

WAMBO COAL PTY LIMITED



SOUTH BATES UNDERGROUND MINE

EXTRACTION PLAN LONGWALLS 11 TO 16

APPENDIX H SUBSIDENCE MONITORING PROGRAM

WAMBO COAL PTY LIMITED
SOUTH BATES UNDERGROUND MINE
SUBSIDENCE MONITORING PROGRAM
LONGWALLS 11 - 16



PREPARED BY
WAMBO COAL PTY LIMITED

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Document No.	SMP LW11-16
Title	Subsidence Monitoring Program for South Bates Underground Mine Longwalls 11 to 16 (Whybrow and Wambo Seams)
General Description	Monitoring program for subsidence effects for mining of Longwalls 11 to 16 at the South Bates Underground Mine
Key Support Documents	-

Revisions

Rev No	Date	Description	By	Checked
A	October 2015	Survey Updates	M. Walker	-
B	October 2015	Final for Submission	M. Walker	T. Britten
C	January 2016	Incorporation of Addendum	WCPL and Resource Strategies	T. Britten
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The nominated Coordinator for this document is	Technical Services Manager
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1 INTRODUCTION

The Wambo Coal Mine is an open cut and underground coal mining operation located approximately 15 kilometres west of Singleton, near the village of Warkworth, New South Wales (NSW). The Wambo Coal Mine is owned and operated by Wambo Coal Pty Limited (WCPL), a subsidiary of Peabody Energy Australia Pty Limited.

The South Bates Underground Mine is a component of the approved Wambo Coal Mine. The South Bates Underground Mine commenced in Longwall 11 in February 2016 and involves extraction of coal by longwall mining methods from the Whybrow Seam and Wambo Seam within Coal Lease (CL) 397 and Mining Lease (ML) 1594.

This Subsidence Monitoring Plan forms a part of the Extraction Plan being developed for the approved Longwalls 11 to 16.

This Subsidence Monitoring Plan has been updated from the previous revision (Revision C) to incorporate Longwalls 14 to 16 in the Wambo Seam.

2 SCOPE

Purpose: This Subsidence Monitoring Program for Longwalls 11 to 16 outlines the monitoring program for subsidence effects for mining of Longwalls 11 to 16 at the South Bates Underground Mine.

Scope: This Subsidence Monitoring Program covers the Longwalls 11 to 16 Application Area.

This Subsidence Monitoring Program is a component of the South Bates Underground Mine Longwalls 11 to 16 Extraction Plan. The Subsidence Monitoring Program has been prepared in accordance with Condition 22C(g) of Schedule 4 of the Development Consent (DA 305-7-2003), which states:

22C. *The Applicant must prepare and implement an Extraction Plan for the second workings within each seam to be mined to the satisfaction of the Secretary. Each Extraction Plan must:*

...

(g) *include the following to the satisfaction of DRE:*

...

- *a subsidence monitoring program to:*
 - *provide data to assist with the management of the risks associated with subsidence;*
 - *validate the subsidence predictions; and*
 - *analyse the relationship between the subsidence effects and impacts under the plan and any ensuing environmental consequences;*

...

This program has been prepared in consideration of the Draft *Guidelines for the Preparation of Extraction Plans Required under Conditions of Development Consents, Project Approvals and Mining Lease Conditions for Underground Coal Mining* (Version 5) (Department of Planning and Environment and NSW Trade & Investment – Division of Resources and Energy, 2015), which requires:

- proposed subsidence monitoring activities (individually specified);
- information or subsidence parameters to be obtained from each monitoring activity;
- proposed locations and/or extents where each monitoring activity will be undertaken, in particular, the proposed layout and/or locations of instrumentation, monitoring points or inspections (including graphical plans);
- proposed timing, frequency and duration of each monitoring activity;
- proposed monitoring methods, technologies, industry standards or Codes of Practice to be applied in undertaking each monitoring activity;
- proposed measures and procedures for quality assurance and competence of personnel undertaking monitoring activities;
- proposed procedures to record monitoring results;
- proposed reporting of monitoring results;
- capacity of the program to detect early warning of deviations from the defined performance measures and associated performance indicators;
- summarise and consolidate the various monitoring programs presented in each of the key component plans; and
- figures showing the monitoring sites for each of the various monitoring programs.

Proposed monitoring and reporting of subsidence effects for Longwalls 11 to 16 is described in **Section 3**. A summary of monitoring of subsidence impacts and environmental consequences is described in **Section 4**.

This Subsidence Monitoring Program has been prepared by WCPL. The appointment of the team of suitably qualified and experienced experts (which includes representatives from WCPL) has been endorsed by the Secretary of the Department of Planning and Environment (DPE).

