# METROPOLITAN COAL

# 2016 ANNUAL REVIEW




Peabody ENERGY

METROPOLITAN COAL

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# 2016 ANNUAL REVIEW

Project No. MET-08-08/8.1
Document No. 00855774

| | |
|---|---|
| **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<br>Mining Lease 1610<br>Mining Lease 1702<br>Mining Purpose Lease 320<br>Coal Lease 379 |
| **Name of Holder of Mining Leases** | Metropolitan Collieries Pty Ltd |
| **Water Licence** | Water Access Licence – WAL25410<br>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 2016 |
| **Annual Review End Date** | 31 December 2016 |

**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 2016 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** | 7/7/2017<br>(Revision to address comments from the DP&E) |

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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 reporting period (31 December 2016) 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 | No |

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. | 6.1.1 and 12.1 |
| Project Approval 08_0149 | Condition 1, Schedule 4 | Noise Impact Assessment Criteria (Table 2) | Non-compliant | Monitoring and noise modelling has identified sustained non-compliances during the reporting period. | 6.2.1 and 12.2 |
| Project Approval 08_0149 | Condition 3, Schedule 4 | Noise Mitigation Criteria (Table 4) | Non-compliant | Noise modelling has identified sustained non-compliances during the reporting period. | 6.2.1 and 12.2 |
| 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. | 6.2.1 and 12.2 |
| Environment Protection Licence No. 767 | Condition M2 | Air Quality Monitoring | Non-compliant | Sampling was not able to be conducted at all monitoring points at the frequencies described in Conditions M2.1 and M2.2. | 6.2.2 and 12.3 |
| Environment Protection Licence No. 767 | L1.1 | Pollution of Waters | Non-compliant | The discharge constituents from Licensed Discharge Point 7 did not meet the requirements of Condition L1.1. | 7 and 12.4 |

## 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:<br>• potential for serious environmental consequences, but is unlikely to occur; or<br>• potential for moderate environmental consequences, but is likely to occur. |
| Low | Non-compliant | Non-compliance with:<br>• potential for moderate environmental consequences, but is unlikely to occur; or<br>• 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 2. The extent of the mine's surface facilities area is shown on Figure 3.

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 for domestic and overseas customers (Figure 1). Previously, a small proportion of the product coal was transported by truck to the Corrimal Coke Works and Coalcliff Coke Works for domestic use (Figure 1). CHPP coal reject material is transported by truck to the Glenlee Washery or the Lend Lease Calderwood Urban Development Project, is emplaced in unused workings, or is used on site for construction purposes.

The Environmental Management Structure of the Project is shown on Figure 4. 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. 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 2016 Annual Review has been prepared to meet the above reporting requirements and to review the environmental performance of the Project during the reporting period (i.e. 1 January to 31 December 2016), 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 | DRE | 1/4/2004 | 26/1/2024 |
| Mining Lease 1610 | DRE | 7/5/2014 | 26/9/2031 |
| Coal Lease 379 | DRE | 14/11/2013* | 4/10/2033 |
| Mining Purpose Lease 320 | DRE | 16/6/2014 | 9/12/2035 |
| Mining Lease 1702 | DRE | 13/10/2014 | 13/10/2035 |
| Bore Licence Certificate 10BL603595 | DPI-Water | 25/1/2013 | 24/1/2018 |
| Camp Creek Weir Surface Water Certificate of Title | DPI-Water | 28/11/2012 | - |
| Environment Protection Licence (EPL) No. 767 | EPA | 9/9/2002 | - |
| Radiation Licence – Radiation Management Licence 5063985 | EPA | 27/8/2016 | 27/9/2017 |
| Licence to store explosives and/or security sensitive dangerous substances | WorkCover NSW | Pending | Pending |

Note: DP&E = NSW Department of Planning and Environment; DRE = NSW Department of Trade and Investment, Regional Infrastructure and Services – Division of Resources and Energy; EPA = NSW Environment Protection Authority; DPI-Water = Department of Primary Industries – Water; WCC = Wollongong City Council.

* Date lease offer was signed.

# 4 OPERATIONS SUMMARY

## 4.1 MINING OPERATIONS

### 4.1.1 Longwalls 20-27 Underground Mining Area

During the reporting period, the extraction of Longwall 25 was completed in April 2016 and Longwall 26 extraction commenced in May 2016 (Figure 5). Longwall 26 was completed in August 2016 and Longwall 27 commenced in September 2016, and continued for the remainder of the reporting period. Longwall 27 will be completed in the next reporting period in March 2017.

During the reporting period, Metropolitan Coal obtained approval to reduce the length of Longwall 26 by 272 metres (m). The change in Longwall 26 extraction length was driven by safety issues relating to the high carbon dioxide gas content ahead of the development roadways.

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

**Table 4**
**Production Summary**

| Material | Approved Limit | 2015 Reporting Period (Actual) | 2016 Reporting Period (Actual) | 2017 Reporting Period (Forecast) |
|---|---|---|---|---|
| Waste Rock/Overburden | N/A | N/A | N/A | N/A |
| ROM Coal | 3.2 Mt per calendar year[1] | 2,297,856 t | 2,237,138 t | 1,816,265 |
| Coal Reject | N/A | 424,453 t | 519,997 t[3] | 297,569 |
| Saleable Product[2] | [2.8 Mt per calendar year[1]] | 1,898,285 t | 1,716,110 t | 1,518,696 |

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 519,997 t of coal reject produced, 255,255 t was transported to the Glenlee Washery for disposal, 125,149 t was transported to the Lend Lease Calderwood Urban Development Project for the beneficial re-use of the coal reject as fill material, approximately 6,000 t was emplaced underground, and the remainder was used to upgrade the Turkeys Nest Dam.

### 4.1.2 Longwalls 301-303 Underground Mining Area

Longwalls 301, 302 and 303 (herein referred to as Longwalls 301-303) define the next mining sub-domain within the Project underground mining area (Figure 2). During the reporting period, Metropolitan Coal prepared the Longwalls 301-303 Extraction Plan to outline the proposed monitoring, management, mitigation and reporting of potential subsidence impacts and environmental consequences in the Project underground mining area during the secondary extraction of Longwalls 301-303. The Longwalls 301-303 Extraction Plan also details the baseline (i.e. pre-mining) data collected for Longwalls 301-303 and surrounds.

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. That is, the Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Extraction Plans will be superseded by the Longwalls 301-303 Extraction Plan following the completion of Longwall 27 (subject to Extraction Plan approval).

The Longwalls 301-303 Extraction Plan was submitted to the DP&E in November 2016. Longwall 301 is scheduled to commence in May 2017. Reporting of Longwalls 301-303 monitoring and management will be included in future Annual Reviews.

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

## 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 reporting period, Metropolitan Coal commenced the transport of coal reject to the Lend Lease Calderwood Urban Development Project for the beneficial re-use of the coal reject as fill material. The coal reject backfill emplacement project also continued during 2016 and the activities are described in Section 6.2.4.

Upgrades to the Turkey's Nest Dam were completed and a new sediment catch pit was constructed to improve the efficiency of the surface facilities water management system. Coal reject material was beneficially re-used for the Turkey's Nest Dam upgrade.

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. Further testwork of the coal reject material was undertaken during the reporting period in this regard.

**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.*<br>*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.*<br>*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). |

**Table 5 (Continued)**
**Other Relevant Operational Conditions**

| Operational Condition | | Operational Condition Met? | Comment |
|---|---|---|---|
| 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:*<br>*(a) the relevant requirements of the BCA; and*<br>*(b) any additional requirements of the MSB in areas where subsidence effects are likely to occur.*<br>*Notes:*<br>• *Under Part 4A of the EP&A Act, the Proponent is required to obtain construction and occupation certificates for the proposed building works.*<br>• *Part 8 of the EP&A Regulation sets out the requirements for the certification of the project.* | Yes | Building construction activities during the reporting period included upgrades to the backfill emplacement plant (completed during 2016).<br>Building Code of Australia requirements were stipulated for all buildings. |
| 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 reporting 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:*<br>*(a) maintained in a proper and efficient condition; and*<br>*(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. |
| 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 reporting period.<br>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 27 will be completed (March 2017) and Longwall 301 will commence (May 2017, subject to Extraction Plan approval) (Figure 6).

Metropolitan Coal will continue the transport of coal reject to the Lend Lease Calderwood Urban Development Project for the beneficial re-use of the coal reject as fill material and will continue its consultation with the Wollongong City Council regarding the potential for coal rejects to be beneficially re-used at the Helensburgh Landfill. Trialling and commissioning of the backfill plant and associated coal reject injection into the goaf will also continue in the next reporting period.

# 5 ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

Metropolitan Coal prepared the Metropolitan Coal 2015 Annual Review to reflect the requirements of the NSW Government (2015) *Annual Review Guideline for State Significant Mining Developments*. Following its submission (April 2016), Metropolitan Coal revised the Metropolitan Coal 2015 Annual Review to provide additional information requested by the DP&E (Compliance Southern Region) and in consideration of comments received from WaterNSW on the April 2016 report. The revised Metropolitan Coal 2015 Annual Review (August 2016) was resubmitted to the DP&E and DRE, and provided to other relevant agencies.

Table 6 details the additional information that the DP&E (Compliance Southern Region) and WaterNSW requested be provided in the next Annual Review[1]. Table 6 also details where each aspect is addressed in this report.

**Table 6**
**Actions Arising from the 2015 Annual Review**

| Action Required | Action Taken | Report Section |
|---|---|---|
| **DP&E COMMENT** | | |
| DP&E requested a comparison between years of complaints data be provided in future Annual Reviews. | A comparison of complaints data between years is provided. | Section 10.3 |
| **WATERNSW COMMENT** | | |
| **Subsidence Monitoring** | | |
| WaterNSW recommended that subsidence predictions and measurements be tabulated in future Annual Reviews.<br>WaterNSW requested details of the assessment subsidence parameters for the occurrences of the Southern Sydney Sheltered Forest on Transitional Sandstone Soils in the Sydney Basin Bioregion Endangered Ecological Community to the east of Longwalls 23-27be included in future Annual Reviews.<br>WaterNSW requested details of such assessments be appended to future Annual Reviews, preferably as interpretative reports. | Additional subsidence information regarding subsidence predictions and measurements, and assessment of subsidence parameters for the occurrences of the Southern Sydney Sheltered Forest on Transitional Sandstone Soils in the Sydney Basin Bioregion Endangered Ecological Community, are provided. | Section 6.1.1 and Appendix A |
| **Water Management** | | |
| WaterNSW requested the detailed surface and groundwater assessments be appended to future Annual Reviews. | The detailed surface water and groundwater assessments are provided in Appendices B and C, respectively. | Appendices B and C |
| WaterNSW requested the detailed threatened flora and fauna assessments be appended to future Annual Reviews. | The detailed threatened flora and fauna assessments for Swamp 20 and Swamp 28 during the reporting period are provided in Appendices H and I. | Appendices H and I |
| WaterNSW requested the current status of the groundwater model be clearly stated in future Annual Reviews. | The current status of the groundwater model is reported. | Section 6.1.2 and Appendix C |
| WaterNSW requested the assessment of upland swamp substrate groundwater levels include other indicators such as frequency and rate of swamp drying. | Analysis of upland swamp groundwater levels includes a comparison of behaviour against control swamps in relation to the rate of recession from high to low water levels. The duration of dry swamp conditions compared to the rainfall record is taken into consideration during qualitative analysis of exceedances, as well as the relative amplitudes of groundwater responses to rainfall events. | Section 6.1.2, Section 6.1.3 and Appendix C |

[1] Metropolitan Coal has provided WaterNSW with detailed responses to their letters dated 9 August 2016 and 27 September 2016.

# 6 ENVIRONMENTAL PERFORMANCE

## 6.1 UNDERGROUND MINING AREA AND SURROUNDS

Section 6.1 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 reporting period.

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

### 6.1.1 Subsidence Monitoring

The Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 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 and Longwalls 23-27 Extraction Plans in accordance with Condition 6(e), Schedule 3 of the Project Approval.

As indicated in previous Metropolitan Coal Annual Reviews, the Metropolitan Coal Longwalls 20-22 Subsidence Monitoring Program has effectively been discontinued as the appropriate subsidence survey lines and points for ongoing monitoring were incorporated into the Metropolitan Coal Longwalls 23-27 Subsidence Monitoring Program. The Metropolitan Coal Longwalls 23-27 Subsidence Monitoring Program was revised during the reporting period to include additional subsidence monitoring at transmission towers located at the end of Longwall 26 and Longwall 27.

Subsidence movements are surveyed in three dimensions using a total station survey instrument. Metropolitan Coal has sought to improve the quality of subsidence survey data during the reporting period, in particular, in relation to achieving consistent survey accuracy by different survey teams. The subsidence parameter monitoring locations are shown on Figure 7.

A review of the subsidence survey results and comparison between the predicted and observed subsidence movements over the reporting period has been conducted by Mine Subsidence Engineering Consultants (MSEC). The report prepared by MSEC is provided in Appendix A of this 2016 Annual Review. A summary of the key findings is provided below.

***Predicted and Observed Subsidence Movements***

The reporting period included the completion of Longwall 25 and the full extraction of Longwall 26. Details of the observed and predicted subsidence movements at the subsidence monitoring locations (Line 9G, Transmission Line, Freeway Line, Waratah Rivulet Cross Lines, Eastern Tributary Cross Line, and Ridge to Ridge Monitoring Points, Figure 7) 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 ongoing pillar squashing of the abandoned mains (B West Mains) between Longwall 20 and Longwalls 1 to 18 due to increasing abutment load with successive longwalls.

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

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 subsidence for the Project after each longwall for Longwalls 3 to 26 is shown on Chart 1.

**Comparison between the maximum observed and maximum predicted total subsidence for Longwalls 3 to 26 at Metropolitan Colliery**

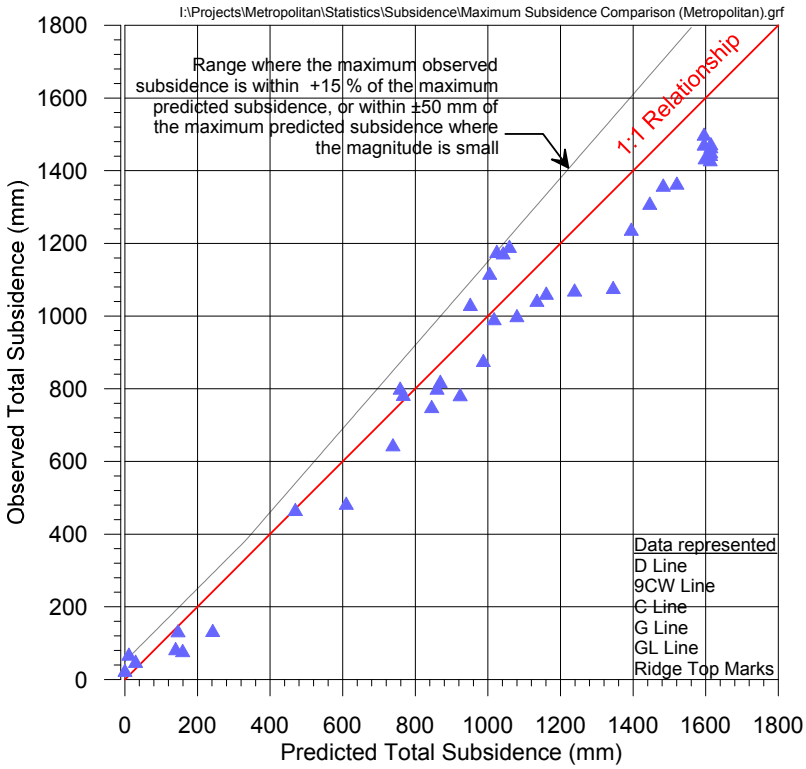



**Chart 1 Comparison between the Maximum Observed and Maximum Predicted Total Subsidence for Longwalls 3 to 26 at Metropolitan Colliery**

Based on the results of survey data to date and comparison with predicted 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%.

Based on the results of survey data to date and comparison with predicted subsidence parameters, the current subsidence prediction model is considered to be suitable for prediction of subsidence parameters for future longwall extraction at Metropolitan Coal.

***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.

During the reporting period Metropolitan Coal continued to consult with WaterNSW in relation to the monitoring of subsidence movements at the Waratah Rivulet gauging station. In December 2015 Metropolitan Coal implemented a program for more closely spaced subsidence monitoring at Pool Q.

While subsidence is predicted to occur in Pool Q, there is considered to be a very low risk of impact to Rock Bar Q, resulting in changes in flow path or surface water diversion due to the extraction of Longwalls 23-27. Notwithstanding, a Contingency Plan has been developed in the event the Waratah Rivulet flow gauging station is subjected to subsidence impacts which render it unsuitable for its primary purpose.

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 Subsidence Monitoring Program. 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).

***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 Biodiversity Management Plan, an assessment 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 has been conducted.

The assessment of subsidence effects included assessment of the Freeway Line and the Transmission Line (Figure 7), which are located between the Endangered Ecological Community and Longwalls 23-27, and which are detailed in Appendix A. The results of the assessment indicate that the subsidence parameters to the east of Longwalls 23-27 were as predicted or less than those predicted for the reporting period.

### 6.1.2 Water Management

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

The Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Water Management Plans were revised during the reporting period in accordance with Condition 4, Schedule 7 of the Project Approval (post submission of the Metropolitan Coal 2015 Annual Review and following the completion of the DP&E review process of the improved water quality performance indicator assessment methods).

Hydro Engineering & Consulting (2017) and HydroSimulations (2017) have reviewed the environmental performance of the Project in relation to surface water and groundwater in the underground mining area and surrounds for the reporting period. The reports prepared in support of this Metropolitan Coal 2016 Annual Review are provided in Appendices B and C, respectively. The surface water and groundwater monitoring locations are shown on Figures 8 to 12.

***Stream Features***

Visual and photographic surveys are conducted monthly when mining is 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 are also conducted within three months of the completion of each longwall.

The visual and photographic surveys conducted within three months of the completion of each longwall provide a detailed photographic record of stream features. A detailed photographic record of the Waratah Rivulet, Eastern Tributary, Tributary A and Tributary B was conducted within three months of Longwall 25 completion and Longwall 26 completion.

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 reporting 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.

The visual and photographic surveys also noted minor scouring along streams with alluvial deposits, as a result of high water flows following heavy rainfall events in January and June 2016.

**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** | No new cracking upstream of the Longwall 23 maingate on the Waratah Rivulet was observed during the reporting period. |
| **Surface Flow/ Pool Water Levels** | Compared to the December 2015 inspection (following the completion of Longwall 24), a reduction in surface flow/pool water levels was noted along the Waratah Rivulet in May 2016 (following the completion of Longwall 25) and in October 2016 (following the completion of Longwall 26) as a result of the prevailing climatic conditions.<br>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 9 and Appendix D). The monitoring results are discussed in the section titled *Pool Water Levels* and Appendix B. |
| **Iron Staining/ Flocculent** | Iron staining/flocculent continues 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 K (February 2016) and Pool L (January to December 2016). Gas releases occurred for the first time in Pool J (February to April 2016). 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 reporting period. |
| **Surface Flow/ Pool Water Levels** | Compared to the December 2015 inspection (following the completion of Longwall 24), a reduction in surface flow/pool water levels was noted along the Waratah Rivulet in May 2016 (following the completion of Longwall 25) and in October 2016 (following the completion of Longwall 26) as a result of the prevailing climatic conditions.<br><br>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 9 and Appendix D). The monitoring results are discussed in the section titled *Pool Water Levels* and Appendix B. |
| **Iron Staining/ Flocculent** | No change in iron staining observed between Pools P to W on the Waratah Rivulet as a result of mining during the reporting 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 (February to December 2016). Gas releases were observed for the first time in Pool U (August to December 2016) and in Pool W (January to May 2016, October 2016) on the Waratah Rivulet. No environmental effects resulting from the gas releases (such as riparian vegetation dieback or dead fish) have been observed.<br><br>During the reporting period, the performance indicator, *No gas releases observed at Pools Q to W on the Waratah Rivulet,* was exceeded for Pool W in the first six months of the reporting period, and exceeded for Pools U and W in the second six months of the reporting period.<br><br>The exceedances triggered assessments 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**).* The assessments were conducted by Associate Professor Barry Noller (The University of Queensland, 2016; 2017) and concluded the performance measure in relation to gas releases had been met (The University of Queensland, 2016; 2017). The assessments are provided in Appendix E.<br><br>The performance measure assessments by Associate Professor Barry Noller have been subject to peer review in accordance with the Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Water Management Plans. The peer reviews conducted by Dr Ross Sadler (Griffith University, 2016; 2017) are provided in Appendix F. The peer reviews also concluded the Waratah Rivulet gas release performance measure had been met. |
| **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** | From January to June 2016 new cracking upstream of the Longwall 26 maingate on the Eastern Tributary was observed at Pool ETN and at Pool ETO (location of stream features shown in Appendix D). From July to December 2016, additional cracking was observed at Pool ETN, Pool ETO and rock bar ETZ, and cracking was observed for the first time at boulderfield ETX, rock bar ETY and rock bar ETAD (location of stream features shown in Appendix D). |
| **Surface Flow/ Pool Water Levels** | A number of pools were observed to be dry on occasions upstream of the Longwall 26 maingate on the Eastern Tributary (in particular, in April/May 2016 and November/December 2016).<br>At the time of the May 2016 visual inspection (following the completion of Longwall 25), pools that were observed to be dry (or dry in part) included Pools ETJ, ETL, ETM, ETN, ETU, ETV, ETW, ETX, ETY and ETZ (location of pools shown in Appendix D). At the time of the October 2016 visual inspection (following the completion of Longwall 26), many of the pools contained water, however, Pools ETL, ETM and ETZ were noted to be dry (location of pools shown in Appendix D).<br>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 9). The monitoring results are discussed in the section titled *Pool Water Levels* and in Appendix B. |
| **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. In particular, iron staining was observed to increase over the reporting period in the reach from Pool ETU to Pool ETAF (locations of pools shown in Appendix D). |
| **Gas Releases** | No gas releases have been observed on the Eastern Tributary upstream of the Longwall 26 maingate. |
| **Water Discoloration/ Opacity** | Orange in colour where iron staining occurred. Pools along the Eastern Tributary observed with a green opacity. |

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

| Stream Feature | Summary of Observations |
|---|---|
| **Surface Cracking** | Cracking downstream of maingate 26 was observed from September to December 2016 on pool and rock bar ETAH, on rock bars ETAN and ETAO, and in pool ETAM (location of stream features shown in Appendix D). As at 17 January 2017, cracking of stream features had been recorded from Pool ETAH downstream to rock bar ETAQ (location of stream features shown in Appendix D). |
| **Surface Flow/ Pool Water Levels** | The pools on the Eastern Tributary downstream of the Longwall 26 maingate have been visually inspected by Metropolitan Coal and photographed to observe whether any changes to the natural drainage behaviour of the pools has occurred.<br><br>From January to June 2016, there were no observed changes in the natural drainage behaviour of pools. 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.]<br><br>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 is provided in Section 12.1.<br><br>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 9 and Appendix D). The monitoring results are discussed in the section titled *Pool Water Levels* and in Appendix B. |
| **Iron Staining/ Flocculent** | Iron staining/flocculent has progressively increased on the Eastern Tributary downstream of the Longwall 26 maingate over the reporting period. 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 is provided in Section 12.1. |
| **Gas Releases** | Gas releases were observed for the first time on the Eastern Tributary in Pool ETAL (January to March 2016) and Pool ETAM (January to June 2016) (location of pools shown in Appendix D). 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. No gas releases were observed on the Eastern Tributary from July to December 2016.<br><br>The performance indicator for the Eastern Tributary, *Gas releases observed over less than 30% of the between the full supply level of the Woronora Reservoir and Pool ETAF,* was not exceeded, however consideration of the gas releases at Pools ETAL and ETAM was made in the assessment conducted for Pool W by Associate Professor Barry Noller (The University of Queensland, 2016) (provided in Appendix E). |
| **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** | On Tributary A, some additional surface cracks were recorded by the visual inspections and photographic mapping. The cracking observed did not appear to be recent (i.e. likely to have occurred prior to 2016). Some of the cracking was not previously evident due to higher pool water levels. Cracking on Tributary A is documented in the end of longwall stream mapping. |
| **Surface Flow/ Pool Water Levels** | Compared to the December 2015 inspection (following the completion of Longwall 24), a reduction in surface flow/pool water levels was noted along Tributary A in May 2016 (following the completion of Longwall 25) and in October 2016 (following the completion of Longwall 26). No surface flow was observed (i.e. standing water was present) at a number of locations including at Pools TA-F, TA-G, TA-J, TA-K and TA-O and at the rock bars and/or boulderfields downstream of Pools TA-J and TA-O (location of pools shown in Appendix D). In addition to reduced surface flow, some locations were noted to be dry, including Pools TA-I and TA-L and the boulderfield downstream of Pool TA-I (location of pools shown in Appendix D). |
| **Iron Staining/ Flocculent** | Iron staining/flocculent continued to be present in sections of Tributary A, in particular at the boulderfields downstream of Pools TA-H and TA-R (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** | On Tributary B, new cracking was observed on the rock bar of Pool TB-AL during the reporting period (by the end of Longwall 26 stream mapping) (location of Pool TB-AL shown in Appendix D). Surface cracking observed on Tributary B is documented in the end of longwall stream mapping. |
| **Surface Flow/ Pool Water Levels** | At the time of the end of Longwall 25 and end of Longwall 26 stream mapping inspections, 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).<br>Water levels in pools on Tributary B (at water level sites RTP1 and RTP2, Figure 9) have been monitored using a continuous water level sensor and logger. The monitoring results are discussed in the section titled *Pool Water Levels* and in Appendix B. |
| **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. |
| **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 and Longwalls 23-27 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 Longwalls 20-22 and Longwalls 23-27 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 Longwalls 20-22 and Longwalls 23-27 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. During the reporting period, the results of monitoring of pool drainage behaviour and pool water levels were consistent with the potential subsidence impacts and environmental consequences described in the Project EA, Preferred Project Report and Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Water Management Plans.

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 (as described in Section 12.1). The results for the Eastern Tributary 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) (to January 2017) 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. The Eastern Tributary Incident is discussed further in Section 12.1.

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 Longwalls 20-22 and Longwalls 23-27 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 6.1.3.

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 reporting period indicates the Waratah Rivulet subsidence impact performance measure has been met. As described in Table 10, iron staining/flocculent has progressively increased on the Eastern Tributary downstream of the Longwall 26 maingate over the reporting period. 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. A summary of the Eastern Tributary Incident is provided in Section 12.1.

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 Longwalls 20-22 and Longwalls 23-27 Water Management Plans recognised there was the potential for gas releases to occur.

Assessments of gas releases in Pools U and W on the Waratah Rivulet during the reporting period (provided in Appendix E) indicate the Waratah Rivulet subsidence impact performance measure has been met (The University of Queensland, 2016; 2017). The performance measure assessments have been subject to peer review in accordance with the Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Water Management Plans. The peer reviews (provided in Appendix F) also concluded the Waratah Rivulet subsidence impact performance measure had been met in relation to gas releases.

***Surface Water Flow***

Waratah Rivulet stream flow data (GS 2132102, Figure 9) 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 20$^{th}$ percentile of the baseline data. Chart 2 indicates that the 12 month sliding median has not fallen below the 20$^{th}$ percentile value.

Surface water flow monitoring at the Waratah Rivulet, Woronora River (Figure 9) and O'Hares Creek gauging stations indicates there has been a negligible reduction in the quantity of water resources reaching the Woronora Reservoir.

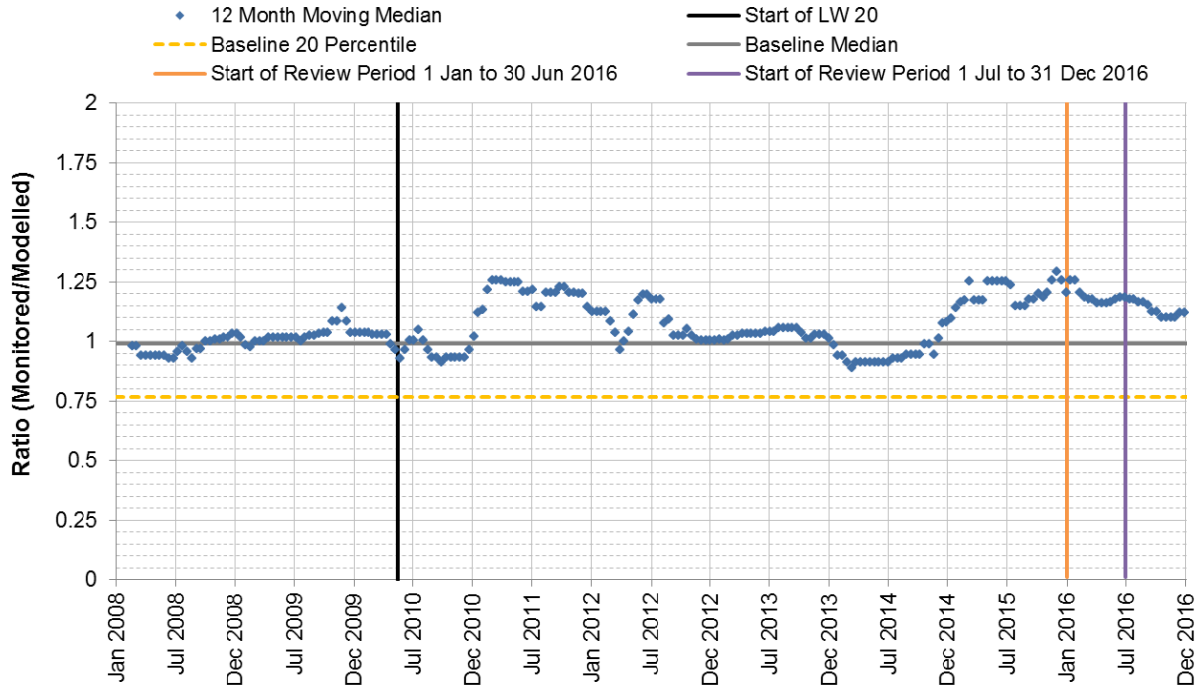



**Chart 2 One Year Sliding Median for the Ratios of the 14 Day Sums of Monitored and Modelled Flow Rates at Waratah Rivulet (GS 2132102)**

Analysis of Eastern Tributary stream flow data (GS 300078, Figure 9) for the reporting period indicates that flows reaching the Woronora Reservoir have not been affected by mining (Chart 3). Chart 3 shows the flow monitoring data that is available since gauging station construction in September 2012 compared to model predictions. The results indicate that flow has been continuous at the gauging station and that it has been consistent with model predictions. This indicates that flows reaching the Woronora Reservoir have not been affected by mining (Appendix B).

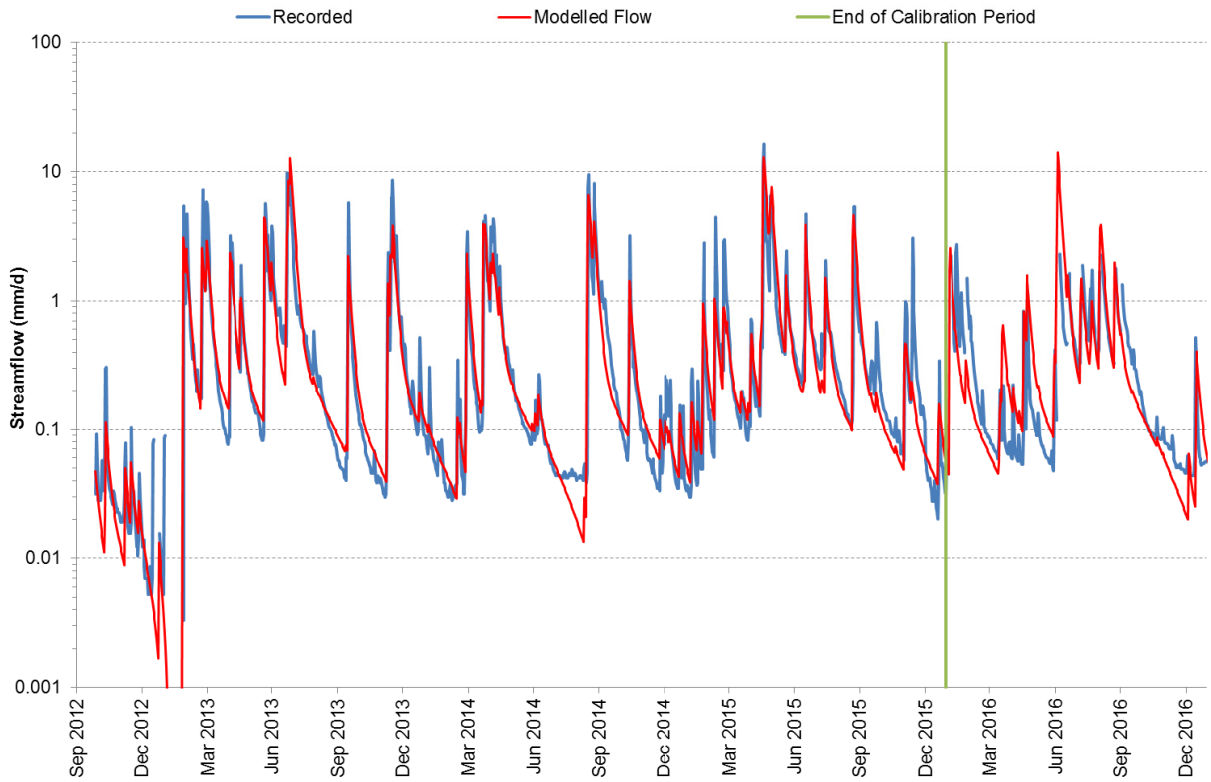



**Chart 3 Monitored and Model Predicted flows – Eastern Tributary Upstream of Woronora Reservoir**

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.

