METROPOLITAN COAL LONGWALL 304

EXTRACTION PLAN




MAIN TEXT

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LONGWALL 304 EXTRACTION PLAN

Revision Status Register

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April 2019

TITLE BLOCK

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Mine	Metropolitan Coal
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Mining Leases	Consolidated Coal Lease 703 Mining Lease 1610 Mining Lease 1702 Coal Lease 379 Mining Purpose Lease 320
Title	Metropolitan Coal Longwall 304 Extraction Plan
Date	5 April 2019
Document Reference Number	EP-R01-A
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Name of Authorised Representative	Jon Degotardi
Title of Authorised Representative	Technical Services Manager
Signature of Authorised Representative	
Name of Mining Engineering Manager	James Hannigan
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Name of General Manager	Andy Hyslop
Signature of General Manager	
Date of Signatures	**5 April 2019**

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1 OVERVIEW OF THE EXTRACTION PLAN

Metropolitan Coal is wholly owned by Peabody Energy Australia Pty Ltd (Peabody), and is located adjacent to the township of Helensburgh and approximately 30 kilometres (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).

Longwall 304 is situated to the west of Longwalls 301-303, and defines the next mining sub-domain within the Project underground mining area (Figures 1 and 2).

1.1 PURPOSE AND SCOPE

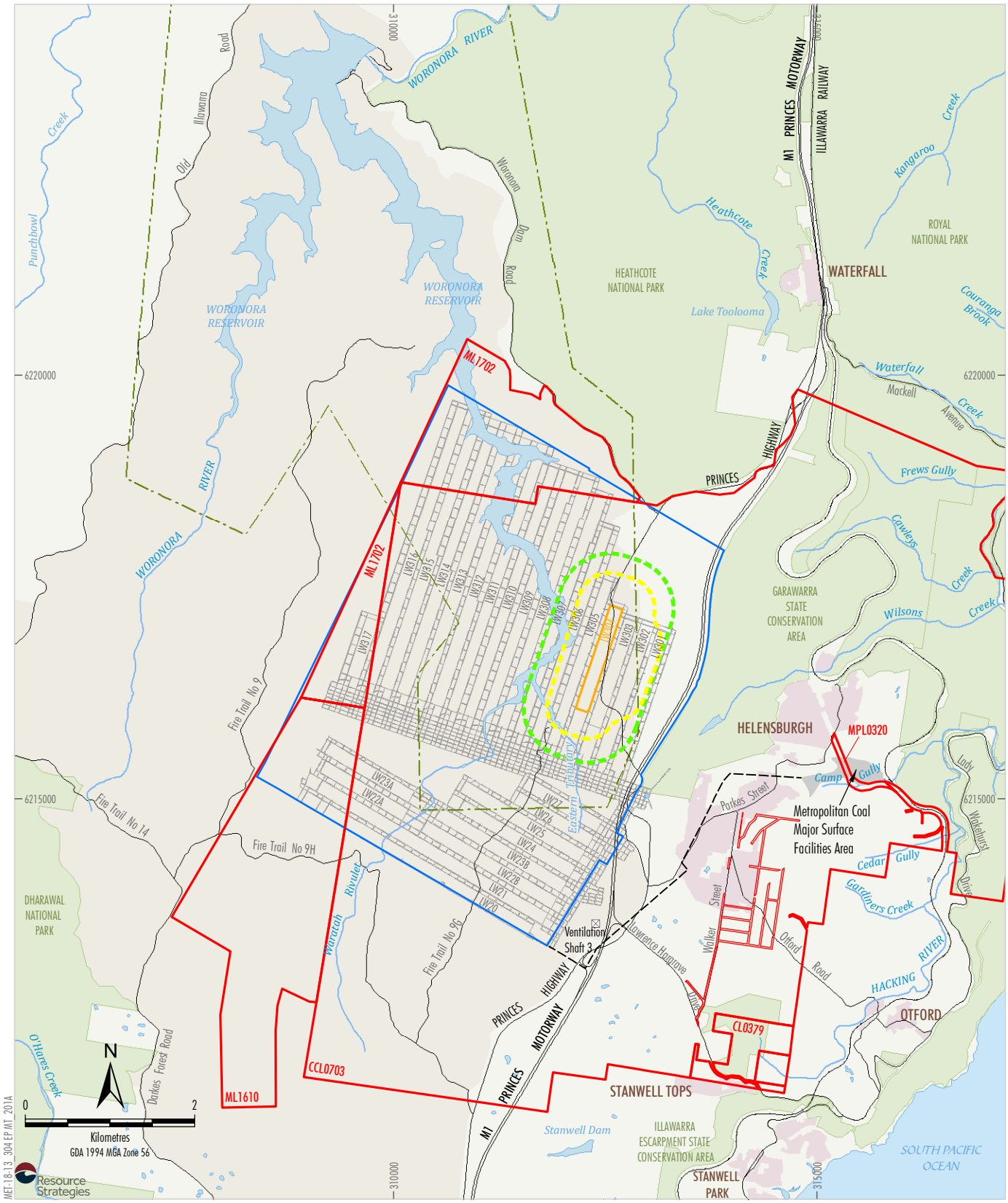
This Extraction Plan outlines the proposed management, mitigation, monitoring and reporting of potential subsidence impacts and environmental consequences in the Project underground mining area during the secondary extraction of Longwall 304 at Metropolitan Coal.

This Extraction Plan has been prepared in consideration of the NSW Department of Planning and Environment (DP&E) and NSW Division of Resources and Energy (DRE) (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 and 301-303, subject to the previously approved Metropolitan Coal Longwalls 301-303 Extraction Plan. That is, the Metropolitan Coal Longwalls 301-303 Extraction Plan is superseded by this Extraction Plan, consistent with the recommended approach in the DP&E and DRE (2015) *Guidelines for the Preparation of Extraction Plans*.

The objectives of this Extraction Plan are to:

- provide detailed plans of Longwall 304;
- outline potential subsidence effects, subsidence impacts and environmental consequences of Longwall 304;
- describe the measures that will be implemented to manage, mitigate and remediate potential subsidence impacts and environmental consequences during the mining of Longwall 304;
- detail the monitoring of subsidence effects, subsidence impacts and environmental consequences during the mining of Longwall 304; and
- provide a contingency plan for subsidence impacts and environmental consequences in relation to the Project's subsidence impact performance measures.



LEGEND

- Mining Lease Boundary
- Woronora Special Area
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwall 304 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Secondary Extraction of Longwall 304
- 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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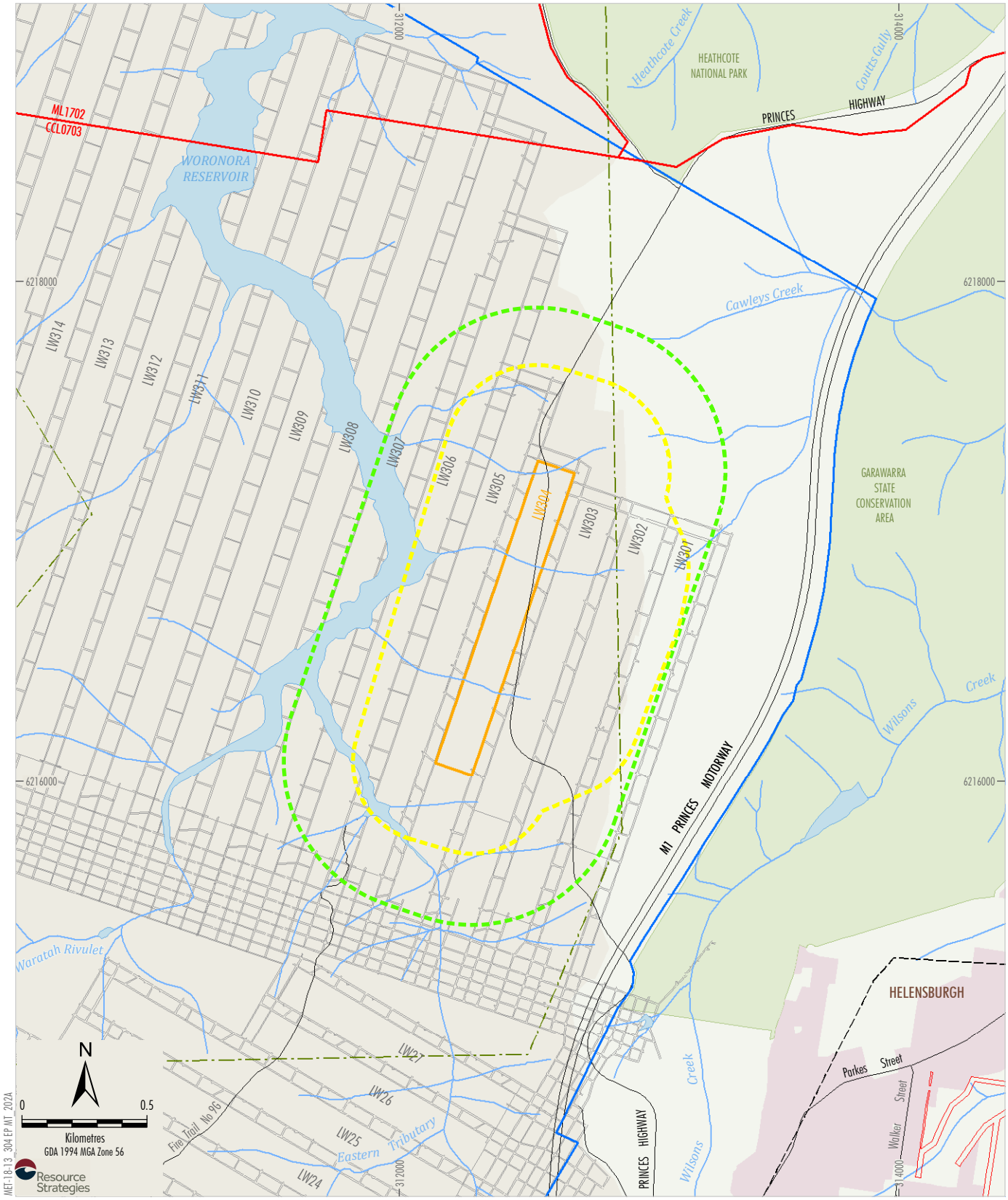
Longwall 304 and Project Underground Mining Area

Figure 1



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

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Longwall 304 Layout

Figure 2

The Extraction Plan area for Longwall 304, 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), HydroSimulations, 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 DP&E 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

Project Approval (08_0149) Condition	Extraction Plan Reference
Condition 6, Schedule 3	
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[1]. 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[2], 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[2]:	
• 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

Table 1 (Continued)
Extraction Plan Requirements

Project Approval (08_0149) Condition	Extraction Plan Reference
Condition 6, Schedule 3 (Continued)	
• a Subsidence Monitoring Program to:	Appendix G
- validate the subsidence predictions; and	
- analyse the relationship between the subsidence effects and subsidence impacts of the Extraction Plan and any ensuing environmental consequences;	
(f) include a:	
• Water Management Plan, which has been prepared in consultation with OEH, SCA[3] and NOW[4], to manage the environmental consequences of the Extraction Plan on watercourses (including the Woronora Reservoir), aquifers and catchment yield;	Appendix A
• Biodiversity Management Plan, which has been prepared in consultation with OEH and DRE (Fisheries)[5], to manage the potential environmental consequences of the Extraction Plan on aquatic and terrestrial flora and fauna, with a specific focus on swamps;	Appendix C
• Land Management Plan, which has been prepared in consultation with SCA[3], to manage the potential environmental consequences of the Extraction Plan on cliffs, overhangs, steep slopes and land in general;	Appendix B
• 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;	Appendix D
• 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	Appendix E
(g) include a Public Safety Management Plan, which has been prepared in consultation with DRE[2] (for any mining within the DSC notification area), to ensure public safety in the mining area.	Appendix F
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.	
Condition 7, Schedule 3	
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:	
(a) a program to collect sufficient baseline data for future Extraction Plans;	Appendices A to E, Attachment 3
(b) a revised assessment of the potential environmental consequences of the Extraction Plan, incorporating any relevant information that has been obtained since this approval;	Appendices A to F, Appendix I
(c) a detailed description of the measures that would be implemented to remediate predicted impacts; and	Appendices A to F, Section 3
(d) a contingency plan that expressly provides for adaptive management.	Appendices A to F, Section 4.1

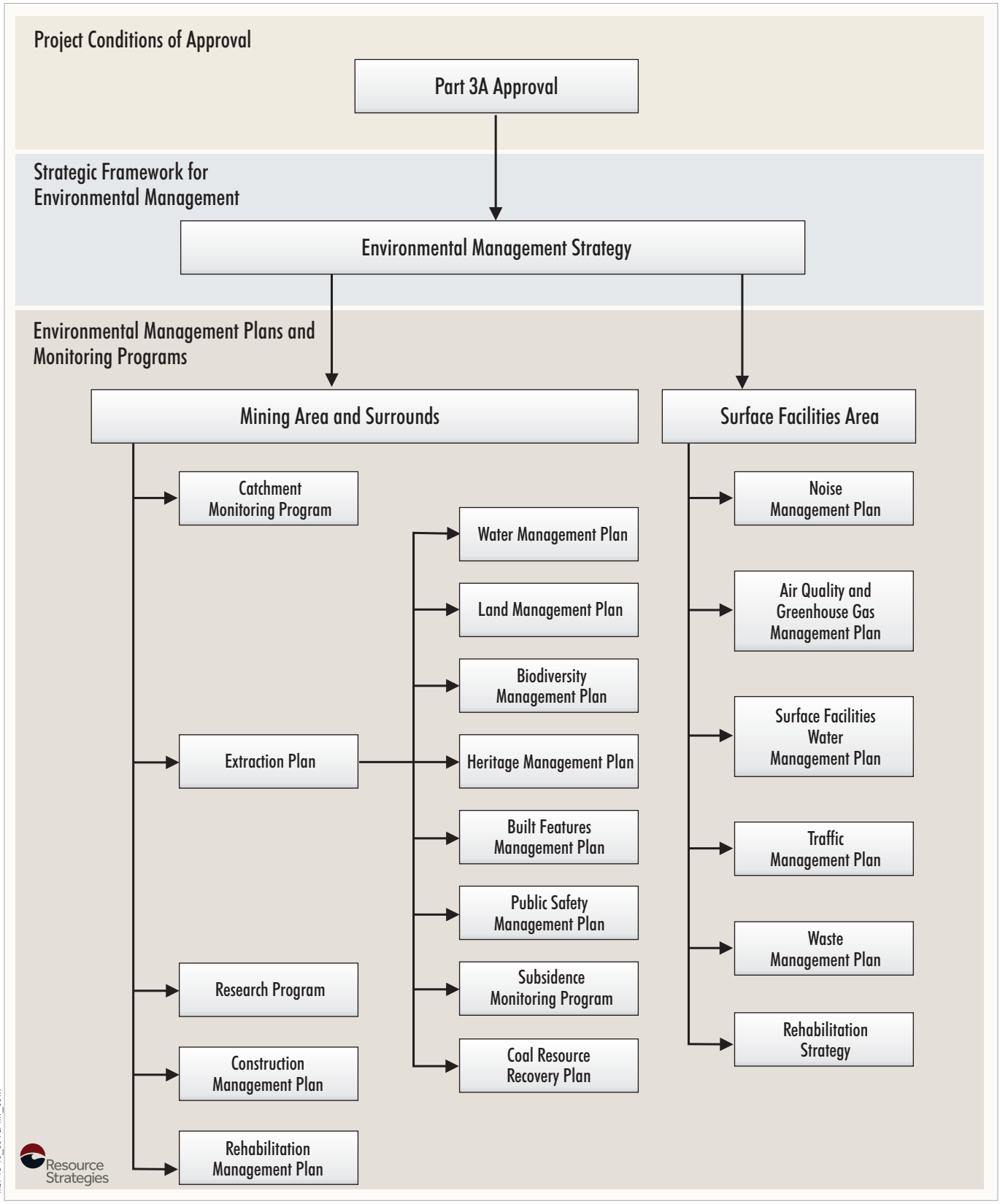
1 The Director-General of the DP&E is now the Secretary of the DP&E.

2 The Division of Resources and Energy (DRE) is now the Division of Resources and Geoscience (DRG).

3 The Sydney Catchment Authority (SCA) is now WaterNSW.

4 The NSW Office of Water (NOW) is now the Department of Industry – Water (DI-Water).

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



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Environmental Management Structure

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 NSW Division of Resources and Geoscience (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 DRG.
- 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 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.

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 – Longwall 304 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 DP&E and DRE (2015) *Guidelines for the Preparation of Extraction Plans*:

Plan 1 Existing, Proposed and Future Workings.

Plan 2 Longwall 304 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 DP&E 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)[1] *Initial Report on Specific Mining Activities at the Metropolitan and Dendrobium Coal Mines* (IEPMC, 2018) (herein referred to as the 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).

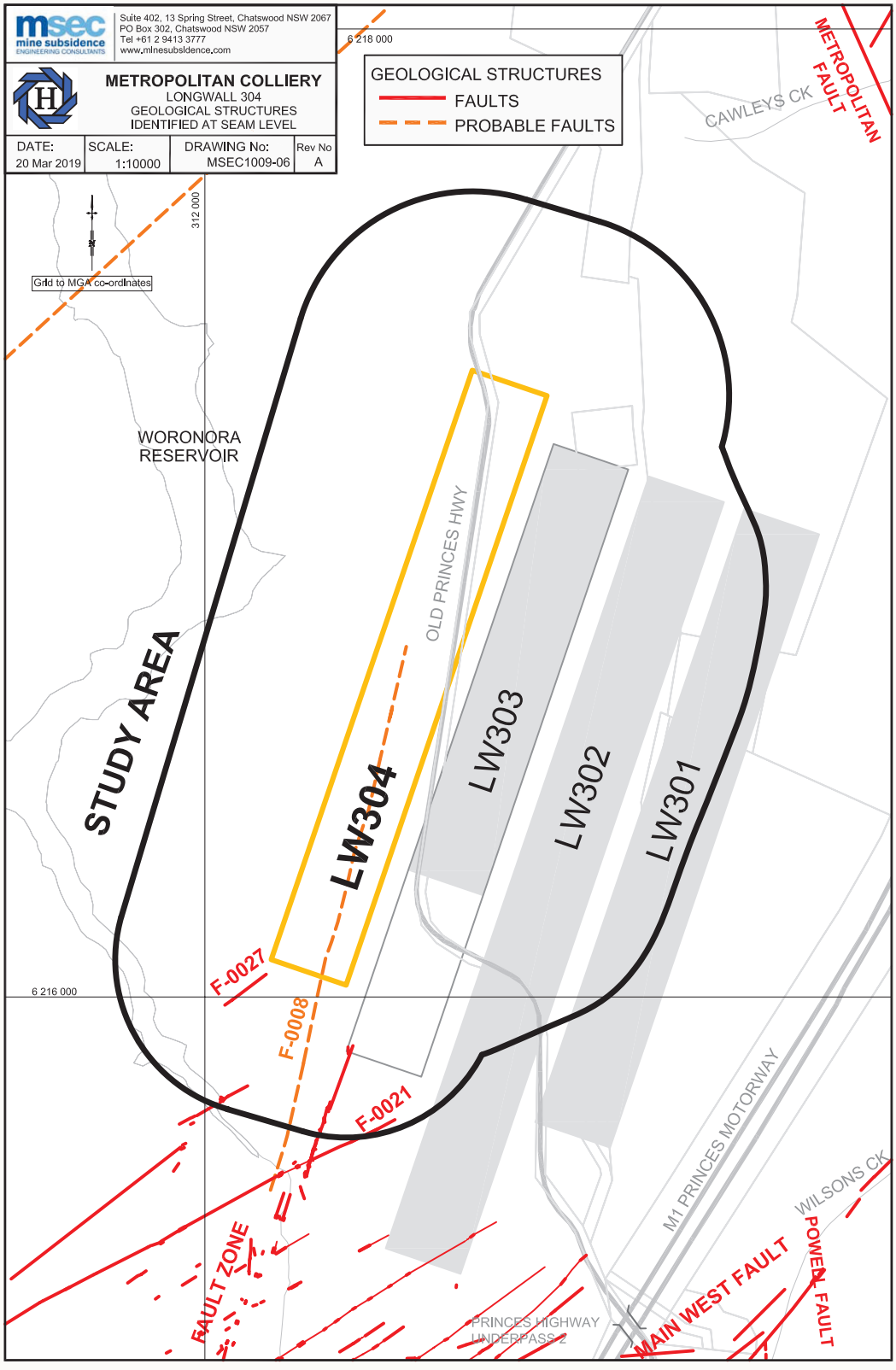
Many features of the NSW Coalfields surface topography are directly correlated to the basement structure, the depth of the basement from the surface through many sedimentary epochs and the deformational episodes of the basement rock. Underlying the Sydney Basin sedimentary rocks is the Palaeozoic granite basement rock. 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.

Longwall 304 is 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 east (Appendix H).

A strike slip fault, F0008 (Figure 4), with up to 1.2 m vertical displacement occurs over Longwalls 20-27, and it is possible that this fault extends 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.

[1] The IEPMC was established in November 2017 by the NSW Government to provide expert advice to the DP&E on the impact of mining activities in the Greater Sydney Water Catchment Special Areas, with a particular focus on risks to the quantity of water in the catchment.