3 SUBSIDENCE EFFECTS MONITORING AND REPORTING

3.1 SUBSIDENCE MONITORING DETAILS

Subsidence monitoring lines are monitored until negligible subsidence is detected. Discontinuance of survey of these lines will be totally at the discretion of the Division of Resources and Energy Principal Subsidence Engineer.

The monitoring lines for Longwalls 11 to 16 (Line 7XL, Line CL11B, Line CL13B) have been installed as star pickets driven to refusal with a mark then punched into the top and labelled. The marks have been capped with a protective cover that will be removed during survey.

Survey pegs shall generally be a minimum of 10 m and a maximum of 20 m apart.

Surveys shall be carried out using either differential levelling to class LC accuracy or Trig heightening methods to an accuracy of class B as specified in the Inter-Governmental Committee on Surveying and Mapping Special Publication 1.

LiDAR monitoring lines (DL11, CL11A, CL12A and CL13A) will be analysed by creating a surface profile along the line from 3 dimensional LiDAR data. The potential for survey error due to displacement of the data would be minimised through the use of fixed reference points outside the angle of draw.

Details of any subsidence impacts observed would be recorded in the Subsidence Impact Register with visual observations documented in the Subsidence Impact Register Assessment Form (**Attachment 2**). Visual inspections would be undertaken in accordance with the inspection checklist provided in **Attachment 2**. The Subsidence Impact Register will be maintained as an electronic spread sheet on-site, with hard copies of assessment forms filed in a folder.

The data collected under this monitoring program for Longwalls 11 to 16 will be provided to the Division of Resources and Energy in a timely fashion and a suitable format.

3.2 SURVEY ACCURACY AND FREQUENCY

The prescribed accuracy, as defined by the Inter-Governmental Committee on the Survey and Mapping Special Publication 1 (ICSM SP1) and the required frequency of the surveys can be seen in **Table 1**.

3.3 SUBSIDENCE EFFECTS RECORDING AND REPORTING

Subsidence survey data for the South Bates Underground Mine will be stored by WCPL in a centralised database, with results from each survey clearly demarcated.

Subsidence survey data is provided to the Division of Resources and Energy Principal Subsidence Engineer promptly following each survey. Subsidence effects are also reported under the reporting framework of the Extraction Plan.

Table 1
Subsidence Effects Monitoring Program Summary

Survey Line	Data Type	Survey Accuracy Classification	Survey Frequency	Survey Status
Visual Inspections	As per the Subsidence Impact Register provided in Attachment 2	N/A	<ul style="list-style-type: none"> • Within 1 month of longwall extraction that may cause surface movement. • 3 monthly or more frequent in areas of significance such as creeks, roads and buildings. 	<ul style="list-style-type: none"> • As per monitoring program.
Line 7XL	x, y, z	ICSM Class B or LC	<ul style="list-style-type: none"> • Twice prior to Longwall extraction that will cause surface movement. • After completion of each Longwall block. 	<ul style="list-style-type: none"> • Installed and surveyed pre LW11. • Surveyed post LW11.
Line CL11B	z (level and strain distances)	ICSM Class B or LC	<ul style="list-style-type: none"> • Twice prior to Longwall extraction that will cause surface movement. • After completion of each Longwall block. 	<ul style="list-style-type: none"> • Installed and surveyed pre LW11. • Surveyed post LW11.
Line CL13B	z (level and strain distances)	ICSM Class B or LC	<ul style="list-style-type: none"> • Prior to Longwall extraction that will cause surface movement. • After completion of each Longwall block. 	<ul style="list-style-type: none"> • Installed. • Base Survey pre LW13 pending.
DL11	Random x, y, z (LiDAR)	<150mm Vert (1 sigma)	<ul style="list-style-type: none"> • Prior to Longwall extraction that will cause surface movement. • After completion of each Longwall block. 	<ul style="list-style-type: none"> • Surveyed pre LW11-16. • Surveyed post LW11.
CL11A	Random x, y, z (LiDAR)	<150mm Vert (1 sigma)	<ul style="list-style-type: none"> • Prior to Longwall extraction that will cause surface movement. • After completion of each Longwall block. 	<ul style="list-style-type: none"> • Surveyed pre LW11-16.
CL12A	Random x, y, z (LiDAR)	<150mm Vert (1 sigma)	<ul style="list-style-type: none"> • Prior to Longwall extraction that will cause surface movement. • After completion of each Longwall block. 	<ul style="list-style-type: none"> • Surveyed pre LW11-16.
DL13	Random x, y, z (LiDAR)	<150mm Vert (1 sigma)	<ul style="list-style-type: none"> • Prior to Longwall extraction that will cause surface movement. • After completion of each Longwall block. 	<ul style="list-style-type: none"> • Surveyed pre LW11-16.
CL13A	Random x, y, z (LiDAR)	<150mm Vert (1 sigma)	<ul style="list-style-type: none"> • Prior to Longwall extraction that will cause surface movement. • After completion of each Longwall block. 	<ul style="list-style-type: none"> • Surveyed pre LW11-16.

