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<b>WHC_PLN_NAR_SUBSIDENCE MONITORING PROGRAM – LW 203 – LW 206</b>			



# NARRABRI MINE

## EXTRACTION PLAN SUBSIDENCE MONITORING PROGRAM

LW 203 – LW 206

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**Prepared by:**

Title	Name	Signature	Date
Senior Environmental Project Manager	Carmen Osborne Onward Consulting		07 February 2023
Environmental Project Manager	Linden Burch Onward Consulting		07 February 2023

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## Acronyms and abbreviations


Acronym	Description
AHD	Australian Height Datum
AoD	angle of draw
CCC	Community Consultative Committee
CF	Cut and flit
Cwlth	Commonwealth
DGS	Ditton Geotechnical Services
DPE	The NSW Department of Planning and Environment
DPE Water	The Water group within DPE
EA	Environmental Assessment
EP 203-206	The Extraction Plan for LW 203 to LW 206
EP-BFMP	Built Features Management Plan (as Appendix E to EP 203-206)
EP-BMP	Biodiversity Management Plan (as Appendix C to EP 203-206)
EP-HMP	Heritage Management Plan (as Appendix D to EP 203-206)
EP-LMP	Land Management Plan (as Appendix B to EP 203-206)
EP-PSMP	Extraction Plan – Public Safety Management Plan (as Appendix F to EP 203-206)
EP-SMP	Subsidence Monitoring Program (this Program)
EP-WMP	Water Management Plan (as Appendix A to EP 203-206)
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i> (NSW)
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cwlth)
ha	hectare
IEA	Independent Environmental Audit
km	kilometre
LiDAR	light detection and ranging
LW	longwall panel
m	metre
ML	mining lease
mm/m	millimetre per metre
Mtpa	million tonnes per annum
NCOPL	Narrabri Coal Operations Pty Ltd
PED	personal emergency device (communications system)
ROM	run of mine
WHC	Whitehaven Coal Limited

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## 1. Introduction

### 1.1 Background

The Narrabri Mine is an existing underground coal mining operation situated in the Gunnedah Coalfield. It is located approximately 25 kilometres (km) south-east of Narrabri and approximately 60 km north-west of Gunnedah, within the Narrabri Shire Council Local Government Area in New South Wales (NSW). The Narrabri Mine includes an underground coal mine, a coal handling and preparation plant and associated rail siding and surface infrastructure.

The Narrabri Mine is operated by Narrabri Coal Operations Pty Ltd (NCOPL), on behalf of the Narrabri Mine Joint Venture, which consists of two Whitehaven Coal Limited (WHC) wholly owned subsidiaries, and other joint-venture partners<sup>1</sup>. The underground mine is covered by Mining Lease (ML) 1609 which covers an area of 5,298 hectares (ha) for the predominant purpose of mining for coal from the Hoskissons Coal Seam.

Stage 1 of the Narrabri Mine was approved in November 2007 under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Construction of the mine and supporting infrastructure commenced in 2008, with production using a continuous miner commencing in 2010. Following the approval of the Stage 2 Environmental Assessment (R.W Corkery & Co., 2009) (the EA) and the issue of the Stage 2 Project Approval 08\_0144 (Project Approval) in July 2010, and *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval (2009/5003) in January 2011, the Narrabri Mine was converted to an 8 million tonnes per annum (Mtpa) run of mine (ROM) longwall mining operation, which commenced in 2012.

The Project Approval has subsequently been modified on a number of occasions. The environmental assessment for Modification 5 (Resource Strategies, 2015) (MOD 5), approved in December 2015, changed the mine geometry by reducing the number of longwall (LW) panels from 26 to 20, increased some LW panel widths and increased the production to 11 Mtpa of ROM coal until July 2031.


Modification 7, the most recent modification of the Project Approval, was approved on 23 November 2021. The environmental assessment for Modification 7 (Resource Strategies, 2021) (MOD 7) describes the change in mining method within the extent of the previously approved LW 201 and LW 202 and allows for up to 0.7 Mtpa via bord and pillar extraction at pillar reduction panels Cut and Flit (CF) 201 to CF 205. There is no change to the previously approved longwall panels LW 203 to LW 209. The bord and pillar mining will occur concurrently with existing longwall operations for a period of approximately five years, with the maximum ROM coal production rate remaining within the approved limit of 11 Mtpa.

### 1.2 Purpose and scope

This Extraction Plan – Subsidence Monitoring Program (EP-SMP or Program) for Longwall (LW) 203 to LW 206 has been prepared in accordance with Schedule 3 Condition 4(g) of the Project Approval and the NSW Department of Planning and Environment (DPE) *Extraction Plan Guideline* (DPE 2022).

The EP-SMP sets out the objectives, monitoring requirements, and proposed 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 Extraction Plan for LW 203 to LW 206 (EP 203-206) and ensuing environmental consequences. This EP-SMP forms Appendix K to EP 203-206.

<sup>1</sup> For full details on the joint venture ownership, refer to the introduction of the Extraction Plan.

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The Ditton Geotechnical Services Pty Ltd (**DGS**) *Mine Subsidence Assessment Report for LW 203 to LW 206* (DGS 2022) (**Mine Subsidence Assessment Report**) has been used as a basis for developing the performance measures and management actions in response to the predicted impacts on built and natural features above LW 203 to LW 206 (**the Extraction Plan Area<sup>2</sup>**). The Mine Subsidence Assessment Report is presented in full as Appendix J to EP 203-206.


The Extraction Plan Area and underground mining layout is presented in Figure 1-1. A detailed description of the underground mining method is provided within EP 203-206.

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<sup>2</sup> The area located within the 45° Angle of Draw (AoD) as shown on Figure 1-1.





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### 1.3 Objectives

The objectives of this EP-SMP are to:

- provide details of the relevant statutory requirements, including any relevant approval, licence or lease conditions;
- describe the ongoing conventional and non-conventional subsidence monitoring program, including consideration of contemporary subsidence monitoring methods;
- provide data to assist with the management of the risks associated with subsidence;
- validate the conventional and non-conventional subsidence predictions;
- analyse the relationship between the predicted and resulting subsidence effects and predicted and resulting impacts under the EP 203-206 and any ensuing environmental consequences;
- provide information of the contingency plan and adaptive management process;
- detail the regulatory reporting requirements;
- describe the protocol for periodic review of this EP-SMP; and
- identify the roles and responsibilities for implementation of this EP-SMP.

### 1.4 Statutory requirements

#### 1.4.1 Project Approval


This EP-SMP has been developed in accordance with Schedule 3 Condition 4 of the Project Approval which requires NCOPL to prepare an Extraction Plan for all second workings within the area of the Approved Mine Plan (Appendix H of EP 203-206) to the satisfaction of the Secretary.