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Source: MSEC (2019)

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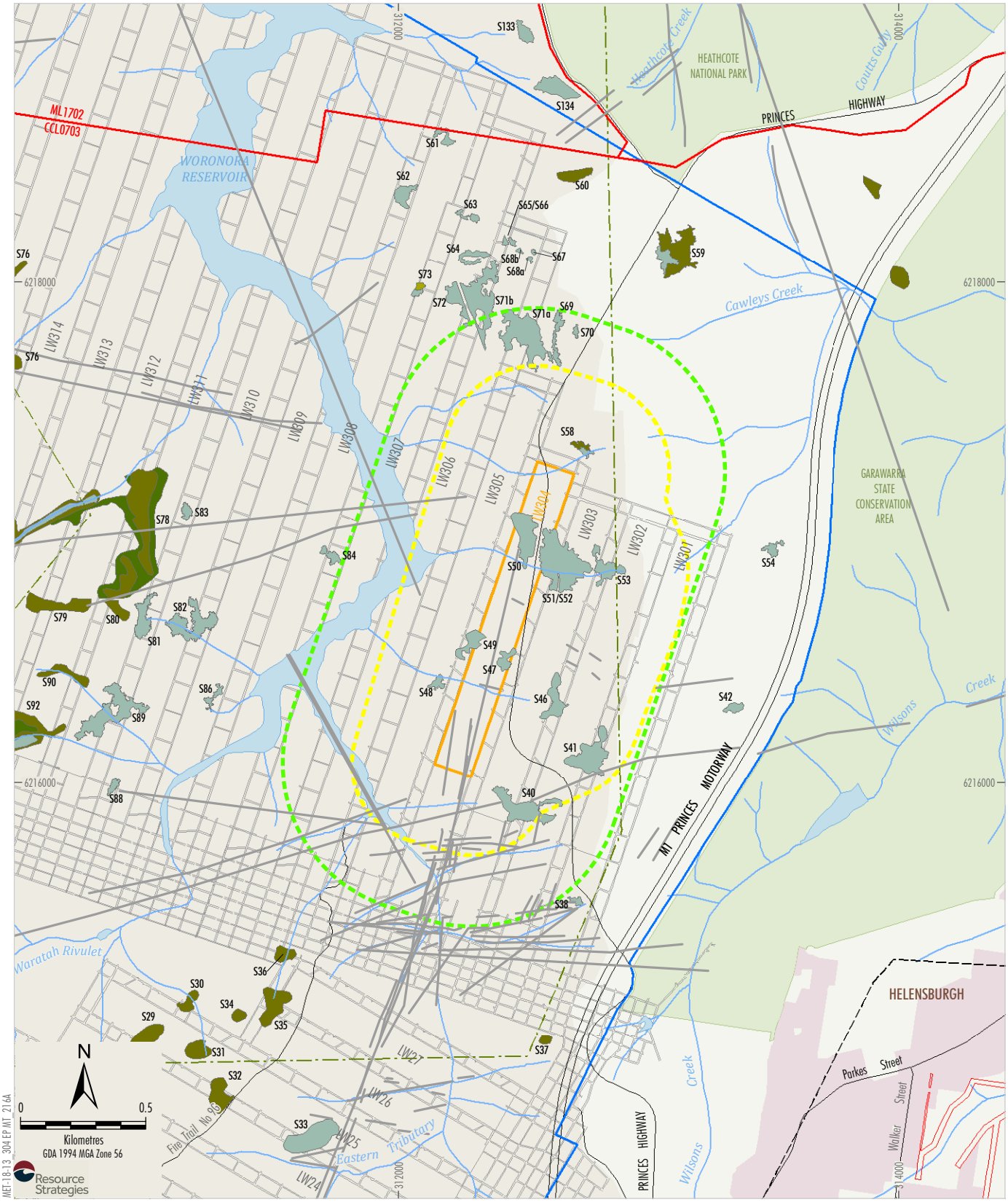
Longwall 304 Geological Structures
Identified at Seam Level

Figure 4



LEGEND

- Mining Lease Boundary
- Woronora Special Area
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwall 304 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Secondary Extraction of Longwall 304
- Woronora Notification Area
- Existing Underground Access Drive (Main Drift)
- Lineament

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

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)

Note: 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.

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Known Lineaments over Longwall 304 and Surrounds

Figure 5

A strike slip fault, F0027 (Figure 4), with zero vertical displacement, has been mapped in the Longwall 304 maingate roadway trending with a surface linear located approximately 250 m west of the end of the Eastern Tributary arm of Woronora Reservoir full supply level (Figure 5). No underground expression of this linear or fault has been mapped in the roadways around Longwall 303 (Figure 4).

A 20 mm wide minor strike-slip fault, F0021 (Figure 4), with zero vertical displacement, has been mapped to the south of Longwall 303. This fault is associated with a surface linear that aligns with the Eastern Tributary at the waterfall at downstream end of rock bar ETAU (Figure 5). No moisture has been evident at seam level where it crosses 300 mains or in the Longwall 303 maingate.

A risk assessment workshop was held on 20 February 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 (previously HCPL) 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 6°). The Secretary of the DP&E 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 DP&E in May 2016 and November 2018, respectively.

Longwalls 301 to 304 have been shortened at the northern commencing ends as a result of the thinning of the coal seam and/or prohibitive carbon dioxide gas content. Avoidance and subsidence mitigation measures that have been incorporated into the longwall layouts have included:

- The finishing end of Longwall 301 was shortened to reduce potential subsidence effects at Bridge 2 (M1 Princes Motorway).
- The commencing ends of Longwalls 302, 303 and 304 were shortened to reduce potential subsidence effects at the Garrawarra Centre Complex.

The finishing ends of Longwall 303 and Longwall 304 have also been shortened to reduce predicted valley closure on the Eastern Tributary. Metropolitan Coal submitted an updated Longwalls 301-303 Extraction Plan to the DP&E in September 2018. On the 8 November 2018, the DP&E granted conditional approval for Longwall 303 extraction. The Extraction Plan approval reflects a precautionary approach, and only allows mining to take place in the first 1,143 m of Longwall 303. The DP&E's correspondence to Metropolitan Coal indicated that should monitoring and further investigations demonstrate that additional mining of Longwall 303 would have no further exceedance of the relevant performance measure, Metropolitan Coal could submit an application to seek further approval from the Secretary to undertake secondary extraction beyond 1,143 m in Longwall 303. Metropolitan Coal submitted its Longwall 303 Extension Application to the DP&E in January 2019 (and a revision in February 2019). Metropolitan Coal's Longwall 303 Extension Application sought to extract an additional 182 m in Longwall 303 (i.e. the first 1,325 m of Longwall 303) and proposed to implement a monitoring and adaptive management approach developed for valley closure movements on the Eastern Tributary.

The layout of Longwall 304 is shown on Figure 2 in this document and on Plan 1 in Attachment 1 of Appendix H. A summary of the longwall dimensions for Longwall 304 is provided in Table 2. The longwall layout includes a 163 m panel width (void) and 45 m pillars (solid).

Table 2
Summary of Longwall 304 Dimensions

Longwall	Longwall Length (m)	Total Void Width (m)	Tailgate Chain Pillar Width (m)
LW304	1,286	163	45

Figure 2 in this document and Plan 1 in Attachment 1 of Appendix H show existing Metropolitan Coal longwalls located within 500 m of Longwall 304, as well as future longwalls (i.e. from Longwall 305 on). The Longwall 304 Extraction Plan is based on a Longwall 303 extraction length of 1,325 m and a Longwall 304 extraction length of 1,286 m. The Longwall 303 extraction length is consistent with Metropolitan Coal's Longwall 303 Extension Applications (January/February 2019), which sought further approval from the Secretary of the DP&E to undertake secondary extraction beyond 1,143 m in Longwall 303 for the first 1,325 m of Longwall 303.

On 29 March 2019 (just prior to the submission of this Extraction Plan), Metropolitan Coal advised the DP&E that due to timing constraints and the need for certainty of mine planning and scheduling that Metropolitan Coal would only seek a 54 m extension to Longwall 303 (i.e. a total Longwall 303 extraction length of 1,197 m). The subsidence predictions, impact and environmental consequence assessments in this Extraction Plan are therefore conservative. The 54 m extension to Longwall 303 was approved by the DP&E on 4 April 2019.

1.3.3 Mining Method

The extraction of Longwall 304 will occur from north to south. Longwall 304 will be extracted using retreating longwall mining methods for secondary extraction of a panel with a 163 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 gateroads 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 130 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 158 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.

1.3.4 Mining Parameters

The Extraction Plan area and proposed mine plan is shown on Figure 2 and key dimensions are summarised in Table 3.

Table 3
Key Mining Parameters

Parameter	Longwall 304
ROM Coal Extracted (Mt)	Approx. 1.2
Gate Road Width (m)	5.2
Gate Road Height (m)	3.2
Maingate (MG) Chain Pillar Width (m)	45
Tailgate (TG) Chain Pillar Width (m)	45
Longwall Void Width (m) (ribline of goaf edge)	163
Longwall Void Length (m)	1,286
Seam Thickness (m)	2.7 – 2.9
Extraction Height (m)	Up to 3.2
Depth of Cover (m)	400 – 555

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 302 is complete, with extraction of Longwall 303 underway.

Longwall 304 is scheduled to commence in July 2019 and be completed in December 2019.

1.3.6 Previous and Future Mining

Mining at Metropolitan Coal commenced in the 1880's 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 Longwall 304 and include Longwalls 1-18, Longwalls 20-27 and Longwalls 301-303. 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 is scheduled to be completed in May 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 305-317 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 305-317 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 Longwall 304 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 Longwall 304. The report includes the maximum predicted conventional subsidence parameters for Longwall 304 including:

- Incremental Subsidence Parameters, which are the predicted subsidence parameters due to the extraction of the single Longwall 304.
- Total Subsidence Parameters, which include the accumulated subsidence parameters after the completion of a series of longwalls.

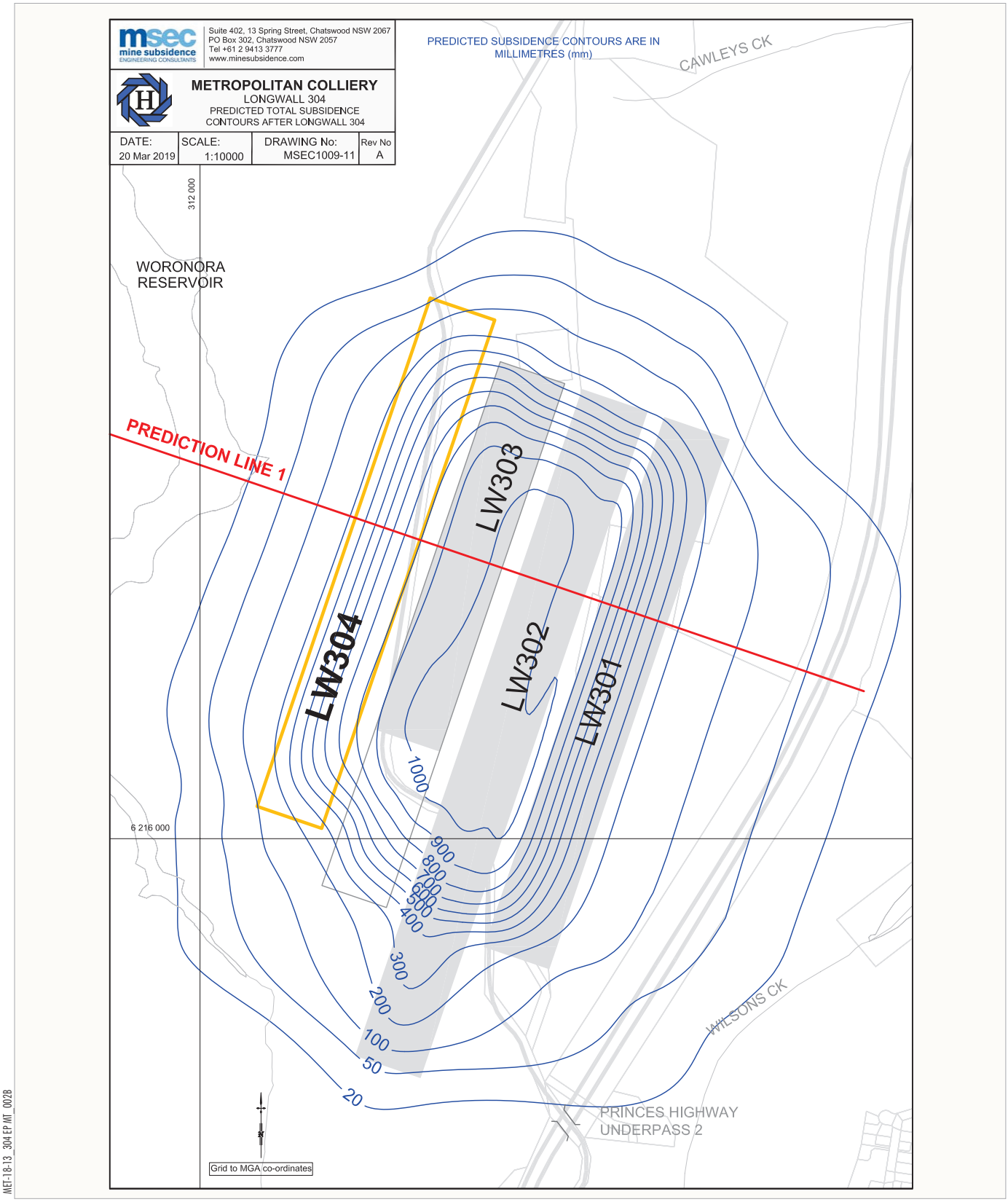
The maximum predicted incremental and total subsidence, tilt and curvatures for Longwall 304 are summarised in Table 4. Figure 6 provides the predicted total subsidence contours after Longwall 304 extraction.

Table 4
Maximum Predicted Subsidence, Tilt and Curvature for Longwall 304

Subsidence Parameter	Longwall 304	
	Incremental Subsidence Predictions	Total Subsidence Predictions
Maximum Subsidence (m)	0.625	1.05
Maximum Tilt (mm/m)	4.0	5.0
Maximum Hogging Curvature (km^{-1})	0.04	0.05
Maximum Sagging Curvature (km^{-1})	0.06	0.13

Source: after MSEC (2019) (Appendix I).
mm/m = millimetres per metre.
km^{-1} = 1/kilometres.

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



Source: MSEC (2019)

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Predicted Total Subsidence Contours after Longwall 304

Figure 6

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 Longwall 304 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 Longwall 304 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 5.

Table 5
Subsidence Impact Performance Measures

Water Resources	
Catchment yield to the Woronora Reservoir	*Negligible reduction to the quality or quantity of water resources reaching the Woronora Reservoir* *No connective cracking between the surface and the mine*
Woronora Reservoir	*Negligible leakage from the Woronora Reservoir* *Negligible reduction in the water quality of Woronora Reservoir*
Watercourses	
Waratah Rivulet between the full supply level of the Woronora Reservoir and the maingate of Longwall 23 (upstream of Pool P)	*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)*
Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26	*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)*
Biodiversity	
Threatened species, populations, or ecological communities	*Negligible impact*
Swamps 76, 77 and 92	*Set through condition 4 below*
Land	
Cliffs	*Less than 3% of the total length of cliffs (and associated overhangs) within the mining area experience mining-induced rock fall*

Table 5 (Continued)
Subsidence Impact Performance Measures

Heritage	
Aboriginal heritage sites	*Less than 10% of Aboriginal heritage sites within the mining area are affected by subsidence impacts*
Items of historical or heritage significance at the Garrawarra Centre	*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.*
Built Features	
Built features	*Safe, serviceable and repairable, unless the owner agrees otherwise in writing*

1.6 SUBSIDENCE MANAGEMENT APPROACH

Potential environmental consequences during the mining of Longwall 304 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 DP&E and DRE (2015) *Guidelines for the Preparation of Extraction Plans*, a number of risk assessments have been undertaken for the Metropolitan Coal Longwall 304 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.

Suitably qualified and experienced experts endorsed by the Secretary of the DP&E for the preparation of this Extraction Plan participated in the ERA[2]. The ERA process involved the key steps described below.

Review of Relevant Documentation

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 *Environmental Risk Analysis* (SP Solutions, 2008) conducted for the Project EA (Appendix O of the Project EA).
- The Preferred Project Report (HCPL, 2009).
- The Longwalls 301-303 Environmental Risk Assessment Report (Metropolitan Coal, 2016)[3].
- Subsidence predictions and assessments included in Metropolitan Coal's Longwalls 304-306 First Workings Application (correspondence to the DP&E dated 9 October 2018).
- Information regarding the Longwalls 301-303 layout and requirement to have no further exceedance of the relevant performance measure applicable to the Eastern Tributary.
- Subsidence predictions for the proposed Longwall 304 Extraction Plan layout (including subsidence contours, Eastern Tributary, cliff sites, upland swamps and Aboriginal heritage sites).

Risk Identification

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 Longwall 304 was conducted on 23 November 2018, with some participants attending via video conferencing and others attending in person at Metropolitan Coal. The ERA workshop was facilitated by an independent specialist, Operational Risk Mentoring.

The general consensus of the workshop participants was the additional (specific) issues/risks identified for Longwall 304 were broadly assessed and ranked as part of the 2008 Environmental Risk Analysis and Longwalls 301-303 ERA. It was considered that the five "loss scenarios" identified for the Longwalls 301-303 ERA (within two key topics of discussion *viz.* Upland Swamps and the Eastern Tributary) were appropriate for the assessment of Longwall 304.

The assessed level of risk for each of the five loss scenarios identified for Longwalls 301-303 were reviewed for Longwall 304, considering the experience to date and using the same probability, consequence and risk rankings tables. A key assumption that was applied to the Longwall 304 ERA was that the Longwall 304 Extraction Plan layout would not result in any further exceedance of the performance measure relevant to the Eastern Tributary.

[2] Participants included Mr Peter DeBono (MSEC, Subsidence and Land), Dr Noel Merrick (HydroSimulations, Groundwater), Mr Lindsay Gilbert and Mr Tony Marszalek (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 Jamie Reeves (Niche Environment and Heritage, Heritage), Ms Stacey Gromadzki (Resource Strategies), Mr Jon Degotardi (Metropolitan Coal) and Mr Stephen Love (Metropolitan Coal).

[3] This report includes a description of the approved changes made to the first workings layout for Longwalls 301-303 in 2015 and 2016.

The assessed levels of risk for Longwalls 301-303 were considered by the participants to remain valid for Longwall 304. The re-assessed risk rankings for Longwall 304 were within the "low" range and consequently the potential outcomes can still be integrated into the existing management systems for effective review and monitoring (Operational Risk Mentoring, 2019).

Review of Issues/Risks and Assessed Levels of Risk for Revised Longwall 304 Extraction Plan Layout

Subsequent to the Longwall 304 ERA workshop, Metropolitan Coal proposed a change to the layout of Longwalls 303 and 304 for the Longwall 304 Extraction Plan. The participants were asked to review a number of additional documents relevant to the risk assessment and revised layouts and Longwall 304 risk assessment. This included:

- Metropolitan Coal's Longwall 303 Extension Application (February 2019), which seeks further approval from the Secretary to undertake secondary extraction beyond 1,143 m in Longwall 303 for the first 1,325 m of Longwall 303. This application includes details of Metropolitan Coal's proposed monitoring and adaptive management approach for the Eastern Tributary. The application states that the same monitoring and adaptive management approach for the Eastern Tributary will be applied to Longwall 304.
- Confirmation that the Longwall 304 Extraction Plan will be based on a Longwall 303 extraction length of 1,325 m and a Longwall 304 extraction length of 1,286 m, noting that this layout differs from that assessed in the ERA Workshop (November 2018), with Longwall 303 being extended by 128 m and Longwall 304 being shortened by 43 m.
- A figure showing the revised Longwall 303 and Longwall 304 layouts to be used for the Longwall 304 Extraction Plan compared to the longwall lengths assessed by the ERA workshop.
- The MSEC (2019) *Metropolitan Mine – Longwall 304 Subsidence Predictions and impact Assessments for the Natural and Built Features in Support of the Extraction Plan* report (Report MSEC1009), detailing the subsidence predictions and impact assessments for the revised longwall layout for the Longwall 304 Extraction Plan.

The ERA participants were asked to identify any additional (specific) issues/risks and/or changes to previously assessed levels of risk associated with the revised Longwall 304 Extraction Plan Layout. The assessed levels of risk were considered to remain valid for the revised Longwall 304 Extraction Plan layout.

ERA Report Review

All ERA participants were asked to review the draft report that was prepared to summarise the outcomes of the risk assessment workshop and risk review as a result of the change in longwall layout. Participants' comments were incorporated into the final Operational Risk Mentoring (2019) report.

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

The IEPMC's (2018) 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.

In relation to the Metropolitan Coal Mine, the IEPMC Initial Report concluded (pg 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 20 February 2019 to assess the potential for mining effects on geological features to impact on the quantity of water available to the Woronora Reservoir. The workshop participants[4] 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.

Additional controls arising from the risk assessment workshop include targeted surface mapping above Longwall 304 to define characteristics of F0008 linear and F0027 linear and dissipation points, correlation of updated linear mapping with underground geological mapping and a specific underground water monitoring program for F0008 and F0027 (Metropolitan Coal, 2019).

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).

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.

Subsequent to the receipt of DP&E 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 during the BFMP risk assessments for Longwalls 301-303 will be implemented for the extraction of Longwall 304.

[4] Participants included Professor Bruce Hebblewhite (B. K. Hebblewhite Consulting), Dr Noel Merrick (HydroSimulations, Groundwater), Mr Peter DeBono (MSEC, Subsidence), Mr Shane Kornek (Metropolitan Coal, Senior Geotechnical Engineer), Mr Jon Degotardi (Metropolitan Coal, Technical Services Manager), Mr Tim Kendrick (Peabody, Water Specialist) and Ms Stacey Gromadzki (Resource Strategies). The risk assessment was facilitated by Mr Mick Allen (Peabody, Safety Superintendent).

A risk assessment workshop was held with representatives from Roads and Maritime Services (RMS), Metropolitan Coal, and MSEC on 18 September 2018 in relation to Longwalls 304-306. The RMS will be provided with revised subsidence predictions specific to Longwall 304 with the revised BFMP-RMS on submission of the Extraction Plan.