### *Pool Water Levels*

The water level in a number of pools on the Waratah Rivulet, Eastern Tributary, Tributary B and Woronora River (Figure 9) has been either manually monitored on a daily basis[2] or monitored using a continuous water level sensor and logger.

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

During the reporting 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[3,4]. Pool A water levels fell to or below the pool's cease to flow level for the period 24 November to 31 December 2016 (Figure 9, Chart 4). Metropolitan Coal's visual inspections indicate Pool A ceased overflowing on most occasions it was inspected during December 2016. To date, 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).

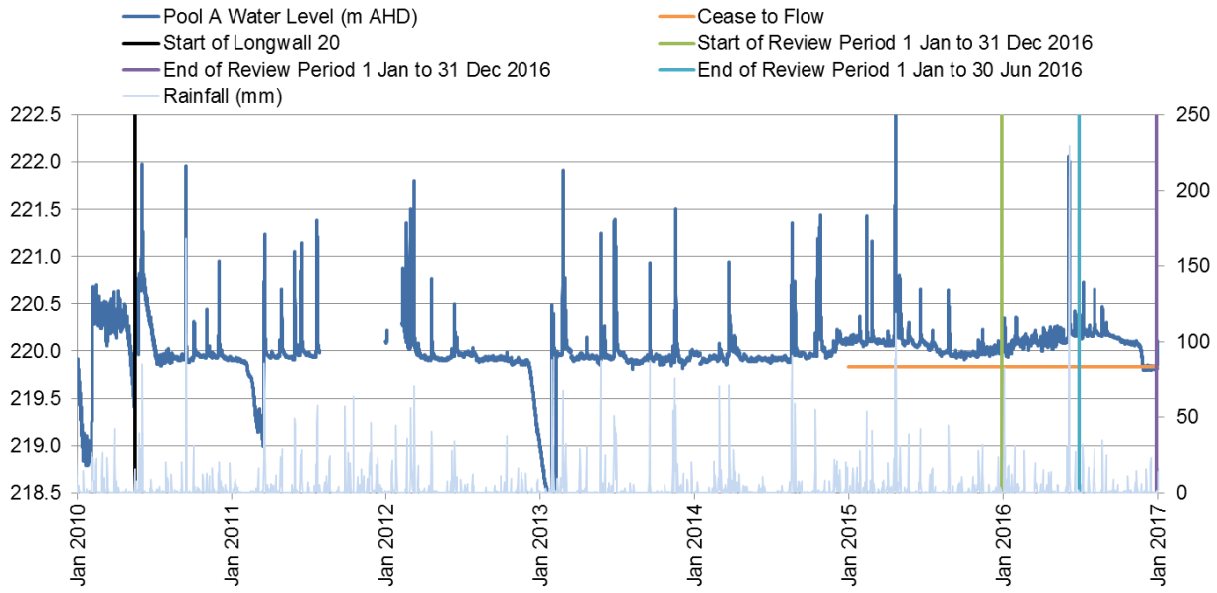



**Chart 4 Pool A Waratah Rivulet**

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 9). Pools ETG, ETJ, ETM, ETU, ETW, ETAH, ETAI and ETAQ on the Eastern Tributary were below their cease to flow levels or below their historical low water levels during the reporting period (Charts 5 to 12, respectively). Pools ETG, ETJ and ETM were impacted by mining during the 2015 reporting period. 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. Pools ETAF and ETAU water levels were consistent with natural behaviour during the reporting period (Appendix B).

[3] The water level in Pool P on the Waratah Rivulet fell below historically recorded water levels during the reporting period, however analysis of recession rates and the shape of the water level hydrograph indicate pool water levels were consistent with natural behaviour (Appendix B). Metropolitan Coal's visual inspections indicate Pool P water levels appeared consistent with natural behaviour on all inspection occasions. It appears there has been a change in the datum levels associated with a change in water level logger housing (Appendix B).

[4] Similarly, recorded water levels fell below historical records at Pool V on two occasions (4 April 2016 and 19 April 2016) during the reporting period (Appendix B). The recorded water level falls were both instantaneous (i.e. occurred in one recorded time interval) and appear to be water level sensor faults with water levels recovering to normal levels on both occasions (Appendix B). Pool water levels were otherwise consistent with natural behaviour (i.e. the pool did not cease to overflow the rock bar). Metropolitan Coal's visual inspections indicate Pool V was overflowing on all inspection occasions.

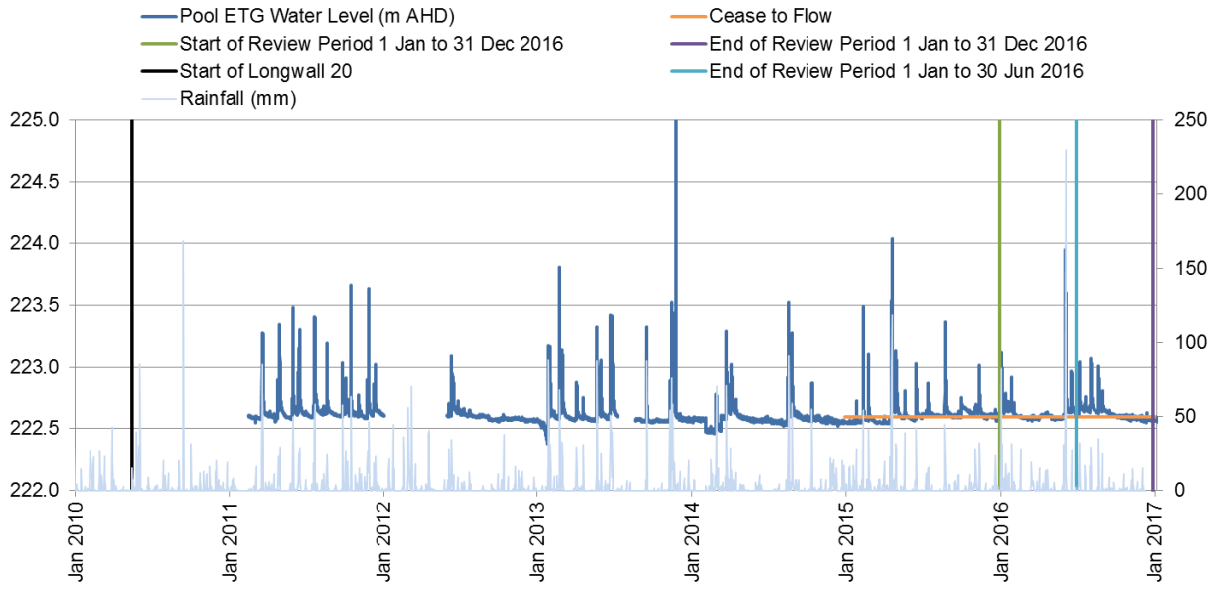



**Chart 5 Pool ETG Eastern Tributary**

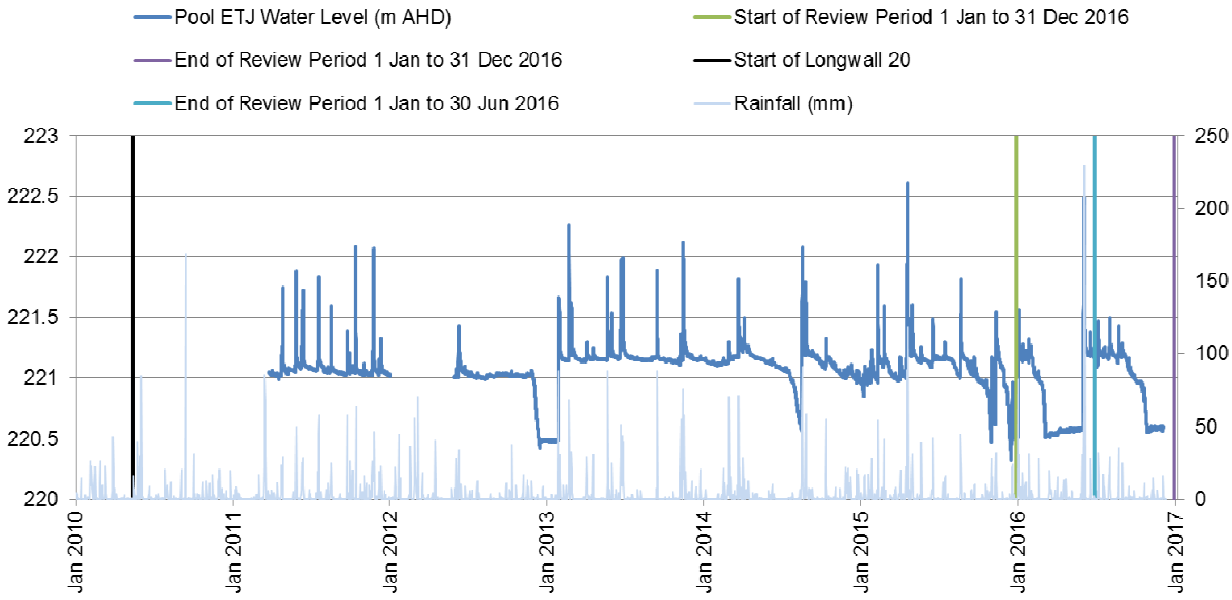



**Chart 6 Pool ETJ Eastern Tributary**

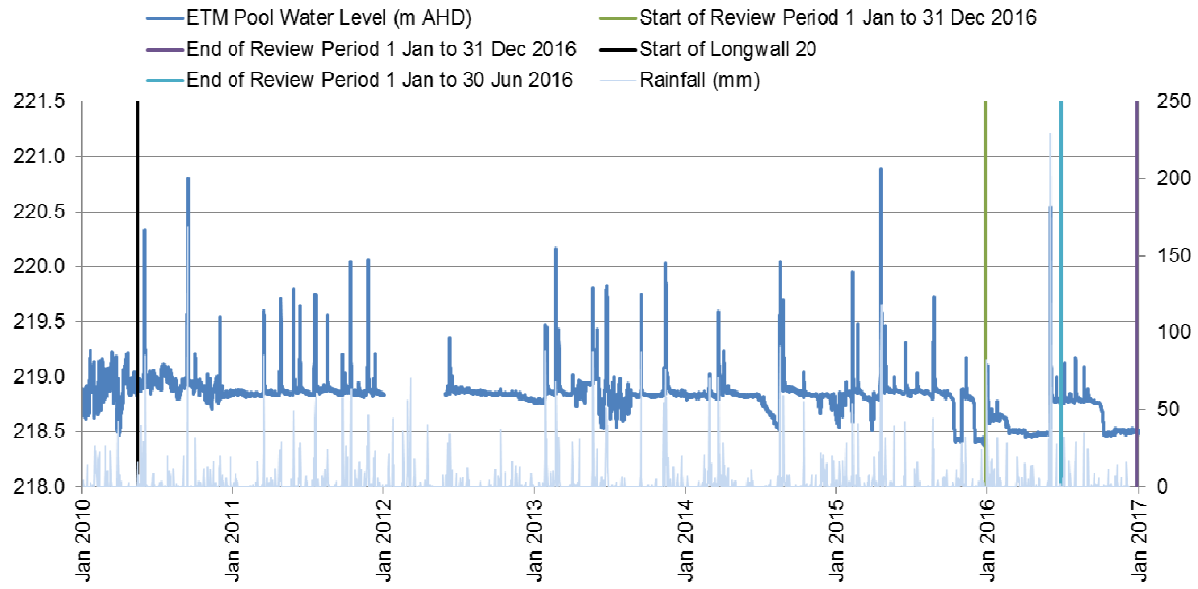



**Chart 7 Pool ETM Eastern Tributary**

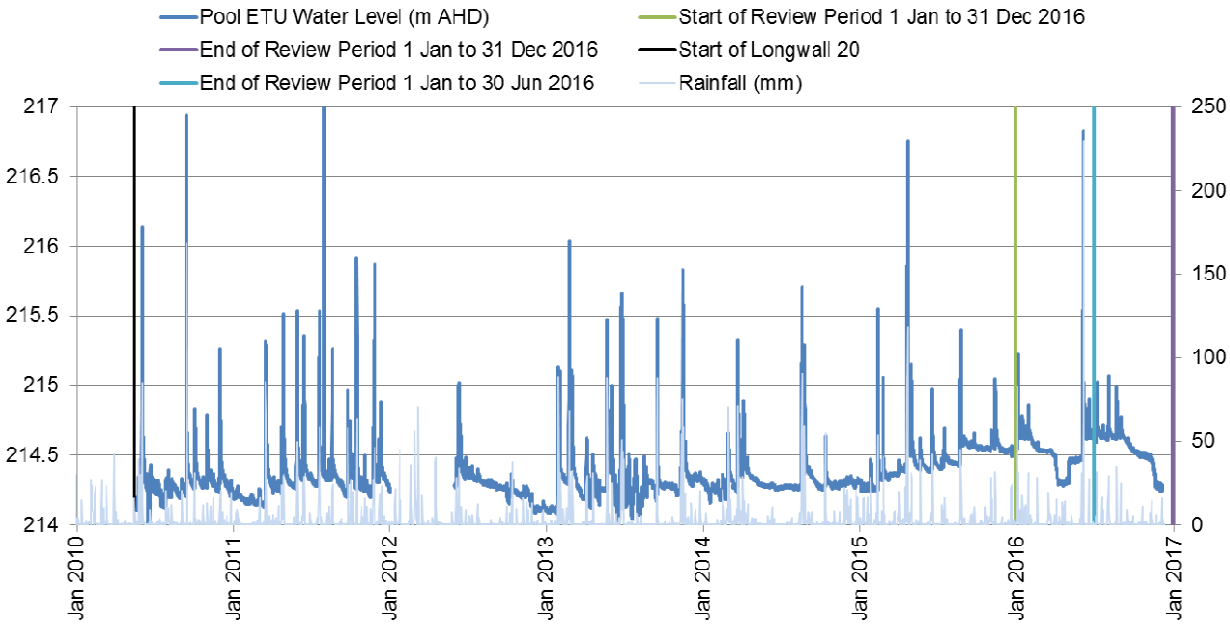



**Chart 8 Pool ETU Eastern Tributary**

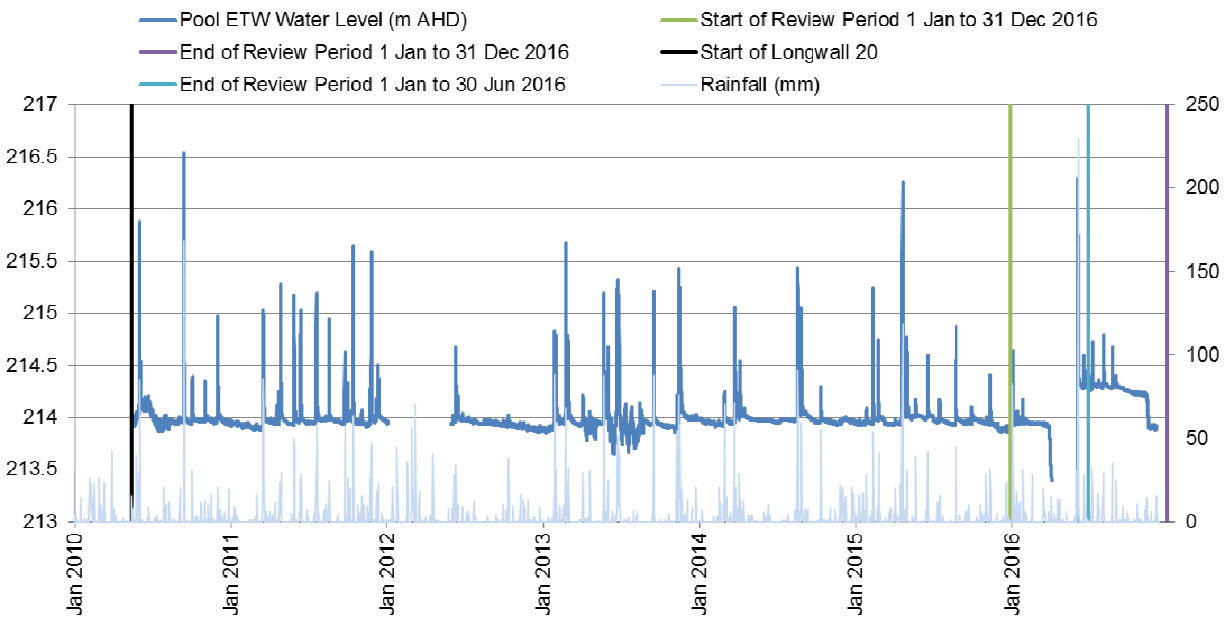



**Chart 9 Pool ETW[5] Eastern Tributary**

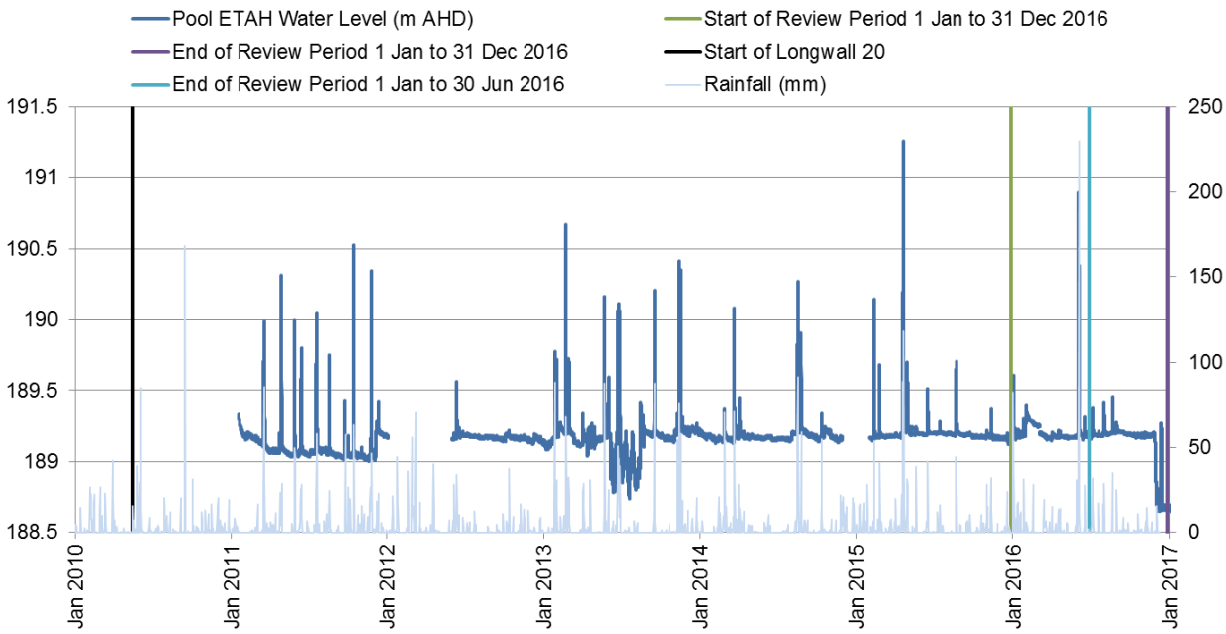



**Chart 10 Pool ETAH Eastern Tributary**

[5] Note, discrepancies in water levels caused by pool being dry and water level sensor being exposed at time of download (Appendix B).

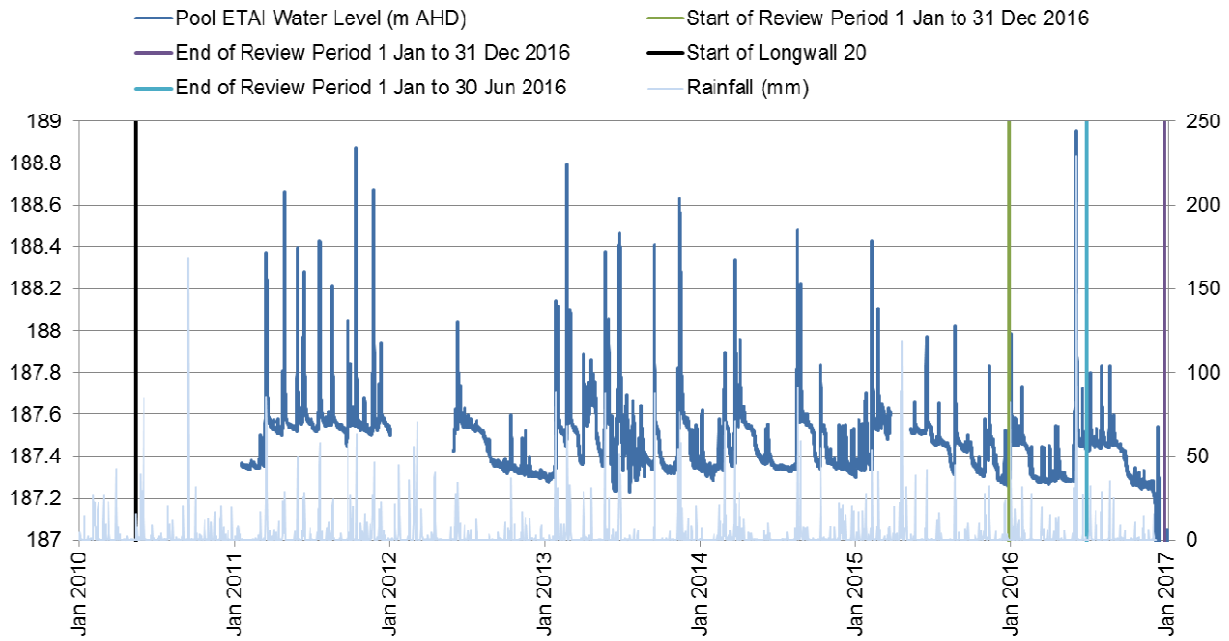



**Chart 11 Pool ETAI Eastern Tributary**

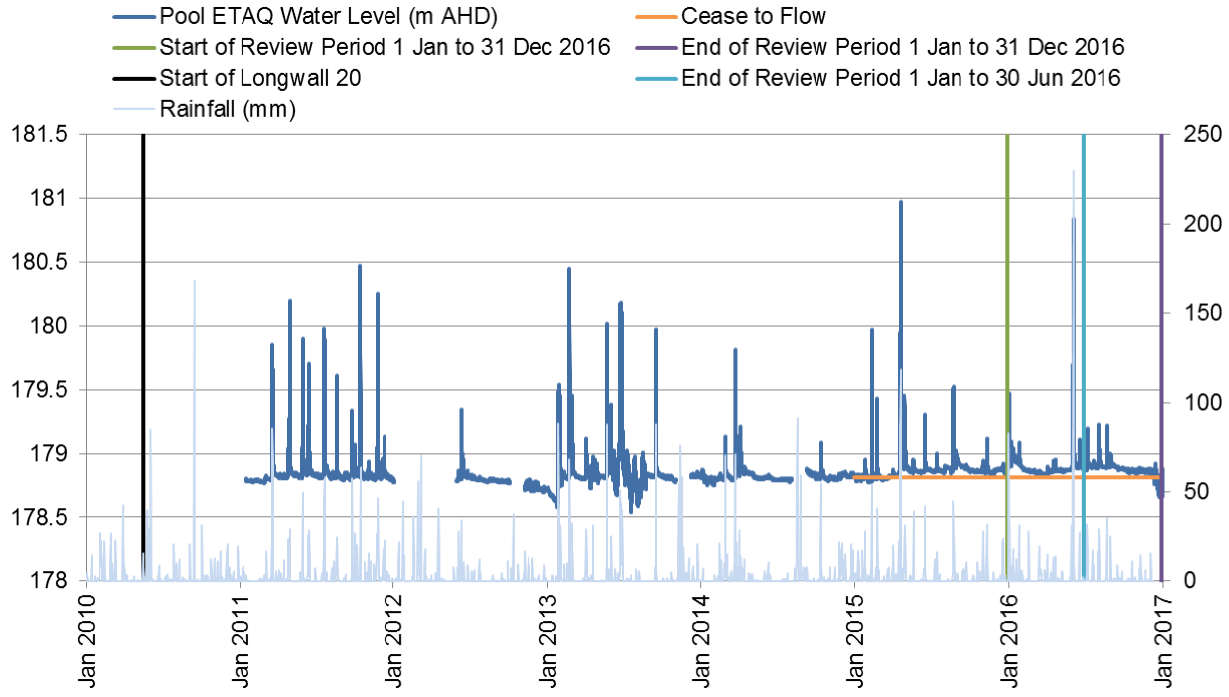



**Chart 12 Pool ETAQ Eastern Tributary**

Pool RTP1 on Tributary B remains typically dry with overflow events limited to significant, wet periods (Appendix B). 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 13). Metropolitan Coal's visual inspections indicate Pool RTP2 has generally been flowing during inspections.

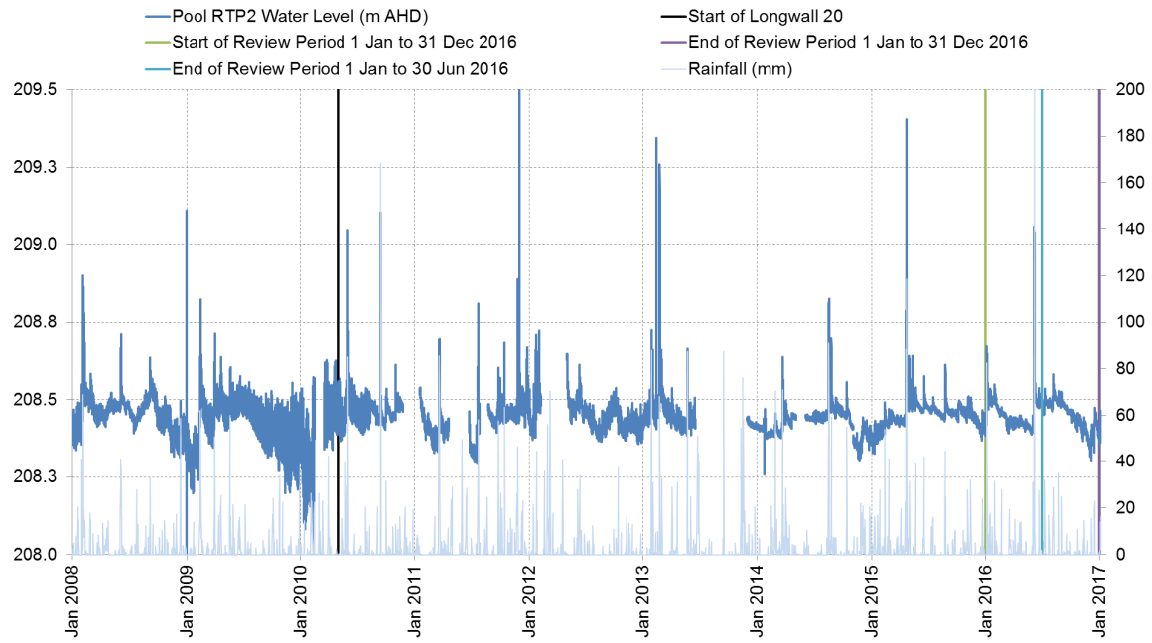



**Chart 13 Pool RTP2 Tributary B**

As described in the *Stream Features* section above, the pool water level monitoring results for the reporting period were consistent with the potential subsidence impacts and environmental consequences described in the Project EA, Preferred Project Report and Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Water Management Plans.

***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) in accordance with the Metropolitan Coal Longwalls 20-22 and 23-27 Water Management Plans (Figure 10).

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.

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 (Appendix B) and shown on Charts 14 to 40.

