

Illawarra Coal



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Appin Area 9

Appin Area 9 Longwalls 901 to 904 Extraction Plan
Annex B - Subsidence Monitoring Program, 2 September 2014

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Attachments

ATTACHMENT A – MASTER TARPS

Review History

Revision	Description of Changes	Date	Approved
A	New Document	5 December 2011	GB
B	Final Document (revised with comments from BHPBIC)	17 January 2012	GB
C	Final Document – Updates with new Mine Plan	1 May 2012	GB
D	Final Document – Updated with Agency Comments	31 October 2013	GB
E	Final Document – Updated with additional Agency Comments	1 August 2014	GB
F	Final Document – Updated with additional Agency Comments	2 September 2014	GB

Persons involved in the development of this document include:

Name	Title	Company
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Gary Brassington	Manager Approvals (Mining)	BHP Billiton Illawarra Coal

1 INTRODUCTION

1.1 PROJECT BACKGROUND

BHP Billiton Illawarra Coal (BHPBIC) operates the Bulli Seam Operations (BSO) (Appin and West Cliff Collieries) extracting hard coking coal used for steel production.

On 22 December 2011 the Planning and Assessment Commission (PAC), under delegation of the Minister for Planning, approved BSO Project (MP 08_0150) under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to continue mining operations until 31 December 2041.

This Subsidence Monitoring Program (Monitoring Program) supports the Longwalls 901 to 904 Extraction Plan for mining of coal from Appin Area 9 (AA9). The relationship between this Monitoring Program and the other components of the Extraction Plan is shown in Figure 1 of the Extraction Plan.

1.2 SCOPE

This Monitoring Program has been prepared in accordance with BSO Approval *Condition 5 (m), Schedule 3* as follows:

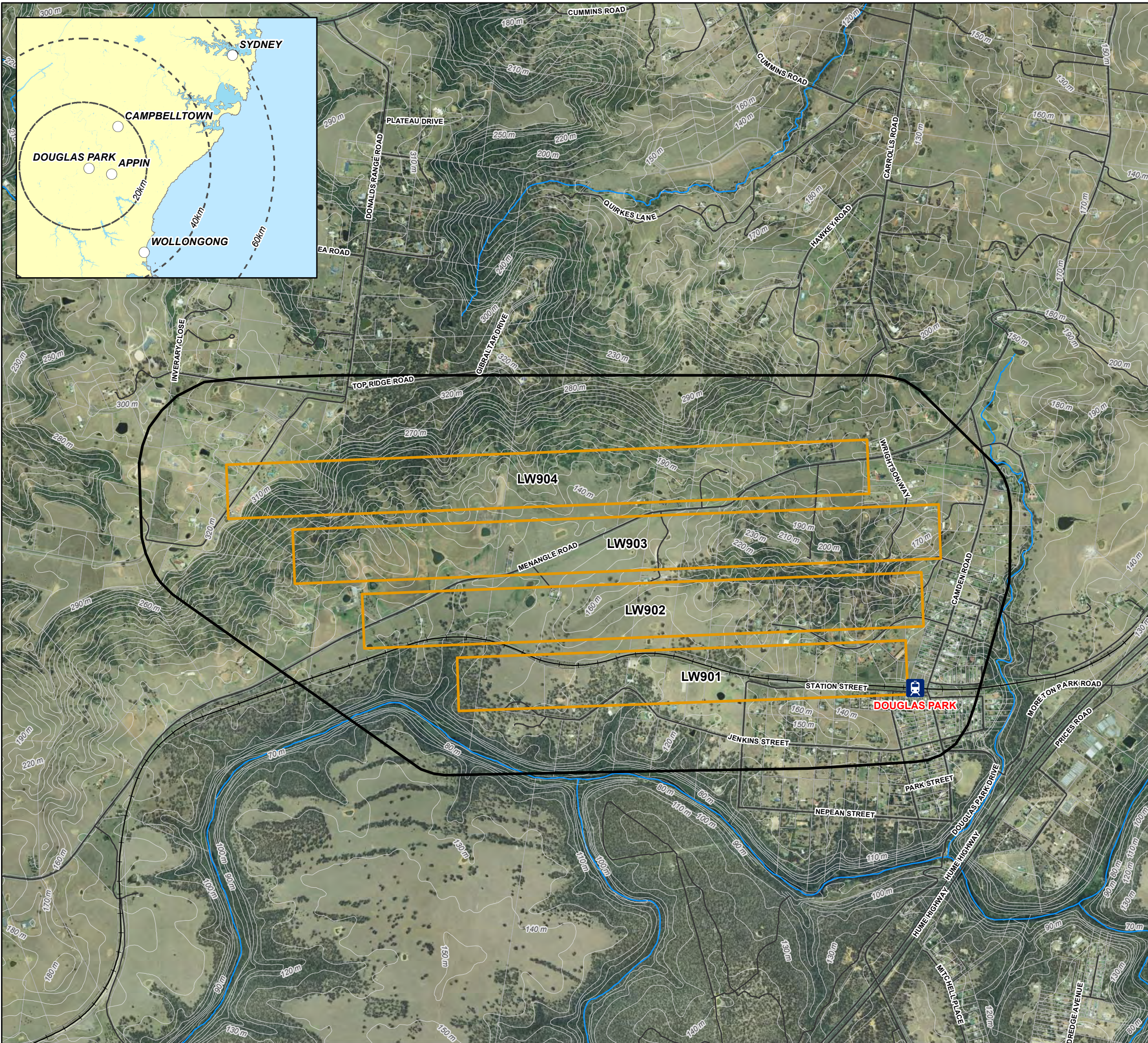
5. The Proponent shall prepare and implement an Extraction Plan for first and second workings within each longwall mining domain to the satisfaction of the Director-General. Each extraction plan must:

- (m) Include a Subsidence Monitoring Program, which has been prepared in consultation with DRE, OEH and SCA to:
- provide data to assist with the management of the risks associated with subsidence;
 - validate the subsidence predictions;
 - analyse the relationship between the predicted and resulting subsidence effects and the predicted and resulting impacts under the plan and any ensuing environmental consequences; and
 - inform the contingency plan and adaptive management process.

The Study Area for the Extraction Plan (refer to **Figure 1-1**) is defined in accordance with MSEC (2012) as *the surface area predicted to be affected by the proposed mining of Longwalls 901 to 904* and encompasses the areas bounded by the following limits:-

- A 35° Angle of Draw line from the maximum depth of cover, which equates to a horizontal distance varying between 345 metres and 510 metres around the limits of the proposed extraction areas proposed for Longwalls 901 to 904, and
- The predicted limit of vertical subsidence, taken as the 20 mm subsidence contour, resulting from the extraction of the proposed Longwalls 901 to 904.

Additionally, features potentially sensitive to far field movements, which includes horizontal, valley closure and upsidence movements that may be outside the 20mm subsidence zone or 35° Angle of Draw line have been assessed.



Appin Area 9 (LW 901- 904) Study Area

Legend

- Railway Stations (LPI)
- Local Roads (LPI)
- Railway (LPI)
- 10m Contours (LPI)
- Watercourses (LPI)
- Cadastre (LPI)
- AA9 Longwall Layout
- Longwalls 901-904 Study Area

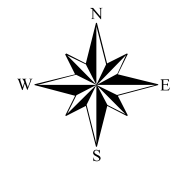
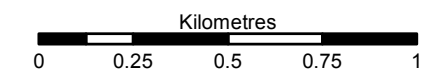


FIGURE 1

Scale 1:20,000 (at A3)



Map Produced by Cardno Wollongong
Date: 31/10/2013
Coordinate System: GDA 1994 MGA Zone 56
Project: 109012-03
Map: 1801_AppinArea9_LW_StudyArea.mxd 07
Aerial imagery supplied by BHPBIC (2009)

1.3 OBJECTIVES

The key objective of this Monitoring Program is to satisfy Condition 5(m) of the BSO Approval in relation to the potential impacts and/or environmental consequences from the proposed mining to sensitive environmental and built features within the Longwalls 901 to 904 Study Area. In order to achieve this, the Plan:

- Provides consolidated monitoring parameters based on the recommendations and commitments in the Management Plans (refer to Annexes C – H of the Extraction Plan).
- Details the process undertaken to validate subsidence predictions.
- Reviews predicted subsidence impacts in the context of ongoing monitoring.
- Provides contingency and management processes responsive to monitoring results.

1.4 DISTRIBUTION

This Monitoring Program will be developed through ongoing consultation with:

- Office of Environment and Heritage (OEH)
- Department of Planning and Environment (DoPE)
- Department of Trade and Investment (DTI – formally DRE)

BHPBIC will make the Monitoring Program and associated documentation publicly available on the BHPBIC website in accord with *Condition 11, Schedule 6* of BSO approval).

2 STATUTORY REQUIREMENTS

Extraction of coal from Longwalls 901 to 904 will be in accordance with the conditions set out in the BSO Approval, applicable legislation as detailed in **Section 2.2** and the requirements of relevant licenses and permits (including conditions attached to mining leases).

2.1 BSO APPROVAL

Condition 5(m), Schedule 3 of the BSO Approval requires the preparation of a Monitoring Program to provide data to assist with the management of the risks associated with subsidence, validate the subsidence predictions, analyse the relationship between the subsidence effects and impacts under the plan and any ensuing environmental consequences and inform the contingency plan adaptive management process.

