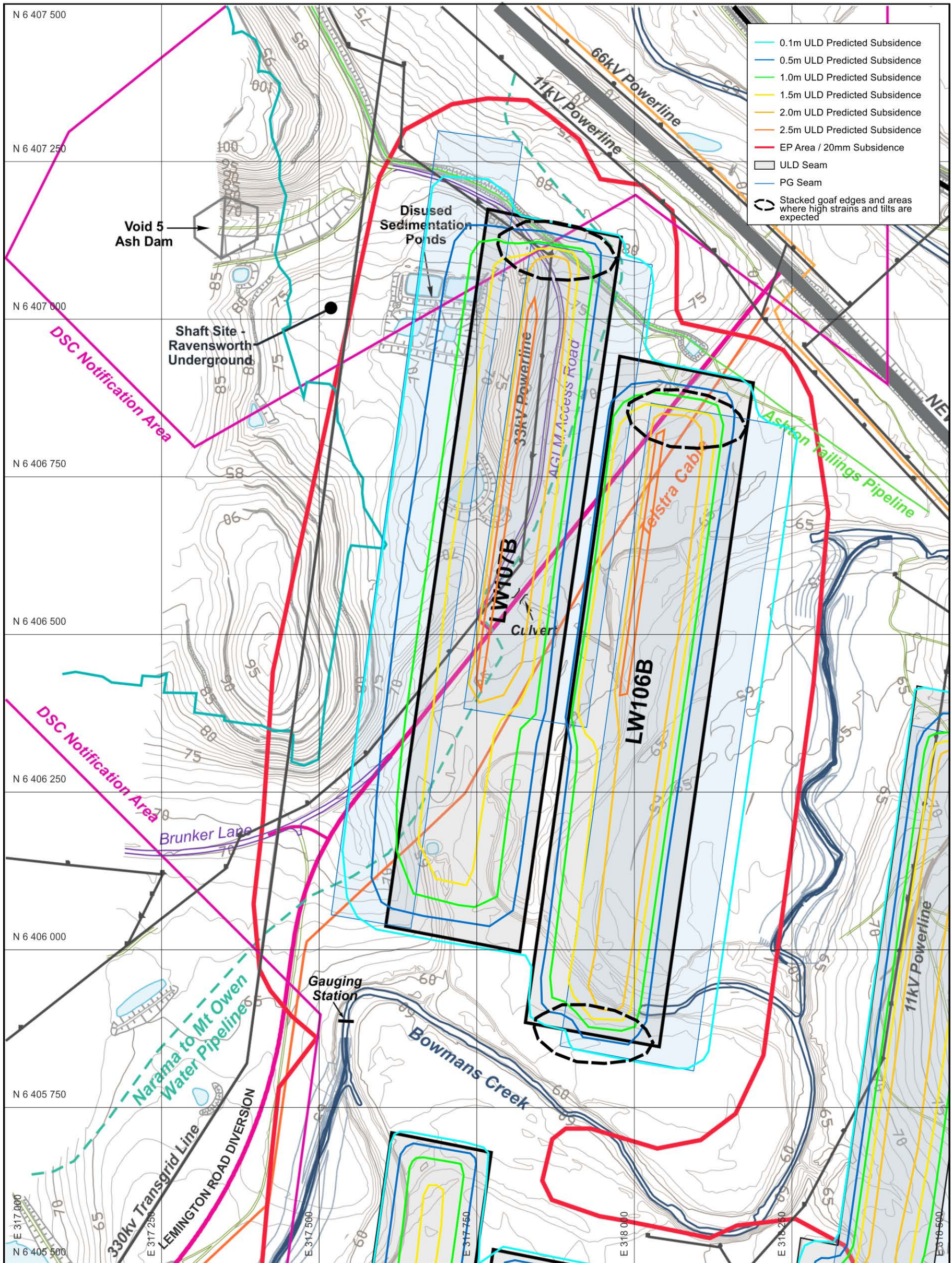


Figure 3 Summary of incremental subsidence contours for northern panels superimposed onto the surface features plan showing areas of stacked goaf edges likely to produce high strains and tilts.