In accordance with Schedule 3 Condition 4(g), the Extraction Plan must include a Subsidence Monitoring Program to monitor the potential impacts and/or environmental consequences of the proposed second workings.

Schedule 3 Condition 4(b) of the Project Approval requires the Extraction Plan and its sub plans to be approved by the Secretary prior to NCOPL carrying out any of the second workings covered by EP 203-206.

In accordance with Schedule 3 Condition 1 and Condition 2 of the Project Approval, NCOPL must ensure that mine subsidence does not cause any exceedances of the performance measures detailed in Table 1-1 and Table 1-2. Condition 2 states that NCOPL will be required to define more detailed performance indicators for each of the performance measures detailed in the Built Features Management Plan and/or Public Safety Management Plan.

Project Approval Schedule 6 Condition 2 lists the requirements for the preparation of management plans which must be prepared in accordance with any relevant guidelines and include details of the relevant approval, licence or lease conditions. Attachment 1, Table A1-1 provides a summary of the Project Approval conditions relevant to this Plan and outlines the section of the EP-SMP in which each of these conditions have been addressed.

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**Table 1-1 Subsidence impact performance measures – natural features**

Feature	Performance measure
<b>Water Resources</b>	
Great Artesian Basin	The Proponent shall ensure that, within 5 years of the date of this approval, any loss of water flow into the Great Artesian Basin aquifers (equal to the maximum predicted impact, or the measured impact of the project, whichever is the greater), is managed, licensed or offset (including the possibility of injection of raffinate) to the satisfaction of DPE Water.
<b>Biodiversity</b>	
Flora and Fauna	The Proponent shall ensure that clearing and disturbance of vegetation above the mining area is minimised, to the satisfaction of the Secretary.

**Table 1-2 Subsidence impact performance measures – built features**

Feature	Performance measure
<b>Built features</b>	
All built features	Always safe. Serviceability will be maintained wherever practicable. Loss of serviceability must be fully compensated. Damage must be fully repairable and must be fully repaired or else replaced or fully compensated.
<b>Public safety</b>	
Public safety	No additional risk

### 1.4.2 Mining lease

NCOPL are the holder of ML 1609 issued under the *Mining Act 1992* in January 2008. As the holder of a mining lease, NCOPL must take all reasonable measures to prevent, or if that is not reasonably practicable, to minimise, harm to the environment caused by activities under the mining lease.


### 1.4.3 EPBC Act approval

The Narrabri Mine was granted EPBC 2009/5003 in 2011 issued under the EPBC Act (last varied on 24 March 2021).

EPBC 2009/5003 prescribes conditions to minimise potential impacts on EPBC Act listed threatened species and communities within the mine site. Condition 3 of EPBC 2009/5003 states that in order to minimise potential impacts on EPBC Act listed threatened species and communities within the mine site, prior to any Works commencing and in accordance with the NSW Director General’s Assessment Report and approval conditions (26 July 2010), the person undertaking the action must develop and implement an Extraction Plan.

## 1.5 Risk assessment

A subsidence risk assessment has been undertaken to identify the risks associated with subsidence at the Narrabri Mine. It builds on previous risk assessments completed for LW 101 to LW 110 and Panels 201 to 202 and is presented as Appendix I to EP 203-206. The updated risk assessment for LW 203 to LW 206 identified

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one high-risk item (i.e. Mayfield GG1) above LW 205. All other risks within the Extraction Plan Area have been assessed as low to moderate.

## 1.6 Preparation and consultation


The development of this EP-SMP does not require any specific individual consultation during preparation. However, in accordance with Schedule 3 Condition 4(g), NCOPL are required to prepare the EP-SMP to the satisfaction of the Resources Regulator. NCOPL held a briefing session with the Resources Regulator on 2 December 2022 (Attachment 3 of EP 203-206). There were no specific actions required by the Resources Regulator to update the EP-SMP following the briefing session.

The overall consultation and approval process required for the Extraction Plan by the Project Approval is detailed in EP 203-206.

## 1.7 Access to information

In accordance with Schedule 6 Condition 10 of the Project Approval, the approved EP 203-206, audits and reports, and summaries of all monitoring data (where relevant) will be made publicly available on the WHC website. All information will be kept up to date.

Note that any printed copies of this EP-SMP are uncontrolled.

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## 2. Surface features

### 2.1 Overview

The Extraction Plan Area includes land exclusively owned by NCOPL. The Pilliga East State Forest exists outside of the Extraction Plan Area to the west. The land holdings have historically been used for livestock grazing and some cereal crop farming and occasional orchard farming (e.g. olive groves).

Topographic relief above the proposed mining area ranges from 279 m Australian Height Datum (**AHD**) to 340 m AHD. The surface terrain is generally flat with slopes ranging from 1° to 5°. Slopes increase to 10° to 35° in several rocky 'hillock' locations, including the ephemeral creeks and tributaries (or gullies), which drain the Extraction Plan Area towards the north-east. The hillocks have Pilliga Sandstone exposures with local topographic relief ranging between 10 m and 15 m above the surrounding plains.

Silty sand and sandy clay surface soils to 4 m depth are present within the Extraction Plan Area and are mildly to highly erosive/dispersive. The clayey soils are associated with the outcropping Garrawilla Volcanics and overlying Purlawaugh formation. Sandy alluvial deposits exist along the creek channels with no rock exposures present. The channels are typically incised with steep to very steep banks between 0.5 m and 3.5 m high. Vegetation includes several stands of native vegetation across the agricultural land use areas and riparian zones along ephemeral creeks.

A range of built features are located within the Extraction Plan Area, which can be summarised as the following elements:

- Water storage dams and soil conservation (contour) banks.
- Roads and access tracks, including unsealed gravel access tracks.
- Property and livestock fences.
- Residential dwellings and machinery sheds.
- Mine infrastructure, including groundwater supply and monitoring bores.
- Domestic power and telecommunication lines.
- State Survey Marks.


Natural features potentially impacted by mining activities and monitored under the scope of this EP-SMP include:

- Gently undulating terrain with ephemeral watercourses associated with Kurrajong Creek and its tributaries.
- Riparian vegetation areas along the creeks.
- Steep rocky slopes up to 15 m high.
- Sub-surface groundwater aquifers at depths ranging from 5 m to 50 m (typically of poor quality).

A detailed list of all built and natural features within the Extraction Plan Area is provided in Plan 2 (Appendix H to EP 203-206).

### 2.2 Public utilities

As stated in section 2.1, the land within the Extraction Plan Area is exclusively owned by NCOPL. There are no known public utilities that exist within Extraction Plan Area.

