

# METROPOLITAN COAL   LONGWALLS 305-307

## EXTRACTION PLAN



## MAIN TEXT

# **METROPOLITAN COAL**

## **LONGWALLS 305-307**




### **EXTRACTION PLAN**

#### **Revision Status Register**

<b>Section/Page/ Annexure</b>	<b>Revision Number</b>	<b>Amendment/Addition</b>	<b>Distribution</b>	<b>DPIE Approval Date</b>
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**January 2020**

**TITLE BLOCK**

<b>Applicant</b>	Peabody Energy Australia Pty Ltd
<b>Mine</b>	Metropolitan Coal
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<b>Mining Leases</b>	Consolidated Coal Lease 703 Mining Lease 1610 Mining Lease 1702 Coal Lease 379 Mining Purpose Lease 320
<b>Title</b>	Metropolitan Coal Longwalls 305-307 Extraction Plan
<b>Date</b>	30 January 2008
<b>Document Reference Number</b>	EP-R01-B
<b>General Description</b>	Management of potential subsidence effects, subsidence impacts and environmental consequences during the mining of Longwalls 305-307 at Metropolitan Coal
<b>Name of Authorised Representative</b>	Jon Degotardi
<b>Title of Authorised Representative</b>	Technical Services Manager
<b>Signature of Authorised Representative</b>	
<b>Name of Mining Engineering Manager</b>	James Hannigan
<b>Signature of Mining Engineering Manager</b>	
<b>Name of General Manager</b>	Rae O'Brien
<b>Signature of General Manager</b>	
<b>Date of Signatures</b>	30 January 2008

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Appendix E      Built Features Management Plan  
Appendix F      Public Safety Management Plan  
Appendix G      Subsidence Monitoring Program  
Appendix H      Coal Resource Recovery Plan  
Appendix I      Subsidence Report

# 1 OVERVIEW OF THE EXTRACTION PLAN

The Metropolitan Coal Mine (**Metropolitan Coal**) is owned and operated by Helensburgh Coal Pty Ltd which is a wholly owned subsidiary of Peabody Energy Australia Pty Ltd (**Peabody**). It is located adjacent to the township of Helensburgh and approximately 30 km north of Wollongong in New South Wales (**NSW**) (Figure 1). Metropolitan Coal is located within Consolidated Coal Lease (CCL) 703, Mining Lease (**ML**) 1610 and ML 1702. Metropolitan Coal is one of the earliest established and longest continually running coal mining operations in Australia, with a history dating back to the 1880s.

Metropolitan Coal was granted approval for the Metropolitan Coal Project (the **Project**) by the Minister for Planning under section 75J of the NSW *Environmental Planning and Assessment Act, 1979* (**EP&A Act**) on 22 June 2009. A copy of the Project Approval is available on the Peabody website (<http://www.peabodyenergy.com>). The Project comprises the continuation, upgrade and extension of underground coal mining operations and surface facilities at Metropolitan Coal.

The Project involves the extraction of coal by longwall mining methods from the Bulli Seam. The potential environmental consequences of the Project were assessed in the *Metropolitan Coal Project Environmental Assessment* (the **Project EA**) (Helensburgh Coal Pty Ltd [HCPL], 2008) and the *Metropolitan Coal Project Preferred Project Report* (the **Preferred Project Report**) (HCPL, 2009).

Longwalls 305-307 are situated to the west of Longwalls 301-304 and define the next mining sub-domain within the Project underground mining area (Figures 1 and 2).

## 1.1 PURPOSE AND SCOPE

This Extraction Plan outlines the proposed management, mitigation, monitoring and reporting of potential subsidence impacts and environmental consequences in the Project underground mining area during the secondary extraction of Longwalls 305-307 at Metropolitan Coal.

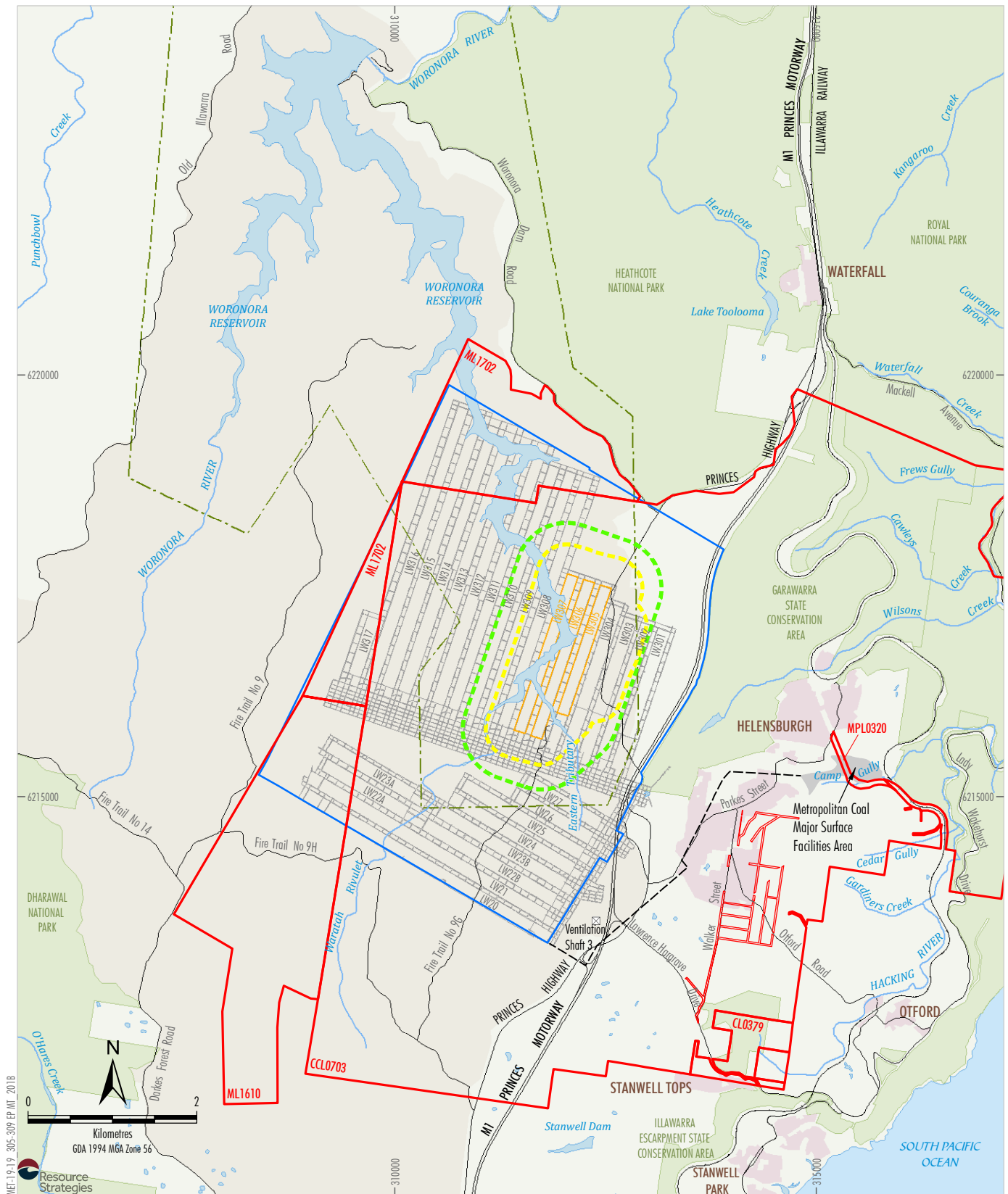
This Extraction Plan has been prepared in consideration of the NSW Department of Planning and Environment (DP&E) (now the NSW Department of Planning, Industry and Environment [**DPIE**]) and NSW Division of Resources and Energy (DRE) (now NSW Division of Resources and Geoscience [**DRG**]) (2015) *Guidelines for the Preparation of Extraction Plans*.

This Extraction Plan includes post-mining monitoring and management of potential subsidence impacts and environmental consequences for Longwalls 20-22, 23-27, 301-303 and 304. This Extraction Plan will supersede the previously approved Metropolitan Coal Longwalls 301-304 Extraction Plans consistent with the recommended approach in the DPE and DRE (2015) *Guidelines for the Preparation of Extraction Plans*.

The objectives of this Extraction Plan are to:

- provide detailed plans of Longwalls 305-307;
- outline potential subsidence effects, subsidence impacts and environmental consequences of Longwalls 305-307;
- describe the measures that will be implemented to manage, mitigate and remediate potential subsidence impacts and environmental consequences during the mining of Longwalls 305-307;
- detail the monitoring of subsidence effects, subsidence impacts and environmental consequences during the mining of Longwalls 305-307; and
- provide a contingency plan for subsidence impacts and environmental consequences in relation to the Project's subsidence impact performance measures.

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#### LEGEND

- Mining Lease Boundary
- Woronora Special Area
- Railway
- Project Underground Mining Area  
Longwalls 20-27 and 301-317
- Longwalls 305-307 Secondary Extraction
- Longwalls 305-307 35° Angle of Draw and/or  
Predicted 20 mm Subsidence Contour
- 600 m from Longwalls 305-307  
Secondary Extraction
- Woronora Notification Area
- Existing Underground Access Drive (Main Drift)

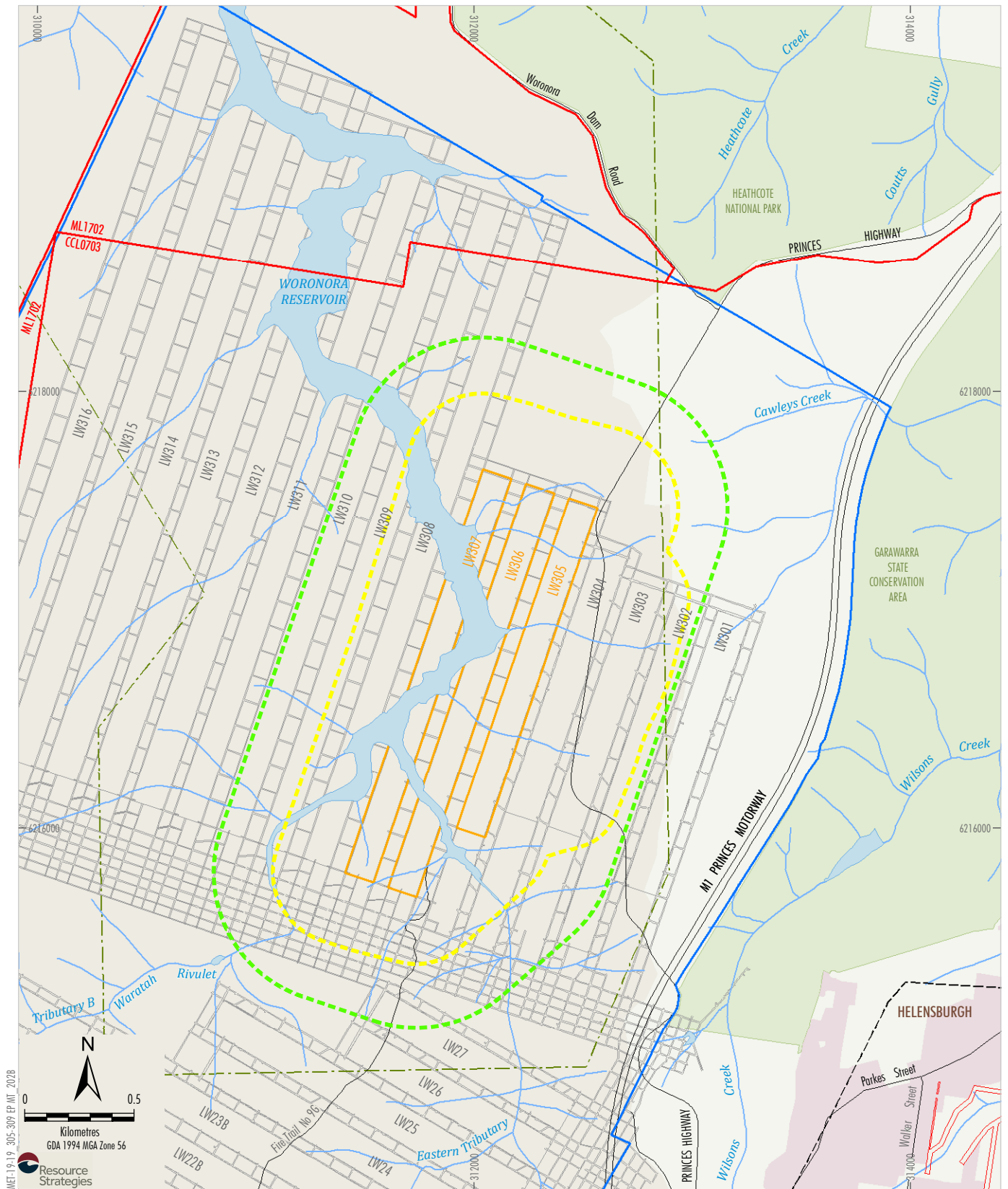
Source: Land and Property Information (2015); Department of Industry (2015);  
Metropolitan Coal (2019); MSEC (2019)

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Longwalls 305-307 and  
Project Underground Mining Area

**Figure 1**



#### LEGEND

- Mining Lease Boundary
- Woronora Special Area
- Project Underground Mining Area  
Longwalls 20-27 and 301-317
- Longwalls 305-307 Secondary Extraction
- - - Longwalls 305-307 35° Angle of Draw and/or  
Predicted 20 mm Subsidence Contour
- - - 600 m from Longwalls 305-307  
Secondary Extraction
- - - Woronora Notification Area
- - - Existing Underground Access Drive (Main Drift)

Source: Land and Property Information (2015); Department of Industry (2015);  
Metropolitan Coal (2019); MSEC (2019)

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Longwalls 305-307 Layout

Figure 2

The Extraction Plan area for Longwalls 305-307, based on a 35 degree (°) angle of draw and/or predicted 20 millimetre (mm) subsidence contour, is shown on Figures 1 and 2.

This Extraction Plan has been prepared by Metropolitan Coal with assistance from a team of suitably qualified and experienced persons including Mine Subsidence Engineering Consultants (MSEC), SLR Consulting, Hydro Engineering & Consulting, Associate Professor Barry Noller, Ecoplanning, Cenwest Environmental Services, Bio-Analysis, Niche Environment and Heritage, and Resource Strategies.

This Extraction Plan forms part of Metropolitan Coal's Environmental Management Strategy. The relationship of this Extraction Plan to the Metropolitan Coal Environmental Management Structure is shown on Figure 3.

### 1.1.1 Statutory Requirements

This Extraction Plan has been prepared in accordance with the conditions of the Project Approval (08\_0149) and in consideration of the DPE and DRE (2015) *Guidelines for the Preparation of Extraction Plans*.

The statutory requirements relevant to this Extraction Plan are summarised below.

#### ***Project Approval (08\_0149)***

This Extraction Plan has been prepared in accordance with Conditions 6 and 7, Schedule 3 of the Project Approval. The requirements of Conditions 6 and 7, Schedule 3 of the Project Approval are summarised in Table 1, along with the relevant section of this Extraction Plan in which the requirements are addressed.

Further detail on the requirements of the Project Approval is provided in Attachment 1.

**Table 1**  
**Extraction Plan Requirements**

<b>Project Approval (08_0149) Condition</b>	<b>Extraction Plan Reference</b>
<b><i>Condition 6, Schedule 3</i></b>	
6. The Proponent shall prepare and implement an Extraction Plan for all second workings in the mining area to the satisfaction of the Director-General <sup>[1]</sup> . This plan must:	This document
(a) be prepared by a team of suitably qualified experts whose appointment has been endorsed by the Director-General;	Section 1.1
(b) be approved by the Director-General before the Proponent is allowed to carry out the second workings covered by the Extraction Plan;	Section 1.1
(c) include a detailed plan for the second workings, which has been prepared to the satisfaction of DRE <sup>[2]</sup> , and provides for adaptive management (from Longwall 23 onwards);	Section 1.3 and Appendix H
(d) include detailed plans of any associated surface construction works;	Section 3 and Appendix G
(e) include the following to the satisfaction of DRE <sup>[2]</sup> :	
• a coal resource recovery plan that demonstrates effective recovery of the available resource;	Appendix H
• revised predictions of the conventional and non-conventional subsidence effects and subsidence impacts of the extraction plan, incorporating any relevant information that has been obtained since this approval; and	Appendix I

<b>Project Approval (08_0149) Condition</b>	<b>Extraction Plan Reference</b>
<p><b>Condition 6, Schedule 3 (Continued)</b></p> <ul style="list-style-type: none"> <li>• a Subsidence Monitoring Program to:               <ul style="list-style-type: none"> <li>- validate the subsidence predictions; and</li> <li>- analyse the relationship between the subsidence effects and subsidence impacts of the Extraction Plan and any ensuing environmental consequences;</li> </ul> </li> <li>(f) include a:               <ul style="list-style-type: none"> <li>• Water Management Plan, which has been prepared in consultation with OEH, SCA<sup>[3]</sup> and NOW<sup>[4]</sup>, to manage the environmental consequences of the Extraction Plan on watercourses (including the Woronora Reservoir), aquifers and catchment yield;</li> <li>• Biodiversity Management Plan, which has been prepared in consultation with OEH and DRE (Fisheries)<sup>[5]</sup>, to manage the potential environmental consequences of the Extraction Plan on aquatic and terrestrial flora and fauna, with a specific focus on swamps;</li> <li>• Land Management Plan, which has been prepared in consultation with SCA<sup>[3]</sup>, to manage the potential environmental consequences of the Extraction Plan on cliffs, overhangs, steep slopes and land in general;</li> <li>• Heritage Management Plan, which has been prepared in consultation with OEH and the relevant Aboriginal groups, to manage the potential environmental consequences of the Extraction Plan on heritage sites or values;</li> <li>• Built Features Management Plan, which has been prepared in consultation with the owner of the relevant feature, to manage the potential environmental consequences of the Extraction Plan on any built features; and</li> </ul> </li> <li>(g) include a Public Safety Management Plan, which has been prepared in consultation with DRE<sup>[2]</sup> (for any mining within the DSC notification area), to ensure public safety in the mining area.</li> </ul> <p><i>Note: In accordance with condition 12 of schedule 2, the preparation and implementation of Extraction Plans for second workings may be staged, with each plan covering a defined area of second workings. In addition, these plans are only required to contain management plans that are relevant to the specific second workings that are being carried out.</i></p>	<p>Appendix G</p>       <p>Appendix A</p>       <p>Appendix C</p>       <p>Appendix B</p>       <p>Appendix D</p>       <p>Appendix E</p>       <p>Appendix F</p>
<p><b>Condition 7, Schedule 3</b></p> <p>7. In addition to standard requirements for management plans (see condition 2 of schedule 7), the Proponent shall ensure that the management plans required under condition 6(f) above include:</p> <ul style="list-style-type: none"> <li>(a) a program to collect sufficient baseline data for future Extraction Plans;</li> <li>(b) a revised assessment of the potential environmental consequences of the Extraction Plan, incorporating any relevant information that has been obtained since this approval;</li> <li>(c) a detailed description of the measures that would be implemented to remediate predicted impacts; and</li> <li>(d) a contingency plan that expressly provides for adaptive management.</li> </ul>	<p>Appendices A to E, Attachment 3</p>       <p>Appendices A to F, Appendix I</p>       <p>Appendices A to F, Section 3</p>       <p>Appendices A to F, Section 4.1</p>

<sup>5</sup> DRE (Fisheries) is now the Department of Primary Industries – Fisheries (DPI-Fisheries).



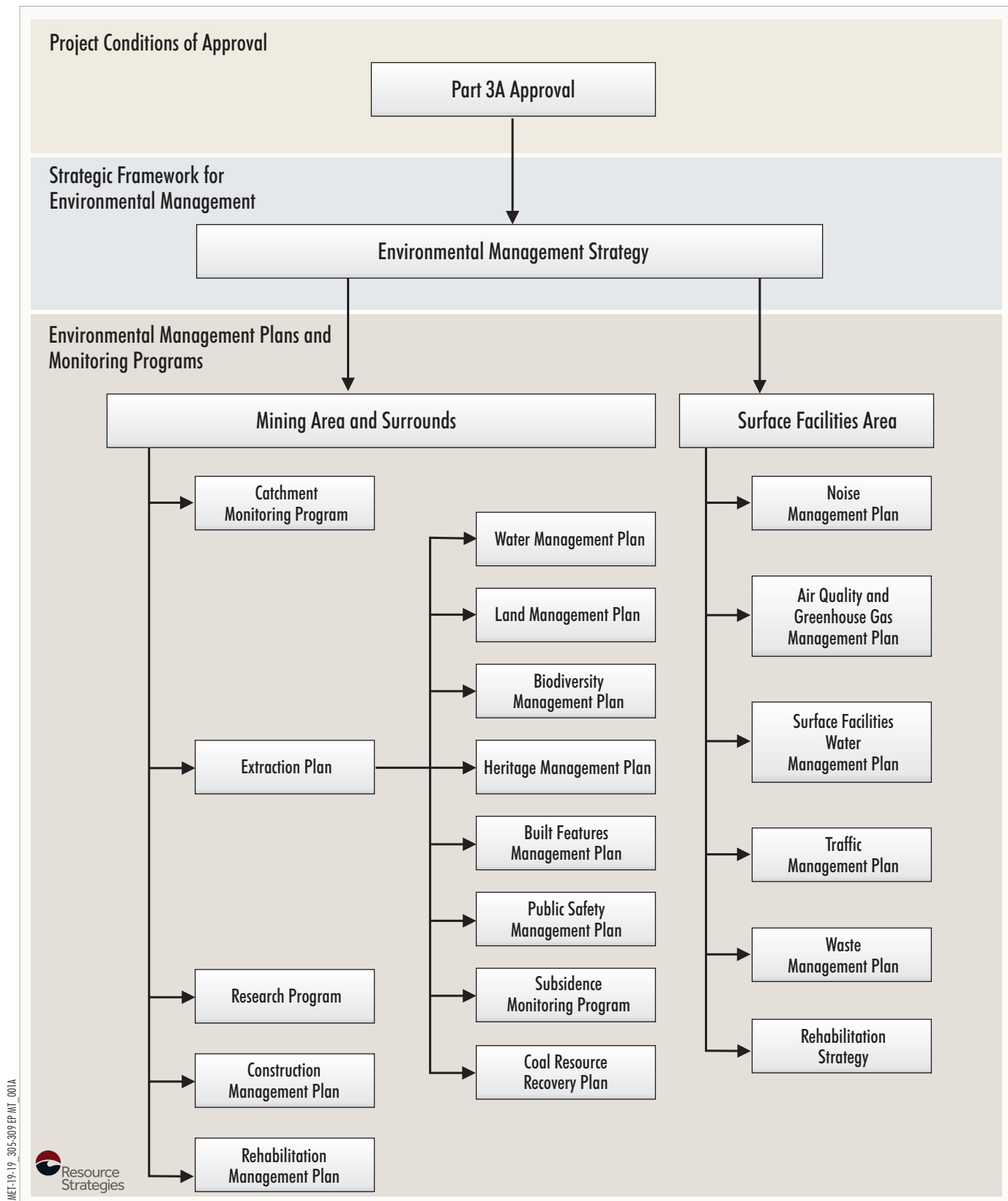


Figure 3

## Licences, Permits and Leases

In addition to the Project Approval, all activities at or in association with Metropolitan Coal will be undertaken in accordance with the following licences, permits and leases which have been issued or are pending.

- The conditions of mining leases issued by the DRG, under the *NSW Mining Act, 1992* (e.g. CCL 703, ML 1610, ML 1702, Coal Lease (**CL**) 379 and Mining Purpose Lease (**MPL**) 320).
- The *Metropolitan Coal Mining Operations Plan 1 October 2012 to 30 September 2019* approved by the DRE.
- The conditions of Environment Protection Licence (**EPL**) No. 767 issued by the NSW Environment Protection Authority (**EPA**) under the *NSW Protection of the Environment Operations Act, 1997*. Revision of the EPL will be required prior to the commencement of Metropolitan Coal activities that differ from those currently licensed.
- The prescribed conditions of specific surface access leases within CCL 703 for the installation of surface facilities as required.
- Water Access Licences (**WALs**) issued by the NSW Department of Planning, Industry and Environment – Water (DPIE - Water) (formerly the Department of Industry - Water) under the *NSW Water Management Act, 2000*, including WAL 36475 under the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011* and WAL 25410 under the *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011*.
- Mining and workplace health and safety related approvals granted by the NSW Resources Regulator and WorkCover NSW.
- Supplementary approvals obtained from WaterNSW for surface activities within the Woronora Special Area (e.g. fire road maintenance activities).

## 1.2 STRUCTURE OF THE EXTRACTION PLAN

This Extraction Plan comprises a main text component (with Attachments) and supporting management plans and studies, which include Appendices A through to I. An overview of the Extraction Plan main text sections and Attachments is presented below:

Section 1	Provides an overview of the Extraction Plan, including a description of the purpose and scope of the Extraction Plan and a summary of the mine plan and design, subsidence predictions, subsidence impact performance measures and subsidence management approach.
Section 2	Describes the process of development of the Extraction Plan, including the conduct of risk assessments, the review of relevant information obtained since Project Approval, the update and review of predicted subsidence effects and potential subsidence impacts and environmental consequences, and a summary of consultation conducted with key stakeholders.
Section 3	Describes the measures that will be implemented to manage, mitigate, remediate and monitor potential subsidence impacts and environmental consequences on natural and built features.
Section 4	Outlines the key elements of plan implementation, including reporting, regular review and key responsibilities.
Section 5	Lists the references cited in Sections 1 to 4 of this Extraction Plan.

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- Attachment 1 Outlines the relevant requirements under the Project Approval and provides the relevant section of this Extraction Plan where the requirements are addressed.
- Attachment 2 Provides Metropolitan Coal's consultation to date for the Extraction Plan.
- Attachment 3 Provides details of a program to collect baseline data for the next Extraction Plan.
- Attachment 4 Provides a key contact register for the Extraction Plan.

Appendices A to H contain component management and monitoring plans of the Extraction Plan, and Appendix I contains the MSEC (2019) *Metropolitan Mine – Longwalls 305-307 Subsidence Predictions and Impact Assessments for the Natural and Built Features in Support of the Extraction Plan*. Appendices A to I are listed below:

- Appendix A Water Management Plan (WMP).
- Appendix B Land Management Plan (LMP).
- Appendix C Biodiversity Management Plan (BMP).
- Appendix D Heritage Management Plan (HMP).
- Appendix E Built Features Management Plan (BFMP).
- Appendix F Public Safety Management Plan (PSMP).
- Appendix G Subsidence Monitoring Program (SMP).
- Appendix H Coal Resource Recovery Plan (CRRP).
- Appendix I Subsidence Report.

The following graphical plans have been prepared in accordance with the DPE and DRE (2015) *Guidelines for the Preparation of Extraction Plans*:

- Plan 1 Existing, Proposed and Future Workings.
- Plan 2 Longwalls 305-307 Surface Features.
- Plan 3 Geological and Seam Data.
- Plan 5 Mining Titles and Land Ownership.
- Plan 6 Geological Section and Geotechnical Logs.
- Plan 7 Subsidence Monitoring Locations.

Plans 1, 2, 3, 5 and 6 are provided in Attachment 1 of the CRRP (Appendix H).

As there are currently no existing and/or planned future workings in seams above and/or below the proposed workings, Plan 4 (referred to in the DPE and DRE (2015) *Guidelines for the Preparation of Extraction Plans*) has not been prepared.

Plan 7 is provided in Attachment 1 of the SMP (Appendix G).

### 1.3 MINE PLANNING AND DESIGN

#### 1.3.1 Geology and Stratigraphy

Metropolitan Coal is located within the Southern Coalfield, within the southern part of the Sydney Basin, which is infilled with sedimentary rocks of Permian age (<270 million years ago) and of Triassic age (<225 million years ago) (HCPL, 2008).

Three formally named coal seams of the Illawarra Coal Measures are present in the Southern Coalfield, namely the Bulli, Balgownie and Wongawilli Seams (HCPL, 2008).

Immediately overlying the Bulli Coal unit of the Illawarra Coal Measures are sandstones and claystones of the Narrabeen Group. The Narrabeen Group contains the Newport Formation (sometimes referred to as the Gosford Formation), the Bald Hill Claystone (also referred to as Chocolate Shale and formed as a result of laterite weathering Gerringong Volcanics), the Bulgo Sandstone, the Stanwell Park Claystone/Shale, the Scarborough Sandstone, the Wombarra Shale and the Coal Cliff Sandstone. At the top of the sequence in the area of interest is the Hawkesbury Sandstone (HCPL, 2008).