## 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 14 to 23) | • Upstream sites (e.g. sites WRWQ2 and WRWQ6) - slightly acidic to near neutral pH values.<br>• Middle and lower reach sites (e.g. sites WRWQ8, WRWQR and WRWQT) - higher (slightly alkaline) pH values. | • Some higher concentrations recorded in January 2016 (e.g. 383 µS/cm at WRWQW; 361 µS/cm at WRWQP; 346 µS/cm at WRWQT and 353 µS/cm at WRWQ9).<br>• Spikes were also recorded at WRWQ6 in February 2016 (570 µS/cm) and at WRWQ2 in December 2016 (322 µS/cm).<br>• Concentrations were otherwise generally low and consistent with earlier values. | • Typically low (below 0.5 mg/L) during the reporting period.<br>• Slightly higher concentrations were recorded at some upper and middle reach sites (up to 0.7 mg/L) and at some lower reach sites (up to 0.84 mg/L) in mid 2016. | • Relatively low at upper and middle reach sites during the reporting period. Elevated concentrations were recorded at WRWQ6 in March 2016 (0.24 mg/L) and December 2016 (0.35 mg/L).<br>• Slightly elevated values were recorded at two downstream sites (WRWQP, 0.148 mg/L and WRWQ9, 0.134 mg/L) in March 2016. | • A spike in concentration was recorded in January 2016 at WRWQ2 (0.16 mg/L) and WRWQ6 (0.12 mg/L).<br>• An elevated value was also recorded at WRWQW (0.19 mg/L) in June 2016. |
| Woronora River (sites WOWQ1 and WOWQ2, control stream) (Charts 24 to 29) | • High variability in pH, typically slightly acidic. | • Elevated concentrations recorded at WOWQ1 and WOWQ2 in January (308 µS/cm and 316 µS/cm, respectively) and March 2016 (318 µS/cm and 671 µS/cm, respectively). | • Generally low and similar to values recorded in Waratah Rivulet. | • Typically low concentrations. | • Typically low concentrations. |

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

| Stream(s) | pH | Electrical Conductivity | Dissolved Iron | Dissolved Manganese | Dissolved Aluminium |
|---|---|---|---|---|---|
| Eastern Tributary (sites ETWQF, ETWQJ, ETWQN, ETWQU, ETWQW, ETWQAF, ETWQAH, ETWQAQ and ETWQAU) (Charts 30 to 35) | • Variable but typically near neutral pH values. | • Some elevated concentrations, with the highest concentration of 410 µS/cm recorded at ETWQF in November 2016. | • Concentrations generally increased over the second half of 2016, particularly at ETWQAQ (6.99 mg/L and 6.47 mg/L in November and December 2016, respectively).<br>• Lesser, but elevated values of 3.38 mg/L and 2.31 mg/L recorded at ETWQJ and ETWQAF in November and December 2016, respectively.<br>• Elevated concentrations in mid to late 2016 corresponded with a period of low flow and mine subsidence impacts to a number of pools. | • Concentrations increased in 2016, with elevated concentrations recorded at a number of sites.<br>• The elevated manganese concentrations from mid to late 2016 corresponded with a period of low flow and mine subsidence impacts to a number of pools.<br>• The highest concentrations recorded (in order of upstream to downstream) were:<br>– 0.508 mg/L at ETWQU in May 2016;<br>– 0.304 mg/L at ETWQW in March 2016;<br>– 0.269 mg/L at ETWQAH in October 2016;<br>– 0.63 mg/L at ETWQAF in December 2016;<br>– 0.727 mg/L at ETWQAQ in November 2016; and<br>– 0.394 mg/L at ETWQAU in December 2016. | • Typically low concentrations. |
| Bee Creek (site BCWQ1, control stream), Honeysuckle Creek (site HCWQ1, control stream), Far Eastern Tributary (site FEWQ1), Tributary B (site RTWQ1) and Un-named Tributary (site UTWQ1) (Charts 36 to 40) | • Bee Creek and Honeysuckle Creek - variable to slightly acidic pH levels.<br>• Far Eastern Tributary, Tributary B and Tributary D - near neutral pH levels. | • Generally low, with the exception of Tributary B.<br>• Tributary B - variable and periodically elevated since late 2013; this trend has continued.<br>• A higher value was recorded at BCWQ1 in January 2016 (365 µS/cm). | • Generally low and consistent with or lower than historical values, with the exception of UTWQ1 in August 2016 (1.88 mg/L). | • Generally low concentrations. | • Low concentrations at Tributary B, Un-named Tributary and Far Eastern Tributary.<br>• Bee Creek and Honeysuckle Creek - higher (in relation to other tributary sites) over the period of record. This trend continued during most of the reporting period.<br>• Highest concentration at Bee Creek in March 2016 (0.51 mg/L). |

