METROPOLITAN COAL

2017 ANNUAL REVIEW




Peabody

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2017 ANNUAL REVIEW

Project No. MET-08-08/8.1
Document No. 00913779

Name of Operation	Metropolitan Coal
Name of Operator	Peabody Energy Australia Pty Ltd
Project Approval	Project Approval 08_0149
Name of Holder of Project Approval	Metropolitan Collieries Pty Ltd
Mining Leases	Consolidated Coal Lease 703 Mining Lease 1610 Mining Lease 1702 Mining Purpose Lease 320 Coal Lease 379
Name of Holder of Mining Leases	Metropolitan Collieries Pty Ltd
Water Licence	Water Access Licence – WAL25410 Bore Licence Certificate – 10BL603595
Name of Holder of Water Licence	Metropolitan Collieries Pty Ltd
MOP Start Date	October 2012
MOP End Date	September 2019
Annual Review Start Date	1 January 2017
Annual Review End Date	31 December 2017

I, Jon Degotardi, certify that this audit report is a true and accurate record of the compliance status of Metropolitan Coal for the period 1 January to 31 December 2017 and that I am authorised to make this statement on behalf of Peabody Energy Australia Pty Ltd.

Note.

a) The Annual Review is an 'environmental audit' for the purposes of section 122B(2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion in) an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, $1 million and for an individual, $250,000.

b) The Crimes Act 1900 contains other offences relating to false and misleading information: section 192G (Intention to defraud by false or misleading statement—maximum penalty 5 years imprisonment); sections 307A, 307B and 307C (False or misleading applications/information/documents—maximum penalty 2 years imprisonment or $22,000, or both).

Name of Authorised Reporting Officer	Jon Degotardi
Title of Authorised Reporting Officer	Manager – Technical Services
Signature of Authorised Reporting Officer	
Date	30/04/2018

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1 STATEMENT OF COMPLIANCE

The compliance status of the Metropolitan Coal Mine with its relevant approval conditions at the end of the review period (31 December 2017) is provided in Table 1.

Table 1
Statement of Compliance

Were all conditions of the relevant approval(s) complied with?	
Project Approval 08_0149	No
Development Consent D90/832	Yes
Consolidated Coal Lease 703	Yes
Mining Lease 1610	Yes
Mining Lease 1702	Yes
Coal Lease 379	Yes
Mining Purpose Lease 320	Yes
Environment Protection Licence No. 767	Yes

Table 2 summarises the non-compliances with the approval conditions.

Table 2
Summary of Non-Compliances

Relevant Approval	Condition Number	Condition Description	Compliance Status	Comment	Report Section
Project Approval 08_0149	Condition 1, Schedule 3	Subsidence Impact Performance Measures (Table 1)	Non-compliant	Exceedance of the Eastern Tributary watercourse subsidence impact performance measure in relation to iron staining and pool flow/drainage behaviour downstream of the Longwall 26 maingate.	6.2 and 13.1
Project Approval 08_0149	Condition 1, Schedule 4	Noise Impact Assessment Criteria (Table 2)	Non-compliant	Noise monitoring has identified sustained non-compliances during the review period.	7.1 and 13.2
Project Approval 08_0149	Condition 1, Schedule 5	Notification of Landowners	Non-compliant	Notifications were not made within the timeframe specified in Condition 1, Schedule 5.	7.1 and 13.2

Compliance Status Key for Table 2 – Non-Compliances

Risk Level	Colour Code	Comment
High	Non-compliant	Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence.
Medium	Non-compliant	Non-compliance with: • potential for serious environmental consequences, but is unlikely to occur; or • potential for moderate environmental consequences, but is likely to occur.
Low	Non-compliant	Non-compliance with: • potential for moderate environmental consequences, but is unlikely to occur; or • potential for low environmental consequences, but is likely to occur.
Administrative Non-compliance	Non-compliant	Only to be applied where the non-compliance does not result in any risk of environmental harm (e.g. submitting a report to government later than required under approval conditions).

2 INTRODUCTION

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 Project Approval (08_0149) 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 underground mining longwall layout is shown on Figure 1. The extent of the mine's surface facilities area is shown on Figure 2.

The surface facilities include administration buildings, workshops, bath houses, ablution facilities, haul roads, access roads, fuel and consumables storages, hardstand areas, a coal handling and preparation plant (CHPP), stockpiles (including run-of-mine [ROM] coal, product coal and coal reject stockpiles), underground coal reject emplacement plant and associated coal handling infrastructure (for example conveyors, transfer points and buffer bins).

Coal extracted from the underground mining operations is transferred by conveyor to the surface facilities area. ROM coal is crushed, screened and washed at the CHPP. The majority of product coal is transported by train to the Port Kembla Coal Terminal (in Wollongong) for domestic and overseas customers. CHPP coal reject material is transported by truck to the Glenlee Washery, is emplaced in unused workings, or is used on site for construction purposes. Previously, an amount of coal reject material was transported to the Lend Lease Calderwood Urban Development Project for re-use as fill material.

The Environmental Management Structure of the Project is shown on Figure 3. It includes the Metropolitan Coal Environmental Management Strategy, developed to provide the strategic context for environmental management at Metropolitan Coal, and management plans and monitoring programs applicable to the underground mining area or mine's surface facilities area. During the review period, Metropolitan Coal commenced the review and revision of the Metropolitan Coal Environmental Management Strategy to be consistent with the Longwalls 301-303 Extraction Plan.

In accordance with the mining lease conditions, Metropolitan Coal has also prepared the *Metropolitan Coal Mining Operations Plan, 2012 – 2019* (herein referred to as the Metropolitan Coal MOP).

2.1 PURPOSE AND SCOPE

Metropolitan Coal's environmental reporting requirements include an Annual Review, which is to be prepared in accordance with Condition 3, Schedule 7 of the Project Approval, an Annual Environmental Management Report (AEMR), to be prepared in accordance with CCL 703, and an Annual Rehabilitation Report, to be prepared in accordance with ML 1610, ML 1702, MPL 320 and CL 379.

The Metropolitan Coal 2017 Annual Review has been prepared to meet the above reporting requirements and to review the environmental performance of the Project during the review period (i.e. 1 January to 31 December 2017), consistent with the NSW Government (2015) *Annual Review Guideline for State Significant Mining Developments*.

2.2 MINE CONTACTS

Contact details for key Metropolitan Coal employees are provided below:

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3 APPROVALS

Metropolitan Coal operates under a number of statutory approvals, leases and licences granted by the NSW Government as outlined in Table 3.

Table 3
Consent, Lease and Licence Details

Consent/Lease/Licence	Authority	Grant/Renewal	Expiry Date
Project Approval 08_0149	DP&E	22/6/2009	22/6/2032
Project Approval 08_0149 – Mod 1	DP&E	8/9/2010	22/6/2032
Project Approval 08_0149 – Mod 2	DP&E	2/7/2011	22/6/2032
Project Approval 08_0149 – Mod 3	DP&E	3/10/2013	22/6/2032
Development Consent D90/832	WCC	5/1/1995	-
Consolidated Coal Lease 703	DRG	1/4/2004	26/1/2024
Mining Lease 1610	DRG	7/5/2014	26/9/2031
Coal Lease 379	DRG	14/11/2013*	4/10/2033
Mining Purpose Lease 320	DRG	16/6/2014	9/12/2035
Mining Lease 1702	DRG	13/10/2014	13/10/2035
Bore Licence Certificate 10BL603595	DI-Water	25/1/2013	24/1/2028
Camp Creek Weir Surface Water Certificate of Title	DI-Water	28/11/2012	-
Environment Protection Licence (EPL) No. 767	EPA	9/9/2002	-
Radiation Licence – Radiation Management Licence 5063985	EPA	27/8/2016	27/9/2018
Licence to store explosives and/or security sensitive dangerous substances – Licence XSTR200082	SafeWork NSW	15/06/2017	15/06/2022

Note: DI-Water = Department of Industry – Water; DP&E = NSW Department of Planning and Environment; DRG = NSW Division of Resources and Geoscience; EPA = NSW Environment Protection Authority; WCC = Wollongong City Council.

* Date lease offer was signed.

4 OPERATIONS SUMMARY

4.1 MINING OPERATIONS

During the review period, the extraction of Longwall 27 was completed in March 2017 (Figure 4).

Metropolitan Coal submitted the Longwalls 301-303 Extraction Plan to the Department of Planning and Environment (DP&E) in November 2016. On the 11 May 2017, the DP&E granted approval for Longwalls 301 and 302 with conditions. Prior to the commencement of Longwall 301, Metropolitan Coal obtained approval to reduce the length of Longwall 301 by 90 m at the commencing (i.e. northern) end of Longwall 301. Longwall 301 was shortened due to the unexpected thinning of the seam and the carbon dioxide content in the coal (which posed safety challenges in order to drain below mining thresholds). The approved longwall layout is shown on Figure 4. The extraction of Longwall 301 commenced on 28 June 2017 and continued for the remainder of the review period (Figure 4).

The amount of waste rock/overburden, ROM coal, coal reject and product coal produced in the previous review period, current review period and forecast for the next reporting period is provided in Table 4.

Table 4
Production Summary

Material	Approved Limit	2016 Reporting Period (Actual)	2017 Reporting Period (Actual)	2018 Reporting Period (Forecast)
Waste Rock/Overburden	N/A	N/A	N/A	N/A
ROM Coal	3.2 Mt per calendar year[1]	2,237,138 t	1,370,574 t	2,086,446 t
Coal Reject	N/A	519,997 t	327,369 t[3]	385,064 t
Saleable Product[2]	[2.8 Mt per calendar year[1]]	1,716,110 t	1,063,269 t	1,709,424 t

N/A = not applicable; Mt = million tonnes; t = tonnes.

[1] Condition 6, Schedule 2 of the Project Approval states:

The Proponent shall not:

(a) extract more than 3.2 million tonnes of ROM coal from the mining area in a calendar year, or

(b) transport more than 2.8 million tonnes of product coal from the site in a calendar year.

[2] Note, there is no Approval limit for saleable product itself. The only Approval limit relating to saleable product is the amount of product coal transported from the site in a calendar year. Note that the quantities presented in Table 4 reflect the saleable product produced by Metropolitan Coal and are therefore not consistent with the quantities dispatched from site that are reported on the Peabody website in the Truck and Rail Register.

[3] Of the 327,369 t of coal reject produced, 272,369 t was transported to the Glenlee Washery for disposal, and approximately 55,000 t was emplaced underground.

4.2 OTHER OPERATIONS – METROPOLITAN COAL SURFACE FACILITIES AREA

In addition to the production approval limits detailed in Table 4, other relevant operational conditions are described in Table 5 and primarily relate to the Metropolitan Coal surface facilities area.

During the review period, Metropolitan Coal continued the coal reject backfill emplacement project and the activities are described in Section 7.4. Metropolitan Coal also continued its consultation with the Wollongong City Council regarding the potential for coal rejects to be beneficially re-used at the Helensburgh Landfill.

Table 5
Other Relevant Operational Conditions

Operational Condition		Operational Condition Met?	Comment
Limits on Approval (Project Approval Conditions 5 and 7, Schedule 2)	5. *The Proponent may undertake mining operations in the mining area for up to 23 years from the date of this approval.* *Note: Under this approval, the Proponent is required to rehabilitate the site and perform additional undertakings to the satisfaction of the Director-General. Consequently, this approval will continue to apply in all other respects other than the right to conduct mining operations until the site has been properly rehabilitated.*	Yes	Metropolitan Coal was granted approval for the Project in June 2009.
	7. *The Proponent shall not export any coal reject from the site after 2021 without the written approval of the Director-General.*	Yes	-
	8. *The Proponent shall not emplace coal reject on the surface of the site without the written approval of the Director-General.* *Note: This condition applies to the Camp Gully Emplacement Area, as well as to the rest of the surface of the site. It does not apply to the proposed additional coal reject stockpile shown in Appendix 4.*	Yes	Metropolitan Coal has DP&E approval to emplace coal reject on the site when used for construction purposes (e.g. as engineered fill material). No construction activities requiring fill were undertaken and no coal reject was emplaced on the surface of the site during the review period.
Structural Adequacy (Project Approval Condition 9, Schedule 2)	9. *The Proponent shall ensure that all new buildings and structures, and any alterations or additions to existing buildings and structure, are constructed in accordance with:* *(a) the relevant requirements of the BCA; and* *(b) any additional requirements of the MSB in areas where subsidence effects are likely to occur.* *Notes:* • *Under Part 4A of the EP&A Act, the Proponent is required to obtain construction and occupation certificates for the proposed building works.* • *Part 8 of the EP&A Regulation sets out the requirements for the certification of the project.*	Yes	Metropolitan Coal did not undertake any building construction activities during the review period.
Demolition (Project Approval Condition 10, Schedule 2)	10. *The Proponent shall ensure that all demolition work is carried out in accordance with Australian Standard AS 2601-2001: The Demolition of Structures, or its latest version.*	Yes	Metropolitan Coal did not undertake any demolition activities during the review period.
Operation of Plant and Equipment (Project Approval Condition 11, Schedule 2)	11. *The Proponent shall ensure that all plant and equipment used at the site is:* *(a) maintained in a proper and efficient condition; and* *(b) operated in a proper and efficient manner.*	Yes	All plant and equipment in use at Metropolitan Coal is regularly serviced in accordance with the relevant Industry & Investment NSW *Mining Design Guidelines* to ensure plant and equipment is maintained in proper and efficient condition. All plant and equipment are operated in a proper and efficient manner.
Rail Noise (Project Approval Condition 4, Schedule 4)	4. *The Proponent shall only use locomotives that are approved to operate on the NSW rail network in accordance with noise limits L6.1 to L6.4 in RailCorp's EPL (No. 12208) and ARTC's EPL (No. 3142) or a Pollution Control Approval issued under the former Pollution Control Act 1970.*	Yes	All locomotives used by Metropolitan Coal are approved to operate on the NSW rail network in accordance with the relevant noise limits.

Table 5 (Continued)
Other Relevant Operational Conditions

Operational Condition		Operational Condition Met?	Comment
Blasting (Project Approval Condition 7, Schedule 4)	7. *The Proponent shall not undertake blasting operations at the surface facilities area without the written approval of the Director-General.*	Yes	No blasting activities were carried out at the surface facilities area during the review period. Minor blasting underground is necessary at times when geological structures are encountered that cannot be excavated by the continuous miner or the longwall mining machine and when a section of the longwall roof falls ahead of the hydraulic supports of the longwall mining machine.

4.3 OPERATIONAL ACTIVITIES ANTICIPATED IN THE NEXT REPORTING PERIOD

In the next reporting period, Longwall 301 will be completed in February 2018 and Longwall 302 will commence in March 2018 (Figure 5).

Metropolitan Coal will seek approval to reduce the length of Longwall 302 (by 90 m) and Longwall 303 (by 90 m) to that shown on Figure 5 (also as a result of thinning of the seam at the northern commencing ends).

The amount of waste rock/overburden, ROM coal, coal reject and product coal forecast for the next reporting period is provided in Table 4.

5 ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

Following the submission of the Metropolitan Coal 2016 Annual Review in April 2017, the DP&E (Compliance Southern Region) requested the Metropolitan Coal 2016 Annual Review be revised to provide additional information. The revised Metropolitan Coal 2016 Annual Review was resubmitted to the DP&E and Division of Resources and Energy (now Division of Resources and Geoscience [DRG]) and provided to other relevant agencies in July 2017.

Table 6 details the additional information that the DP&E (Compliance Southern Region) and WaterNSW (4 October 2017) requested be provided in the next Annual Review. Table 6 also details where each aspect is addressed in this report.

Table 6
Actions Arising from the 2016 Annual Review

Action Required	Action Taken	2017 Annual Review Report Section
DP&E REQUEST		
DP&E Compliance requested the 2016 Annual Review be updated to include a comprehensive review of the noise monitoring results of the project over the past calendar year, including a comparison of the results against the noise monitoring results of previous years.	Metropolitan Coal revised the 2016 Annual Review (April 2017) to address DP&E Compliance's request (re-submitted in July 2017).	Section 7.1
DP&E Compliance requested the 2016 Annual Review be updated to include the identification of any trends in the noise monitoring data over the life of the project.	Metropolitan Coal revised the 2016 Annual Review (April 2017) to address DP&E Compliance's request (re-submitted in July 2017).	Section 7.1
DP&E Compliance requested the 2016 Annual Review be updated to include a status update on any outstanding action proposed to address any outstanding recommendations made in the 2015 Independent Environmental Audit Report.	Metropolitan Coal revised the 2016 Annual Review (April 2017) to address DP&E Compliance's request (re-submitted in July 2017).	Section 12
WATERNSW REQUEST		
Subsidence		
WaterNSW requested further clarification or survey accuracy limits and error estimates be provided in relation to subsidence monitoring.	Metropolitan Coal has improved the definition of accuracy limits to better reflect the varying topographical conditions, and has reviewed field surveying practices to improve the consistency of the monitoring data.	Section 6.1
WaterNSW requested clarification of the 15% tolerance limit and rationale for not including cross-line subsidence data in this assessment.	The Annual Review clarifies that the comparison of conventional subsidence effects excludes the valley cross lines which represent non-conventional subsidence movements.	Section 6.1
Surface Water		
WaterNSW requested reporting clarify where and when remediation of pools has been undertaken.	Clarification of stream remediation timing is provided.	Section 10.3.2

6 ENVIRONMENTAL PERFORMANCE – UNDERGROUND MINING AREA AND SURROUNDS

Section 6 provides a summary of the key environmental monitoring results for subsidence, surface water, groundwater, biodiversity, land, heritage, built features and public safety in the underground mining area, an assessment of environmental performance and a description of the management measures implemented during the review period.

Each section indicates the relevant management plan or monitoring program where details of the underground mining management and monitoring are available. The Metropolitan Coal management plans/monitoring programs are available on the Peabody website (http://www.peabodyenergy.com).

As described in Section 4, Longwall 27 was completed in March 2017 and Longwall 301 commenced on 28 June 2017. The Longwalls 301-303 Extraction Plan includes post-mining monitoring and management of potential subsidence impacts and environmental consequences, subject to the two previously approved Metropolitan Coal Extraction Plans for Longwalls 20-22 and Longwalls 23-27.

Section 6.8 summarises the assessments against the subsidence impact performance indicators and measures for the period January to June 2017 in accordance with the Longwalls 20-22 and Longwalls 23-27 management plans (Table 14) and for the period July to December 2017 in accordance with the Longwalls 301-303 management plans (Table 15).

6.1 SUBSIDENCE MONITORING

The Metropolitan Coal Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 Subsidence Monitoring Programs were prepared to validate subsidence predictions and analyse the relationship between the subsidence effects and subsidence impacts of the Metropolitan Coal Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 Extraction Plans in accordance with Condition 6(e), Schedule 3 of the Project Approval.

Subsidence movements are surveyed in three dimensions using a total station survey instrument. The subsidence parameter monitoring locations for Longwalls 23-27 and/or Longwalls 301-303 are shown on Figure 6.

During the review period, Metropolitan Coal installed additional ridge top monitoring stations over the 300 series longwalls to provide additional subsidence and valley closure monitoring data, including data relevant to Longwalls 301-303. Metropolitan Coal also established additional cross lines on the Eastern Tributary (at ETAT and ETAU) to monitor subsidence movements (valley closure).

Metropolitan Coal also conducted a LiDAR baseline survey of Longwalls 301-303. In the next reporting period Metropolitan Coal will trial the effectiveness of the LiDAR survey as a subsidence survey technique compared to traditional subsidence survey techniques following the extraction of Longwall 301.

A review of the subsidence survey results and comparison between the predicted and observed subsidence movements for the review period has been conducted by Mine Subsidence Engineering Consultants (MSEC). The report prepared by MSEC is provided in Appendix A of this 2017 Annual Review. A summary of the key findings is provided below.

6.1.1 Predicted and Observed Subsidence Movements

The review period included the completion of Longwall 27 and part extraction of Longwall 301. Details of the observed and predicted subsidence movements at the subsidence monitoring locations (D Line, Line 9G, Transmission Line, Transmission Towers, Freeway Line, Ridge Top Survey Stations, Waratah Rivulet Cross Lines, Eastern Tributary Cross Line, M1 North Bound Line and Optic Water Line, Figure 6) are provided in Appendix A.

Consistent with prior reporting, the maximum observed total subsidence along Line 9G was slightly greater than predicted above the previously extracted Longwalls 20 and 21. A review conducted following the completion of Longwall 24 indicated that the increased subsidence and steep subsidence profile may be the result of the localised geological conditions (a zone of small scale fracturing and increased jointing were identified from geological records) and pillar consolidation of the abandoned mains (B West Mains) from prior longwalls between Longwall 20 and Longwalls 1 to 18 due to increasing abutment load with successive longwalls.

The observed profile shapes and conventional subsidence parameters at other subsidence monitoring locations were generally less than predicted or within the limits of survey accuracy.

Condition 3, Schedule 3 of the Project Approval states:

> *3. If the subsidence effects and subsidence impacts of the project exceed the relevant predictions by more than 15% at any time after mining has progressed beyond the halfway mark of Longwall 21, or if the profile of vertical displacement does not reflect predictions, then the Proponent shall use appropriate numerical modelling to supplement the subsequent predictions of subsidence effects and subsidence impacts for the project to the satisfaction of the Director-General.*

A comparison of the maximum observed and maximum predicted total conventional subsidence for the Project after each longwall for Longwalls 3 to 27 is shown on Chart 1. The comparison of conventional subsidence effects excludes the valley cross lines which represent non-conventional subsidence movements.

Based on the results of survey data to date and comparison with predicted conventional subsidence parameters, the profile of vertical displacement adequately reflects the predictions and subsidence effects of the Project do not exceed predictions by more than 15%.

Some observed subsidence parameters, while small in magnitude, are greater than the quoted survey accuracy limits and have been attributed to survey accuracy in the MSEC report. Following analysis of the subsidence monitoring data for the period 1 January to 30 June 2017, Metropolitan Coal improved the definition of accuracy limits to better reflect the varying topographical conditions and undertook a review of surveying practices to improve consistency of monitoring data. This review considered the following:

- Review of accuracy limits. The standard limits of quoted survey accuracy may be difficult to achieve in some situations where, for example, surveys are conducted in the base of valleys as steep valley sides limit the number of satellites available for accurate positioning. Space limitations created by vegetation or surface features may also prevent suitable triangulation and base line length available for accurate surveys. Stated limits of survey accuracy have been revised for locations where such features are present and will be included in future survey data reports.

- Standardised field survey procedures have been improved to establish increased consistency of field surveys. Such procedures include specified minimum set times for establishing satellite data for field surveys, denoted by physical location, and prequalifying contractor survey equipment to ensure the use of the same satellite systems (i.e. both GPS and GNSS reception capabilities as a minimum) for all field surveys.
- Recognition that GPS survey variability limitations can affect baseline surveys. Increased base survey requirement from a single survey to up to three (3) surveys prior to mining to improve the reliability of the baseline data set. The intent is to level out satellite variability on the baseline data set and improve comparisons to post mining data sets.

Comparison between the maximum observed and maximum predicted total subsidence for Longwalls 3 to 27 at Metropolitan Colliery

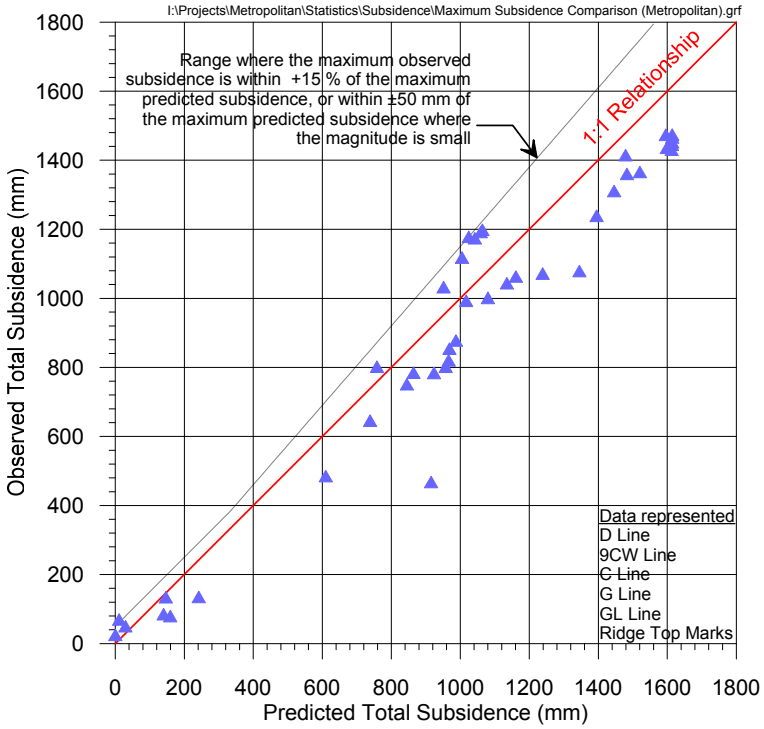


Chart 1 Comparison between the Maximum Observed and Maximum Predicted Total Conventional Subsidence for Longwalls 3 to 27 at Metropolitan Colliery

6.1.2 Subsidence Movements at the Waratah Rivulet Gauging Station

The Waratah Rivulet gauging station, owned by WaterNSW, is located at Pool Q. The primary purpose of the gauging station is the monitoring of stream flows. WaterNSW's use of the stream flow monitoring data includes the assessment of Woronora Reservoir environmental flow release requirements. Metropolitan Coal sources the stream flow monitoring data from WaterNSW to assess potential mining-related impacts on Waratah Rivulet stream flows.

Metropolitan Coal has monitored and assessed subsidence in the vicinity of the Pool Q gauging station in accordance with the Metropolitan Coal Longwalls 23-27 and Longwalls 301-303 Subsidence Monitoring Programs. The Waratah Rivulet Gauging Station Contingency Plan indicates that in the event the differential survey data indicates that vertical and horizontal movements exceed ±15 millimetres (mm) Metropolitan Coal will assess the extent of the movement and whether the movement has the potential to alter the stream flow rating curve. Differential vertical movements at the Q, QA and QB subsidence monitoring lines were less than 15 mm (Appendix A).

6.1.3 Southern Sydney Sheltered Forest on Transitional Sandstone Soils in the Sydney Basin Bioregion Endangered Ecological Community

In accordance with the Metropolitan Coal Longwalls 23-27 and Longwalls 301-303 Biodiversity Management Plans, an assessment has been conducted of the subsidence effects at the occurrences of the Southern Sydney Sheltered Forest on Transitional Sandstone Soils in the Sydney Basin Bioregion Endangered Ecological Community situated approximately 300 m to 500 m to the east of Longwalls 23-27 and over 375 m to the north of Longwall 301.

The assessment of subsidence effects included assessment of the Freeway Line, M1 North Bound Line, Transmission Line and Transmission Tower which are located between the Endangered Ecological Community and the extracted longwalls, detailed in Appendix A. The results of the assessment indicate that the subsidence parameters to the east of Longwalls 23-27 and to the north of Longwall 301 were generally less than predicted or within limits of accuracy of the predicted subsidence parameters for the review period.

6.2 WATER MANAGEMENT

The Metropolitan Coal Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 Water Management Plans were prepared to manage the potential environmental consequences of the Metropolitan Coal Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 Extraction Plans on watercourses (including the Woronora Reservoir), aquifers and catchment yield in accordance with Condition 6, Schedule 3 of the Project Approval.

The Longwalls 301-303 Water Management Plan includes post-mining monitoring and management of potential subsidence impacts and environmental consequences associated with Longwalls 20-22 and Longwalls 23-27. During the review period, the Longwalls 301-303 Water Management Plan Trigger Action Response Plan was reviewed and revised.

Hydro Engineering & Consulting (2018a, 2018b) and HydroSimulations (2018a, 2018b) have reviewed the environmental performance of the Project in relation to surface water and groundwater in the underground mining area and surrounds for the Annual Review period. This includes the assessment of surface water and groundwater for the January to June 2017 period in accordance with the Longwalls 20-22 and Longwalls 23-27 Water Management Plans (Appendices B1 and C1) and the assessment of surface water and groundwater for the July to December 2017 period in accordance with the Longwalls 301-303 Water Management Plan (Appendices B2 and C2).

The surface water, groundwater and meteorological monitoring locations are shown on Figures 7 to 12.

Sections 6.2.1 to 6.2.11 provide a summary of the surface water and groundwater assessments for the review period. Section 6.2.12 provides a summary of the Woronora Reservoir Impact Strategy, conducted in accordance with Condition 2 of the Longwalls 301 and 302 approval.

Section 6.8 provides a summary of the assessments against the water resource and watercourse subsidence impact performance indicators and measures for the January to June 2017 period in Table 14 and for the July to December 2017 period in Table 15.

During the review period, Metropolitan Coal commenced the review and revision of the Metropolitan Coal Catchment Monitoring Program to be consistent with the Longwalls 301-303 Extraction Plan.

6.2.1 Stream Features

Visual and photographic surveys are conducted monthly when Longwalls 20-27 are within 400 m of the Waratah Rivulet and Eastern Tributary, and within three months of the completion of each longwall. Visual and photographic surveys of Tributary A and Tributary B have also been conducted within three months of the completion of each longwall for Longwalls 20-27.

The visual and photographic surveys conducted at the end of each longwall provide a detailed photographic record of stream features. During the review period, a detailed photographic record of stream features was conducted at the end of Longwall 27. The visual and photographic surveys have recorded observations of mining impacts including surface cracking, iron staining, gas releases and water discoloration/opacity. A summary of the observations for the review period is provided for the Waratah Rivulet (Tables 7 and 8), Eastern Tributary (Tables 9 and 10), Tributary A (Table 11) and Tributary B (Table 12). The location of mapped pools on the Waratah Rivulet, Eastern Tributary, Tributary A and Tributary B are provided in Appendix D.

During the review period, weekly inspections have been undertaken where gas releases occur, and monthly inspections have been undertaken of the Eastern Tributary downstream of the Longwall 26 maingate to document surface cracking and iron staining. The results of these inspections are also included in Tables 7 to10.

The visual and photographic surveys also noted continued scouring along streams with alluvial deposits, as a result of high water flows following heavy rainfall events.

Visual inspections and photographic surveys of the Waratah Rivulet (from Pool P to the full supply level of the Woronora Reservoir) and Eastern Tributary (from the Woronora Reservoir full supply level to the Longwall 26 maingate) will be conducted within three months of the completion of Longwall 301 (i.e within the next reporting period). Visual inspection and photographic surveys of the Eastern Tributary from the full supply level of the Woronora Reservoir to the maingate of Longwall 26 will also be conducted monthly when mining is within 400 m of the stream.

Table 7
Monitoring of Stream Features
Waratah Rivulet, Upstream of the Longwall 23 Maingate (upstream of Pool P)

Stream Feature	Summary of Observations
Surface Cracking	Some widening of existing cracking was observed at the downstream end of the rock bar of Pool H on the Waratah Rivulet at the time of the Longwall 27 inspections. No new cracking upstream of the Longwall 23 maingate on the Waratah Rivulet was observed.
Surface Flow/ Pool Water Levels	Compared to the October 2016 inspection (following the completion of Longwall 26), a reduction in surface flow/pool water levels was noted along the Waratah Rivulet during the Longwall 27 visual inspections conducted in January/February 2017 as a result of the prevailing climatic conditions. Water levels in pools on the Waratah Rivulet upstream of Pool P (i.e. in Pools A, B, C, E, F, G, G1, H, I, J, K, L, M, N and O) have either been manually monitored or monitored using a continuous water level sensor and logger (Figure 7 and Appendix D). The monitoring results are discussed in Section 6.2.3 and Appendices B1 and B2 for the review period.
Iron Staining/ Flocculent	At the time of the Longwall 27 inspection iron staining/flocculent continued to be observed at rock bars and/or pools on Waratah Rivulet upstream of the Longwall 23 maingate consistent with prior reporting.
Gas Releases	Gas releases continued to be observed and monitored in Pool L throughout the review period (January to May 2017; July 2017; September to December 2017). Gas releases were also observed in Pool A (February to July 2017; September to October 2017). No environmental effects resulting from the gas releases (such as riparian vegetation dieback or dead fish) have been observed.
Water Discoloration/ Opacity	Orange in colour where iron staining occurred. Pools along the Waratah Rivulet continue to be observed with a green opacity.

Table 8
Monitoring of Stream Features
Waratah Rivulet, Downstream of Longwall 23 Maingate

Stream Feature	Summary of Observations
Surface Cracking	No surface cracking was observed downstream of the Longwall 23 maingate on the Waratah Rivulet during the Longwall 27 inspections.
Surface Flow/ Pool Water Levels	Compared to the October 2016 inspection (following the completion of Longwall 26), a reduction in surface flow/pool water levels was noted along the Waratah Rivulet during the Longwall 27 visual inspections in January/February 2017 as a result of the prevailing climatic conditions. Water levels in pools on the Waratah Rivulet from Pool P to the full supply level of the Woronora Reservoir (i.e. in Pools P, Q, R, S, T, U, V and W) have been monitored using a continuous water level sensor and logger (Figure 7 and Appendix D). The monitoring results are discussed in Section 6.2.3 and Appendices B1 and B2 for the review period.
Iron Staining/ Flocculent	No change in iron staining was observed between Pools P to W on the Waratah Rivulet as a result of mining during the review period. Natural seeps and associated iron staining (as recorded by baseline mapping) continues to be recorded within this reach. Iron staining has also been recorded in Tributary B, near the confluence with the Waratah Rivulet at the upstream end of Pool P.
Gas Releases	Gas releases continued to be observed and monitored in Pool P and in Pool U from January to December 2017 on the Waratah Rivulet. Gas releases were observed for the first time in Pool S in December 2017. No environmental effects resulting from the gas releases (such as riparian vegetation dieback or dead fish) have been observed. Gas releases in Pool U in the period January to June 2017 triggered an assessment against the performance measure for the Waratah Rivulet between the full supply level of the Woronora Reservoir and the maingate of Longwall 23 (emphasis added): *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**) (refer Table 14).* The assessment was conducted by Associate Professor Barry Noller and concluded the performance measure in relation to gas releases had been met (The University of Queensland, 2017). The assessment is provided in Appendix E1.
Gas Releases (continued)	The performance measure assessment by Associate Professor Barry Noller was subject to peer review in accordance with the Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Water Management Plans. The peer review conducted by Dr Ross Sadler (Griffith University, 2017) is provided in Appendix E2. The peer review also concluded the Waratah Rivulet gas release performance measure had been met. Gas releases in Pool P and Pool U in the period July to December 2017 also triggered an assessment against the performance measure for the Waratah Rivulet between the full supply level of the Woronora Reservoir and the maingate of Longwall 23 in accordance with the Metropolitan Coal Longwalls 301-303 Water Management Plan (Table 15). The assessment conducted by Associate Professor Barry Noller concluded the performance measure in relation to gas releases had been met (The University of Queensland, 2018). The assessment is provided in Appendix E3.
Water Discoloration/ Opacity	Pools along the Waratah Rivulet continue to be observed with a green opacity.

Table 9
Monitoring of Stream Features
Eastern Tributary, Upstream of Longwall 26 Maingate

Stream Feature	Summary of Observations
Surface Cracking	New cracking was observed upstream of the Longwall 26 maingate on the Eastern Tributary at Rock bar ETY and the previously recorded cracking at Boulderfield ETX and Rock bar ETZ was observed to have increased at the time of the Longwall 27 visual inspection (location of stream features shown in Appendix D).
Surface Flow/ Pool Water Levels	From January to February 2017, Pools ETG to ETZ were observed to be dry or without surface flow. At the time of the March/April 2017 Longwall 27 visual inspections, all pools upstream of the Longwall 26 maingate on the Eastern Tributary contained water and surface flow (i.e. no pools were dry). Water levels in a number of pools on the Eastern Tributary upstream of the Longwall 26 maingate (i.e. in Pools ETG, ETJ, ETM, ETU, ETW and ETAF) have been monitored using a continuous water level sensor and logger (Figure 7). The monitoring results are discussed in Section 6.2.3 and in Appendices B1 and B2 for the review period.
Iron Staining/ Flocculent	Iron staining/flocculent continues to be observed at rock bars and/or pools on the Eastern Tributary upstream of the Longwall 26 maingate consistent with prior reporting. The extent of iron staining/flocculent was reduced at a number of pools at the time of the Longwall 27 visual inspections as a result of recent rain.

Table 9 (Continued)
Monitoring of Stream Features
Eastern Tributary, Upstream of Longwall 26 Maingate

Stream Feature	Summary of Observations
Gas Releases	No gas releases were observed on the Eastern Tributary upstream of the Longwall 26 maingate during the review period.
Water Discoloration/ Opacity	Pools along the Eastern Tributary observed with a green opacity, and orange in colour where iron staining occurred. The water coloration of a number of pools was observed to be clearer in March/April 2017 at the time of the visual inspections for Longwall 27.

Table 10
Monitoring of Stream Features
Eastern Tributary, Downstream of Longwall 26 Maingate

Stream Feature	Summary of Observations
Surface Cracking	Monthly inspections undertaken since January 2017 have identified new and increased cracking at a number of stream features. As at 28 June 2017, cracking had been recorded at Rock bar ETAF(2), Pool ETAG, Pool ETAH, Rock bar ETAH, Pool ETAI, Rock bar ETAI, Pool ETAJ, Pool ETAK, Rock bar ETAK, Pool ETAL, Boulderfield ETAL, Rock bar ETAL, Pool ETAM, Boulderfield ETAM, Pool ETAN, Rock bar ETAN, Pool ETAO, Rock bar ETAO, Pool ETAP, Rock bar ETAP, Pool ETAQ. Rock bar ETAQ, Pool ETAR and Rock bar ETAU. From March 2017 to June 2017, increased water levels in a number of pools resulted in the majority of previously recorded cracks being submerged and unable to be observed. From July to December 2017, no changes in cracking were observed at some sites, while at others new cracking was recorded (primarily in the period July to September when pool levels dropped), or existing cracking was observed to have widened and/or lengthened. No cracking has been recorded at Pool ETAS or Pool ETAT to date. The existing crack at ETAU was observed to have widened in July 2017.
Surface Flow/ Pool Water Levels	The pools on the Eastern Tributary downstream of the Longwall 26 maingate have been visually inspected by Metropolitan Coal to observe whether any changes to the natural drainage behaviour of the pools has occurred. As at December 2016, changes in the natural drainage behaviour of pools had been observed at Pools ETAH, ETAI, ETAJ, ETAK, ETAL, ETAM, ETAN and ETAR (location of pools shown in Appendix D). [The Longwalls 23-27 Water Management Plan indicated that the valley closure subsidence predictions would likely result in the cracking and dilation of bedrock resulting in the localised diversion of flow at Pools ETAH, ETAI, ETAJ, ETAK, ETAL.] In January 2017, the natural drainage behaviour of additional pools on the Eastern Tributary was observed to be impacted by mine subsidence. The observed impacts to the Eastern Tributary pools resulted in the exceedance of the negligible environmental consequences performance measure for the Eastern Tributary in relation to diversion of flows and drainage behaviour (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).* The exceedance of this component of the Eastern Tributary performance measure was reported to the DP&E and other relevant agencies on 3 February 2017. A summary of the Eastern Tributary Incident was provided in the Metropolitan Coal 2016 Annual Review. Metropolitan Coal's actions in relation to the Eastern Tributary Incident are described in Section 13.1. No additional pools to those identified previously as being impacted (in terms of drainage behaviour) have been observed to be impacted by mine subsidence. Water levels in a number of pools on the Eastern Tributary downstream of the Longwall 26 maingate (i.e. in Pools ETAG, ETAH, ETAI, ETAQ and ETAU) have been monitored using a continuous water level sensor and logger (Figure 7 and Appendix D). The monitoring results are discussed in Section 6.2.3 and in Appendices B1 and B2.
Iron Staining/ Flocculent	On 14 October 2016, Metropolitan Coal reported the exceedance of the Eastern Tributary performance measure in relation to iron staining to the DP&E and other relevant agencies (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).* A summary of the Eastern Tributary Incident was provided in the Metropolitan Coal 2016 Annual Review. Metropolitan Coal's actions in relation to the Eastern Tributary Incident are described in Section 13.1. Since October 2016, inspections have been conducted monthly to record the extent of iron staining. A period of high rainfall in March 2017 resulted in a reduction in the previously recorded extent of iron staining in the Eastern Tributary. As at 28 June 2017, iron staining/flocculent remained present at a number of stream features between the maingate of Longwall 26 and the full supply level of the Woronora Reservoir, including; Boulderfield ETAF, Rock bar ETAF(2), Pool ETAG, Boulderfield ETAG, Rock bar ETAH, Pool ETAK, Boulderfield ETAL, Rock bar ETAL, Boulderfield ETAM, Boulderfield ETAP, Rock bar ETAP, Rock bar ETAQ, Pool ETAR, Boulderfield ETAR and Rock bar ETAU. From July to December 2017, iron staining was generally not visible from Boulderfield ETAF to Rock bar ETAP as a result of the limited amount or absence of water in the pools. Iron staining was evident in the reach from Pool ETAQ to Boulderfield ETAU.

Table 10 (Continued)
Monitoring of Stream Features
Eastern Tributary, Downstream of Longwall 26 Maingate

Stream Feature	Summary of Observations
Gas Releases	Gas releases were observed in Pool ETAG on 15 February 2017 and in Pool ETAI on 1 March 2017 (location of pools shown in Appendix D). No gas releases were observed on the Eastern Tributary for the remainder of the review period. The gas releases were predominantly comprised of methane. No environmental effects resulting from the gas releases (such as riparian vegetation dieback or dead fish) have been observed. The Longwalls 20-22 and Longwalls 23-27 Water Management Plans performance indicator for the Eastern Tributary, *Gas releases observed over less than 30% of the Eastern Tributary between the full supply level of the Woronora Reservoir and Pool ETAF,* was not exceeded, however consideration of the gas releases at Pools ETAG and ETAI was made in the assessment conducted for Pool U by Associate Professor Barry Noller (The University of Queensland, 2017) in accordance with the Longwalls 20-22 and Longwalls 23-27 Water Management Plans (refer to Appendices E1 and E2).
Water Discoloration/ Opacity	Orange in colour where iron staining occurred. Pools along the Eastern Tributary observed with a green opacity.

Table 11
Monitoring of Stream Features – Tributary A

Stream Feature	Summary of Observations
Surface Cracking	No new cracking on Tributary A was recorded by the Longwall 27 visual inspections.
Surface Flow/ Pool Water Levels	An increase in surface flow/pool water levels was observed along Tributary A by the Longwall 27 visual inspections (May 2017), including at locations noted in the previous inspection (October 2016) to be dry.
Iron Staining/ Flocculent	Iron staining/flocculent continued to be present in sections of Tributary A, in particular, at Pool TA-H, Pool TA-L, Pool TA-M and in the boulderfield downstream of Pool TA-R at the time of the Longwall 27 visual inspections (location of pools shown in Appendix D).
Gas Releases	No gas releases have been observed on Tributary A.
Water Discoloration/ Opacity	Orange in colour where iron staining occurred.

Table 12
Monitoring of Stream Features – Tributary B

Stream Feature	Summary of Observations
Surface Cracking	No new cracking on Tributary B was recorded by the Longwall 27 visual inspections.
Surface Flow/ Pool Water Levels	At the time of the end of Longwall 27 stream mapping inspection, sections of Tributary B were dry with no surface flow; in particular in the reach between Pools TB-I and TB-Z (location of pool reach shown in Appendix D). Some of the visual inspections were conducted in May 2017, subsequent to heavy rainfall in March 2017. Water levels in a number of pools along Tributary B were noted to be higher compared to observations made in October 2016 (end of Longwall 26 visual observations). Water levels in pools on Tributary B (at water level sites RTP1 and RTP2, Figure 7) have been monitored using a continuous water level sensor and logger. The monitoring results are discussed in Section 6.2.3 and in Appendices B1 and B2 for the review period.
Iron Staining/ Flocculent	Iron staining/flocculent continued to be present in a number of pools/rock bars along Tributary B to its confluence with the Waratah Rivulet at the time of the visual inspections.
Gas Releases	No gas releases have been observed on Tributary B.
Water Discoloration/ Opacity	Orange in colour where iron staining occurred. Some pools with green opacity.

The results of the stream inspections are consistent with the potential subsidence impacts described in the Metropolitan Coal Project Environmental Assessment (Project EA) (Helensburgh Coal Pty Ltd [HCPL], 2008), the Preferred Project Report (HCPL, 2009) and Metropolitan Coal Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 Water Management Plans, including cracking and dilation of bedrock which has resulted in the localised diversion of a portion of the surface flow through either:

- **diversion into subterranean flows**, where water travels via new mining induced fractures and opened natural joints in the bedrock into near-surface dilated strata beneath the bedrock, ultimately re-emerging at the surface downstream; or
- **leakage through rock bars**, where the rate of leakage from pools through rock bars to the downstream reaches of the stream is increased by new mining induced fractures.

The Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans indicated that the effects of underflow would be localised to the subsidence affected reaches of streams. Underflow has been observed to result in lower water levels in pools as they become hydraulically connected with the fracture network. During prolonged dry periods when flows recede to low levels, the number of instances where loss of flow continuity between pools occurs increases with a greater proportion of the flow being conveyed entirely in the subsurface fracture network.

The Preferred Project Report and Metropolitan Coal Water Management Plans indicated that valley closure values of greater than 200 mm were predicted at pools/rock bars on the Waratah Rivulet upstream of the maingate of Longwall 23, on the Eastern Tributary, downstream to rock bar ETAL, and on Tributary B. The NSW Planning Assessment Commission's Report for the Metropolitan Coal Project (NSW Planning Assessment Commission, 2009) indicates the Panel considered 'negligible consequence' for a watercourse 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.

Up until December 2016 the monitoring of water levels/drainage behaviour of pools on the Eastern Tributary between the maingate of Longwall 26 and the full supply level of the Woronora Reservoir was consistent with predictions. In the Longwalls 20-22 Extraction Plan Subsidence Assessment it was recognised that fracturing resulting in surface flow diversion could be observed at a site where the predicted total closure is less than 200 mm, although none had been observed to date. The report also noted that reference to the 200 mm predicted total closure value should be viewed as an indication of low probability (10%) of impact rather than certainty. In the Longwalls 23-27 Extraction Plan Subsidence Assessment, additional case studies were added to the pool impact model, including cases where loss of pool water levels had occurred at less than 200 mm predicted total closure. Similar to the previous database for Longwalls 20-22, the updated database showed that based on a maximum predicted total closure of 200 mm, the proportion of pools that experienced loss of pool water levels was around 10%.

In December 2016 and January 2017, a number of pools with predicted closure values of less than 200 mm experienced loss of pool water levels. This resulted in the exceedance of the negligible environmental consequences performance measure for the Eastern Tributary in relation to diversion of flows and drainage behaviour. The impacts are considered to be anomalous in that more than 15% of pools on the Eastern Tributary have experienced loss of pool water levels at predicted closure values of less than 200 mm. However, the combined data that is available to MSEC for the Southern Coalfield (including the Waratah Rivulet and Eastern Tributary results) indicates that less than 10% of all pools have experienced the diversion of flow at predicted closure values of less than 200 mm, consistent with previous assessments of potential pool impacts. On their own, the impacts for the Eastern Tributary are outside of the predictions of the empirical based model.

Metropolitan Coal's actions in relation to the Eastern Tributary Incident are described in Section 13.1. No additional pools downstream of the Longwall 26 maingate to those identified previously as being impacted (in terms of drainage behaviour) have been impacted during the review period.

The key potential subsidence impacts and environmental consequences in relation to bed gradients, scouring and stream alignment described in the Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans included:

- Potential changes in bed gradients could occur, however, were anticipated to be small relative to the existing grades.
- An increased potential for scouring of the stream bed and banks (at locations where the predicted tilts considerably increase the natural pre-mining stream gradients). The potential for scouring is greatest in stream sections with alluvial deposits. Since the streambed of the Waratah Rivulet and the Eastern Tributary is predominantly erosion-resistant Hawkesbury Sandstone, scouring was expected to be very low.
- Subsidence fracturing of bedrock has the potential to cause dislodgement of rock fragments during high flow events.
- The potential for changes to stream alignment as a result of mine subsidence effects was considered to be low.
- Minor stream bank erosion, where changes in channel gradients result in increases in flow energy. It would be expected that bank erosion would be relatively minor and comprise a slow retreat of the bank until a new dynamic equilibrium is reached.

The results of the stream inspections have generally been consistent with these predictions. On the Waratah Rivulet (in a section of the stream over Longwall 21) and Eastern Tributary (in a section of the stream over Longwalls 20 and 21) increased ponding from changes in bed gradients has previously resulted in the prolonged inundation of the adjacent riparian vegetation which has resulted in some vegetation dieback on a local scale as described in Section 6.3.

As described in the Southern Coalfield Panel Report (Department of Planning [DoP], 2008) and the NSW Planning Assessment Commission's Report for the Metropolitan Coal Project (NSW Planning Assessment Commission, 2009), under certain conditions the cracking of stream beds and underlying strata has the potential to result in changes in water quality, particularly ferruginous springs and/or development of iron bacterial mats. Experience at Metropolitan Coal prior to Project Approval indicated that areas of the substratum can be covered by iron flocculent material for several hundred metres downstream of mine subsidence fractures.

Metropolitan Coal has monitored the extent of iron staining through visual and photographic surveys and assessed the extent of iron staining against the subsidence impact performance measures as follows:

- *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).*
- *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) on the Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26.*

Monitoring during the review period indicates the Waratah Rivulet subsidence impact performance measure has been met. Monitoring during the previous review period indicated the iron staining component of the Eastern Tributary subsidence impact performance measure had been exceeded. Metropolitan Coal reported the exceedance of the Eastern Tributary performance measure in relation to iron staining to the DP&E and other relevant agencies in October 2016 (Section 13.1). Metropolitan Coal's actions in relation to the Eastern Tributary Incident are described in Section 13.1.

Prior to approval of the Project in 2009, no gas releases had been observed along the Waratah Rivulet, Eastern Tributary or other tributaries over the Metropolitan Coal lease, either before or during mining. Notwithstanding, the Project EA, Preferred Project Report, and Metropolitan Coal Water Management Plans recognised there was the potential for gas releases to occur.

Assessment of gas releases in Pool U on the Waratah Rivulet for the period January to June 2017 (provided in Appendix E1) indicate the Waratah Rivulet subsidence impact performance measure had been met (The University of Queensland, 2017). The performance measure assessment was subject to peer review in accordance with the Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Water Management Plans. The peer review (provided in Appendix E2) also concluded the Waratah Rivulet subsidence impact performance measure had been met in relation to gas releases (Griffith University, 2017). Assessment of gas releases in Pools P and U on the Waratah Rivulet for the period July to December 2017 in accordance with the Metropolitan Coal Longwalls 301-303 Water Management Plan (provided in Appendix E3) indicate the Waratah Rivulet subsidence impact performance measure has been met (The University of Queensland, 2018).

6.2.2 Surface Water Flow

Waratah Rivulet stream flow data (GS 2132102, Figure 7) is analysed to assess whether a statistically significant reduction in the quantity of water entering Woronora Reservoir in the post-mine period relative to the pre-mine period has occurred, that has not also occurred in the control catchment(s).

The quantity of water entering the Woronora Reservoir is not considered to be significantly different post-mining compared to pre-mining if the median of the ratios (of 14 day sums of monitored flow) for the 'sliding' 1 year period does not fall below the 20th percentile of the baseline data.

The analysis of Waratah Rivulet stream flow data was improved during the review period for the Longwalls 301-303 Water Management Plan by focussing the assessment on low flows. The monitored flows are filtered numerically (in order to remove the effect of high flows) by setting monitored flows that are greater than 1 mm/day to equal modelled flows. Chart 2 indicates that the 12 month sliding median has not fallen below the 20th percentile value.

Surface water flow monitoring at the Waratah Rivulet gauging stations indicate there has been a negligible reduction in the quantity of water resources reaching the Woronora Reservoir (Appendices B1 and B2).

Chart 3 shows the flow monitoring data that is available since gauging station construction on the Eastern Tributary (GS 300078, Figure 7) in September 2012 compared to model predictions. The results for the review period indicates that flow has been continuous at the gauging station and that it has been generally consistent with, or above, model predictions (Chart 3). This indicates that flows reaching the Woronora Reservoir have not been reduced by mining (Appendices B1 and B2).

For the Project EA a comprehensive analysis of stream flow data and data on the yield behaviour of Woronora Reservoir indicated that past mining at Metropolitan Coal had no discernible effect on the inflow to, or yield from, the reservoir. Surface water flow monitoring indicates there has been a negligible reduction in the quantity of water resources reaching the Woronora Reservoir during the review period.

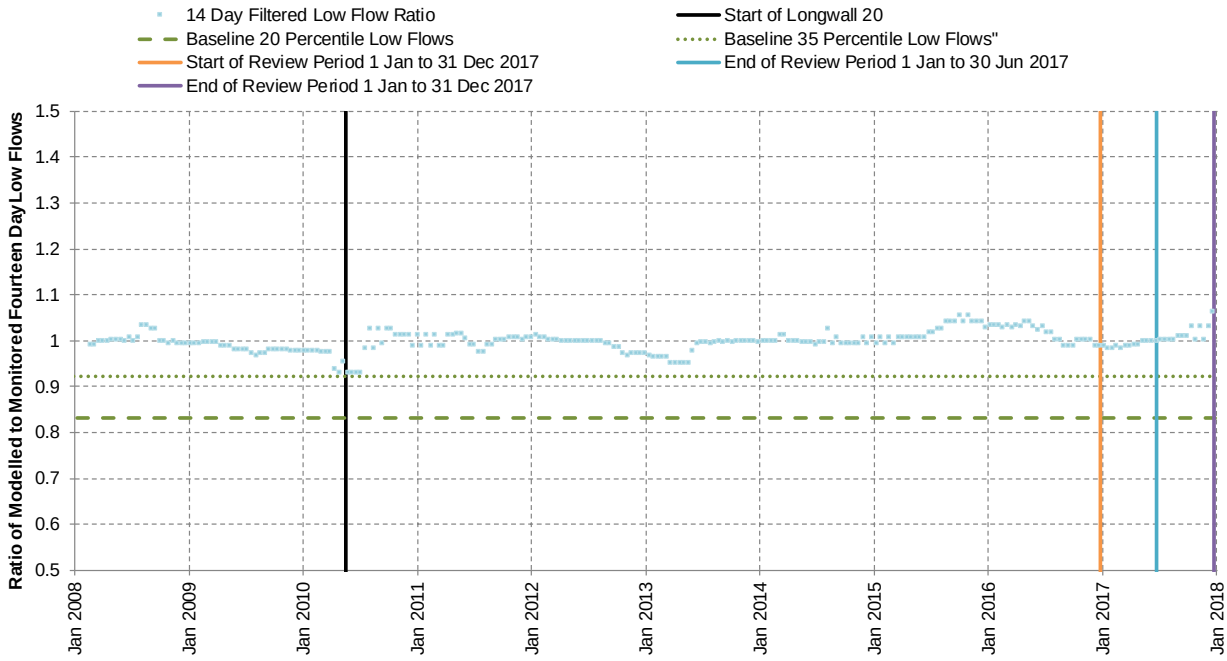


Chart 2 **One Year Sliding Median for the Ratios of the 14 Day Sums of Monitored and Modelled Flow Rates at Waratah Rivulet (GS 2132102)**

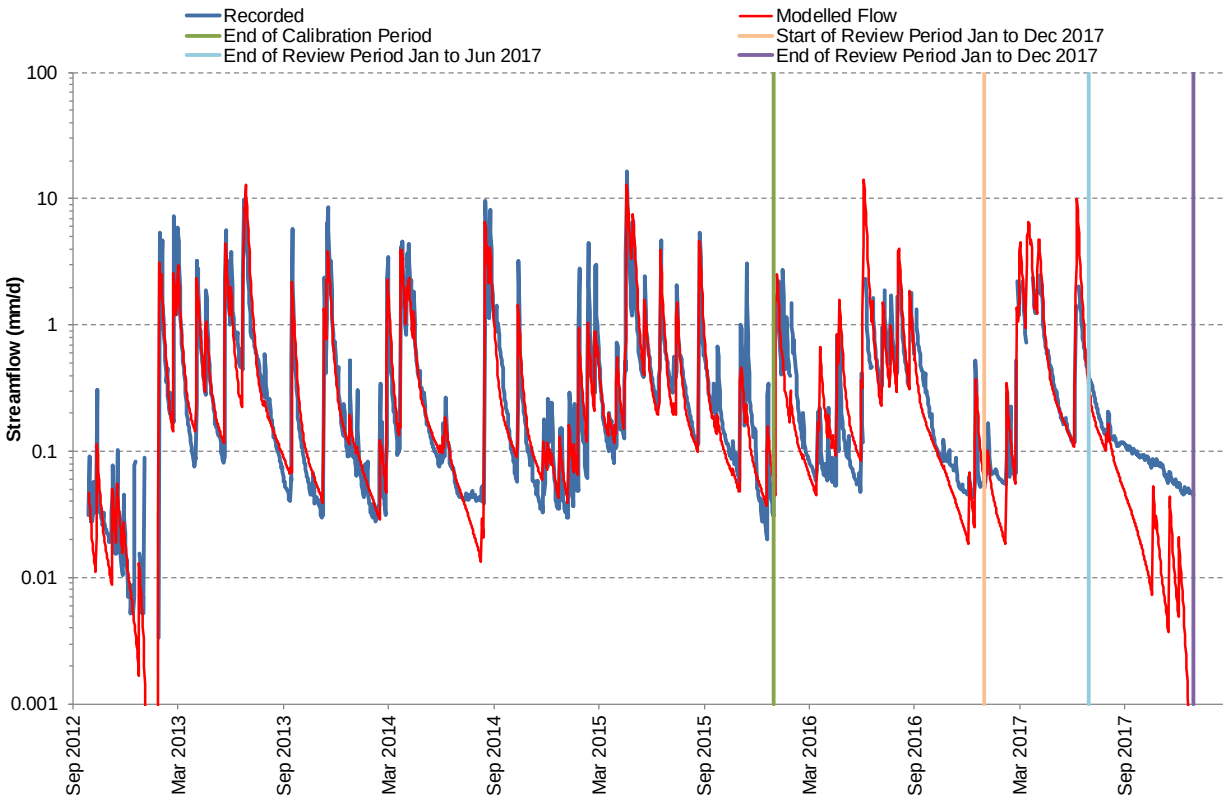


Chart 3 **Monitored and Model Predicted flows – Eastern Tributary Upstream of Woronora Reservoir**

6.2.3 Pool Water Levels

The water level in a number of pools on the Waratah Rivulet, Eastern Tributary, Tributary B and Woronora River (Figure 7) has been either manually monitored on a daily basis[1] or monitored using a continuous water level sensor and logger.

During the review period, all pools on the Waratah Rivulet remained above their cease to flow levels or exhibited natural behaviour (i.e. pools that do not have 'solid' rock-bar controls), with the exception of Pool A, Pool B and Pool N (Appendices B1 and B2).

Water levels in Pool A were predominantly below the pool cease to flow level in January, early February, November and December (Figure 7, Chart 4). Pool A water levels recovered and remained above the cease to flow level from late February 2017 until the end of October 2017 when they fell and remained below the cease-to-flow level for the remainder of the review period (Chart 4).

Water levels in Pool B remained above the cease to flow level until late December 2017 where it fell below the pool cease to flow level (Figure 7, Chart 5). Water levels in Pool N fell below the cease to flow level for relatively short periods in January and February 2017, and in the latter half of December 2017 (Figure 7, Chart 6). Pools WRP2 and WRP3 on the Woronora River also stopped flowing in the same January to February and late December 2017 period and the behaviour of the control pool is consistent with Pools B and N at this time (Appendices B1 and B2).

Mining has not resulted in the diversion of flows or change to the natural drainage behaviour of pools on the Waratah Rivulet downstream of the maingate of Longwall 23 (i.e. Pools P to W).

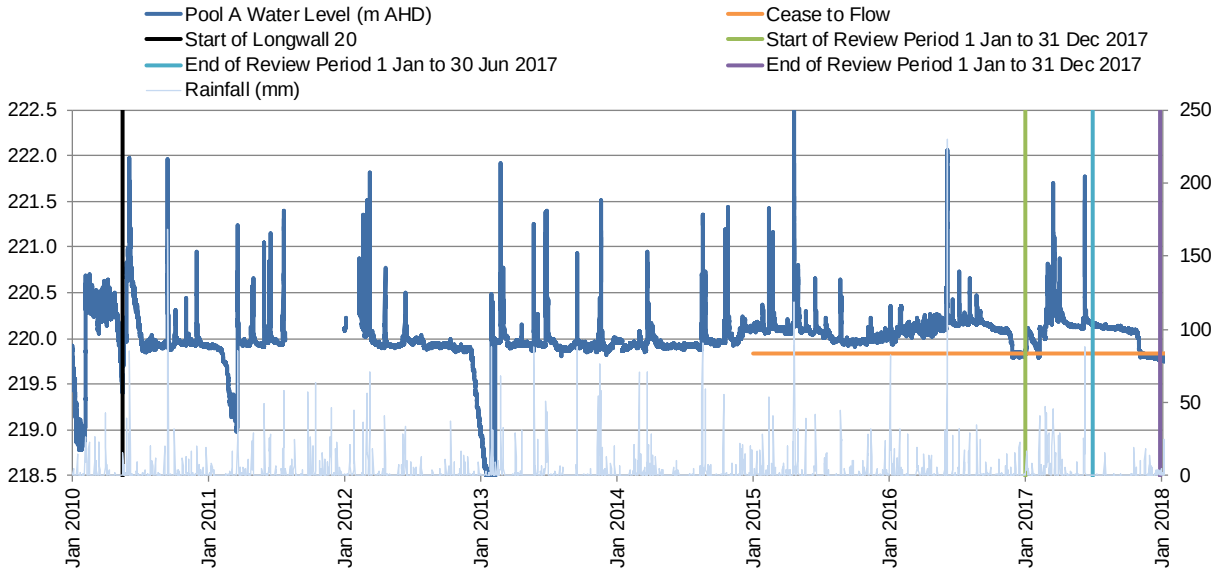


Chart 4 Pool A Waratah Rivulet

[1] Specifically, Pools B, C, E, G, G1, H and I on Waratah Rivulet.

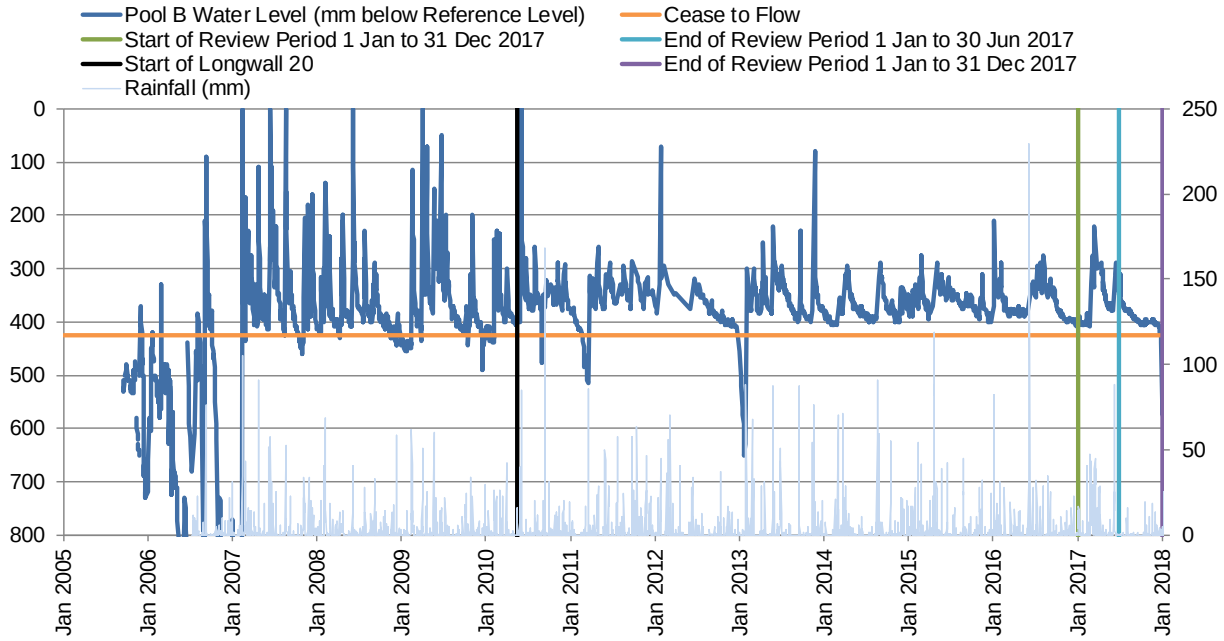


Chart 5 Pool B Waratah Rivulet (Manual Observations)

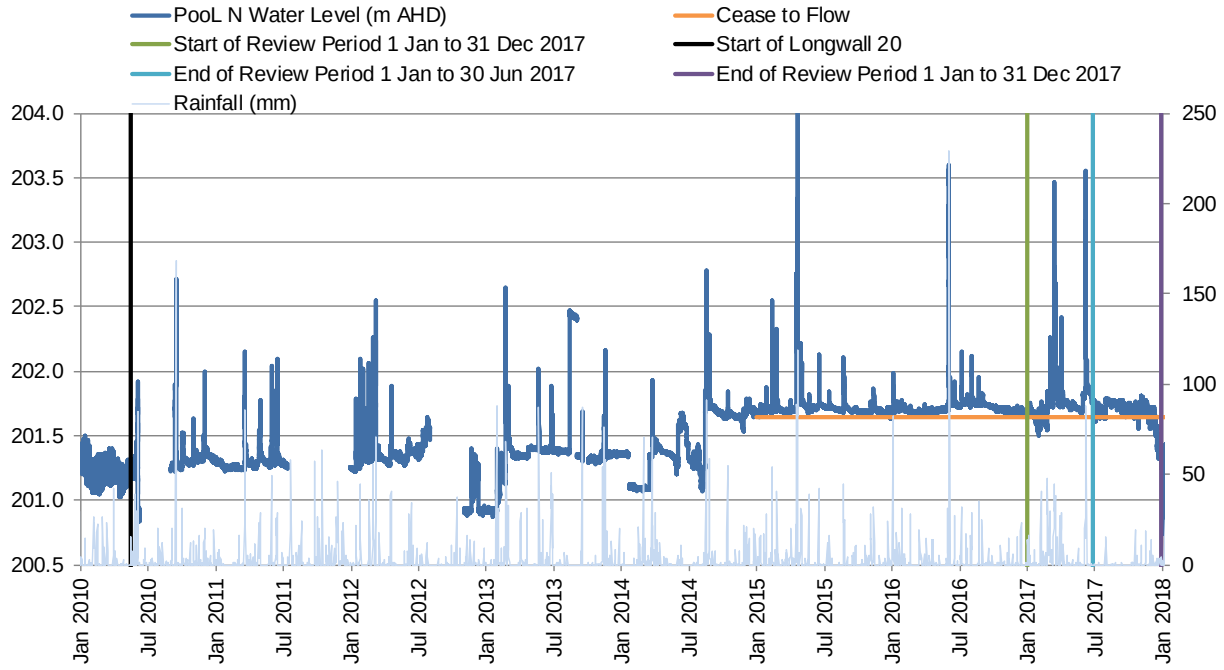


Chart 6 Pool N Waratah Rivulet

On the Eastern Tributary, water levels in Pools ETG, ETJ, ETM, ETU, ETW, ETAF, ETAG, ETAH, ETAI, ETAQ and ETAU are monitored using a continuous water level sensor and logger (Figure 7).

Pools ETG, ETJ, ETM, ETU, ETW, ETAF, ETAG, ETAH, ETAI and ETAQ on the Eastern Tributary were below their cease to flow levels or below their historical low water levels during the review period (Charts 7 to 16, respectively). Pools ETG, ETJ and ETM were impacted by mining in 2015. Pools ETU and ETW were impacted by mining in early 2016 and downstream pools ETAH, ETAI and ETAQ were impacted by mining in late 2016. Pool ETAG was impacted by mining in January 2017 and Pool ETAF was impacted by mining in September 2017. Pool ETAU did not fall below its cease to flow level during the review period (Chart 17; Appendices B1 and B2).

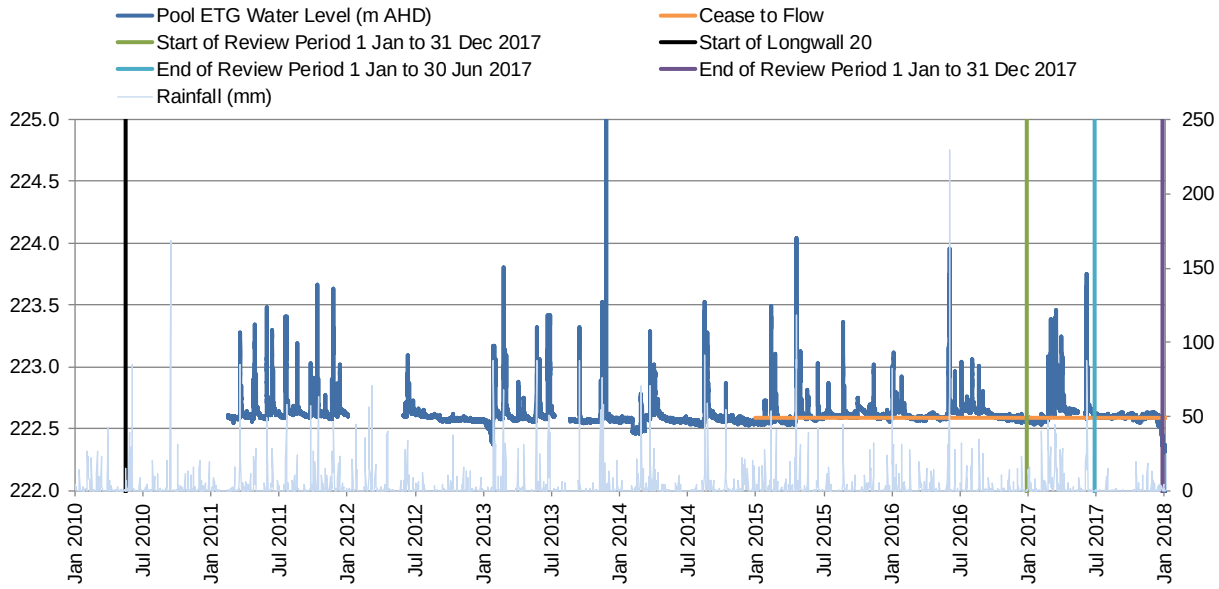


Chart 7 Pool ETG Eastern Tributary

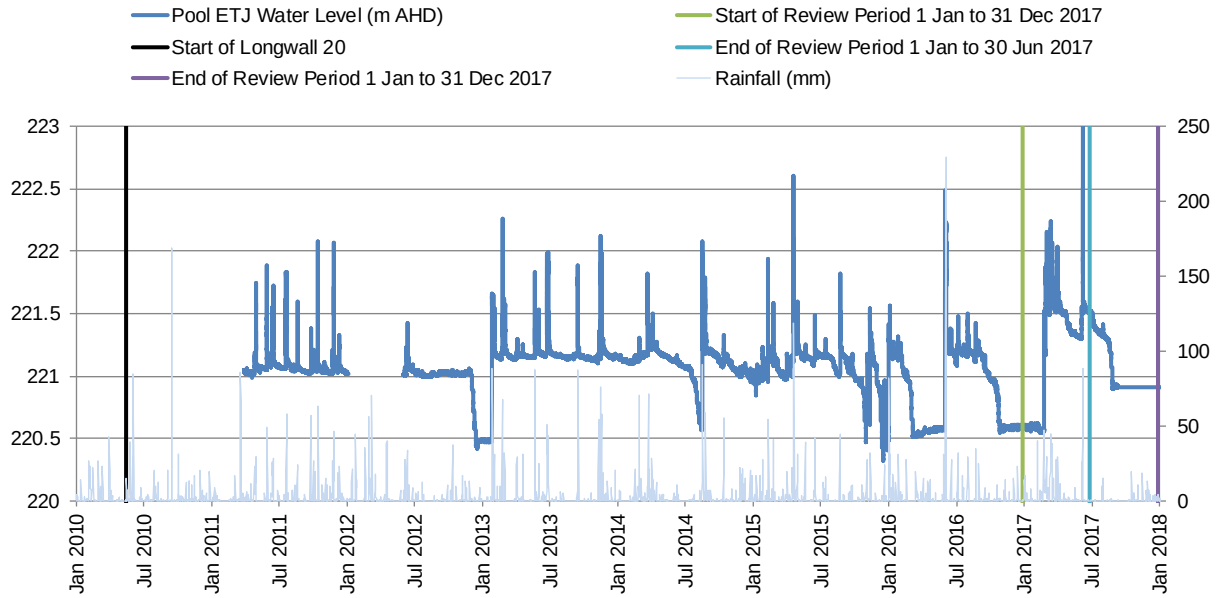


Chart 8 Pool ETJ Eastern Tributary

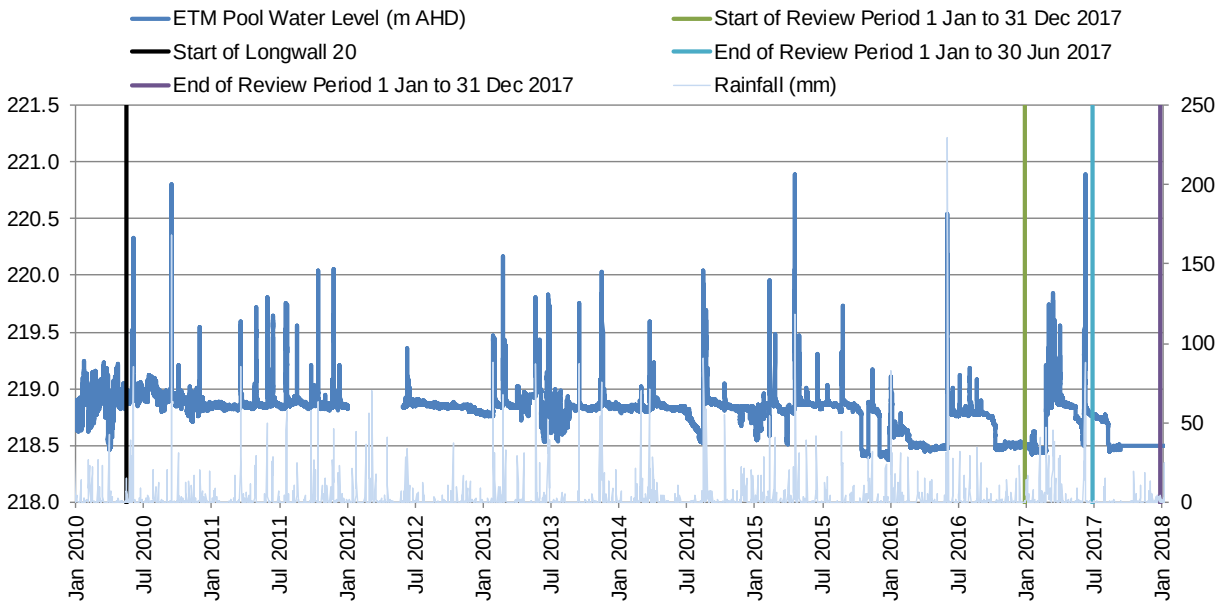


Chart 9 Pool ETM Eastern Tributary

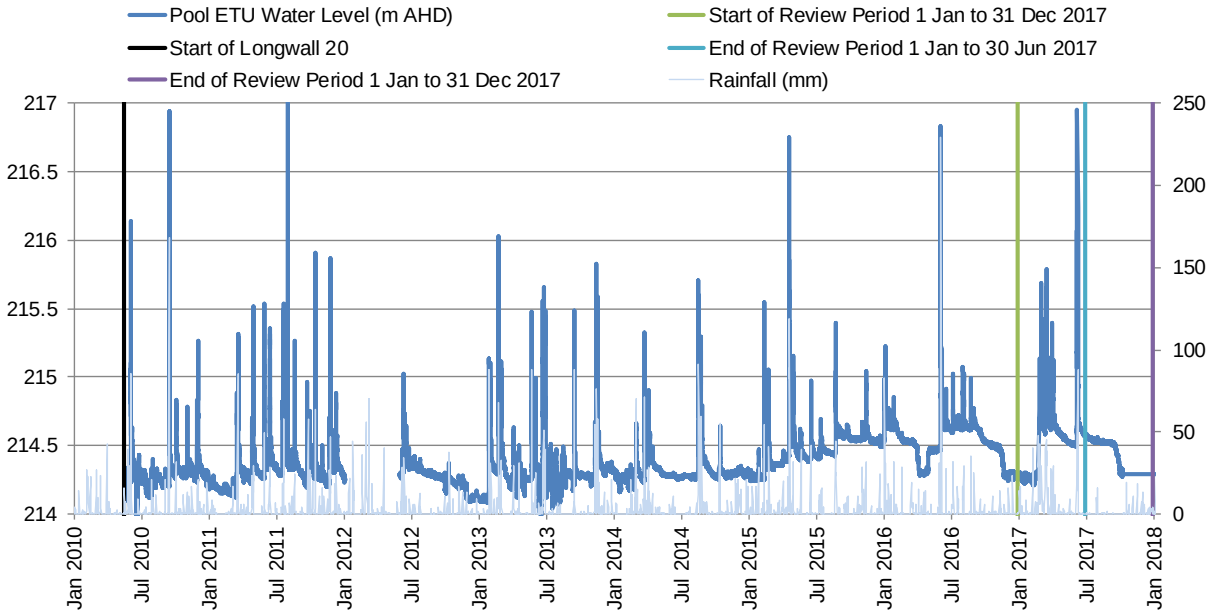


Chart 10 Pool ETU Eastern Tributary

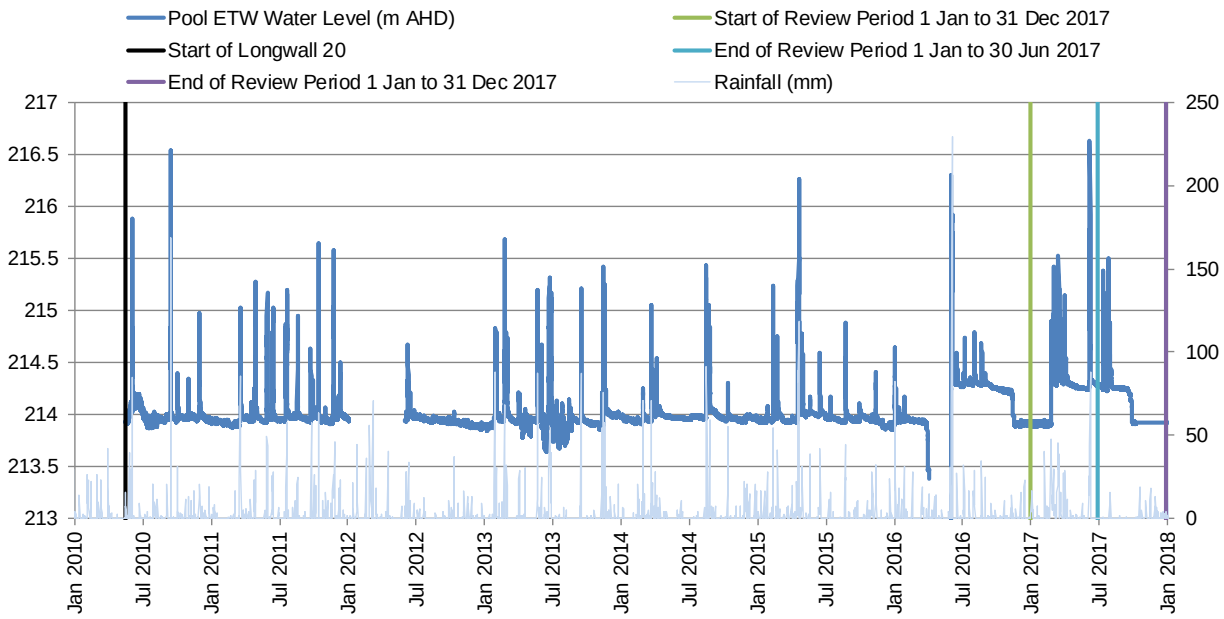


Chart 11 Pool ETW[2] Eastern Tributary

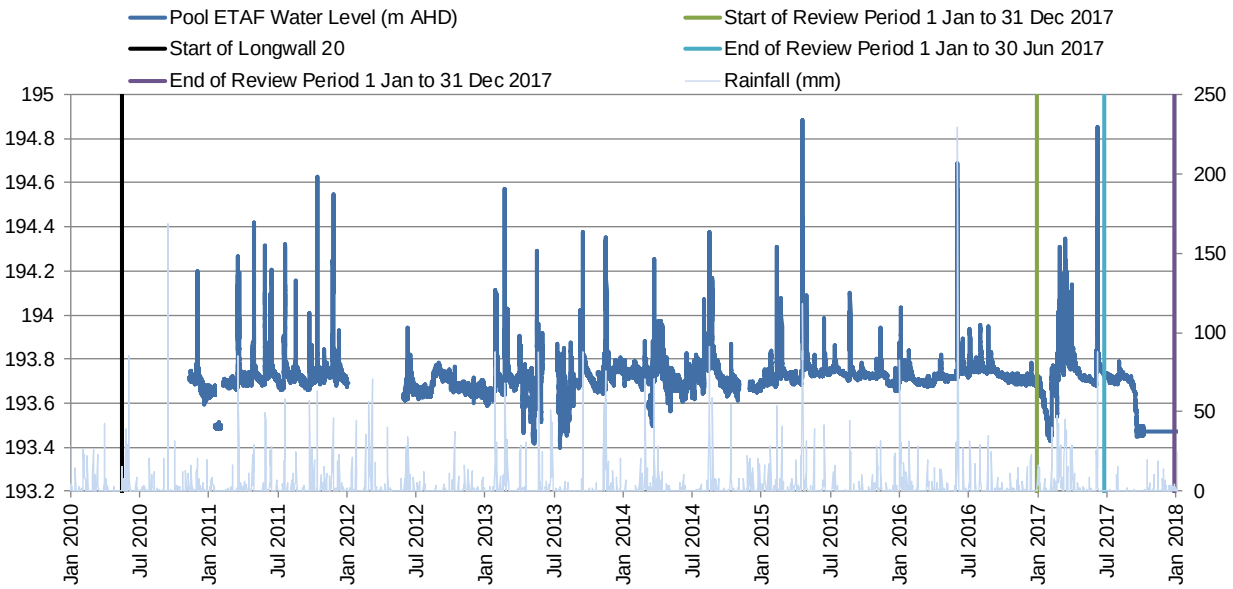


Chart 12 Pool ETAF Eastern Tributary

[2] Note discrepancies in water levels caused by pool being dry and water level sensor being exposed at time of download.