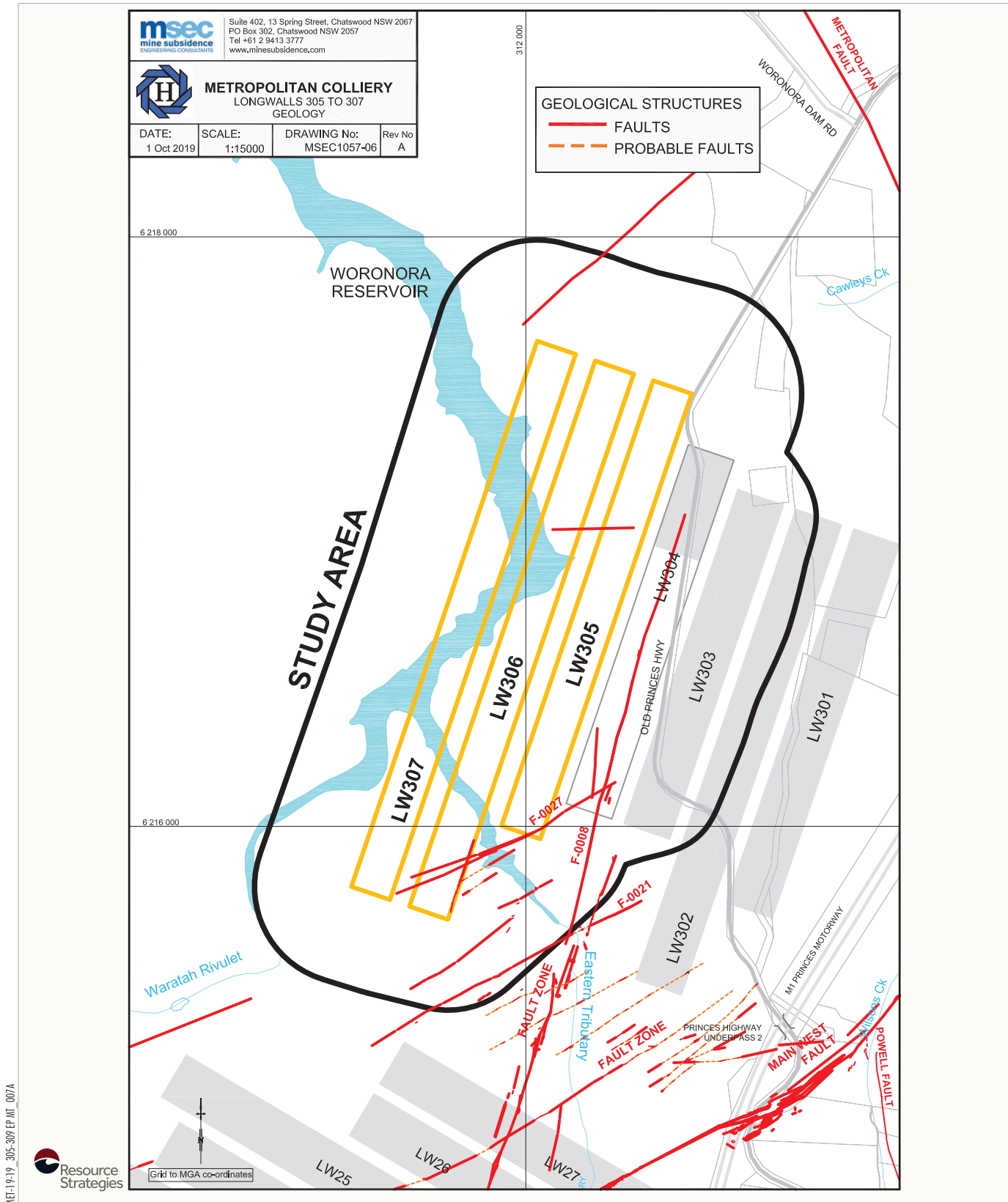
The Independent Expert Panel for Mining in the Catchment (IEPMC)<sup>1</sup> *Initial Report on Specific Mining Activities at the Metropolitan and Dendrobium Coal Mines* (IEPMC, 2018) (herein referred to as the IEPMC Initial Report) indicates that in recent years it has been identified in the Western Coalfield that surface subsidence, groundwater and surface water responses to longwall mining can be significantly modified in the vicinity of lineaments. Drawing comparisons of lineament behaviour between two geographically separated regions is problematic given the degree of variables potentially present. Depth to the basement rock is a variable with likely substantive influence on behaviour of lineaments and markedly different between the Western and Southern Coalfields (Appendix H).

Many features of the NSW Coalfields surface topography are directly correlated to the basement structure, the depth of the basement from the surface through many sedimentary epochs and the deformational episodes of the basement rock. The Palaeozoic granite basement rock underlies the Sydney Basin sedimentary rocks. At Metropolitan Coal the total depth of Sydney Basin sedimentation is 2.3 km (Appendix H). The major geological features mapped at seam level are shown on Figure 4.

Surface lineaments are linear features in the surface landscape, preferentially eroded, that may be the surface expression of an underlying geological structure, fault or dyke or simply a result of surface joint sets. Lineaments are identified from aerial photography, LiDAR and from digital topographic sets. Lineaments mapped by Metropolitan Coal are shown on Figure 5. Additional LiDAR mapping was conducted by Metropolitan Coal in July/August 2019 to identify any new linear features within the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour. The 2019 LiDAR review confirmed the existing lineament mapping analysis.

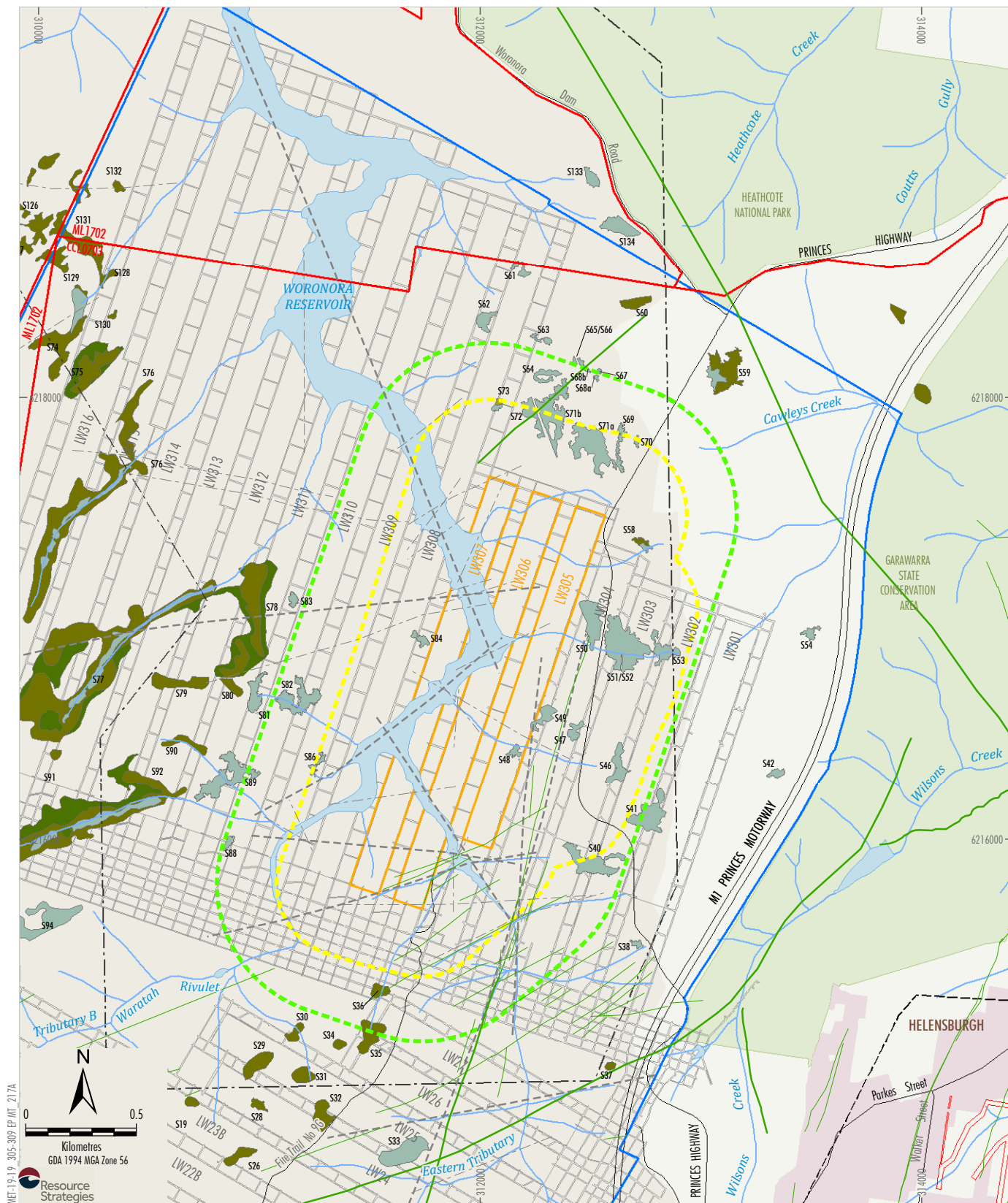
Longwalls 305-307 are located approximately 900 metres (m) south-west of the Metropolitan Fault. The Metropolitan Fault has a north-northwest to south-southeast strike and dips to the south-west (Appendix H).

<sup>1</sup> The IEPMC was established in November 2017 by the NSW Government to provide expert advice to the DPIE on the impact of mining activities in the Greater Sydney Water Catchment Special Areas, with a focus on risks to the quantity of water in the catchment.



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Longwalls 305-307 Geological Structures  
Identified at Seam Level

Figure 4



#### LEGEND

- Mining Lease Boundary
- Woronora Special Area
- Project Underground Mining Area
- Longwalls 20-27 and 301-317
- Longwalls 305-307 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Longwalls 305-307
- Secondary Extraction
- Woronora Notification Area
- Existing Underground Access Drive (Main Drift)
- Faults and Dykes (vertical displacement > 1m)
- Faults and Dykes (vertical displacement < 1m)
- Lineament (prominent)
- Lineament (minor)

#### Map Unit

- 3a Upland Swamp: Banksia Thicket
- 3b Upland Swamps: Tea Tree Thicket
- 3c Upland Swamp: Sedgeland-heath Complex
- 3d Upland Swamp: Fringing Eucalypt Woodland

Note: 1. The NSW Native Vegetation Interim Type Standard 2009 requires patches of vegetation to be mapped if the dimensions of the representative polygon on a map sheet are 2 mm x 2 mm or greater (i.e. 0.25 hectares or greater at a scale of 1:25,000). Eco Logical Australia conducted field inspections of upland swamp vegetation previously mapped by Bangalay Botanical Surveys (2008) overlying or proximal to Longwalls 301-310 to confirm the upland swamp vegetation communities present and to confirm or update the swamp vegetation boundaries. It is noted that the revised boundaries of a number of upland swamps (Swamps 37, 38, 42, 48, 54, 58, 61, 63, 65/66, 67, 68a, 68b, 70, 73, 83, 86 and 88) are less than 0.25 hectares in area and consistent with NSW vegetation mapping guidelines are not required to be mapped. Notwithstanding, the revised swamp vegetation mapping boundaries (including those swamps less than 0.25 hectares in area) are shown on this figure to document the changes to previous vegetation mapping.

Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019); after NPWS (2003), Bangalay Botanical Surveys (2008) and Eco Logical Australia (2015; 2016; 2018)

**Peabody**

**METROPOLITAN COAL**  
Known Lineaments over Longwalls 305-307 and Surrounds

**Figure 5**

A strike slip fault, F0008 (Figure 4), with up to 1.2 m vertical displacement occurs over Longwalls 20-27, and this fault extends partially through Longwall 304. This fault is associated with a surface linear that aligns with the Eastern Tributary and then passes east of the Woronora Reservoir full supply level dissipating into the landscape (Figure 5). Longwall 20 through 27 were extracted through this feature directly under the Eastern Tributary with no moisture evident at seam level and no change in mine water balance during the seven years of extraction in the area. At the time of writing, Longwall 304 extraction had not intercepted F0008 projected extents.

A strike slip fault, F0027, with zero vertical displacement, has been mapped in the gate roads leading into Longwall 304 and 305 and is projected to be in the extraction area of Longwall 306. The associated surface linear is located approximately 250 m west of the end of the Eastern Tributary arm of Woronora Reservoir full supply level. No moisture has been evident where F0027 structures intersects the seam.

A risk assessment workshop was held on 19 July 2019 to assess the potential for mining effects on geological features to impact on the quantity of water available to the Woronora Reservoir. The outcomes of the risk assessment are described in Section 2.1.2 and provided in Appendix H.

### 1.3.2 Mining Geometry

During the NSW Government's assessment phase of the Project EA (HCPL, 2008), and in recognition of concerns raised by key stakeholders during the formal Planning Assessment Commission (PAC) assessment process, Metropolitan Coal considered it appropriate to reduce the proposed extent of the original Project longwall mining area (i.e. Longwalls 20-44).

The Project Approval granted by the Minister for Planning in June 2009 included a layout for Longwalls 301-317 referred to as the Preferred Project Layout (as described in the Preferred Project Report [HCPL, 2009]). Longwalls 301-317 included in the Preferred Project Layout comprised 163 m panel widths (void) with 45 m pillars (solid) beyond 500 m from the Woronora Reservoir, and 138 m panel widths (void) with 70 m pillars (solid) within 500 m of the Woronora Reservoir.

Following further mine planning investigations, Metropolitan Coal identified that significant operational efficiencies and consequently a significant economic benefit would be achieved by rotating the first workings of Longwalls 301-317 to be square with the 300 Mains (a rotation of approximately six degrees). The Secretary of the DPE approved the revised first workings in accordance with Condition 5, Schedule 3 of the Project Approval in April 2015.

Subsequently, Metropolitan Coal proposed to consolidate the panel and chain pillar widths of Longwalls 301-304 to 163 m (void) panel widths and 45 m wide pillars (solid). Changes to the first workings of Longwalls 301-303 and Longwall 304 were approved by the DPE in May 2016 and November 2018, respectively.

During the stakeholder consultation phase for the Metropolitan Coal Longwalls 301-303 Extraction Plan, an agreed subsidence parameter was developed with Garrawarra (NSW Health) to keep the active dementia care buildings at or below the 20 mm vertical subsidence contour and minimise the chance of cracking to these health facilities. This design principle has been applied to the Longwalls 305 and 306 northern starting positions. The Longwall 307 starting position has been set based on seam thickness and coal quality considerations.

Consistent with the precautionary approach adopted for Longwall 303 and Longwall 304, the finishing end (southern end) of Longwall 305 was shortened to reduce predicted valley closure on the Eastern Tributary.

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Following submission of the Longwalls 305-307 Extraction Plan in October 2019, Metropolitan Coal requested approval from the Secretary of the DPIE for a revision of the Longwalls 305 and 306 first working layout<sup>2</sup>. The revised layout includes a reduction to the panel (void) lengths of Longwall 305 (from 1,596 metres [m] to 1,547 m) and Longwall 306 (from 1,956 m to 1,907 m) and associated changes to the cut-through positions for the Longwalls 305 and 306 maingates. The revised layout of Longwalls 305 and 306 did not change the panel widths, pillar widths or panel orientation

The revised layout of Longwalls 305-307 is shown on Plan 1 of Attachment 1 in Appendix H. A summary of the longwall dimensions for Longwalls 305-307 is provided in Table 2. The Longwall 305 layout includes a 138 m panel width (void), a 45 m tailgate pillar width and a 70 m maingate pillar width. The layout of Longwalls 306 and 307 includes 138 m panel widths (void) and 70 m pillars (solid) consistent with the Preferred Project Layout.

**Table 2**  
**Summary of Longwall Dimensions for Longwalls 305-307**

Longwall	Longwall Length (m)	Total Void Width (m)	Tailgate Chain Pillar Width (m)
LW305	1,547	138	45
LW306	1,907	138	70
LW307	1,956	138	70

Metropolitan Coal notes that Figures 1 to 22, and the figures included in the Longwalls 305-307 component management and monitoring plans (i.e. Appendices A to H) show the original layout of Longwalls 305 and 306 (i.e. Longwalls 305 and 306 panel [void] lengths of 1,596 m and 1,956 m, respectively). The revised Longwalls 305-307 layout would not result in any new or increased impacts, and would result in a reduction in subsidence impacts at the northern end of the longwall panels, compared to the layout shown in this Extraction Plan.

Plan 1 in Attachment 1 of Appendix H show existing Metropolitan Coal longwalls located within 500 m of Longwalls 305-307, as well as future longwalls (i.e. Longwalls 308 on).

### 1.3.3 Mining Method

Longwalls 305-307 extraction will occur from north to south. Longwalls 305-307 will be extracted using retreating longwall mining methods for secondary extraction of a panel with a 138 m void width. The longwall panel will be formed by driving two sets of gate roads (the tailgate and maingate roads). Each gate road requires two roadways (headings) to be driven parallel to each other. The two roadways will be used for ventilation purposes, with one of the roadways utilised as a transport road and the other roadway used to convey the coal that will be mined back to the main conveyors. Construction of development main headings and gate roads are mined using continuous miners.

The dimensions of the headings will be approximately 5.2 m wide and 3.2 m in height. The headings are connected approximately every 120 m by driving a cut-through from one heading to another which forms pillars of coal along the length of the gate road. The tailgate and maingate roads are separated by the 133 m wide longwall panel (measured between roadway centrelines). The maingate roads and tailgate roads are then linked together by driving an installation road and bleeder road at the top end of the longwall panels. Run-of-mine (ROM) coal will be conveyed by the maingate conveyor to the main conveyor which will carry coal to the surface of the mine.

<sup>2</sup> Correspondence to the DPIE (dated 15 January 2020) incorrectly stated that Longwalls 305 and 306 would reduce in length to 1,544 m and 1,904 m, respectively,



### 1.3.4 Mining Parameters

The Extraction Plan area and proposed mine plan is shown on Plan 1 of Attachment 1 in Appendix H and key dimensions are summarised in Table 3.

**Table 3**  
**Key Mining Parameters**

Parameter	Longwalls 305-307
ROM Coal Extracted (Mt)	Approx. 3.4
Gate Road Width (m)	5.2
Gate Road Height (m)	3.2
Maingate Chain Pillar Width (m)	70
Tailgate Chain Pillar Width (m)	45 (LW305), 70 (LW306 and LW307)
Longwall Void Width (m) (ribline of goaf edge)	138
Longwall Void Length (m)	1,547 (LW305), 1,907 (LW306), 1,956 (LW307)
Seam Thickness (m)	2.6 – 2.9
Extraction Height (m)	Up to 3.2
Depth of Cover (m)	410 – 535

Mt = million tonnes.

### 1.3.5 Mining Schedule

Metropolitan Coal operates seven days a week, 24 hours a day on a rotating shift basis. The extraction of Longwalls 1 to 303 is complete, with extraction of Longwall 304 underway.

The provisional extraction schedule for Longwalls 305-307 is provided in Table 4.

**Table 4**  
**Provisional Extraction Schedule**

Longwall	Estimated Start Date	Estimated Duration	Estimated Completion Date
Longwall 305	March 2020	7 Months	October 2020
Longwall 306	November 2020	8 Months	July 2021
Longwall 307	August 2021	8 Months	April 2022

The future Extraction Plans will consider the cumulative subsidence effects, subsidence impacts and/or environmental consequences. Note that the total cumulative predicted subsidence effects, subsidence impacts and/or environmental consequences at the completion of the Project are considered in the Project EA (HCPL, 2008) and the Preferred Project Report (HCPL, 2009).

### 1.3.6 Previous and Future Mining

Mining at Metropolitan Coal commenced in the 1880s after the Bulli Seam was identified during exploration in 1884. Prior to the commencement of longwall mining in 1995, bord and pillar underground mining methods were primarily employed.

Previous longwall mining areas at Metropolitan Coal are located to the east and south of Longwalls 305-307 and include Longwalls 1-18, Longwalls 20-27 and Longwalls 301-304. Extraction of Longwalls 1-18 commenced in 1995 and was completed in 2009. Extraction of Longwalls 20-27 commenced in 2010 and was completed in early 2017. Extraction of Longwalls 301-303 commenced in mid-2017 and was completed in May 2019. Extraction of Longwall 304 commenced in July 2019 and is scheduled to be completed in December 2019. The location of historic and previous mining at Metropolitan Coal is shown on Plan 1 in Attachment 1 of the CRRP (Appendix H).

The current layout of Longwalls 308-317 is shown on Figure 1 in this document, and on Plan 1 in Attachment 1 of the CRRP (Appendix H) and includes narrow longwalls (138 m wide) beneath and within 500 m of the Woronora Reservoir.

The layouts of Longwalls 308-317 will however be subject to further review for future Extraction Plans in consideration of potential subsidence impacts and environmental consequences.

Currently there are no plans for mining other coal seams (i.e. other than the Bulli Seam) at Metropolitan Coal.

#### 1.4 SUBSIDENCE PREDICTIONS

Revised predictions of subsidence effects for Longwalls 305-307 were developed by MSEC (2019) (Appendix I). The process for the development of these predictions is described in Section 2.3.1.

##### ***Predicted Conventional Subsidence Movements***

MSEC (2019) provides a detailed description of the development of mine subsidence and the method used to predict the mine subsidence movements resulting from the extraction of Longwalls 305-307. The report includes the maximum predicted conventional subsidence parameters for Longwalls 305-307 including:

- Incremental Subsidence Parameters, which are the predicted subsidence parameters due to the extraction of Longwalls 305-307.
- Total Subsidence Parameters, which include the accumulated subsidence parameters after the completion of a series of longwalls.

The maximum predicted incremental and total subsidence, tilt and curvatures for Longwalls 305-307 are summarised in Table 5. Figure 6 provides the predicted total subsidence contours after Longwalls 305-307 extraction.

**Table 5**  
**Maximum Predicted Subsidence, Tilt and Curvature for Longwalls 305-307**

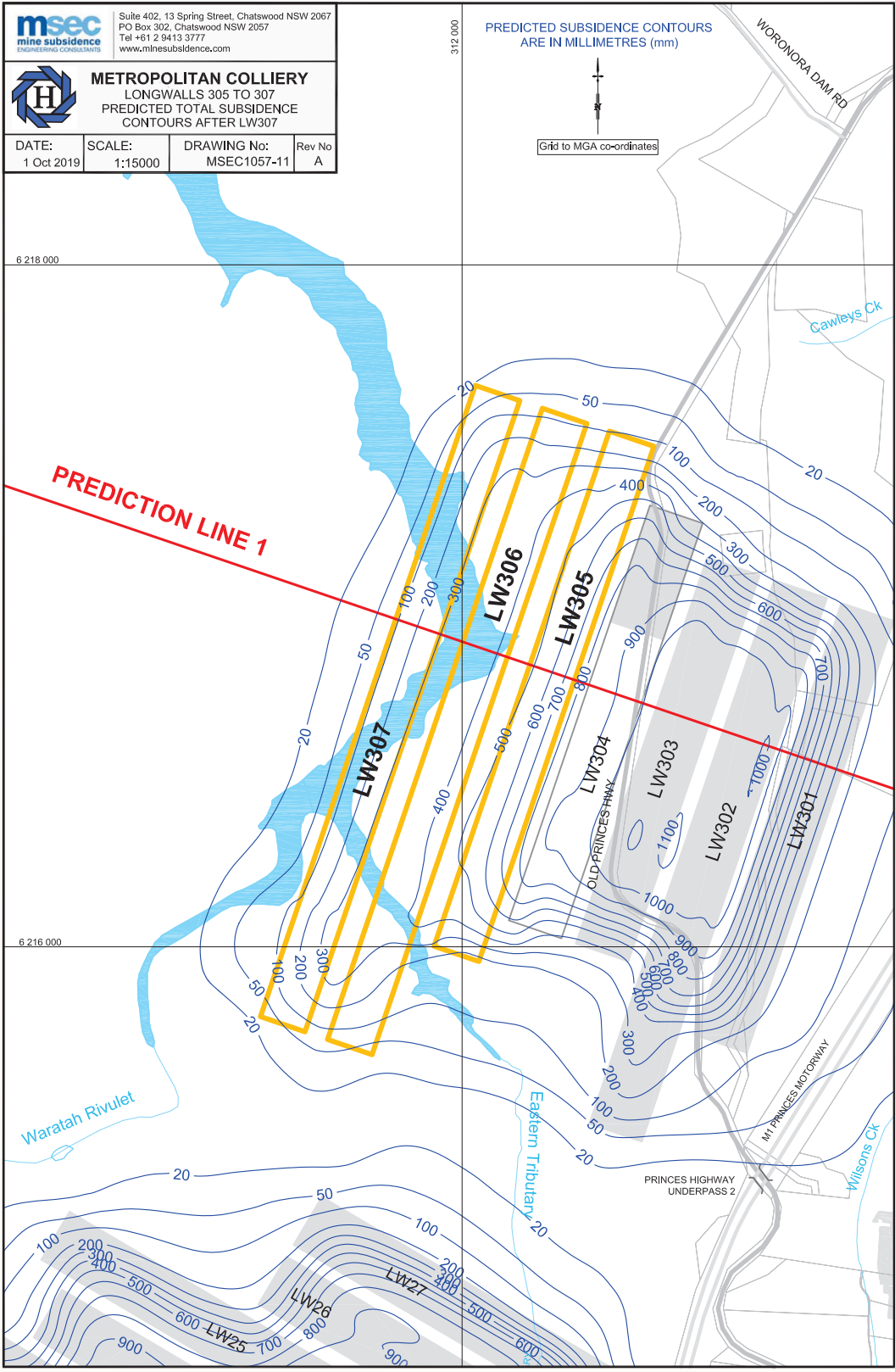
Subsidence Parameter	Incremental Subsidence Predictions			Total Subsidence Predictions (after LW305-307)
	Longwall 305	Longwall 306	Longwall 307	
Maximum Subsidence (m)	0.525	0.3	0.275	1.1
Maximum Tilt (mm/m)	4.0	2.0	2.0	4.5
Maximum Hogging Curvature (km <sup>-1</sup> )	0.05	0.04	0.04	0.06
Maximum Sagging Curvature (km <sup>-1</sup> )	0.1	0.07	0.07	0.09

Source: after MSEC (2019) (Appendix I).

mm/m = millimetres per metre.

km<sup>-1</sup> = 1/kilometres.

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Figure 6

The predictions of conventional subsidence parameters do not include the valley related upsidence and closure movements.

### **Non-Conventional Ground Movements**

MSEC (2019) (Appendix I) considers it likely that non-conventional ground movements will occur due to near surface geological conditions, steep topography and valley related movements, which are often accompanied by elevated tilts and curvatures. The potential subsidence impacts from non-conventional subsidence movements are described for natural and built features in Appendix I.

In most cases, it is not possible to predict the exact locations or magnitudes of the non-conventional anomalous movements due to near surface geological conditions. For this reason, the strain predictions provided in Appendix I are based on a statistical analysis of measured strains in the Southern Coalfield, including both conventional and non-conventional anomalous strains.

### **Predicted Far-Field Movements**

Based on an empirical model for the Southern Coalfield, MSEC (2019) (Appendix I) concluded that the predicted far-field horizontal movements resulting from Longwalls 305-307 extraction are very small and could only be detected by precise surveys. While the impacts of far-field horizontal movements on natural and built features within the vicinity of Longwalls 305-307 are not expected to be significant, there are structures which are sensitive to small differential movements, including transmission towers and road bridges to the east of Longwall 301 (Appendix I). The BFMP (Appendix E) has been developed to manage the potential impact of far-field movements on sensitive infrastructure.

## **1.5 SUBSIDENCE IMPACT PERFORMANCE MEASURES**

The Project Approval requires Metropolitan Coal not to exceed the subsidence impact performance measures outlined in Table 1 of Condition 1, Schedule 3. The subsidence impact performance measures are detailed in Table 6.

**Table 6**  
**Subsidence Impact Performance Measures**

<b>Water Resources</b>	
<i>Catchment yield to the Woronora Reservoir</i>	<i>Negligible reduction to the quality or quantity of water resources reaching the Woronora Reservoir</i> <i>No connective cracking between the surface and the mine</i>
<i>Woronora Reservoir</i>	<i>Negligible leakage from the Woronora Reservoir</i> <i>Negligible reduction in the water quality of Woronora Reservoir</i>
<b>Watercourses</b>	
<i>Waratah Rivulet between the full supply level of the Woronora Reservoir and the maingate of Longwall 23 (upstream of Pool P)</i>	<i>Negligible environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases)</i>
<i>Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26</i>	<i>Negligible environmental consequences over at least 70% of the stream length (that is no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining and minimal gas releases)</i>
<b>Biodiversity</b>	
<i>Threatened species, populations, or ecological communities</i>	<i>Negligible impact</i>
<i>Swamps 76, 77 and 92</i>	<i>Set through condition 4 below</i>

**Table 6 (Continued)**  
**Subsidence Impact Performance Measures**

<b>Land</b>	
<i>Cliffs</i>	<i>Less than 3% of the total length of cliffs (and associated overhangs) within the mining area experience mining-induced rock fall</i>
<b>Heritage</b>	
<i>Aboriginal heritage sites</i>	<i>Less than 10% of Aboriginal heritage sites within the mining area are affected by subsidence impacts</i>
<i>Items of historical or heritage significance at the Garrawarra Centre</i>	<i>Negligible damage (that is fine or hairline cracks that do not require repair), unless the owner of the item and the appropriate heritage authority agree otherwise in writing.</i>
<b>Built Features</b>	
<i>Built features</i>	<i>Safe, serviceable and repairable, unless the owner agrees otherwise in writing</i>

## 1.6 SUBSIDENCE MANAGEMENT APPROACH

Potential environmental consequences during the mining of Longwalls 305-307 will be managed in accordance with the relevant requirements of the Project Approval and other approvals, through:

- **Mine Planning and Design** – The design of the mine, including avoidance and subsidence mitigation measures (Section 1.3.2).
- **Subsidence Monitoring** – Monitoring to confirm predictions of subsidence effects and potential subsidence impacts and environmental consequences (Section 3.7).
- **Management Measures and Remediation** – Implementation of management measures and/or remediation, as required, to address subsidence impacts and/or environmental consequences.
- **Adaptive Management** – The implementation of adaptive management where appropriate (Section 4.2).
- **Contingency Plans** – Implementation of Contingency Plans in the event an exceedance of a subsidence impact performance measure or an unexpected impact is detected (Section 4.1), including consideration of identified potential contingency measures (Sections 3.1 to 3.6).

## 2 DEVELOPMENT OF THE EXTRACTION PLAN

### 2.1 RISK ASSESSMENTS

In accordance with the DPE and DRE (2015) *Guidelines for the Preparation of Extraction Plans*, a number of risk assessments have been undertaken for the Metropolitan Coal Longwalls 305-307 Extraction Plan to ensure that appropriate consideration was given to risk assessment and risk management in each component management plan.

#### 2.1.1 Environmental Risk Assessment

An Environmental Risk Assessment (ERA) was conducted for four of the key component plans of this Extraction Plan viz. WMP, LMP, BMP and LMP.

The suitably qualified and experienced experts endorsed by the Secretary of the DPE for the preparation of the Metropolitan Coal Longwalls 305-307 Extraction Plan participated in the ERA<sup>3</sup>. The ERA process involved the key steps described below.