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### 2.3 Industrial, commercial and business establishments

No industrial, commercial or business establishments are located within the Extraction Plan Area, with the exception of infrastructure associated with the Narrabri Mine. Affected mine infrastructure is limited to the surface facilities associated with surface to in-seam gas drainage bores and unsealed access tracks. A number of buried Personal Emergency Device (PED) cables are also located within previously mined areas.

### 2.4 Areas of archaeological or heritage significance

Aboriginal cultural heritage sites have been identified and are detailed within the Extraction Plan Heritage Management Plan (EP-HMP). The majority of Aboriginal cultural heritage sites are isolated finds and artefact scatters.

The majority of artefact scatters and isolated artefacts occur on actively degrading surfaces, and it is assumed that most of the artefacts have already been displaced by slope-wash, stock movement, land clearance, ploughing, harrowing and vehicular traffic. There will be few artefacts in their original depositional context or provenance, and the direct impact of subsidence (vertical or horizontal displacement) is likely to be minimal. As a result, subsidence impacts on these sites will be minimal and therefore negligible. Significant subsidence events (cracks larger than 50 mm in width) and subsequent site remediation works, such as the ripping of large surface cracks or channel earthworks, have the potential to impact artefact scatters. It is unlikely that cracking alone will impact surface artefacts, although they may be displaced through related surface erosional processes.

There is one grinding groove site ('Mayfield GG1') located above proposed LW 205. The site is located on sandstone bedrock or possibly 'loose' boulders. The quality of the grinding groove site varies from 'fair' to 'excellent'.

Potential subsidence-related impacts to these sites will be monitored and managed in accordance with the EP-HMP provided as Appendix D to EP 203-206.


### 2.5 Residential dwellings

There are two NOCPL-owned properties with dwellings above the proposed LW 204 ('Westhaven' and an unnamed property).

Moderate to significant damage to the existing buildings and tanks are likely where tilts exceed 7 mm/m and tensile or compressive strains exceed 4 mm/m. The severity of the damage will also be dependent on the type and geometry of each structure and whether localised 'humps' and 'troughs' develop over the goaf as it consolidates.

Impacts to the buildings are likely to include high residual tilt, distortion of frames, sticking doors and windows, splitting/shearing of support posts, and loss of weather tightness and floor bearer or support. The dimension and type of building will allow significantly higher strain (> 5 mm/m) and curvature > 1 km<sup>-1</sup> to occur before significant impact develops. Similar impacts are assessed for the machinery sheds, with potential collapse due to frame distortion and connection failure.

Refer to Plan 2 in Appendix H of EP 203-206 for the locations of the dwellings and sheds within the Extraction Plan Area.

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### 3. Subsidence monitoring

#### 3.1 Overview

The subsidence monitoring program consists of survey monitoring to quantify subsidence parameters, i.e. vertical movements, ground tilts and strains (refer to section 3.2) and a consolidated summary of environmental consequence monitoring (refer to section 3.3) to identify subsidence-related impacts to environmental and built features. Additional monitoring to identify height of fracturing will be conducted using a network of surface extensometers. The analysis of piezometric data to determine impacts on groundwater is dealt with separately in the Extraction Plan - Water Management Plan (**EP-WMP**).

The objectives of this monitoring program are to:

- measure baseline information – establish background data for the surface and environment within the Extraction Plan Area;
- monitor the effects of mining – monitor identified subsidence parameters and environmental aspects at key positions relative to the longwall position;
- regularly assess and interpret monitoring – analyse the relationship between the subsidence effects and impacts under the plan and any ensuing environmental consequences;
- report subsidence results;
- re-assess subsidence impacts – where variations are greater than predictions, review of impacts will be undertaken; and
- identify and implement remedial actions / contingency plans – review of impacts may indicate that remedial action is required. Implementation of remedial work and contingency plans will be undertaken in consultation with relevant stakeholders where appropriate.


The subsidence monitoring program will also enable NCOPL to obtain data on subsidence parameters and subsidence impacts relating to the extraction of LW 203 to LW 206. This data will be used to confirm if actual subsidence and environmental consequences are within predicted limits, as well as to:

- validate the subsidence modelling methodology and predictions; and
- establish and develop a subsidence database at Narrabri Mine for the purpose of future mine planning, subsidence prediction and assessment of environmental consequences for subsequent longwall and possibly bord and pillar extraction.

#### 3.2 Subsidence survey monitoring

A subsidence survey monitoring program has been developed which includes the following elements:

- a transverse subsidence line across the longwall panels installed along an existing access track above LW 203 to LW 205. The line will be installed into the next adjacent longwall before undermining occurs and will be discontinued in areas where movement has ceased;
- install a longitudinal line extending in-bye and out-bye from the longwall panel starting points where it is feasible (i.e. does not require clearing of native vegetation) for a minimum distance equal to the cover depth, both at starting and finishing points; and
- remote sensing (annual multispectral imaging and triennial light detection and ranging (**LIDAR**) surveys) across the affected longwalls.

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The proposed subsidence monitoring lines are shown on Plan 7 (Appendix H to EP 203-206), where the longitudinal lines cannot be installed due to native vegetation clearing restrictions, the lines will be monitored via remote sensing only. Remote sensing will allow comprehensive ground movement monitoring over the entire Extraction Plan Area. The remote sensing may be linked into the already established survey markers and provide subsidence data to within +/-0.1m and will be calibrated using the subsidence line physical survey measurements. It is anticipated that remote sensing will provide a more thorough picture of the subsidence development along creeks and surface terrain generally. Provided the remote sensing proves adequate as a monitoring technique, the longitudinal monitoring lines will be progressively phased out. The subsidence line monitoring standards, schedule and methodology are detailed in Attachment 2. The visual monitoring methods for roads and tracks, water storage areas, and property and fences are provided in Attachment 3.

### 3.3 Monitoring of environmental consequences

Monitoring proposed under the EP 203-206 and all key sub-plans to identify and assist in the management of environmental consequences is summarised in Table 3-1. Detailed subsidence impact monitoring is provided in the relevant sub-plan to EP 203-206.

### 3.4 Monitoring for extent of fracturing


A monitoring program to determine the height of fracturing and extent of subsidence over the longwall panels has been developed using surface extensometers. This data has been used to update the height of fracturing information in the subsidence predictions provided as Appendix J to EP 203-206.