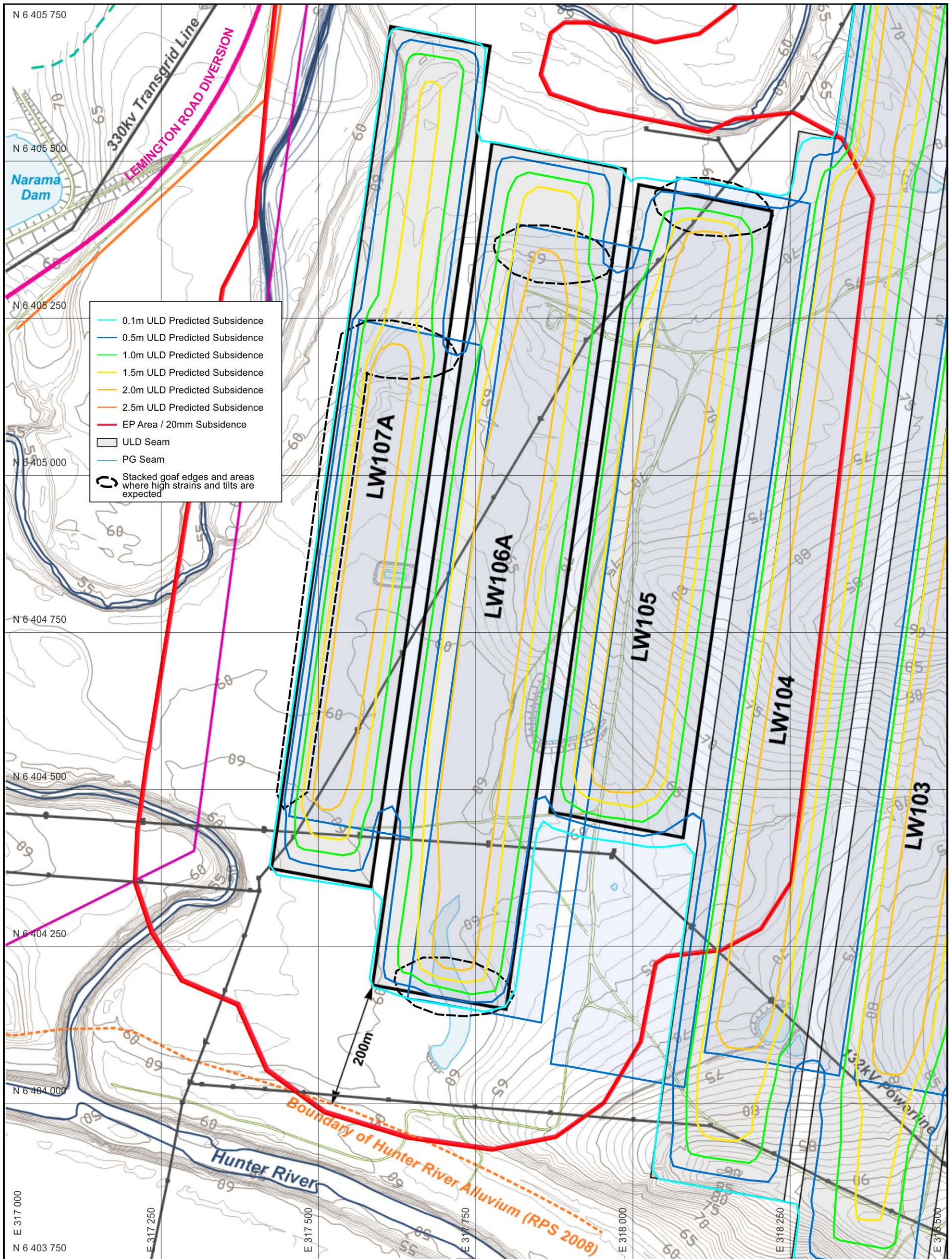


Figure 4 Summary of incremental subsidence contours for southern panels superimposed onto the surface features plan showing areas of stacked goaf edges likely to produce high strains and tilts.

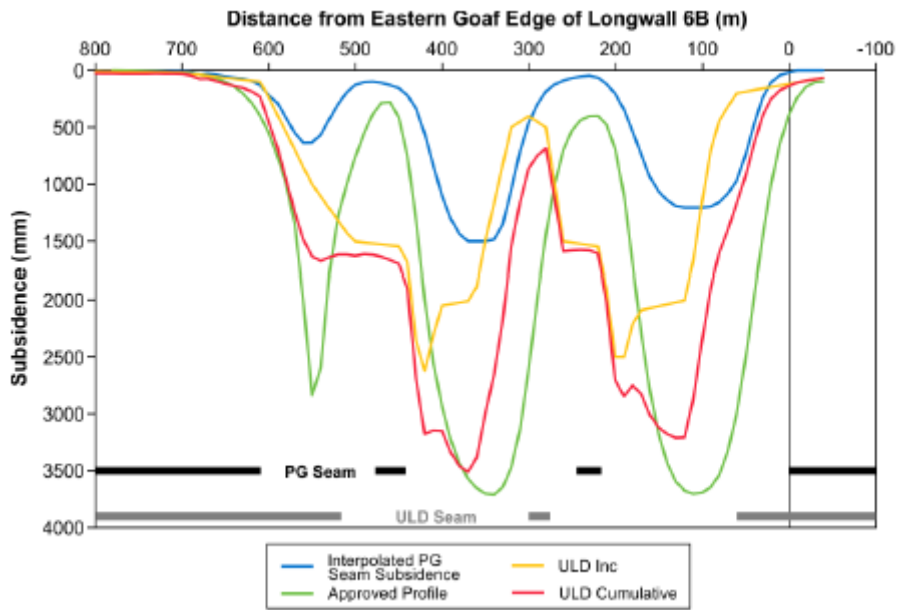


Figure 5 Subsidence Profile Predicted across LW 106B and 107B and Comparison with the Subsidence Profiles for the approved BCD Modification (SCT, 2015)

4.3 SUBSIDENCE IMPACTS AND MANAGEMENT

The SCT report (**Volume 2 – Technical Report 1**) includes a revised subsidence assessment of potential impacts to natural and built features. A Surface and Groundwater Impact Assessment was prepared by RPS, with this included as **Volume 2 – Technical Report 2**.

4.3.1 Impacts and Management of Natural and Heritage Features

Impacts and management of natural features and heritage are summarised in **Table 8**.

Table 8 Summary of Impacts and Management of Natural and Heritage Features

Aspect	Predicted Impact	Controls
Surface Water – Fluvial Geomorphology	RPS (2015) states that no impacts to the fluvial geomorphology of Bowmans Creek, Glennies Creek or the Hunter River are anticipated as a result of the extraction of ULD LW105 to LW107B.	Monitoring and management as per ACOL <i>Water Management Plan</i> . Subsidence monitoring as per the <i>Subsidence Effects Monitoring Program</i> .
Flooding	RPS (2015) states that the magnitude and extent of subsidence is predicted to be equal to, or less than, that of the approved mine plan, no additional impacts on flooding are anticipated.	
Ponding	SCT (2015) completed an assessment of proposed ponding associated with the mining of LW 105 to 107. The flood plain around Bowmans Creek is expected to be subsided in the southern panels by a total of up to about 3.8 m cumulative subsidence (some 2.1 m of incremental subsidence) and in the northern panels by up to 4.0 m (some 2.7 m of incremental subsidence). Along the stacked goaf edges on the western side of Longwall 107A, at the start of Longwall 106A, and at the start of Longwall 106B, the subsidence step is likely to be relatively steep with final landform gradients of up to about 160 mm/m or 1 in 6. These steps in the landform are expected to present a barrier to natural drainage and some ponding is expected as a result. The barriers may lead to ponding that is up to several metres deep depending on the gradients in the original landform and any landform drainage works that may have been undertaken since the completion of mining in the PG Seam. Potential management options for ponding are outlined in Section 4.1.2 of the SCT Report.	
Water Quality	RPS (2015) predicts no impact to water quality.	
Groundwater - Inflows	RPS (2015) predicts possible short to medium term inflows of up to six month duration, as observed following LW6B, may be expected to occur associated with undermining LW6B. Peak inflows of the order of 50% in excess of predicted values may be expected to occur.	