### ***Review of Relevant Documentation and Risk Identification***

In preparation for the ERA workshop, the ERA participants reviewed a number of documents relevant to the risk assessment. This included (but was not limited to):

- The 2008 *Environmental Risk Analysis* (SP Solutions, 2008) conducted for the Project EA (Appendix O of the Project EA).
- The Preferred Project Report (HCPL, 2009). During the NSW Government's assessment phase of the Project EA, and in recognition of concerns raised by key stakeholders during the formal PAC assessment process, HCPL considered it appropriate to reduce the proposed extent of the original Project longwall mining area (i.e. Longwalls 20-44). This reduction in the extent of longwall mining resulted in a significant reduction to the extent of potential subsidence effects to the Waratah Rivulet and the Eastern Tributary and a reduction in the consequential potential environmental impacts.
- The Longwall 304 Environmental Risk Assessment Report (Operational Risk Mentoring, 2019a) (which included consideration of the Longwalls 301-303 Environmental Risk Assessment Report).
- Figures showing the Longwalls 305-307 layout in relation to key surface features.
- Subsidence predictions for Longwalls 305-307 (including subsidence contours, Eastern Tributary, Waratah Rivulet, Woronora Reservoir, other streams, cliff sites, upland swamps and Aboriginal heritage sites).

The participants were asked to identify any additional (specific) issues/risks and/or changes to previously assessed levels of risk in preparation for the ERA workshop.

### ***ERA Workshop***

The ERA workshop for Longwalls 305-307 was conducted on 16 July 2019, with some participants attending via video conferencing and others attending in person at the Metropolitan Coal Mine. The ERA workshop was facilitated by an independent specialist, Dr Peter Standish of Operational Risk Mentoring and conducted in accordance with AS/NZS ISO 31000: 2009 *Risk Management – Principles and Guidelines*.

The general consensus of the workshop participants was the additional (specific) issues/risks identified for Longwalls 305-307 were broadly assessed and ranked as part of the 2008 Environmental Risk Analysis, Longwalls 301-303 ERA and/or Longwall 304 ERA. However, additional (specific) issues were identified by the workshop participants relevant to Longwalls 305-307. Each of the issues/risks were explained systematically by the relevant workshop participants and each carefully reviewed.

Loss scenarios for the key potential environmental issues were identified for upland swamps, the Eastern Tributary, Waratah Rivulet and the Woronora Reservoir. The risk rankings are within the "low" range and consequently the potential outcomes can be integrated into the existing management systems for effective review and monitoring.

<sup>3</sup> Participants included Mr Peter DeBono (Mine Subsidence Engineering Consultants, Subsidence and Land), Dr Noel Merrick (SLR Consulting, Groundwater), Mr Lindsay Gilbert (Hydro Engineering & Consulting, Surface Water), Associate Professor Barry Noller (The University of Queensland, Surface Water Quality), Dr David Goldney (Cenwest Environmental Services, Fauna), Ms Elizabeth Norris (Ecoplanning, Flora), Mr Jon Degotardi (Metropolitan Coal), Mr Stephen Love (Metropolitan Coal), Mr Shane Kornek (Metropolitan Coal), Ms Stacey Gromadzki (Resource Strategies), Mr Joe Flanagan (Resource Strategies) and Mr Sam Webber (Resource Strategies). Mr Jamie Reeves (Niche Environment and Heritage, Heritage) contributed to the risk assessment external to the workshop.

## ERA Report Review

All ERA participants were asked to review the draft Longwalls 305-307 ERA report that was prepared to summarise the outcomes of the risk assessment. Participants' comments were incorporated into the final Operational Risk Mentoring (2019b) report.

The WMP, LMP, BMP and HMP have been prepared to provide for effective management of the identified subsidence risks.

### 2.1.2 Risk Assessment on Geological Features with Potential to Affect Water Quantity Available to Woronora Reservoir

The IEPMC Initial Report recommended that the potential implications for water quantity of faulting, basal shear planes and lineaments be carefully considered and risk assessed at all mining operations in the Catchment Special Areas (IEPMC, 2018).

In relation to the Metropolitan Coal Mine, the IEPMC Initial Report concluded (p. 127):

*In the case of Metropolitan Mine:*

- .....
- *the potential for water be diverted out of Woronora Reservoir and into other catchments through valley closure shear planes and geological structures including lineaments will require careful assessment in the future because it is planned that most of the remaining longwall panels in the approved mining area will pass beneath the reservoir.*

A risk assessment workshop was held on 19 July 2019 to assess the potential for Longwalls 305-307 mining effects on geological features to impact on the quantity of water available to the Woronora Reservoir. The workshop participants identified and assessed the potential for mining effects on lineaments, joints, faulting, basal shear planes and dykes to impact on the quantity of water to the Woronora Reservoir, including the potential for water to be diverted out of Woronora Reservoir and into other catchments.

The participants considered the risk control measures and procedures to be reasonable to manage the identified risks. The risk assessment is provided in Attachment 2 of the CRRP (Appendix H).

Further information on the risk assessment is provided in the Longwalls 305-307 CRRP (Appendix H).

### 2.1.3 Built Features Management Plan Risk Assessments

Individual risk assessment meetings were held with each infrastructure owner (facilitated by an independent specialist) during the preparation of the Longwalls 301-303 Extraction Plan (Version A), to inform the development of the Longwalls 301-303 BFMP.

In summary, the investigation and analysis methods used during the risk assessments typically included:

- the identification of the infrastructure owner or manager's assets;
- a review of the revised subsidence predictions and potential impacts on the infrastructure owner's or manager's assets (including consideration of past experience in the Southern Coalfield);
- the development of a preliminary monitoring plan; and
- the identification of risk control measures and procedures.

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Subsequent to the receipt of DPE approval for Longwalls 301 and 302 and in consultation with the infrastructure owners, Metropolitan Coal reviewed and where required, revised the risk assessments.

The risk control measures and procedures identified and implemented for Longwalls 301-303 were reviewed and continued for the extraction of Longwall 304 and will be continued for the extraction of Longwalls 305-307, where applicable.

Risk assessment workshops were held with representatives from relevant infrastructure owners/managers (Axicom, Garrawarra, Roads & Maritime Services [RMS], Sydney Trains, Sydney Water, Telstra, TransGrid and Wollongong City Council [WCC]) in relation to Longwalls 305-307. As the Extraction Plan Layout moves further away from built features, Metropolitan Coal has reviewed and where required, revised the risk assessments. The asset owners were provided with revised subsidence predictions specific to Longwalls 305-307 with the relevant BFMP on submission of the Extraction Plan.

#### **2.1.4 Public Safety Management Plan Risk Assessment**

A risk assessment was held for the Longwalls 305-307 PSMP (Appendix F) to identify and address potential safety hazards to the public, including:

- potential subsidence impacts on built features;
- potential instability of cliff formations or steep slopes caused by subsidence;
- deformations or fracturing of any land caused by subsidence; and
- any other impacts of subsidence.

The risk assessment held on 16 July 2019, was facilitated by an independent specialist, AXYS Consulting. Several risk control and management measures were identified during the risk assessment which considered the extraction of coal beneath land and infrastructure.

Metropolitan Coal considers all risk control measures and procedures to be feasible to manage all identified risks.

## **2.2 REVIEW OF RELEVANT INFORMATION OBTAINED SINCE PROJECT APPROVAL**

The six management plans of this Extraction Plan (i.e. the WMP [Appendix A], LMP [Appendix B], BMP [Appendix C], HMP [Appendix D], BFMP [Appendix E] and PSMP [Appendix F]) have been prepared in consideration of the information obtained since Project Approval (i.e. the results of monitoring of subsidence impacts and environmental consequences).

In particular, Appendices A to D provide a detailed summary of the information obtained since Project Approval by the Water, Land, Biodiversity and Heritage Management Plans, respectively.

A summary of the information obtained since Project Approval most relevant to the Longwalls 305-307 Extraction Plan has been provided below.

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### ***Eastern Tributary and Waratah Rivulet***

The Preferred Project Report (HCPL, 2009) indicated that valley closure values of greater than 200 mm were predicted for a number of pools/rock bars on the Waratah Rivulet, Eastern Tributary and other streams. 'Negligible consequence' for a watercourse was considered by the Project Approval to mean, *'no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases'*, and was assumed to be achieved in circumstances where predicted valley closure was less than 200 mm. Subsidence impacts to a number of pools on the Eastern Tributary occurred during the mining of Longwalls 26 and 27 at predicted total valley closure values of less than 200 mm and resulted in the exceedance of the negligible environmental consequences performance measure for the Eastern Tributary.

The IEPMC Initial Report recommended that the concept of restricting predicted valley closure to a maximum of 200 mm to avoid significant environmental consequences be revised for watercourses (IEPMC, 2018). Metropolitan Coal agreed that the 200 mm valley closure concept required revision in relation to the Eastern Tributary, noting that the unexpected impacts are particular to the Eastern Tributary and not the Waratah Rivulet. Restricting predicted valley closure to 200 mm has however been a successful design tool for mining in the vicinity of the Waratah Rivulet.

The negligible environmental consequences performance measure for watercourses as described above applied specifically for the Waratah Rivulet along the portion of the *'Waratah Rivulet between the full supply level of the Woronora Reservoir and the maingate of Longwall 23 (upstream of Pool P)'*. This section of the Waratah Rivulet includes Pool P to rock bar W, located to the south of Longwalls 305-307.

To date, the restriction of predicted valley closure to 200 mm has been a successful design tool on the Waratah Rivulet, with no impacts to pools and rock bars along the Waratah Rivulet at predicted total valley closure of less than 200 mm. Pool P to rock bar W have not exceeded the negligible environmental consequence performance measure for the Waratah Rivulet. Predicted total valley closure for Pool P to rock bar W was less than 200 mm for the extraction of Longwalls 20-27 and Longwalls 301-303 and did not increase after Longwall 27 for any of the 300 series longwalls.

Pool A to Pool O4 (a total of 16 pools) are located upstream of Pool P and are therefore not subject to the Waratah Rivulet negligible environmental impact performance measure. It is noted that the majority of these pools were predicted to experience maximum predicted total closure of greater than 200 mm. However, of these pools, only two (Pools G1 and N) have experienced subsidence impacts that would have resulted in an exceedance of the negligible environmental impact performance measure. Impacts that have occurred at these pools have been the result of mining directly beneath the Waratah Rivulet or in close proximity (< 100 m) to the rock bars, at predicted total valley closure greater than 200 mm.

Although subsidence impacts were observed at a number of pools on the Eastern Tributary at predicted total valley closure values of less than 200 mm during the mining of Longwalls 26 and 27, restricting predicted total valley closure to 200 mm is no longer applied for the Eastern Tributary.

A geotechnical study of the Waratah Rivulet stream bed investigated the geological characteristics of the stream bed, with the aim of identifying any characteristics that would make the Waratah Rivulet more susceptible to subsidence movements (similar to the Eastern Tributary). The study focussed on Pool P to rock bar W on the Waratah Rivulet, and compared these sites to Pool ETAM on the Eastern Tributary, which has experienced subsidence movements due to historical mining.

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The geotechnical study identified a thick unit (approximately 25 m) of thinly bedded sandstone along the Eastern Tributary at the location of Pool ETAM. The thinly bedded sandstone is considered to be of lower strength, and more weathered than adjoining thickly bedded sandstone units and therefore more prone to impact from valley closure movements. In addition, a higher frequency of seam level faults and surface lineaments have been identified in the vicinity of the Eastern Tributary. The thinly bedded units identified along the along Waratah Rivulet were limited to less than 5 m thickness and the frequency of seam level faults and surface lineaments was considerably less.

Based on the results of the assessment, the geological features identified along the Eastern Tributary are considered to be unique, compared to the Waratah Rivulet. The Eastern Tributary is therefore more likely to be susceptible to subsidence movements. Restricting valley closure to 200 mm therefore continues to be an appropriate design tool for the Waratah Rivulet. Further discussion on the subsidence predictions and 200 mm valley closure design tool for Longwalls 305-307 is provided in the WMP (Appendix A).

Metropolitan Coal developed a monitoring and adaptive management approach to the mining of Longwall 303 towards the Eastern Tributary. As Longwall 303 mined towards the Eastern Tributary, Metropolitan Coal used a Trigger Action Response Plan (TARP) designed to monitor valley closure movements on the Eastern Tributary. The Eastern Tributary Valley Closure TARP has been successfully implemented by Metropolitan Coal for Longwall 303. The monitoring and adaptive management approach will also be implemented for Longwall 304 as it mines closer to the Eastern Tributary. The Eastern Tributary Valley Closure TARP is presented in the WMP (Appendix A). Similar monitoring of subsidence movements has been successfully implemented to avoid impacts on the Sandy Creek Waterfall at the Dendrobium Coal Mine by South32.

### ***Woronora Reservoir***

The Extraction Plan Layout includes the first of the 300 series longwalls proposed to extend beneath the Woronora Reservoir full supply level, namely Longwalls 306 and 307. Longwall 305 does not extend beneath the full supply level of the Woronora Reservoir.

The potential impacts of mining proximal to or beneath the Woronora Reservoir have been considered by Metropolitan Coal in the Project EA, Preferred Project Report and extraction plans prepared to date.

As part of the approval conditions for Longwalls 301 and 302, Metropolitan Coal was required to conduct further investigation into potential impacts on the Woronora Reservoir. Metropolitan Coal engaged independent experts to prepare a Woronora Reservoir Impact Strategy to provide a staged plan of action for further investigations and a report into the impacts of mining near the reservoir. Professor Bruce Hebblewhite (B. K. Hebblewhite Consulting), Dr Frans Kalf (Kalf and Associates Pty Ltd) and Emeritus Professor Thomas McMahon (University of Melbourne) (the Independent Experts) were endorsed by the DPIE to undertake the Woronora Reservoir Impact Strategy in May 2017.

The *Woronora Reservoir Strategy Report - Stage 1* (Stage 1 report) (Hebblewhite *et. al.*, 2017) was provided by the Independent Experts to the DPIE (then DPE) in September 2017 and was approved by the Secretary for Planning in December 2017. The *Woronora Reservoir Strategy Report – Stage 2* (Stage 2 report) (Hebblewhite *et. al.*, 2019) report was provided by the independent experts to the DPIE in June 2019. At the time of the preparation of the Extraction Plan the Stage 2 report was undergoing review by the DPIE.

The Stage 1 report included recommendations for further groundwater and surface water investigations and monitoring. The key outcomes and recommendations of the Stage 1 report were considered in the Longwall 304 Extraction Plan.

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The Stage 2 report includes additional recommendations in regard to groundwater and surface water investigations and monitoring, based on further data and analysis arising from the ongoing monitoring programs, including those implemented by Metropolitan Coal in the original Stage 1 report. Key outcomes of the additional investigations are described below and in the WMP (Appendix A).

As the Extraction Plan Layout proposes to mine beneath the Woronora Reservoir full supply level, Metropolitan Coal has considered the recommendations of the Woronora Reservoir Impact Strategy in the preparation of the Extraction Plan, specifically in regard to the potential impacts on the Woronora Reservoir.

A comprehensive analysis of stream flow data and data on the yield behaviour of Woronora Reservoir was conducted as part of the Project EA, and indicated that past mining at Metropolitan Coal has had no discernible effect on the inflow to, or yield from, the reservoir. Surface water flow monitoring to date also supports this and indicates there is no evidence of a loss of flow from the Waratah Rivulet or Eastern Tributary reaching the Woronora Reservoir as a result of mining.

The Stage 1 report developed a surface water strategy to assist in assessing any impact of mining of Longwalls 301-303 on the surface flows in the small sub-catchments that drain to the west of Longwalls 301-303 (i.e. sub-catchments I and K that flow to the Woronora Reservoir). The Stage 1 report recommended the installation of streamflow monitoring stations and a pluviometer on these sub-catchments, which have been installed by Metropolitan Coal. The Stage 1 report also recommended the development of a preliminary water balance of the Woronora Reservoir to identify losses from the reservoir.

The Stage 2 report presented the outcomes of this additional monitoring. The Stage 2 report found that results from the additional sub-catchment monitoring stations are consistent with surface water flow monitoring to date on the Waratah Rivulet and Eastern Tributary (i.e. mining has not impacted on the quantity of water resources in these streams).

The primary purpose of the water balance analysis was to establish whether a loss from the Woronora Reservoir because of longwall mining being undertaken in the catchment and/or from other activities that may affect the water balance could be estimated. However, the Stage 2 report recommended that due to bias and uncertainty in the data used in the model, it was doubtful the water balance provided a satisfactory baseline for assessing the potential loss of reservoir water through the bed and recommended that a Stage 2 water balance study be not undertaken.

Notwithstanding, monitoring to date (including additional monitoring that has been implemented by Metropolitan Coal in response to the Woronora Reservoir Impact Strategy) indicates that mining to date has not impacted on inflow to the Woronora Reservoir.

A number of groundwater monitoring bores and inclinometer monitoring points have also been installed by Metropolitan Coal as a component of the Woronora Reservoir Impact Strategy. Monitoring results to date support the assessment of no connective cracking between the surface and the mine. This has also been supported by the IEPMC (2018), who concluded *“In the case of Metropolitan Mine the average daily water inflow of about 0.5 ML/day displays no evidence of a connected fracture regime to surface or correlation with rainfall”*. The results of groundwater monitoring to date are discussed further in the WMP (Appendix A).

## 2.3 REVIEW OF PREDICTIONS

The predicted subsidence effects, subsidence impacts and environmental consequences of the Project were assessed in the Project EA and Preferred Project Report. This section describes the process of reviewing and updating these predictions to consider the Extraction Plan Layout.

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### 2.3.1 Predicted Subsidence Effects and Subsidence Impacts

A detailed subsidence assessment for Longwalls 305-307 has been prepared in support of this Extraction Plan by MSEC (2019), with the outcomes of this assessment incorporated into the management plans in Appendices A to F. The Subsidence Report by MSEC (2019) is provided in Appendix I.

#### ***Review of Subsidence Prediction Methodology***

The predictions of subsidence effects for Longwalls 305-307 were developed by MSEC (2019) using the Incremental Profile Method, calibrated using observed monitoring data above the previously extracted longwalls at Metropolitan Coal (Appendix I). The Incremental Profile Method is based on a large database of observed subsidence movements in the Southern Coalfield and has been found, in most cases, to give reasonable, if not conservative, predictions of maximum subsidence, tilt and curvature.

Based on monitoring data from the Southern Coalfield, there is an approximate 90 percent (%) confidence level that the maximum observed incremental subsidence will be less than the maximum predicted incremental subsidence using the standard model (Appendix I).

#### ***Comparison with Previous Predictions of Subsidence Effects***

MSEC (2019) (Appendix I) provides a comparison of the maximum predicted conventional total subsidence parameters for the Extraction Plan Layout and the Preferred Project Layout for Longwalls 305-307. The values are the maxima anywhere above the longwall layouts. The maximum predicted total subsidence, tilt and curvature for the Extraction Plan Layout are similar to or less than predicted based on the Preferred Project Layout (Appendix I).

A feature of the Preferred Project Layout is increased pillar widths beneath and in close proximity to the Woronora Reservoir. As a result, the maxima based on the Preferred Project Layout occurred in the north-east area of the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour, however, these areas have been left unmined by the shortening of Longwalls 305-307 for the Extraction Plan Layout. At the southern end of Longwall 305 (the location of Prediction Line 1), where the Preferred Project Layout has greater pillar widths, the predicted subsidence parameters are less than those based on the Extraction Plan Layout (Appendix I).

Longwalls 306 and 307 based on the Extraction Plan Layout extend beneath the Woronora Reservoir full supply level and the Woronora Reservoir is within the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour. Longwall 305 does not extend beneath the Woronora Reservoir full supply level (Figure 2). The maximum predicted vertical subsidence, upsidence and closure for the Woronora Reservoir full supply level, based on the Extraction Plan Layout, are less than the maxima predicted based on the Preferred Project Layout (Appendix I).

The Eastern Tributary flows in a northerly direction into the full supply level of the Woronora Reservoir approximately 300 m to the south-east of Longwalls 305 and 306 (Figure 2). The maximum predicted vertical subsidence, upsidence and closure for the Eastern Tributary, based on the Extraction Plan Layout, are less than the maxima predicted based on the Preferred Project Layout (Appendix I).

The Waratah Rivulet flows to the north-east and into the full supply level of the Woronora Reservoir, approximately 330 m to the south-west of Longwall 307 (Figure 2). The maximum predicted vertical subsidence, upsidence and closure for the Waratah Rivulet, based on the Extraction Plan Layout, are less than the maxima predicted based on the Preferred Project Layout (Appendix I).

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### ***Predicted Subsidence Impacts***

MSEC (2019) (Appendix I) has conducted a detailed assessment of potential subsidence impacts for each of the natural and built features identified in the vicinity of Longwalls 305-307. Potential subsidence impacts identified by MSEC (2019) are consistent with those identified in the Project EA and Preferred Project Report and include:

- surface cracking, heaving, buckling, humping and stepping;
- sub-surface fracturing;
- changes in gradients, ponding, scouring/erosion and changes in stream alignment; and
- instability of land features, including rock falls.

Potential impacts with respect to structures include cracking of road surfaces, opening of joints in pipelines, alteration of tension of electricity transmission lines and cracks in masonry.

The revised subsidence predictions for the Extraction Plan Layout do not change the subsidence impact assessments provided in the Project EA and Preferred Project Report (Appendix I).

### **2.3.2 Potential Environmental Consequences**

Detailed discussion of potential environmental consequences is provided in the management plans in Appendices A to F. The suitably qualified experts conducted a review of the potential environmental consequences due to Longwalls 305-307 extraction for the preparation of each management plan.

The IEPMC Initial Report indicates that in recent years it has been identified in the Western Coalfield that surface subsidence, groundwater and surface water responses to longwall mining can be significantly modified in the vicinity of lineaments. Further to advice from the IEPMC, the DPIE requested that specific regard be given to the potential impacts of mining near and under lineaments on surface water features, including swamps and waterfalls. This consideration of lineaments is included in the BMP (Appendix C) and WMP (Appendix A), respectively.

The potential impacts of mining effects on geological features on the quantity of water resources to the reservoir are assessed in the CRRP (Appendix H).

## **2.4 CONSULTATION**

Metropolitan Coal was granted Project Approval (08\_0149) for the Project in June 2009. Since then, extensive consultation with stakeholders has been undertaken in relation to the Extraction Plans and component management plans prepared for Longwalls 20-22, 23-27, 301-303 and 304 in accordance with Condition 6, Schedule 3 of the Project Approval. This consultation has informed the development of the Longwalls 305-307 Extraction Plan and component management plans.

Consultation undertaken with stakeholders to date in relation to the Longwalls 305-307 Extraction Plan is described below.

### **2.4.1 NSW Government Agencies**

Metropolitan Coal requested the endorsement of the Extraction Plan team as suitably qualified and experienced experts on 19 June 2019. The Extraction Plan team was endorsed by the DPE on 20 June 2019 (Attachment 2).

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During the preparation of previous Metropolitan Coal extraction plans (i.e. the Longwalls 20-22, 23-27, 301-303 and 304 Extraction Plans), component management plans were distributed to stakeholders for comment prior to submission to the DPE. To allow for the timely assessment of the Longwalls 305-307 Extraction Plan by the DPIE, and to ensure continuation of mining at Metropolitan Coal, stakeholder consultation will be conducted in parallel with the DPIE's assessment of the Longwalls 305-307 Extraction Plan.

#### 2.4.2 Landholders

A land ownership plan is provided on Figure 7. In summary, seven lots are located within 600 m of Longwalls 305-307, and the ownership details are as follows:

- two lots are owned by WaterNSW;
- two lots are owned by The State of NSW (Crown Land);
- two lots are owned by the Health Administration Corporation (NSW Health); and
- one lot is owned by the Trustees of the Macedonian Orthodox Monasteries.

For land owned by the State of NSW (Crown Land), the Crown Lands Nowra District Office previously requested (for the Longwalls 301-303 Extraction Plan) that a copy of the Extraction Plan be provided on submission to the DPE. Metropolitan Coal will provide a copy of the Longwalls 305-307 Extraction Plan to the Crown Lands Nowra District Office on submission of the Extraction Plan.

Consultation with WaterNSW to date is described in Section 2.4.1 above. Metropolitan Coal will provide a copy of the Longwalls 305-307 Extraction Plan to WaterNSW on submission of the Extraction Plan.

Extensive consultation with the Health Administration Corporation (NSW Health) was conducted for the preparation of the BFMP – Garrawarra Centre Complex in relation to Longwalls 301-303 and Longwall 304. This BFMP has been updated to include Longwalls 305-307 and will be provided to the Health Administration Corporation (NSW Health) on submission of the Extraction Plan.

#### 2.4.3 Aboriginal Groups

As described in Section 2.4.1, stakeholder consultation will be conducted in parallel with the DPIE's assessment of the Longwalls 305-307 Extraction Plan. A draft of the Longwalls 305-307 HMP will therefore be provided to Aboriginal stakeholders registered at Metropolitan Coal for their review and comment upon submission of the Longwalls 305-307 Extraction Plan to the DPIE.

#### 2.4.4 Infrastructure Owners

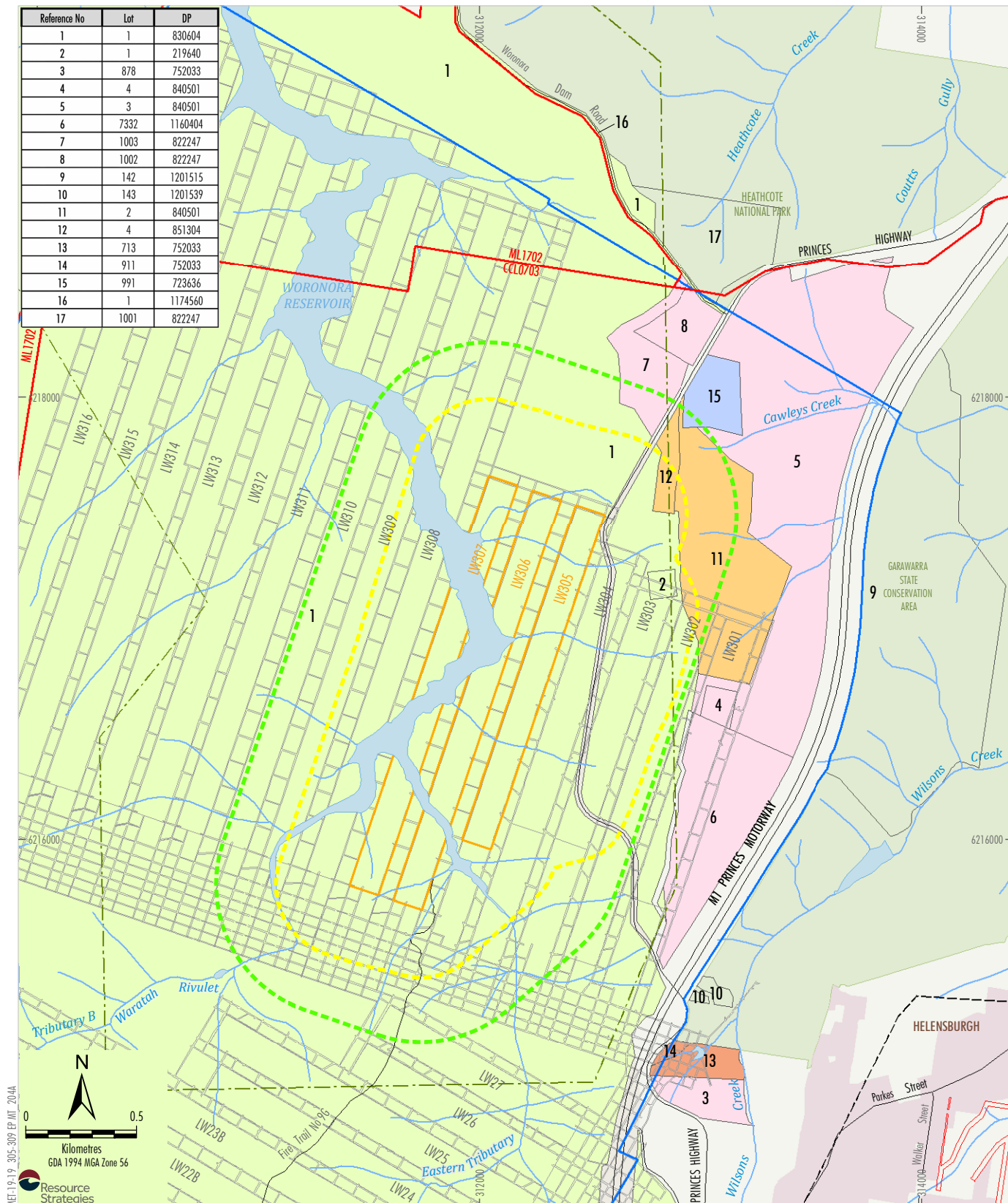
Extensive consultation with each infrastructure owner/manager was conducted for the Longwalls 301-303 and Longwall 304 Extraction Plans. The relevant infrastructure owners/managers have been contacted by Metropolitan Coal to advise that the existing BFMPs (approved in July 2019) were being updated to include Longwalls 305-307.

As described in Section 2.1.3, risk assessment workshops were held with representatives from the relevant infrastructure owners/managers (Axicom, Garrawarra, RMS, Sydney Trains, Sydney Water, Telstra, TransGrid and WCC) in relation to Longwalls 305-307.

Each of the infrastructure owners/managers will be provided a copy of the relevant Longwalls 305-307 BFMP component plan upon submission of the Longwalls 305-307 Extraction Plan to the DPIE.

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Reference No	Lot	DP
1	1	830604
2	1	219640
3	878	752033
4	4	840501
5	3	840501
6	7332	1160404
7	1003	822247
8	1002	822247
9	142	1201515
10	143	1201539
11	2	840501
12	4	851304
13	713	752033
14	911	752033
15	991	723636
16	1	1174560
17	1001	822247



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Land Ownership within  
600 m of Longwalls 305-307

Figure 7

Metropolitan Coal have consulted with Vocus advising that the BFMP component plan associated with the Vocus infrastructure would not be required for the extraction of Longwalls 305-307. These features are not predicted to experience any measurable conventional subsidence, tilts or curvatures due to the extraction of Longwalls 305-307.

#### **2.4.5 Public Consultation**

The Metropolitan Coal Community Consultative Committee (CCC) was advised of the development of the Extraction Plan at a meeting on 11 July 2019. The CCC was informed that submission of the Extraction Plan was anticipated in September 2019.