2.2 LEGISLATION AND GUIDELINES

This Monitoring Program has been developed taking account of the requirements of the following legislation and associated advisory documents and guidelines where applicable including:

- *Contaminated Land Management Act, 1997;*
- *Dangerous Goods Act, 1975;*
- *Mining Act, 1992;*
- *Noxious Weeds Act, 1993;*
- *Rail Safety Act, 2002;*
- *Road and Rail Transport (Dangerous Goods) Act, 1997*
- *Roads Act, 1993;*
- *Protection of the Environment Operations Act, 1997;*
- *Threatened Species Conservation Act, 1995;*

- *National Parks and Wildlife Act, 1974*
- *Environmental Protection Biodiversity and Conservation Act, 2000*
- *Sydney Water Catchment Management Act, 1998;*
- *Coal Mine Health and Safety Act, 2002;*
- *Crown Lands Act, 1989;*
- *Dams Safety Act, 1978;*
- *Energy and Utilities Administration Act, 1987;*
- *Fisheries Management Act, 1994;*
- *Water Act, 1912; and*
- *Water Management Act, 2000*
- *Work Health and Safety Act, 2011.*

Further details of applicable advisory documentation and guidelines can be found in the relevant management plans annexed to the Extraction Plan (Annexes C – H of the Extraction Plan).

2.3 RELEVANT LEASES AND LICENSES

The following leases and licences are applicable to BHPBIC's operations in AA9:

- Mining Leases as per **Table 2.1**.
- Environmental Protection Licence (EPL) 2504 which applies to the BSO, including both Appin and West Cliff Mines. A copy of the licence can be accessed at the EPA website via the following link <http://www.epa.nsw.gov.au/prpoeo/index.htm>.
- BSO Mining Operation Plan 1/10/2012 to 30/09/2019.
- All relevant OH&S and HSEC approvals.
- Additional leases, licences of approvals resulting from the BSO Approval.

Table 2.1 – Appin Mine Leases, Licences and Other Reference Documents

Mining Lease - Document Number	Issue Date	Expiry Date/ Anniversary Date
CCL 767	29/10/1991	08/07/2029
CL 388	22/1/1992	21/01/2013 Renewal Pending
ML 1382	20/12/1995	19/12/2016
ML 1433	24/7/1998	23/07/2019
ML 1678	26/06/2014	26/06/2035

3 PLAN ADMINISTRATION

3.1 REVIEW AND UPDATE

This Monitoring Program will be reviewed on a regular basis to ensure that it incorporates any recommended measures to improve the environmental performance of the project.

If deficiencies in the Monitoring Program and/or Extraction Plan are identified throughout the course of extraction the plans will be modified as required. This process will ensure that environmental documentation continues to meet current environmental requirements,

including changes in technology and operational practice, as well as the expectations of stakeholders.

3.2 EXTRACTION SEQUENCE

Extraction of the longwalls will occur in a staged process commencing with Longwall 901 and continuing consecutively to Longwall 904. The planned schedule for mining Longwalls 901 to 904 is shown in **Table 3.1**.

Table 3.1 – Expected Schedule for Longwall Extraction 901 to 904

LW	Start	End	Characteristics (void length and width)
901	February 2016	December 2016	2445 x 305 m
902	January 2017	February 2018	3065 x 305 m
903	March 2018	May 2019	3505 x 305 m
904	June 2019	July 2020	3510 x 305 m

The geology, seam structure, and depth of cover are described in the Extraction Plan. In summary, the depth of cover to the Bulli Seam above the longwalls vary between a minimum of 490 m, above the western end of the proposed Longwall 901, and a maximum of 725 m, above the western end of the proposed Longwall 904. The seam floor within the Study Area generally dips from the south to the north.

The seam thickness within the proposed longwalls varies between 2.65 m and 3.15 m. The proposed longwalls will extract the full seam height.

4 SURFACE FEATURES INCLUDED IN THE MONITORING PROGRAM

4.1 THE STUDY AREA

The Study Area is defined by MSEC (2012) in **Section 2.1** and includes features within the 35 degree angle of draw of the proposed longwalls and those features that lie outside the Study Area that are expected to experience either far-field movements, or valley related upsidence and closure movements. The features assessed include:

- Watercourses within the predicted limits of 20mm total upsidence and 20mm total closure
- Cliffs and natural rock formations
- Steep slopes
- The HW2 Hume Highway
- The Twin Bridges over the Nepean River
- Moreton Park Road Bridge (South)
- Buildings and public infrastructure
- Groundwater bores
- Survey control marks.

4.2 OVERVIEW OF POTENTIALLY AFFECTED FEATURES

The features identified by the Management Plans are discussed in detail in MSEC (2012) and summarised below to provide context for the development of the monitoring programs.

4.2.1 Natural Features

Watercourses within the Study Area are shown in MSEC (2013) Drawing No. MSEC448-07 and include:

- The Nepean River
- Harris Creek
- Nepean River Tributary 1
- Other small drainage lines.

A comprehensive survey of the above watercourses is provided in MSEC (2012) and Ecoengineers (2012).

Aquifers or known groundwater resources within the Study Area do not comprise *Ground Water Management Areas*, as defined by the Department of Environment, Climate Change and Water (DECCW). However, there are groundwater resources, which are extracted using groundwater bores, the locations of which are shown in (MSEC 2012) Drawing No. MSEC448-32.

Cliffs and associated overhangs within the Study Area are shown in MSEC (2013) Drawing No. MSEC448-12 and are located:

- Generally within the valley of the Nepean River and associated tributaries.
- The cliffs within the valley of Harris Creek, which are located just outside the general Study Area, have also been included in the assessments, as they overhang Douglas Park Drive.
- There are also rock outcrops which are located along the Razorback Range.

Steep slopes within the Study Area are shown in MSEC (2012) Drawing No. MSEC448-12 and include:

- Steep slopes are located along the Razorback Range, which is located directly above the proposed longwalls. The range has natural slopes typically ranging between 1 in 3 and 1 in 2, with isolated areas having natural slopes greater than 1 in 2.
- Steep slopes are located within the valleys of the Nepean River and its tributaries. The natural slopes in the Nepean River valley and lower reaches of the tributaries are typically greater than 1 in 2. The natural slopes in the upper reaches of the tributaries, which are directly mined beneath, are typically less than 1 in 2.

Swamps, Wetlands or Water Related Ecosystems are not located within the mining area, however, there are water related ecosystems within the Study Area associated with the Nepean River and the major tributaries.

Protected or Threatened Species, which have been declared as critical habitat under the *Threatened Species Conservation Act 1995*, are not located within the Study Area. There are, however, threatened and protected species within the Study Area which are described in the report by *Biosis* (2012a) and *Cardno Ecology Lab* (2012).

Natural Vegetation in the Study Area can be seen from the aerial photograph provided in Figure 2 of the Biodiversity Management Plan (Extraction Plan Annex D). The locations of the *Endangered Ecological Communities* are indicated on MSEC (2012) Drawing No. MSEC448-07. A survey of the natural vegetation within the Study Area has been undertaken and details are provided in the report by *Biosis* (2012a).

4.2.2 Public Utilities

Railway infrastructure within the Study Area includes:

- Approximately 3.8 km (between 72.98 km and 76.78 km) of the Main Southern Railway as illustrated in MSEC (2012) Drawing No. MSEC448-13

- Culverts, embankments and cuttings
- A partially filled subway
- An emergency crossover
- Douglas Park Station
- Automated vehicular level crossing at Camden Road, Douglas Park
- Two small level crossings for private property access
- Signalling and communications systems, including a communication tower.

Major Roads either located within or potentially affected by far field movements include:

- The HW2 Hume Highway, which is located at a distance of 750 metres south-east of Longwall 901, at its closest point to the proposed longwalls.
- Moreton Park Road crosses over the HW2 Hume Highway at a distance of 1 kilometre east of the proposed Longwall 901.
- A number of smaller structures including drainage culverts, cuttings, embankments, an emergency phone system and road signage.

Bridges potentially affected by subsidence include:

- The Twin Bridges over the Nepean River, which is shown in MSEC (2012) Drawing No. MSEC448-14.
- Moreton Park Road Bridge (South) located at a distance of 1 kilometre east of Longwall 901, at its closest point.
- Blades Bridge located at a distance of 650 metres south-east of Longwall 901.

Local Roads within the Study area are shown in MSEC (2012) Drawing No. MSEC448-14 and include:

- The main local road within the Study Area is Menangle Road which crosses directly above the proposed Longwalls 902 to 904.
- There are also a number of local roads within the township of Douglas Park which are located directly above the eastern ends of the proposed longwalls.

Local Road Drainage Culverts along Menangle Road and Wrightson Way are shown in MSEC (2012) Drawing No. MSEC448-14. A summary of these culverts are provided in **Table 4.1**.

Table 4.1 – Drainage Culverts Along Menangle Road and Wrightson Way

Culvert Ref.	Type	Location
MR-A9-C01	1 x ϕ 350 Culvert	500 m west of LW902
MR-A9-C02	1 x ϕ 450 Culvert	350 m west of LW902
MR-A9-C03	1 x ϕ 800 Culvert	Above western end of LW902
MR-A9-C04	2 x ϕ 450 Culvert	Above western end of LW902
MR-A9-C05	2 x ϕ 1800 Culvert	Above tailgate of LW903
MR-A9-C06	1 x 1500W x ϕ 1200H Box Culvert	Above LW903
MR-A9-C07	2 x 2000W x ϕ 1200H Box Culvert	Above LW903

MR-A9-C08	1 x ϕ 900 Culvert	Above eastern end of LW904
MR-A9-C09	1 x ϕ 700 Culvert	500 metres east of LW 904
WW-A9-C01	2 x 2800W x 950H Box Culvert	50 metres east of LW904

Sydney Water infrastructure within the Study Area is shown in MSEC (2012) Drawing No. MSEC448-15.

SCA infrastructure within the Study Area comprises the Douglas Park Weir, causeway and Fish Passage, constructed from reinforced concrete, which are all located approximately 900 metres south of proposed Longwall 901.

Electrical infrastructure within the Study Area is summarised in **Table 4.2**.