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**Table 3-1 Environmental consequences monitoring summary**

Aspect / feature	Frequency	Parameters	Management plan
<b>Built features and public safety</b>			
Water storage dams, tanks, and soil conservation contour banks	Pre-mining (baseline) and post-mining.	Obtain xyz coordinates along contour banks and water storage dams, e.g. LiDAR data.	Extraction Plan – Built Features Management Plan ( <b>EP-BFMP</b> ) and Extraction Plan – Public Safety Management Plan ( <b>EP-PSMP</b> )
	Pre-mining (baseline) and post-mining.	Photographic records of all dams and contour banks within the Extraction Plan Area.	
	Daily during active subsidence.	Visual inspections of dams and tanks noting their condition and any changes in accordance with the Subsidence Monitoring Program.	
	Post-subsidence, within 12 months of mining.	Assess each dam to determine any required remediation works.	
Roads, access tracks, power, and tele-communications	On an as-needed basis (access tracks and roads are used daily by mine personnel).	Visual monitoring of access roads and any affected internal access tracks to note any subsidence impacts that require remediation or implementation of additional traffic controls.	EP-BFMP and EP-PSMP
Property and livestock fences	Pre-subsidence (baseline).	Survey (aerial) to identify all existing fence lines and location and type of gates or access points (i.e. cattle grids).	EP-BFMP and EP-PSMP
	On an as needed basis.	Visual inspections of fences and gates/cattle grids within active subsidence zone noting their condition and functionality.	
Residential dwelling and machinery sheds	Prior to undermining.	Undertake assessment of potentially affected building(s) to identify the presence of asbestos or other hazardous building materials/ substances unable to remain in situ.	EP-BFMP and EP-PSMP
	Following completion of active subsidence. Prior to intended re-use.	Inspection of buildings/structures that are to be retained by a person(s) suitably qualified to assess their structural stability. Structures will only be returned to use once it is confirmed that the structures are sound and fit for purpose.	
Mine infrastructure	Prior to mining and following active subsidence.	Inspect decommissioned SIS gas drainage sites to confirm all structures have been safely decommissioned and site is stable and safe.	EP-BFMP and EP-PSMP




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Aspect / feature	Frequency	Parameters	Management plan
	Prior to mining and following active subsidence.	Survey collars of all affected piezometers and standpipes to confirm accurate levels for monitoring of groundwater.	
	Ongoing.	Continue to monitor subsidence affected groundwater piezometers and standpipes following active subsidence (note: life-of-mine network installed outside of Extraction Plan Area to monitor impacts).	
Survey Marks	Application must be made at least 14 days prior to active subsidence.	Approval to be sought under the <i>NSW Surveying and Spatial Information Regulation 2017</i> as required by the <i>Surveyor-General's Direction No. 11 Preservation of Survey Infrastructure</i> , prior to removing, damaging, destroying, obliterating, or defacing any survey marks.	EP-BFMP and EP-PSMP


**Water**

**Surface water**


KC1TOP, KC1US, KCTOP, KCUS	Quarterly, in the event of flow during the quarter.	Field analysis: <ul style="list-style-type: none"> <li>• pH</li> <li>• EC</li> <li>• turbidity</li> <li>• DO</li> <li>• temperature</li> </ul> Laboratory analysis: <ul style="list-style-type: none"> <li>• pH</li> <li>• EC</li> <li>• TDS</li> <li>• TSS</li> <li>• turbidity</li> <li>• TOC</li> <li>• Oil &amp; grease</li> </ul>	EP-WMP
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Aspect / feature	Frequency	Parameters	Management plan
		<ul style="list-style-type: none"> <li>Metals and metalloids: aluminium, arsenic, cadmium, chromium, copper, lead, nickel, selenium, zinc, iron, molybdenum, antimony, mercury, cobalt</li> </ul>	
	Quarterly, in the event of flow during the quarter.	Visual inspections to record streamflow characteristics: <ul style="list-style-type: none"> <li>no ponding/flow</li> <li>ponded water</li> <li>trickle flow</li> <li>flowing water</li> </ul>	
Surface cracking	During active subsidence, monthly and following a significant rainfall event (defined as a rainfall event >38.4 mm over 5 consecutive days).	<ul style="list-style-type: none"> <li>Surface crack GPS location, depth, width and length.</li> <li>Ponding GPS location, width, depth, area, presence of vegetation.</li> <li>Bed and bank stability.</li> <li>Erosion and potential for erosion (e.g., knickpoints, head cuts).</li> </ul> Vegetation health is to be monitored in accordance with the Extraction Plan - Biodiversity Management Plan.	
Watercourses and ponding	Baseline and then quarterly during active subsidence.	<ul style="list-style-type: none"> <li>Ponding GPS location, width, depth, area, presence of vegetation.</li> <li>Bed and bank stability.</li> <li>Watercourse erosion and potential for erosion (e.g., knickpoints, head cuts).</li> </ul>	EP-WMP
Topography and landscape morphology	Baseline then every 3 years (triennially).	LiDAR over entire site: <ul style="list-style-type: none"> <li>High resolution topography.</li> <li>Creek line slope and volumes.</li> </ul>	EP-WMP
Vegetative cover characteristics and erosion monitoring	Baseline and then annually.	Multi-spectral imaging: <ul style="list-style-type: none"> <li>Vegetative biomass and cover (pasture).</li> <li>Erosion.</li> </ul>	EP-WMP

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Aspect / feature	Frequency	Parameters	Management plan
Geomorphic survey	Baseline and then annually for a period of 2 years following longwall mining.	<ul style="list-style-type: none"> <li>Mapping and description.</li> <li>Survey (100 m reach).</li> </ul>	EP-WMP
Channel survey	Baseline and then annually for a period of 2 years following longwall mining.	<ul style="list-style-type: none"> <li>Identification of ponding - GPS location, width, depth, area, significant vegetation.</li> <li>Channel parameters.</li> <li>Advancement of gully erosion.</li> </ul>	EP-WMP
Direct field survey	Following changes detected during remote sensing.	<ul style="list-style-type: none"> <li>Determined during field survey.</li> </ul>	EP-WMP
<b>Groundwater</b>			
VWPs Site: P70	Continuous VWP sensor with quarterly download of data.	Pressure data.	EP-WMP
Standpipes Sites: P7, P8, P9, P10, P11, P68, P69, P82	<ul style="list-style-type: none"> <li>Quarterly for water level, EC and pH.</li> <li>Annually for all other parameters.</li> </ul>	<ul style="list-style-type: none"> <li>Water level</li> <li>Field EC and pH</li> <li>Laboratory analysis: <ul style="list-style-type: none"> <li>physical parameters (e.g. alkalinity, ED, TDS, TSS and pH);</li> <li>cations (e.g. calcium, magnesium, sodium and potassium);</li> <li>anions (e.g. carbonate, bicarbonate, sulphate and chloride);</li> <li>dissolved metals (e.g. aluminium, antimony, arsenic, boron, cobalt, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, silver, selenium and zinc); and</li> <li>nutrients (e.g. ammonia, nitrate, phosphorous and reactive phosphorous).</li> </ul> </li> </ul>	
Monitoring of water quality entering the underground mine workings (i.e. in the mine water collection	Continuous.	<ul style="list-style-type: none"> <li>TDS</li> <li>pH</li> </ul>	