### **3 SUBSIDENCE MANAGEMENT AND MONITORING**

Surface and sub-surface features within the vicinity of Longwalls 305-307 are listed in Table 7. Features within the Longwalls 305-307 35° angle of draw and/or 20 mm predicted subsidence contour may potentially be impacted by the secondary extraction of Longwalls 305-307. There are also features that lie outside the Longwalls 305-307 35° angle of draw and/or 20 mm predicted subsidence contour that may experience either far-field movements, or valley related movements. The surface features which are sensitive to such movements have been identified and have been included in the subsidence assessments provided in MSEC (2019) (Appendix I).

The location of natural features and known Aboriginal heritage sites within 600 m of Longwalls 305-307 and surrounds are shown on Figures 8, 9 and 10. The locations of surface infrastructure/built features over and adjacent to Longwalls 305-307 are shown on Figures 11a, 11b and 12. Descriptions of each of these features are contained within the relevant management plan referenced in Table 7.

Subsidence predictions and potential impacts to surface and sub-surface features are provided and described in MSEC (2019) (Appendix I).

Management measures and monitoring for each feature are included in each of the management plans as indicated in Table 7 and summarised in Sections 3.1 to 3.6.

The SMP (Appendix G) has been prepared to validate the subsidence predictions and analyse the relationship between the subsidence effects and subsidence impacts of the Extraction Plan and any ensuing environmental consequences. A summary of the proposed monitoring for the Extraction Plan is provided in Section 3.7.

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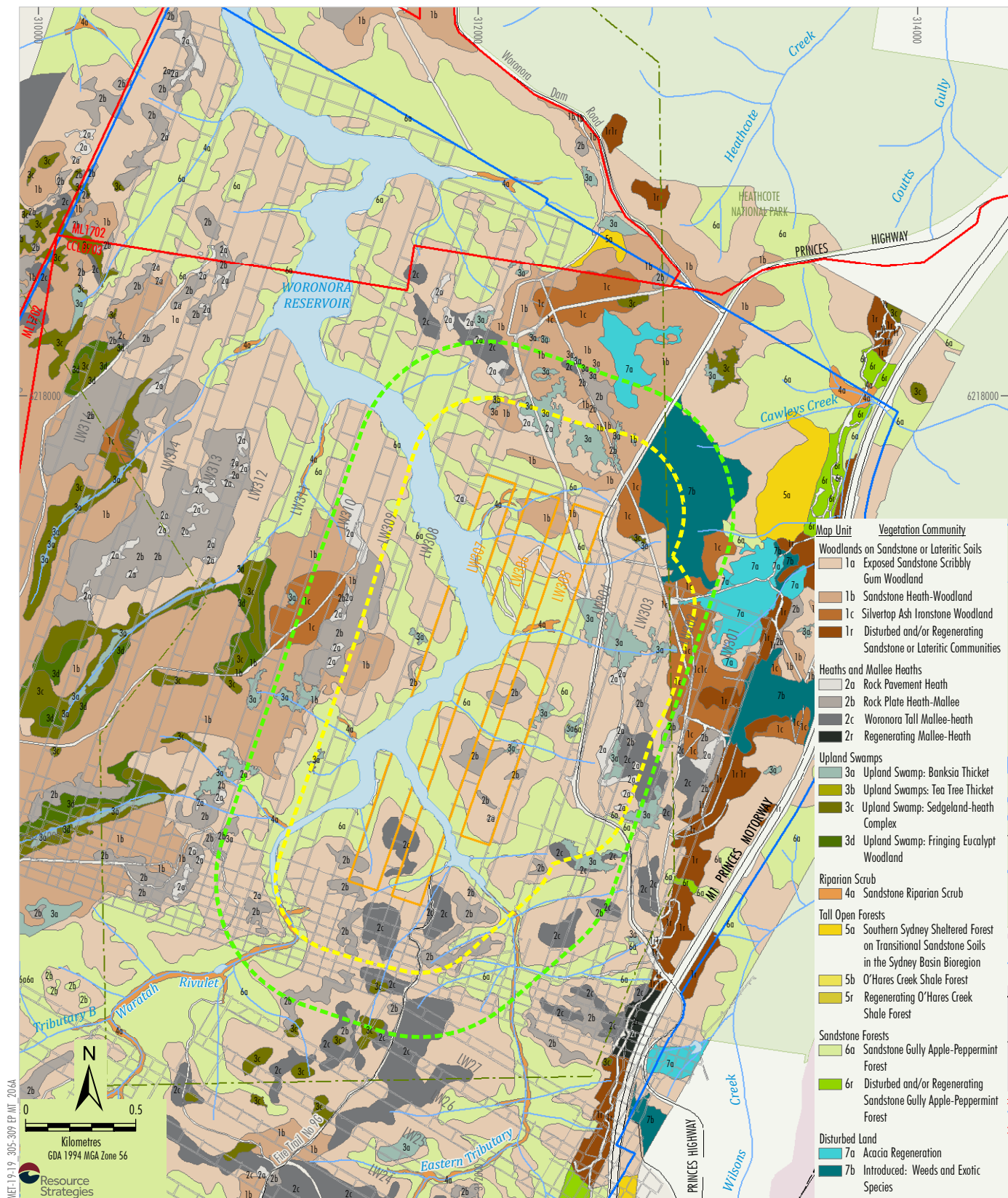


**Table 7**  
**Surface and Sub-surface Features**

Feature	Section/Management Plan Reference
Natural Features	
Streams	Section 3.1 and WMP (Appendix A)
Cliffs and overhangs, Steep Slopes and Land in General (including rock ledges and outcrops)	Section 3.2 and LMP (Appendix B)
Upland Swamps	Section 3.3 and BMP (Appendix C)
Natural Vegetation	
Public Utilities and Other Infrastructure	
NSW Health – Garrawarra Centre Complex	Section 3.5 and BFMP (Appendix E)
Endeavour Energy – Electrical Infrastructure	
TransGrid – Electrical Infrastructure	
Vocus – Telecommunications Infrastructure <sup>1</sup>	
Optus – Telecommunications Infrastructure	
Telstra – Telecommunications Infrastructure	
Axicom – Telecommunications Infrastructure	
Sydney Trains – Illawarra Railway and Telecommunications Infrastructure	
RMS – M1 Princes Motorway and Bridges	
WCC – Old Princes Highway	
WCC – Waterfall General (Garrawarra) Cemetery <sup>1</sup>	
Sydney Water – Water Pipelines	
Woronora Reservoir	Section 3.1 and WMP (Appendix A)
Exploration Boreholes	Section 3.5 and Subsidence Report (Appendix I)
Survey Control Marks	
Fire Trails and Vehicular Tracks	Sections 3.2 and 3.5, LMP (Appendix B) and BFMP (Appendix E)
Areas of Archaeological and/or Heritage Significance	
Known Aboriginal Heritage Sites	Section 3.4 and HMP (Appendix D)
Waterfall General (Garrawarra) Cemetery	Section 3.5 and BFMP (Appendix E)
Garrawarra Centre Complex	

<sup>1</sup> As described in Section 2.4.4, a BFMP component plan for the Vocus infrastructure has not been developed for the Longwalls 305-307 BFMP, as the Vocus infrastructure is not predicted to experience any measurable conventional subsidence, tilts or curvatures due to the extraction of Longwalls 305-307.



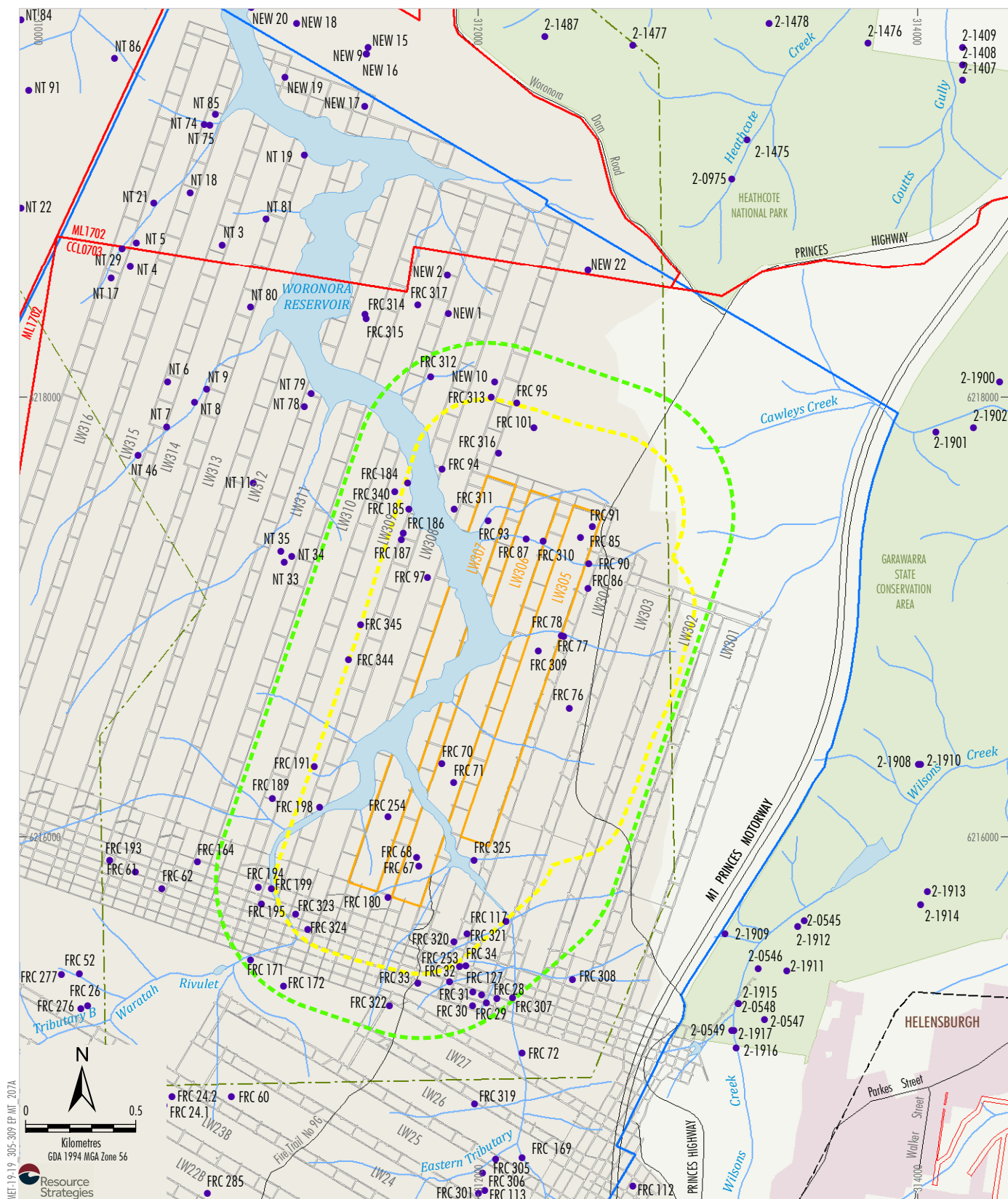


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Longwalls 305-307 Vegetation Mapping

**Figure 9**





#### LEGEND

- Mining Lease Boundary
- Woronora Special Area
- Project Underground Mining Area
- Longwalls 20-27 and 301-317
- Longwalls 305-307 Secondary Extraction
- Longwalls 305-307 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Longwalls 305-307 Secondary Extraction
- Woronora Notification Area
- Existing Underground Access Drive (Main Drift)
- Aboriginal Heritage Site

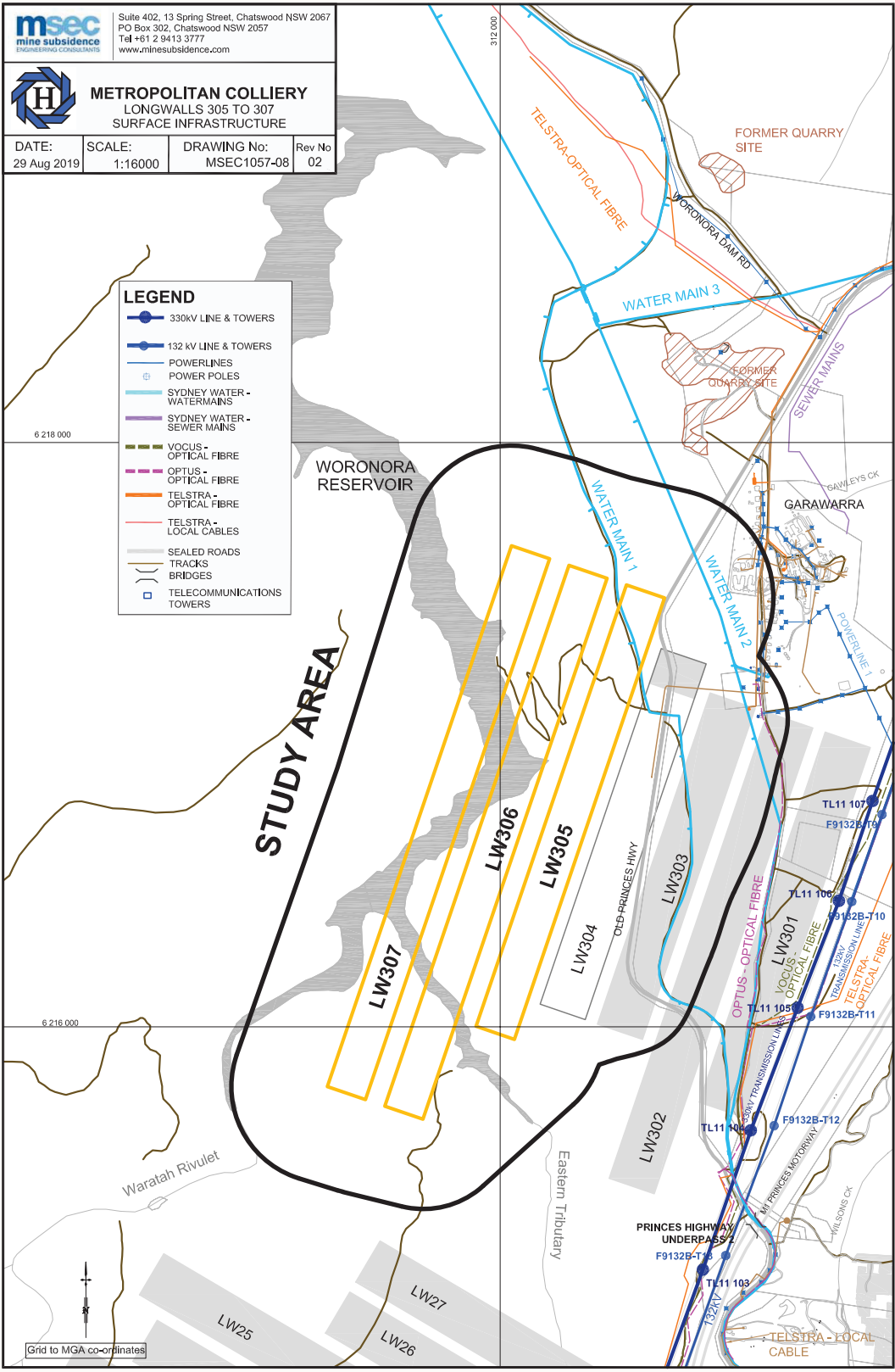
Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019); Illawarra Prehistory Group (2007; 2008); AHIMS (2007); Kayandel Archaeological Services (2006; 2007; 2008); Niche Environmental and Heritage (2013)

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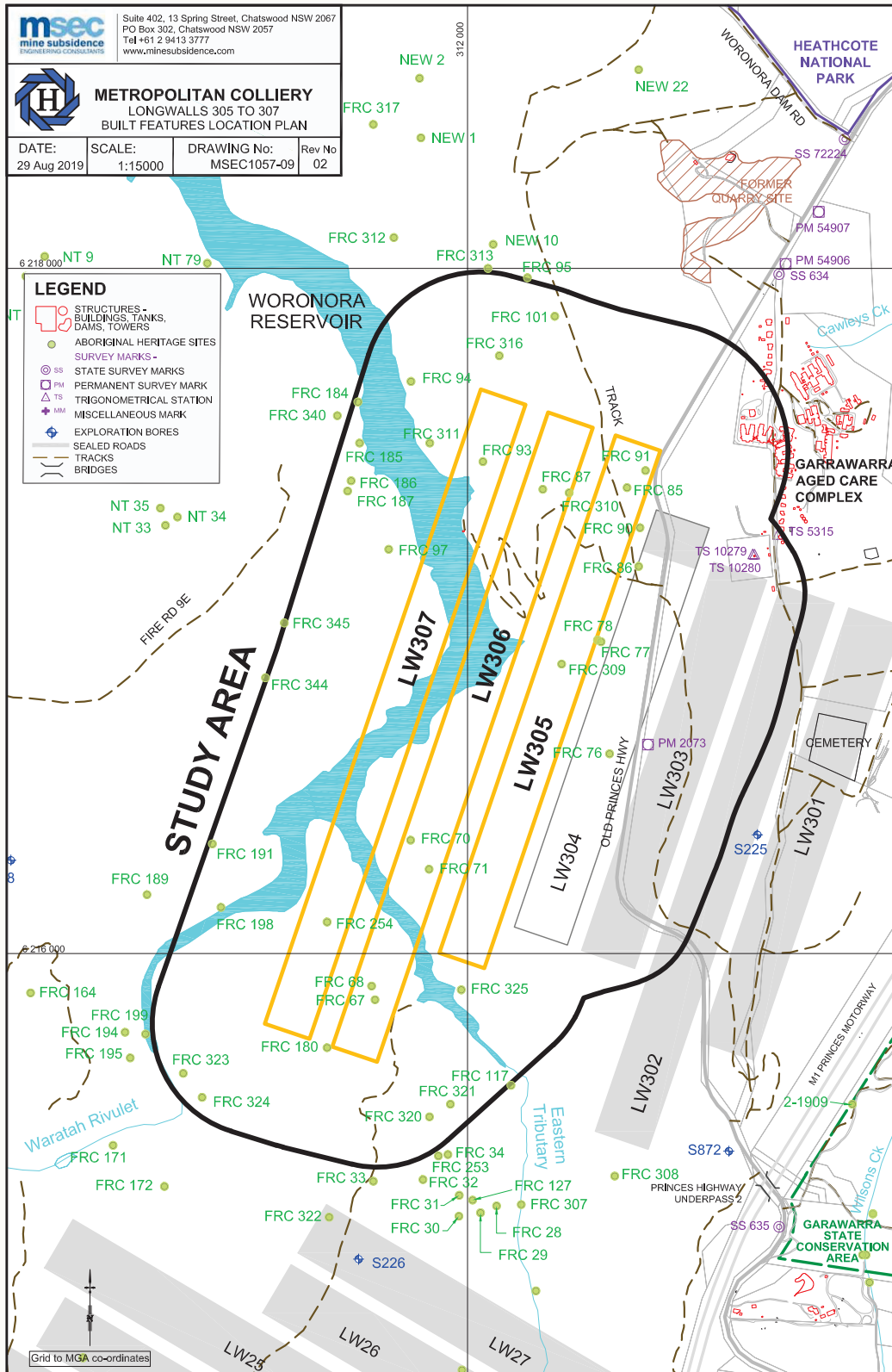
Longwalls 305-307  
Known Aboriginal Heritage Sites

Figure 10



MET-19-19 305-309 EP MT 003A





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Surface Infrastructure Over and  
Adjacent to the Longwalls 305-307  
Study Area

Figure 11b



### 3.1 WATER MANAGEMENT

#### 3.1.1 Overview

The WMP is provided in Appendix A. The purpose and scope of the WMP are summarised below:

- Purpose:** To manage the potential environmental consequences of the Extraction Plan on watercourses (including the Woronora Reservoir), aquifers and catchment yield.
- Scope:** Surface water and groundwater resources during the mining of Longwalls 305-307.

#### 3.1.2 Key Water Issues, Monitoring and Management Measures

First and second order streams are located within the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour (Figure 8). These streams consist of shallow drainage lines from the topographical high points, forming streams where valley heights increase and drain into the Woronora Reservoir. The streams are located above Longwalls 305-307, and could experience the full range of predicted subsidence movements (Appendix I).

Longwalls 305-307 are the first of the 300 series longwalls to undermine the Woronora Reservoir. The Woronora Reservoir full supply level is located above Longwalls 306 and 307 and within the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour (Figure 8). Longwall 305 does not extend beneath the Woronora Reservoir full supply level. As described in Section 1.4 and the WMP (Appendix A), the potential impacts on the Woronora Reservoir based on the Extraction Plan Layout are predicted to be consistent with those based on the Preferred Project Layout.

The Woronora Reservoir Impact Strategy, developed by the Independent Experts, provides a staged plan of action for further investigation into the impacts of mining near the reservoir. Metropolitan Coal have implemented a number of additional groundwater and surface water monitoring sites in response to the Stage 1 and Stage 2 reports. The Woronora Reservoir Impact Strategy is described in Section 2.2 and the WMP (Appendix A).

The Eastern Tributary flows in a northerly direction into the full supply level of the Woronora Reservoir approximately 300 m to the south-east of Longwalls 305 and 306 (Figure 8). The finishing ends of Longwalls 303, 304 and 305 have been set back to minimise predicted valley closure at the Eastern Tributary to minimise the likelihood of impacts occurring.

Metropolitan Coal established a comprehensive monitoring and adaptive management program to identify subsidence related movements at the Eastern Tributary during the extraction of Longwall 303, so that additional mining of Longwall 303 would have no further exceedance of the Eastern Tributary performance measure. The same monitoring and adaptive management approach will be used for the extraction of Longwall 304 and for the extraction of Longwalls 305 and 306. The Longwalls 305 and 306 Eastern Tributary Valley Closure TARP is provided in the WMP (Appendix A).

The intent of the Eastern Tributary Valley Closure TARP is to identify the initial development of valley closure prior to an impact occurring. The adaptive management approach is based on Metropolitan Coal conducting high frequency and high-resolution monitoring of the Eastern Tributary to detect mining-induced effects, allowing the cessation of mining prior to mining resulting in any unacceptable or adverse impacts on the Eastern Tributary. The monitoring provides the earliest possible indicator for development of valley closure. The development of valley closure is recognised as the dominant mechanism that results in impact to a rockbar.

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The Eastern Tributary Valley Closure TARP has been successfully implemented by Metropolitan Coal for Longwall 303. Consistent with the TARP, the decision to cease mining of Longwall 303 was made at a very low magnitude of valley closure and once the longwall was completed, the rate of additional closure development reduced. This approach has also been successfully utilised for the Sandy Creek Waterfall by South32.

As described in Section 2.2, restricting predicted valley closure to 200 mm has been a successful design tool to date for mining in the vicinity of the Waratah Rivulet and Metropolitan Coal will adopt this approach for the extraction of Longwalls 305-307.

The geotechnical study of the Waratah Rivulet stream bed (Section 2.2) investigated the geological characteristics of the stream bed, with the aim of identifying any characteristics that would make the Waratah Rivulet more susceptible to subsidence movements (similar to the Eastern Tributary). The study focussed on Pool P to rock bar W on the Waratah Rivulet, and compared these sites to Pool ETAM on the Eastern Tributary, which has experienced subsidence movements due to historical mining. Based on the results of the assessment, the geological features identified along the Eastern Tributary are considered to be unique, compared to the Waratah Rivulet. The Eastern Tributary is therefore more likely to be susceptible to subsidence movements. Restricting valley closure to 200 mm therefore continues to be an appropriate design tool for the Waratah Rivulet. Further discussion on the subsidence predictions and 200 mm valley closure design tool for Longwalls 305-307 is provided in the WMP (Appendix A).

Notwithstanding, the potential impacts of mining near and under lineaments on surface water features, including the waterfall at rock bar ETAU on the Eastern Tributary has been assessed. Hydraulic connectivity via lineaments to the waterfall at rock bar ETAU on the Eastern Tributary is considered to be highly unlikely as a result of the extraction of Longwalls 305-307 (Appendix A).

A risk assessment workshop was held on 19 July 2019 to assess the potential for mining effects from Longwalls 305-307 on geological features to impact on the quantity of water available to the Woronora Reservoir. The potential for mining effects on lineaments, joints, faulting, basal shear planes and dykes to impact on the quantity of water to the Woronora Reservoir, including the potential for water to be diverted out of Woronora Reservoir and into other catchments, were identified and assessed. The risk control measures and procedures were considered to be reasonable to manage the identified risks. The risk assessment details are provided in the CRRP (Appendix H).

The key issues relating to subsidence impacts on surface water and groundwater resources are described in the WMP and the relevant monitoring and management measures are summarised in Table 8 and Section 3.7.

**Table 8**  
**Management Issues for Water Resources and Watercourses during Longwalls 305-307 Extraction**

Issue	Approved Impact	Monitoring	Management
Catchment yield to the Woronora Reservoir	<ul style="list-style-type: none"> <li>Negligible reduction to the quality or quantity of water resources reaching the Woronora Reservoir.</li> <li>No connective cracking between the surface and the mine.</li> </ul>	<p>Monitoring in accordance with the WMP, including:</p> <ul style="list-style-type: none"> <li>Surface water quality.</li> <li>Surface water flow.</li> <li>Eastern Tributary gauging station functionality.</li> <li>Groundwater pressure/level.</li> <li>Inspections of underground workings for water accumulation.</li> <li>Mine water make.</li> <li>Woronora Reservoir water quality.</li> <li>Visual inspections of stream cracking, gas releases, iron staining and drainage behaviour.</li> <li>Gas releases.</li> <li>Pool water levels.</li> <li>Groundwater quality.</li> </ul> <p>Subsidence monitoring at Eastern Tributary gauging station.</p> <p>Subsidence monitoring for the Eastern Tributary Valley Closure TARP.</p> <p>Subsidence monitoring in accordance with the SMP.</p>	<ul style="list-style-type: none"> <li>Mine planning and design: <ul style="list-style-type: none"> <li>Conservative mining geometry.</li> <li>Shortening of Longwalls 303, 304 and 305.</li> </ul> </li> <li>Adaptive management – Eastern Tributary Valley Closure TARP.</li> <li>Risk assessments.</li> <li>Additional monitoring (e.g. increase in monitoring frequency or additional sampling).</li> <li>Stream remediation.</li> <li>Revegetation measures.</li> <li>Offsets.</li> </ul>
Woronora Reservoir	<ul style="list-style-type: none"> <li>Negligible leakage from the Woronora Reservoir.</li> <li>Negligible reduction in water quality of Woronora Reservoir.</li> </ul>		
Waratah Rivulet between the full supply level of the Woronora Reservoir and the maingate of Longwall 23 (upstream of Pool P)	<ul style="list-style-type: none"> <li>Negligible environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases).</li> </ul>		
Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26	<ul style="list-style-type: none"> <li>Negligible environmental consequences over at least 70% of the stream length (that is no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining and minimal gas releases).</li> </ul>		

### 3.1.3 Assessment of Performance Indicators and Measures

Performance indicators developed for the subsidence impact performance measures relating to water resources and watercourses are presented in the WMP and are summarised in Table 9.