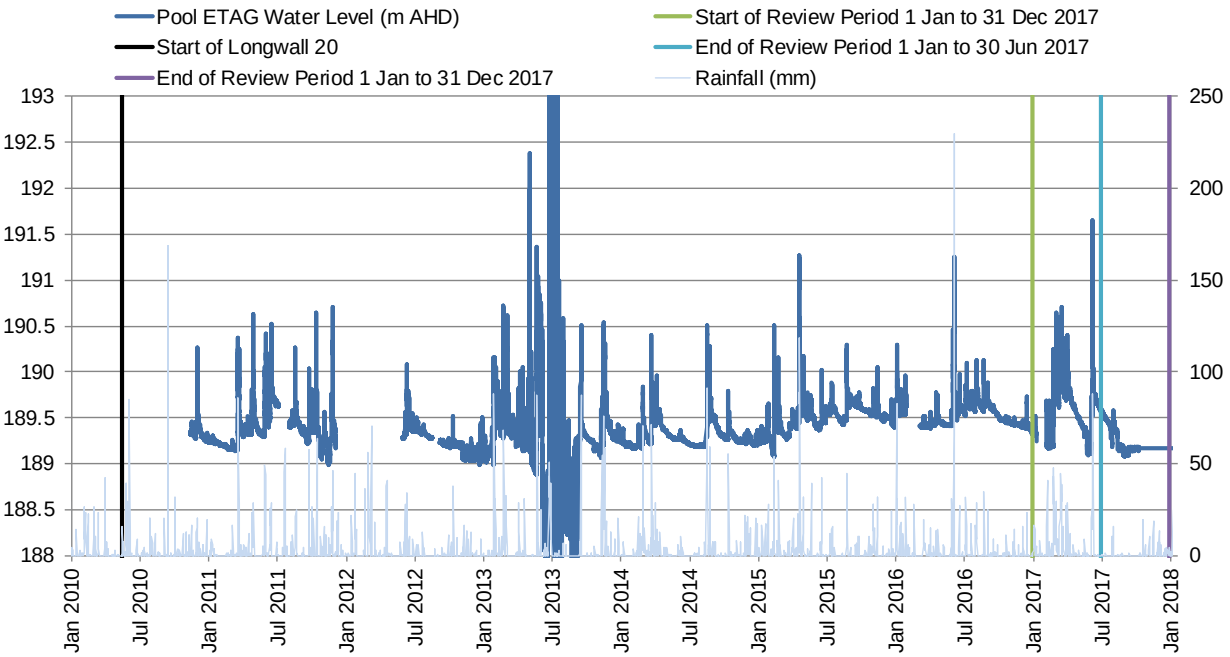


Chart 13 Pool ETAG Eastern Tributary

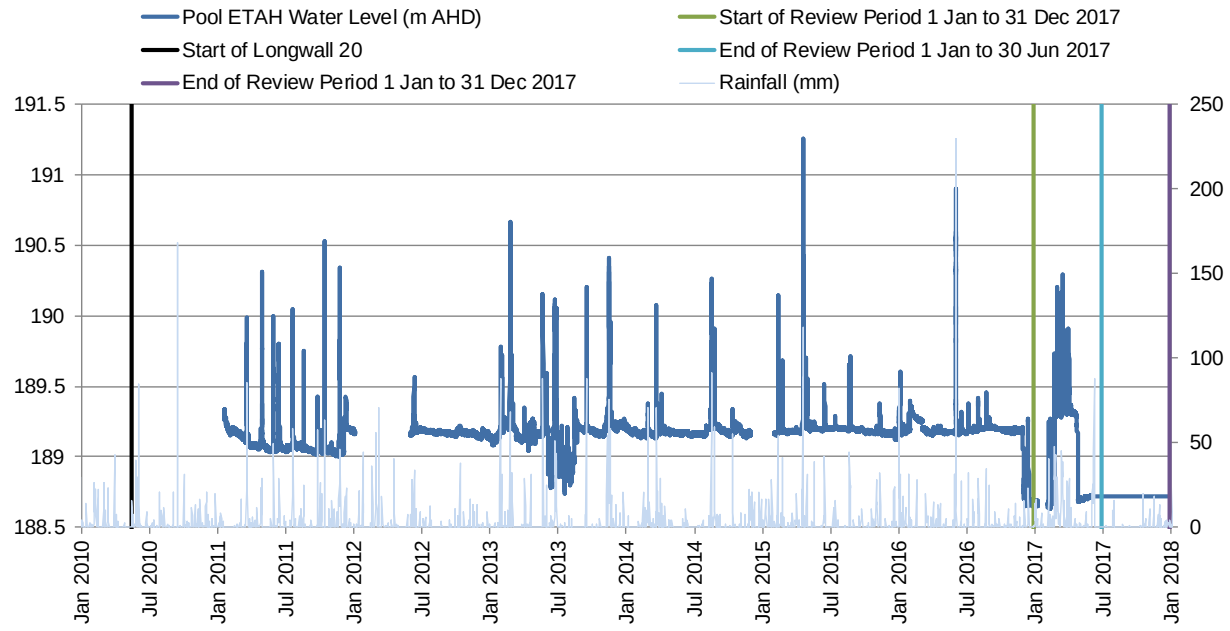


Chart 14 Pool ETAH Eastern Tributary

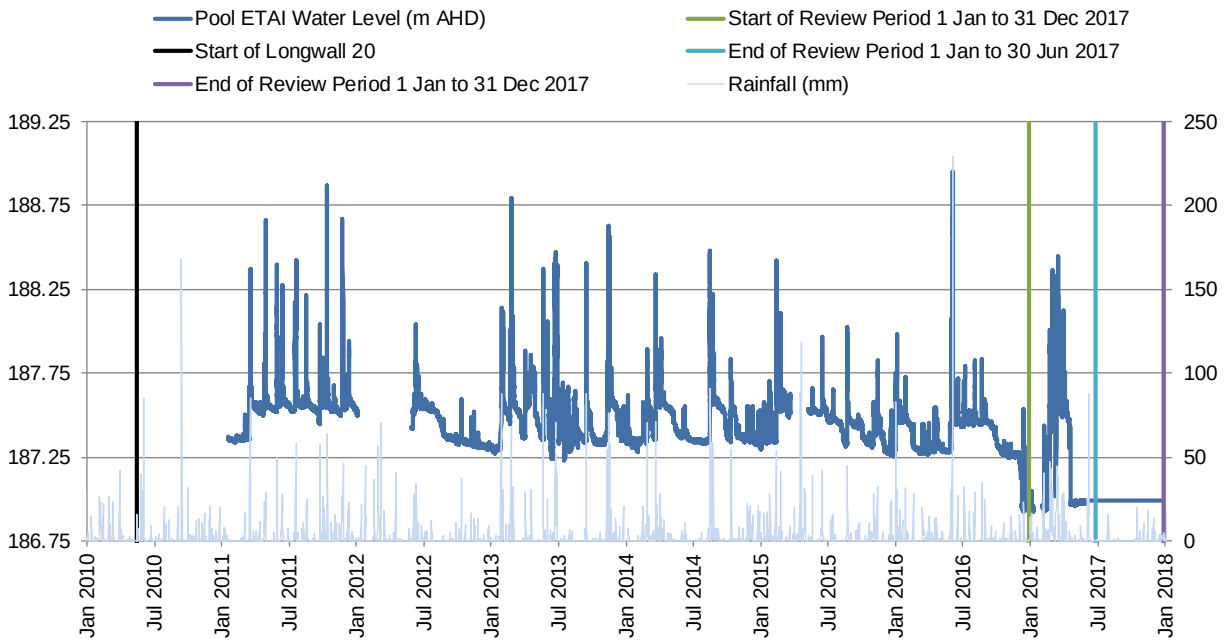


Chart 15 Pool ETAI Eastern Tributary

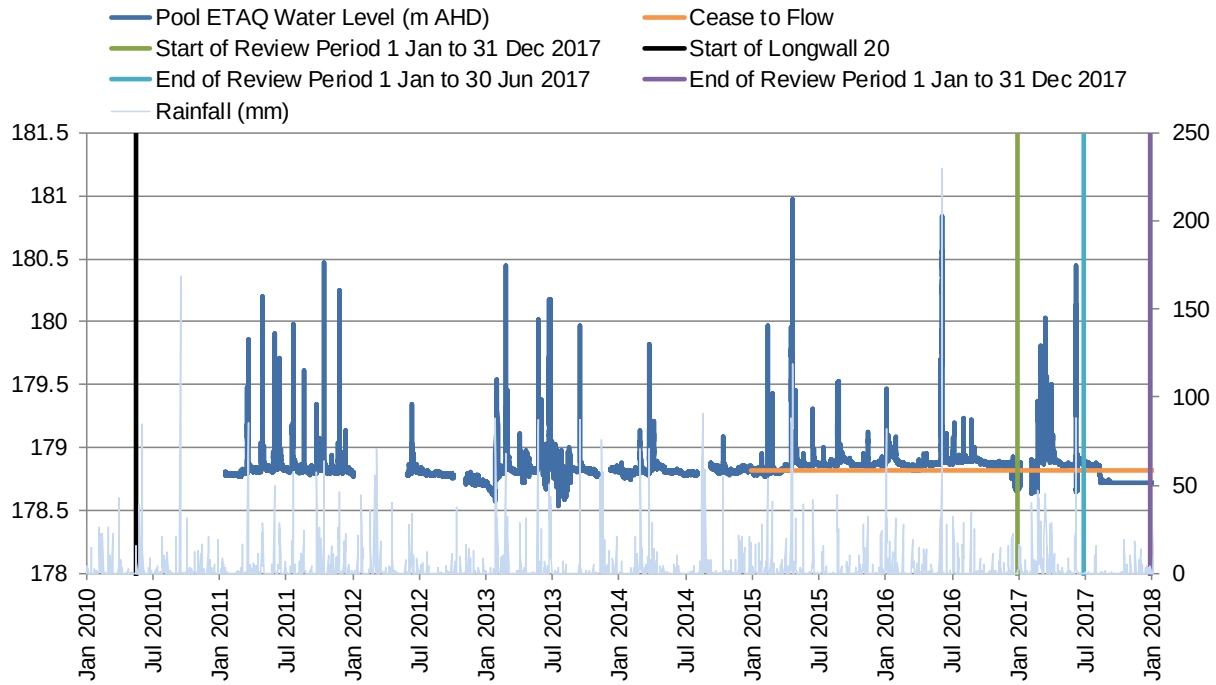


Chart 16 Pool ETAQ Eastern Tributary

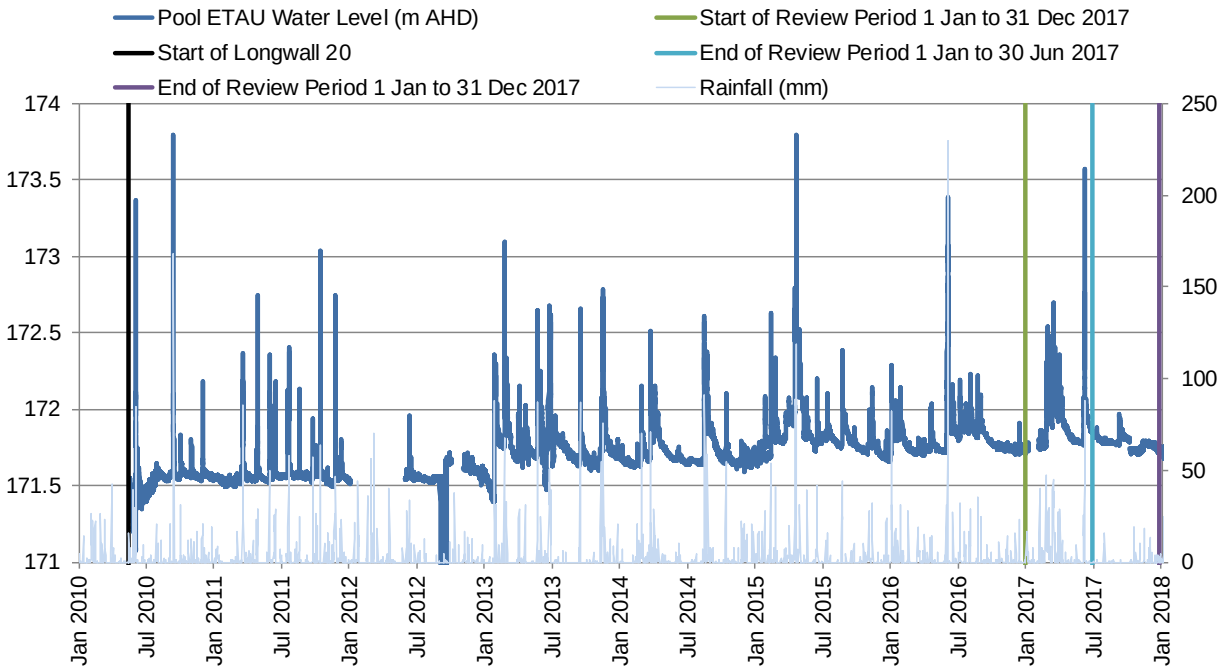


Chart 17 Pool ETAU Eastern Tributary

Pool RTP1 on Tributary B remains typically dry with overflow events limited to significant, wet periods (Chart 18). Since 2012 this section of Tributary B has been mostly dry with no surface flow. Pool RTP2 on Tributary B has continued to regularly fall below its cease to flow level, however generally overflows during and following rainfall events (Chart 19).

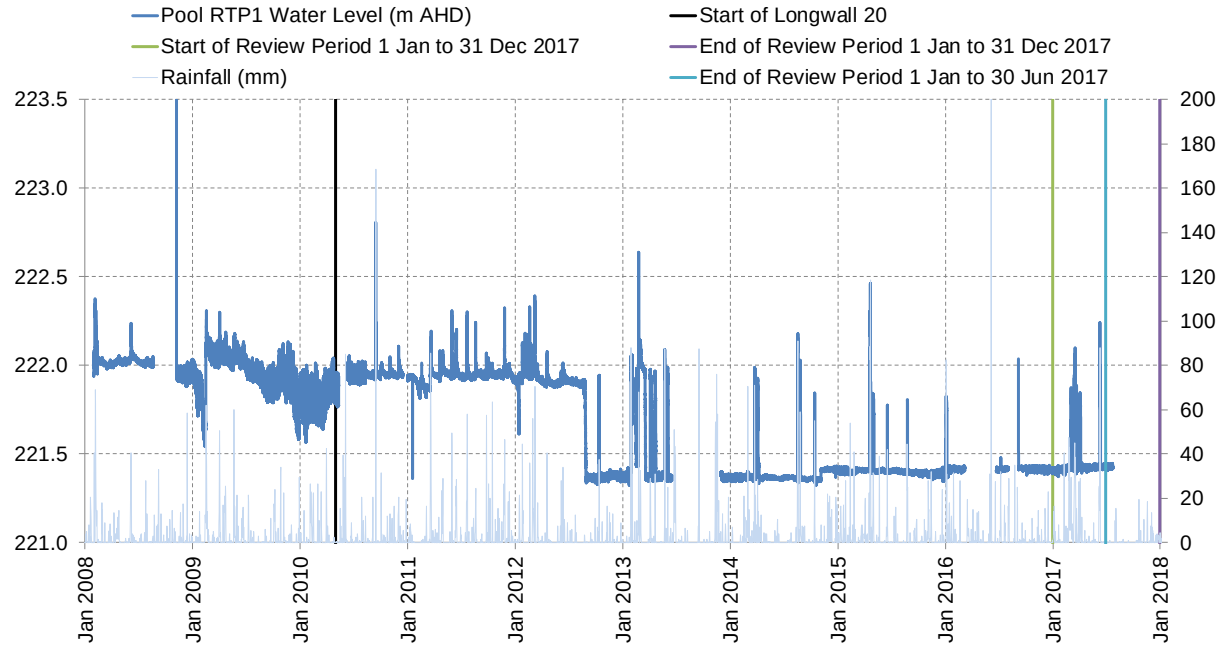


Chart 18 Pool RTP1[3] Tributary B

[3] Metropolitan Coal is not able to access the catchment during significant rain events and has been unable to reduce the recorded data to an equivalent water level (m AHD) because the pool has been invariably dry when the water level logger has been downloaded. The water level rises shown on the chart should be considered as being indicative of water level rises associated with rainfall-runoff events and should be regarded as being indicative of relative pool water level changes.

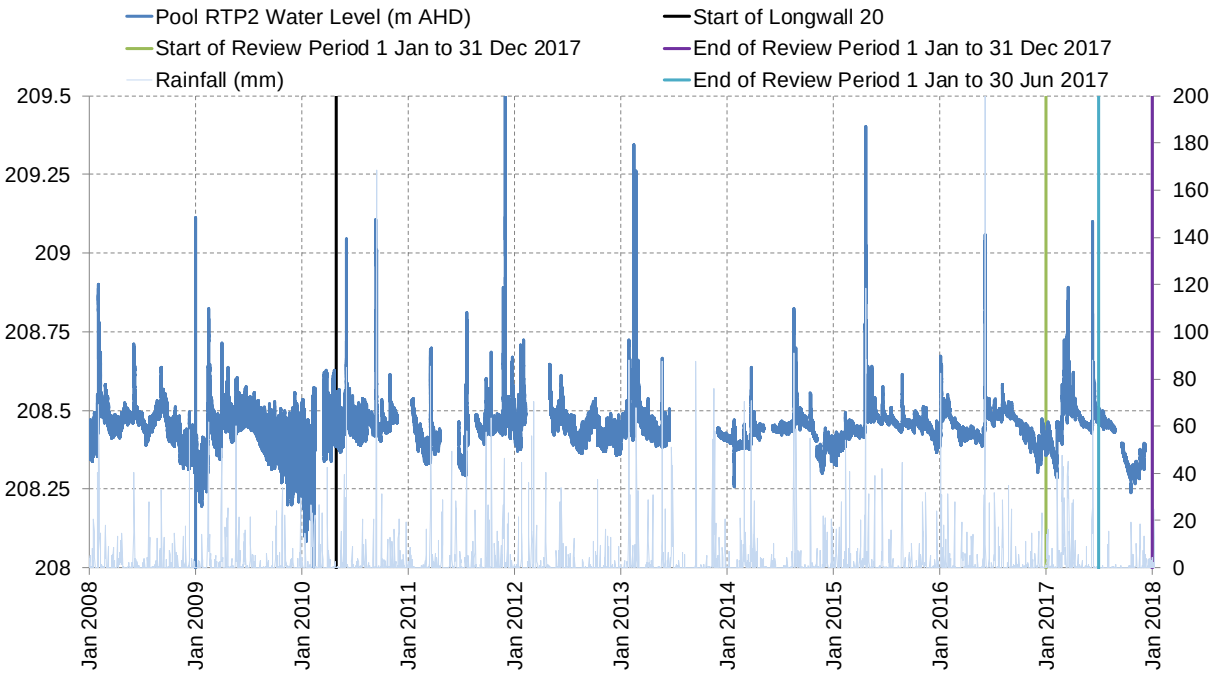


Chart 19 Pool RTP2 Tributary B

As described in Section 6.2.1, the pool water level monitoring results for the review period were consistent with the potential subsidence impacts and environmental consequences described in the Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans in that data that is available to MSEC for the Southern Coalfield (including the Waratah Rivulet and Eastern Tributary results) indicates that less than 10% of all pools have experienced the diversion of flow at predicted closure values of less than 200 mm, consistent with previous assessments of potential pool impacts. On their own, the impacts for the Eastern Tributary are outside of the predictions of the empirical based model.

6.2.4 Stream Water Quality

Surface water quality sampling has been conducted monthly at the following sites on Waratah Rivulet (sites WRWQ2, WRWQ6, WRWQ8, WRWQ9, WRWQM, WRWQN, WRWQP, WRWQR, WRWQT, WRWQW), Eastern Tributary (sites ETWQF, ETWQJ, ETWQN, ETWQU, ETWQW, ETWQAF, ETWQAH, ETWQAQ, ETWQAU), Tributary B (site RTWQ1), Tributary D (site UTWQ1), Far Eastern Tributary (site FEWQ1), Honeysuckle Creek (site HCWQ1), Bee Creek (site BCWQ1) and the Woronora River (WOWQ1 and WOWQ2) (Figure 8) in accordance with the Metropolitan Coal Water Management Plans.

In October 2016, Metropolitan Coal increased the frequency of water quality sampling at select sites on the Eastern Tributary (sites ETWQF, ETWQN, ETWQAF, ETWQAG, ETWQAH, ETWQAI, ETWQAK, ETWQAQ and ETWQAU) and at site WOWQ2 on the Woronora Reservoir from monthly to weekly in response to the Eastern Tributary iron staining incident. The weekly sampling has continued throughout the review period.

Trends in the monitoring data to date for key parameters (pH, electrical conductivity, dissolved iron, dissolved manganese and dissolved aluminium) are summarised in Table 13 and shown on Charts 20 to 44 (Appendices B1 and B2).

Table 13
Summary of Results for Key Water Quality Parameters

Stream(s)	pH	Electrical Conductivity	Dissolved Iron	Dissolved Manganese	Dissolved Aluminium
Waratah Rivulet (sites WRWQ2, WRWQ6, WRWQ8, WRWQ9, WRWQM, WRWQN, WRWQP, WRWQR, WRWQT and WRWQW) (Charts 20 to 29)	• Upstream sites (e.g. sites WRWQ2 and WRWQ6) - slightly acidic to near neutral pH values. • Middle and lower reach sites (e.g. sites WRWQ8, WRWQT and WRWQW) - higher (slightly alkaline) pH values.	• Concentrations were generally consistent with historical trends. • The highest concentrations during the review period were recorded at WRWQR in June 2017 (410 µS/cm) and September 2017 (357 µS/cm).	• Typically low (below 0.5 mg/L) during the review period.	• Elevated concentrations (relative to historic levels) were recorded in February 2017 at WRWQ6 and WRWQM (0.54 mg/L and 0.36 mg/L, respectively). • Dissolved manganese concentrations at other sites were generally low and consistent with historical trends.	• Dissolved aluminium concentrations were either low or below the detection limit.
Woronora River (sites WOWQ1 and WOWQ2, control stream) (Charts 30 to 34)	• High variability in pH, typically slightly acidic, consistent with historical trends. • pH ranged from pH 4.8 to pH 5.4 at site WOWQ1 and from pH 5.2 to 7.2 at site WOWQ2.	• Slightly elevated concentrations were recorded at WOWQ1 in January 2017 (313 µS/cm) and at WOWQ2 in November (315 µS/cm) and December 2017 (maximum of 318 µS/cm). • Concentrations were otherwise relatively low and consistent with historical trends. • Low concentrations were recorded following high rainfall in March 2017.	• Generally low and similar to values recorded in Waratah Rivulet.	• Typically low, with elevated (relative to historical levels) concentrations recorded at WOWQ1 and WOWQ2 in February 2017 (0.158 mg/L and 0.114 mg/L, respectively).	• Typically low concentrations.
Eastern Tributary (sites ETWQF, ETWQJ, ETWQN, ETWQU, ETWQW, ETWQAF, ETWQAH, ETWQAQ and ETWQAU) (Charts 35 to 39) (Note, a number of pools were dry and could not be sampled on occasions during the review period.)	• Near neutral to slightly acidic pH values, consistent with historical results. • An isolated, relatively low, pH 4.25 was recorded at ETWQAH in February 2017, corresponding to a period when pool levels were low and the pool was not overflowing.	• More variable during the reporting period. • Erroneous field concentrations recorded from October to December 2017 (Chart 36b). • Elevated concentrations above 350 µS/cm (based on field measurements from January to September and lab measurements from October to December 2017) were recorded: – in January and February at ETWQAQ; – in February 2017 at ETWQAH and ETWQU, – in February, May and December 2017 at ETWQAU associated with low water levels.	• Large spikes in concentrations were recorded at ETWQAQ from January to March 2017, in June 2017 and from August to November 2017 (highest concentration of 8.42 mg/L recorded in February 2017). The pool was dry and unable to be sampled from mid-November to December 2017. • Elevated concentrations corresponded with a period of low flow and mine subsidence impacts to a number of pools.	• The higher concentrations recorded in mid to late 2016 continued to increase in January/February 2017; corresponding with an extended period of low flow/rainfall and mine subsidence impacts to a number of pools. • In particular, large spikes in concentrations were recorded in January and/or February 2017 at ETWQU, ETWQAH, ETWQ AQ and ETWQAU. • The highest concentrations recorded at these sites were 0.96 mg/L (at ETWQU in February 2017), 1.15 mg/L (at ETWQAH in February 2017), 1.31 mg/L (at ETWQAQ in February 2017) and 0.93 mg/L (at ETWQAU in January 2017). • Elevated concentrations were also recorded from May to December 2017 at ETWQAQ and ETWQAU during periods of low flow.	• Typically low concentrations. • Some spikes in concentrations were recorded, most notably during April and June 2017 at ETWQF, ETWQAH and ETWQAU following rain. • Highest concentration recorded in April 2017 at ETWQF (0.14 mg/L) during the reporting period.

Table 13 (Continued)
Summary of Results for Key Water Quality Parameters

Stream(s)	pH	Electrical Conductivity	Dissolved Iron	Dissolved Manganese	Dissolved Aluminium
Bee Creek (site BCWQ1, control stream), Honeysuckle Creek (site HCWQ1, control stream), Far Eastern Tributary (site FEWQ1), Tributary B (site RTWQ1) and Tributary D (site UTWQ1) (Charts 40 to 44)	• Bee Creek and Honeysuckle Creek - variable to slightly acidic pH levels. • Far Eastern Tributary, Tributary B and Tributary D - near neutral pH levels. • Since mid-2015, the pH at all sites has generally been less variable.	• Generally low, with the exception of Tributary B. • Tributary B - variable and periodically elevated since late 2013; this trend has continued in 2017.	• Generally low and consistent with historical values.	• Generally low and consistent with historical values.	• Low concentrations at Tributary B, Tributary D and Far Eastern Tributary. • Bee Creek and Honeysuckle Creek - higher (in relation to other tributary sites) over the period of record. This trend continued during the review period. • Concentrations recorded at all sties during the review period were typically lower than historic values.

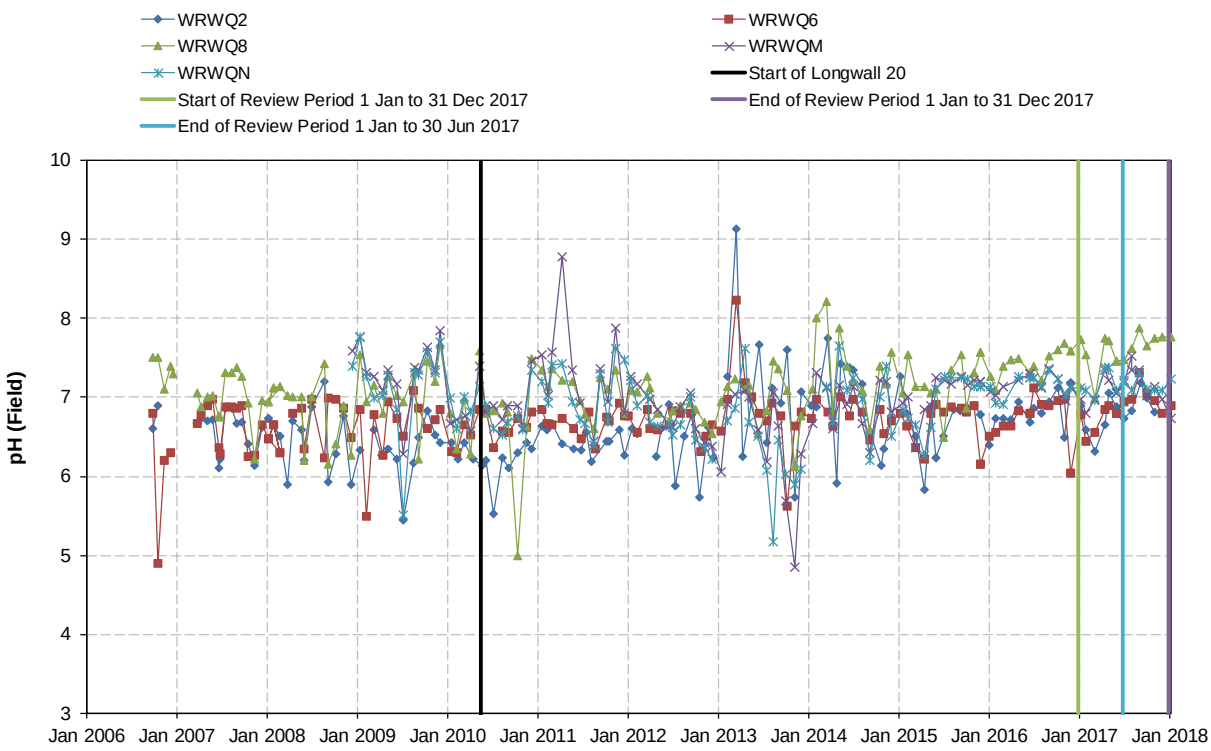


Chart 20 pH Levels Waratah Rivulet – Upper to Middle Reach Sites

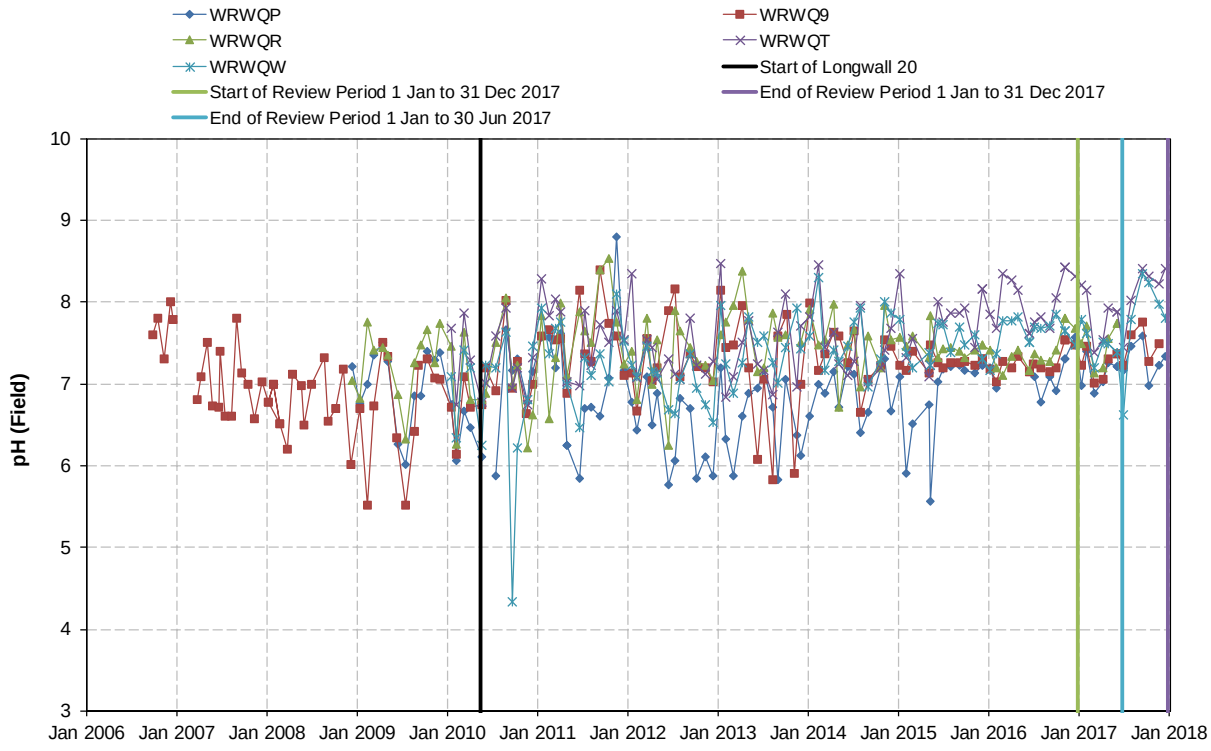


Chart 21 pH Levels Waratah Rivulet – Lower Reach Sites

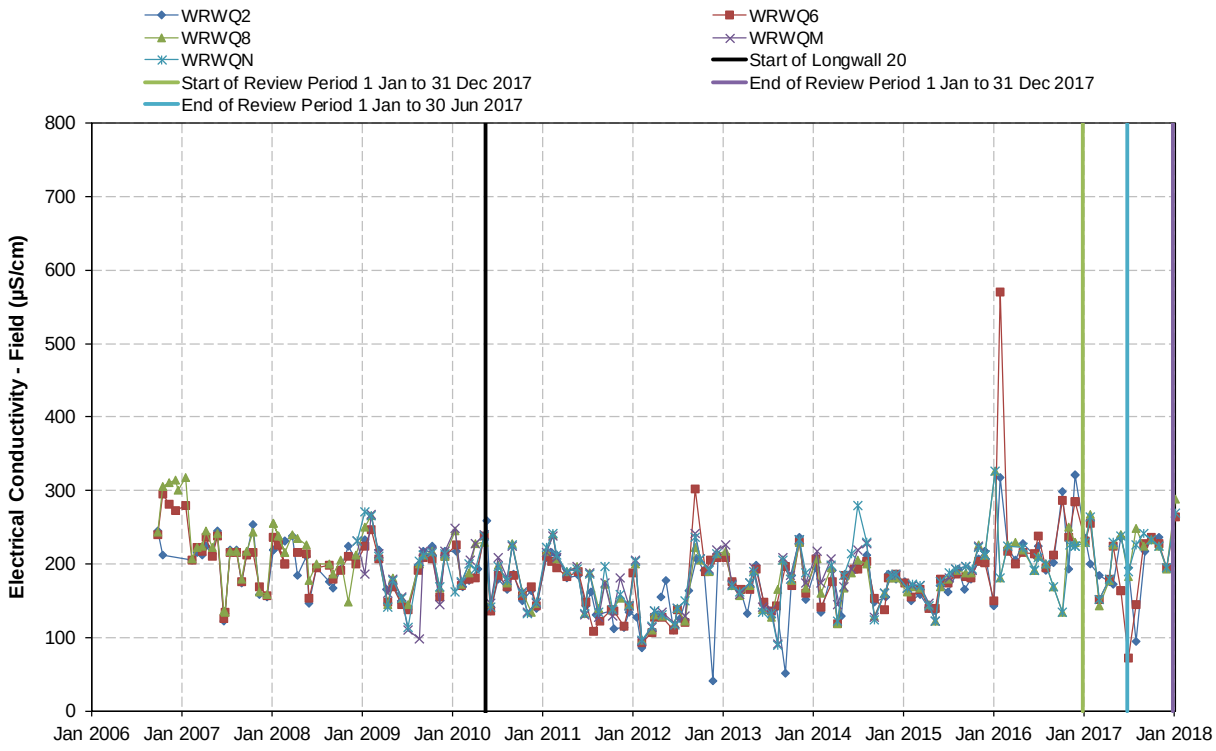


Chart 22 Electrical Conductivity (EC) Waratah Rivulet – Upper to Middle Reach Sites

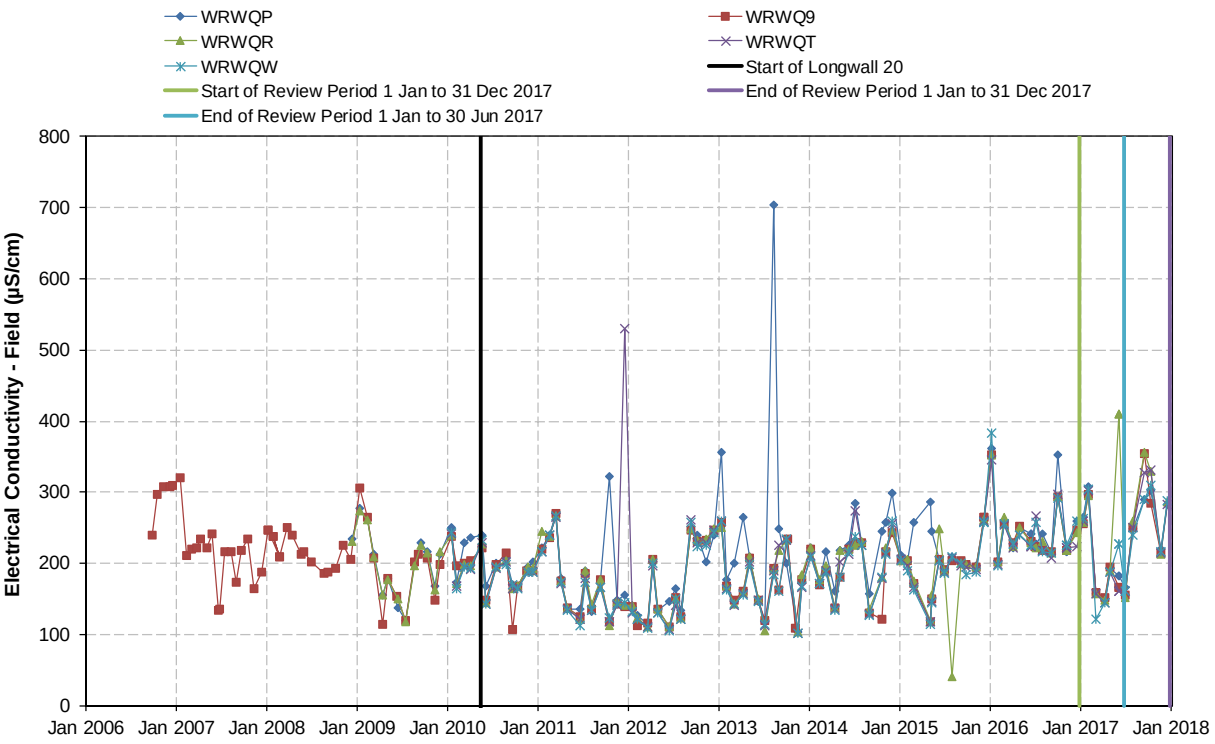


Chart 23 Electrical Conductivity (EC) Waratah Rivulet – Lower Reach Sites

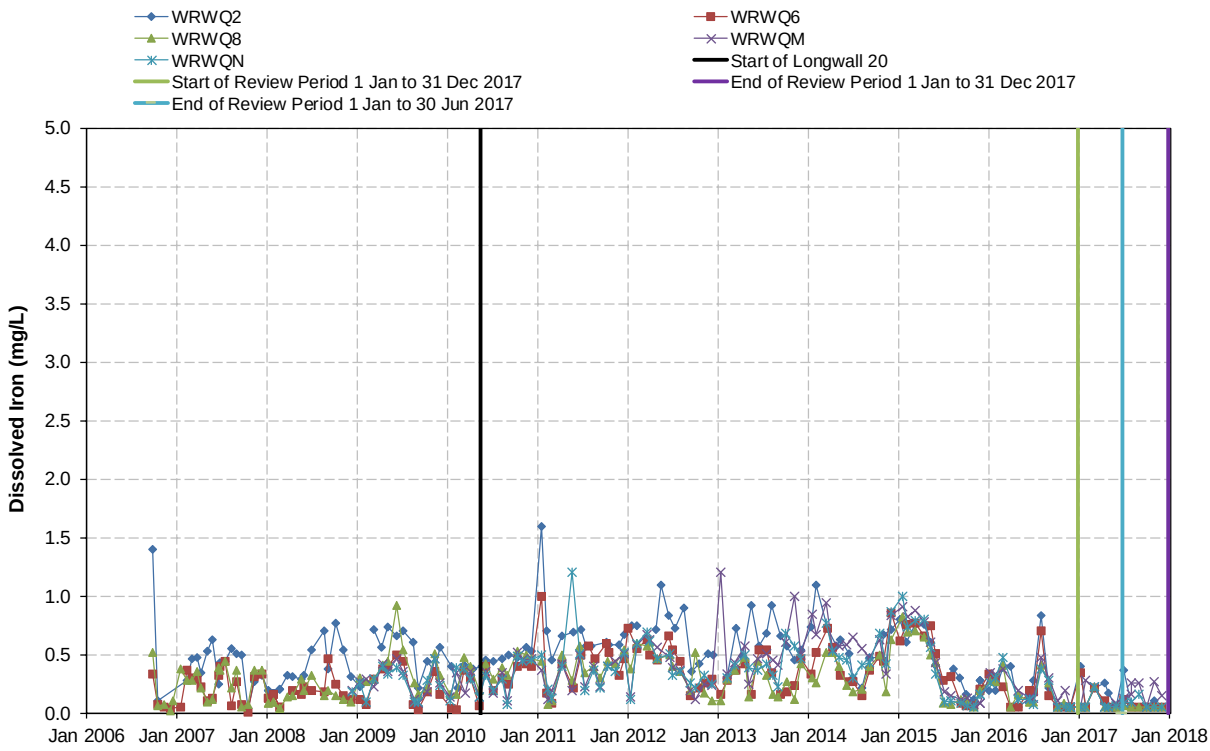


Chart 24 Dissolved Iron Waratah Rivulet – Upper and Middle Reach Sites

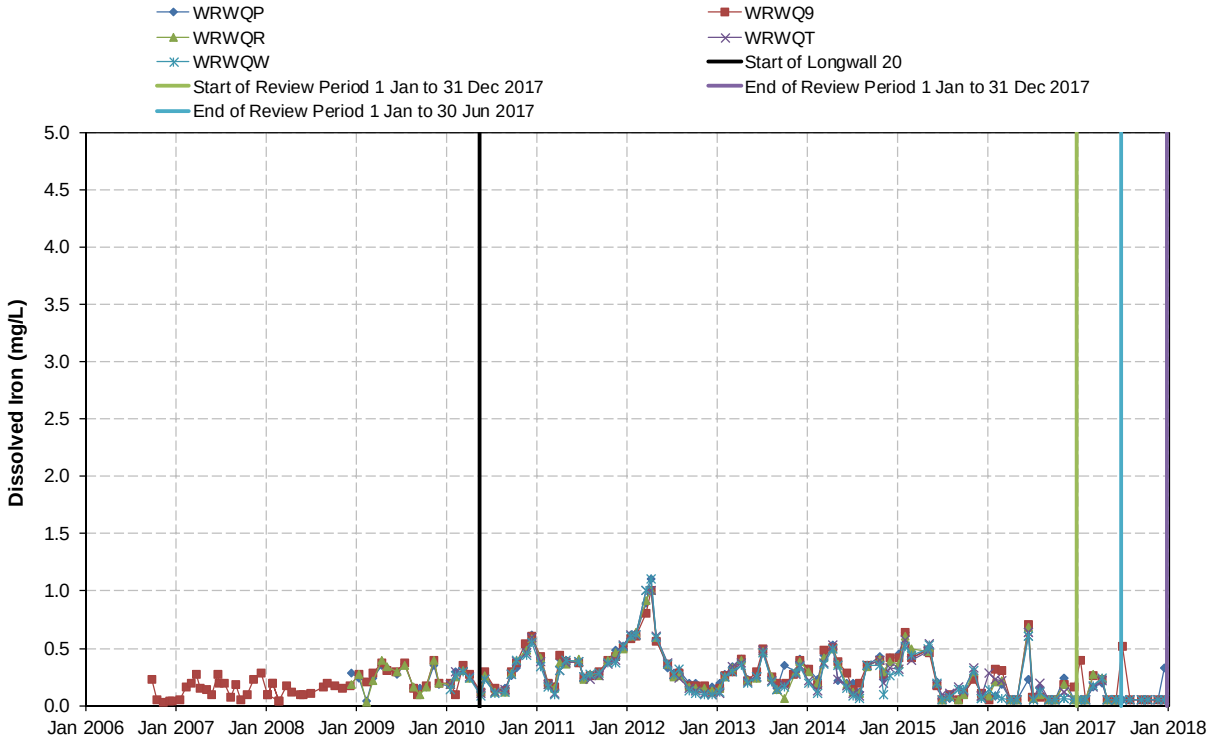


Chart 25 Dissolved Iron Waratah Rivulet – Lower Reach Sites

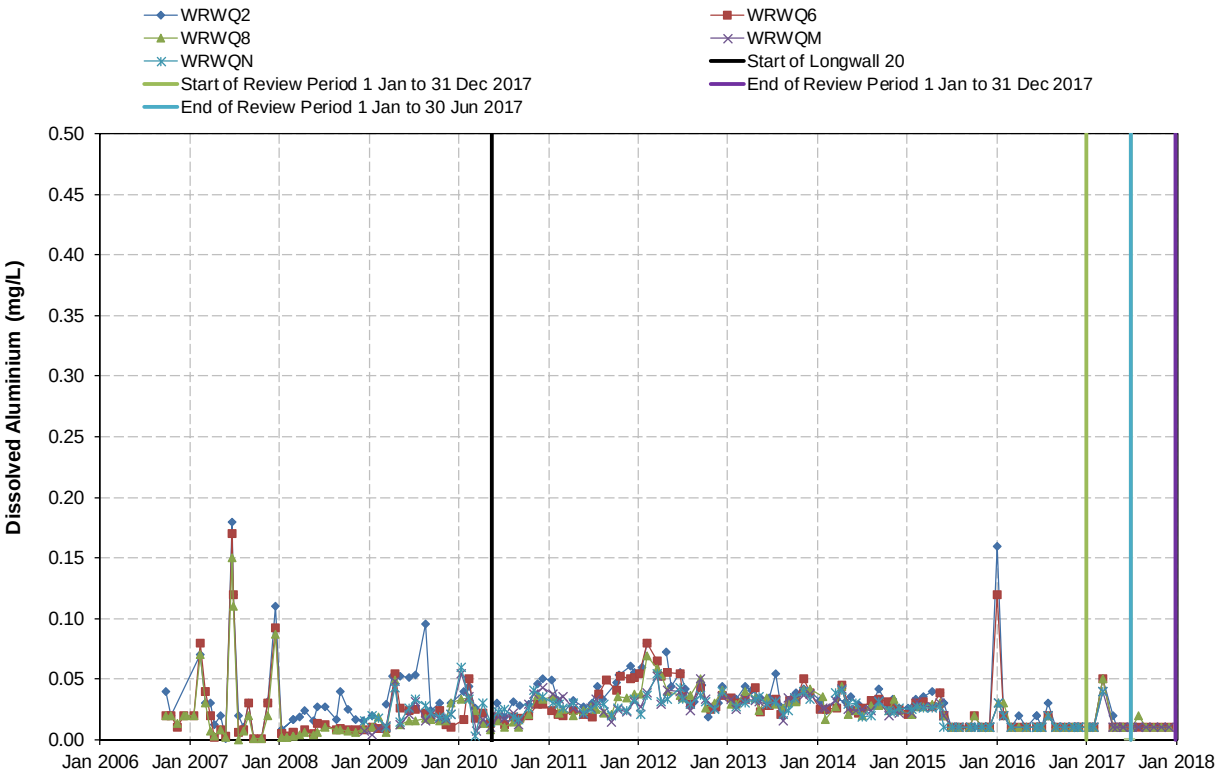


Chart 26 Dissolved Aluminium Waratah Rivulet – Upper to Middle Reach Sites

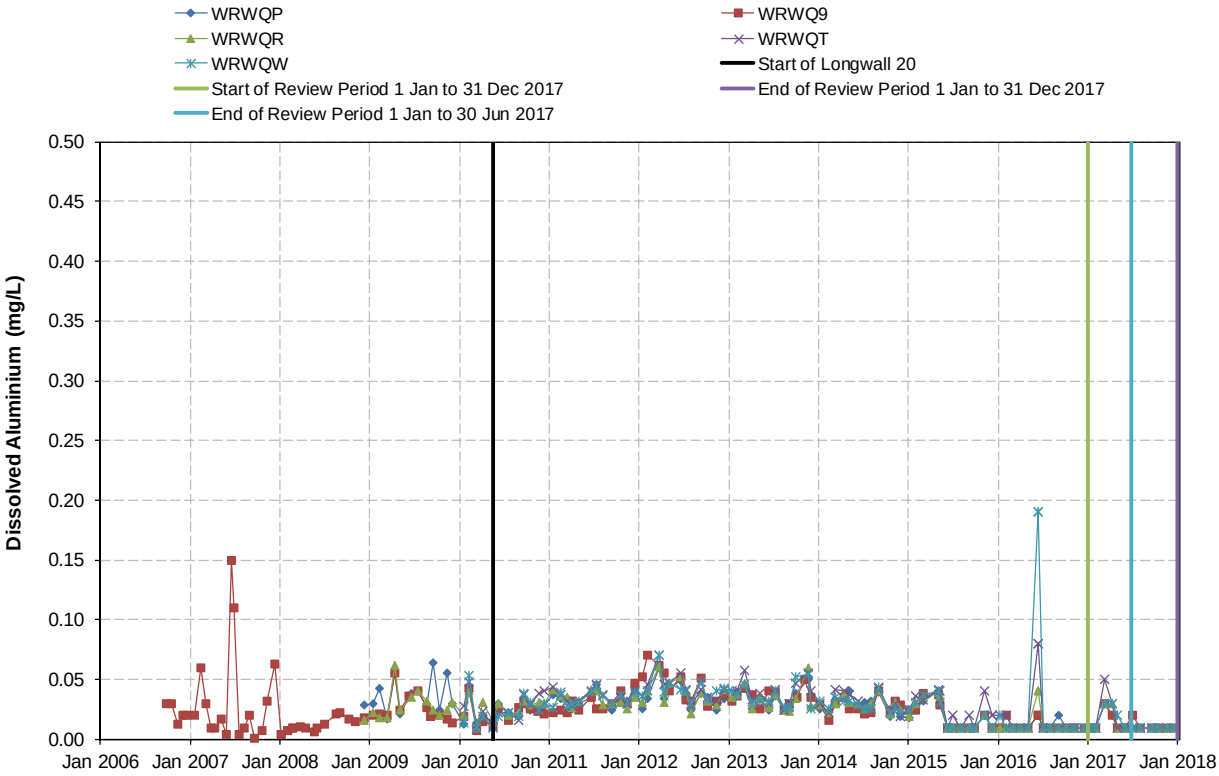


Chart 27 Dissolved Aluminium Waratah Rivulet – Lower Reach Sites

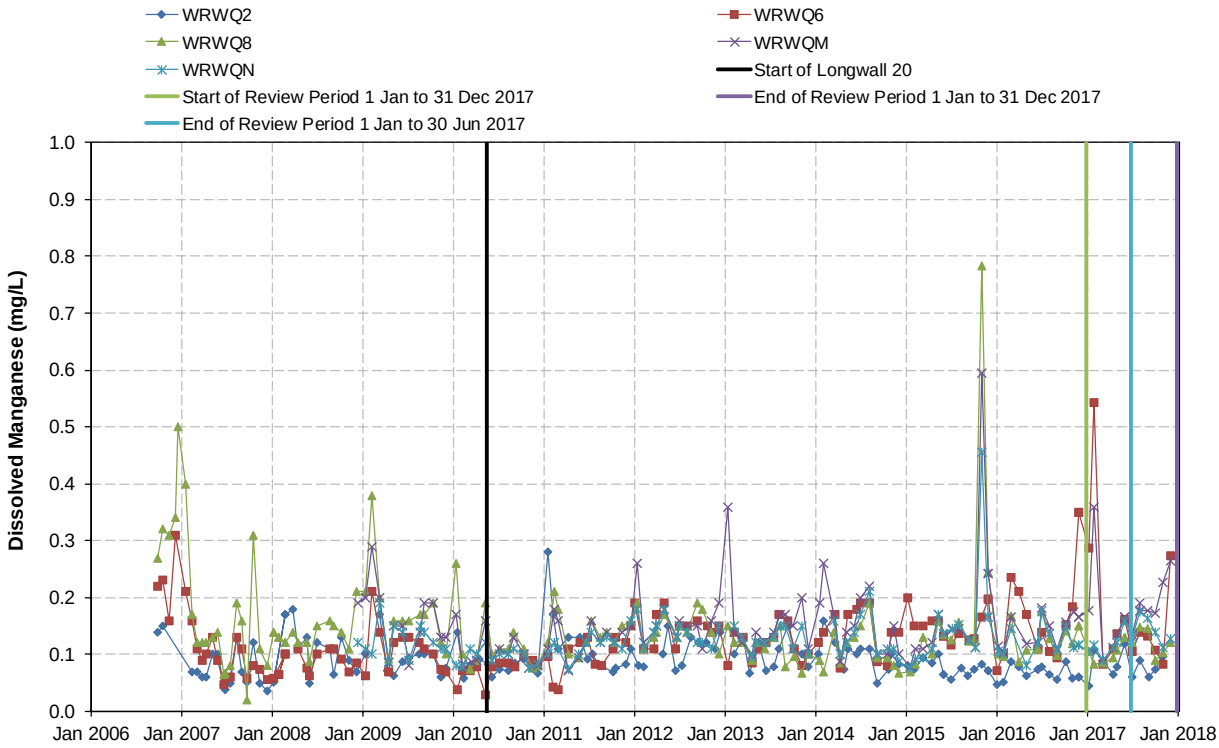


Chart 28 Dissolved Manganese Waratah Rivulet – Upper to Middle Reach Sites

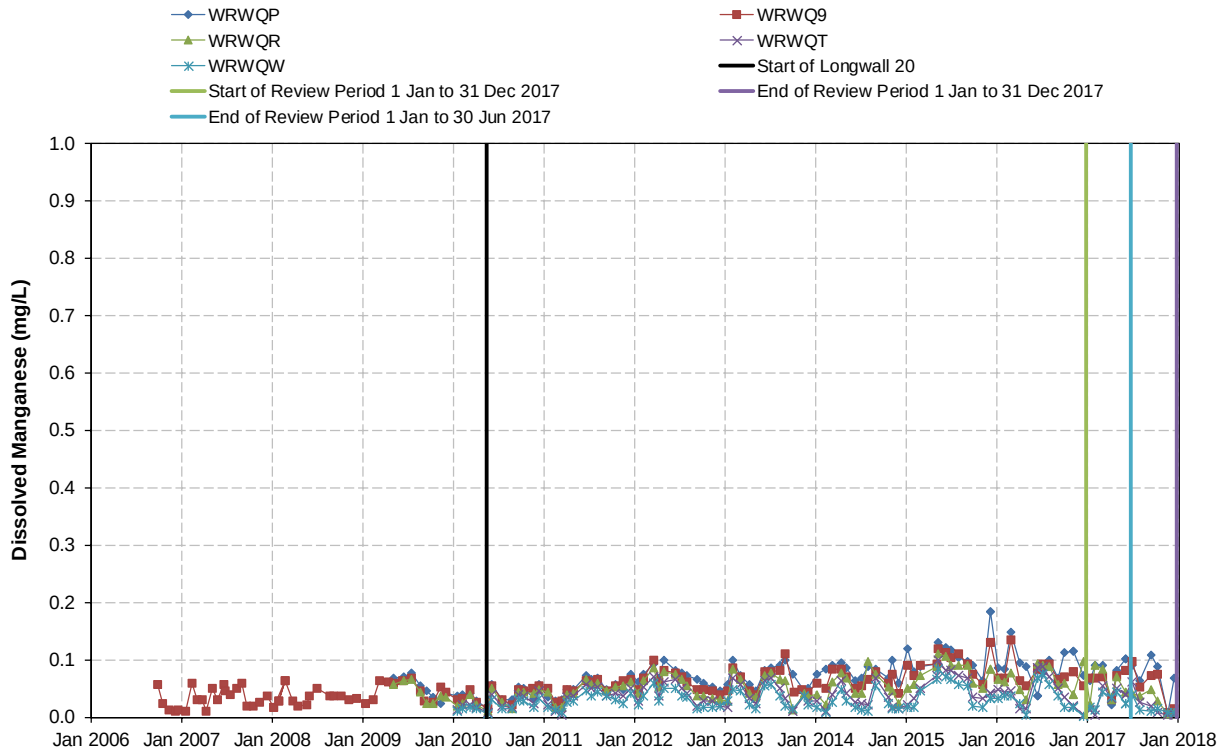


Chart 29 Dissolved Manganese Waratah Rivulet – Lower Reach Sites

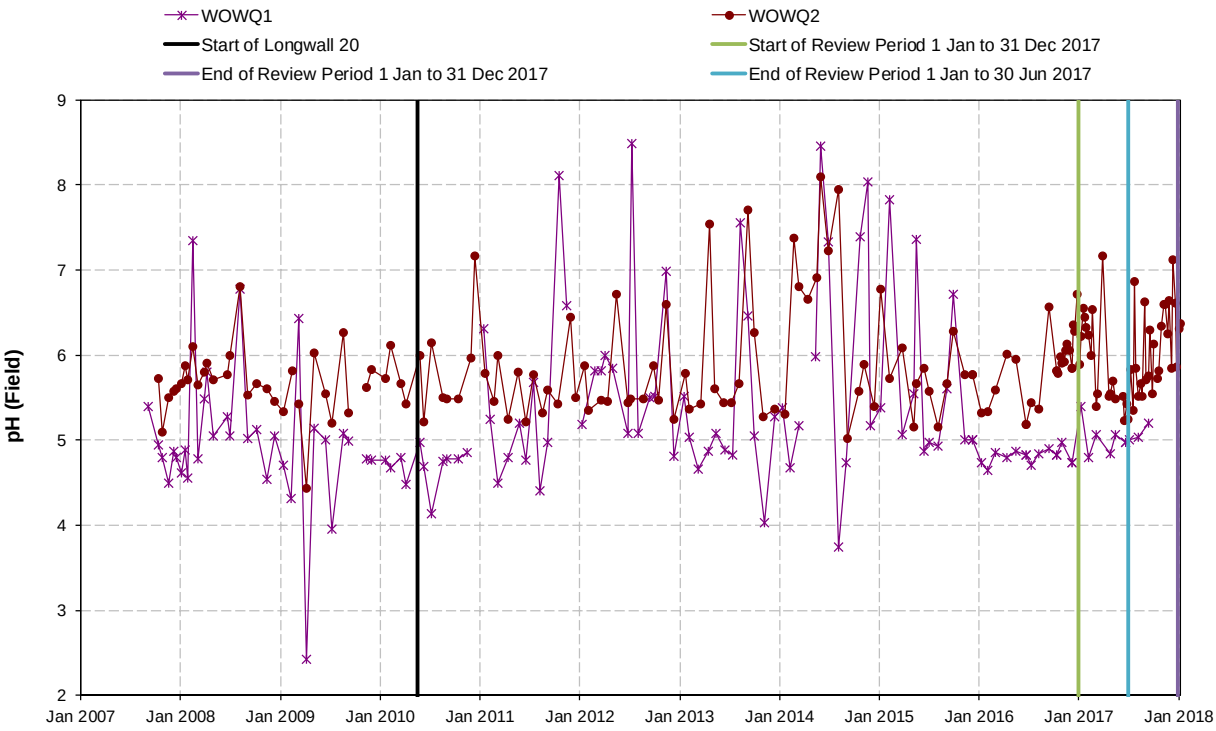


Chart 30 pH Levels Woronora River

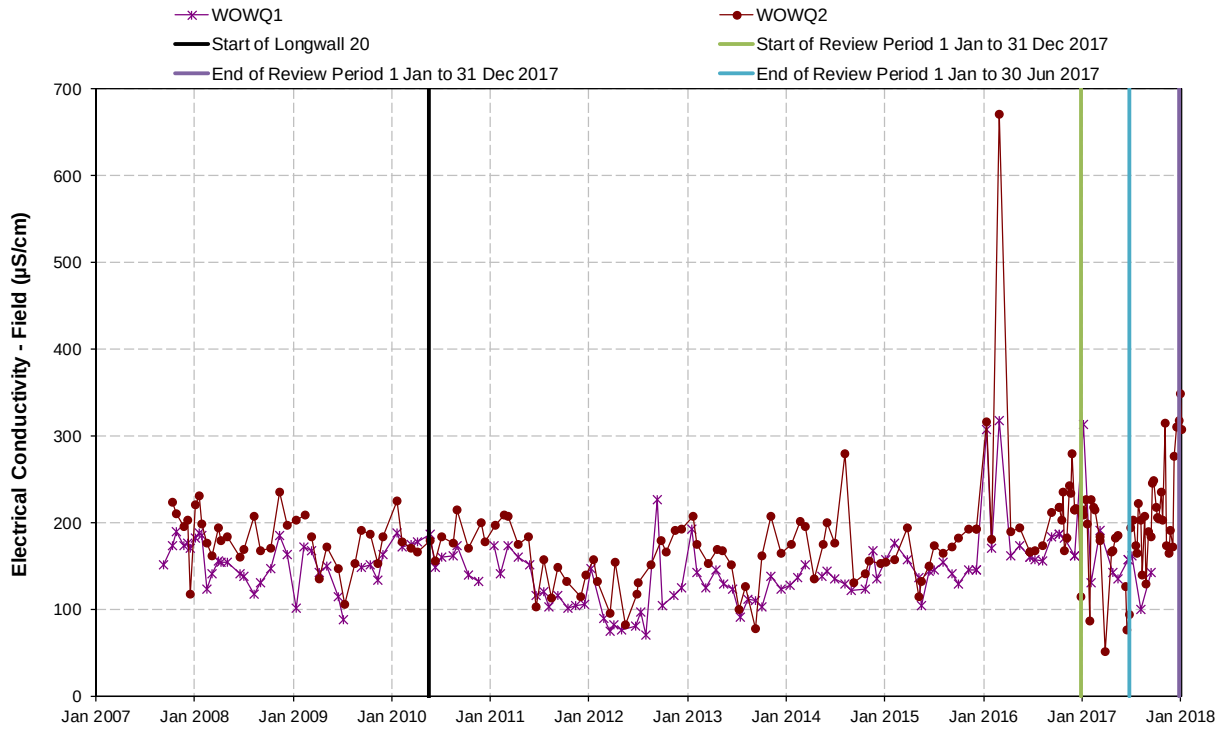


Chart 31 Electrical Conductivity (EC) Woronora River

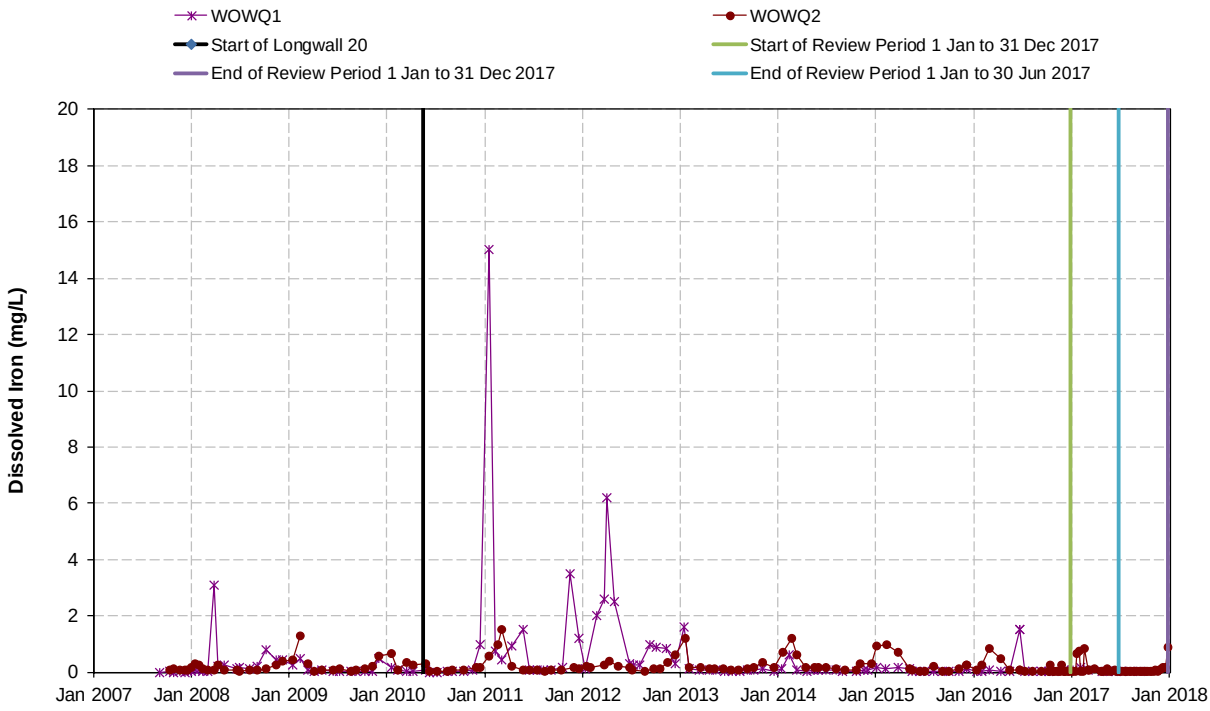


Chart 32 Dissolved Iron Woronora River

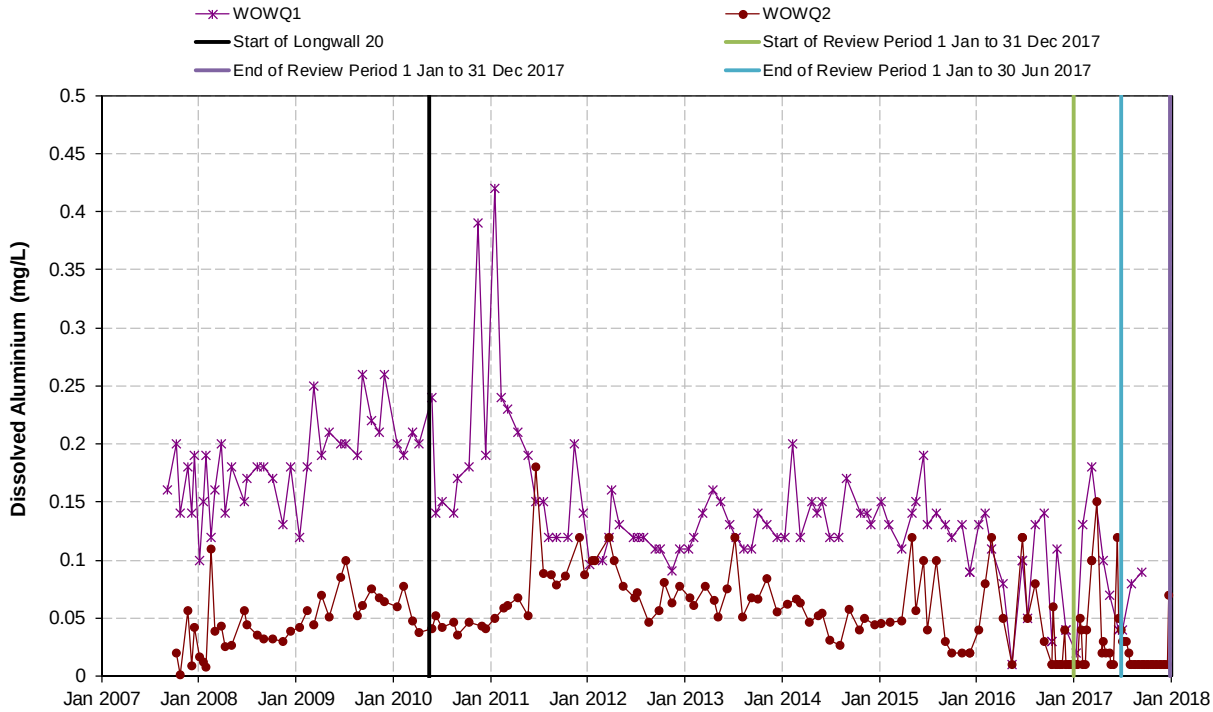


Chart 33 Dissolved Aluminium Woronora River

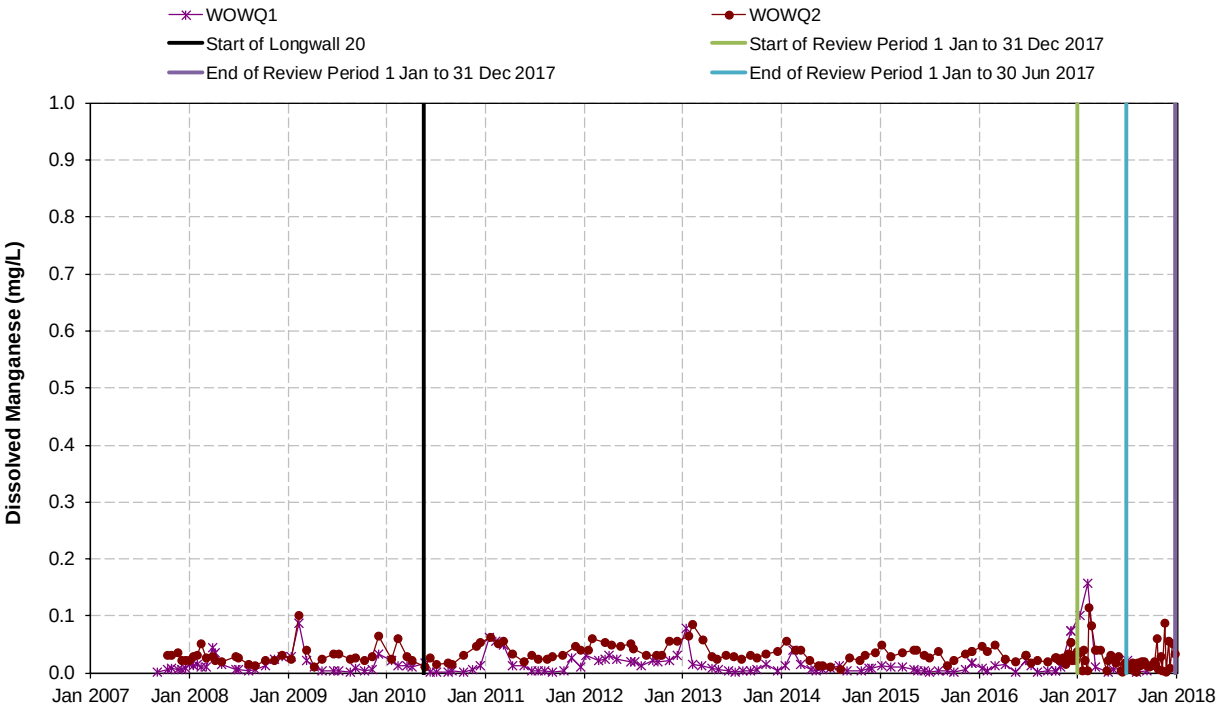


Chart 34 Dissolved Manganese Woronora River

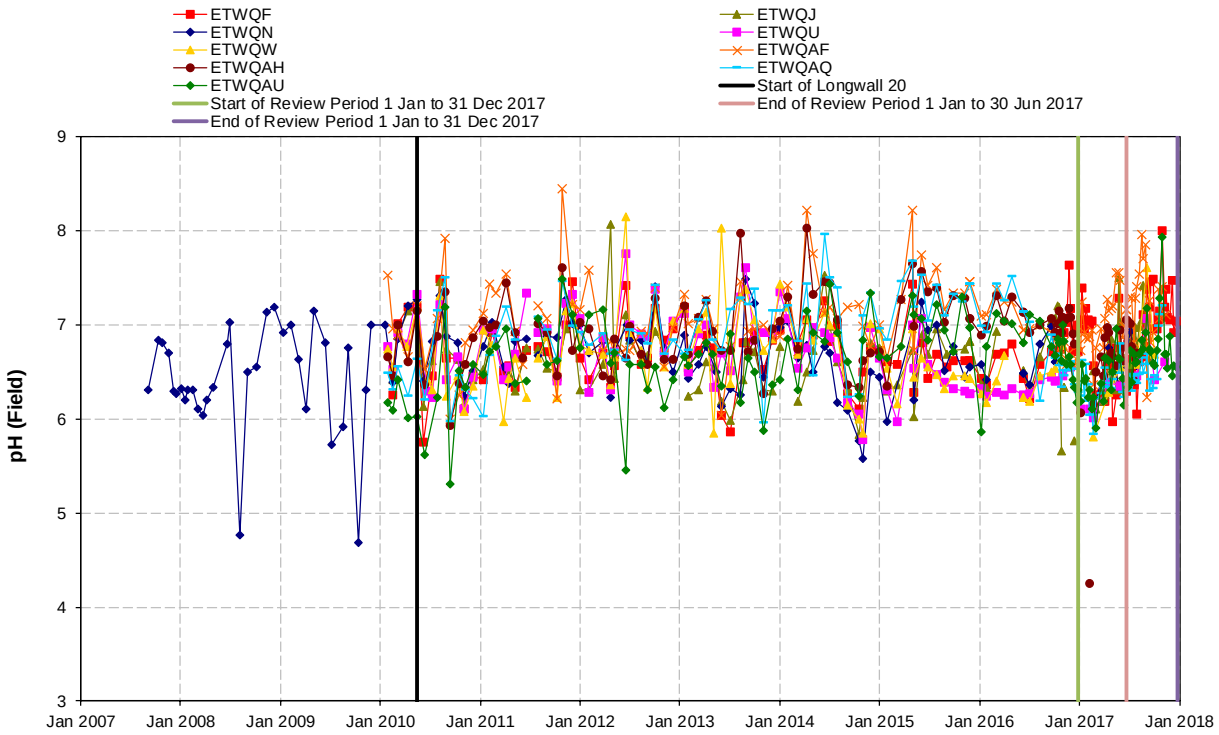


Chart 35 pH Levels Eastern Tributary

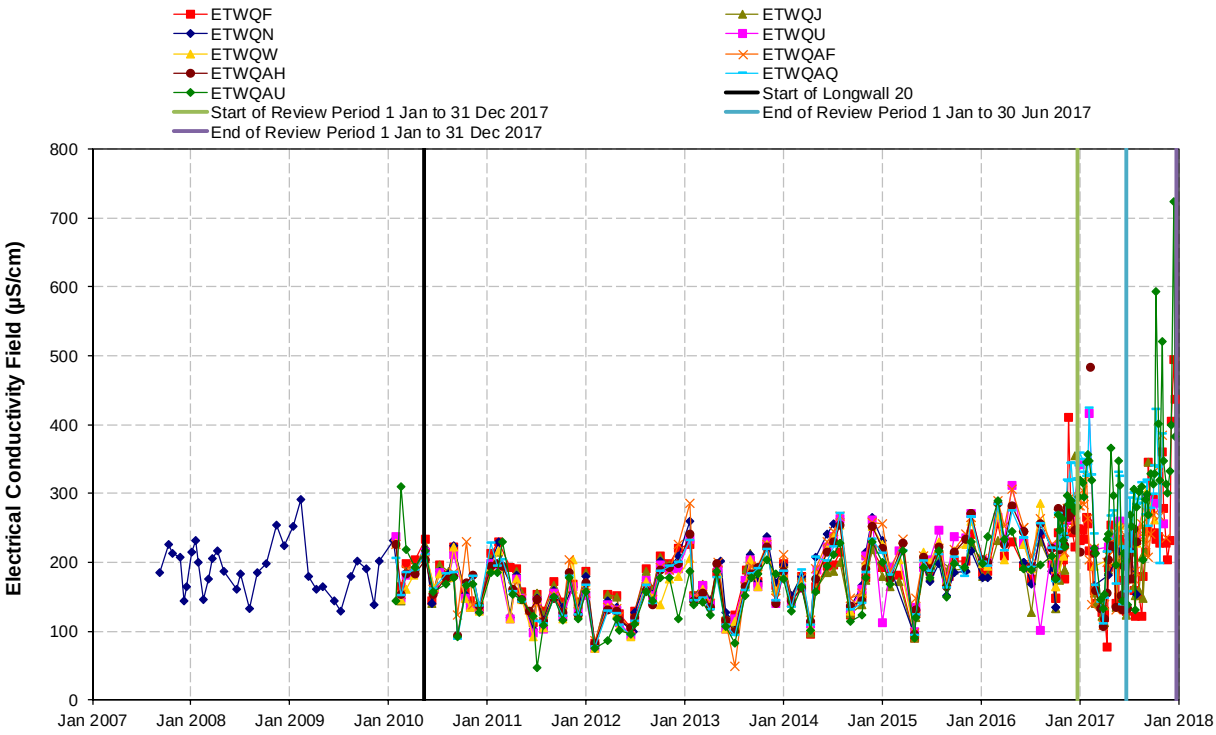


Chart 36a Electrical Conductivity (EC) Eastern Tributary

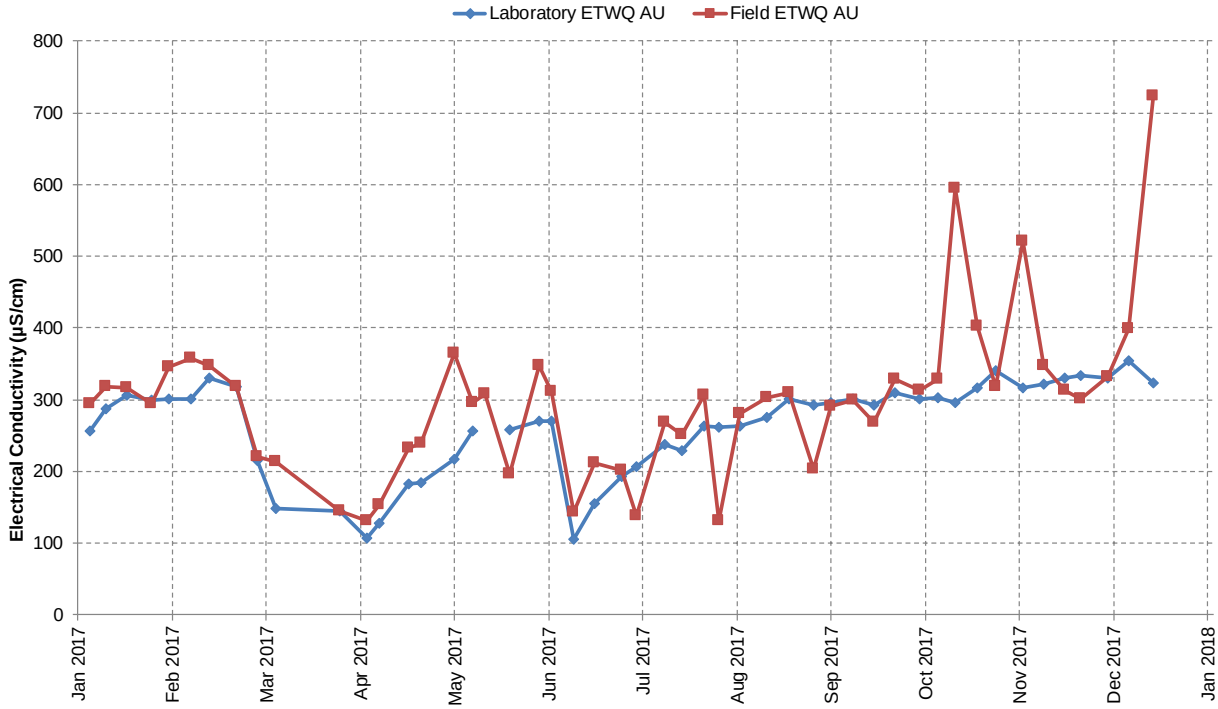


Chart 36b Comparison of Electrical Conductivity as Measured in the Field and Analysed in the Laboratory during the Review Period