A risk assessment workshop was also held with representatives from Axicom, Metropolitan Coal and MSEC on 2 November 2018 in relation to Longwall 304. Axicom will be provided with revised subsidence predictions specific to Longwall 304 with the revised BFMP-AXICOM on submission of the Extraction Plan.

2.1.4 Public Safety Management Plan Risk Assessment

A risk assessment was held for the 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 14 December 2018, was facilitated by an independent specialist, AXYS Consulting. A number of 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.

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 have occurred at predicted 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 agrees that the 200 mm valley closure concept requires 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 been a successful design tool for mining in the vicinity of the Waratah Rivulet.

Metropolitan Coal has developed a monitoring and adaptive management approach to the mining of Longwall 303 towards the Eastern Tributary. As Longwall 303 mines towards the Eastern Tributary, Metropolitan Coal will use a Trigger Action Response Plan (TARP) designed to monitor valley closure movements on the Eastern Tributary. Similar monitoring of subsidence movements has been successfully implemented to avoid impacts on the Sandy Creek Waterfall at the Dendrobium Coal Mine by South32.

The monitoring and adaptive management approach will also be implemented for Longwall 304 as it mines closer to the Eastern Tributary. Details of the Longwall 304 Eastern Tributary Valley Closure TARP is provided 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.

2.3.1 Predicted Subsidence Effects and Subsidence Impacts

A detailed subsidence assessment for Longwall 304 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 Longwall 304 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% 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 Longwall 304. 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, occur at the northern end of Longwall 304 and this area has been left unmined by the shortening of Longwall 304 for the Extraction Plan Layout. At the southern end of Longwall 304 (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).

Longwall 304 based on the Extraction Plan Layout does not extend beneath the Woronora Reservoir full supply level, however, a portion of the Woronora Reservoir full supply level is located within the Longwall 304 35° angle of draw and/or predicted 20 mm subsidence contour (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).

To the south of the 35° angle of draw and/or predicted 20 mm subsidence contour of the Extraction Plan Layout, the Eastern Tributary flows in a northerly direction into the Woronora Reservoir full supply level (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).

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 Longwall 304. 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 Longwall 304 extraction for the preparation of each management plan.

The IEPMC (2018) 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 DP&E requested that specific regard be given in the Longwall 304 Extraction Plan 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 and 301-303 in accordance with Condition 6, Schedule 3 of the Project Approval. This consultation has informed the development of the Longwall 304 Extraction Plan and component management plans.

Consultation undertaken with stakeholders to date in relation to the Longwall 304 Extraction Plan is described below.

2.4.1 Government Agencies

Metropolitan Coal requested the endorsement of the Extraction Plan team as suitably qualified and experienced experts on 26 October 2018. The Extraction Plan team was endorsed by the DP&E on 11 November 2018 (Attachment 2).

A number of management plans have been distributed to stakeholders for comment, as detailed below:

- The HMP was provided to the Office of Environment and Heritage (OEH) and DP&E on 20 February 2019.
- The LMP was provided to WaterNSW and the DP&E on 6 March 2019.
- The PSMP was provided to the DRG, Dams Safety Committee (DSC), WaterNSW and DP&E on 6 March 2019.
- The BMP was provided to the OEH, DPI-Fisheries and DP&E on 7 March 2019.

Copies of the abovementioned consultation letters are provided in Attachment 2.

WaterNSW advised Metropolitan Coal (11 March 2019) that it would not be in a position to provide comments on the LMP or PSMP before the 5 April 2019, and queried whether there were any particular aspects Metropolitan Coal was seeking comment on. Metropolitan Coal advised WaterNSW (12 March 2019) that WaterNSW could hold their comments on the LMP and PSMP until Metropolitan Coal's submission of the Longwall 304 Extraction Plan around this time. On 3 April 2019 WaterNSW advised Metropolitan Coal that WaterNSW is satisfied that the LMP and PSMP adequately cover their intended functions, and has no further comment at this time.

WaterNSW representatives[5] were taken underground at the Metropolitan Coal Mine on 19 March 2019. The visit included inspection of the minor strike-slip fault (F0021) and fault F0008, which are the subject of assessment in the WMP and CRRP. The DP&E's request for specific regard to be given in the Longwall 304 Extraction Plan to the potential impacts of mining near and under lineaments on surface water features, including swamps and waterfalls is provided in Attachment 2.

The OEH provided comments on the HMP on 6 March 2019 and on the BMP on 2 April 2019 (Attachment 2). Metropolitan Coal will respond to OEH's comments on the HMP and BMP during the Longwall 304 assessment process. Any proposed amendments will be incorporated in the next revisions of the HMP and BMP.

As at 4 April 2019, no other comments or feedback had been received from the stakeholders.

[5] WaterNSW representatives on the underground visit included Ms Fiona Smith (Executive Manager, Water and Catchment Protection) and Mr Peter Dupen (Manager, Mining).

2.4.2 Landholders

A title search of land within 600 m of Longwall 304 identified the following (Figure 7):

- two lots are owned by WaterNSW;
- four lots are owned by The State of NSW (Crown Land); and
- two lots are owned by the Health Administration Corporation (NSW Health).

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 DP&E. Metropolitan Coal will provide a copy of the Longwall 304 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 Longwall 304 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. This BFMP has been updated to include Longwall 304 and will be provided to the Health Administration Corporation (NSW Health) on submission of the Extraction Plan.

2.4.3 Aboriginal Groups

A draft of the Longwall 304 HMP was provided to Aboriginal stakeholders registered at Metropolitan Coal for their review and comment on 20 February 2019. Copies of the abovementioned consultation letters are provided in Attachment 2.

As at 4 April 2019, no comments had been received from the Aboriginal stakeholders.

2.4.4 Infrastructure Owners

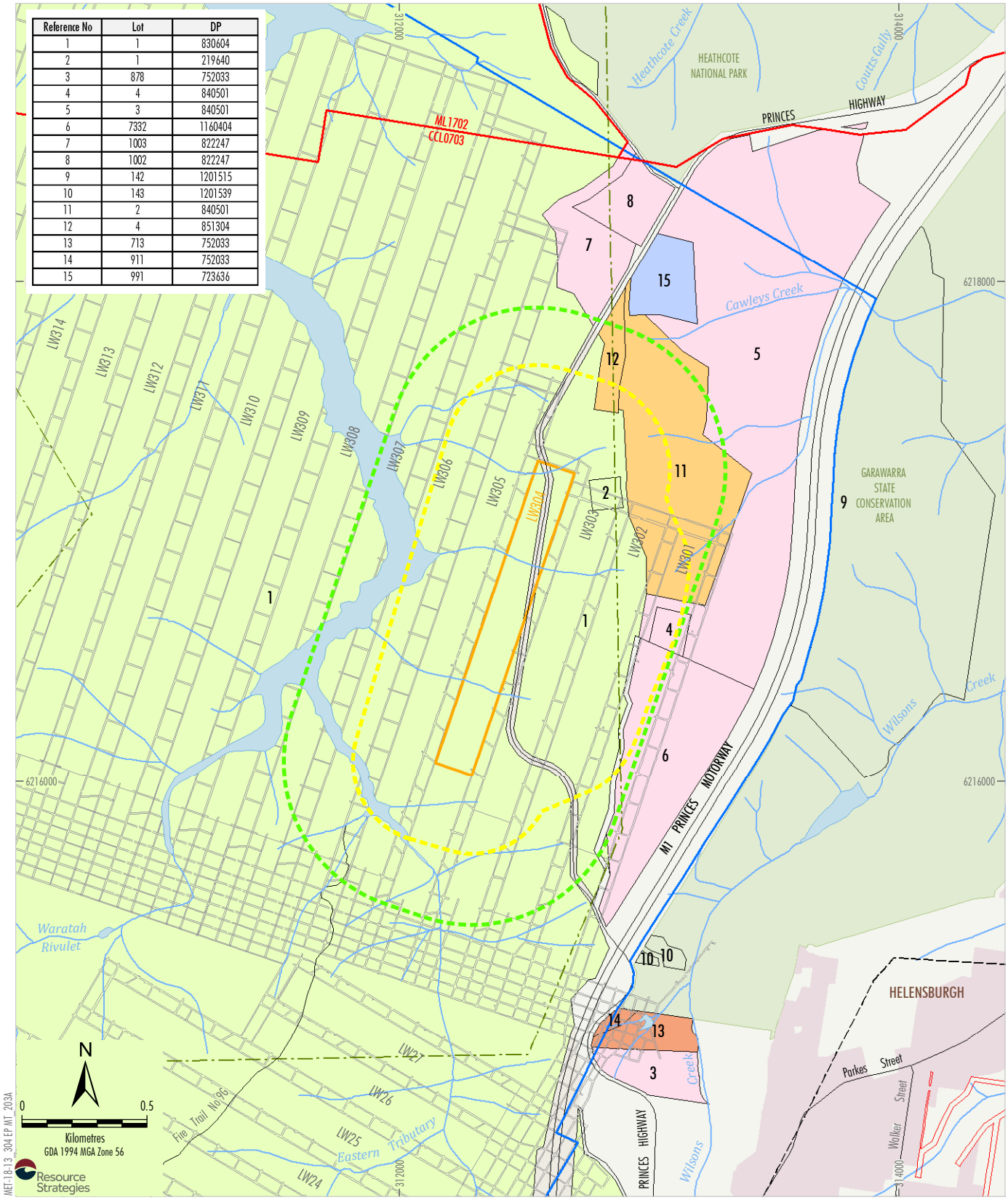
Extensive consultation with each infrastructure owner/manager was conducted for the Longwalls 301-303 Extraction Plan. Each infrastructure owner/manager has been contacted by Metropolitan Coal to advise that the existing BFMPs (approved in November 2018) were being updated to include Longwall 304.

A risk assessment workshop was held with representatives from RMS, Metropolitan Coal, and MSEC on 18 September 2018 in relation to Longwalls 304-306. The RMS will be provided with revised subsidence predictions specific to Longwall 304 with the revised BFMP-RMS on submission of the Extraction Plan.

A risk assessment workshop was held with representatives from Axicom, Metropolitan Coal and MSEC on 2 November 2018 in relation to Longwall 304. Axicom will be provided with revised subsidence predictions specific to Longwall 304 with the revised BFMP-AXICOM on submission of the Extraction Plan.

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 12 December 2018. The CCC was informed that submission of the Extraction Plan was anticipated in March/April 2019.



LEGEND

- Mining Lease Boundary
- Woronora Special Area
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwall 304 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Secondary Extraction of Longwall 304
- Woronora Notification Area
- Existing Underground Access Drive (Main Drift)

Landholder

- WaterNSW
- The State of New South Wales (Crown Land)
- The State of New South Wales (Garawarra State Conservation Area)
- Health Administration Corporation
- The Trustees of the Macedonian Orthodox Monastery
- R & C Stewart

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

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Land Ownership Within 600 m of Longwall 304

Figure 7

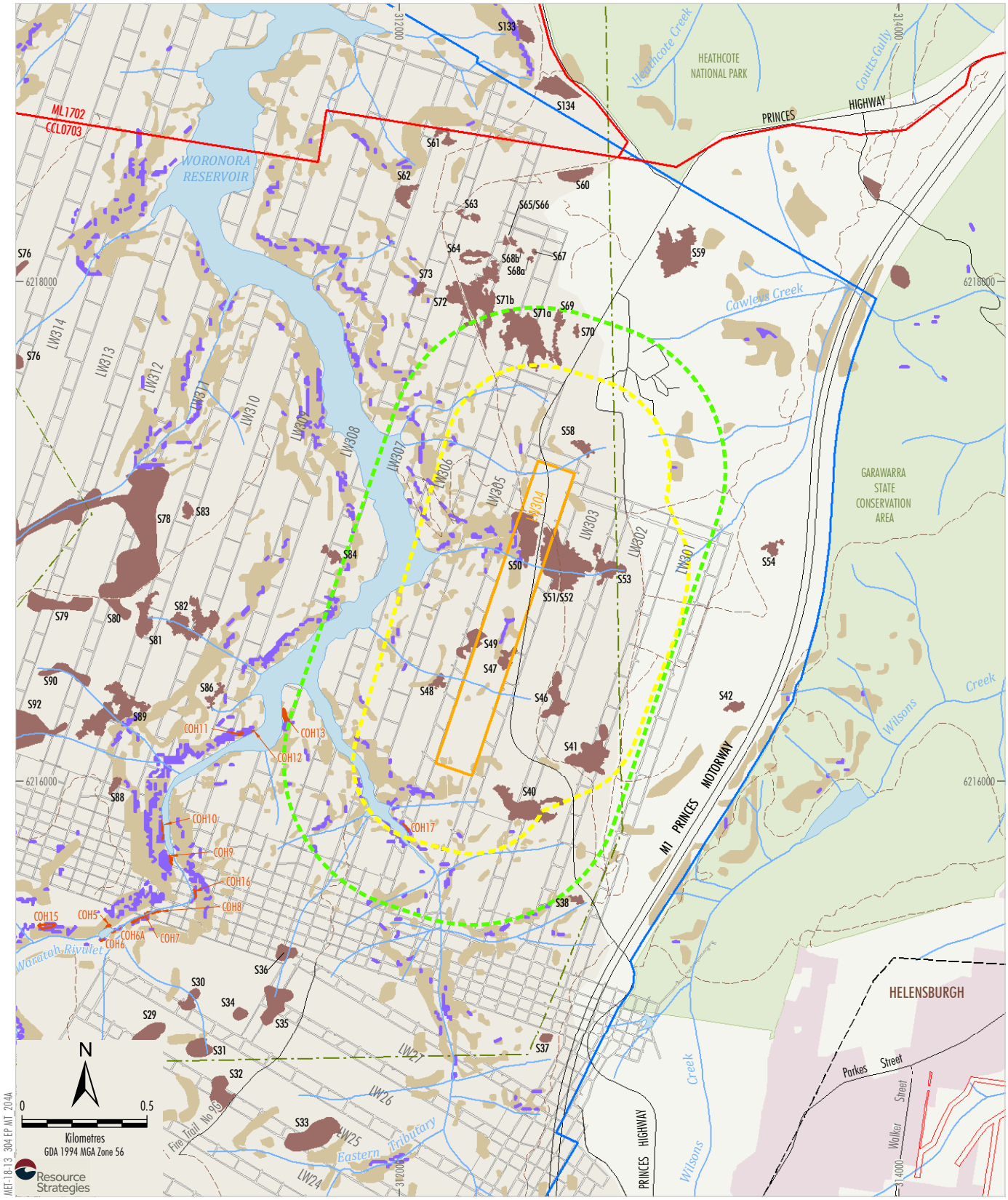
3 SUBSIDENCE MANAGEMENT AND MONITORING

Surface and sub-surface features within the vicinity of Longwall 304 are listed in Table 6. Features within the 35° angle of draw and/or 20 mm predicted subsidence contour of Longwall 304 may potentially be impacted by the secondary extraction of Longwall 304. There are also features that lie outside the Longwall 304 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 Longwall 304 and surrounds are shown on Figures 8, 9 and 10. The locations of surface infrastructure/built features over and adjacent to the Longwall 304 are shown on Figures 11a, 11b and 12. Descriptions of each of these features are contained within the relevant management plan referenced in Table 6.

Table 6
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	
Optus – Telecommunications Infrastructure	
Telstra – Telecommunications Infrastructure	
Axicom – Telecommunications Infrastructure	
Sydney Trains – Illawarra Railway and Telecommunications Infrastructure	
RMS – M1 Princes Motorway and Bridges	
Wollongong City Council (WCC) – Old Princes Highway	
WCC – Waterfall General (Garrawarra) Cemetery	
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	



LEGEND

- Mining Lease Boundary
- Woronora Special Area
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwall 304 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Secondary Extraction of Longwall 304
- Woronora Notification Area
- Existing Underground Access Drive (Main Drift)
- Road
- Vehicular Track
- Streams
- Cliffs and Overhangs
- Steep Slopes (Project Approval)
- Steep Slopes (Project Environmental Assessment)
- Upland Swamp

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

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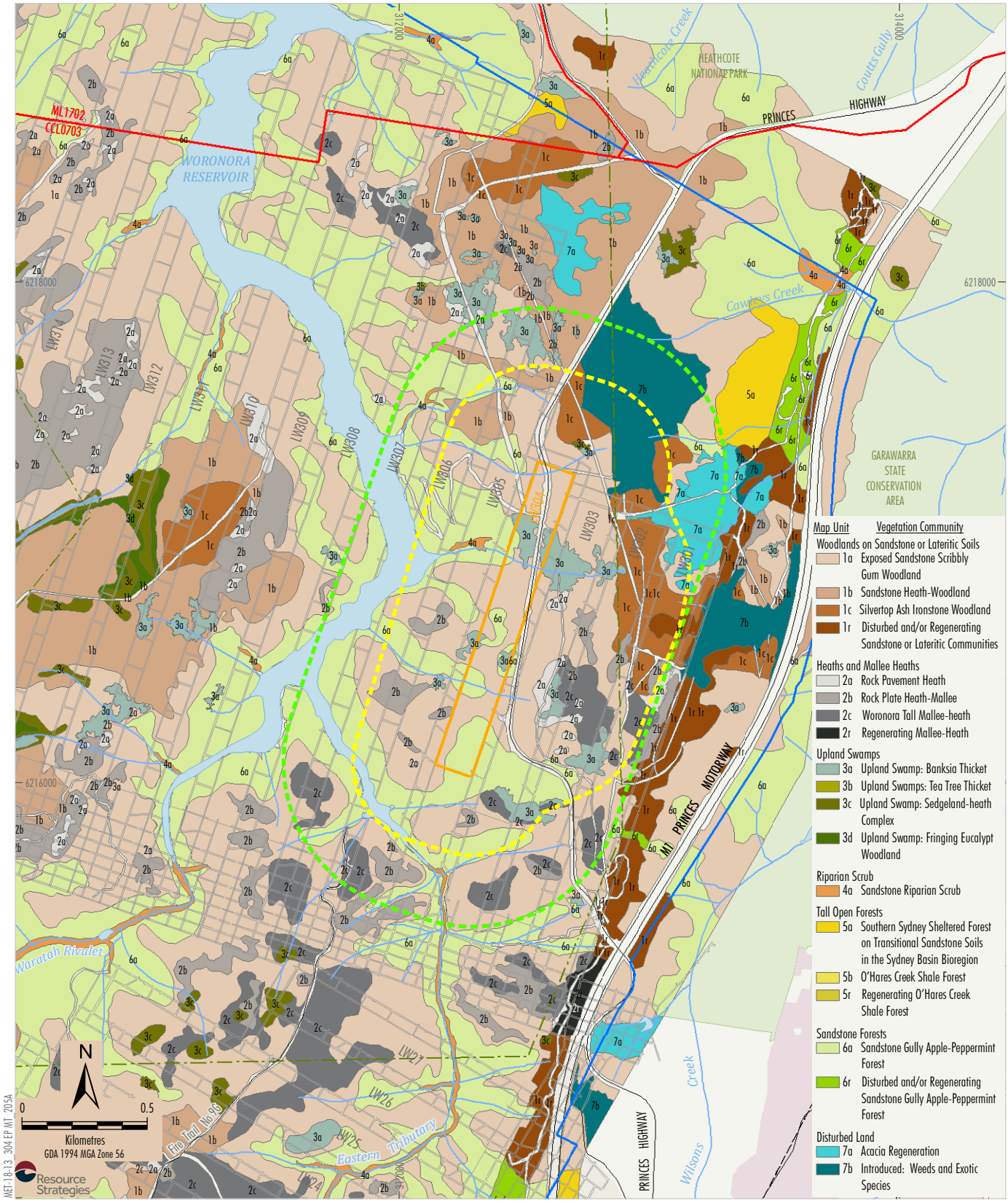
Streams, Cliffs and Overhangs, Steep Slopes and Upland Swamps within 600 m of Longwall 304 and Surrounds

Figure 8



LEGEND

- Mining Lease Boundary
- Woronora Special Area
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwall 304 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Secondary Extraction of Longwall 304
- Woronora Notification Area
- Existing Underground Access Drive (Main Drift)

Note: *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)