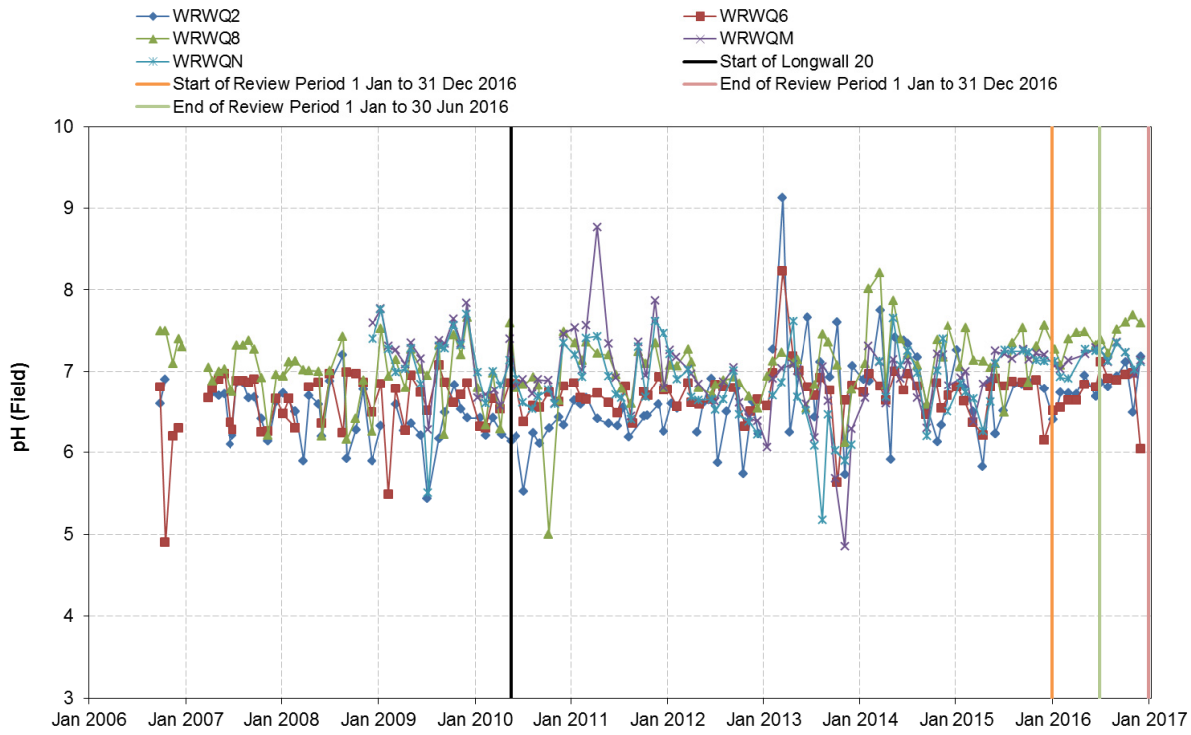



**Chart 14 pH Levels Waratah Rivulet – Upper to Middle Reach Sites**

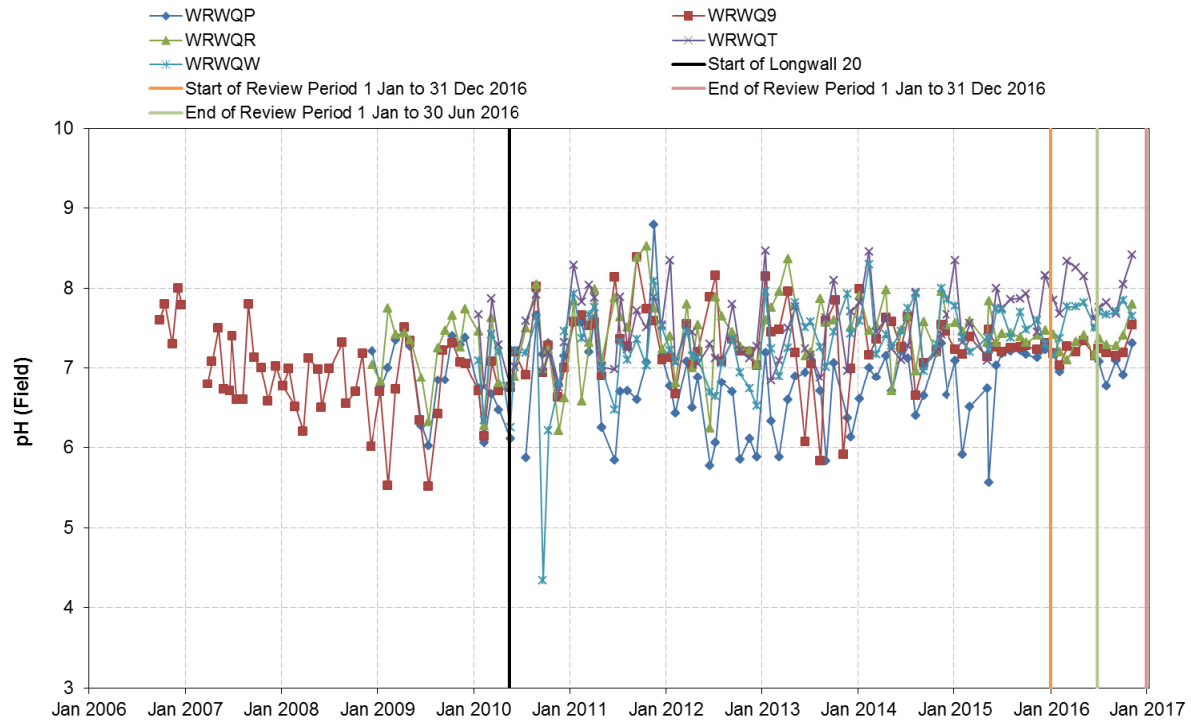



**Chart 15 pH Levels Waratah Rivulet – Lower Reach Sites**

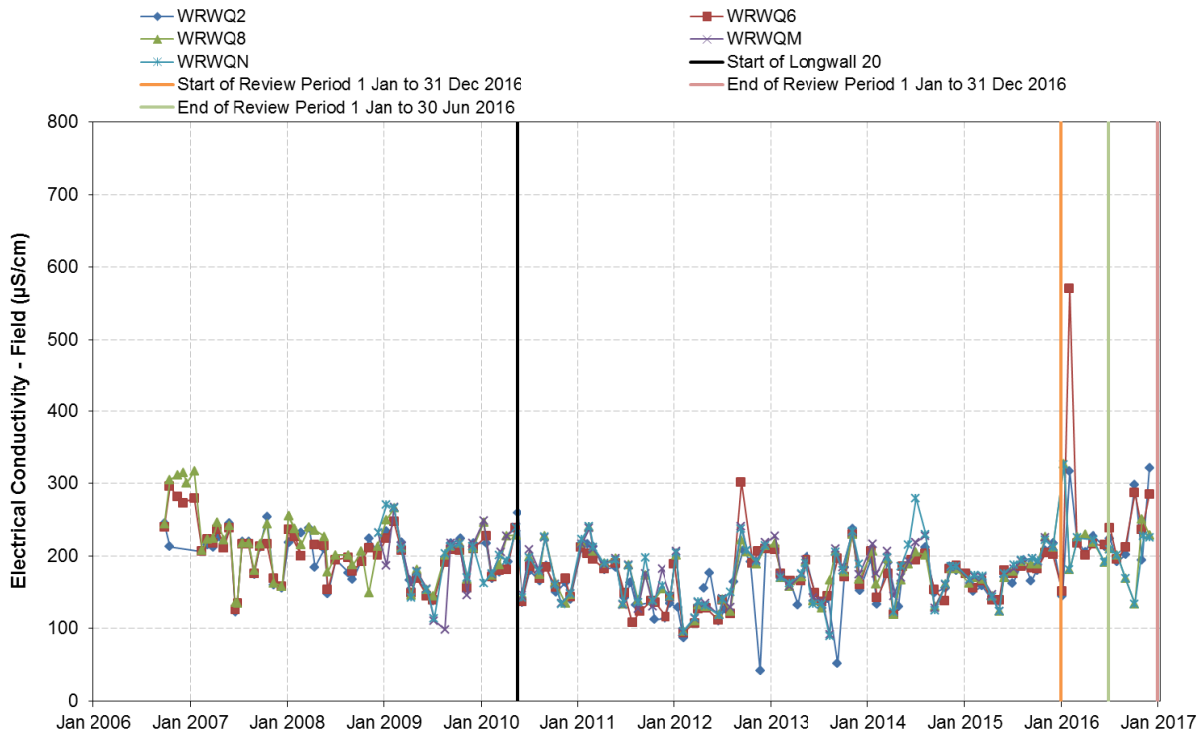



**Chart 16 Electrical Conductivity (EC) Waratah Rivulet – Upper to Middle Reach Sites**

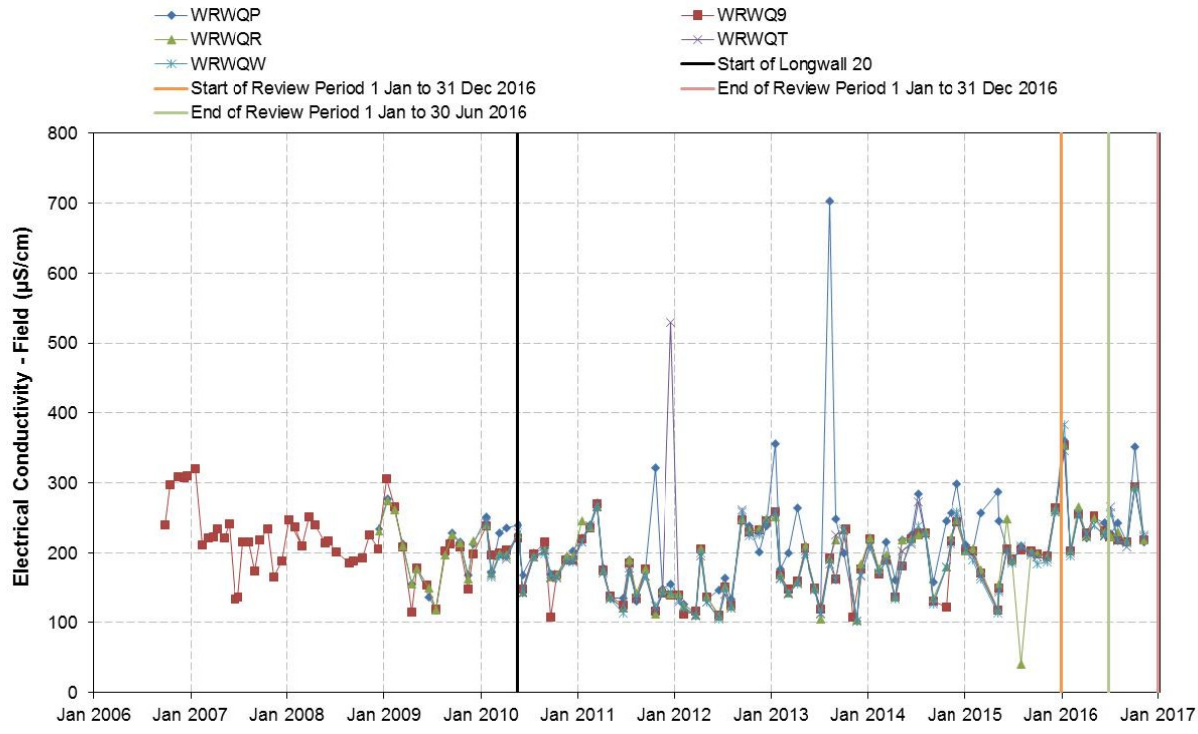



**Chart 17 Electrical Conductivity (EC) Waratah Rivulet – Lower Reach Sites**

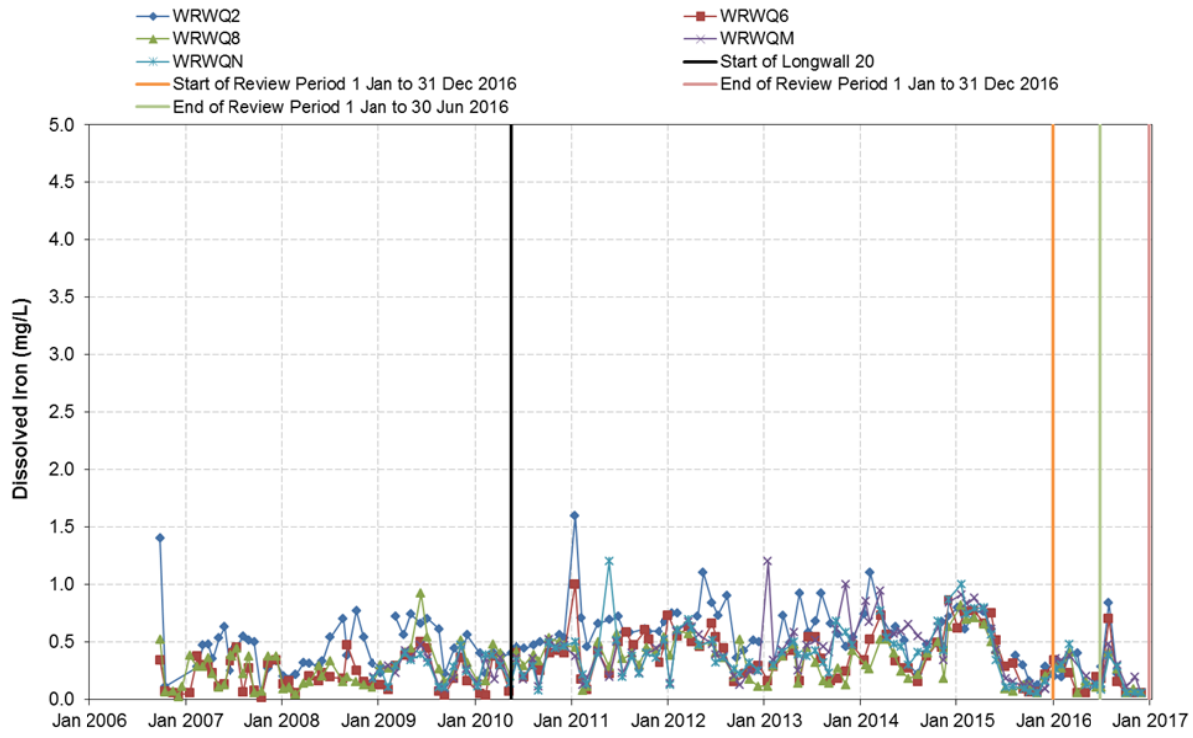



**Chart 18 Dissolved Iron Waratah Rivulet – Upper and Middle Reach Sites**

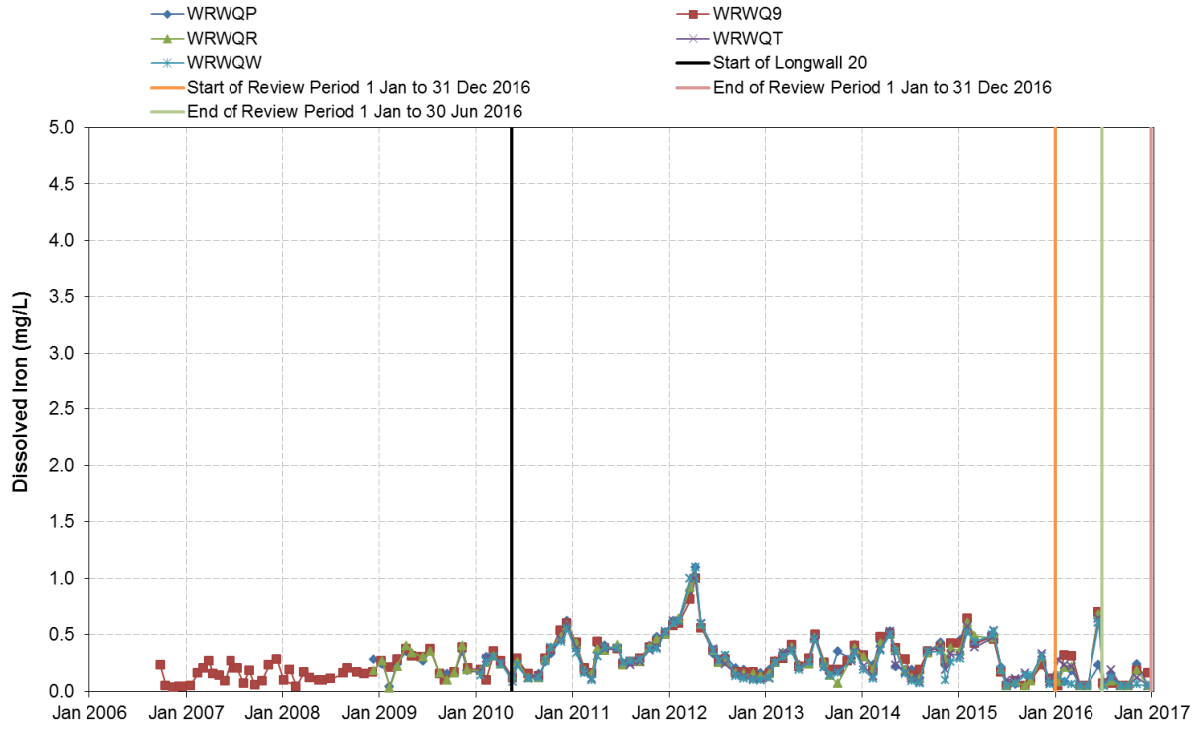



**Chart 19 Dissolved Iron Waratah Rivulet – Lower Reach Sites**

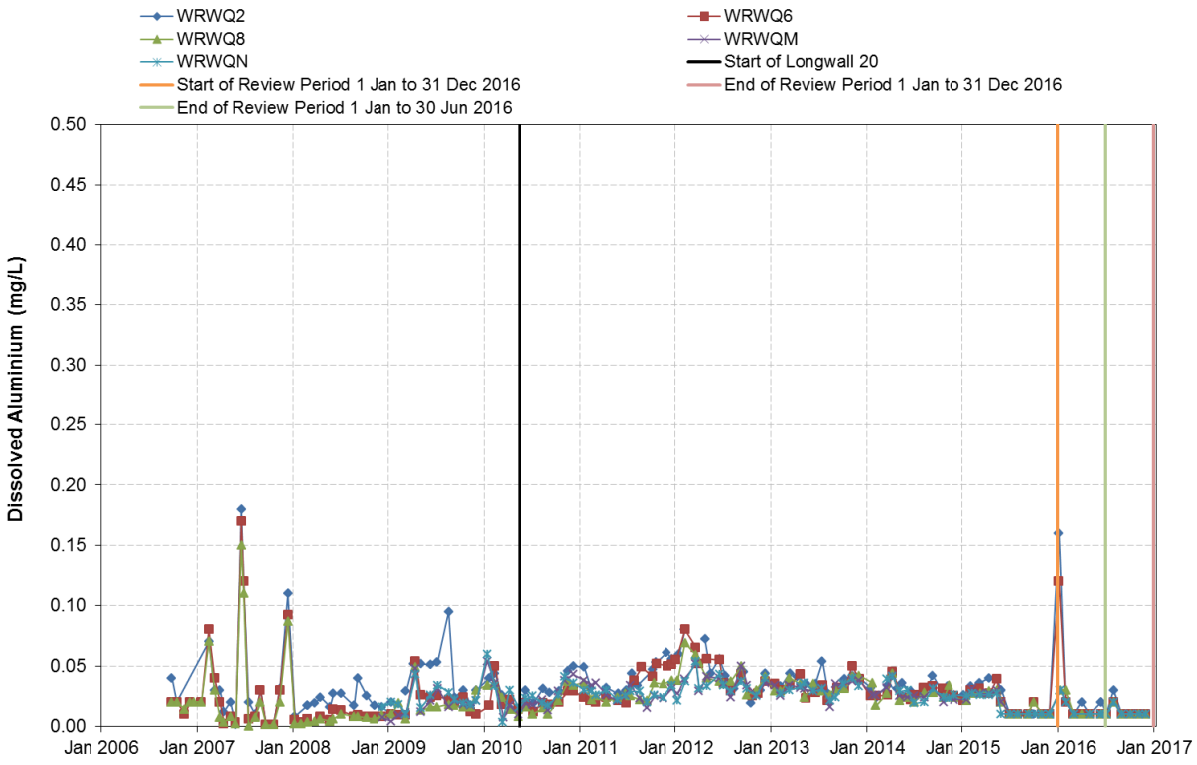



**Chart 20 Dissolved Aluminium Waratah Rivulet – Upper to Middle Reach Sites**

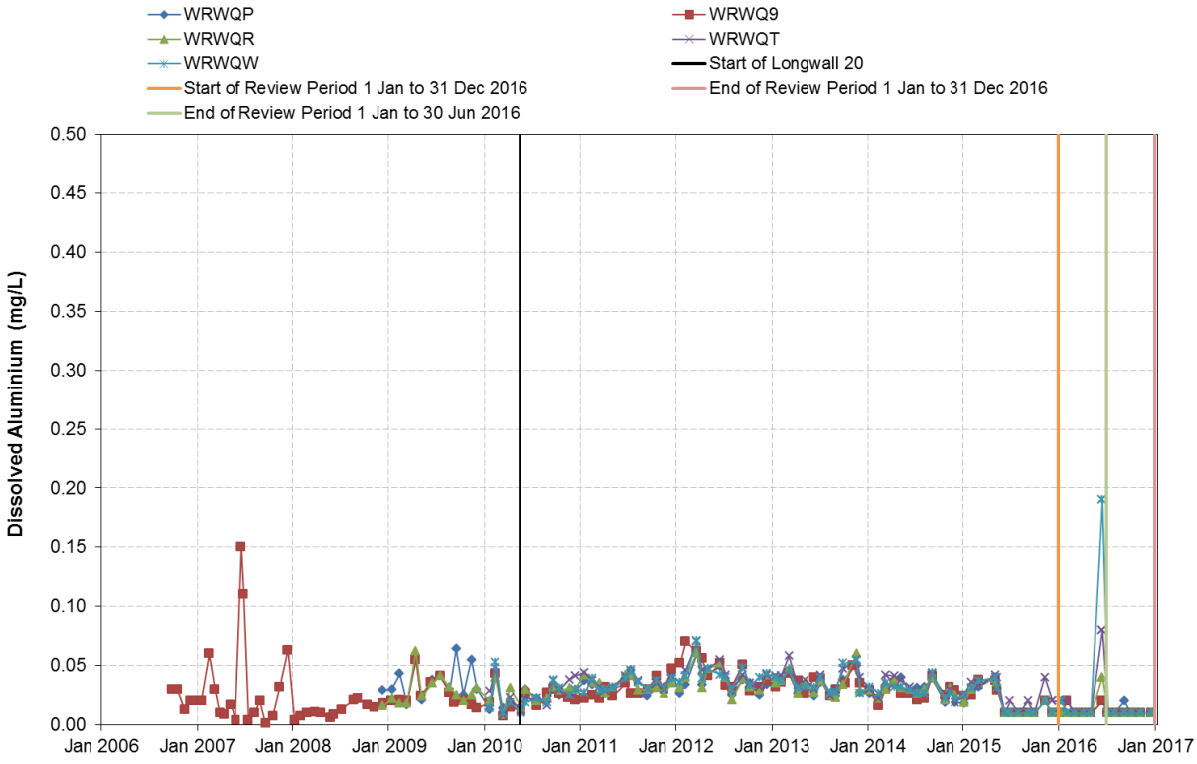



**Chart 21 Dissolved Aluminium Waratah Rivulet – Lower Reach Sites**

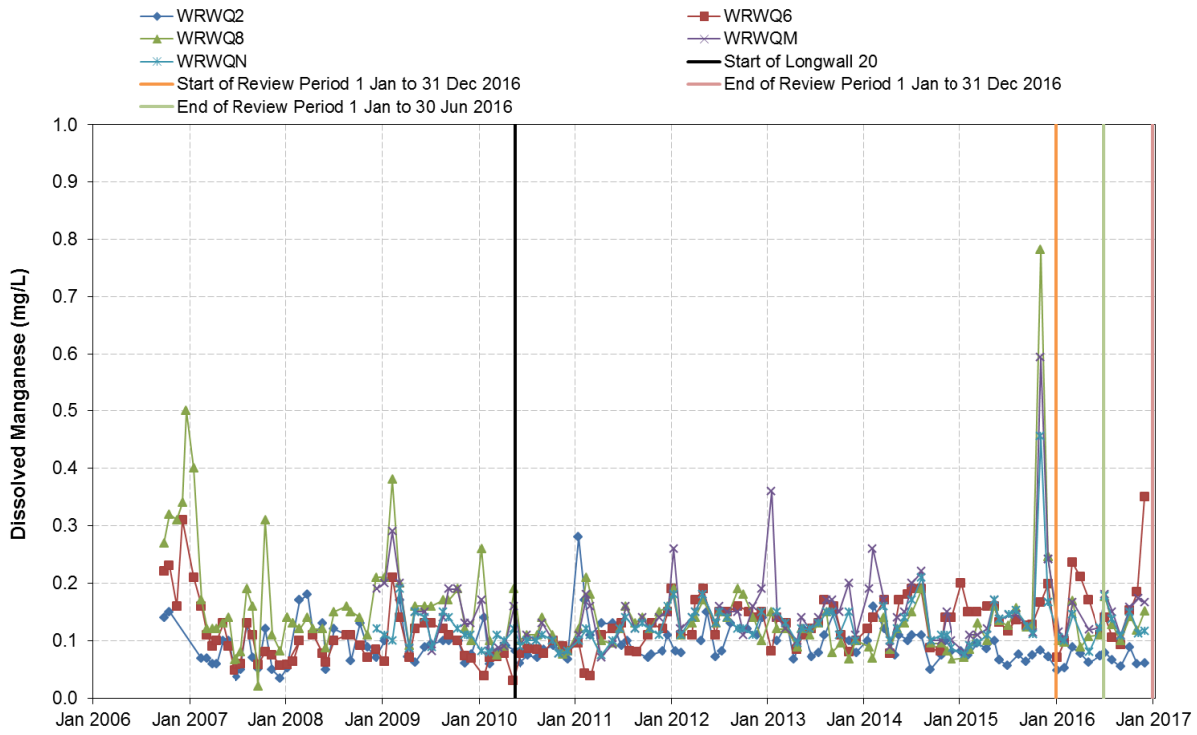



**Chart 22 Dissolved Manganese Waratah Rivulet – Upper to Middle Reach Sites**

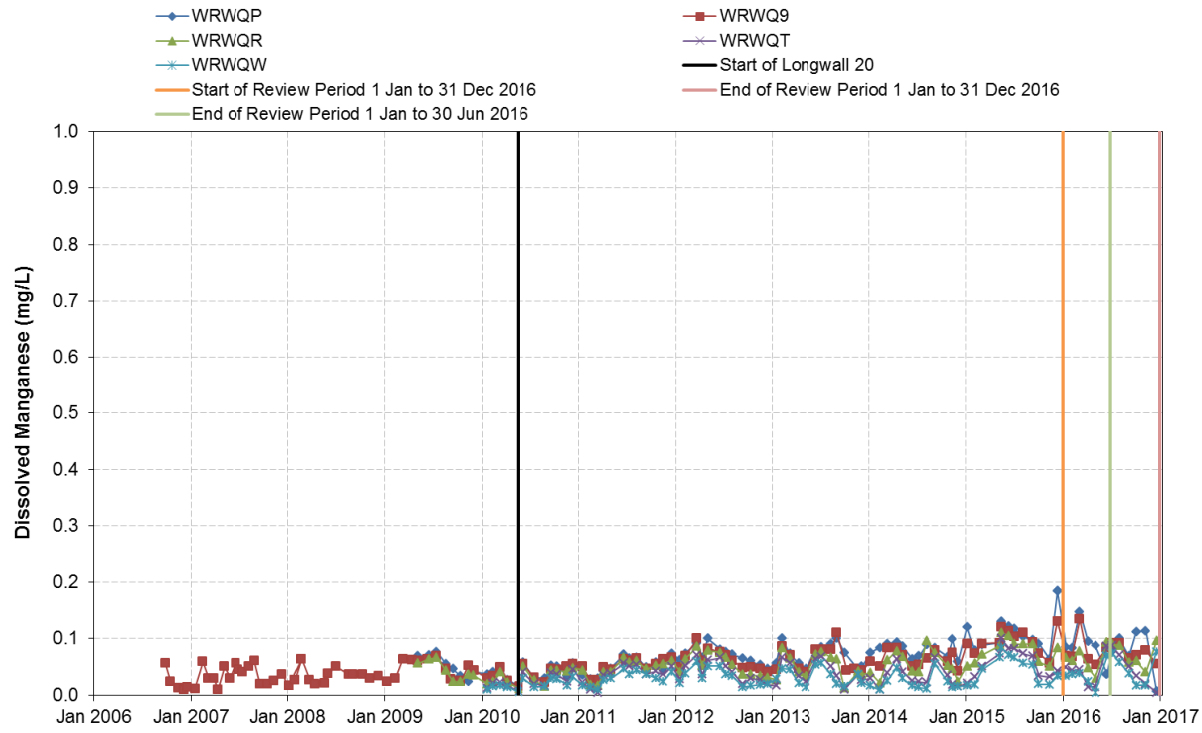



**Chart 23 Dissolved Manganese Waratah Rivulet – Lower Reach Sites**

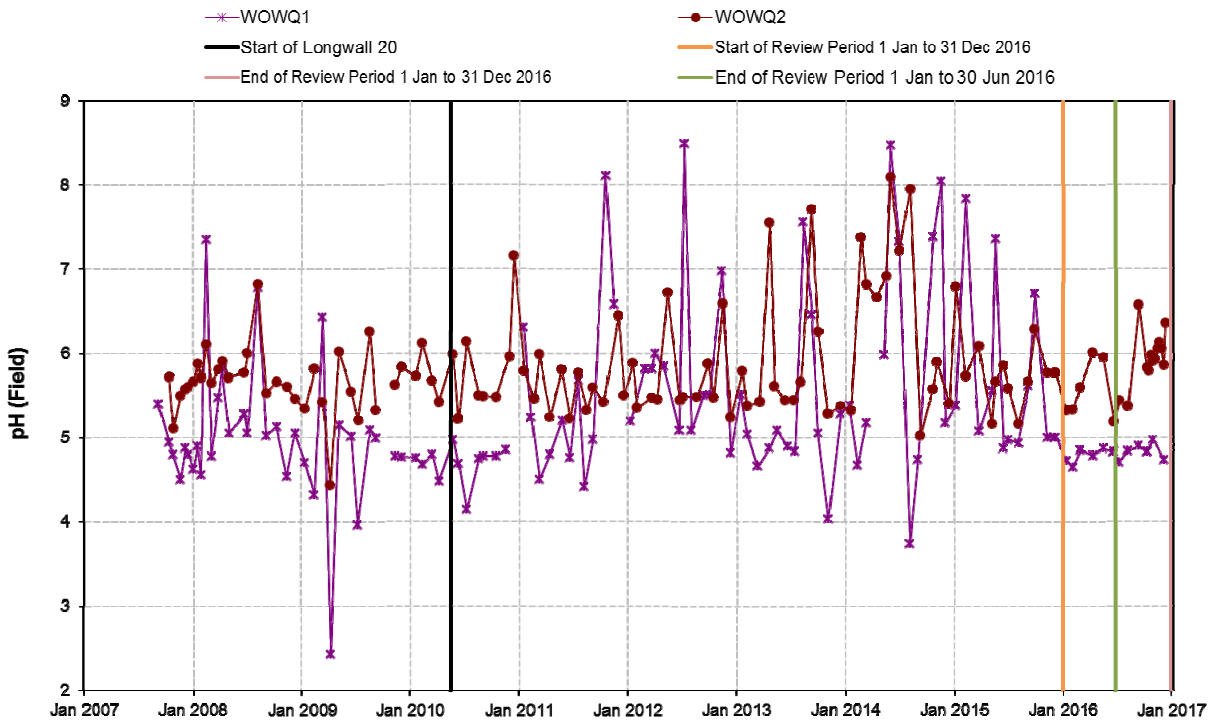



**Chart 24 pH Levels Woronora River**

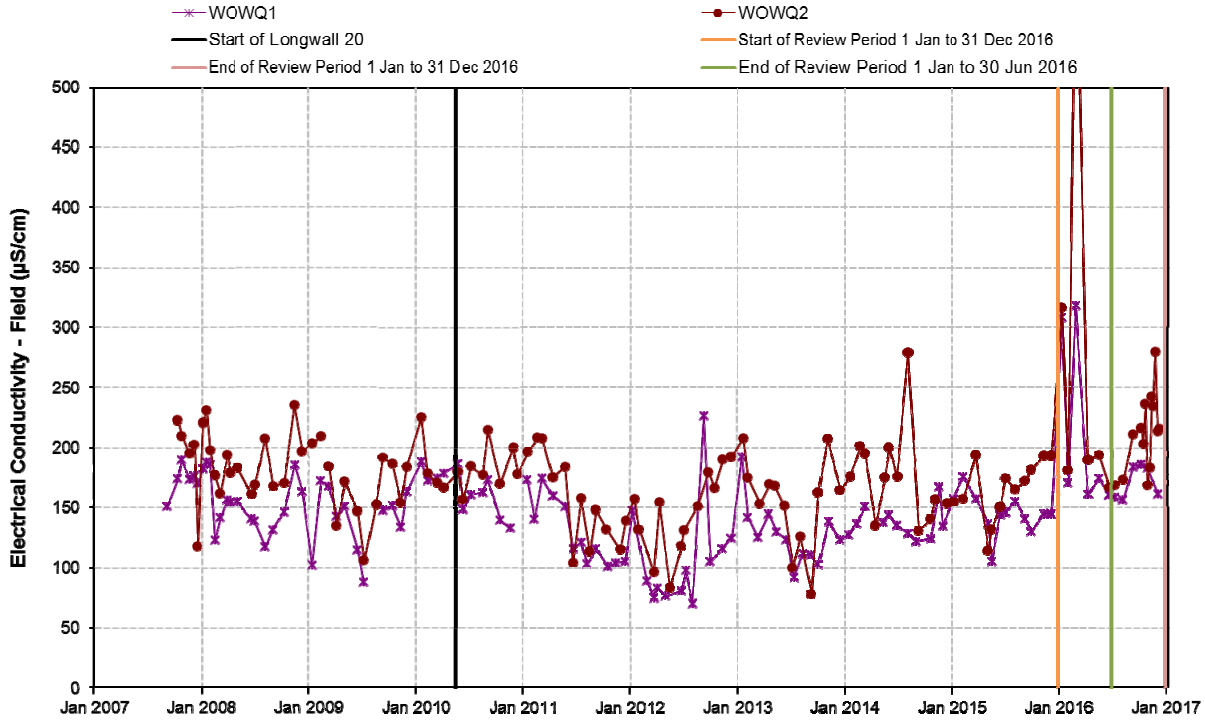



**Chart 25 Electrical Conductivity (EC) Woronora River**

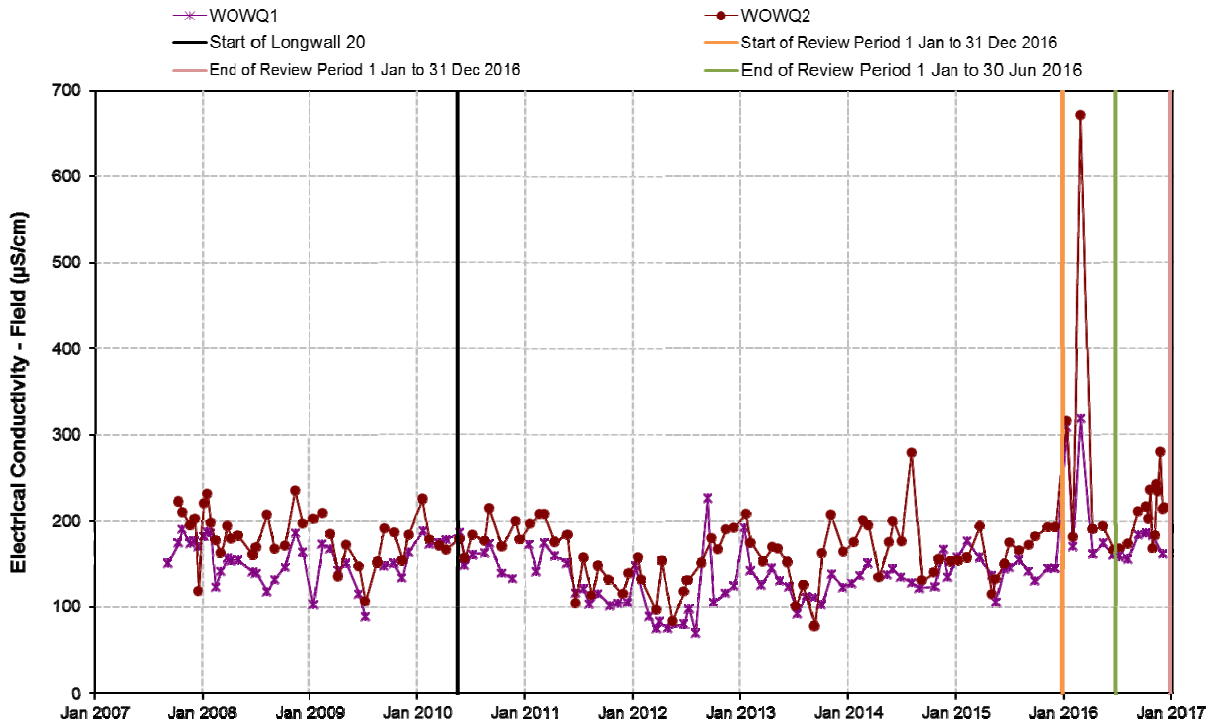



**Chart 26 Electrical Conductivity (EC) Woronora River**

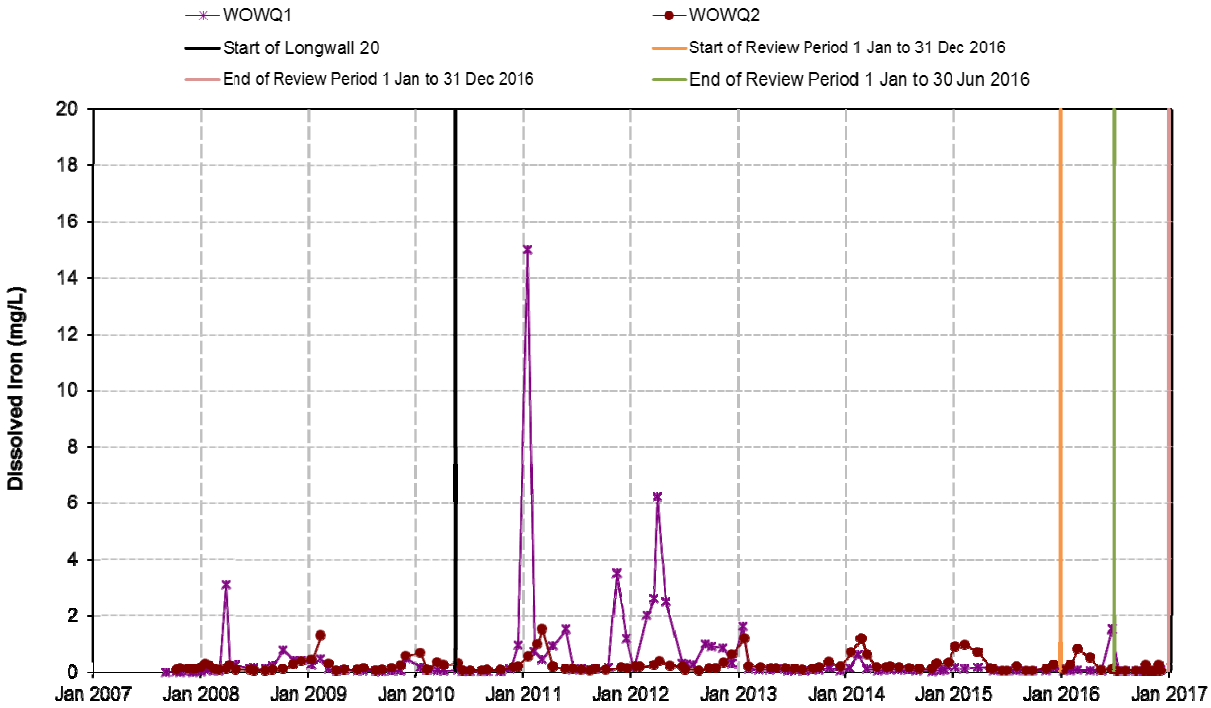



**Chart 27 Dissolved Iron Woronora River**

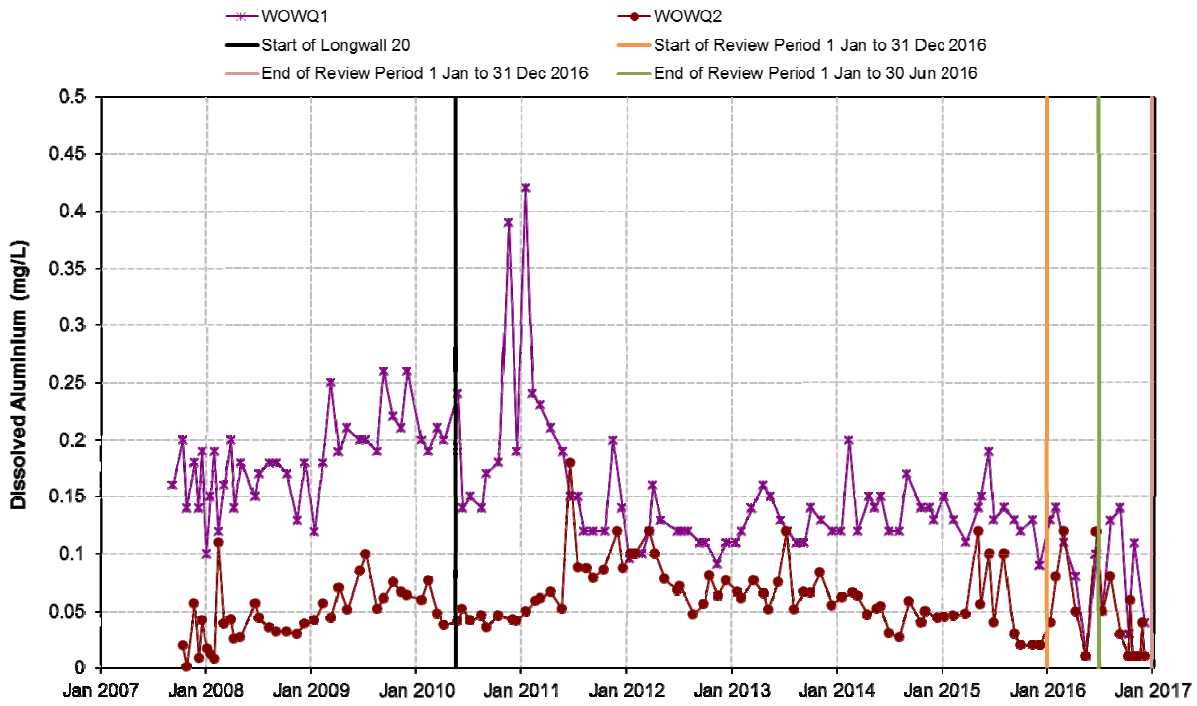



**Chart 28 Dissolved Aluminium Woronora River**

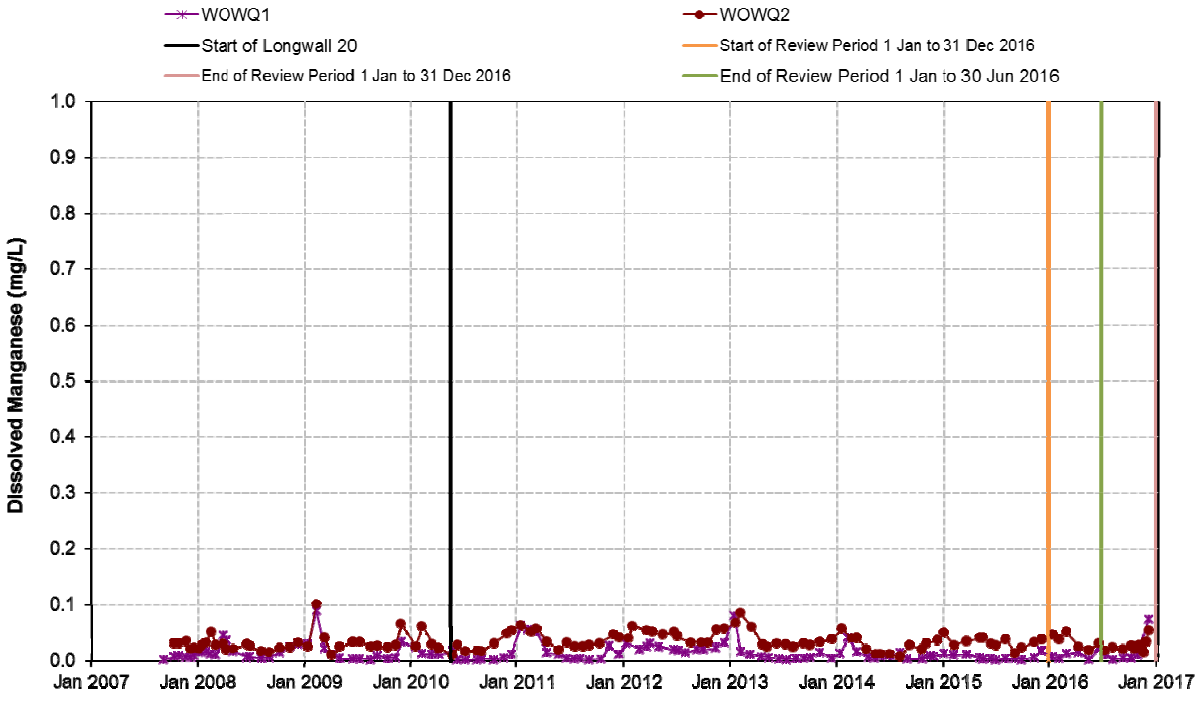



**Chart 29 Dissolved Manganese Woronora River**

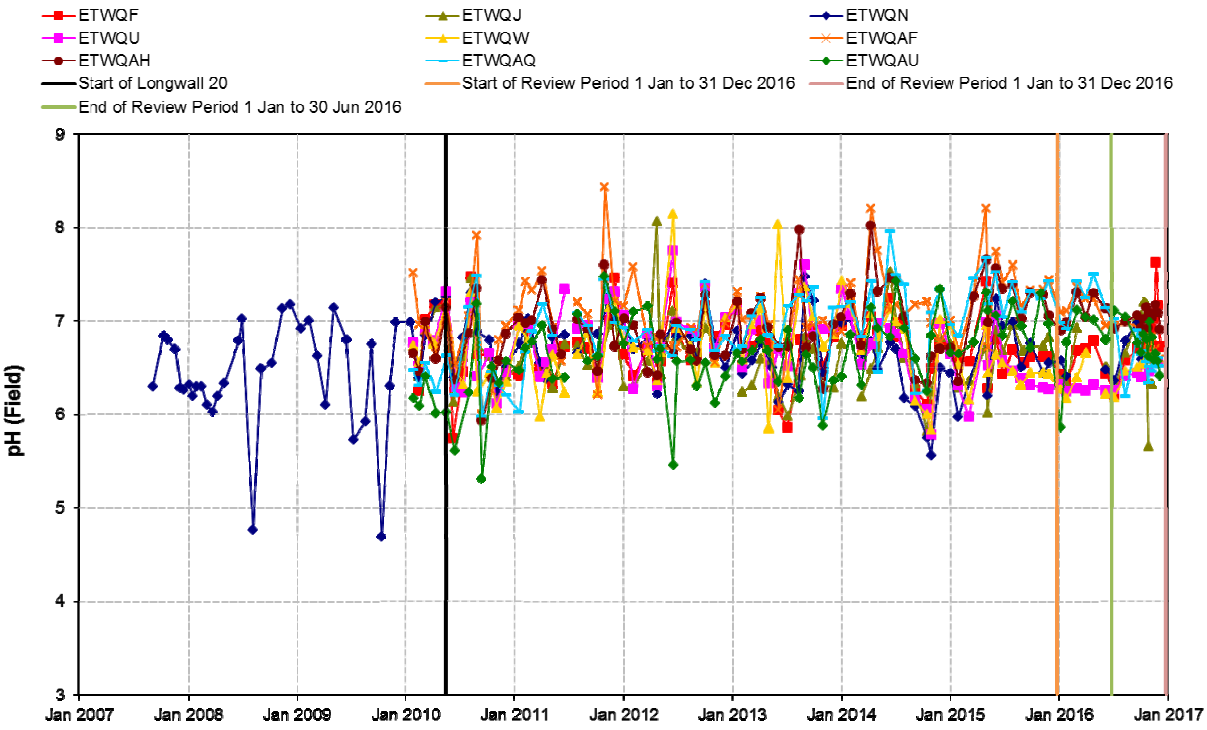



**Chart 30 pH Levels Eastern Tributary**

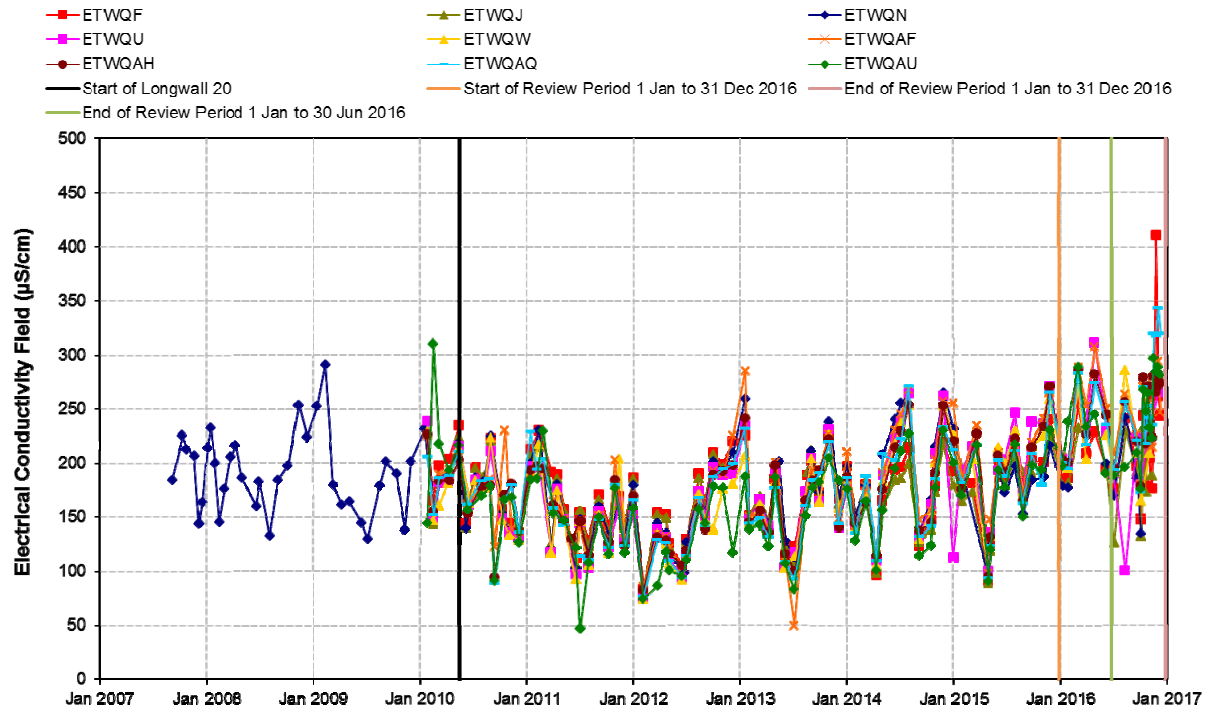



**Chart 31 Electrical Conductivity (EC) Eastern Tributary**

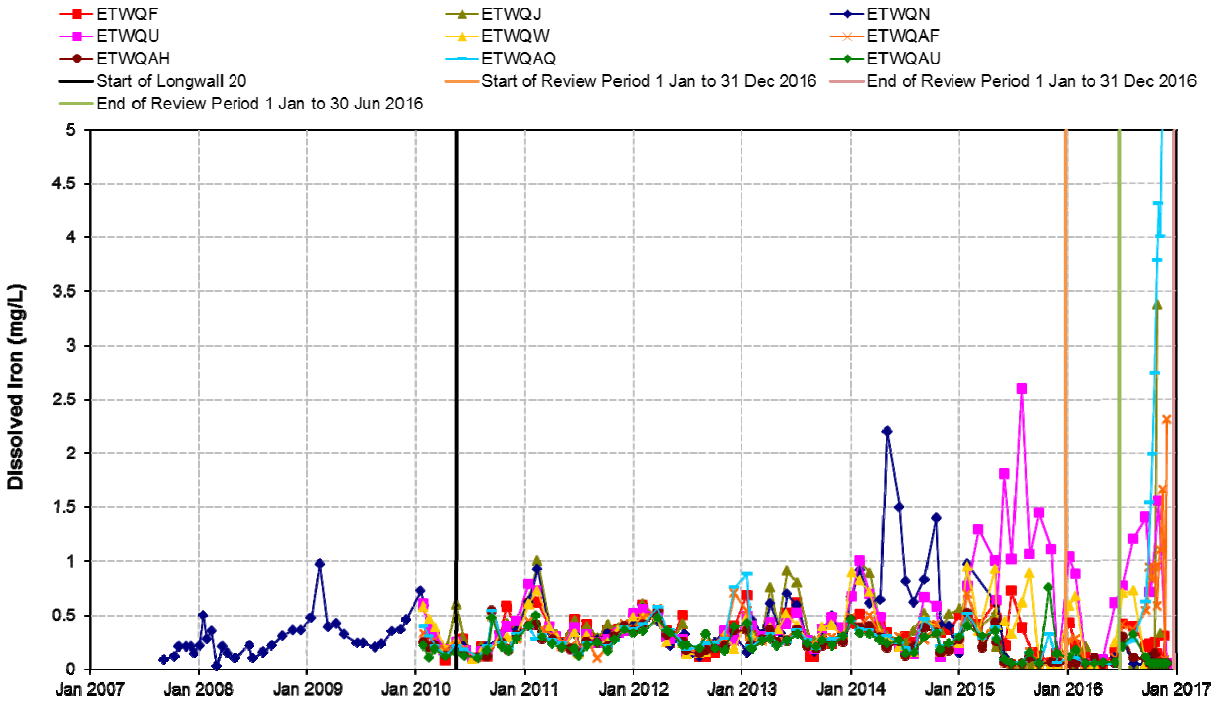



**Chart 32 Dissolved Iron Eastern Tributary**

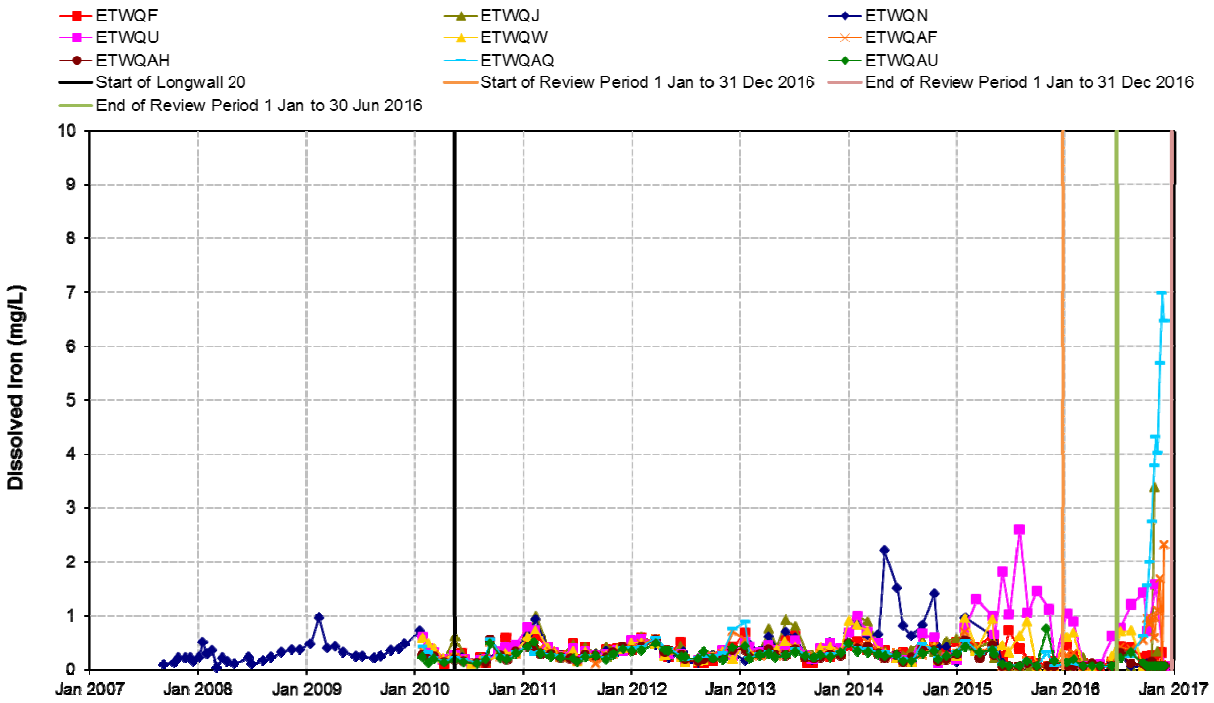



**Chart 33 Dissolved Iron Eastern Tributary**

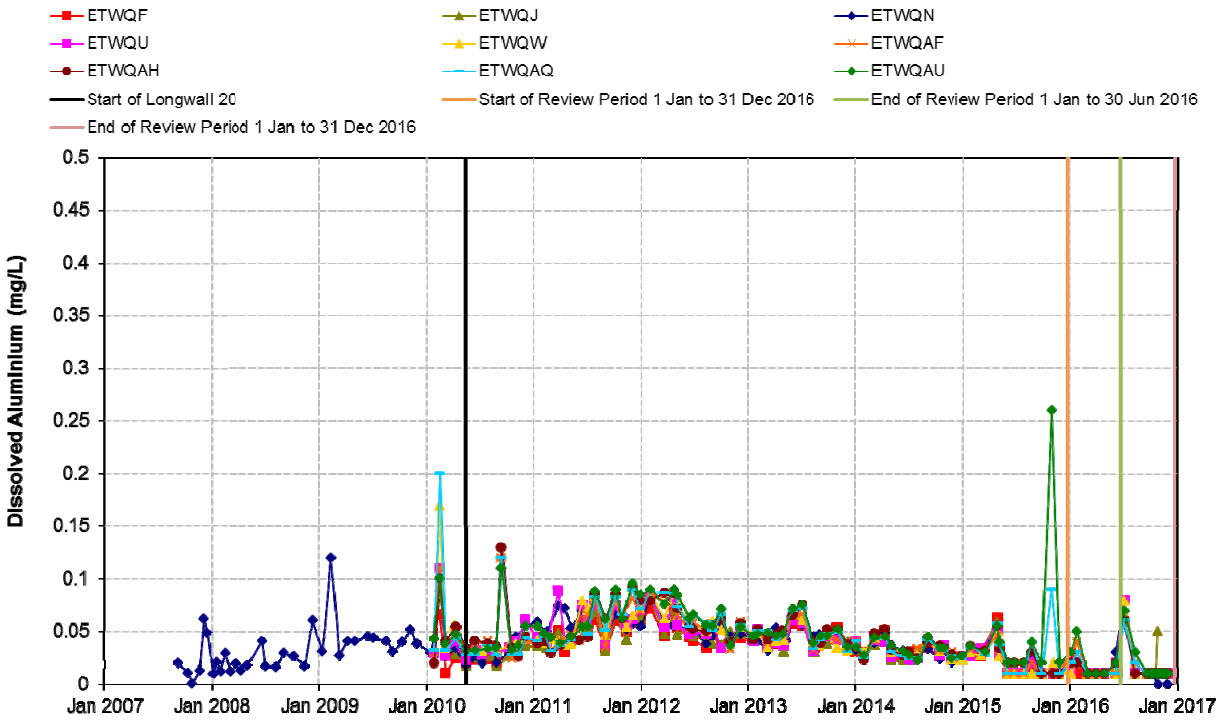



**Chart 34 Dissolved Aluminium Eastern Tributary**

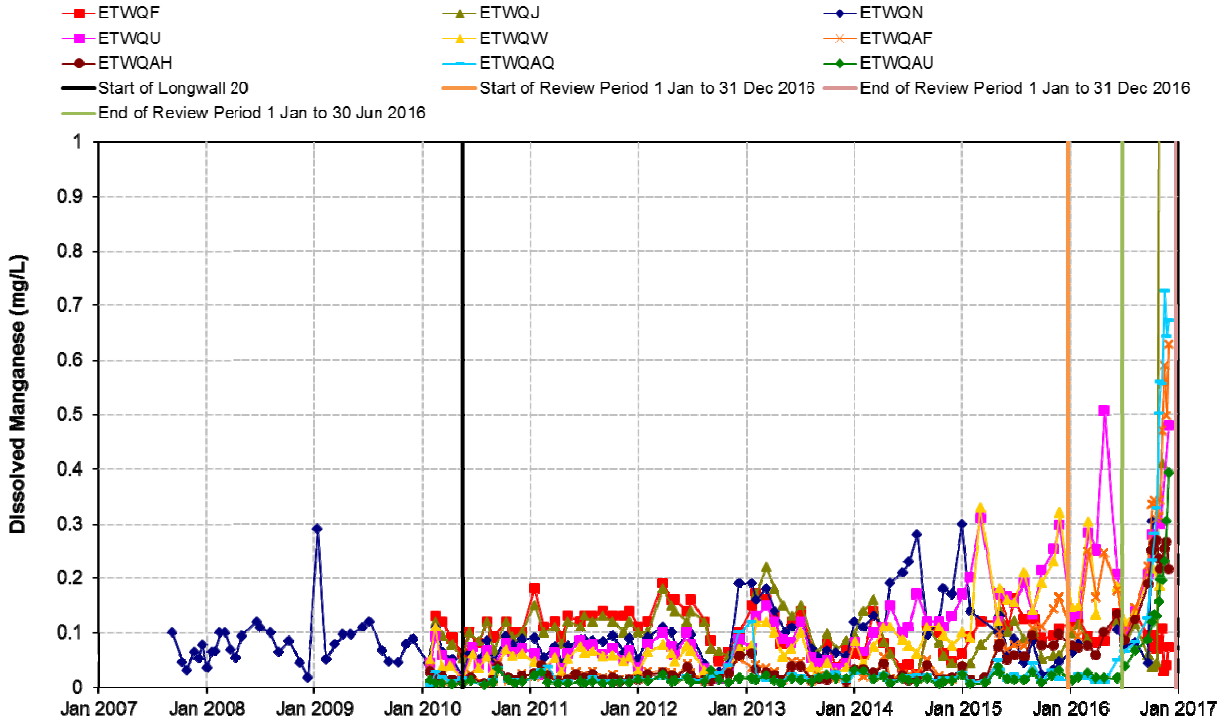



**Chart 35a Dissolved Manganese Eastern Tributary**

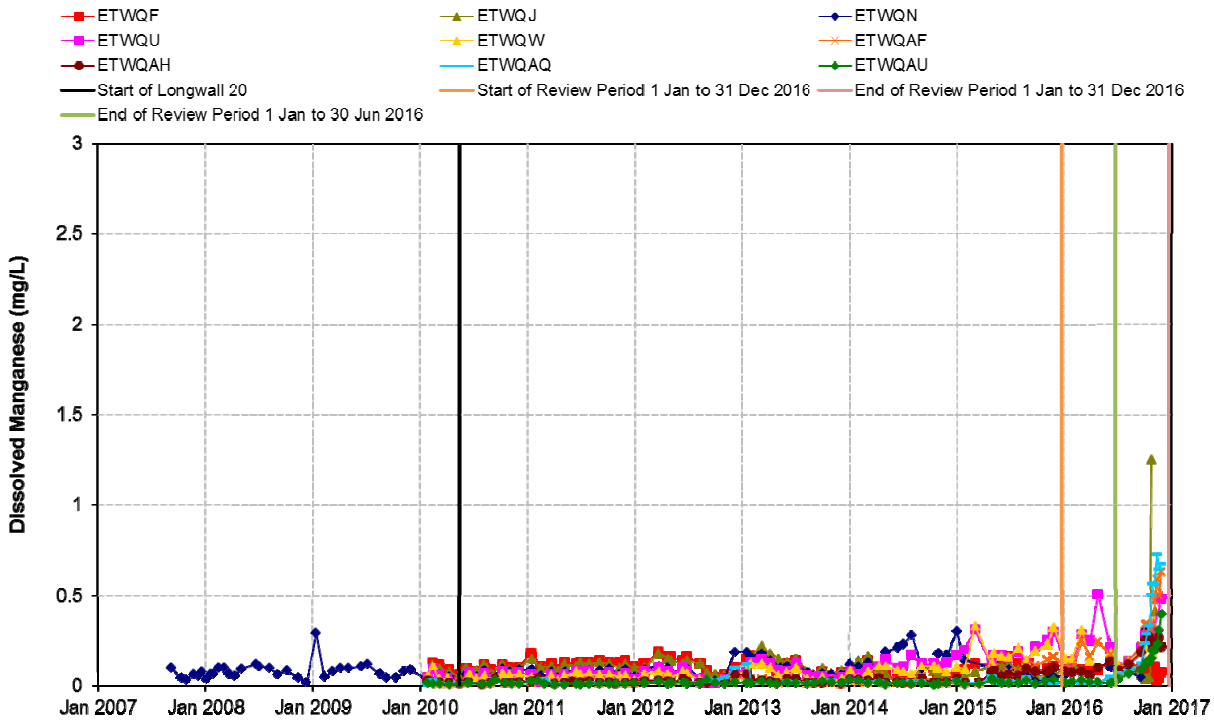



**Chart 35b Dissolved Manganese Eastern Tributary**

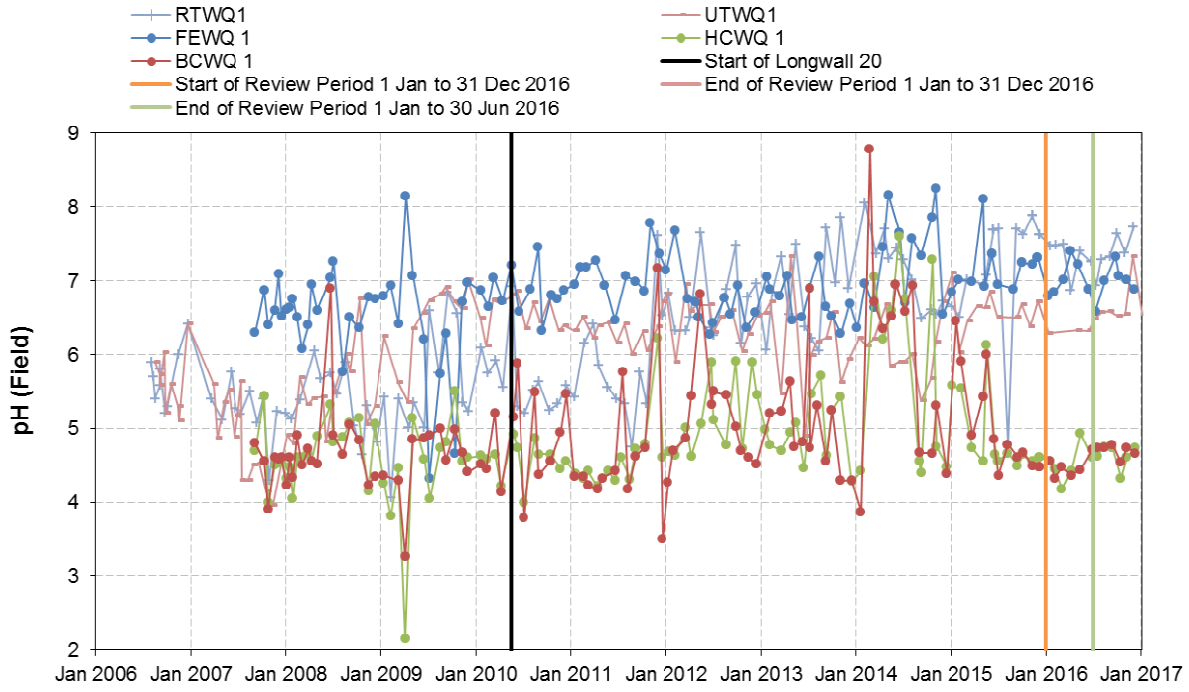



**Chart 36 pH Levels Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek**

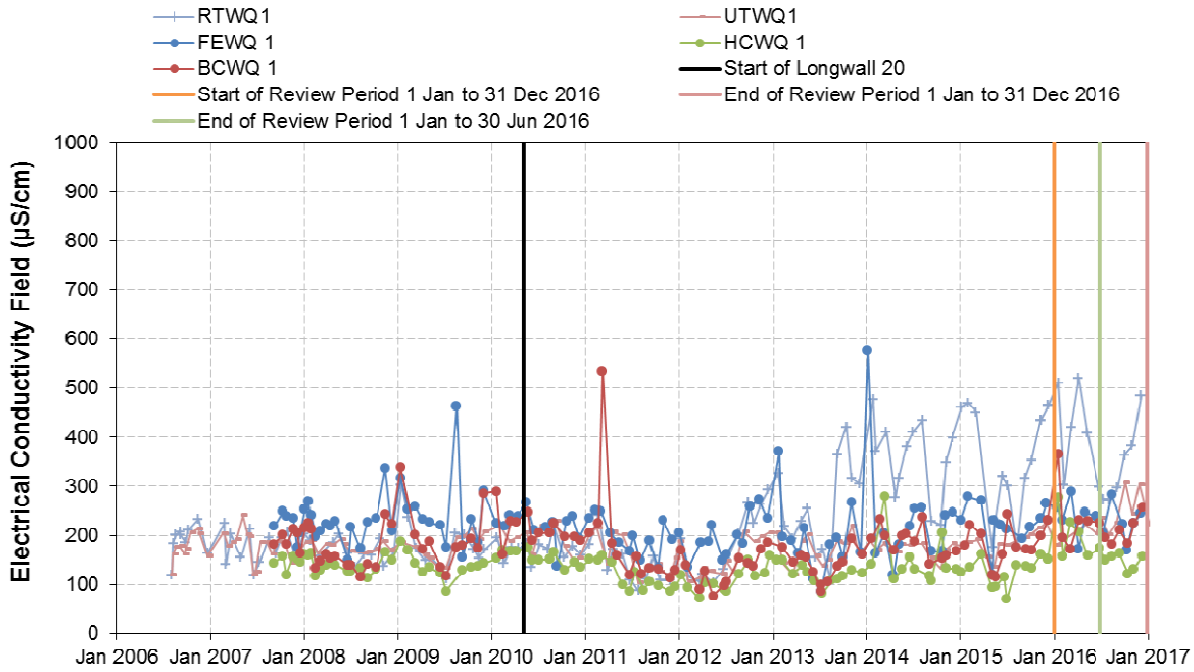



**Chart 37 Electrical Conductivity (EC) Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek**

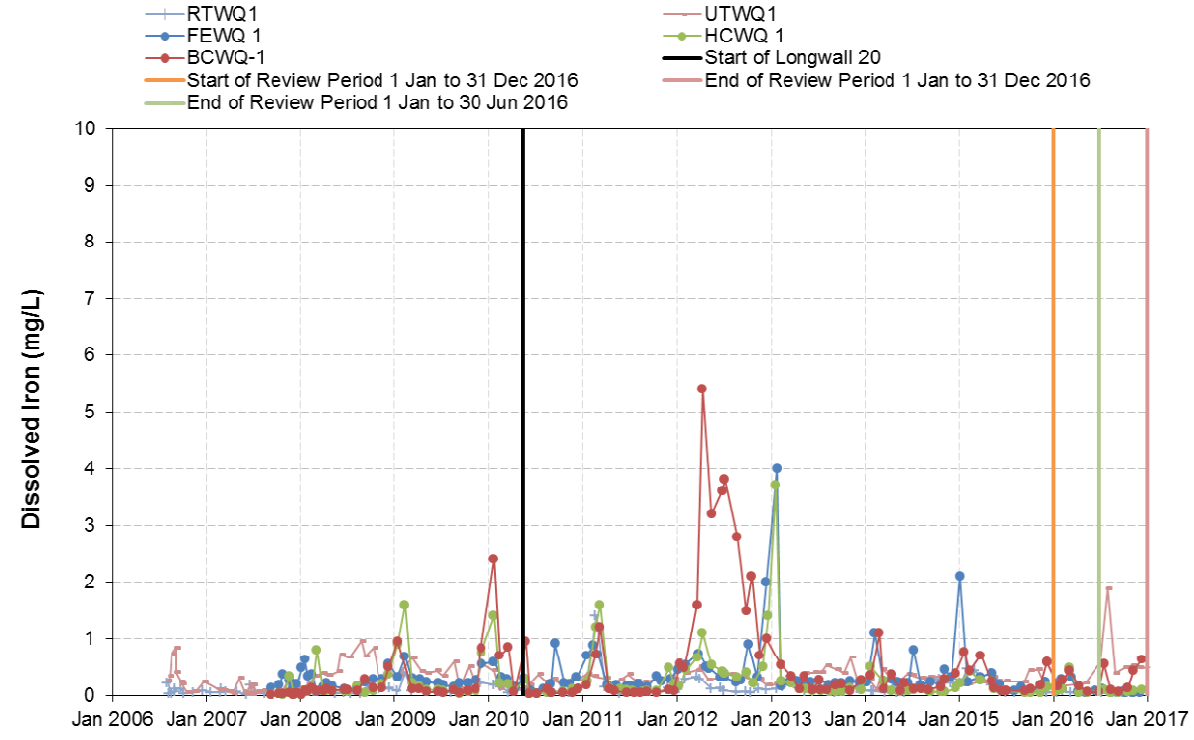



**Chart 38 Dissolved Iron Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek**

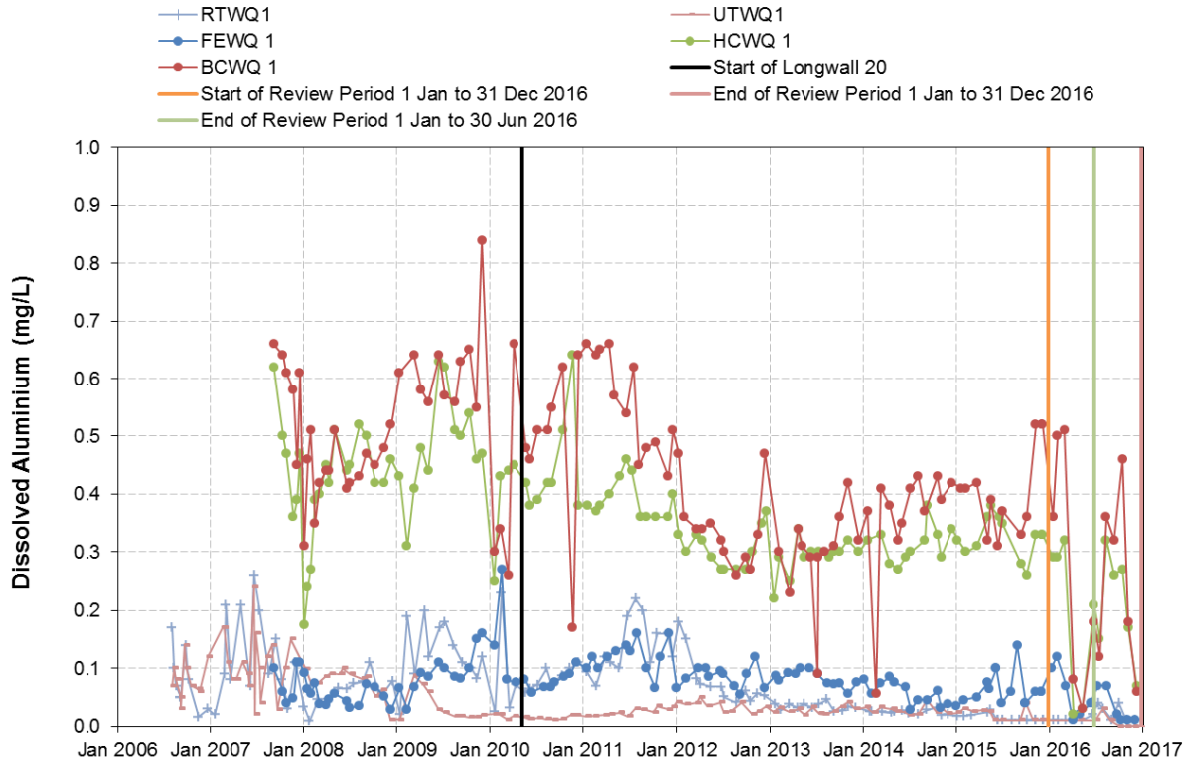



**Chart 39 Dissolved Aluminium Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek**

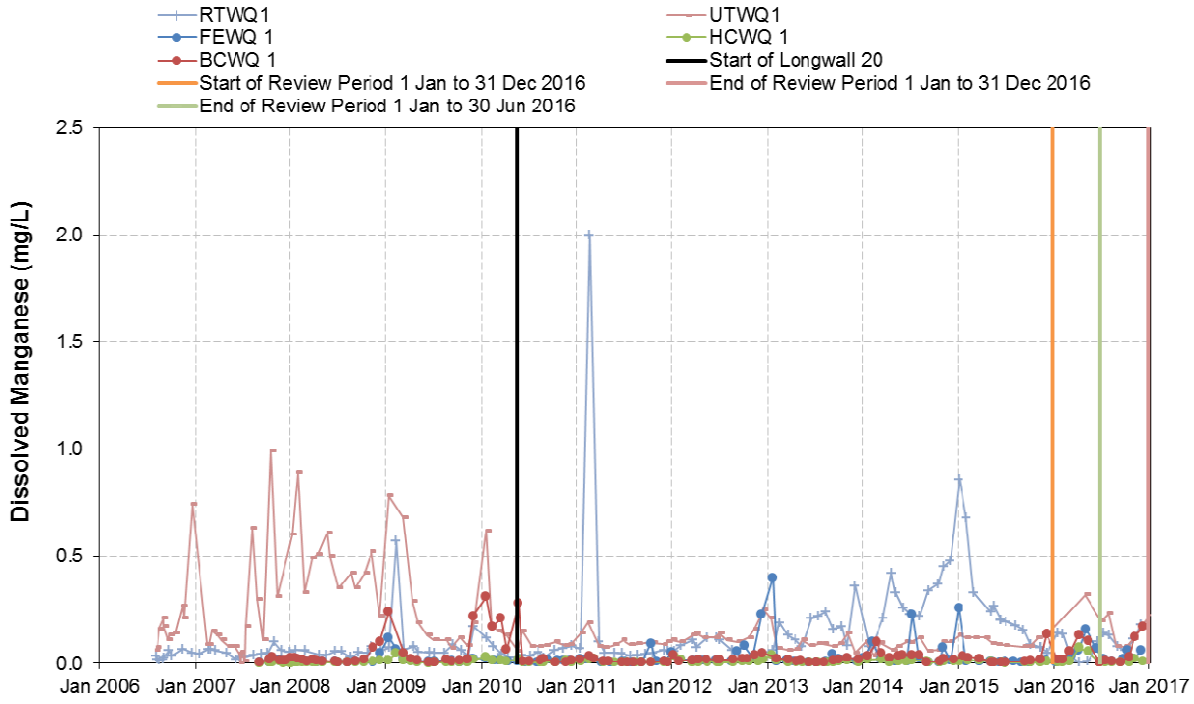



**Chart 40 Dissolved Manganese Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek**

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[6]:

- 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 or dissolved aluminium at site WRWQ9 on Waratah Rivulet.

There was also no exceedance of the performance indicator as a result of the assessment methods for dissolved manganese at site WRWQ9, with the exception of the six month mean exceeding the adjusted baseline mean plus one standard deviation for two consecutive assessment periods at site WRWQ9 (Chart 41). There was no exceedance of this measure at the control site on Woronora River at site WOWQ2.