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Aspect / feature	Frequency	Parameters	Management plan
system via the monitoring at the box cut sump).		<ul style="list-style-type: none"> <li>temperature.</li> </ul>	
Monitoring of water quality entering the underground mine workings (i.e. within longwall panels)	Initial 6 month period and annually thereafter.	<ul style="list-style-type: none"> <li>EC</li> <li>TDS</li> </ul>	
Mine water pumping inflow and outflow	Weekly meter read.	<ul style="list-style-type: none"> <li>Discharge rate</li> </ul>	
Subsidence calibration borehole P80 (deep borehole piezometers, shallow standpipe piezometers) and geotechnical borehole P81 (deep wireline extensometer) above LW 203	Continuous.	<ul style="list-style-type: none"> <li>Water level</li> <li>Displacement</li> </ul>	
Site visits to Mayfield Spring	Annually.	Site photographs (x4) and observations of: <ul style="list-style-type: none"> <li>Flow rates</li> <li>Surface conditions</li> <li>Surface water levels and field water quality (EC and pH) in any standing pools</li> </ul>	
<b>Biodiversity</b>			
Subsidence	<ul style="list-style-type: none"> <li>During active subsidence, monthly and following a significant rainfall event*.</li> <li>Three months following remediation of surface cracks.</li> </ul> <p><b>Note:</b> * defined as a 5-day 90<sup>th</sup> percentile rainfall event which is 38.4 mm over 5 consecutive</p>	<ul style="list-style-type: none"> <li>Surface crack GPS location, depth, width and length.</li> <li>Ponding GPS location, width, depth, area, presence of vegetation.</li> <li>Bed and bank stability.</li> <li>Watercourse erosion and potential for erosion (e.g., knickpoints, head cuts).</li> </ul>	Extraction Plan – Biodiversity Management Plan ( <b>EP-BMP</b> )

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Aspect / feature	Frequency	Parameters	Management plan
	days.		
Watercourses and ponding	Baseline and then quarterly during active subsidence.	<ul style="list-style-type: none"> <li>Ponding GPS location, width, depth, area, presence of vegetation.</li> <li>Bed and bank stability.</li> <li>Watercourse erosion and potential for erosion (e.g., knickpoints, head cuts).</li> </ul>	
Creek line surveys (geomorphic and channel surveys)	Baseline and then annually for two years after the completion of each longwall.	<ul style="list-style-type: none"> <li>Mapping and description.</li> <li>Survey (100 m reach).</li> <li>Identification of ponding - GPS location, width, depth, area, vegetation.</li> <li>Channel parameters.</li> <li>Advancement of gully erosion.</li> </ul>	EP-BMP
LiDAR	Baseline then every three years (triennially).	<ul style="list-style-type: none"> <li>Topographic form and change.</li> <li>Creek line slope and volumes.</li> </ul>	EP-BMP
Multi spectral imaging	Baseline and then annually in spring until the completion of mining for LW 203 to LW 206.	<ul style="list-style-type: none"> <li>Vegetative biomass and cover within Extraction Plan Area.</li> <li>Weed presence.</li> <li>Erosion.</li> </ul>	EP-BMP
Direct field survey	Following changes detected during remote sensing.	<ul style="list-style-type: none"> <li>Determined during field survey.</li> </ul>	EP-BMP
Native vegetation (FBS)	Prior to mining: <ul style="list-style-type: none"> <li>Baseline field survey in spring.</li> </ul> Year 1: <ul style="list-style-type: none"> <li>Multi-spectral imaging (as above) and targeted field surveys to determine the cause of any changes detected.</li> </ul>	Canopy health and defoliation (all 5% increments): <ul style="list-style-type: none"> <li>Percentage of epicormic foliage in relation to total tree foliage.</li> <li>Proportion of primary branches within canopy that have died back.</li> <li>Percentage of current canopy foliage as a proportion of the estimated canopy foliage volume/potential canopy.</li> <li>Percentage of canopy foliage discoloured.</li> </ul>	EP-BMP

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Aspect / feature	Frequency	Parameters	Management plan
	Year 2: <ul style="list-style-type: none"> <li>Follow up field survey in spring.</li> </ul>	Vegetation structure: <ul style="list-style-type: none"> <li>Projected foliage cover (PFC: 1-5%, then 5% increments) of native grass/ground cover; native shrubs &lt;1 m height, native shrubs/small trees &gt;1 m height.</li> <li>PFC 5% increments of upper canopy (assessed at each quadrat corner and averaged).</li> <li>Lower, estimated median and upper height of canopy.</li> <li>Lower, estimated median and diameter at breast height (DBH) over bark of canopy stems (cm).</li> <li>Abundance of each canopy species; calculated, total stems per ha.</li> <li>Exotic species cover.</li> </ul> Photograph of canopy: <ul style="list-style-type: none"> <li>Photograph of the canopy (camera placed on top of the star picket, facing up); photograph facing due north, south, east and west from the star picket.</li> </ul>	
Vegetation in ponded areas	Annually.	<ul style="list-style-type: none"> <li>Photo sequences of vegetation health and regeneration.</li> <li>Dominant vegetation types and health occurring within three zones i.e., inundated (&lt;30 cm), not inundated but moist/boggy, and dry.</li> <li>Analysis of downstream water quality (EC).</li> </ul>	EP-BMP
Soil moisture within riparian vegetation along Kurradjong Creek Tributary 1	Prior to mining: <ul style="list-style-type: none"> <li>Baseline.</li> </ul> Following mining: <ul style="list-style-type: none"> <li>Annually in spring for two years after the completion of each longwall.</li> </ul>	Soil water moisture content.	EP-BMP