Aspect	Predicted Impact	Controls
	In the Memorandum from RPS dated 20 October 2015 (see Volume 2), given the reduced mine inflows predicted by the 2014 model, combined with a reduced drawdown in the alluvium (predicted and observed) it reasonable to conclude that the corresponding alluvial water take would therefore also be less than that of the 2009 EA.	
Groundwater - Levels	RPS (2015) states that modelling results from the 2012 Groundwater Impact Assessment and the 2015 model update in terms of groundwater drawdowns in alluvial aquifers are generally very consistent and are within the approved impacts of the 2009 EA	
Groundwater – Baseflow Impacts	RPS (2015) predicts baseflow impacts in the order of 1.5L/s in Bowmans Creek and 1L/s or less in The Hunter River and Glennies Creek are anticipated.	
Groundwater Quality	RPS (2015) predicts no impact to groundwater quality.	
Ecology	There is predicted to be no impact to ecology greater than approved in the Development Consent.	Monitoring and Management as per the site <i>Flora and Fauna (Biodiversity) Management Plan</i> .
Heritage	There is predicted to be no impact to Aboriginal Heritage greater than approved in the Development Consent.	Managed as per the site <i>Archaeological Cultural Heritage Management Plan</i> .

4.3.2 Impacts and Management of Built Features

Impacts and management of built features are summarised in **Table 9**. Additional detail is provided in the *Built Features Management Plan* and specific AMPs.

Table 9 Impacts and Management of Built Features

Infrastructure	Owner/Manager	Brief Description	Summary of Impact (Predicted by SCT 2015)	Summary of Monitoring and Mitigation Measures
Roads	Singleton Council Road. Glencore and ACOL assist in management	Lemington Road and culvert	Incremental subsidence to 2.7m with high strains and tilts at the stacked goaf edge of LW106B. Impacts slightly scaled down version of LW102 stacked end. Significant monitoring and incremental repair to the road is likely to be required. Monitoring of the culvert and potential mitigation required to ensure capping plate does not become dislodged or cracking leads to piping failure.	<ul style="list-style-type: none"> • Pre, during and post subsidence monitoring; • Visual inspections; • Erection of signage; • Onsite crew available to make repairs; • Management and repairs in accordance with Lemington Road Subsidence Deed; • Consultation with Glencore and SSC; • Management as per the Glencore and SSC AMPs; and • Reporting as per EP Guidelines.
	RMS	New England Highway	No impact to the road or public safety.	<ul style="list-style-type: none"> • Pre, during and post active subsidence as required under RMS AMP; • Installation of additional survey monitoring locations prior to the commencement of monitoring; • Management as per the AMP; and • Reporting as per EP Guidelines.
	AGL Macquarie	South Access Road on AGLM	Incremental subsidence to 2.7m with high strains and tilts at the northern edge of LW107B. Impacts slightly scaled down version of LW102 stacked end.	<ul style="list-style-type: none"> • Pre, during and post subsidence monitoring; • Inspections of road; • Erection of signage warning of subsidence; • Repair road (cracking) as required; • Liaison with AGL Macquarie; • Management as per the AMP; and • Reporting as per EP Guidelines.
	Private	Alternate Right of Way to Property 130	No interruption to Property 130 Access.	<ul style="list-style-type: none"> • ACOL to undertake regrading if required; and • Liaison with property owner.
Power Transmission Lines	Ausgrid	132 kV traversing the southern extent of the ACOL Mining Lease	Impacts similar to observed over LW101 and LW102. Mitigation measure required. It should be noted that with the shortening of LW 105, the impacts to the Ausgrid 132 kV powerline are lower than previously	<ul style="list-style-type: none"> • Pre, during and post subsidence monitoring in accordance with respective AMP's; • Structural assessment of transmission lines and implement remedial works to transmission line, if required;

Infrastructure	Owner/Manager	Brief Description	Summary of Impact (Predicted by SCT 2015)	Summary of Monitoring and Mitigation Measures
			predicted based on the mine plan in the July 2015 Extraction Plan submission for LW 105-107.	<ul style="list-style-type: none"> • Consultation with asset owners; and • Reporting as per EP Guidelines.
	Ausgrid	11 kV line traversing ACP	Impacts generally similar to those previously experienced for the PG Seam. Mitigation measure required.	
	Glencore	33 kV transmission line on western side of Lemington Road	Impacts generally similar to those previously experienced for the PG Seam. Mitigation measure required.	
	Ausgrid	132 kV and Combined 66/11 kV lines parallel to New England Highway	No Impact.	<ul style="list-style-type: none"> • No proposed monitoring or management.
	Transgrid	330 kV line along western lease boundary	Minor movements less than the infrastructure are designed to accommodate.	<ul style="list-style-type: none"> • Monitoring as per the Transgrid AMP; • Consultation with asset owners; and • Reporting as per EP Guidelines.
Buried Communication Lines	Telstra (Copper Line)	Telstra cables providing service to subdivided blocks on Ravensworth Operations	Some damage to buried cabling is considered possible, especially through stacked goaf edge zones. Re-routing of the lines or exposure in high strain zones likely to be required. No impact to public safety.	<ul style="list-style-type: none"> • Pre, during and post subsidence monitoring in accordance with respective AMP's; • ACOL to inform Glencore and Telstra if subsidence impacts have been identified; • Suitably qualified engineer/technician to test and repair communications if issue has been observed; • Management as per the AMP; and • Reporting as per EP Guidelines.
	Telstra	Telstra cables providing service to DPI Water Stream Gauging Station on Bowman's Creek	Some damage to buried cabling is considered possible, especially through stacked goaf edge zones. Re-routing of the lines or exposure in high strain zones likely to be required. No impact to public safety.	
	Telstra (Optic Fibre Line)	Fibre optic Underground Cable along Lemington Road (Telstra owned – used by Glencore)	Some damage to buried cabling is considered possible, especially through stacked goaf edge zones. Re-routing of the lines or exposure in high strain zones likely to be required. No impact to public safety.	<ul style="list-style-type: none"> • It is not the responsibility of ACOL to undertake any repairs as a result of subsidence impacts on the fibre optic line as this was installed as part of the Ravensworth North Project. ACOL will however inform Glencore of any subsidence impacts on the cable; and • Management as per the AMP.
	AAPT Line	A fibre optic cable linking Sydney and Brisbane is located alongside the New England Highway	This fibre optic cable is located beyond the area where perceptible subsidence movements are expected to occur.	<ul style="list-style-type: none"> • No proposed impacts therefore no proposed monitoring or management.