**Table 9**  
**Water Resources and Watercourses Performance Measures and Performance Indicators**

Performance Measure	Performance Indicator(s)
Negligible reduction to the quantity of water resources reaching the Woronora Reservoir.	<ul style="list-style-type: none"> <li>Changes in the quantity of water entering Woronora Reservoir are not significantly different post-mining compared to pre-mining, that are not also occurring in the control catchment(s).</li> </ul>
Negligible reduction to the quality of water resources reaching the Woronora Reservoir.	<ul style="list-style-type: none"> <li>Changes in the quality of water entering Woronora Reservoir are not significantly different post-mining compared to pre-mining concentrations that are not also occurring at control site WOWQ2.</li> </ul>
No connective cracking between the surface and the mine.	<ul style="list-style-type: none"> <li>Visual inspection does not identify abnormal water flow from the goaf, geological structure, or the strata generally.</li> <li>The 20-day average mine water make does not exceed 1 ML/day.</li> <li>Significant departure from the predicted envelope of the vertical potentiometric head profile at Bore 9GGW2B does not occur.</li> <li>Significant departure from the predicted envelope of the vertical potentiometric head profile at Bore F6GW3A does not occur.</li> </ul>
No connective cracking between the surface and the mine. Negligible leakage from the Woronora Reservoir.	<ul style="list-style-type: none"> <li>The hydraulic gradient to the Woronora Reservoir at full supply level from Bore PHGW2A is reduced by no more than 40% from that measured to 30 June 2017.</li> <li>The groundwater head of Bore F6GW4A is greater than 10 m above the Woronora Reservoir full supply level.</li> </ul>
Negligible leakage from the Woronora Reservoir.	<ul style="list-style-type: none"> <li>The hydraulic gradient to the Woronora Reservoir at full supply level from Bore 9GGW2B is reduced by no more than 40% from that measured to 30 June 2017.</li> <li>The hydraulic gradient to the Woronora Reservoir at full supply level from Bore 9EGW2A is reduced by no more than 40% from that measured to 30 June 2017.</li> <li>The hydraulic gradient to the Woronora Reservoir at full supply level from Bore PM02 is reduced by no more than 40% from that measured to 30 June 2017.</li> <li>The hydraulic gradient from transect bore T5 to bore T3 is reduced by no more than 10% from that measured on 30 June 2017.</li> <li>The hydraulic gradient to the Woronora Reservoir from transect bore T2 is reduced by no more than 10% from that measured on 30 June 2017.</li> <li>The hydraulic gradient to the Woronora Reservoir from transect bore T3 is reduced by no more than 10% from that measured on 30 June 2017.</li> </ul>
Negligible reduction in the water quality of Woronora Reservoir.	<ul style="list-style-type: none"> <li>Changes in the quality of water in the Woronora Reservoir are not significantly different post-mining compared to pre-mining concentrations.</li> </ul>

**Table 9 (Continued)**  
**Water Resources and Watercourses Performance Measures and Performance Indicators**

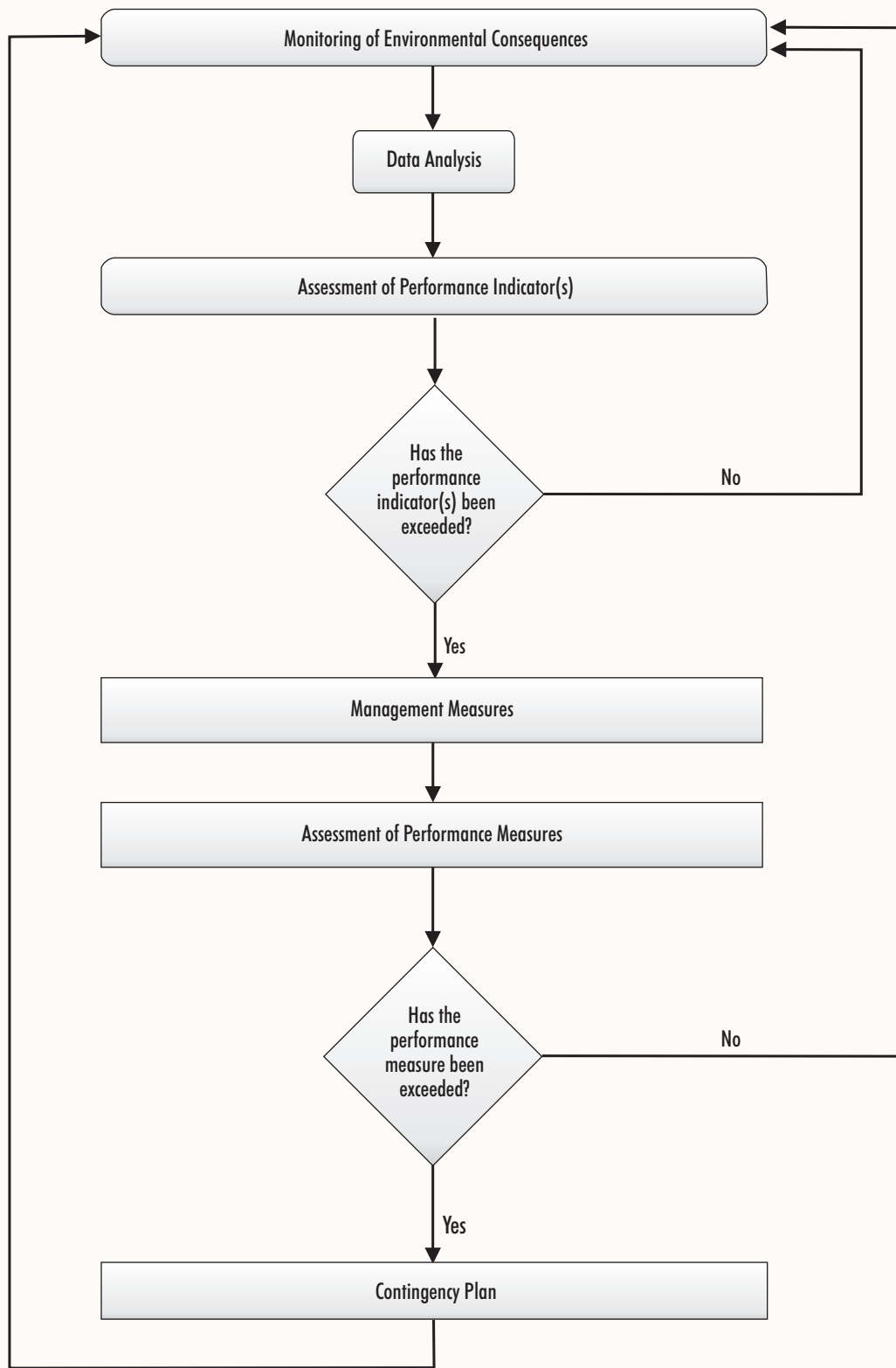
Performance Measure	Performance Indicator(s)
Negligible environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases) on the Waratah Rivulet between the full supply level of the Woronora Reservoir and the maingate of Longwall 23 (upstream of Pool P).	<ul style="list-style-type: none"> <li>No change to the natural drainage behaviour of Pools P, Q, R, S, T, U, V and W.</li> <li>Analysis of water level data for Pools P, T, U, V and W indicates the water level is at or above the pool's previous minimum.</li> <li>Analysis of water level data for Pools Q, R and S indicates the water levels are above that required to maintain water over the downstream rock bar.</li> <li>Visual inspection of the Waratah Rivulet from Pool P to the full supply level of the Woronora Reservoir does not show significant changes in the extent or nature of iron staining that isn't also occurring in the Woronora River (control site).</li> <li>Gas releases in Waratah Rivulet from Pool P to the full supply level of the Woronora Reservoir have not increased beyond those observed up to the commencement of Longwall 301 extraction.</li> </ul>
Negligible environmental consequences over at least 70% of the stream length (that is no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining and minimal gas releases) of the Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26.	<ul style="list-style-type: none"> <li>No change to the natural drainage behaviour of Pools ETAS, ETAT and ETAU.</li> <li>Analysis of water level data for Pools ETAS/ETAT and ETAU indicates the water levels are above that required to maintain water over the downstream rock bars.</li> <li>Gas releases in Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26 have not increased beyond those observed up to the commencement of Longwall 301 extraction.</li> </ul>

Monitoring against these performance indicators during the mining of Longwalls 305-307 is summarised in Table 8 and Section 3.7 and described in detail in Appendix A. The procedure that will be followed to assess the extraction of Longwalls 305-307 against the performance indicators and performance measures is outlined in Figure 13 and described in detail in the WMP (Appendix A).

Monitoring conducted in accordance with the Metropolitan Coal Longwalls 23-27 WMP identified that the following watercourse impact performance measure for the Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26 had been exceeded in relation to minimal iron staining and no diversion of flows/no change in the natural drainage behaviour of pools (emphasis added):

*Negligible environmental consequences over at least 70% of the stream length (that is **no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining** and minimal gas releases)*

Metropolitan Coal provided the DPIE with a proposed course of action in relation to the exceedance of the Eastern Tributary subsidence impact performance measure, focused on the implementation of stream remediation measures. In accordance with Condition 1, Schedule 6 of the Project Approval, Metropolitan Coal is required to restore surface flow and pool holding capacity on the Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26. Metropolitan Coal is committed to the remediation of pools on the Eastern Tributary.



### 3.1.4 Contingency Plan

In the event that a water resource or watercourse subsidence impact performance measure is exceeded, Metropolitan Coal will implement a Contingency Plan as described in the WMP and summarised in Section 4.1. Potential contingency measures for an exceedance of the water resource or watercourse performance measures include:

- The conduct of additional monitoring (e.g. increase in monitoring frequency or additional sampling) to inform the proposed contingency measures.
- The implementation of stream remediation measures to restore surface water flow/pool holding capacity.
- The implementation of revegetation measures to remediate impacts of gas releases on riparian vegetation.
- The purchase of water from Sydney Water in accordance with a license agreement established to the satisfaction of WaterNSW and the DPIE.
- The provision of a suitable offset(s) to compensate for the reduction in the quantity of water resources reaching the Woronora Reservoir. Examples of potential offsets include improvement works in the Woronora Reservoir water supply catchment.
- The implementation of adaptive management measures. Examples of adaptive management measures include stepping-around a longwall, the use of stand-offs (environmental pillar) from a particular location, or increasing the setback of the longwalls already subject to stand-off.

As indicated in Section 3.1.3 above, Metropolitan Coal will conduct stream remediation on the Eastern Tributary in response to the exceedance of the Eastern Tributary watercourse subsidence impact performance measure during the mining of Longwalls 23-27.

## 3.2 LAND MANAGEMENT

### 3.2.1 Overview

The LMP is provided in Appendix B. The purpose and scope of the LMP are summarised below:

**Purpose:** To manage the potential environmental consequences of the Extraction Plan on cliffs and overhangs, steep slopes and land in general.

**Scope:** Cliffs and overhangs, steep slopes and land in general during the mining of Longwalls 305-307.

### 3.2.2 Key Land Issues, Monitoring and Management Measures

Cliffs are defined as a continuous rock face, including overhangs, having a minimum height of 10 m and a slope of greater than 66°. Overhangs associated with cliffs and/or considered sensitive to potential mine subsidence movements (due to their location relative to the Waratah Rivulet) were also identified within the Project underground mining area (Figure 8).

Five cliff and overhang sites (sites COH11, COH12, COH13, COH16 and COH17) have been identified within the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour (Figure 8). An additional four cliffs (COH7, COH8, COH9 and COH10) are outside the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour but within 600 m of Longwalls 305-307. None of the cliffs are located directly above Longwalls 305-307. Detailed baseline recording for these sites has been conducted and is included in Appendix B.

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Visual inspections for subsidence impacts on cliff site COH17 will be conducted when Longwall 304 extraction is within 400 m of the site and at the completion of Longwall 304. Visual inspections for Longwalls 305-307 will be conducted at sites COH11, COH12, COH13, COH16 and COH17:

- prior to the commencement of Longwall 305 extraction;
- monthly at cliff site(s) located within 400 m of longwall extraction; and
- within three months of the completion of Longwall 305, Longwall 306 and Longwall 307.

The next nearest cliffs are located more than 600 m to the south-west of Longwalls 305-307 (Figure 8). At these distances, the cliffs are not expected to experience any measurable vertical subsidence resulting from the extraction of Longwalls 305-307 (Appendix B).

In the Project Approval, steep slopes are defined as an area of land having a natural gradient of between 33° and 66° (Figure 8). Steep slopes have been identified to highlight areas where existing ground slopes may be marginally stable. However, no significant slope failures have been observed in the Southern Coalfield as a result of longwall mining.

Land in general refers to the general landscape other than cliffs and steep slopes. There are rock ledges, also called rock outcrops and minor cliffs, which occur within 600 m of Longwalls 305-307 (Appendix B). Land in general includes other land features such as fire trails and vehicular tracks (Figure 8), however excludes surface features such as streams and upland swamps which are addressed in the WMP and BMP, respectively.

The key issues relating to subsidence impacts on land are described in the LMP and the relevant monitoring and management measures are summarised in Table 10 and Section 3.7.

### 3.2.3 Assessment of Performance Indicators and Measures

The Project Approval requires Metropolitan Coal not to exceed the subsidence impact performance measure relating to land, as specified in Table 1 of Condition 1, Schedule 3:

*Less than 3% of the total length of cliffs (and associated overhangs) within the mining area experience mining-induced rock fall.*

Metropolitan Coal will assess the Project against the following performance indicator:

*Cliff sites COH11, COH12, COH13, COH16 and/or COH17 experience cliff instabilities that do not require management measures to be implemented.*

Metropolitan Coal will assess steep slopes and land in general against the following performance indicator:

*Steep slopes and land in general experience sandstone fracturing/cracking and rock falls that do not require management measures to be implemented.*

Monitoring against the performance indicators and performance measure during the mining of Longwalls 305-307 is summarised in Table 10 and Section 3.7 and described in detail in Appendix B. The procedure that will be followed to assess the extraction of Longwalls 305-307 against the performance indicators and performance measure is outlined in Figure 13 and described in detail in the LMP (Appendix B).

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**Table 10**  
**Management Issues for Land during Longwalls 305-307 Extraction**

Issue	Approved Impact	Monitoring	Management
Cliffs and overhangs	<ul style="list-style-type: none"> <li>Less than 3% of the total length of cliffs (and associated overhangs) within the mining area experience mining-induced rock fall.</li> </ul>	<p>Monitoring in accordance with the LMP, including visual observations of:</p> <ul style="list-style-type: none"> <li>Cliff instabilities or cracking.</li> <li>Sandstone fracturing.</li> <li>Rock falls.</li> </ul> <p>Subsidence monitoring in accordance with the SMP.</p>	<ul style="list-style-type: none"> <li>Stabilisation techniques including: <ul style="list-style-type: none"> <li>Installation of artificial rock support.</li> <li>Installation of standing supports.</li> </ul> </li> <li>Improvement of appearance including: <ul style="list-style-type: none"> <li>Application of product to enhance the weathered appearance of a cliff face.</li> <li>Planting of endemic native vegetation.</li> </ul> </li> <li>Implementation of erosion and sediment controls.</li> <li>Permanent filling of surface tension cracks.</li> <li>Measures to address safety hazards.</li> </ul>
Steep slopes and land in general	<ul style="list-style-type: none"> <li>Sandstone fracturing (including surface tension cracking) and subsequent rock falls consistent with that observed during the extraction of previous longwalls at Metropolitan Coal.</li> </ul>		



### 3.2.4 Contingency Plan

In the event that subsidence impacts observed exceed the land subsidence impact performance measure, Metropolitan Coal will implement a Contingency Plan as described in the LMP and summarised in Section 4.1.

## 3.3 BIODIVERSITY MANAGEMENT

### 3.3.1 Overview

The BMP is provided in Appendix C. The purpose and scope of the BMP are summarised below:

- Purpose:** To manage the potential environmental consequences of the Extraction Plan on aquatic and terrestrial flora and fauna, with a specific focus on swamps.
- Scope:** Aquatic and terrestrial flora and fauna (including swamps) during the mining of Longwalls 305-307.

### 3.3.2 Key Biodiversity Issues, Monitoring and Management Measures

Eighteen upland swamps are located within the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour (Swamps 40, 41, 46, 47, 48, 49, 50, 51/52, 53, 58, 69, 70, 71a, 71b, 72, 73, 84 and 86) (Figures 5 and 8). All of these swamps are valley side swamps.

Riparian vegetation and habitats for aquatic biota occur along streams which flow to the Woronora Reservoir (Figure 9). No threatened aquatic biota listed under the *Fisheries Management Act, 1994*, *NSW Biodiversity Conservation Act, 2016* (BC Act) or *Commonwealth Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) have been recorded within the Project underground mining area.

Vegetation communities mapped on slopes and ridgetops within 600 m of Longwalls 305-307 secondary extraction include woodlands on sandstone or lateritic soils, heaths and mallee heaths, sandstone forests and disturbed land (Figure 9).

The cliffs and overhangs, steep slopes, and land in general described in Section 3.2 also provide habitat for terrestrial flora and fauna.

A number of threatened terrestrial flora and fauna species listed under the BC Act or EPBC Act are known to occur, or have the potential to occur within the Project underground mining area or surrounds. No endangered flora or fauna populations occur within the Project underground mining area or surrounds.

Endangered Ecological Communities (EECs) listed under the BC Act at the time of Project Approval and identified as occurring in the Project underground mining area or surrounds includes the Southern Sydney Sheltered Forest on Transitional Sandstone Soils in the Sydney Basin Bioregion EEC and the O'Hares Creek Shale Forest EEC. An occurrence of the Southern Sydney Sheltered Forest on Transitional Sandstone Soils in the Sydney Basin Bioregion EEC is situated to the north of Longwall 301 and outside of the Longwalls 305-307 35° angle of draw and/or 20 mm subsidence contour (Figure 9).

The key issues relating to subsidence impacts on biodiversity are described in the BMP and the relevant monitoring and management measures are summarised in Table 11 and Section 3.7.

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Other subsidence impact performance measures and indicators of relevance to biodiversity include the water resource and watercourse performance measures detailed in the WMP and the land subsidence impact performance measure detailed in the LMP.

**Table 11**  
**Management Issues for Biodiversity during Longwalls 305-307 Extraction**

Issue	Approved Impact	Monitoring	Management
Threatened species, populations, or ecological communities	Negligible impact	<b><i>Upland Swamps</i></b> <ul style="list-style-type: none"> <li>Vegetation monitoring. <ul style="list-style-type: none"> <li>Visual inspections.</li> <li>Transect/quadrat monitoring.</li> <li>Indicator species.</li> </ul> </li> <li>Groundwater monitoring.</li> </ul>	<ul style="list-style-type: none"> <li>Swamp remediation techniques.</li> <li>Additional monitoring (e.g. increase in monitoring frequency or additional sampling).</li> </ul>
		<b><i>Riparian Vegetation</i></b> <ul style="list-style-type: none"> <li>Vegetation monitoring. <ul style="list-style-type: none"> <li>Visual inspections.</li> <li>Quadrat monitoring.</li> <li>Indicator species.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Stream remediation.</li> <li>Weed control measures.</li> <li>Planting of endemic species.</li> <li>Stream bank erosion control measures in accordance with the WMP.</li> <li>Management measures for impacts associated with cliffs and overhang sites include: <ul style="list-style-type: none"> <li>the implementation of erosion and sediment control measures; and</li> <li>stabilisation techniques;</li> </ul> in accordance with the LMP. </li> <li>Additional monitoring (e.g. increase in monitoring frequency or additional sampling).</li> </ul>
		<b><i>Slopes and Ridgetops</i></b> <ul style="list-style-type: none"> <li>Visual inspections of cliffs and overhangs, steep slopes and land in general.</li> </ul>	<ul style="list-style-type: none"> <li>Management measures for impacts associated with cliffs and overhang sites include: <ul style="list-style-type: none"> <li>the implementation of erosion and sediment control measures; and</li> <li>stabilisation techniques;</li> </ul> in accordance with the LMP. </li> <li>Filling of surface tension cracks in accordance with the LMP.</li> </ul>
		<b><i>Aquatic Biota and their Habitats</i></b> <ul style="list-style-type: none"> <li>Watercourses (i.e. aquatic habitats) in accordance with WMP.</li> <li>Aquatic biota stream monitoring.</li> </ul> Aquatic biota pool monitoring.	<ul style="list-style-type: none"> <li>Mine planning and design: <ul style="list-style-type: none"> <li>Conservative mining geometry.</li> <li>Shortening of Longwalls 303, 304 and 305.</li> </ul> </li> <li>Adaptive management – Eastern Tributary Valley Closure TARP.</li> <li>Stream remediation.</li> <li>Additional monitoring (e.g. increase in monitoring frequency or additional sampling).</li> </ul>

**Table 11 (Continued)**  
**Management Issues for Biodiversity during Longwalls 305-307 Extraction**

Issue	Approved Impact	Monitoring	Management
Threatened species, populations, or ecological communities (Cont.)	Negligible impact (Cont.)	<p><b><i>Terrestrial Fauna and their Habitats</i></b></p> <ul style="list-style-type: none"> <li>Terrestrial fauna habitats, as discussed for upland swamps, riparian vegetation, slopes and ridgetops and aquatic habitats above.</li> <li>Amphibian monitoring.</li> </ul>	<ul style="list-style-type: none"> <li>Mine planning and design: <ul style="list-style-type: none"> <li>Conservative mining geometry.</li> <li>Shortening of Longwalls 303, 304 and 305.</li> </ul> </li> <li>Adaptive management – Eastern Tributary Valley Closure TARP.</li> <li>Swamp remediation techniques.</li> <li>Stream remediation.</li> <li>Weed control measures.</li> <li>Planting of endemic species.</li> <li>Stream bank erosion control measures in accordance with the WMP.</li> <li>Management measures for impacts associated with cliffs and overhang sites include: <ul style="list-style-type: none"> <li>the implementation of erosion and sediment control measures; and</li> <li>stabilisation techniques; in accordance with the LMP.</li> </ul> </li> <li>Filling of surface tension cracks in accordance with the LMP.</li> <li>Additional monitoring (e.g. increase in monitoring frequency or additional sampling).</li> </ul>

### 3.3.3 Assessment of Performance Indicators and Measure

Performance indicators developed for the subsidence impact performance measure relating to biodiversity are presented in the BMP and are summarised in Table 12.

**Table 12**  
**Biodiversity Performance Measure and Performance Indicators**

Performance Measure	Performance Indicators
Negligible impact to threatened species, populations, or ecological communities.	<p><b>Upland Swamps</b></p> <ul style="list-style-type: none"> <li>The vegetation in upland swamps is not expected to experience changes significantly different to vegetation in control swamps.</li> <li>Surface cracking within upland swamps resulting from mine subsidence is not expected to result in measurable changes to swamp groundwater levels when compared to control swamps or seasonal variations in water levels experienced by upland swamps prior to mining.</li> </ul> <p><b>Riparian Vegetation</b></p> <ul style="list-style-type: none"> <li>Impacts to riparian vegetation are expected to be localised and limited in extent, similar to the impacts previously experienced at Metropolitan Coal.</li> </ul> <p><b>Aquatic Biota</b></p> <ul style="list-style-type: none"> <li>The aquatic macroinvertebrate and macrophyte assemblages in streams are not expected to experience long-term impacts as a result of mine subsidence.</li> </ul> <p><b>Terrestrial Fauna</b></p> <ul style="list-style-type: none"> <li>The amphibian assemblage is not expected to experience changes significantly different to the amphibian assemblage at control sites.</li> </ul>

Monitoring against these performance indicators during the mining of Longwalls 305-307 is summarised in Table 11 and Section 3.7 and described in detail in the BMP (Appendix C). The procedure that will be followed to assess the extraction of Longwalls 305-307 against the performance indicators and performance measures is outlined in Figure 13 and described in detail in the BMP.

### 3.3.4 Contingency Plan

In the event the subsidence impact performance measure for threatened species, populations or ecological communities is considered to have been exceeded, Metropolitan Coal will implement a Contingency Plan as described in the BMP and summarised in Section 4.1.

## 3.4 HERITAGE MANAGEMENT

### 3.4.1 Overview

The HMP is provided in Appendix D. The purpose and scope of the HMP are summarised below:

**Purpose:** To manage the potential environmental consequences of the Extraction Plan on Aboriginal heritage sites or values.

**Scope:** Aboriginal heritage sites or values that could experience subsidence effects during the mining of Longwalls 305-307.

### 3.4.2 Key Aboriginal Heritage Issues, Monitoring and Management Measures

Thirty-five known sandstone overhang sites are located within the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour (Figure 10). Of the 35 sites with overhangs, 13 have art only and 22 have art and/or artefacts and/or a deposit or Potential Archaeological Deposit. One open site is located within the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour (site FRC 101, an open site with grinding grooves). Twelve of these sites are located over Longwalls 305-307.

Five Aboriginal heritage sites of high archaeological significance and/or particular cultural significance are located within the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour (Figure 10). Site FRC 185 is of high archaeological significance and particular cultural significance, Sites FRC 68 and FRC 191 are of high archaeological significance, and sites FRC 198 and FRC 316 are of particular cultural significance.

A geotechnical risk assessment report was prepared for the sites of high archaeological significance and/or particular cultural significance within the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour, provided as Appendix 3 of the HMP (Appendix D).

Metropolitan Coal acknowledges that all Aboriginal heritage sites are of cultural significance to the Aboriginal people who have a traditional connection to Country.

The key issues relating to subsidence impacts on Aboriginal heritage sites and values are described in the HMP and the relevant monitoring and management measures are summarised in Table 13 and Section 3.7.

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**Table 13**  
**Management Issues for Aboriginal Heritage during Longwalls 305-307 Extraction**

Issue	Approved Impact	Monitoring	Management
Aboriginal heritage sites	Less than 10% of Aboriginal heritage sites within the mining area are affected by subsidence impacts.	<ul style="list-style-type: none"> <li>Aboriginal heritage sites.</li> </ul>	<ul style="list-style-type: none"> <li>Installation of an artificial dripline (e.g. silicone dripline) to direct increased moisture/water seepage away from art panels.</li> <li>Installation of artificial rock support (e.g. rock bolts, cable bolts, cement sprays [e.g. shotcrete], injections of a binding agent [PUR or similar]).</li> <li>Installation of standing supports (e.g. timber props, timber cogs, sandbags and metal [hydraulic] props).</li> <li>Scaling/dislodgement/removal of remaining loose rock.</li> <li>Salvage of artefacts for safekeeping and storage and/or display at a suitable location in consultation with the Aboriginal community.</li> <li>Use of cosmetic treatments (e.g. in the form of coloured grout or similar) to restore aesthetic values.</li> <li>Installation of a stress relief slot or stress focus notch.</li> </ul>

### 3.4.3 Assessment of Performance Indicators and Measure

The Project Approval requires Metropolitan Coal not to exceed the subsidence impact performance measure relating to Aboriginal heritage sites, as specified in Table 1 of Condition 1, Schedule 3:

*Less than 10% of Aboriginal Heritage sites within the mining area are affected by subsidence impacts.*

The performance indicator developed for the subsidence impact performance measure relating to Aboriginal heritage sites is presented in the HMP and is summarised in Table 14.

Monitoring against the performance indicator during the mining of Longwalls 305-307 is summarised in Table 13 and Section 3.7 and described in detail in the HMP (Appendix D). The procedure that will be followed to assess the extraction of Longwalls 305-307 against the performance indicator and performance measure is outlined in Figure 13 and described in detail in the HMP (Appendix D).

**Table 14**  
**Heritage Performance Measure and Performance Indicator**

Performance Measure	Performance Indicator
Less than 10% of Aboriginal heritage sites within the mining area are affected by subsidence impacts.	<p>Metropolitan Coal will assess the Project against the following performance indicator to allow early recognition of mining impacts:</p> <p><i>Less than 7% of Aboriginal heritage sites within the mining area are affected by subsidence impacts.</i></p> <p>Sites are considered to be “affected by subsidence impacts” if they exhibit one or more the following consequences that cannot be attributed to natural weathering or deterioration:</p> <ul style="list-style-type: none"> <li>overhang collapse;</li> <li>cracking of sandstone that coincides with Aboriginal art or grinding grooves; and</li> <li>rock fall that damages Aboriginal art.</li> </ul>

### 3.4.4 Contingency Plan

In the event the Aboriginal heritage sites subsidence impact performance measure has been exceeded, Metropolitan Coal will implement a Contingency Plan as described in the HMP and summarised in Section 4.1.

## 3.5 BUILT FEATURES MANAGEMENT

### 3.5.1 Overview

The BFMP is provided in Appendix E and includes component plans for the individual infrastructure owners. The purpose and scope of the BFMP are summarised below:

- Purpose:** To manage the potential environmental consequences of the Extraction Plan on built features.
- Scope:** Built features that could experience subsidence effects during the mining of Longwalls 305-307.

### 3.5.2 Key Built Features Issues, Monitoring and Management Measures

Built features within the vicinity of Longwalls 305-307 consist of (Figures 11a, 11b and 12):

- telecommunication towers and compounds (Telstra, Axicom and Sydney Trains);
- telecommunication (e.g. optical fibre, copper) cabling (Telstra, Vocus, Optus, Garrawarra Centre Complex);
- underground water mains (Sydney Water);
- Waterfall General (Garrawarra) Cemetery;
- public roads (M1 Princes Motorway [RMS] and Old Princes Highway [Wollongong City Council, WCC]) and associated infrastructure (e.g. culverts, cuttings, roadside furniture);
- private roads (Garrawarra Centre Complex);
- bridges (RMS);
- Illawarra Railway (Sydney Trains);
- local power distribution and wooden poles (Endeavour Energy, Garrawarra Centre Complex);
- electricity transmission lines and transmission structures (330 kilovolt [kV] [TransGrid] and 132 kV [Endeavour Energy]);
- access roads/tracks (including fire trails and vehicular tracks);
- water storage tanks (Garrawarra Centre Complex);
- gas storage tank and connecting pipelines (Garrawarra Centre Complex);
- aged care (occupied) buildings (Garrawarra Centre Complex);
- abandoned buildings (Garrawarra Centre Complex); and
- houses and associated infrastructure (Garrawarra Centre Complex).

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Longwalls 305-307 BFMP component plans for the Vocus infrastructure and the Waterfall General (Garrawarra) Cemetery have not been developed, as these features are not predicted to experience any measurable conventional subsidence, tilts or curvatures due to the extraction of Longwalls 305-307. The access roads/tracks (including fire trails and vehicular tracks) will be managed in accordance with the LMP and the BFMP component plans.

Appendix I of the Extraction Plan (Subsidence Report) also assesses potential subsidence effects, impacts and environmental consequences of other built features not subject to the component plans including survey marks, exploration boreholes and the Woronora Dam.

The key issues relating to management of built features in regard to subsidence impacts are described in the relevant component plans of the BFMP (Appendix E). The relevant monitoring and management measures for these built features are summarised in Table 15 and Section 3.7.

### 3.5.3 Assessment of Performance Indicators and Measures

The subsidence impact performance measure specified in Table 1 of Condition 1, Schedule 3 of the Project Approval in relation to built features is:

*Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing.*

Performance indicators developed for the subsidence impact performance measure relating to built features are presented in the component plans of the BFMP and are summarised in Table 15. Monitoring against the performance indicators is described in detail in the component plans of the BFMP and summarised in Table 15 and Section 3.7.

Of specific relevance to the Garrawarra Centre Complex, a subsidence impact performance measure outlined in Table 1 of Condition 1, Schedule 3 in relation to items of historical or heritage significance at the Garrawarra Centre Complex is:

*Negligible damage (that is fine or hairline cracks that do not require repair), unless the owner of the item and the appropriate heritage authority agree otherwise in writing.*

Performance indicators developed for the subsidence impact performance measure relating to items of historical or heritage significance are presented in the Garrawarra Centre Complex component of the BFMP, and are summarised in Table 15. Monitoring conducted against the performance indicators is described in detail in the Garrawarra Centre Complex component of the BFMP and is summarised in Table 15 and Section 3.7.

The procedure followed to assess the extraction of Longwalls 305-307 against the performance indicators and performance measures is outlined in Figure 13 and described in detail in the component plans of the BFMP (Appendix E).

### 3.5.4 Contingency Plan

In the event that a subsidence impact performance measure relating to built features is considered to have been exceeded, Metropolitan Coal will implement a Contingency Plan as described in detail in the component plans of the BFMP and summarised in Section 4.1.