Table 4.2 – Summary of Electrical Infrastructure within the Study Area

Type	Location
66kV Powerline	Partially above LW902 to LW904
11kV Powerlines	Partially above LW901 to LW904
Low Voltage Powerlines	Partially above LW901 to LW904

Telecommunications infrastructure within the Study Area as shown in MSEC (2012) Drawing No. MSEC448-17 comprises:

- Direct buried optical fibre cable
- Aerial and direct buried copper cables
- A mobile phone telecommunications tower.

A summary of the telecommunications cables within the Study Area is provided in **Table 4.3**.

Table 4.3 – Summary of Telecommunications Infrastructure within the Study Area

Type	Location	Total length of cable within the Study Area (km)
Optical Fibre Cables	Above LW901 to LW903	11.2
Copper Cables	Above LW901 to LW904	32.6

4.2.3 Public Amenities

Public infrastructure and amenities within the Study Area are illustrated in MSEC (2012) Drawing No. MSEC448-18 and includes:

- Douglas Park Primary School located 225 metres east of the finishing (eastern) end of the proposed Longwall 902.
- The Douglas Park Community Hall is located outside the Study Area, 400 metres south-east of the finishing (eastern) end of proposed Longwall 901.
- There is an oval south-east of the Study Area, which is located 475 metres from the finishing (eastern) end of proposed Longwall 901.
- There is a public tennis court facility south-east of the Study Area, which is located 450 metres from the finishing (eastern) end of proposed Longwall 901.
- The Douglas Park Train Station is located east of the proposed Longwall 901.

- The Fidgety Frogs Long Day Care Centre is located in Douglas Park, east of the proposed longwalls.

4.2.4 Farmland and Facilities

Rural Building Structures within the Study Area are shown in MSEC (2012) drawing Nos. MSEC448-19 to MSEC448-31 and comprise 655 rural building structures, which include sheds, garages, gazebos, pergolas, greenhouses, playhouses, shade structures and other non-residential building structures.

Farm Dams are located across the Study Area as shown in MSEC (2012) Drawings No's. MSEC448-19 to MSEC448-31.

- There are 158 farm dams that have been identified in the Study Area
- Dams are typically of earthen construction and have been established by localised cut and fill operations within the natural drainage lines. The farm dams are generally shallow, with the dam wall heights generally being less than 3 metres.

Groundwater Bores within the Study Area are detailed within the Water Management Plan and Geoterra (2012) and comprise six registered bores.

4.2.5 Industrial Commercial and Business Establishments

Business or Commercial Establishments or Improvements within the Study Area are located in the Township of Douglas Park. Although, Douglas Park is located in the Study Area, it is outside of the extents of the proposed longwalls. The location of the business and commercial establishments are shown in MSEC (2012) Drawing No. MSEC448-18.

Gas or Fuel Storage and Associated Plant within the Study Area are associated with the petrol station in Douglas Park. There are no other known commercial gas or fuel storages, or associated plant within the Study Area.

4.2.6 Areas of Archaeological or Heritage Significance

Archaeological Sites are not located within the Study Area. There is one Shelter with Art which has been identified just outside the Study Area, as shown in MSEC (2012) Drawing No. MSEC448-33.

There are no declared Aboriginal Places under the *National Parks and Wildlife Act 1974* or identified Aboriginal Sites within the Study Area.

Heritage Sites listed in the Study Area comprise the Railway Cottage at Douglas Park Station, which is listed in the Wollondilly Local Environmental Plan 1999, the location of which is shown in MSEC (2012) Drawing No. MSEC448-33.

4.2.7 Permanent Survey Control Marks

A number of Survey Control marks are located within the Study Area. The location of the Survey Control Marks is shown in MSEC (2012) Drawing No. MSEC448-32. The survey control marks are located across the Study Area and are expected to experience the full range of predicted subsidence movements.

4.2.8 Residential Establishments

There were 254 houses identified in the Study Area (at the date of the MSEC Report). The locations of houses within the Study Area are shown in MSEC (2012) Drawings Nos. MSEC448-19 to MSEC448-31.

There are 78 privately owned swimming pools identified within the Study Area, as shown in MSEC (2012) Drawings Nos. MSEC448-19 to MSEC448-31.

There are four privately owned tennis courts which have been identified within the Study Area, of which three have concrete or Astroturf surfaces and one has a grass or clay surface.

5 REVISED SUBSIDENCE PARAMETERS AND SUBSIDENCE IMPACTS DUE TO LONGWALLS 901 TO 904 EXTRACTION

MSEC (2012) provides a detailed description of the mine subsidence process and methods used to predict subsidence movements resulting from the extraction of the longwalls. The report includes the maximum predicted systematic subsidence parameters for the longwalls (Chapter 4 of MSEC [2012]) including:

- **Incremental Subsidence Parameters**, which are the predicted subsidence parameters due to the extraction of a single Longwall.
- **Cumulative Subsidence Parameters**, which are the accumulated parameters which result from the extraction of a series of longwalls.
- **Total Subsidence Parameters**, which include the predicted subsidence parameters resulting from the extraction of Longwalls 901 to 904 and also include the predicted total subsidence parameters from previously extracted longwalls.

The maximum predicted incremental systematic subsidence parameters for the Extraction Plan Layout are generally less than or equal to those for the BSO Part 3A EA Layout. The greatest maximum incremental subsidence of 850 millimeters (mm) has been predicted for Longwall 902, and the smallest maximum incremental subsidence of 600mm has been predicted for Longwall 901.

It can be seen from Section 4.3 of MSEC (2012) that the maximum predicted total conventional subsidence, based on the Extraction Plan Layout, is 200mm less than that predicted based on the Part 3A Layout. The maximum predicted tilt and curvatures, based on the Extraction Plan Layout are similar to those predicted based on the Part 3A Layout.

5.1 PREDICTED SUBSIDENCE PARAMETERS AND IMPACTS FOR THE NATURAL FEATURES AND ITEMS OF SURFACE INFRASTRUCTURE WITHIN THE STUDY AREA

MSEC (2012) provides a comprehensive description of revised (since the BSO EA) site specific predicted subsidence parameters and impact assessments for each of the natural features and items of surface infrastructure that are located within the Study Area, due to the extraction of Longwalls 901 to 904. Additionally, natural features and items of surface infrastructure located outside the Study Area, which may be subjected to far-field movements and may be sensitive to the predicted subsidence parameters, were also included in the revised assessments undertaken by MSEC (2012). An overview of the surface features assessed is provided in **Section 4.2** of this Monitoring Program.

The monitoring described below was developed in consideration of the predicted subsidence parameters and subsidence impacts outlined in MSEC (2012) as well as the findings, recommendations and commitments within specific management plans (refer to the Extraction Plan Annexes C – H).

6 MONITORING

The objectives of the Monitoring Program are discussed in **Section 1.3**. This Monitoring Program is comprised of two components:

1. The monitoring of subsidence movements (refer to **Section 6.1**) and
2. The monitoring of subsequent environmental and other consequences of those movements (refer to **Section 6.2**).

6.1 SUBSIDENCE MOVEMENTS

The program of monitoring and management of subsidence movements established for Appin Area 7 is proposed to be extended to AA9. The Monitoring Program will illustrate if subsidence movements or impacts are greater than predicted. If subsidence movements or impacts are greater than predicted, BHPBIC will initiate management and/or contingency actions, including investigating reasons for the occurrence.

All data from the Monitoring Program will be available to technical experts and government agencies. BHPBIC has provided significant quantities of data for the refinement of predictive models and research related to mining induced subsidence and will continue to do so.

Subsidence movement monitoring supports other components of the Monitoring Program. This is important for impact assessment, mitigation and rehabilitation. Regular reviews of subsidence data will be undertaken and an End of Panel Report reviewing subsidence in the area will be undertaken at the completion of each longwall panel.

The Monitoring Program would include a number of components as detailed below.

6.1.1 Airborne Laser Scanning

Due to the efficiencies of remote sensing, the primary method of monitoring the subsidence bowl over AA9 will be via Airborne Laser Scanning (ALS). This technique generates a complete topographic model of the terrain. Base survey for AA9 will be conducted prior to extraction.

Contours of the complete subsidence bowl from each longwall will be provided. A survey is generally undertaken after the completion of each longwall and 12 months after the completion of longwall extraction in each mining domain.

6.1.2 3D Survey Points

Selected 3D survey marks will be established and monitored to augment the ALS data. The points will be established in accessible areas as control for the ALS and at selected features sensitive to subsidence movements.

6.1.3 2D Survey Lines

Monitoring of 2D subsidence will be undertaken at selected lines throughout the Study Area. Where applicable these lines will be integrated with the existing 2D Monitoring Lines in Appin Area 7.

6.2 ENVIRONMENTAL CONSEQUENCES OF SUBSIDENCE

Monitoring of the environmental and other consequences of subsidence is comprised of the recommended monitoring regimes detailed in the management plans and associated Trigger Action Response Plans (TARPs). The master TARPs containing a consolidated monitoring program and TARPs table are located at **Attachment A** of this report. **Table 6.1** provides a directory to each of the feature specific monitoring regimes.

The AA9 monitoring sites which have been (or will be) installed to identify the consequences of mining are provided in **Figure Figure 6-1**.