Infrastructure	Owner/Manager	Brief Description	Summary of Impact (Predicted by SCT 2015)	Summary of Monitoring and Mitigation Measures
		immediately to the north of the EP Area.		
DPI Water Station	DPI Water	Subsidence monitoring within the EP area will be undertaken.	Overall subsidence monitoring within the EP area – pre, during and post active subsidence.	<ul style="list-style-type: none"> • Overall subsidence monitoring within the EP area – pre, during and post active subsidence; and • Management as per the AMP.
Pipelines	Glencore	315 mm Diameter Pipeline	Some impact expected where these cross stacked edges and some uncovering may be appropriate.	<ul style="list-style-type: none"> • Visual inspection / monitoring of exposed sections of pipeline. Glencore to continue monitoring of pipeline flows; • Expose pipeline and place on surface to reduce subsidence impacts and/or provision for leak detection; • If required Glencore is to ensure pumping is stopped and to notify ACOL immediately so that potential damage to the pipeline can be investigated; • Management as per the AMP; and • Repairs to pipeline as soon as practicable.
Dams	Glencore	Narama Dam	No impact on dam or public safety.	<ul style="list-style-type: none"> • Pre and post subsidence monitoring of established survey pegs; • Liaison with Glencore; • Management as per the AMP; and • Reporting as per EP Guidelines.
	AGL Macquarie	Void 5 Ash Dam DSC Notification Area	No impact on dam or public safety.	<ul style="list-style-type: none"> • Pre and post subsidence monitoring of established survey pegs; • Obtain DSC approval to mine within the notification area of the Void 5 Ash Dam; • Liaison with AGL Macquarie; • Management as per the AMP; and • Reporting as per EP Guidelines.
Underground Mines	Glencore - RUM	Ravensworth Underground Mine and No. 5 Shaft	Minor shear movements possible at the shaft location but not expected to be perceptible or affect integrity of shaft.	<ul style="list-style-type: none"> • Site inspections; • Management as per the AMP; and • Reporting as per EP Guidelines.

5 SUBSIDENCE MONITORING AND MANAGEMENT

5.1 SUBSIDENCE PERFORMANCE MEASURES

Subsidence performance measures are specified under Schedule 2 Conditions 3.9 and 3.10 of the Development Consent:

- 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 <i>National Parks and Wildlife Act 1974</i>

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.*

5.2 SUBSIDENCE MONITORING

The *Subsidence Effects Monitoring Program* is provided in **Volume 1 - Appendix B** and includes a program for survey monitoring and subsidence inspections. The purpose of the *Subsidence Effects Monitoring Program* is to enable subsidence effects to be quantified (i.e. vertical movements, ground tilts and strains).

The *Subsidence Effects Monitoring Program* for the ULD Seam is generally consistent with that previously established and monitored during longwall extraction of the PG Seam (LW 1 to 8) and extraction of LW 101 to 103 in the ULD Seam. The subsidence monitoring program 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).

Other techniques included in the *Subsidence Effects Monitoring Program* include potentially using remote sensing (e.g. LiDAR), for monitoring subsidence movements and use of a survey control network for the monitoring of far-field subsidence movements. The *Subsidence Effects Monitoring Program* also summarises the monitoring of environmental and built features.

5.3 SUBSIDENCE MANAGEMENT

Surface and sub-surface features within the EP area or located close to the EP area are listed in **Table 10 and Table 11**. These features may be potentially impacted by the secondary extraction of LW 105 to 107. The location of built features and natural features are shown in **Figure 2** and environmental features. Descriptions of each of these features are contained within the relevant management plan referenced in **Table 10 and Table 11**.

Revised subsidence predictions and impacts to these surface and sub-surface features have been provided in **Volume 2 Appendix A**.

Table 10 Surface and Sub-Surface Features

Feature	Reference Document
Natural Features	
Bowmans Creek and Bowmans Creek diversion	Water Management Plan (Appendix E), MOP
Bowmans Creek floodplain	Water Management Plan (Appendix E), MOP
Hunter River	Water Management Plan (Appendix E), MOP
Groundwater resources	Water Management Plan (Appendix E), MOP
Threatened flora and fauna	Flora and Fauna (Biodiversity) Management Plan (Appendix F)
Public Utilities	
New England Highway	Built Features Management Plan (Appendix C)
Lemington Road, bridges and culverts	Built Features Management Plan (Appendix C)
Private access roads	Built Features Management Plan (Appendix C)
Electricity transmission lines	Built Features Management Plan (Appendix C)
Telecommunications lines	Built Features Management Plan (Appendix C)
Farm Land and Facilities	
Fences and gates (ACOL owned)	Built Features Management Plan (Appendix C)
Farm dams (ACOL owned)	Built Features Management Plan (Appendix C)
Farm buildings (ACOL owned)	Built Features Management Plan (Appendix C)
Mine Infrastructure	
Rehabilitated open cut (Macquarie Generation and RUM)	Built Features Management Plan (Appendix C)
Water and tailings pipelines, sediment dams	Built Features Management Plan (Appendix C)
Prescribed Dam Notification Area – Macquarie Generation Void 5 Ash Dam	Built Features Management Plan (Appendix C)
Narama Dam	Built Features Management Plan (Appendix C)
Underground Mine Workings (RUM)	Built Features Management Plan (Appendix C)
ACOL Gas Infrastructure	Built Features Management Plan (Appendix C)
Archaeology and/or Heritage Significance	
Aboriginal archaeological deposits	Archaeology and Cultural Heritage Management Plan (Appendix G)
Residential Establishments	
Uninhabited Rural residences – ACOL owned	Built Features Management Plan (Appendix C)