4 MONITORING OF ENVIRONMENTAL CONSEQUENCES

The various monitoring programs presented in each of the management plans under the Extraction Plan are summarised in **Table 2** and the location of environmental monitoring sites included in Wambo's various environmental monitoring programs are presented in **Figures 1 and 2**.

Figure 1 presents the location of surface water and groundwater monitoring sites.

Figure 2 presents the location of biodiversity monitoring sites. As described in **Table 2**, visual observation of the Wollemi National Park escarpment will be undertaken as part of the BMP monitoring program.

Details of any subsidence impacts observed will be recorded in the Subsidence Impact Register with visual observations documented in the Subsidence Impact Register Assessment Form as provided in **Attachment 2**. Visual inspections will be undertaken in accordance with the inspection checklist provided in **Attachment 2**.

The Subsidence Impact Register will be maintained as an electronic spreadsheet on-site, with hard copies of assessment forms filed in a folder.

Table 2
Longwalls 11 to 16 Monitoring Program Summary

Management Plan	Monitoring Component	Parameter	Frequency
Water Management Plan	Bed and bank stability.	<ul style="list-style-type: none"> Monitoring to distinguish between erosion from mine subsidence instability and erosion from other causes along North Wambo Creek Diversion and Stony Creek. 	<ul style="list-style-type: none"> In accordance with the SWMP.
	Monitoring of surface water quality and flow monitoring sites.	<ul style="list-style-type: none"> Monitoring of surface water flow and quality along North Wambo Creek Diversion, Stony Creek and Wollombi Brook in accordance with the SWMP. 	<ul style="list-style-type: none"> In accordance with the SWMP.
	Monitoring of groundwater level and quality.	<ul style="list-style-type: none"> Monitoring of groundwater level and quality within the vicinity of the Wambo Coal Mine. 	<ul style="list-style-type: none"> In accordance with the GWMP.
	Inflows to underground workings.	<ul style="list-style-type: none"> Dewatering volumes and underground water levels in accordance with the GWMP. 	<ul style="list-style-type: none"> In accordance with the SWMP.
	Diversion and subsidence monitoring program for the North Wambo Creek Diversion.	<ul style="list-style-type: none"> As outlined in the SWMP, including: monitoring of Index of Diversion Condition; Landscape Function Analysis (LFA); riparian vegetation; aerial photography; long and cross-section surveys (extracted from LiDAR); and geomorphic condition and efficacy of subsidence management or rehabilitation works. 	<ul style="list-style-type: none"> In accordance with the SWMP.
	Visual inspection of the North Wambo Creek Diversion.	<ul style="list-style-type: none"> Inspections for surface cracking and/or surface ponding. 	<ul style="list-style-type: none"> Daily inspections when extraction is occurring directly beneath North Wambo Creek Diversion.
Land Management Plan	Fences.	<ul style="list-style-type: none"> Visual observation to record the initial condition of fences. Visual observation to record the condition of fences following extraction of Longwalls 11 to 16. 	<ul style="list-style-type: none"> Prior to secondary extraction of Longwalls 11 to 16. Following completion of secondary extraction of Longwalls 11 to 16.

Table 2 (Continued)
Longwalls 11 to 16 Monitoring Program Summary

Management Plan	Monitoring Component	Parameter	Frequency
Land Management Plan (Cont.)	Ground surface.	<ul style="list-style-type: none"> Visual observation to record the initial condition of the ground surface. Visual observations of the ground surface behind the longwall face to identify potential surface cracks. Visual observations of low lying areas (i.e. the North Wambo Creek Diversion) to identify potential surface ponding. Visual observations of the ground surface to identify stabilisation of erosion and groundcover. 	<ul style="list-style-type: none"> Prior to secondary extraction of Longwalls 11 to 16. Monthly inspections during secondary extraction of Longwalls 11 to 16, increased to weekly inspections during extraction within 100 m of the North Wambo Creek Diversion. Following a significant rainfall event (i.e. 40 mm within 24 hours).¹ Monthly inspections until stabilisation of erosion and groundcover is >60%.
	Cliffs.	<ul style="list-style-type: none"> Visual observations of cliffs for signs of recent rock fall and/or instability (high definition video/photos recorded via an unmanned aerial vehicle [UAV]). 	<ul style="list-style-type: none"> Prior to secondary extraction of Longwalls 11 to 16; following completion of secondary extraction of Longwall 11; following completion of secondary extraction of Longwall 12; following completion of secondary extraction of Longwall 13; following completion of secondary extraction of Longwall 14; following completion of secondary extraction of Longwall 15; and following completion of secondary extraction of Longwall 16.