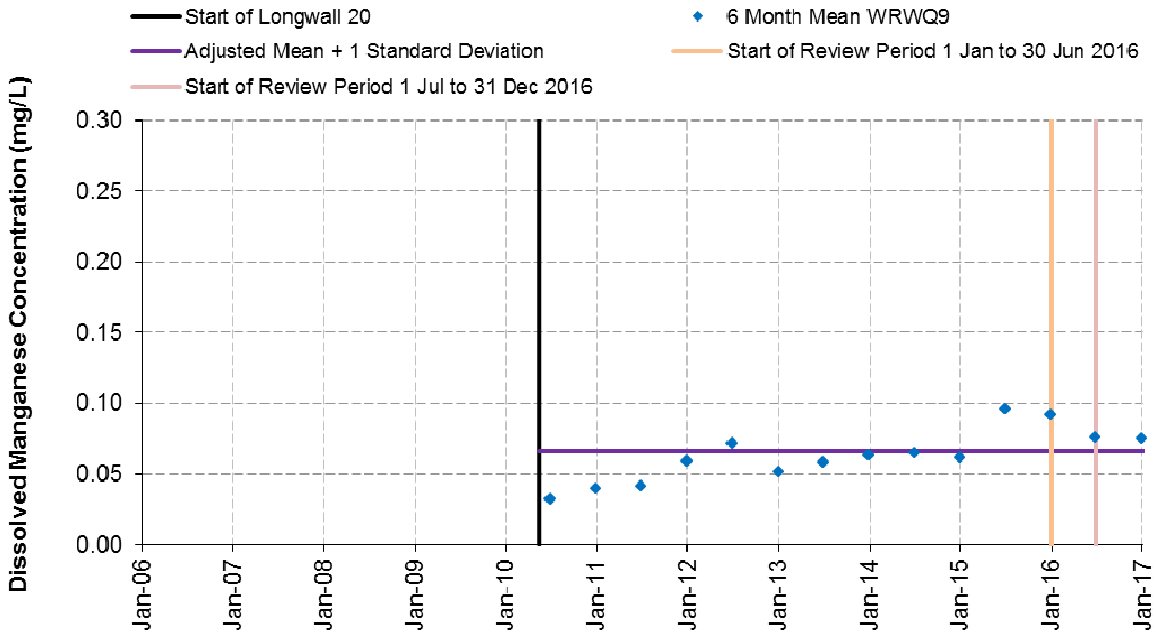



**Chart 41 Six Monthly Means of Dissolved Manganese Concentrations in Waratah Rivulet at WRWQ9**

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

The same indicator (two consecutive six month means exceeding the adjusted baseline mean plus one standard deviation) was exceeded for manganese at site WRWQ9 during the July to December 2015 and January to June 2016 review periods (Hydro Engineering & Consulting, 2016a; Hydro Engineering & Consulting, 2016b). Assessments of whether the associated subsidence impact performance measure, *Negligible reduction to the quality of water resources reaching the Woronora Reservoir,* had been exceeded concluded that it had not (Hydro Engineering & Consulting, 2016a; Hydro Engineering & Consulting, 2016b). Independent peer reviews of those assessments have been conducted by Dr Steve Perrens (Advisian, 2016; 2017), a specialist approved by the DP&E, and are provided in Appendix G. The peer reviews concurred with the assessments that the subsidence impact performance measure had been met.

The current exceedance of the performance indicator for dissolved manganese is a continuation of the previous exceedance events. Dissolved manganese concentrations have decreased in the latter part of the reporting period (Chart 41 and Chart 42). Notwithstanding, an updated assessment has been undertaken by Hydro Engineering & Consulting (2017) against the subsidence impact performance measure and is provided in Appendix B. Assessment of the monitoring data indicates there has been a negligible reduction to the quality of water resources reaching the Woronora Reservoir. The assessment by Hydro Engineering & Consulting will be subject to peer review in accordance with the Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Water Management Plans.

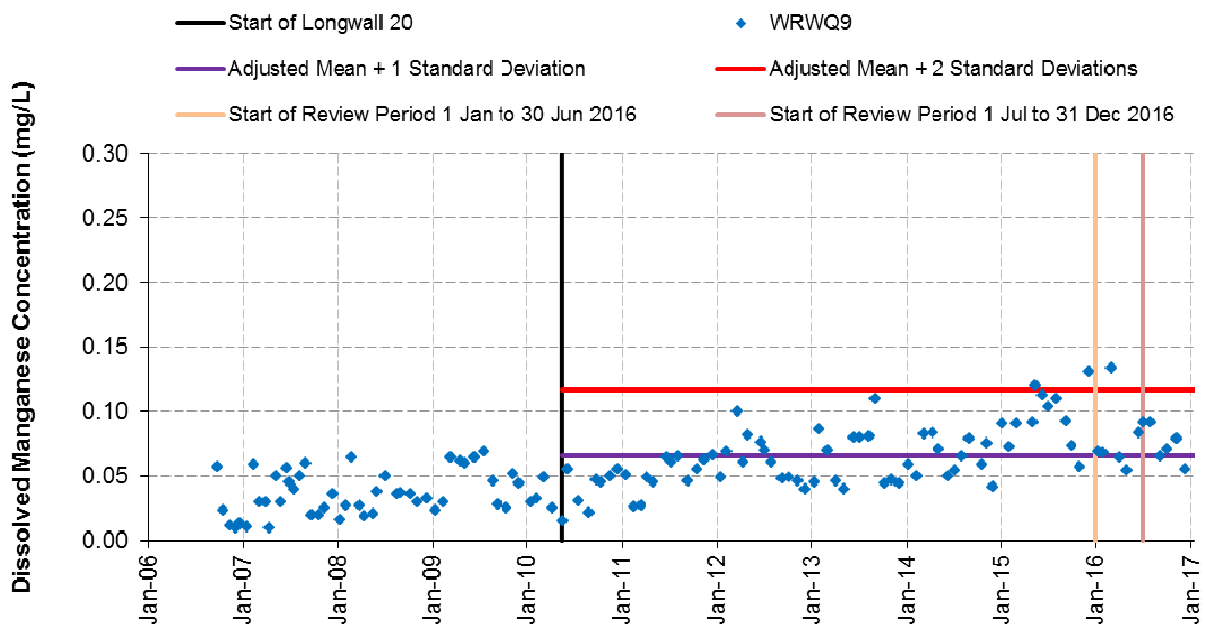



**Chart 42 Dissolved Manganese Concentrations in Waratah Rivulet at WRWQ9**

Assessment of Water Quality at Site ETWQ AU

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. 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 from July to December 2016 (Chart 43).

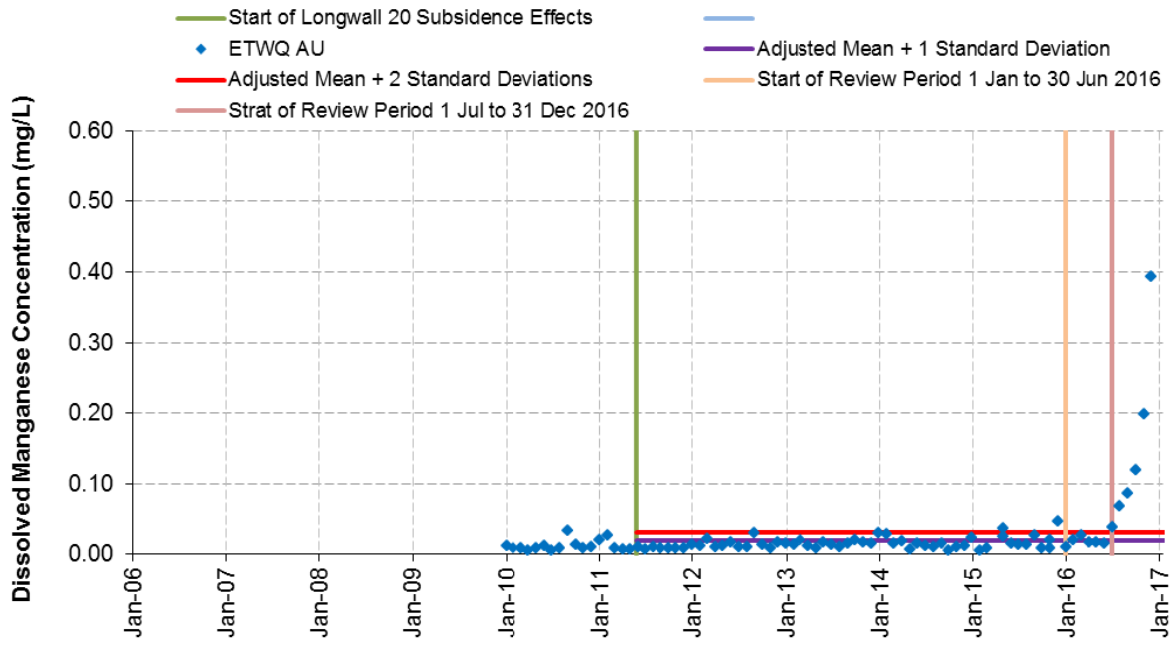



**Chart 43 Dissolved Manganese Concentrations in Eastern Tributary at ETWQ AU**

There were no exceedances of this measure at the control site on Woronora River at site WOWQ2 during the reporting period. 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 Hydro Engineering & Consulting (2017) is provided in the report in Appendix B. Assessment of the monitoring data indicates there has been a negligible reduction to the quality of water resources reaching the Woronora Reservoir. The assessment by Hydro Engineering & Consulting will be subject to peer review in accordance with the Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Water Management Plans.

The environmental consequences of subsidence impacts on water quality were predicted by the Project EA, Preferred Project Report and Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 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.

***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 44, 45 and 46.

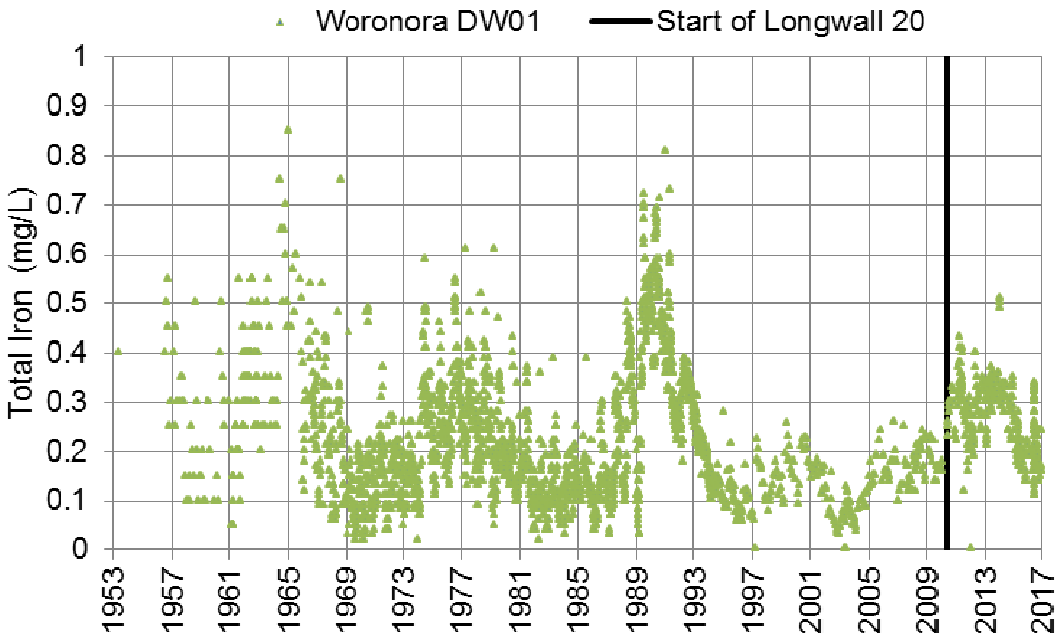



**Chart 44 Total Iron Concentration Woronora Reservoir**

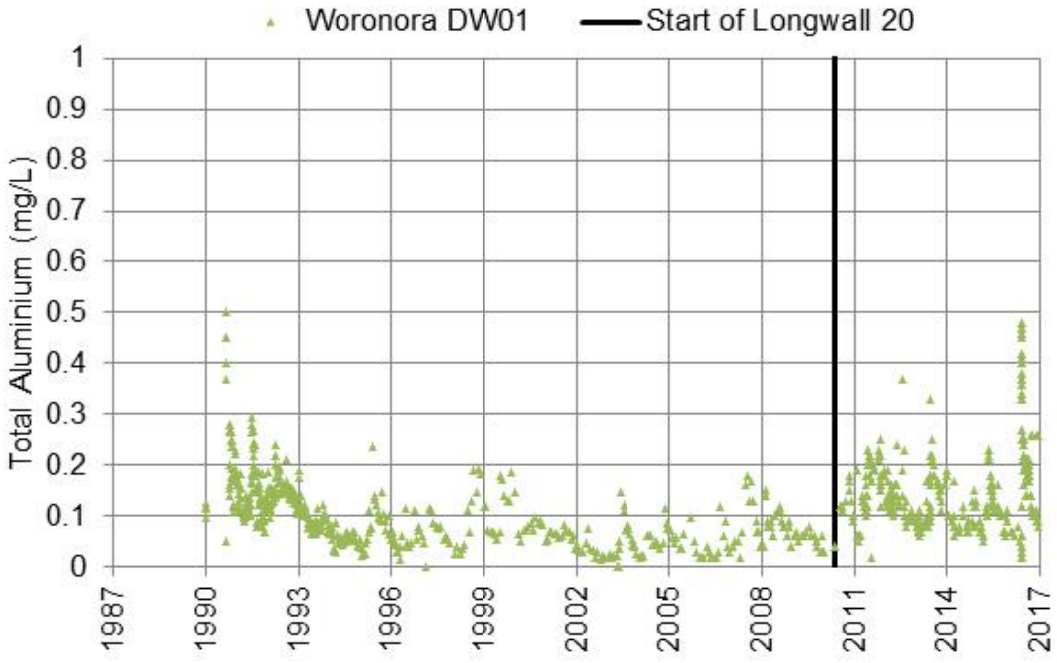



**Chart 45 Total Aluminium Concentration Woronora Reservoir**

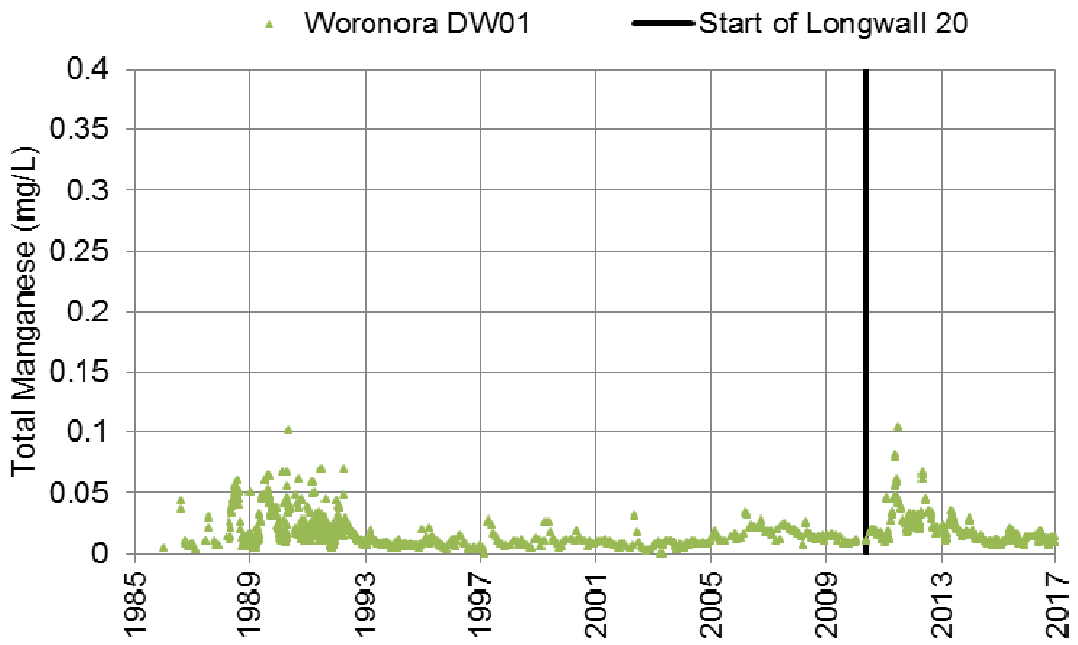



**Chart 46 Total Manganese Concentration Woronora Reservoir**

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 Charts 47 to 49.