Table 11 Surface and Sub-surface Features by Asset Owner

Asset	Brief Description	Management Document
Ausgrid		
Electricity transmission lines	132 kV traversing the southern extent of the ACOL Mining Lease	Built Features MP – Appendix C (Asset MP)
	Combined 132 kV and 66/11 kV located parallel to the New England Highway	
	11 kV transmission lines traversing the ACP	
Transgrid		
Electricity transmission lines	330kV transmission line	Built Features MP – Appendix C (Asset MP)
Glencore – Ravensworth Operations		
Electricity transmission lines	33 kV transmission line	Built Features MP – Appendix C (Asset MP)
Pipelines	315 mm PN10 PE100 pipeline	
Public Roads	Lemington Road	
Narama Dam	Narama Dam owned and managed by Glencore	
Glencore – Ravensworth Underground Mine		
Underground Mine Workings	Underground mining activity in proximity to the ACP and No.5 Shaft	Built Features MP – Appendix C (Asset MP)
AGL Macquarie		
Roads	Access roads	Built Features MP – Appendix C (Asset MP)
Prescribed Dam	Void 5 Ash Dam	
Surface Water Storages	Surface water dams	
Gas pipeline	Proposed surface gas pipeline to Liddell Powerstation	
Goaf Gas Drainage Boreholes	Goaf gas drainage boreholes (ACOL owned)	
Fences	Boundary fencing, internal fencing and gates	
NSW Roads & Maritime Services		
Public roads	New England Highway	Built Features MP – Appendix C (Asset MP)
Telstra		
Telecommunication lines	Telstra cables providing service to DPI Water Stream Gauging Station on Bowman’s Creek	Built Features MP – Appendix C (Asset MP)
	Telstra cables providing service to Property No. 130 (Private Property)	
	Underground Telstra copper telephone cable providing service to subdivided blocks on Ravensworth Operations Pty Ltd lease area (parallel to Lemington Road)	
	Underground Telstra optic fibre cable providing service to subdivided blocks on Ravensworth Operations Pty Ltd lease area (parallel to Lemington Road)	

Asset	Brief Description	Management Document
NSW DPI Water		
Stream gauging station	'Foy Brook' Station No. 210130, on Bowmans Creek	Built Features MP – Appendix C (Asset MP)
AAPT		
Telecommunication lines	Sydney to Brisbane fibre optic cable	Built Features MP – Appendix C (Asset MP)
Property No. 130		
Roads	Property access including Ashton access road, registered Right of Way access & private unsealed roads	Built Features MP – Appendix C (Asset MP)
ACOL		
Roads	Access road and tracks	Built Features MP – Appendix C (Asset MP) Internal management document
Farm buildings	Rural residences (incl. various sheds)	
	Farm sheds	
Fences	Boundary fencing, internal fencing, gates and cattle grids	
Pipelines	Hunter River pipeline (200 mm PE80 PN8)	
	Underground borehole pump pipeline (355 mm PE100 PN8) – planned to be installed.	
	Clean water line (900D PN12.5 PE100)	
	Mine water line (250OD PN20 HDPE PE100)	
	Two tailings lines (280OD PN20 HDPE PE100)	
Decant return (250OD PN20 HDPE PE100)		
Surface water storages	Farm dams	
Landform	Bowmans Creek diversion	
Goaf Gas Drainage Boreholes	Goaf gas drainage boreholes (Additional Proposed)	
Singleton Shire Council		
Roads	Lemington Road	Built Features MP – Appendix C (Asset MP)

Note: For additional information regarding assets see the BFMP

5.4 CONTINGENCY RESPONSE

In the event that observed subsidence impacts exceed the performance measures identified in **Section 5.1** (and relevant management plans), the following process and actions will be implemented:

- The observation will be reported to the Technical Services Manager or Environment and Community Relations Manager as soon as practicable, ideally within 24 hours.
- The observation will be recorded for the purposes of the EP 6 Monthly Subsidence Report (provided to DP&E and DRE, refer to **Section 6.5**).
- 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.
- Report any incident to the relevant stakeholders (as identified in each sub-plan to this EP) as soon as practicable after ACOL becomes aware of the exceedance.
- Assess impacts on environmental features and Aboriginal Heritage sites. Implement appropriate measures in accordance with the relevant management plans.
- **Investigate**, in consultation with affected stakeholders (where appropriate) to evaluate the contributing factors to the exceedance/issue. The investigation may include (where applicable):
 - 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&E.
- **Reporting** as per the requirements of the EP Guidelines.
- **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.

Specific AMPs and site Environmental Management Plans provide details of monitoring, management, incident response and notification, consultation and reporting.

5.5 MONITORING OF THE SUCCESS OF REMEDIATION MEASURES

Regular inspections will be undertaken following the implementation of remediation measures. Subsidence remediation measures will be recorded in the key reports to stakeholders and government departments (including DRE and DP&E).

6 IMPLEMENTATION AND OPERATION

6.1 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 6** and described below.