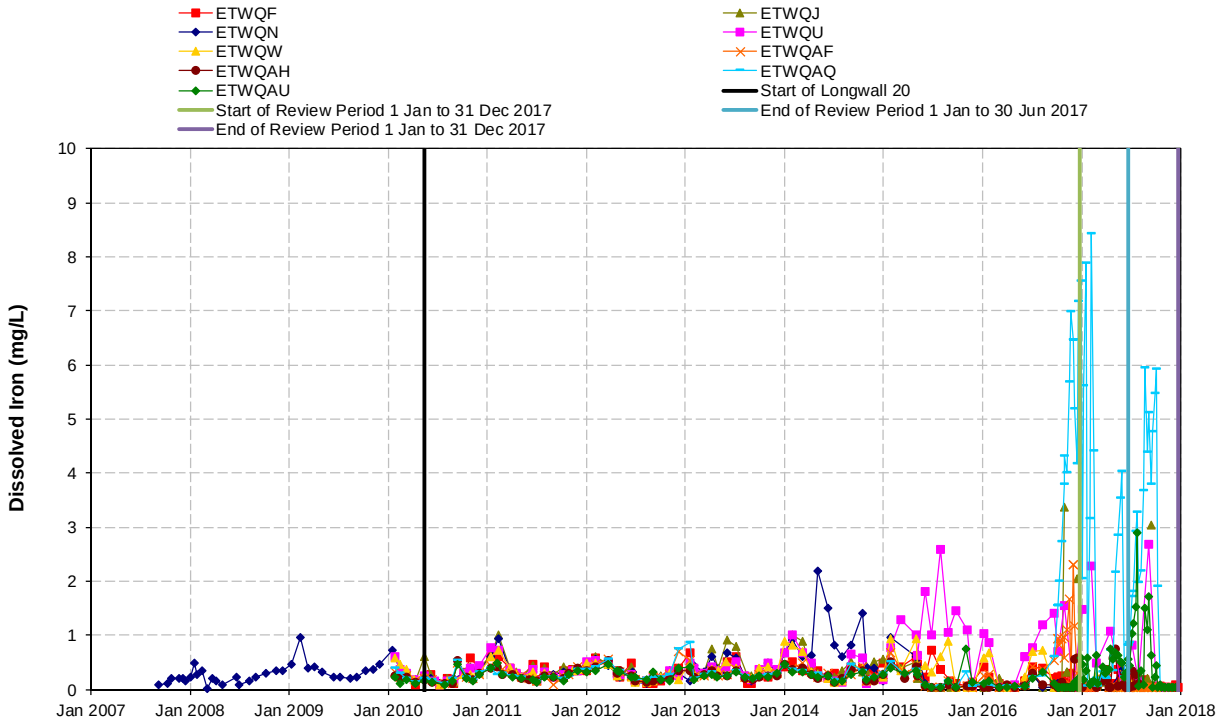


Chart 37 Dissolved Iron Eastern Tributary

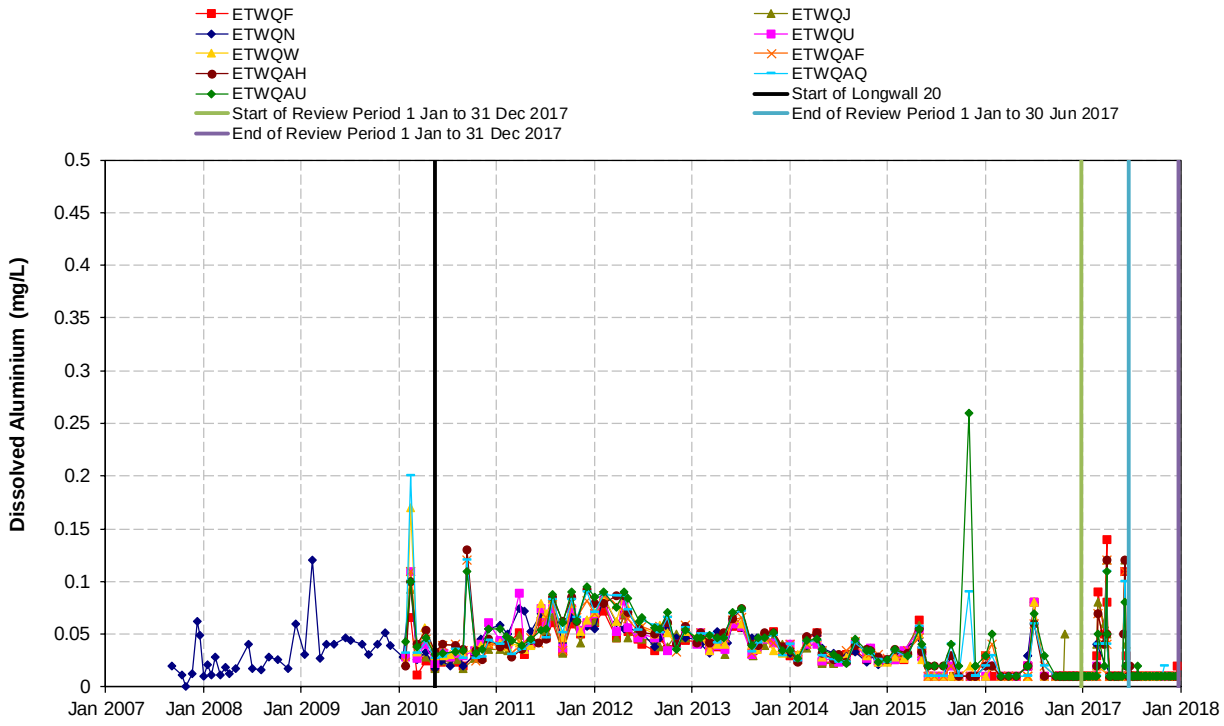


Chart 38 Dissolved Aluminium Eastern Tributary

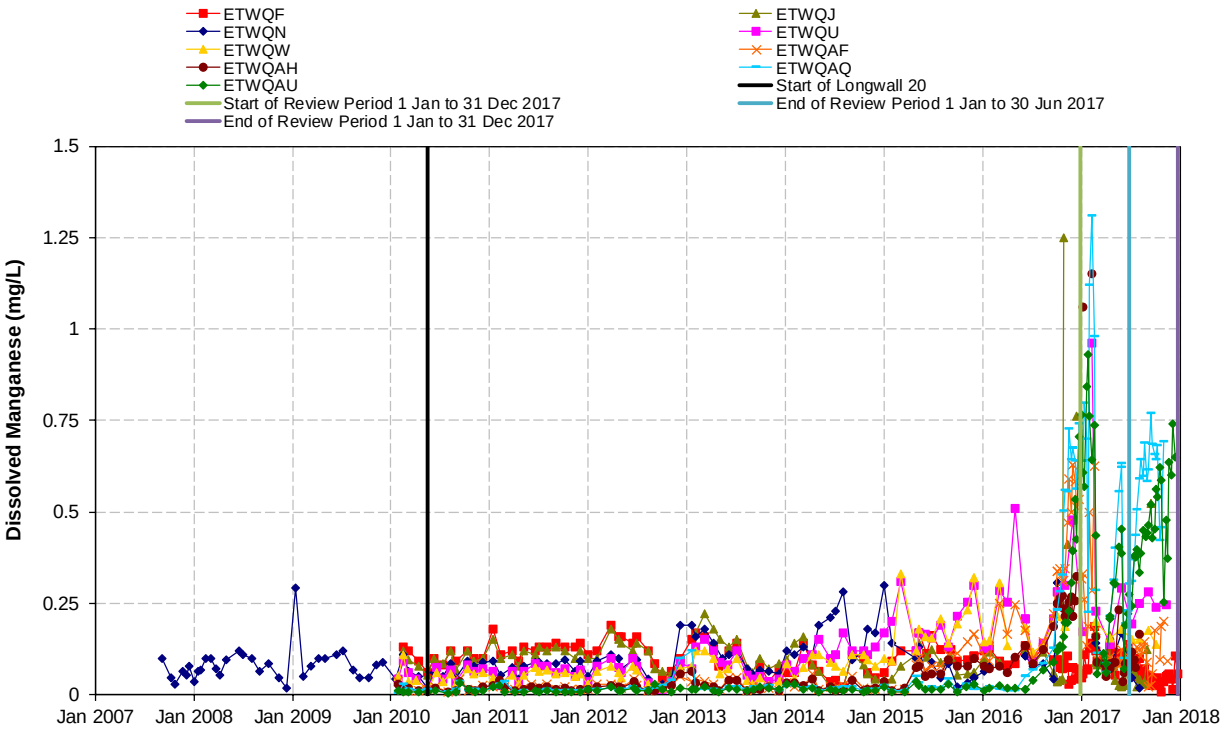


Chart 39 Dissolved Manganese Eastern Tributary

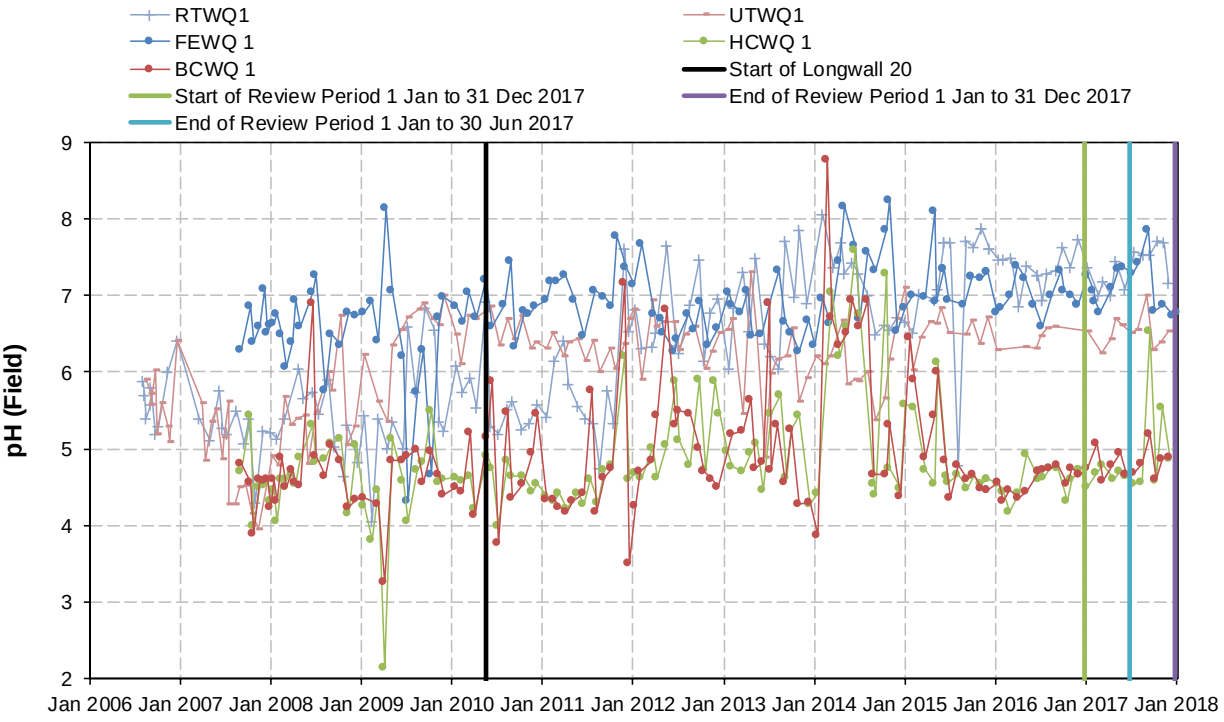


Chart 40 pH Levels Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

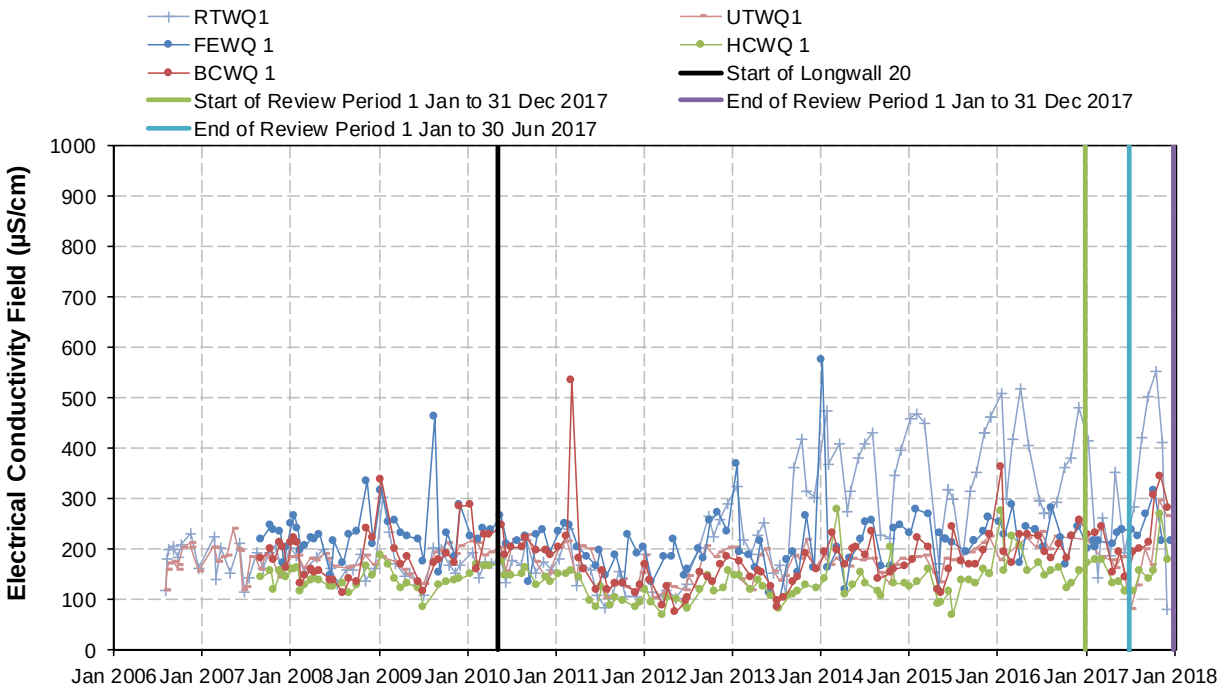


Chart 41 **Electrical Conductivity (EC) Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek**

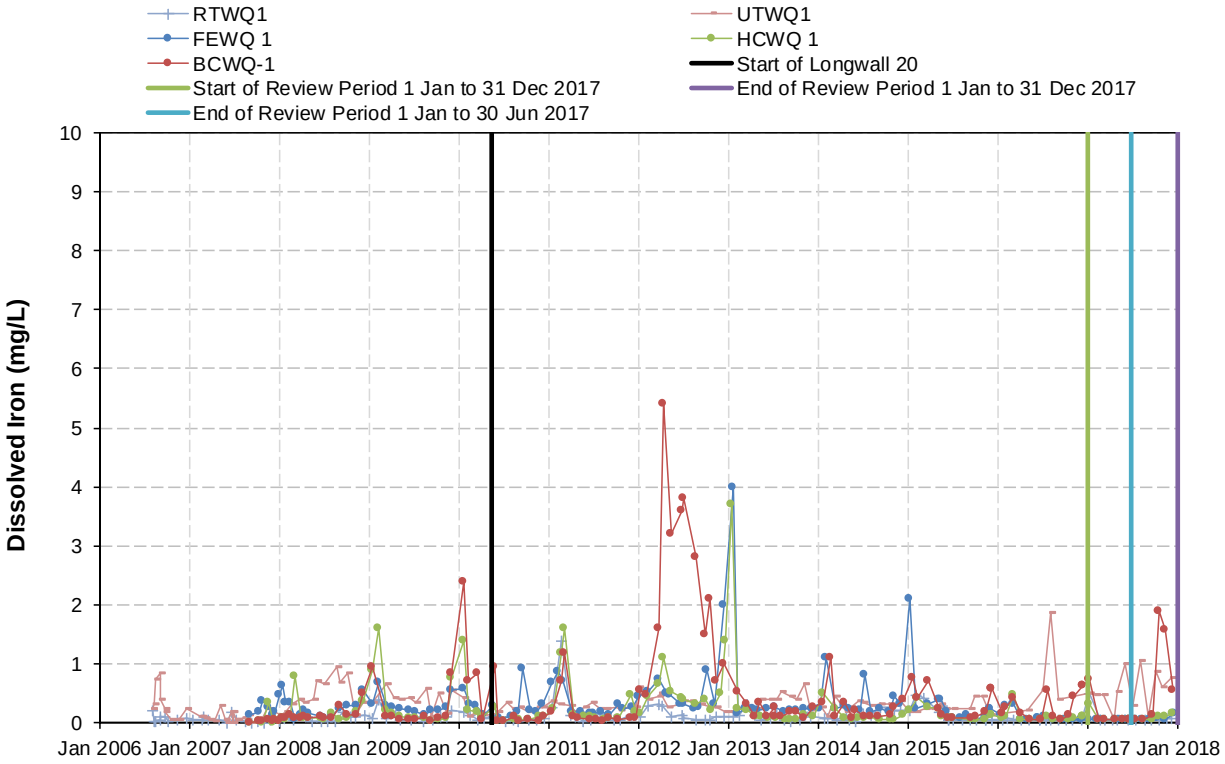


Chart 42 **Dissolved Iron Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek**

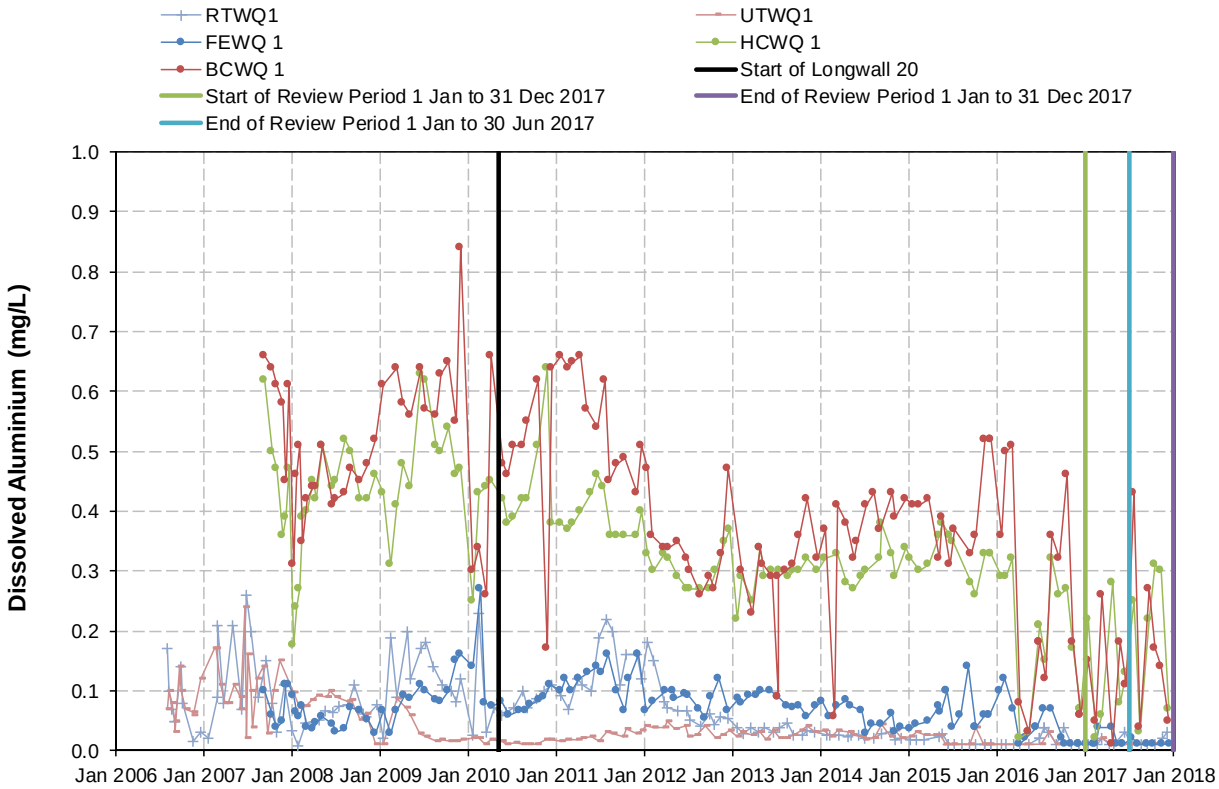


Chart 43 Dissolved Aluminium Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

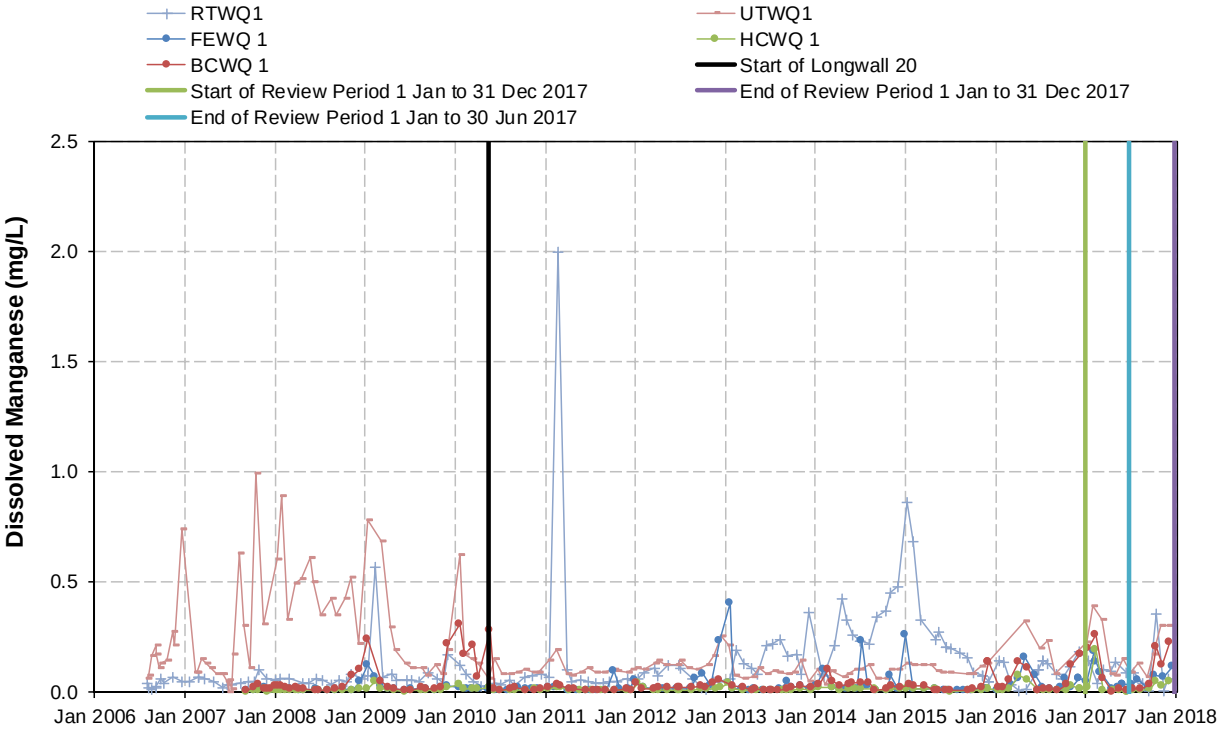


Chart 44 Dissolved Manganese Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

Water quality data has been analysed for key water quality parameters of relevance to water supply and the effects of subsidence, namely iron, manganese and aluminium at site WRWQ9 on Waratah Rivulet, site ETWQ AU on Eastern Tributary and at control site WOWQ2 on the Woronora River.

The performance indicator, *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,* is considered to have been exceeded if data analysis indicates a significant change in the quality of water post mining of Longwall 20. Specifically, if[4]:

- any water quality parameter exceeds the adjusted baseline mean plus two standard deviations for two consecutive months; or
- over a three month period the water quality parameter exceeds the adjusted mean plus two standard deviations in the first month, the adjusted mean plus one standard deviation in the next month and the adjusted mean plus two standard deviations in the third month; or
- the six month mean of the water quality parameter exceeds the adjusted baseline mean plus one standard deviation for two consecutive assessment periods (i.e. over two six monthly reports); and
- there was not a similar exceedance of the trigger at the control site.

Assessment of Water Quality at Site WRWQ9

There was no exceedance of the performance indicator as a result of the assessment methods for dissolved iron, dissolved aluminium or dissolved manganese at site WRWQ9 on Waratah Rivulet during the review period (either in the January to June 2017 assessment period or the July to December 2017 assessment period) (Appendices B1 and B2). There was no exceedance of the measures at the control site on the Woronora River at site WOWQ2 (Appendices B1 and B2).

Assessment of Water Quality at Site ETWQ AU

<u>January to June 2017 Assessment</u>

There was no exceedance of the performance indicator as a result of the assessment methods for dissolved iron or dissolved aluminium at site ETWQ AU on Eastern Tributary in the January to June 2017 assessment period (Appendix B1).

There were a series of consecutive monthly exceedances of the adjusted baseline mean plus two standard deviations of dissolved manganese in Eastern Tributary at site ETWQ AU in the January to June 2017 assessment period (Chart 45, Appendix B1). There was also an exceedance of the adjusted baseline mean plus one standard deviation for two consecutive six month means for dissolved manganese in Eastern Tributary at site ETWQ AU in the January to June 2017 assessment period (Chart 46). There was no exceedance of the measures at the control site on Woronora River at site WOWQ2.

As a result, an assessment was made against the subsidence impact performance measure, *Negligible reduction to the quality of water resources reaching the Woronora Reservoir.* The assessment undertaken by Associate Professor Barry Noller (The University of Queensland, 2017) is provided in Appendix F1. Assessment of the monitoring data concluded there has been a negligible reduction to the quality of water resources reaching the Woronora Reservoir (Appendix F1).

[4] Note each 'mean' is calculated as a geometric mean.

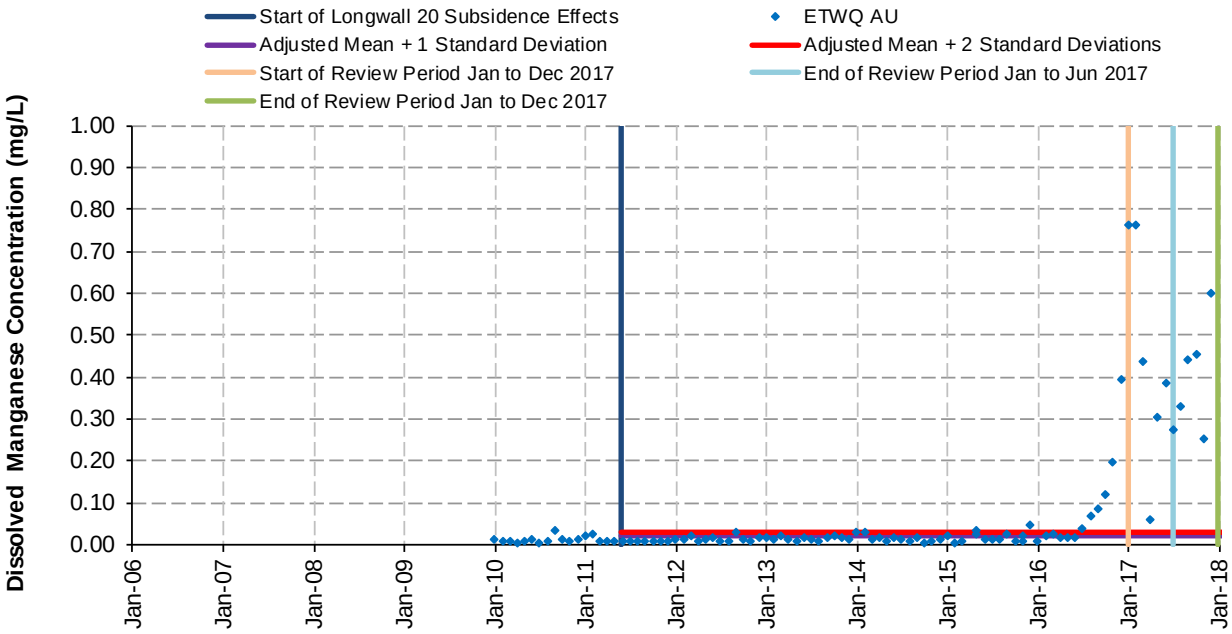


Chart 45 Monthly Dissolved Manganese Concentrations in Eastern Tributary at ETWQ AU

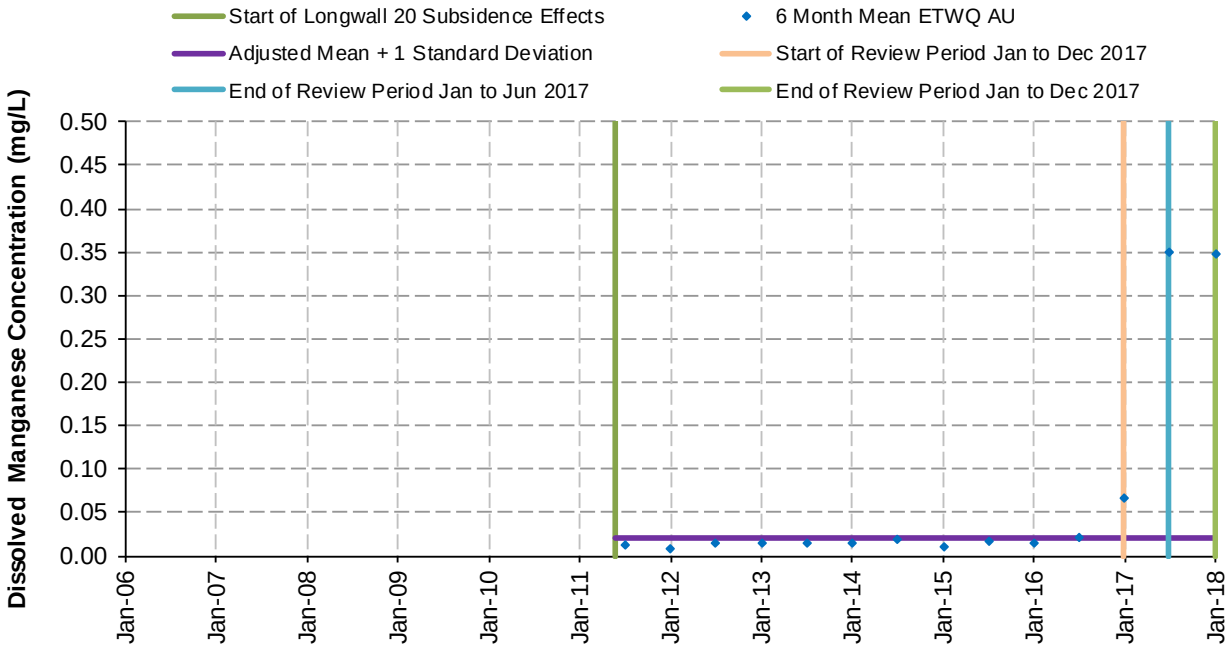


Chart 46 Six Month Means of Dissolved Manganese Concentrations in Eastern Tributary at ETWQ AU

July to December 2017 Assessment

There was no exceedance of the performance indicator as a result of the assessment methods for dissolved iron or dissolved aluminium at site ETWQ AU on Eastern Tributary in the July to December 2017 assessment period (Appendix B2). There was one exceedance of the adjusted baseline mean plus two standard deviations for dissolved iron at site ETWQ AU in September 2017 (equating to a Level 2 significance level [Table 15 in Section 6.8], but not an exceedance of the performance indicator) (Appendix B2).

There was an exceedance of the performance indicator as a result of the assessment methods for dissolved manganese at site ETWQ AU on Eastern Tributary in the July to December 2017 assessment period (Appendix B2). The monthly dissolved manganese concentrations exceeded the adjusted baseline mean plus two standard deviations of dissolved manganese in Eastern Tributary at site ETWQ AU from July to December 2017 (Chart 45, Appendix B2). Dissolved manganese concentrations also exceeded the adjusted mean plus two standard deviations in the first month, the adjusted mean plus one standard deviation in the next month and the adjusted mean plus two standard deviations in the third month. There was also an exceedance of the adjusted baseline mean plus one standard deviation for two consecutive six month means for dissolved manganese in Eastern Tributary at site ETWQ AU in the July to December 2017 assessment period (Chart 46, Appendix B2). There were no exceedances of these measures at the control site on Woronora River at site WOWQ2.

As a result, an assessment has been made against the subsidence impact performance measure, *Negligible reduction to the quality of water resources reaching the Woronora Reservoir.* The assessment undertaken by Associate Professor Barry Noller (The University of Queensland, 2018) is provided in Appendix F2. Assessment of the monitoring data concluded there has been a negligible reduction to the quality of water resources reaching the Woronora Reservoir (Appendix F2).

The environmental consequences of subsidence impacts on water quality were predicted by the Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans to be similar to that previously observed at Metropolitan Coal, specifically, transient pulses of iron, manganese and aluminium, which would likely occur following fresh cracking of the stream bed.

Water quality monitoring results to date indicate there has been a negligible reduction in the quality of water resources reaching the Woronora Reservoir.

6.2.5 Woronora Reservoir Water Quality

Metropolitan Coal has sourced water quality data for the Woronora Reservoir from WaterNSW in accordance with a data exchange agreement. Results in relation to total iron, aluminium and manganese levels from 0 m to 9 m below the reservoir surface for Woronora Reservoir throughout the period of record are presented in Charts 47, 48 and 49.

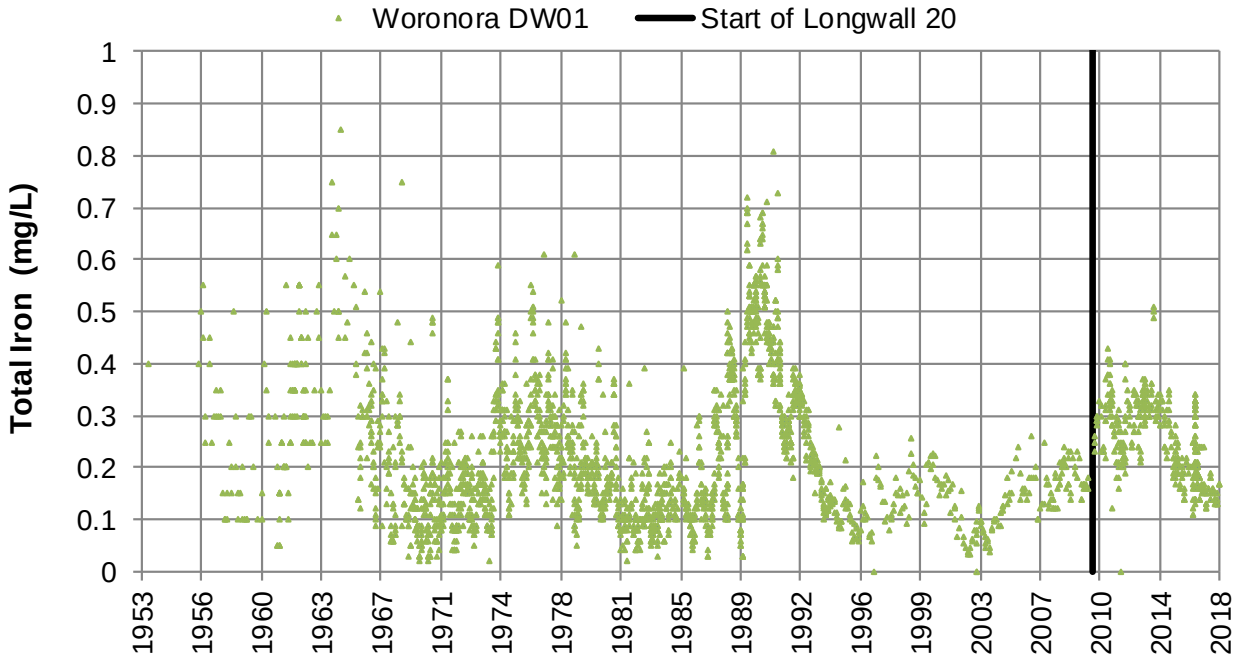


Chart 47 Total Iron Concentration Woronora Reservoir

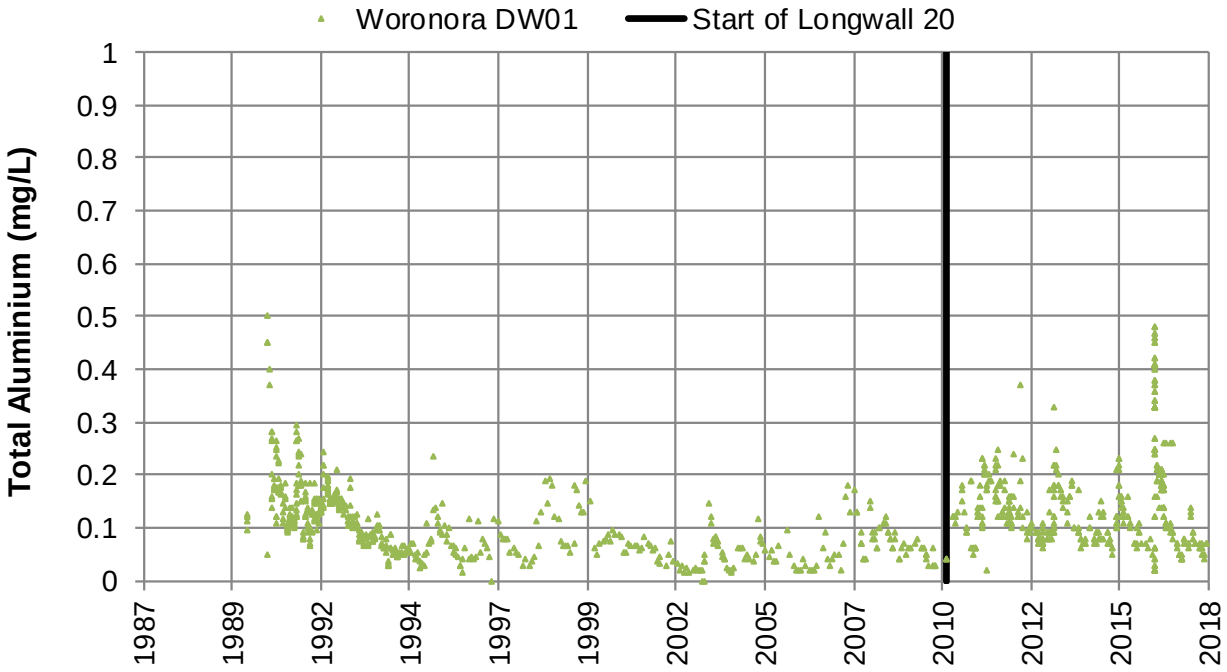


Chart 48 Total Aluminium Concentration Woronora Reservoir

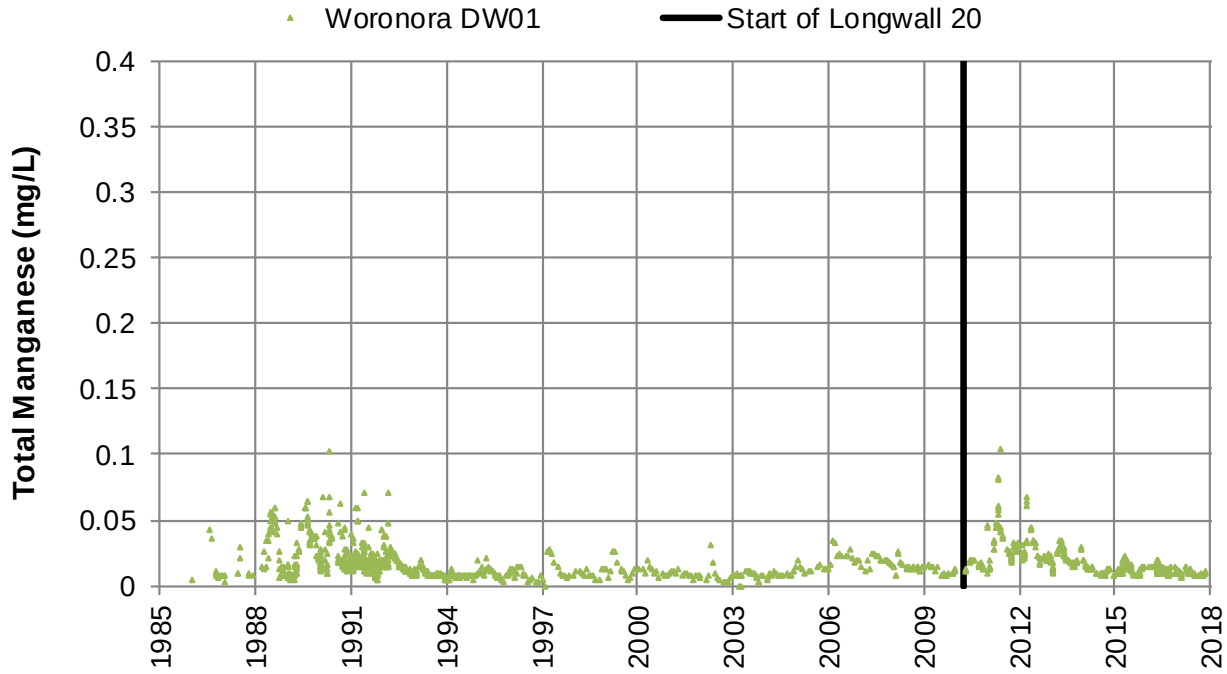


Chart 49 Total Manganese Concentration Woronora Reservoir

Water quality data in the Woronora Reservoir is analysed annually and assessed against the following performance indicator:

> *Changes in the quality of water in the Woronora Reservoir are not significantly different post-mining compared to pre-mining concentrations.*

The performance indicator is considered to have been exceeded if data analysis indicates a significant change in the quality of water post-mining, specifically if the current year's duration exceedance curve for a water quality parameter in Woronora Reservoir (total iron, total manganese and total aluminium) is above the baseline 20 year average recurrence interval (ARI) exceedance curve for any range of the duration percentages from 0% to 75%. The results of this assessment are shown on Chart 50, Chart 51 and Chart 52, respectively.

There were no exceedances of the Woronora Reservoir water quality performance indicator (the 20 year ARI exceedance curve) for total iron, total aluminium or total manganese during the review period (Charts 50, 51 and 52, respectively) (Appendix B2). There were also no exceedances of the 10 year ARI exceedance curve for total iron, total aluminium or total manganese (Charts 50, 51 and 52, respectively) (Appendix B2).

The Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans predicted the Project would not impact on the performance of the Woronora Reservoir and would have a neutral effect on water quality. The water quality monitoring results are consistent with the predictions.

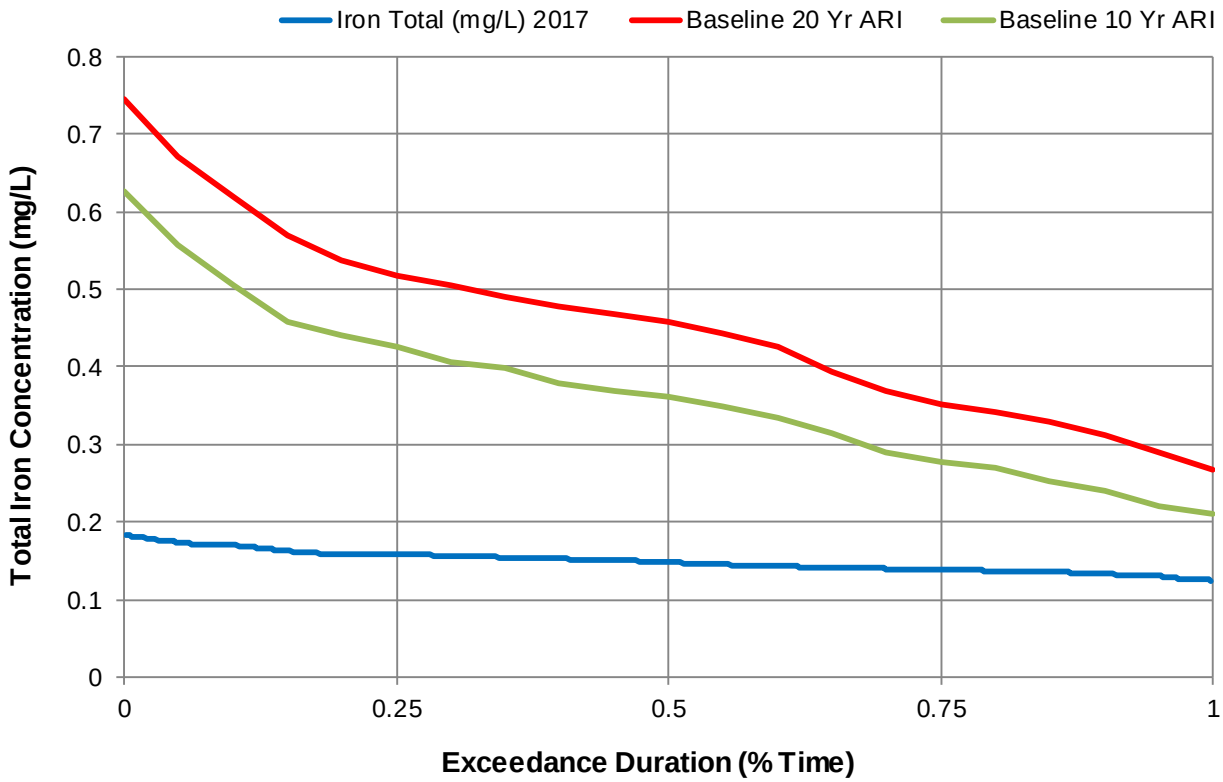


Chart 50 Total Iron Performance Indicator Woronora Reservoir 2017

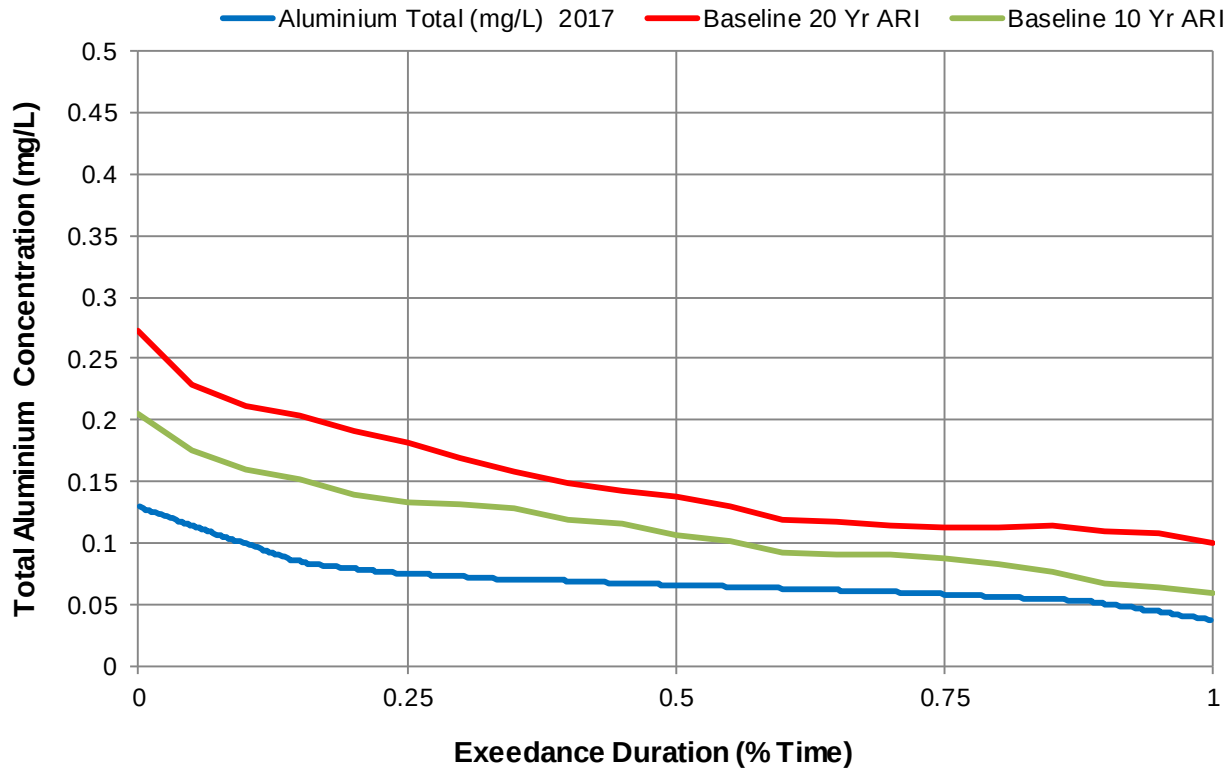


Chart 51 Total Aluminium Performance Indicator Woronora Reservoir 2017

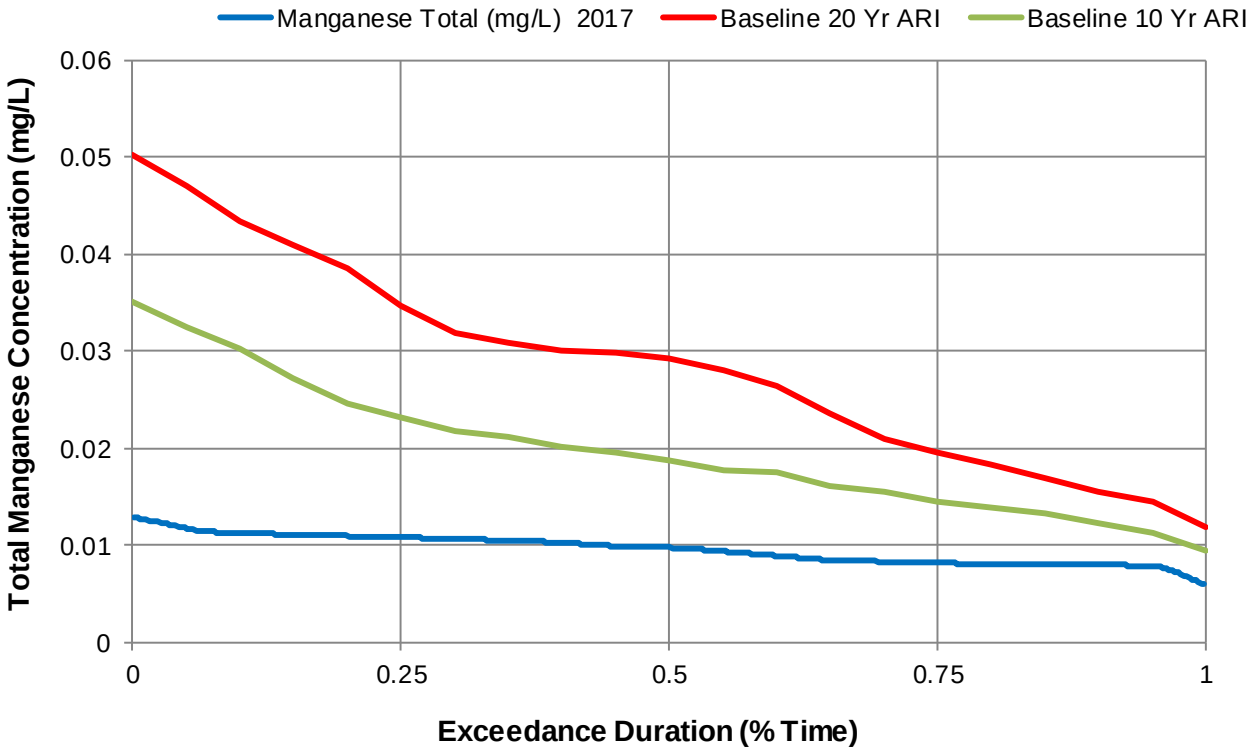


Chart 52 Total Manganese Performance Indicator Woronora Reservoir 2017

6.2.6 Swamp Groundwater Levels

Groundwater monitoring of upland swamps has involved the use, where practicable, of paired piezometers, one in the swamp substrate (at approximately 1 m depth) and one in the underlying sandstone (at a depth of approximately 10 m) (Figure 9). Data shows that water levels within the swamps over longwalls are typically perched above those of the local Hawkesbury sandstone groundwater levels and indicates a separate control on swamp water levels. That is, the swamps are primarily surface water fed systems and generally water infiltrates downwards from the swamps to the groundwater.

Swamp substrate water levels are assessed against the following upland swamp groundwater performance indicator:

> *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*.

Swamp Monitoring for Longwalls 20-27

Paired piezometers have been monitored in Swamp 25 overlying Longwalls 20-22, Swamps 28, 30, 33 and 35 overlying Longwalls 23-27, and in control swamps 101, 137a, 137b and Bee Creek Swamp (Figure 9). At Swamp 20 and at control swamp Woronora River Swamp 1, multiple piezometers have been monitored (i.e. one swamp substrate piezometer to a depth of approximately 1 m and two sandstone piezometers to depths of approximately 4 and 10 m) (Figure 9).

The upland swamp groundwater performance indicator has been exceeded at Swamp 20 since 2012 and at Swamp 28 since 2016. Swamp 20 substrate water levels changed from being permanently saturated to being periodically saturated as a result of the passing of Longwall 21 (Chart 53 and Appendices C1 and C2). This trend continued to be observed throughout the review period (Chart 53). It is considered that Longwall 21 caused a mining effect at Swamp 20, but the effects have not been exacerbated by Longwalls 22-27 or Longwall 301 (Appendices C1 and C2).

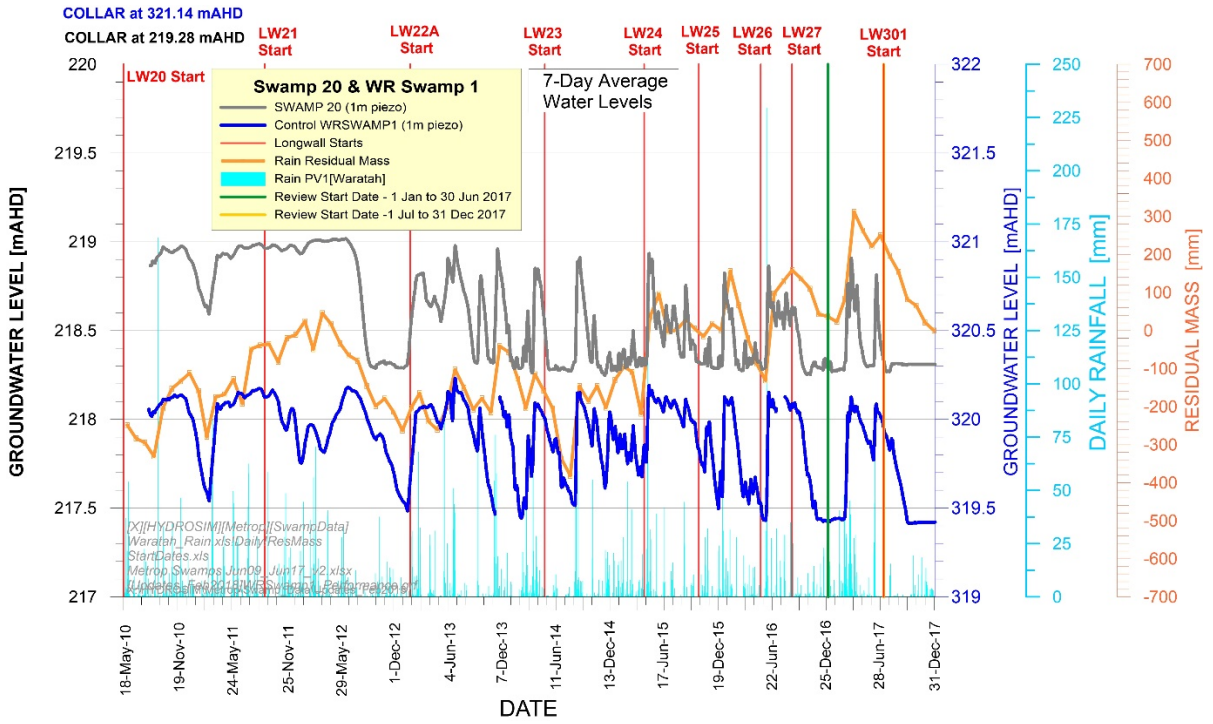


Chart 53 Comparison of Piezometer Responses at Swamp 20 and Woronora River 1 Control Swamp

A mining effect to the substrate water levels of Swamp 28 (overlying Longwall 24) was identified in 2016 based on the incomplete recovery of substrate water levels following rainfall events (Chart 54 and Appendices C1 and C2). Swamp 28 is considered to have an impact from mining of Longwall 25, although no effect on swamp substrate water levels occurred when Longwall 24 passed directly beneath the monitoring site (Appendices C1 and C2). During the review period from March to June 2017, the substrate piezometer in Swamp 28 displayed a response to increased rainfall residual similar to that of the control swamps and the upper height of saturation has almost returned to normal. The substrate piezometer at Swamp 28 returned to dry conditions from September 2017 until the end of 2017, as did the two control swamp piezometers.

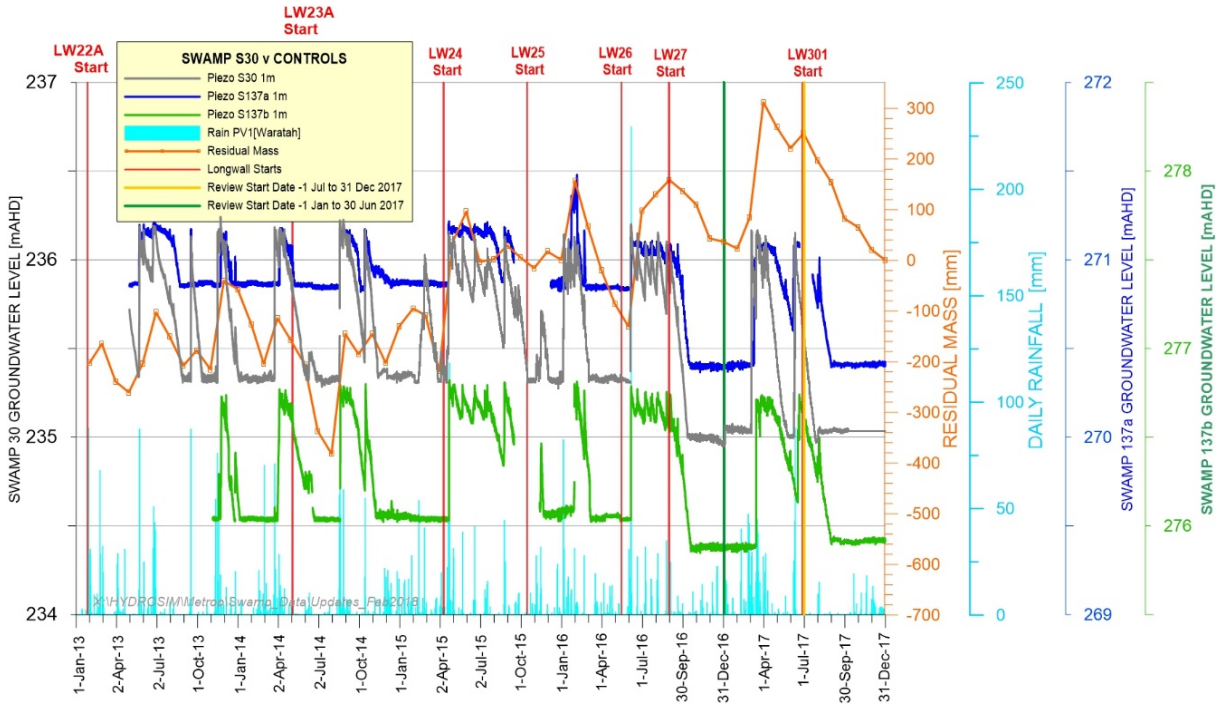


Chart 54 Groundwater Hydrographs at Swamp 28 and Two Control Swamps (137a and 137b)

During the review period the swamp substrate water levels of Swamps 25, 30, 33 and 35 remained perched (Appendices C1 and C2).

Swamp Monitoring for Longwalls 301-303

Paired piezometers (i.e. one swamp substrate piezometer and one sandstone piezometer) have also been monitored in Swamps 40, 41, 46, 51, 52 and 53 overlying Longwalls 301-303 (Figure 9). As indicated in Section 4.1, Longwall 301 commenced on 28 June 2017.

In summary, the swamp substrate water levels of Swamps 40, 41, 46, 51, 52 and 53 remained perched during the reporting period (Appendix C2).

The seven day moving average for Swamps 46, 51 and 53 was at or above the swamp's minimum recorded in the baseline period. Swamps 46, 51 and 53 are assessed as being at Level 1 trigger levels (Trigger Action Response Plan for upland swamp groundwater monitoring in the Longwalls 301-303 Biodiversity Management Plan, refer Table 15). The seven day moving average for Swamps 40, 41 and 52 was below the swamp's minimum recorded in the baseline period. Swamps 40, 41 and 52 are assessed as being at Level 2 trigger levels (Table 15).

The key potential subsidence impacts and environmental consequences on perched groundwater systems described in the Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans and Biodiversity Management Plans, included:

- Any cracking of the bedrock within upland swamps is expected to be isolated and of a minor nature, due to the relatively low magnitudes of the predicted strains and the relatively high depths of cover.
- Surface cracking resulting from mine subsidence within the upland swamps is not expected to result in an increase in the vertical movement of water from the perched water table into the regional aquifer as the sandstone bedrock is massive in structure and permeability decreases with depth.
- It is expected that any surface cracking that may occur would be superficial in nature (i.e. would be relatively shallow) and would terminate within the unsaturated part of the low permeability sandstone. Any changes in swamp water levels as a result of cracking are expected to be immeasurable when compared to the scale of seasonal and even individual rainfall event based changes in swamp groundwater levels.
- Whilst swamp grades vary naturally, the predicted maximum mining-induced tilts are generally orders of magnitude lower than the existing natural grades within the swamps. The predicted tilts would not have any significant effect on the localised or overall gradient of the swamps or the flow of water. Any minor mining-induced tilting of the scale and nature predicted is not expected to significantly increase lateral surface water movements which are small in relation to the other components in the swamp water balance.

No change to the fundamental surface hydrological processes and upland swamp vegetation were expected within upland swamps.

In relation to impacts of the Project on upland swamps, the NSW Planning Assessment Commission (2009) concluded that the mining parameters were such that:

- for most swamps in the Project Area, there was low risk of negative environmental consequences; and
- that there was a very low risk that a significant number of swamps would suffer such consequences.

While the water lost from Swamp 20 and Swamp 28 was retained in the unsaturated sandstone above the regional water table, the changes in swamp water levels as a result of cracking are measurable when compared to seasonal individual rainfall event based changes in swamp groundwater levels. There is currently no sign that the vegetation in Swamp 20 is being impacted by the changed hydrological conditions, however, the autumn 2017 vegetation monitoring results suggest that the changes in vegetation occurring in Swamp 28 are significantly different to changes in the control swamps (refer Section 6.3.1).

6.2.7 Shallow Groundwater Levels

Shallow Groundwater Level Sites near Streams

Continuous water level monitoring of shallow groundwater levels has been conducted at sites WRGW1, WRGW2 and WRGW7 along Waratah Rivulet and sites ETGW1 and ETGW2 on the Eastern Tributary (Figure 10).

At the time of passage of the Longwall 21 mining face past the piezometer sites WRGW1 and WRGW2 on the Waratah Rivulet (March 2012), the groundwater levels dropped by about 1 m (Chart 55). Since March 2012, groundwater levels recorded in WRGW1 and WRGW2 have fluctuated in response to seasonal rainfall variations with a seasonal (dry) minimum that is approximately 0.75 m below previous levels. Although the water levels have not returned to pre-March 2012 levels, throughout the review period the water levels at sites WRGW1 and WRGW2 have correlated closely with rainfall trends (as indicated by the residual mass curve on Chart 55) (Appendices C1 and C2).

Shallow groundwater levels at site WRGW7 remained correlated with rainfall trends and unaffected by mining during the review period (Chart 56) (Appendices C1 and C2).

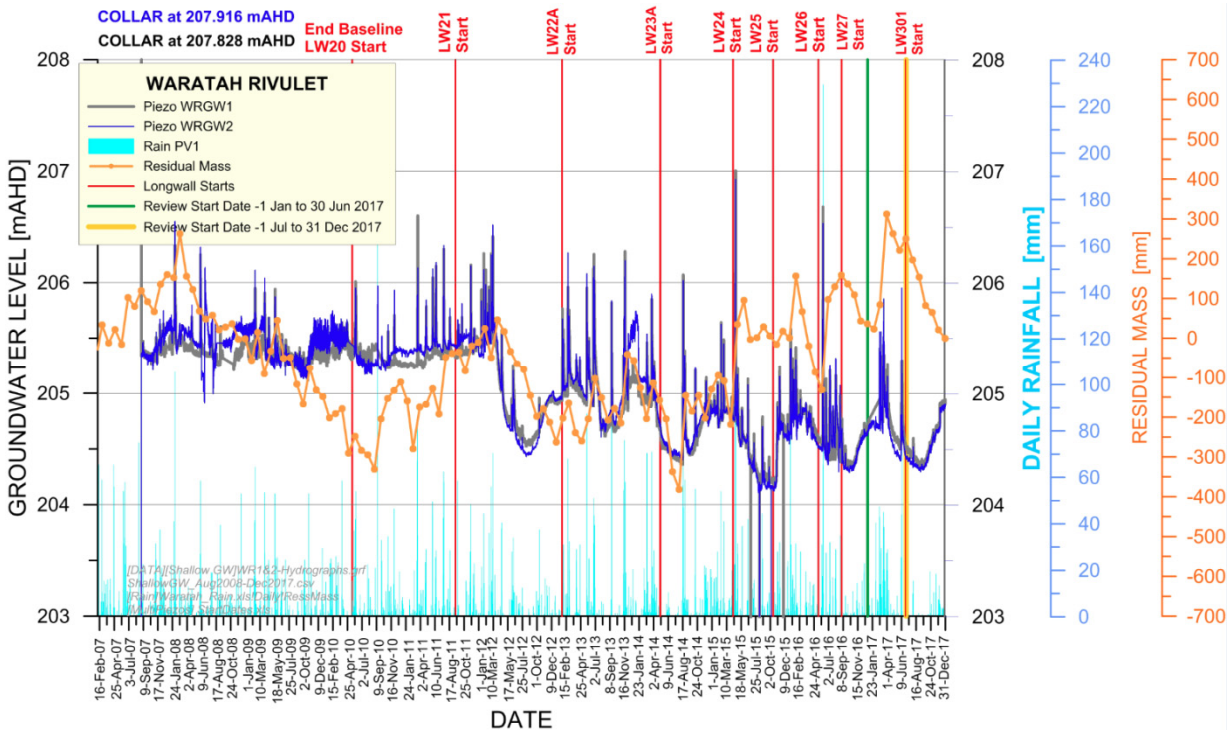


Chart 55 Shallow Groundwater Hydrographs on Waratah Rivulet at WRGW1 and WRGW2

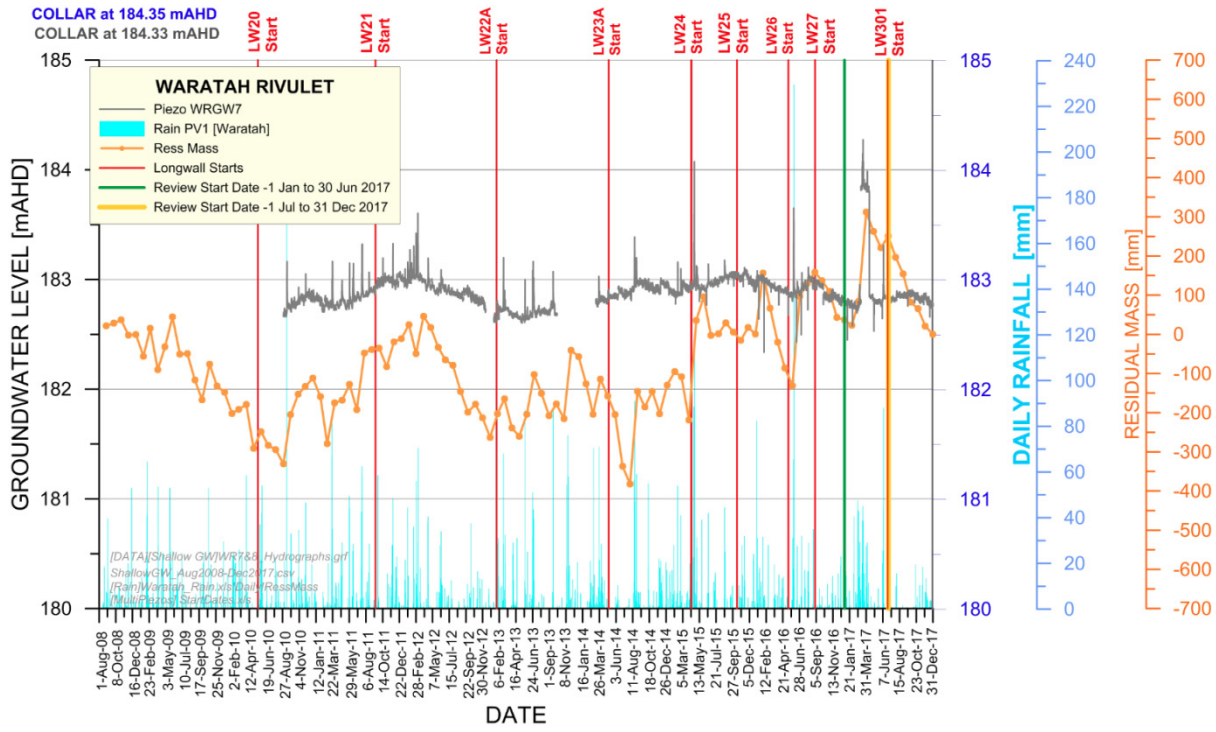


Chart 56 Shallow Groundwater Hydrographs on Waratah Rivulet at WRGW7

At the Eastern Tributary sites ETGW1 and ETGW2, shallow groundwater levels have previously followed the rainfall trends closely (Chart 57) and have continued to show a close correlation during the review period. The variations at these sites are unrelated to mining (Appendices C1 and C2).

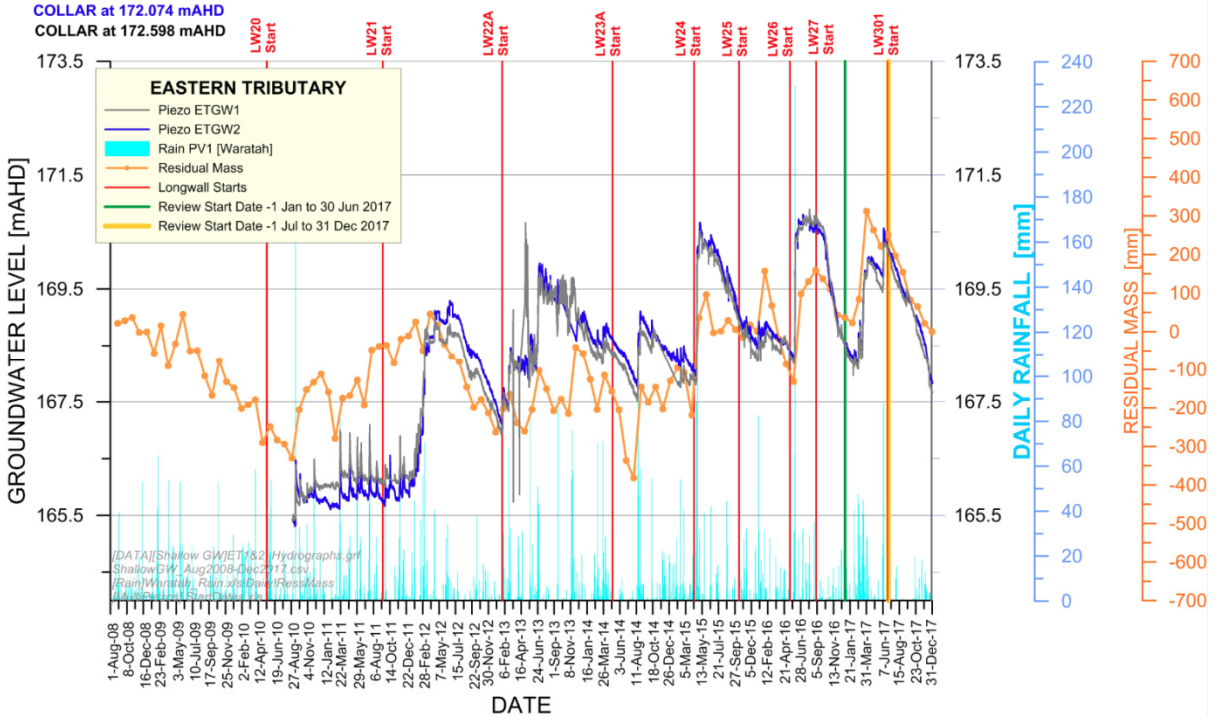


Chart 57 Shallow Groundwater Hydrographs on Eastern Tributary at ETGW1 and ETGW2

Shallow Groundwater Transect

Continuous groundwater level monitoring has also been conducted at an approximately east-west transect of bores (sites T1, T2, T3, T4 and T5) located to the west of Longwalls 301-303 (Figure 10) in accordance with the Longwalls 301-303 Water Management Plan (Chart 58). Bore T1 is the nearest of the five bores to the Woronora Reservoir, and is most sensitive to fluctuations in lake level (Appendix C2).

Groundwater levels at transect bores T2, T3 and T5 are assessed against the following performance indicators for Longwalls 301-303:

The water level at bore T2 is greater than 170.0 m AHD.

The water level at bore T3 is greater than 171.8 m AHD.

The hydraulic gradient from transect bore T5 to bore T3 is reduced by no more than 10% from that measured on 30 June 2017.

The performance indicators were not exceeded during the review period.

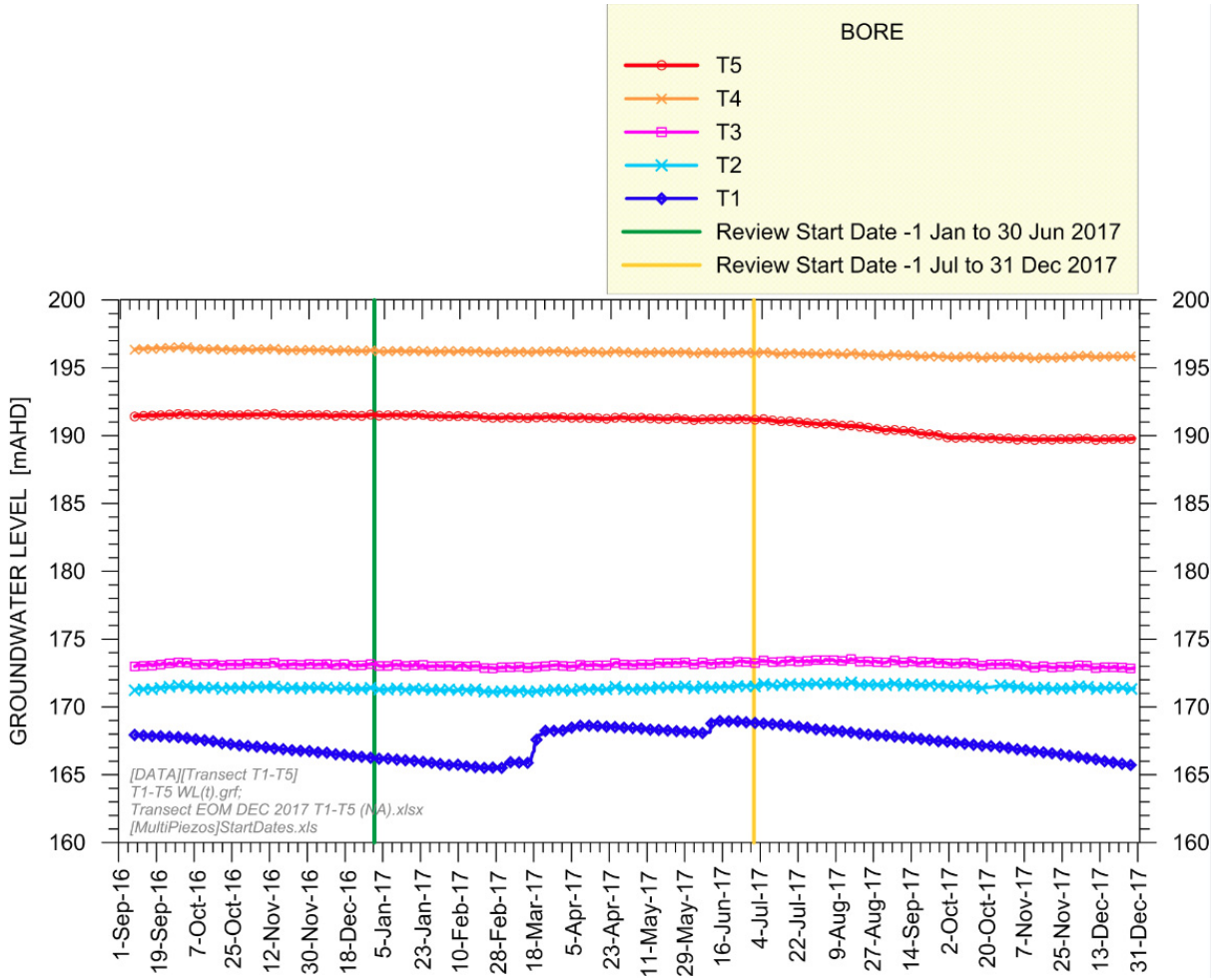


Chart 58 Groundwater Level in Bores T1 to T5

The key potential subsidence impacts and environmental consequences on shallow groundwater systems and inflows to the Woronora Reservoir described in the Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans included:

- Permanent mining-induced changes in the groundwater levels of shallow aquifers in connection with streams and ecosystems at Metropolitan Coal would not occur to any significant degree (i.e. the direction of shallow groundwater system flow [i.e. in the Hawkesbury Sandstone] has not been altered by mining).
- As there is an alternation of thick sandstone/claystone lithologies, there is a constrained zone in the overburden that remains rigid and acts as a bridge which isolates shallow and deep aquifers. At the substantial depths of cover of the Project, there would not be connective cracking from the mined seam to the surface.
- The depressurisation effects described below for the deep groundwater system would not propagate to the Hawkesbury Sandstone where the shallow groundwater system is located. As a result, no measurable impacts on registered bores in the wider Project area and surrounds would be expected.

Based on the analysis of the conceptual groundwater system, there would be negligible loss of groundwater yield to the Woronora Reservoir. This is reinforced by the groundwater modelling which indicates negligible reduction in cumulative average inflows to the Woronora Reservoir. In relation to the potential loss of catchment yield, the NSW Planning Assessment Commission (2009) was of the view that the risk of any significant loss is very low unless a major geological discontinuity is encountered during mining that provides a direct hydraulic connection between the surface and the mine workings.

The groundwater monitoring results are considered to be consistent with the potential subsidence impacts and environmental consequences described in the Project EA, Preferred Project Report and the Metropolitan Coal Water Management Plans.

6.2.8 Deep Groundwater Levels

Immediately above a mined coal seam, rocks collapse into the void created by the removal of coal to form a caved zone and a fractured zone develops above the caved zone. This causes aquifer properties to change (e.g. permeability and porosity) and results in a higher vertical permeability as a result of mining.

A three-dimensional numerical model of groundwater flow was developed for the mine and its surroundings prior to the commencement of Longwall 20. Since then, the model has been recalibrated and refined in the upper layers (Hawkesbury Sandstone) and extended from 13 to 15 layers. The groundwater model has been updated progressively as new multi-level piezometric data became available from the monitoring program. Model outputs have been examined every six months for review of environmental performance.

Transient calibration has been undertaken to incorporate Metropolitan Coal updates to the geological model. The revised model includes an update of the topographical surface and geological interfaces, the addition of two model layers below the Bulli seam and updated estimates of the fractured zone height. A draft report has been prepared for the updated model which is currently under review. The updated model has not been used for assessments in this Annual Review (Appendices C1 and C2), however will be used for the assessment of future longwalls.

Continuous groundwater level/pressure monitoring is conducted at bores 9HGW0 (Longwall 10 Goaf Hole), 9EGW1B, 9FGW1A, 9GGW1-80, 9GGW2B, 9HGW1B, PM02, PM01, 9EGW2A, PM03, PHGW1B, PHGW2A, F6GW3 and F6GW4 (Figure 10). The time-series head variations and vertical head differences for these bores have been examined (Charts 59 to 72).

As described earlier in Section 6.2, HydroSimulations (2018a, 2018b) has reviewed the environmental performance of the Project in relation to groundwater in the underground mining area and surrounds for the Annual Review period. This includes the assessment of groundwater for the January to June 2017 period in accordance with the Longwalls 20-22 and Longwalls 23-27 Water Management Plans (Appendix C1) and the assessment of groundwater for the July to December 2017 period in accordance with the Longwalls 301-303 Water Management Plan (Appendix C2). The results are described below and are assessed against the applicable performance indicators and measures in Table 14 (January to June 2017 assessment period) and Table 15 (July to December 2017 assessment period).

Time Series Head Variations and Vertical Head Differences

January to June 2017 Assessment

The monitoring sites closest to Longwalls 23-27 are bore 9EGW1B (approximately 300 m north of Longwall 23A) and bore 9GGW2B (above Longwall 27 headings) (Figure 10).

The time-series record for bore 9EGW1B (Chart 60) shows fairly stable heads that decline with depth in a regular manner, except for piezometer 233 m in the upper Bulgo Sandstone whose head is out of sequence. The deepest piezometer (542 m in Coal Cliff Sandstone), which has been declining slowly since the commencement of Longwall 20 due to far-field depressurisation, changed from a declining to increasing trend of potentiometric head during the reporting period. Groundwater pressures were relatively stable during the reporting period in all other piezometers, with no sign of any effect from Longwalls 24 to 27 (Appendix C1).

The time-series record for bore 9GGW2B is shown on Chart 63[5]. During the passage of Longwall 24 (>600 m away), minor drawdowns were observed in the Bulli Coal Seam and the Scarborough Sandstone, but other sensors exhibited no effect or a rise in head. The passage of Longwall 25 (>400 m away) caused distinct drawdowns in the Scarborough Sandstone, Wombarra Claystone, Stanwell Park Claystone and upper Bulgo Sandstone. Characteristic arcuate segments between cusps associated with subsequent longwall crossings are evident in the Scarborough Sandstone, Wombarra Claystone and Stanwell Park Claystone, but not in the Bulli Coal Seam. The lower Bulgo Sandstone shows rising head arcuate segments for Longwall 26 and Longwall 27 crossings, due to compression at that level. Sympathetic drawdowns are also exhibited in the three Hawkesbury Sandstone piezometers at the times of the Longwall 26 and Longwall 27 crossings[6] (Appendix C1).

July to December 2017 Assessment

The monitoring sites closest to Longwall 301 are bore F6GW4A (west of Longwall 303), bore F6GW3A (to the south of Longwall 301) and bore 9GGW2B (above 300-series mains and to the south-west of Longwall 303) (Figure 10 and Appendix C2).

The time-series record for bore F6GW4 is shown on Chart 72. The hydrographs show variation within 2017. All piezometers above the Bulli Seam (P512) piezometer responded in a predictable way showing pressure drawdown response from September 2017 when it was passed by Longwall 301 at a distance of about 400 m. The P512 piezometer showed a pressure increase from that time, which may be attributable to lateral compression at seam level. However, this is unexpected as F6GW4 is two panel widths away from Longwall 301 and the recorded head is above seam level[7] (Appendix C2).

5 As the hydrographs show inconsistent head variations with depth, some of the piezometers are unreliable.

6 The 138 m, 163 m, 304 m and 474 m deep vibrating wire piezometers did not record data during the January to June 2017 and July to December 2017 assessment periods; all other piezometers showed stable trends.

7 Recent measurements in 2018 show a return to more normal levels.

The time-series record for bore F6GW3A is shown on Chart 71. Bore F6GW3A is located adjacent to Longwall 301 at its southern end, and at about 800 m from Longwall 27. Significant depressurisation has occurred from historical workings to the east about 500 m distance (Appendix C2). The 450 m deep piezometer at the base of the Coal Cliff Sandstone displays significant depressurisation continuing from the mining of the first heading in the 300 mains in November 2013 (Appendix C2).

The time-series record for bore 9GGW2B is shown on Chart 63[8]. Mild declines were observed in the mid and lower Hawkesbury Sandstone piezometers (80 m, 106 m), while the upper Hawkesbury Sandstone piezometer (55 m) remained stable (Appendix C2).

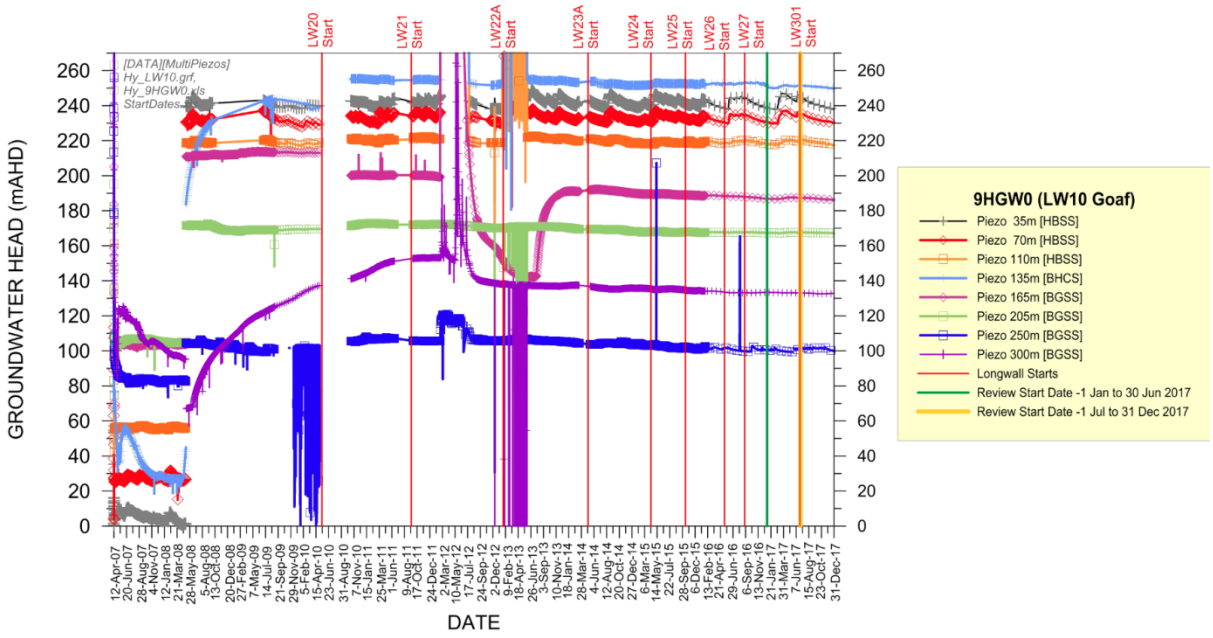


Chart 59 Time Variations in Potentiometric Heads at 9HGW0

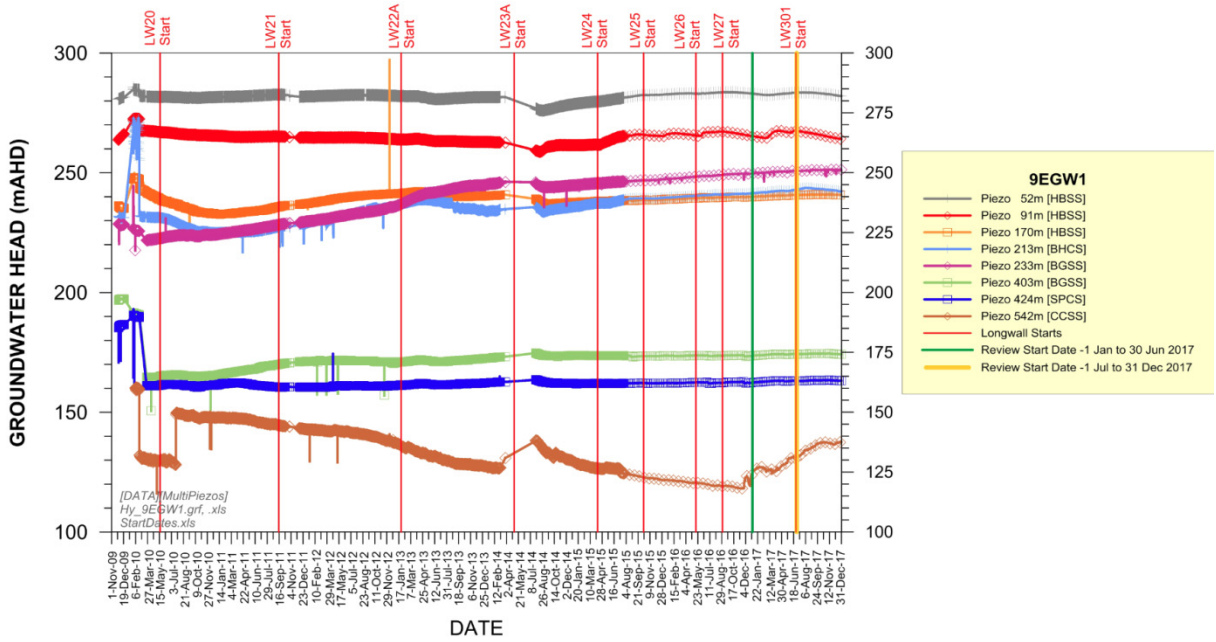


Chart 60 Time Variations in Potentiometric Heads at 9EGW1B

[8] The 340 m piezometer did not record data from July to December 2017.