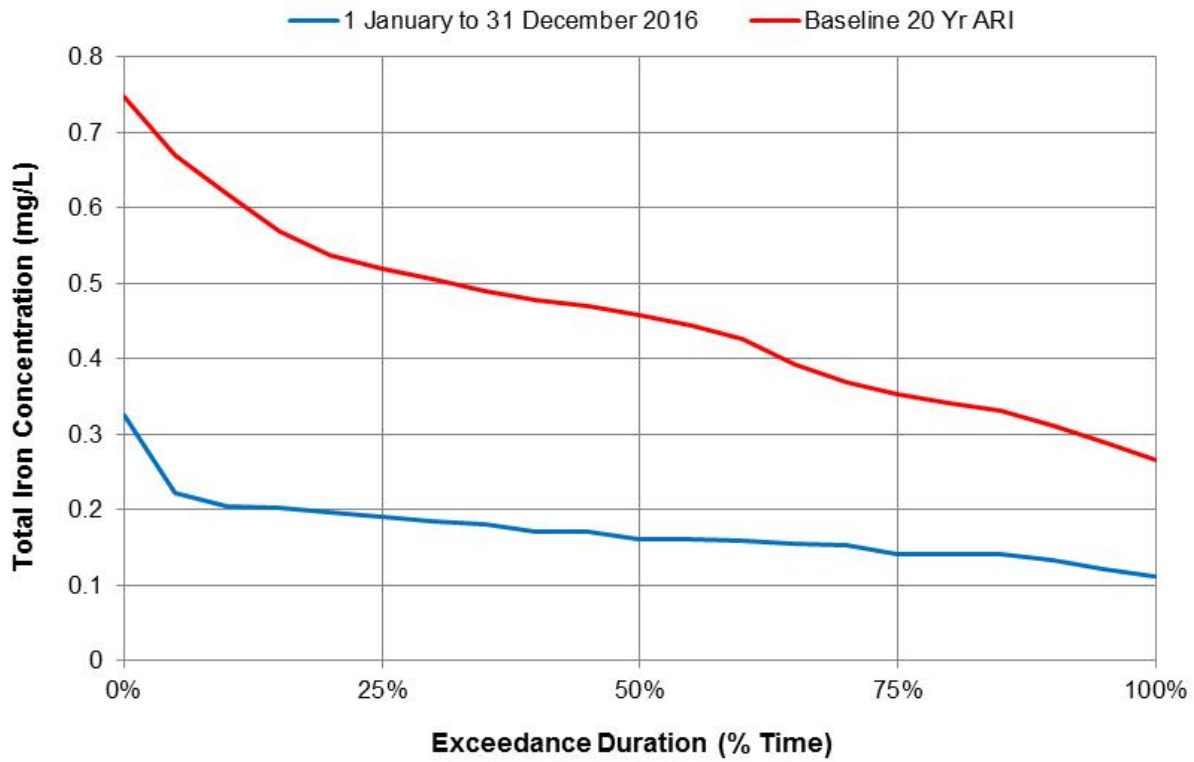



**Chart 47 Total Iron Performance Indicator Woronora Reservoir 2016**

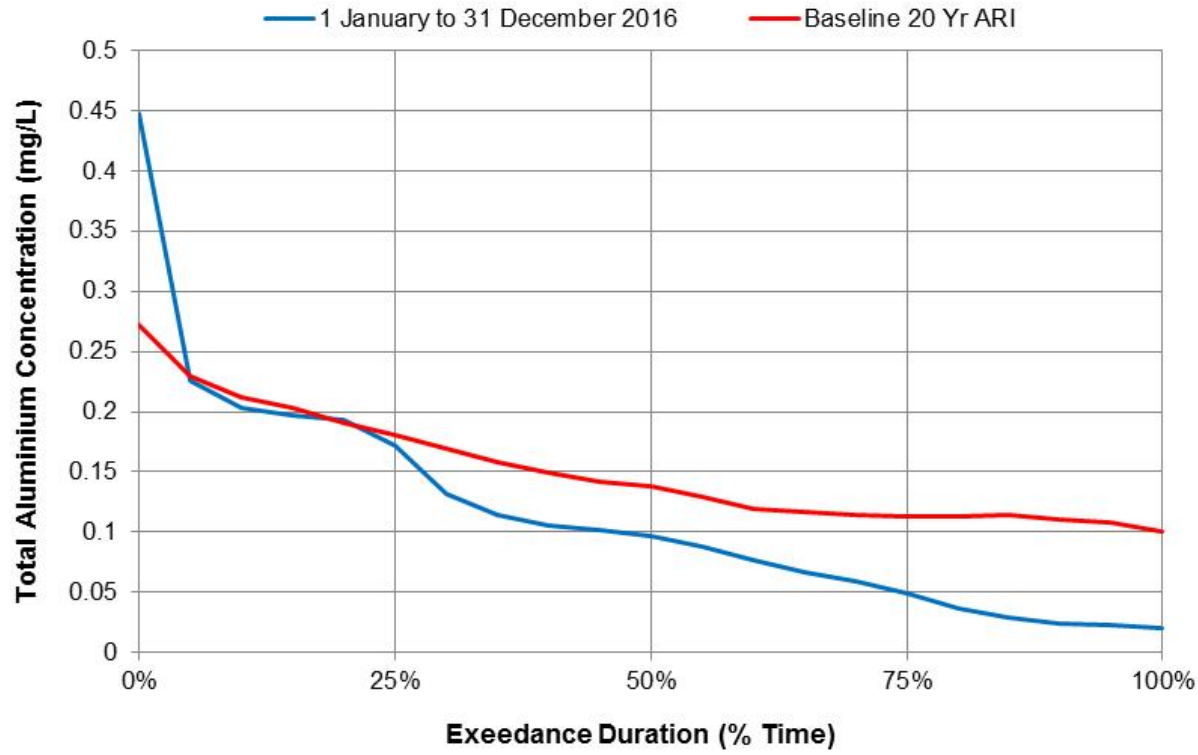



**Chart 48 Total Aluminium Performance Indicator Woronora Reservoir 2016**

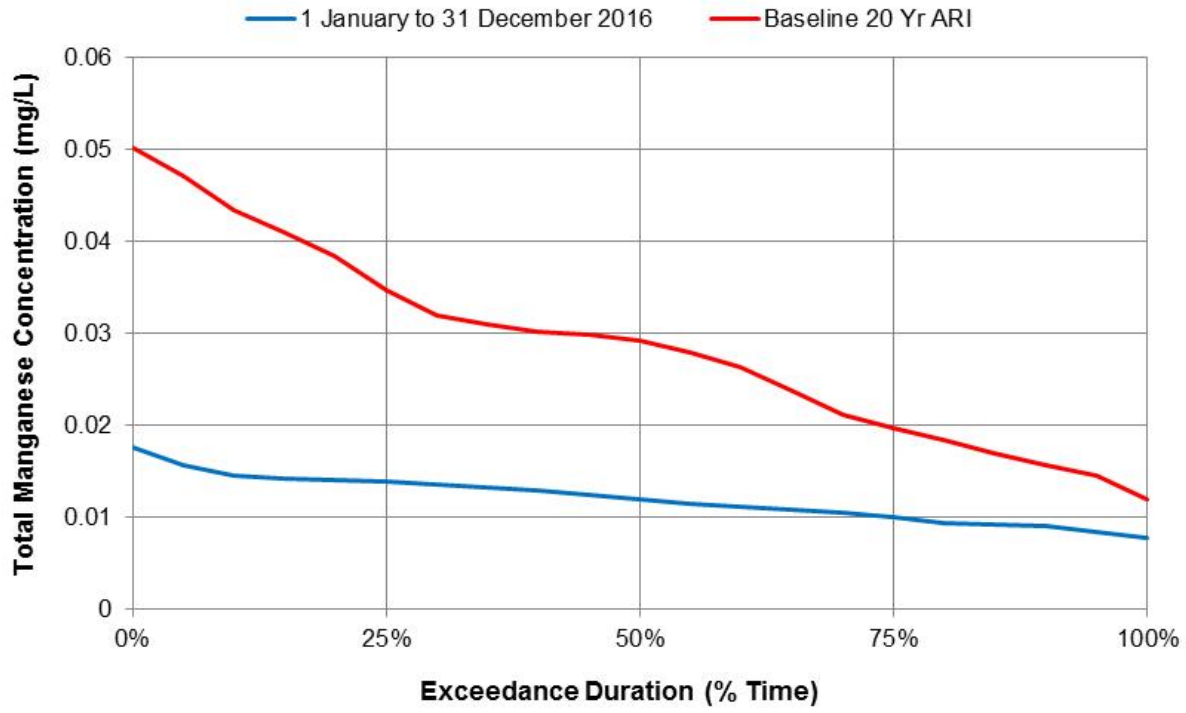



**Chart 49 Total Manganese Performance Indicator Woronora Reservoir 2016**

There were no exceedances of the Woronora Reservoir water quality performance indicator for total iron or total manganese during the reporting period (Charts 47 and 49). There was an exceedance of the Woronora Reservoir water quality performance indicator for total aluminium during the reporting period as the 20 year ARI exceedance curve was exceeded for the 0% to 20% exceedance durations (Chart 48). As a result, an assessment was undertaken against the subsidence impact performance measure, *Negligible reduction to the quality of water of Woronora Reservoir.*

The assessment undertaken by Hydro Engineering & Consulting (2017) is provided in the report in Appendix B. While analyses for aluminium in streams reaching the Woronora Reservoir are conducted using field filtered samples, the data for dissolved aluminium at site WRWQ9 on the Waratah Rivulet and site ETWQ AU on the Eastern Tributary indicate that concentrations have been low. Similarly, whilst dissolved aluminium concentrations were significantly higher at Bee Creek (site BCWQ1) and Honeysuckle Creek (site HCWQ1) there was no change evident in aluminium during the period prior to, during or after the reported elevated total aluminium levels in the Woronora Reservoir which would link them to inflow concentrations.

Comparison of total aluminium concentrations in the Nepean, Cataract and Woronora Reservoirs indicated there is a similar pattern between the three storages and that aluminium concentrations increased rapidly (which was able to be captured by the frequent sampling conducted during the period of elevated aluminium), followed by a relatively rapid partial fall, and subsequent slow decline. These changes suggest limnological processes rather than mining or changes in catchment inflows.

Comparison of the water quality data with the Woronora Reservoir Bulk Water Supply Agreement indicates that the bulk water supply value of 0.4 mg/L for total aluminium was exceeded for a short period based on the results of samples collected during the period 14 - 20 June 2016. A maximum total aluminium value of 0.47 mg/L was recorded. Total aluminium concentrations of 0.4 mg/L have rarely been exceeded previously in the Woronora Reservoir.

Hydro Engineering & Consulting (2017) concluded that the performance measure, *Negligible reduction in the water quality of Woronora Reservoir*, has been met. The assessment by Hydro Engineering & Consulting will be subject to peer review in accordance with the Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Water Management Plans.

The Project EA, Preferred Project Report and Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 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.

***Swamp Groundwater Levels***

Groundwater monitoring of upland swamps for Longwalls 20-22 and 23-27 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 11). Specifically, 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 11). 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 11).

The swamp substrate piezometer represents water levels within the swamp sediments, and the piezometer at approximate depths of 4 m and 10 m allows comparison with the shallow water table in the Hawkesbury Sandstone. 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*.

In summary, the swamp substrate water levels of Swamps 25, 30, 33 and 35 remained perched during the reporting period (Appendix C). Exceedances of the upland swamp groundwater performance indicator have occurred at Swamp 20 (since 2012) and during the reporting period at Swamp 28, as described below.

During the reporting period, several quantitative methods were investigated to assess potential impacts of mining on swamp substrate water levels; however, none was found to be consistently reliable. Instead, analysis of upland swamp groundwater levels is based on a qualitative comparison of behaviour against control swamps in relation to the rate of recession from high to low water levels, the duration of dry swamp conditions compared to the rainfall record, and relative amplitudes of groundwater responses to rainfall events.

*Swamp 20*

Consistent with previous reporting, 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 50 and Appendix C). This trend continued to be observed throughout the reporting period (Chart 50). It is considered that Longwall 21 caused a mining effect at Swamp 20, but the effects have not been exacerbated by Longwalls 22-27 (Chart 50 and Appendix C).

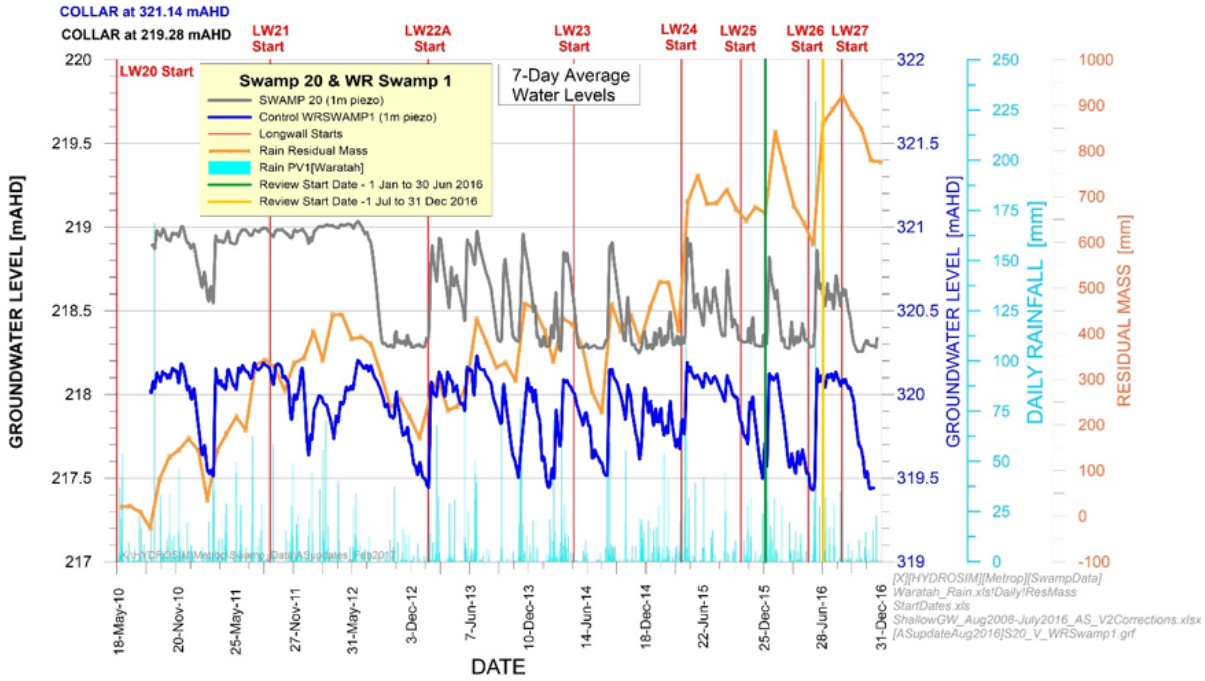



**Chart 50 Comparison of Piezometer Responses at Swamp 20 and Woronora River 1 Control Swamp**

*Swamp 28*

The substrate groundwater levels in Swamp 28 increase in response to rainfall events in February 2016 and June 2016, and remain high until late September 2016 (Chart 51). To assess whether there is a mining effect on the substrate water levels, the Swamp 28 hydrograph was compared with the responses at the two relevant control swamps (137a and 137b) (Chart 51). Unlike the control swamps, the water level recovery in Swamp 28 has been incomplete during the reporting period, being about 60% of full recovery for the January-February 2016 rain events and about 80% for the June 2016 superstorm (Appendix C). As nearby swamp responses (at Swamps 30, 33 and 35) show full recovery at these times, 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.

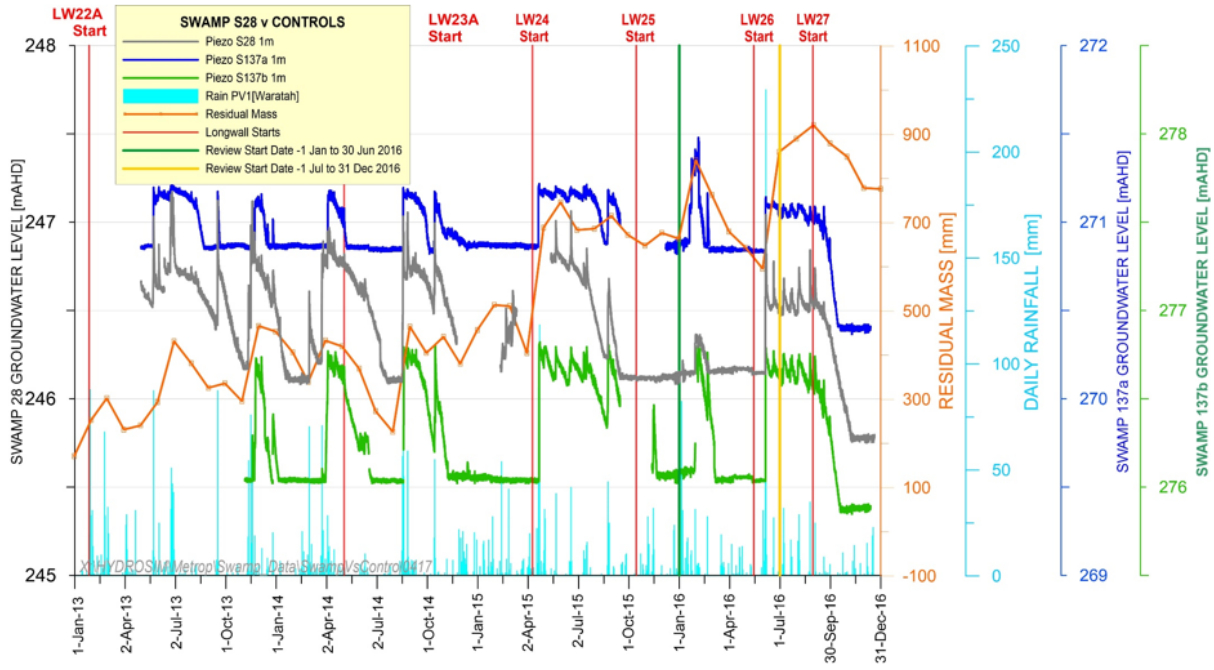



**Chart 51 Groundwater Hydrographs at Swamp 28 and Two Control Swamps (137a and 137b)**

The key potential subsidence impacts and environmental consequences on perched groundwater systems 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, 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.

The subsidence predictions presented in the Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Water Management Plans and Biodiversity Management Plans indicated that Swamp 20 was most at risk of subsidence impacts. Swamp 20 is an in-valley swamp situated on a second order tributary over Longwall 21 (Figure 11). All other swamps over Longwalls 20-22 and Longwalls 23-27 (Figure 11) are valley side swamps.

The results of upland swamp monitoring for Longwalls 20-22 and Longwalls 23-27 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 Longwalls 20-22 and Longwalls 23-27 Water Management Plans and Biodiversity Management Plans. However, 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. However, there are no currently no signs that swamp vegetation is being impacted by the changed hydrological conditions (refer Section 6.1.3).

***Shallow Groundwater Levels***

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 11 and Charts 52, 53 and 54).

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 52). 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. Throughout the reporting period, the water levels at sites WRGW1 and WRGW2 have correlated closely with rainfall trends (as indicated by the residual mass curve on Chart 52) and show a general declining trend in groundwater level until June 2016 when groundwater levels increase in response to above average rainfall. Since then, water levels again declined in response to the lack of rainfall, with a slight increase in the last few months of the reporting period.

Shallow groundwater levels at site WRGW7 remained correlated with rainfall trends and unaffected by mining during the reporting period (Chart 53). At the Eastern Tributary sites, ETGW1 and ETGW2, shallow groundwater levels have previously followed the rainfall trends closely (Chart 54) and show a particularly close correlation during the reporting period. The variations at these sites are unrelated to mining.

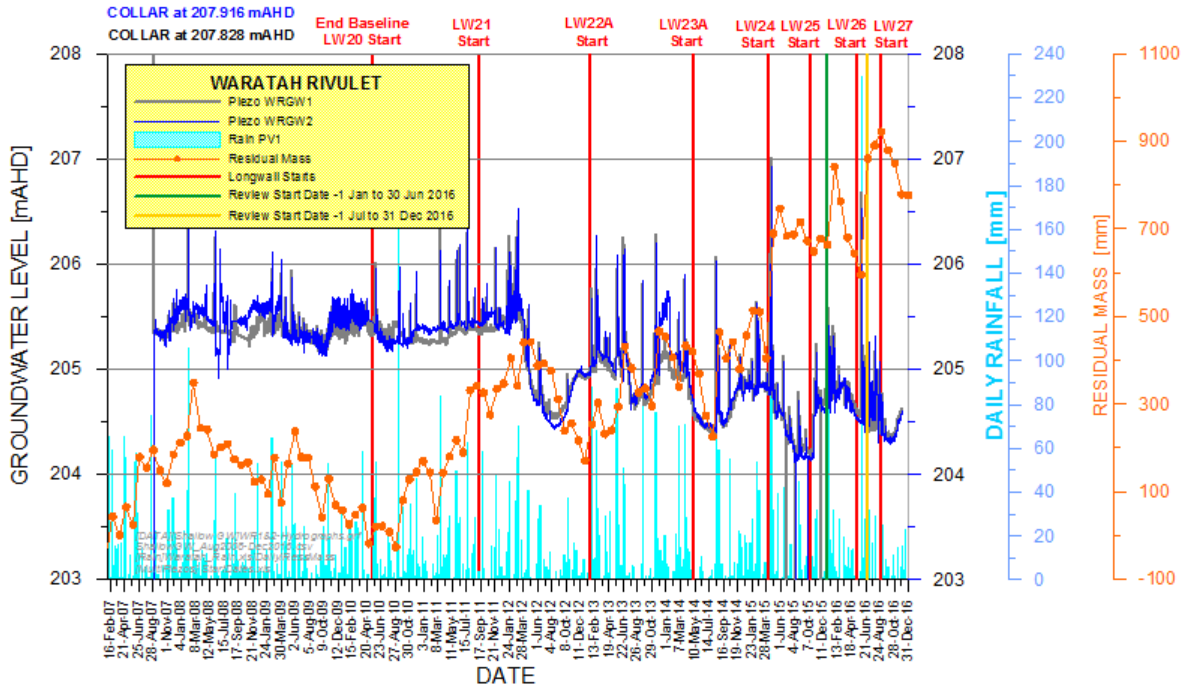



**Chart 52 Shallow Groundwater Hydrographs on Waratah Rivulet at WRGW1 and WRGW2**

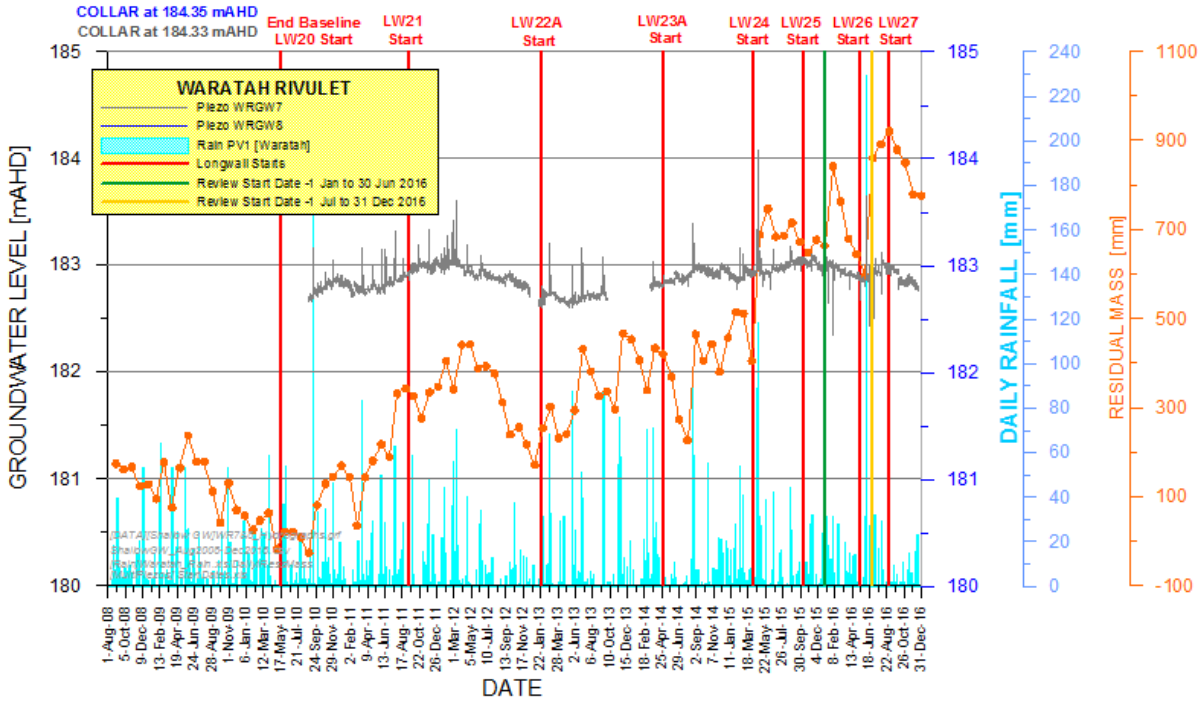



**Chart 53 Shallow Groundwater Hydrographs on Waratah Rivulet at WRGW7**

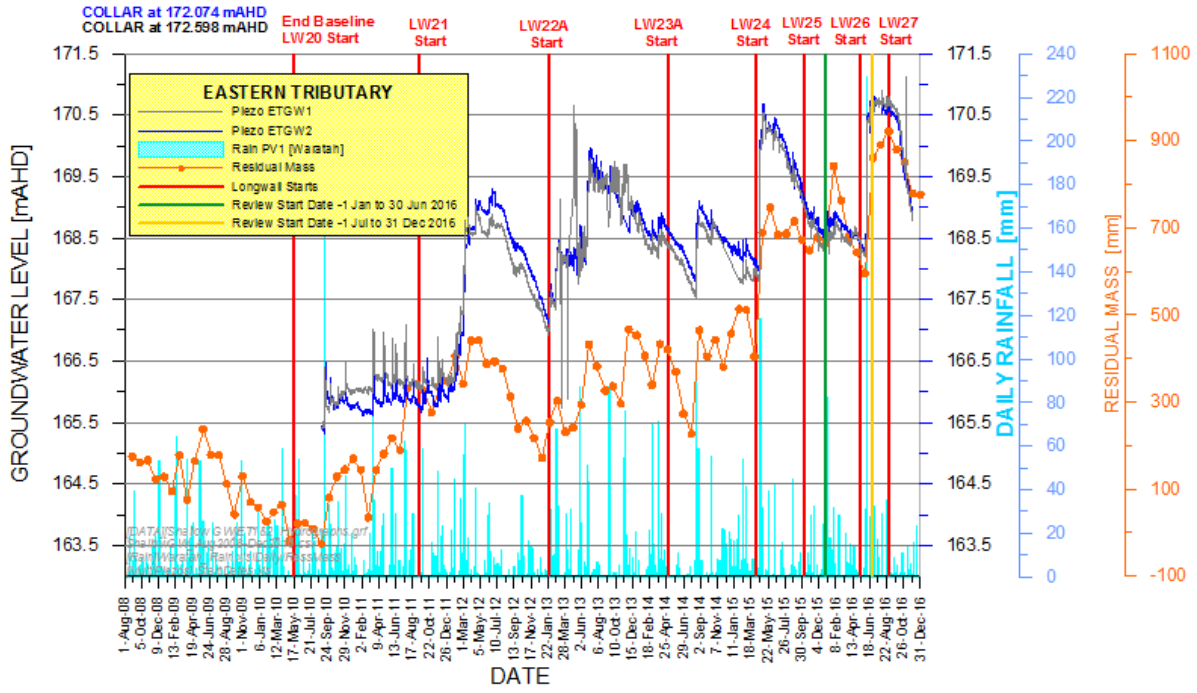



**Chart 54 Shallow Groundwater Hydrographs on Eastern Tributary at ETGW1 and ETGW2**

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 the Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 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 for Longwalls 20-22 and Longwalls 23-27 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 Longwalls 20-22 and Longwalls 23-27 Water Management Plans.

***Deep Groundwater Levels/Pressures***

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 during the reporting period 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.

Continuous groundwater level/pressure monitoring has been conducted at bores 9HGW0 (Longwall 10 Goaf Hole), 9EGW1B, 9FGW1A, 9GGW1-80, 9GGW2B, 9HGW1B, PM02, PM01, 9EGW2A, PM03, PHGW1B, PHGW2A, F6GW3 and F6GW4 in accordance with the Longwalls 20-22 and/or Longwalls 23-27 Water Management Plans (Figure 11). The time-series head variations and vertical head differences for these bores have been examined (Charts 55 to 68).

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 11).

The time-series record for bore 9EGW1B on Chart 56 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) retains about 350 m pressure head, which has been declining slowly since the commencement of Longwall 20 due to far-field depressurisation. 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 C).

The time-series record for bore 9GGW2B is shown on Chart 59[7]. 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[8] (Appendix C).

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

8 The sensor at 106 m depth in the Hawkesbury Sandstone shows an increase in pressure during the first half of reporting period which is inconsistent with the other sensors.

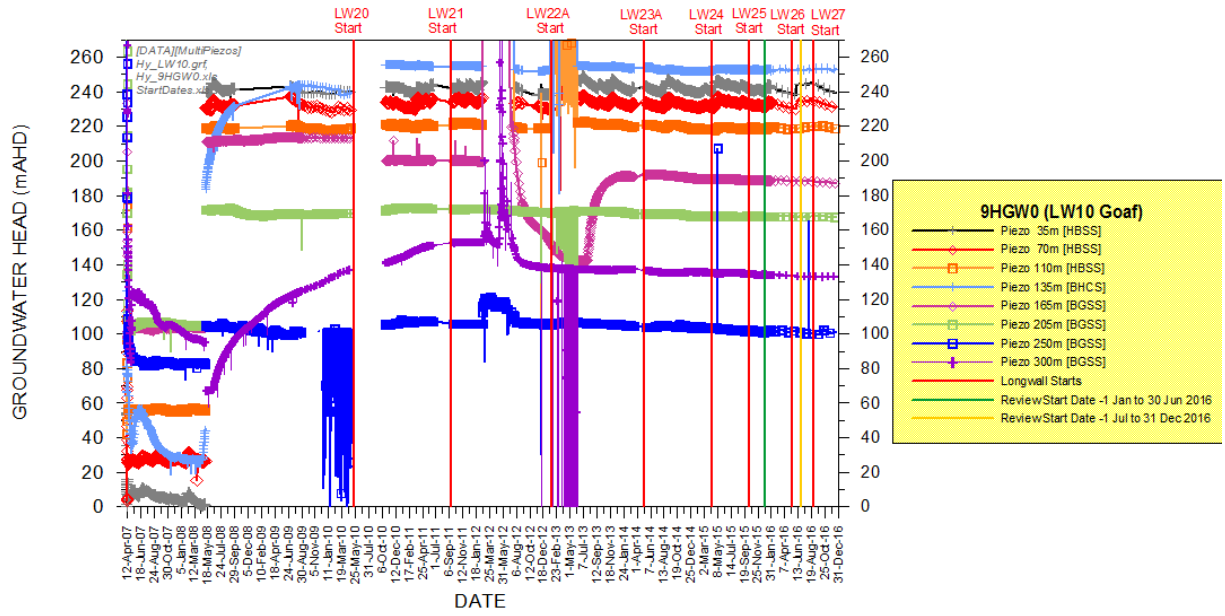



**Chart 55 Time Variations in Potentiometric Heads at 9HGW0**

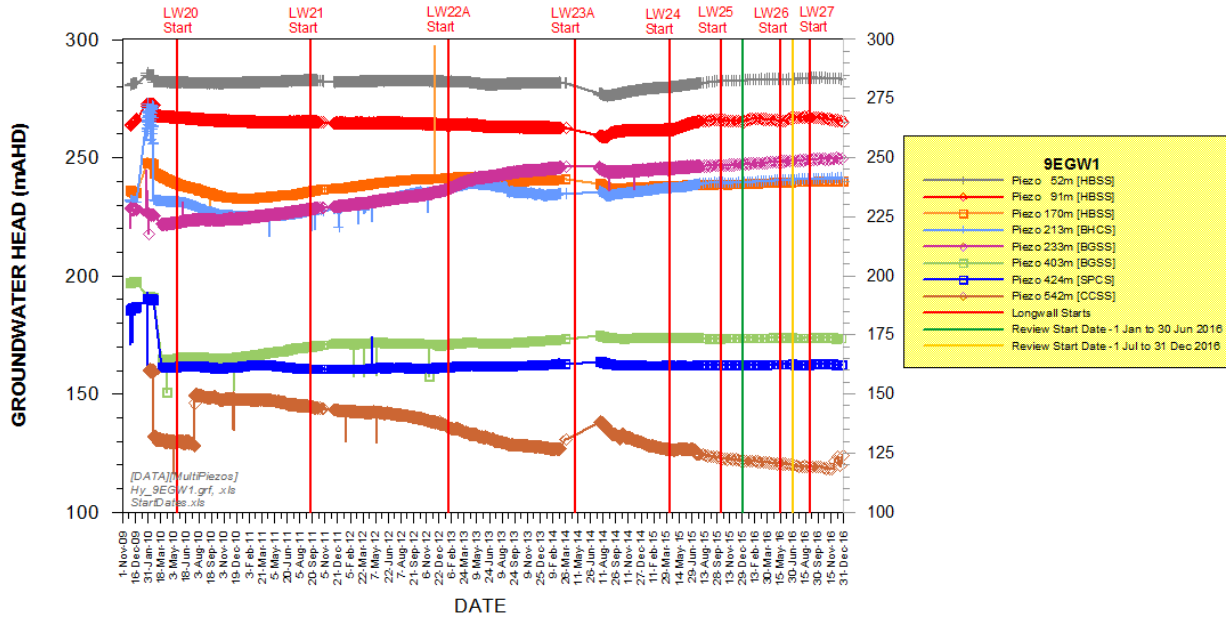
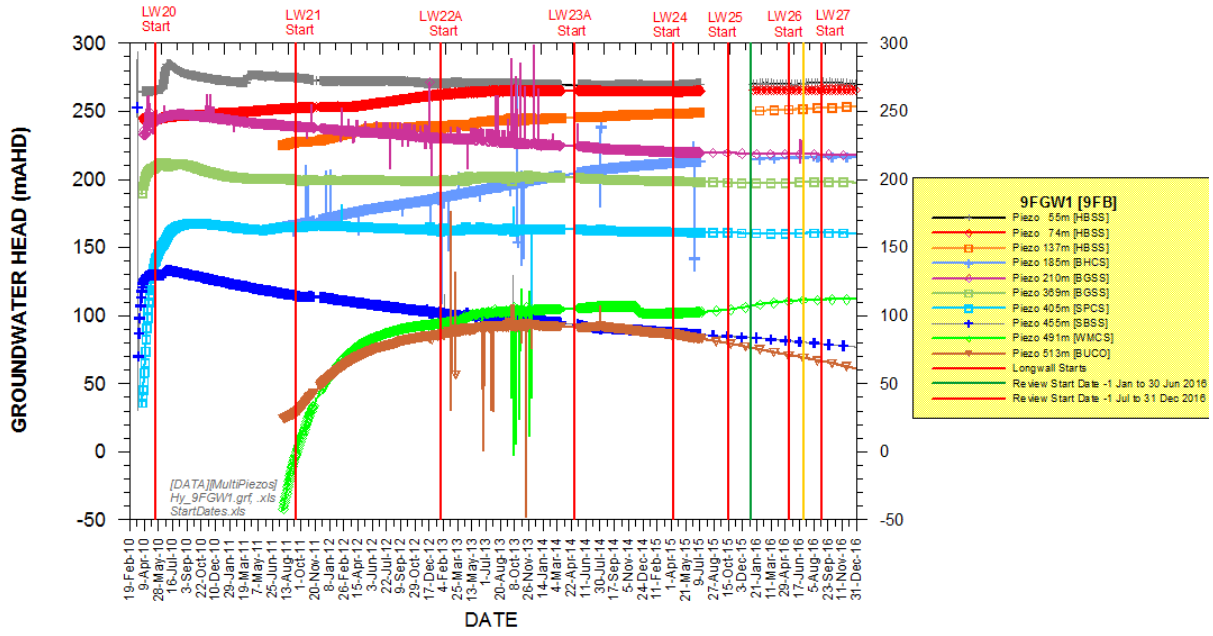



**Chart 56 Time Variations in Potentiometric Heads at 9EGW1B**




Due to a connection failure, previously "lost" data from mid-2015 have now been recovered.