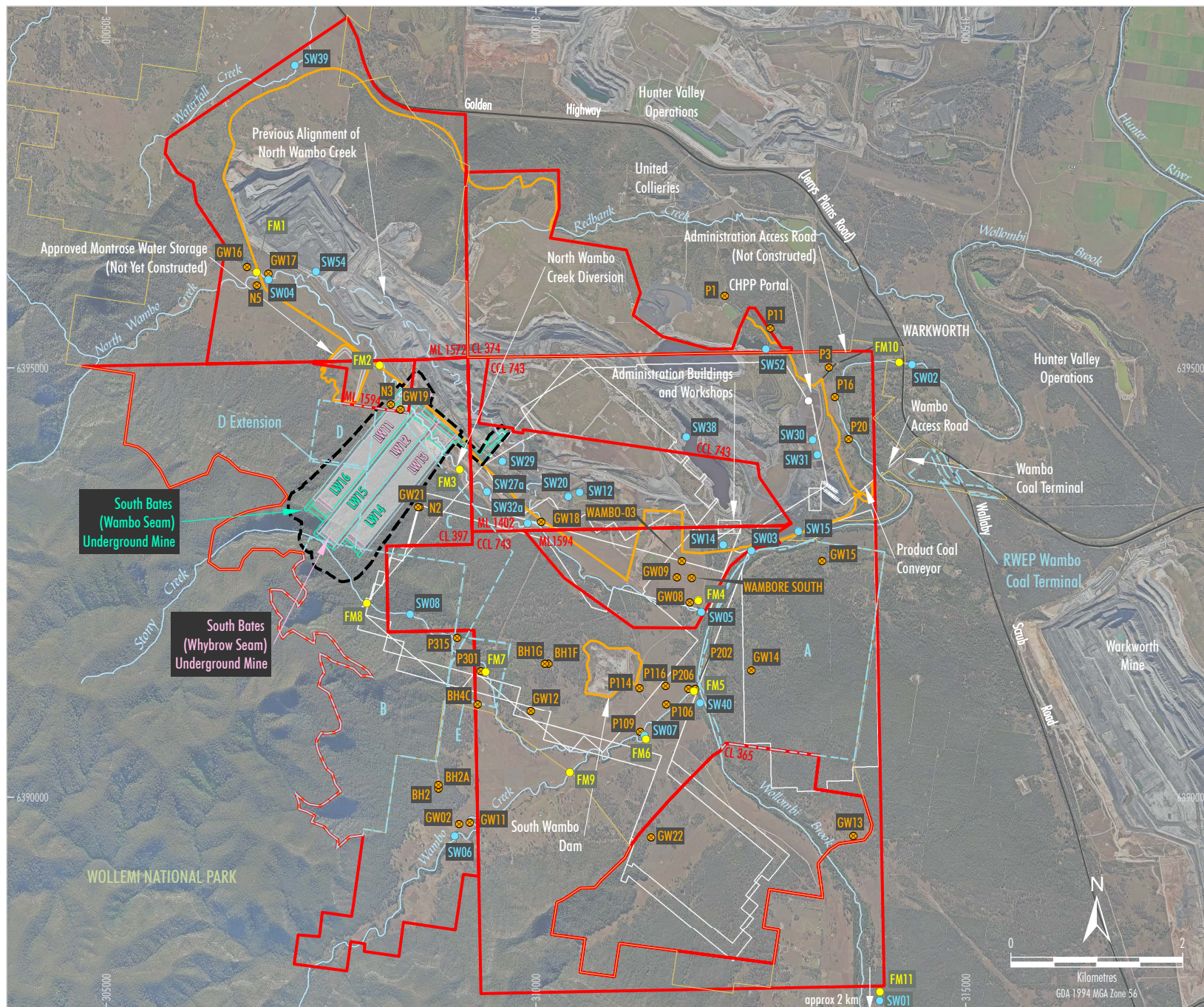
Table 2 (Continued)
Longwalls 11 to 16 Monitoring Program Summary