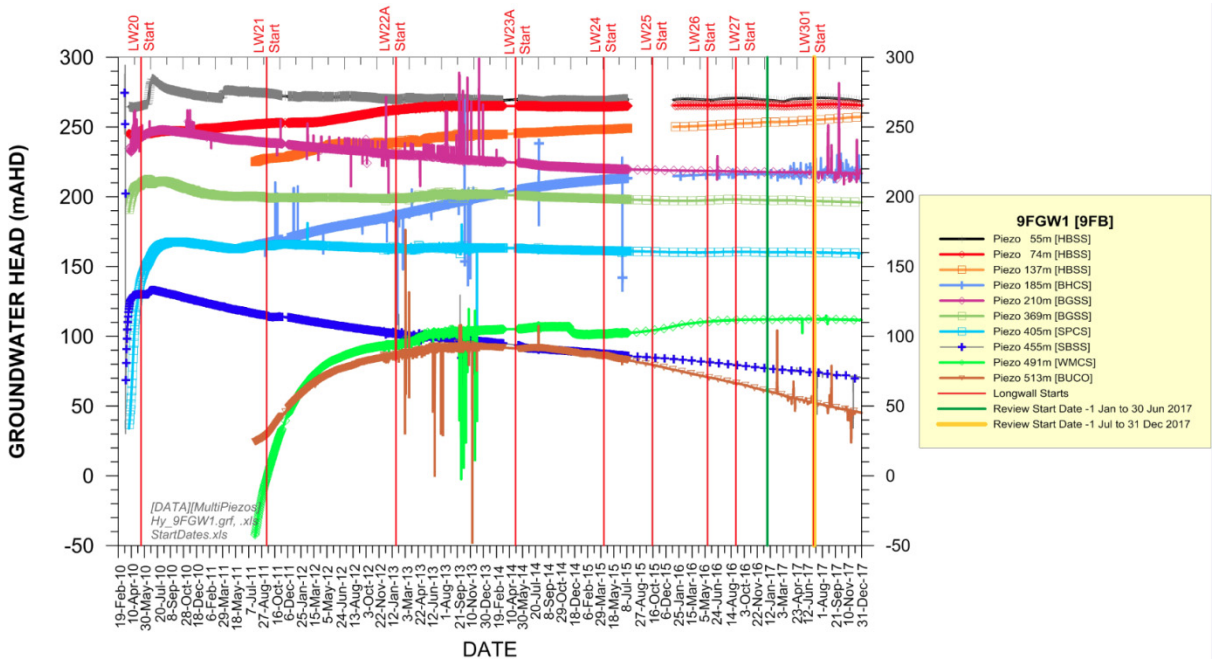


Chart 61 Time Variations in Potentiometric Heads at 9FGW1A

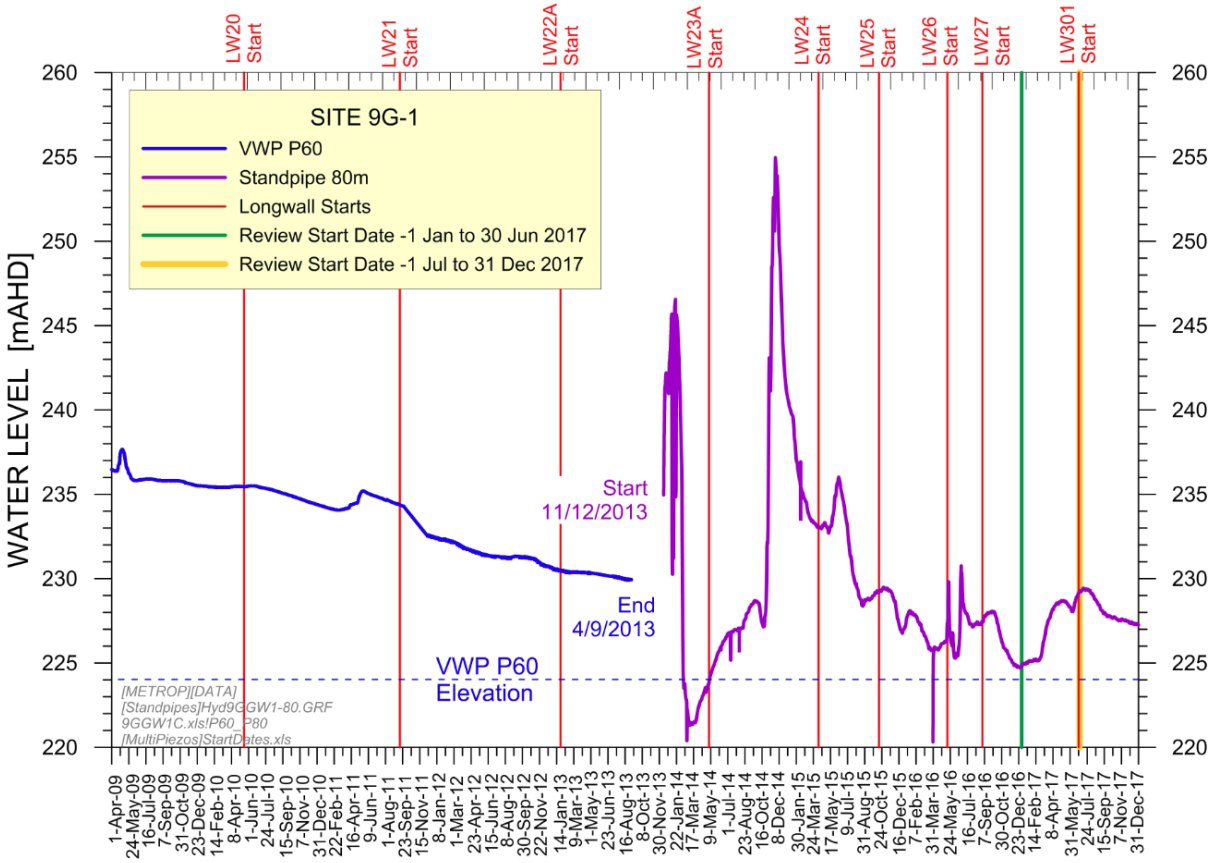


Chart 62 Time Variations in Water Table at Sandpipe 9GGW1-80 and Decommissioned Vibrating Wire Piezometer 9GGW1-60

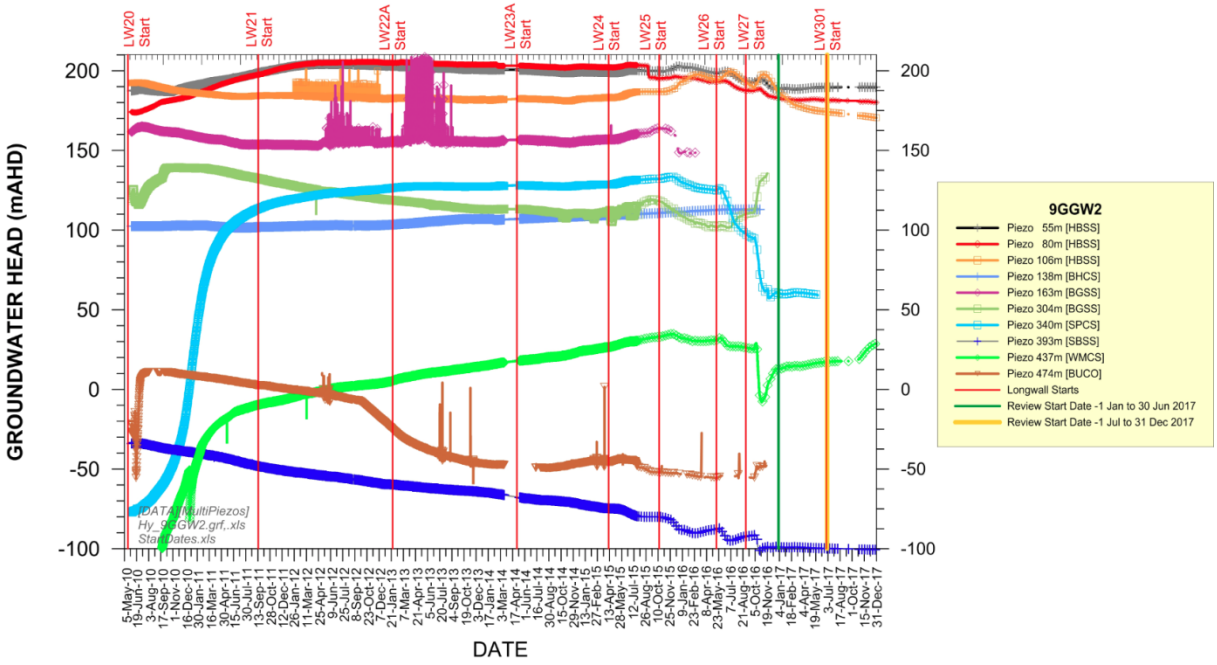


Chart 63 Time Variations in Potentiometric Heads at 9GGW2B

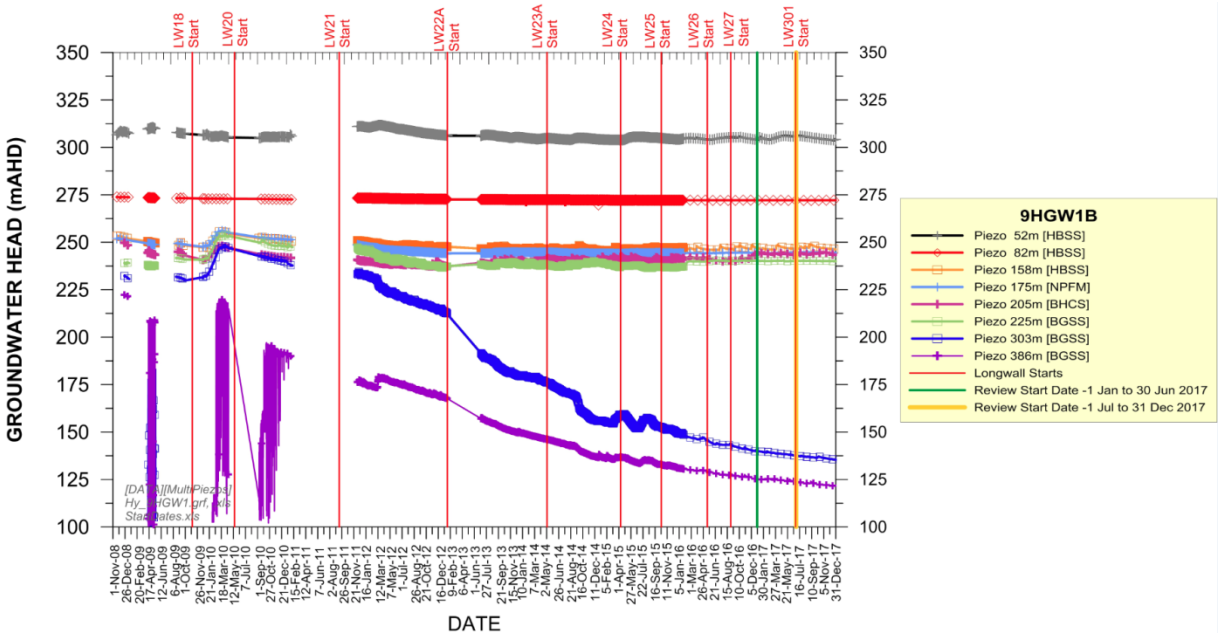


Chart 64 Time Variations in Potentiometric Heads at 9HGW1B

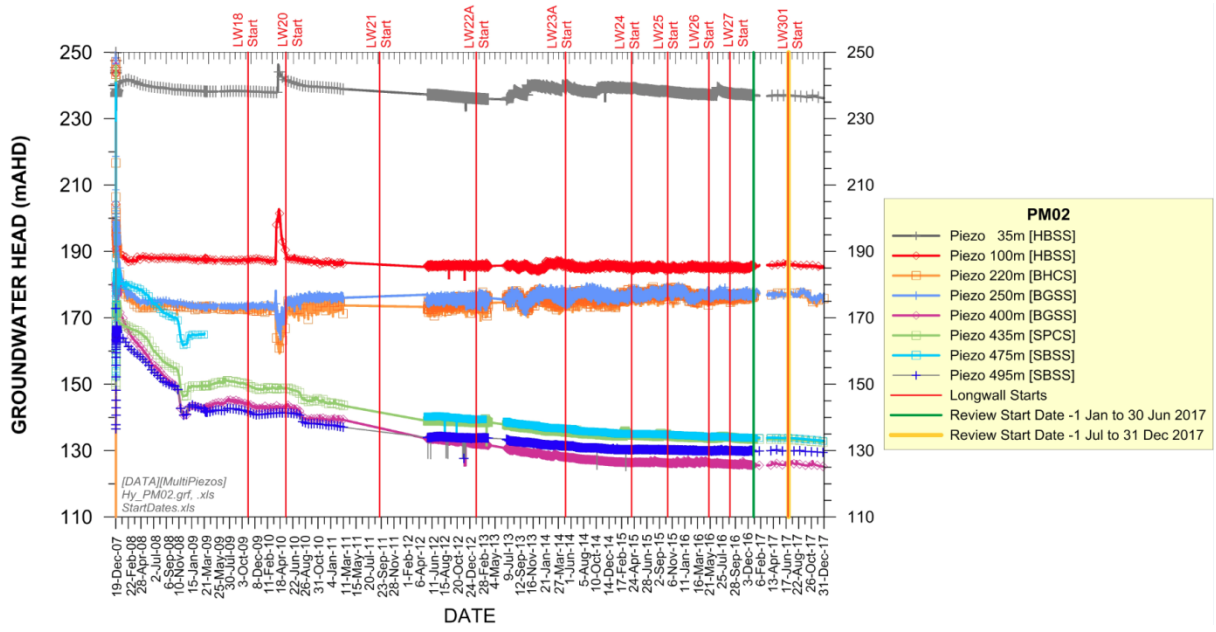


Chart 65 Time Variations in Potentiometric Heads at PM02

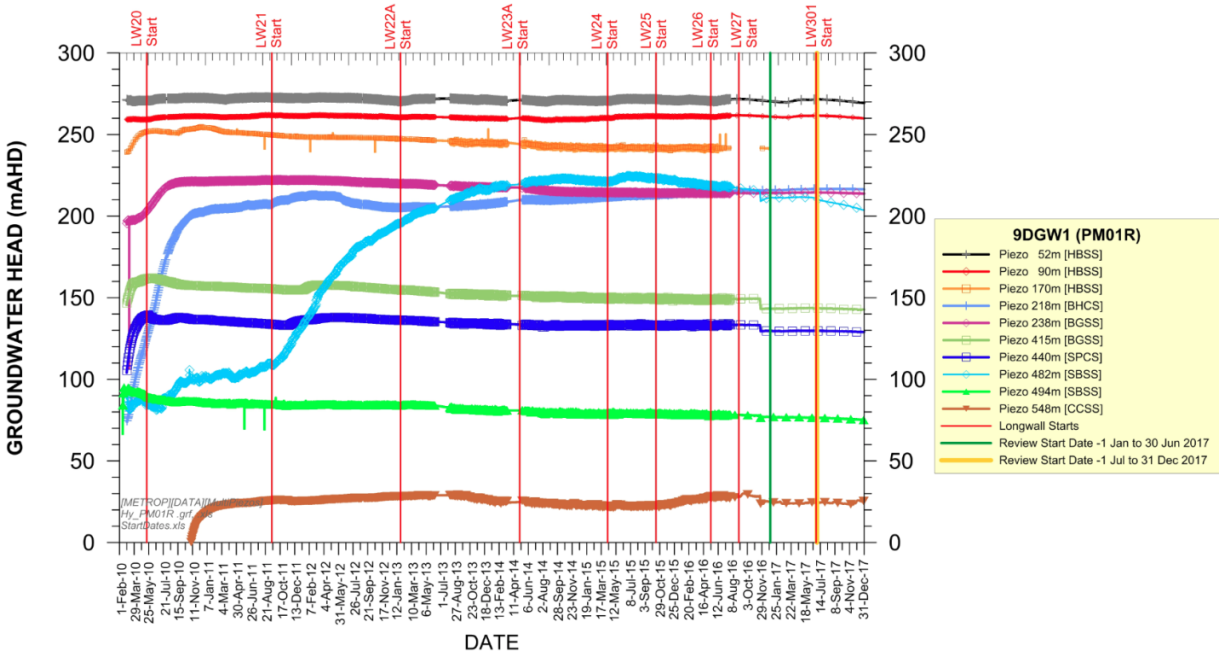


Chart 66 Time Variations in Potentiometric Heads at PM01

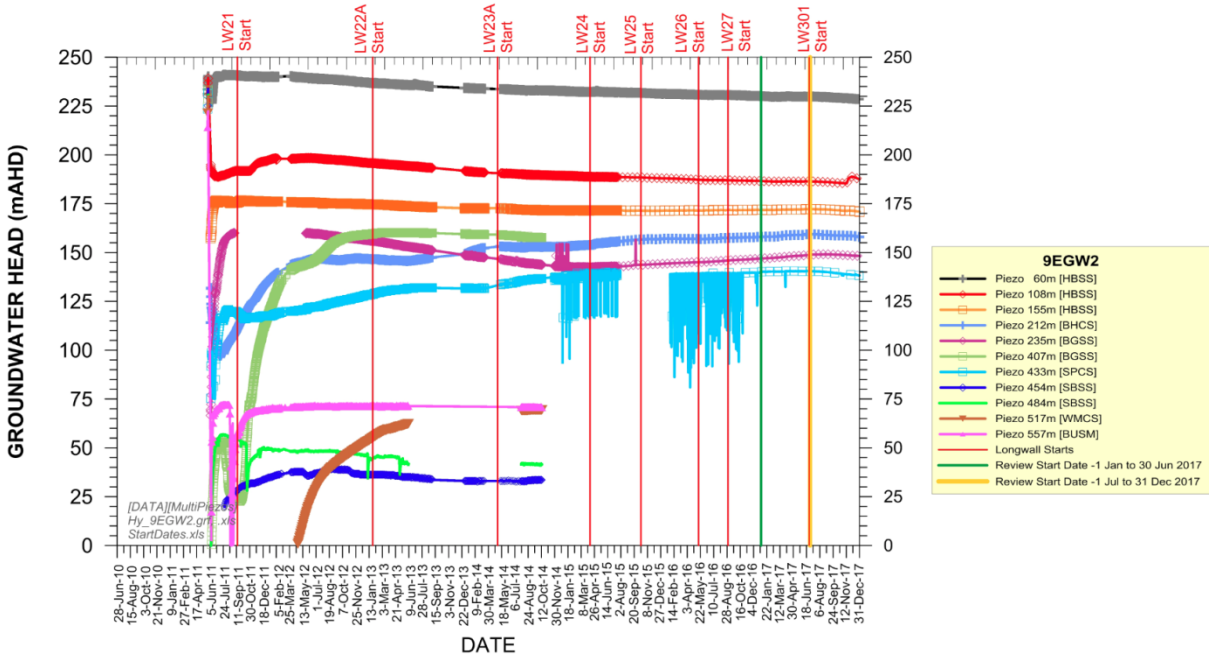


Chart 67 Time Variations in Potentiometric Heads at 9EGW2A

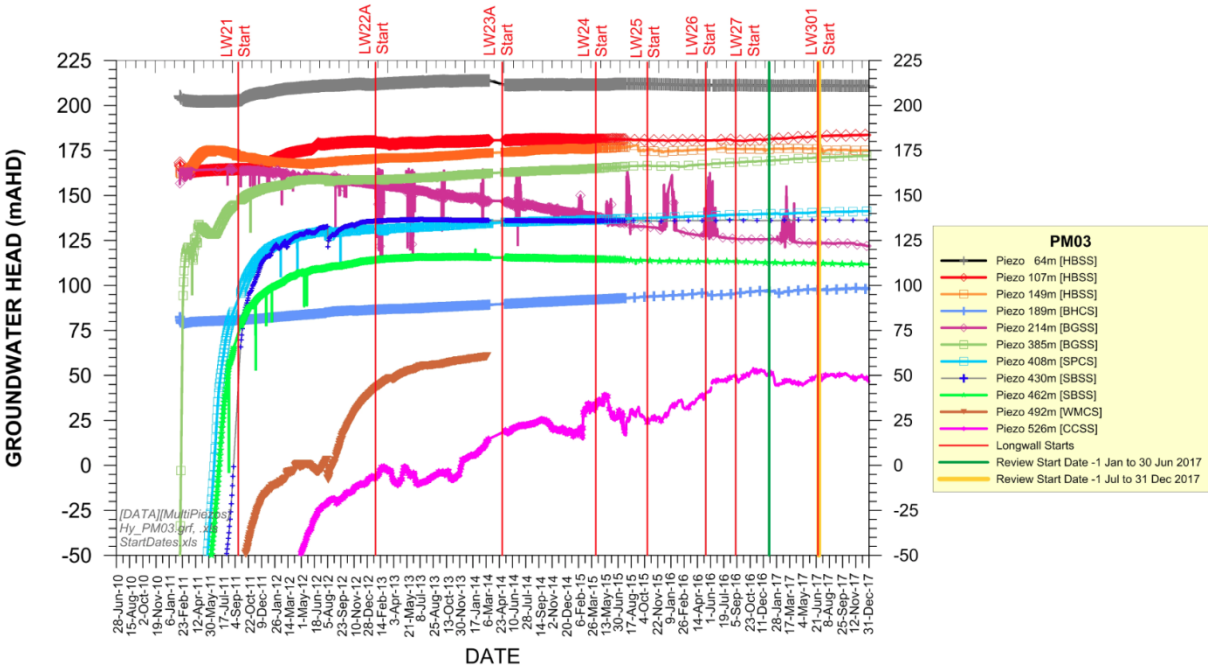


Chart 68 Time Variations in Potentiometric Heads at PM03

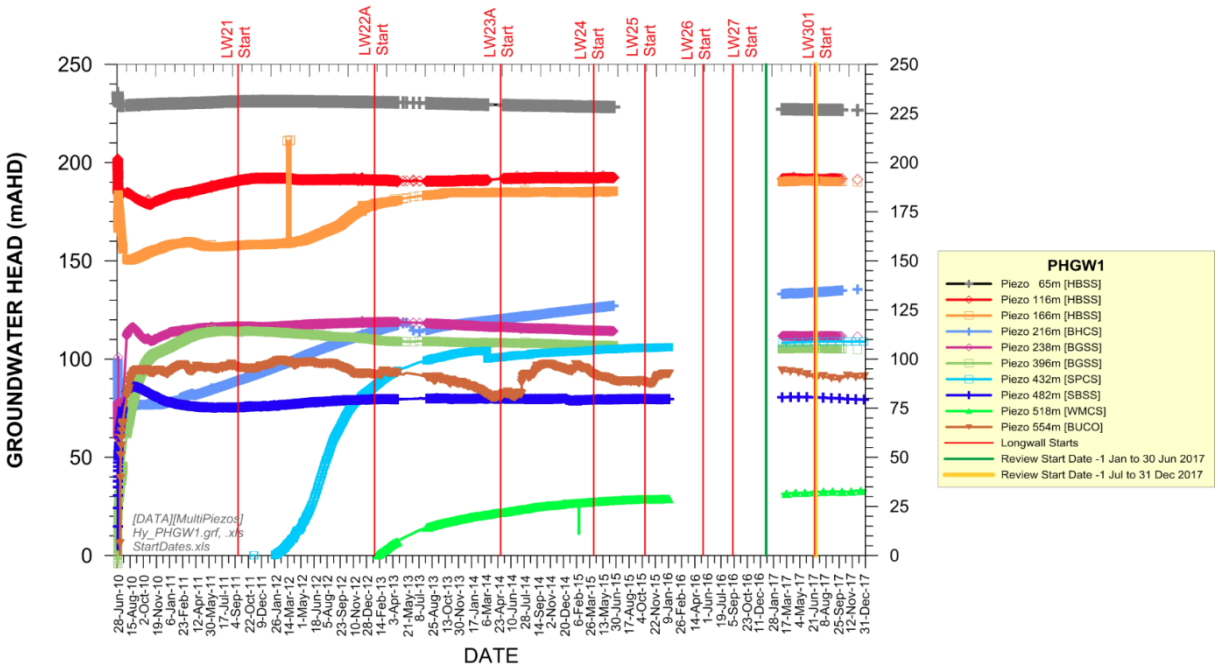


Chart 69 Time Variations in Potentiometric Heads at PHGW1B

Note that a connection failure prevented upload of data for sensors in PHGW1B in 2016. Sensors have now been reinstated.

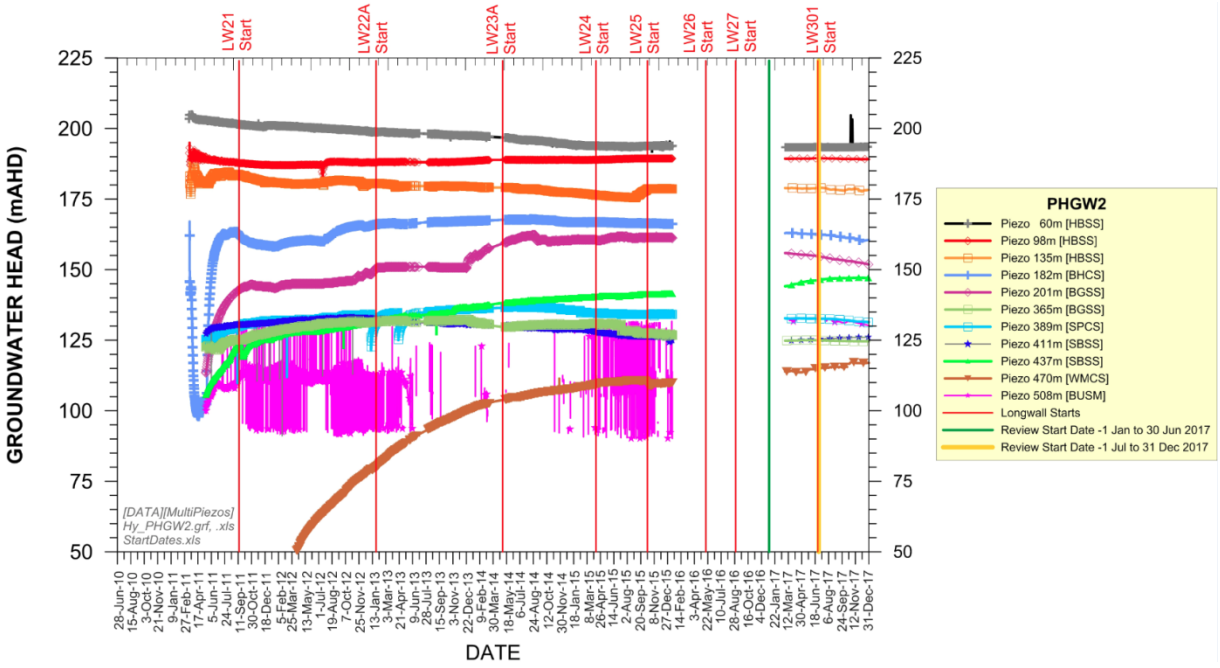


Chart 70 Time Variations in Potentiometric Heads at PHGW2A

Note that a connection failure prevented upload of data for sensors in PHGW2A in 2016. Sensors have now been reinstated.

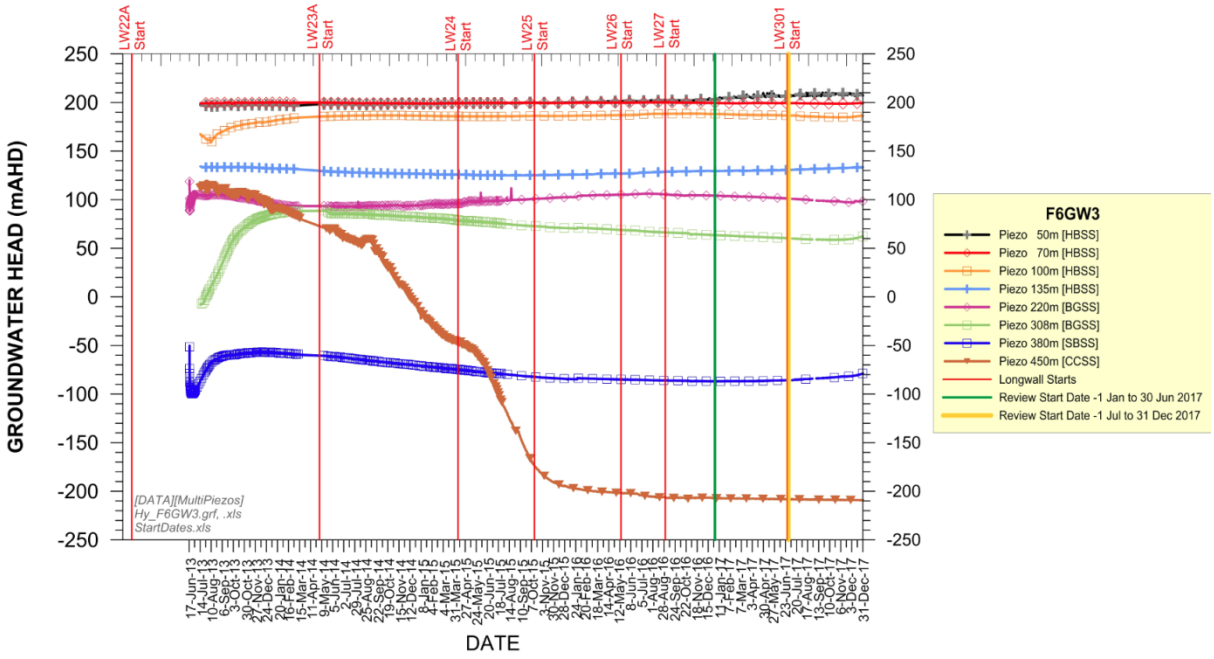


Chart 71 Time Variations in Potentiometric Heads at F6GW3

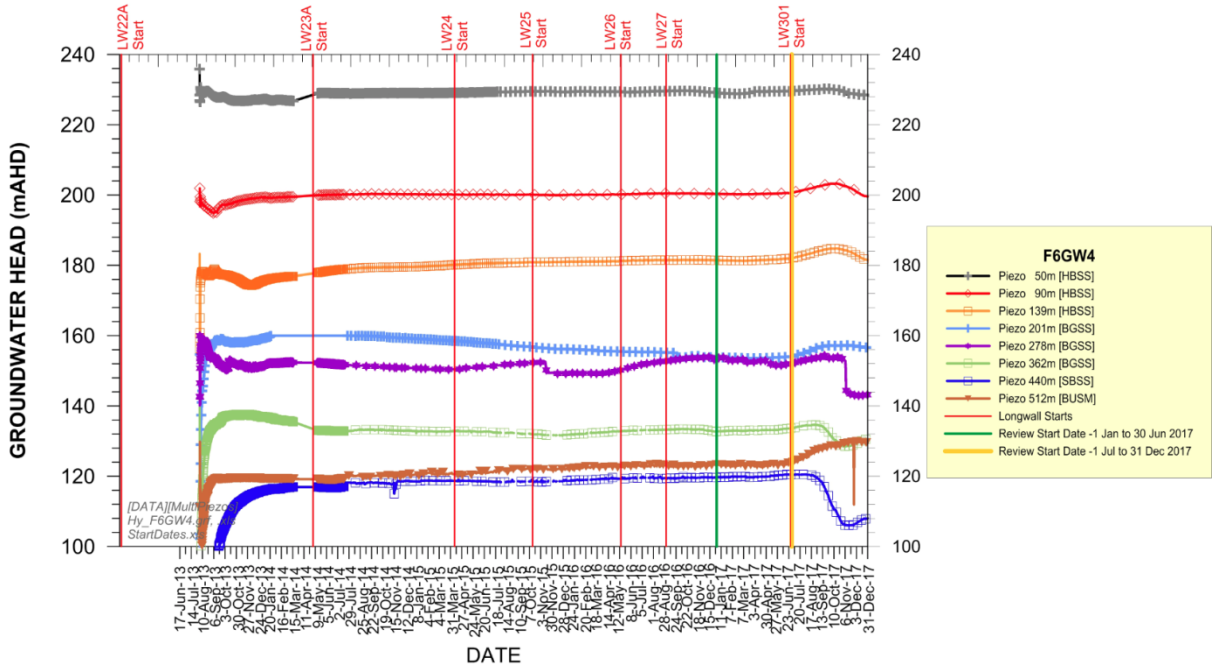


Chart 72 Time Variations in Potentiometric Heads at F6GW4

Analysis of Water Table Transect along Longwall 22

January to June 2017 Assessment

In accordance with the Longwalls 20-22 and Longwalls 23-27 Water Management Plans, the water tables measured at Bores 9FGW1A and 9GGW1-80 at the 55 m and 80 m piezometers, respectively, are compared to the water levels of streams crossed by a transect along Longwall 22 to 30 June 2017. The transect on Chart 73 provides an illustration of relative ground and water levels on transect A-A' along Longwall 22 through indicator sites 9FGW1A and 9GGW1-80. The transect from west to east crosses Tributary B (twice), Waratah Rivulet, Tributary A and the Eastern Tributary. The monitoring results to June 2017 indicate that the average water levels measured in the two piezometers are above the floor levels of the nearest streams (Chart 73) (Appendix C1).

The results have been assessed against the following performance indicator:

> *The water tables measured at Bores 9FGW1A and 9GGW1-80 are higher than the water levels of streams crossed by a transect along Longwall 22 (i.e. a hydraulic gradient exists from each bore to the nearest watercourse)*

The performance indicator was not exceeded (Appendix C1).

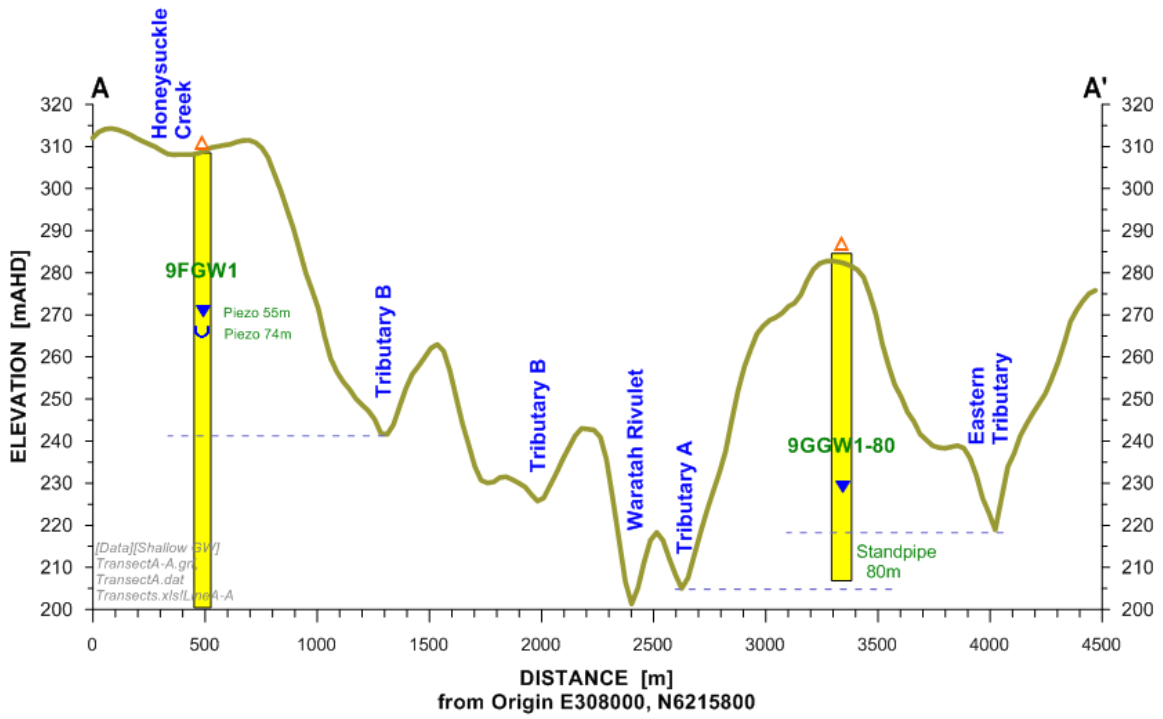


Chart 73 Topographic Transect A-A' along Longwall 22 and Hawkesbury Sandstone Water Levels (9GGW1-80 and 9FGW1A at 30 June 2017)

Assessment of Vertical Potentiometric Head Profiles

January to June 2017 Assessment

Vertical potentiometric head profiles at Bores 9GGW2B and 9FGW1A have been used to assess connective cracking between the surface and the mine in accordance with the Longwalls 20-22 and Longwalls 23-27 Water Management Plan.

The vertical potentiometric head profiles have been assessed against the following performance indicators:

> *Significant departures from the predicted envelope of vertical potentiometric head profiles at Bores 9GGW2B and 9FGW1A do not occur.* (Longwalls 20-22)
>
> *Significant departure from the predicted envelope of the vertical potentiometric head profile at Bore 9GGW2B does not occur* (Longwalls 23-27)

The performance indicators were not exceeded (Appendix C1).

July to December 2017 Assessment

Vertical potentiometric head profiles at Bores 9GGW2B and F6GW3A are used to assess connective cracking between the surface and the mine in accordance with the Longwalls 301-303 Water Management Plan.

The vertical potentiometric head profiles have been assessed against the following performance indicators:

> *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.*

The performance indicators were not exceeded (Appendix C2).

Assessment of Hydraulic Gradient to the Woronora Reservoir

January to June 2017 Assessment

The groundwater levels measured at Bores 9GGW2B and PM02 at the 55 m and 35 m piezometers, respectively, are compared to the Woronora Reservoir at the level of the regional water table (Chart 74).

The results have been assessed against the following performance indicator:

> *The groundwater head of Bores 9GGW2B and PM02 is higher than the water level of Woronora Reservoir (i.e. a hydraulic gradient exists from the bores to the Woronora Reservoir)*

Chart 74 indicates that the seven day average groundwater levels are well above the reservoir water level (i.e. a hydraulic gradient exists from the bores to the Woronora Reservoir). The performance indicator was not exceeded (Appendix C1).

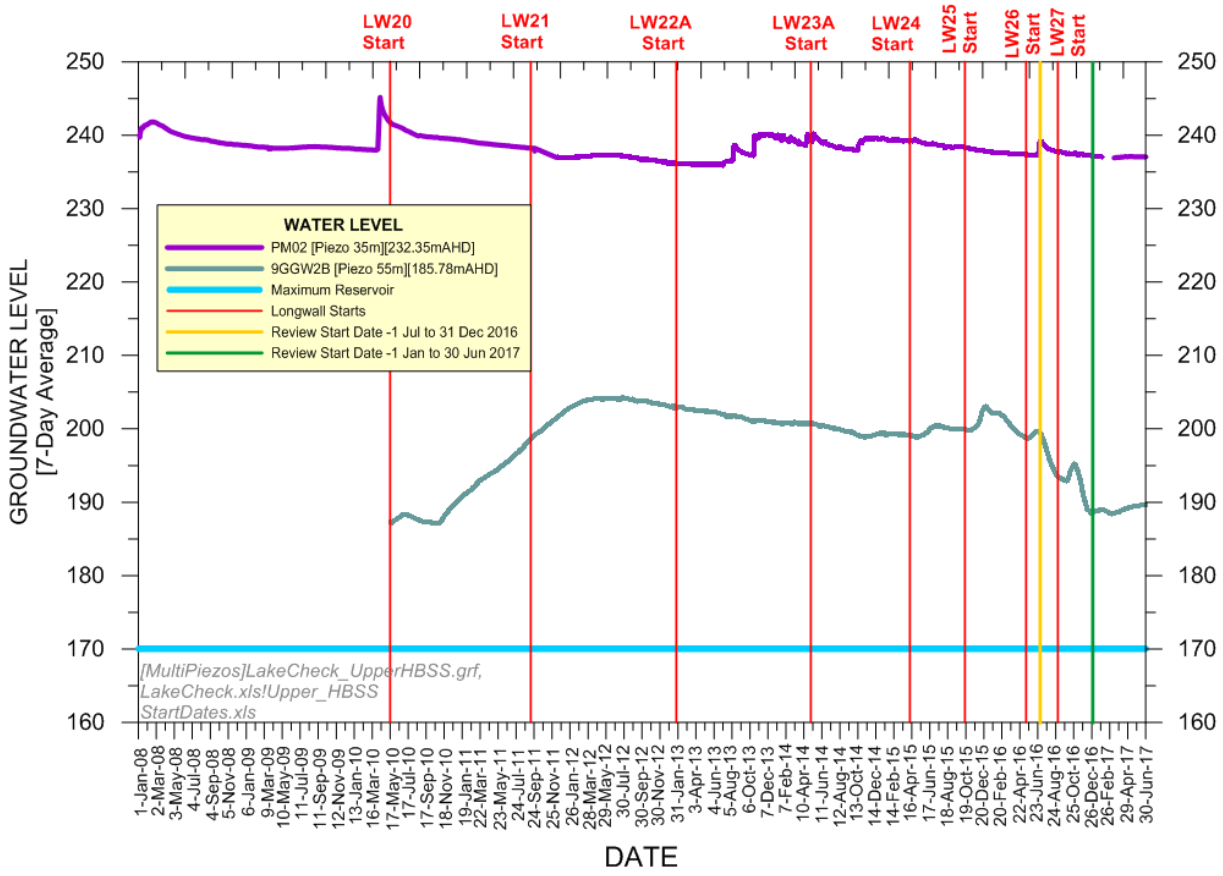


Chart 74 Seven Day Average Shallow Hawkesbury Sandstone Groundwater Levels at PM02 and 9GGW2B

July to December 2017 Assessment

The groundwater head of Bores F6GW4A, PHGW2A, 9GGW2B, 9EGW2A and PM02 are compared to the full supply level of the Woronora Reservoir to assess reductions in hydraulic gradient from the bores to the Woronora Reservoir.

The results have been assessed against the following performance indicators:

The hydraulic gradient to the Woronora Reservoir at full supply level from Bore F6GW4A is reduced by no more than 20% from that measured to 30 June 2017.

The hydraulic gradient to the Woronora Reservoir at full supply level from Bore PHGW2A is reduced by no more than 20% from that measured to 30 June 2017.

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 20% 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 20% from that measured to 30 June 2017.

The performance indicators were not exceeded in the July to December 2017 assessment period (Appendix C2).

The key potential subsidence impacts and environmental consequences on the deep groundwater system described in the Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans, included:

- Based on experience at Metropolitan Coal, substantial depressurisation of the deep aquifers in the fractured zone above the goaf is restricted to a height of less than 130 m from the top of the goaf, while transient pressure effects have been observed to propagate to a height of about 300 m above the goaf. That is, there is a pronounced increase in vertical hydraulic gradient in the deep groundwater system over the Metropolitan Coal longwalls.
- Above goaf zones there would be substantial changes in fracture porosity and permeability, due to opening up of existing joints, new fractures and bed separation. Permeability increases would have accompanying reductions in lateral hydraulic gradients, with associated changes in groundwater levels and pressures. Pronounced changes in groundwater levels can occur without any significant drainage into a mine, particularly from the Narrabeen Group sandstones.
- Groundwater discharge to the mined seam would occur from above and below the seam in proportion to local permeabilities. The water make (i.e. groundwater inflow) is expected to be in the order of 0.1 ML/day for Longwalls 20-27 and from 0.045 to 0.6 ML/day for Longwalls 301-303. Modelling indicated that the inflow could be up to 0.5 ML/day from the deep groundwater system during the mining of Longwall 24 and up to 0.6 ML/day during the mining of Longwall 302.
- Due to the substantial depths of cover at the Project, there would not be connective cracking from the mined seam to the surface. Groundwater modelling for the Project indicates that there is expected to be eventual recovery of deep groundwater system pressures over many decades following the cessation of mining.

The NSW Planning Assessment Commission (2009) concluded that given the considerable depth of mining and the restricted panel width in the Project area, that, in the absence of geological structures such as faults and igneous intrusions (sills, dykes and diatremes), there is a very high probability that a constrained zone will be associated with the mine layout proposed over the Project area, thereby preventing direct hydraulic connections between mine workings and surface water bodies.

The groundwater monitoring results are considered to be consistent with the potential subsidence impacts and environmental consequences described in the Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans.

6.2.9 Groundwater Quality

Groundwater quality monitoring at sites WRGW1 to WRGW7 on Waratah Rivulet (Figure 11) indicates dissolved iron concentrations are usually in the 1 - 10 mg/L range, with the exception of sites WRGW1 and WRGW2 which peaked at 14 mg/L in earlier years (2010-2011) (Chart 75). Dissolved iron concentrations have remained below 10 mg/L during review period (Chart 75, Appendices C1 and C2).

Dissolved manganese concentrations at the Waratah Rivulet sites have typically been less than 1 mg/L, with the exception of higher concentrations recorded at WRGW3 in June 2015 (3.36 mg/L) and September 2015 (1.47 mg/L) (Chart 76). Higher dissolved manganese concentrations were also recorded in the review period at WRGW3 (1.31 mg/L in March 2017 and 1.65 mg/L in April 2017) and WRGW6 (1.77 mg/L in April 2017). The manganese concentrations returned to below 0.9 mg/L for the remainder of the 2017 review period (Chart 76, Appendices C1 and C2).

Dissolved aluminium concentrations have been low, and largely below the detection limit (Appendices C1 and C2).

pH at the Waratah Rivulet sites has been generally acidic and usually between pH 5.5 and 7. Occasional excursions in excess of pH 9 and less than pH 5 in prior reporting periods are unsustained outliers. pH at all sites remained within the historical range during the review period, except for a reading of pH 7.8 at WRGW7 in October 2017 (Chart 77, Appendices C1 and C2).

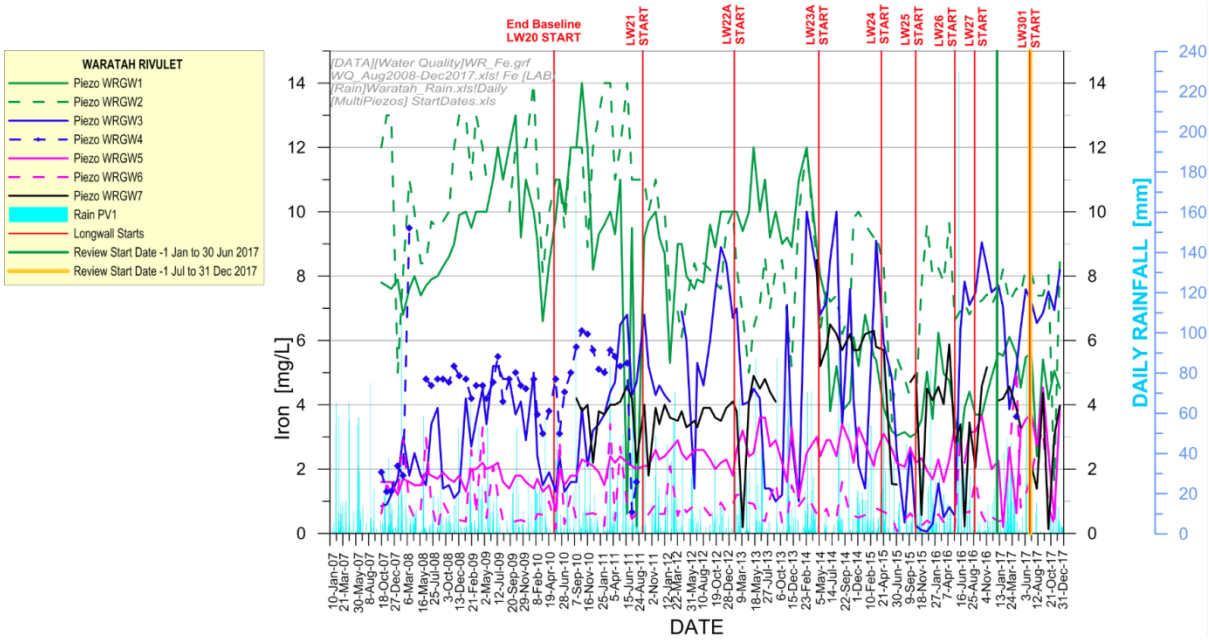


Chart 75 Iron Concentrations at WRGW1 to WRGW7 on Waratah Rivulet

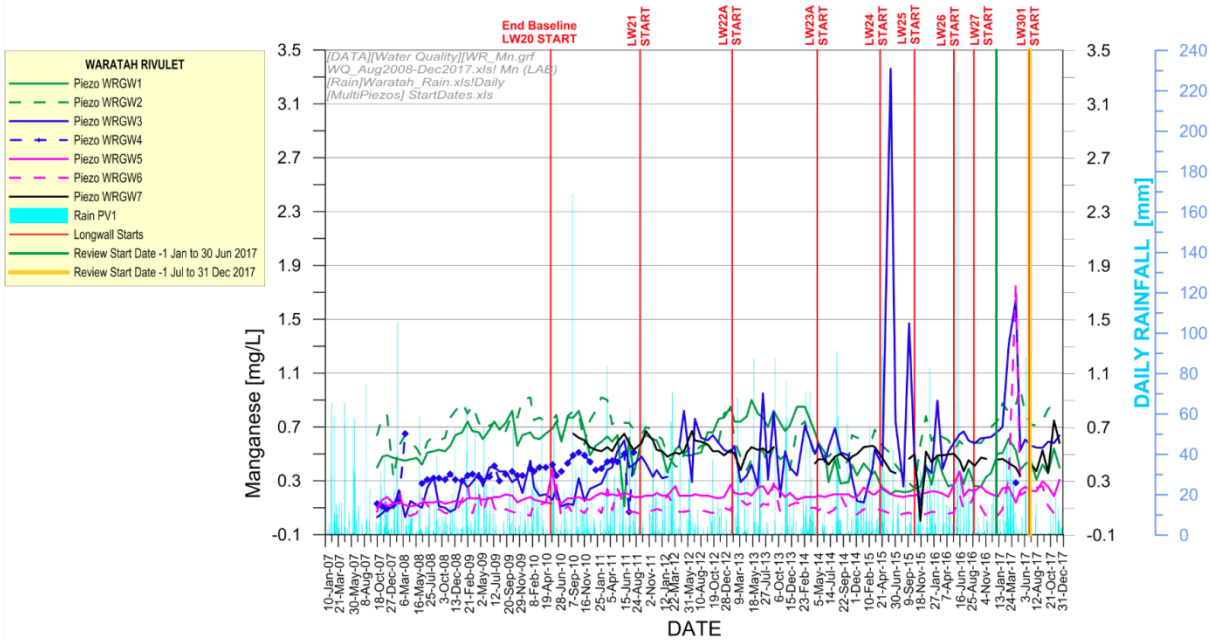


Chart 76 Manganese Concentrations at WRGW1 to WRGW7 on Waratah Rivulet

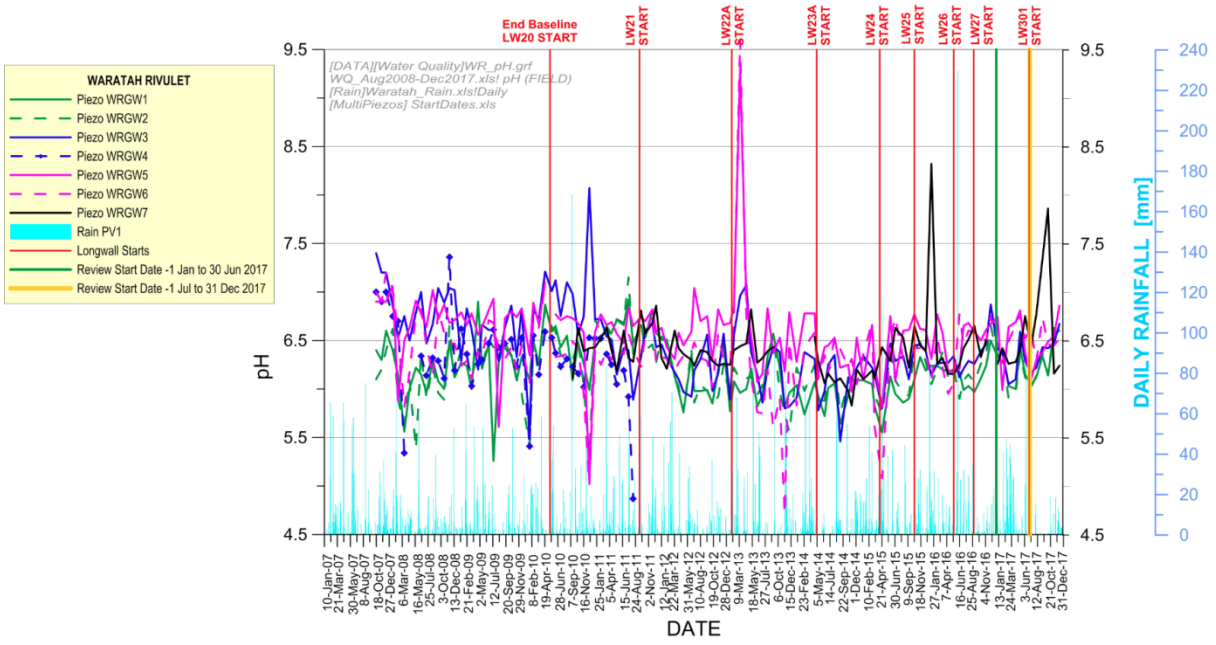


Chart 77 pH Levels at WRGW1 to WRGW7 on Waratah Rivulet

Groundwater quality monitoring at sites ETGW1[9] to ETGW2 on the Eastern Tributary (Figure 11) indicates the higher dissolved iron concentrations recorded in 2016 (17-18 mg/L) continued during the review period until July 2017 when the concentration decreased (Chart 78). Dissolved iron concentrations at site ETGW2 displayed a variable trend, with the highest concentration for the period of record (21.5 mg/L) being recorded in June 2017 and a minimum concentration (6.4 mg/L) being recorded in September 2017 (Chart 78).

Dissolved manganese concentrations remain below 1 mg/L (Chart 79), however, the values continue to be consistently higher than the historically recorded manganese concentrations (Chart 79). ETGW2 recorded its highest concentration of the period of record (0.97 mg/L) in February 2017 (Chart 79) (Appendices C1 and C2).

Aluminium was at or below 0.05 mg/L in all samples (Appendices C1 and C2).

The groundwater at the Eastern Tributary sites is generally acidic, ranging between pH 5.5 and pH 6.5 for most of the monitoring record (since 2010). At the beginning of the review period the rising trend noted at the end of 2016 continued, and then decreased following high rainfall in March 2017, before increasing again in August 2017 (Chart 80) (Appendices C1 and C2).

The Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans predicted local surface water quality impacts as a result of enhanced groundwater-surface water interactions (as described for surface water quality above). The groundwater quality monitoring results are considered to be consistent with the predictions.

[9] ETGW1 was not sampled from January to March, or since August 2017.

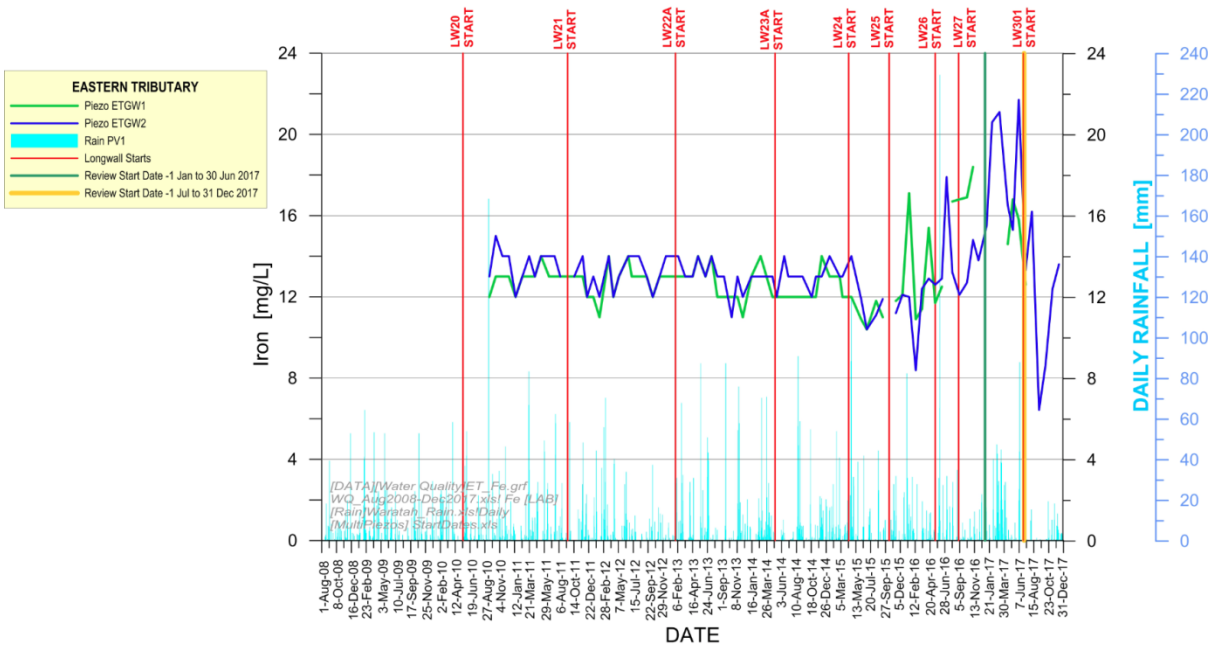


Chart 78 Iron Concentrations at ETGW1 and ETGW2

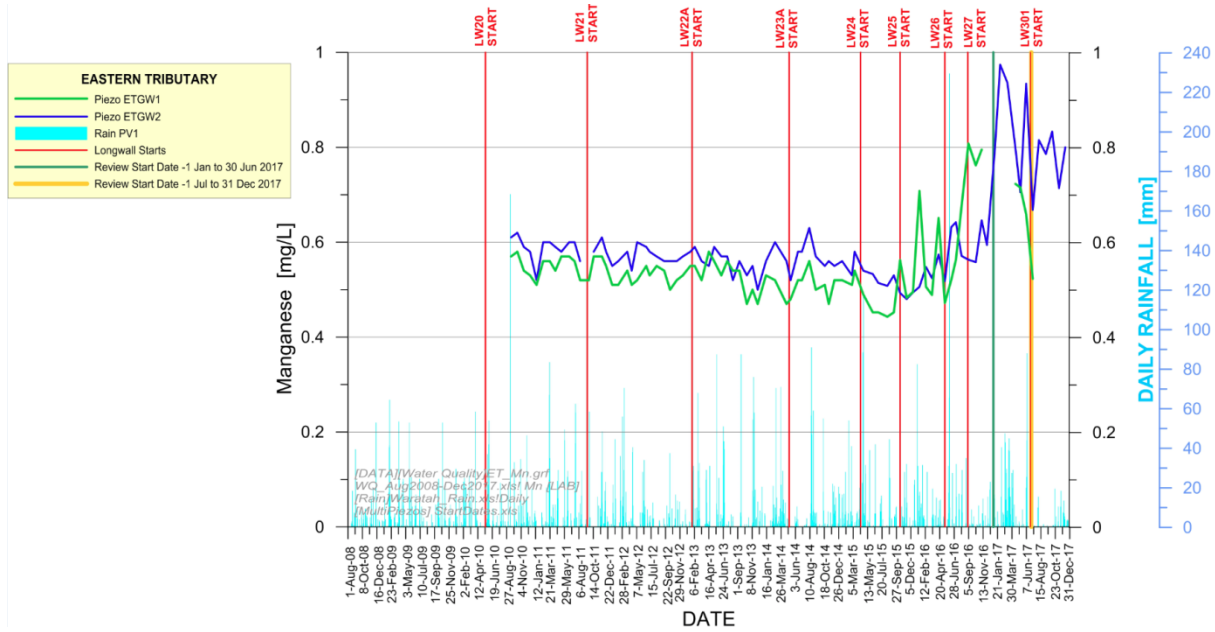


Chart 79 Manganese Concentrations at ETGW1 and ETGW2

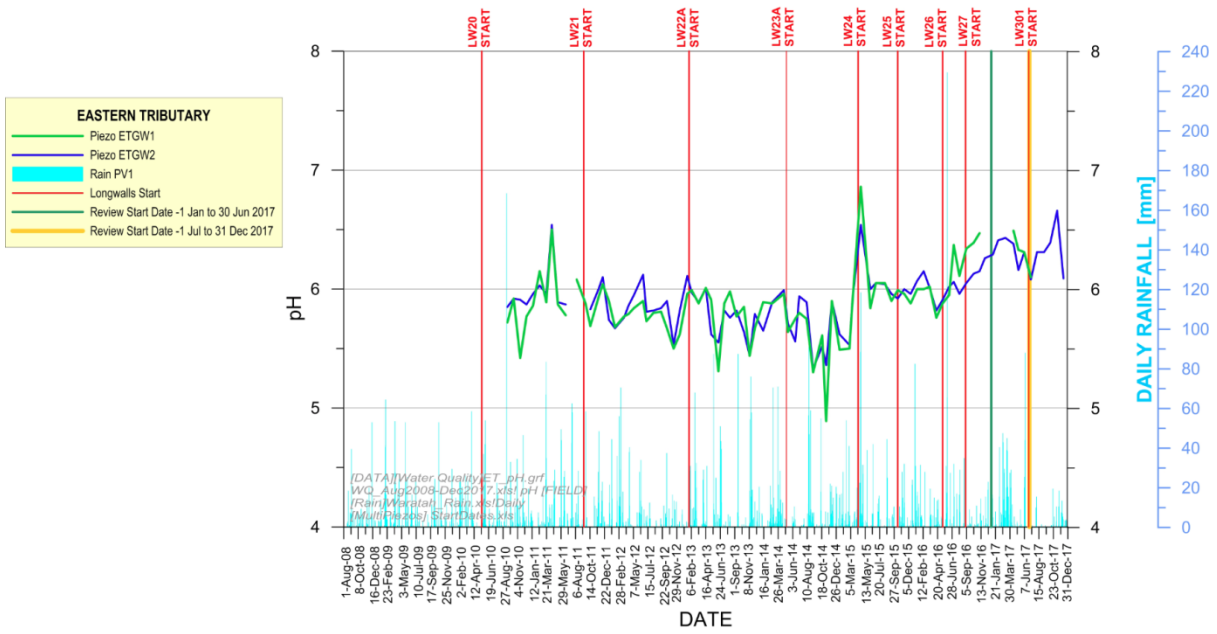


Chart 80 pH Levels at ETGW1 and ETGW2

6.2.10 Inspections of Mine Workings

Mine inspections did not identify any abnormal water flows from the goaf, geological structure, or strata generally during the review period.

The observations are consistent with the Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans, as described for mine water make below.

6.2.11 Mine Water Intake

Monitoring of the mine water balance comprises:

- Metered water reticulated into the mine (recorded continuously and downloaded monthly).
- Metered water reticulated out of the mine (recorded continuously and downloaded monthly).
- Manual measurement of moisture content into and out of the mine through the mine ventilation system using a digital psychrometer. The frequency of readings will be as follows:
  - every hour over a 9 hour period on two occasions during a 12 month period;
  - daily (week day) except public holidays or other circumstances (access, fan maintenance, etc.) that prevent readings to be taken; and
  - once per week as a minimum.
- Measurement of the *in-situ* moisture content of the coal during channel sampling for coal quality.
- Measurement of the moisture content of backfill by density gauge as it enters the mine by pipe.
- Measurement of the moisture content of run-of-mine (ROM) coal conveyed out of the mine at the drift portal using an automated moisture scanner. A fully automated data acquisition system records and stores the data.

The inferred water make (i.e. groundwater that has seeped into the mine from the strata) is calculated from the difference between total mine inflows (reticulated water into the mine, moisture in the downcast ventilation, and the *in-situ* coal moisture content) and total mine outflows (reticulated water out of the mine, moisture in the exhaust ventilation, and moisture in the ROM coal). Given the large fluctuations in daily water usage and the cycle period for water entering the mine, a 20 day average is used to provide a more reliable estimate of water make.

The 20 day average daily mine water make[10] was less than 0.5 ML/day during the reporting period (Chart 81).

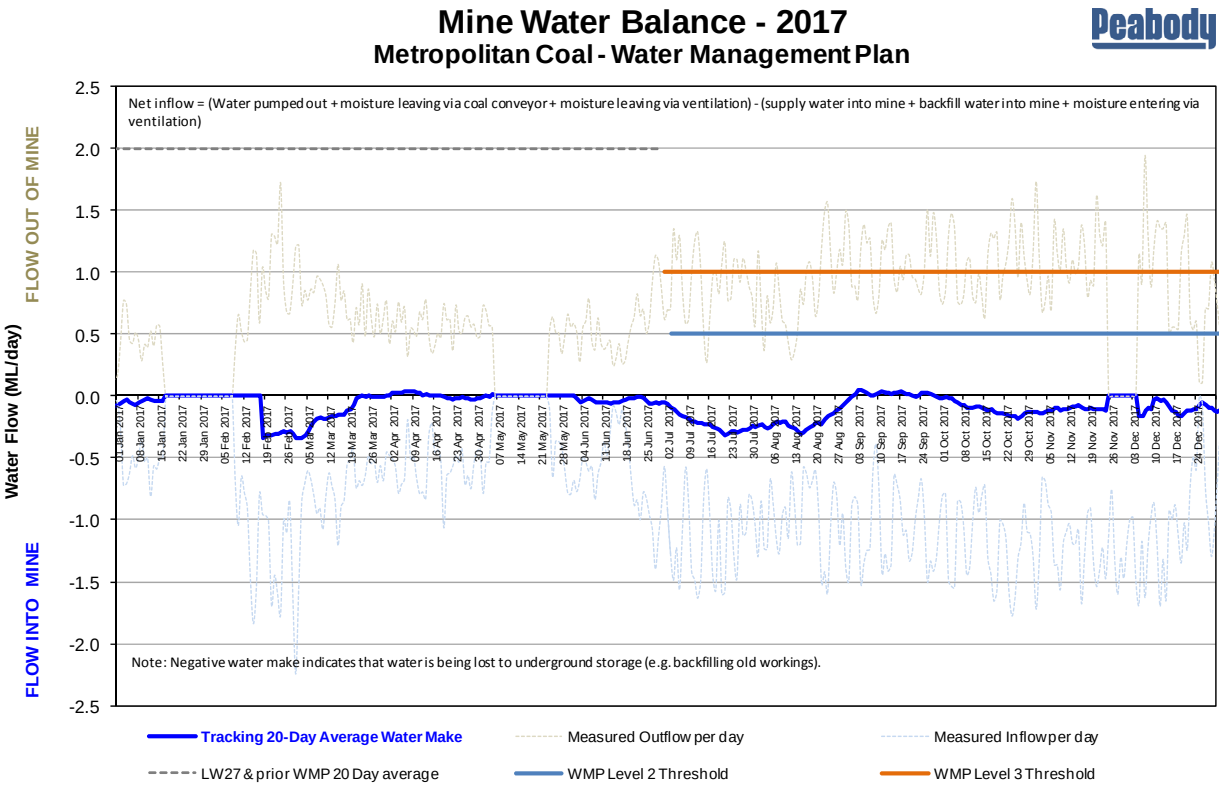


Chart 81 Estimated Daily Mine Water Make

The mine water make monitoring results are consistent with the potential subsidence impacts and environmental consequences described in the Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans, which predicted the water make (i.e. groundwater inflow) to be in the order of 0.1 ML/day for Longwalls 20-27 and from 0.045 to 0.6 ML/day for Longwalls 301-303. Modelling indicated that the inflow could be up to 0.5 ML/day from the deep groundwater system during the mining of Longwall 24 and up to 0.6 ML/day during the mining of Longwall 302. Due to the substantial depths of cover at the Project, it was predicted there would not be connective cracking from the mined seam to the surface. The monitoring results are consistent with the predictions for mine water make.

[10] Water make was unable to be calculated from 17 January to 8 February 2017, from 6 May to 23 May 2017 and from 25 November to 4 December 2017, due to equipment malfunctions.

6.2.12 Woronora Reservoir Impact Strategy

Condition 2 of the Longwalls 301 and 302 approval requires Metropolitan Coal to conduct further investigation into potential impacts on Woronora Reservoir. During the review period Metropolitan Coal engaged independent experts to prepare a Woronora Reservoir Impact Strategy to provide a staged plan of action for further investigations and a report into the impacts of mining near the reservoir. Professor Bruce Hebblewhite (B. K. Hebblewhite Consulting), Dr Frans Kalf (Kalf and Associates Pty Ltd) and Emeritus Professor Thomas McMahon (University of Melbourne) were endorsed by the DP&E for the Woronora Reservoir Impact Strategy in May 2017.

The *Woronora Reservoir Strategy Report - Stage 1* was provided by the independent experts to the DP&E in September 2017. The Stage 1 report included recommendations for further groundwater and surface water investigations and monitoring and was approved by the Secretary for Planning in December 2017.

The *Woronora Reservoir Strategy Report - Stage 1* recommendations included:

- Longwall 301 monitoring/investigation bores (301GW01, 301GW02).
- Longwall 302 monitoring/investigation bores (302GW02, 302GW03 and 302GW04).
- Longwall 303 monitoring/investigation bores (TBS3a and TBS3b).
- Further investigation by independent experts of LIDAR, InSAR and bathymetric survey technologies for ongoing subsidence/geotechnical monitoring.
- Installation of two stream flow gauging stations on the eastern side of Woronora Reservoir (in sub-catchments I and K).
- Installation of a pluviometer in the vicinity of the northern end of Longwall 307.
- Implementation of a preliminary water balance of Woronora Reservoir, and depending on the outcome of the preliminary water balance, implementation a more detailed water balance including additional hydrologic monitoring as required.

Section 9 provides a summary of the status of monitoring equipment installation.

The independent experts will consider the use of LIDAR, InSAR and bathymetric survey technologies for ongoing subsidence/geotechnical monitoring in the Woronora Reservoir Impact Strategy – Stage 2 Report in the next reporting period.

The preliminary water balance will also be conducted in the next reporting period.

The *Woronora Reservoir Strategy Report - Stage 2* report is anticipated to be prepared by the independent experts by December 2018.

6.3 BIODIVERSITY MANAGEMENT

The Metropolitan Coal Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 Biodiversity Management Plans were prepared to manage the potential environmental consequences of the Metropolitan Coal Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 Extraction Plans on aquatic and terrestrial flora and fauna, with a specific focus on swamps, in accordance with Condition 6, Schedule 3 of the Project Approval.

The Longwalls 301-303 Biodiversity Management Plan includes post-mining monitoring and management of potential subsidence impacts and environmental consequences associated with Longwalls 20-22 and Longwalls 23-27. During the reporting period the Longwalls 301-303 Biodiversity Management Plan Trigger Action Response Plan was reviewed and revised.

Sections 6.3.1 to 6.3.5 provide a summary of the biodiversity assessments for the review period. Section 6.8 provides a summary of the assessments against the biodiversity subsidence impact performance indicators and measures for the January to June 2017 period in Table 14 and for the July to December 2017 period in Table 15.

6.3.1 Upland Swamp Vegetation Monitoring

6.3.1.1 Longwalls 20-22 and Longwalls 23-27

Upland swamp vegetation monitoring is conducted biannually (in autumn and spring) at a number of swamps overlying or adjacent to Longwalls 20-22 and Longwalls 23-27 and at a number of control swamps (Figure 9).

In autumn 2017, visual inspections were conducted in Swamps 16, 17, 18, 19, 20, 23, 24, 25, 26, 27, 28, 30, 31, 32, 33, 34, 35, 36, 93, 94, 95, 96, 97 and 98 overlying or adjacent to Longwalls 20-27[11], transect/quadrat monitoring was conducted in Swamps 16, 17, 18, 20, 24 and 25 overlying Longwalls 20-22, Swamps 28, 30, 33, 35 and 94 overlying or adjacent to Longwalls 23-27 and in control Swamps 101, 111a, 125, 135, 136, 137a, 137b, 138, Bee Creek Swamp, Woronora River 1, Woronora River south arm and Dahlia Swamp (Figure 9).

Indicator species monitoring for Longwalls 20-22 includes 20 tagged individuals of *Epacris obtusifolia* (in Swamps 18, 24, 25, 101, 111a and 125), *Sprengelia incarnata* (in Swamps 24, 101 and 125) and *Pultenaea aristata* (in Swamps 18, 24, 25, 101 and 111a). Three indicator species characteristic of the Tea Tree Thicket vegetation namely, *Banksia robur, Callistemon citrinus* and *Leptospermum juniperinum* are monitored in Swamp 20 and at control sites Woronora River 1, Woronora River south arm and Dahlia Swamp.

Indicator species monitoring for Longwalls 23-27 includes 20 tagged individuals of *Epacris obtusifolia* (in Swamps 19, 30, 33, 35, 94, 135, 136, 137a, 137b and 138), *Sprengelia incarnata* (in Swamps 19, 33, 35, 94, 135, 136, 137a and 138), *Pultenaea aristata* (in Swamps 19, 30, 33, 35, 94, 135, 136, 137a and 138) and *Banksia robur* and *Callistemon citrinus* in Swamp 28 and control Swamps Woronora River 1, Woronora River south arm and Dahlia Swamp.

The vegetation survey results for autumn 2017 have been assessed in accordance with the Longwalls 301-303 Biodiversity Management Plan. The results of the autumn 2017 survey in relation to the Biodiversity Management Plan Trigger Action Response Plan are summarised in Table 15 in Section 6.8. The results of the Longwalls 20-22 and Longwalls 23-27 upland swamp vegetation monitoring programs (up to and including the autumn 2017 survey) can be summarised as follows:

[11] Visual inspections of Swamps 16, 17, 20, 24, 25, 28, 30, 31, 32, 33, 34, 35, 36 and 94 will be conducted biannually during the mining of Longwalls 301-303.

- No cracking of exposed bedrock areas or swamp sediments was observed in either longwall or control swamps, other than those recorded during the baseline surveys.
- Areas in which active erosion was observed were all minor and limited to access tracks, drainage lines and sheet erosion.
- Iron-stained groundwater seepage has been observed since spring 2012 on the terminal rocky step and/or the small rocky step of Swamp 20. In autumn 2017 iron staining was confined to the terminal rocky step and continues to be reduced in area compared to previous seasons.
- Visual inspections across all upland swamps identified that vegetation at both longwall and control sites was generally in good condition in autumn 2017 with no unusual areas of stressed or senescing vegetation observed, and with new growth recorded on shrubs and ground layer species. Some isolated dieback and senescence of scattered individuals were recorded throughout most longwall and control swamps. For the Restioid Heath/Banksia Thicket swamps, this included individuals of *Petrophile pulchella, Banksia ericifolia* subsp. *ericifolia* and *Hakea teretifolia*, and for the Tea Tree Thicket swamps the main species included *Banksia robur, Gleichenia microphylla, Empodisma minus, Acacia longifolia* subsp. *longifolia, Gymnoschoenus sphaerocephalus* and *Lepidosperma forsythia*.
- Consistent with previous observations including the baseline monitoring period, dieback of *Empodisma minus* and *Gleichenia microphylla* in longwall Swamp 28 appeared to be more common compared to control swamps, attributed to the dense mid-storey vegetation shading the understorey. Dieback of *Banksia robur* also appeared to be more common in longwall Swamp 28 compared to control swamps. Swamp 28 has consistently been observed with drier swamp sediments than the larger control swamps, including during the baseline monitoring period.
- No notable changes in vegetation structure, dominant species or estimated cover and abundance which could be attributed to impacts associated with the mining of Longwalls 20-27 were recorded within longwall or control swamps in autumn 2017.
- Fluctuations in species cover/abundance and condition have been recorded across all sites. No patterns of increasing or decreasing cover/abundance, or declines in vegetation condition, were identified in relation to individual species across sites or groups of species (i.e. swamp indicator species, generalist species, shrubs, ground covers) within sites.
- Species richness within individual Restioid Heath/Banksia Thicket swamps in autumn 2017 was within the range of previous seasons for most sites, with the exception of control sites (Swamp 101, Swamp 137b and Bee Creek Swamp) which was lower than the previously recorded ranges for these sites, by one or two species (Charts 82 and 83). Analysis of species richness within Restioid Heath/Banksia Thicket sites using analysis of variance (ANOVA) did not detect significant differences between longwall and control sites in any season including autumn 2017.
- Species richness within individual Tea Tree Thicket sites in autumn 2017 was within the range of previous seasons at all control sites and at longwall Swamp 20 over Longwalls 20-22. Species richness within the longwall swamp supporting Tea Tree Thicket (Swamp 28 – Transect 2) over Longwalls 23-27 continues to decline and in autumn 2017 was below previous records (Chart 84). Analysis of changes in species richness over time indicate the decrease in species richness has predominantly occurred prior to subsidence impacts occurring to Swamp 28 substrate groundwater levels in 2016. Rainfall during autumn and spring 2016 was well below average, although heavy rains fell in June 2016. Similarly, rainfall leading up to the autumn 2017 survey was well below average. Swamp 28 is very small, does not contain any internal drainage lines and free surface water has never been observed at this site since the inception of monitoring.