**Chart 57 Time Variations in Potentiometric Heads at 9FGW1A**

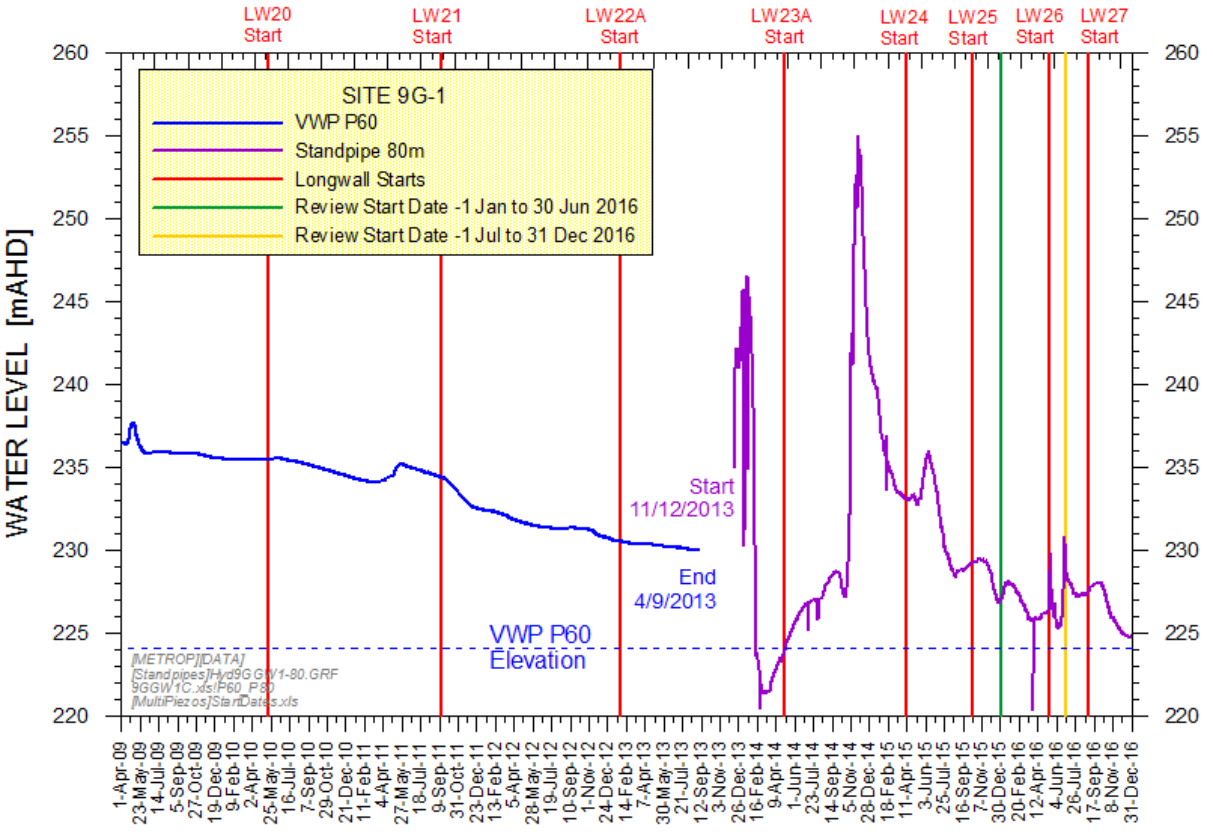



**Chart 58 Time Variations in Water Table at Standpipe 9GGW1-80 and Decommissioned Vibrating Wire Piezometer 9GGW1-60**

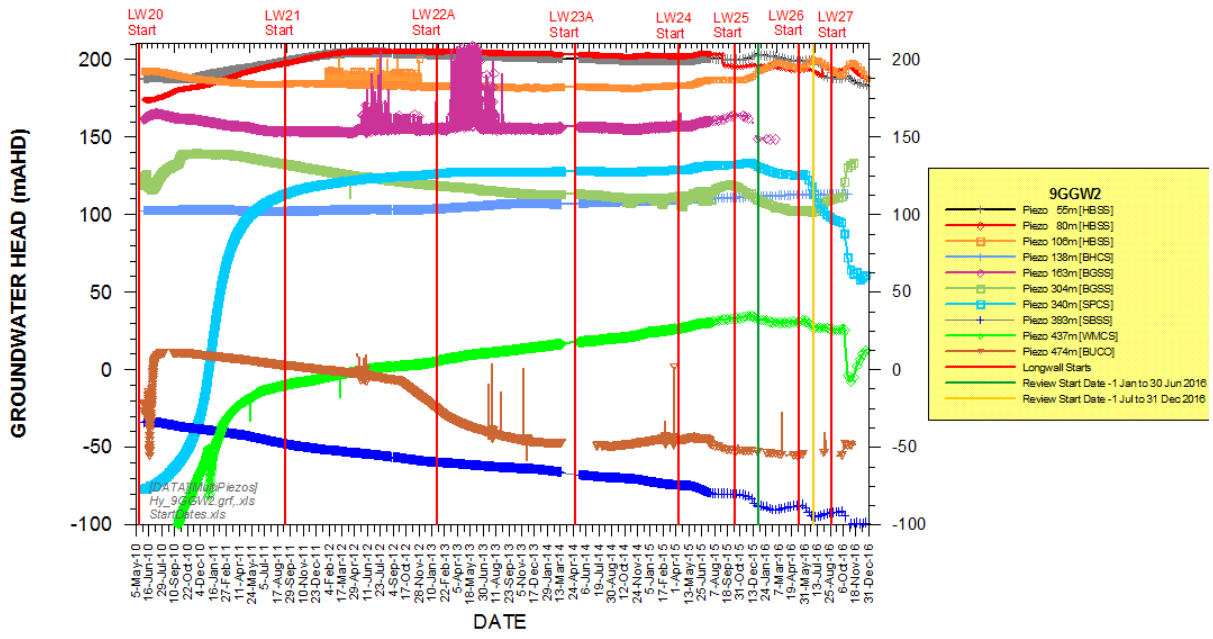



**Chart 59 Time Variations in Potentiometric Heads at 9GGW2B**

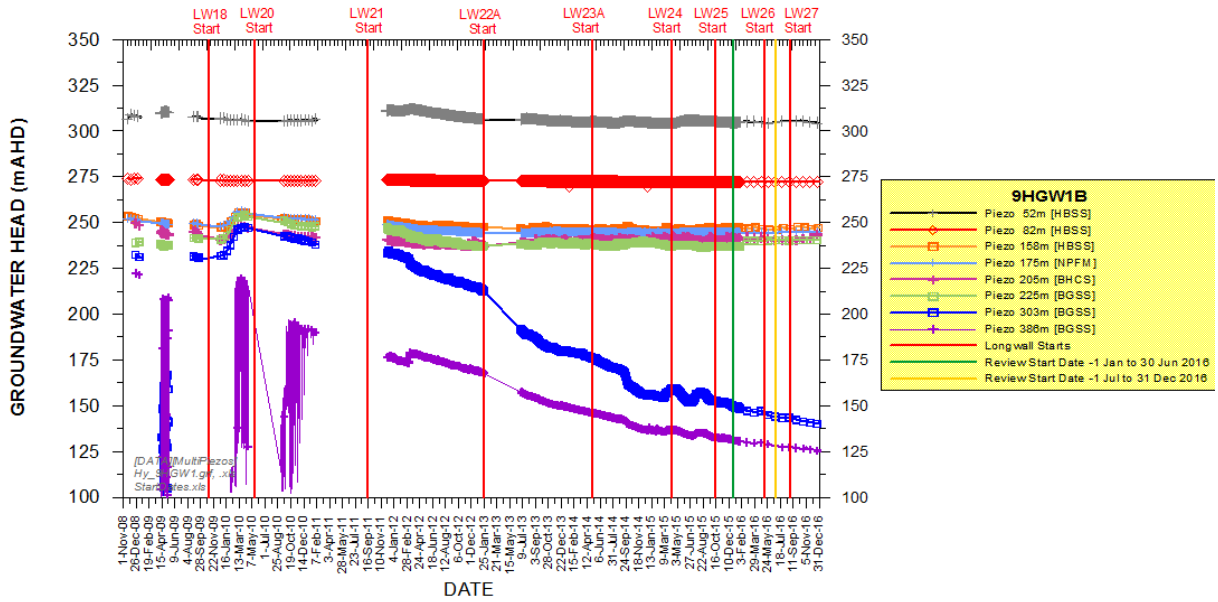



**Chart 60 Time Variations in Potentiometric Heads at 9HGW1B**

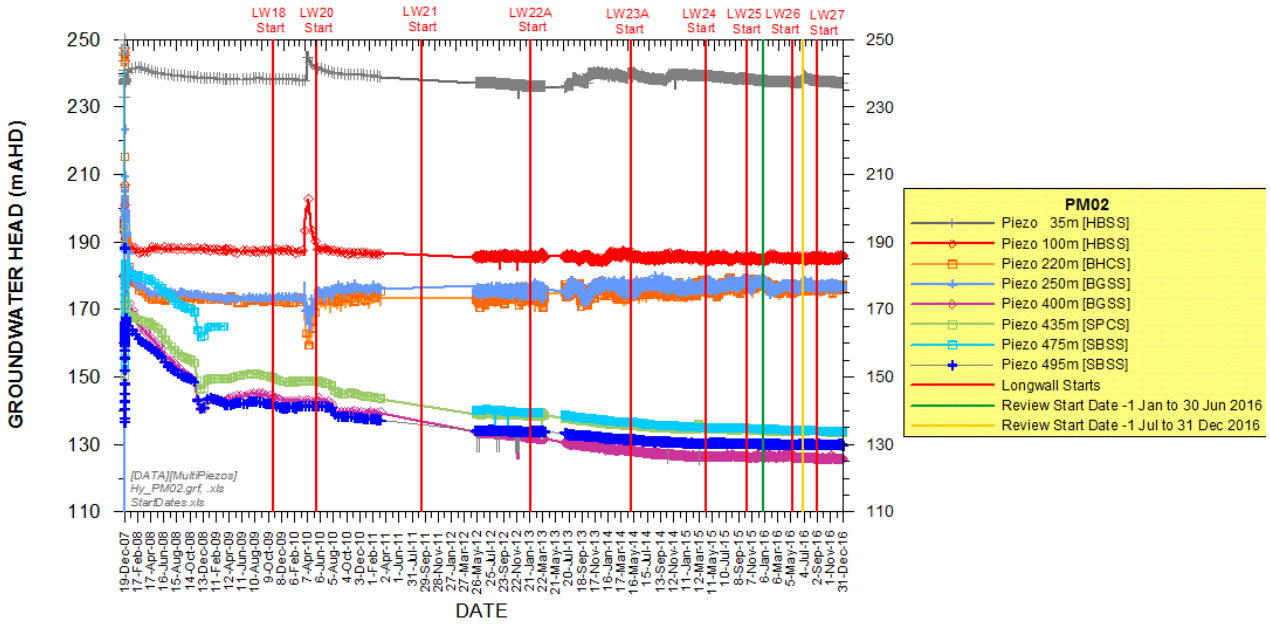



**Chart 61 Time Variations in Potentiometric Heads at PM02**

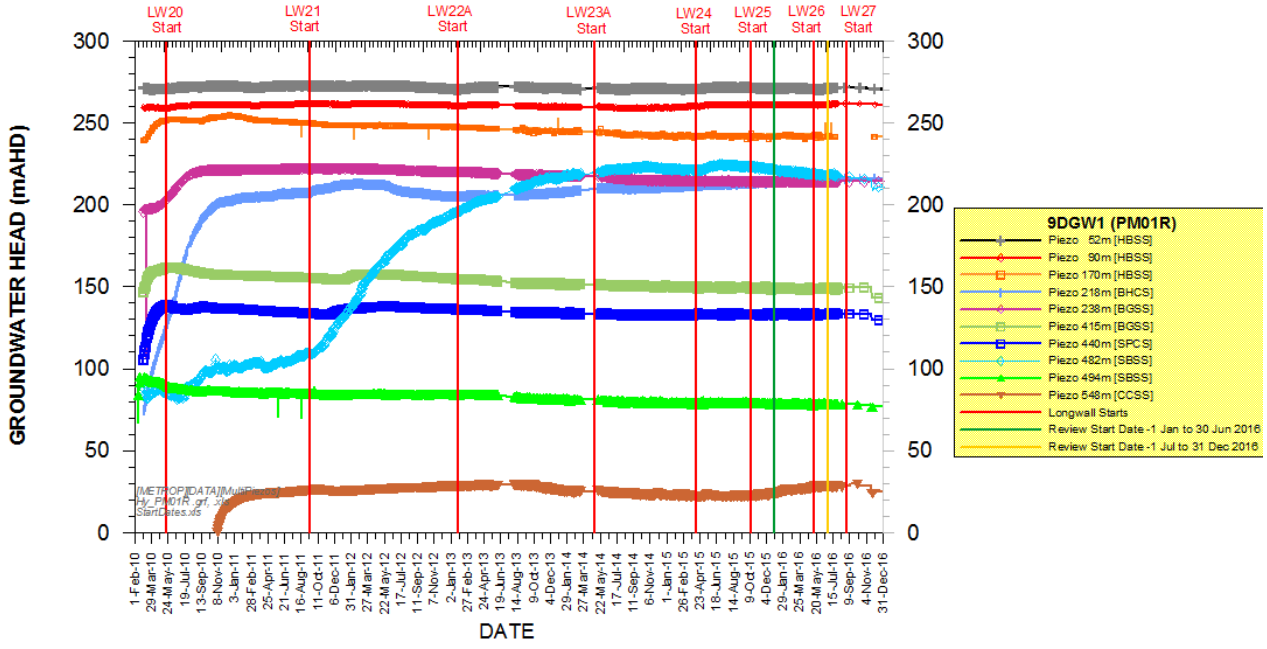



**Chart 62 Time Variations in Potentiometric Heads at PM01**

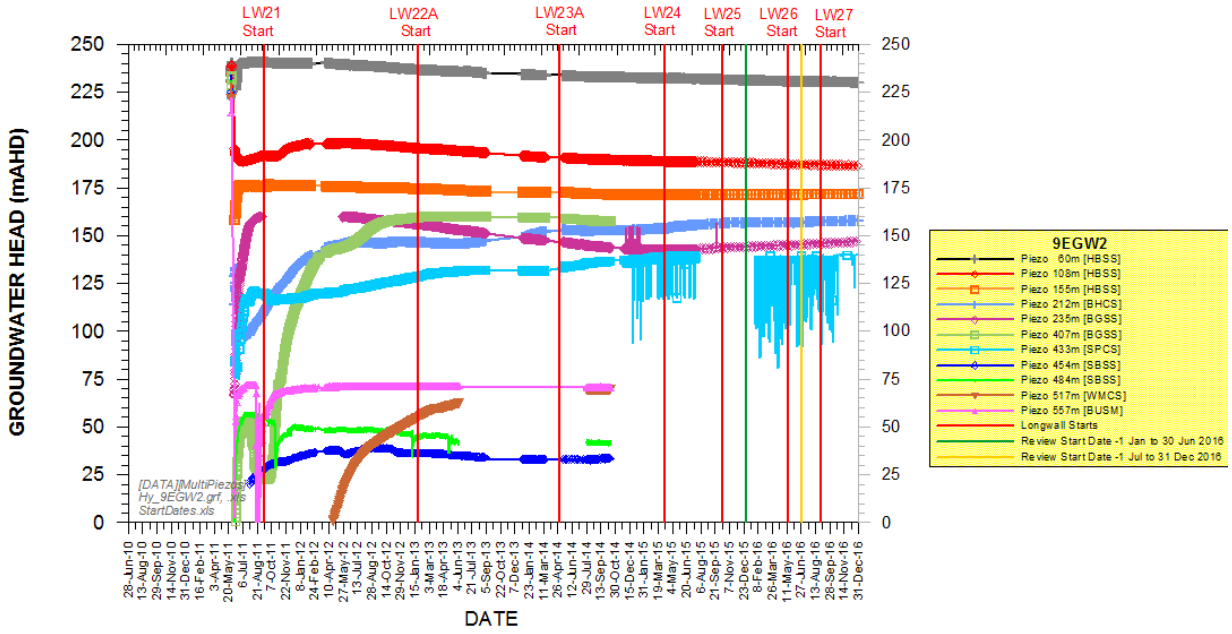



**Chart 63 Time Variations in Potentiometric Heads at 9EGW2A**

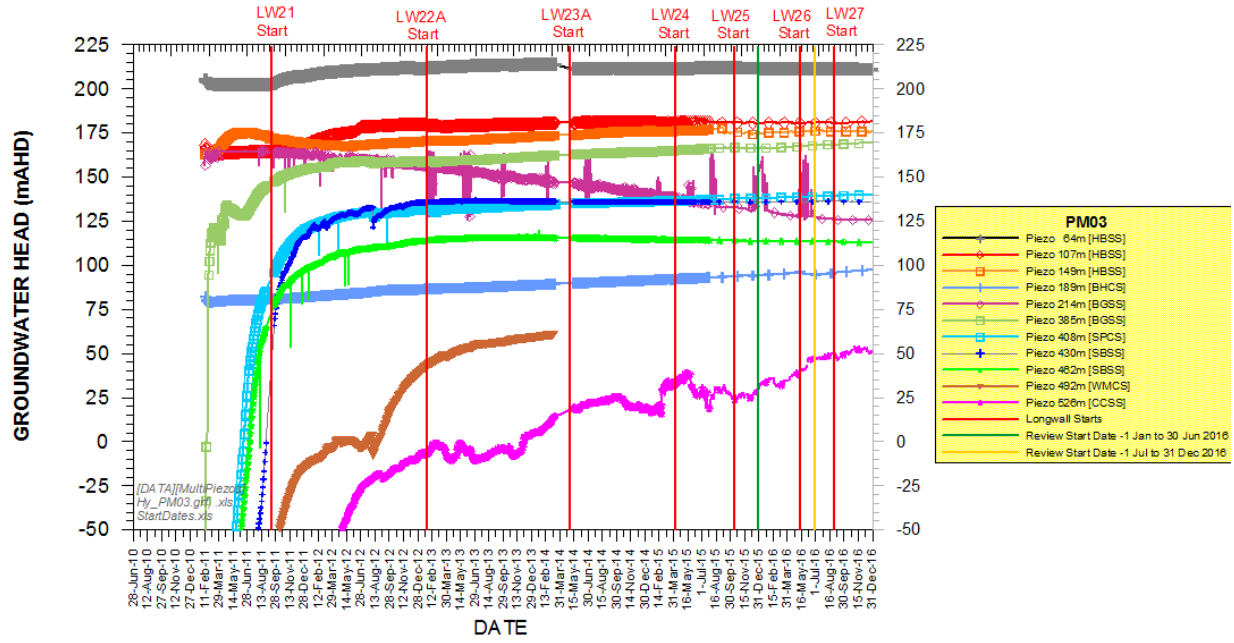
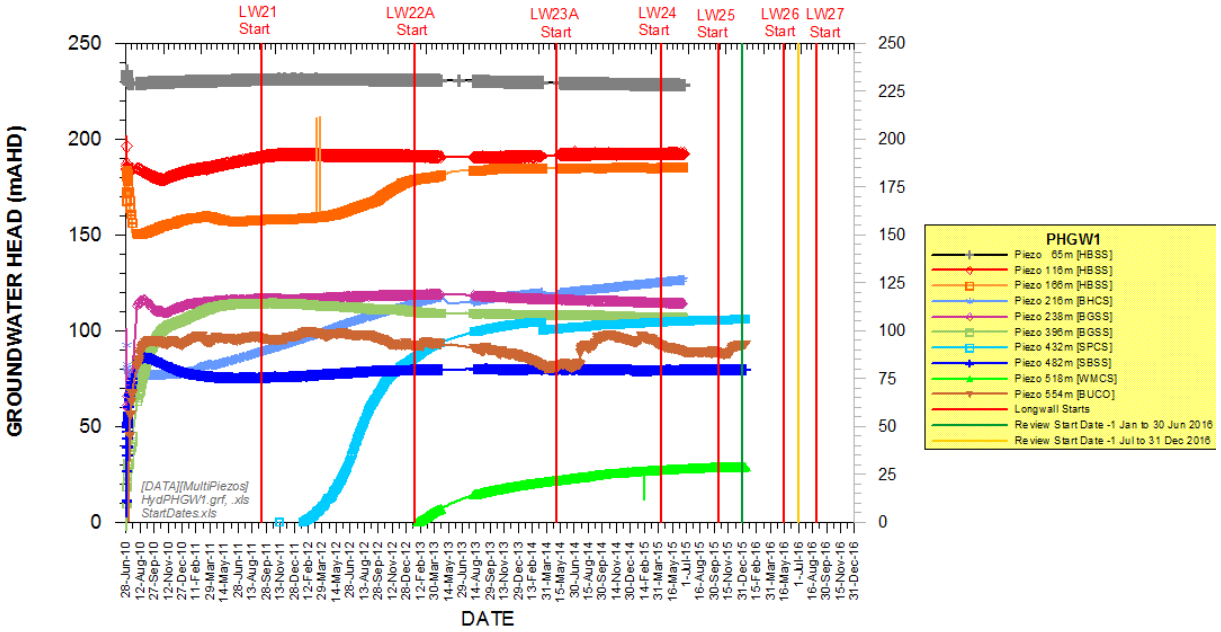
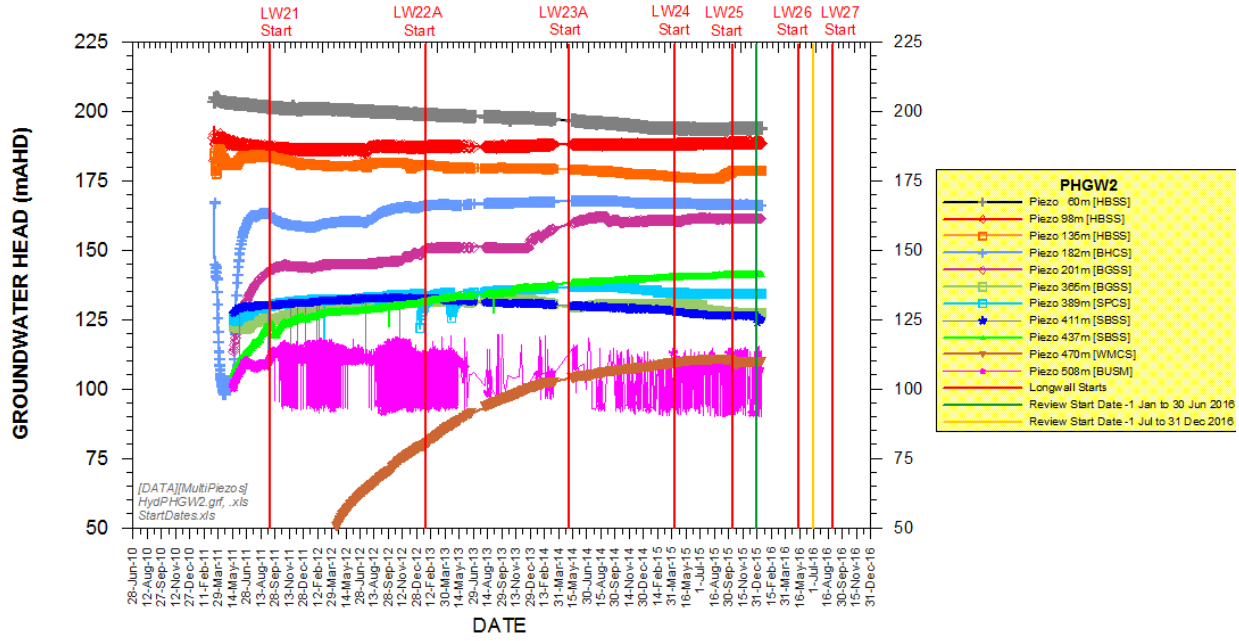



**Chart 64 Time Variations in Potentiometric Heads at PM03**




Note that a connection failure prevented upload of data for sensors in PHGW1B. The equipment supplier has not been able to recover the data.

**Chart 65 Time Variations in Potentiometric Heads at PHGW1B**




Note that a connection failure prevented upload of data for sensors in PHGW2A. The equipment supplier has not been able to recover the data.

**Chart 66 Time Variations in Potentiometric Heads at PHGW2A**

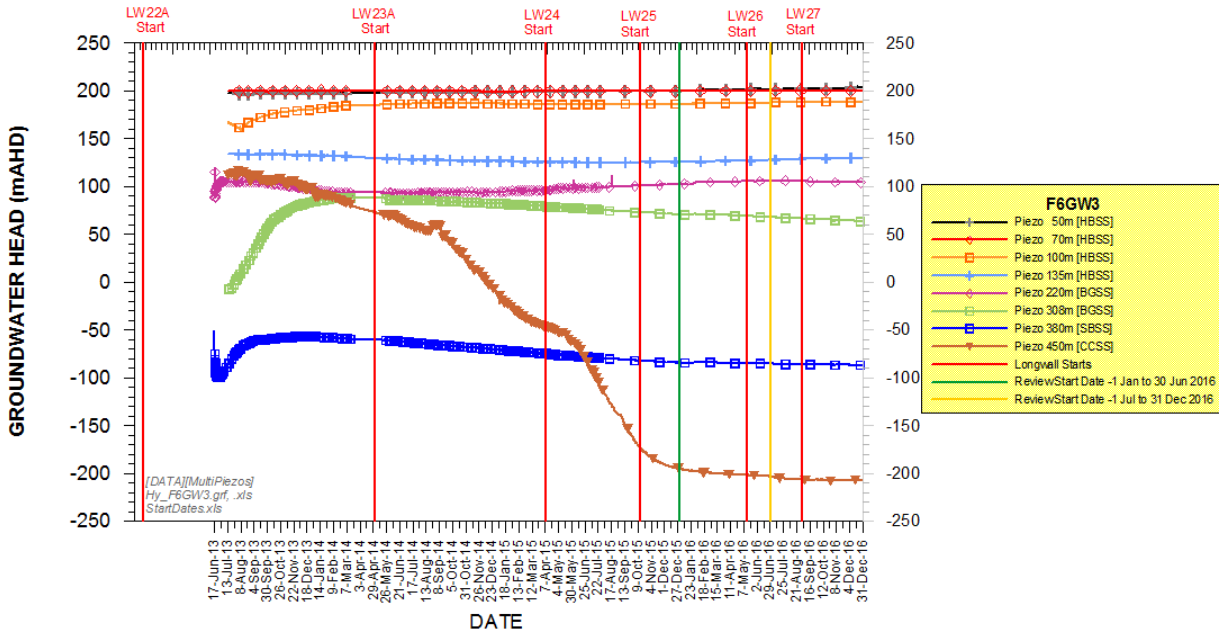
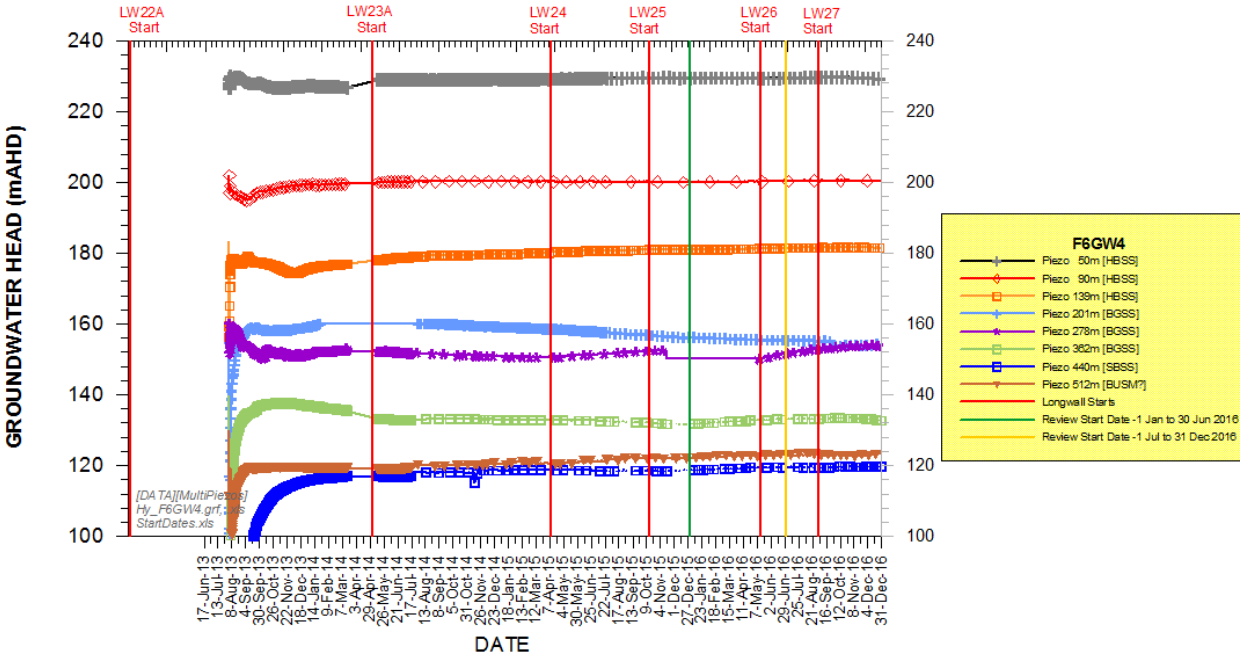



**Chart 67 Time Variations in Potentiometric Heads at F6GW3**




Due to a connection failure, previously “lost” data from October 2015 have now been recovered.

**Chart 68 Time Variations in Potentiometric Heads at F6GW4**

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. The transect on Chart 69 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 indicate that a hydraulic gradient is maintained between piezometers and the floor levels of the nearest streams (Chart 69).