Management Plan	Monitoring Component	Parameter	Frequency
Biodiversity Management Plan	General monitoring of flora, fauna and aquatic ecosystems.	<ul style="list-style-type: none"> Monitoring in accordance with the BMP. 	<ul style="list-style-type: none"> In accordance with the BMP.
	Subsidence impacts to Wollemi National Park escarpment.	<ul style="list-style-type: none"> Visual observations of the Wollemi National Park escarpment for signs of recent rock fall and/or instability (high definition video/photos recorded via an UAV). 	<ul style="list-style-type: none"> Prior to and following completion of each longwall in accordance with the LMP.
Heritage Management Plan	Artefact scatters and isolated finds.	<ul style="list-style-type: none"> Surface cracks and/or erosion in the vicinity of artefact scatters or isolated finds. 	<ul style="list-style-type: none"> In accordance with the HMP (monthly during extraction of longwall panels in immediate proximity to a site).
Built Features Management Plan – WCPL Asset Management Plan	All built features.	<ul style="list-style-type: none"> Visual observations to record the general condition of WCPL assets including safety and serviceability. 	<ul style="list-style-type: none"> Monthly inspection during secondary extraction of Longwalls 11 to 16.
	Active service lines.	<ul style="list-style-type: none"> Visual observations to record the general condition of WCPL active service lines including safety and serviceability. 	<ul style="list-style-type: none"> Daily inspections commencing when secondary extraction is within 100 m of WCPL active service lines and undertaken until the active mining face is 100 m past the line.
	Culverts.	<ul style="list-style-type: none"> Visual observations to record cracking of concrete culverts or grade reversal. 	<ul style="list-style-type: none"> Prior to secondary extraction within 100 m of culverts and undertaken at 50 m intervals until the active mining face is 100 m past the culverts.
	Roads and tracks.	<ul style="list-style-type: none"> Visual observations to record condition of roads and tracks, including surface cracks, buckling and general safety. 	<ul style="list-style-type: none"> Prior to secondary extraction within 100 m of any WCPL asset and undertaken at 50 m intervals until the active mining face is 100 m past the WCPL asset.

Table 2 (Continued)
Longwalls 11 to 16 Monitoring Program Summary

Management Plan	Monitoring Component	Parameter	Frequency
Built Features Management Plan – WCPL Asset Management Plan (Cont.)	Mine dewatering and water supply pipelines.	<ul style="list-style-type: none"> Monitoring of pipeline integrity at fixed points. Monitoring to detect abnormal changes in flow. 	<ul style="list-style-type: none"> Daily inspections commencing when secondary extraction is within 100 m of WCPL active service lines and undertaken until the active mining face is 100 m past the pipeline. Continuous (SCADA) monitoring of pump and pipeline conditions.
Public Safety Management Plan	Fences.	<ul style="list-style-type: none"> Visual observation to record the initial condition of fences. Visual observations to record the condition of fences during extraction of Longwalls 11 to 16. Visual observations to record the condition of fences following extraction of Longwalls 11 to 16. 	<ul style="list-style-type: none"> Prior to secondary extraction of Longwalls 11 to 16. Monthly inspections during secondary extraction of Longwalls 11 to 16. Following completion of secondary extraction of Longwalls 11 to 16.
	Warning signs.	<ul style="list-style-type: none"> Visual observation to record the initial condition of existing warning signs (e.g. legibility). Visual observations to record the condition of warning signs (e.g. legibility) during extraction of Longwalls 11 to 16. 	<ul style="list-style-type: none"> Prior to secondary extraction of Longwalls Longwalls 11 to 16. Monthly inspections during secondary extraction of Longwalls Longwalls 11 to 16.
Rehabilitation Management Plan (MOP)	Remediate subsidence areas.	<ul style="list-style-type: none"> Visual monitoring to identify any requirement for maintenance measures and/or remedial works. 	<ul style="list-style-type: none"> Monthly inspections until monitoring confirms stabilisations of erosion and groundcover is >60%.
	Installed sediment control structures.	<ul style="list-style-type: none"> Inspected of capacity, structural integrity and effectiveness in accordance with the ESCP. 	<ul style="list-style-type: none"> Monthly and/or following a significant rainfall event (i.e. 20 mm within 24 hours, midnight to midnight).

¹ Inspection to occur once access is practically available following the rainfall event. Inspections would not occur for subsequent rainfall events within 7 days of previous inspection.