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Appin Area 9
LW 901-904

Monitoring Locations

Figure 6.1

Legend

- Surface Water Monitoring Sites
- Aquatic Ecology
- Aboriginal Archaeology
- European Heritage
- Groundwater Monitoring
- Private borehole

Steep Slopes (MSEC 2012)

- Steep Slopes (1 in 1.5 to 1 in 1)
- Steep Slopes (1 in 2 to 1 in 1.5)
- Steep Slopes (1 in 3 to 1 in 2)
- Cliffs (MSEC 2012)

Longwalls 901-904 Study Area

- Longwalls 901-904 Study Area
- Appin Area 9 Longwall Layout

Major Roads

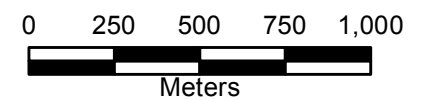
- Major Roads
- +— Railway Lines
- Rivers
- Creeks

Inset Legend

- ▲ Flow Monitoring Stations
- BSO Approved Mining Area

Inset Legend

- ▲ Flow Monitoring Stations
- BSO Approved Mining Area



Date: 22 August, 2014
 Author: P.Crowe
 Approved: G.Brassington

Version 2
 Horizontal Datum
 MGA - Zone 56

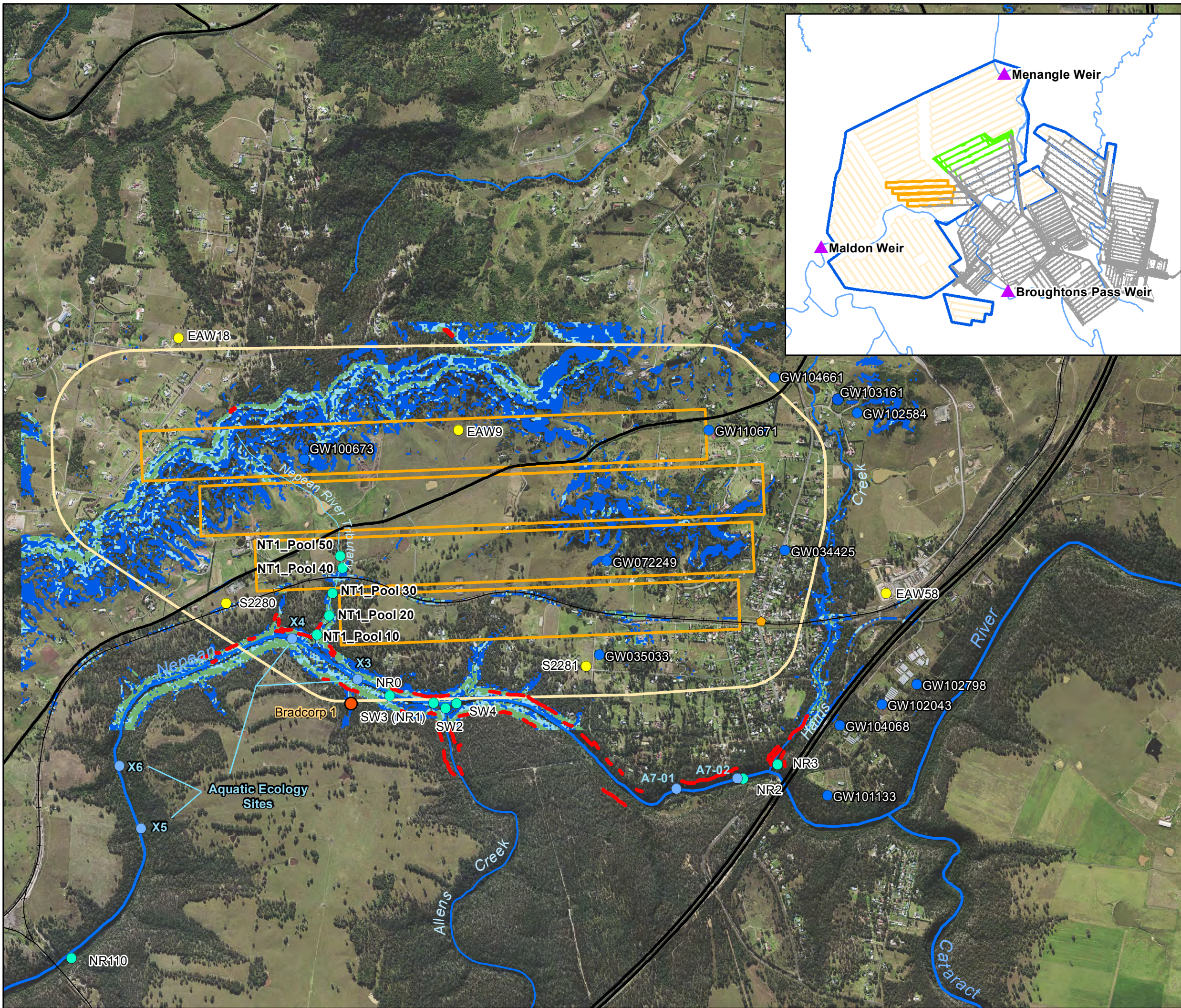
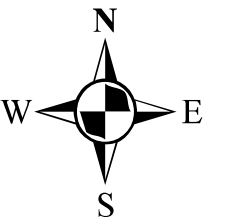


Table 6.1 – Monitoring Directory

Monitoring Component	Documentation	Monitoring Summary	Location
Natural Features			
Rivers or Creeks	<p>A Surface Water and Groundwater Management Plan has been developed in consultation with DP&I, DRE and OEH to manage the potential impacts on the Nepean River as a result of the extraction of the longwalls in Appin Area 7.</p> <p>The Management Plan includes both surface and groundwater monitoring, which have been reviewed and extended to include the proposed Longwalls 901 to 904.</p>	<p>Additional Nepean River cross lines will be installed across the gorge prior to mining to measure any valley related closure movements.</p> <p>Baseline surface flow and water quality monitoring has been undertaken in the Nepean River upriver and adjacent to proposed Longwalls 901 to 904 and in lower Allens and Harris Creeks and this will continue up until the commencement of Longwall 901. The stream surface flow and quality monitoring program would continue during extraction of Longwalls 901 to 904 and until 2 years post mining.</p> <p>Following commencement of Longwall 901 water quality TARPs for pH, Electrical Conductivity, Dissolved Oxygen, Total Iron and Total Manganese will be implemented for monitoring sites NR 0 and 2.</p>	<p>Extraction Plan Annex C <i>Assessment of Surface Water Flow and Quality Affects</i> (Ecoengineers, 2012)</p>
Cliffs, Steep Slopes	<p>A Cliff and Steep Slope Management Plan for Longwalls 701 to 710 in Appin Area 7 has been developed to manage the potential impacts on the cliffs in the Nepean River gorge.</p> <p>The Management Plan addresses monitoring, response action, reporting and public safety. The management plan has been reviewed and, where required, revised to include the proposed Longwalls 901 to 904.</p>	<p>Geotechnical investigations to assess the potential for instabilities in the cliffs along Harris Creek, which rise above and overhang Douglas Park Drive have been undertaken. The findings of the investigations have been discussed with Wollondilly Shire Council and collaborative management strategies based on the detailed investigations will be prepared to ensure the safety of people using the road.</p> <p>A detailed Subsidence Movement Survey Plan will be developed in consultation with key stakeholders, including Wollondilly Shire Council, prior to mining.</p>	<p>Extraction Plan Annex E <i>Harris Creek Cliffline, Douglas Park - Geotechnical Hazard Mapping</i> (GHD Geotechnics, 2010)</p> <p><i>Landslide Risk Assessment From Mine Subsidence Effects – Appin Area 9 Proposed Longwalls, Razorback Range, Douglas Park, NSW</i> (Coffey, 2011)</p>

Monitoring Component	Documentation	Monitoring Summary	Location
Public Utilities			
Railways	BHPBIC in collaboration with Xstrata and the Australian Rail Track Corporation (ARTC) have developed detailed risk management plans for managing potential mine subsidence impacts on the Main Southern Railway due to the extraction of Appin Colliery Longwalls 703 and 704 and Tahmoor Colliery Longwalls 25 and 26. The resultant Management Plans have proven to be highly successful in managing the impacts of mine subsidence on rail and associated structures. It is proposed that the Management Plan will be reviewed and revised in consultation with key stakeholders to include the proposed Longwalls 901 to 904.	As per the current management plans the revised plan will: <ul style="list-style-type: none"> • Assess pre-mining conditions to understand all rail track and associated structure (i.e. culverts, cuttings, embankments, signalling infrastructure, etc) issues which may be influenced by the development of subsidence; • Identify potential sites of non-systematic movement, such as creeks and geological structures, • Assess the required mitigation; • Install the mitigation; • Install a monitoring system, which includes, among other things, the monitoring of ground movements, rail stress, rail temperature, switch displacement and track geometry; • Regularly review and assess the monitoring data; • Conduct regular visual inspections; and • Adjust the track in response to monitoring results during mining and implement management plan and contingency strategies as required. 	Extraction Plan Annex H
Roads	The HW2 Hume Highway is located at a distance of 750 metres south-east of Longwall 901, at its closest point and progressively further away from Longwalls 902 to 904. At this distance it is likely to experience far-field movements only. BHPBIC has developed management strategies for HW2 Hume Highway for the longwalls in Appin Area 7 which are being	Subsidence movement monitoring will be installed prior to mining to measure far field subsidence movements at sensitive features in proximity to Longwalls 901 – 904.	Extraction Plan Annex H