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Aspect / feature	Frequency	Parameters	Management plan
Weeds	Baseline and then biannually for the life of mine.  (Reduce to annually when vegetation established in rehabilitation areas).	The location (mapping extent), species, and estimation of cover will be recorded during each monitoring event.	EP-BMP
Pest animals	Biannually for the life of mine.	Record pest animal species, abundance, location.	EP-BMP
<b>Land</b>			
Subsidence inspections	During active subsidence, monthly and following a significant rainfall event*. Three months following remediation of surface cracks. <b>Note:</b> * defined as a 5-day 90 <sup>th</sup> percentile rainfall event which is 38.4 mm over 5 consecutive days.	<ul style="list-style-type: none"> <li>• Surface crack GPS location, depth, width and length.</li> <li>• Ponding GPS location, width, depth, area, presence of vegetation.</li> <li>• Bed and bank stability.</li> <li>• Watercourse erosion and potential for erosion (e.g., knickpoints, head cuts).</li> </ul>	Extraction Plan – Land Management Plan ( <b>EP-LMP</b> )
Watercourses and ponding	Baseline and then quarterly for a period of two years.	<ul style="list-style-type: none"> <li>• Ponding GPS location, width, depth, area, presence of vegetation.</li> <li>• Bed and bank stability.</li> <li>• Watercourse erosion and potential for erosion (e.g., knickpoints, head cuts).</li> </ul>	
Creek line surveys (geomorphic and channel surveys)	Baseline and then annually for two years after the completion of each longwall.	<ul style="list-style-type: none"> <li>• Mapping and description.</li> <li>• Survey (100 m reach).</li> <li>• Identification of ponding - GPS location, width, depth, area, vegetation.</li> <li>• Channel parameters.</li> <li>• Advancement of gully erosion.</li> </ul>	
LiDAR	Baseline then every three years (triennially).	<ul style="list-style-type: none"> <li>• Topographic form and change.</li> <li>• Creek line slope and volumes.</li> </ul>	

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Aspect / feature	Frequency	Parameters	Management plan
Multi spectral imaging	Baseline and then annually in spring for two years after the completion of each longwall.	<ul style="list-style-type: none"> <li>Vegetative biomass and cover within Extraction Plan Area.</li> <li>Weed presence.</li> <li>Erosion.</li> </ul>	
Direct field survey	Following changes detected during remote sensing.	Determined during field survey.	
Soil moisture within riparian vegetation along Kurradjong Creek Tributary 1	Prior to mining: <ul style="list-style-type: none"> <li>Baseline.</li> </ul> Following mining: <ul style="list-style-type: none"> <li>Annually in spring for two years after the completion of each longwall.</li> </ul>	Soil water moisture content.	
<b>Heritage</b>			
Aboriginal cultural heritage sites	Monthly during mining and monthly following mining for a period of 12 months.	Monitoring of Mayfield GG1 (AHIMS 19-6-0191) above LW 205 to detect potential cracking or damage from erosion.	EP-HMP
	Prior to, and within six months of the cessation of mining.	Inspections (including photographs) of all sites above a given longwall panel to record condition of each site. These inspections will be undertaken by a qualified archaeologist in consultation with RAPs.	
	Annually.	Audit of existing site fences to ensure fencing is maintained and in good condition.	
Subsidence	Monthly during mining, directly behind the longwall face.	Visual inspections to determine surface cracking, ponding, and erosion. Monitoring to determine if remediation works and/or salvage is required and if repairs to Aboriginal cultural heritage site fencing is needed.	
	Within three months of remediation.	Inspection of remediated surface cracks.	
Surface disturbance	During disturbance activities within 100 m of watercourse or drainage line.	Any soil disturbance work within 100 m of a watercourse or drainage line is to be monitored by representatives of the RAPs (i.e. Cultural Heritage Monitors).	



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## 4. Reporting, evaluation and review

### 4.1 Annual review

In accordance with Schedule 6 Condition 6, NCOPL will review the performance of its environmental management for the previous calendar year and report the relevant results within the Annual Review, to the satisfaction of the Secretary. The Annual Review will at minimum provide information regarding the effectiveness of the management measures to prevent, and if prevention is not reasonable and feasible, to minimise any subsidence impacts and environmental consequences.

Further, the Annual Review requires a number of items to be reviewed or assessed. In summary these are:

- monitoring results and complaints;
- non-compliances and incidents;
- compliance with performance measures;
- discrepancies between predicted and actual impacts; and
- measures to be implemented to improve environmental performance.

The Annual Review may also make recommendations for any additions, changes, or improvements to NCOPLs environmental management procedures.

The Annual Review will be made available on the WHC website.

### 4.2 Independent environmental audits

Prior to 13 September 2010, and every 3 years thereafter, unless the Secretary directs otherwise, NCOPL will commission and pay the full cost of an Independent Environmental Audit (**IEA**) of the development (Stages 1 and 2), to be conducted in accordance with the requirements of Schedule 6 Condition 7.

The audit team will be led by a suitably qualified auditor and the IEA will be conducted by suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the Secretary.


### 4.3 Management plan review and evaluation

As required by Schedule 6 Condition 3 of the Project Approval, within three months of any of the following:

- completion of an IEA (as required by Schedule 6 Condition 7);
- submission of an Incident Report (as required by Schedule 6 Condition 4);
- submission of an Annual Review (as required by Schedule 6 Condition 6); and
- any modification to the conditions of the Project Approval (unless the conditions require otherwise).

NCOPL will then review, and if necessary, revise this EP-SMP. This is to ensure that the strategies, plans and programs are updated on a regular basis, and incorporate any recommended measures to improve the environmental performance of the Narrabri Mine operations.

Condition 3 of Schedule 6 further states that if the review determines that this EP-SMP requires revision, then this will be completed to the satisfaction of the Secretary. A dedicated review register will be maintained which will provide the details of the review of all relevant strategies, plans and programs that need to be reviewed as

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required by Schedule 6 Condition 3 of the Project Approval. The revision status of this EP-SMP is indicated in section 8.


#### 4.4 Improvement measures

Project Approval Schedule 6 Condition 2(f) requires this Plan to include a program to investigate and implement ways to improve the environmental performance of the development over time. Improvement measures may be investigated through review of the following:

- monitoring data, and any assessment of trends;
- audit outcomes, including audits of subsidence management measures; and
- incident reports, including any community complaints.

Reasonable and feasible improvement measures will be implemented and documented as a management measure in a revision to the Plan as described in section 4.3.

In accordance with Schedule 6 Condition 2(g) a protocol for periodic review of this Plan has been addressed under section 4.3.

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## 5. Plan implementation

### 5.1 Roles and responsibilities

During the operational phases of the development, the Narrabri Mine will be managed by the General Manager who will have overall responsibility for ensuring contractors, employees and service providers comply with all laws, regulations, licences, and approvals. Table 5-1 outlines the roles and responsibilities applicable to this EP-SMP.