LEGEND

- WCPL Owned Land
- Mining and Coal Lease Boundary
- Existing/Approved Surface Development Area
- South Bates (Whybrow Seam) Underground Mine
- South Bates (Wambo Seam) Underground Mine
- Other Approved Underground Development
- Remnant Woodland Enhancement Program (RWEF) Area
- Extraction Plan Application Area
- Groundwater Monitoring Site
- Surface Water Quality Monitoring Site
- Surface Water Flow Monitoring Site

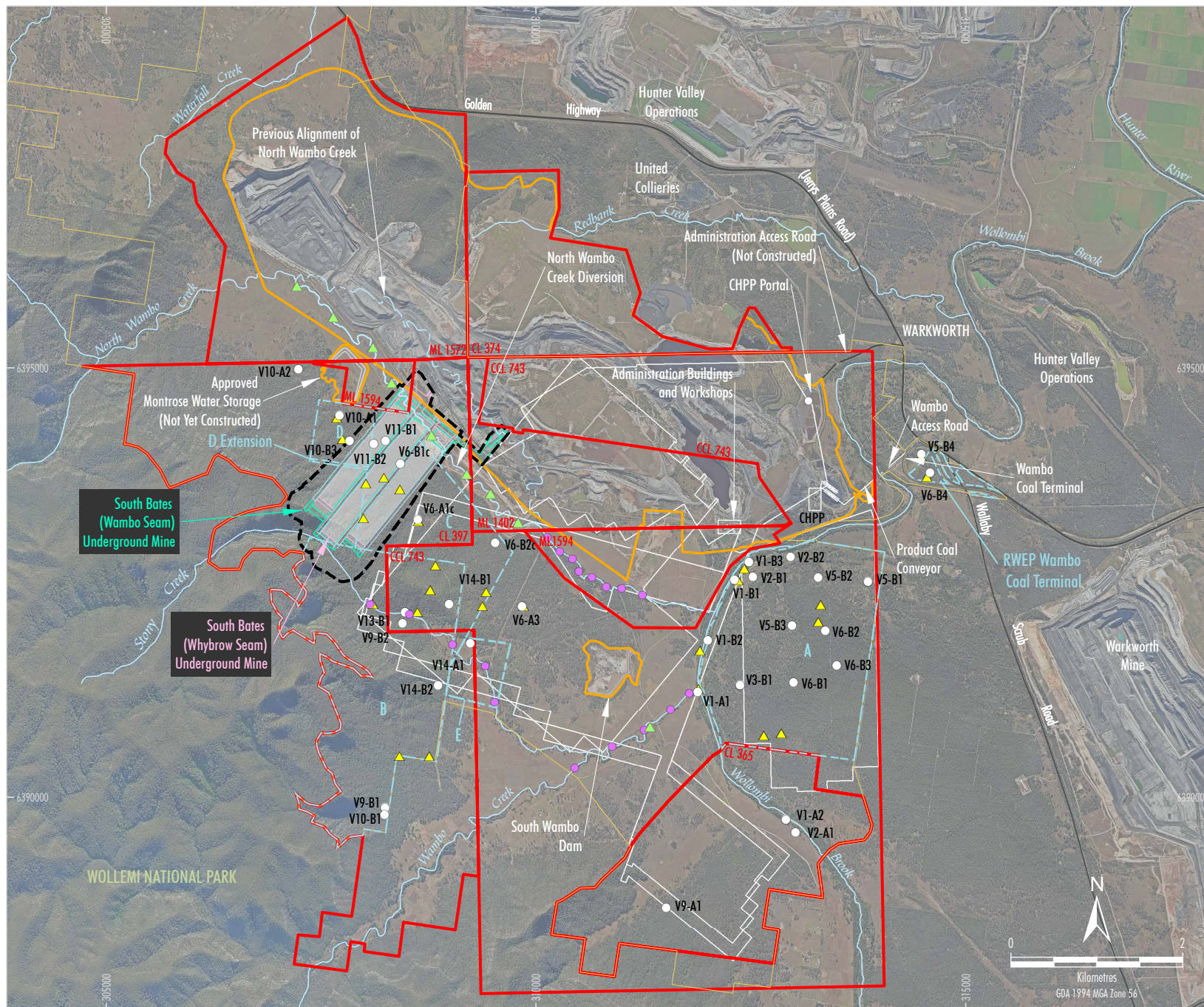
Source: Department of Lands (July 2009); WCPL (2016); WCPL Orthophoto (July 2016)

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Locations of Surface Water and Groundwater Monitoring Sites

Figure 1



- LEGEND**
- WCPL Owned Land
 - Mining and Coal Lease Boundary
 - Existing/Approved Surface Development Area
 - South Bates (Whybrow Seam) Underground Mine
 - South Bates (Wambo Seam) Underground Mine
 - Other Approved Underground Development
 - Remnant Woodland Enhancement Program (RWEF) Area
 - Extraction Plan Application Area
 - Flora Monitoring Plot
 - Bird Monitoring Site
 - Riparian Monitoring Cross-section
 - LFA Monitoring Location - Riparian

Source: Department of Lands (July 2009); WCPL (2016); WCPL Orthophoto (July 2016)

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Locations of Relevant
Biodiversity Monitoring Sites

Figure 2

5 ROLES AND RESPONSIBILITIES

Key responsibilities of WCPL personnel in relation to this Subsidence Monitoring Program are summarised in **Table 3**. Responsibilities may be delegated as required.