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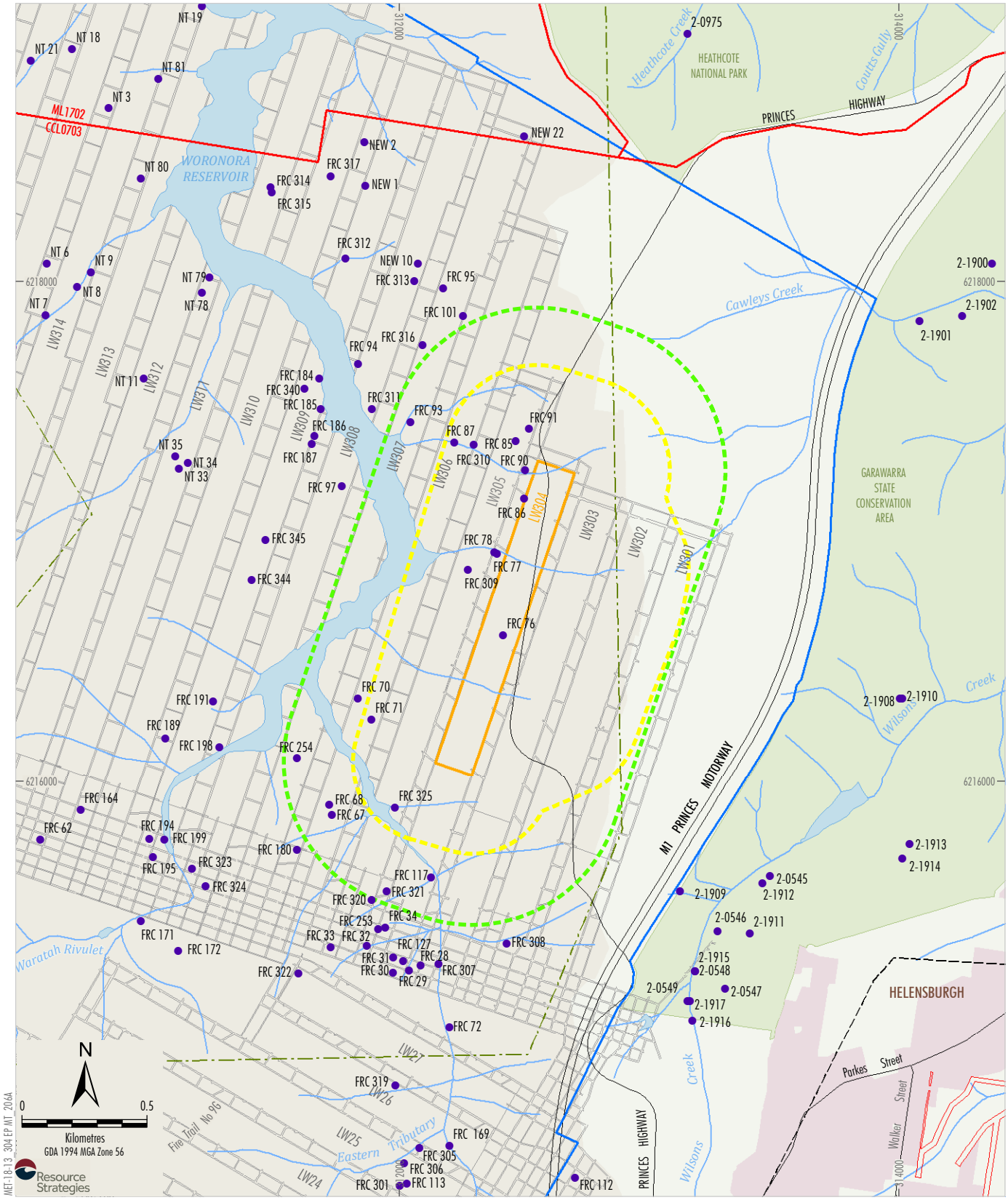
METROPOLITAN COAL

Longwall 304 Vegetation Mapping

Figure 9



LEGEND

- Mining Lease Boundary
- Woronora Special Area
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwall 304 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Secondary Extraction of Longwall 304
- 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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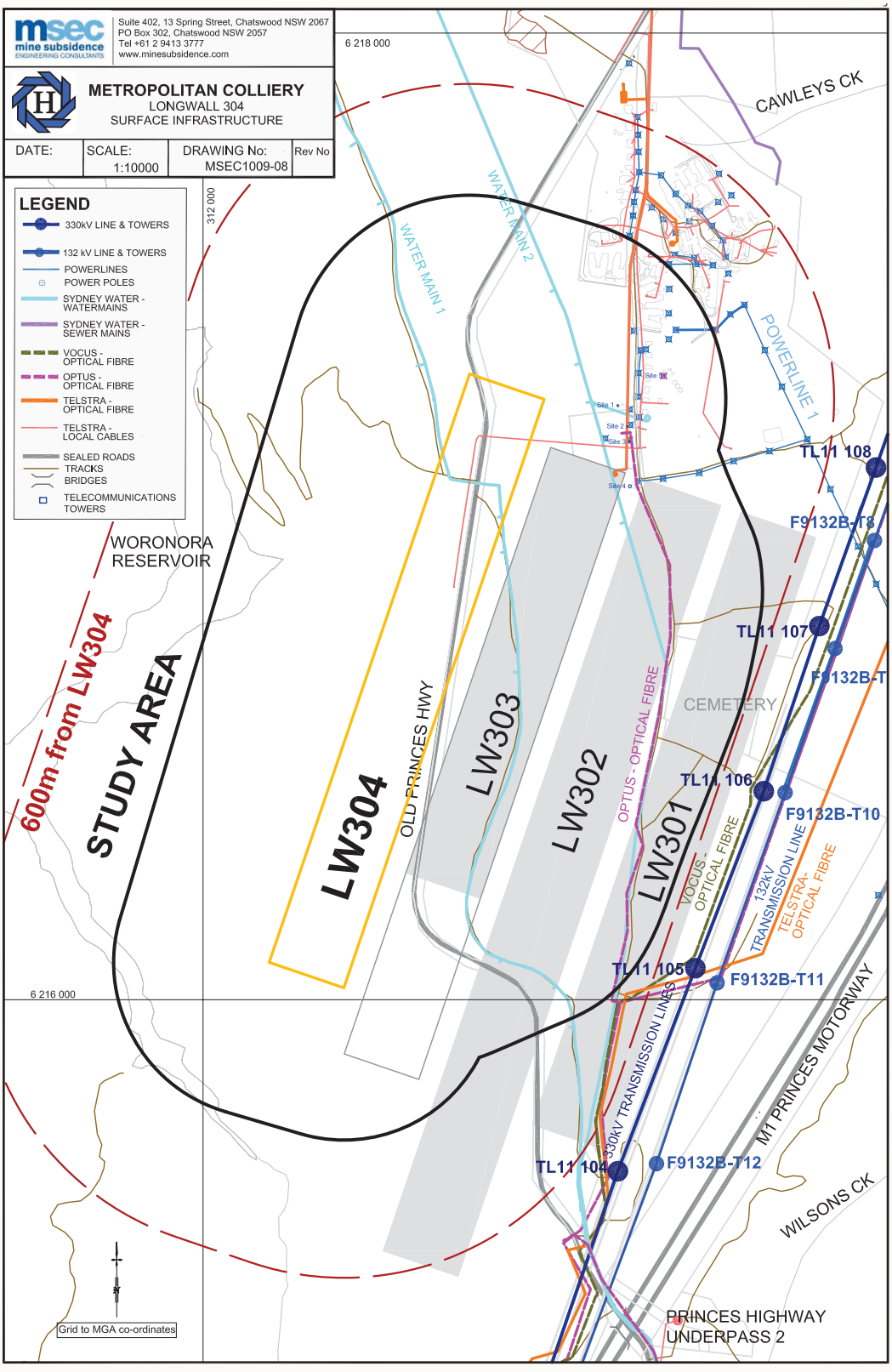
Known Aboriginal Heritage Sites Within 600 m of Longwall 304 and Surrounds

Figure 10



MET-18-13_304 EP MT_003B

Source: MSEC (2019)

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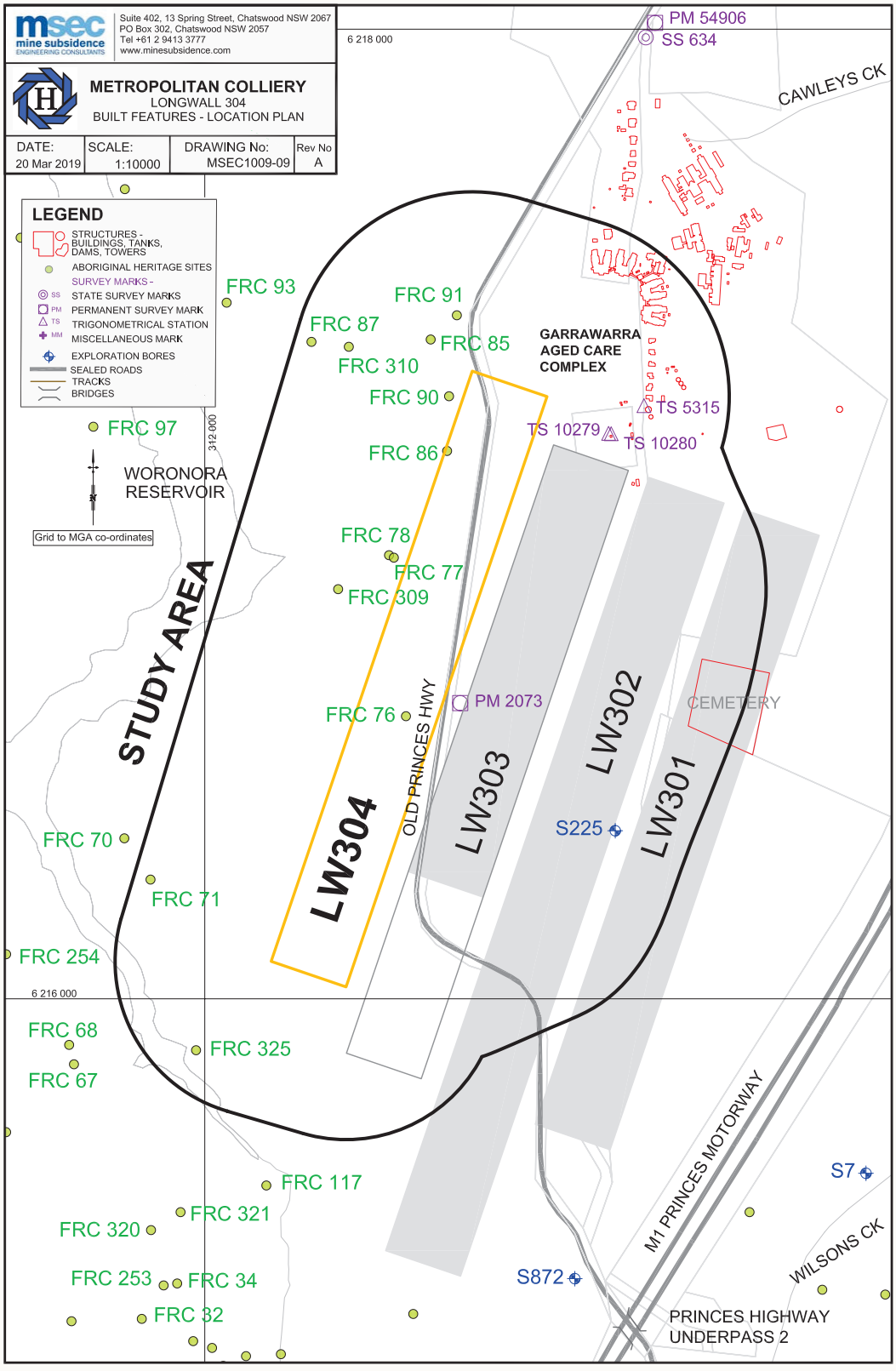
METROPOLITAN COAL

Surface Infrastructure Over and Adjacent to the Longwall 304 Study Area

Figure 11a



MET-18-13_304 EP MT_004B

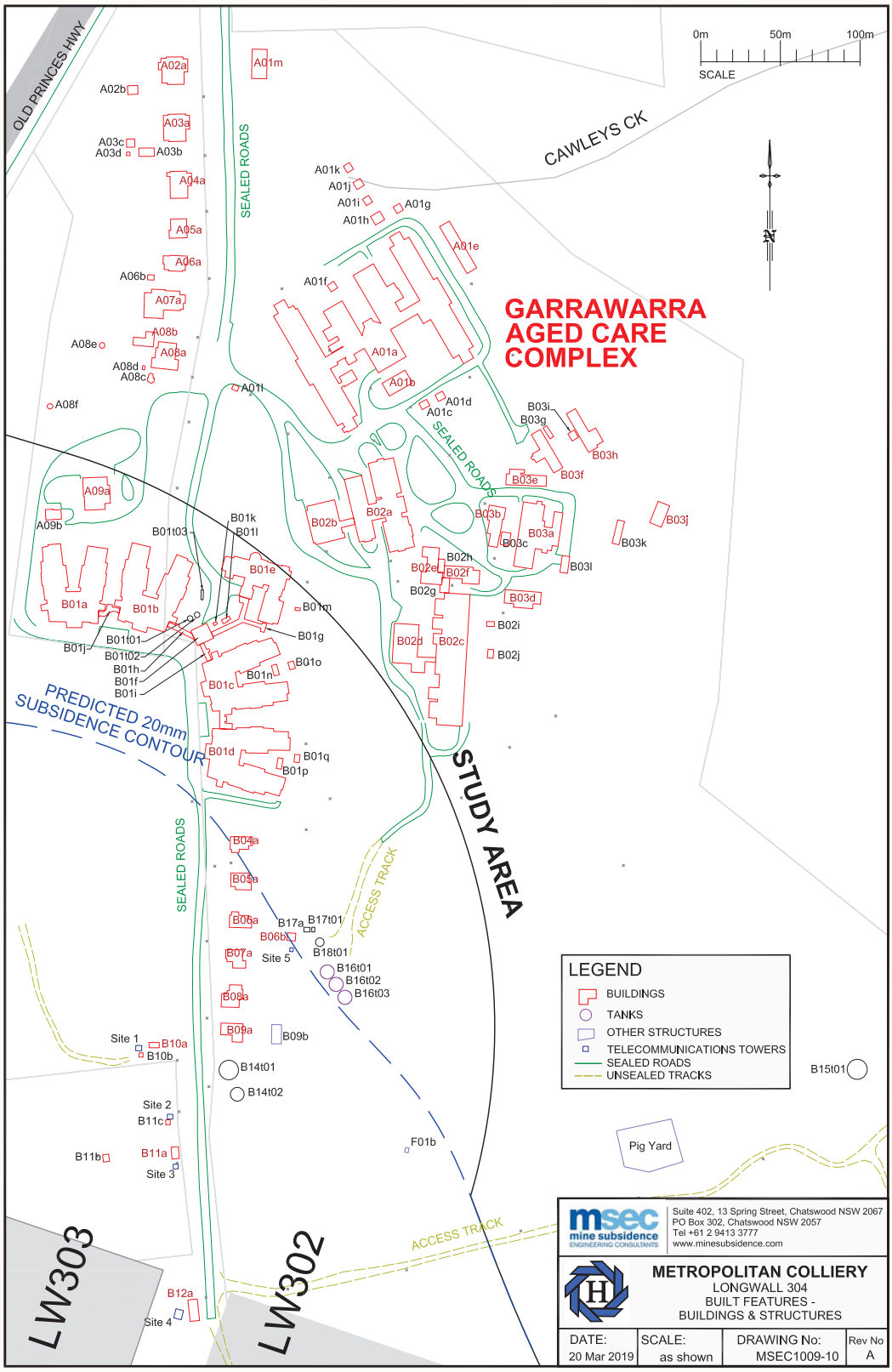
Source: MSEC (2019)

Peabody

METROPOLITAN COAL

Surface Infrastructure Over and Adjacent to the Longwall 304 Study Area

Figure 11b



MET-18-13_304 EP MT_005B

Source: MSEC (2019)

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Location of the Garrawarra Centre Complex
Buildings Structures and Built Features

Figure 12

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 6 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.

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 Longwall 304.

3.1.2 Key Water Issues, Monitoring and Management Measures

Small first and second order streams are located within the Longwall 304 35° angle of draw and/or predicted 20 mm subsidence contour (Figure 8). These streams consist of shallow drainage lines from the topographical high point above Longwalls 301-303, forming streams where valley heights increase and drain into the Woronora Reservoir to the west of the longwalls. Three streams are located above Longwall 304, and could experience the full range of predicted subsidence movements (Appendix I).

A portion of the Woronora Reservoir full supply level is located within the Longwall 304 35° angle of draw and/or predicted 20 mm subsidence contour, to the south-west of Longwall 304 (Figure 8). Longwall 304 does not extend beneath the Woronora Reservoir full supply level. As a result, there is a much lower likelihood of impacts due to the Extraction Plan Layout compared to impacts assessed for the Preferred Project Layout.

The Eastern Tributary flows in a northerly direction into the full supply level of the Woronora Reservoir to the south of the 35° angle of draw and/or predicted 20 mm subsidence contour for Longwall 304 (Figure 8). The finishing ends of Longwalls 303 and 304 have been set back to minimise predicted valley closure at the Eastern Tributary to minimise the likelihood of impacts occurring.

Metropolitan Coal has established a comprehensive monitoring and adaptive management program to identify subsidence related movements at the Eastern Tributary during the extraction of Longwall 304. The Longwall 304 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. This approach has successfully been utilised for the Sandy Creek Waterfall by South32.

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 (Appendix A).

A risk assessment workshop was held on 20 February 2019 to assess the potential for mining effects 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 7 and Section 3.7.

Table 7
Management Issues for Water Resources and Watercourses during Longwall 304 Extraction

Issue	Approved Impact	Monitoring	Management
Catchment yield to the Woronora Reservoir	• Negligible reduction to the quality or quantity of water resources reaching the Woronora Reservoir. • No connective cracking between the surface and the mine.	Monitoring in accordance with the WMP, including: • Surface water quality. • Surface water flow. • Eastern Tributary gauging station functionality. • Groundwater pressure/level. • Inspections of underground workings for water accumulation. • Mine water make. • Woronora Reservoir water quality. • Visual inspections of stream cracking, gas releases, iron staining and drainage behaviour. • Gas releases. • Pool water levels. • Groundwater quality. Subsidence monitoring at Eastern Tributary gauging station. Subsidence monitoring for the Eastern Tributary Valley Closure TARP. Subsidence monitoring in accordance with the SMP.	• Mine planning and design: - Conservative mining geometry. - Shortening of Longwalls 303 and 304. • Adaptive management – Eastern Tributary valley closure TARP. • Risk assessments. • Additional monitoring (e.g. increase in monitoring frequency or additional sampling). • Stream remediation. • Revegetation measures. • Offsets.
Woronora Reservoir	• Negligible leakage from the Woronora Reservoir. • Negligible reduction in water quality of Woronora Reservoir.		
Waratah Rivulet between the full supply level of the Woronora Reservoir and the maingate of Longwall 23 (upstream of Pool P)	• 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).		
Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26	• 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).		

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 8.

Table 8
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	• 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).
Negligible reduction to the quality of water resources reaching the Woronora Reservoir	• 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.
No connective cracking between the surface and the mine	• Visual inspection does not identify abnormal water flow from the goaf, geological structure, or the strata generally. • The 20-day average mine water make does not exceed 1 ML/day. • Significant departure from the predicted envelope of the vertical potentiometric head profile at Bore 9GGW2B does not occur. • Significant departure from the predicted envelope of the vertical potentiometric head profile at Bore F6GW3A does not occur.
No connective cracking between the surface and the mine. Negligible leakage from the Woronora Reservoir.	• 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.
Negligible leakage from the Woronora Reservoir	• 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. • 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. • 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. • The hydraulic gradient from transect bore T5 to bore T3 is reduced by no more than 10% from that measured on 30 June 2017.
Negligible reduction in the water quality of Woronora Reservoir	• Changes in the quality of water in the Woronora Reservoir are not significantly different post-mining compared to pre-mining concentrations.
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)	• No change to the natural drainage behaviour of Pools P, Q, R, S, T, U, V and W. • 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. • 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. • 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). • 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.

Table 8 (Continued)
Water Resources and Watercourses Performance Measures and Performance Indicators

Performance Measure	Performance Indicator(s)
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	• No change to the natural drainage behaviour of Pools ETAS, ETAT and ETAU. • 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. • 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.

Monitoring against these performance indicators during the mining of Longwall 304 is summarised in Table 7 and Section 3.7 and described in detail in Appendix A. The procedure that will be followed to assess the extraction of Longwall 304 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 Water Management Plan 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):

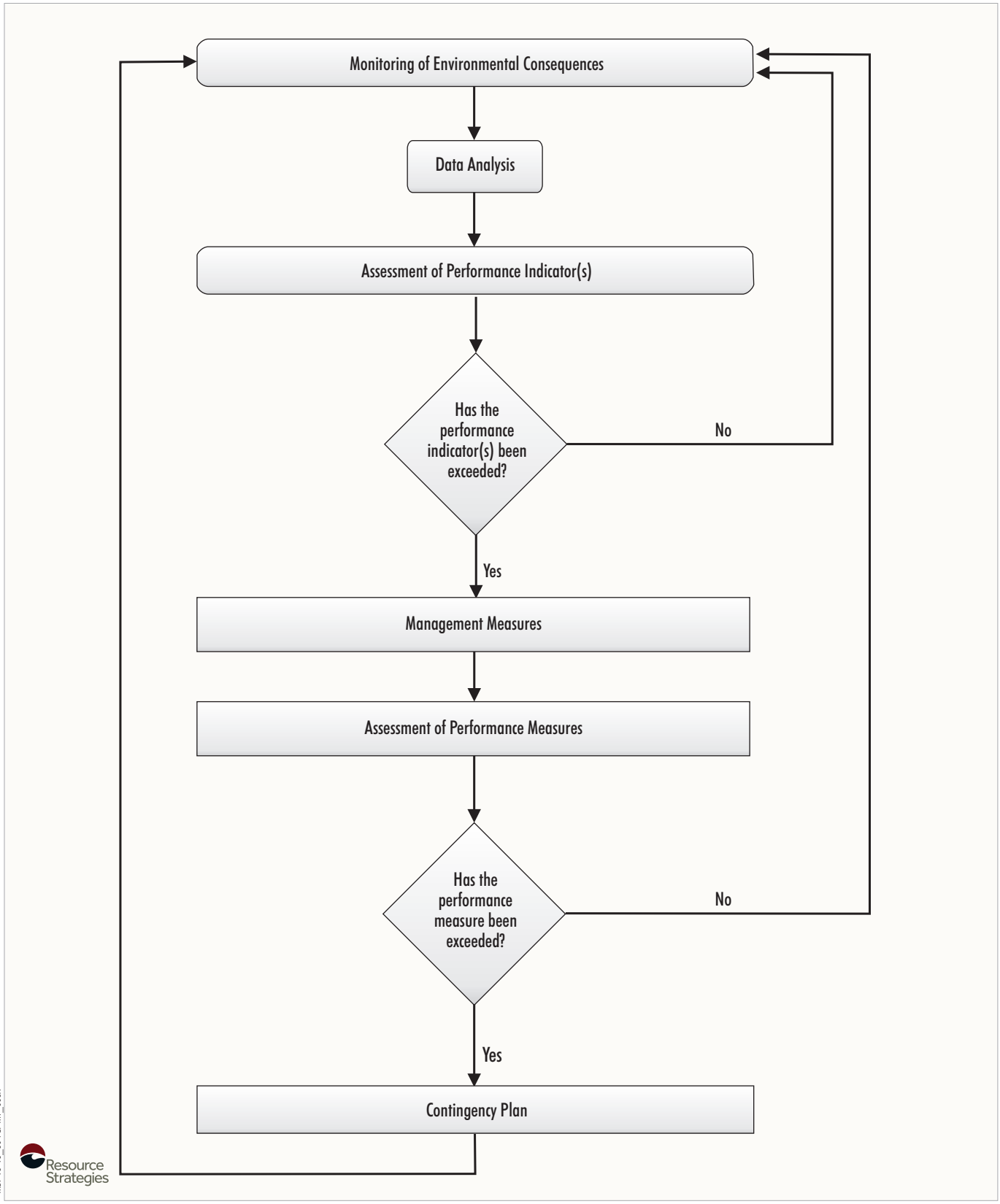
> *Negligible environmental consequences over at least 70% of the stream length (that is **no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining** and minimal gas releases)*

Metropolitan Coal provided the DP&E 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 DP&E.