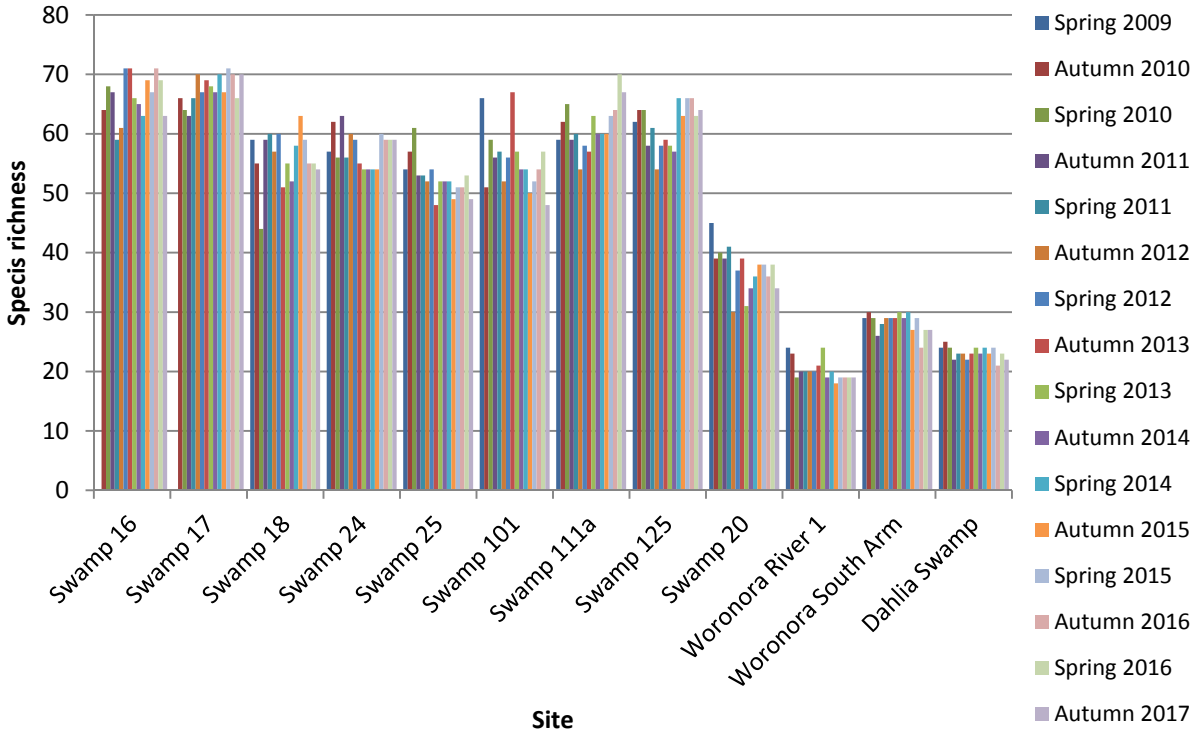


Chart 82 Native Species Richness in Longwalls 20-22 Upland Swamp Sites, Spring 2009 – Autumn 2017

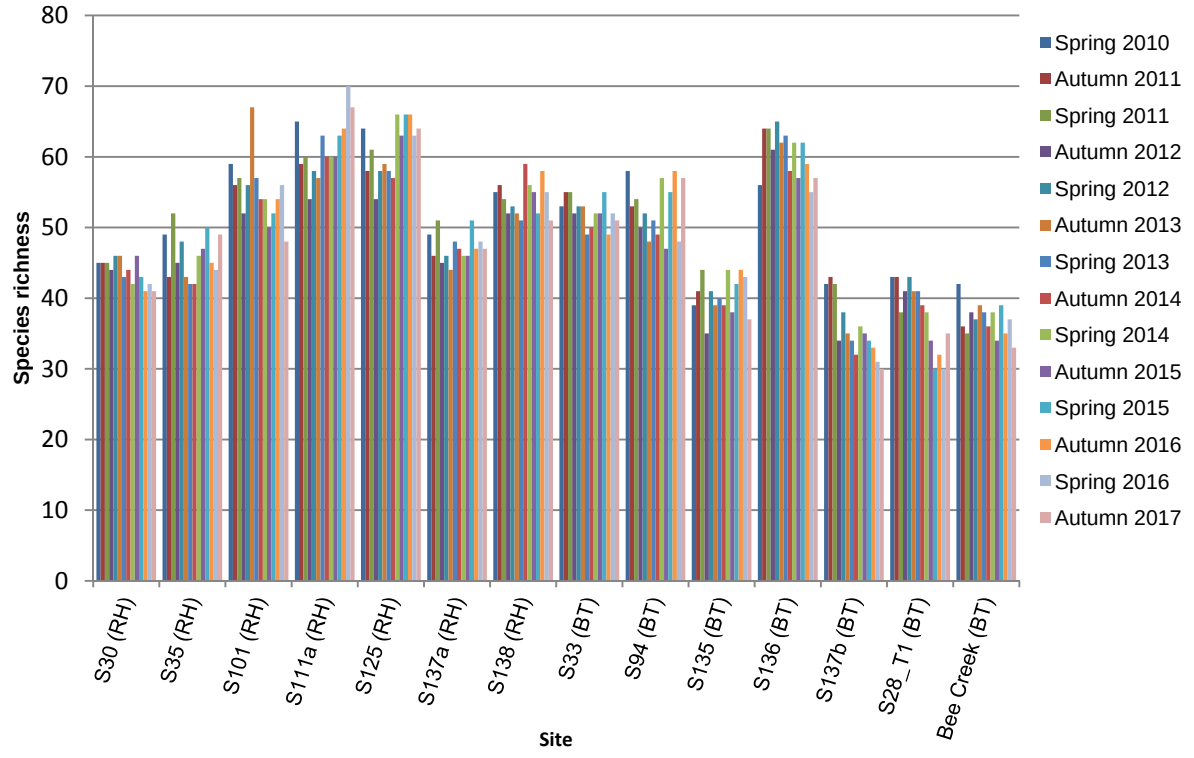


Chart 83 Native Species Richness within Longwalls 23-27 Upland Swamp Sites Supporting Restioid Heath and Banksia Thicket, Spring 2010 – Autumn 2017

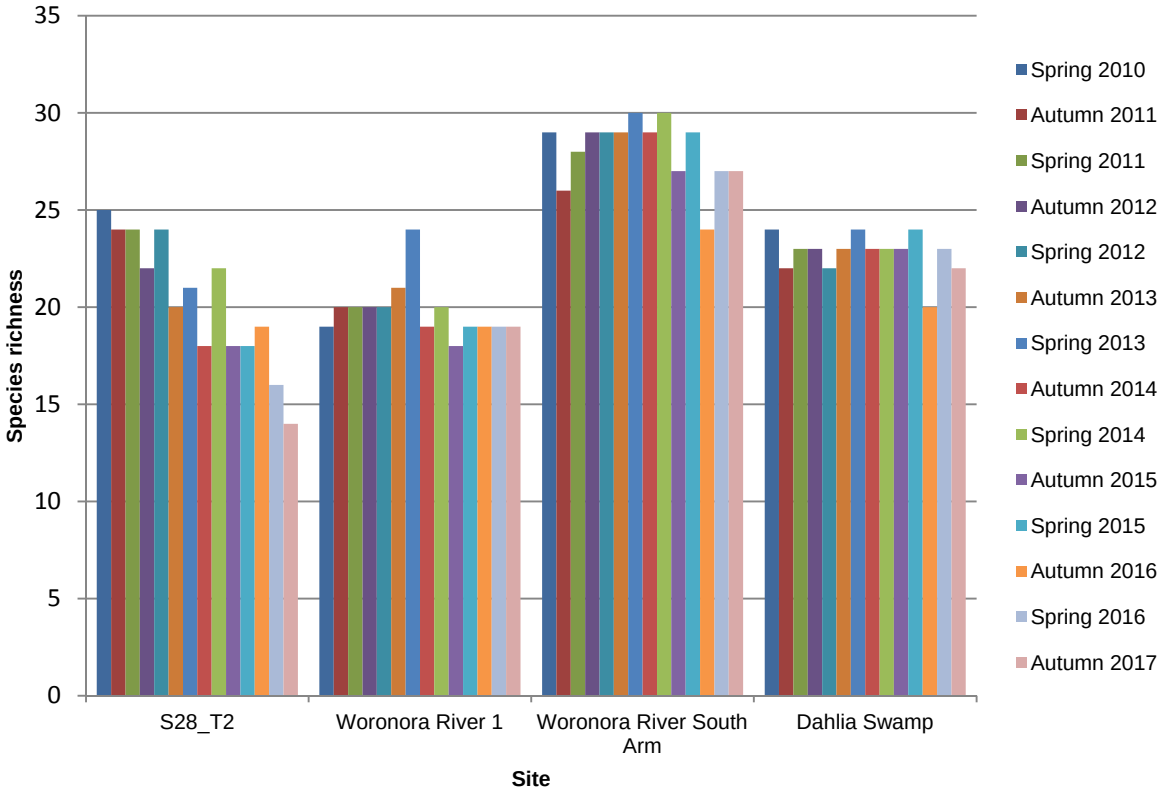


Chart 84 Native Species Richness within Longwalls 23-27 Upland Swamp Sites Supporting Tea Tree Thicket, Spring 2010 – Autumn 2017

- For Longwalls 20-22, monitoring of indicator species in the Restioid Heath/Banksia Thicket swamps indicated that the mortality rate of swamp indicator species was greater at longwall sites than control sites for *Epacris obtusifolia* and *Sprengelia incarnata*, although the margins of these differences were generally small. The proportion of tagged *Pultenaea aristata* individuals recorded in Condition 1 was the same between control sites and longwall sites. The rate of increase in mortality has been similar between longwall and control swamps, and the observed mortality appears to be driven by natural factors including predation, competition with other vegetation and abiotic factors. For the Tea Tree Thicket Swamps (Swamp 20 and controls), monitoring of indicator species identified that the mortality rate of tagged indicator species was greater within control swamps than longwall swamps. The observed mortality is considered attributable to natural factors including predation, competition with other vegetation and abiotic factors.
- For Longwalls 23-27, monitoring of indicator species continued to identify higher mortality rates within longwall sites compared to control sites for *Epacris obtusifolia, Pultenaea aristata* and *Banksia robur* in autumn 2017, and higher mortality rates in control swamps for *Sprengelia incarnata.* Similar rates of differences were observed during the baseline monitoring period and following the commencement of mining, indicating that the increased mortality does not appear to be related to the mining of Longwalls 23-27 for *Epacris obtusifolia* and *Pultenaea aristata*. The mortality of *Banksia robur* in autumn 2017 was more than six times greater within longwall Swamp 28 compared to that within control swamps. The increased mortality of *Banksia robur* at the single Tea Tree Thicket longwall site (Swamp 28) over Longwalls 23-27 has been observed since spring 2012 prior to the commencement of mining Longwalls 23-27. This suggests that it is attributable to natural factors, however its rate of decline since autumn 2015 and in particular since spring 2016 to autumn 2017 may also be indicative of the drying out of the swamp sediments as a result of the mine subsidence impacts as indicated by piezometer data.

- Five species of conservation significance were recorded at upland swamp monitoring sites in autumn 2017, namely *Acacia baueri* subsp. *aspera, Darwinia diminuta, Eucalyptus luehmanniana, Pultenaea aristata* and *Tetratheca neglecta*. These species were generally recorded in good condition in autumn 2017.
- Observations of weed species within upland swamps in autumn 2017 were limited to a single longwall swamp, Swamp 95, where three weed species (*Conyza* sp., *Hypochaeris radicata* and *Andropogon virginicus*) were recorded at the edge of the swamp in a table drain.
- The upland swamp vegetation performance indicator, *The vegetation in upland swamps is not expected to experience changes significantly different to changes in control swamps*, has not been exceeded for any of the monitored Restioid Heath/Banksia Thicket Swamps or Swamp 20 (Tea Tree Thicket vegetation). However, for longwall Tea Tree Thicket Swamp 28, based on the autumn 2017 continual decline in condition of both the understorey and species richness, and the high mortality rate of *Banksia robur* in comparison to the control sites the upland swamp vegetation performance indicator is considered to have been exceeded at this site. Assessments against the biodiversity subsidence impact performance measure, *negligible impact on the species, populations or ecological communities* have been completed and the performance measure has been met (Appendices H1 and H2).

The spring 2016 Longwalls 20-22 and Longwalls 23-27 *Vegetation Monitoring Reports prepared by Eco Logical Australia Pty Ltd, a Tetra Tech company (Eco Logical) are provided* in Appendix G (G1 and G2, respectively). The autumn 2017 Longwalls 20-22 and Longwalls 23-27 Vegetation Monitoring Reports prepared by Eco Logical are provided in Appendix G (G3 and G4, respectively).

The key potential subsidence impacts and environmental consequences on upland swamps described in the Project *EA, Preferred* Project Report and Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Water Management Plans and Biodiversity Management Plans are described in Section 6.2.6 (Swamp Groundwater Levels). As a result of the potential subsidence impacts and environmental consequences, no changes to upland swamp vegetation were expected within upland swamps. To date, no changes to the vegetation in swamps (including Swamp 20) have been detected that is significantly different to changes in control swamps, with the exception of Swamp 28 as determined by the autumn 2017 survey.

6.3.1.2 Longwalls 301-303

During the review period, Metropolitan Coal completed the upland swamp baseline vegetation surveys in accordance with the Longwalls 301-303 Biodiversity Management Plan. Baseline upland swamp vegetation surveys for Longwalls 301-303 have been conducted in spring 2015, autumn 2016, spring 2016 and autumn 2017. The survey methods used for the Longwalls 301-303 baseline surveys (visual, transect/quadrat and indicator species monitoring) are consistent with those used for the Longwalls 20-22 and Longwalls 23-27 upland swamp vegetation monitoring programs.

Baseline transect and quadrat data has been obtained for Swamps 40, 41, 46, 51/52 and 53 overlying Longwalls 301-303 and for control Swamps 101, 135, 136, 137a and 137b (Figure 9). Baseline data for the indicator species *Epacris obtusifolia* has been obtained in Swamps 40, 51/52 and 53 overlying Longwalls 301-303 and in control Swamps 101, 136 and 137a. Baseline data for the indicator species *Sprengelia incarnata* has been obtained in Swamps 40, 51/52 and 53 overlying Longwalls 301-303 and in control Swamps 101, 136 and 137b. The Longwalls 301-303 Baseline Vegetation Monitoring report prepared by Eco Logical is provided in Appendix G5.

During the review period, a number of the upland swamps were subject to WaterNSW hazard reduction burns (post the autumn 2017 baseline survey) resulting in vegetation along some transects no longer being comparable to the control swamps.

6.3.2 Upland Swamp Groundwater Monitoring

Swamp substrate water levels are assessed against the following upland swamp groundwater performance indicator:

> *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*.

As described in Section 6.2.6, the swamp substrate water levels of Swamps 30, 33, 35, 40, 41, 46, 51, 52 and 53 remained perched during the review period.

Swamp 20 substrate water levels previously changed from being permanently saturated to being periodically saturated as a result of the passing of Longwall 21 (Chart 53; Appendices C1 and C2). This trend continued at Swamp 20 during the review period.

A mining effect to the substrate water levels of Swamp 28 was identified in 2016 based on the incomplete recovery of substrate water levels following rainfall events (Chart 54; Appendices C1 and C2). Swamp 28 is considered to have an impact from mining of Longwall 25, although no effect on swamp substrate water levels occurred when Longwall 24 passed directly beneath the monitoring site (Appendices C1 and C2). From March to June 2017, the substrate piezometer in Swamp 28 displayed a response to increased rainfall residual similar to that of the control swamps and the upper height of saturation has almost returned to normal. The substrate piezometer at Swamp 28 returned to dry conditions from September 2017 until the end of 2017, as did the two control swamp piezometers.

The subsidence impacts on the substrate water levels of Swamp 20 and Swamp 28 have triggered assessments against the biodiversity subsidence impact performance measure, *Negligible impact on threatened species, populations, or ecological communities*. The Swamp 20 and Swamp 28 threatened flora and fauna assessments by Eco Logical and Cenwest Environmental Services are provided in Appendices H1 and H2, respectively. The assessments conclude that the subsidence impact performance measure has been met.

6.3.3 Riparian Vegetation Monitoring

Riparian vegetation monitoring is conducted at a number of sites on the Waratah Rivulet and Eastern Tributary, overlying Longwalls 20-27 and downstream of Longwalls 20-27 (Figure 13). As described in Section 6.3, the Longwalls 301-303 Biodiversity Management Plan includes post-mining monitoring and management of potential subsidence impacts and environmental consequences associated with Longwalls 20-22 and Longwalls 23-27. No additional riparian vegetation monitoring sites have been established for Longwalls 301-303.

The vegetation survey results for autumn 2017 have been assessed in accordance with the Longwalls 301-303 Biodiversity Management Plan. The results of the autumn 2017 survey in relation to the Biodiversity Management Plan Trigger Action Response Plan is summarised in Table 15 in Section 6.8. The results of the Longwalls 20-22 and Longwalls 23-27 riparian vegetation monitoring programs (up to and including the autumn 2017 survey) can be summarised as follows:

- Sites MRIP01, MRIP02, MRIP03, MRIP04 and MRIP10 on the Waratah Rivulet were surveyed after high rainfall in June 2017. Water levels at the time of the survey were relatively high, with bank inundation remaining present at site MRIP02 similar to spring 2016.

- Sites MRIP09, MRIP05, MRIP06, MRIP11, MRIP12, MRIP07 and MRIP08 were surveyed prior to the high rainfall that was recorded for June 2017. Water levels at the time of the survey were low at MRIP09 and MRIP06 but water flow was present and continuous. The pool at MRIP05 which was dry in spring 2016 was full in autumn 2017 following above average rainfall in February and March 2017. Water levels at site MRIP11 were similar to that of spring 2016. At site MRIP12, no water flow was observed and Pools ETAG to ETAJ were dry in autumn 2017.
- Prior to the autumn 2017 survey, mine subsidence impacts to pool drainage behaviour were recorded by Metropolitan Coal (as reported in the Metropolitan Coal 2016 Annual Review) at sites MRIP07 and MRIP08 (and are no longer used as control sites). At the time of the autumn 2017 survey there was little water flow at site MRIP07 and downstream through site MRIP08.
- All riparian sites were subject to high flows in March 2017, resulting in impacts including flood-swept and prone vegetation, loss of individual plants, burial of vegetation by adjacent vegetation, burial by woody flood debris and sediment. The impacts were evident across all sites. Scouring of the stream bank and erosion of sediments was again observed across all riparian monitoring sites in autumn 2017, attributed to high water flows following heavy rain events. The extent of bank scouring was often associated with sandy areas where vegetation was lost during high water flows. Areas of sediment deposition were observed along both the Waratah Rivulet and the Eastern Tributary. This was most apparent at sites MRIP02 and MRIP09 where large areas of sediment deposition forming banks continued to be observed.
- Apart from the described flood effects, vegetation was generally observed in good condition across and adjacent to the riparian monitoring sites. Visual inspections of riparian vegetation continued to identify vegetation dieback greater than 50 cm from the Waratah Rivulet at site MRIP02, however the extent of dieback has not increased compared to previous surveys. Vegetation dieback (less than 50 cm from the stream) has been recorded at sites MRIP05, MRIP09, MRIP11 and MRIP12.
- Species richness in autumn 2017 was generally similar to previous seasons with most values within the previously recorded ranges for each site (Charts 85 and 86), with the exception of longwall sites MRIP06 and MRIP12, where species richness was lower than previously recorded.
- Two species of conservation significance were recorded at riparian vegetation monitoring sites in autumn 2017, namely *Hibbertia nitida* and *Lomandra fluviatilis*. *Hibbertia nitida* was commonly recorded in good condition or with isolated occurrences of this species with minor dieback. *Lomandra fluviatilis* was commonly observed with minor damage at sites MRIP04, MRIP07, MRIP08 and MRIP12 associated with previous flood impacts to vegetation.
- Within riparian monitoring sites three weed species were recorded in autumn 2017 including at longwall site MRIP02 (*Cyperus* sp.) and control site MRIP04 (*Andropogon virginicus* and *Senecio madagascariensis*). Observations of these species within riparian monitoring sites were limited to isolated individuals.

The spring 2016 Longwalls 20-22 and Longwalls 23-27 Vegetation Monitoring Reports prepared by Eco Logical are provided in Appendix G (G1 and G2, respectively). The autumn 2017 Longwalls 20-22 and Longwalls 23-27 Vegetation Monitoring Reports prepared by Eco Logical are provided in Appendix G (G3 and G4, respectively). The monitoring results are consistent with the predictions described in the Project EA, Preferred Project Report and Metropolitan Coal Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 Biodiversity Management Plans, which predicted potential impacts on riparian vegetation (vegetation dieback) primarily as a result of changes in stream water levels (including both a reduction in water levels or increased ponding from changes in bed gradients resulting in the prolonged inundation of the adjacent riparian vegetation).

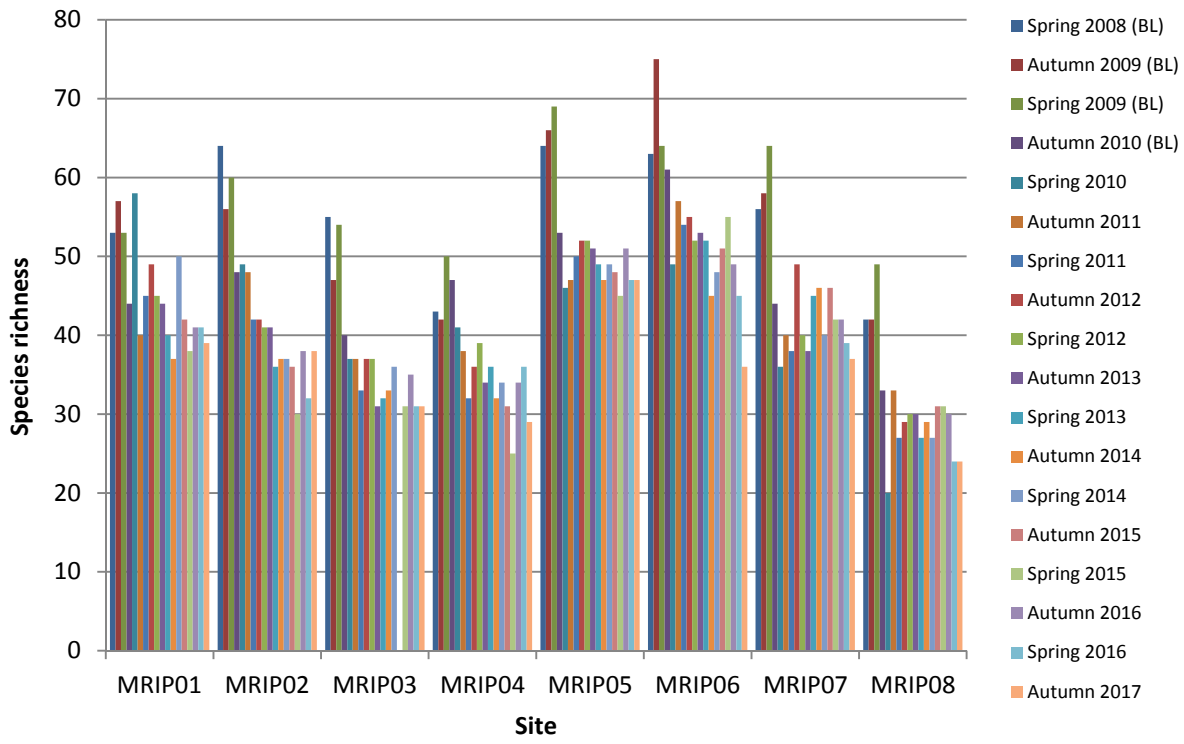


Chart 85 Native Species Richness within Riparian Monitoring Sites across All Seasons - Longwalls 20-22 Monitoring Program

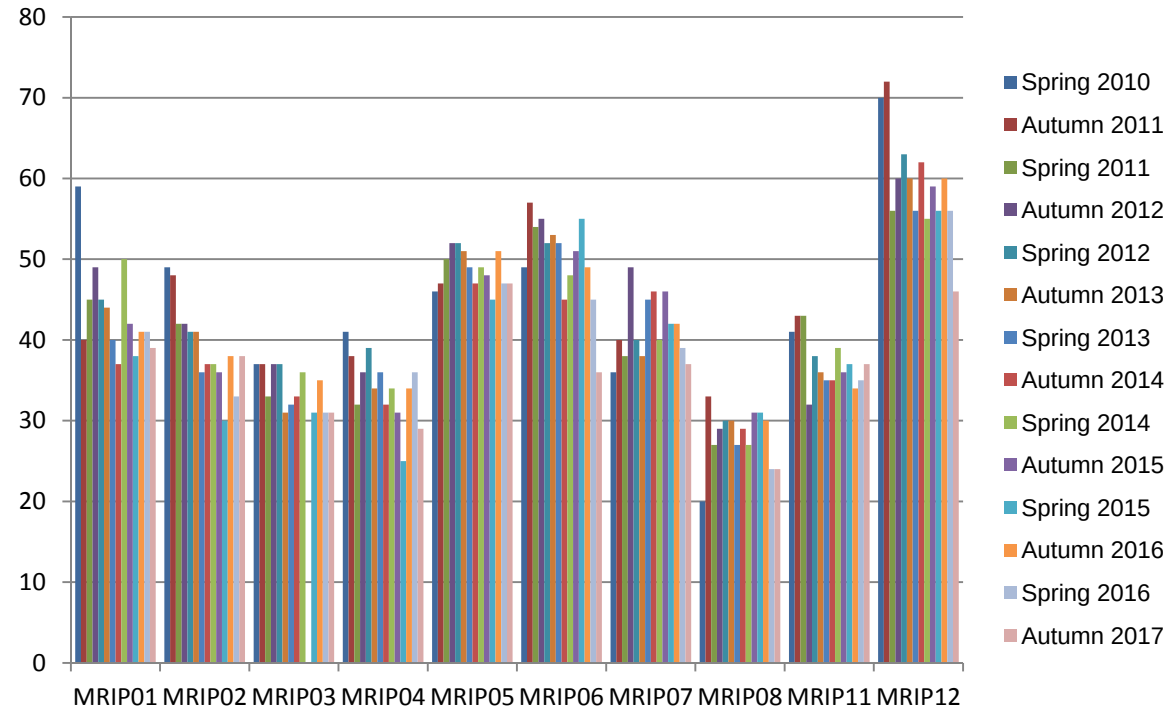


Chart 86 Native Species Richness within Riparian Monitoring Sites across All Seasons- Longwalls 23-27 Monitoring Program

6.3.4 Aquatic Biota and their Habitats

The aquatic ecology monitoring programs for Longwalls 20-22 and Longwalls 23-27 were designed to monitor subsidence-induced impacts on aquatic ecology (referred to as stream monitoring) and the response of aquatic ecosystems to the implementation of potential future stream remediation works (referred to as pool monitoring). The locations of the monitoring sites are shown on Figure 14.

As described in Section 6.3, the Longwalls 301-303 Biodiversity Management Plan includes post-mining monitoring and management of potential subsidence impacts and environmental consequences associated with Longwalls 20-22 and Longwalls 23-27. No additional aquatic ecology monitoring sites have been established for Longwalls 301-303.

Multivariate and univariate statistical procedures (Permutational Multivariate Analyses of Variance [PERMANOVA] and Plymouth Routines in Multivariate Ecological research [PRIMER] software packages) are used to examine temporal and spatial patterns in macroinvertebrates and macrophytes sampled within the study area. Specifically, PERMANOVA's are used to test hypotheses related to differential changes (e.g. before-vs-after commencement of mining) in multivariate and univariate (e.g. total number of taxa, total abundance and abundances of the most important taxonomic groups identified from the samples) estimates occurring in streams or pools subject to mining (i.e. potential 'impact' streams) in comparison to independent streams or pools that are not subject to mine subsidence (i.e. control places).

The spring 2016 Longwalls 20-22 and Longwalls 23-27 Aquatic Ecology Monitoring Reports prepared by Bio-Analysis Pty Ltd are provided in Appendix I (I1 and I2, respectively). The autumn 2017 Longwalls 20-22 and Longwalls 23-27 Aquatic Ecology Monitoring Reports prepared by Bio-Analysis Pty Ltd are provided in Appendix I (I3 and I4, respectively).

The results of the Longwalls 20-22 and Longwalls 23-27 aquatic ecology programs (up to and including the autumn 2017 survey) are summarised below.

6.3.4.1 Stream Monitoring Program

Eastern Tributary

As indicated in Section 6.2, Metropolitan Coal reported the exceedance of the Eastern Tributary watercourse performance measure in relation to iron staining to the DP&E and other relevant agencies in October 2016 and exceedance of the performance measure in relation to the natural drainage behaviour of pools in February 2017.

In spring 2016, mining impacts to pool water levels continued to be observed on the Eastern Tributary[12] at locations sampled upstream of the Longwall 26 maingate. At the time of the spring 2016 survey, water levels had increased in some pools since autumn 2016 or were similar to autumn 2016 water levels. In autumn 2017, pool water levels had increased since spring 2016, however, appeared to remain below pre-mining levels. Pool water levels at Location C1 in autumn 2017 appeared to be similar to pre-mining levels. No mining impacts to water levels were noted at Location C2 in spring 2016 or autumn 2017. Iron staining/flocculent was observed for the first time since aquatic sampling commenced at Location C2 (downstream of the maingate of Longwall 26) in spring 2016 and remained present at all sampling locations in autumn 2017.

[12] The Eastern Tributary is also known as Tributary C. Locations ET1 to ET4 shown on Figure 16 are the same as Locations C1 to C4 discussed in this section of the 2017 Annual Review, and in the Appendices J1 to J4.

Multivariate and univariate analyses of the monitoring data were used to test whether there was evidence of significant change in aquatic macroinvertebrate and macrophyte indicators at Eastern Tributary locations before vs after mining of Longwall 20 (mining commenced in May 2010) and Longwall 23 (mining commenced in May 2014), in relation to Control locations.

Multivariate analyses indicate that any effect of longwall mining on assemblages of aquatic macroinvertebrates at Locations C2, C3 and C4 are within the range of natural variability in these assemblages in relation to the control locations. Since sampling commenced, multivariate analyses have detected a significant before to after change in the structure of the assemblage of aquatic macroinvertebrates at Location C1 in spring 2016 (Longwalls 23-27 program only), but not in autumn 2017.

Univariate analyses for Longwalls 23-27 detected a significant before (spring 2009 to spring 2013) vs after (autumn 2014 to autumn 2017) mining change in numbers of Leptophlebiidae at Location C1 for the autumn 2015 to autumn 2017 surveys, due to an increase in abundance of Leptophlebiidae at Location C1 in relation to control places. However, univariate analyses for Longwalls 20-22 have not detected a significant change in numbers of Leptophlebiidae at Location C1 from before (spring 2008 to autumn 2010) to after (spring 2010 to autumn 2017) the commencement of Longwall 20.

Univariate analyses for Longwalls 23-27 detected a significant before to after mining change in mean numbers of Atyidae at Location C2 in autumn 2016, spring 2016 and autumn 2017, in relation to the control locations. Overall, fewer Atyidae have been collected at Location C2 within the after Longwall 23 period, compared to the before period. Univariate analyses for Longwalls 20-22 detected a significant before to after mining change in mean numbers of Atyidae at Location C2 in spring 2015, in relation to the control locations. However, no detectable difference has been found by subsequent Longwalls 20-22 surveys including spring 2016 and autumn 2017.

Univariate analyses for Longwalls 23-27 also detected a significant before to after mining change in mean numbers of Atyidae at Location C4 in autumn 2016 and spring 2016 in relation to the control locations, however did not find a detectable difference in autumn 2017.

To date, univariate analyses have found no significant difference in the total diversity and abundance of aquatic macroinvertebrates at Locations C1, C2, C3 and C4 in relation to the control locations that would indicate an impact from mining of Longwalls 20-22 or Longwalls 23-27.

Multivariate and univariate analyses of monitoring data before versus after commencement of mining (of Longwall 20 and Longwall 23) indicates that any effect of longwall mining on assemblages of aquatic macrophytes at Locations C1, C2, C3 and C4 are within the range of natural variability in these assemblages in relation to the control locations.

A significant before to after mining change in the structure of the assemblage of aquatic macrophytes was detected at Location C1 in spring 2014, in relation to the control locations, by the Longwalls 20-22 monitoring program. However, since spring 2014, there has been no indication of significant differences between Location C1 and control locations. No detectable difference has been found by the Longwalls 23-27 monitoring program.

Similarly, Longwalls 23-27 analyses detected a significant increase in species diversity of aquatic macrophytes at Location C2 in autumn 2017 within the Longwall 23 after period. However, no detectable difference has been found by the Longwalls 20-22 monitoring program.

Waratah Rivulet

Multivariate analyses comparing temporal changes in components of the aquatic macroinvertebrate and macrophyte assemblages at locations sampled along the Waratah Rivulet (Locations WT3, WT4 and WT5) with control locations have not detected significant changes from before- to after-commencement of mining of the Longwalls 20-22 underground mining area.

For the first time since sampling commenced (spring 2008), univariate analyses for spring 2016 detected a significant increase in mean diversity at Location WT3 within the after-period, in relation to the control locations. No significant changes were detected by the autumn 2017 survey.

Tributary B - Location B1

A considerable drop in water level was noted in a large pool at Location B1 in spring 2012. Since autumn 2013 pools along the study reach have been mostly dry and there has been no surface flow as a result of mine subsidence. Quantitative sampling of aquatic macroinvertebrates has not been carried out at Location B1 on Tributary B in spring 2013 or from spring 2014 to autumn 2017 due to insufficient habitat available for sampling.

Multivariate analyses for spring 2016 and autumn 2017 indicate that assemblages of macroinvertebrates at Location B1 continued to differ significantly from before to after spring 2012, in relation to the control locations. A significant decrease in mean diversity, total abundance, and numbers of Atyidae has also been detected by univariate analyses at Location B1 from before to after spring 2012 in relation to the control locations. Univariate analyses at Location B1 from before to after spring 2012 have not detected a significant change in numbers of Leptophlebiidae in relation to the control locations.

The multivariate analyses for spring 2016 and autumn 2017 indicate that assemblages of macrophytes at Location B1 continue not to differ significantly from before to after spring 2012, in relation to the control locations. Univariate analyses have consistently found no significant differences in total diversity of macrophytes at Location B1. Significant differences in the total cover of macrophytes at Location B1 compared to the controls were identified in spring 2015 but not in autumn 2016, spring 2016 or autumn 2017. However, considerable dieback of the fern, *Gleichenia dicarpa*, has occurred at Location B1 since spring 2012. It appears that while not statistically significant, aquatic macrophyte assemblages at Location B1 have experienced a degree of environmental stress since spring 2012 as a result of Longwalls 20-22.

Tributary B - Location B2

Mining impacts (i.e. iron staining) were first noted at Location B2 in spring 2014. Minor fracturing of the stream substratum was first noted at the most upstream site (Site B2-1) in autumn 2015 and in autumn 2016 at the downstream site (Site B2-2).

Multivariate analyses have found a significant change in the structure of the assemblage of aquatic macroinvertebrates at Location B2 before to after mining compared to the control locations from autumn 2014 to autumn 2017.

Univariate analyses detected a significant decrease in mean numbers of Leptophlebiidae at Location B2 in relation to the control locations in spring 2015, autumn 2015 and spring 2014. However, no detectable difference was found by the autumn 2016, spring 2016 or autumn 2017 surveys. Leptophlebiidae have increased at Location B2 since spring 2015. In spring 2016 and autumn 2017 univariate analyses of Atyidae at Location B2 detected a significant decrease in mean numbers within the after mining period, in relation to the control locations. No significant changes in mean diversity or abundance of macroinvertebrates have been detected before to after mining at Location B2 in relation to the control locations.

Analyses examining changes in aquatic macrophytes found no evidence of impacts at Location B2 that could be related to mining activities.

Aquatic Ecology Performance Indicator

The aquatic ecology subsidence impact performance indicator: *The aquatic macroinvertebrate and macrophyte assemblages in streams are not expected to experience long-term impacts as a result of mine subsidence* was exceeded for Locations B1 and B2 on Tributary B in relation to aquatic macroinvertebrates in spring 2016 and autumn 2017.

This triggered threatened species assessments against the biodiversity subsidence impact performance measure, *Negligible impact on threatened species, populations, or ecological communities.* The assessment against the biodiversity performance measure has been conducted in relation to threatened terrestrial flora and fauna; there are no threatened aquatic fauna or flora known, or considered likely to occur. Assessments conducted by Eco Logical and Cenwest Environmental Services for threatened flora and threatened fauna, respectively, concluded that the subsidence impact performance measure has been met. The threatened flora and fauna assessments are provided in Appendices H3 and H4.

6.3.4.2 Pool Monitoring Program

Pools on Eastern Tributary

Iron staining was first observed within Pool ETAH in spring 2016, and flow diversion and reductions in pool water level were noted in autumn 2017. Multivariate analyses indicated significant differences in the structure of aquatic macroinvertebrate assemblages in large Pool ETAH before-to-after mining in autumn 2015, autumn 2016 and autumn 2017 compared to control locations. However, univariate analyses for Pool ETAH have consistently found no significant differences in total diversity, total abundance, numbers of Leptophlebiidae or Atyidae that could be associated with mining of the Longwalls 23-27 area. There have been no detectable impacts to macrophytes at Pool ETAH, in relation to the control locations.

Iron staining was first observed within the small Eastern Tributary pools in spring 2016. Flow diversion and reductions in pool water level were observed in Pools ETAG, ETAI and ETAK in autumn 2017. To date, analyses examining changes in aquatic macroinvertebrates and macrophytes in Pools ETAG, ETAI and ETAK have not detected significant changes in relation to the control locations.

Pools on Waratah Rivulet

Multivariate analyses comparing temporal and spatial patterns of change in assemblages of aquatic macroinvertebrates in large pools (J, M1 and N) and small pools (K, L and M) sampled on the Waratah Rivulet with the control pools have not detected significant differences in the structure of assemblages of macroinvertebrates. Univariate analyses have detected a significant increase in mean diversity of macroinvertebrates in Pools J, M1, K, L and M in relation to the control pools since autumn 2015.

Multivariate analyses comparing temporal and spatial patterns of change in assemblages of aquatic macrophytes in large pools (J, M1 and N) and small pools (K, L and M) sampled on the Waratah Rivulet with the control pools have not detected significant differences when comparing the before-to-after mining periods. From autumn 2016 to autumn 2017, univariate analyses detected a significant change in the mean cover of macrophytes at Pool M1 after mining, in relation to the control pools. Mean cover decreased at Pool M1 but increased at the control pools within the after period. Univariate analyses indicated that mean diversity of macrophytes at Pool N from autumn 2016 to autumn 2017 had changed significantly in relation to the control pools. Mean diversity at Pool N has changed little between periods but increased at the control pools within the after period.

6.3.4.3 Assessment of Subsidence Impacts and Environmental Consequences on Aquatic Habitats and Biodiversity

The key potential subsidence impacts and environmental consequences for streams described in the Project EA, Preferred Project Report and Metropolitan Coal Biodiversity Management Plans are described in Section 6.3. Potential environmental consequences include impacts on aquatic habitats (e.g. alteration of hydrology, pool habitat, in-stream connectivity and water quality), and on biodiversity (e.g. aquatic macrophytes, macroinvertebrates, fish and riparian vegetation). In summary, the key potential environmental consequences described in the Project EA, Preferred Project Report, and Metropolitan Coal Biodiversity Management Plans include:

- Changes in stream flows as a result of fracturing of bedrock and the consequent diversion of a portion of the total stream flow as underflow. The effects of underflow would be most noticeable during periods of low flow and on the frequency of no flow, while the effects on the frequency and magnitude of high flows would be negligible.
- Changes in pool water levels and in-stream connectivity - underflow has been observed to result in lower water levels in pools as they become hydraulically connected with the fracture network. During prolonged dry periods when flows recede to low levels, the number of instances where loss of flow continuity between pools occurs increases with a greater proportion of these lower flows being conveyed entirely in the subsurface fracture network.
- Impacts on water quality following cracking of the stream bed that can reduce the quality of habitat for aquatic biota (e.g. generation of iron flocculent material).
- Minor stream bank erosion, where changes in channel gradients result in increases in flow energy.
- Impacts on aquatic macrophytes plants (e.g. as a result of changes in hydrology described above) resulting in exposure and desiccation or smothering of plants by iron flocculent material. Aquatic macrophytes have evolved reproductive strategies to cope with the variable nature of flow in streams and wetlands within Australia. Obligate water plants generally require permanent water, however they can recolonise once water becomes available again.
- Localised impacts on aquatic macroinvertebrates as a result of changes in aquatic habitat/hydrology described above. The Project is unlikely to have any significant long-term impacts on assemblages of macroinvertebrates.
- The conveyance of surface water flows to sub-surface fractures in the area affected by subsidence has the potential to reduce available habitat for fish and connectivity among sections of the stream channel, impeding fish passage.

The results of aquatic ecology monitoring are considered to be consistent with the potential subsidence impacts and environmental consequences described in the Project EA, Preferred Project Report and the Metropolitan Coal Water Management Plans and Biodiversity Management Plans.

However, subsidence impacts on Tributary B have resulted in no surface flow along the stream in the vicinity of Location B1 for an extended period of time. This change in aquatic habitat/hydrology has resulted in long term impacts to the aquatic macroinvertebrate assemblage at this location (location B1) and downstream at location B2. This has not resulted in an exceedance of the biodiversity subsidence impact performance measure, *Negligible impact on threatened species, populations or ecological communities* (Appendices H3 and H4).

6.3.5 Amphibian Surveys

Monitoring programs have been developed for Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 to monitor amphibian species, with a focus on the habitats of the Giant Burrowing Frog (*Heleiporus australiacus*) and Red-crowned Toadlet (*Pseudophryne australis*) associated with tributaries. The locations of the monitoring sites are shown on Figure 15.

Sites are surveyed annually in spring/summer (i.e. October to February) during suitable weather conditions. The 2016 spring/summer survey was carried out in three separate surveys, over ten days and ten nights in February 2017, March 2017 and April 2017. The first survey period was delayed due to the prevailing dry weather conditions from October 2016 to January 2017. The survey in March 2017 was conducted to provide additional breeding data, however, was cut short due to the exceptionally wet weather resulting in catchment closure. The amphibian survey was completed in April 2017.

6.3.5.1 Longwalls 20-22 Amphibian Monitoring

The Spring/Summer 2016 Longwalls 20-22 Amphibian Monitoring Report prepared by Cenwest Environmental Services is provided in Appendix J1.

The spring/summer 2016 survey is the eighth amphibian survey for Longwalls 20-22. At the time of the spring/summer 2016 survey six test sites above Longwalls 20-22 had been undermined for periods ranging from three to five years. Habitats of five test sites (1, 2, 4, 5 and 6) have been adversely impacted by longwall mining.

Six amphibian species were recorded by the spring/summer 2016 survey, including four in test sites and six in control sites, being representatives from the two families Myobatrachidae and Hylidae. The most species diverse sites in the spring/summer 2016 survey with four species were test site 6 and control sites 8 and 10 (Figure 15). The Red-crowned Toadlet was located at two test sites (site 5 and site 6) and three control sites (sites 7, 8 and 12). The Giant Burrowing Frog was observed calling and breeding at site 10. Individuals of the Giant Burrowing Frog have not been recorded at test or control sites in either the spring/summer 2010 or spring/summer 2012 to 2015 surveys.

Fourteen breeding events (five species) were recorded by the spring/summer 2016 survey in both test and control sites. No breeding events were recorded for the Red-crowned Toadlet. One breeding event was recorded for the Giant Burrowing Frog.

Since the commencement of the Longwalls 20-22 amphibian monitoring program, species diversity across all sites has varied between five (2013) and 11 (2009). At test sites, species diversity has varied between 4-9 species and at control sites, between 2-9 species.

6.3.5.2 Longwalls 23-27 Amphibian Monitoring

The Spring/Summer 2016 Longwalls 23-27 Amphibian Monitoring Report prepared by Cenwest Environmental Services is provided in Appendix J2.

The spring/summer 2016 survey is the seventh amphibian survey for Longwalls 23-27. Five test sites above Longwalls 23-27 had been undermined by the commencement of the 2016 spring/summer survey. Habitats of two sites (13 and 14) have been adversely impacted by longwall mining.

Four amphibian species were recorded by the spring/summer 2016 survey, including three in test sites and four in control sites, also being representatives from the two families Myobatrachidae and Hylidae. The most widespread frog was the Common Eastern Froglet, recorded at all monitoring sites. All other frog species were patchily distributed. Adults of the Red-crowned Toadlet were located at one test site (site 14) and three control sites (sites 20, 21 and 22). The Giant Burrowing Frog was not located during the survey.

Only two species (Common Eastern Froglet and the Southern Rocket Frog), were found breeding in the spring/summer 2016 survey. The Common Eastern Froglet was not breeding at test sites, but was found breeding in large numbers at control sites 18, 20, 21 and 22. The Southern Rocket Frog was located breeding in modest numbers only in control sites 18 and 20. No breeding events were recorded for the Red-crowned Toadlet or Giant Burrowing Frog.

Since the commencement of the Longwalls 23-27 amphibian monitoring program, species diversity across all sites has varied between four (2016) and eight (2010). At test sites, species diversity has varied between 3-7 species and at control sites, between 2-6 species.

6.3.5.3 Longwalls 301-303 Amphibian Monitoring

Baseline amphibian surveys have been conducted in spring/summer 2015 and spring/summer 2016 at six test sites (23, 24, 25, 26, 27 and 28) overlying Longwalls 301-303 (Figure 15). The control sites for Longwalls 301-303 consist of the eleven existing sites associated with Longwalls 20-22 and Longwalls 23-27. The baseline spring/summer 2015 and spring/summer 2016 Longwalls 301-303 Amphibian Monitoring Reports prepared by Cenwest Environmental Services are provided in Appendices J3 and J4, respectively.

In the spring/summer 2015 survey, three amphibian species were recorded at the longwall test sites. Adults of the Common Eastern Froglet were located at five of the six test sites, one adult Broad-palmed Frog was observed at site 26, and one adult Red-crowned Toadlet was located at site 25. There was no evidence of breeding events for any species at the six test sites.

In the spring/summer 2016 survey, seven species were recorded at the longwall test sites. Species diversity varied across sites from zero to three. The number of sites used by each species varied between one and five. Two adult Red-crowned Toadlets were located, one at site 25 and one at site 26. No evidence of breeding for this species was observed at the six test sites. Neither adults, nor evidence of breeding, were observed at the six test sites for the Giant Burrowing Frog.

One new species, the Littlejohn's Tree Frog (*Litoria littlejohni*), was located for the first time at site 24 (one adult) in the spring/summer 2016 survey. No evidence of breeding was observed for this species. Within the Greater Southern Sydney Bioregion, the Woronora Plateau and the higher rainfall areas of the Blue Mountains are considered two key areas that are important to this species (DECC, 2007). In the past, Littlejohn's Tree Frog has been reported to be common at Darkes Forest (A. White pers. comm. in DECC, 2007). This species has not been recorded by the Longwalls 20-22 or Longwalls 23-27 amphibian surveys and was not recorded in the pre-mining baseline surveys conducted for the Metropolitan Coal Project Environmental Assessment.

Metropolitan Coal commissioned a targeted survey for the Littlejohn's Tree Frog to be carried out in August or September 2017 when adult calling was likely to be at its peak under wet conditions to determine the status of the species within the Project area. However, the dry weather conditions experienced in August and September 2017 did not provide suitable weather conditions for the conduct of the targeted survey. The survey has had to be postponed until 2018.

6.3.5.4 Statistical Analysis of Amphibian Monitoring Results

A feature of the amphibian surveys to date is the high numbers of zero records that dominate the data, indicating a non-normal distribution (i.e. a skewed distribution of data). This means that the results of the amphibian surveys cannot be analysed by simple parametric statistics such as Chi^2 or an analysis of variance (ANOVA). A Poisson regression[13] analysis has been carried out by Dr Bernard Ellem for Cenwest Environmental Services to analyse the amphibian survey results obtained to date (i.e. to spring/summer 2016). The three data sets (Longwalls 20-22, 23-27 and 301-303) have been analysed together to increase the resolution of the analyses. No adverse impact from mining has been detected for the amphibian assemblage at the 95% confidence level.

The amphibian species distribution, diversity and abundance data appear to be consistent with expected population variations and cycles in response to seasonal variations. There are no significant differences between the test and control sites at the 95% confidence level. The amphibian performance indicator, *The amphibian assemblage is not expected to experience changes significantly different to the amphibian assemblage at control sites*, has not been exceeded.

The monitoring results are consistent with the predictions described in the Project EA, Preferred Project Report, and Metropolitan Coal Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 Biodiversity Management Plans, specifically, that it is unlikely that any vertebrate population would be put at risk by the Project.

6.4 LAND MANAGEMENT

The Metropolitan Coal Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 Land Management Plans were prepared to manage the potential environmental consequences of the Metropolitan Coal Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 Extraction Plans on cliffs, overhangs, steep slopes and land in general, in accordance with Condition 6, Schedule 3 of the Project Approval.

The Longwalls 301-303 Land Management Plan includes post-mining monitoring and management of potential subsidence impacts and environmental consequences associated with Longwalls 20-22 and Longwalls 23-27. During the review period the Longwalls 301-303 Land Management Plan Trigger Action Response Plan was reviewed and revised.

Sections 6.4.1 and 6.4.2 provide a summary of the land assessments for the review period. Section 6.8 provides a summary of the assessments against the cliffs and overhangs, steep slopes and land in general subsidence impact performance indicators and measures for the January to June 2017 period in Table 14 and for the July to December 2017 period in Table 15.

6.4.1 Steep Slopes and Land in General

Visual inspections for subsidence impacts on steep slopes and land in general are conducted by Metropolitan Coal and its contractors as part of routine works conducted in the catchment.

During the review period, a surface tension crack was recorded on a rock platform located over Longwall 25 in the vicinity of Aboriginal heritage site FRC 301 in February 2017 (Figure 17). The surface crack was approximately 10 mm wide and 25 m in length.

[13] Poisson regression is a generalized linear model form of regression analysis used to model count data and contingency tables.

Rock fall from a rock ledge was also observed in February 2017 in the vicinity of Aboriginal heritage site FRC 285 located over Longwall 22B (Figure 17). The fallen rock was approximately 60 cm wide and 80 cm in length, and dislodged from the underside of the sandstone boulder overhang. The rock landed on the uneven rock surface beneath the overhang, causing it to break into smaller sections.

The potential for environmental consequences or safety hazard were assessed and documented by Metropolitan Coal in the Land Management Plan – Subsidence Impact Register. No management measures were required to be implemented.

The recorded subsidence impacts are consistent with the potential subsidence impacts described in the Project EA, Preferred Project Report and Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 Land Management Plans, specifically that the size and extent of surface cracking at the steep slopes and land in general would be similar to that observed previously at Metropolitan Coal, and that the maximum predicted systematic strains would be of sufficient magnitude to result in the fracturing of sandstone and, hence, there is potential for rock falls, particularly where rock ledges are marginally stable.

6.4.2 Cliffs and Overhangs

Visual inspections have been conducted monthly for the period of time Longwalls 23-27 extraction has been within 400 m of cliff and overhang sites COH2, COH3, COH4, COH5, COH6, COH6a, COH7, COH8, COH9, COH10, COH14, COH15 and COH16 (Figure 16) and following the completion of each longwall to record evidence of subsidence impacts.

During the review period Longwall 27 was not within 400 m of the cliff sites. Following the completion of Longwall 27, no new cliff instabilities (i.e. freshly exposed rock face and debris scattered around the base of the cliff or overhang) or areas of water seepage in excess of that expected to result from rainfall conditions were evident at the cliff and overhang sites.

A small rock fall at site COH2 had previously been recorded in December 2013. Following the completion of Longwall 27 and prior to the commencement of Longwall 301, only the one cliff site (COH2) located over Longwall 20 has been recorded with cliff instabilities, approximately 1.5 m in length.

No cliff and overhang sites have been identified within 600 m of Longwalls 301-303 secondary extraction. The nearest cliff and overhang sites are located more than 800 m to the west of Longwalls 301-303. At these distances, the cliff and overhang sites are not expected to experience any measurable vertical subsidence resulting from the extraction of Longwalls 301-303.

The Project EA, Preferred Project Report and Metropolitan Coal Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 Land Management Plans predicted that the length of potential cliff instabilities would be expected to be less than 3% of the lengths of the cliffs. The total length of cliffs and associated overhangs within the Project underground mining area is approximately 772 m. The total length of cliffs and associated overhangs within the mining area to experience cliff instability (i.e. the exposure of a fresh face of rock and debris scattered around the base of the cliff or overhang) is to be less than 23 m. Less than 3% of the total length of cliffs (and associated overhangs) within the mining area have experienced mining-induced rock fall.

6.5 HERITAGE MANAGEMENT

The Metropolitan Coal Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 Heritage Management Plans were prepared to manage the potential environmental consequences of the Metropolitan Coal Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 Extraction Plans on Aboriginal heritage sites or values in accordance with Condition 6, Schedule 3 of the Project Approval.

The Longwalls 301-303 Heritage Management Plan includes post-mining monitoring and management of potential subsidence impacts and environmental consequences associated with Longwalls 20-22 and Longwalls 23-27. During the review period the Longwalls 301-303 Heritage Management Plan Trigger Action Response Plan was reviewed and revised.

Section 6.5.1 provides a summary of the heritage assessments for the review period. Section 6.8 provides a summary of the assessments against the Aboriginal heritage sites subsidence impact performance indicators and measures.

6.5.1 Longwalls 20-22 and Longwalls 23-27

A monitoring program has been implemented to monitor the impacts and consequences of mine related subsidence on Aboriginal heritage sites located within the 35^{o} angle of draw of Longwalls 20-22 and Longwalls 23-27 (Figure 17). The Aboriginal heritage sites monitoring program has been carried out by an archaeologist (with experience in rock art recording and management) and Aboriginal stakeholder representatives.

Seven heritage sites (FRC 15, FRC 176, FRC 275, FRC 281, FRC 283, FRC 284 and MET 1) were determined by the Longwalls 20-22 Rounds 1, 2 and 3 and Longwalls 23-27 Round 1, Round 2 and Round 3 Aboriginal heritage surveys to have changes due to mine subsidence from Longwalls 20-22 and Longwalls 23-27 (as reported in the Metropolitan Coal 2016 Annual Review).

During the review period, the Longwalls 23-27 Round 4 and Round 5 Aboriginal heritage surveys were conducted by Niche Environment and Heritage following the completion of Longwall 26 and Longwall 27, respectively. The fourth round of monitoring for Longwalls 23-27 was conducted in February 2017, and the fifth round of monitoring for Longwalls 23-27 was conducted in September 2017.

Changes due to mining were recorded at site FRC 301 (a grinding groove site) during the Round 4 survey. A surface crack was recorded on the rock platform, approximately 10 mm wide and 25 m in length, approximately 3 m to the north of the grinding groove (as described in Section 6.4). The grinding groove has not been affected by the cracking. No further changes to Aboriginal heritage sites as a result of mining were recorded during the Round 4 survey. The Longwalls 23-27 Round 4 monitoring report is provided in Appendix K1.

During the Longwalls 23-27 Round 5 survey, changes due to mining were recorded at four Aboriginal heritage sites, namely, FRC 28, FRC 29, FRC 34 and FRC 60. The observed changes at each site were as follows:

- Site FRC 28 – vertical cracking of the rear shelter wall, opening of horizontal planes/joints and movement of the rock shelf that is part of the shelter floor, not coincident with any art.
- Site FRC 29 – horizontal crack along the back wall and a joining vertical crack, not coincident with any art.
- Site FRC 34 – horizontal cracking along the roof of the shelter and cracking over the most southern hand stencil on the back panel.

- Site FRC 60 – three vertical cracks along the back wall of the shelter, no art recorded at this shelter, the artefacts could not be relocated.

The Longwalls 23-27 Round 5 monitoring report is provided in Appendix K2.

In summary, of the 52 Aboriginal heritage sites that have been subject to monitoring for Longwalls 20-22 and Longwalls 23-27, 12 have been determined to have changes due to mining induced subsidence.

Aboriginal heritage site monitoring results are used to assess the Project against the Aboriginal heritage subsidence impact performance measure:

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

For the purpose of measuring performance against the Aboriginal heritage subsidence impact performance measure, sites are considered to be "affected by subsidence impacts" if they exhibit one or more of 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.

The mining area is defined by the Project Approval and is shown on Figure 1 of this report (labelled Project Longwalls 20-27 and Longwalls 301-317 layout). Of the sites at which changes due to mining induced subsidence have occurred, sites FRC 34 and FRC 281 have been affected by subsidence impacts as a result of cracking of sandstone that coincides with Aboriginal art. This means that less than 2% of sites within the mining area have been affected.

Metropolitan Coal acknowledges that all Aboriginal heritage sites are considered to be culturally significant to the Aboriginal people who have a traditional connection to Country.

The Aboriginal heritage monitoring results are consistent with the potential subsidence impacts and environmental consequences described in the Project EA, Preferred Project Report and Metropolitan Coal Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 Heritage Management Plans, including the potential for open sites and overhang sites to be impacted by the cracking of sandstone resulting from mine subsidence. The observed rate of subsidence effects at the time of the Project EA and Preferred Project Report was that up to 10% of sites experience an effect such as cracking, accelerated weathering or blockfall. It was expected that the majority of identified Aboriginal heritage sites would experience no significant change, particularly when compared to natural deteriorating processes unrelated to mining.

6.5.2 Longwalls 301-303

Monitoring of Aboriginal heritage site FRC 76 (sandstone overhang with art only) and site FRC 117 (sandstone overhang with art and PAD) will be undertaken within three months of the completion of Longwall 303 (Figure 17).

Monitoring will also be conducted of Longwalls 20-27 Aboriginal heritage sites at which previous monitoring indicates continued change due to mining induced subsidence. The Aboriginal heritage sites that show continued change by the Round 5 monitoring survey are sites MET 1 and FRC 176. Sites FRC 28, FRC 29, FRC 34 and FRC 60 were observed to have shown change for the first time during the Round 5 survey (Appendix K2). These sites will be monitored within three months of the completion of Longwall 303.

6.6 BUILT FEATURES MANAGEMENT

The Metropolitan Coal Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 Built Features Management Plans were prepared to manage the potential environmental consequences of the Metropolitan Coal Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 Extraction Plans on built features in accordance with Condition 6, Schedule 3 of the Project Approval.

The Longwalls 301-303 Built Features Management Plans includes post-mining monitoring and management of potential subsidence impacts and environmental consequences associated with Longwalls 20-22 and Longwalls 23-27.

During the review period Metropolitan Coal installed approximately 12.5 km of new subsidence monitoring for built features associated with Longwalls 301-303.

Metropolitan Coal also continued baseline data collection for infrastructure in the vicinity of Longwalls 301-303, including:

- Continued baseline monitoring Bridge 2 (BN616 [southbound and BN617 [northbound]) using the high precision Fibre Bragg Grating (FBG) system.
- Deployment of real-time Global Positioning Systems (GPS) to five TransGrid towers (T11-108 to T11-104), the Cawley Road overbridge and Bridge 2 (BN617) to track absolute movement and trigger detailed survey events.
- A pre-mining audit of all marked grave sites at the Waterfall General (Garrawarra) Cemetery to document the baseline condition of each grave site, including photographs and commentary.
- Structural analysis of two culverts for Sydney Trains.

Metropolitan Coal also implemented a number of contingency measures in relation to potential subsidence impacts on infrastructure during the review period, including the design and sourcing of replacement towers for the TransGrid 330 kV transmission line.

The Longwalls 301-303 Built Features Management Plans Trigger Action Response Plans were reviewed and revised during the review period. Metropolitan Coal also reviewed and updated the Garrawarra Centre Complex Built Features Management Plan, in consultation with the NSW Resources Regulator and NSW Health (South Eastern Sydney Local Health District, SESLHD) to improve monitoring at the Garrawarra Centre.

The SESLHD and Metropolitan Coal also developed a Memorandum of Understanding to remove designated Garrawarra Centre assets (Cottages B04a-B09a, water tank B14t02, Kiln F01b and building B03d) as part of a risk mitigation process (subject to Wollongong City Council development approval).

Monitoring of infrastructure owned by Endeavour Energy, Nextgen, TransGrid, Optus, Telstra, Roads and Maritime Services, Sydney Water and Wollongong City Council was conducted during the review period for subsidence impacts. No subsidence impact to any built feature was evident over the review period.

The Project Approval requires Metropolitan Coal not to exceed the following built features subsidence impact performance measure:

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

The built features subsidence impact performance measure was not exceeded during the review period.

The Project Approval also requires Metropolitan Coal not to exceed the subsidence impact performance measure for items of heritage or historical significance at the Garrawarra Centre:

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

The heritage subsidence impact performance measure for the Garrawarra Centre was not exceeded during the review period.

6.7 PUBLIC SAFETY MANAGEMENT

The Metropolitan Coal Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 Public Safety Management Plans were prepared to manage the potential consequences of the Metropolitan Coal Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 Extraction Plans on public safety within the underground mining areas in accordance with Condition 6, Schedule 3 of the Project Approval.

The Longwalls 301-303 Public Safety Management Plan includes post-mining monitoring and management of potential subsidence impacts and environmental consequences associated with Longwalls 20-22 and Longwalls 23-27.

Monitoring of cliffs and overhangs, steep slopes and land in general has been conducted for subsidence impacts in accordance with the Metropolitan Coal Land Management Plans. Monitoring of infrastructure items has been conducted in accordance with the Metropolitan Coal Built Features Management Plans. No subsidence impacts were identified during the review period that were considered to pose a risk to public safety.

Further, no subsidence safety incidents were reported by visitors, personnel or contractors to Metropolitan Coal in the underground mining area during the review period.

6.8 ASSESSMENT OF ENVIRONMENTAL PERFORMANCE

The subsidence impact performance indicators and performance measures in Table 14 and Table 15 were developed to address the predictions of subsidence impacts and environmental consequences on water resources, watercourses, biodiversity, land, heritage, built features and public safety included in the Project EA, Preferred Project Report, Metropolitan Coal Longwalls 20-22 Extraction Plan, Longwalls 23-27 Extraction Plan, and/or Longwalls 301-303 Extraction Plan. Assessment against the subsidence impact performance indicators and performance measures for Longwalls 20-22 and Longwalls 23-27 have been conducted for the January to June 2017 assessment period in Table 14 and July to December 2017 assessment period in Table 15.

Table 14
Underground Mining Area and Surrounds Assessment of Environmental Performance, January to June 2017

Monitoring Components	Subsidence Impact Performance Indicator(s)	Longwalls 20-22 Extraction Plan*	Longwalls 23-27 Extraction Plan#	Subsidence Impact Performance Indicator Exceeded?	Resulting Actions	Subsidence Impact Performance Measure	Subsidence Impact Performance Measure Exceeded?
WATER MANAGEMENT							
Surface Water Flow	*Changes in the quantity of water entering Woronora Reservoir is not significantly different post-mining compared to pre-mining, that is not also occurring in the control catchment(s)*	✓	✓	No	-	*Negligible reduction to the quantity of water resources reaching the Woronora Reservoir*	No
Water Quality Reaching 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*	✓	✓	Yes (dissolved manganese at site ETWQ AU)	Assessment against the performance measure conducted for the Eastern Tributary by Associate Professor Barry Noller (The University of Queensland, 2017) (Appendix F1)	*Negligible reduction to the quality of water resources reaching the Woronora Reservoir*	No
Connective Cracking	*Visual inspection does not identify abnormal water flow from the goaf, geological structure, or the strata generally*	✓	✓	No	-	*No connective cracking between the surface and the mine*	No
	The 20-day average mine water make does not exceed 2 ML/day	✓	✓	No	-		No
	Significant departures from the predicted envelope of vertical potentiometric head profiles at Bores 9GGW2B and 9FGW1A do not occur	✓	×	No	-		No
	Significant departure from the predicted envelope of the vertical potentiometric head profile at Bore 9GGW2B does not occur	×	✓	No	-		No
	The water tables measured at Bores 9FGW1A and 9GGW1-80 are higher than the water levels of streams crossed by a transect along Longwall 22 (i.e. a hydraulic gradient exists from each bore to the nearest watercourse)	✓	✓	No	-		No
Leakage from the Woronora Reservoir	*The groundwater head of Bores 9GGW2B and PM02 is higher than the water level of Woronora Reservoir (i.e. a hydraulic gradient exists from the bores to the Woronora Reservoir)*	✓	✓	No	-	*Negligible leakage from the Woronora Reservoir*	No
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*	✓	✓	To be assessed in the 2017 Annual Review	-	*Negligible reduction in the water quality of Woronora Reservoir*	No
Waratah Rivulet Environmental Consequences	*No change to the natural drainage behaviour of Pool P. Specific indicators include: no new cracking in the stream bed of Pool P or rock bar; continual flow through/below the rock bar of Pool P such that water is ponded upstream; and continual surface water flow along the length of Pool P*	✓	×	No	-	*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
	No change to the natural drainage behaviour of Pools P, Q, R, S, T, U, V and W. Specific indicators include: no new cracking in the stream bed of pools or rock bars (where relevant); continual flow over/ through/below the rock bars/terminal boulder fields of pools such that water is ponded upstream; and continual surface water flow along the length of the pools	×	✓	No	-		No
	Analysis of water depth data for Pool P (when mining is within 400 m of Pool P) indicates the water depth is at or above the pool's previous minimum (i.e. when mining is beyond 400 m of Pool P)	✓	×	No	-		No
	Analysis of water depth data for Pools P, T and V (when mining is within 400 m of the pools) indicates the water depth is at or above the pool's previous minimum (i.e. when mining is beyond 400 m of the pools)	×	✓	No	-		No
	Analysis of water depth data for Pools Q, R and S on Waratah Rivulet indicates the water depths are above that required to maintain water over the downstream rock bar	✓	✓	No	-		No
	Visual inspection of the Waratah Rivulet between the full supply level of the Woronora Reservoir and Pool P does not show significant changes in the extent or nature of iron staining that isn't also occurring in the Woronora River (control site)	×	✓	No	-		No
	Visual observations of gas releases in Pool P on the Waratah Rivulet indicate the gas releases have increased beyond those observed up to 17 April 2014	✓	✓	No	-		No

Table 14 (Continued)
Underground Mining Area and Surrounds Assessment of Environmental Performance, January to June 2017

Monitoring Components	Subsidence Impact Performance Indicator(s)	Longwalls 20-22 Extraction Plan*	Longwalls 23-27 Extraction Plan#	Subsidence Impact Performance Indicator Exceeded?	Resulting Actions	Subsidence Impact Performance Measure	Subsidence Impact Performance Measure Exceeded?
WATER MANAGEMENT (Continued)							
Waratah Rivulet Environmental Consequences (Continued)	*No gas releases observed at Pools Q to W on the Waratah Rivulet*	×	✓	Yes (at Pool U)	Assessment against the performance measure conducted by Associate Professor Barry Noller (The University of Queensland, 2017) (Appendix E1)		No. Assessment subject to peer review (Appendix E2)
Eastern Tributary Environmental Consequences	*No change to the natural drainage behaviour of at least 70% of the stream reach (from Pools ETAF to ETAU). Specific indicators include: no new cracking in the stream bed of pools or rock bars (where relevant); continual flow over/through/below the rock bar of pools/terminal boulder fields such that water is ponded upstream; and continual surface water flow along the length of pools*	×	✓	Yes (in January 2017)	Assessment against the performance measure. Contingency Plan process previously initiated by the exceedance of the iron staining component of the performance measure in October 2016 (see below)	*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) on the Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26*	Yes
	Analysis of water depth data for Pool ETAI on the Eastern Tributary (when mining is within 400 m of the pool) indicates the water depth is at or above the pool's previous minimum (i.e. when mining is beyond 400 m of the pool)	×	✓	Yes (in December 2016)			Yes
	No significant change to the extent or nature of iron staining over more than 30% of the Eastern Tributary between maingate 26 and full supply level	×	✓	Yes (in October 2016)	Assessment against the performance measure. Contingency Plan and Incident Notification initiated		Yes
	Gas releases observed over less than 30% of the Eastern Tributary between maingate 26 and full supply level, that is not also occurring in the Woronora River (control site)	×	✓	No	-		No
BIODIVERSITY MANAGEMENT							
Upland Swamps Vegetation Monitoring	*The vegetation in upland swamps is not expected to experience changes significantly different to vegetation in control swamps*	✓	✓	No	-	*Negligible impact on threatened species, populations, or ecological communities*	No
Upland Swamps Groundwater Monitoring	*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*	✓	✓	Yes – continuation of performance indicator exceedance for Swamp 20 (Longwalls 20-22 upland swamps) (Appendix C1) Yes – continuation of performance indicator exceedance for Swamp 28 (Longwalls 23-27 upland swamps) (Appendix C1)	Assessments against the performance measure conducted by Eco Logical (threatened flora) and Cenwest Environmental Services (threatened fauna) (Appendices H1 and H2)		No
Riparian Vegetation	*Impacts to riparian vegetation are expected to be localised and limited in extent, similar to the impacts previously experienced at Metropolitan Coal*	✓	✓	Yes – continuation of performance indicator exceedance at site MRIP02 on the Waratah Rivulet (Appendices G1 and G2)	Assessment against the performance measure conducted by Eco Logical (threatened flora) and Cenwest Environmental Services (threatened fauna) (Appendices H2 and H3)		No
Southern Sydney Sheltered Forest on Transitional Sandstone Soils in the Sydney Basin Bioregion EEC	*Subsidence effects at the occurrences of the Southern Sydney Sheltered Forest on Transitional Sandstone Soils in the Sydney Basin Bioregion EEC situated approximately 400 m to the east of Longwalls 20-22 are expected to be negligible*	✓	×	No	-	*Negligible impact on threatened species, populations, or ecological communities*	No
	Subsidence effects at the occurrences of the Southern Sydney Sheltered Forest on Transitional Sandstone Soils in the Sydney Basin Bioregion EEC situated approximately 300 to 500 m to the east of Longwalls 23-27 are expected to be negligible	×	✓	No	-		No
Aquatic Biota	*The aquatic macroinvertebrate and macrophyte assemblages in streams and pools are not expected to experience long-term impacts as a result of mine subsidence*	✓	✓	Yes, at Locations B1 and B2 on Tributary B (macroinvertebrate assemblage component)	Assessments against the performance measure conducted by Eco Logical (threatened flora) and Cenwest Environmental Services (threatened fauna) (Appendices H3 and H4)		No
Amphibian Monitoring	*The amphibian assemblage is not expected to experience changes significantly different to the amphibian assemblage at control sites*	✓	✓	No	-		No

Table 14 (Continued)
Underground Mining Area and Surrounds Assessment of Environmental Performance, January to June 2017

Monitoring Components	Subsidence Impact Performance Indicator(s)	Longwalls 20-22 Extraction Plan*	Longwalls 23-27 Extraction Plan#	Subsidence Impact Performance Indicator Exceeded?	Resulting Actions	Subsidence Impact Performance Measure	Subsidence Impact Performance Measure Exceeded?
LAND MANAGEMENT							
Steep Slopes and Land in General	*Steep slopes and land in general are expected to experience surface tension cracking no greater than 0.1 m wide and 25 m in length*	✓	✓	No	-	-	-
Cliffs and Overhangs	-	✓	✓	-	-	*Less than 3% of the total length of cliffs (and associated overhangs) within the mining area experience mining-induced rock fall*	No
HERITAGE MANAGEMENT							
Aboriginal Heritage Sites	-	✓	✓	-	-	*Less than 10% of Aboriginal heritage sites within the mining area are affected by subsidence impacts*	No (Round 4 and Round 5 surveys)
BUILT FEATURES MANAGEMENT							
Built Features	-	✓	✓	-	-	*Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing*	No
Items of historical or heritage significance at the Garrawarra Centre	-	✓	✓	-	-	*Negligible damage (fine or hairline cracks that do not require repair), unless the owner of the item and the appropriate heritage authority agree otherwise in writing*	No
PUBLIC SAFETY MANAGEMENT							
Public Safety	*Public safety will be ensured in the event that any hazard to the general public arising from subsidence effects becomes evident*	✓	✓	No	-	*Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing*	No

* Performance indicator applicable to Longwalls 20-22 (✓) Yes; (×) No.

\# Performance indicator applicable to Longwalls 23-27 (✓) Yes; (×) No.

Table 15
Underground Mining Area and Surrounds Assessment of Environmental Performance, July to December 2017

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Comments	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
WATER MANAGEMENT								
Negligible Reduction to the Quantity of Water Resources Reaching the Woronora Reservoir								
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)*	WaterNSW gauging station on Waratah Rivulet (GS 2132102)	Surface water flow	Level 1	The median of the ratios does not fall below the 35th percentile of the baseline data	-	No	No
Negligible Reduction to the Quality of Water Resources Reaching the Woronora Reservoir								
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*	Site WRWQ9 on the Waratah Rivulet	Iron (Fe) Manganese (Mn) Aluminium (Al) [Field filtered]	Level 1	Data analysis indicates no water quality parameter exceeds the adjusted baseline mean plus two standard deviations	Dissolved iron, aluminium and manganese	No	No
		Site ETWQ AU on the Eastern Tributary	Iron (Fe) Manganese (Mn) Aluminium (Al) [Field filtered]	Level 1	Data analysis indicates no water quality parameter exceeds the adjusted baseline mean plus two standard deviations	Dissolved aluminium	No	No
				Level 2	Data analysis indicates any water quality parameter exceeds the adjusted baseline mean plus two standard deviations for one month	Dissolved iron	No	No
				Level 3	Data analysis indicates: • any water quality parameter exceeds the adjusted baseline mean plus two standard deviations for two consecutive months; or • over a three month period the water quality parameter exceeds the adjusted mean plus two standard deviations in the first month, the adjusted mean plus one standard deviation in the next month and the adjusted mean plus two standard deviations in the third month; or • the six month mean exceeds the adjusted baseline mean plus one standard deviation for two consecutive assessment periods (i.e. over two six monthly reports); and there was not a similar exceedance of the trigger at the control site	Dissolved manganese Assessment required against performance measure	Yes	No Assessment conducted by Associate Professor Barry Noller (Appendix F2)
No Connective Cracking Between the Surface and the Mine and Negligible Leakage from Woronora Reservoir								
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*	Underground	Inspections of development workings for water accumulation	Level 1	Normal water flow identified from the goaf, geological structure, or the strata generally	-	No	No
	The 20-day average mine water make does not exceed 1 ML/day	Underground	• Metered water reticulated into the mine (mine inflow) • Metered water reticulated out of the mine (mine outflow) • Moisture content into and out of the mine through the mine ventilation system (mine inflow and outflow) • *In-situ* moisture content of the coal (mine inflow) • Moisture content of ROM coal conveyed out of the mine at the drift portal (mine outflow)	Level 1	20-day average mine water make is less than or equal to 0.5 ML/day	-	No	No

Table 15 (Continued)
Underground Mining Area and Surrounds Assessment of Environmental Performance, July to December 2017

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Comments	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
WATER MANAGEMENT (Continued)								
No Connective Cracking Between the Surface and the Mine and Negligible Leakage from Woronora Reservoir (Continued)								
No connective cracking between the surface and the mine	*Significant departure from the predicted envelope of the vertical potentiometric head profile at Bore 9GGW2B does not occur*	Bore 9GGW2B	Groundwater pressures/levels	Level 2	9GGW2B Head Profile is consistent with the shape of, and does not lie significantly to the left of the predicted High Inflow Model Curve	-	No	No
	Significant departure from the predicted envelope of the vertical potentiometric head profile at Bore F6GW3A does not occur	Bore F6GW3A	Groundwater pressures/levels	Level 2	F6GW3A Head Profile is consistent with the shape of, and does not lie significantly to the left of the predicted High Inflow Model Curve	-	No	No
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 F6GW4A is reduced by no more than 20% from that measured to 30 June 2017*	Bore F6GW4A (90.0 m)	Groundwater pressures/levels	Level 2	F6GW4A < 199.92 m AHD and > 193.71 m AHD	-	No	No
	The hydraulic gradient to the Woronora Reservoir at full supply level from Bore PHGW2A is reduced by no more than 20% from that measured to 30 June 2017	Bore PHGW2A (97.5 m)	Groundwater pressures/levels	Level 1	PHGW2A >= 186.92 m AHD	-	No	No
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*	Bore 9GGW2B (80.3 m)	Groundwater pressures/levels	Level 2	9GGW2B < 181.38 m AHD and > 176.38 m AHD	-	No	No
	The hydraulic gradient to the Woronora Reservoir at full supply level from Bore 9EGW2A is reduced by no more than 20% from that measured to 30 June 2017	Bore 9EGW2A (107.5 m)	Groundwater pressures/levels	Level 2	9EGW2A < 186.32 m AHD and > 182.83 m AHD	-	No	No
	The hydraulic gradient to the Woronora Reservoir at full supply level from Bore PM02 is reduced by no more than 20% from that measured to 30 June 2017	Bore PM02 (100 m)	Groundwater pressures/levels	Level 1	PM02 >= 183.86 m AHD	-	No	No
	The water level at bore T2 is greater than 170. 0 m	Bore T2	Groundwater levels	Level 1	T2 >= 171.0 m AHD	-	No	No
	The water level at bore T3 is greater than 171.8 m	Bore T3	Groundwater levels	Level 1	T3 >= 172.8 m AHD	-	No	No
	The hydraulic gradient from transect bore T5 to bore T3 is reduced by no more than 10% from that measured on 30 June 2017	Bores T3 and T5	Groundwater levels	Level 2	T5-T3 < 17.92 m and > 16.13 m	-	No	No
Negligible Reduction to the Quality of Water Resources in the Woronora Reservoir								
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*	Woronora Reservoir (site DW01) (subject to data availability from WaterNSW)	Total Iron (Fe) Total Manganese (Mn) Total Aluminium (Al)	Level 1	The current year's duration exceedance curve for a water quality parameter in Woronora Reservoir (total iron, total manganese and total aluminium) is below the baseline 10 year ARI exceedance curve for any range of the duration percentages from 0% to 75%	-	No	No

Table 15 (Continued)
Underground Mining Area and Surrounds Assessment of Environmental Performance, July to December 2017

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Comments	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
WATER MANAGEMENT (Continued)								
Negligible Environmental Consequences on Waratah Rivulet								
			No Diversion of Flows, No Change in the Natural Drainage Behaviour					
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*	Pools P to W on Waratah Rivulet	Streambed cracking and drainage behaviour (visual observations)	Level 1	No mine-induced surface cracking or impacts to natural drainage behaviour observed	-	No	No
	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	Pools P, T, U, V and W on Waratah Rivulet	Pool water level	Level 1	The water level in Pools P, T, U, V or W has not been below the pool's previous minimum	Pools U, V and W	No	No
				Level 2	The water level in Pools P, T, U, V or W has been below the pool's previous minimum, however, is considered to be due to an error type	Pools P and T	No	No
	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	Pools Q, R and S on the Waratah Rivulet	Pool water level	Level 1	The water level in Pools Q, R or S has been above that required to maintain water over the downstream rock bar	-	No	No
			Minimal Iron Staining					
	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)	Waratah Rivulet, from Pool P to the full supply level of the Woronora Reservoir	Nature and extent of iron staining	Level 1	The extent or nature of iron staining in the Waratah Rivulet from Pool P to the full supply level of the Woronora Reservoir has not changed	-	No	No
			Minimal Gas Releases					
	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	Waratah Rivulet, from Pool P to the full supply level of the Woronora Reservoir	Free Carbon Dioxide as CO_2 (mg/L) Methane (mg/L)	Level 1	Free carbon dioxide concentrations are equal to or less than 4 mg/L in Waratah Rivulet pools from Pool P to the full supply level of the Woronora Reservoir Methane concentrations are equal to or less than 0.159 mg/L in Waratah Rivulet pools from Pool P to the full supply level of the Woronora Reservoir	Pool S	No	No
				Level 3	Free carbon dioxide concentrations are above 13 mg/L in Waratah Rivulet pools from Pool P to the full supply level of the Woronora Reservoir Methane concentrations are above 0.478 mg/L in Waratah Rivulet pools from Pool P to the full supply level of the Woronora Reservoir	Pools P and U free carbon dioxide concentration	Yes	No Assessment against performance measure conducted by Associate Professor Barry Noller (The University of Queensland, 2017) (Appendix E3)

Table 15 (Continued)
Underground Mining Area and Surrounds Assessment of Environmental Performance, July to December 2017

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Comments	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
WATER MANAGEMENT (Continued)								
Negligible Environmental Consequences on Eastern Tributary								
			No Diversion of Flows, No Change in the Natural Drainage Behaviour					
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) on the Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26[1, 2]	*No change to the natural drainage behaviour of Pools ETAS, ETAT and ETAU*	Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26	Stream cracking and drainage behaviour (visual observations)	Level 1	No mine-induced surface cracking at Pool ETAS or Pool ETAT; no increase in previous cracking at Pool ETAU No impacts to natural drainage behaviour observed	-	No	No
	Analysis of water level data for Pool ETAU indicates the water levels are above that required to maintain water over the downstream rock bar	Pool ETAU on the Eastern Tributary	Pool water level	Level 1	The water level in Pool ETAU have been above that required to maintain water over the downstream rock bar	-	No	No
	Observed total closure at cross line ETAT and cross line ETAU is less than the predicted total closure	Cross lines ETAT and ETAU on the Eastern Tributary	Observed total valley closure (mm) Predicted total valley closure (mm)	-	-	To be assessed during the extraction of Longwall 302 consistent with the Longwalls 301-303 Water Management Plan	N/A	N/A
			Minimal Iron Staining					
	N/A	Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26	Nature and extent of iron staining	On 14 October 2016, Metropolitan Coal reported the exceedance of the Eastern Tributary performance measure in relation to iron staining to the DP&E and other relevant agencies Iron staining/flocculent is present at a number of stream features between the maingate of Longwall 26 and the full supply level of the Woronora Reservoir Metropolitan Coal to monitor the nature and extent of iron staining on the Eastern Tributary during the mining of Longwalls 301- 303 Metropolitan Coal to implement contingency measures (stream remediation measures) in accordance with the Project Approval and to the satisfaction of the Executive Director of the Division of Resources and Geoscience		-	N/A	Yes
			Minimal Gas Releases					
	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	Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26	Free Carbon Dioxide as CO_2 (mg/L) Methane (mg/L)	Level 1	Free carbon dioxide concentrations are equal to or less than 4 mg/L in Eastern Tributary pools between the full supply level of the Woronora Reservoir and the maingate of Longwall 26 Methane concentrations are equal to or less than 0.159 mg/L in Eastern Tributary pools between the full supply level of the Woronora Reservoir and the maingate of Longwall 26	-	No	No

Table 15 (Continued)
Underground Mining Area and Surrounds Assessment of Environmental Performance, July to December 2017

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Comments	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
BIODIVERSITY MANAGEMENT								
Upland Swamp Vegetation Monitoring								
Negligible impact on Threatened Species, Populations, or Ecological Communities	*The vegetation in upland swamps is not expected to experience changes significantly different to vegetation in control swamps*	Swamps 16, 17, 18, 20, 24 and 25 overlying or adjacent to Longwalls 20-22 Swamps 28, 30, 31, 32, 33, 34, 35, 36 and 94 overlying or adjacent to Longwalls 23-27 Swamps 38, 40, 41, 46, 47, 48, 49, 50, 51/52, 53 and 58 overlying or adjacent to Longwalls 301-303[3]	Visual inspections Transect/ quadrat data Population monitoring of indicator species	Level 1	Data analysis indicates: - there is not a declining trend in the condition of longwall swamp vegetation; and - there are no significant changes in vegetation between the mined and control swamps	Swamps 16, 17, 18, 24 and 25 Swamps 30, 31, 32, 33, 34, 35, 36 and 94	No	No
				Level 2	Data analysis indicates: - there is a declining trend in the condition of longwall swamp vegetation over time, however a similar trend is occurring in control swamp vegetation; or - there are significant differences in vegetation between the mined and control swamps, however, the data indicates longwall swamp vegetation is consistent with the baseline monitoring results	Swamp 20 (*Gleichenia microphylla* and *Empodisma minus* dieback in the north-east section of the swamp)	No	No
				Level 3	Data analysis indicates: - there is a declining trend in the condition of longwall swamp vegetation over time that is not occurring in control swamp vegetation; or - there are significant differences in vegetation between the mined and control swamps, and the data indicates longwall swamp vegetation is not consistent with the baseline monitoring results	Swamp 28 Assessments against the performance measure conducted by Eco Logical (threatened flora) and Cenwest Environmental Services (threatened fauna) (Appendices H1 and H2)	Yes	No (Appendices H1 and H2)
Upland Swamp Groundwater Monitoring								
Negligible impact on Threatened Species, Populations, or Ecological Communities	*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*[4]	Swamp 25 overlying Longwalls 20-22 Swamps 30, 33 and 35 overlying Longwalls 23-27 Swamps 40, 41, 46, 51, 52 and 53 overlying Longwalls 301-303	Groundwater levels	Level 1	Data analysis for Longwalls 20-27 swamps indicates: - the seven day moving average for Swamps 25, 30 and 33 is within the 5th percentile established for the swamp's full length of record; and - the seven day moving average for Swamp 35 is within two standard deviations below the mean established for the swamp's full length of record Data analysis for Longwalls 301-303 swamps indicates: - the seven day moving average for Swamps 40, 41, 46, 51, 52 and 53 is at or above the minimum established for the swamp's full length of record	Swamps 46, 51 and 53	No	No
				Level 2	Data analysis for Longwalls 20-27 swamps indicates: - the seven day moving average for Swamps 25, 30 and 33 is below the 5th percentile established for the swamp's full length of record; - the seven day moving average for Swamp 35 lie outside two standard deviations below the mean established for the swamp's full length of record; and - semi-quantitative comparisons with control swamps and rainfall record indicates that dry swamp conditions are natural Data analysis for Longwalls 301-303 swamps indicates: - the seven day moving average for Swamps 40, 41, 46, 51, 52 and 53 is below the minimum established for the swamp's full length of record; and - semi-quantitative comparisons with control swamps and rainfall record indicates that dry swamp conditions are natural	Swamps 25, 30, 33, 35, 40, 41 and 52	No	No

Table 15 (Continued)
Underground Mining Area and Surrounds Assessment of Environmental Performance, July to December 2017