Table 3
Subsidence Monitoring Program Responsibilities Summary

Responsibility	Task
General Manager	<ul style="list-style-type: none"> Ensure resources are available to WCPL personnel to facilitate the completion of responsibilities under this Subsidence Monitoring Program.
Mining Engineering Manager (Underground Mine Manager)	<ul style="list-style-type: none"> Ensure this Subsidence Monitoring Program is implemented.
Technical Services Manager	<ul style="list-style-type: none"> Ensure monitoring and reporting required in accordance with this Subsidence Monitoring Program is carried out within specified timeframes, are adequately checked and processed and are prepared to the required standard.
Environment and Community Manager	<ul style="list-style-type: none"> Undertake environmental monitoring required in accordance with the Extraction Plan and ensure the Subsidence Impact Register is kept up to date and hard copies of the assessment forms are filed / stored correctly.
Underground Mining Engineer	<ul style="list-style-type: none"> Become familiarised with environmental aspects which require monitoring in accordance with the Extraction Plan.
Mine Surveyor	<ul style="list-style-type: none"> Undertake all monitoring in accordance with this Subsidence Monitoring Program to the required standard within the specified timeframes and ensure data are adequately checked, processed and recorded.

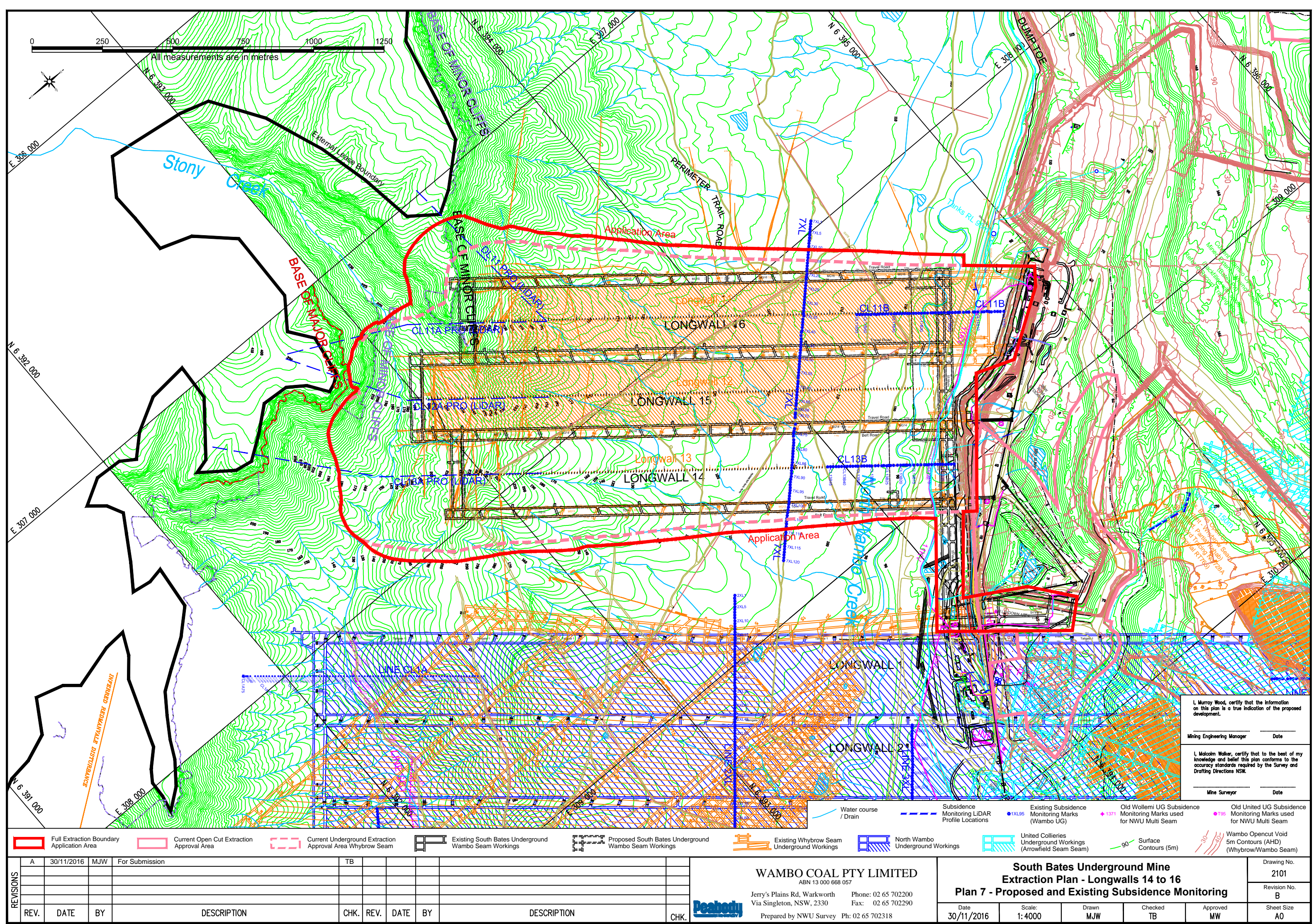
6 REFERENCES

Department of Planning and Environment and NSW Trade & Investment – Division of Resources and Energy (2015) *Guidelines for the Preparation of Extraction Plans Required under Conditions of Development Consents, Project Approvals and Mining Lease Conditions for Underground Coal Mining*. Version 5. Draft.

Wambo Coal Pty Limited (2003) *Wambo Development Project Environmental Impact Statement*.

ATTACHMENT 1

EXISTING AND PROPOSED SUBSIDENCE MONITORING LINES



ATTACHMENT 2
SUBSIDENCE IMPACT REGISTER

Table A2-1
Example Subsidence Impact Register (Electronic Version Maintained On-Site)

Impact Register Number ¹	Impact Description	Does Impact Exceed the Performance Measure/Indicators? (Yes/No/Not Applicable)	Management Measures Implemented	Were Management Measures Effective? (Yes/No)

Notes:

1: Fill out all details in the Assessment Form and record the register number here.

SUBSIDENCE IMPACT REGISTER ASSESSMENT FORM		