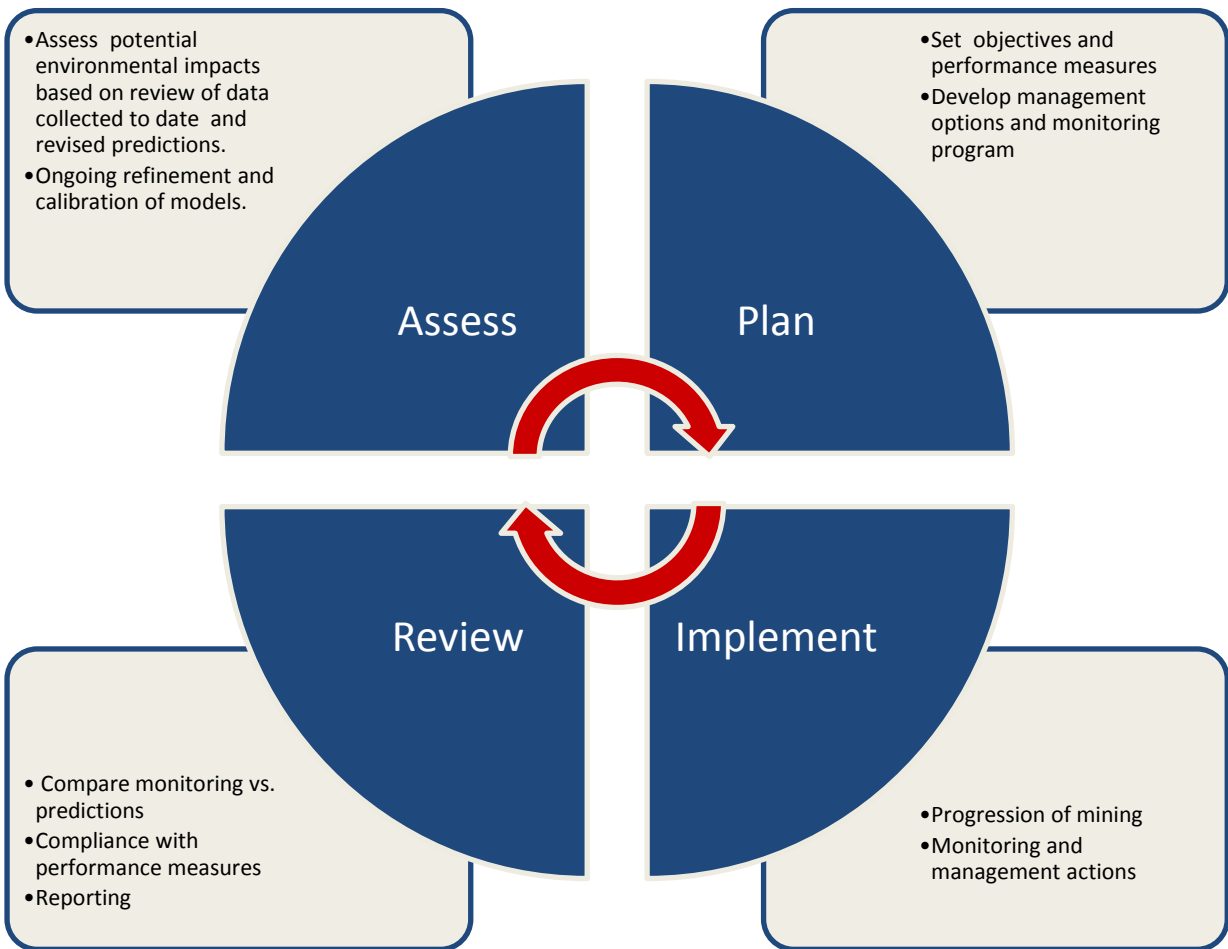


Figure 6 Adaptive Management Loop

6.2 RESPONSIBILITIES AND RESOURCES

Roles and responsibilities are outlined in **Table 12** below.

Table 12 Summary of Key Roles and Responsibilities

Role	Responsibilities
Operations Manager	<ul style="list-style-type: none"> ▪ Ensure whole Site is committed to implementing the monitoring and management regime described in the EP.
	<ul style="list-style-type: none"> ▪ Ensure that adequate resources are available to ACOL personnel to facilitate the completion of their responsibilities under this EP.
	<ul style="list-style-type: none"> ▪ Ensure the EP and associated documents are adhered to.
Environment and Community Manager	<ul style="list-style-type: none"> ▪ 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.
	<ul style="list-style-type: none"> ▪ Ensure that the ongoing stakeholder consultation processes detailed in this plan and the specific <i>AMPs</i> are carried out.
Technical Services Manager	<ul style="list-style-type: none"> ▪ Ensure that all subsidence monitoring and reporting is carried out within the timeframes specified, checked, processed, filed and appropriately reported.
	<ul style="list-style-type: none"> ▪ Liaise with stakeholders regarding subsidence impact management.
Statutory Mine Surveyor	<ul style="list-style-type: none"> ▪ 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 7**. The full organisation structure for the underground mine is contained within ACOL’s Site Safety Standards “Structure and Responsibility Charts”.