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Comments	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
BIODIVERSITY MANAGEMENT (Continued)								
Riparian Vegetation Monitoring								
Negligible impact on Threatened Species, Populations, or Ecological Communities	*Impacts to riparian vegetation are expected to be localised and limited in extent, similar to the impacts previously experienced at Metropolitan Coal*	Locations adjacent to riparian vegetation monitoring sites (MRIP01 to MRIP12) and areas traversed whilst accessing the monitoring sites: • sites MRIP01, MRIP02, MRIP05, MRIP06 and MRIP09 overlying Longwalls 20-22; • sites MRIP11 and MRIP12 overlying Longwalls 23-27; • sites MRIP03, MRIP04 andMRIP10 downstream of Longwall 23A; and • sites MRIP07 and MRIP08 downstream of Longwalls 23-27 and within the 35° angle of draw and/or predicted 20 mm subsidence contour for Longwalls 301-303	The extent of vegetation subject to vegetation dieback	Level 1	No dieback of riparian vegetation greater than 50 cm from the stream as a result of mine subsidence	Sites MRIP01, MRIP03, MRIP04, MRIP06, MRIP07, MRIP08, MRIP10, MRIP11 and MRIP12	No	No
				Level 2	Vegetation monitoring: - does not identify an increase in the extent of vegetation dieback compared to that observed at site MRIP02 on the Waratah Rivulet and between sites MRIP05 and MRIP09 on the Eastern Tributary; and - does not identify vegetation dieback greater than 50 cm from the stream at sites MRIP01, MRIP03, MRIP04, MRIP06, MRIP07, MRIP08, MRIP10, MRIP11 or MRIP12, as a result of mine subsidence	Sites MRIP02, MRIP05 and MRIP09	No	No
Southern Sydney Sheltered Forest on Transitional Sandstone Soils in the Sydney Basin Bioregion EEC								
Negligible impact on Threatened Species, Populations, or Ecological Communities	*Subsidence movements are not expected to adversely affect the occurrence of the Southern Sydney Sheltered Forest on Transitional Sandstone Soils in the Sydney Basin Bioregion EEC situated to the north of Longwall 301*	Monitoring lines as described in the Metropolitan Coal Longwalls 301-303 Subsidence Monitoring Program: • Transmission line from Peg TL90 to TL97 • Transmission Tower FB9132B-T7 • M1 North Bound Line from Peg 245 to 275	Total subsidence (20 mm), total tilt (0.5 mm/m) and total strain (0.5 mm/m)	Level 1	Assessment of subsidence parameters indicates subsidence effects at the occurrence of the Southern Sydney Sheltered Forest on Transitional Sandstone Soils in the Sydney Basin Bioregion EEC situated to the north of Longwall 301 are within typical magnitudes of survey accuracy	-	No	No
Monitoring of Aquatic Biota, Stream Monitoring								
Negligible impact on Threatened Species, Populations, or Ecological Communities	*The aquatic macroinvertebrate and macrophyte assemblages in streams are not expected to experience long-term impacts as a result of mine subsidence*[5]	Two sampling sites (approximately 100 m in length) at the following locations: • Location WT3 on Waratah Rivulet, Locations ET1, ET3 and ET4 on the Eastern Tributary overlying Longwalls 20-27 • Locations WT4 and WT5 on the Waratah Rivulet, downstream of Longwalls 20-27 • Location ET2 on the Eastern Tributary, downstream of Longwalls 20-27 and within the Longwalls 301 303 35° angle of draw and/or predicted 20 mm subsidence contour	Aquatic macroinvertebrates Aquatic macrophytes	-	-	Results of autumn 2017 survey (prior to the extraction of Longwalls 301-303) assessed in Table 14. Results of the spring 2017 aquatic ecology surveys will be assessed against the trigger action response plan for monitoring of aquatic biota, stream monitoring in the next reporting period	Refer Table 14	Refer Table 14

Table 15 (Continued)
Underground Mining Area and Surrounds Assessment of Environmental Performance, July to December 2017

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Comments	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
BIODIVERSITY MANAGEMENT (Continued)								
Monitoring of Aquatic Biota, Pool Monitoring								
Negligible impact on Threatened Species, Populations, or Ecological Communities	*The aquatic macroinvertebrate and macrophyte assemblages in pools are not expected to experience long-term impacts as a result of mine subsidence*	Larger pools J, M1 and N on Waratah Rivulet and ETAH on the Eastern Tributary, overlying Longwalls 20-27 Smaller pools K, L and M on Waratah Rivulet and ETAG, ETAK and ETAI on the Eastern Tributary, overlying Longwalls 20-27	Aquatic macroinvertebrates Aquatic macrophytes	Level 1	Data analysis indicates no significant changes or significant (not long term) changes in relation to control places pre-mining compared to post-extraction: - occur in the aquatic macroinvertebrate and macrophyte assemblages at pools J, K, L, M1, M or N; or - occur in the aquatic macroinvertebrate and macrophyte assemblages at pools ETAG, ETAH, ETAI or ETAK	-	Refer Table 14	Refer Table 14
Amphibian Monitoring								
Negligible impact on Threatened Species, Populations, or Ecological Communities	*The amphibian assemblage is not expected to experience changes significantly different to the amphibian assemblage at control sites*	Test sites 1 to 6 overlying Longwalls 20-22 Test sites 13 to 17 overlying Longwalls 23-27 Test sites 23 to 28 overlying Longwalls 301-303	Amphibian species diversity and relative abundance	-	-	Results of the spring/summer 2016 survey (prior to the extraction of Longwall 301) assessed in Table 14. Results of the spring/summer 2017 survey will be assessed against the trigger action response plan for amphibian monitoring in the next reporting period	Refer Table 14	Refer Table 14
LAND MANAGEMENT								
Cliffs and Overhangs, Steep Slopes and Land in General								
Less than 3% of the total length of cliffs (and associated overhangs) within the mining area experience mining-induced rock fall	-	Cliff sites COH1, COH2, COH3, COH4, COH5, COH6, COH6A, COH7, COH8, COH9, COH10, COH14, COH15 and COH16	Cliff instabilities	- Visual inspections of the cliffs and overhangs were conducted monthly when mining of Longwalls 20-22 and/or Longwalls 23-27 were within 400 m of sites and following the completion of each longwall to record evidence of subsidence impacts - Visual inspections of the cliffs and overhangs following the completion of Longwall 27 did not identify any additional subsidence impacts to those recorded during the mining of Longwalls 20-27 - No cliffs have been identified within 600 m of Longwalls 301-303. The nearest cliffs are located more than 800 m to the west of Longwalls 301-303. At these distances, the cliffs are not expected to experience any measurable vertical subsidence resulting from the extraction of Longwalls 301-303		-	-	No
-	*Steep slopes and land in general experience sandstone fracturing/cracking and rock falls that do not require management measures to be implemented*	Steep slopes and land in general within 600 m of Longwalls 20-27 and Longwalls 301-303	Sandstone fracturing/cracking and rock falls	Level 1	No subsidence impacts (i.e. sandstone fracturing/ cracking and rock falls) recorded on steep slopes or land in general: - not previously recorded within 600 m of Longwalls 20-27; or - recorded within 600 m of Longwalls 301-303	Note sandstone fracturing/cracking recorded at Aboriginal heritage sites during Round 5 surveys (refer Section 6.5.1), which are incorporated in the Aboriginal heritage sites monitoring trigger action response plan	No	-
HERITAGE MANAGEMENT								
Aboriginal Heritage Sites Monitoring								
Less than 10% of Aboriginal heritage sites within the mining area are affected by subsidence impacts	*Less than 7% of Aboriginal heritage sites within the mining area are affected by subsidence impacts*	Monitoring of the Longwalls 20-22 and Longwalls 23-27 Aboriginal heritage sites at which Longwalls 23-27 Round 5 monitoring indicates continued change due to mining induced subsidence, namely sites MET 1, FRC 28, FRC 29, FRC 34, FRC 60 and FRC 176 Monitoring of Aboriginal heritage sites FRC 76 (sandstone overhang with art only) and FRC 117 (sandstone overhang with art and PAD)	Cracking of sandstone at open sites Cracking and/or exfoliation of sandstone, blockfall, displacement, breakage and/or collapse of sandstone overhang sites Damage or deterioration of art motifs	Level 1	Monitoring results indicate sites FRC 281 and FRC 34 have been affected by subsidence impacts	Currently at Level 1 significance level Survey of Aboriginal heritage sites will be conducted within three months of the completion of Longwall 303	No	No

Table 15 (Continued)
Underground Mining Area and Surrounds Assessment of Environmental Performance, July to December 2017

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
BUILT FEATURES MANAGEMENT – GARRAWARRA CENTRE COMPLEX							
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 **Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing**	• *No greater tilt impact to buildings than Category A or B (i.e. mining induced ground tilt of less than 7 mm/m) for items of historical or heritage significance (i.e. either 'high' or 'exceptional' in the Conservation Plan for the Garrawarra Centre for Aged Care [Howard Tanner & Associates, 1993])* • *No greater strain impact to buildings than Category 0 or 1 (i.e. crack width of less than 1 mm) for items of historical or heritage significance (i.e. either 'high' or 'exceptional' in the Conservation Plan for the Garrawarra Centre for Aged Care [Howard Tanner & Associates, 1993])* • *No more than repairable (minor) defects (cracks, etc.) in the structural integrity for all other buildings, houses, structures and other services (including telecommunications towers and compounds, powerlines, pipelines and associated connections) 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)*	Garrawarra Centre Complex Buildings/Structures (Excluding Services)	Subsidence effects parameters, fine or hair line cracks, cracking at pre-existing rock joints, columns, opening and closing of joints, or tilting of piers, water tank leaks and structural integrity	Level 1	Expected subsidence conditions	No	No
		Garrawarra Centre Complex Services	Subsidence effects parameters, ground tension cracks and faults	Level 1	Expected subsidence conditions	No	No
BUILT FEATURES MANAGEMENT – ENDEAVOUR ENERGY							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	• *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*	132 kV Towers	Subsidence effects parameters, differential movements, ground deformations, observable surface cracking, and faults	Level 1	Expected subsidence conditions	No	No
BUILT FEATURES MANAGEMENT – TRANSGRID							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	• *The structural integrity of the transmission line and towers is maintained* • *The electrical clearance from vegetation is maintained* • *The serviceability of the access roads/tracks is maintained*	330 kV Towers	Subsidence effects parameters, differential movements, ground deformations, observable surface cracking, and faults	Level 1	Expected subsidence conditions	No	No
BUILT FEATURES MANAGEMENT – NEXTGEN							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	• *Negligible transmission loss in fibre optic cables from mine subsidence impacts* • *The structural integrity of the cable line and associated joint housing pit is maintained* • *The serviceability of the access roads/tracks is maintained*	Optical Fibre Cable – Major Interstate Trunk Cable: SM1 *Waterfall to Corrimal Section*	Subsidence effects parameters, Optical Time Domain Reflectometer (OTDR) signal loss, and faults	Level 1	Expected subsidence conditions	No	No
BUILT FEATURES MANAGEMENT – OPTUS							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	• *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*	Optical Fibre Cable – Trunk: IOF SYD-MEL 2 *(Coastal Inter Office Fibre two sections known as WAT-WOL 2 and WAT-WOL 3)*	Subsidence effects parameters, OTDR signal loss, and faults	Level 1	Expected subsidence conditions	No	No
		Optical Fibre Cable – Cable: 36S SMOF *(In leased Telstra Conduit and Manholes/pits. Cable manufacturer: MM Olex. Heavy polyethylene sheath, manufactured prior to 1993 and installation completed 1993)*	Subsidence effects parameters, OTDR signal loss, and faults	Level 1	Expected subsidence conditions	No	No

Table 15 (Continued)
Underground Mining Area and Surrounds Assessment of Environmental Performance, July to December 2017

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
BUILT FEATURES MANAGEMENT – TELSTRA							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	• *Negligible transmission loss in fibre optic cables from mine subsidence impacts* • *The structural integrity of the cable line and associated facilities is maintained* • *The structural integrity of the telecommunications tower and compound is maintained* • *The serviceability of the access roads/tracks is maintained*	Trunk Cable F KNST 2005 ENGA-HBGH 80f Sydney-Melbourne No.3 Optical Fibre Cable (*Labelled as Cable 1)*	Subsidence effects parameters, OTDR signal loss, and faults	Level 1	Expected subsidence conditions	No	No
		Customer Access Network (CAN) Cables: F ENGA 3001 6f Engadine-Garrawarra-Mobile Phone Tower optical fibre cable / F ENGA 3005 12f Engadine-Garrawarra-RIM and Garrawarra Hospital customer cable *(Labelled as Cable 2)*	Subsidence effects parameters, OTDR signal loss, and faults	Level 1	Expected subsidence conditions	No	No
		Customer Access Network (CAN) Copper Cables	Subsidence effects parameters, anomalous service condition, complaints and faults	Level 1	Expected subsidence conditions	No	No
		Telecommunications Tower (and Compound)	Subsidence effects parameters and faults	Level 1	Expected subsidence conditions	No	No
BUILT FEATURES MANAGEMENT – ROADS AND MARITIME SERVICES							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	*Bridge Distortion and Cracking* • *absolute 3D horizontal movement of survey lines (M1 Northbound Line and Transmission Line) of 30 mm or more at key points on the ground near the bridge;* • *relative movement of 5 mm or more between any two points monitored by the conventional survey system;* • *relative movement of 2 mm or more between any two points monitored by the FBG sensor system; and* • *crack in concrete elements exceeding 0.2 mm width* *M1 Princes Motorway Pavement Deformation* • *a measured compressive ground strain of greater than 0.5 mm/m;* • *pavement cracking;* • *deterioration in ride quality; and* • *defects in minor structures such as kerbs and gutters, pits, etc.* *Cuttings and Faults* • *a measured ground strain of greater than 0.5 mm/m;* • *rock falls;* • *cracking or visual deterioration at the rock face; and* • *visual displacement at joints* *Culverts* • *visual displacement at joints;* • *cracks in culverts; and* • *ponding*	Bridge 2 (Old Princes Highway Underpass)	Subsidence effects parameters, absolute horizontal movements, incremental relative movement, structural cracks, observable subsidence ground deformations, and faults	Level 1	Expected subsidence conditions	No	No
		Cawley Road Overpass	Subsidence effects parameters, absolute horizontal movements, incremental relative movement, structural cracks, observable subsidence ground deformations, and faults	Level 1	Expected subsidence conditions	No	No
		Pavements	Subsidence effects parameters, absolute horizontal movements, observable subsidence ground deformations, pavement cracking, deterioration in ride quality, defects in structure, and faults	Level 1	Expected subsidence conditions	No	No
		Cuttings	Subsidence effects parameters, absolute horizontal movements, observable subsidence ground deformation, rock fall, cracking or visual deterioration at the rock face, visual displacement at joints, and faults	Level 1	Expected subsidence conditions	No	No
		Culverts	Subsidence effects parameters, absolute horizontal movements, observable subsidence ground deformations, cracking in culverts, visual displacement at joints, ponding, and faults	Level 1	Expected subsidence conditions	No	No
BUILT FEATURES MANAGEMENT – WOLLONGONG CITY COUNCIL OLD PRINCES HIGHWAY							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	• *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 301-303* • *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*	Pavements, Drainage Structures and Furniture	Subsidence effects parameters, observable subsidence ground deformations including ponding, pavement cracking, joint displacement or cracking/defects of drainage structures, defects in minor structures, and faults	Level 1	Expected subsidence conditions	No	No

Table 15 (Continued)
Underground Mining Area and Surrounds Assessment of Environmental Performance, July to December 2017

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
BUILT FEATURES MANAGEMENT – WOLLONGONG CITY COUNCIL GENERAL [GARRAWARRA] CEMETERY							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	• *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)*	Waterfall General [Garrawarra] Cemetery	Subsidence effects parameters, observable impacts to fencing, surface cracking and buckling, and damage to grave sites and/or monuments	Level 1	Expected subsidence conditions	No	No
BUILT FEATURES MANAGEMENT – SYDNEY WATER							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	• *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*	Pipelines	Subsidence effects parameters, observable subsidence ground deformations or surface cracks, cracks or leaks, loss of flow/pressure, and faults	Level 1	Expected subsidence conditions	No	No
BUILT FEATURES MANAGEMENT – SYDNEY TRAINS							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	• *No defects or deformation of the Illawarra Railway Line due to mining* • *The structural integrity of the telecommunications tower (and compound) is maintained*	Illawarra Railway Line	Subsidence effects parameters, absolute horizontal movements, observable subsidence ground deformations, defects or deformation, and faults	Level 1	Expected subsidence conditions	No	No
		Telecommunications Tower (and Compound)	Subsidence effects parameters, anomalous service condition, and faults	Level 1	Expected subsidence conditions	No	No
BUILT FEATURES MANAGEMENT – AXICOM							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	• *Structural integrity of the telecommunications towers and compounds has been maintained* • *Serviceability of the access roads/tracks has been maintained*	Telecommunications Towers (and Compounds)	Subsidence effects parameters, differential horizontal movement, and faults	Level 1	Expected subsidence conditions	No	No
PUBLIC SAFETY MANAGEMENT							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	*Public safety will be ensured in the event that any hazard to the general public arising from subsidence effects becomes evident.*	Cliffs and overhangs, steep slopes and land in general Built features	Public safety	Level 1	Expected subsidence conditions	No	No

1 The no diversion of flows, no change in natural drainage behaviour component of this performance measure was exceeded during the mining of Longwalls 23-37, triggering contingency measures for the impacted pools. This TARP monitors pools not impacted during the mining of Longwalls 23-27.

2 The minimal iron staining component of this performance measure was exceeded during the mining of Longwalls 23-37, triggering contingency measures for the impacted pools. The nature and extent of iron staining on the Eastern Tributary will continue to be monitored during the mining of Longwalls 301-303.

3 Autumn 2017 survey results represent baseline data for Longwalls 301-303 upland swamps. The spring 2017 survey results for Longwalls 301-303 will be assessed against the upland swamp vegetation monitoring Trigger Action Response Plan in the next reporting period.

4 This performance indicator has been exceeded at Swamp 20 since 2012 and at Swamp 28 since 2016. Swamp water levels at Swamp 20 and Swamp 28 will continue to be analysed on a six monthly basis and assessments against the performance measure will be conducted annually.

5 This performance indicator has been exceeded at Location B1 since the autumn 2016 survey and at Location B2 since the spring 2016 survey and assessments have been made against the performance measure. Aquatic macroinvertebrate (if sufficient aquatic habitat is available for sampling) and macrophyte sampling at these locations will be conducted every three years after spring 2018, in autumn and spring (i.e. next surveys to be conducted in autumn 2021 and spring 2021) consistent with the revised monitoring schedule for Location B1 for previous Longwalls18-19A. Given the distance from Longwall 301-303, Tributary B will not experience any measurable subsidence or valley related movements resulting from the extraction of Longwalls 301-303.

7 ENVIRONMENTAL PERFORMANCE – SURFACE FACILITIES AREA

Section 7 provides a summary of the key environmental monitoring results for noise, air quality, traffic and waste at the surface facilities area, an assessment of environmental performance and a description of the management measures implemented during the review period.

The environmental performance of surface facilities water management is described in Section 8.

Each section indicates in which management plan details of the surface facilities management and monitoring are available. The Metropolitan Coal management plans are available on the Peabody website (http://www.peabodyenergy.com).

7.1 NOISE MANAGEMENT

The Metropolitan Coal Noise Management Plan has been prepared for the surface facilities area in accordance with Condition 8, Schedule 4 of the Project Approval.

Real-time Noise Monitoring

Real-time noise monitoring for the Project is undertaken using an unattended statistical noise logger located at the northern boundary of 16 Oxley Place (Figure 18). Real-time noise monitoring is used as an internal noise management tool and not for compliance purposes.

The real-time noise monitor records noise levels 24 hours a day, 7 days a week, and a graphical summary of the previous 24 hours of noise is sent to mine staff via email on a daily basis.

A real-time noise performance indicator, *The $L_{Aeq(5\ minute)}$ night-time noise level does not exceed 50 dB(A) for six consecutive 5 minute samples*, has been developed in consideration of façade reflection and as an alert to the potential exceedance of the noise acquisition criteria.

Real-time noise monitoring includes an audio function which allows the monitor to record audio of the noise signal and an 'alarm' function whereby noise data is processed and compared against the real-time noise performance indicator. The audio of these events can then be reviewed to see if the cause is Project related, allowing Metropolitan Coal to investigate the causes and potential controls for high Project related noise events.

The real-time noise performance indicator is considered to be exceeded if the $L_{Aeq(5\ minute)}$ night-time noise level exceeds 50 A-weighted decibels (dB[A]) for six consecutive 5 minute samples.

The real-time noise performance indicator was triggered some 178 times during the review period. Reviews conducted following these triggers typically indicated that the source was overflying aircraft, birds, bats, insects, vehicles on Parkes Street, dogs barking, wind and/or rain.

However, on one occasion, a distinct noise event was identified that warranted further investigation to determine whether it was the result of mine activities. A loud vehicle (truck) in close proximity to the noise monitor was detected in June 2017, but could not be sourced to any on-site activities. It was concluded that a truck was likely hauling up Parkes Street (past the mine entrance) under load, proximal to the real-time monitoring location.

Attended Noise Monitoring

Consistent with the Metropolitan Coal Noise Management Plan, attended noise monitoring for the Project has consisted of quarterly monitoring at 16 Oxley Place, 53 Parkes Street, 50 Parkes Street and 36 Old Station Road (sites representative of the nearest residences to the Project [Figure 18]) to quantify the intrusive noise emissions from the mine, including coal processing and transportation operations that contribute to the overall level of ambient noise.

Noise monitoring is conducted for 15 minute periods during the daytime, evening and night-time over two consecutive days and nights and compared to applicable Noise Impact Assessment Criteria, Noise Mitigation Criteria and Noise Acquisition Criteria (refer Section 7.5 and Appendix L).

The attended quarterly noise monitoring and compliance results for the review period are available in the quarterly monitoring reports prepared by SLR Consulting Pty Ltd (Appendix L). A comparison of the quarterly attended monitoring results at each location for the period September 2010 to December 2017 is provided in Figures 19a to 19d.

In summary, during 2017, attended monitoring indicated exceedances of the noise criteria detailed in Conditions 1, 2 and 3, Schedule 4 of Project Approval (08_0149) as follows:

- Daytime (L_{Aeq}):
  - Monitoring at 16 Oxley Place (in Quarter 3) measured a noise level of 53 dBA, which was conditionally[14] non-compliant with the daytime Noise Impact Assessment Criterion (50 dBA).
  - No exceedances of the daytime Noise Mitigation Criterion (53 dBA) or Noise Acquisition Criterion (55 dBA) were recorded.
- Evening (L_{Aeq}):
  - Monitoring at 16 Oxley Place (in Quarter 1) measured a noise level of 49 dBA, which was conditionally[14] non-compliant with the evening Noise Impact Assessment Criterion (45 dBA) and exceeded the Noise Mitigation Criterion (48 dBA).
  - No exceedances of the evening Noise Acquisition Criterion (50 dBA) were recorded.
- Night-time (L_{Aeq}):
  - Monitoring at 16 Oxley Place (in Quarters 3 and 4) measured noise levels of 48 dBA and 49 dBA, which were conditionally[14] non-compliant with the night-time Noise Impact Assessment Criterion (45 dBA) and exceeded the night-time Noise Mitigation Assessment Criterion (48 dBA).
  - No exceedances of the night-time Noise Acquisition Criterion (50 dBA) were recorded.
- Night-time (L_{A1}):
  - Monitoring at 16 Oxley Place (in Quarters 1, 2, and 4) measured noise levels of 61 dBA, 60 dBA and 57 dBA, respectively, which were non-compliant (61 dBA) and conditionally[14] non-compliant (60 dBA and 57 dBA) with the night-time L_{A1} Noise Impact Assessment Criterion (50 dBA).
  - Monitoring at 36 Old Station Road (in Quarter 3) measured a noise level of 60 dBA, which was conditionally[14] non-compliant with the night-time L_{A1} Noise Impact Assessment Criterion (50 dBA).

[14] A conditional non-compliance has been nominated for attended monitoring results that exceed the Noise Impact Assessment Criteria by more than 2 dBA and were recorded during temperature inversions with Stability Class F. Stability Class F corresponds to an estimated Environmental Lapse Rate (ELR) ranging from 1.5°C/100 m to 4.0°C/100 m. Project Approval 08_0149 limits temperature inversions up to 3.0°C/100 m. In the absence of direct measurement of the ELR, it cannot be certain if the actual temperature inversion was less than 3.0°C/100 m for this period.

Identification of Sustained Non-compliances – Attended Noise Monitoring

A sustained non-compliance has been defined as two consecutive quarters of non-compliant noise monitoring results at the same representative attended noise monitoring location, coinciding with normal mine operations.

Conditional[15] sustained non-compliances with respect to the evening and night-time intrusive (L_{Aeq}) Noise Impact Assessment Criteria (Table 2, Condition 1, Schedule 4 of the Project Approval) have been identified during 2017 at 16 Oxley Place. The conditional[15] sustained non-compliances at 16 Oxley Place occurred in Quarters 1 (evening) and 4 (night-time) (Appendix L).

A conditional[15] sustained non-compliance with respect to the night-time maximum (L_{A1}) Noise Impact Assessment Criteria (Table 2, Condition 1, Schedule 4 of the Project Approval) was also identified during 2017 at 16 Oxley Place. The conditional[15] sustained non-compliance at 16 Oxley Place occurred in Quarter 2 (Appendix L).

Further details are provided in Table 16.

Identification of Non-compliances – Noise Modelling

Metropolitan Coal, in consultation with its noise specialist (SLR Consulting), has continued to review and evaluate appropriate contingency measures and conduct further technical evaluation of the implementation of these measures during 2017.

This has included updated noise modelling of predicted noise levels at nearby residences in order to determine the remaining reasonable and feasible noise mitigation measures that could be implemented in consultation with the DP&E.

In the absence of the identified remaining reasonable and feasible mitigation measures, the noise modelling predicted non-compliances with the Noise Impact Assessment Criteria at 10 residences (nine residences in Oxley Place and one residence on Parkes Street) and conditional compliances at five residences (three residences in Oxley Place and two residences on Parkes Street) during the day-time, evening and night-time. Exceedances of the Noise Mitigation Criteria were also predicted at the nine residences in Oxley Place during the day-time, evening and night-time. The modelling also predicted exceedances of the Noise Acquisition Criteria at four residences in Oxley Place during 2017 (it is noted these residences were predicted to exceed the Noise Acquisition Criteria by 1 dBA).

Further details are provided in Table 16.

It should be noted that all of the residences predicted to be experiencing exceedances of the Noise Mitigation Criteria have previously been offered noise mitigation measures on a voluntary basis by Metropolitan Coal (in the form of double glazing). Of the nine residences, only two did not accept the previous offer by Metropolitan Coal (Appendix M).

Reporting and Notification of Noise Exceedances

The Quarter 1 and Quarter 2 conditional sustained non-compliances in these quarters were not identified until after the Quarter 4 conditional sustained non-compliance was identified.

[15] A conditional non-compliance has been nominated for attended monitoring results that exceed the Noise Impact Assessment Criteria by more than 2 dBA and were recorded during temperature inversions with Stability Class F. Stability Class F corresponds to an estimated Environmental Lapse Rate (ELR) ranging from 1.5°C/100 m to 4.0°C/100 m. Project Approval 08_0149 limits temperature inversions up to 3.0°C/100m. In the absence of direct measurement of the ELR, it cannot be certain if the actual temperature inversion was less than 3.0°C/100 m for this period.

In March 2018 (i.e. following conclusive identification of sustained non-compliances and review of associated noise modelling), Metropolitan Coal notified a number of nearby residents that the most recent noise modelling continues to predict are experiencing noise levels exceeding the Noise Impact Assessment Criteria contained in the Project Approval. Residences predicted to experience non-compliances or conditional compliances based on the most recent noise modelling were notified. The notifications also advised the residents of the current process underway to re-assess noise impacts and reasonable and feasible controls (Section 14).

Noise Management

Operational noise levels from the Metropolitan Coal Mine were materially higher prior to the approval of the Metropolitan Coal Project in June 2009.

A range of operational noise control measures has been implemented since that time, in association with extensive upgrades of existing infrastructure at the surface facilities area, including the upgrade of the CHPP. Extensive noise reduction works have been implemented progressively and noise monitoring and modelling has been used to identify areas where additional reasonable and feasible noise attenuation measures could be implemented. The Metropolitan Coal 2010 to 2016 Annual Reviews describe the noise mitigation measures implemented prior to 2017.

The extensive and long running noise control program has reduced noise emissions at nearby residences. However, Metropolitan Coal has found the number of remaining material, reasonable and feasible noise controls is diminishing.

During the review period, in consultation with the DP&E, Metropolitan Coal prepared a technical review of remaining available feasible noise mitigation measures and an associated evaluation of the reasonableness of these options (the Noise Mitigation Assessment) (SLR Consulting, 2017). This assessment was independently peer reviewed by Hatch. The reasonable and feasible contingency mitigation measures identified by Metropolitan Coal included:

- Ensuring all crusher and washer doors are closed at all times (except when being accessed).
- Progressively replacing the idlers on all surface conveyors with low noise idlers.

Following DP&E's review of the Noise Mitigation Assessment, Metropolitan Coal signed a Voluntary Undertaking which formalised the implementation of the mitigation measures identified by the 2017 Noise Mitigation Assessment. This included a timeframe for implementation of the identified mitigation measures (i.e. all existing conveyor idlers are to be replaced with low noise idlers by 31 December 2018), subsequent remodelling of noise levels and consultation with residents with predicted residual noise exceedances.

The Voluntary Undertaking also outlined a process for re-assessing predicted noise levels and reasonable and feasible noise controls, including:

- Commencing and completing an assessment under the Noise Policy for Industry (released in 2017).
- Consultation with the DP&E regarding the outcomes of the new assessment and options for achieving compliance with noise assessment criteria.

Metropolitan Coal will continue to implement noise monitoring, management and modelling in accordance with the Metropolitan Coal Noise Management Plan.

It is noted that Metropolitan Coal did not receive any requests for at-receiver noise mitigation in accordance with Condition 3, Schedule 4 of Project Approval (08_0149) in 2017. Metropolitan Coal has previously offered double glazing noise mitigation voluntarily to a number of the nearest private residences.

Operational Noise Complaints

One operational noise related complaint was received by Metropolitan Coal during the review period. The complaint was due to train loading noise.

Metropolitan Coal is investigating the implementation of a coal wagon profiler, which has the potential to reduce train loading noise.

7.2 AIR QUALITY AND GREENHOUSE GASES MANAGEMENT

The Metropolitan Coal Air Quality and Greenhouse Gas Management Plan has been prepared for the surface facilities area in accordance with Condition 13, Schedule 4 of the Project Approval.

Pacific Environment Operations Pty Ltd has reviewed the environmental performance of the Project in relation to air quality for the review period. The report prepared in support of this Metropolitan Coal 2017 Annual Review is provided in Appendix N.

Dust Deposition

Metropolitan Coal monitors monthly dust deposition rates at ten dust gauges (DG1 to DG10, Figure 20), consistent with EPL No. 767 and the Metropolitan Coal Air Quality and Greenhouse Gas Management Plan.

Sampling during the review period was conducted at all monitoring points at the frequencies described in Conditions M2.1 and M2.2 of EPL No. 767. All of the potential 120 samples (10 sites over 12 months) were collected in 2017, representing 100% data availability.

The results of the dust deposition monitoring are assessed against air quality performance indicators and air quality impact assessment criteria. The results of the assessment are provided in Section 7.5 and key aspects are summarised below.

The performance indicator concentration for annual average deposited dust of 3 grams per square metre per month (g/m^2/month) was met at all dust deposition monitoring sites during the review period (Chart 87). The annual average dust deposition rate at all dust gauges was below the long-term impact assessment criteria for deposited dust of 4 g/m^2/month (Chart 87).

Annual average dust deposition rates at each gauge from 2003 to 2017 are shown in Chart 88a and Chart 88b. From 2003 to 2017, there were no clear trends in dust deposition rates; however, relatively higher dust deposition rates were recorded at some sites in 2009 and 2015. The annual average dust deposition rate at each gauge in 2017 was within or below the range previously recorded for the dust gauges.

The Project EA (modelling for Years 3 and 15) predicted that the annual average dust deposition due to the Project plus background would not be above the applicable 4 g/m^2/month amenity criterion at any receiver (modelling for Years 3 and 15). The air quality monitoring results are consistent with the Project EA predictions in relation to dust deposition.

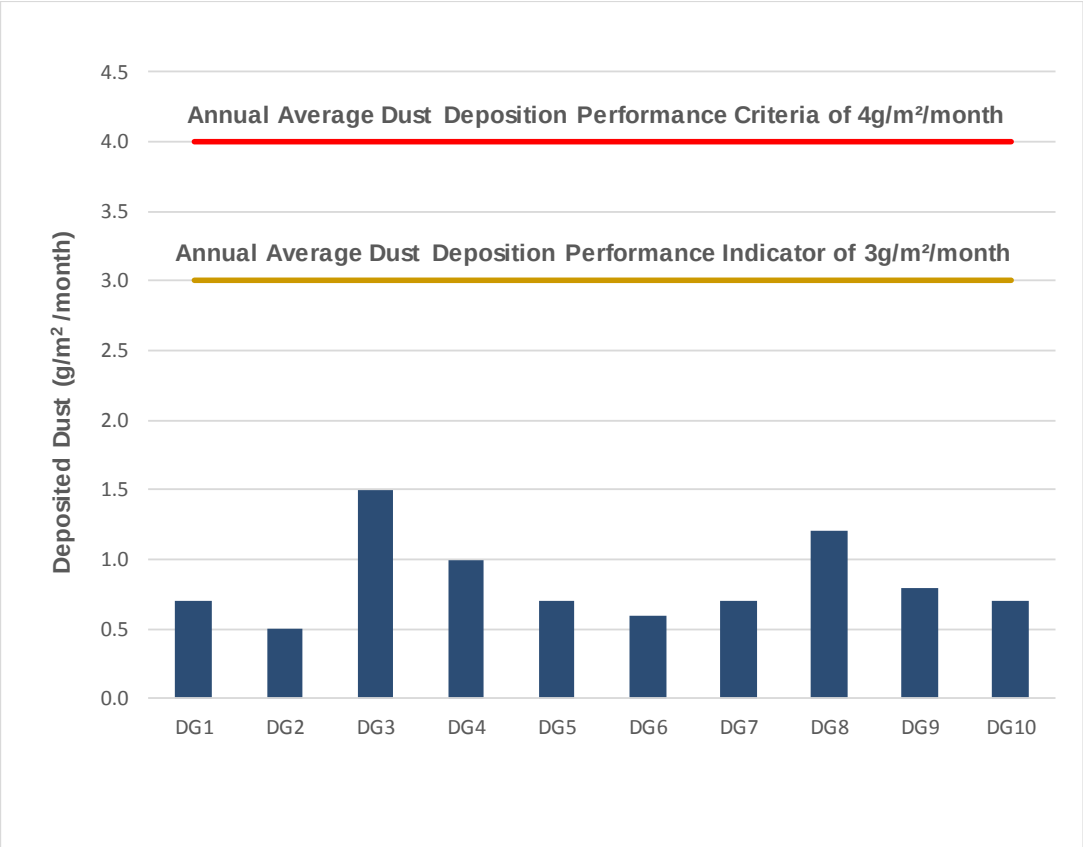


Chart 87 Annual Average Dust Deposition Rates Measured at Dust Gauges (DG1 to DG10)

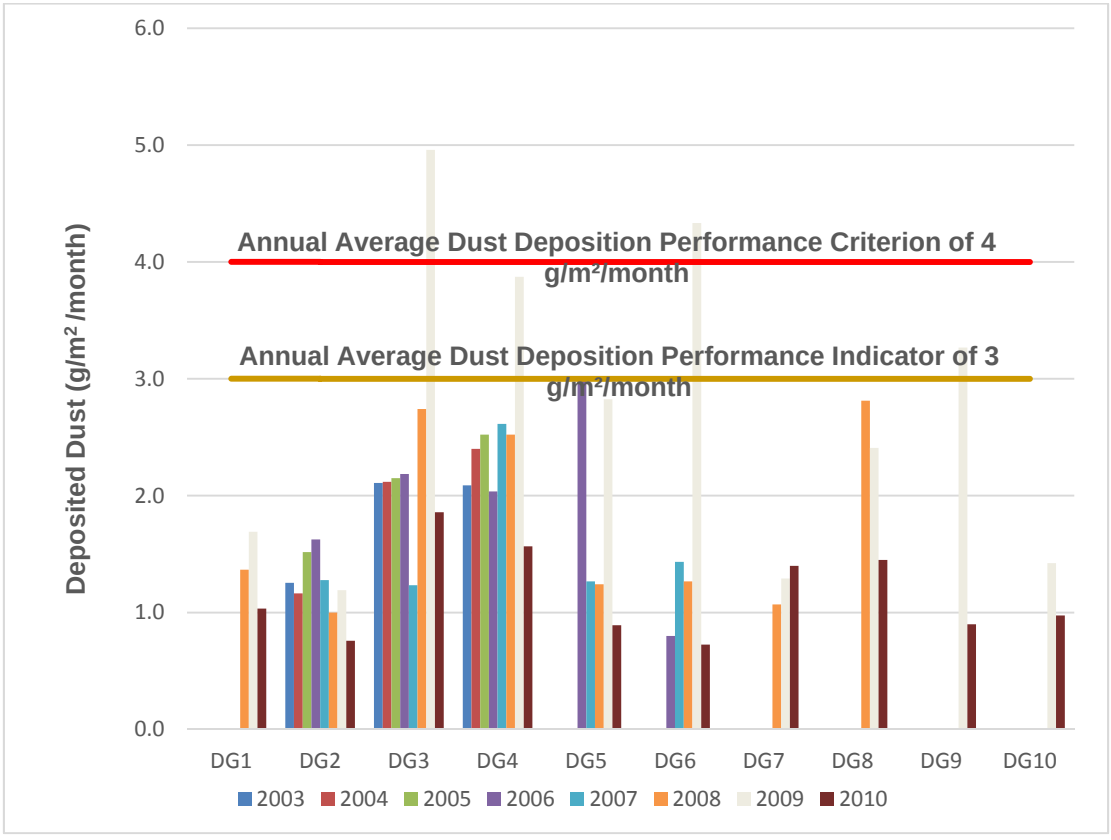


Chart 88a Annual Average Dust Deposition Rates at DG1 to DG10 from 2003 to 2010

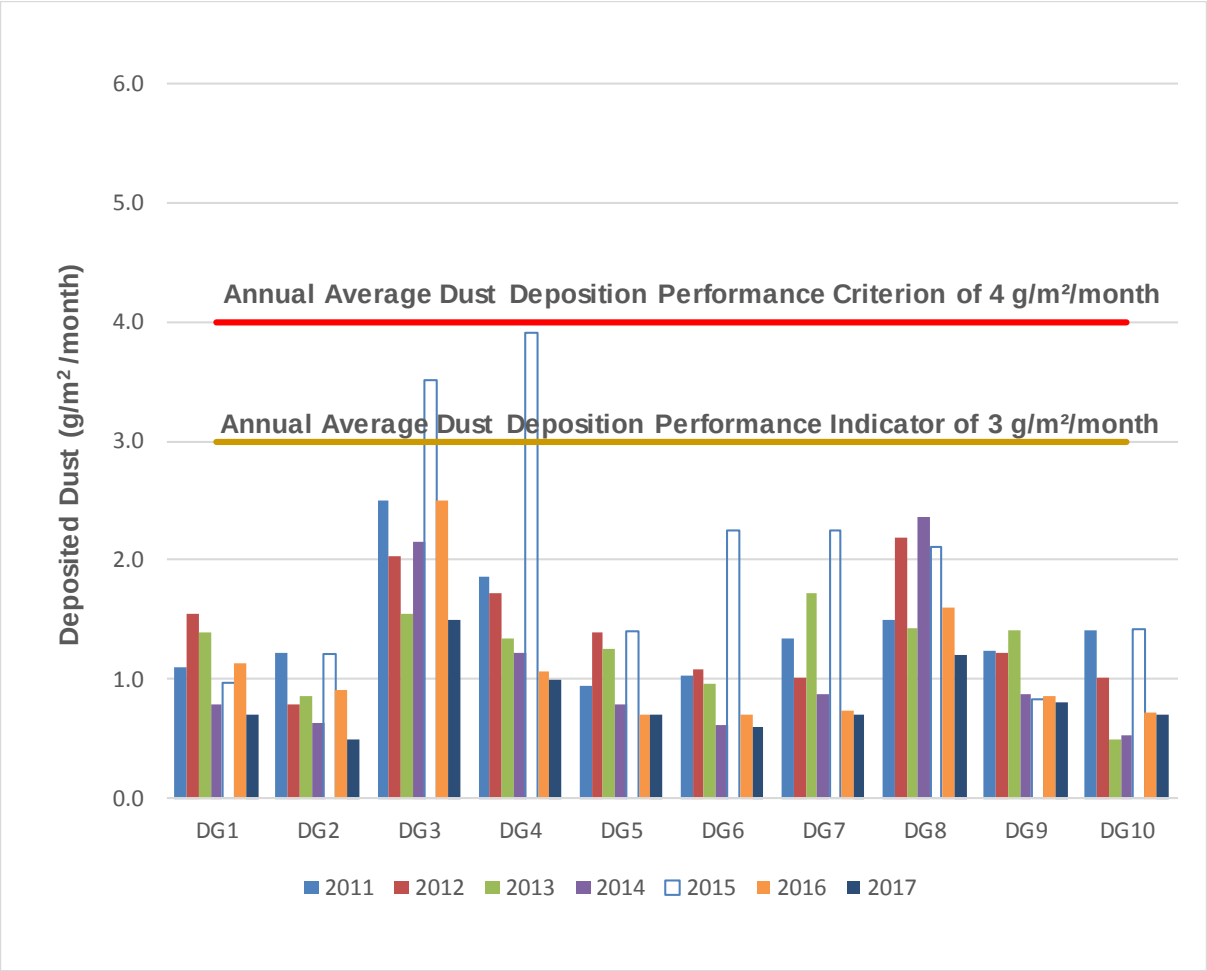


Chart 88b Annual Average Dust Deposition Rates at DG1 to DG10 from 2011 to 2017

A temporary dust deposition gauge was established at the mine entrance on the corner of Parkes Street and Colliery Road to conduct microscopic analysis of the dust deposition samples to assess potential impacts of trucks entering and leaving the Metropolitan Coal mine site, as well as any dust that might migrate off the site. The temporary dust deposition gauge was monitored from April to June 2017. Microscopic analysis indicated the samples contained only trace levels of coal matter (<2%) and major (>95%) proportion of insect and plant fragments.

Particulate Matter

One Tapered Element Oscillating Microbalance (TEOM) and one High Volume Air Sampler (HVAS) are located near the surface facilities area (Figure 20). The TEOM allows for continuous measurement of particulate matter less than 10 micrometers in diameter (PM_{10}) concentrations at ten-minute intervals, while the HVAS provides an average PM_{10} concentration for a specific 24-hour period, on a one-day-in-six cycle.

Sampling of PM_{10} during the review period was conducted at all monitoring points at the frequencies described in Conditions M2.1 and M2.2 of EPL No. 767.

The results of the PM_{10} monitoring are assessed against air quality performance indicators and air quality impact assessment criteria. The results of the assessment are provided in Section 7.5 and key aspects are summarised below.

The annual average PM_{10} concentrations (measured by the HVAS) from 2007 to 2017 are shown on Chart 89. The annual average PM_{10} concentration measured at the HVAS for the review period was 12.2 micrograms per cubic metre (µg/m^3), which is lower than the annual average PM_{10} performance indicator of 25 µg/m^3 and well below the annual average PM_{10} air quality impact assessment criterion of 30 µg/m^3 (Chart 89). This annual average concentration was the lowest recorded between 2007 and 2017.

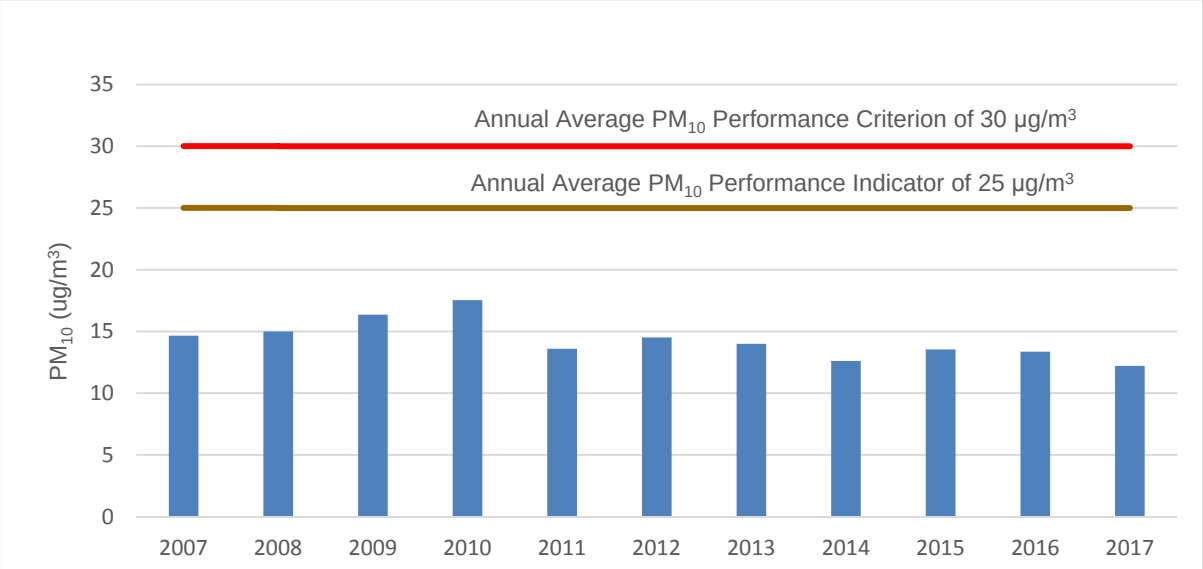


Chart 89 Annual Average PM_{10} Concentrations from 2007 to 2017 (measured by the HVAS)

The performance indicator for 24-hour average PM_{10} concentration is 37.5 µg/m^3. A 24-hour average PM_{10} concentration of 44.1 µg/m^3 was recorded at the TEOM on 24 September 2017 (Chart 90). However, this is considered to be related to a regional particulate matter event due to bushfire activity in the nearby Royal National Park. The highest 24-hour average PM_{10} concentration recorded at the HVAS was 33.5 µg/m^3 on 27 September 2017 and did not exceed the performance indicator (Chart 91). Again, this observation coincided with bushfire activity within the Royal National Park. All recorded 24-hour average PM_{10} concentrations at the TEOM and HVAS sites were below the short-term impact assessment criterion of 50 µg/m^3.

The highest 10-minute average PM_{10} concentration measured at the TEOM for the review period was 154.6 µg/m^3 which was recorded for two consecutive 10-minute averages on 24 September 2017. These values marginally exceeded the air quality performance indicator for the 10-minute average PM_{10} concentration of 150 µg/m^3. However, these observations are considered to be a result of bushfire activity within the nearby Royal National Park and, as a result, the exceedance of the performance indicator is not considered to be a result of the Project.

The predicted annual average PM_{10} (Project plus background) concentrations modelled for Years 3 and 15 in the Project EA were not predicted to be above the 30 µg/m^3 assessment criterion at any receiver. The maximum 24-hour average PM_{10} concentrations modelled for Years 3 and 15 by the Project EA were not predicted to exceed the assessment criterion (Project only) of 50 µg/m^3 at any receiver. Residences located in close proximity to the major surface facilities area on Parkes Street were predicted to experience maximum 24-hour average PM_{10} concentrations close to the criteria (i.e. 49 µg/m^3) in Year 15 due to their close proximity to the coal stockpiles and train loading activities.

The monitoring results are consistent with the Project EA predictions in relation to particulate matter.

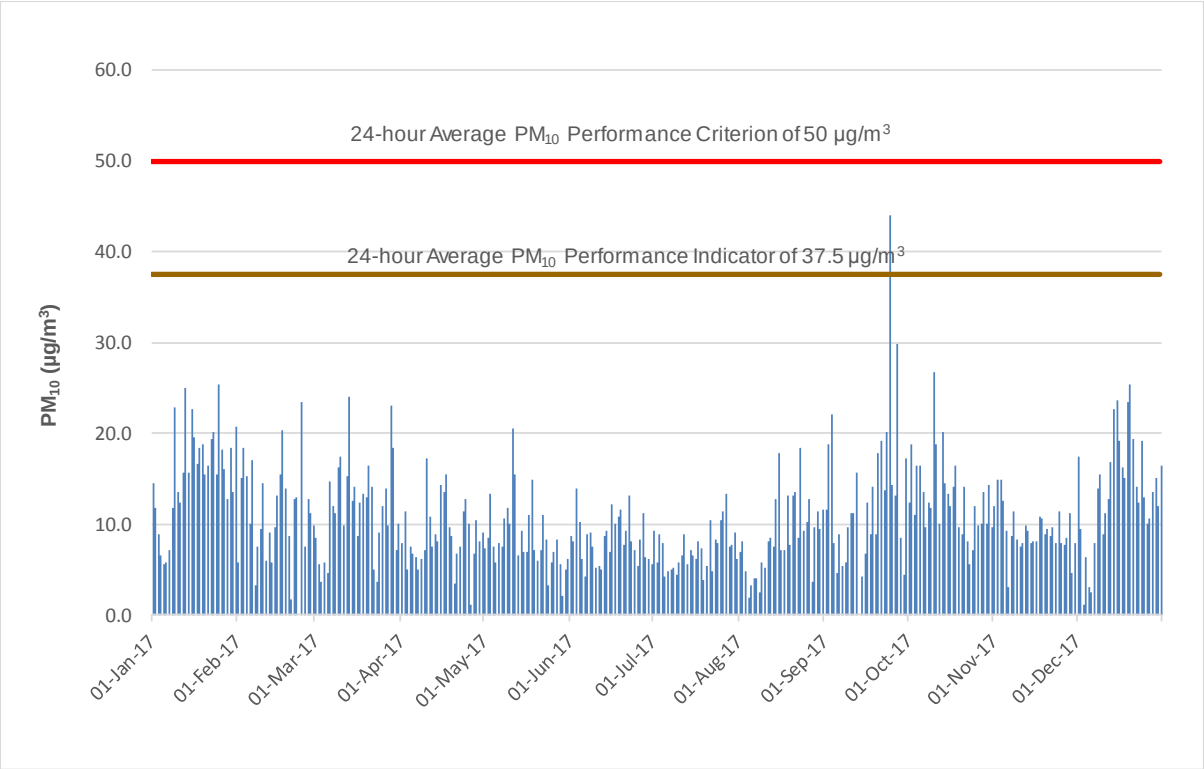


Chart 90 24-hour Average PM_{10} Concentrations (measured by the TEOM)

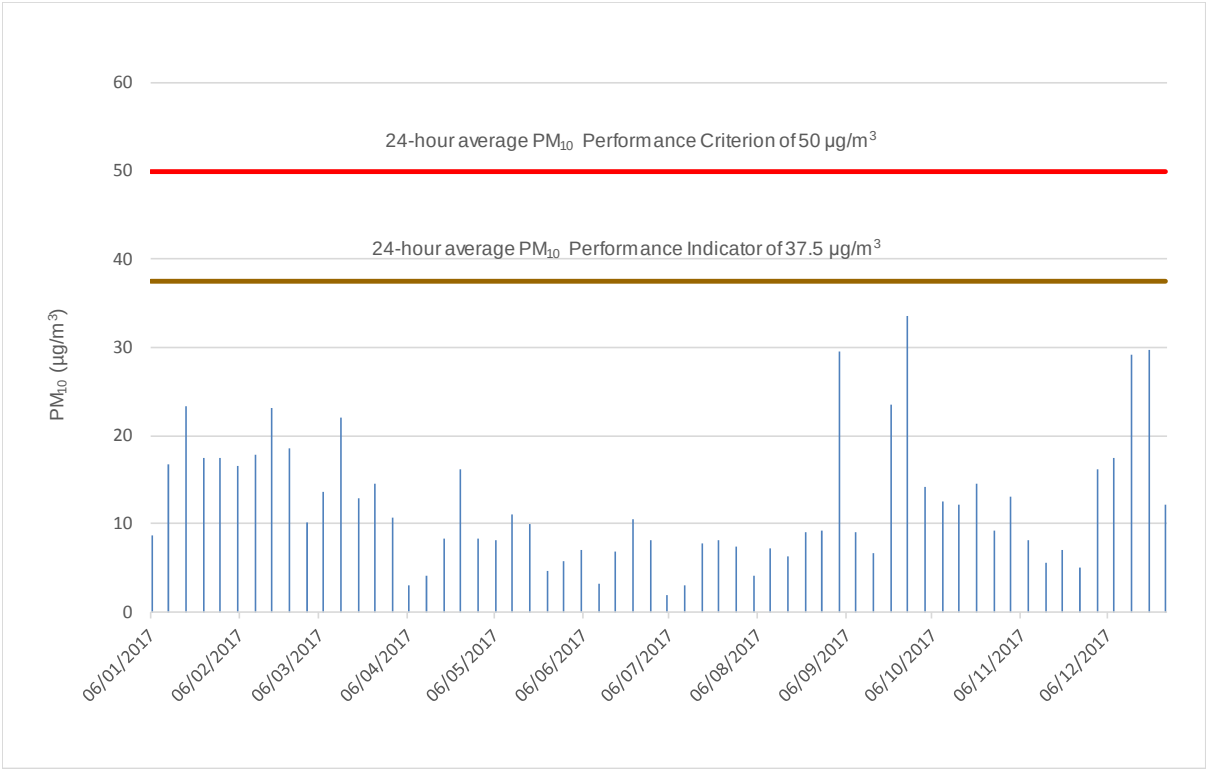


Chart 91 24-hour Average PM_{10} Concentrations (measured by the HVAS)

Management Measures

A number of ongoing air quality management measures are implemented at Metropolitan Coal to manage and mitigate air quality impacts, as reported in previous Annual Reviews. During the review period Metropolitan Coal assessed the feasibility of installing a camera to allow for remote monitoring of dust emissions from coal stockpiles. Installation of the proposed cameras was considered to provide limited benefit to the current effective monitoring system and was not installed.

7.3 TRAFFIC MANAGEMENT

The Metropolitan Coal Traffic Management Plan has been prepared to minimise the traffic impacts of the Project on the residential areas and schools within Helensburgh in accordance with Condition 22, Schedule 4 of the Project Approval.

Metropolitan Coal monitors the amount of product coal transported from site by road and by rail. A total of 992,778 tonnes (t) of product coal was transported from site by rail during the review period. No product coal was transported from the site by road.

Metropolitan Coal also monitors the amount of coal reject that is transported from the site by road each year. A total of 272,369 t of coal reject was transported from the site by road in 2017. The coal reject was transported to the Glenlee Washery for disposal.

In September 2010, a Road Safety Audit of the Mine Access Road and Parkes Street intersection was conducted in accordance with Condition 17(a), Schedule 4 of the Project Approval. The Road Safety Audit recommended an upgrade of the Parkes Street and Colliery Road intersection. However, Metropolitan Coal was unable to address all of the recommended intersection upgrades due to the inability to obtain a mutually acceptable outcome with the Wollongong City Council (as reported in the 2016 Annual Review). In May 2016, the DP&E (Compliance Southern Region) noted that Metropolitan Coal had made considerable effort to address the findings in the road safety report, however recommended a road safety expert be engaged to review whether the works undertaken are sufficient to address the original risk identified, or whether alternative/additional actions can be undertaken to address the risk.

During the 2016 review period, Metropolitan Coal engaged a road safety expert, J Wyndham Prince in accordance with the DP&E's recommendation. The review indicated that the civil works associated with the full intersection upgrade were not achievable within the Colliery Road Crown Land lease area. Additional viable upgrades were recommended including repainting stop lines and installing a school zone sign on Colliery Road, where it intersects with Parkes Street. These were implemented following the road safety review. Metropolitan Coal will seek to meet with the Wollongong City Council in the next reporting period to consult further in relation to the recent J Wyndham Prince recommendations.

7.4 WASTE MANAGEMENT

The Metropolitan Coal Waste Management Plan has been prepared for the surface facilities area in accordance with Condition 25, Schedule 4 of the Project Approval to identify waste streams and monitor the quantities generated, identify waste management measures to minimise waste generation, and ensure that waste generated by Metropolitan Coal is appropriately stored, handled and disposed.

Waste generated by Metropolitan Coal can include tyres, oil, sewage effluent, paint, lead acid batteries, coal rejects, drift waste rock, office waste (e.g. paper, plastics, and cardboard), scrap metal, general inert waste (e.g. concrete, timber, pipe, rope and rags), underground waste (e.g. packaging, cloths and pipe), oil/fuel filters, aerosol cans, absorbents (e.g. spent oil spill material) and food waste.

Metropolitan Coal monitors waste generated on a monthly basis through waste disposal receipts provided by Metropolitan Coal's waste contractors. Figure 21(a) shows the amount of general waste disposed of in 2017 compared with previous calendar years. Approximately 288,255 kilograms (kg) of general waste was disposed of at a licensed landfill facility in 2017. Approximately 23,820 kg of diesel particulate filters from underground mine equipment, was also disposed of at a licensed landfill facility during the review period.

The slight increase in general waste disposal during the 2017 review period is associated with the extraction of Longwall 27 being completed and the extraction of Longwall 301 commencing (Figure 21a). The changeover between longwalls generally leads to slight increases in general waste disposal, as observed in previous years.

Waste recycled by Metropolitan Coal during the review period included waste oil, scrap metal and office waste (e.g. paper, cardboard and plastic). Figure 21(b-e) shows the amount of waste oil, scrap wood, scrap metal and office waste recycled in 2017, respectively, compared with previous calendar years.

Figure 21(f) and Figure 21(g) show the amount of coal reject emplaced by Metropolitan Coal in underground workings and disposed of at the Glenlee Washery, respectively, during the 2012 to 2017 calendar years. In 2017, approximately 55,000 t of coal reject were emplaced underground and approximately 272,369 t of coal reject were disposed of at the Glenlee Washery.

During the 2016 review period, the capacity of the coal reject backfill emplacement plant was upgraded to allow up to 60% of coal rejects generated by Metropolitan Coal to be disposed of by underground emplacement into the operating goaf. During the review period updates to the coal reject emplacement plant included replacement of the agitator, removal of the separator tank and installation of a screen to improve flows. The coal reject backfill emplacement project will continue in 2018.

The Wollongong City Council is continuing works to confirm the suitability of Metropolitan Coal rejects to be beneficially re-used at the Helensburgh Landfill in consultation with the EPA.

The education program continued to be implemented during the review period to increase the awareness of mine site personnel in relation to waste management and measures to minimise the generation of waste. Metropolitan Coal will continue to seek opportunities for additional waste minimisation and for the recycling and re-use of materials at the site.

7.5 ASSESSMENT OF ENVIRONMENTAL PERFORMANCE

The performance indicators, impact assessment criteria and Project Approval conditions in Table 16 assess the performance of environmental management at the surface facilities area including those related to noise, air quality, greenhouse gases, odour, traffic, waste and visual impacts for the review period and reflect the predictions included in the Project EA, Preferred Project Report and the surface facilities management plans (Noise Management Plan, Air Quality and Greenhouse Gas Management Plan, Traffic Management Plan, Surface Facilities Water Management Plan and Waste Management Plan).

Table 16
Assessment of Environmental Performance – Surface Facilities Area

Monitoring Aspect	Performance Indicator, Impact Assessment Criteria and/or Project Approval Condition	Indicator, Criteria or Condition Met?	Comments
NOISE			
Real-time Noise Performance Indicator	*The $L_{Aeq(5\ minute)}$ night-time noise level does not exceed 50 dB(A) for six consecutive 5 minute samples.*	No	On one occasion in 2017, a distinct noise event was identified that warranted further investigation to determine whether it was the result of mine activities. A loud vehicle (truck) in close proximity to the noise monitor was detected in June 2017, but could not be sourced to any on-site activities. It was concluded that a truck was likely hauling up Parkes Street (past the mine entrance) under load, proximal to the real-time monitoring location (Appendix L).
Noise Impact Assessment Criteria (Project Approval Table 2, Condition 1, Schedule 4)	Day $L_{Aeq(15\ minute)}$ – 50 dBA	No	No sustained non-compliances with respect to the day-time Noise Impact Assessment Criterion were identified by monitoring during the review period (Appendix L). Modelling predicts that there may have been sustained non-compliances with respect to the day-time Noise Impact Assessment Criteria in Oxley Place (Appendix M).
	Evening $L_{Aeq(15\ minute)}$ – 45 dBA	No	A conditional sustained non-compliance with respect to the evening Noise Impact Assessment Criterion was identified by monitoring at 16 Oxley Place as a result of consecutive exceedances in Quarter 4 (2016) and Quarter 1 (2017) (measured noise levels of 49 dBA and 49 dBA respectively) (Appendix L). Consistent with the monitoring results, it can be inferred from noise modelling that sustained non-compliances with respect to the evening Noise Impact Assessment Criteria occurred in Oxley Place and may also have occurred in Parkes Street (Appendix M).
	Night $L_{Aeq(15\ minute)}$ – 45 dBA	No	A conditional sustained non-compliance with respect to the night-time Noise Impact Assessment Criterion was identified by noise monitoring at 16 Oxley Place as a result of consecutive exceedances in Quarter 3 (2017) and Quarter 4 (2017) (measured noise levels of 48 dBA and 49 dBA, respectively) (Appendix L). Consistent with the monitoring results, it can be inferred from noise modelling that sustained non-compliances with respect to the night-time Noise Impact Assessment Criteria occurred in Oxley Place and may also have occurred in Parkes Street (Appendix M).
	Night $L_{A1(1\ minute)}$ – 50 dBA	No	A conditional sustained non-compliance with respect to the night-time maximum Noise Impact Assessment Criterion was identified by noise monitoring at 16 Oxley Place as a result of consecutive exceedances in Quarter 1 (2017) and Quarter 2 (2017) (measured noise levels of 61 dBA and 60 dBA, respectively) (Appendix L). Consistent with the monitoring results, it can be inferred from noise modelling that sustained non-compliances with respect to the night-time maximum Noise Impact Assessment Criteria occurred in Oxley Place and may also have occurred in Parkes Street (Appendix M).

Table 16 (Continued)
Assessment of Environmental Performance – Surface Facilities Area

Monitoring Aspect	Performance Indicator, Impact Assessment Criteria and/or Project Approval Condition	Indicator, Criteria or Condition Met?	Comments
NOISE (Continued)			
Noise Mitigation Criteria (Project Approval Table 4, Condition 3, Schedule 4)	Day $L_{Aeq(15\ minute)}$ – 53 dBA	No	No sustained exceedances of the day-time Noise Mitigation Criteria were identified by monitoring during the review period (Appendix L). Modelling predicts that there may have been sustained exceedances of the day-time Noise Mitigation Criteria in Oxley Place (Appendix M).
	Evening $L_{Aeq(15\ minute)}$ – 48 dBA	No	A sustained exceedance of the evening Noise Mitigation Criterion was identified by noise monitoring at 16 Oxley Place as a result of consecutive exceedances in Quarter 4 (2016) and Quarter 1 (2017) (measured noise levels of 49 dBA and 49 dBA, respectively) (Appendix L). Consistent with the monitoring results, it can be inferred from noise modelling that sustained exceedances of the evening Noise Mitigation Criteria occurred in Oxley Place (Appendix M).
	Night $L_{Aeq(15\ minute)}$ – 48 dBA	No	No sustained exceedances of the night-time Noise Mitigation Criterion were identified by monitoring during the review period (Appendix L). Modelling predicts that there may have been sustained exceedances of the night-time Noise Mitigation Criteria in Oxley Place (Appendix M).
Noise Acquisition Criteria (Project Approval Table 3, Condition 2, Schedule 4)	Day $L_{Aeq(15\ minute)}$ – 55 dBA	Yes	No sustained exceedances of the day-time Noise Acquisition Criterion were identified by monitoring or modelling during the review period (Appendix L and Appendix M).
	Evening $L_{Aeq(15\ minute)}$ – 50 dBA	No	No sustained exceedances of the evening or night-time Noise Acquisition Criterion were identified by monitoring during the review period (Appendix L). Modelling predicts that there may have been exceedances of the evening and night-time Noise Acquisition Criterion at four residences in Oxley Place (by 1 dBA) during the review period (Appendix M).
	Night $L_{Aeq(15\ minute)}$ – 50 dBA	No	
Rail Noise (Project Approval Conditions 4, 5 and 6, Schedule 4)	*4. The Proponent shall only use locomotives that are approved to operate on the NSW rail network in accordance with noise limits L6.1 to L6.4 in RailCorp's EPL (No. 12208) and ARTC's EPL (No. 3142) or a Pollution Control Approval issued under the former Pollution Control Act 1970.*	Yes	All locomotives used by Metropolitan Coal are approved for operations in accordance with the noise limits in the relevant EPL.
	5. The Proponent shall use its best endeavours to minimise night-time movements of rolling stock on the Metropolitan rail spur.	Yes	Metropolitan Coal has endeavoured to minimise night-time movements of rolling stock on the Metropolitan rail spur.
	6. In the event of any rail noise or vibration issues that may arise from the haulage of coal over the life of the Project, the Proponent shall liaise with the CCC and the rail service provider to facilitate resolution of these issues and implement additional noise reduction measures where appropriate.	Yes	No issues with rail noise or vibration were identified during the review period.

Table 16 (Continued)
Assessment of Environmental Performance – Surface Facilities Area

Monitoring Aspect	Performance Indicator, Impact Assessment Criteria and/or Project Approval Condition	Indicator, Criteria or Condition Met?	Comments
NOISE (Continued)			
Notification of Landowners (Project Approval Condition 1, Schedule 5)	1. *If the results of the monitoring required in schedule 4 identify that impacts generated by the project are greater than the relevant impact assessment criteria in schedule 4, except where a negotiated agreement has been entered into in relation to that impact, then the Proponent shall, within 2 weeks of obtaining the monitoring results, notify the Executive Director Mineral Resources, the affected landowners and tenants (including tenants of mine owned properties) accordingly, and provide quarterly monitoring results to each of these parties until the results show that the project is complying with the criteria in schedule 4.*	No	The Quarter 1 and Quarter 2 conditional sustained non-compliances were not identified until after the Quarter 4 conditional sustained con-compliance was identified. In March 2018 (i.e. following conclusive identification of sustained non-compliances and review of associated noise modelling), Metropolitan Coal notified a number of nearby residents that the most recent noise modelling continues to predict are experiencing noise levels exceeding the Noise Impact Assessment Criteria contained in the Project Approval. The notifications also advised the residents of the current process underway re-assess noise impacts and reasonable and feasible controls (Section 13.2).
AIR QUALITY			
Air Quality Performance Indicators [1,2]	PM_{10} indicator = 150 µg/m^3 (10 minute averaging period assessed using TEOM data)	Yes	The maximum 10 minute average PM_{10} concentration recorded by the TEOM was 154.6 µg/m^3 for two consecutive observations on 24 September 2017. However, these concentrations are considered to be a result of bushfire activity within the nearby Royal National Park. The exceedance of the performance indicator is not considered to be a result of the Project (Appendix N).
	PM_{10} indicator = 37.5 µg/m^3 (24-hour averaging period assessed using TEOM data)	Yes	While one exceedance of the 24-hour average PM_{10} performance indicator concentration of 37.5 µg/m^3 was recorded on 24 September 2017 by the TEOM of 44.1 µg/m^3, observations at the time noted the occurrence of a bushfire within the nearby Royal National Park. The exceedance of the performance indicator is not considered to be a result of the Project (Appendix N).
	PM_{10} indicator = 37.5 µg/m^3 (24-hour averaging period assessed using HVAS data)	Yes	A 24-hour average PM_{10} concentration of 33.5 µg/m^3 was recorded by the HVAS (on the 27 September 2017) (Appendix N).
	PM10 indicator = 25 µg/m3 (Annual averaging period assessed using HVAS data)	Yes	An annual average PM10 concentration of 12.2 µg/m3 was recorded by the HVAS (Appendix N).
	Maximum total deposited dust level = 3 g/m2/month (Annual averaging period)3	Yes	The performance indicator concentration for annual average deposited dust of 3 g/m2/month was met at all dust deposition sites during the review period (Appendix N).

Table 16 (Continued)
Assessment of Environmental Performance – Surface Facilities Area

Monitoring Aspect	Performance Indicator, Impact Assessment Criteria and/or Project Approval Condition	Indicator, Criteria or Condition Met?	Comments
AIR QUALITY (Continued)			
Air Quality Impact Assessment Criteria (Project Approval Condition 11, Schedule 4)	TSP Criteria[4] = 90 µg/m^3 (Annual averaging period)	Yes	Based on the annual average PM_{10} concentrations recorded by the HVAS, the annual average TSP for the next review period is estimated to be less than 24.4 µg/m^3 (Appendix N).
	PM_{10} Criteria[4] = 30 µg/m^3 (Annual averaging period)	Yes	An annual average PM_{10} concentration of 12.2 µg/m^3 was recorded by the HVAS (Appendix N).
	PM_{10} Criteria[4] = 50 µg/m^3 (24 hour averaging period)	Yes	A 24-hour average PM_{10} concentration of 33.5 µg/m^3 was recorded by the HVAS (Appendix N).
	Maximum total deposited dust level = 4 g/m^2/month (Annual averaging period)	Yes	The maximum annual average dust deposition was below 4 g/m^2/month during the review period at all dust gauges (Appendix N).
ODOUR			
Odour (Project Approval Condition 9, Schedule 4)	*9. The Proponent shall not cause or permit the emission of offensive odours from the site, as defined under Section 129 of the POEO Act.*	Yes	No odour complaints were received during the review period.
GREENHOUSE GASES			
Greenhouse Gas Emissions (Project Approval Condition 10, Schedule 4)	*10. The Proponent shall implement all reasonable and feasible measures to minimise:* *(a) energy use on site; and* *(b) the scope 1, 2 and 3 greenhouse gas emissions produced on site,* *to the satisfaction of the Director-General[5].*	Yes	Metropolitan Coal has implemented the viable energy saving measures contained within their Energy Savings Action Plan.
TRAFFIC			
Annual Road Maintenance Performance Indicators	*When annual road maintenance contribution negotiations are required, the negotiations should commence with the relevant councils and/or DP&I by 31 August.*	Yes	No negotiations with the Wollongong City Council, Campbelltown City Council and Wollondilly Shire Council were required during the review period.
	Annual road maintenance contributions to relevant councils are made by 30 November.	No	Metropolitan Coal sought to make contributions to the Wollongong City Council, Campbelltown City Council and Wollondilly Shire Council by 30 November 2017, however, were unable to meet this timeframe as the requested invoices from the Councils had not been received. Metropolitan Coal made the contributions in December 2017/January 2018.
Coal Transport Off-site Performance Indicators	*Coal transported off-site by road in a calendar year does not reach 150,000 tonnes prior to 31 October.*	Yes	Metropolitan Coal did not transport any product coal from the site by road in the 2017 calendar year.

Table 16 (Continued)
Assessment of Environmental Performance – Surface Facilities Area

Monitoring Aspect	Performance Indicator, Impact Assessment Criteria and/or Project Approval Condition	Indicator, Criteria or Condition Met?	Comments
TRAFFIC (Continued)			
Coal Transport Off-site Performance Indicators (Continued)	*Product coal truck movements to the Corrimal Cokeworks and Coalcliff Cokeworks do not exceed 22 and 27 movements respectively in any one day.*	Yes	Metropolitan Coal has ceased the transport of product coal to Corrimal Cokeworks and Coalcliff Cokeworks. No product coal was transported by road during the review period.
Limits on Approval (Project Approval Condition 6[b], Schedule 2)	• *The Proponent shall not:* *(a) ...* *(b) transport more than 2.8 million tonnes of product coal from the site in a calendar year.*	Yes	Metropolitan Coal transported a total of 992,778 t of product coal from site by rail in the 2017 calendar year.
Transport (Project Approval Conditions 17, 18, 19, 20 and 21, Schedule 4)	*17. By the end of 2010, the Proponent shall:* *(a) undertake a road safety audit of the Parkes Street and Colliery Road intersection, in consultation with the RTA and WCC; and* *(b) implement any recommendations of this audit,* *to the satisfaction of the Director-General[5].*	Yes, the road safety audit has been undertaken. Further actions required in relation to the audit recommendations.	The Road Safety Audit of the Mine Access Road and Parkes Street intersection was conducted in September 2010 in accordance with Condition 17(a), Schedule 4 of the Project Approval. The Road Safety Audit recommended an upgrade of the Parkes Street and Colliery Road intersection. However, Metropolitan Coal was unable to address all of the recommended intersection upgrades due to the inability to obtain a mutually acceptable outcome with the Wollongong City Council. Metropolitan Coal engaged a road safety expert to review whether the works undertaken are sufficient to address the original risk identified, or whether alternative/additional actions can be undertaken to address the risk. The review indicated that the civil works associated with the full intersection upgrade were not achievable within the Colliery Road Crown Land lease area. Metropolitan Coal will seek to meet with the Wollongong City Council in the next reporting period to consult further in relation to the recent recommendations.
	18. From the end of 2009, the Proponent shall make a suitable annual contribution to WCC, WSC, and CC for the maintenance of local roads that are used as haulage routes by the project. If there is any dispute over the amount of the contribution, the matter must be referred to the Director-General[5] for resolution.	Yes	Metropolitan Coal has made a suitable annual contribution to the Wollongong City Council, Campbelltown City Council and Wollondilly Shire Council.

Table 16 (Continued)
Assessment of Environmental Performance – Surface Facilities Area

Monitoring Aspect	Performance Indicator, Impact Assessment Criteria and/or Project Approval Condition	Indicator, Criteria or Condition Met?	Comments
TRAFFIC (Continued)			
Transport (Project Approval Conditions 17, 18, 19, 20 and 21, Schedule 4) (Continued)	*19. The Proponent shall not:* *(a) load coal or coal reject onto trucks, or transport it off site by road, outside the hours of 7am and 6pm Monday to Friday;* *(b) transport more than 170,000 tonnes of coal off site by road in a calendar year;* *(c) transport any coal off site to the Port Kembla Coal Terminal by road;* *(d) permit the departure of more than 25 trucks containing product coal for delivery to the Corrimal Cokeworks on any given day; or* *(e) permit the departure of more than 30 trucks containing product coal for delivery to the Coalcliff Cokeworks on any given day.*	Yes	The loading and transport of coal product and coal reject has been undertaken in accordance with Condition 19, Schedule 4 of the Project Approval.
	20. During emergencies (such as the disruption of rail services) the Proponent may exceed the restrictions in condition 19 above with the written approval of the Director-General[5].	Yes	No emergencies requiring amendments to Condition 19 occurred during the review period.
	21. The Proponent shall monitor the amount of coal and coal reject transported from the site by road and rail each year, and report the results of this monitoring on its website every six months.	Yes	The results of coal and coal reject transport monitoring have been provided on Metropolitan Coal's website and updated every six months.
WASTE			
Waste Generation Performance Indicator	*Waste generation has been minimised, as evidenced by:* • *an increase in the amount or type of waste recycled;* • *a decrease in the amount of waste generated that is disposed of to licensed landfill facilities; and/or* • *no practicable opportunities for additional waste minimisation have been identified to those currently being implemented.*	Yes	Metropolitan Coal has minimised waste generation during the review period. The underground emplacement project reduced the off-site disposal of coal reject by approximately 167,837 t at the end of the review period. No further practicable opportunities for waste minimisation were identified.

Table 16 (Continued)
Assessment of Environmental Performance – Surface Facilities Area

Monitoring Aspect	Performance Indicator, Impact Assessment Criteria and/or Project Approval Condition	Indicator, Criteria or Condition Met?	Comments
WASTE (Continued)			
Storage of Waste Performance Indicator	*Waste has been separated and stored according to type in appropriate storage facilities (e.g. sealed containers for liquid waste).*	Yes	Waste on-site is adequately sorted and stored according to waste type prior to collection. Weekly site inspections are conducted by the site Environment & Community Superintendent to ensure waste is separated and stored in accordance with the Metropolitan Coal Waste Management Plan.
Handling and Disposal of Waste Performance Indicator	*The transport of particular waste types has been tracked in accordance with NSW EPA waste tracking requirements.* *Metropolitan Coal's waste management contracts, where relevant, specify that the waste is to be transported by an appropriately licensed contractor and disposed of at an appropriately licensed facility.*	Yes	All transport of waste from the Metropolitan Coal site has been tracked in accordance with the NSW Office of Environment and Heritage waste tracking requirements. Metropolitan Coal's waste management contracts specify waste is to be removed by an appropriately licensed contractor and disposed of at an appropriately licensed facility.
Waste Generation (Project Approval Condition 24, Schedule 4)	*24. The Proponent shall:* *(a) minimise the waste (including coal reject) generated by the project; and* *(b) ensure that the waste generated by the project is appropriately stored, handled, and disposed of,* *to the satisfaction of the Director-General.*	Yes	Metropolitan Coal has minimised waste (including coal reject) generated during the review period. The underground emplacement project had reduced the off-site disposal of coal reject by approximately 177,837 t at the end of the review period. Waste on-site is adequately sorted and stored according to waste type prior to collection. Weekly site inspections are conducted by the site Environment & Community Superintendent to ensure waste is separated and stored in accordance with the Metropolitan Coal Waste Management Plan. Metropolitan Coal's waste management contracts specify waste is to be removed by an appropriately licensed contractor and disposed of at an appropriately licensed facility.
VISUAL			
Visual Impacts (Project Approval Condition 23, Schedule 4)	*23. The Proponent shall minimise the visual impacts, and particularly the off-site lighting impacts, of the surface facilities area and two ventilation shaft sites to the satisfaction of the Director-General.*	Yes	

Note: $L_{Aeq(15\ minute)}$ = intrusive equivalent noise level; $L_{A1(1\ minute)}$ = short-term noise level; dBA = A-weighted decibels; PM_{10} = Particulate matter less than 10 microns; HVAS1 = High Volume Air Sampler 1; TEOM1 = Tapered Element Oscillating Microbalance 1; $\mu g/m^3$ = micrograms per cubic metre; g/m^2/month = grams per square metre per month; TSP = total suspended particulate matter.

[1] Total measured level excluding extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents, illegal activities.

[2] Background PM_{10} concentrations due to all other sources plus the incremental increase in PM_{10} concentrations due to the mine alone.

[3] Dust deposition assessment criteria are to be measured using DG1 to DG10 excluding DG4, which is a control dust gauge that is located at the Helensburgh Golf Course some 2 km from the mine's surface facilities area.

[4] PM_{10} air quality impact assessment criteria are to be measured using HVAS data.

8 WATER MANAGEMENT

A Metropolitan Coal Surface Facilities Water Management Plan has been prepared for the surface facilities area and two ventilation shaft sites in accordance with Condition 15, Schedule 4 of the Project Approval.

This section details the water use, licensed discharge and water quality monitoring results for the surface facilities area and the management measures implemented during the review period. The environmental performance of water management in the underground mining area and surrounds is described in Section 6.2.

The surface facilities area is located in a steep-sided valley adjacent to the town of Helensburgh and next to Camp Gully (Figure 2). The site water management system comprises a series of collection dams, sumps and treatment systems. The system is operated to avoid the mixing of clean water runoff and mine water, minimise off-site release of runoff, and to provide water supply requirements on-site.

Water Use

The main uses of water on site are to supply underground mining operations and the coal washery. Metropolitan Coal draws its water from three main sources, namely, Camp Gully, the potable town water supply and water captured on-site.

Camp Gully runs adjacent to the southern edge of Metropolitan Coal's surface facilities area (Figure 22). Metropolitan Coal's extraction of water from Camp Gully is specifically regulated by the Camp Creek Weir Surface Water Certificate of Title and more generally by the *Water Act, 1912* and the *Water Management Act, 2000*.

Metropolitan Coal's annual entitlement under the Camp Gully extraction licence is 130 megalitres (ML). A concrete weir was historically constructed on Camp Gully (approximately 1930s) to facilitate the extraction of water for the mine. Table 17 describes the volume of water sourced from Camp Gully during the review period, a total of 39 ML. In comparison, Metropolitan Coal sourced 70 ML of water from Camp Gully in the 2016 calendar year, 47 ML of water in the 2015 calendar year, 77 ML of water in the 2014 calendar year, 99 ML in the 2013 calendar year and 94 ML in the 2012 calendar year.

Table 17
Camp Gully Water Take, 1 January to 31 December 2017

Water Licence	Water Licence Number	Entitlement (ML)	Passive take/inflows (ML)	Active Pumping (ML)	Total (ML)
Camp Creek Weir Surface Water Certificate of Title	WAL25410	130	0	39	39

The use of potable water (sourced from Sydney Water) for mine purposes occurs when insufficient water is available from Camp Gully and/or on-site harvesting. Potable water is sourced from two mains, one of which supplies the bathhouses and drinking water utilities and one that supplements water supplies for mining purposes. Use of potable water is recorded and minimised in accordance with the site's commitments under the Water Savings Action Plan. Metropolitan Coal used approximately 513 ML of potable town water (as recorded by the Sydney Water meter) during 2017 (a monthly average of approximately 42.8 ML), in comparison to 386 ML in 2016, 378 ML in 2015 and 388 ML in 2014.

The use of potable water per tonne of ROM coal produced is variable and is generally higher during periods of low rainfall (Chart 92). Ongoing site auditing during the review period has not identified incidences of potable water being used where there is a viable alternative. The high values for potable water used per ROM tonne for April, May and June 2017 in Chart 92 is a result of the low ROM output at the time of the longwall changeover (from Longwall 27 to Longwall 301), low rainfall and an increase in backfill plant operations (which use considerable amounts of water).