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Monitoring of Environmental Consequences against Performance Indicators and Measures

Figure 13

- 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 Longwall 304.

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 66º. 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).

One cliff and overhang site (COH17) has been identified within the 35° angle of draw and/or predicted 20 mm subsidence contour for Longwall 304 (Figure 8). Detailed baseline recording for this site has been conducted and is included in Appendix B. Visual inspections for subsidence impacts on cliff site COH17 will be conducted following the completion of Longwall 303. Visual inspections for subsidence impacts on cliff site COH17 will also be conducted monthly when Longwall 304 extraction is within 400 m of the site and following the completion of Longwall 304.

The next nearest cliffs are located more than 600 m to the west of Longwall 304 (Figure 8). At these distances, the cliffs are not expected to experience any measurable vertical subsidence resulting from the extraction of Longwall 304 (Appendix B).

In the Project Approval, steep slopes are defined as an area of land having a natural gradient of between 33º and 66º (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 Longwall 304 (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 9 and Section 3.7.

Table 9
Management Issues for Land during Longwall 304 Extraction

Issue	Approved Impact	Monitoring	Management
Cliffs and overhangs	• Less than 3% of the total length of cliffs (and associated overhangs) within the mining area experience mining-induced rock fall.	Monitoring in accordance with the LMP, including visual observations of: • Cliff instabilities or cracking. • Sandstone fracturing. • Rock falls. Subsidence monitoring in accordance with the SMP.	• Stabilisation techniques including: – Installation of artificial rock support. – Installation of standing supports. • Improvement of appearance including: – Application of product to enhance the weathered appearance of a cliff face. – Planting of endemic native vegetation. • Implementation of erosion and sediment controls. • Permanent filling of surface tension cracks. • Measures to address safety hazards.
Steep slopes and land in general	• Sandstone fracturing (including surface tension cracking) and subsequent rock falls consistent with that observed during the extraction of previous longwalls at Metropolitan Coal.		

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 site COH17 experiences 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 do not experience sandstone fracturing/cracking or rock falls that require management measures to be implemented.*

Monitoring against the performance indicators and performance measure during the mining of Longwall 304 is summarised in Table 9 and Section 3.7 and described in detail in Appendix B. The procedure that will be followed to assess the extraction of Longwall 304 against the performance indicators and performance measure is outlined in Figure 13 and described in detail in the LMP (Appendix B).

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 Longwall 304.

3.3.2 Key Biodiversity Issues, Monitoring and Management Measures

Eleven upland swamps are located within the 35° angle of draw and/or predicted 20 mm subsidence contour for Longwall 304 (Swamps 40, 41, 46, 47, 48, 49, 50, 51/52, 53 and 58, and a small portion of Swamp 71a) (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 Longwall 304 secondary extraction include woodlands on sandstone or lateritic soils, heaths and mallee heaths, tall open forests, 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 Longwall 304 35º 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 10 and Section 3.7.

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 10
Management Issues for Biodiversity during Longwall 304 Extraction

Issue	Approved Impact	Monitoring	Management
Threatened species, populations, or ecological communities	Negligible impact	***Upland Swamps*** • Vegetation monitoring. - Visual inspections. - Transect/quadrat monitoring. - Indicator species. • Groundwater monitoring.	• Swamp remediation techniques. • Additional monitoring (e.g. increase in monitoring frequency or additional sampling).
		Riparian Vegetation • Vegetation monitoring. - Visual inspections. - Quadrat monitoring. - Indicator species.	• Stream remediation. • Weed control measures. • Planting of endemic species. • Stream bank erosion control measures in accordance with the WMP. • Management measures for impacts associated with cliffs and overhang sites include: – the implementation of erosion and sediment control measures; and – stabilisation techniques; in accordance with the LMP. • Additional monitoring (e.g. increase in monitoring frequency or additional sampling).
		Slopes and Ridgetops • Visual inspections of cliffs and overhangs, steep slopes and land in general.	• Management measures for impacts associated with cliffs and overhang sites include: – the implementation of erosion and sediment control measures; and – stabilisation techniques; in accordance with the LMP. • Filling of surface tension cracks in accordance with the LMP.
		Aquatic Biota and their Habitats • Watercourses (i.e. aquatic habitats) in accordance with WMP. • Aquatic biota stream monitoring. • Aquatic biota pool monitoring.	• Mine planning and design: - Conservative mining geometry. - Shortening of Longwalls 303 and 304 • Adaptive management – Eastern Tributary Valley Closure TARP. • Stream remediation. • Additional monitoring (e.g. increase in monitoring frequency or additional sampling).

Table 10 (Continued)
Management Issues for Biodiversity during Longwall 304 Extraction

Issue	Approved Impact	Monitoring	Management
Threatened species, populations, or ecological communities (Cont.)	Negligible impact (Cont.)	***Terrestrial Fauna and their Habitats*** • Terrestrial fauna habitats, as discussed for upland swamps, riparian vegetation, slopes and ridgetops and aquatic habitats above. • Amphibian monitoring.	• Mine planning and design: - Conservative mining geometry. - Shortening of Longwalls 303 and 304 • Adaptive management – Eastern Tributary Valley Closure TARP. • Swamp remediation techniques. • Stream remediation. • Weed control measures. • Planting of endemic species. • Stream bank erosion control measures in accordance with the WMP. • Management measures for impacts associated with cliffs and overhang sites include: – the implementation of erosion and sediment control measures; and – stabilisation techniques; in accordance with the LMP. • Filling of surface tension cracks in accordance with the LMP. • Additional monitoring (e.g. increase in monitoring frequency or additional sampling).

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 11.

Table 11
Biodiversity Performance Measure and Performance Indicators

Performance Measure	Performance Indicators
Negligible impact to threatened species, populations, or ecological communities.	**Upland Swamps** • The vegetation in upland swamps is not expected to experience changes significantly different to vegetation in control swamps. • 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. **Riparian Vegetation** • Impacts to riparian vegetation are expected to be localised and limited in extent, similar to the impacts previously experienced at Metropolitan Coal. **Aquatic Biota** • The aquatic macroinvertebrate and macrophyte assemblages in streams are not expected to experience long-term impacts as a result of mine subsidence. **Terrestrial Fauna** • The amphibian assemblage is not expected to experience changes significantly different to the amphibian assemblage at control sites.

Monitoring against these performance indicators during the mining of Longwall 304 is summarised in Table 10 and Section 3.7 and described in detail in the BMP (Appendix C). The procedure that will be followed to assess the extraction of Longwall 304 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 Longwall 304.

3.4.2 Key Aboriginal Heritage Issues, Monitoring and Management Measures

Twelve known sandstone overhang sites (including FRC 76) are located within the 35^{o} angle of draw and/or predicted 20 mm subsidence contour for Longwall 304 (Figure 10). Of the 12 sites with overhangs, six have art only and six have art and/or artefacts and/or Potential Archaeological Deposit (PAD). One site (FRC 76) is located directly above Longwall 304 (Figure 10).

No Aboriginal heritage sites of high archaeological significance are located within the 35^{o} angle of draw and/or predicted 20 mm subsidence contour of Longwall 304. No sites or areas of particular cultural significance have been identified within the area bound by the Longwall 304 35^{o} angle of draw and/or predicted 20 mm subsidence contour. Notwithstanding, 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 12 and Section 3.7.

Table 12
Management Issues for Aboriginal Heritage during Longwall 304 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.	• Aboriginal heritage sites.	• Installation of an artificial dripline (e.g. silicone dripline) to direct increased moisture/water seepage away from art panels. • Installation of artificial rock support (e.g. rock bolts, cable bolts, cement sprays [e.g. shotcrete], injections of a binding agent [PUR or similar]). • Installation of standing supports (e.g. timber props, timber cogs, sandbags and metal [hydraulic] props). • Scaling/dislodgement/removal of remaining loose rock. • Salvage of artefacts for safekeeping and storage and/or display at a suitable location in consultation with the Aboriginal community. • Use of cosmetic treatments (e.g. in the form of coloured grout or similar) to restore aesthetic values. • Installation of a stress relief slot or stress focus notch.

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 13.

Monitoring against the performance indicator during the mining of Longwall 304 is summarised in Table 12 and Section 3.7 and described in detail in the HMP (Appendix D). The procedure that will be followed to assess the extraction of Longwall 304 against the performance indicator and performance measure is outlined in Figure 13 and described in detail in the HMP (Appendix D).

Table 13
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.	Metropolitan Coal will assess the Project against the following performance indicator to allow early recognition of mining impacts: *Less than 7% of Aboriginal heritage sites within the mining area are affected by subsidence impacts.* 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: • overhang collapse; • cracking of sandstone that coincides with Aboriginal art or grinding grooves; and • rock fall that damages Aboriginal art.

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 Longwall 304.

3.5.2 Key Built Features Issues, Monitoring and Management Measures

Built features within the vicinity of Longwall 304 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).

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 14 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 14. Monitoring against the performance indicators is described in detail in the component plans of the BFMP and summarised in Table 14 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 14. Monitoring conducted against the performance indicators is described in detail in the Garrawarra Centre Complex component of the BFMP and is summarised in Table 14 and Section 3.7.

The procedure followed to assess the extraction of Longwall 304 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.

Table 14
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	• No greater tilt impacts to buildings than Category A or B for items of historical or heritage significance. • No greater strain impact to buildings than Category 0 or 1 for items of historical or heritage significance. • No more than repairable (minor) defects (cracks, etc.) in the structural integrity for all other buildings, houses, structures and other services due to mining. • The electrical clearance from vegetation is maintained. • Serviceability of the private roads and access roads/tracks has been maintained. • 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).	• Subsidence, tilt, tensile strain and compressive strain. • Structural integrity. • Cracking at pre-existing rock joints. • Tilt at pre-existing tilted piers. • Opening and closing of joints. • Leaks. • Cracking in columns, elevated ring beam or central access shaft. • Structural integrity of the telecommunications tower and compound. • Electrical clearance from vegetation. • Cracks or leaks in the pipelines. • Surface cracks, buckling and general safety.	A number of potential management measures in relation to the Garrawarra Centre Complex are considered to be applicable. These include: • For buildings or houses requiring repairs, normal building maintenance techniques could be applied in consultation with NSW Health and relevant authorities. • 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. • For powerlines and poles, management measures may include alteration of conductor tensions or strengthening of timber poles footings. • 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). Management measures for access roads/tracks will be implemented in accordance with the LMP. 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). Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.

Table 14 (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	• The structural integrity of the 132 kV transmission lines and towers is maintained. • The structural integrity of the timber poles and high voltage powerlines is maintained. • The electrical clearance from vegetation is maintained. • The serviceability of the access roads/tracks is maintained.	• Subsidence, tilt, tensile strain, compressive strain, absolute horizontal translation, and differential leg movement. • Degradation of tower structure. • Degradation of tower foundations/footings. • Vegetation, land and road clearance. • Movement of insulator strings/conductors. • Surface cracks, buckling, and general safety.	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: • alteration of conductor tensions; • modification to attachment points such as placement of stringing sheaves to earth wires and/or phase conductors; • strengthening of tower structures through installation of cruciform footings; and • strengthening of timber poles' footings. Management measures for access roads/tracks will be implemented in accordance with the LMP. Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.
TransGrid 330 kV transmission line and towers	• The structural integrity of the transmission line and towers is maintained. • The electrical clearance from vegetation is maintained. • The serviceability of access roads/tracks is maintained.	• Subsidence, tilt, tensile strain, compressive strain, absolute horizontal translation and differential leg movement. • Surface cracks, buckling and general safety. • Real-time survey monitoring trial. • Degradation of tower foundations/footings. • Movement of insulator strings. • Vegetation, land and road clearance. • Visual check by TransGrid of earthwire/optical ground wire and conductor movement, and integrity and function of support clamps. • Calculation of differential leg movement.	A number of potential management measures considered to be applicable to transmission lines, include: • alteration of conductor tensions; • installation of temporary structures; • modification to attachment points such as placement of stringing sheaves to earth wires and/or phase conductors; and • strengthening of tower structures (e.g. through installation of cruciform footings). Management measures for access roads/tracks will be implemented in accordance with the LMP. Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.

Table 14 (Continued)
Built Features Performance Indicators, Monitoring and Management Measures

Built Features	Performance Indicator(s)	Monitoring	Relevant Management Measures
Vocus optical fibre cable	• Negligible transmission loss in fibre optic cables from mine subsidence impacts. • Structural integrity of the cable line and associated joint housing pit is maintained. • Serviceability of the access roads/tracks is maintained.	• Subsidence, tilt, tensile strain and compressive strain. • Signal integrity. • Movement of conduit, degree of freedom of cable in conduit, ground compression/tension. • Surface cracks, buckling and general safety.	A number of potential management measures in relation to fibre optic cables are considered to be applicable. These are described in the Vocus Management Plan Agreement (Appendix E). Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.
Optus optical fibre cables	• Negligible transmission loss from mine subsidence impacts. • The structural integrity of the cable lines and associated facilities is maintained. • The serviceability of the access roads/tracks is maintained.	• Subsidence, tilt, tensile strain and compressive strain. • Signal integrity. • Movement of conduit, degree of freedom of cable in conduit, ground compression/tension. • Surface cracks, buckling and general safety.	A number of potential management measures in relation to cable lines are considered to be applicable. Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.
Telstra telecommunications tower and compound, optical fibre cables, associated infrastructure and copper telecommunication cables	• Negligible transmission loss in fibre optic cables from mine subsidence impacts. • Structural integrity of the cable line and associated facilities is maintained. • Structural integrity of the telecommunications tower and compound is maintained. • Serviceability of the access roads/tracks is maintained.	• Subsidence, tilt, tensile strain and compressive strain. • Signal integrity. • Structural integrity of the telecommunications tower and compound. • Surface cracks, buckling and general safety.	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). Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.

Table 14 (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	• Measured absolute horizontal movements. • Distortion of bridge elements. • Cracking of bridge elements. • Pavement cracking and deformation. • Visual consequence of slope movement. • Defects in culverts.	• Subsidence, tilt, tensile strain and compressive strain. • Horizontal movement. *Bridge 2* • Real-time survey monitoring. • 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. • 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. *Cawley Road Overbridge* • Real-time survey monitoring. • Monitoring of movements including: absolute 3D movement of the survey reference pillar and relative 3D movements of all bridge monitoring points. • Visual inspection for impacts on: abutments, pier blade wall, Tetron bearings, deck expansion joints, steel traffic barrier joints and safety screen joints.	A number of general management measures in relation to RMS assets are applicable. These include: • review of scope and frequency of monitoring; • site inspections; • review by relevant specialists; • initiate traffic management procedures; • review of potential factors contributing to the exceedance of the performance trigger including review of subsidence measurements and predictions; and • review of effectiveness of management measures. 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.

Table 14 (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.	*Other Relevant Infrastructure* • Monitoring of movements including absolute 3D movement of the survey reference pillar, and relative 3D movements of Towers TL11-104 to TL11-108, including: - subsidence line along the transmission line; - tower legs; and - four ground points at each tower. • 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.	A number of potential management measures in relation to the M1 Princes Motorway pavement are considered to be applicable. These include: • mill and replace pavement layers; • slotting; and • crack sealing. A number of potential management measures in relation to cuttings are considered to be applicable. These include: • rock bolting; • scaling; • shotcreting; • installation of rockfall mesh; • installation of barriers; and • trimming of the cut face. A number of potential management measures in relation to culverts are considered to be applicable. These include: • point repairs; • lining; • grouting; and • culvert replacement.

Table 14 (Continued)
Built Features Performance Indicators, Monitoring and Management Measures

Built Features	Performance Indicator(s)	Monitoring	Relevant Management Measures
WCC Old Princes Highway	• No pavement cracking exceeding 5 mm, or other defects of the road pavement resulting in deterioration of ride quality. • No ponding of water on the road surface as a result of changes in grade from subsidence associated with Longwalls 301-304. • No joint displacement or cracking or other defects of the drainage structure (e.g. pipes/culverts) in excess of 5 mm. • Serviceability of guard rails, marker posts and signage is maintained.	• Subsidence, tilt, tensile strain and compressive strain. • Impacts to the surface including cracks, buckling and stepping. • Impacts to the visible surfaces of pipes/culverts including cracking, buckling, shearing and collapse. • Visible impacts to furniture.	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: • mill and/or replace pavement layers; • crack sealing/repair; • point repairs; • replace sections of pipe/culvert; • grouting/sealing of cracks; and • repair/replacement of furniture. 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. Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.
WCC Waterfall General (Garrawarra) Cemetery	• No defects to the structural integrity of headstones or fencing (beyond the baseline [pre-mining] conditions). • 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).	• Subsidence, tilt, tensile strain and compressive strain. • Pre and post mining audits (photographic record and commentary). • Surface cracks, buckling and general safety.	A number of potential management measures in relation to the Waterfall Cemetery are considered to be applicable and are summarised in the relevant rectification plan/protocol (Appendix E). Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.

Table 14 (Continued)
Built Features Performance Indicators, Monitoring and Management Measures

Built Features	Performance Indicator(s)	Monitoring	Relevant Management Measures
Sydney Water water pipelines	• No more than repairable (minor) leakages of the water pipelines occur due to mining. • No more than repairable (minor) defects (cracks, etc.) in the structural integrity of the pipes and associated connections occur due to mining.	• Subsidence, tilt, tensile strain and compressive strain. • Surface ground cracks. • Cracks or leaks in the pipelines. • Leakage in pipeline. • Acoustic monitoring.	A number of potential management measures in relation to pipelines are considered to be applicable. These include: • repair of broken pipes or fittings by Sydney Water maintenance staff; and • 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. Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.
Sydney Trains Illawarra Railway Line and telecommunications tower (and compound)	• No defects or deformation of the Illawarra Railway Line due to mining. • The structural integrity of the telecommunications tower (and compound) is maintained.	• Subsidence, tilt, tensile strain and compressive strain. • Any defects or deformation of the rail line and associated infrastructure. • Structural integrity of the telecommunications tower and compound.	A number of potential management measures in relation to the rail line are considered to be applicable, if required. These may include: • speed restriction of trains; and • minor repair of track. 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. Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.
Axicom telecommunications tower (and compounds)	• Structural integrity of the telecommunications towers and compounds has been maintained. • Serviceability of the access roads/tracks has been maintained.	• Subsidence, tilt, tensile strain and compressive strain, absolute horizontal translation, and differential leg movements. • Structural integrity of the compounds. • Surface cracks, buckling and general safety.	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). Management measures for access roads/tracks will be implemented in accordance with the LMP. Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.

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 Longwall 304 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 Longwall 304 is owned and/or managed by WaterNSW or The State of New South Wales (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 Longwall 304.

Longwall 304 is located within the Woronora Notification Area (Figure 2). The Woronora Dam wall is located approximately 7 km from the commencing end of Longwall 304 and the distance from the labyrinth spillway, which is to the south of the dam wall, is approximately 6.6 km (Figure 1). The dam wall and spillway are located at large distances from Longwall 304. 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 Longwall 304 (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 Longwall 304 are described in the PSMP (Appendix F). The relevant monitoring and management measures are summarised in Table 15 and Section 3.7.

Table 15
Management Issues for Public Safety during Longwall 304 Extraction

Issue	Approved Impact	Monitoring	Management
Public Safety	• Public safety to be ensured within the mining area. • Built features – Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing.	• Monitoring in accordance with the LMP. • Monitoring in accordance with the BFMP.	• Restricted access. • Woronora Special Areas Consent. • Woronora Special Area Catchment Induction. • Management of roads/tracks (including fire trails and vehicular tracks) in accordance with the LMP and BFMP. • Management of built features in accordance with the BFMP. • DSC approval requirements. • Consultation with landowners and infrastructure owners. • Other management measures in relation to public safety may include: - traffic control including diversion of traffic; - temporary speed restrictions; - warning signs/lights; - restriction of public access; - erection of barriers; - implementation of security services; and - use of emergency services for public control.

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 Longwall 304 is summarised in Table 15 and Section 3.7 and described in detail in Appendix F. The procedure that will be followed to assess the extraction of Longwall 304 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 16. The location of environmental monitoring sites included in Metropolitan Coal's various environmental monitoring programs detailed in Table 16, 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 Longwall 304.