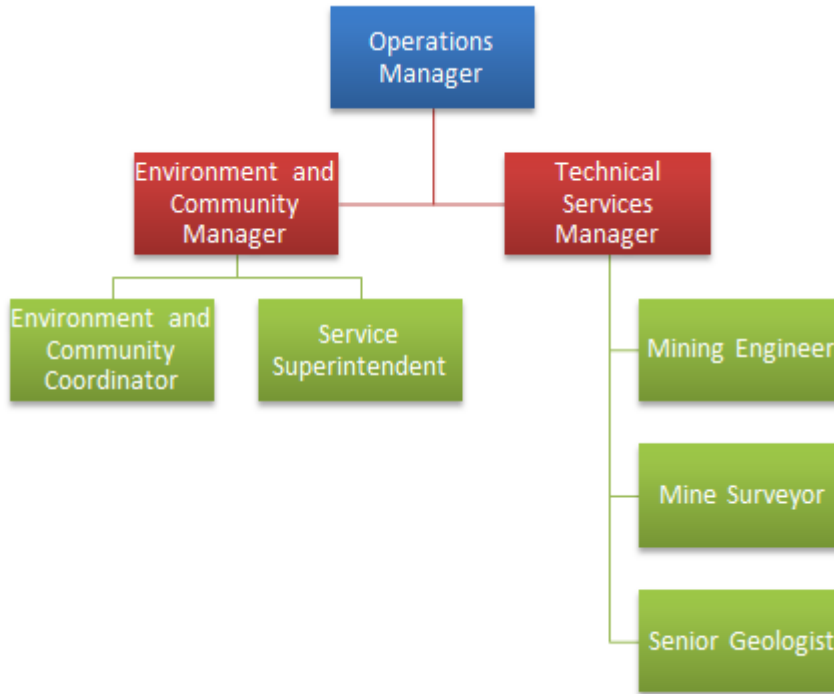


Figure 7 Organisation Chart

6.3 COMMUNICATIONS

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

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

6.4 REVIEW

All 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.

6.4.1 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 6.3**);
- 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 (when 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, or in response to feedback on the following reports.

6.5 REPORTS

A fortnightly update will be prepared to asset owners which are affected by subsidence impacts. Reporting to DP&E and DRE will be completed in accordance with Section 6 of the EP Guidelines (summarised in **Table 13** below).

Table 13 EP Reporting Requirements

Reporting Requirement	Summary	Reporting Method
Incident Reporting	Incident reporting, following any occasion of incident, in accordance with the conditions of consent and/or environment protection licence and/or any requirements in the TARP(s).	Email or phone call - DRE/DP&E.
Bi-monthly Reporting	Bi-monthly (every two months) subsidence impact reporting, following regular monthly inspections, but only if any new impact is identified.	Every two months if new impacts are identified. Email – DRE/DP&E.
Six Monthly Reporting	Six-monthly reporting of all impacts and environmental monitoring results, including: <ul style="list-style-type: none"> • A comprehensive summary of all impacts, including a revised characterisation according to the relevant TARP(s); • Any proposed actions resulting from Triggers being met in the TARP, or other actions; • Assessment of compliance with all relevant performance measures and indicators. 	Email – DRE/DP&E.
AEMR	AEMR reporting, to be based on each two successive six-monthly reports of impacts and environmental monitoring results. A summary of subsidence effects monitoring results will also be included.	Hard Copy and CD – DRE/DP&E and other stakeholders. Put on website.

6.6 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;
- Dated, with revision status indicated;
- Legible, and maintained in an orderly manner; and
- Retained for specific periods.

7 CONSULTATION FOR THE DEVELOPMENT OF THE EP

The following stakeholders (Table 14) were consulted as part of the preparation of this EP.

Table 14 Summary of Stakeholder Consultation

Department/Stakeholder Name	Personnel	Details of Consultation
Department of Planning and Environment	<p>The following people attended the meeting:</p> <p>Howard Reed (DP&E) Jessie Evans (DP&E) Aaron McGuigan (ACOL) Digby Short (ACOL) James Barben (ACOL) Chris Jones (SLR)</p>	<p>ACOL presented an outline of the EP on 12 March 2015 detailing document structure, key features, predicted impacts and mitigation measures.</p> <p>DP&E were sent a copy of the EP (electronic and hard copy) and associated documents as part of the application dated July 2015 (Lodged 6 August 2015) application. A letter was sent from the DP&E to ACOL dated 4 September 2015, requesting additional information mostly relating to subsidence impact performance measures and hydrological impacts. A response letter was sent from ACOL to DP&E dated 26 October 2015. Addendum reports by SCT and RPS were provided in this response letter relating to subsidence and hydrology respectively. A copy of these reports has been included in Volume 2 of the EP.</p> <p>Post lodgement ACOL proposed to shorten LW 105. DP&E then requested that the EP documentation be updated based on the shortening of LW 105. The December 2015 EP submission covers the new shortened LW 105 mine plan.</p>
Division of Resources and Energy	<p>The following people attended the meeting:</p> <p>Paul Langley (DRE) Ray Ramage (DRE) John Trotter (DRE) Jenny Mulcahy (DRE) Aaron McGuigan (ACOL) James Barben (ACOL) Chris Jones (SLR)</p>	<p>ACOL presented an outline of the EP on 20 March 2015 detailing document structure, key features, predicted impacts and mitigation measures.</p> <p>DRE were copy of the EP and associated documents for the initial LW 105-107 EP lodgement (Lodged with DP&E, DRE and sent to other stakeholders on 6 August 2015).</p>
Roads and Maritime Service	<p>Present at the meeting were:</p> <p>Joe Krsul (RMS) Adam McKenzie (RMS) Aaron McGuigan James Barben (ACOL) and; Chris Jones (SLR Consulting).</p>	<p>ACOL attended a meeting at RMS offices on 3 June 2015 to outline the draft RMS AMP. A final draft of the RMS AMP was sent to RMS on 23 June 2015.</p> <p>RMS approved the AMP on 22/06/2015 and it is included in Appendix C. RMS were sent a copy of the EP (electronic version) and associated documents for the initial LW 105-107 EP lodgement (Lodged with DP&E, DRE and sent to other stakeholders on 6 August 2015).</p>
NSW DPI Water	Mitchell Isaac	A copy of the DPI Water AMP and a cover letter outlining water management relating to the