Monitoring Component	Documentation	Monitoring Summary	Location
	<p>extracted directly beneath the road.</p> <p>It is proposed that these existing management strategies be reviewed, in consultation with key stakeholders, including Roads and Maritime Services (RMS), based on the potential movements resulting from the extraction of the proposed Longwalls 901 to 904.</p>		
Bridges	<p>The Twin Bridges over the Nepean River at Douglas Park are located at a distance of 1 kilometre south of the proposed Longwall 901.</p> <p>BHPBIC has developed management strategies for the Twin Bridges for the previously extracted Longwalls 16 and 17 at Tower Colliery and Longwalls 701 and 704 at Appin Colliery. It is proposed that these existing management strategies be reviewed, in consultation with RMS, based on the potential movements resulting from the extraction of the proposed longwalls. The investigations will involve input from structural and geotechnical engineers, and subsidence engineers.</p>	<p>The management measures will include a combination of:</p> <ul style="list-style-type: none"> • Mitigation measures prior to mining; • Installation of a monitoring system, which would be likely to include the monitoring of ground movements, structure movements, sub-surface ground movements, bridge joint displacements and visual inspections; • Implementation of a response plan, where actions are triggered by monitoring results; and • Implementation of a reporting and communication plan. 	Extraction Plan Annex H
Local Roads – Culverts	<p>BHPBIC has developed a Public Road Management Plan for the longwalls at West Cliff and Appin Area 7 to manage the potential impacts on public roads. The Management Plan was developed in consultation with the Wollondilly Shire Council, the Roads and Traffic Authority and the Mine Subsidence Board.</p> <p>It is proposed that the Management Plan be</p>	<p>Specific management strategies developed from the Razorback Range Steep Slope Assessment will also be included in the Public Road Management Plan. Measurement of subsidence movements on steep slopes will be implemented prior to the extraction of the proposed Longwalls 901 to 904.</p>	Extraction Plan Annex H

Monitoring Component	Documentation	Monitoring Summary	Location
	reviewed and, where required, revised to include the local roads within the potentially affected area.		
Local Roads – Bridges	<p>Moreton Park Road Bridge (South) is managed as part of RMS assets. The Hume Highway Technical Committee has undertaken detailed investigations and assessments of potential impacts on the Moreton Park Road Bridge (South) resulting from the extraction of the Appin Area 7 longwalls. A management plan has been developed for the bridge.</p> <p>It is proposed that the existing management plan for the bridge be reviewed, in consultation with RMS, based on the potential movements resulting from the extraction of the proposed Longwalls 901 to 904.</p> <p>The new Blades Bridge is a Wollondilly Shire Council Asset and will be incorporated into the revised Public Road Management Plan. Blades Bridge has recently been reconstructed, and includes provision for large subsidence movements in the design while only small subsidence movements are predicted at the bridge.</p>	<p>It is proposed that the existing management plan for the Moreton Park Road Bridge (South) is updated to incorporate the proposed Longwalls 901 to 904, with the following management measures:</p> <ul style="list-style-type: none"> • Installation of a monitoring system, which includes, among other things, the monitoring of ground movements, structure movements, bridge joint displacements and visual inspections; • Implementation of a response plan, where actions are triggered by monitoring results. This includes the ability to provide additional structural support to the bridge if triggered by monitoring results. BHPBIC and RMS have already installed additional footings at the bridge and fabricated structural frames, which are stored on standby for swift installation if required; and • Implementation of a reporting and communication plan. 	Extraction Plan Annex H
Sydney Water Infrastructure	Management strategies have been developed by BHPBIC, in consultation with Sydney Water, to manage the impacts on water infrastructure in Appin Areas 3 and 7 and at West Cliff Colliery.	The management strategies and associated monitoring will be extended to include the proposed Longwalls 901 to 904.	Extraction Plan Annex H
Integral Energy	BHPBIC has an Integral Energy Transmission Structure Monitoring and	The Monitoring and Management Plan will be reviewed and, where required, revised to incorporate the power lines	Extraction Plan Annex H

Monitoring Component	Documentation	Monitoring Summary	Location
Infrastructure	Management Plan for the longwalls at Appin Area 7, West Cliff and Dendrobium to manage the potential impacts on electrical infrastructure. The Management Plan was developed in consultation with Integral Energy. The existing management plan would be reviewed, in consultation with the infrastructure owners, and amendments made where necessary to include electrical infrastructure within the Study Area.	within the area affected by proposed Longwalls 901 – 904.	
Telecommunication Lines or Associated Plant	BHPBIC has developed specific telecommunication infrastructure management plans for the longwalls at Appin Area 7 and West Cliff to manage the potential impacts on copper and optical fibre cables owned by Telstra, Optus, NextGen and PowerTel. The Management Plans were developed in consultation with telecommunications experts and the infrastructure owners. The Management Plans will be reviewed and, where required, revised to incorporate the telecommunications infrastructure within the Study Area.	The management strategies and associated monitoring will be extended to include the proposed Longwalls 901 to 904.	Extraction Plan Annex H
Residential Establishments			
Houses	BHPBIC has developed a number of management strategies for houses which have been directly mined beneath by previously extracted longwalls at Appin, Tower and West Cliff Collieries. Similar management strategies will be developed for the houses within the potentially affected area.	<p>The PSMPs will include any recommendations from steep slope assessments and structural assessments of the houses. The PSMPs are also anticipated to include the following where access is provided to the property:</p> <ul style="list-style-type: none"> • Inspection of houses considered to be at higher risk by a structural engineer or a suitably qualified building inspector prior to the longwall mining directly beneath them; 	Extraction Plan Annex H

Monitoring Component	Documentation	Monitoring Summary	Location
	<p>Illawarra Coal issued letters 3 May 2012 to all residents located in close proximity to the longwall layout (based on subsidence predictions) to commence the Built Features Management Plan (BFMP) process. This process involved first trying to establish one to one meetings with landholders in the study area to discuss the mine plan layout, impact predictions at property dwellings, and proposed timetable for longwall mining in the region.</p> <p>Meetings were progressively scheduled throughout 2012/13 to either discuss the BFMP, or to deliver the BFMP to the residence (and meet subsequently). The mine plan has been communicated to all landholders in the Mining Area.</p>	<ul style="list-style-type: none"> • Implementing any mitigation measures, where necessary to address specific identified risks to public safety; • Undertaking detailed monitoring of ground movements at or around structures, where necessary to address specific identified risks to public safety; • Periodic inspections of structures that are considered to be at risk. These may include: <ul style="list-style-type: none"> - Structures in close proximity to steep slopes where recommended by a geotechnical or subsidence engineer, - Structures identified as being potentially unstable where recommended by a structural or subsidence engineer, and - Pool fences. 	
Associated Structures	As above.	As above.	As above.

7 MONITORING VALIDATION

The performance of the Monitoring Program is validated through ongoing reporting and review as outlined below; with contingency measures in place should environmental consequences exceed predictions.

7.1 REPORTING

The Monitoring Program survey results are typically reported within 48 hours of the completion of a survey. Results will be forwarded electronically in an "Excel" spread sheet to asset owners, technical experts and regulators as prescribed in the various management plans. Particular presentation formats i.e. coordinate listings, relative / absolute movements, and graphical presentation will be defined in consultation with key stakeholders, including asset owners. Embedded within the spreadsheet is a plan showing the nominal position of the longwall currently being mined at the time of the survey.

Individual management plans contain monitoring and reporting protocols. Reporting is generally undertaken at the completion of baseline data collection, as well as annually in the Annual Environmental Management Report (AEMR), in accordance with *Condition 4, Schedule 6* of the BSO approval. The AEMR details the outcomes of monitoring undertaken, as well as providing results of visual inspections to determine whether performance indicators have been exceeded and whether mitigation/contingency measures are required.

End of Panel (EoP) reports would be prepared on completion of extraction from each longwall. The EoP reports would detail the findings of the monitoring programs and inspections associated with the longwall extraction.

7.2 REVIEW

All survey results are checked, reviewed and assessed prior to reporting, with further review performed by BHPBIC's Subsidence Management Committee which meets on a monthly basis. The analysis undertaken by the Subsidence Management Committee includes:

- Comparison of predicted subsidence effects and measured parameters
- Comparison of predicted subsidence impacts and measured impacts
- Analysis of any variations between predicted and measured subsidence effects and impacts (e.g. consideration of underlying parameters to determine the predicted subsidence profile); analysis of variations between predicted and measured non-systematic subsidence effects and impacts
- Analysis of the 3D movement associated with longwall extraction with particular reference to the transverse and longitudinal movements versus distance in advance of the longwall panel.

The analysis will be used to assess the validity of the subsidence predictions detailed in the MSEC Report (2012) (refer to Extraction Plan, Annex A) and to provide feedback and data to MSEC to refine the predictive methods where appropriate.

Should the movements be classed as '*greater than predicted*' a review of the potential causes of the exceedance would be undertaken and if there are associated impacts, mitigation/contingency measures would be considered and implemented if required (refer to **Section 7.3**). The mitigation/contingency measures would be implemented to limit potential environmental consequences, improving the environmental performance of the project.

A comprehensive review of the objectives and targets associated with the BSO is undertaken on an annual basis via the BHPBIC Balanced Planning (1 year outlook) and Balanced Strategy (5 year outlook) processes. These reviews, which include involvement from senior management and other key personnel, assess the performance of the mine over the previous year and develop goals and targets for the following period.

If deficiencies in the Monitoring Program are identified in the interim period, the plans will be modified as required. This process has been designed to ensure that all environmental documentation continues to meet current environmental requirements, including changes in technology, operational practice, and the expectations of stakeholders.

7.3 CONTINGENCY AND RESPONSE PLAN

Contingency and emergency response options are available and will be implemented if it is demonstrated that environmental consequences are greater than those predicted or authorised by the BSO Consent. This would involve:

- Capture and record the event.
- Notify relevant stakeholders soon as practicable.
- Notify relevant agencies and specialists soon as practicable.
- Offer site visits with stakeholders.
- Contract specialists to investigate and report on changes identified.
- Provide incident report to relevant agencies.
- Establish appropriate monitoring frequency until stabilised.
- Updates from specialists on investigation process.
- Inform relevant agencies and stakeholders of results of investigation.
- Develop site Corrective Management Action (CMA) in consultation with key stakeholders if required, (pending stakeholder availability) and seek approvals.
- Implement CMA as agreed with stakeholders following approvals.
- Conduct initial follow up monitoring and reporting after CMA completion.
- Review Management Plan.
- Report in regular reporting and AEMR.