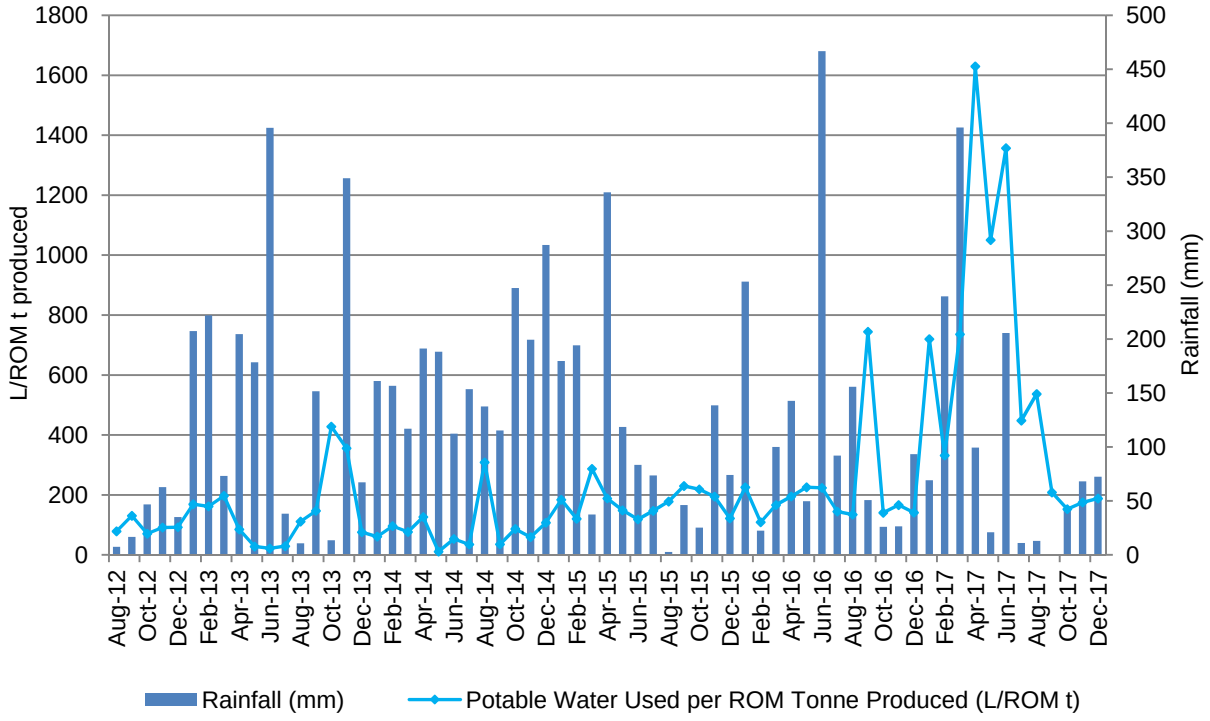


Chart 92 Potable Water Used per ROM Tonne Produced vs Rainfall

Licensed Discharge

Water discharged from the Water Treatment Plant to Camp Gully is monitored in accordance with EPL No. 767, which requires Metropolitan Coal to continuously monitor the volume (kilolitres per day) of water discharged from the clean water tank in the Water Treatment Plant to Camp Gully. The total amount of water discharged from the Water Treatment Plant to Camp Gully during the review period was approximately 113 ML, in comparison to 166 ML in 2016, 96 ML in 2015, 109 ML in 2014, 151 ML in 2013 and 98 ML in 2012.

Water Quality

Surface water quality monitoring of pH, oil and grease and total suspended solids is conducted at the Water Treatment Plant in accordance with EPL No. 767.

The water quality monitoring results indicate that pH levels (ranging from 8.1 to 8.4 pH), oil and grease (less than 5 mg/L) and total suspended solids (ranging from less than 5 mg/L to 12 mg/L) were within the water quality limits prescribed by EPL No. 767 (i.e. 6.5 to 8.5 pH, 10 mg/L for oil and grease, and 30 mg/L for total suspended solids) during the review period. Similarly, no exceedances of the EPL No. 767 concentration limits were recorded by Metropolitan Coal in the 2011 to 2016 calendar years.

The Project EA predicted there would be no material effect to downstream water quality as a result of water releases from the major surface facilities area to Camp Gully (which are constrained by EPL No. 767). The monitoring results are consistent with the Project EA predictions in relation to water quality.

Overall System Integrity

Surface facilities water management items (such as pipelines and pumps, bunded areas, main water storages, signs of discharge of site runoff, upslope diversions and erosion control measures) are visually inspected by Metropolitan Coal and reported in accordance with the mine's maintenance system.

During the review period, erosion and sediment controls were installed and maintained around the perimeter of the Turkey's Nest Dam (which was upgraded during the 2016 review period) while revegetation works of the Turkey's Nest outer batters have been conducted. Erosion and sediment controls will continue until the revegetation works have been completed.

Metropolitan Coal installed spoon drains and re-worked stockpile surfaces on site to minimise surface water runoff from steep sections of roads and to improve drainage paths to stormwater retention dams. Grass and groundcover species were also sown on steep sections of roads to minimise erosion during heavy rainfall events.

The Turkey's Nest Dam and Sediment Ponds were de-silted during the review period to increase the available water capacity of the storages. De-silting of the storages will continue in the next reporting period.

Assessment of Environmental Performance

In accordance with the Metropolitan Coal Surface Facilities Water Management Plan, an assessment of the environmental performance of water management at the surface facilities area is provided in Table 18.

Table 18
Assessment of Environmental Performance – Surface Facilities Water Management

Monitoring Aspect	Performance Indicator or Project Approval Condition	Indicator or Condition Met?	Comments
SURFACE FACILITIES WATER MANAGEMENT			
Water Use Performance Indicator	*The use of potable water (i.e. megalitres of town water used per tonne of coal produced) does not increase over time, after taking into consideration climatic conditions.* *Potable water has not been used in circumstances where there is a viable alternative.*	Yes	Ongoing site auditing during the review period has not identified incidences of potable water being used where there is a viable alternative.
Erosion Control Performance Indicator	*Inspections of the major surface facilities area and ventilation shaft(s) indicate the measures implemented are effectively controlling erosion.*	Yes	Weekly inspections of the surface facilities area and ventilation shaft(s) indicate that the erosion control measures implemented during the review period have effectively controlled erosion.
Containment of Contaminants Performance Indicator	*Effective containment and/or isolation measures are in place for potential contaminants on site.*	Yes	Weekly inspections have confirmed that effective containment and isolation measures have been in place for potential contaminants on-site.
Licensed Discharge Performance Indicator	*Surface water discharges comply with the requirements of EPL No. 767.*	Yes	All water discharge criteria were met during the review period.

Table 18 (Continued)
Assessment of Environmental Performance – Surface Facilities Water Management

Monitoring Aspect	Performance Indicator or Project Approval Condition	Indicator or Condition Met?	Comments
SURFACE FACILITIES WATER MANAGEMENT (Continued)			
System Integrity Performance Indicator	*Inspections of system components indicate the integrity of the system is not at risk of being compromised.*	Yes	Daily and weekly inspections of the water management system confirmed the integrity of the system was not at risk.
Discharges (Project Approval Condition 14, Schedule 4)	*14. The Proponent shall ensure that all surface water discharges from the site comply with the discharge limits (both volume and quality) set for the project in any EPL.*	Yes	The water discharge volume and quality limits were met during the review period.

9 CONSTRUCTION MANAGEMENT

A Metropolitan Coal Construction Management Plan has been prepared for surface construction works (excluding remediation or rehabilitation works) in the Woronora Special Area in accordance with Condition 11, Schedule 3 of the Project Approval. During the review period Metropolitan Coal commenced the review and revision of the Metropolitan Coal Construction Management Plan to be consistent with the Longwalls 301-303 Extraction Plan.

As the requirement for surface construction works arise, Metropolitan Coal provide the specific details of the proposed surface construction works (in the form of a completed Surface Works Assessment Form) to the DP&E and WaterNSW for comment. The Surface Works Assessment Form details the specific management measures that will be implemented to minimise potential impacts associated with surface construction works, including management measures relevant to vegetation, Aboriginal heritage, erosion and sediment control, fuel and spill management, transport, waste, bushfire preparedness, pest management and site clean-up.

Following consultation with WaterNSW, Metropolitan Coal investigated the potential installation of two new screened piezometers between bore 9EGW2A and the Woronora Reservoir, however, only one was considered practicable (shallow groundwater transect hole T6) due to terrain/access constraints.

Metropolitan Coal also investigated the potential siting of an additional Vibrating Wire Piezometer bore to the north-east of Longwall 301 to assess the effect of depressurisation by the century-old workings, however, this was also not practicable due to access constraints (Garrawarra State Conservation Area administered by the NSW National Parks and Wildlife Service).

During the review period, Metropolitan Coal submitted a number of Construction Management Plan Surface Works Assessment Forms to the DP&E and WaterNSW for the proposed installation of environmental monitoring equipment and exploration bores. This included Surface Works Assessment Forms for:

- the installation of additional deep groundwater monitoring bores over Longwall 301 and Longwall 302 (i.e. bore holes 301GW01, 301GW02, 302GW02 [an open 80 m bore hole further to a request from WaterNSW], 302GW03 and 302GW04);
- the installation of two flow gauging stations (in sub-catchments I and K) and a pluviometer on the road verge of Fire Road 9J over the 300 series longwalls; and
- the installation of additional deep groundwater monitoring bores over Longwall 303 (TBS3a, TBS3b), a shallow groundwater transect hole (T6) requested by WaterNSW, a replacement deep groundwater bore (9EGW2-4) and three coal exploration holes (PHEX01, PHEX02 and PHEX03).

Metropolitan Coal was unable to gain landholder consent from Crown Lands in the timeframe required to obtain pre-mining data for the Longwall 301 holes. As a result, bore holes 301GW01 and 301GW02 were not installed.

The relevant approvals have been obtained for the additional Surface Works Assessment Forms. Bore holes 302GW02, 302GW03 and 302GW04, T6 and replacement deep groundwater bore 9EGW2-4 were installed during the reporting period.

No other construction activities in the underground mining area were conducted during the review period.

In the next reporting period, Metropolitan Coal will install the two gauging stations (at sub-catchments I and K) and the pluviometer over the 300 series longwalls, the additional deep groundwater bores over Longwall 303 and coal exploration holes. Metropolitan Coal will also prepare Surface Works Assessment Forms and install additional upland swamp groundwater piezometers in swamps over and/or proximal to Longwalls 304-306.

10 REHABILITATION

10.1 REHABILITATION SUMMARY

Metropolitan Coal has prepared a Rehabilitation Strategy for the surface facilities area in accordance with Condition 2, Schedule 6 of the Project Approval. The surface facilities area includes roads, facilities (e.g. the CHPP, administration buildings and workshops), stockpiles (coal and reject stockpiles), railroads, water storages and infrastructure. Rehabilitation of the surface facilities area is described in Section 10.2.

A Metropolitan Coal Rehabilitation Management Plan has been prepared for underground mining areas requiring rehabilitation or remediation measures, including surface disturbance and stream pool/rock bar remediation in accordance with Condition 4, Schedule 6 of the Project Approval. Rehabilitation of the underground mining area is described in Section 10.3. During the review period, Metropolitan Coal commenced the review and revision of the Metropolitan Coal Rehabilitation Management Plan to be consistent with the Longwalls 301-303 Extraction Plan.

A summary of the rehabilitation status at Metropolitan Coal for the previous, current and forecast review periods is provided in Table 19.

The total mine footprint includes the Metropolitan Coal surface facilities, the No. 3 Ventilation Shaft facilities, the temporary cable runway and electricity cable, disturbance associated with exploration boreholes and monitoring equipment installation in the underground mining area.

Two Catchment Improvement Works Projects have been conducted in accordance with Condition 5(b), Schedule 6 of the Project Approval, which requires Metropolitan Coal to carry out catchment improvement works in the Woronora catchment area. Catchment improvement work activities conducted in the review period are described in Section 10.4.

An assessment of rehabilitation environmental performance is provided in Section 10.5.

Table 19
Rehabilitation Status

Mine Area Type	As at December 2016	As at December 2017	As at December 2018 (Forecast)
A. Total mine footprint[1]	~ 17 ha	~ 17 ha	~ 17 ha
B. Total active disturbance[2]	~ 17 ha	~ 17 ha	~ 17 ha
C. Land being prepared for rehabilitation[3]	0	0	0
D. Land under active rehabilitation[4]	0	0	0
E. Completed rehabilitation[5]	0	0	0

1 ***Total mine footprint:*** *includes all areas within a mining lease that either have at some point in time, or continue to, pose a rehabilitation liability due to mining and associated activities. As such, it is the sum of total active disturbance, decommissioning, landform establishment, growth medium development, ecosystem establishment, ecosystem development and relinquished lands (as defined in the DRE (now DRG) MOP/RMP Guidelines). Please note that subsidence remediation areas are excluded.*

2 ***Total active disturbance:*** *includes all areas ultimately requiring rehabilitation such as: on-lease exploration areas, stripped areas ahead of mining, infrastructure areas, water management infrastructure, sewage treatment facilities, topsoil stockpile areas, access tracks and haul roads, active mining areas, waste emplacements (active/unshaped/in or out-of-pit), and tailings dams (active/unshaped/uncapped).*

3 ***Land being prepared for rehabilitation:*** *includes the sum of mine disturbed land that is under the following rehabilitation phases – decommissioning, landform establishment and growth medium development (as defined in DRE (now DRG) MOP/RMP Guidelines).*

4 ***Land under active rehabilitation:*** *includes areas under rehabilitation and being managed to achieve relinquishment – includes the following rehabilitation phases as described in the DRE (now DRG) MOP/RMP Guidelines – "ecosystem and land use establishment" (area seeded OR surface developed in accordance with final land use) and "ecosystem and land use sustainability" (revegetation assessed as showing signs of trending towards relinquishment OR infrastructure development).*

5 ***Completed rehabilitation:*** *requires formal sign-off by DRE (now DRG) that the area has successfully met the rehabilitation land use objectives and completion criteria.*

10.2 REHABILITATION STRATEGY – SURFACE FACILITIES AREA

The Metropolitan Coal Rehabilitation Strategy has been developed to be a concise framework document which describes the development of rehabilitation objectives and completion criteria for the preferred future landuse for the surface facilities area following the completion of mining activities. Detailed rehabilitation plans for the surface facilities area will be developed over the life of the Project and will be presented in the Mine Closure Plan and future revisions of the Rehabilitation Strategy.

As various factors will influence the landuse options available for the surface facilities area following the completion of mining activities, it is not possible for Metropolitan Coal to define a final landuse option (and associated final rehabilitation objectives and completion criteria) at this stage of the Project life. The final landuse and associated final rehabilitation objectives and completion criteria will be documented in future Metropolitan Coal MOP and the Mine Closure Plan as part of the Mining, Rehabilitation and Environmental Management Process. The Metropolitan Coal MOP has been prepared for the operating period 2012 to 2019.

Disturbance areas at the Metropolitan Coal surface facilities area are minimal and have remained relatively unchanged for many years. The surface facilities area includes roads, facilities (e.g. the CHPP, administration buildings and workshops), stockpiles (coal and reject stockpiles), railroads, water storages and infrastructure. The surface facilities area is an active operational area which will be required for the entire mine life.

Figure 23 shows the designated rehabilitation zones (1 to 7) that are currently available for rehabilitation at the surface facilities area. Rehabilitation activities undertaken during the review period included active planting of native vegetation (some 300 native plants) and control of introduced and environmental weeds across the designated rehabilitation zones (in particular Lantana [*Lantana camara*], Ginger Lily [*Hedychium gardnerianum*], Crofton Weed [*Agerantina adenophora*], Mistflower [*Ageratina riparia*] and exotic grasses).

No buildings were renovated or removed during the review period.

10.3 REHABILITATION MANAGEMENT – UNDERGROUND MINING AREA

10.3.1 Rehabilitation of Surface Disturbance Areas

Some surface disturbance areas will be able to be rehabilitated during the life of the Project (e.g. monitoring sites no longer required), while other surface disturbance areas will likely remain until after the completion of mining operations.

No surface disturbance areas in the underground mining area were rehabilitated during the review period as the majority of disturbance pertains to the installation and ongoing maintenance of environmental monitoring sites which are a life of mine asset. These sites will be rehabilitated to appropriate standards following cessation of mining.

10.3.2 Stream Remediation Measures

Waratah Rivulet

In accordance with Condition 1, Schedule 6 of the Project Approval, Metropolitan Coal is required to achieve the rehabilitation objective, *restore surface flow and pool holding capacity as soon as reasonably practicable,* for Waratah Rivulet, between the downstream edge of Flat Rock Swamp and the full supply level of the Woronora Reservoir.

Stream remediation is initiated at pools/rock bars on Waratah Rivulet between the downstream edge of Flat Rock Swamp and the full supply level of the Woronora Reservoir if the water level in a pool falls below its cease to overflow level (i.e. stops overflowing), except as a result of climatic conditions.

As a result of previous mining, the water levels in pools upstream of Flat Rock Crossing (i.e. Pools A to G) and immediately downstream of Flat Rock Crossing (Pool G1) have previously been impacted by mine subsidence (i.e. the pool water level has fallen below its cease to flow level). Metropolitan Coal identified that the water level in Pool N fell below its cease to flow level in early September 2012.

Stream remediation activities have been conducted at Pools A, F and G on the Waratah Rivulet in previous review periods. Stream remediation campaigns using polyurethane were completed at Pool A in June 2012, at Pool F in July 2015 and at Pool G in August 2016. The rock bars at Pools A and F are considered to largely control the pools located upstream of these rock bars. As a result, Metropolitan Coal anticipated that the restoration of surface flow and pool holding capacity at Pools A and F would restore the surface flow and pool holding capacity of pools between Flat Rock Swamp and Pool F.

The results of pool water level monitoring on the Waratah Rivulet for the review period are described in Section 6.2.3. In summary, all pools on Waratah Rivulet remained above their cease to flow levels or exhibited natural behaviour (i.e. pools that do not have ‘solid’ rock-bar controls) during the review period, except Pool A, Pool B and Pool N.

Water levels in Pool A were observed to be predominately below the pool cease-to-flow level in January and early February 2017. Pool WRP2 on the Woronora River also stopped flowing in the same period. Water levels recovered and remained above the cease-to-flow level from late February 2017 until late October 2017 when they fell and remained below the cease-to-flow level for the remainder of the review period (Figure 7, Chart 4, and Appendix B2).

Pool B was observed to cease overflowing the rock-bar in late December 2017 (Figure 7, Chart 5, and Appendix B2). Metropolitan Coal's visual inspections indicate Pool B was overflowing on all inspection occasions except on the last two observations conducted in 2017 (i.e. 28 and 29 December 2017). Metropolitan Coal's visual inspections indicated control pools on the Woronora River also ceased overflowing. Pool B is considered likely to have been affected by reduced flows from the low water levels in Pool A situated immediately upstream of Pool B (Appendix B2).

Water levels in Pool N fell below the cease-to-flow level for relatively short periods in January and February 2017. Water levels also fell below the cease-to-flow level in the latter half of December 2017 (Figure 7, Chart 6, and Appendix B2). Control Pools WRP2 and WRP3 on the Woronora River also stopped flowing in the same periods.

Following the conduct of stream remediation activities, Pools C to F, and Pool G1 (Figure 7) have overflowed their rock bars since February 2013. Since the stream remediation activities at Pool A in June 2012, Pool A has stopped overflowing its downstream rock bar in December 2012/January 2013, November/December 2016, January/February 2017 and November to December 2017 (Appendices B1 and B2). Pool B also stopped overflowing in December 2012/January 2013, January/February 2017 and in late December 2017. The reference pools on Woronora River also ceased overflowing during the same periods listed for Pool A and Pool B[16].

Stream remediation activities at Pool G were conducted in 2015 and 2016. The water levels in Pool G have continued to overflow its rock bar since mid-2015.

Pool N, which fell below its cease to flow level in early September 2012, had overflowed its rock bar since December 2014 until the relatively short periods where it ceases to flow in January and February 2017.

Metropolitan Coal considers the pool remediation efforts to have been successful but continues to monitor the performance of these works.

During the review period, Metropolitan Coal conducted brush matting near Pool F on the Waratah Rivulet using locally collected vegetative material (including *Banksia* sp., *Casuarina* sp., *Hakea* sp., *Eucalyptus* sp. and *Leptospermum* sp.). Weed control measures to encourage the regeneration of native vegetation were implemented.

Eastern Tributary

In accordance with Condition 1, Schedule 6 of the Project Approval, Metropolitan Coal is required to achieve the rehabilitation objective, *restore surface flow and pool holding capacity as soon as reasonably practicable,* for the Eastern Tributary, between the maingate of Longwall 26 and the full supply level of the Woronora Reservoir.

The Project Approval also requires Metropolitan Coal not to exceed the subsidence impact performance measures outlined in Table 1 of Condition 1, Schedule 3. The subsidence impact performance measure specified in Table 1 of Condition 1, Schedule 3 in relation to the Eastern Tributary watercourse is:

Table 1: Subsidence Impact Performance Measures

Watercourses	
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)*

[16] Reference pools stopped overflowing in late December 2017 (rather than from October to December 2017).

Pools ETAG to ETAU on the Eastern Tributary are situated between the maingate of Longwall 26 and the full supply level of the Woronora Reservoir (Appendix D).

Stream remediation will be triggered at Pools ETAG, ETAH, ETAI, ETAJ, ETAK, ETAL, ETAM, ETAN, ETAO, ETAP, ETAQ, ETAR, ETAS, ETAT or ETAU if the assessment of monitoring results indicates the subsidence impact performance measure:

> *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, …….) on the Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26*

has been exceeded.

As described in Section 6.2.1, the pools on the Eastern Tributary downstream of the Longwall 26 maingate have been visually inspected by Metropolitan Coal to observe whether any changes to the natural drainage behaviour of the pools has occurred. Water levels in a number of pools (i.e. Pools ETAG, ETAH, ETAI, ETAQ and ETAU) have also been monitored using a continuous water level sensor and logger.

As at December 2016, changes in the natural drainage behaviour of pools downstream of the Longwall 26 maingate had been observed at Pools ETAH, ETAI, ETAJ, ETAK, ETAL, ETAM, ETAN and ETAR (location of pools shown in Appendix D). [The Longwalls 23-27 Water Management Plan indicated that the valley closure subsidence predictions would likely result in the cracking and dilation of bedrock resulting in the localised diversion of flow at Pools ETAH, ETAI, ETAJ, ETAK and ETAL.]

In January 2017, the natural drainage behaviour of additional pools on the Eastern Tributary was observed to be impacted by mine subsidence. The water levels in Pools ETAG to ETAR have been impacted by mine subsidence. The observed impacts to the Eastern Tributary pools in December 2016/January 2017 resulted in the exceedance of the negligible environmental consequences performance measure for the Eastern Tributary in relation to diversion of flows and drainage behaviour. The exceedance of this component of the Eastern Tributary performance measure was reported to the DP&E and other relevant agencies as described in Section 13.1.

In accordance with Section 9 (Contingency Plan) of the Metropolitan Coal Longwalls 23-27 Water Management Plan, Metropolitan Coal provided the DP&E (21 February 2017) with a proposed course of action in relation to the exceedance of the watercourse performance measure for the Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26. The proposed course of action is focussed on the implementation of stream remediation measures.

In accordance with the proposed course of action, Metropolitan Coal conducted an aerial LiDAR survey of the Eastern Tributary in April 2017 to inform the preparation of the detailed stream remediation plans and commissioned Golder Associates to prepare detailed stream remediation plans for pools on the Eastern Tributary. Metropolitan Coal considered the full range of available techniques in the design of stream remediation programs for individual rock bars on the Eastern Tributary. The injection of polyurethane (PUR) grouting products was considered to be the most appropriate technique for the stream remediation program.

During the review period, Metropolitan Coal commenced the review and revision of the Metropolitan Coal Rehabilitation Management Plan. The Metropolitan Coal Rehabilitation Management Plan includes the draft stream remediation plans and will be provided to the DRG, DP&E and other relevant agencies for review and comment in the next reporting period.

In the next reporting period, Metropolitan Coal propose to conduct stream remediation on the Eastern Tributary at Pool ETO (immediately upstream of the Fire Road 9J crossing and upstream of the Longwall 26 maingate), followed by stream remediation at Pools ETAH and ETAK.

10.4 CATCHMENT IMPROVEMENT WORKS

Two Rehabilitation Projects have been conducted in accordance with Condition 5(b), Schedule 6 of the Project Approval which requires Metropolitan Coal to carry out catchment improvement works in the Woronora catchment area. The catchment improvement works include:

- the rehabilitation of a former quarry on Fire Road 9H; and
- the rehabilitation of a disused access track to the Darkes Forest Mine (a historic mine located to the south of Metropolitan Coal).

Rehabilitation activities at the former quarry on Fire Road 9H during the review period included supplementary brush matting in areas of low regeneration potential and the direct seeding of local native plant species. Weed control activities at the former quarry and along of Fire Road 9H were also undertaken.

Rehabilitation activities along the disused access track to the Darkes Forest Mine during the review period included supplementary brush matting and weed control measures targeting Crofton Weed (*Ageratina adenophora*), Fleabane (*Conyza spp.*), Whiskey Grass (*Andropogon virginicus*) and introduced grass species.

Additional catchment improvement works conducted by Metropolitan Coal during the review period included the implementation of weed control measures along Fire Road 9J targeting Crofton Weed, Fleabane, Scotch Thistle (*Onopordum acanthium*) and Whiskey Grass.

10.5 ASSESSMENT OF ENVIRONMENTAL PERFORMANCE

An assessment of the environmental performance of rehabilitation management during the review period is provided in Table 20.

Table 20
Assessment of Environmental Performance – Rehabilitation

Monitoring Component		Performance Indicator, Rehabilitation Objective and/or Project Approval Condition	Indicator, Objective or Condition Met?	Comments
Other land affected by the Project Performance Indicator		*Redundant equipment/infrastructure items have been removed.* *The site is neat and tidy (i.e. it does not contain any rubbish).* *No weed management measures are required.* *No erosion or sediment control measures are required.* *Where appropriate, native vegetation is naturally regenerating or active revegetation is establishing.* *No further active revegetation measures are required.*	Not currently applicable	Not currently applicable during the review period as no rehabilitation of surface distribution areas in the underground mining area has been conducted. Once a surface disturbance area is no longer being utilised, Metropolitan Coal will use the Rehabilitation Management Plan – Surface Disturbance Register to monitor the performance of the measures implemented to rehabilitate surface disturbance areas.
Stream Remediation Performance Indicator		*Analysis of water level recession rates for a pool indicates a similar pool behaviour to that which existed prior to being impacted by subsidence.*	To be determined	While stream remediation activities have been conducted at Pools A, F and G on the Waratah Rivulet, assessment against the rehabilitation performance indicator has not been made to date. Assessment following the stream remediation works was delayed until a significant period of drier climatic conditions had been experienced.
Rehabilitation Objectives (Project Approval Table 11, Condition 1 Schedule 6)	*Surface Facilities Area*	*Set through condition 2 below.*	Yes	The rehabilitation objective for the surface facilities area is addressed in the Metropolitan Coal Rehabilitation Strategy.
	Waratah Rivulet, between the downstream edge of Flat Rock Swamp and the full supply level of the Woronora Reservoir	*Restore surface flow and pool holding capacity as soon as reasonably practicable.*	To be determined	Metropolitan Coal will assess surface flow and pool holding capacity using the results of the assessment of the stream remediation performance indicator for the completed stream remediation activities at Pools A, F and G once a significant period of drier climatic conditions has been experienced.
	Eastern Tributary, between the maingate of Longwall 26 and the full supply level of the Woronora Reservoir		To be determined	Draft stream remediation plans for individual rock bars on the Eastern Tributary have been prepared as a component of the revised draft Metropolitan Coal Rehabilitation Management Plan (as described in Section 10.3.2).
	Cliffs	*Ensure that there is no safety hazard beyond that existing prior to mining.*	Yes	No safety hazard associated with cliffs was identified during the review period.
	Other land affected by the Project	*Restore ecosystem function, including maintaining or establishing self sustaining native ecosystems:* • *comprised of local native plant species; with* • *a landform consistent with the surrounding environment.*	Not currently applicable	The Rehabilitation Management Plan – Surface Disturbance Register will be used to manage the implementation of rehabilitation measures. The performance indicator for other land affected by the Project will be used to monitor the performance of rehabilitation measures being implemented.

Table 20 (Continued)
Assessment of Environmental Performance – Rehabilitation

Monitoring Component		Performance Indicator, Rehabilitation Objective and/or Project Approval Condition	Indicator, Objective or Condition Met?	Comments
Rehabilitation Objectives (Project Approval Table 11, Condition 1 Schedule 6) (Continued)	*Built features*	*Repair/restore to pre-mining condition or equivalent.*	Yes	Assessed through the Metropolitan Coal Built Features Management Plans. No impacts to built features were recorded during the review period.
	Community	*Minimise the adverse socio-economic effects associated with mine closure including the reduction in local and regional employment.*	Not currently applicable	The socio-economic effects associated with mine closure will be addressed in the Metropolitan Coal Mine Closure Plan and will be considered in consultation with the local community (through the Community Consultative Committee [CCC]) when determining the final landuse option.
		Ensure public safety.	Yes	Assessed through the Metropolitan Coal Public Safety Management Plan for the underground mining area and in the Metropolitan Coal Rehabilitation Strategy for the surface facilities area.
Rehabilitation Strategy – Surface Facilities Area (Project Approval Condition 2, Schedule 6)		*2. By the end of October 2011, the Proponent shall prepare a Rehabilitation Strategy for the surface facilities area to the satisfaction of the Director-General. This strategy must:* *(a) be prepared by a team of suitably qualified and experienced experts whose appointment has been endorsed by the Director-General;* *(b) be prepared in consultation with relevant stakeholders, including the WCC and the CCC;* *(c) investigate options for the future use of the area upon the completion of mining;* *(d) describe and justify the proposed rehabilitation strategy for the area; and* *(e) define the rehabilitation objectives for the area, as well as the proposed completion criteria for this rehabilitation.*	Yes	-
Progressive Rehabilitation (Project Approval Condition 3, Schedule 6)		*3. To the extent that mining operations permit, the Proponent shall carry out rehabilitation progressively, that is, as soon as reasonably practicable following the disturbance.*	Yes	-

Table 20 (Continued)
Assessment of Environmental Performance – Rehabilitation

Monitoring Component	Performance Indicator, Rehabilitation Objective and/or Project Approval Condition	Indicator, Objective or Condition Met?	Comments
Rehabilitation Management Plan (Project Approval Condition 4, Schedule 6)	*4. The Proponent shall prepare and implement a Rehabilitation Management Plan for the project to the satisfaction of the Executive Director Mineral Resources. This plan must be prepared in consultation with the relevant stakeholders, and submitted to DRE for approval prior to carrying out any second workings in the mining area.* *Note: In accordance with condition 12 of schedule 2, the preparation and implementation of Rehabilitation Management Plans is likely to be staged, with each plan covering a defined area (or domain) for rehabilitation. In addition, while mining operations are being carried out, some of the proposed remediation or rehabilitation measures may be included in the detailed management plans that form part of the Extraction Plan. If this is the case, however, then the Proponent will be required to ensure that there is good cross-referencing between the various management plans.*	Yes	-
Catchment Improvement Works (Project Approval Condition 5, Schedule 6)	*5. The Proponent shall:* *(a) pay SCA $100,000 by the end of 2011 to carry out catchment improvement works within the Woronora catchment area; or* *(b) carry out catchment improvement works within this area that have an equivalent value to the satisfaction of SCA.*	Yes	Metropolitan Coal conducts catchment improvement works in the Woronora catchment area in accordance with Condition 5(b), Schedule 6 of the Project Approval (refer Section 10.4).
Offsets (Project Approval Condition 6, Schedule 6)	*6. If the Proponent exceeds the performance measures in Table 1 of this approval, and either* *(a) The contingency measures implemented by the Proponent have failed to remediate the impact; or* *(b) The Director-General determines that it is not reasonable or feasible to remediate the impact,* *then the Proponent shall provide a suitable offset to compensate for the impact to the satisfaction of the Director-General.* *Note: Any offsets required under this condition must be proportionate with the significance of the impact.*	To be determined	In October 2016 Metropolitan Coal identified the subsidence impact performance measure for the Eastern Tributary, between the full supply level of the Woronora Reservoir and the Longwall 26 maingate in Table 1, Condition 1, Schedule 2 of the Project Approval had been exceeded in relation to iron staining. In early 2017 the same performance measure was identified as being exceeded in relation to pool drainage behaviour (refer to Sections 6.2, 10.3 and 13.1). Metropolitan Coal proposed to conduct stream remediation measures on the Eastern Tributary in accordance with the Longwalls 23-27 Water Management Plan Contingency Plan.

11 COMMUNITY

Metropolitan Coal engages with the Helensburgh community and strives to maintain positive relationships with stakeholders given the extensive history shared between the mine and township. Generations of locals have worked at the mine and it is widely accepted that the operation is an integral component of the Helensburgh community.

The majority of workers reside in the local area or within 50 km of the mine. As far as practicable, the mine seeks to employ local contractors, supply companies and services during the course of its operations.

Metropolitan Coal has also continued to provide sponsorship and/or donations to the local community during the review period. Metropolitan Coal's proactive community engagement program aims to work in partnership with the community for mutually beneficial and sustainable outcomes, and achieves this through the development of specific community programs as discussed below.

11.1 COMMUNITY ENGAGEMENT ACTIVITES AND INITIATIVES

Community Consultative Committee

Three Community Consultative Committee (CCC) meetings were held during the review period (19 April, 9 August and 13 December 2017). These meetings facilitated Metropolitan Coal consultation and engagement with community members on matters of general business and the environmental performance of the operation. Discussions during the review period included the Longwalls 301-303 Extraction Plan, monitoring of the Eastern Tributary, groundwater monitoring, noise mitigation, trucking movements and community funding.

A report on the progress of the CCC in 2017 was provided to the Secretary of the DP&E on 12 February 2018 and a copy of the letter is provided as Appendix O.

Community and Environment Newsletters

Metropolitan Coal distributed a Community Newsletter in August 2017 (via letterbox drop) to provide an update on Metropolitan Coal's operations and mine activities. The newsletter included an operations update, employment of local community members, the rehabilitation of surface areas and reduction in truck movements through Helensburgh.

The newsletter included relevant contact details of the CCC, and reference to the Peabody Metropolitan Coal website and 24-hour Community Line to facilitate further communication with the community.

11.2 COMMUNITY CONTRIBUTIONS

In addition to the community engagement activities and initiatives discussed above, Metropolitan Coal has made a number of significant donations to support the community of Helensburgh and the greater Illawarra region throughout 2017. All donation requests were assessed on their individual merit and funding was distributed accordingly.

In total, community donations and sponsorship during 2017 amounted to over $80,000 and included the following:

- Donation to the Era Surf Life Saving Club.
- Donation to the Helensburgh Stanwell Park Surf Life Saving Club.

- Donation to the Helensburgh Christmas Carols Fireworks display.
- Donation to the Helensburgh Tigers Rugby League Club.
- Donation to the Helensburgh Tigers Junior Rugby League Club.
- Ongoing sponsorship of the Helensburgh Public School and Holy Cross Primary School environment programs.
- Donation to the Otford Public School for their Colour Run fundraiser.
- Donation to the Rotary Club of Fairy Meadow for the Razzamatazz Annual Children's Festival.
- Donation to the Helensburgh Santa's Fire Truck Christmas Event.
- Donation to the Lions Club of Woonona for their World Festival of Magic fundraiser.
- Ongoing Sponsorship of local BMX athletes.
- Sponsorship of Metropolitan Coal employee's participation in the TourXOz Ride Event raising funds for the Black Dog Institute.

11.3 COMMUNITY COMPLAINTS

A protocol for the management and reporting of complaints has been developed as a component of Metropolitan Coal's Environmental Management Strategy. A dedicated telephone number for the provision of comments or complaints is maintained by Metropolitan Coal (1800 115 003) and is displayed on signage at an entrance to the mine. Metropolitan Coal records and responds to all complaints and maintains a complaints register on its website.

During the review period, one complaint was received in November 2017 from a Helensburgh resident regarding noise levels during early morning loading of a train on the weekend (25-26 November 2017). Metropolitan Coal confirmed that loading was undertaken in accordance with current best practice (an experienced loader operator using noise mitigated loaders). Metropolitan Coal also conducted an investigation of the factors that may have contributed to elevated noise levels on the weekend in question. Metropolitan Coal communicated results of the investigation to the resident.

Metropolitan Coal is investigating the implementation of a coal wagon profiler, which has the potential to reduce train loading noise.

A summary of community complaints received since January 2006 is provided on Figure 24. Very few complaints have been received on an annual basis since the Project was approved in June 2009, and have typically related to noise, dust and/or traffic.

12 INDEPENDENT ENVIRONMENTAL AUDIT

In accordance with Condition 8, Schedule 7 of the Project Approval, an Independent Environmental Audit of the Project is to be commissioned by the end of December 2011, and every 3 years thereafter, and be conducted by a team of experienced and independent experts endorsed by the Director-General (now Secretary) of Planning.

Two Independent Environmental Audits have been completed to date (as reported in previous Annual Reviews).

The next Independent Environmental Audit was commissioned by 31 December 2017 and will be submitted to the DP&E by 30 June 2018.

13 INCIDENTS AND NON-COMPLIANCES DURING THE REPORTING PERIOD

13.1 EASTERN TRIBUTARY PERFORMANCE MEASURE

The Metropolitan Coal Project Approval (08_0149) requires Metropolitan Coal not to exceed the subsidence impact performance measures outlined in Table 1 of Condition 1, Schedule 3.

The subsidence impact performance measure for the Eastern Tributary watercourse is:

> *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)*

Monitoring conducted in accordance with the Metropolitan Coal Longwalls 23-27 Water Management Plan identified that the Eastern Tributary watercourse performance measure for the Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26 was exceeded in relation to *minimal iron staining* in the previous review period. The exceedance was reported to the Secretary of the DP&E and other relevant agencies on the 14 October 2016 in accordance with Condition 6, Schedule 7 of the Project Approval and the Metropolitan Coal Longwalls 23-27 Water Management Plan Contingency Plan.

The *no diversion of flows, no change in the natural drainage behaviour of pools* component of the Eastern Tributary subsidence impact performance measure was exceeded in January 2017 and reported to the DP&E and other relevant agencies.

In February 2017 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 the proposed course of action, Metropolitan Coal conducted an aerial LiDAR survey of the Eastern Tributary in April 2017 to inform the preparation of the detailed stream remediation plans and commissioned Golder Associates to prepare detailed stream remediation plans for pools on the Eastern Tributary.

During the review period, Metropolitan Coal commenced the review and revision of the Metropolitan Coal Rehabilitation Management Plan. The Metropolitan Coal Rehabilitation Management Plan includes the draft stream remediation plans and will be provided to the DRG, DP&E and other relevant agencies for review and comment in the next reporting period.

13.2 NOISE

Sustained Non-compliances – Attended Noise Monitoring and Modelling

Conclusive identification of the Quarter 1 and 2 conditional sustained noise non-compliances in 2017 were not determined until Quarter 1 of 2018. The Quarter 4 conditional sustained non-compliance was identified in Quarter 4.

As described in Section 7.1, during 2017 Metropolitan Coal identified conditional sustained non-compliances at one representative noise monitoring location (16 Oxley Place) with respect to the Noise Impact Assessment Criteria (Condition 1, Schedule 4 of the Project Approval).

As part of the Noise Mitigation Strategy and as a result of the continuation of the monitored non-compliances, modelling of predicted noise levels for nearby residences was conducted and identified non-compliances with respect to the Noise Impact Assessment Criteria at 10 residences (nine residences in Oxley Place and one residence on Parkes Street) and conditional compliances at five residences (three residences in Oxley Place and two residences on Parkes Street) during the day-time, evening and night-time. The modelling also predicted that nine private residences in Oxley Place also experienced exceedances of the Noise Mitigation Criteria (Condition 3, Schedule 4 of the Project Approval) and four of the private residences in Oxley Place were predicted to experience exceedances of the Noise Acquisition Criteria (Condition 2, Schedule 4 of the Project Approval) (it is noted these residences were predicted to exceed the criteria by 1 dBA).

It is noted that the locations predicted to experience non-compliances were experiencing daytime, evening and night-time operational noise levels from the Metropolitan Coal Mine prior to the approval of the Project in June 2009 that were materially higher than the levels recorded in the current review period, and a range of operational noise control measures have been implemented since Project Approval (Section 7.1).

It should also be noted that all of the residences predicted to be experiencing sustained exceedances of the Noise Mitigation Criteria have previously been offered noise mitigation measures on a voluntary basis by Metropolitan Coal (in the form of double glazing). Of the nine residences, only two did not accept the previous offer by Metropolitan Coal (Appendix M).

The extensive and long running noise control program at Metropolitan Coal has reduced noise emissions at nearby residences, however, the number of remaining material, reasonable and feasible noise controls is diminishing and the Noise Impact Assessment Criteria may not be achievable in the medium to long term.

During the review period, in consultation with the DP&E, Metropolitan Coal prepared a technical review of remaining available feasible noise mitigation measures and an associated evaluation of the reasonableness of these options. This assessment was independently peer reviewed.

Following DP&E's review of the Noise Mitigation Strategy, Metropolitan Coal signed a Voluntary Undertaking which formalised the implementation of the mitigation measures identified by the Mitigation Strategy. The Voluntary Undertaking also outlined a process for re-assessing predicted noise levels and reasonable and feasible noise controls in accordance with the Noise Policy for Industry released in 2017.

Metropolitan Coal anticipates that, during implementation of the Voluntary Undertaking, sustained non-compliances with respect to the Noise Impact Assessment Criteria and, to a lesser extent, exceedances of the Noise Mitigation Criteria, will continue to be observed. Metropolitan Coal will continue to consult with the DP&E, DRG, EPA and the local community and implement all identified reasonable and feasible mitigation options.

Reporting and Notification of Noise Exceedances

Metropolitan Coal has identified an administrative non-compliance with respect to the associated Notification of Landowners (Condition 1, Schedule 5 of the Project Approval). Due to the delay in identifying exceedances of the Noise Impact Assessment Criteria, notifications were not made within the timeframe specified in Condition 1, Schedule 5.

In March 2018 (i.e. following conclusive identification of the sustained conditional non-compliances), Metropolitan Coal notified a number of nearby residents that noise modelling predicted are experiencing noise levels exceeding the Noise Impact Assessment Criteria contained in the Project Approval. Residences predicted to experience non-compliances or conditional compliances based on the most recent noise modelling were notified. The notifications also advised the residents of the current process underway to re-evaluate noise impacts under the new Noise Policy for Industry (Section 14).

During the next reporting period, Metropolitan Coal will continue to consult with the DP&E, DRG and EPA and will continue to notify relevant residences.

14 ACTIVITIES PROPOSED IN THE NEXT REPORTING PERIOD

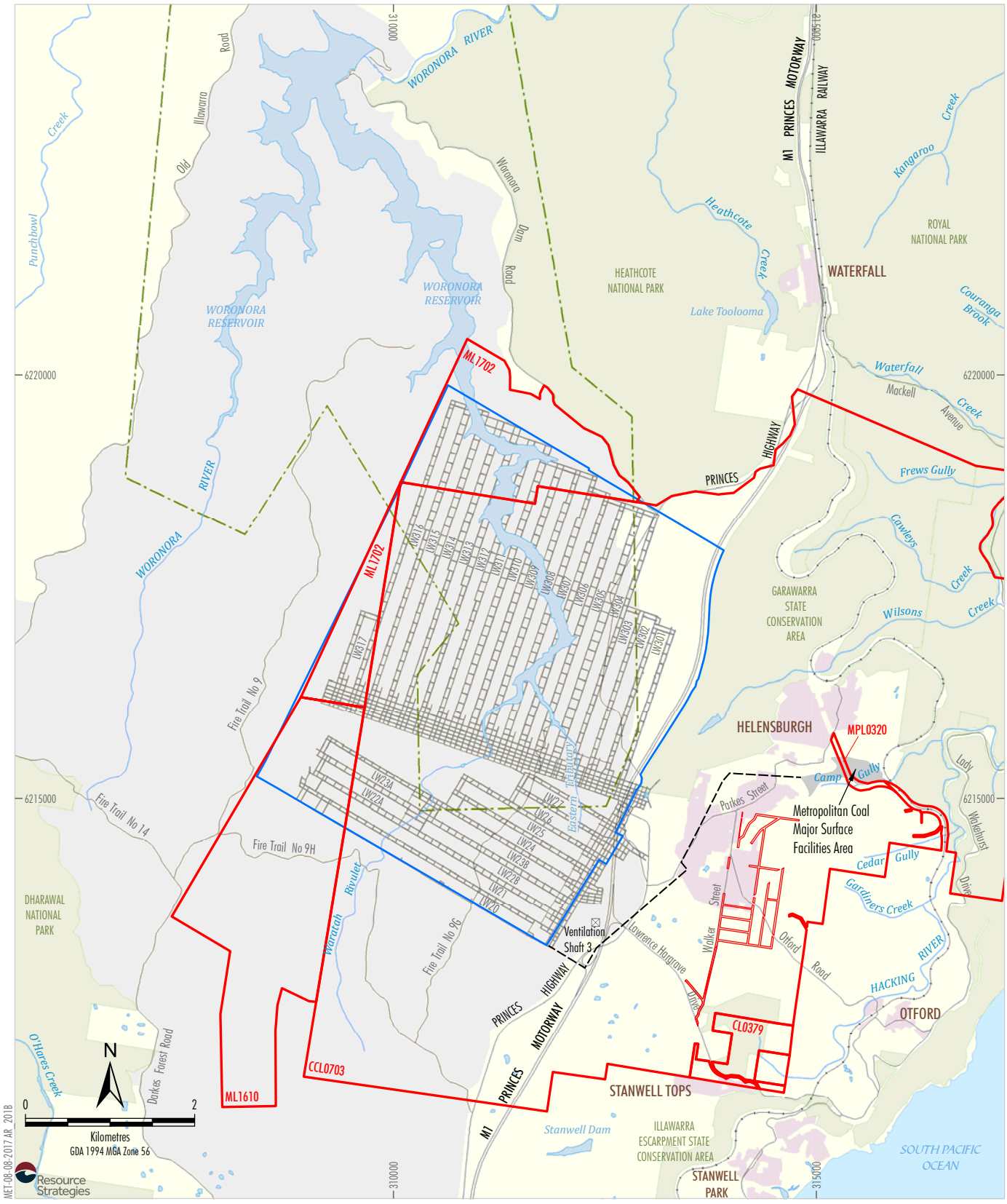
In the next reporting period, Longwall 301 will be completed in February 2018 and Longwall 302 will commence in March 2018 (Figure 5).

In the next reporting period, the following activities will be conducted:

- Longwall 301 will be completed in February 2018 and Longwall 302 will commence in March 2018.
- Metropolitan Coal will prepare and consult with stakeholders in relation to the Longwalls 304-306 Extraction Plan throughout 2018.
- Metropolitan Coal will finalise and submit the revised Metropolitan Coal Environmental Management Strategy, Metropolitan Coal Catchment Monitoring Program and Metropolitan Coal Construction Management Plan to the DP&E for approval by April 2018.
- Metropolitan Coal will trial the effectiveness of the LiDAR survey as a subsidence survey technique compared to traditional subsidence survey techniques following the extraction of Longwall 301 (anticipated to occur by July 2018).
- As a result of the Noise Mitigation Assessment and commencement of the Voluntary Undertaking throughout 2018:
  - All crusher and washer doors will be closed at all times (except when being accessed).
  - The existing idlers on all surface conveyors will be progressively replaced with low noise idlers.
  - Metropolitan Coal will comply with the requirements of the Voluntary Undertaking, including the commencement and completion of a noise assessment (to be completed by late April 2018) under the Noise Policy for Industry to assess options for consideration by the DP&E to achieve compliance for the Project.
  - Metropolitan Coal will continue to consult with the DP&E, DRG and EPA and to notify relevant residences of noise exceedances.
  - Metropolitan Coal will implement a coal wagon profiler, which has the potential to reduce train loading noise (installation anticipated to occur by June 2018).
- Metropolitan Coal will continue its ongoing consultation with the Wollongong City Council regarding the potential for coal rejects to be beneficially re-used at the Helensburgh Landfill.
- The coal reject backfill emplacement project will also continue throughout 2018.
- Metropolitan Coal will seek to consult with the Wollongong City Council in relation to the road safety report completed for the Mine Access Road and Parkes Street intersection by June 2018.

- Metropolitan Coal will install the two gauging stations (at sub-catchments I and K) and the pluviometer over the 300 series longwalls, additional deep groundwater bores over Longwall 303 and coal exploration holes by May 2018.
- Metropolitan Coal will also prepare Surface Works Assessment Forms and install additional upland swamp groundwater piezometers in swamps over and/or proximal to Longwalls 304-306 by June 2018.
- Metropolitan Coal will continue to revegetate/rehabilitate the outer batters of the Turkey's Nest Dam.
- Metropolitan Coal will provide the revised draft Rehabilitation Management Plan, including the draft stream remediation plans for the Eastern Tributary to stakeholders for review and comment by April 2018.
- Metropolitan Coal propose to conduct stream remediation on the Eastern Tributary at Pool ETO (immediately upstream of the Fire Road 9J crossing and upstream of the Longwall 26 maingate), followed by stream remediation at Pools ETAH and ETAK.
- Catchment improvement works will continue in the Woronora catchment area, namely, rehabilitation of the former quarry on Fire Road 9H and rehabilitation of the disused access track to the Darkes Forest Mine. Weather permitting, catchment improvement works in the Woronora catchment area will be undertaken as required throughout 2018.

FIGURES



LEGEND

- Mining Lease Boundary
- Woronora Special Area
- Railway
- Project Underground Mining Area
  Longwalls 20-27 and 301-317
- Woronora Notification Area
- Existing Underground Access Drive (Main Drift)

Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2016); MSEC (2016)

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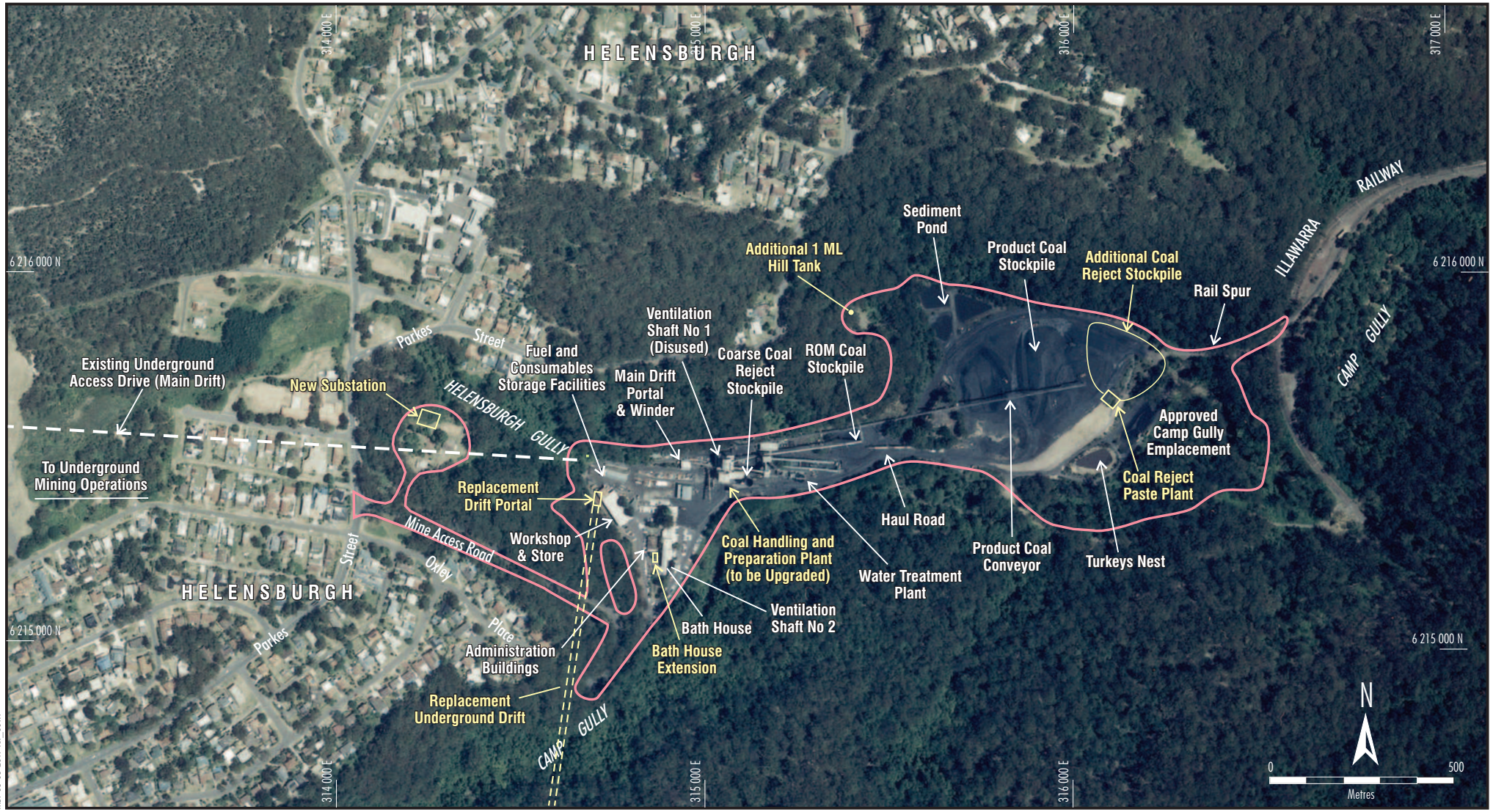
METROPOLITAN COAL

Project Longwalls 20-27 and Longwalls 301-317 Layout

Figure 1



MET-08-06-2017 AR_001A

LEGEND

Additional/Upgraded Project Infrastructure

Approximate Extent of Major Surface Facilities Area

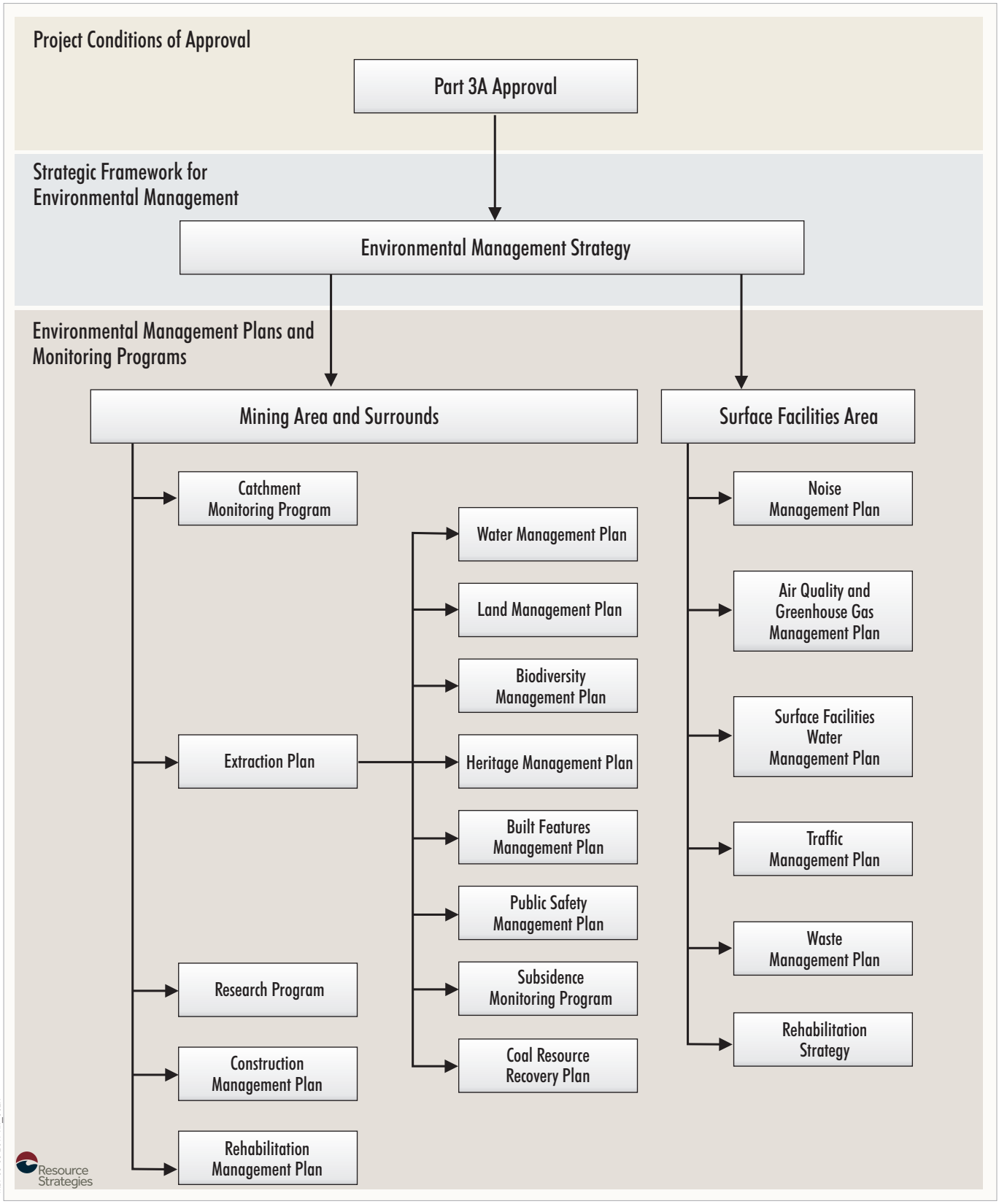
Source: Aerial Photography (2005)

Peabody

METROPOLITAN COAL

General Arrangement of the Major Surface Facilities Area

Figure 2



MET-08-08-2017 AR_002A

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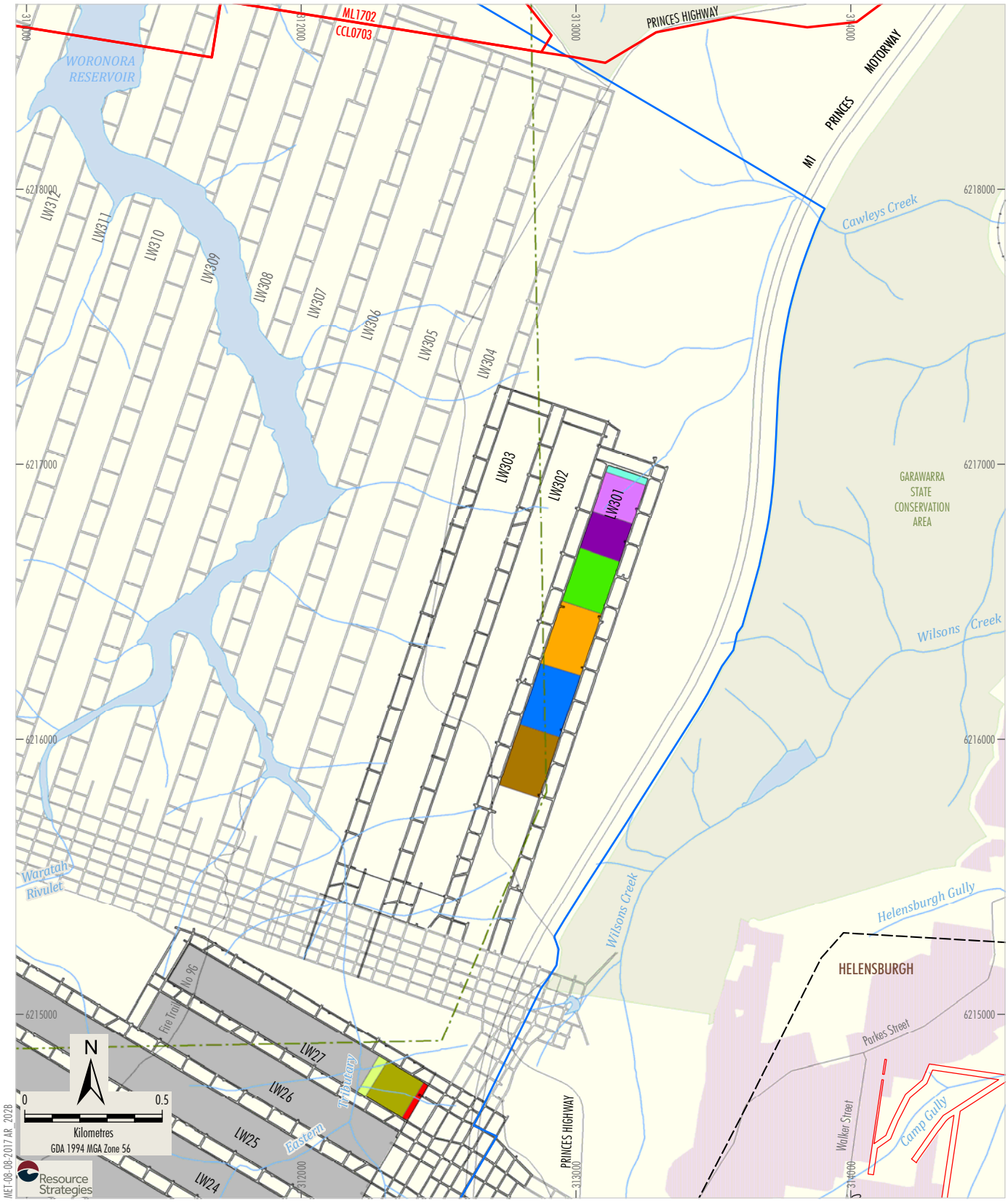
METROPOLITAN COAL

Environmental Management Structure

Figure 3



LEGEND

- Mining Lease Boundary
- Woronora Special Area
- Previous Extraction
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Woronora Notification Area
- Existing Underground Access Drive (Main Drift)

Monthly Development

- January
- February
- March
- June
- July
- August
- September
- October
- November
- December

Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2016); MSEC (2016)

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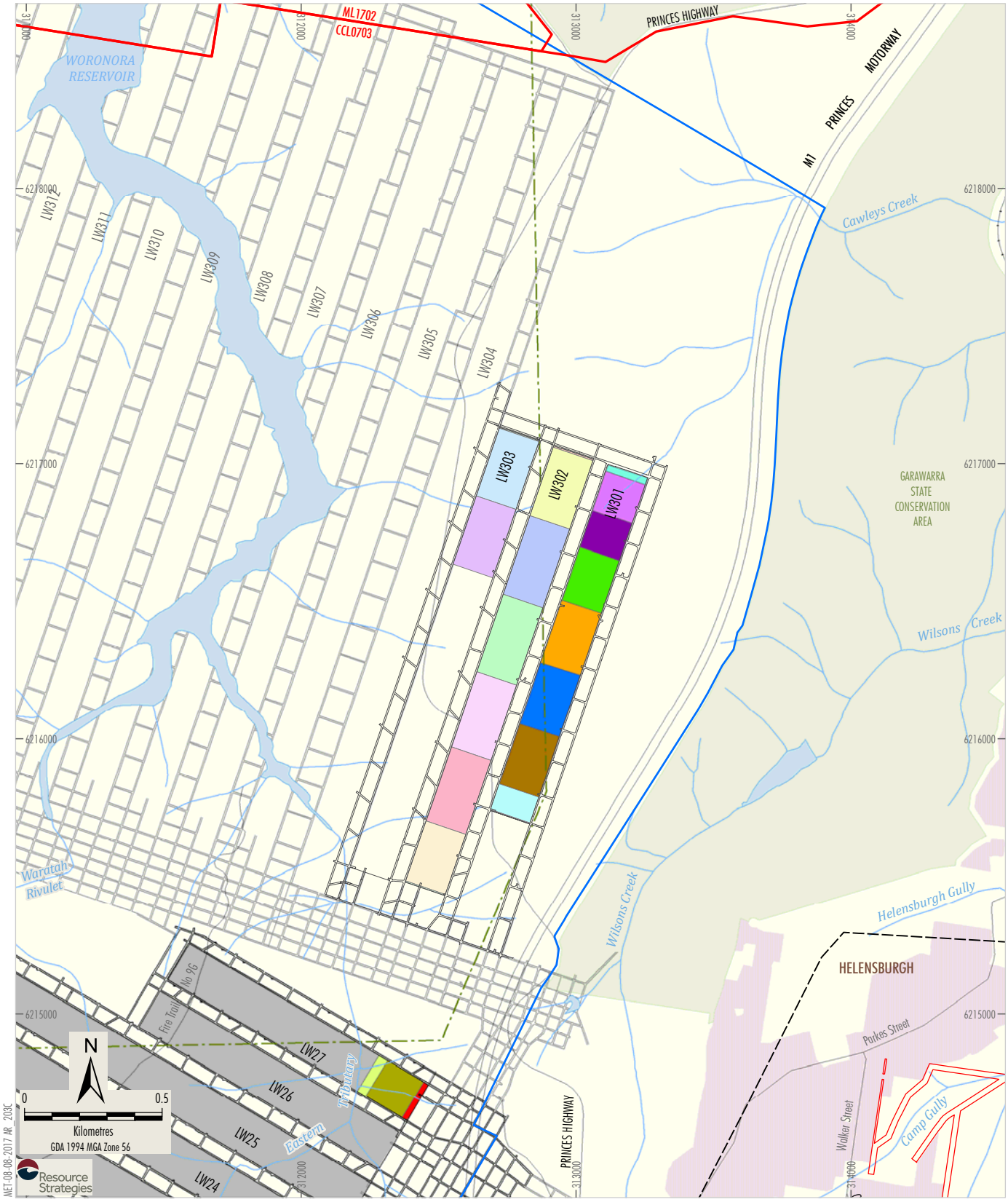
METROPOLITAN COAL

Monthly Production Plan
January to December 2017

Figure 4



LEGEND

- Mining Lease Boundary
- Previous Extraction
- Railway
- Project Underground Mining Area
  Longwalls 20-27 and 301-317
- Woronora Notification Area
- Existing Underground Access Drive (Main Drift)

Monthly Development 2017

- January
- February
- March
- June
- July
- August
- September
- October
- November
- December

Monthly Development 2018

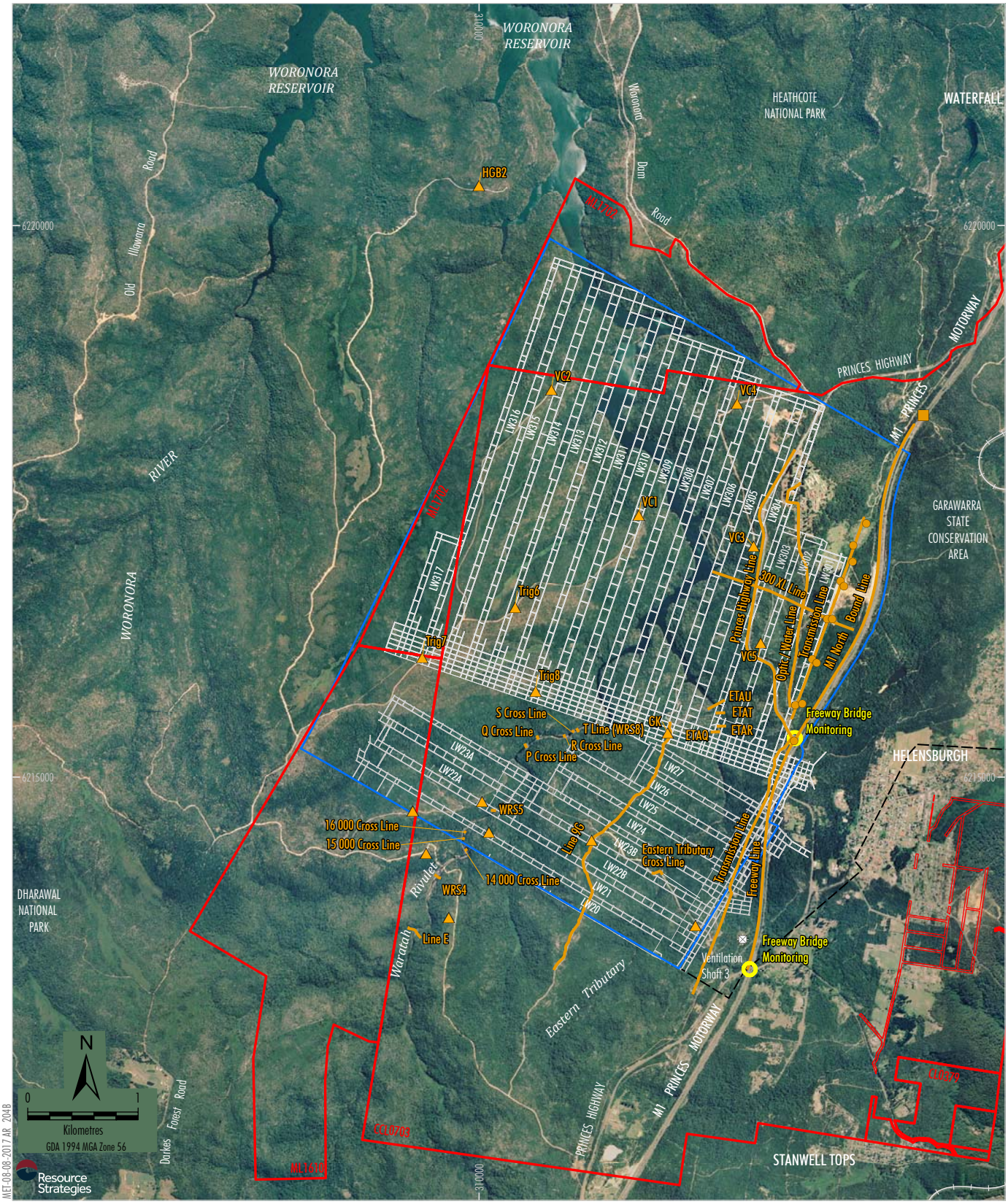
- January
- February
- March
- April
- May
- June
- July
- August
- September
- October
- November
- December

Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2016); MSEC (2016)

Peabody
METROPOLITAN COAL

Production Plan Forecast
January to December 2018

Figure 5



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)
- Ridge Survey Point
- Subsidence Line
- Freeway Bridge Subsidence Monitoring
- Cawley Road Overbridge
- Transmission Towers - Endeavour Energy and TransGrid

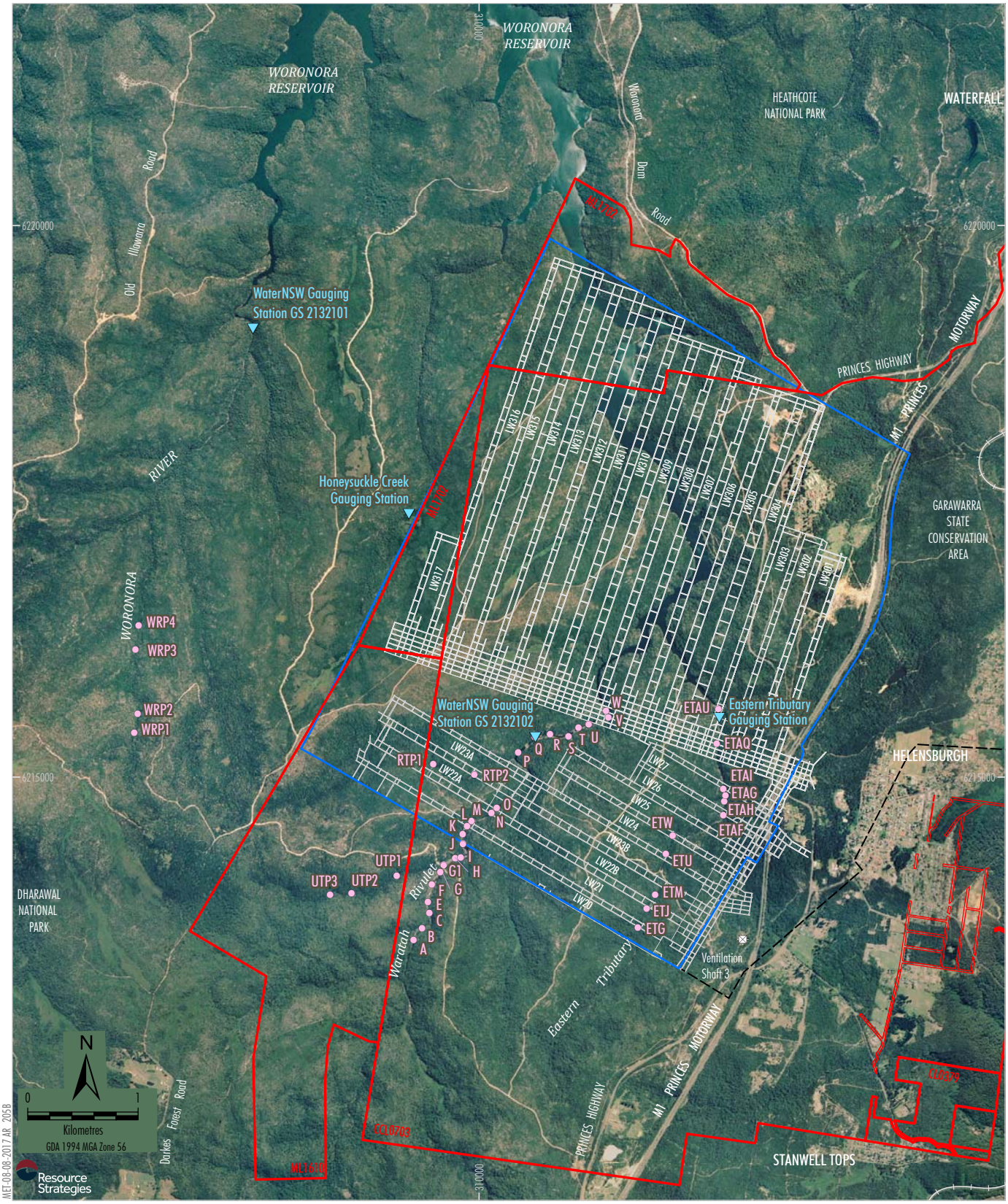
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2016); MSEC (2016)

Peabody

METROPOLITAN COAL

Subsidence Monitoring Locations

Figure 6



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area
  Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)
- Gauging Station
- Pool Water Level Site

Note: Pool numbering is consistent with the detailed stream mapping for Waratah Rivulet and the Eastern Tributary provided in WMP Appendices 1 to 4.