**Table 5-1 Roles and responsibilities**

Roles	Responsibilities
General Manager	<ul style="list-style-type: none"> <li>Ensure that adequate resources are available to NCOPL personnel to facilitate the completion of their responsibilities under this EP-SMP.</li> </ul>
Mine Manager	<ul style="list-style-type: none"> <li>Ensure all contractors, sub-contractors and service-personnel are appropriately qualified, competent, and licensed to undertake the required work under this EP-SMP and have a good environmental performance record.</li> <li>Ensure the subsidence monitoring program is implemented and adhered to.</li> </ul>
Environmental Superintendent	<ul style="list-style-type: none"> <li>Ensure that all environmental monitoring and reporting is undertaken in accordance with this EP-SMP and various approval requirements, and is checked, processed, and filed appropriately.</li> <li>Communicate with statutory agencies and departments, public authorities and the community.</li> <li>Advise on matters identified in all approval, permit, licence, and consent documents and ensure all operations are conducted in compliance with those conditions, and all other environmental obligations.</li> <li>Liaise with stakeholders regarding subsidence impact management.</li> <li>Authorise changes to this EP-SMP.</li> </ul>
Surface Operations Manager	<ul style="list-style-type: none"> <li>Provides notification to all mine personnel advising of potential subsidence hazards and impacts.</li> </ul>
Civil Services Coordinator	<ul style="list-style-type: none"> <li>Manages the condition and safety of roads and tracks around the mine site.</li> <li>Remediates subsidence impacts to maintain trafficability of access roads and tracks.</li> <li>Maintains access to critical infrastructure and facilitates inspections and remedial works.</li> <li>Designs and installs PED cables (personal emergency device communications system).</li> </ul>
Technical Services Manager	<ul style="list-style-type: none"> <li>Decommissions Surface to in-seam (SIS) drainage sites and structures prior to subsidence impacts.</li> </ul>
Registered Mine Surveyor	<ul style="list-style-type: none"> <li>Ensure that all subsidence monitoring is carried out in accordance with the Subsidence Monitoring Program to the accuracy required, within the specified timeframes and are checked, processed and filed appropriately.</li> </ul>

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## 6. References


Department of Planning and Environment (October 2022). *Extraction Plan Guideline*

Ditton Geotechnical Services (2022) *Mine Subsidence Assessment for Longwalls LW203 to LW206 at the Narrabri Underground Mine*. Prepared for Narrabri Coal Operations Pty Ltd.

Intergovernmental Committee on Surveying and Mapping (2017) *Standards and Practices for Control Surveys (SP1) Version 1.7*.


NSW Department of Planning, Industry and Environment (November 2021). *Project Approval Narrabri Coal Project – Stage 2*

RW. Corkery & Co. Pty. Limited. (2009). *Environmental Assessment for the Narrabri Coal Mine Stage 2 Longwall Project*. Prepared for Narrabri Coal Operations Pty Ltd.


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## 7. Glossary

Term	Definition
Aboriginal cultural heritage site	Location of evidence of Aboriginal occupation (typically, Aboriginal objects, but also places of traditional or historical cultural value for which no Aboriginal objects exist).
Active subsidence	The period of time that movement of the ground can occur after underground mining.
Angle of Draw (AoD)	The angle with the vertical, made by a straight line extending away from the limits of extraction at seam level to the ground surface, spanning the horizontal distance in which subsidence may occur.
Artefact	An object made by human agency (e.g. stone artefacts).
Compressive strain	A decrease in the distance between two points on the surface. This can cause shear cracking or steps at the surface if > 3 millimetres per metre (mm/m).
Cover depth	The depth of coal seam from the ground surface (metres).
Department	Planning and Assessment Group within the NSW Department of Planning and Environment (DPE).
Development	The Stage 2 development described in the EA as modified by the Project Approval.
Environmental consequences	The environmental consequences of subsidence impacts including: damage to built features; 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 to aquatic ecology; ponding.
Extraction Plan Area	The area predicted to be affected by the proposed secondary extraction of the approved longwall panels LW 203 to LW 206.
Goaf	The mined-out area into which the immediate roof strata breaks.
Groundwater	Water contained in the interconnected pore spaces and voids of the saturated zone of sediments and rocks.
Incident	A set of circumstances that causes or threatens to cause material harm to the environment, and/or breaches or exceeds the limits of performance measures/criteria in the Project Approval.
Material harm	Material harm to the environment is defined in section 147 of the POEO Act.
MOD 5	Reduced the number of longwall panels from 26 to 20; increased the longwall panel widths for LW 107 to LW 120 from approximately 295 m to approximately 400 m; extended the western footprint approximately 60 m; and increased the maximum ROM coal processing rate from 8 Mtpa to 11 Mtpa.
MOD 7	Describes the change in mining method within the extent of the previously approved LW 201 and LW 202 and allows for up to 0.7 Mtpa via bord and pillar extraction at pillar reduction panels CF 201 to CF 205.
Narrabri Mine	The development approved under the Project Approval 05_0102 and Project Approval 08_0144.
Project Approval	Development consent (PA 08_0144) issued on 26th July 2010 under Section 75J of the <i>Environmental Planning and Assessment Act 1979</i> by the Department of Planning & Infrastructure (as modified).


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Term	Definition
Rehabilitation	The treatment or management of land disturbed by the project for the purpose of establishing a safe, stable and non-polluting environment including the remediation of impacts.
Remediation	Activities associated with partially or fully repairing or rehabilitating the impacts of the project or controlling the environmental consequences of this impact.
Second workings	Extraction of coal from longwall panels, mini-wall panels, or pillar extraction.
Secretary	Planning Secretary under the EP&A Act, or nominee.
Stage 1	The project approval granted by the Minister Planning for the Narrabri Coal Project, dated 14 November 2007.
Stage 2	Narrabri Mine Stage 2 approved under Project Approval 08_0144.
Statement of Commitments	The Proponent's revised commitments in Appendix 3 of the Project Approval, dated May 2010.
Subsidence	The totality of subsidence effects, subsidence impacts and environmental consequences of subsidence impacts.
Subsidence effects	Deformation of the ground mass due to mining, including all mining-induced ground movements, such as 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.
the Proponent	Narrabri Coal Operations Pty Ltd
Tilt	The rate of change of subsidence between two points (A and B), measured at set distances apart (usually 10m). Tilt is plotted at the mid-point between the points and is a measure of the amount of differential subsidence.
Watercourse	A river, creek or other stream, including a stream in the form of an anabranch or tributary, in which water flows permanently or intermittently, regardless of the frequency of flow events: In a natural channel, whether artificially modified or not, or in an artificial channel that has changed the course of the stream. It also includes weirs, lakes and dams.