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**Table 15**  
**Built Features Performance Indicators, Monitoring and Management Measures**

Built Features	Performance Indicator(s)	Monitoring	Relevant Management Measures
Garrawarra Centre Complex (NSW Health) abandoned hospital buildings, aged care building structures and houses and associated infrastructure, water storage tanks, trickle filter tank, gas storage tank, kiln and telecommunications towers and associated compounds	<ul style="list-style-type: none"> <li>No greater tilt impacts to buildings than Category A or B for items of historical or heritage significance.</li> <li>No greater strain impact to buildings than Category 0 or 1 for items of historical or heritage significance.</li> <li>No more than repairable (minor) defects (cracks, etc.) in the structural integrity for all other buildings, houses, structures and other services due to mining.</li> <li>The electrical clearance from vegetation is maintained.</li> <li>Serviceability of the private roads and access roads/tracks has been maintained.</li> <li>The land in general is expected to experience minor cracking consistent with that observed during the extraction of previous longwalls at Metropolitan Coal (i.e. no more than minor cracking).</li> </ul>	<ul style="list-style-type: none"> <li>Subsidence, tilt, tensile strain and compressive strain.</li> <li>Structural integrity.</li> <li>Cracking at pre-existing rock joints.</li> <li>Tilt at pre-existing tilted piers.</li> <li>Opening and closing of joints.</li> <li>Leaks.</li> <li>Cracking in columns, elevated ring beam or central access shaft.</li> <li>Structural integrity of the telecommunications tower and compound.</li> <li>Electrical clearance from vegetation.</li> <li>Cracks or leaks in the pipelines.</li> <li>Surface cracks, buckling and general safety.</li> </ul>	<p>A number of potential management measures in relation to the Garrawarra Centre Complex are considered to be applicable. These include:</p> <ul style="list-style-type: none"> <li>For buildings or houses requiring repairs, normal building maintenance techniques could be applied in consultation with NSW Health and relevant authorities.</li> <li>For the water storage tanks, if the tank base or lower sections of the tank walls were to develop leakage or if pre-existing leakage were to increase, the tank could be temporarily drained and lined with high-density polyethylene to establish a watertight envelope. For water pipelines, leaks could be remediated by locally exposing the pipeline and repairing or replacing the affected section.</li> <li>For powerlines and poles, management measures may include alteration of conductor tensions or strengthening of timber poles footings.</li> <li>For the kiln, a barrier fence will be erected to maintain an exclusion zone with a radius of 1.5 times the chimney height during active mining (i.e. which may result in impact on the kiln up to Longwall 303).</li> </ul> <p>Management measures for access roads/tracks will be implemented in accordance with the LMP.</p> <p>Management measures for other services at the Garrawarra Centre Complex have also been developed separately with each asset owner in the BFMPs (e.g. Endeavour Energy, Sydney Water, Telstra, Axicom and Sydney Trains).</p> <p>Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.</p>



**Table 15 (Continued)**  
**Built Features Performance Indicators, Monitoring and Management Measures**

Built Features	Performance Indicator(s)	Monitoring	Relevant Management Measures
Endeavour Energy 132 kV transmission line and towers and other high voltage powerlines and poles	<ul style="list-style-type: none"> <li>The structural integrity of the 132 kV transmission lines and towers is maintained.</li> <li>The structural integrity of the timber poles and high voltage powerlines is maintained.</li> <li>The electrical clearance from vegetation is maintained.</li> <li>The serviceability of the access roads/tracks is maintained.</li> </ul>	<ul style="list-style-type: none"> <li>Subsidence, tilt, tensile strain, compressive strain, absolute horizontal translation, and differential leg movement.</li> <li>Degradation of tower structure.</li> <li>Degradation of tower foundations/footings.</li> <li>Vegetation, land and road clearance.</li> <li>Movement of insulator strings/conductors.</li> <li>Surface cracks, buckling, and general safety.</li> </ul>	<p>A number of potential management measures in relation to 132 kV towers and transmission lines and other high voltage powerlines and poles are considered to be applicable. These include:</p> <ul style="list-style-type: none"> <li>alteration of conductor tensions;</li> <li>modification to attachment points such as placement of stringing sheaves to earth wires and/or phase conductors;</li> <li>strengthening of tower structures through installation of cruciform footings; and</li> <li>strengthening of timber poles' footings.</li> </ul> <p>Management measures for access roads/tracks will be implemented in accordance with the LMP.</p> <p>Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.</p>
TransGrid 330 kV transmission line and towers	<ul style="list-style-type: none"> <li>The structural integrity of the transmission line and towers is maintained.</li> <li>The electrical clearance from vegetation is maintained.</li> <li>The serviceability of access roads/tracks is maintained.</li> </ul>	<ul style="list-style-type: none"> <li>Subsidence, tilt, tensile strain, compressive strain, absolute horizontal translation and differential leg movement.</li> <li>Surface cracks, buckling and general safety.</li> <li>Real-time survey monitoring trial.</li> <li>Degradation of tower foundations/footings.</li> <li>Movement of insulator strings.</li> <li>Vegetation, land and road clearance.</li> <li>Visual check by TransGrid of earthwire/optical ground wire and conductor movement, and integrity and function of support clamps.</li> <li>Calculation of differential leg movement.</li> </ul>	<p>A number of potential management measures considered to be applicable to transmission lines, include:</p> <ul style="list-style-type: none"> <li>alteration of conductor tensions;</li> <li>installation of temporary structures;</li> <li>modification to attachment points such as placement of stringing sheaves to earth wires and/or phase conductors; and</li> <li>strengthening of tower structures (e.g. through installation of cruciform footings).</li> </ul> <p>Management measures for access roads/tracks will be implemented in accordance with the LMP.</p> <p>Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.</p>

**Table 15 (Continued)**  
**Built Features Performance Indicators, Monitoring and Management Measures**

<b>Built Features</b>	<b>Performance Indicator(s)</b>	<b>Monitoring</b>	<b>Relevant Management Measures</b>
Optus optical fibre cables	<ul style="list-style-type: none"> <li>Negligible transmission loss from mine subsidence impacts.</li> <li>The structural integrity of the cable lines and associated facilities is maintained.</li> <li>The serviceability of the access roads/tracks is maintained.</li> </ul>	<ul style="list-style-type: none"> <li>Subsidence, tilt, tensile strain and compressive strain.</li> <li>Signal integrity.</li> <li>Movement of conduit, degree of freedom of cable in conduit, ground compression/tension.</li> <li>Surface cracks, buckling and general safety.</li> </ul>	<p>A number of potential management measures in relation to cable lines are considered to be applicable.</p> <p>Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.</p>
Telstra telecommunications tower and compound, optical fibre cables, associated infrastructure and copper telecommunication cables	<ul style="list-style-type: none"> <li>Negligible transmission loss in fibre optic cables from mine subsidence impacts.</li> <li>Structural integrity of the cable line and associated facilities is maintained.</li> <li>Serviceability of the access roads/tracks is maintained.</li> </ul>	<ul style="list-style-type: none"> <li>Subsidence, tilt, tensile strain and compressive strain.</li> <li>Signal integrity.</li> <li>Surface cracks, buckling and general safety.</li> </ul>	<p>A number of potential management measures in relation to cable lines are considered to be applicable. These are described in the Telstra Management Plan Agreement (Appendix E).</p> <p>Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.</p>

**Table 15 (Continued)**  
**Built Features Performance Indicators, Monitoring and Management Measures**

Built Features	Performance Indicator(s)	Monitoring	Relevant Management Measures
RMS M1 Princes Motorway, Bridge 2 and Cawley Road Overbridge	<ul style="list-style-type: none"> <li>Measured absolute horizontal movements.</li> <li>Distortion of bridge elements.</li> <li>Cracking of bridge elements.</li> <li>Pavement cracking and deformation.</li> <li>Visual consequence of slope movement.</li> <li>Defects in culverts.</li> </ul>	<ul style="list-style-type: none"> <li>Subsidence, tilt, tensile strain and compressive strain.</li> <li>Horizontal movement.</li> </ul> <p><i>Bridge 2</i></p> <ul style="list-style-type: none"> <li>Real-time survey monitoring.</li> <li>Monitoring of movements including: Absolute three dimensional (3D) movement of the survey reference pillar, relative 3D movements of all bridge monitoring points, changes in length of Fibre Bragg Grating (FBG) sensors and tilts of FBG tiltmeters.</li> <li>Visual inspection for impacts on: abutments, pier frames, elastomeric bearings, soffits of girders, deck expansion joints, steel traffic barrier joints and other areas of substructure and adjoining areas including concrete paths, stairs, and slope protection.</li> </ul> <p><i>Cawley Road Overbridge</i></p> <ul style="list-style-type: none"> <li>Real-time survey monitoring.</li> <li>Monitoring of movements including: absolute 3D movement of the survey reference pillar and relative 3D movements of all bridge monitoring points.</li> <li>Visual inspection for impacts on: abutments, pier blade wall, Tetron bearings, deck expansion joints, steel traffic barrier joints and safety screen joints.</li> </ul>	<p>A number of general management measures in relation to RMS assets are applicable. These include:</p> <ul style="list-style-type: none"> <li>review of scope and frequency of monitoring;</li> <li>site inspections;</li> <li>review by relevant specialists;</li> <li>initiate traffic management procedures;</li> <li>review of potential factors contributing to the exceedance of the performance trigger including review of subsidence measurements and predictions; and</li> <li>review of effectiveness of management measures.</li> </ul> <p>Potential management measures that can be implemented for Bridge 2 and Cawley Road Overbridge include repair of cracked elements where the crack width is within the acceptable limit. This can be carried out after ground movements due to mining have ceased as their presence during mining does not affect to safe operation of the bridge.</p>

**Table 15 (Continued)**  
**Built Features Performance Indicators, Monitoring and Management Measures**

Built Features	Performance Indicator(s)	Monitoring	Relevant Management Measures
RMS M1 Princes Motorway, Bridge 2 and Cawley Road Overbridge (Cont.)	As above.	<p><i>Other Relevant Infrastructure</i></p> <ul style="list-style-type: none"> <li>Monitoring of movements including absolute 3D movement of the survey reference pillar, and relative 3D movements of Towers TL11-104 to TL11-108, including: <ul style="list-style-type: none"> <li>subsidence line along the transmission line;</li> <li>tower legs; and</li> <li>four ground points at each tower.</li> </ul> </li> <li>Visual inspection for impacts on: asphaltic concrete surface, kerbs, gutters and pits, signs or other road infrastructure, cuttings along the M1 Princes Motorway and closed circuit television (CCTV) inspection for impacts on internal surfaces of culverts.</li> </ul>	<p>A number of potential management measures in relation to the M1 Princes Motorway pavement are considered to be applicable. These include:</p> <ul style="list-style-type: none"> <li>mill and replace pavement layers;</li> <li>slotting; and</li> <li>crack sealing.</li> </ul> <p>A number of potential management measures in relation to cuttings are considered to be applicable. These include:</p> <ul style="list-style-type: none"> <li>rock bolting;</li> <li>scaling;</li> <li>shotcreting;</li> <li>installation of rockfall mesh;</li> <li>installation of barriers; and</li> <li>trimming of the cut face.</li> </ul> <p>A number of potential management measures in relation to culverts are considered to be applicable. These include:</p> <ul style="list-style-type: none"> <li>point repairs;</li> <li>lining;</li> <li>grouting; and</li> <li>culvert replacement.</li> </ul>

**Table 15 (Continued)**  
**Built Features Performance Indicators, Monitoring and Management Measures**

Built Features	Performance Indicator(s)	Monitoring	Relevant Management Measures
WCC Old Princes Highway	<ul style="list-style-type: none"> <li>No pavement cracking exceeding 5 mm, or other defects of the road pavement resulting in deterioration of ride quality.</li> <li>No ponding of water on the road surface as a result of changes in grade from subsidence associated with Longwalls 305-307.</li> <li>No joint displacement or cracking or other defects of the drainage structure (e.g. pipes/culverts) in excess of 5 mm.</li> <li>Serviceability of guard rails, marker posts and signage is maintained.</li> </ul>	<ul style="list-style-type: none"> <li>Subsidence, tilt, tensile strain and compressive strain.</li> <li>Impacts to the surface including cracks, buckling and stepping.</li> <li>Impacts to the visible surfaces of pipes/culverts including cracking, buckling, shearing and collapse.</li> <li>Visible impacts to furniture.</li> </ul>	<p>A number of potential management measures in relation to the Old Princes Highway pavement, drainage structures and other furniture are considered to be applicable. These include:</p> <ul style="list-style-type: none"> <li>mill and/or replace pavement layers;</li> <li>crack sealing/repair;</li> <li>point repairs;</li> <li>replace sections of pipe/culvert;</li> <li>grouting/sealing of cracks; and</li> <li>repair/replacement of furniture.</li> </ul> <p>In the event that repairs are required, traffic control measures such as contra-flow of traffic or partial carriageway closures may be used to divert traffic off one carriageway, lane or shoulder. Repairs would be carried out as soon as practicable in consultation with the WCC.</p> <p>Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.</p>

**Table 15 (Continued)**  
**Built Features Performance Indicators, Monitoring and Management Measures**

Built Features	Performance Indicator(s)	Monitoring	Relevant Management Measures
Sydney Water water pipelines	<ul style="list-style-type: none"> <li>No more than repairable (minor) leakages of the water pipelines occur due to mining.</li> <li>No more than repairable (minor) defects (cracks, etc.) in the structural integrity of the pipes and associated connections occur due to mining.</li> </ul>	<ul style="list-style-type: none"> <li>Subsidence, tilt, tensile strain and compressive strain.</li> <li>Surface ground cracks.</li> <li>Cracks or leaks in the pipelines.</li> <li>Leakage in pipeline.</li> <li>Acoustic monitoring.</li> </ul>	<p>A number of potential management measures in relation to pipelines are considered to be applicable. These include:</p> <ul style="list-style-type: none"> <li>repair of broken pipes or fittings by Sydney Water maintenance staff; and</li> <li>if major adjustment is required to re-align pipe, the pipe can be temporarily end capped to maintain supply to customers either side of break and/or alternative water supply provided to service properties while repair of water main is in progress.</li> </ul> <p>Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.</p>
Sydney Trains telecommunications tower (and compound)	<ul style="list-style-type: none"> <li>The structural integrity of the telecommunications tower (and compound) is maintained.</li> </ul>	<ul style="list-style-type: none"> <li>Subsidence, tilt, tensile strain and compressive strain.</li> <li>Any defects or deformation of the rail line and associated infrastructure.</li> <li>Structural integrity of the telecommunications tower and compound.</li> </ul>	<p>Potential management measures for the telecommunications tower and compound include pre-mining bracing and/or changing splice plates to relieve any mining induced stress and/or implementation of building maintenance techniques.</p> <p>Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.</p>
Axicom telecommunications tower (and compounds)	<ul style="list-style-type: none"> <li>Structural integrity of the telecommunications towers and compounds has been maintained.</li> <li>Serviceability of the access roads/tracks has been maintained.</li> </ul>	<ul style="list-style-type: none"> <li>Subsidence, tilt, tensile strain and compressive strain, absolute horizontal translation, and differential leg movements.</li> <li>Structural integrity of the compounds.</li> <li>Surface cracks, buckling and general safety.</li> </ul>	<p>A number of potential management measures in relation to telecommunications towers and compounds are considered to be applicable and further measures are summarised in the BFMP (Appendix E).</p> <p>Management measures for access roads/tracks will be implemented in accordance with the LMP.</p> <p>Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.</p>

### 3.6 PUBLIC SAFETY MANAGEMENT

#### 3.6.1 Overview

The PSMP is provided in Appendix F. The purpose and scope of the PSMP are summarised below:

- Purpose:** To manage the potential consequences of the Extraction Plan on public safety within the mining area.
- Scope:** Land within the mining area where potential risks to the public could be encountered.

#### 3.6.2 Key Public Safety Issues, Monitoring and Management Measures

The primary hazards associated with the extraction of Longwalls 305-307 include:

- potential subsidence impacts on built features;
- potential instability of cliff formations or steep slopes caused by subsidence;
- deformations or fracturing of any land caused by subsidence; and
- any other impacts of subsidence.

A large proportion of the land within 600 m of Longwalls 305-307 is owned and/or managed by WaterNSW or The State of NSW (Crown Land), and therefore accessibility to the general public is restricted (Figure 7). The general public are not allowed in the Woronora Special Area for any recreational or other purpose. Access restrictions are also applicable to some of the identified built features in the vicinity of Longwalls 305-307.

Longwalls 305-307 are located within the Woronora Notification Area (Figure 2). At its closest point to Longwalls 305-307, the Woronora Dam wall is located approximately 6.4 km from the commencing end of Longwall 307 and the distance from the labyrinth spillway, which is to the south of the dam wall, is approximately 6 km (Figure 1). The dam wall and spillway are located at large distances from Longwalls 305-307. It is not expected that measurable conventional subsidence movements would occur at the dam wall and spillway (Appendix I). In addition, it is unlikely that non-conventional subsidence movements would be observed at the distances of the dam wall and spillway from Longwalls 305-307 (Appendix I).

Metropolitan Coal is required to obtain all necessary approvals from the Minister administering the NSW *Mining Act, 1992* in accordance with the requirements of the NSW *Dams Safety Act, 2015* and the DSC.

The key issues relating to potential risks to public safety during the extraction of Longwalls 305-307 are described in the PSMP (Appendix F). The relevant monitoring and management measures are summarised in Table 16 and Section 3.7.

**Table 16**  
**Management Issues for Public Safety during Longwalls 305-307 Extraction**

Issue	Approved Impact	Monitoring	Management
Public Safety	<ul style="list-style-type: none"> <li>Public safety to be ensured within the mining area.</li> <li>Built features – Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing.</li> </ul>	<ul style="list-style-type: none"> <li>Monitoring in accordance with the LMP.</li> <li>Monitoring in accordance with the BFMP.</li> </ul>	<ul style="list-style-type: none"> <li>Restricted access.</li> <li>Woronora Special Areas Consent.</li> <li>Woronora Special Area Catchment Induction.</li> <li>Management of roads/tracks (including fire trails and vehicular tracks) in accordance with the LMP and BFMP.</li> <li>Management of built features in accordance with the BFMP.</li> <li>DSC approval requirements.</li> <li>Consultation with landowners and infrastructure owners.</li> <li>Other management measures in relation to public safety may include: <ul style="list-style-type: none"> <li>traffic control including diversion of traffic;</li> <li>temporary speed restrictions;</li> <li>warning signs/lights;</li> <li>restriction of public access;</li> <li>erection of barriers;</li> <li>implementation of security services; and</li> <li>use of emergency services for public control.</li> </ul> </li> </ul>

### 3.6.3 Assessment of Performance Indicators and Measures

The Project Approval requires Metropolitan Coal not to exceed the subsidence impact performance measure relating to built features, as specified in Table 1 of Condition 1, Schedule 3:

*Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing.*

Metropolitan Coal will also assess the Project against the following public safety performance indicator:

*Public safety will be ensured in the event that any hazard to the general public arising from subsidence effects becomes evident.*

Specific performance indicators have also been developed with each asset owner as described in Section 3.5 and the BFMP (Appendix E).

Monitoring against the performance indicator and performance measure during the mining of Longwalls 305-307 is summarised in Table 16 and Section 3.7 and described in detail in Appendix F. The procedure that will be followed to assess the extraction of Longwalls 305-307 against the performance indicator and performance measure is outlined in Figure 13 and described in detail in the PSMP (Appendix F).



#### **3.6.4 Contingency Plan**

In the event the built features subsidence impact performance measure of 'safe' is considered to have been exceeded or is likely to be exceeded, Metropolitan Coal will implement a Contingency Plan as described in the PSMP and summarised in Section 4.1.

### **3.7 SUBSIDENCE MONITORING**

The various monitoring programs that are detailed in each of the management plans (Appendices A to F) are summarised in Table 17. The location of environmental monitoring sites included in Metropolitan Coal's various environmental monitoring programs detailed in Table 17, are shown on Figure 8, and Figures 14 to 22.

Plan 7 in Attachment 1 of Appendix G shows the subsidence monitoring locations during the mining of Longwalls 305-307.

**Table 17**  
**Longwalls 305-307 Environmental Monitoring Program Summary**

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
WMP	Stream Features	<ul style="list-style-type: none"> <li>The Eastern Tributary from full supply level of the Woronora Reservoir to the maingate of Longwall 26.</li> <li>The Waratah Rivulet from Pool P to the full supply level of the Woronora Reservoir.</li> </ul>	<ul style="list-style-type: none"> <li>Location, approximate dimensions (length, width and depth), and orientation of surface cracks (specifically whether cracks are developed perpendicular to the stream flow or are controlled by rock joints or other factors, etc.).</li> <li>Nature of iron staining (e.g. whether isolated or across the entire streambed).</li> <li>Extent of iron staining (e.g. the length of stream affected).</li> <li>Description of gas release (e.g. isolated bubbles or continuous stream, and type of gas [methane or carbon dioxide]).</li> <li>Nature of scouring, for example the depth of scouring, type of soil exposed, any obvious vegetation impact, potential for severe erosion, etc.</li> <li>Water discoloration or opacity if present.</li> <li>Rock bar characteristics such as extent of cracking, seepage, underflow.</li> </ul>	<ul style="list-style-type: none"> <li>Visual inspection and photographic survey of the Eastern Tributary conducted monthly when mining is within 450 m of the stream.</li> <li>Visual inspection and photographic survey within 3 months of the completion of Longwalls 305-307.</li> <li>Weekly monitoring at pools observed with gas releases, until no gas releases have been observed at the pool for three consecutive weeks.</li> </ul>
	Surface Water Flow	<ul style="list-style-type: none"> <li>Eastern Tributary (GS 300078).</li> <li>Waratah Rivulet (GS 2132102).</li> <li>Woronora Reservoir Sub-catchment I (GS 300092).</li> <li>Woronora Reservoir Sub-catchment K (GS 300093).</li> <li>Woronora River (GS 2132101).</li> <li>Honeysuckle Creek (GS 300077).</li> <li>O'Hares Creek (GS 213200).</li> </ul>	<ul style="list-style-type: none"> <li>Stream flow data.</li> </ul>	<ul style="list-style-type: none"> <li>Continuous (downloaded monthly).</li> </ul>

**Table 17 (Continued)**  
**Longwalls 305-307 Environmental Monitoring Program Summary**

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
WMP (Cont.)	Pool Water Levels and Drainage Behaviour	<ul style="list-style-type: none"> <li>Eastern Tributary Pools ETG, ETJ, ETM, ETO, ETU, ETW, ETAF, ETAG, ETAH, ETAJ/ETAJ/ETAK, ETAL, ETAM, ETAN, ETAO, ETAP, ETAQ, ETAR, ETAS/ETAT<sup>3</sup> and ETAU.</li> <li>Waratah Rivulet Pools A, F, J, K, L, M, N, O, P, Q, R, S, T, U, V and W.</li> <li>Pools SR1, SR2 and SP1 on tributaries of the Woronora Reservoir.</li> <li>Woronora River Control Pools WRP1, WRP2, WRP3 and WRP4.</li> </ul>	<ul style="list-style-type: none"> <li>Pool water levels.</li> </ul>	<ul style="list-style-type: none"> <li>Continuous water level sensor and logger (downloaded monthly at all sites).</li> <li>Pool ETAU - continuous water level sensor and logger (downloaded weekly when Longwalls 305 and 306 extraction is within 450 m of the Eastern Tributary).</li> </ul>
		<ul style="list-style-type: none"> <li>Waratah Rivulet Pools B, C, E, G, G1, H and I.</li> </ul>	<ul style="list-style-type: none"> <li>Pool water levels.</li> </ul>	<ul style="list-style-type: none"> <li>Manually monitored daily.</li> </ul>
		<ul style="list-style-type: none"> <li>Pools ETAS, ETAT and ETAU on the Eastern Tributary.</li> </ul>	<ul style="list-style-type: none"> <li>Evidence of new cracking within the stream bed or rock bar.</li> <li>Whether the pools continue to flow over, through and/or below the rock bars (where relevant).</li> </ul>	<ul style="list-style-type: none"> <li>Visual inspections conducted at the time of download (monthly) and weekly when longwall extraction is within 450 m of the stream.</li> </ul>
		<ul style="list-style-type: none"> <li>Pools on the Waratah Rivulet from Pool P to the full supply level of the Woronora Reservoir.</li> </ul>	<ul style="list-style-type: none"> <li>Whether surface flow is evident along the length of the pools prior to flowing over/through/below the rock bars or boulder fields.</li> </ul>	<ul style="list-style-type: none"> <li>Visual inspections conducted at the time of download (monthly).</li> </ul>
	Stream Water Quality	<ul style="list-style-type: none"> <li>Eastern Tributary sites ETWQ F, ETWQ J, ETWQ N, ETWQ U, ETWQ W, ETWQ AF, ETWQ AH, ETWQ AQ and ETWQ AU.</li> <li>Waratah Rivulet sites WRWQ 2, WRWQ 6, WRWQ 8, WRWQ 9, WRWQ M, WRWQ N, WRWQ P, WRWQ R, WRWQ T, WRWQ U, WRWQ V, and WRWQ W.</li> <li>Tributary B site RTWQ 1.</li> <li>Tributary D site UTWQ 1.</li> <li>Far Eastern Tributary site FEWQ 1.</li> <li>Honeysuckle Creek site HCWQ 1.</li> <li>Bee Creek site BCWQ1.</li> <li>Woronora River control sites WOWQ1 and WOWQ 2.</li> </ul>	<ul style="list-style-type: none"> <li>Water quality parameters as described in the WMP (samples collected for metal analysis to be field filtered).</li> </ul>	<ul style="list-style-type: none"> <li>Monthly.</li> </ul>

**Table 17 (Continued)**  
**Longwalls 305-307 Environmental Monitoring Program Summary**

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
WMP (Cont.)	Stream Water Quality (Cont.)	<ul style="list-style-type: none"> <li>Eastern Tributary sites ETWQ F, ETWQ J, ETWQ N, ETWQ AF and ETWQ AQ.</li> <li>Waratah Rivulet sites WRWQ 2, WRWQ 6, WRWQ 8, WRWQ 9, WRWQ M, WRWQ N and WRWQ P.</li> <li>Woronora River control site WOWQ 2.</li> </ul>	<ul style="list-style-type: none"> <li>Unfiltered water quality samples analysed for total iron.</li> </ul>	<ul style="list-style-type: none"> <li>Monthly.</li> </ul>
		<ul style="list-style-type: none"> <li>Eastern Tributary sites ETWQ AQ and ETWQ AU.</li> <li>Woronora River site WOWQ 2.</li> </ul>	<ul style="list-style-type: none"> <li>Water quality parameters as described in the WMP (samples collected for metal analysis to be field filtered).</li> <li>Unfiltered water quality samples analysed for total iron and total manganese.</li> </ul>	<ul style="list-style-type: none"> <li>Fortnightly from the commencement of Longwall 304 to the completion of Longwall 307.</li> </ul>
		<ul style="list-style-type: none"> <li>Site ETAU, and at a minimum of three downstream sites (site ETFSL 0, site ETFSL 20, site ETFSL 40, site ETFSL 60, site ETFSL 80, site ETFSL 100, ETFSL 200, site ETFSL 300, site ETFSL 400, site ETFSL 500, site CONFLU1, site WDFS1 and/or site WDFS1+100).</li> <li>Site WARARM5.</li> </ul>	<ul style="list-style-type: none"> <li>Water quality parameters as described in the WMP (samples collected for metal analysis to be field filtered).</li> <li>Unfiltered water quality samples analysed for total iron and total manganese.</li> </ul>	<ul style="list-style-type: none"> <li>Site ETAU, and at a minimum of three downstream sites - weekly (until the site ETWQ AU monitoring results are at Level 1 or Level 2 of the WMP TARP for the quality of water resources reaching the Woronora Reservoir for four consecutive assessment periods.</li> <li>Site ETAU, and at a minimum of three downstream sites - fortnightly (once the site ETWQ AU monitoring results have returned to Level 1 or Level 2 TARP levels for four consecutive assessment periods, unless the TARP level returns to Level 3).</li> <li>Site WARARM5 - at the same frequency described above when the sites downstream of site CONFLU1 can be accessed for sampling (i.e. when the Woronora Reservoir water levels are suitably low).</li> </ul>
	Woronora, Nepean and Cataract Reservoir Water Quality	<ul style="list-style-type: none"> <li>Woronora Reservoir (site DW01).</li> <li>Nepean Reservoir.</li> <li>Cataract Reservoir.</li> </ul>	<ul style="list-style-type: none"> <li>Total iron, total manganese and total aluminium.</li> </ul>	<ul style="list-style-type: none"> <li>As made available by WaterNSW.</li> </ul>

**Table 17 (Continued)**  
**Longwalls 305-307 Environmental Monitoring Program Summary**

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
WMP (Cont.)	Shallow Groundwater Levels Near Streams	<ul style="list-style-type: none"> <li>Eastern Tributary sites ETGW1 and ETGW2.</li> <li>Eastern Tributary sites ETO1, ETO2, ETO3 and ETO4 (adjacent to Pool ETO).</li> <li>Waratah Rivulet sites WRGW1, WRGW2 and WRGW7.</li> </ul>	<ul style="list-style-type: none"> <li>Groundwater levels.</li> </ul>	<ul style="list-style-type: none"> <li>Data downloaded monthly at all sites.</li> </ul>
	Groundwater Levels/Pressures	<ul style="list-style-type: none"> <li>Transect sites T1, T2, T3, T5 and T6.</li> <li>Groundwater standpipes TBS02-90, TBS02-15, TBS03-15 and TBS02-190.</li> <li>Site 9HGW0 (Longwall 10 Goaf Hole).</li> <li>Site 9EGW1B.</li> <li>Site 9FGW1A.</li> <li>Site 9GGW2B.</li> <li>Site 9HGW1B.</li> <li>Site PM02.</li> <li>Site 9GGW1-80.</li> <li>Site PM01 (9DGW1B).</li> <li>Site 9EGW2A.</li> <li>Site 9EGW2-4.</li> <li>Site PM03.</li> <li>Site PHGW1B.</li> <li>Site PHGW2A.</li> <li>Site F6GW3A.</li> <li>Site F6GW4A.</li> <li>Site TBS02-250R.</li> <li>Site TBS03-230R.</li> </ul>	<ul style="list-style-type: none"> <li>Groundwater levels.</li> </ul>	<ul style="list-style-type: none"> <li>Data downloaded/reading monthly.</li> <li>Analysis at the frequency described in the WMP.</li> </ul>
	Groundwater Quality	<ul style="list-style-type: none"> <li>Eastern Tributary site ETGW2.</li> <li>Waratah Rivulet sites WRGW1, WRGW2 and WRGW7.</li> </ul>	<ul style="list-style-type: none"> <li>Water quality parameters as described in the WMP.</li> </ul>	<ul style="list-style-type: none"> <li>Monthly.</li> </ul>