BHPBIC will consult with appropriate specialists and relevant agencies in order to devise an appropriate response in respect to any identified exceedance.

If the contingency measures implemented by BHPBIC fail to remediate the impact or the Director-General determines that it is not reasonable or feasible to remediate the impact BHPBIC will provide a suitable offset to compensate for the impact to the satisfaction of the Director-General of DP&I in accordance with the BSO Approval *Condition 2, Schedule 3*.

The individual management plans supporting the Extraction Plan (Annex C – H) provide further detail relating to specific features and the actions that will be undertaken.

8 REFERENCES

Biosis Research, 2012a, *Appin Area 9 Longwalls 901 to 904 Biodiversity Impact Assessment*. Report prepared for BHPBIC.

Biosis Research, 2012b, *Appin Area 9 Longwalls 901 to 904 Revised Heritage Impact Assessment*. Report prepared for BHPBIC.

Ecoengineers, 2012, *Assessment of Water Quality Flow and Quality Effects Appin Colliery Longwalls 901 to 904*. Report prepared for BHPBIC.

Geoterra, 2011, *Appin Area 9 Longwalls 901 to 904 Groundwater Assessment*. Report prepared for BHPBIC.

Mine Subsidence Engineering Consultants, 2009, *Bulli Seam Operations Subsidence Assessment*. Report for BHPBIC.

Mine Subsidence Engineering Consultants, 2012, *Appin Colliery – Longwalls 901-904. Subsidence Predictions and Impact Assessments for the Natural Features and Surface Infrastructure in support of the Extraction Plan*: Report Number: MSEC448 Revision 3. A report to BHPBIC.

Attachment A – Master TARPs

Attachment A – Appin Area 9 Key Monitoring

Monitoring Site	Monitoring Type	Monitoring Frequency	Parameters	
SURFACE WATER				
AREA 9	<p>Nepean River and tributaries</p> <ul style="list-style-type: none"> • NR110 (Lab, Field, Level, Obs) • NR0 (Lab, Field, Level, Obs) • SW2 (Lab, Field, Obs) • SW3 (NR1) (Field, Obs – LW901 only) • SW4 (Field, Obs – LW901 only) • NR2 (Lab, Field, Level, Obs) • NR3 (Lab, Field, Obs) • NT1_Pool 10 (Lab, Field, Level, Obs) • NT1_Pool 20 (Field, Level, Obs) • NT1_Pool 30 (Field, Level, Obs) • NT1_Pool 40 (Field, Level, Obs) • NT1_Pool 50 (Field, Level, Obs) • If and where strata gas emission plumes above 3000 L/min are detected (Lab, Field, Obs) 	<ul style="list-style-type: none"> • Lab sample • Field parameters • Water levels • Observations 	<ul style="list-style-type: none"> • Monthly baseline monitoring prior to mining • Weekly observations and field analysis during active subsidence • Monthly laboratory analysis during active subsidence • Monthly monitoring for two years post mining 	<p>Field Parameters:</p> <ul style="list-style-type: none"> • Temperature • Dissolved Oxygen (DO) • Specific Conductivity • pH • ORP <p>Standard Lab Sample:</p> <ul style="list-style-type: none"> • pH and EC • Filtered, Na, K, Ca, Mg, Cl, Ni, Zn, Fe, Mn, Al, SO₄ • Total Fe, Mn, Al • Total Alkalinity • TKN, TP, NH₃-N, NO_x-N (TON), FRP, TSS, DOC <p>Lab Sample for Gas Releases:</p> <ul style="list-style-type: none"> • CH₄ • C₂H₆ • Trace Phenols • Sulphide <p>Observations:</p> <ul style="list-style-type: none"> • Iron or salinity staining (e.g. orange or white staining in water or on banks/seeps) • Evidence of springs in the Nepean River • Visual signs of impacts (i.e. cracking, fracturing, vegetation changes, increased erosion, changes in water colour etc) • Stream flow and pool water level • Impacts determined from comparing photo points taken prior to, during and post mining
AREA 9	<p>Flow monitoring</p> <ul style="list-style-type: none"> • Maldon Weir • Broughtons Pass Weir • Menangle Weir 	<ul style="list-style-type: none"> • Gauged flow station 	<ul style="list-style-type: none"> • Daily flow 	<p>Analysis:</p> <ul style="list-style-type: none"> • 51 baseline dry weather recession periods for Menangle minus Maldon minus Broughtons Pass Weirs with recession curve slope ranging from 0.76 to 0.99 • Recession curves calculated during and post mining • These recessions will be compared from the period of mining to the pre-mining period

GROUNDWATER				
AREA 9	Private Bores <ul style="list-style-type: none"> • GW 34425 • GW 35033 • GW 72249 • GW 100673 • GW 101133 • GW 102043 • GW 102584 • GW 102798 • GW 103161 • GW 104068 • GW 104602 • GW 104661 • GW 110671 <i>(in consultation with bore owner)</i>	<ul style="list-style-type: none"> • Lab sample • Field parameters • Water levels • Observations 	<ul style="list-style-type: none"> • Where access is available and granted, water level and water quality monitoring at least once before and once after the bore is mined under 	Field Parameters: <ul style="list-style-type: none"> • Temperature • Dissolved Oxygen (DO) • Specific Conductivity • pH • ORP Standard Lab Sample: <ul style="list-style-type: none"> • pH and EC • Filtered, Na, K, Ca, Mg, Cl, Ni, Zn, Fe, Mn, Al, SO₄ • Total Fe, Mn, Al • Total Alkalinity • TKN, TP, NH₃-N, NO_x-N (TON), FRP, TSS, TDS, DOC Lab Sample for Gas Releases: <ul style="list-style-type: none"> • CH₄ • C₂H₆ • Trace Phenols • Sulphide Observations: <ul style="list-style-type: none"> • Iron or salinity staining (e.g. orange or white staining in water or in the bores) • Evidence of inflows to the bores e.g. sound of falling water • Visual signs of impacts (i.e. cracking, fracturing near the bore or changes in water colour etc.)
	BHPBIC Piezometers: <ul style="list-style-type: none"> • Potentiometric head; <ul style="list-style-type: none"> – EAW9 – EAW18 – EAW58 • Piezometers and water samples between Longwall 901 and the Nepean River <ul style="list-style-type: none"> – S2280 (POSP A) – S2281 (POSP B) 	<ul style="list-style-type: none"> • Lab sample • Field parameters • Water levels • Observations 	<ul style="list-style-type: none"> • Water levels to be logged at least twice daily in the pre-mining baseline, impact and post-mining period • At least one appropriately purged sample pre-mining and post mining, where access permits, tested for the analytes in the previous column 	
	Groundwater inflows to the mine	<ul style="list-style-type: none"> • Mine water budget • Observations 	<ul style="list-style-type: none"> • Flow meters 	Water flow from the goaf to the mine (analyzed as a moving average i.e. 20 day average)
AQUATIC ECOLOGY				
AREA 9	Nepean River <ul style="list-style-type: none"> • Sites 1 and 2 (downstream) • Sites X3 and X4 (adjacent to Longwalls 901 and 902) • Sites X5 and X6 (upstream) • Sites X7 and X8 to be identified (upstream) 	<ul style="list-style-type: none"> • Water quality - field parameters • Survey and sampling • Observations 	<ul style="list-style-type: none"> • Twice in spring for two years prior to the commencement of mining • Once every two years during mining • Once every two years after mining 	<ul style="list-style-type: none"> • Habitat surveys • Aquatic macrophyte observations • Macroinvertebrate monitoring • AUSRIVAS sampling • Fish sampling • Observations of threatened species • Assessments of: <ul style="list-style-type: none"> ○ Water quality ○ Flow ○ River morphology

TERRESTRIAL ECOLOGY				
AREA 9	<ul style="list-style-type: none"> Inspection of the area will be conducted as outlined in the Landscape TARP 	<ul style="list-style-type: none"> As indicated in the Landscape TARP 	<ul style="list-style-type: none"> Prior to mining provide pre-mining baseline survey of vegetation communities and threatened flora populations for comparison with post-mining Monthly prior to mining Weekly during active subsidence In response to any identified impacts on flora/fauna or threatened species, communities or populations 	<ul style="list-style-type: none"> Observations of threatened species and endangered ecological communities Changes in vegetation condition Stressed or dead vegetation not readily explained by natural processes (causes may include rock / cliff falls or mass movement, gas emissions, changes in flooding/ ponding)
ABORIGINAL ARCHAEOLOGY				
AREA 9	<ul style="list-style-type: none"> Impacts to the cliff lines on the southern side of the Nepean River will trigger an inspection of Bradcorp 1 and any adjacent sections of the river and creek valleys that have not been inspected 	<ul style="list-style-type: none"> Observational and photographic monitoring 	<ul style="list-style-type: none"> In accordance with Landscape TARP 	<ul style="list-style-type: none"> Subsidence Impacts to cliff lines on the southern side of the Nepean River (e.g. directly north of Bradcorp 1)
	<ul style="list-style-type: none"> Bradcorp 1 (if required) 	<ul style="list-style-type: none"> Observational and photographic monitoring 	<ul style="list-style-type: none"> Baseline archival recording (when triggered by above) During the extraction of Longwalls 901, 902 and 903 Final impact assessment recording twelve months after final subsidence movement at the site 	<ul style="list-style-type: none"> Macro and micro recording using digital photography Detailed elevation plans of shelter walls recording structural and surface features including but not limited to the art, graffiti, joints, bedding planes, exfoliation scars, cracks, mineral and micro-organism growth, drip line and water seepage locations
EUROPEAN HERITAGE				
AREA 9	<ul style="list-style-type: none"> Douglas Park Railway Cottage – Item 30 	<ul style="list-style-type: none"> Observational monitoring 	<ul style="list-style-type: none"> Baseline archival recording prior to commencement of mining Impact assessment recording following the identification of impacts or when a MSB claim is lodged Final assessment recording following the completion of mining of Longwalls 901 and 902 and/or after any repairs 	<ul style="list-style-type: none"> With the consent of the owner, the subsidence monitoring program will include: Pre-mining inspection and assessment (as part of PSMP) Observational monitoring to identify potential subsidence impacts to the fabric of the building and/or its interior Assessment of heritage impacts by a suitably qualified heritage expert (if required) This assessment would be made available to the MSB and include recommendations for management of heritage value during any repairs