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## 8. Review history

Revision	Comments	Author	Authorised by	Date

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## Attachment 1 - Compliance conditions relevant to this Program



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**Table A1-1 Project Approval 08\_0144 directly relevant to this Plan**

Condition	Requirement	Document reference
Schedule 2 Condition 11	<p>With the approval of the Secretary, the Proponent may submit any management plan or monitoring program required by this approval on a progressive basis.</p> <p><i><b>Note:</b> The conditions of this approval require certain strategies, plans, and programs to be prepared for the project. They also require these documents to be reviewed and audited on a regular basis to ensure they remain effective. However, in some instances, it will not be necessary or practicable to prepare these documents for the whole project at any one time, particularly as these documents are intended to be dynamic and improved over time. Consequently, the documents may be prepared and implemented on a progressive basis, subject to the conditions of this approval. In doing this however, the Proponent will need to demonstrate that it has suitable documents in place to manage the existing operations of the project.</i></p>	No staging of the EP-SMP proposed
Schedule 3 Condition 4	<p>The Proponent shall prepare and implement Extraction Plans for any second workings to be mined to the satisfaction of the Secretary. Each Extraction Plan must:</p> <p>(g) include the following to the satisfaction of the Resources Regulator:</p> <ul style="list-style-type: none"> <li>• a Subsidence Monitoring Program to: <ul style="list-style-type: none"> <li>▪ provide data to assist with the management of the risks associated with subsidence;</li> <li>▪ validate the subsidence predictions; and</li> <li>▪ analyse the relationship between the subsidence effects and impacts under the plan and any ensuing environmental consequences</li> </ul> </li> </ul>	
Schedule 6 Condition 3	<p>Within 3 months of the submission of an:</p> <p>(a) audit under condition 7 of Schedule 6;</p> <p>(a) incident report under condition 4 of Schedule 6; and</p> <p>(b) annual review under condition 5 of Schedule 6; and</p> <p>(c) any modification to the conditions of this approval (unless the conditions require otherwise),</p> <p>the Proponent shall review, and if necessary revise, the strategies, plans, and programs required under this approval to the satisfaction of the Secretary.</p>	Section 4.3
Schedule 6 Condition 6	By the end of March each year, the Proponent must submit a review of the environmental performance of the project for the previous calendar year to the satisfaction of the Secretary.	Section 4.1
Schedule 6 Condition 7	Prior to 13 September 2010, and every 3 years thereafter, unless the Secretary directs otherwise, the Proponent shall commission and pay the full cost of an Independent Environmental Audit of the project (Stages 1 and 2).	Section 4.2




**NARRABRI MINE  
ENVIRONMENTAL  
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SYSTEM**


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**WHC\_PLN\_NAR\_SUBSIDENCE MONITORING PROGRAM – LW 203 – LW 206**

Condition	Requirement	Document reference
Schedule 6 Condition 10	<p>The Proponent shall:</p> <p>(a) make copies of the following publicly available on its website:</p> <ul style="list-style-type: none"> <li>• the documents referred to in Condition 2 of Schedule 2;</li> <li>• all current statutory approvals for the project;</li> <li>• all approved strategies, plans and programs required under the conditions of this approval;</li> <li>• a comprehensive summary of the monitoring results of the project, reported in accordance with the specifications in any conditions of this approval, or any approved plans and programs;</li> <li>• a complaints register, updated on a monthly basis;</li> <li>• minutes of CCC meetings;</li> <li>• the annual reviews of the project;</li> <li>• any independent environmental audit of the project, and the Proponent's response to the recommendations in any audit;</li> <li>• any other matter required by the Secretary; and</li> </ul>	Section 1.7
	(b) keep this information up-to-date, to the satisfaction of the Secretary.	Section 1.7

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## Attachment 2 - Survey monitoring method and schedule

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## Standards


All monitoring will be planned and surveyed to ensure these surveys satisfy the conditions to achieve a standard of accuracy of “Class D” as prescribed in ICSM SP1 (The Inter-Governmental Committee on Surveying and Mapping Special Publication 1 “Standards and Practices for Control Surveys”). Target accuracy for survey of all points in the following tables will have a relative accuracy of +/- 3mm between co-ordinated monitoring points. Each survey will be conducted in 3D. The monitoring schedule is explained in greater detail in the following sections.

## Subsidence line monitoring


Subsidence lines are to be installed to monitor subsidence, tilt, strain and angle of draw across LW 203 to LW 206. The installation and monitoring details for the subsidence lines are shown in Table A3-1.

**Table A3-1 Subsidence line monitoring details**

Aspect	Description
Mark type	Star pickets driven to refusal at 10 m intervals
Depth of cover (extension)	To be confirmed – depending on longwall panel
Survey monitoring method	Total station traverses from terrestrial baseline
Monitoring frequency	Prior to and post mining each panel
	6 monthly until movement ceases

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## Attachment 3 - Visual monitoring method

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## Visual inspection of roads and access tracks

Visual monitoring of affected sections of unsealed access road will be conducted on as needs basis whilst affected by active subsidence. Monitoring to note and document where appropriate:

1. Location of longwall relative to the affected section of road.
2. Confirmation that any required signage under the EP-BFMP and the EP-PSMP is located in an appropriate location and is visible / legible to road users.
3. Presence and width of any subsidence cracking within the road pavement.
4. Any subsidence effects that on inspection may affect the road formation and safe use of the road (i.e. compression humps or ground tilts).
5. Affected cattle grids (i.e. sharp edges protruding or gaps) or gates not able to be easily opened /closed.
6. Any damage/alteration to table drains or culverts that may result in water ponding or inadequate drainage during rainfall.
7. Any other road obstructions.

Any observations of subsidence impacts requiring remediation or repair are to be recorded in the checklist provided in the EP-BFMP and reported to the Technical Services Manager.

## Visual inspection of water storages

Visual inspection of water storages/dams (if storing water) during active subsidence to note and document where appropriate:

- 1) Any sudden changes (drops) in stored water level compared to previous day's inspection (use painted wooden survey stake or similar).
- 2) Condition of the dam wall and spillway, in particular noting any:
  - a) cracking within embankment;
  - b) signs of possible embankment failure (i.e. slumping or collapse of partial section);
  - c) formation of erosion (particularly formation of tunnel erosion or holes);
  - d) water seepage through wall; and
  - e) spillway damage (will be level, lower than embankment height and non-eroding).

If any of the above signs are noted, they will be reported to the Technical Services Manager. Assessment of the dam undertaken and works implemented in accordance with the EP-BFMP.

## Visual inspection of property and livestock fences

Visual monitoring of affected sections of fence lines will be conducted whilst affected by active subsidence. Monitoring to note and document where appropriate:

- 1) any breakage of permanent or temporary fencing; and
- 2) location of grazing stock in relation to damaged fencing and confirmation that they are safely contained (or otherwise).

Where damage to fence lines may result in unplanned movement of livestock (i.e. Kamilaroi Highway), this is to be reported to the Environmental Superintendent.