Table 16
Longwall 304 Environmental Monitoring Program Summary

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
WMP	Stream Features	• The Eastern Tributary from full supply level of the Woronora Reservoir to the maingate of Longwall 26. • The Waratah Rivulet from Pool P to the full supply level of the Woronora Reservoir.	• 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.). • Nature of iron staining (e.g. whether isolated or across the entire streambed). • Extent of iron staining (e.g. the length of stream affected). • Description of gas release (e.g. isolated bubbles or continuous stream, and type of gas [methane or carbon dioxide]). • Nature of scouring, for example the depth of scouring, type of soil exposed, any obvious vegetation impact, potential for severe erosion, etc. • Water discoloration or opacity if present. • Rock bar characteristics such as extent of cracking, seepage, underflow.	• Visual inspection and photographic survey of the Eastern Tributary conducted monthly when mining is within 450 m of the stream. • Visual inspection and photographic survey within 3 months of the completion of Longwall 304. • Weekly monitoring at pools observed with gas releases t, until no gas releases have been observed at the pool for three consecutive weeks.
	Surface Water Flow	• Eastern Tributary (GS 300078). • Waratah Rivulet (GS 2132102). • Woronora Reservoir Sub-catchment I (GS 300092). • Woronora Reservoir Sub-catchment K (GS 300093). • Woronora River (GS 2132101). • Honeysuckle Creek (GS 300077). • O'Hares Creek (GS 213200).	• Stream flow data.	• Continuous (downloaded monthly).

Table 16 (Continued)
Longwall 304 Environmental Monitoring Program Summary

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
WMP (Cont.)	Pool Water Levels and Drainage Behaviour	• Eastern Tributary Pools ETG, ETJ, ETM, ETO, ETU, ETW, ETAF, ETAG, ETAH, ETAI/ETAJ/ETAK, ETAL, ETAM, ETAN, ETAO, ETAP, ETAQ, ETAR, ETAS/ETAT[3] and ETAU. • Waratah Rivulet Pools A, F, J, K, L, M, N, O, P, Q, R, S, T, U, V and W. • Woronora River Control Pools WRP1, WRP2, WRP3 and WRP4.	• Pool water levels.	• Continuous water level sensor and logger (downloaded monthly at all sites). • Pools ETAS/ETAT and ETAU - continuous water level sensor and logger (downloaded weekly when Longwall 304 extraction is within 450 m of the Eastern Tributary).
		• Waratah Rivulet Pools B, C, E, G, G1, H and I.	• Pool water levels.	• Manually monitored daily, until such time that continuous sensors are installed.
		• Pools ETAS, ETAT and ETAU on the Eastern Tributary.	• Evidence of new cracking within the stream bed or rock bar. • Whether the pools continue to flow over, through and/or below the rock bars (where relevant). • Whether surface flow is evident along the length of the pools prior to flowing over/through/below the rock bars or boulder fields.	• Visual inspections conducted weekly when mining is within 450 m of the stream.
		• Pools on the Waratah Rivulet from Pool P to the full supply level of the Woronora Reservoir.		• Visual inspections conducted at the time of download (monthly).
	Stream Water Quality	• Eastern Tributary sites ETWQ F, ETWQ J, ETWQ N, ETWQ U, ETWQ W, ETWQ AF, ETWQ AH, ETWQ AQ and ETWQ AU. • 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. • Tributary B site RTWQ 1. • Tributary D site UTWQ 1. • Far Eastern Tributary site FEWQ 1. • Honeysuckle Creek site HCWQ 1. • Bee Creek site BCWQ1. • Woronora River sites WOWQ1 and WOWQ 2.	• Water quality parameters as described in the WMP (samples collected for metal analysis to be field filtered).	• Monthly.

Table 16 (Continued)
Longwall 304 Environmental Monitoring Program Summary

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
WMP (Cont.)	Stream Water Quality (Cont.)	• Eastern Tributary sites ETWQ F, ETWQ J, ETWQ N, ETWQ AF and ETWQ AQ. • Waratah Rivulet sites WRWQ 2, WRWQ 6, WRWQ 8, WRWQ 9, WRWQ M, WRWQ N and WRWQ P. • Woronora River site WOWQ 2.	• Unfiltered water quality samples analysed for total iron.	• Monthly.
		• Eastern Tributary sites ETWQ AQ and ETWQ AU. • Woronora River site WOWQ 2.	• Water quality parameters as described in the WMP (samples collected for metal analysis to be field filtered). • Unfiltered water quality samples analysed for total iron and total manganese.	• Fortnightly at the commencement of Longwall 304.
		• 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). • Site WARARM5.	• Water quality parameters as described in the WMP (samples collected for metal analysis to be field filtered). • Unfiltered water quality samples analysed for total iron and total manganese.	• 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. • 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). • Site WARARM5 - at the same frequency described above when the sites downstream of site CONFLU can be accessed for sampling (i.e. when the Woronora Reservoir water levels are suitably low).
	Woronora, Nepean and Cataract Reservoir Water Quality	• Woronora Reservoir (site DW01). • Nepean Reservoir. • Cataract Reservoir.	• Total iron, total manganese and total aluminium.	• As made available by WaterNSW.

Table 16 (Continued)
Longwall 304 Environmental Monitoring Program Summary

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
WMP (Cont.)	Shallow Groundwater Levels Near Streams	• Eastern Tributary sites ETGW1 and ETGW2. • Waratah Rivulet sites WRGW1, WRGW2 and WRGW7.	• Groundwater levels.	• Data downloaded monthly at all sites; analysis on a six-monthly basis. • Sites ETGW1 and ETGW2 downloaded weekly when Longwall 304 extraction is within 450 m of the Eastern Tributary.
	Groundwater Levels/Pressures	• Transect sites T1, T2, T3, T5 and T6. • Groundwater standpipes TBS02-90, TBS02-15, TBS03-15 and TBS02-190. • Site 9HGW0 (Longwall 10 Goaf Hole). • Site 9EGW1B. • Site 9FGW1A. • Site 9GGW2B. • Site 9HGW1B. • Site PM02. • Site 9GGW1-80. • Site PM01 (9DGW1B). • Site 9EGW2A. • Site 9EGW2-4. • Site PM03. • Site PHGW1B. • Site PHGW2A. • Site F6GW3A. • Site F6GW4A. • Site TBS02-250R. • Site TBS03-230.	• Groundwater levels.	• Data downloaded/reading monthly. Analysis at the frequency described in the WMP.
	Groundwater Quality	• Eastern Tributary site ETGW2. • Waratah Rivulet sites WRGW1, WRGW2 and WRGW7.	• Water quality parameters as described in the WMP.	• Monthly.

Table 16 (Continued)
Longwall 304 Environmental Monitoring Program Summary

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
WMP (Cont.)	Mine Water Make	Underground.	• Groundwater inflow to the mine (20-day average).	• Mine water balance inputs (as described in the WMP). • Weekly statutory inspections.
LMP	Cliffs and overhangs	• Cliff site COH17.	• 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.	• Visual inspection following the completion of Longwall 303. • Monthly when Longwall 304 extraction is within 400 m of the site. • Following the completion of Longwall 304.
	Steep slopes and land in general	• Steep slopes and other land within 600 m of Longwalls 20-27 and Longwalls 301-304 secondary extraction.	• Sandstone fracturing and rock falls (nature and extent of surface tension cracks and rock ledge collapse, compared against the land subsidence impact performance indicator).	• Visual observations during catchment visits.
BMP	Upland Swamps – Vegetation	• 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). • Swamps 40, 41, 46, 47, 48, 49, 50, 51/52, 53 and 58 (overlying or adjacent to Longwalls 301-303). • All swamps located within the 35° angle of draw and/or predicted 20 mm subsidence contour for Longwall 304 will be subject to visual inspections as a component of the existing Longwalls 301-303 upland swamp vegetation monitoring program. • Control Swamps 101, 111a, 125, 135, 136, 137a, 137b, 138, Bee Creek Swamp, Woronora River 1, Woronora River south arm and Dahlia Swamp.	• Cracking of exposed bedrock areas and/or swamp substrate. • Areas of increased erosion, particularly along any existing drainage line. • Any changes in water colour, particularly evidence of iron precipitation. • Changes in vegetation condition, including areas of stressed vegetation (i.e. plants that demonstrate symptoms of stress) and dead/dying plants that appear unusual. • 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).	• Visual inspections bi-annually in spring and autumn.

Table 16 (Continued)
Longwall 304 Environmental Monitoring Program Summary

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
BMP (Cont.)	Upland Swamps – Vegetation (Cont.)	• Swamps 16, 17, 18, 20, 24 and 25 (Longwalls 20-22). • Swamps 28, 30, 33, 35 and 94 (Longwalls 23-27). • Swamps 40, 41, 46, 51/52 and 53 (Longwalls 301-303). • Swamps 48 and 50 (Longwall 304). • Control Swamps 101, 111a, 125, 135, 136, 137a, 137b, 138, Bee Creek Swamp, Woronora River 1, Woronora River south arm and Dahlia Swamp.	• Vegetation structure. • Dominant species. • Estimated cover and height for each stratum. • Full floristics. • Estimated cover abundance for each species using seven point Braun-Blanquet scale. • Condition/health rating for each species in the quadrat.	• Transect and quadrat monitoring bi-annually in spring and autumn.
		• Twenty tagged individuals (*Epacris obtusifolia*) in each of Swamps 18, 24 and 25 (Longwalls 20-22) and Control Swamps 101, 111a and 125. • Twenty tagged individuals (*Epacris obtusifolia*) in each of Swamps 19, 30, 33, 35 and 94 (Longwalls 23-27) and Control Swamps 135, 136, 137a, 137b and 138. • Twenty tagged individuals (*Epacris obtusifolia*) in each of Swamps 40 and 53 (Longwalls 301-303) and Control Swamps 101, 136 and 137a. • Twenty tagged individuals (*Sprengelia incarnata*) in each of Swamps 24 (Longwalls 20-22) and Control Swamps 101 and 125. • Twenty tagged individuals (*Sprengelia incarnata*) in each of Swamps 19, 33, 35 and 94 (Longwalls 23-27) and Control Swamps 135, 136, 137a and 138. • Twenty tagged individuals (*Sprengelia incarnata)* in each of Swamps 40 and 53 (Longwalls 301-303) and Control Swamps 101, 136 and 137b.	• Population monitoring data including condition/health rating for each plant and reproductive rating.	• Indicator species monitoring bi-annually in spring and autumn.

Table 16 (Continued)
Longwall 304 Environmental Monitoring Program Summary

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
BMP (Cont.)	Upland Swamps – Vegetation (Cont.)	• Twenty tagged individuals (*Pultenaea aristata*) in each of Swamps 18, 24 and 25 (Longwalls 20-22) and Control Swamps 101 and 111a. • Twenty tagged individuals (*Pultenaea aristata*) in each of Swamps 19, 30, 33, 35 and 94 (Longwalls 23-27) and Control Swamps 135, 136, 137a and 138. • Twenty tagged individuals (*Banksia robur, Callistemon citrinus* and *Leptospermum juniperinum*) in each of Swamps 20 (Longwalls 20-22) and Control Swamps Woronora River 1, Woronora River south arm and Dahlia Swamp. • Twenty tagged individuals (*Banksia robur* and *Callistemon citrinus*) in each of Swamps 28 (Longwalls 23-27) and Control Swamps Woronora River 1, Woronora River south arm and Dahlia Swamp.	• Population monitoring data including condition/health rating for each plant and reproductive rating.	• Indicator species monitoring bi-annually in spring and autumn.
	Upland Swamps - Groundwater	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). • Swamps 20 and 25 (Longwalls 20-22). • Swamps 28, 30, 33 and 35 (Longwalls 23-27). • Swamps 40, 41, 46, 51, 52 and 53 (Longwalls 301-303). • Swamp 50 (Longwall 304). • Control Swamps 101, 137a, 137b, Bee Creek Swamp and Woronora River 1.	• Groundwater levels.	• Datalogger (continuous).
	Riparian Vegetation	• Sites MRIP01 to MRIP12.	• Areas of new water ponding. • Any cracking or rock displacement. • Changes in vegetation condition, including areas of stressed vegetation that appear unusual.	• Visual inspections bi-annually in spring and autumn.

Table 16 (Continued)
Longwall 304 Environmental Monitoring Program Summary

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
BMP (Cont.)	Riparian Vegetation (cont.)	• Sites MRIP01 to MRIP08, MRIP11 and MRIP12.	• Vegetation structure. • Dominant species. • Estimated cover and height for each stratum. • Full floristics. • Estimated cover abundance for each species using seven point Braun-Blanquet scale. • Condition/health rating for each species in the quadrat.	• Permanent quadrat (20 m x 2 m) monitoring bi-annually in spring and autumn.
		• Existing tagged individuals (*Prostanthera linearis*, *Schoenus melanostachys* and *Lomatia myricoides*) at sites MRIP01 to MRIP12	• Population monitoring data including condition/health rating for each plant and reproductive rating.	• Indicator species monitoring bi-annually in spring and autumn.
	Aquatic Biota and their Habitats	• Surface water resources and watercourses in accordance with the WMP.	• Monitoring of aquatic habitats in accordance with the WMP.	• In accordance with the WMP.
		• Stream monitoring at following Locations (if sufficient aquatic habitat is available for sampling); – WT3, WT4, WT5, ET1, ET2, ET3 and ET4. – Control Locations: WR1 and OC.	Impacts on aquatic ecology: • Habitat Characteristics. • Water Quality. • Aquatic Macroinvertebrates. • Aquatic Macrophytes.	• Biannually in spring (15 September to 15 December) and autumn (15 March to 15 June).
	Aquatic Biota and their Habitats (cont.)	– Larger pools ETAH on the Eastern Tributary and control Pool WP on the Woronora River and Pool OC on O'Hares Creek. – 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.	The response of aquatic ecosystems to the implementation of stream remediation works: • Habitat Characteristics. • Water Quality. • Aquatic Macroinvertebrates. • Aquatic Macrophytes.	• 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). • 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).

Table 16 (Continued)
Longwall 304 Environmental Monitoring Program Summary

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
BMP (Cont.)	Amphibian Monitoring	• Sites 1-6 (Longwalls 20-22), 13-17 (Longwalls 23-27) and 23-28 (Longwalls 301-303). • Control Sites 7, 8, 9, 10, 11, 12, 18, 19, 20, 21 and 22.	Species assigned to relative abundance categories for tadpole and adult stages.	• Survey annually in spring/summer (i.e. October to February) during suitable weather conditions.
HMP	Aboriginal Heritage	• Sites MET 1, FRC 176, FRC 28, FRC 29, FRC 34, FRC 60 and FRC 117.	• Inspections of rock surfaces for cracking and/or exfoliation and/or blockfall. • Inspection of art motifs for damage or deterioration. • Identification of any natural weathering processes that may result in deterioration (e.g. fire, vegetation growth and water seepage). • Comparison of the physical characteristics of the site at the time of monitoring against the previous monitoring and the baseline record.	• Within three months of the completion of Longwall 303. Sites that show continued change due to mining induced subsidence during this monitoring will also be monitored within three months of the completion of Longwall 304.
		• Sites FRC 76, FRC 77, FRC 78, FRC 86, FRC 90 and FRC 309		• Within three months of the completion of Longwall 304.
BFMP-Garrawarra	Garrawarra Centre Complex – House Structures	• Houses (B04a-B09a). • Palmer House (A09a).	• Structural integrity and cracking of pre-existing rock joints.	• Following the completion of Longwall 304.
	Garrawarra Centre Complex – Aged Care Buildings	• Building structures (B01a-B01e). • Administration / Kitchen Group (Buildings B02a and B02b).	• Structural integrity. • Cracking at pre-existing rock joints. • Opening and closing of joints between Buildings B02a and B02b.	• Following the completion of Longwall 304.
	Garrawarra Centre Complex – Water Storage Tanks	• Water storage tanks (B14t01, B14t02, B16t01-B16t03, B17t01 and B18t01) and trickle filter tank (B15t01).	• Structural integrity. • New Leaks. • Cracking in columns, elevated ring beam or central access shaft (B14t02). B14t02 is derelict structure and does not hold water.	• Weekly visual inspection for B14t02 on commencement of Longwall 304 until wall has retreated 400 m. • Within 3 months following the completion of Longwall 304.
	Garrawarra Centre Complex – Gas Storage Tank	• Gas storage tank (B01t03).	• Structural integrity. • Leaks.	• Within 3 months following the completion of Longwall 304.

Table 16 (Continued)
Longwall 304 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)	• Timber poles and powerlines.	• Degradation of structure. • Movement of conductors. • Vegetation clearance. • Land clearance. • Road clearance. • Integrity and function of support clamps or other items.	• Following the completion of Longwall 304. • At any time in case of fault or emergency.
	Garrawarra Centre Complex – Other Services (Water Pipelines)	• Water pipelines within the Study Area.	• Surface ground cracks. • Cracks or leaks in the pipelines. • Fittings can be accessed beneath surface fittings and are operable.	• Following the completion of Longwall 304.
	Garrawarra Centre Complex – Private Roads and Access Roads/Tracks	• Within 600 m of Longwall 304 extraction.	• Surface cracks, buckling and general safety.	• Following the completion of Longwall 304. • As per the LMP.
BFMP-Endeavour Energy	132 kV Towers external to study area	• Towers T8 to T12.	• Degradation of tower structure. • Degradation of tower foundations/footings. • Movement of insulator strings.	• Monthly survey of tower legs during extraction of Longwall 304. • Endeavour Energy inspections (annual ground inspection, six yearly climbing inspection). • At any time in case of fault or emergency.
	Local Powerlines – poles and wires	• Timber poles and wires within the Study Area.	• Degradation of structure. • Movement of conductors. • Vegetation clearance. • Land clearance. • Road clearance.	• Within 3 months following the completion of Longwall 304. • Routinely as per Endeavour Energy inspections. • At any time in case of fault or emergency.

Table 16 (Continued)
Longwall 304 Environmental Monitoring Program Summary

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
BFMP-Endeavour Energy (Cont.)	Access Roads/Tracks	• Within 600 m of Longwall 304 extraction.	• Surface cracks, buckling and general safety.	• Monthly during Longwall 304 extraction (field observations recorded by surveyors accessing towers). • Within 3 months following the completion of Longwall 304. • Routinely as per Endeavour Energy inspections.
BFMP - TransGrid	330 kV Towers	• Towers TL11-104 to TL11-108.	• Calculation of differential leg movement. • Degradation of tower structure. • Degradation of tower foundations/footings. • Movement of insulator strings. • Visual check by TransGrid of earthwire/OPGW and conductor movement.	• Monthly survey of tower legs during extraction of Longwall 304. • Within 3 months following the completion of Longwall 304. • Routinely as per TransGrid inspections (annual ground inspection, six yearly climbing inspection). • At any time in case of fault or emergency.
	330 kV Transmission Lines	• Conductor lines strung from Towers TL11-104 to TL11-108. • Ground survey. • Climbing inspection.	• Vegetation clearance. • Land clearance. • Road clearance. • Integrity and function of support clamps or other items.	• Routinely as per TransGrid inspections (annual ground inspection, six yearly climbing inspection). • At any time in case of fault or emergency.
	Access Roads/Tracks	• Within 600 m of Longwall 304 extraction.	• Surface cracks, buckling and general safety.	• Within 3 months following the completion of Longwall 304. • Routinely as per TransGrid inspections.
BFMP-Vocus	Fibre Optic Cable line and/or joint housing pit	• Areas within 600 m of Longwall 304 extraction.	• Movement of conduit, degree of freedom of cable in conduit, ground compression / tension.	• Monthly during extraction of Longwall 304 RFMS records loss event ±0.3 dB; ±0.5 dB; or exceeds ±1.0 dB.
	Access Roads/Tracks	• Within 600 m of Longwall 304 extraction.	• Surface cracks, buckling and general safety.	• Following the completion of Longwall 304.

Table 16 (Continued)
Longwall 304 Environmental Monitoring Program Summary

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
BFMP-Optus	Fibre Optic Cables	• Within 600 m of Longwall 304 extraction.	• Ground subsidence, tilt and compression / tension.	• Weekly on commencement of Longwall 304 until subsidence movement stabilises. • Within 3 months following the completion of Longwall 304.
	Cable lines and associated pits	• Within 600 m of Longwall 304 extraction.	• Movement of conduit, degree of freedom of cable in conduit. (Optus to inspect)	• If Optus detects a fault or loss of signal integrity
	Access Roads/Tracks	• Within 600 m of Longwall 304 extraction.	• Surface cracks, buckling and general safety.	• Visual observations as part of routine works and inspections. • Following the completion of Longwall 304.
BFMP-Telstra	Fibre Optic Cable line 1 and associated pits	• Point loss or area of loss within 600 m of Longwall 304 extraction.	• Movement of conduit, degree of freedom of cable in conduit, ground compression / tension.	• Monthly during extraction of Longwall 304 Remote Fibre Monitoring System (RFMS) records loss event ±0.3 dB; or exceeds ±1.0 dB.
	Fibre Optic Cable line 2 and associated pits	• Point loss or area of loss within 600 m of Longwall 304 extraction.	• Movement of conduit, degree of freedom of cable in conduit, ground compression / tension.	• Monthly during extraction of Longwall 304 RFMS records loss event ±0.3 dB; or exceeds ±1.0 dB.
	Telecommunications Tower (and compound)	• Tower	• Structural integrity of the telecommunications tower and compound.	• Weekly survey on commencement of mining Longwall 304 until subsidence no longer detectable. • Within 3 months following the completion of Longwall 304.
	Access Roads/Tracks	• Within 600 m of Longwall 304 extraction.	• Surface cracks, buckling and general safety.	• Following the completion of Longwall 304. • Visual observations during catchment visits as per the LMP.