Date and Time		
Observer (Name and position)		
Register Number (i.e. Number 1, 2, etc.)		
Longwall Number		
Longwall Chainage		
Area Inspected <u>Examples:</u> location of crack, include GPS co-ordinates and a sketch		
INSPECTION ITEM	CHECKED	COMMENTS (<u>Examples:</u> nature and extent of impact, any relevant information, attach photographs)
Surface Cracking		
Surface Humps (compression)		
Surface Ponding		
Access Tracks/Serviceability of built features		
Warning Signage		
Powerline – poles, insulators, conductors, conductor clearance		
Other		
Actions Required		
Management or Contingency Measures Implemented		
Effectiveness of Management or Contingency Measures		
WCPL Key Personnel Notified (include date of email)		
Technical Services Manager	<input type="checkbox"/>	__/__/__
Environment and Community Manager	<input type="checkbox"/>	__/__/__

SUBSIDENCE INSPECTION CHECKLIST

WHERE TO INSPECT

- 500 metres behind and 100 metres in front of the current longwall face position.

EXTENT OF INSPECTION

- Include the area of active subsidence based on the 26.5 degree angle of draw.

WHAT TO LOOK FOR

- **Surface Cracking:** inspect edges of extraction void and travelling abutments.
- **Surface Humps:** inspect near centre of extracted panels and travelling abutment.
- **Surface Ponding:** inspect low lying areas for evidence of increased/new ponding.
- **Access Tracks:** inspect for step change in land surface and changes in access for serviceability.
- **Warning Signage:** inspect condition and legibility of relevant warning signage.
- **Powerlines:** inspect for changes of conductor clearance and power pole condition.
- Check the serviceability of built features (e.g. fences, buildings, dams and access tracks).
- Note any flooding hazards for access tracks.
- Carry out any inspections required in accordance with the Built Features Management Plan for Longwalls 11 to 16.

ACTIONS IF AN IMPACT IS IDENTIFIED

1. Employ additional subsidence warning signs if necessary.
2. Notify Key Personnel (including asset owner if relevant [e.g. if asset is not a WCPL-owned asset]).
3. Assess impact against requirements of the relevant TARP and implement actions as required.
4. Record implemented actions in the Subsidence Impact Register Assessment Form.
5. Notify the principal subsidence engineer.
6. Notify other stakeholders as required (e.g. DPE, DRE etc.).