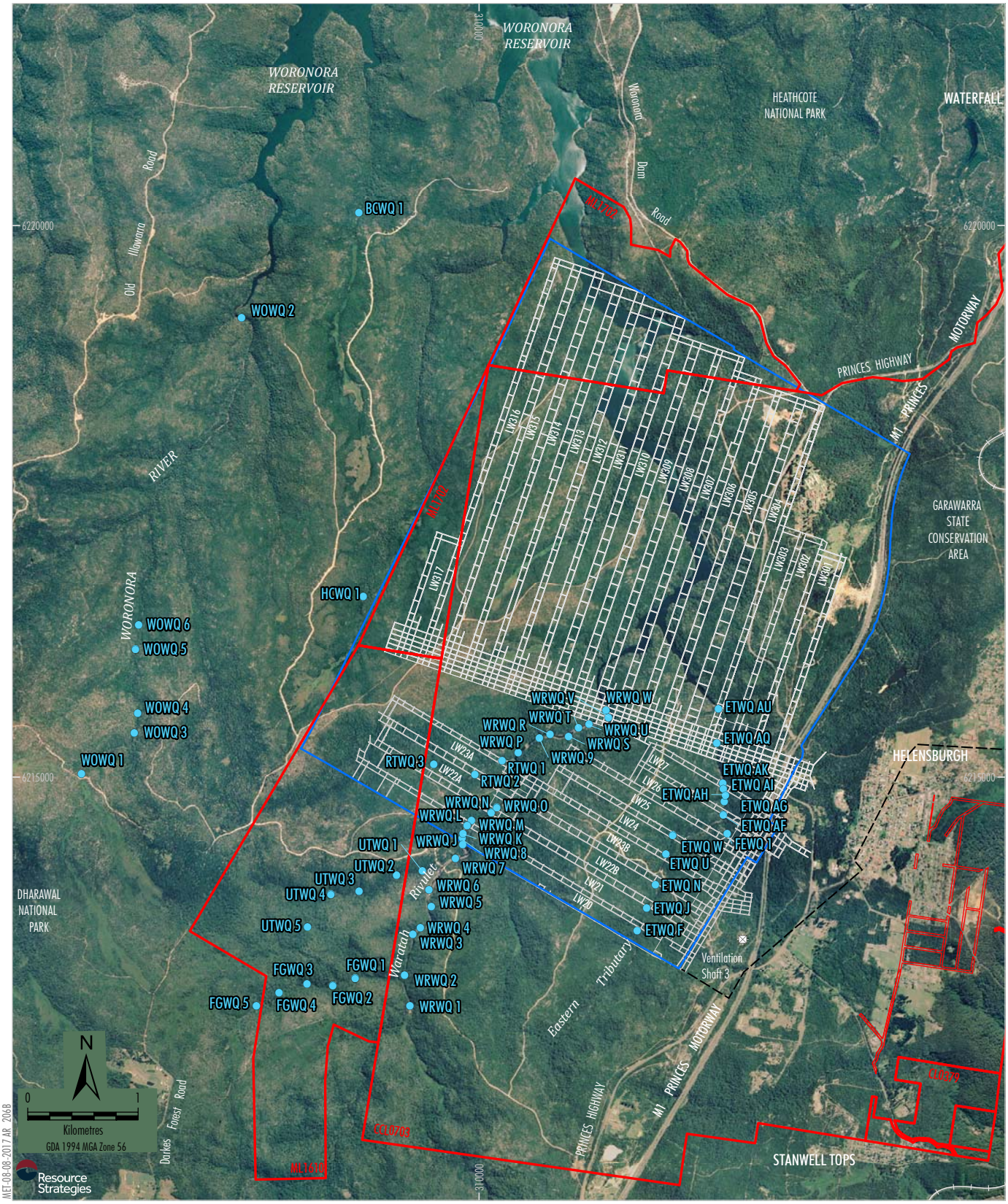
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2016); MSEC (2016)

Peabody

METROPOLITAN COAL

Surface Water Quantity Sites

Figure 7



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area
  Longwalls 20-27 and 301-317
- 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 (2016); MSEC (2016)

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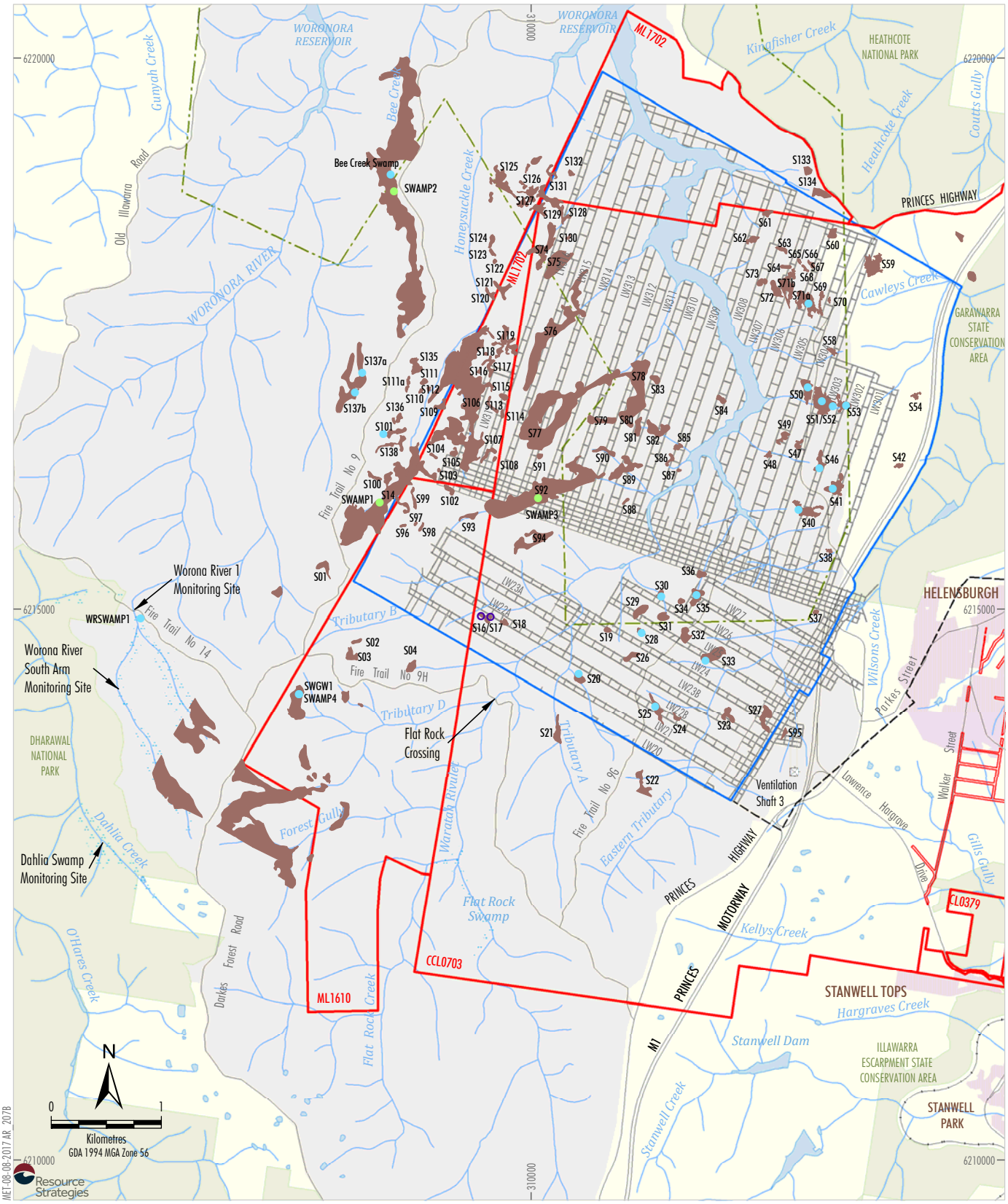
METROPOLITAN COAL

Surface Water Quality Sites

Figure 8



LEGEND

- Mining Lease Boundary
- Woronora Special Area
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Woronora Notification Area
- Existing Underground Access Drive (Main Drift)
- Upland Swamp
- Swamp Substrate and Shallow Groundwater Piezometer
- Swamp Substrate Groundwater Piezometer
- Swamp Shallow Groundwater Piezometer

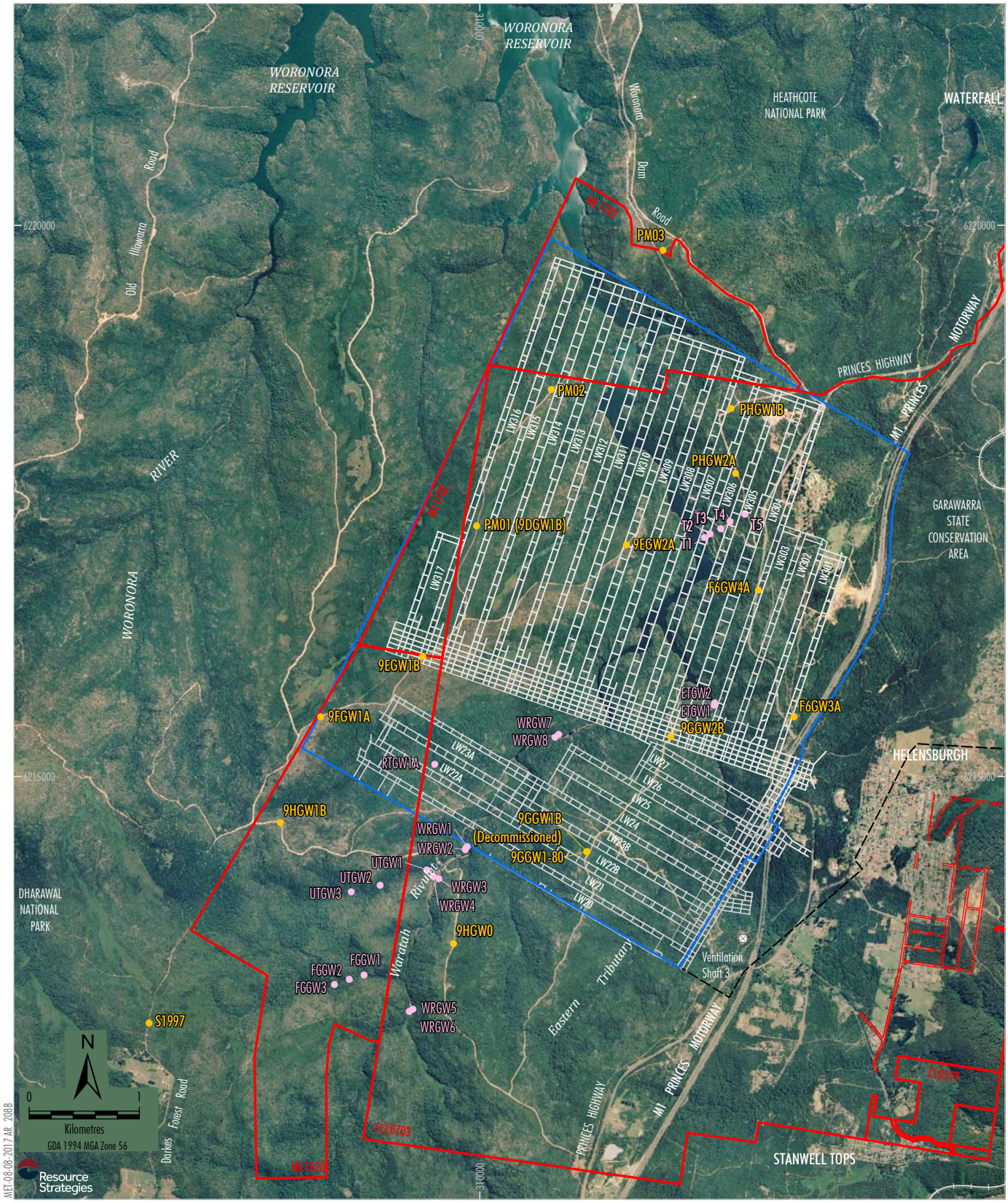
Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2016); MSEC (2016)

Peabody

METROPOLITAN COAL

Upland Swamp Groundwater Piezometer Locations

Figure 9



LEGEND

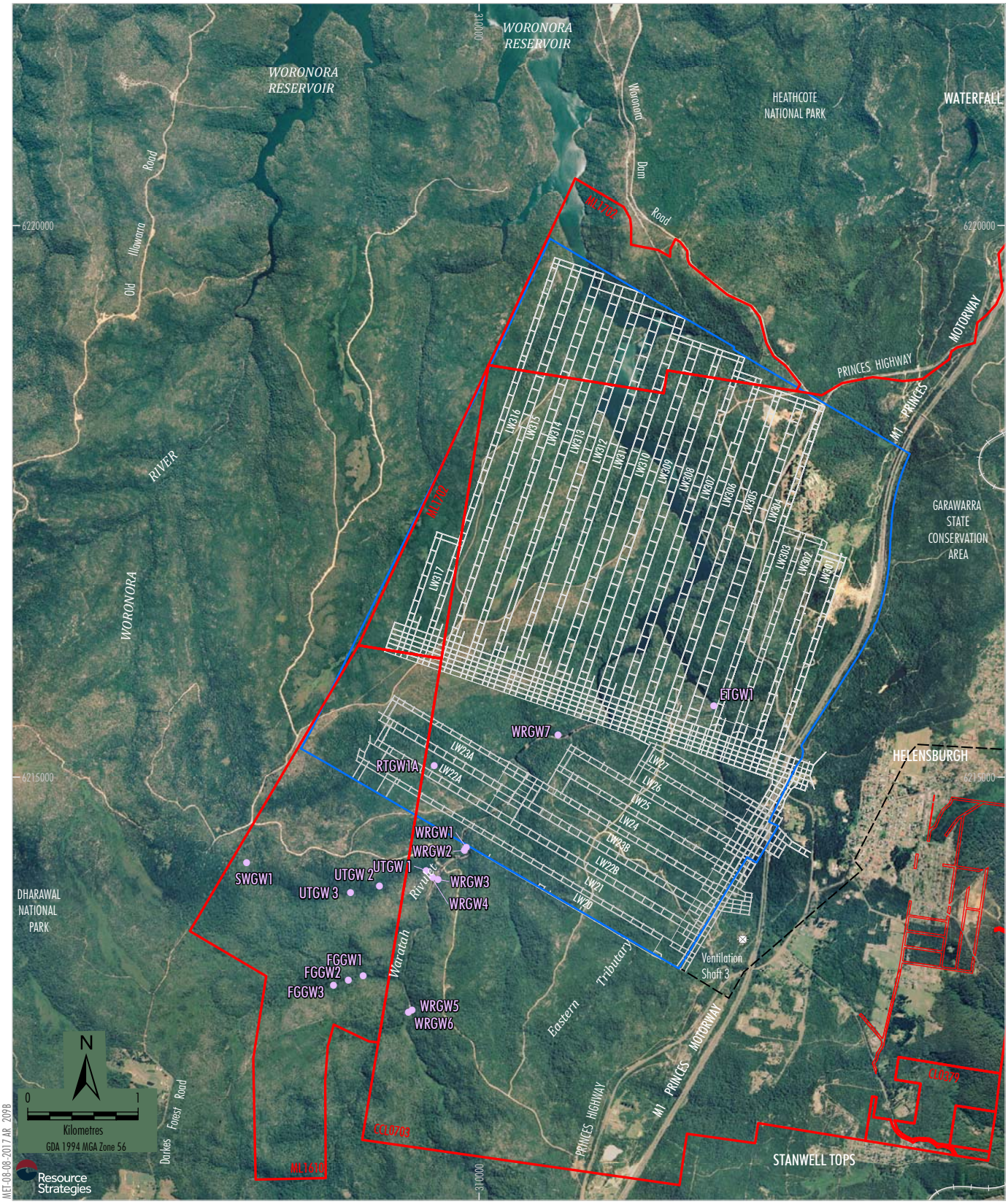
- Mining Lease Boundary
- Railway
- Project Underground Mining Area
  Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)
- Groundwater Level/Pressure Bore
- Groundwater Level Bore

Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2016); MSEC (2016)

Peabody
METROPOLITAN COAL

Groundwater Level and/or Pressure Bore Locations

Figure 10



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area
  Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)
- Shallow Groundwater Quality Site

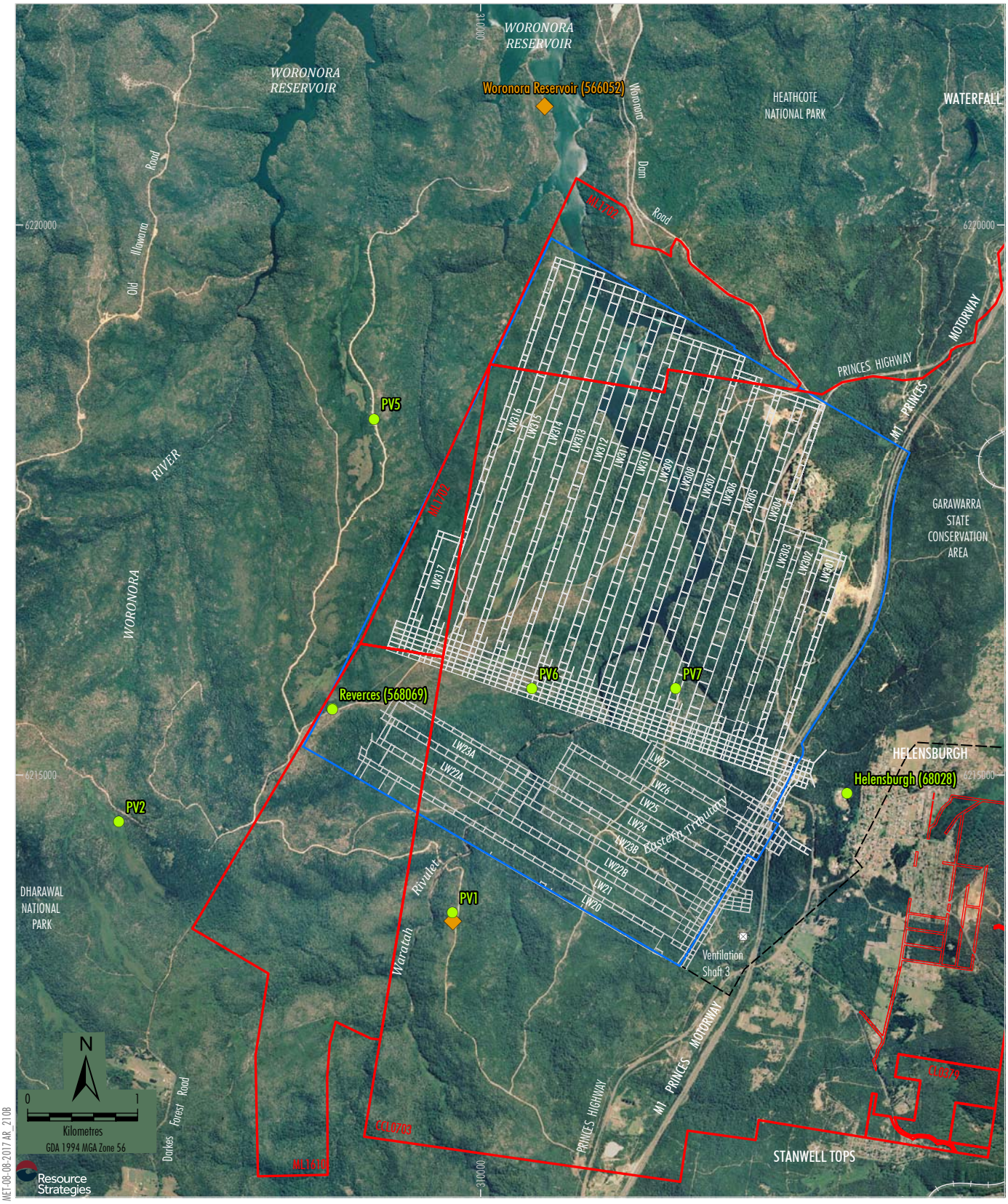
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2016); MSEC (2016)

Peabody

METROPOLITAN COAL

Shallow Groundwater Quality Sites

Figure 11



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)
- Evaporimeter
- Pluviometer

Note: 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).

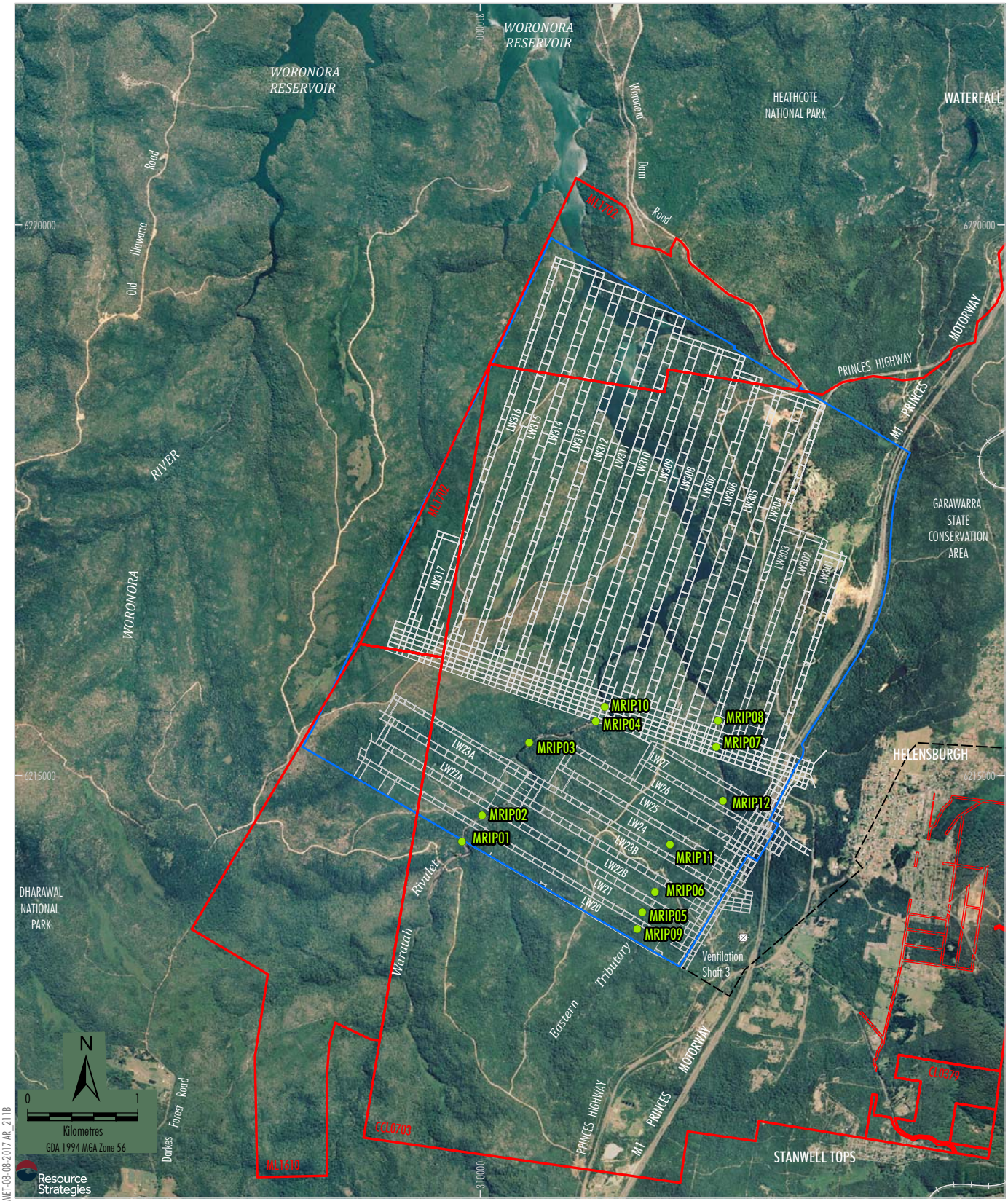
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2016); MSEC (2016)

Peabody

METROPOLITAN COAL

Meteorological Sites

Figure 12



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area
  Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)

Monitoring Site

- Riparian Vegetation Monitoring Site

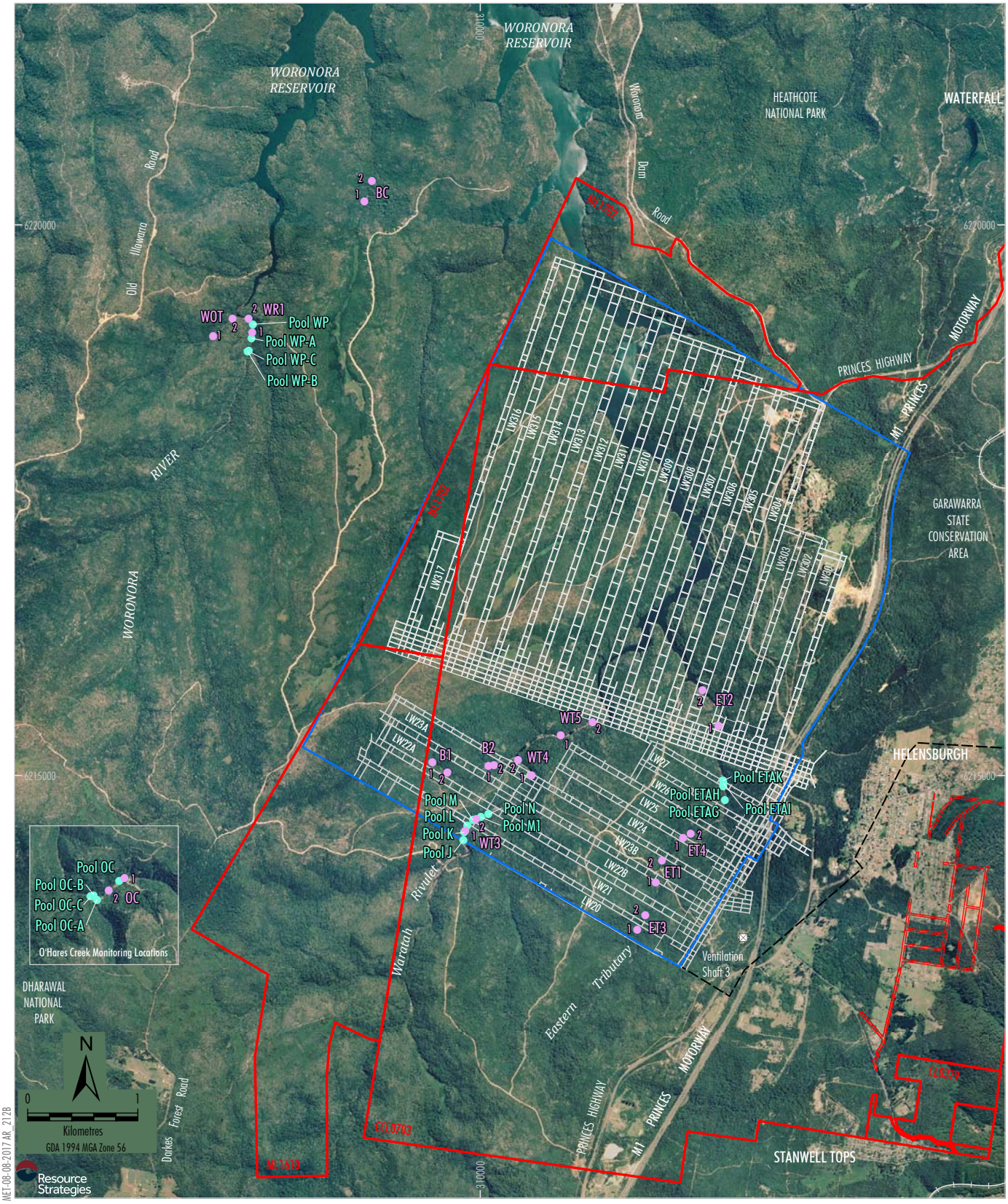
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2016); MSEC (2016)

Peabody

METROPOLITAN COAL

Riparian Vegetation Monitoring Locations

Figure 13



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area
  Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)

Monitoring

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

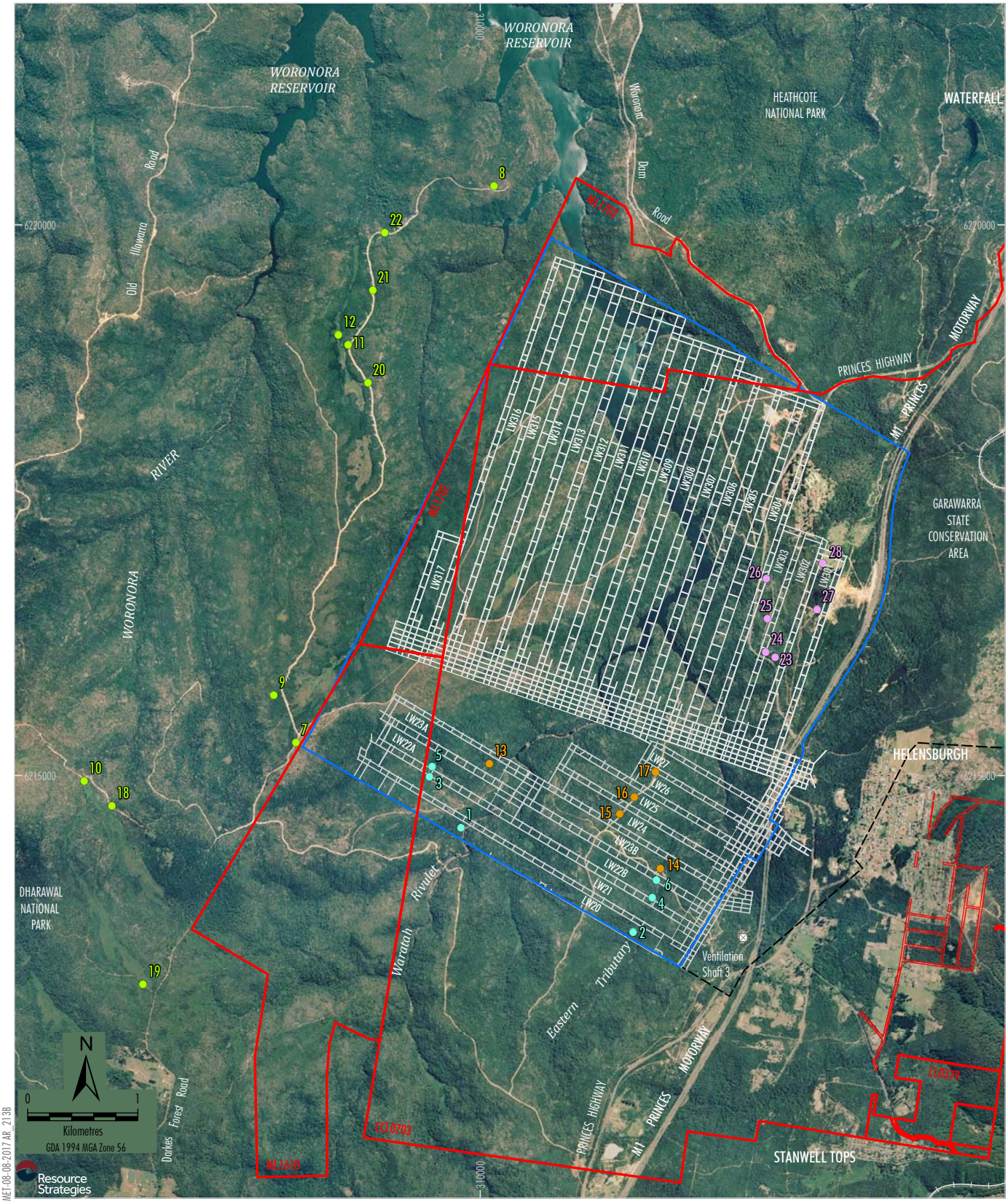
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2016); MSEC (2016)

Peabody

METROPOLITAN COAL

Aquatic Ecology Monitoring Locations

Figure 14



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area
  Longwalls 20-27 and 301-317
- 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

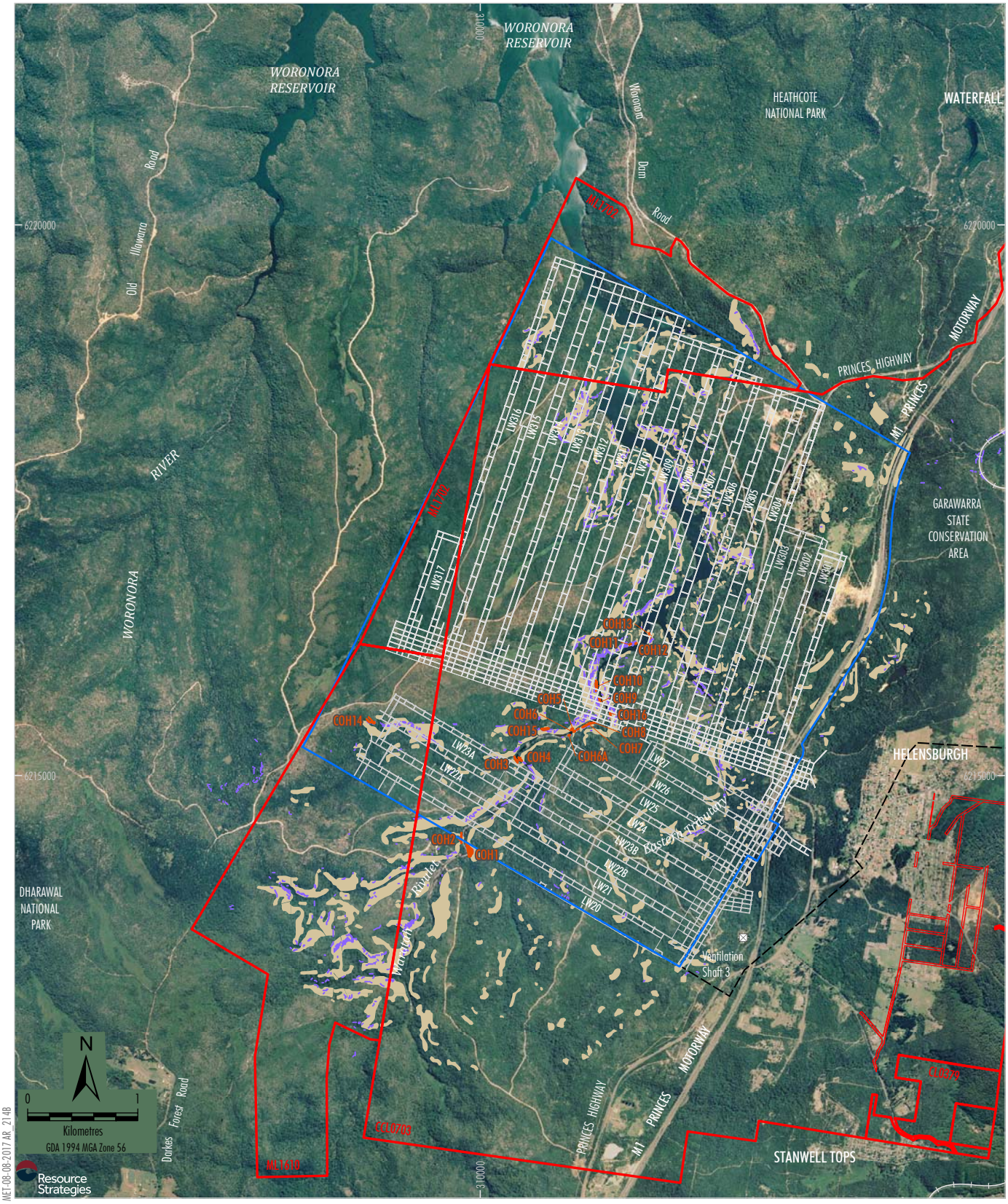
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2016); MSEC (2016)

Peabody

METROPOLITAN COAL

Amphibian Monitoring Locations

Figure 15



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)
- Cliffs and Overhangs
- Steep Slopes (Project Approval)
- Steep Slopes (Project Environmental Assessment)

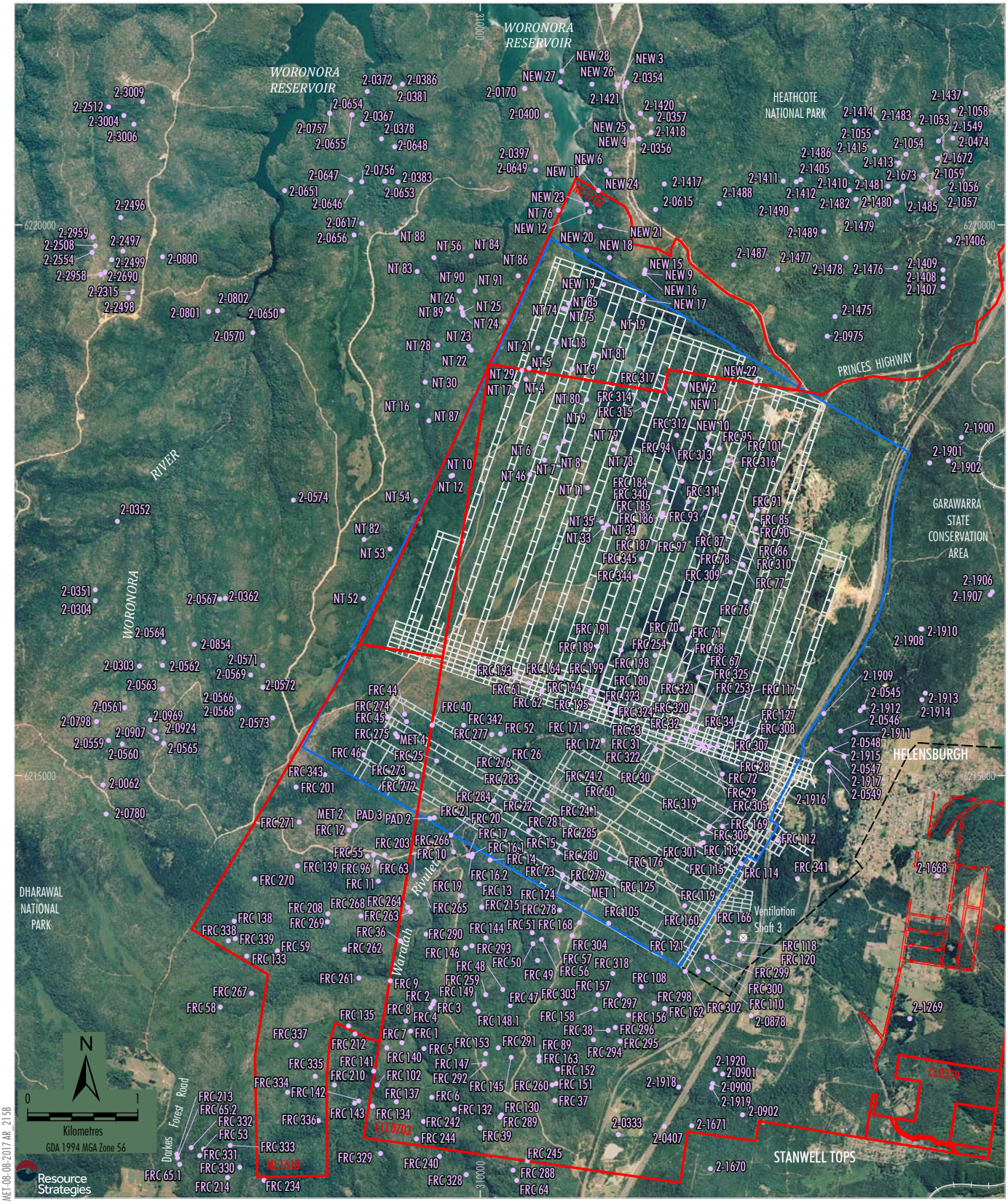
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2016); MSEC (2008; 2016)

Peabody

METROPOLITAN COAL

Cliffs and Overhangs, Steep Slopes and Land in General within the Project Underground Mining Area and Surrounds

Figure 16



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area
  Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)
- Aboriginal Heritage Site

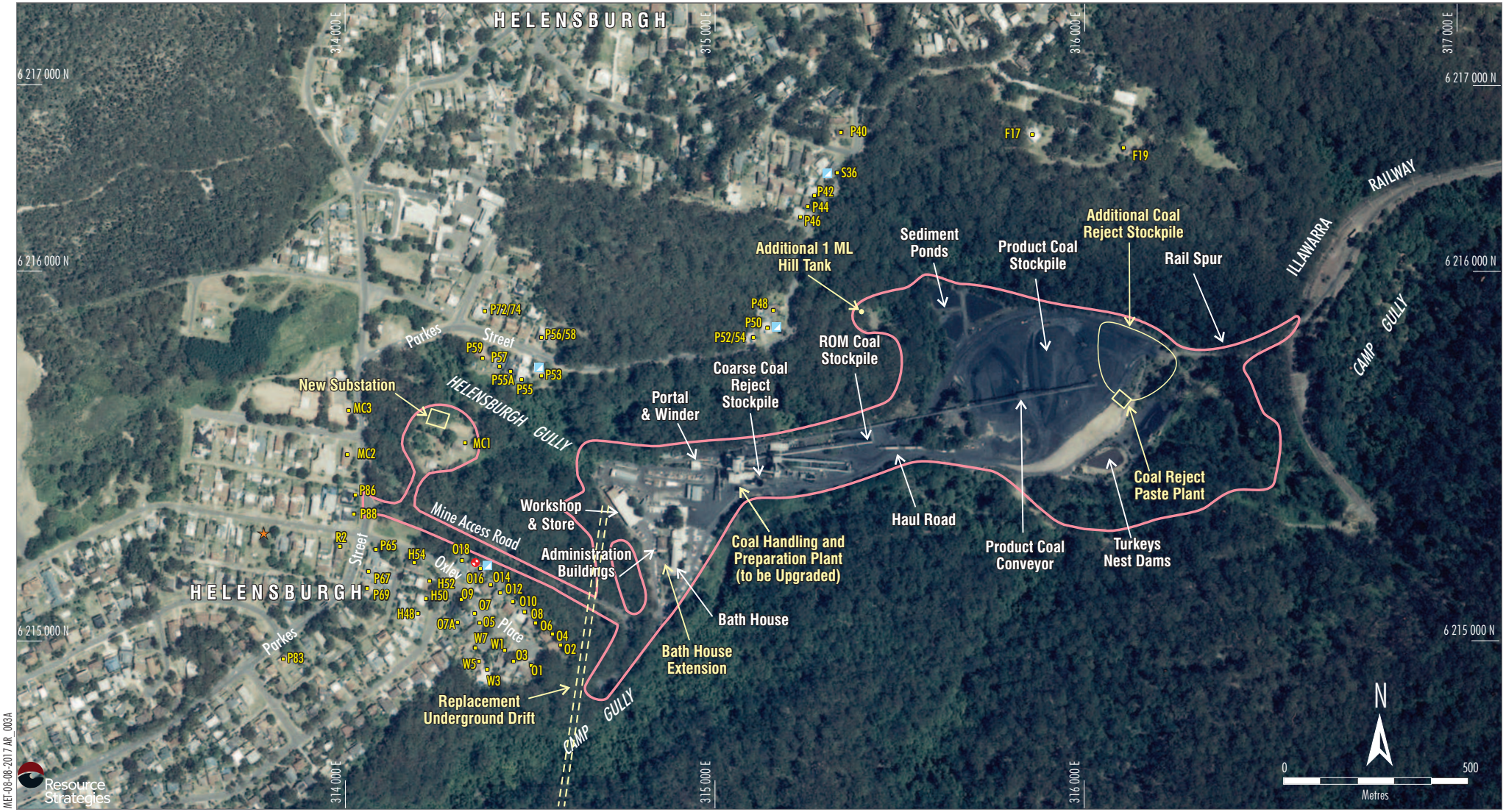
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2016); MSEC (2016); Illawarra Prehistory Group (2007; 2008); AHIMS (2007); Kayandel Archaeological Services (2006; 2007; 2008); Niche Environment and Heritage (2013)

Peabody

METROPOLITAN COAL

Known Aboriginal Heritage Sites Within Project Underground Mining Area and Surrounds

Figure 17



LEGEND

- P40 Receiver Location
- Approximate Extent of Major Surface Facilities Area
- Real-time Noise Monitoring Site
- Attended Noise Monitoring Site
- Automatic Weather Station

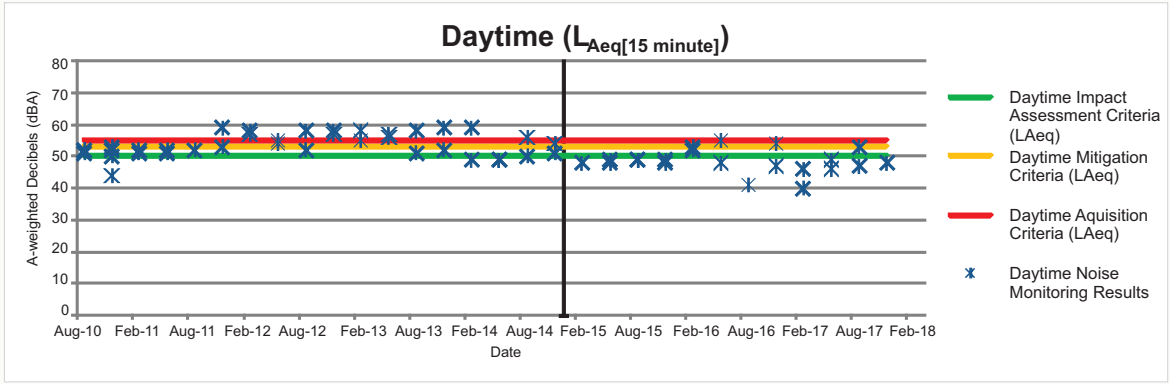
Peabody

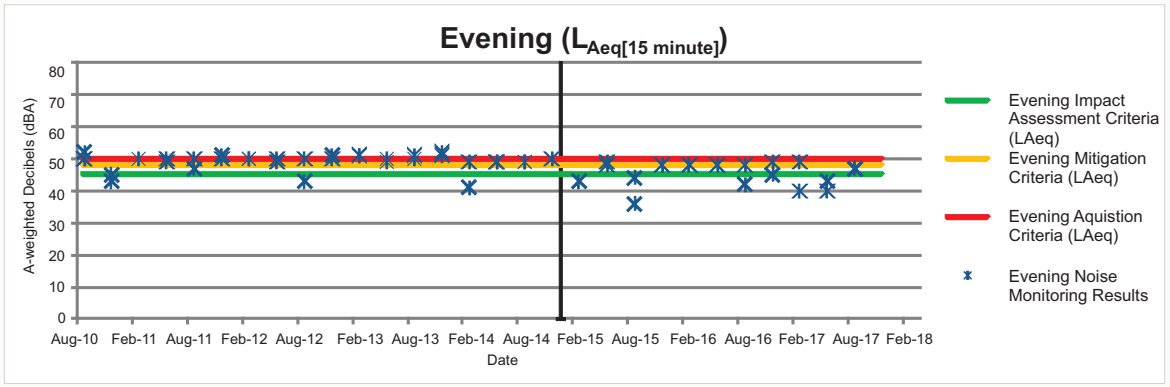
METROPOLITAN COAL

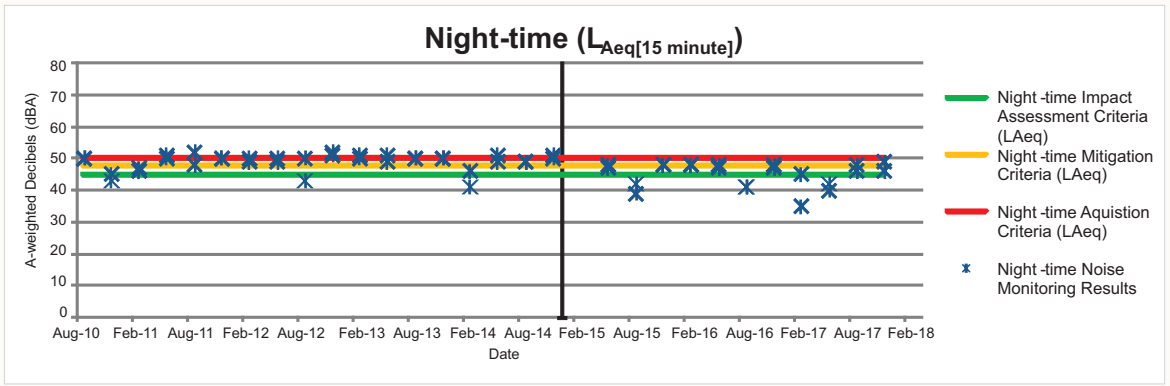
Noise Monitoring Locations

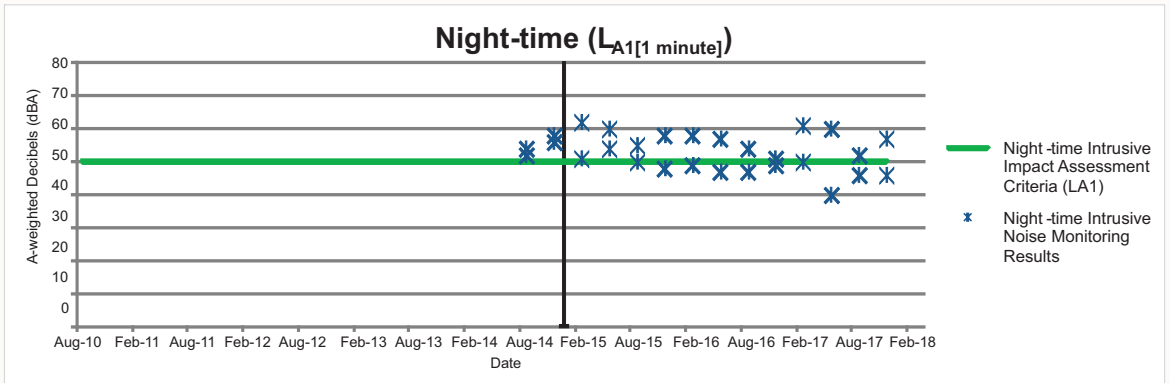
Source: Aerial Photography 2005

Figure 18









MET-08-08-2017 AR_0098

Resource Strategies

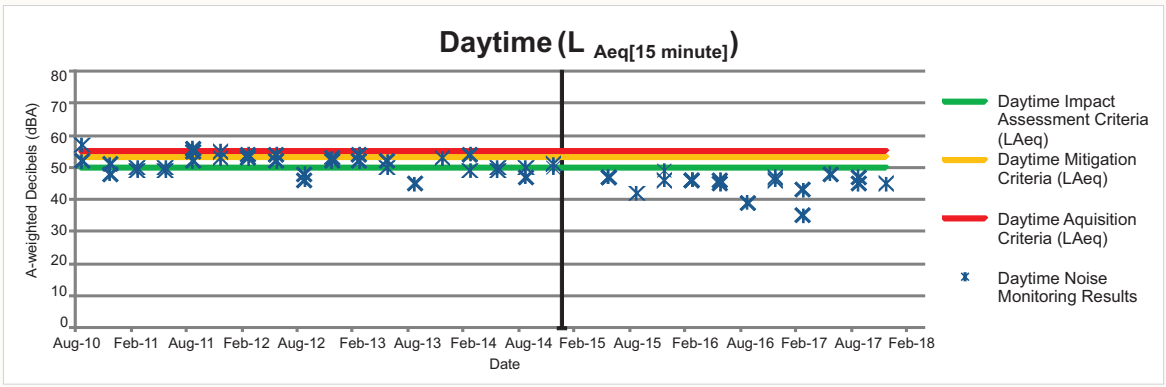
Note: In accordance with Conditions 1, 2 and 3, Schedule 4 of the Project Approval, the assessment, acquisition and mitigation criteria are only applicable from the end of 2014

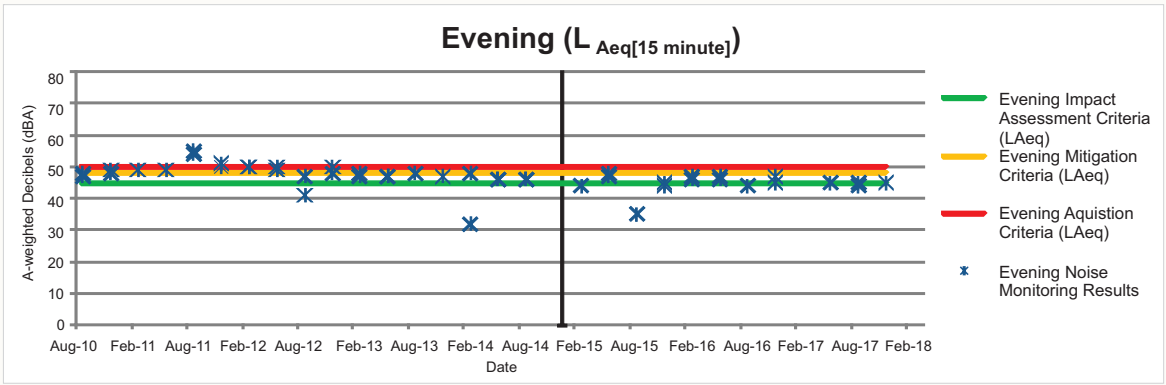
Peabody

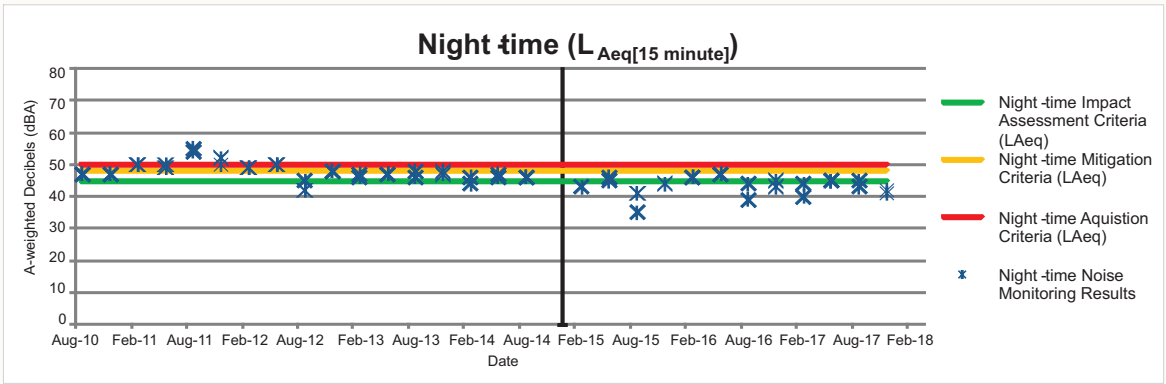
METROPOLITAN COAL

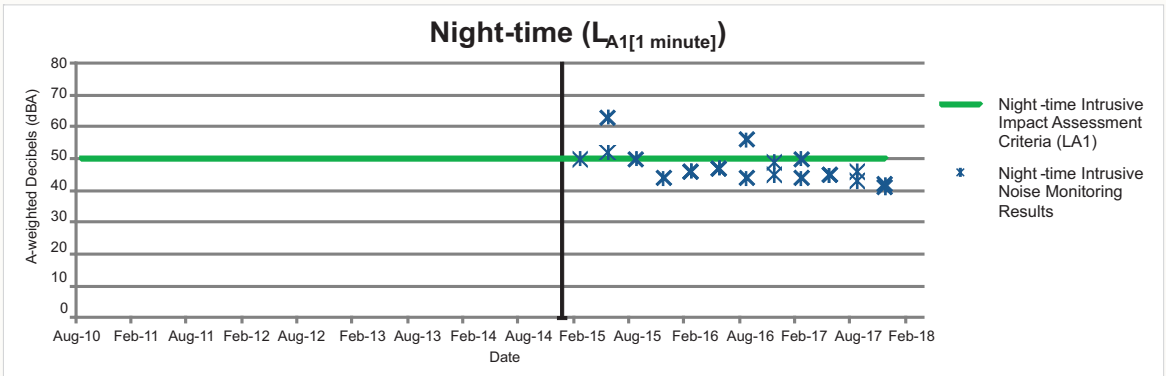
Quarterly Operator Attended Noise Monitoring Results at 16 Oxley Place (September 2010 to December 2017)

Figure 19a









MET-08-08-2017 AR_0108

Resource Strategies

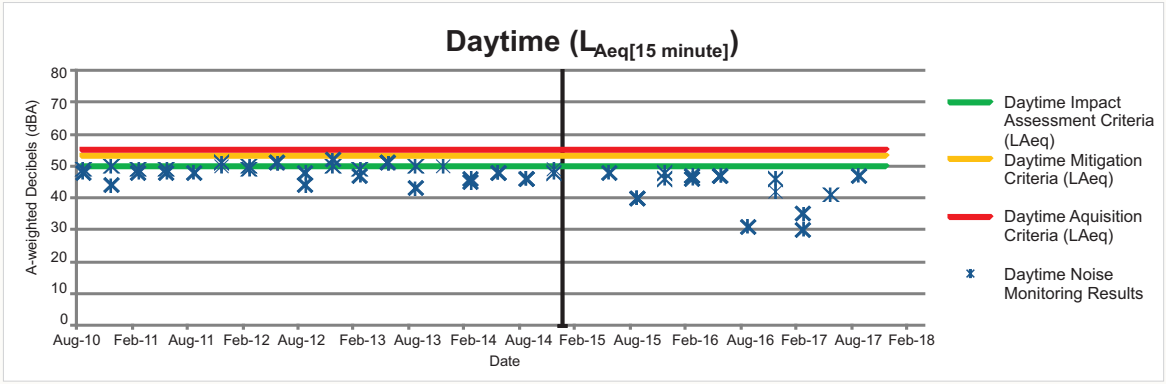
Note: In accordance with Conditions 1, 2 and 3, Schedule 4 of the Project Approval, the assessment, acquisition and mitigation criteria are only applicable from the end of 2014

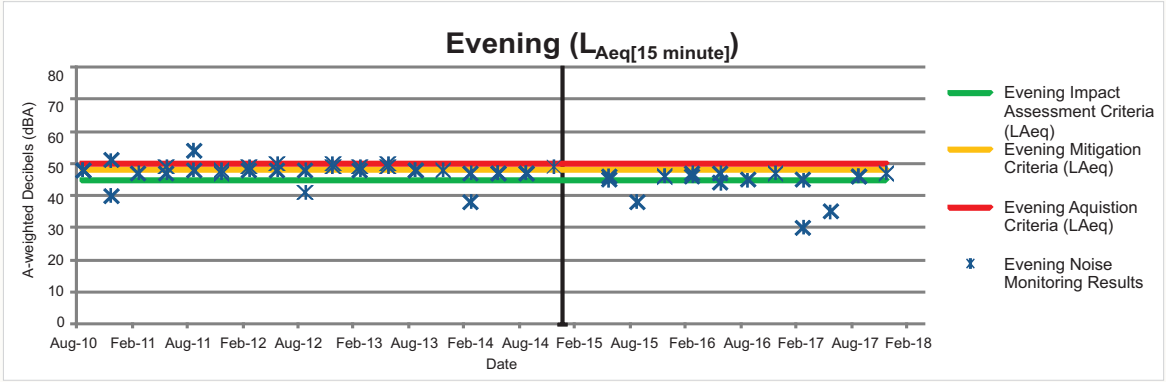
Peabody

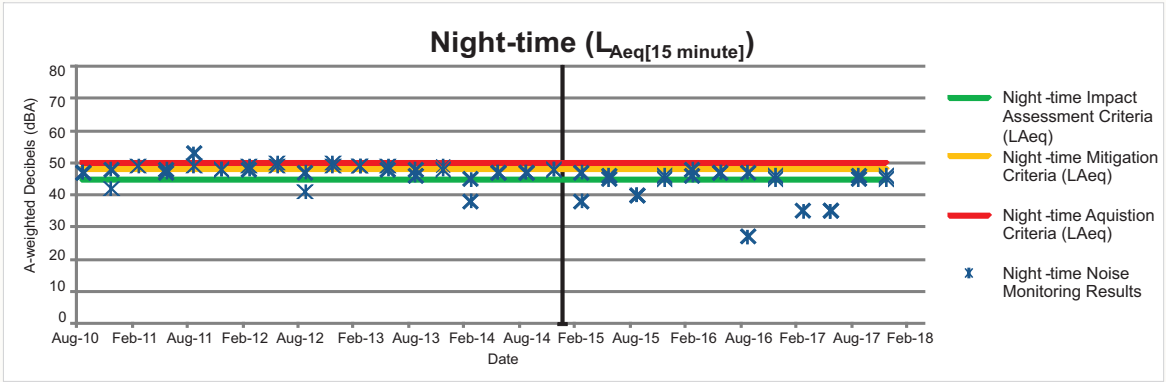
METROPOLITAN COAL

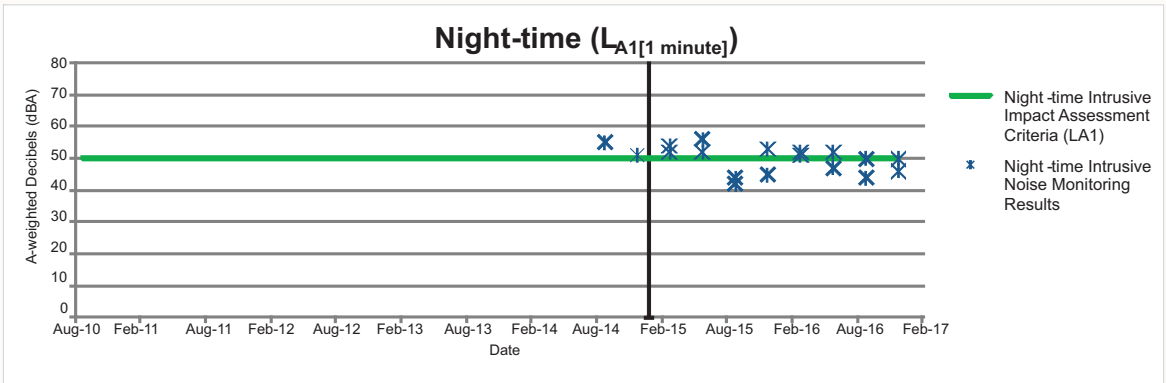
Quarterly Operator Attended Noise Monitoring Results at 53 Parkes Street (September 2010 to December 2017)

Figure 19b









MET-08-08-2017 AR_011B

Resource Strategies

Note: In accordance with Conditions 1, 2 and 3, Schedule 4 of the Project Approval, the assessment, acquisition and mitigation criteria are only applicable from the end of 2014

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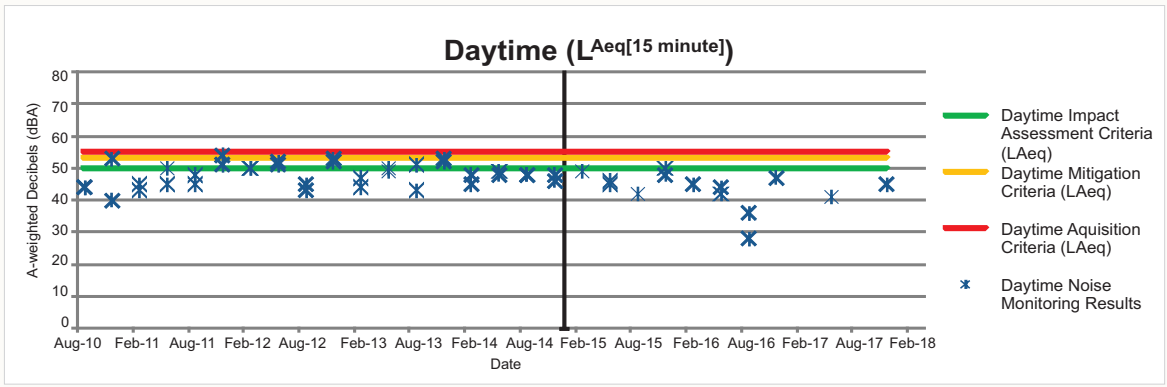
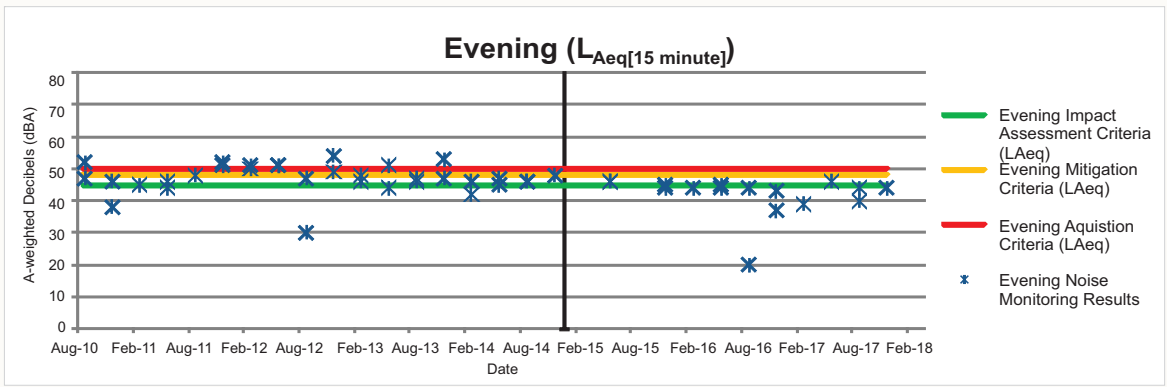
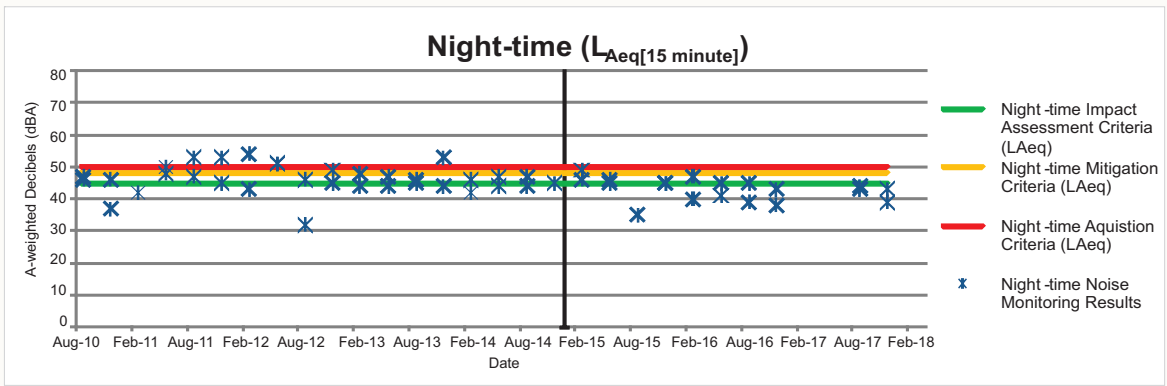
METROPOLITAN COAL

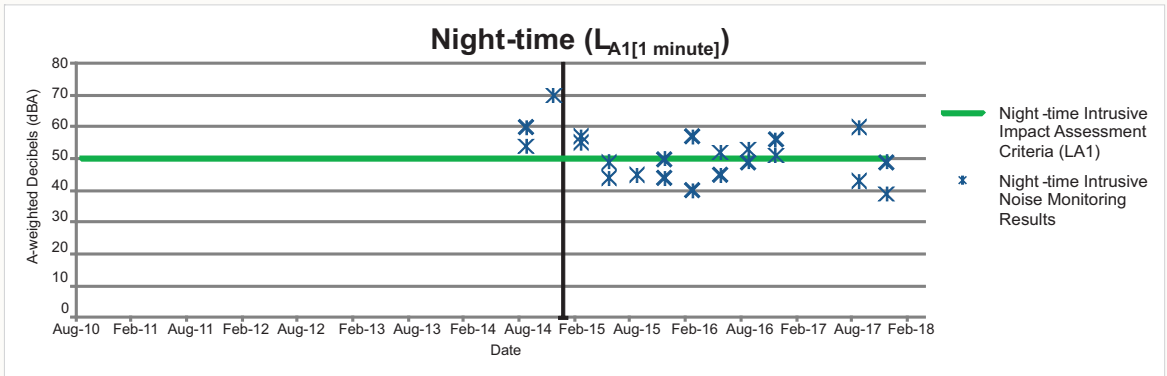
Quarterly Operator Attended Noise Monitoring Results at 50 Parkes Street (September 2010 to December 2017)

Figure 19c









MET-08-08-2017 AR_012B

Resource Strategies

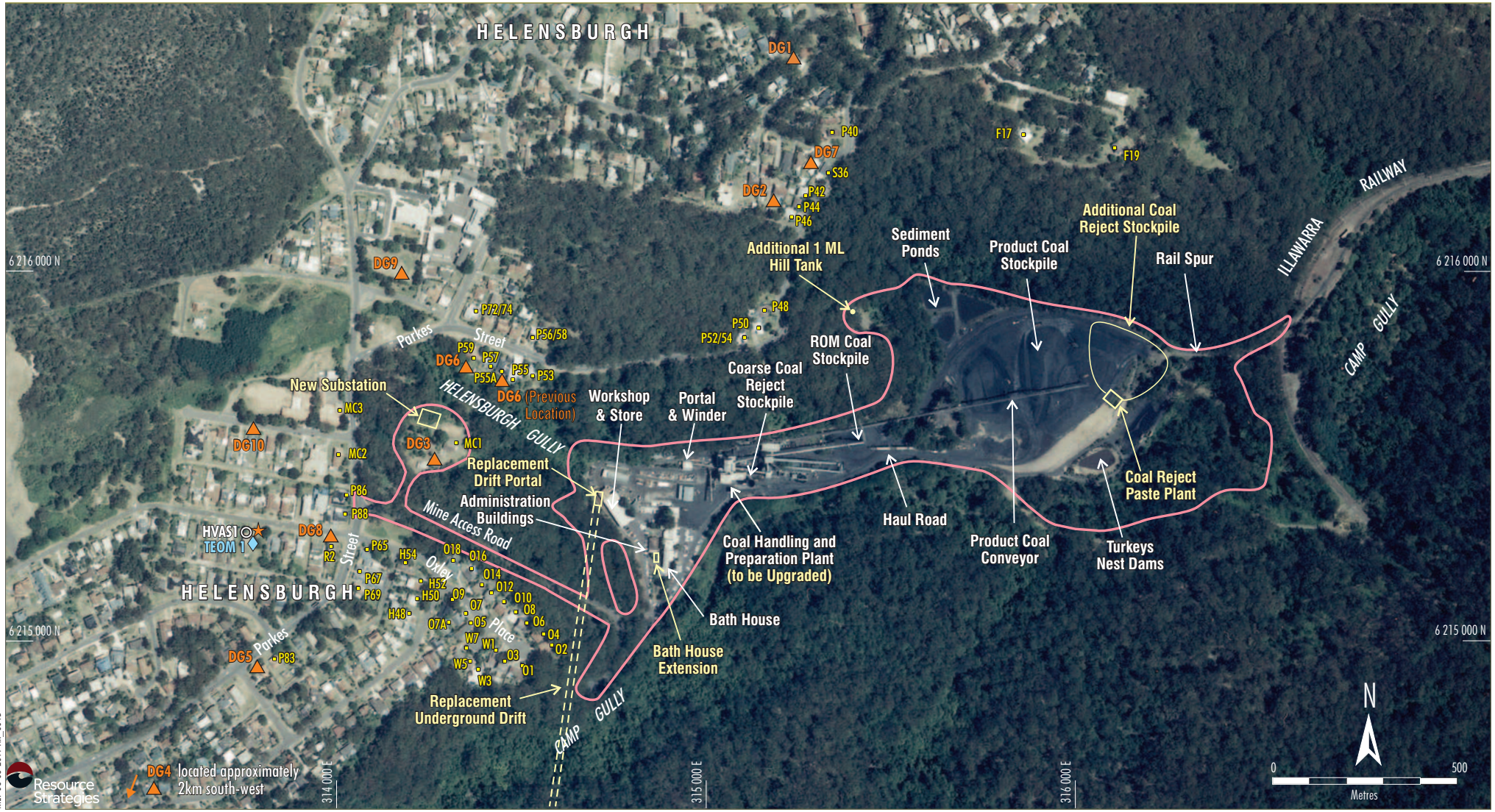
Note: In accordance with Conditions 1, 2 and 3, Schedule 4 of the Project Approval, the assessment, acquisition and mitigation criteria are only applicable from the end of 2014

Peabody

METROPOLITAN COAL

Quarterly Operator Attended Noise Monitoring Results at 36 Old Station Road (September 2010 to December 2017)

Figure 19d



LEGEND

- Approximate Extent of Major Surface Facilities Area
- P40 Receiver Location
- EPA Licenced Dust Deposition Gauge
- Automatic Weather Station
- High Volume Air Sampler
- TEOM Real Time Dust Monitor

Source: Aerial Photography 2005

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METROPOLITAN COAL

Air Quality Monitoring Sites

Figure 20

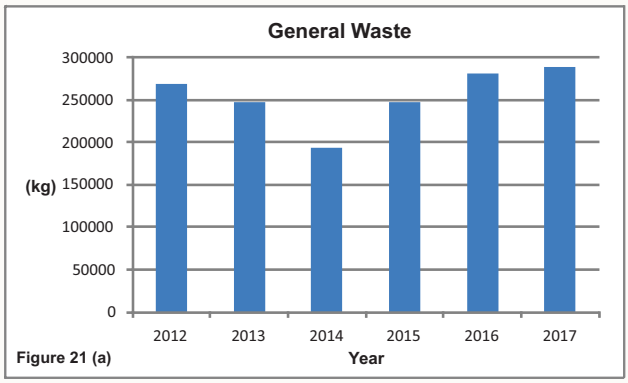

Figure 21 (a)

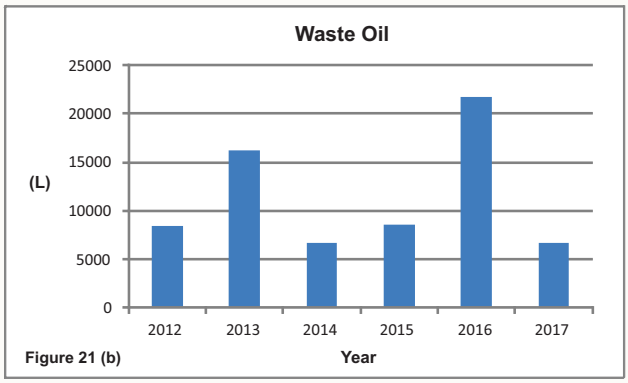

Figure 21 (b)

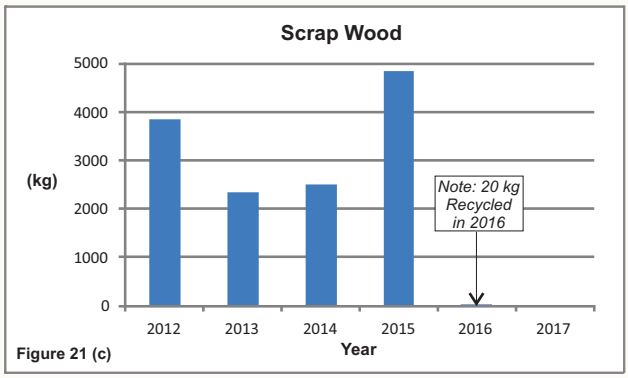

Figure 21 (c)

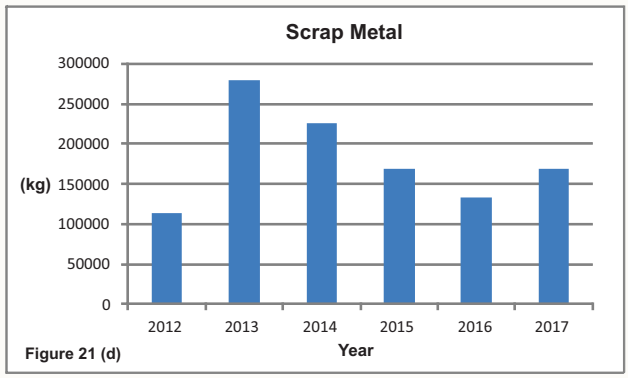

Figure 21 (d)

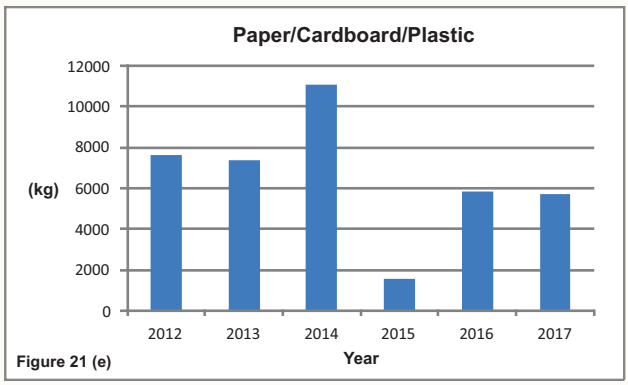

Figure 21 (e)

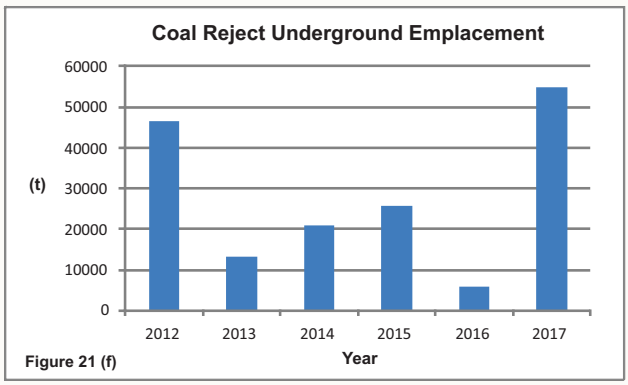

Figure 21 (f)

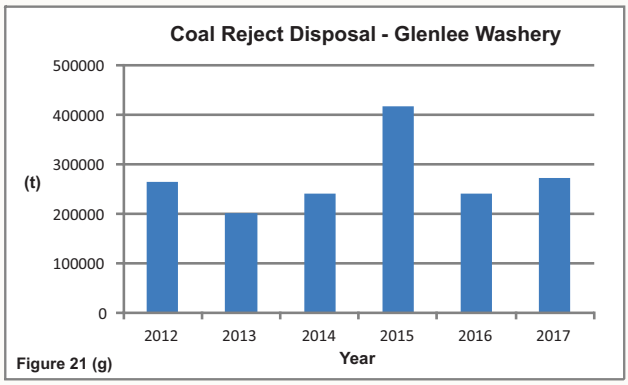

Figure 21 (g)

MET-08-08-2017 AR_005C

Resource Strategies

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METROPOLITAN COAL

Comparison of Waste Generated and Recycled in 2017 with Previous Years

Figure 21

MET-08-08-2017 AR_0016A

Resource Strategies

LEGEND

- Water Pipeline
- Camp Gully Water Extraction Pipeline
- Licensed Discharge Point
- Water Quality Monitoring
- Volume Monitoring

Note: Site D is located approximately 2.3 km upstream of Site A

Source: Metropolitan Coal (2014) Date of Aerial Photography October 2014

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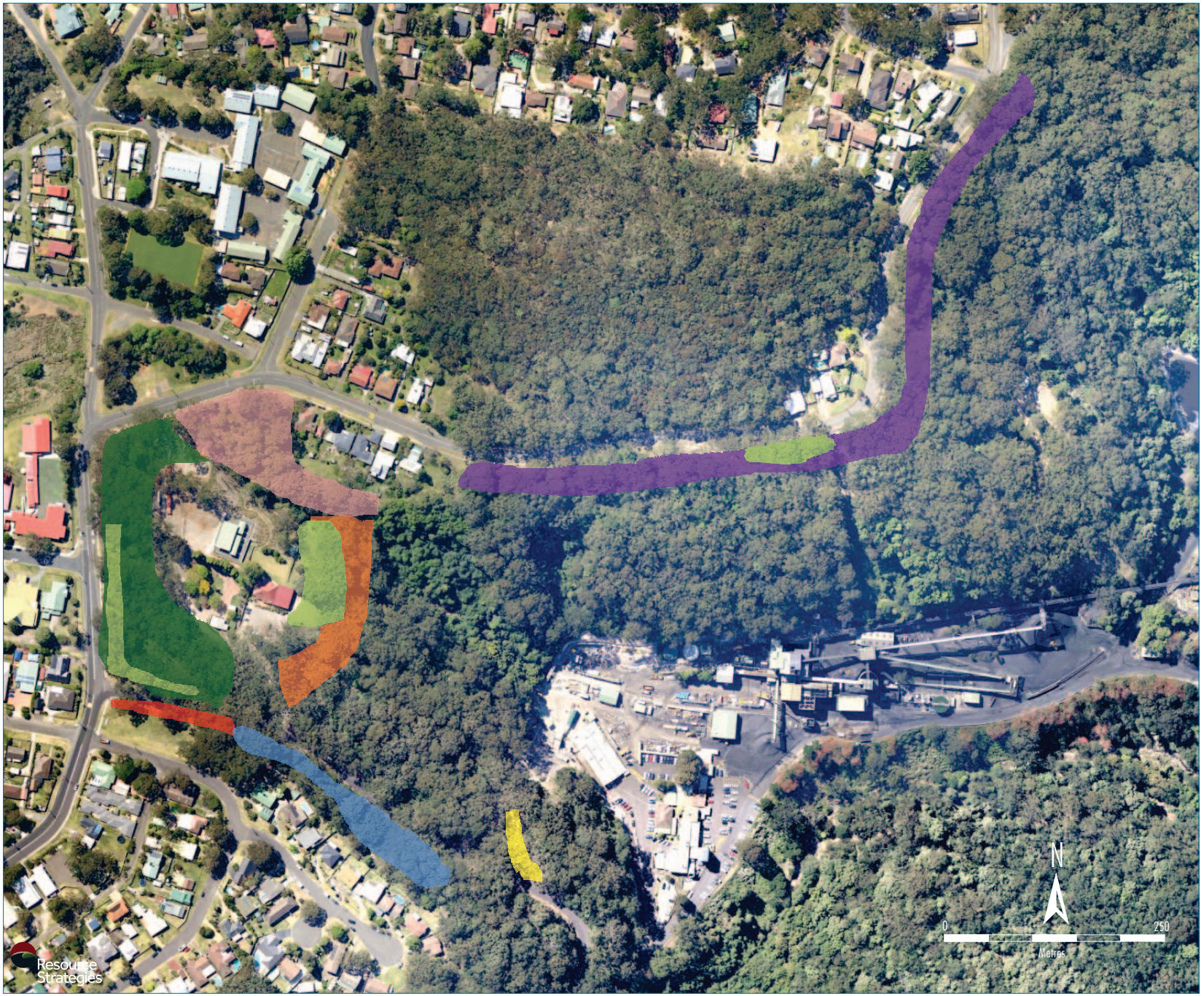
METROPOLITAN COAL

Surface Facilities Area
Water Monitoring Sites

Figure 22



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METROPOLITAN COAL

Rehabilitation Zones Currently Available at the Surface Facilities Area

Figure 23

MET-08-08-2017 AR_007A

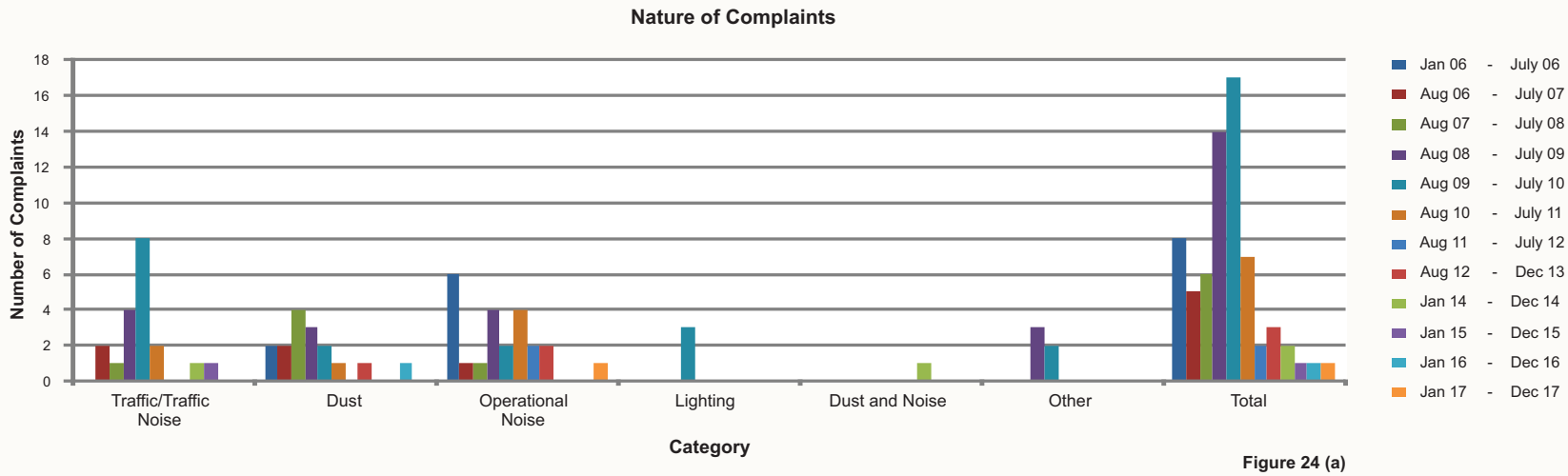

Figure 24 (a)

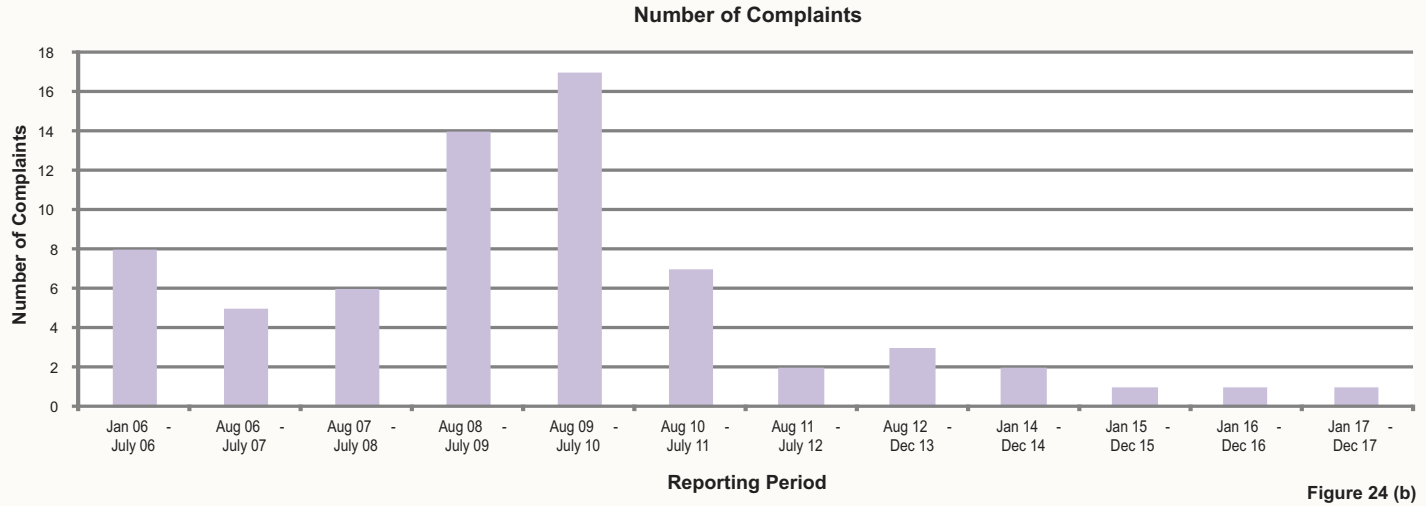

Figure 24 (b)

MET-08-08-2017.AR_0088

Resource Strategies

Peabody

METROPOLITAN COAL

Summary of Complaints Recorded,
January 2006 to December 2017

Figure 24

APPENDICES

APPENDICES A TO O ARE AVAILABLE ON CD (AS LISTED BELOW):

APPENDIX A	2017 ANNUAL REVIEW SUBSIDENCE MONITORING RESULTS
APPENDIX B1	METROPOLITAN COAL SIX MONTHLY SURFACE WATER REVIEW 1 JANUARY TO 30 JUNE 2017
APPENDIX B2	METROPOLITAN COAL SIX MONTHLY SURFACE WATER REVIEW 1 JULY TO 31 DECEMBER 2017
APPENDIX C1	METROPOLITAN COAL SIX MONTHLY REVIEW GROUNDWATER MONITORING AND ENVIRONMENTAL PERFORMANCE ASSESSMENT 1 JANUARY TO 30 JUNE 2017
APPENDIX C2	METROPOLITAN COAL SIX MONTHLY REVIEW GROUNDWATER MONITORING AND ENVIRONMENTAL PERFORMANCE ASSESSMENT 1 JULY TO 31 DECEMBER 2017
APPENDIX D	MAPPED POOL LOCATIONS ON THE WARATAH RIVULET, EASTERN TRIBUTARY, TRIBUTARY A AND TRIBUTARY B
APPENDIX E1	POOL U GAS RELEASES PERFORMANCE MEASURE ASSESSMENT
APPENDIX E2	PEER REVIEW OF POOL U GAS RELEASES ASSESSMENT
APPENDIX E3	POOLS P AND U GAS RELEASES PERFORMANCE MEASURE ASSESSMENT
APPENDIX F1	ASSESSMENT AGAINST WATER QUALITY PERFORMANCE MEASURE FOR THE EASTERN TRIBUTARY, 1 JANUARY TO 30 JUNE 2017
APPENDIX F2	ASSESSMENT AGAINST WATER QUALITY PERFORMANCE MEASURE FOR THE EASTERN TRIBUTARY, 1 JULY TO 31 DECEMBER 2017
APPENDIX G1	LONGWALLS 20-22 SPRING 2016 VEGETATION MONITORING REPORT
APPENDIX G2	LONGWALLS 23-27 SPRING 2016 VEGETATION MONITORING REPORT
APPENDIX G3	LONGWALLS 20-22 AUTUMN 2017 VEGETATION MONITORING REPORT
APPENDIX G4	LONGWALLS 23-27 AUTUMN 2017 VEGETATION MONITORING REPORT
APPENDIX G5	LONGWALLS 301-303 BASELINE VEGETATION MONITORING REPORT
APPENDIX H1	SWAMP 20 AND SWAMP 28 THREATENED FLORA ASSESSMENTS

APPENDIX H2	SWAMP 20, SWAMP 28 AND RIPARIAN VEGETATION THREATENED FAUNA ASSESSMENTS
APPENDIX H3	RIPARIAN VEGETATION AND TRIBUTARY B THREATENED FLORA ASSESSMENTS
APPENDIX H4	TRIBUTARY B THREATENED FAUNA ASSESSMENT
APPENDIX I1	LONGWALLS 20-22 SPRING 2016 AQUATIC ECOLOGY MONITORING REPORT
APPENDIX I2	LONGWALLS 23-27 SPRING 2016 AQUATIC ECOLOGY MONITORING REPORT
APPENDIX I3	LONGWALLS 20-22 AUTUMN 2017 AQUATIC ECOLOGY MONITORING REPORT
APPENDIX I4	LONGWALLS 23-27 AUTUMN 2017 AQUATIC ECOLOGY MONITORING REPORT
APPENDIX J1	LONGWALLS 20-22 SPRING-SUMMER 2016 AMPHIBIAN SURVEY REPORT
APPENDIX J2	LONGWALLS 23-27 SPRING-SUMMER 2016 AMPHIBIAN SURVEY REPORT
APPENDIX J3	LONGWALLS 301-303 SPRING-SUMMER 2015 AMPHIBIAN SURVEY REPORT
APPENDIX J4	LONGWALLS 301-303 SPRING-SUMMER 2016 AMPHIBIAN SURVEY REPORT
APPENDIX K1	LONGWALLS 23-27 ROUND 4 MONITORING OF ABORIGINAL HERITAGE SITES
APPENDIX K2	LONGWALLS 23-27 ROUND 5 MONITORING OF ABORIGINAL HERITAGE SITES
APPENDIX L	2017 QUARTERLY ATTENDED NOISE MONITORING RESULTS
APPENDIX M	QUARTER 2, QUARTER 3 AND QUARTER 4 2017 NOISE MODELLING PREDICTIONS
APPENDIX N	AIR QUALITY MONITORING AND ENVIRONMENTAL PERFORMANCE ASSESSMENT REPORT
APPENDIX O	LETTER FROM THE INDEPENDENT CHAIR OF THE COMMUNITY CONSULTATIVE COMMITTEE TO THE SECRETARY OF THE DEPARTMENT OF PLANNING AND ENVIRONMENT