Department/Stakeholder Name	Personnel	Details of Consultation
		<p>project was provided to DPI Water on 18 June 2015, with comments provided by Mitchell Issacs at DPI Water on 15 July 2015. The only comments were that Section 6 be expanded to include details of reporting mechanisms and recipients. The document was updated following these comments.</p> <p>DPI Water were sent a copy of the EP and associated documents for the initial LW 105-107 EP lodgement (Lodged with DP&E, DRE and sent to other stakeholders on 6 August 2015).</p>
Singleton Shire Council	Mursaleen Shah	<p>A meeting was held with SSC on 9 June 2015 regarding this AMP. Attendees at the meeting included Mursaleen Shah from SSC, Aaron McGuigan (ACOL) and James Barben (ACOL). At the meeting, it was agreed that a <i>Transport Management Plan</i> will be developed by ACOL and implemented for Lemington Road. The AMP is scheduled to be presented to the SSC roads committee on 30 July 2015 and according to SSC will go to the following Council meeting in August 2015 for endorsement. SSC were sent a copy of the EP and associated documents (electronic version) for the initial LW 105-107 EP lodgement (Lodged with DP&E, DRE and sent to other stakeholders on 6 August 2015).</p>
Mine Subsidence Board	Richard Pickles	<p>MSB were sent a copy of the EP and associated documents (electronic version) for the initial LW 105-107 EP lodgement (Lodged with DP&E, DRE and sent to other stakeholders on 6 August 2015).</p>
AGL Macquarie	Kathie Burton	<p>A meeting was held with AGL Macquarie to discuss the draft AMP on 28 January 2015. The AMP was updated following the meeting and subsequent consultation in February 2015.</p> <p>AGL Macquarie sent a copy of the EP and associated documents (electronic version) for the initial LW 105-107 EP lodgement (Lodged with DP&E, DRE and sent to other stakeholders on 6 August 2015).</p>
Glencore	Andrew Kelly	<p>Meeting was held with Glencore on 27 February 2015 to discuss the Glencore AMP. A draft copy of the Glencore AMP was provided at this meeting. A copy of the draft management plan was updated following the meeting and submitted to Glencore on 16 March 2015. Further feedback was supplied by Glencore on 25 March 2015, with the management plan subsequently updated.</p> <p>Glencore were sent a copy of the EP and associated documents (electronic version) for the initial LW 105-107 EP lodgement (Lodged with DP&E, DRE and sent to other stakeholders on 6 August 2015).</p>
Telstra	Mark Schneider	<p>This AMP was sent to Telstra for comment on 8 July 2015. ACOL and SLR (lead consultants preparing the EP) have had several discussions with Telstra regarding the project and outlined key controls relating the management of Telstra assets. This AMP will be updated following feedback on the document from Telstra.</p> <p>Telstra were sent a copy of the EP and associated documents (electronic version) for the initial</p>

Department/Stakeholder Name	Personnel	Details of Consultation
		LW 105-107 EP lodgement (Lodged with DP&E, DRE and sent to other stakeholders on 6 August 2015).
AAPT	Neil McKensie	AAPT were sent a copy of the EP and associated documents (electronic version) for the initial LW 105-107 EP lodgement (Lodged with DP&E, DRE and sent to other stakeholders on 6 August 2015). The AAPT powerline is outside the potential subsidence footprint, therefore the original AMP covering the LW 101 – 108 alignment has not been updated.
Ausgrid	Ian Hall	<p>ACOL met with Brendon Osbourne from Ausgrid to discuss interactions between ACOL and Ausgrid assets on 15 April 2015. At the meeting which included a discussion on subsidence management for the LW 105 to 107 Extraction Plan Area it was agreed that the same process previously undertaken for Ausgrid assets would be undertaken for LW 105 to 107. This involves ACOL upgrading the poles affected by subsidence, with Ausgrid approving the AMP prior to subsiding the poles.</p> <p>Ausgrid were sent a copy of the EP and associated documents (electronic version) for the initial LW 105-107 EP lodgement (Lodged with DP&E, DRE and sent to other stakeholders on 6 August 2015).</p>
Transgrid	Timothy Cowdroy and Lauren Vine	<p>Transgrid were sent a copy of the draft AMP on 8 July 2015. Further information was provided to Transgrid during July relating to the design of the 330 kV powerline. ACOL and SLR (lead consultants preparing the EP) have had several discussions with Transgrid regarding the project and outlined key controls relating the management of the 330kV powerline. The AMP will be updated following feedback from Transgrid.</p> <p>Transgrid were sent a copy of the EP and associated documents (electronic version) for the initial LW 105-107 EP lodgement (Lodged with DP&E, DRE and sent to other stakeholders on 6 August 2015).</p>

8 REFERENCES

AECOM (2012) Flora and Fauna (Biodiversity) Management Plan

AECOM (2013) Mining Operations Plan – 2013 to 2017

Department of Planning (2010) Notice of Modification (DA 309-11-2001-i), Department of Planning & Infrastructure NSW, Australia.

Department of Planning and Environment (DP&E) and Department of Resources and Energy (DRE) (Version 5, 2015) Guidelines for the Preparation of Extraction Plans.

Evans and Peck (2009) Bowmans Creek Diversion Environmental Assessment. Evans and Peck, Sydney NSW Australia.

Gilberts and Associates (2014) Water Management Plan

Insite Heritage (2012) Archaeology and Cultural Heritage Management Plan

RPS (2015) Surface and Groundwater Assessment Upper Liddell Seam, Longwalls 105 to 107 – Ashton Coal Project

SCT (2011) Subsidence Assessment for Extraction Plan for Longwalls 105 – 107 in the Upper Liddell Seam, prepared for Ashton Coal Mine, Strata Control Technology Operations Pty Ltd, Wollongong, NSW, Australia

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APPENDIX A – COAL RESOURCE RECOVERY PLAN

APPENDIX B – SUBSIDENCE EFFECTS MONITORING PROGRAM

APPENDIX C – BUILT FEATURES

APPENDIX D – PUBLIC SAFETY MANAGEMENT PLAN

APPENDIX E – WATER MANAGEMENT PLAN

APPENDIX F – FLORA AND FAUNA (BIODIVERSITY) MANAGEMENT PLAN

APPENDIX G – ARCHAEOLOGICAL AND CULTURAL HERITAGE MANAGEMENT PLAN

APPENDIX H – LAND MANAGEMENT PLAN