Table 16 (Continued)
Longwall 304 Environmental Monitoring Program Summary

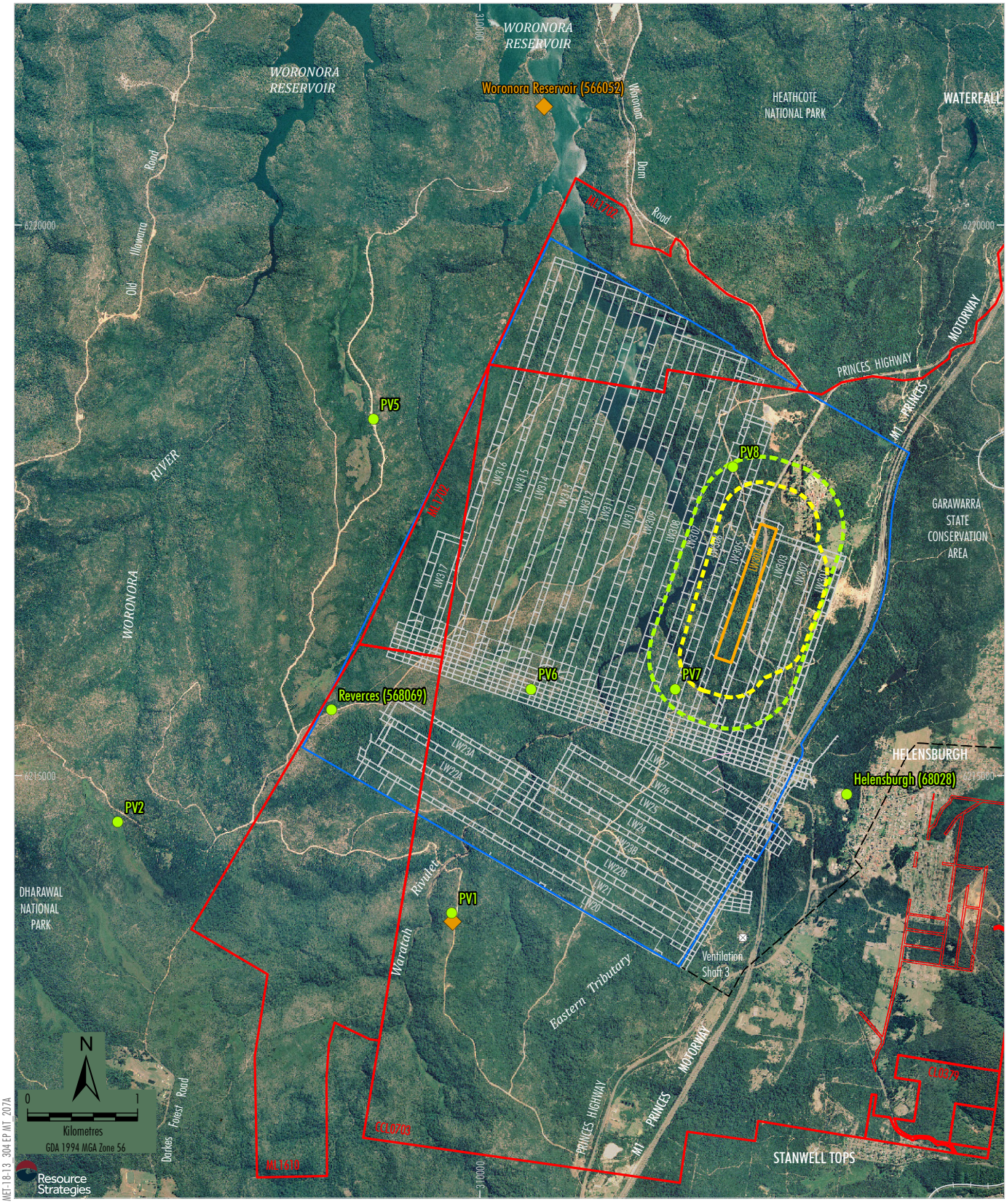
Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
BFMP-RMS	M1 Princes Motorway - Pavement	Visual inspection for impacts on: • Asphaltic concrete surface. • Kerbs, gutters and pits. • Signs or other road infrastructure.	To identify development of, or changes in existing: • Asphaltic concrete surface including cracks, buckling and stepping. • Kerbs and gutters including cracking, buckling and joint movement.	• Following the completion of Longwall 304. • Greater frequency if determined in consultation with the Technical Committee. • Network Safety Inspection twice weekly during the extraction of Longwall 304.
	M1 Princes Motorway - Cuttings	Visual inspection for impacts on: • Cuttings along the M1 Princes Motorway as described in the BFMP-RMS.	To identify: • Changes in cutting condition, including opening of cracks, spalling. • Changes in groundwater seepage or surface water flows. • Rockfalls. • Changes in RMS risk ranking.	• Following the completion of Longwall 304. • Greater frequency if determined in consultation with the Technical Committee • Network Safety Inspection twice weekly during the extraction of Longwall 304.
	M1 Princes Motorway - Culverts	• Closed circuit television (CCTV) inspection for impacts on internal surfaces.	• To identify changes to the visible surfaces of the culverts including cracking, buckling, shearing, and collapse.	• Following the completion of Longwall 304 or more frequent if determined in consultation with the RMS Technical Committee.
	Bridge 2 (Old Princes Highway Underpass)	Visual inspection for impacts on: • Abutments. • Pier frames. • Elastomeric bearings. • Soffits of girders. • Deck expansion joints. • Steel traffic barrier joints. • Other areas of substructure and adjoining areas including concrete paths, stairs, and slope protection.	To identify development of, or changes in existing: • Surface cracks. • Closing or opening of joints. • Distortion or damage to elastomeric bearings.	• Following the completion of Longwall 304. • Greater frequency if determined in consultation with the Technical Committee.

Table 16 (Continued)
Longwall 304 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: • Abutments. • Pier blade wall. • Tetron bearings. • Deck expansion joints. • Steel traffic barrier and safety screen joints.	To identify development of, or changes in existing: • Surface cracks. • Closing or opening of joints. • Distortion or damage to Tetron bearings.	• Following completion of Longwall 304. • Greater frequency if determined in consultation with the RMS Technical Committee.
BFMP-WCC	Old Princes Highway - Pavement	From the Old Princes Highway Underpass (Bridge 2) to the entrance to the Garrawarra Centre Complex.	• Impacts to the surface including cracks, buckling and stepping.	• Progress monitoring (visual inspections) to occur weekly as longwall face within 400 m of passing under asset. • Following completion of Longwall 304.
	Old Princes Highway – Drainage Structures (Pipe/Culverts) and Other Furniture	Drainage structures and other furniture within the Study Area.	• Impacts to the visible surfaces of pipes/culverts including cracking, buckling, shearing, and collapse. • Visible impacts to furniture.	• Progress monitoring (visual inspections) to occur weekly as longwall face within 400 m of passing under asset. • Within 3 months following the completion of extraction of Longwall 304.
BFMP-Cemetery	Waterfall General (Garrawarra) Cemetery site	• Waterfall General (Garrawarra) Cemetery site.	• Structural integrity of headstones and fencing. • Surface cracks, buckling and general safety.	• Following completion of Longwall 304. • A follow up audit be undertaken two years after Longwall 303 (in 2021) to review any longer-term effects.
	Access Roads/Tracks	• Within 600 m of Longwall 304 extraction.	• Surface cracks, buckling and general safety.	• Following the completion of Longwall 304. • As per the LMP.
BFMP-Sydney Water	Water pipelines	• Water Main 1 • Water Main 2	• Surface ground cracks. • Cracks or leaks in the pipelines. • Fittings can be accessed beneath surface covers and are operable.	• Routinely as per Sydney Water inspections. • Weekly when active longwall face within 400m of passing under pipeline for Longwall 304 • Following the completion of Longwall 304.

Table 16 (Continued)
Longwall 304 Environmental Monitoring Program Summary

Management Plan	Monitoring Component	Sites	Monitoring Parameter/Analysis	Monitoring Frequency
BFMP-Sydney Trains	Telecommunications Tower (and compound)	• Tower and compound.	• Structural integrity of the telecommunications tower, compound and cable entries.	• Weekly on commencement of Longwall 304 until subsidence no longer detectable. • Within 3 months following the completion of Longwall 304.
BFMP-Axicom	Telecommunications Towers (and compounds)	• Towers and compounds.	• Structural integrity of the compounds.	• Weekly on commencement of Longwall 304 until subsidence no longer detectable. • Within 3 months following the completion of Longwall 304.
	Access Roads/Tracks	• Within 600 m of Longwall 304 extraction.	• Surface cracks, buckling and general safety.	• Weekly on commencement of Longwall 304 until effects of subsidence no longer detectable. • Following the completion of Longwall 304. • Visual observations during catchment visits as per the LMP.



MET-18-13 304 EP MT 207A

LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwall 304 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Secondary Extraction of Longwall 304
- 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).

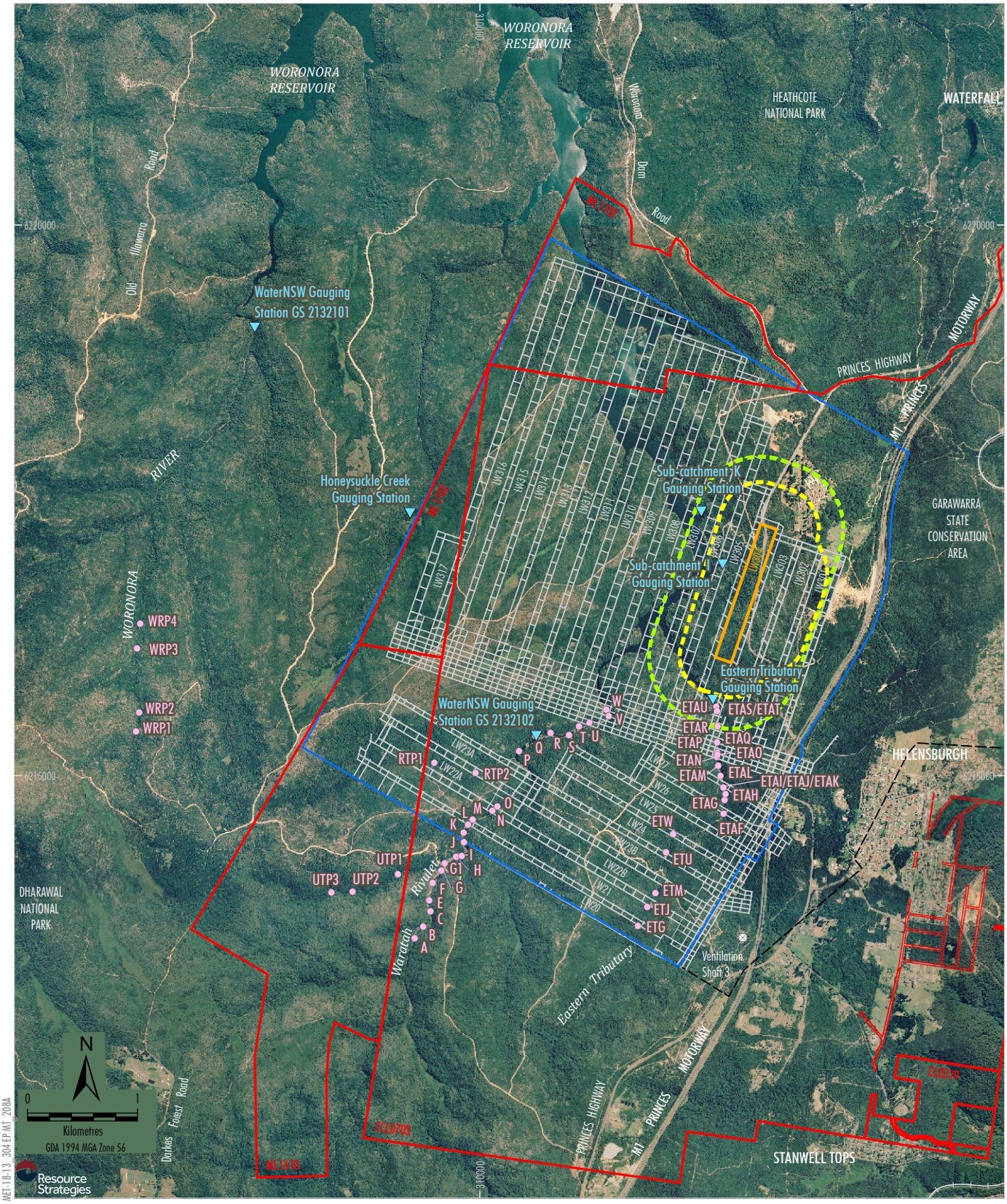
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019)

Peabody

METROPOLITAN COAL

Meteorological Sites

Figure 14



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwall 304 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Secondary Extraction of Longwall 304
- Existing Underground Access Drive (Main Drift)
- Gauging Station
- Pool Water Level Site

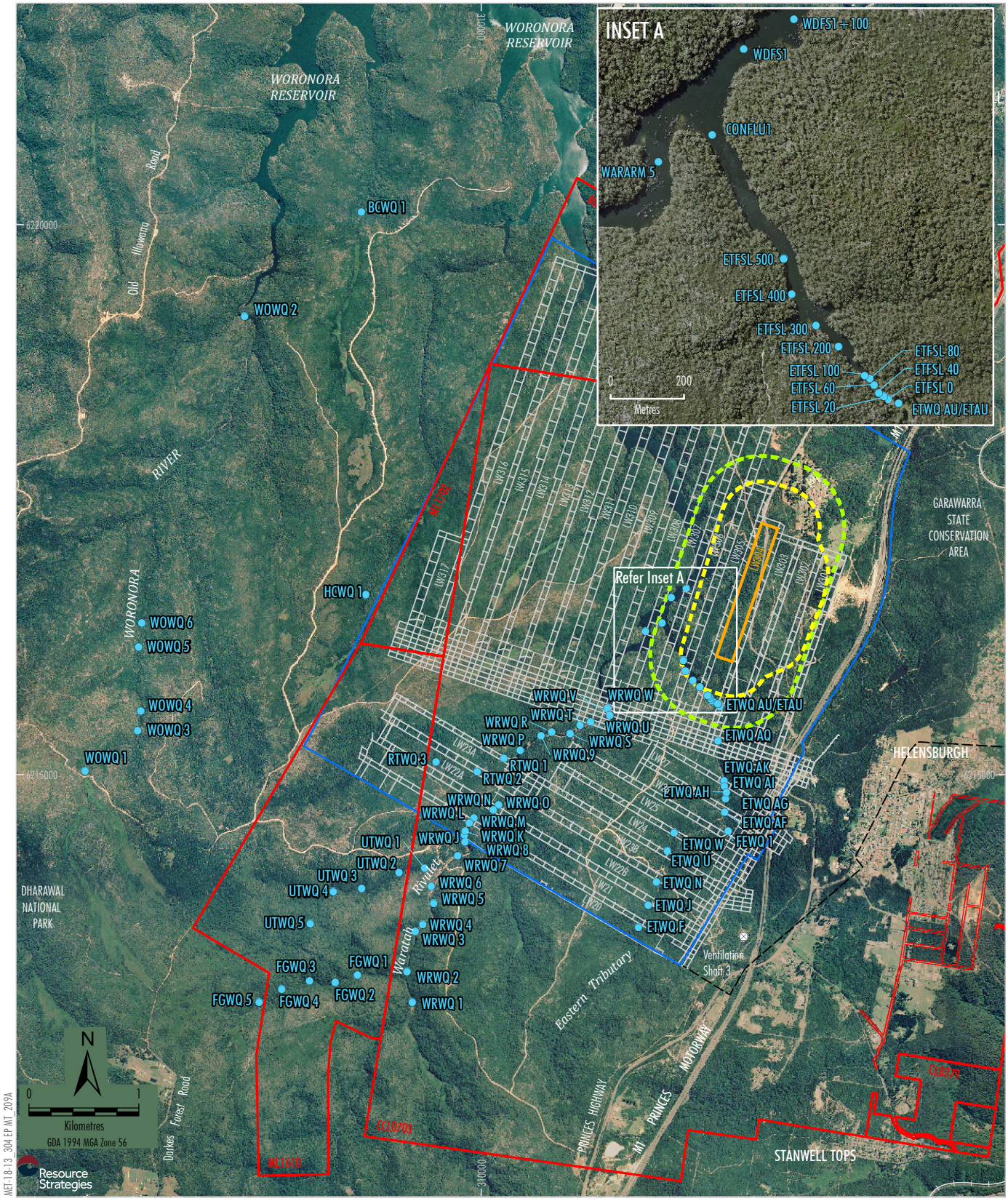
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019)

Peabody

METROPOLITAN COAL

Surface Water Quantity Sites

Figure 15



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwall 304 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Secondary Extraction of Longwall 304
- Existing Underground Access Drive (Main Drift)
- Surface Water Quality Site

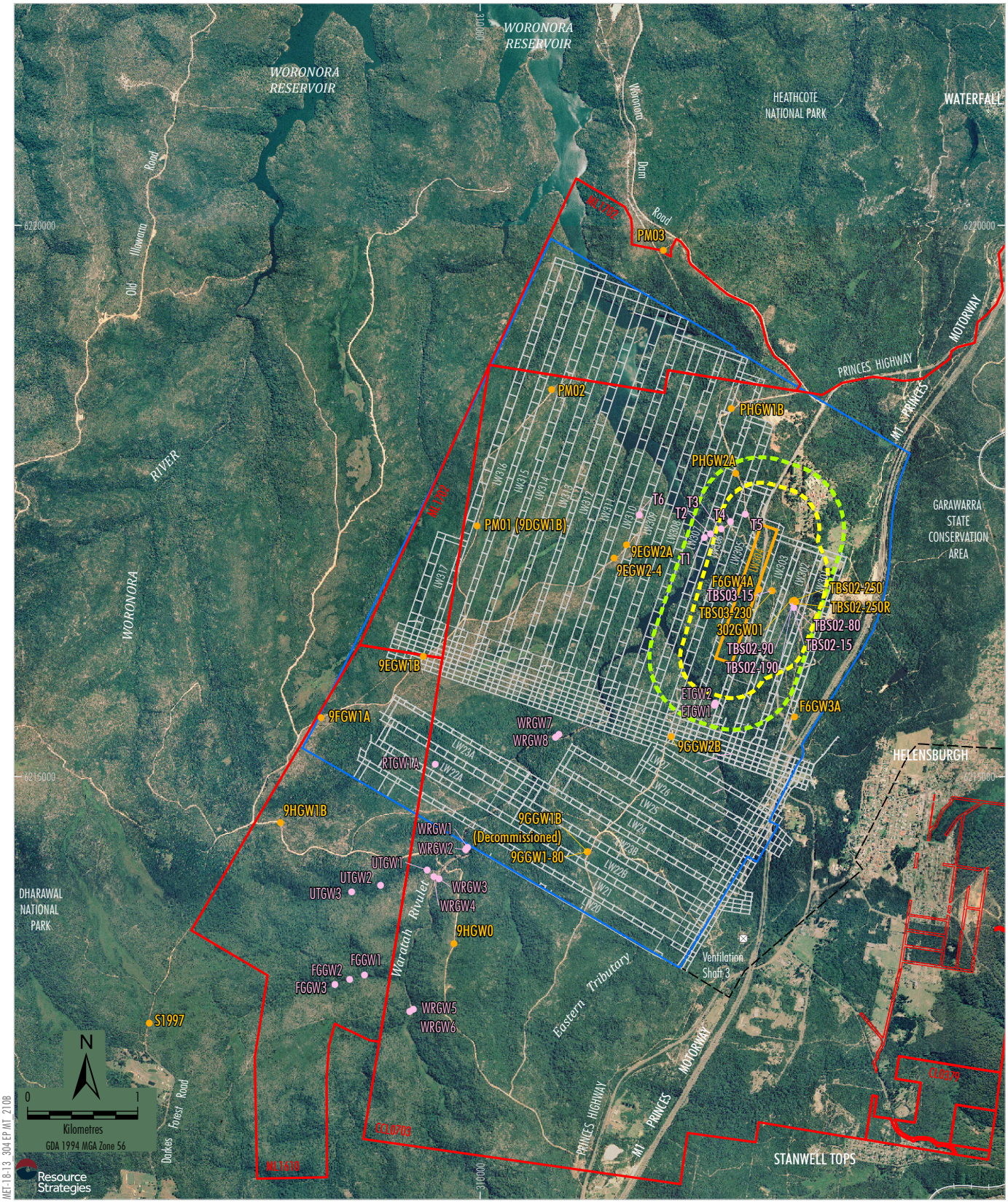
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019)

Peabody

METROPOLITAN COAL

Surface Water Quality Sites

Figure 16



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwall 304 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Secondary Extraction of Longwall 304
- Existing Underground Access Drive (Main Drift)
- Groundwater Level/Pressure Bore
- Groundwater Level Bore