LANDSCAPE FEATURES

<p>AREA 9</p>	<ul style="list-style-type: none"> • Nepean River cliff lines • Harris Creek cliff lines • Sensitive terrain near built features (Razorback Range, Douglas Park Ridge) <p>Monitoring locations on private properties to be determined as appropriate/required in consultation with landowner/s</p>	<ul style="list-style-type: none"> • Observational and photographic monitoring • Piezometers • Slope inclinometers 	<ul style="list-style-type: none"> • Harris Creek and Nepean River cliff lines <ul style="list-style-type: none"> - Baseline recording once prior to mining. - Monthly routine inspections with weekly inspections during critical periods • Low Terrain Sensitivity (visual inspection) <ul style="list-style-type: none"> - 6 months prior to mining - 6 months after active subsidence • Medium Terrain Sensitivity <ul style="list-style-type: none"> - 6 to 12 months prior to mining - 3 monthly during active subsidence - 6 months after active subsidence • High Terrain Sensitivity <ul style="list-style-type: none"> • 12 months before commencement of subsidence for visual and on ground survey • Monthly for visual during active subsidence • 3 monthly for ground survey during active subsidence • Installation of piezometers and inclinometers as required and in consultation with landowners as part of PSMP process 	<ul style="list-style-type: none"> • Visual inspections • Photographic records • Ground survey (mid to high terrain sensitivity) • Piezometers (high terrain sensitivity) • Slope inclinometers (high terrain sensitivity)
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Attachment A – AA9 Master TARPS, Key Monitoring, Triggers and Response

Monitoring	Trigger	Action
WATER QUALITY		
Adjacent and downstream sites: <ul style="list-style-type: none"> • Nepean River: <ul style="list-style-type: none"> – NR0 – SW3 (NR1) – NR2 – If and where strata gas emission plumes above 3000 L/min are detected 	Level 1* Impact monitoring sites when comparing the baseline period to the mining period for that site: <ul style="list-style-type: none"> • pH reduction greater than 1 standard deviation but less than 2 standard deviation from pre-mining mean resulting from the mining for two consecutive months • DO reduction greater than 1 standard deviation but less than 2 standard deviation from pre-mining mean resulting from the mining for two consecutive months • Identification of strata gas plume of flow rate < 3000 L/min 	<ul style="list-style-type: none"> • Continue monitoring program • Submit an Impact Report to OEH, DoPI, DPI and other relevant resource managers • Report in the End of Panel Report • Summarise actions and monitoring in AEMR
	Level 2* Impact monitoring sites when comparing the baseline period to the mining period for that site: <ul style="list-style-type: none"> • pH reduction greater than 2 standard deviation from pre-mining mean resulting from the mining for two consecutive months • DO reduction greater than 2 standard deviation from pre-mining mean resulting from the mining for two consecutive months • EC, total Fe and total Mn increases greater than 2 standard deviation from pre-mining mean resulting from the mining for two consecutive months • Identification of strata gas plume of flow rate >3000 L/min 	<ul style="list-style-type: none"> • <i>Actions stated for Level 1</i> • Review monitoring program • Notify relevant technical specialists and seek advice on any CMA required • Implement agreed CMAs as approved <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. water quality changes with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p> <p><i>Strata Gas Emission Plume:</i></p> <ul style="list-style-type: none"> • Estimate gas emission flow rates. Re-estimate should significant change be observed • Take sample of plume (if possible) for: <ul style="list-style-type: none"> – chemical composition – dissolved methane from exactly above gas plume and at established downriver monitoring site – dissolved sulfide and total phenols from exactly above gas plume and at nearest downriver monitoring site
	Level 3* Impact monitoring sites when comparing the baseline period to the mining period for that site: <ul style="list-style-type: none"> • Level 2-type reduction in water quality resulting from the mining observed for more than 6 consecutive months 	<ul style="list-style-type: none"> • <i>Actions stated for Level 2</i> • Notify OEH, DP&I, NoW, DPI, DRE, relevant resource managers and technical specialists and seek advice on any CMA required • Invite stakeholders for site visit • Develop site CMA (subject to stakeholder feedback) • Completion of works following approvals, including monitoring and reporting on success • Review the TARP and Management Plan in consultation with key stakeholders <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. water quality changes with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>

Monitoring	Trigger	Action
	<p>Exceeding Performance Measures</p> <ul style="list-style-type: none"> Mining results in more than negligible gas releases, iron staining or water cloudiness 	<ul style="list-style-type: none"> Actions stated for Level 3 Investigate reasons for the exceedance Update future predictions based on the outcomes of the investigation Provide environmental offset if CMAs are unsuccessful
GROUNDWATER		
<p>Groundwater flow into the mine</p> <p>Registered Bores:</p> <p>GW 34425 GW 35033 GW 72249 GW 100673 GW 101133 GW 102043 GW 102584 GW 102798 GW 103161 GW 104068 GW 104602 GW 104661 GW 110671</p> <p>BHPBIC Piezometers:</p> <p>EAW9 EAW18 EAW58 PROSP A PROSP B</p>	<p>Level 1*</p> <ul style="list-style-type: none"> Increase in water flow from the goaf between 2.7 to 3 ML/day (over 20 day average) 5.0 – 7.5 m reduction in the Hawkesbury Sandstone greater than predicted standing water level or pressure (outside of pumping influences in private bores) over a minimum 2 month period <p>Level 2*</p> <ul style="list-style-type: none"> Increase in water flow from the goaf between 3 to 3.4ML (over 20 day average) 7.5 – 10 m reduction in the Hawkesbury Sandstone greater than predicted standing water level or pressure (outside of pumping influences in private bores) over a minimum 2 month period <p>Level 3*</p> <ul style="list-style-type: none"> Abnormal increase in water flow from the goaf >3.4ML (20 day average) >10m reduction in the Hawkesbury Sandstone standing water level or pressure (outside of pumping influences in private bores) over a minimum 2 month period Mining results in groundwater bores unsafe, unserviceable or damaged 	<ul style="list-style-type: none"> Continue monitoring program Submit an Impact Report to OEH, DoPI, DPI and other relevant resource managers Report in the End of Panel Report Summarise actions and monitoring in AEMR <p><i>Actions stated for Level 1</i></p> <ul style="list-style-type: none"> Review monitoring program Notify relevant technical specialists and seek advice on any CMA required Implement agreed CMAs as approved <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p> <ul style="list-style-type: none"> Actions stated for Level 2 Notify OEH, DP&I, DPI, NoW, DRE, relevant resource managers and technical specialists and seek advice on any CMA required. Invite stakeholders for site visit Develop site CMA (subject to stakeholder feedback). This may include: <ul style="list-style-type: none"> Make area safe Any actions agreed to in the Property Subsidence Management Plan Provisions of alternate water supply where this has been impacted by mining MSB to repair any infrastructure damaged by mining Completion of works following approvals, including monitoring and reporting on success Review the Groundwater Model, TARP and Management Plan in consultation with key stakeholders <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>
LANDSCAPE FEATURES		
<p>Cliffs and Steep Slopes</p> <ul style="list-style-type: none"> Nepean River cliff lines Harris Creek cliff lines 	<p>Level 1</p> <ul style="list-style-type: none"> Rock fall from a cliff where the cliff is left mostly intact (<10% length of any single cliff) 	<ul style="list-style-type: none"> Continue monitoring program Submit an Impact Report to OEH, DoPI, DPI and other relevant resource managers

Monitoring	Trigger	Action
<ul style="list-style-type: none"> Sensitive terrain near built features (Razorback Range, Douglas Park Ridge) <p>Monitoring locations on private properties to be determined as appropriate/required in consultation with landowner</p>	<ul style="list-style-type: none"> Surface movement or rock displacement where any exposed soil surface is stable Crack at the surface which does not result in ongoing erosion or ground movement Erosion which stabilises within the period of monitoring without CMA Crack or fracture up to 100 mm width Crack or fracture up to 10 m length 	<ul style="list-style-type: none"> Report in the End of Panel Report Summarise actions and monitoring in AEMR
	<p>Level 2</p> <ul style="list-style-type: none"> Rock fall from cliff where the characteristics of the cliff change (>10% length of any single cliff) Ground disturbance that is unlikely to stabilise within the period of monitoring without CMA Mass movement of a slope causing areas of exposed soil Crack or fracture between 100 – 300 mm width Crack or fracture between 10 – 50 m length 	<ul style="list-style-type: none"> Actions stated for Level 1 Report trigger to key stakeholders Review monitoring program Notify relevant specialists and develop and implement any CMA required. Provide safety signage and barricades where appropriate in areas as required for public safety (refer PSMP) Implement agreed CMA's as approved <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>
	<p>Level 3 *</p> <ul style="list-style-type: none"> Cliff collapse (100% length of any single cliff) Ground disturbance that does not stabilise within the period of monitoring Mass movement of a slope causing areas of exposed soil that does not stabilise within the period of monitoring Crack or fracture over 300 mm width Crack or fracture over 50 m length 	<ul style="list-style-type: none"> Actions stated for Level 2 Notify OEH, DP&I, DPI, NoW, DRE, relevant resource managers and technical specialists and seek advice on any CMA required. Invite stakeholders for site visit Develop site CMA (subject to stakeholder feedback). This may include: <ul style="list-style-type: none"> Erosion prevention works Establishment of vegetation Completion of works following approvals, including monitoring and reporting on success Review the TARP and Management Plan in consultation with key stakeholders <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>
	<p>Exceeding Performance Measures</p> <ul style="list-style-type: none"> For cliffs of 'special significance' and other cliffs flanking the Nepean River - mining results in more than negligible environmental consequences (i.e. more than occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing, that in total impact more than 0.5% of the total face area of such cliffs within any longwall mining domain) Other cliffs – mining results in more than minor environmental consequences (that is occasional rockfalls, displacement or dislodgment of boulders or slabs or fracturing, that in total impact more than 3% of the total face area of such cliffs within any longwall mining domain) 	<ul style="list-style-type: none"> Actions stated for Level 3 Make area safe Investigate reasons for the exceedance Update future predictions based on the outcomes of the investigation Provide environmental offset if CMAs are unsuccessful