**Table 17 (Continued)**  
**Longwalls 305-307 Environmental Monitoring Program Summary**

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
WMP (Cont.)	Mine Water Make	Underground.	<ul style="list-style-type: none"> <li>Groundwater inflow to the mine (20-day average).</li> </ul>	<ul style="list-style-type: none"> <li>Mine water balance inputs (as described in the WMP).</li> <li>Weekly statutory inspections.</li> </ul>
LMP	Cliffs and overhangs	<ul style="list-style-type: none"> <li>Cliff sites COH11, COH12, COH13, COH16 and COH17.</li> </ul>	<ul style="list-style-type: none"> <li>Cliff instabilities – length of cliff/overhang that experiences mining-induced rock fall (i.e. the exposure of a fresh face of rock and debris scattered around the base of the cliff or overhang), compared against the land subsidence impact performance indicator and subsidence impact performance measure.</li> </ul>	<ul style="list-style-type: none"> <li>Visual inspection prior to Longwall 305 extraction.</li> <li>Monthly when longwall extraction is within 400 m of each site.</li> <li>Following the completion of each longwall.</li> </ul>
	Steep slopes and land in general	<ul style="list-style-type: none"> <li>Steep slopes and other land within 600 m of Longwalls 20-27 and Longwalls 301-307.</li> </ul>	<ul style="list-style-type: none"> <li>Sandstone fracturing and rock falls (nature and extent of surface tension cracks and rock ledge collapse, compared against the land subsidence impact performance indicator).</li> </ul>	<ul style="list-style-type: none"> <li>Visual inspections as part of routine works conducted in the catchment.</li> </ul>
BMP	Upland Swamps – Vegetation	<ul style="list-style-type: none"> <li>Swamps 16, 17, 18, 19, 20, 24, 25, 28, 30, 31, 32, 33, 34, 35, 36 and 94 (overlying or adjacent to Longwalls 20-27).</li> <li>Swamps 40, 41, 46, 47, 48, 49, 50, 51/52, 53 and 58 (overlying or adjacent to Longwalls 301-304).</li> <li>Swamps 69, 70, 71a, 71b, 72 and 73 within the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour.</li> <li>Control Swamps 101, 111a, 125, 135, 136, 137a, 137b, 138, Bee Creek Swamp, Woronora River 1, Woronora River south arm and Dahlia Swamp.</li> </ul>	<ul style="list-style-type: none"> <li>Cracking of exposed bedrock areas and/or swamp substrate.</li> <li>Areas of increased erosion, particularly along any existing drainage line.</li> <li>Any changes in water colour, particularly evidence of iron precipitation.</li> <li>Changes in vegetation condition, including areas of stressed vegetation (i.e. plants that demonstrate symptoms of stress) and dead/dying plants that appear unusual.</li> <li>Whether the amount of seepage (at the terminal step/over exposed surfaces of the swamp) at the time of inspection appears unusual (relative to recent rainfall).</li> </ul>	<ul style="list-style-type: none"> <li>Visual inspections bi-annually in spring and autumn.</li> </ul>

**Table 17 (Continued)**  
**Longwalls 305-307 Environmental Monitoring Program Summary**

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
BMP (Cont.)	Upland Swamps – Vegetation (Cont.)	<ul style="list-style-type: none"> <li>Swamps 16, 17, 18, 20, 24 and 25 (Longwalls 20-22).</li> <li>Swamps 28, 30, 33, 35 and 94 (Longwalls 23-27).</li> <li>Swamps 40, 41, 46, 48, 50, 51/52 and 53 (Longwalls 301-304).</li> <li>Control Swamps 101, 111a, 125, 135, 136, 137a, 137b, 138, Bee Creek Swamp, Woronora River 1, Woronora River south arm and Dahlia Swamp.</li> </ul>	<ul style="list-style-type: none"> <li>Vegetation structure.</li> <li>Dominant species.</li> <li>Estimated cover and height for each stratum.</li> <li>Full floristics.</li> <li>Estimated cover abundance for each species using seven point Braun-Blanquet scale.</li> <li>Condition/health rating for each species in the quadrat.</li> </ul>	<ul style="list-style-type: none"> <li>Transect and quadrat monitoring bi-annually in spring and autumn.</li> </ul>
		<ul style="list-style-type: none"> <li>Twenty tagged individuals (<i>Epacris obtusifolia</i>) in each of Swamps 18, 24 and 25 (Longwalls 20-22) and Control Swamps 101, 111a and 125.</li> <li>Twenty tagged individuals (<i>Epacris obtusifolia</i>) in each of Swamps 19, 30, 33, 35 and 94 (Longwalls 23-27) and Control Swamps 135, 136, 137a, 137b and 138.</li> <li>Twenty tagged individuals (<i>Epacris obtusifolia</i>) in each of Swamps 40 and 53 (Longwalls 301-303) and Control Swamps 101, 136 and 137a.</li> <li>Twenty tagged individuals (<i>Sprengelia incarnata</i>) in each of Swamps 24 (Longwalls 20-22) and Control Swamps 101 and 125.</li> <li>Twenty tagged individuals (<i>Sprengelia incarnata</i>) in each of Swamps 19, 33, 35 and 94 (Longwalls 23-27) and Control Swamps 135, 136, 137a and 138.</li> <li>Twenty tagged individuals (<i>Sprengelia incarnata</i>) in each of Swamps 40 and 53 (Longwalls 301-303) and Control Swamps 101, 136 and 137b.</li> </ul>	<ul style="list-style-type: none"> <li>Population monitoring data including condition/health rating for each plant and reproductive rating.</li> </ul>	<ul style="list-style-type: none"> <li>Indicator species monitoring bi-annually in spring and autumn.</li> </ul>

**Table 17 (Continued)**  
**Longwalls 305-307 Environmental Monitoring Program Summary**

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
BMP (Cont.)	Upland Swamps – Vegetation (Cont.)	<ul style="list-style-type: none"> <li>Twenty tagged individuals (<i>Pultenaea aristata</i>) in each of Swamps 18, 24 and 25 (Longwalls 20-22) and Control Swamps 101 and 111a.</li> <li>Twenty tagged individuals (<i>Pultenaea aristata</i>) in each of Swamps 19, 30, 33, 35 and 94 (Longwalls 23-27) and Control Swamps 135, 136, 137a and 138.</li> <li>Twenty tagged individuals (<i>Banksia robur</i>, <i>Callistemon citrinus</i> and <i>Leptospermum juniperinum</i>) in each of Swamps 20 (Longwalls 20-22) and Control Swamps Woronora River 1, Woronora River south arm and Dahlia Swamp.</li> <li>Twenty tagged individuals (<i>Banksia robur</i> and <i>Callistemon citrinus</i>) in each of Swamps 28 (Longwalls 23-27) and Control Swamps Woronora River 1, Woronora River south arm and Dahlia Swamp.</li> </ul>	<ul style="list-style-type: none"> <li>Population monitoring data including condition/health rating for each plant and reproductive rating.</li> </ul>	<ul style="list-style-type: none"> <li>Indicator species monitoring bi-annually in spring and autumn.</li> </ul>
	Upland Swamps - Groundwater	<p>Includes paired piezometers (i.e. one swamp substrate piezometer to a depth of approximately 1 m and one sandstone piezometer to a depth of approximately 10 m).</p> <ul style="list-style-type: none"> <li>Swamps 20 and 25 (Longwalls 20-22).</li> <li>Swamps 28, 30, 33 and 35 (Longwalls 23-27).</li> <li>Swamps 40, 41, 46, 50, 51, 52 and 53 (Longwalls 301-304).</li> <li>Swamp 50 (Longwall 304).</li> <li>Swamps 71a and 72 (Longwalls 305-307).</li> <li>Control Swamps 101, 137a, 137b, Bee Creek Swamp and Woronora River 1.</li> </ul>	<ul style="list-style-type: none"> <li>Groundwater levels.</li> </ul>	<ul style="list-style-type: none"> <li>Datalogger (continuous).</li> </ul>
	Riparian Vegetation	<ul style="list-style-type: none"> <li>Sites MRIP01 to MRIP12.</li> </ul>	<ul style="list-style-type: none"> <li>Areas of new water ponding.</li> <li>Any cracking or rock displacement.</li> <li>Changes in vegetation condition, including areas of stressed vegetation that appear unusual.</li> </ul>	<ul style="list-style-type: none"> <li>Visual inspections bi-annually in spring and autumn.</li> </ul>



**Table 17 (Continued)**  
**Longwalls 305-307 Environmental Monitoring Program Summary**

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
BMP (Cont.)	Riparian Vegetation (cont.)	<ul style="list-style-type: none"> <li>Sites MRIP01 to MRIP08, MRIP11 and MRIP12.</li> </ul>	<ul style="list-style-type: none"> <li>Vegetation structure.</li> <li>Dominant species.</li> <li>Estimated cover and height for each stratum.</li> <li>Full floristics.</li> <li>Estimated cover abundance for each species using seven point Braun-Blanquet scale.</li> <li>Condition/health rating for each species in the quadrat.</li> </ul>	<ul style="list-style-type: none"> <li>Permanent quadrat (20 m x 2 m) monitoring bi-annually in spring and autumn.</li> </ul>
		<ul style="list-style-type: none"> <li>Existing tagged individuals (<i>Prostanthera linearis</i>, <i>Schoenus melanostachys</i> and <i>Lomatia myricoides</i>) at sites MRIP01 to MRIP12.</li> </ul>	<ul style="list-style-type: none"> <li>Population monitoring data including condition/health rating for each plant and reproductive rating.</li> </ul>	<ul style="list-style-type: none"> <li>Indicator species monitoring bi-annually in spring and autumn.</li> </ul>
	Aquatic Biota and their Habitats	<ul style="list-style-type: none"> <li>Surface water resources and watercourses in accordance with the WMP.</li> </ul>	<ul style="list-style-type: none"> <li>Monitoring of aquatic habitats in accordance with the WMP.</li> </ul>	<ul style="list-style-type: none"> <li>In accordance with the WMP.</li> </ul>
		<ul style="list-style-type: none"> <li>Stream monitoring at following Locations (if sufficient aquatic habitat is available for sampling); <ul style="list-style-type: none"> <li>WT3, WT4, WT5, ET1, ET2, ET3 and ET4.</li> <li>Control Locations: WR1 and OC.</li> </ul> </li> </ul>	Impacts on aquatic ecology: <ul style="list-style-type: none"> <li>Habitat Characteristics.</li> <li>Water Quality.</li> <li>Aquatic Macroinvertebrates.</li> <li>Aquatic Macrophytes.</li> </ul>	<ul style="list-style-type: none"> <li>Biannually in spring (15 September to 15 December) and autumn (15 March to 15 June).</li> </ul>
	Aquatic Biota and their Habitats (cont.)	<ul style="list-style-type: none"> <li>Larger pools ETAH on the Eastern Tributary and control Pool WP on the Woronora River and Pool OC on O'Hares Creek.</li> <li>Smaller pools ETAG, ETAI and ETAK on the Eastern Tributary and control Pools WP-A, WP-B and WP-C on the Woronora River and Pools OC-A, OC-B and OC-C on O'Hares Creek.</li> </ul>	The response of aquatic ecosystems to the implementation of stream remediation works: <ul style="list-style-type: none"> <li>Habitat Characteristics.</li> <li>Water Quality.</li> <li>Aquatic Macroinvertebrates.</li> <li>Aquatic Macrophytes.</li> </ul>	<ul style="list-style-type: none"> <li>Monitoring of Pools ETAG and ETAH will recommence subsequent to the conduct of stream remediation activities at Pool ETAH and will be conducted bi-annually in spring (15 September to 15 December) and autumn (15 March to 15 June).</li> <li>Monitoring of Pools ETAI and ETAK will recommence subsequent to the conduct of stream remediation activities at Pool ETAK and will be conducted bi-annually in spring (15 September to 15 December) and autumn (15 March to 15 June).</li> </ul>

**Table 17 (Continued)**  
**Longwalls 305-307 Environmental Monitoring Program Summary**

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
BMP (Cont.)	Amphibian Monitoring	<ul style="list-style-type: none"> <li>Sites 1-6 (Longwalls 20-22), 13-17 (Longwalls 23-27) and 23-28 (Longwalls 301-303).</li> <li>Sites 29 and 30 (Longwalls 305-307).</li> <li>Control Sites 7, 8, 9, 10, 11, 12, 18, 19, 20, 21 and 22.</li> </ul>	Species assigned to relative abundance categories for tadpole and adult stages.	<ul style="list-style-type: none"> <li>Survey annually in spring/summer (i.e. October to February) during suitable weather conditions.</li> </ul>
HMP	Aboriginal Heritage	<ul style="list-style-type: none"> <li>Sites FRC 76, FRC 77, FRC 78, FRC 86, FRC 90 and FRC 309</li> </ul>	<ul style="list-style-type: none"> <li>Inspections of rock surfaces for cracking and/or exfoliation and/or blockfall.</li> <li>Inspection of art motifs for damage or deterioration.</li> <li>Identification of any natural weathering processes that may result in deterioration (e.g. fire, vegetation growth and water seepage).</li> <li>Comparison of the physical characteristics of the site at the time of monitoring against the previous monitoring and the baseline record.</li> </ul>	<ul style="list-style-type: none"> <li>Within three months of the completion of Longwall 304.</li> </ul>
		<ul style="list-style-type: none"> <li>All sites within the Longwall 305 35° angle of draw and/or predicted 20 mm subsidence contour, namely Sites FRC 67, FRC 68, FRC 70, FRC 71, FRC 76, FRC 77, FRC 78, FRC 85, FRC 86, FRC 87, FRC 90, FRC 91, FRC 93, FRC 117, FRC 309, FRC 310 and FRC 325.</li> </ul>		<ul style="list-style-type: none"> <li>Within three months following the completion of Longwall 305.</li> </ul>
		<ul style="list-style-type: none"> <li>All sites within the Longwalls 305 35° angle of draw and/or predicted 20 mm subsidence contour above, in addition to all sites within the Longwall 306 35° angle of draw and/or predicted 20 mm subsidence contour, namely Sites FRC 97, FRC 101, FRC 180, FRC 254, FRC 311, FRC 316, FRC 320 and FRC 321.</li> </ul>		<ul style="list-style-type: none"> <li>Within three months following the completion of Longwall 306.</li> </ul>
		<ul style="list-style-type: none"> <li>All sites within the Longwalls 305-306 35° angle of draw and/or predicted 20 mm subsidence contour above, in addition to all remaining sites within the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour, namely Sites FRC 94, FRC 184, FRC 185, FRC 186, FRC 187, FRC 191, FRC 198, FRC 323, FRC 324 FRC 344 and FRC 345.</li> </ul>		<ul style="list-style-type: none"> <li>Within three months following the completion of Longwall 307.</li> </ul>

**Table 17 (Continued)**  
**Longwalls 305-307 Environmental Monitoring Program Summary**

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
BFMP-Garrawarra	Garrawarra Centre Complex – House Structures	<ul style="list-style-type: none"> <li>Palmer House (A09a).</li> </ul>	<ul style="list-style-type: none"> <li>Structural integrity changes.</li> <li>Fresh cracking.</li> </ul>	<ul style="list-style-type: none"> <li>External inspection only due to degraded state of derelict buildings.</li> <li>Following the completion of Longwall 307.</li> </ul>
	Garrawarra Centre Complex – Aged Care Buildings	<ul style="list-style-type: none"> <li>Building structures (B01a-B01e).</li> <li>Administration / Kitchen Group (Buildings B02a and B02b).</li> </ul>	<ul style="list-style-type: none"> <li>Structural integrity changes.</li> <li>Cracking at pre-existing joints.</li> </ul>	<ul style="list-style-type: none"> <li>Following the completion of Longwall 307.</li> </ul>
	Garrawarra Centre Complex – Water Storage Tanks	<ul style="list-style-type: none"> <li>Water storage tanks (B14t01, B14t02, B16t01-B16t03, B17t01 and B18t01) and trickle filter tank (B15t01).</li> </ul>	<ul style="list-style-type: none"> <li>Structural integrity changes.</li> <li>New Leaks.</li> <li>Cracking in columns, elevated ring beam or central access shaft (B14t02). B14t02 is derelict structure and does not hold water.</li> </ul>	<ul style="list-style-type: none"> <li>Following the completion of Longwall 307.</li> </ul>
	Garrawarra Centre Complex – Gas Storage Tank	<ul style="list-style-type: none"> <li>Gas storage tank (B01t03).</li> </ul>	<ul style="list-style-type: none"> <li>Structural integrity.</li> <li>Leaks.</li> </ul>	<ul style="list-style-type: none"> <li>Following the completion of Longwall 307.</li> </ul>

**Table 17 (Continued)**  
**Longwalls 305-307 Environmental Monitoring Program Summary**

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
BFMP-Garrawarra (Cont.)	Garrawarra Centre Complex – Other Services (Powerlines and Poles)	<ul style="list-style-type: none"> <li>Timber poles and powerlines.</li> </ul>	<ul style="list-style-type: none"> <li>Degradation of structure.</li> <li>Movement of conductors.</li> <li>Vegetation clearance.</li> <li>Land clearance.</li> <li>Road clearance.</li> <li>Integrity and function of support clamps or other items.</li> </ul>	<ul style="list-style-type: none"> <li>Following the completion of Longwall 307.</li> <li>At any time in case of fault or emergency.</li> </ul>
	Garrawarra Centre Complex – Other Services (Water Pipelines)	<ul style="list-style-type: none"> <li>Water pipelines within the Study Area.</li> </ul>	<ul style="list-style-type: none"> <li>Surface ground cracks.</li> <li>Cracks or leaks in the pipelines.</li> <li>Fittings can be accessed beneath surface fittings and are operable.</li> </ul>	<ul style="list-style-type: none"> <li>Following the completion of Longwall 307.</li> </ul>
	Garrawarra Centre Complex – Private Roads and Access Roads/Tracks	<ul style="list-style-type: none"> <li>Within 600 m of Longwall 305-307 extraction.</li> </ul>	<ul style="list-style-type: none"> <li>Surface cracks, buckling and general safety.</li> </ul>	<ul style="list-style-type: none"> <li>Following the completion of Longwall 307.</li> <li>As per the LMP.</li> </ul>
BFMP-Endeavour Energy	132 kV Towers external to study area	<ul style="list-style-type: none"> <li>Towers T8 to T12.</li> </ul>	<ul style="list-style-type: none"> <li>Degradation of tower structure.</li> <li>Degradation of tower foundations/footings.</li> <li>Movement of insulator strings.</li> </ul>	<ul style="list-style-type: none"> <li>Prior to the commencement of Longwall 305.</li> <li>End of panel survey of tower legs at completion of extraction of each longwall.</li> <li>Endeavour Energy inspections (annual ground inspection, six yearly climbing inspection).</li> <li>At any time in case of fault or emergency.</li> </ul>
	Local Powerlines – poles and wires	<ul style="list-style-type: none"> <li>Timber poles and wires within the Study Area.</li> </ul>	<ul style="list-style-type: none"> <li>Degradation of structure.</li> <li>Movement of conductors.</li> <li>Vegetation clearance.</li> <li>Land clearance.</li> <li>Road clearance.</li> <li>Integrity and function of support clamps or other items.</li> </ul>	<ul style="list-style-type: none"> <li>Prior to the commencement of Longwall 305</li> <li>Within 3 months following the completion of each Longwall.</li> <li>Routinely as per Endeavour Energy inspections.</li> <li>At any time in case of fault or emergency.</li> </ul>

**Table 17 (Continued)**  
**Longwalls 305-307 Environmental Monitoring Program Summary**

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
BFMP- Endeavour Energy (Cont.)	Access Roads/Tracks	<ul style="list-style-type: none"> <li>Within 600 m of Longwalls 305-307 extraction.</li> </ul>	<ul style="list-style-type: none"> <li>Surface cracks, buckling and general safety.</li> </ul>	<ul style="list-style-type: none"> <li>Within 3 months following the completion of each Longwall.</li> <li>Routinely as per Endeavour Energy inspections.</li> </ul>
BFMP - TransGrid	330 kV Towers	<ul style="list-style-type: none"> <li>Towers TL11-104 to TL11-108.</li> </ul>	<ul style="list-style-type: none"> <li>Calculation of differential leg movement.</li> <li>Degradation of tower structure.</li> <li>Degradation of tower foundations/footings.</li> <li>Movement of insulator strings.</li> <li>Visual check by TransGrid of earthwire/OPGW and conductor movement.</li> </ul>	<ul style="list-style-type: none"> <li>Prior to the commencement of Longwall 305</li> <li>Survey of tower legs at 2 month intervals during Longwall 305</li> <li>End of panel survey of tower legs at completion of extraction of each Longwall.</li> <li>Routinely as per TransGrid inspections (annual ground inspection, six yearly climbing inspection).</li> <li>At any time in case of fault or emergency.</li> </ul>
	330 kV Transmission Lines	<ul style="list-style-type: none"> <li>Conductor lines strung from Towers TL11-104 to TL11-108.</li> <li>Ground survey.</li> <li>Climbing inspection.</li> </ul>	<ul style="list-style-type: none"> <li>Vegetation clearance.</li> <li>Land clearance.</li> <li>Road clearance.</li> <li>Integrity and function of support clamps or other items.</li> </ul>	<ul style="list-style-type: none"> <li>Routinely as per TransGrid inspections (annual ground inspection, six yearly climbing inspection).</li> <li>At any time in case of fault or emergency.</li> </ul>
	Access Roads/Tracks	<ul style="list-style-type: none"> <li>Within 600 m of Longwalls 305-307 extraction.</li> </ul>	<ul style="list-style-type: none"> <li>Surface cracks, buckling and general safety.</li> </ul>	<ul style="list-style-type: none"> <li>Within 3 months following the completion of each longwall.</li> <li>Routinely as per TransGrid inspections.</li> </ul>

**Table 17 (Continued)**  
**Longwalls 305-307 Environmental Monitoring Program Summary**

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
BFMP-Optus	Fibre Optic Cables	<ul style="list-style-type: none"> <li>Within 600 m of Longwalls 305-307 extraction.</li> </ul>	<ul style="list-style-type: none"> <li>Ground compression / tension.</li> </ul>	<ul style="list-style-type: none"> <li>Weekly on commencement of Longwall 305 for first 400 m of extraction Surveys will continue until movement stabilises.</li> <li>Within 3 months following the completion of each longwall.</li> </ul>
	Cable lines and associated pits	<ul style="list-style-type: none"> <li>Within 600 m of Longwalls 305-307 extraction.</li> </ul>	<ul style="list-style-type: none"> <li>Movement of conduit, degree of freedom of cable in conduit. (Optus to inspect)</li> </ul>	<ul style="list-style-type: none"> <li>If Optus detects a fault or loss of signal integrity</li> </ul>
	Access Roads/Tracks	<ul style="list-style-type: none"> <li>Within 600 m of Longwalls 305-307 extraction.</li> </ul>	<ul style="list-style-type: none"> <li>Surface cracks, buckling and general safety.</li> </ul>	<ul style="list-style-type: none"> <li>Visual observations as part of routine works and inspections.</li> <li>Following the completion of each longwall.</li> </ul>
BFMP-Telstra	Fibre Optic Cable line 2 and associated pits  Telecommunications Tower (and compound)	<ul style="list-style-type: none"> <li>Fibre Optic Cable line 2 and associated pits</li> <li>Tower and compound.</li> </ul>	<ul style="list-style-type: none"> <li>Monitor fibre signal integrity (loss signal).</li> <li>Structural integrity of the telecommunications tower and compound.</li> </ul>	<ul style="list-style-type: none"> <li>Monitoring to occur when longwall face approaches within 400 m of the cables.</li> <li>Weekly survey on commencement of mining Longwall 305 for first 400 m of extraction and then until subsidence no longer detectable.</li> <li>Within 3 months following the completion of each longwall.</li> </ul>
	Access Roads/Tracks	<ul style="list-style-type: none"> <li>Within 600 m of Longwalls 305-307 extraction.</li> </ul>	<ul style="list-style-type: none"> <li>Surface cracks, buckling and general safety.</li> </ul>	<ul style="list-style-type: none"> <li>Following the completion of each Longwall.</li> <li>Visual observations during catchment visits as per the LMP.</li> </ul>

**Table 17 (Continued)**  
**Longwalls 305-307 Environmental Monitoring Program Summary**

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
BFMP-RMS	M1 Princes Motorway - Pavement	Visual inspection for impacts on: <ul style="list-style-type: none"> <li>Asphaltic concrete surface.</li> <li>Kerbs, gutters and pits.</li> <li>Signs or other road infrastructure.</li> </ul>	To identify development of, or changes in existing: <ul style="list-style-type: none"> <li>Asphaltic concrete surface including cracks, buckling and stepping.</li> <li>Kerbs and gutters including cracking, buckling and joint movement.</li> </ul>	<ul style="list-style-type: none"> <li>Following the completion of Longwall 307.</li> <li>Greater frequency if determined in consultation with the Technical Committee</li> <li>Network Safety Inspection twice weekly during longwall extraction.</li> </ul>
	M1 Princes Motorway - Cuttings	Visual inspection for impacts on: <ul style="list-style-type: none"> <li>Cuttings along the M1 Princes Motorway as described in the BFMP-RMS.</li> </ul>	To identify: <ul style="list-style-type: none"> <li>Changes in cutting condition, including opening of cracks, spalling.</li> <li>Changes in groundwater seepage or surface water flows.</li> <li>Rockfalls.</li> <li>Changes in RMS risk ranking.</li> </ul>	<ul style="list-style-type: none"> <li>Following the completion of Longwall 307.</li> <li>Greater frequency if determined in consultation with the RMS Technical Committee</li> <li>Network Safety Inspection twice weekly during longwall extraction.</li> </ul>
	M1 Princes Motorway - Culverts	<ul style="list-style-type: none"> <li>Closed circuit television (CCTV) inspection for impacts on internal surfaces.</li> </ul>	<ul style="list-style-type: none"> <li>To identify changes to the visible surfaces of the culverts including cracking, buckling, shearing, and collapse.</li> </ul>	<ul style="list-style-type: none"> <li>Following the completion of Longwall 311</li> <li>Greater frequency if determined in consultation with the RMS Technical Committee</li> </ul>
	Bridge 2 (Old Princes Highway Underpass)	Visual inspection for impacts on: <ul style="list-style-type: none"> <li>Abutments.</li> <li>Pier frames.</li> <li>Elastomeric bearings.</li> <li>Soffits of girders.</li> <li>Deck expansion joints.</li> <li>Steel traffic barrier joints.</li> <li>Other areas of substructure and adjoining areas including concrete paths, stairs, and slope protection.</li> </ul>	To identify development of, or changes in existing: <ul style="list-style-type: none"> <li>Surface cracks.</li> <li>Closing or opening of joints.</li> <li>Distortion or damage to elastomeric bearings.</li> </ul>	<ul style="list-style-type: none"> <li>Following the completion of Longwall 309.</li> <li>Greater frequency if determined in consultation with the Technical Committee.</li> </ul>

**Table 17 (Continued)**  
**Longwalls 305-307 Environmental Monitoring Program Summary**

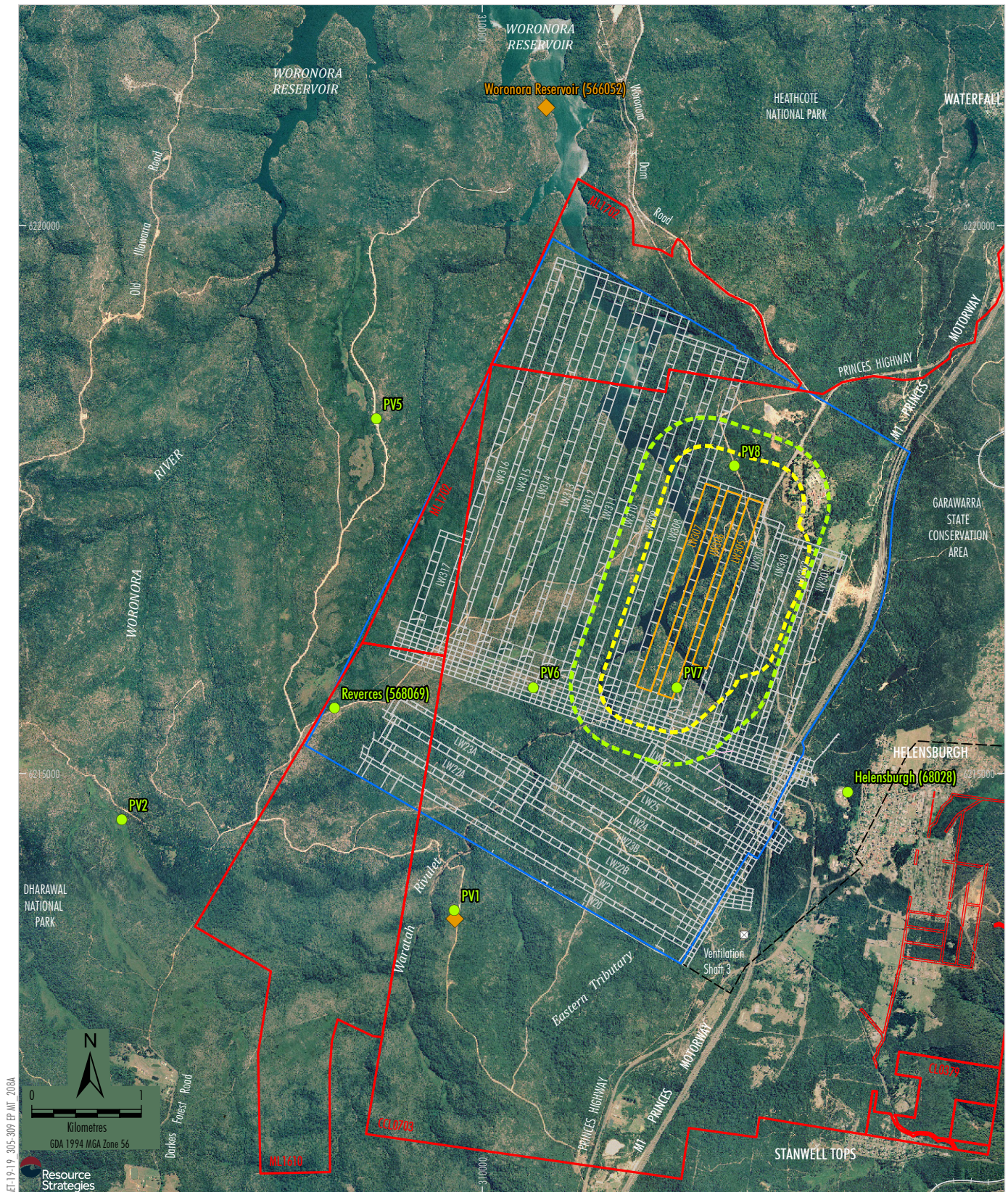
Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
BFMP-RMS (Cont.)	Cawley Road Overbridge	Visual inspection for impacts on: <ul style="list-style-type: none"> <li>Abutments.</li> <li>Pier blade wall.</li> <li>Tetron bearings.</li> <li>Deck expansion joints.</li> <li>Steel traffic barrier and safety screen joints.</li> </ul>	To identify development of, or changes in existing: <ul style="list-style-type: none"> <li>Surface cracks.</li> <li>Closing or opening of joints.</li> <li>Distortion or damage to Tetron bearings.</li> </ul>	<ul style="list-style-type: none"> <li>Following completion of Longwall 307.</li> <li>Greater frequency if determined in consultation with the RMS Technical Committee.</li> </ul>
BFMP-WCC	Old Princes Highway - Pavement	From the Old Princes Highway Underpass (Bridge 2) to the entrance to the Garrawarra Centre Complex.	<ul style="list-style-type: none"> <li>Impacts to the surface including cracks, buckling and stepping.</li> </ul>	<ul style="list-style-type: none"> <li>Progress monitoring (visual inspections) coinciding with ground survey extents to occur weekly on commencement of Longwalls 305 and 306 for first 400 m of extraction and then until subsidence reduces to less than survey accuracy.</li> <li>Following completion of each longwall.</li> </ul>
	Old Princes Highway – Drainage Structures (Pipe/Culverts) and Other Furniture	Drainage structures and other furniture within the Study Area.	<ul style="list-style-type: none"> <li>Impacts to the visible surfaces of pipes/culverts including cracking, buckling, shearing, and collapse.</li> <li>Visible impacts to furniture.</li> </ul>	<ul style="list-style-type: none"> <li>Progress monitoring (visual inspections) coinciding with ground survey extents to occur weekly on commencement of Longwalls 305 and 306 for first 400 m of extraction and then until subsidence reduces to less than survey accuracy.</li> <li>Within 3 months following the completion of extraction of each longwall.</li> </ul>
BFMP-Cemetery	Waterfall General (Garrawarra) Cemetery site	<ul style="list-style-type: none"> <li>Waterfall General (Garrawarra) Cemetery site.</li> </ul>	<ul style="list-style-type: none"> <li>Structural integrity of headstones and fencing.</li> <li>Surface cracks, buckling and general safety.</li> </ul>	<ul style="list-style-type: none"> <li>A follow up audit be undertaken two years after Longwall 304 (in 2022) to review any longer-term effects.</li> </ul>
	Access Roads/Tracks	<ul style="list-style-type: none"> <li>Within 600 m of Longwalls 305-307 extraction.</li> </ul>	<ul style="list-style-type: none"> <li>Surface cracks, buckling and general safety.</li> </ul>	<ul style="list-style-type: none"> <li>Following the completion of Longwall 307.</li> <li>As per the LMP.</li> </ul>