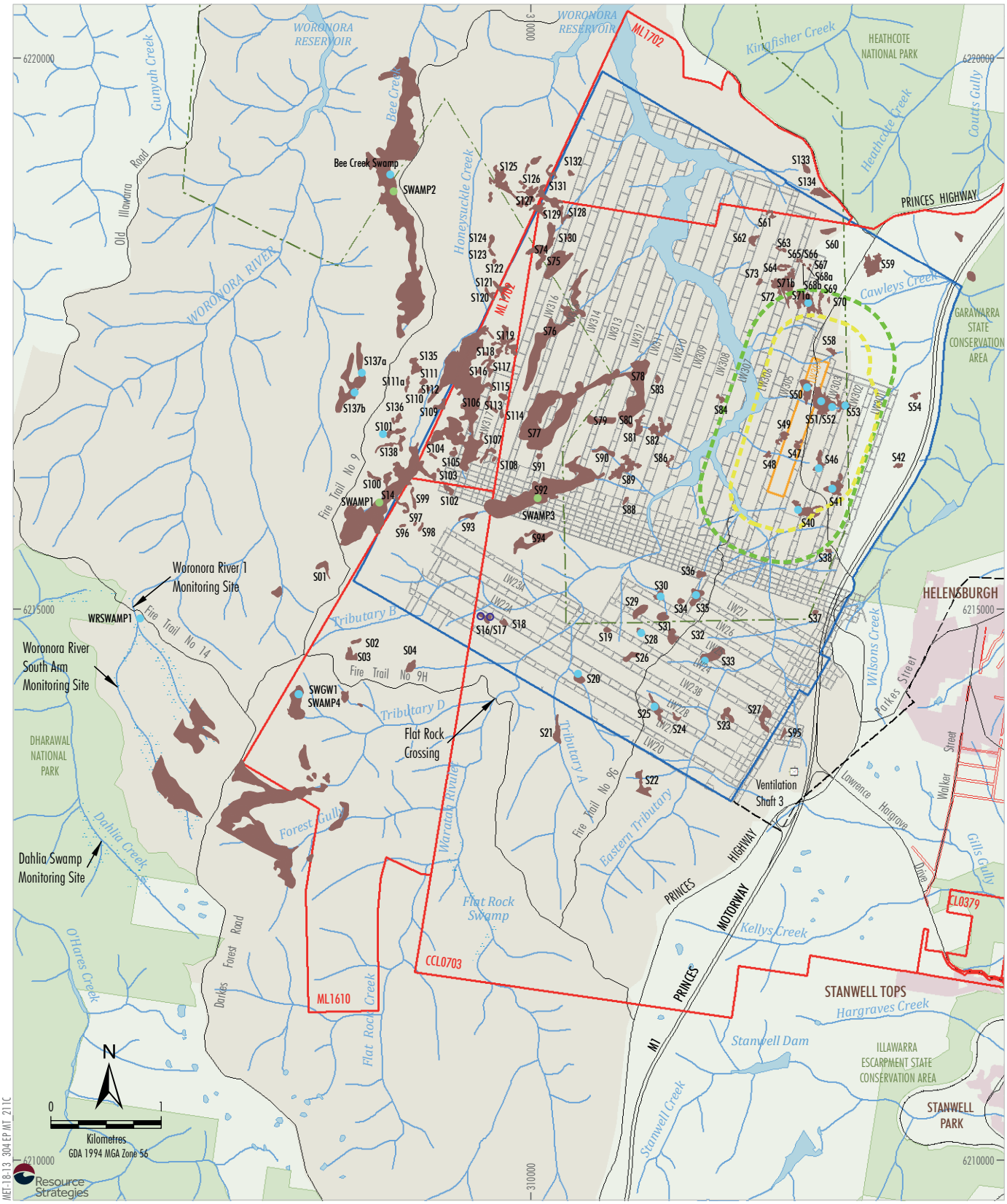
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019)

Peabody

METROPOLITAN COAL

Groundwater Level and/or Pressure Bore Locations

Figure 17



LEGEND

- Mining Lease Boundary
- Woronora Special Area
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwall 304 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Secondary Extraction of Longwall 304
- 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

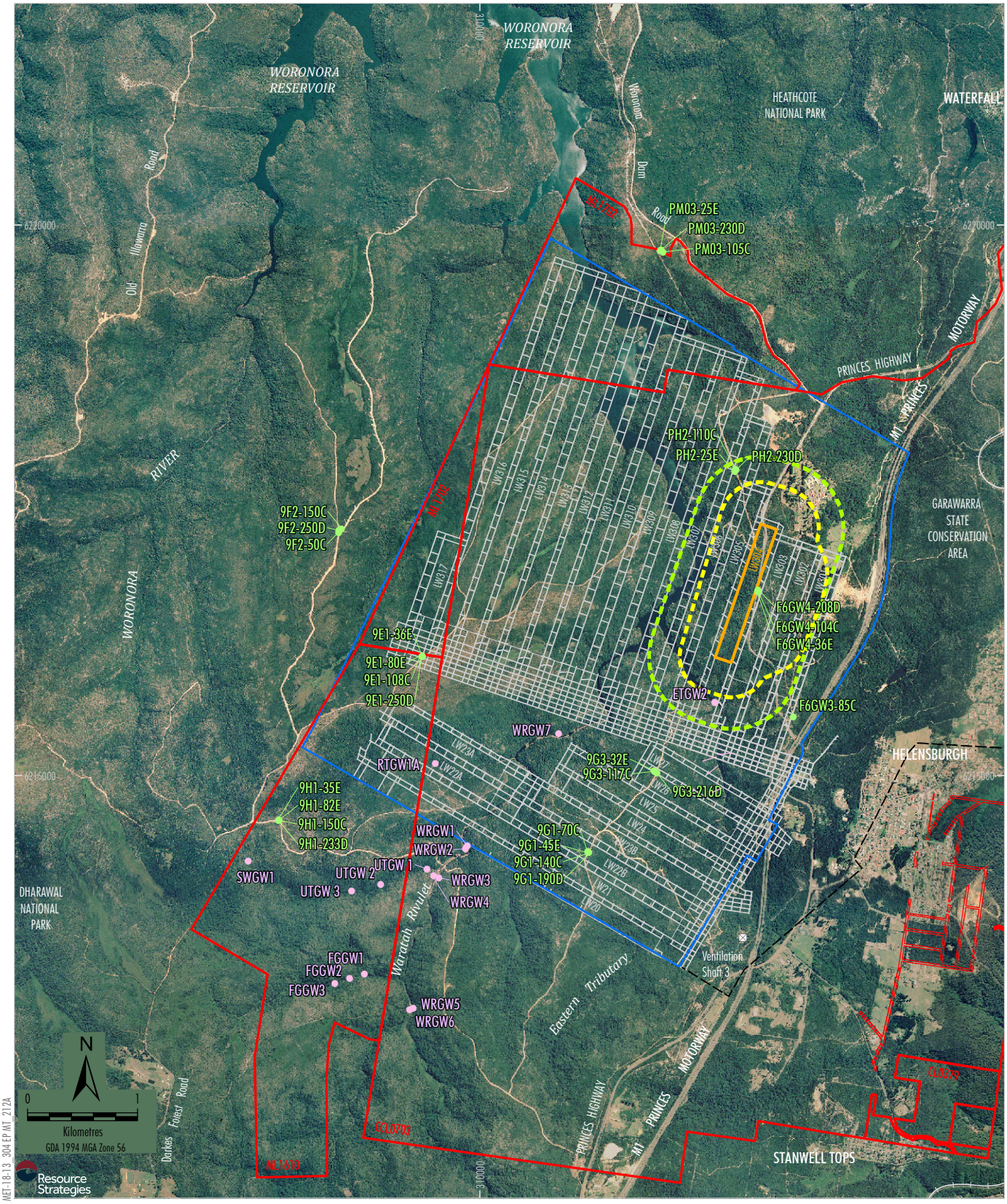
Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019); after NPWS (2003), Bangalay Botanical Surveys (2008) and Eco Logical Australia (2015; 2016; 2018)

Peabody

METROPOLITAN COAL

Upland Swamp Groundwater Piezometer Locations

Figure 18



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwall 304 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Secondary Extraction of Longwall 304
- Existing Underground Access Drive (Main Drift)
- Deep Groundwater Chemistry Monitoring Site
- Stream Shallow Groundwater Quality Monitoring Site

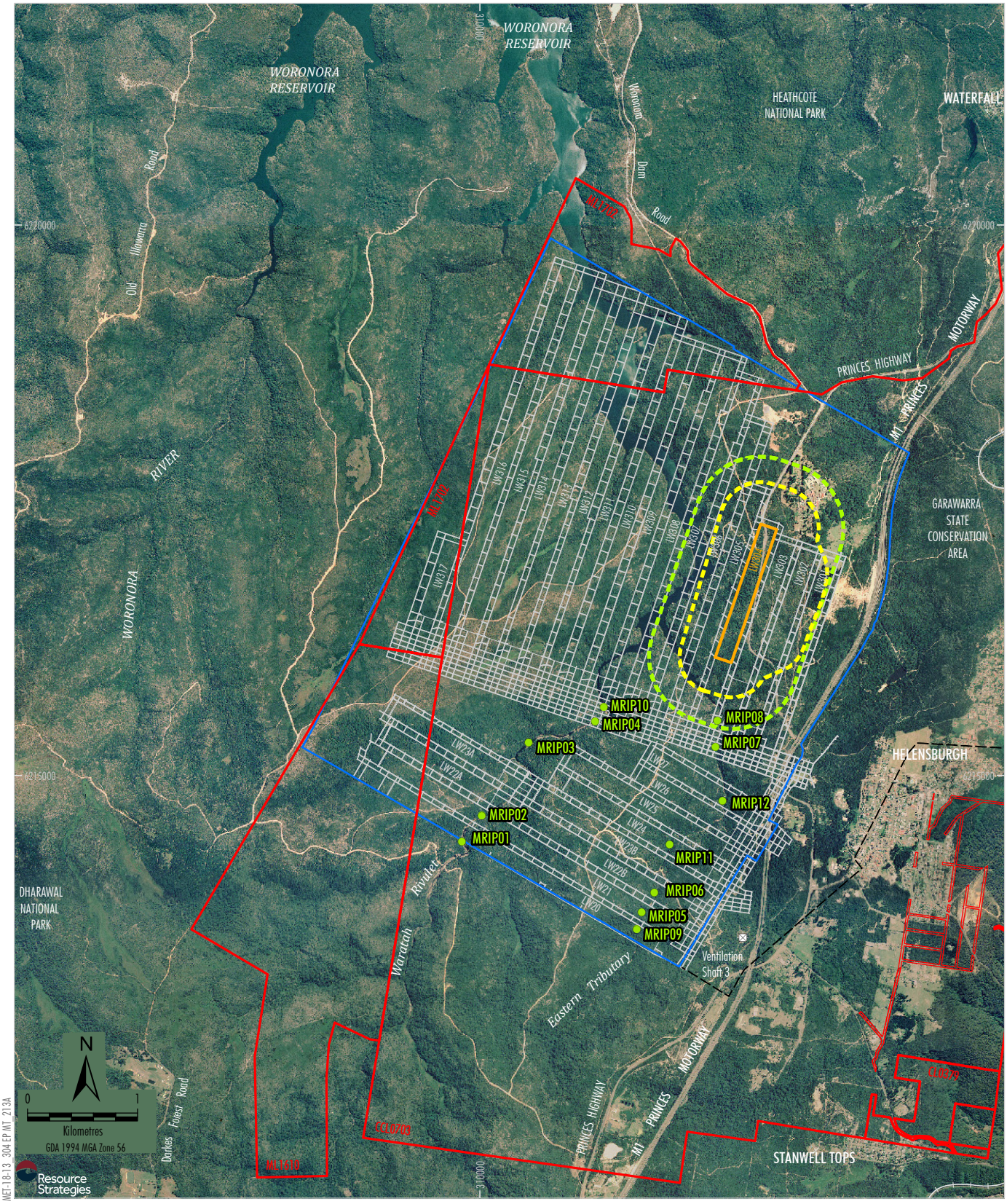
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019)

Peabody

METROPOLITAN COAL

Groundwater Quality Sites

Figure 19



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LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwall 304 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Secondary Extraction of Longwall 304
- Existing Underground Access Drive (Main Drift)

Monitoring Site

- Riparian Vegetation Monitoring Site

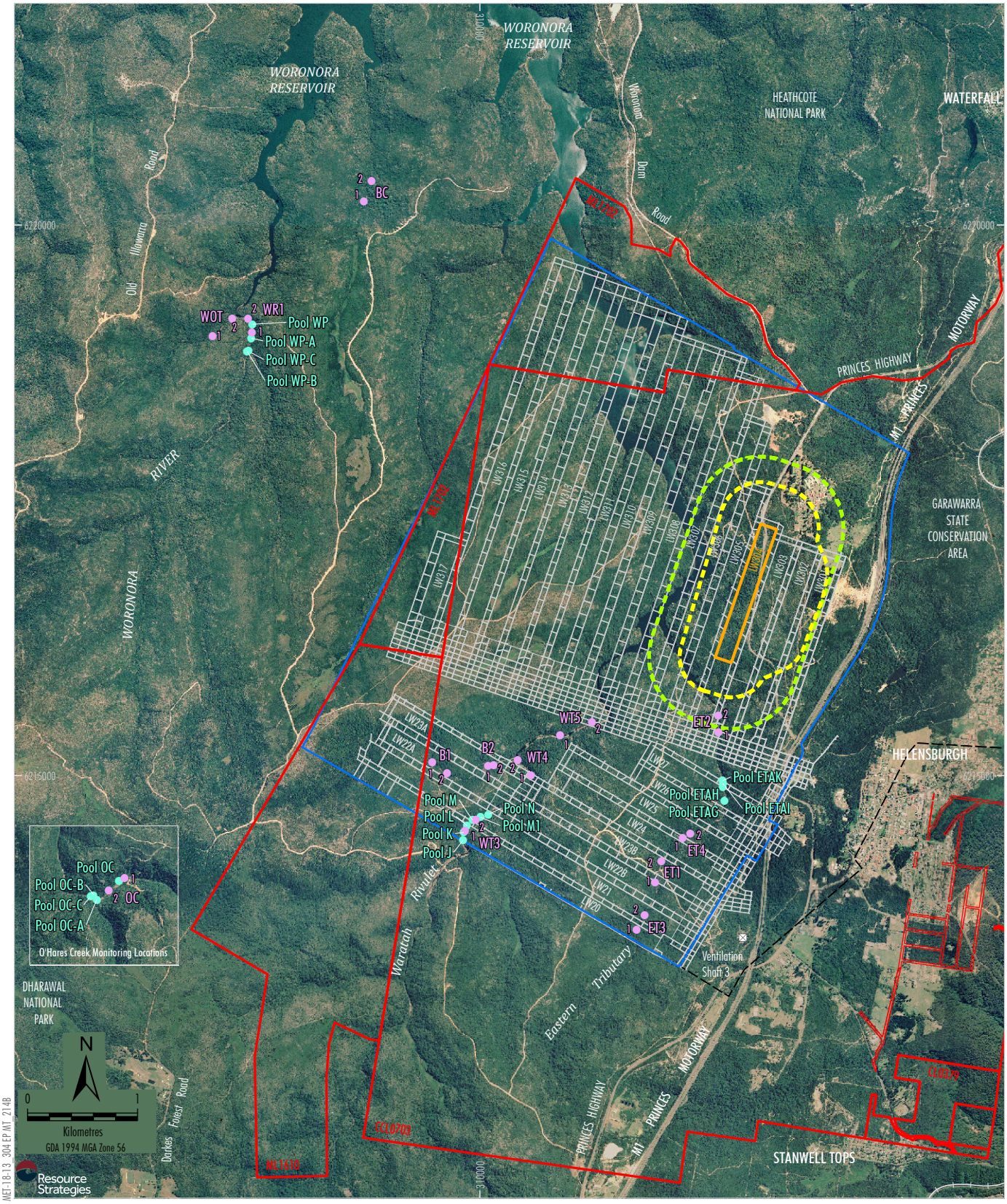
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019)

Peabody

METROPOLITAN COAL

Riparian Vegetation Monitoring Locations

Figure 20



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwall 304 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Secondary Extraction of Longwall 304
- Existing Underground Access Drive (Main Drift)

Monitoring

- Pool Aquatic Ecology Sampling Site
- Stream Aquatic Ecology Sampling Site

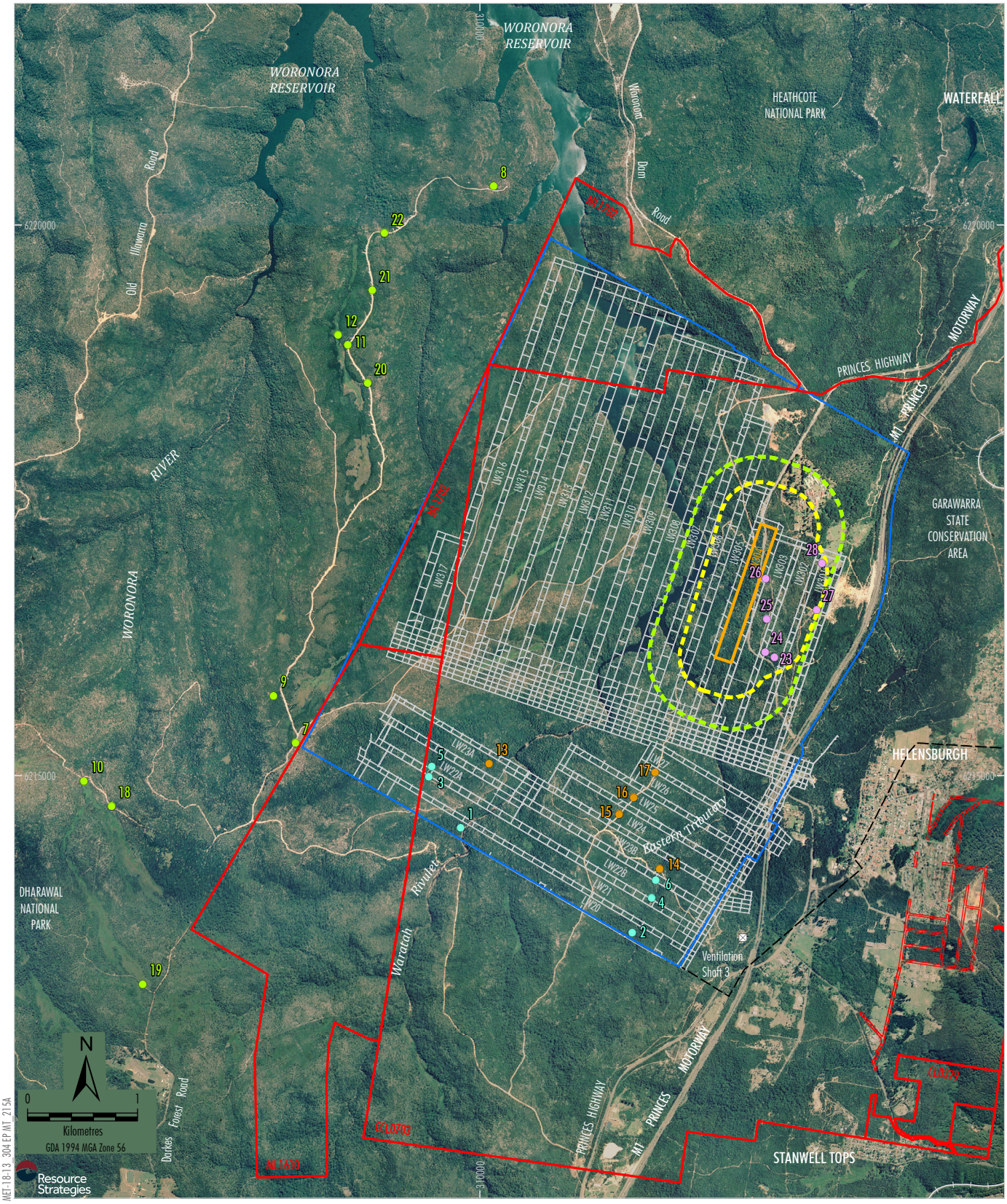
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019)

Peabody

METROPOLITAN COAL

Aquatic Ecology Sampling Locations

Figure 21



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwall 304 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Secondary Extraction of Longwall 304
- Existing Underground Access Drive (Main Drift)

Monitoring Sites

- Longwalls 20-22 Amphibian Monitoring
- Longwalls 23-27 Amphibian Monitoring
- Longwalls 301-303 Amphibian Monitoring
- Control Site

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

Peabody

METROPOLITAN COAL

Amphibian Monitoring Locations

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 Longwall 304 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 Manager – Technical Services and/or the Environment & Community Superintendent within 24 hours.
- The Manager – Technical Services 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 DP&E, 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 DP&E for approval.
- Metropolitan Coal will implement the approved course of action to the satisfaction of the DP&E.

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 DP&E if either the contingency measures implemented by Metropolitan Coal have failed to remediate the impact or the Secretary of the DP&E 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 18 is designed to support the TARPs provided in the component management plans (Appendices A to F).

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 17 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 DP&E and any other relevant agencies (Table 17) 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 DP&E 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.

Table 17
Summary of Reporting Framework

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

[1] See Attachment 4 for distribution details.

4.3.2 Six Monthly Reporting

A Six Monthly Report will be prepared to report on subsidence impacts and environmental consequences associated with the Longwall 304 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 DP&E 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.

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 DP&E, 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 DP&E. 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.

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 18. The component management plans provide additional responsibilities under the plans.

Table 18
Key Extraction Plan Responsibilities

Responsibility	Task
General Manager	• Ensure resources are available to Metropolitan Coal personnel to facilitate the completion of responsibilities under this Extraction Plan. • Ensure the safety of Metropolitan Coal employees and the public in relation to Metropolitan Coal operations. • Approve and instruct implementation of remediation/corrective action/compensation, if necessary.
Mining Engineering Manager	• Ensure the safety of Metropolitan Coal employees and the public in relation to Metropolitan Coal operations. • Ensure adequate resources are available for implementation of remediation/corrective actions.
Manager – Technical Services	• Liaise with relevant stakeholders regarding environmental management. • 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. • Ensure that any Incident Reports are lodged in a timely manner with all available information. • Ensure that reviews of the strategies, plans and programs are conducted as described in Section 4.4. • Liaise with relevant stakeholders regarding subsidence impact management and related public safety hazards.
Environment & Community Superintendent	• Liaise with relevant stakeholders regarding environmental management. • 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. • Ensure that any Incident Reports are lodged in a timely manner with all available information. • Ensure that reviews of the strategies, plans and programs are conducted as described in Section 4.4.
Registered Mine Surveyor	• Undertake all subsidence monitoring to the required standard within the specified timeframes and ensure data are adequately checked, processed and recorded.

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.

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.

Metropolitan Coal Pty Ltd (2016) *Metropolitan Coal Longwalls 301-303 Environmental Risk Assessment Report.* June 2016.

Metropolitan Coal Pty Ltd (2019) *ME-ENV-RISK-0333 Longwall 304 Risk Assessment – Potential for geological features in study area to affect water quantity available to Woronora Reservoir*. 20 February 2019.

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 (2019) *Metropolitan Collieries Pty Ltd – Longwall 304 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*.