AQUATIC ECOLOGY		
Nepean River <ul style="list-style-type: none"> Sites 1 and 2 (downstream) Sites X3 and X4 (adjacent to Longwalls 901 and 902) 	Level 1* <ul style="list-style-type: none"> Reduction in aquatic habitat resulting from the mining over 1 season 	<ul style="list-style-type: none"> Continue monitoring program Submit an Impact Report to OEH, DoPI, DPI and other relevant resource managers Report in the End of Panel Report Summarise actions and monitoring in AEMR
	Level 2* <ul style="list-style-type: none"> Reduction in aquatic habitat resulting from the mining over 2 seasons 	<ul style="list-style-type: none"> Actions stated for Level 1 Report trigger to key stakeholders Review monitoring program Notify relevant specialists and develop and implement any CMA required. Implement agreed CMA's as approved <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. impacts to aquatic habitat with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>
	Level 3* <ul style="list-style-type: none"> Reduction in aquatic habitat resulting from the mining for >2 consecutive seasons or complete loss of habitat 	<ul style="list-style-type: none"> Actions stated for Level 2 Notify OEH, DP&I, DPI, NoW, DRE, relevant resource managers and technical specialists and seek advice on any CMA required. Invite stakeholders for site visit Develop site CMA (subject to stakeholder feedback). This may include: <ul style="list-style-type: none"> Grouting of fractures which result in flow diversion Completion of works following approvals Completion of works following approvals, including monitoring and reporting on success Review the TARP and Management Plan in consultation with key stakeholders <i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. impacts to aquatic ecology with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i>
	Exceeding Performance Measures <ul style="list-style-type: none"> Mining results in more than negligible environmental consequences for a threatened species, threatened population or endangered ecological communities 	<ul style="list-style-type: none"> Actions stated for Level 3 Investigate reasons for the exceedance Update future predictions based on the outcomes of the investigation Provide environmental offset if CMAs are unsuccessful
TERRESTRIAL ECOLOGY		
Visual inspections as part of landscape and water monitoring programs in active mining areas	Level 1* <ul style="list-style-type: none"> Impacts detectable via observational monitoring (e.g. canopy thinning, thinning of shrub layer, minor loss of ground cover) to a single vegetation strata Subsidence impacts (such as surface cracking, rock falls) resulting in small areas of disturbance that will mitigate without CMA 	<ul style="list-style-type: none"> Continue monitoring program Submit an Impact Report to OEH, DoPI, DPI and other relevant resource managers Report in the End of Panel Report Summarise actions and monitoring in AEMR

	<p>Level 2*</p> <ul style="list-style-type: none"> Impacts detectable via observational monitoring (e.g. canopy thinning with dead branches present, thinning of the shrub layer with dead branches, loss of ground cover in multiple areas) to multiple vegetation strata Subsidence impacts (such as surface cracking, rock falls) resulting in small areas of disturbance that will not mitigate without CMA 	<ul style="list-style-type: none"> Actions stated for Level 1 Report trigger to key stakeholders Review monitoring program Notify relevant specialists and develop and implement any CMA required. Implement agreed CMA's as approved <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. impacts to terrestrial with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>
	<p>Level 3*</p> <ul style="list-style-type: none"> Impacts (e.g. canopy thinning with dead branches present, thinning of the shrub layer with dead branches, loss of ground cover in multiple areas) to multiple vegetation strata caused by subsidence effects Subsidence impacts (such as surface cracking, rock falls) resulting in large areas of disturbance that will not mitigate without CMA Negligible environmental consequences to threatened species, populations or EEC 	<ul style="list-style-type: none"> Actions stated for Level 2 Notify OEH, DP&I, DPI, NoW, DRE, relevant resource managers and technical specialists and seek advice on any CMA required. Invite stakeholders for site visit Develop site CMA (subject to stakeholder feedback). This may include: <ul style="list-style-type: none"> Erosion prevention works Establishment of vegetation Completion of works following approvals, including monitoring and reporting on success Review the TARP and Management Plan in consultation with key stakeholders <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. impacts to terrestrial ecology with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>
	<p>Exceeding Performance Measures</p> <ul style="list-style-type: none"> Mining results in more than negligible environmental consequences on threatened species, threatened populations, or endangered ecological communities 	<ul style="list-style-type: none"> Actions stated for Level 3 Investigate reasons for the exceedance Update future predictions based on the outcomes of the investigation Provide environmental offset if CMAs are unsuccessful
ABORIGINAL ARCHAEOLOGY		
<ul style="list-style-type: none"> Impacts to the cliff lines on the southern side of the Nepean River will trigger an inspection of Bradcorp 1 and any sections of the river and creek valleys that have not been surveyed for Aboriginal heritage 	<p>Level 1*</p> <ul style="list-style-type: none"> Change in shelter conditions not attributable to natural weathering or preservation that do not alter the heritage values of the place e.g. mineral growth or micro-organism growth Changes external to shelter conditions that effect the sites context e.g. ground cracking, boulder slumping, rock and/or tree falls 	<ul style="list-style-type: none"> Continue with monitoring program Condition assessment and photographic record Notify relevant specialists and key stakeholders (e.g. Registered Aboriginal Parties) Summarise impacts and report in the End of Panel Report and AEMR
	<p>Level 2*</p> <ul style="list-style-type: none"> Change in shelter conditions not attributable to natural weathering or preservation e.g. change in drip line or seepage, cracking or exfoliation of overhang or shelter, movement or opening of existing planes and joints 	<ul style="list-style-type: none"> Actions stated for Level 1 Review monitoring program Review impacts against the Performance Measures Develop site management plan to mitigate effects in consultation with Registered Aboriginal Parties and the landowner
	<p>Level 3*</p> <ul style="list-style-type: none"> Change in shelter conditions not attributable to natural weathering or preservation e.g. cracking or exfoliation of art panel, movement of existing planes and joints at panel, block fall within shelter or overhang, shelter or overhang collapse 	<ul style="list-style-type: none"> Actions stated for Level 2 Investigate reasons for impacts Update future predictions based on outcomes of the investigation

	<p>Exceeding Performance Measures</p> <ul style="list-style-type: none"> • More than 10% of sites across the mining area are affected by subsidence impacts (other than negligible impacts or environmental consequence) 	<ul style="list-style-type: none"> • <i>Actions stated for Level 3</i> • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation
EUROPEAN HERITAGE		
<ul style="list-style-type: none"> • Douglas Park Railway Cottage – Item 30 from the BSOP EA 	<p>Level 1*</p> <ul style="list-style-type: none"> • Cracks or warping of external weatherboards, • Cracks or movement < 5 mm in width in any external or internal wall claddings, linings, or finish • Isolated cracked, loose, or drummy floor or wall tiles • No impact to heritage values of the site 	<ul style="list-style-type: none"> • Continue monitoring program • Condition assessment and photographic record • Notify relevant specialists and key stakeholders • Summarise impacts and report in the End of Panel Report and AEMR
	<p>Level 2*</p> <ul style="list-style-type: none"> • Continuous cracking or warping of weatherboards, • Slippage along the damp proof course of 5 to 15 mm • Loss of bearing to isolated walls, piers, columns, or other load-bearing elements • Loss of stability of isolated structural elements • Loss of heritage value no greater than predicted in HMP 	<ul style="list-style-type: none"> • <i>Actions stated for Level 1</i> • Review monitoring program • Review impacts against the Performance Measures • Develop site management plan to mitigate effects in consultation with stakeholders, where appropriate
	<p>Level 3*</p> <ul style="list-style-type: none"> • Continuous cracking or warping of weatherboards • Slippage along the damp proof course of 15 mm or greater anywhere in the total external façade • Re-levelling of building • Loss of stability of several structural elements • Loss of heritage value greater than predicted in HMP 	<ul style="list-style-type: none"> • <i>Actions stated for Level 2</i> • Investigate reason for impacts • Notify DP&I and MSB as soon as practicable • Seek advice on any CMA required. • Consultation with stakeholders (undertake site inspection if required). • Review the relevant TARP and Management Plan in consultation with key stakeholders
	<p>Exceeding Performance Measures</p> <ul style="list-style-type: none"> • Loss of heritage value greater than predicted under the Heritage Management Plan 	<ul style="list-style-type: none"> • <i>Actions stated for Level 3</i> • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation

* These may be revised in consultation with DoPE and DT&I and other key stakeholders following analysis of natural variability within the pre-mining baseline data.

Office of Environment and Heritage (OEH)

Department of Planning and Environment (DoPE)

NSW Trade and Investment: including Division of Resources and Energy (DRE), and Fisheries (DPI)

NSW Office of Water (NoW)

Mine Subsidence Board (MSB)