**Table 17 (Continued)**  
**Longwalls 305-307 Environmental Monitoring Program Summary**

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
BFMP-Sydney Water	Water pipelines	<ul style="list-style-type: none"> <li>Water Main 1.</li> <li>Water Main 2.</li> </ul>	<ul style="list-style-type: none"> <li>Surface ground cracks.</li> <li>Cracks or leaks in the pipelines.</li> </ul>	<ul style="list-style-type: none"> <li>Routinely as per Sydney Water inspections.</li> <li>Weekly for Watermain 1 on commencement of mining Longwalls 305 and 306 for first 400 m of extraction and then until subsidence no longer detectable.</li> <li>Following the completion of each Longwall.</li> </ul>
BFMP-Sydney Trains	Telecommunications Tower (and compound)	<ul style="list-style-type: none"> <li>Tower and compound.</li> </ul>	<ul style="list-style-type: none"> <li>Structural integrity of the telecommunications tower and compound.</li> </ul>	<ul style="list-style-type: none"> <li>Weekly survey on commencement of mining Longwall 305 for first 400m of extraction and then until subsidence no longer detectable.</li> <li>Within 3 months following the completion of each longwall.</li> </ul>
BFMP-Axicom	Telecommunications Towers (and compounds)	<ul style="list-style-type: none"> <li>Towers and compounds.</li> </ul>	<ul style="list-style-type: none"> <li>Structural integrity of the telecommunications tower and compound.</li> </ul>	<ul style="list-style-type: none"> <li>Weekly survey on commencement of mining Longwall 305 for first 400m of extraction and then until subsidence no longer detectable.</li> <li>Within 3 months following the completion of each longwall.</li> </ul>
	Access Roads/Tracks	<ul style="list-style-type: none"> <li>Within 600 m of Longwalls 305-307 extraction.</li> </ul>	<ul style="list-style-type: none"> <li>Surface cracks, buckling and general safety.</li> </ul>	<ul style="list-style-type: none"> <li>Following the completion of each Longwall.</li> <li>Visual observations during catchment visits as per the LMP.</li> </ul>





#### LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area  
Longwalls 20-27 and 301-317
- Longwalls 305-307 Secondary Extraction
- Longwalls 305-307 35° Angle of Draw and/or  
Predicted 20 mm Subsidence Contour
- 600 m from Longwalls 305-307  
Secondary Extraction
- Existing Underground Access Drive (Main Drift)
- ◆ Evaporimeter
- Pluviometer

- Notes: 1. The Bureau of Meteorology pluviometer at Darkes Forest (68024) is not shown. It is located approximately 3.75 km south of the Metropolitan Coal pluviometer (PV2).
2. The Bureau of Meteorology pluviometer at Lucas Heights (66078) is not shown. It is located approximately 12.5 km north of the Metropolitan Coal pluviometer (PV8).

Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019)

**Peabody**  
METROPOLITAN COAL  
Meteorological Sites

Figure 14












**Figure 15**







### LEGEND

-  Mining Lease Boundary
-  Railway
-  Project Underground Mining Area
- Longwalls 20-27 and 301-317
-  Longwalls 305-307 Secondary Extraction
-  Longwalls 305-307 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
-  600 m from Longwalls 305-307 Secondary Extraction
-  Existing Underground Access Drive (Main Drift)
-  Groundwater Level/Pressure Bore
-  Groundwater Level Bore

Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019)

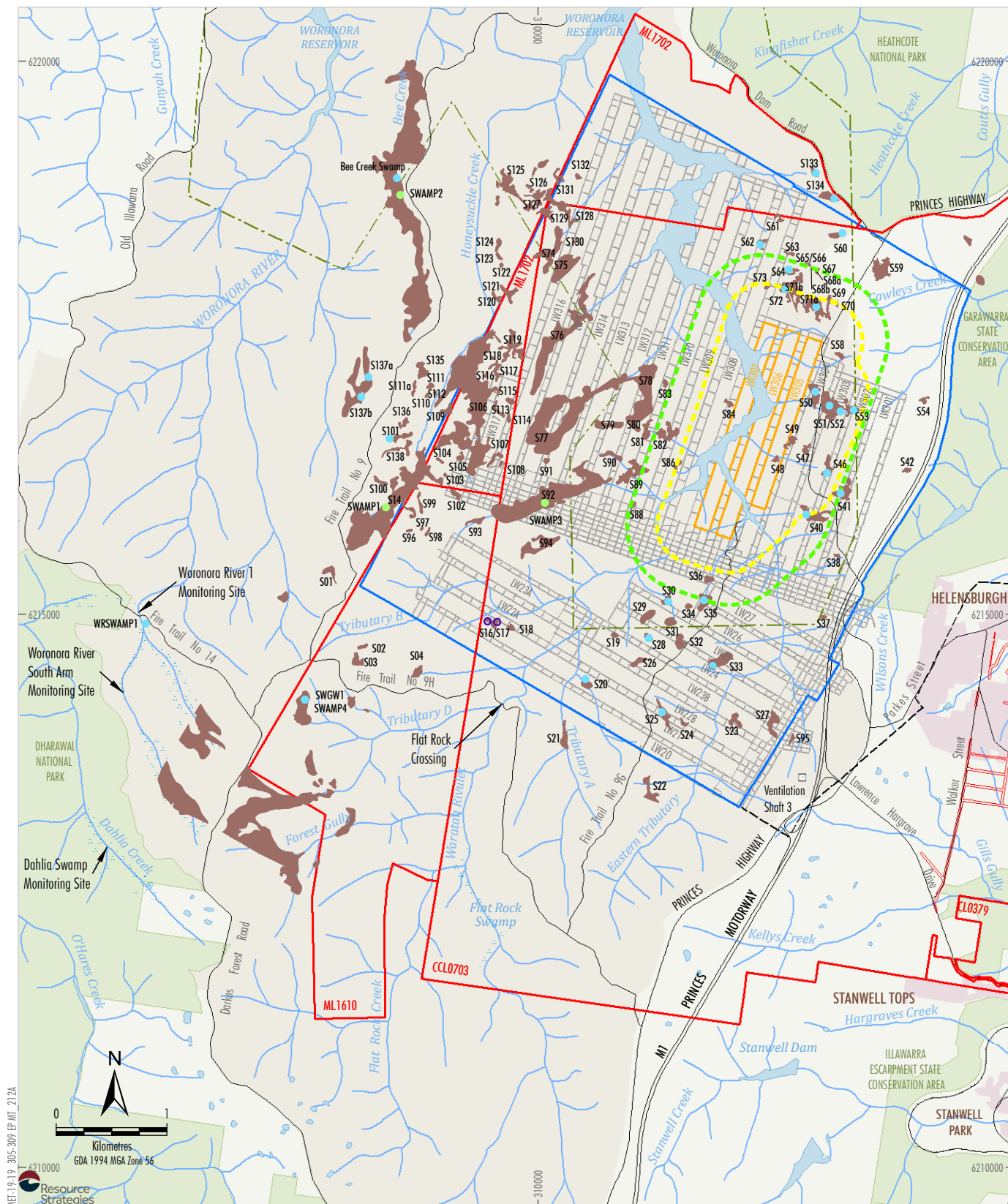
**Peabody**

METROPOLITAN COAL

**Groundwater Level  
and/or Pressure Bore Locations**

**Figure 17**





Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019); after NPWS (2003), Bangalay Botanical Surveys (2008); Eco Logical Australia (2015; 2016; 2018)

#### LEGEND

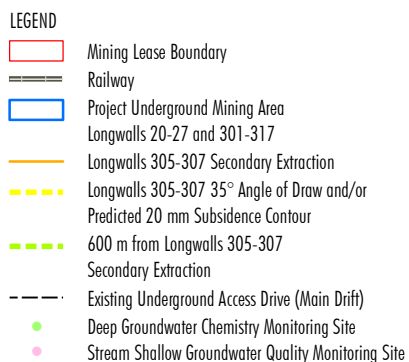
- Mining Lease Boundary
- Woronora Special Area
- Railway
- Project Underground Mining Area
- Longwalls 20-27 and 301-317
- Longwalls 305-307 Secondary Extraction
- Longwalls 305-307 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Longwalls 305-307 Secondary Extraction
- Existing Underground Access Drive (Main Drift)
- Woronora Notification Area

- Upland Swamp
- Swamp Substrate and Shallow Groundwater Piezometer
- Swamp Substrate Groundwater Piezometer
- Swamp Shallow Groundwater Piezometer

**Peabody**  
METROPOLITAN COAL  
Upland Swamps Groundwater  
Piezometer Locations

Figure 18

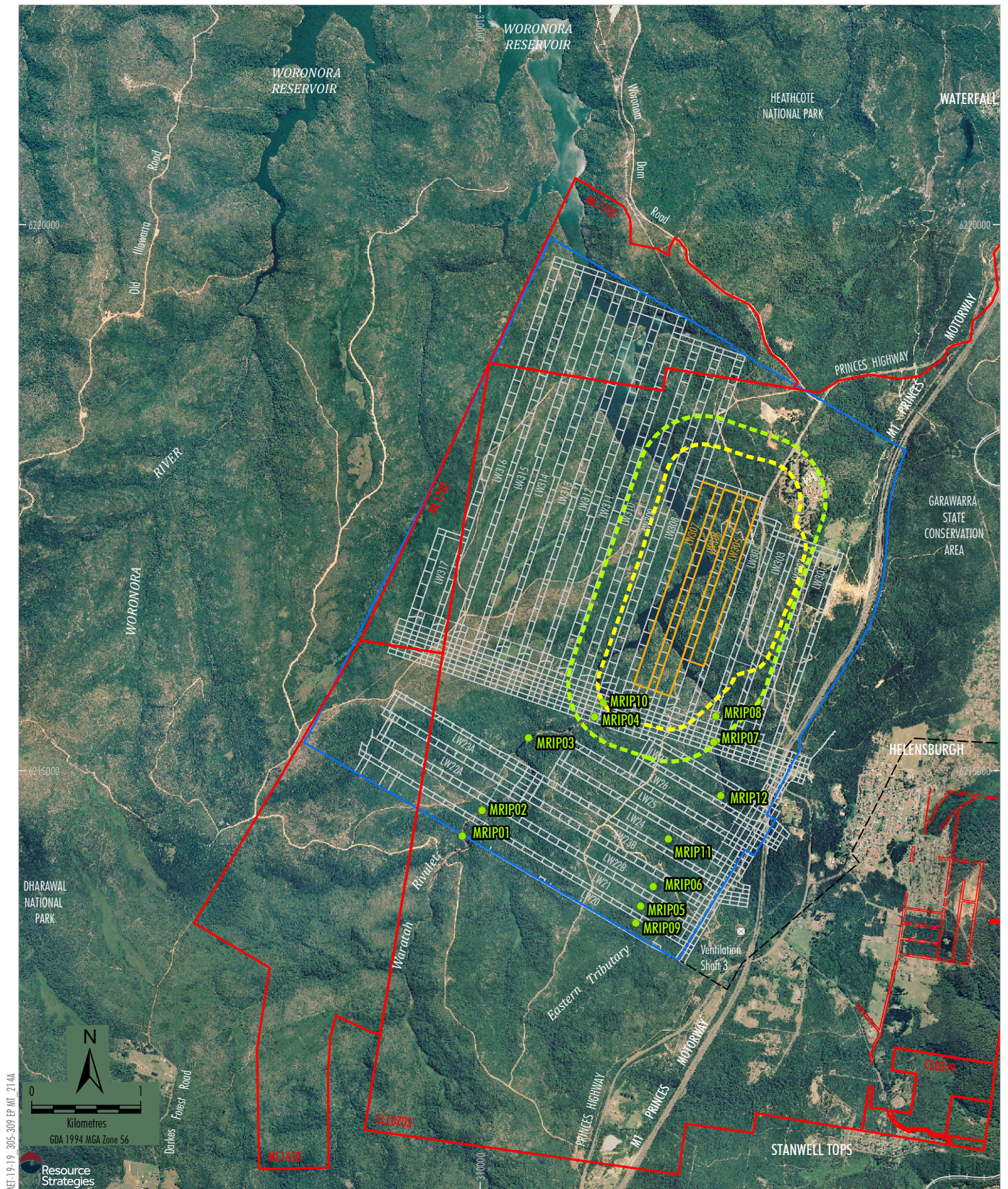




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METROPOLITAN COAL  
Groundwater Quality Sites

**Figure 19**

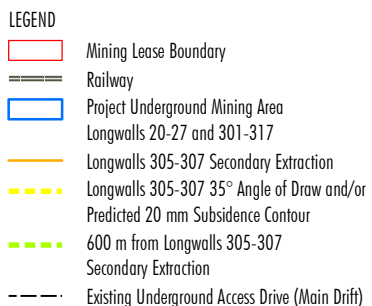




**Peabody**  
**METROPOLITAN COAL**  
**Riparian Vegetation Monitoring Locations**

**Figure 20**





METROPOLITAN COAL  
Aquatic Ecology Sampling Locations

**Figure 21**



**Figure 22**



## 4 IMPLEMENTATION

### 4.1 CONTINGENCY RESPONSE

In the event a subsidence impact performance measure described in Sections 3.1 to 3.6 has been exceeded as a result of Longwalls 305-307 extraction, Metropolitan Coal will implement the relevant Contingency Plan detailed in the WMP (Appendix A), LMP (Appendix B), BMP (Appendix C), HMP (Appendix D), BFMP (Appendix E) or the PSMP (Appendix F). In general, the Contingency Plans include the following:

- The likely exceedance will be reported to the Technical Services Manager and/or the Environment & Community Superintendent within 24 hours.
- The Technical Services Manager or the Environment & Community Superintendent will report the likely exceedance to the General Manager as soon as practicable after becoming aware of the exceedance.
- Metropolitan Coal will report the exceedance to the DPIE, relevant agencies and relevant stakeholders as soon as practicable after Metropolitan Coal becomes aware of the exceedance.
- Metropolitan Coal will conduct an investigation to evaluate the potential contributing factors.
- Metropolitan Coal will identify an appropriate course of action with respect to the identified impact(s), in consultation with specialists, relevant agencies and relevant stakeholders as necessary. For example:
  - proposed management and/or mitigation measures (Section 3);
  - a program to review the effectiveness of the management and/or mitigation measures; and
  - consideration of offsets or adaptive management.

Contingency measures will be developed in consideration of the specific circumstances of the exceedance and the assessment of environmental consequences.

- Metropolitan Coal will submit the proposed course of action to the DPIE for approval.
- Metropolitan Coal will implement the approved course of action to the satisfaction of the DPIE.

In accordance with Condition 6, Schedule 6 of the Project Approval, Metropolitan Coal will provide a suitable offset to compensate for the impact to the satisfaction of the Secretary of the DPIE if either the contingency measures implemented by Metropolitan Coal have failed to remediate the impact or the Secretary of the DPIE determines that it is not reasonable or feasible to remediate the impact.

Relevant management and contingency measures are summarised in Section 3 and outlined in the component management plans (Appendices A to F).

Responsibilities during contingency response are outlined in Section 4.6, which is designed to clearly outline actions, levels of responsibility within Metropolitan Coal and reporting requirements where monitoring results indicate that impacts are exceeding (or likely to exceed) predicted or approved limits. Table 19 is designed to support the TARPs provided in the component management plans (Appendices A to F).

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## 4.2 ADAPTIVE MANAGEMENT

Metropolitan Coal will implement an adaptive management approach for the Project. Adaptive management will involve:

- Planning – developing management strategies to meet performance measures; identifying performance indicators to assess performance; and establishing monitoring programs to monitor against the performance measures.
- Implementation – implementing management strategies and monitoring impacts against performance indicators.
- Review – reviewing and evaluating the effectiveness of management strategies by analysis of monitoring data against predicted impacts, performance indicators and performance measures in accordance with the schematic presented in Figure 13.
- Contingency Response – implementing contingency plans where an exceedance of a subsidence impact performance measure or an unexpected impact is detected (Section 4.1).
- Adjustment – adjusting management strategies to improve performance.

## 4.3 REPORTING FRAMEWORK

Metropolitan Coal has developed a reporting framework for the Extraction Plan based on the nature of the predicted subsidence impacts and consequences and streamlining of reporting requirements.

Table 18 provides a summary of the proposed reporting framework, including which stakeholders will receive copies of each report and the distribution method. The subsections below provide further detail on the contents of each reporting mechanism.

### 4.3.1 Incident Report

An incident is defined as a set of circumstances that causes or threatens to cause or threatens to cause material harm to the environment, and/or breaches or exceeds the limits or performance measures/criteria in the Project Approval.

The reporting of incidents will be conducted in accordance with Condition 6, Schedule 7 of the Project Approval. Metropolitan Coal will notify the Secretary of the DPIE and any other relevant agencies (Table 18) of any incident associated with the Project as soon as practicable after Metropolitan Coal becomes aware of the incident. Within seven days of the date of the incident, Metropolitan Coal will provide the Secretary of the DPIE and relevant agencies with a detailed report on the incident.

An Incident Report will include the following:

- details on the nature of the incident (including survey results, photographs and date of the incident);
- results of investigation(s) to identify/evaluate the contributing factors to the incident;
- proposed course of action and development of contingency measures; and
- relevant Metropolitan Coal contact details to obtain further information on the incident.

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**Table 18**  
**Summary of Reporting Framework**

Report	Frequency	Distribution	Distribution Method <sup>1</sup>	Responsibility for Data Collation and Preparation	Responsibility for Submission
Incident Report	As required	DPIE (Secretary of the DPIE, c/- Executive Director) DRG (Manager and Principal Inspector, Environment) Other regulators as specified in management plans	Email	Technical Services Manager or Environment & Community Superintendent	Technical Services Manager, Environment & Community Superintendent or General Manager
Six Monthly Report	Six monthly	DPIE (Director, Resource Assessments)	Email and Website	Technical Services Manager or Environment & Community Superintendent	Technical Services Manager or Environment & Community Superintendent
Annual Review	Annually	DPIE (Director, Resource Assessments) DRG (Manager and Principal Inspector, Environment) Other regulators as specified in management plans Metropolitan Coal website	Email and Website	Technical Services Manager or Environment & Community Superintendent	Technical Services Manager or Environment & Community Superintendent
Complaints Register	Updated following receipt of complaints	Metropolitan Coal website	Website	Environment & Community Superintendent	Environment & Community Superintendent

<sup>1</sup> See Attachment 4 for distribution details.

#### 4.3.2 Six Monthly Reporting

A six monthly report (**Six Monthly Report**) will be prepared to report on subsidence impacts and environmental consequences associated with the Longwalls 305-307 Extraction Plan. The Six Monthly Report will include:

- a comprehensive summary of all subsidence impacts, including a revised characterisation according to the relevant TARP(s);
- any proposed actions resulting from triggers being met in the TARP(s), or other actions;
- assessment of compliance with all relevant subsidence impact performance measures and indicators; and
- a comprehensive summary of all quantitative and qualitative environmental monitoring results, including landscape monitoring, water quality data, water flow and pool level data, piezometer readings, etc.

#### 4.3.3 Annual Review

An Annual Review will be prepared and submitted in accordance with Condition 3, Schedule 7 of the Project Approval. The Annual Review will review the performance of the Project to the satisfaction of the Secretary of the DPIE and will:

- describe the works that were carried out in the past calendar year, and the works that are proposed to be carried out over the current calendar year;
- include a comprehensive review of the monitoring results and complaints records of the Project over the past calendar year, which includes a comparison of these results against:
  - the relevant statutory requirements, limits or performance measures/criteria;
  - the monitoring results of previous years; and
  - the relevant predictions in the Project EA, Preferred Project Report and Extraction Plan.
- identify any non-compliance over the last year, and describe what actions were (or are being) taken to ensure compliance;
- identify any trends in the monitoring data over the life of the Project;
- identify any discrepancies between the predicted and actual impacts of the Project, and analyse the potential cause of any significant discrepancies; and
- describe what measures will be implemented over the next year to improve the environmental performance of the Project.

#### 4.3.4 Complaints

The Environment & Community Superintendent is responsible for maintaining a system for recording complaints.

Metropolitan Coal will maintain public signage advertising the telephone number on which environmental complaints can be made. The Environment & Community Superintendent is responsible for ensuring that the currency and effectiveness of the service is maintained. Notifications of complaints received are to be provided as quickly as practicable to the Environment & Community Superintendent.

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Complaints and enquiries do not have to be received via the telephone line and may be received in any other form. Any complaint or enquiry relating to environmental management or performance is to be relayed to the Environment & Community Superintendent as soon as practicable. All employees are responsible for ensuring the prompt relaying of complaints. All complaints will be recorded in a complaints register.

For each complaint, the following information will be recorded in the complaints register:

- date and time of complaint;
- method by which the complaint was made;
- personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
- nature of the complaint;
- the action(s) taken by Metropolitan Coal in relation to the complaint, including any follow-up contact with the complainant; and
- if no action was taken by Metropolitan Coal, the reason why no action was taken.

The Environment & Community Superintendent is responsible for ensuring that all complaints are appropriately investigated, actioned and that information is fed back to the complainant, unless requested to the contrary.

In accordance with Condition 10, Schedule 7 of the Project Approval, the complaints register will be made publicly available on the website and updated on a monthly basis. A summary of complaints received and actions taken will be presented to the CCC as part of the operational performance review.

#### **4.4 REVIEW AND REVISION OF STRATEGIES, PLANS AND PROGRAMS**

In accordance with Condition 4, Schedule 7 of the Project Approval, the strategies, plans and programs required under The Project Approval will be reviewed within three months of the submission of:

- (a) an audit under Condition 8, Schedule 7;
- (b) an incident report under Condition 6, Schedule 7;
- (c) an annual review under Condition 3, Schedule 7; and

if necessary, revised to the satisfaction of the Secretary of the DPIE, to ensure the strategies, plans and programs are updated on a regular basis and to incorporate any recommended measures to improve environmental performance.

The strategies, plans and programs will also be reviewed within three months of approval of any Project modification and if necessary, revised to the satisfaction of the DPIE. The revision status of the strategies, plans and programs is indicated on the title page of each copy.

#### **4.5 DISTRIBUTION**

In accordance with Condition 10, Schedule 7 of the Project Approval 'Access to Information', Metropolitan Coal will make the Extraction Plan publicly available on the Peabody website. A hard copy of the Extraction Plan will also be maintained at the Metropolitan Coal site.

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Metropolitan Coal recognises that various regulators have different distribution requirements, both in relation to whom documents should be sent and in what format. An Environmental Management Plan and Monitoring Program Distribution Register has been established in consultation with the relevant agencies and infrastructure owners that indicates:

- to whom the Metropolitan Coal plans and programs, such as the Extraction Plan, will be distributed;
- the format (i.e. electronic or hard copy) of distribution; and
- the format of revision notification.

Metropolitan Coal will make the Distribution Register publicly available on the Peabody website. Metropolitan Coal will be responsible for maintaining the Distribution Register and for ensuring that notification of revisions is sent by email or post as appropriate.

In addition, Metropolitan Coal employees with local computer network access will be able to view the controlled electronic version of this Extraction Plan on the Metropolitan Coal local area network. Metropolitan Coal will not be responsible for maintaining uncontrolled copies beyond ensuring the most recent version is maintained on Metropolitan Coal's computer system and the Peabody website.

#### 4.6 KEY RESPONSIBILITIES

Key responsibilities under this Extraction Plan are summarised in Table 19. The component management plans provide additional responsibilities under the plans.

**Table 19**  
**Key Extraction Plan Responsibilities**

<b>Responsibility</b>	<b>Task</b>
General Manager	<ul style="list-style-type: none"> <li>• Ensure resources are available to Metropolitan Coal personnel to facilitate the completion of responsibilities under this Extraction Plan.</li> <li>• Ensure the safety of Metropolitan Coal employees and the public in relation to Metropolitan Coal operations.</li> <li>• Approve and instruct implementation of remediation/corrective action/compensation, if necessary.</li> </ul>
Mining Engineering Manager	<ul style="list-style-type: none"> <li>• Ensure the safety of Metropolitan Coal employees and the public in relation to Metropolitan Coal operations.</li> <li>• Ensure adequate resources are available for implementation of remediation/corrective actions.</li> </ul>
Technical Services Manager	<ul style="list-style-type: none"> <li>• Liaise with relevant stakeholders regarding environmental management.</li> <li>• Ensure monitoring and reporting required in accordance with this Extraction Plan are carried out within specified timeframes, are adequately checked and processed and are prepared to the required standard.</li> <li>• Ensure that any Incident Reports are lodged in a timely manner with all available information.</li> <li>• Ensure that reviews of the strategies, plans and programs are conducted as described in Section 4.4.</li> <li>• Liaise with relevant stakeholders regarding subsidence impact management and related public safety hazards.</li> </ul>
Environment & Community Superintendent	<ul style="list-style-type: none"> <li>• Liaise with relevant stakeholders regarding environmental management.</li> <li>• Ensure monitoring and reporting required in accordance with this Extraction Plan are carried out within specified timeframes, are adequately checked and processed and are prepared to the required standard.</li> <li>• Ensure that any Incident Reports are lodged in a timely manner with all available information.</li> <li>• Ensure that reviews of the strategies, plans and programs are conducted as described in Section 4.4.</li> </ul>
Registered Mine Surveyor	<ul style="list-style-type: none"> <li>• Undertake all subsidence monitoring to the required standard within the specified timeframes and ensure data are adequately checked, processed and recorded.</li> </ul>



## 5 REFERENCES

- Department of Planning and Environment and NSW Trade & Investment – Division of Resources and Energy (2015) *Guidelines for the Preparation of Extraction Plans Required under Conditions of Development Consents, Project Approvals and Mining Lease Conditions for Underground Coal Mining*. Version 5. Draft.
- Hebblewhite, B., Kalf, F. and McMahon T. (2017) *Woronora Reservoir Strategy Report – Stage 1 Report - Metropolitan Coal – Longwall mining near and beneath Woronora Reservoir*.
- Hebblewhite, B., Kalf, F. and McMahon T. (2019) *Woronora Reservoir Strategy Report – Stage 2 Report - Metropolitan Coal – Longwall mining near and beneath Woronora Reservoir*.
- Helensburgh Coal Pty Ltd (2008) *Metropolitan Coal Project Environmental Assessment*.
- Helensburgh Coal Pty Ltd (2009) *Metropolitan Coal Project Preferred Project Report*.
- Independent Expert Panel for Mining in the Catchment (2018) *Initial Report on Specific Mining Activities at the Metropolitan and Dendrobium Coal Mines*. 12 November 2018.
- Mine Subsidence Engineering Consultants (2019) *Metropolitan Mine – Longwall 304 Subsidence Predictions and Impact Assessments for the Natural and Built Features in Support of the Extraction Plan (MSEC Report MSEC1009)*.
- Operational Risk Mentoring (2019a) *Metropolitan Collieries Pty Ltd – Longwall 304 Environmental Risk Assessment Report*.
- Operational Risk Mentoring (2019b) *Metropolitan Collieries Pty Ltd – Longwalls 305-307 Environmental Risk Assessment Report*.
- SP Solutions (2008) *Metropolitan Coal Project Environmental Risk Analysis*. Appendix O in the Helensburgh Coal Pty Ltd (2008) *Metropolitan Coal Project Environmental Assessment*.

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