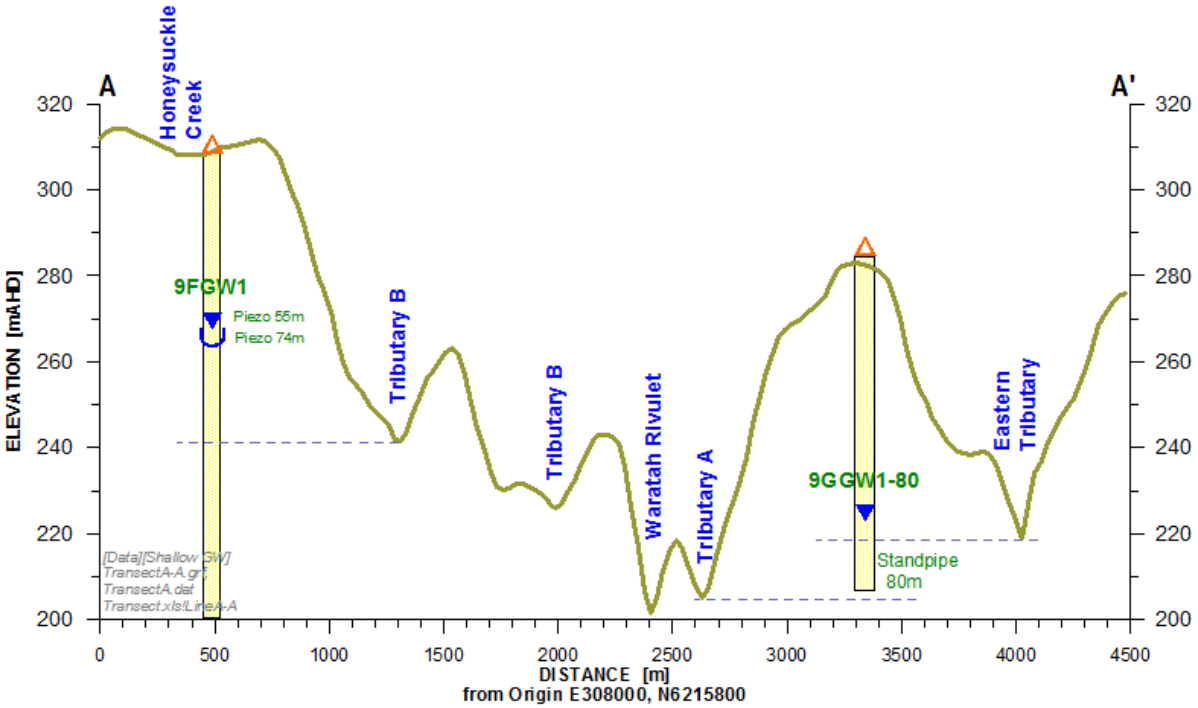



**Chart 69 Topographic Transect A-A' along Longwall 22 and Hawkesbury Sandstone Water Levels (9GGW1-80 at 31 December 2016 and 9FGW1A at 31 December 2016)**

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 70 indicates that the seven day average groundwater levels have not fallen below the reservoir water level (i.e. a hydraulic gradient exists from the bores to the Woronora Reservoir).

The vertical potentiometric head profiles at Bores 9GGW2B and 9FGW1A also support the assessment of no connective cracking between the surface and the mine.

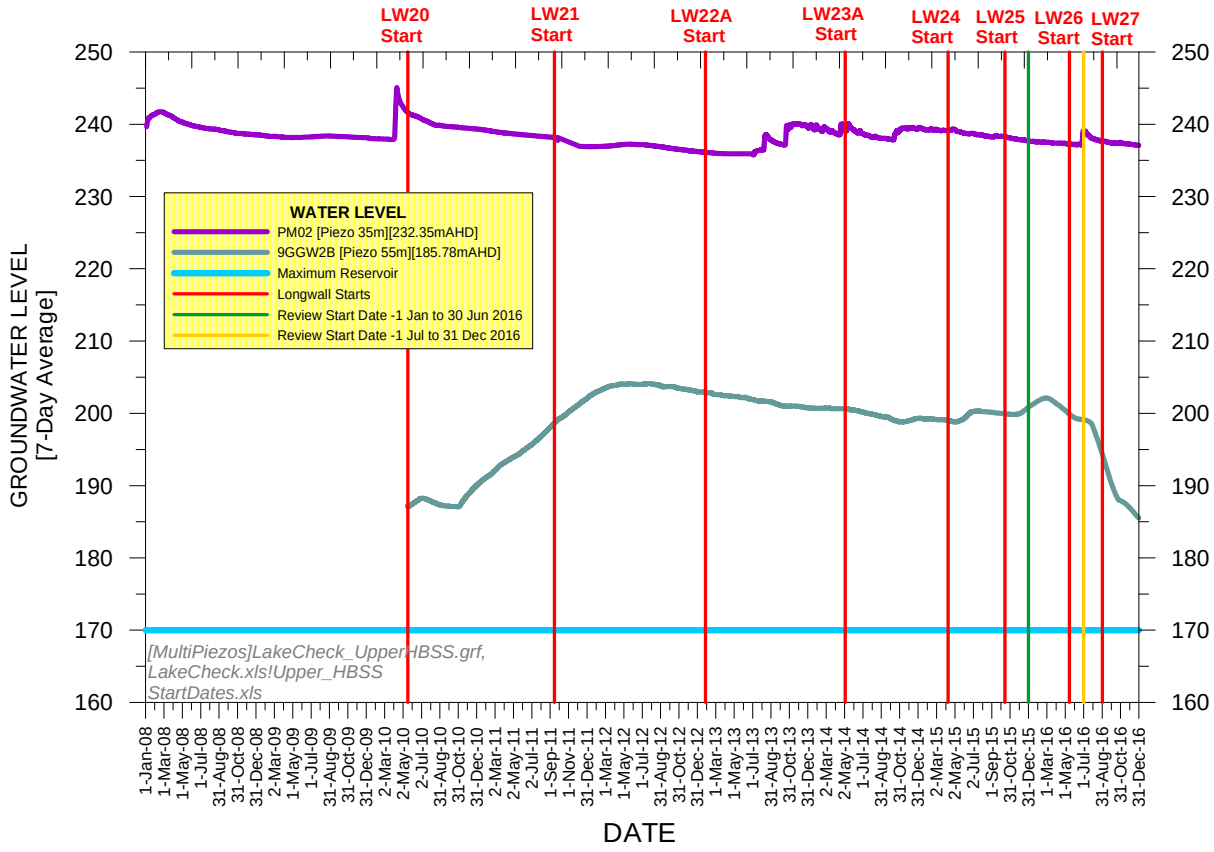



**Chart 70 Seven Day Average Shallow Hawkesbury Sandstone Groundwater Levels at PM02 and 9GGW2B**

The key potential subsidence impacts and environmental consequences on the deep groundwater system described in the Project EA, Preferred Project Report and Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 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 megalitres per day (ML/day), but modelling indicates that the inflow could be up to 0.5 ML/day from the deep groundwater system during mining of Longwall 24.
- 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 for Longwalls 20-22 and Longwalls 23-27 are considered to be consistent with the potential subsidence impacts and environmental consequences described in the Project EA, Preferred Project Report and Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Water Management Plans.

***Groundwater Quality***

Groundwater quality monitoring at sites WRGW1 to WRGW7 on Waratah Rivulet (Figure 12) during the reporting period indicates iron concentrations have remained below 10 mg/L (Chart 71) consistent with the previous reporting period. Manganese concentrations at the Waratah Rivulet sites have typically been less than 1 mg/L during the reporting period (Chart 72) and aluminium concentrations have been low. pH at the Waratah Rivulet sites has been generally acidic and usually between pH 5.5 and 7, however a pH 8.3 was measured at WRGW7 during the reporting period (Chart 73). The observations are consistent with those reported previously.

Groundwater quality monitoring at sites ETGW1 to ETGW2 on the Eastern Tributary (Figure 12) during the reporting period indicates higher iron concentrations (17.1 mg/L and 15.4 mg/L) recorded at ETGW1 in January 2016 and April 2016, respectively, were sustained in the second half of the reporting period (about 17-18 mg/L), despite an excursion to less than 1 mg/L after the June 2016 high rainfall event (Chart 74). Iron concentrations at ETGW2 were consistent with, or lower, than previously recorded concentrations (Chart 74). Although manganese concentrations remain low at both Eastern Tributary sites, the higher manganese concentrations (0.71 mg/L and 0.65 mg/L) recorded at ETGW1 in January 2016 and April 2016, respectively, have been sustained in the second half of the reporting period (about 0.8 mg/L) (Chart 75). The values are now consistently higher than the previously recorded manganese concentrations at this site. Aluminium was at or below 0.05 mg/L in all samples. The groundwater at the Eastern Tributary sites is generally acidic, predominantly between pH 5.7 and pH 6.2 in the reporting period with some indication of a rising trend in latter months (Chart 76).

The Project EA, Preferred Project Report and Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 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 observations for the reporting period are consistent with those reported previously. There groundwater quality monitoring results are considered to be consistent with the predictions.

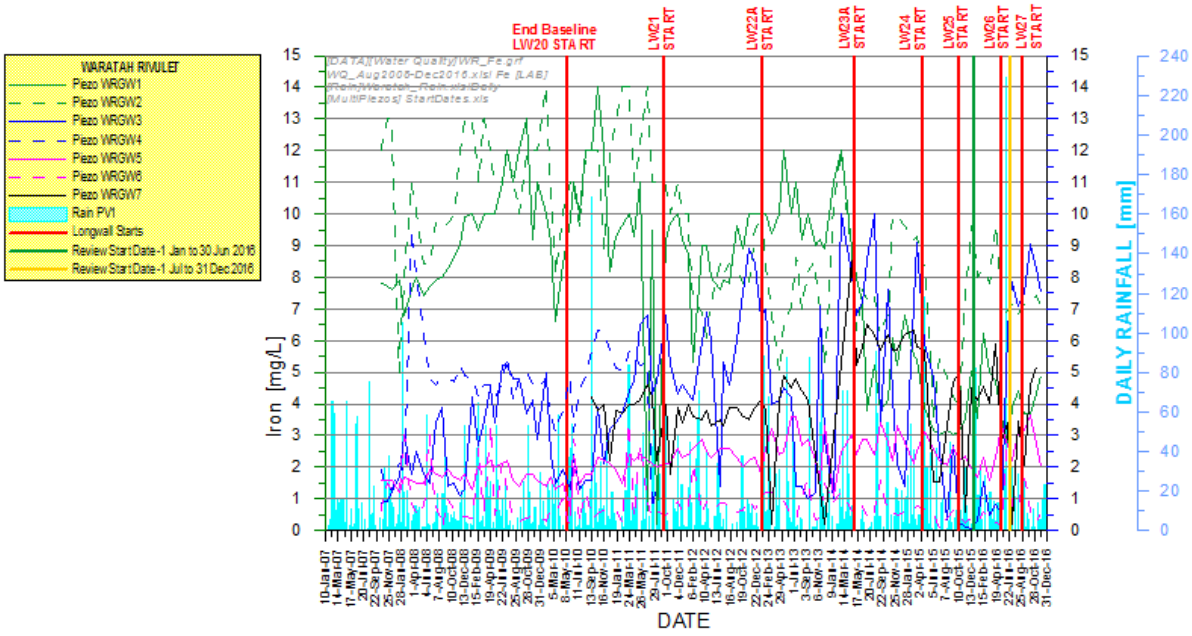



**Chart 71 Iron Concentrations at WRGW1 to WRGW7 on Waratah Rivulet**

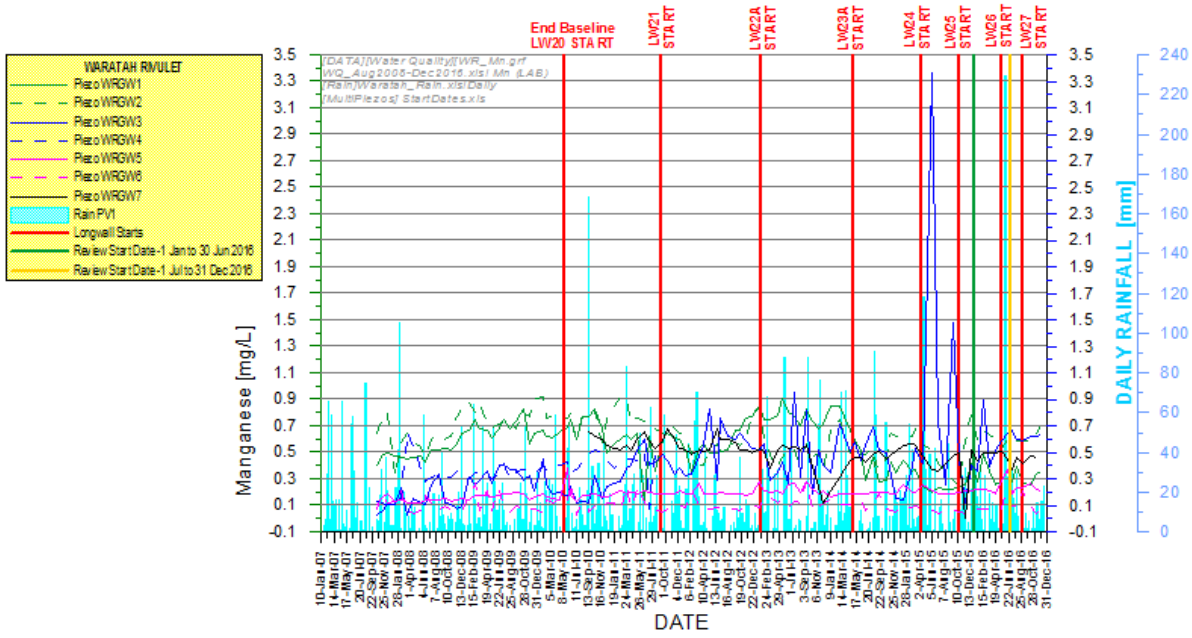



**Chart 72 Manganese Concentrations at WRGW1 to WRGW7 on Waratah Rivulet**

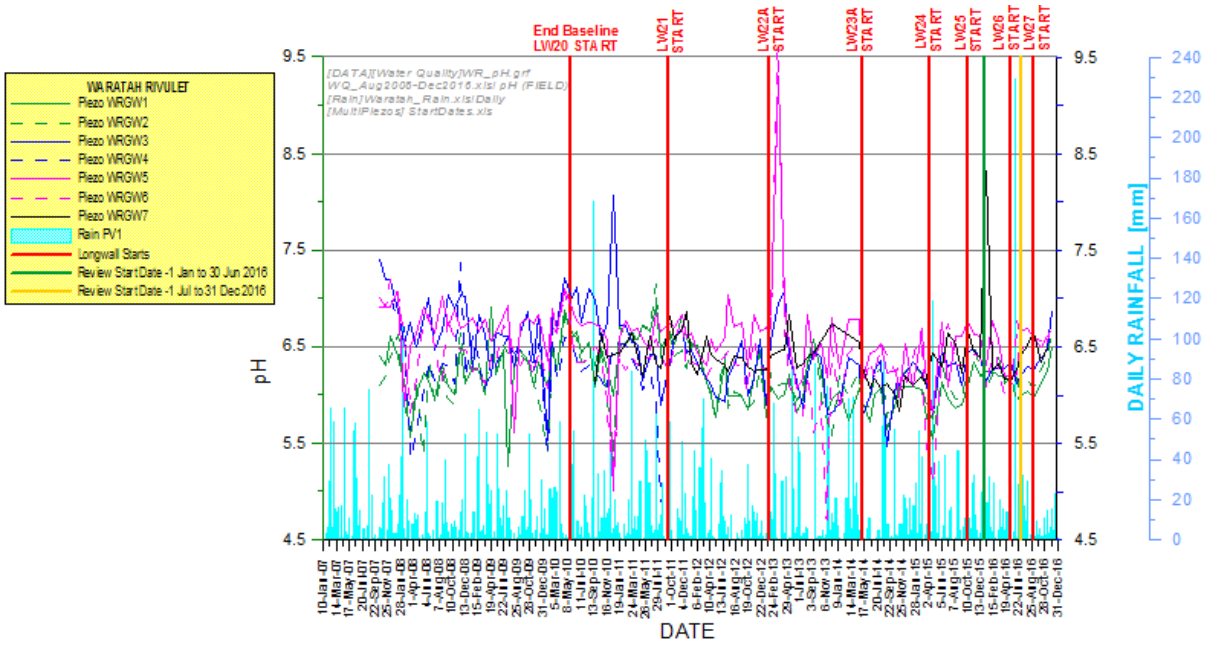



**Chart 73 pH Levels at WRGW1 to WRGW7 on Waratah Rivulet**

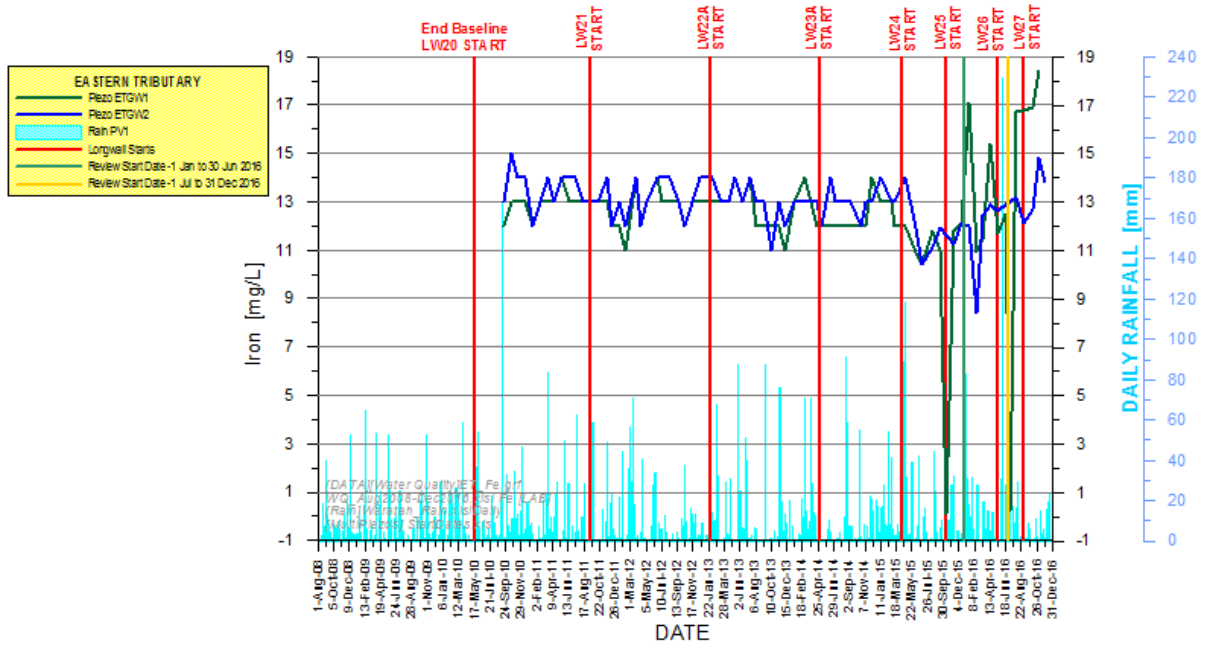



**Chart 74 Iron Concentrations at ETGW1 and ETGW2 on Eastern Tributary**

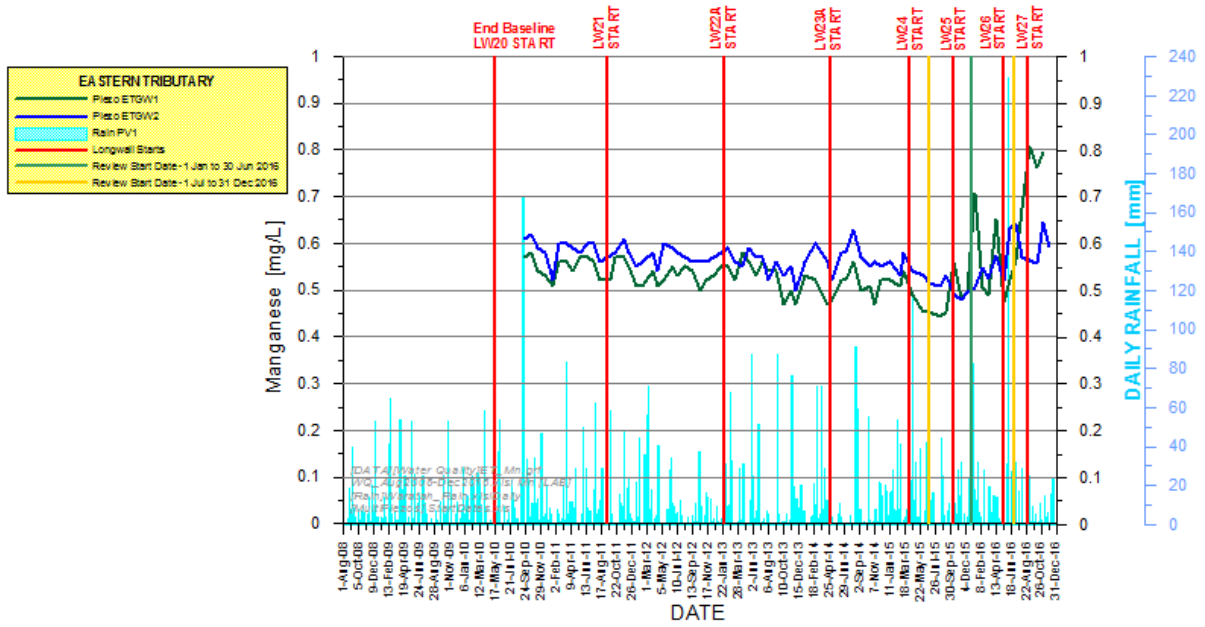



**Chart 75 Manganese Concentrations at ETGW1 and ETGW2 on Eastern Tributary**

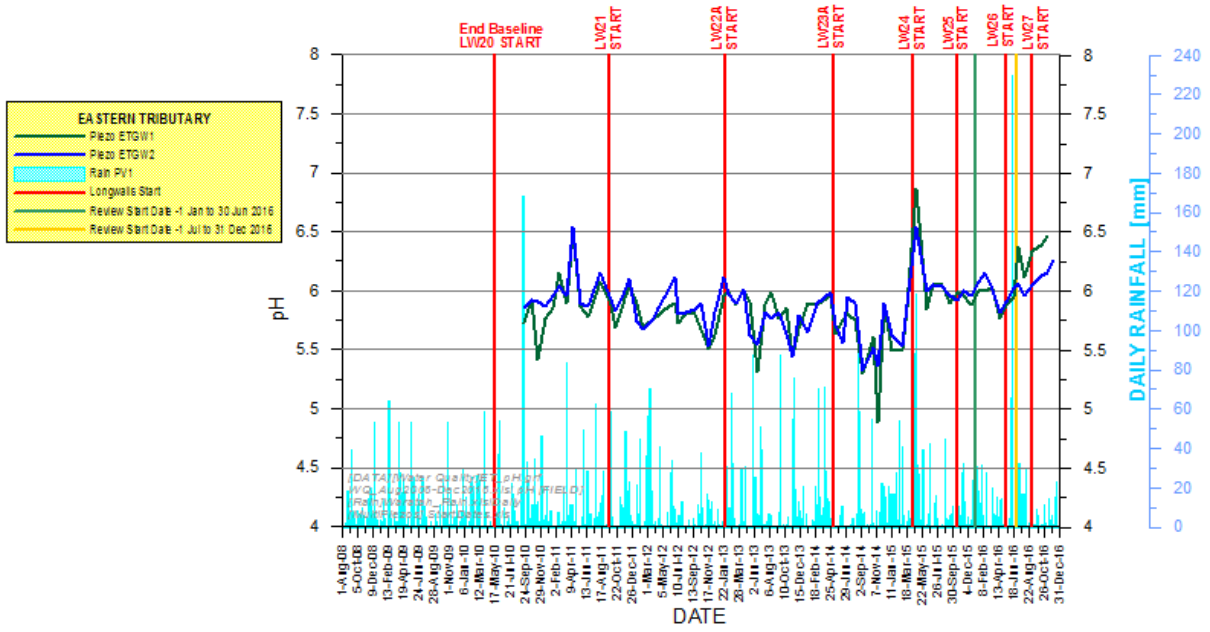



**Chart 76 pH Levels at ETGW1 and ETGW2 on Eastern Tributary**

### *Inspections of Mine Workings*

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

The observations are consistent with the Project EA, Preferred Project Report and Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Water Management Plans, as described for mine water make below.

### *Mine Water Make*

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 and total mine outflows. 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 is assessed against a subsidence impact performance indicator for mine water make of no more than 2 ML/day. The 20 day average daily mine water make has been less than 0.5 ML/day during the reporting period (Chart 77).

The reduction in total mine inflows and outflows recorded in May 2016 and September 2016 (Chart 77) reflect the limited production while underground mining operations moved to the next longwall (Longwall 26 and Longwall 27, respectively).

The net water inflow recorded in November and December 2016 reflects the commencement of the coal reject emplacement backfill plant pumping coal reject directly to the goaf of Longwall 27. There is a net loss of water into the caved zone as not all water is able to be returned to the surface.

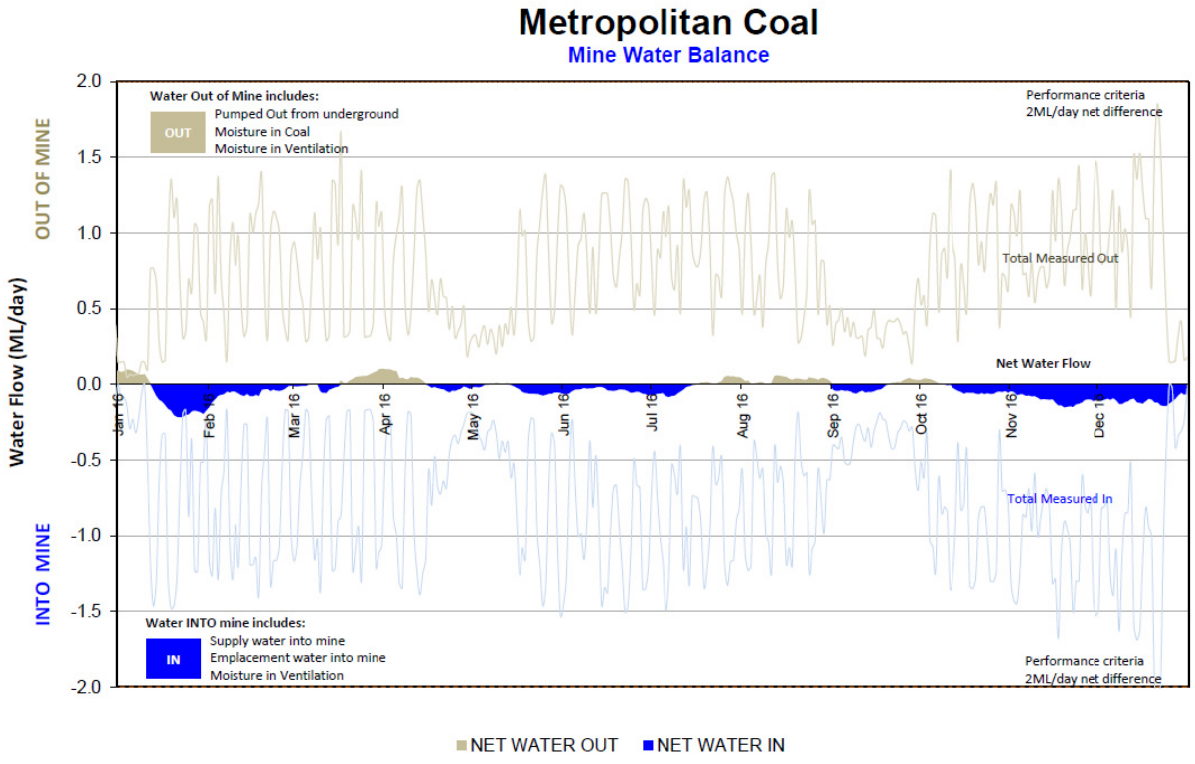



**Chart 77 Estimated Daily Mine Water Make**

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 Longwalls 20-22 and Longwalls 23-27 Water Management Plans, which predicted the water make (i.e. groundwater inflow) to be in the order of 0.1 ML/day. Modelling indicated that the inflow could be up to 0.5 ML/day from the deep groundwater system during the mining of Longwall 24. 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 for Longwalls 20-22 and Longwalls 23-27 are considered to be consistent with the predictions for mine water make.

### 6.1.3 Biodiversity Management

The Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Biodiversity Management Plans have been prepared to manage the potential environmental consequences of the Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 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.

***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 6.1.2, the swamp substrate water levels of Swamps 25, 30, 33 and 35 remained perched during the reporting period (consistent with previous monitoring results).

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 50 and Appendix C). As a result the upland swamp groundwater performance indicator continued to be exceeded at Swamp 20 during the reporting period.

A mining effect to the substrate water levels of Swamp 28 was also identified during the reporting period based on the incomplete recovery of substrate water levels following rainfall events (Chart 51 and Appendix C). As a result the upland swamp groundwater performance indicator was exceeded at Swamp 28 during the reporting period.

Exceedances of the performance indicator at Swamp 20 and Swamp 28 have triggered assessments against the performance measure, *Negligible impact on threatened species and populations*. The Swamp 20 assessments by FloraSearch and Cenwest Environmental Services are provided in Appendix H. The Swamp 28 assessments by FloraSearch and Cenwest Environmental Services are provided in Appendix I. The assessments conclude that the subsidence impact performance measure has not been exceeded.

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 6.1.2 (Swamp Groundwater Levels). The results of upland swamp monitoring for Longwalls 20-22 and Longwalls 23-27 are considered to be consistent with the potential subsidence impacts and environmental consequences 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. However, 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.

In relation to threatened flora and fauna, the Project was considered unlikely to have a significant effect on threatened flora or fauna (Appendix G of the Project EA). The assessments undertaken to date are consistent with the assessments made in the Project EA for species associated with upland swamps (Appendices H and I).

### *Upland Swamp Vegetation Monitoring*

Upland swamp vegetation monitoring is conducted at a number of swamps overlying or adjacent to Longwalls 20-27 and at a number of control swamps (Figures 13 and 14).

The results of the Longwalls 20-22 and Longwalls 23-27 upland swamp vegetation monitoring programs (up to and including the autumn 2016 survey) can be summarised as follows:

- 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 areas of bare earth without vegetation cover. Iron-stained groundwater seepage has been observed since spring 2012 on the terminal rocky step and/or a small rocky step of Swamp 20. In autumn 2016, the level of iron staining associated with this seep was reduced 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 2016 with no unusual areas of vegetation senescence observed. Some isolated dieback and senescence of scattered individuals were recorded throughout most longwall and control swamps. For the Restioid Heath/Banksia Thicket swamps the main species included *Petrophile pulchella* and *Banksia ericifolia* subsp. *ericifolia* in valley side swamps, and for the Tea Tree Thicket swamps the main species included *Banksia robur* and *Gleichenia microphylla*.
- 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 2016.
- 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 Restioid Heath/Banksia Thicket sites was variable but for most swamps was within ranges previously recorded (Charts 78 and 79). 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 2016.
- Species richness within individual Tea Tree Thicket sites in autumn 2016 was also within the range of previous seasons, with the exception of two control swamps (Woronora River south arm and Dahlia Swamp), where a small decrease in species was recorded (Charts 78 and 80). In autumn 2016, a small decrease in species richness from spring 2015 was observed in longwall Swamp 20. In autumn 2016, an increase in species richness from spring 2015 was observed in longwall Swamp 28 (by a single species). The changes in species richness recorded in autumn 2016 are consistent with the fluctuations observed within the baseline monitoring period. All observed changes in species richness are considered to be within the range of natural fluctuations in response to weather, population dynamics, seasonality of survey and natural disturbances including grazing by fauna species.
- Analysis of quadrat/transect data indicates that the vegetation in upland swamps overlying longwall mining has not experienced changes significantly different to changes in control swamps.
- 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, although the differences are small for all species (proportional differences of less than three individuals) and the rate of increase in mortality has been similar between longwall and control swamps.

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 at the Restioid Heath/Banksia Thicket and Tea Tree Thicket swamps is attributed to natural factors including predation, competition with other vegetation and abiotic factors.

In autumn 2016 the mean vegetation condition of tagged indicator species within Restioid Heath/Banksia Thicket swamps and Tea Tree Thicket swamps was similar between longwall and control swamps, with the exception of *Leptospermum juniperinum* where mean vegetation condition was greater at the single longwall swamp than control swamps. The mean reproductive status of tagged indicator species was also similar at longwall and control sites in autumn 2016.

- 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 2016. Similar 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. Similarly, lower mean vegetation condition of *Epacris obtusifolia* and *Banksia robur* was recorded within longwall swamps compared to control swamps in autumn 2016. Similar differences were observed during the baseline monitoring period and following the commencement of mining, indicating that the lower mean vegetation condition does not appear to be related to the mining of Longwalls 23-27.

  Monitoring of indicator species recorded similar mean reproductive status within longwall and control swamps for all indicator species, indicating the reproductive status of tagged indicator species within longwall swamps has not been altered as a result of the mining of Longwalls 23-27.

- No weed species were observed within any of the longwall upland swamps. Observations of weed species within upland swamps were limited to a single control swamp, Dahlia Swamp.

- 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.

The spring 2015 Longwalls 20-22 and Longwalls 23-27 Vegetation Monitoring Reports prepared by Eco Logical Australia Pty Ltd are provided in Appendix J. The autumn 2016 Longwalls 20-22 and Longwalls 23-27 Vegetation Monitoring Reports prepared by Eco Logical Australia Pty Ltd are provided in Appendix K.

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 6.1.2 (Swamp Groundwater Levels). As a result of the potential subsidence impacts and environmental consequences, no change to the fundamental surface hydrological processes and upland swamp vegetation were expected within upland swamps.

The results of upland swamp monitoring for Longwalls 20-22 and Longwalls 23-27 are considered to be consistent with the potential subsidence impacts and environmental consequences 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. However, 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. To date, no changes to the vegetation in swamps, including Swamp 20 and Swamp 28, have been detected that is significantly different to changes in control swamps.

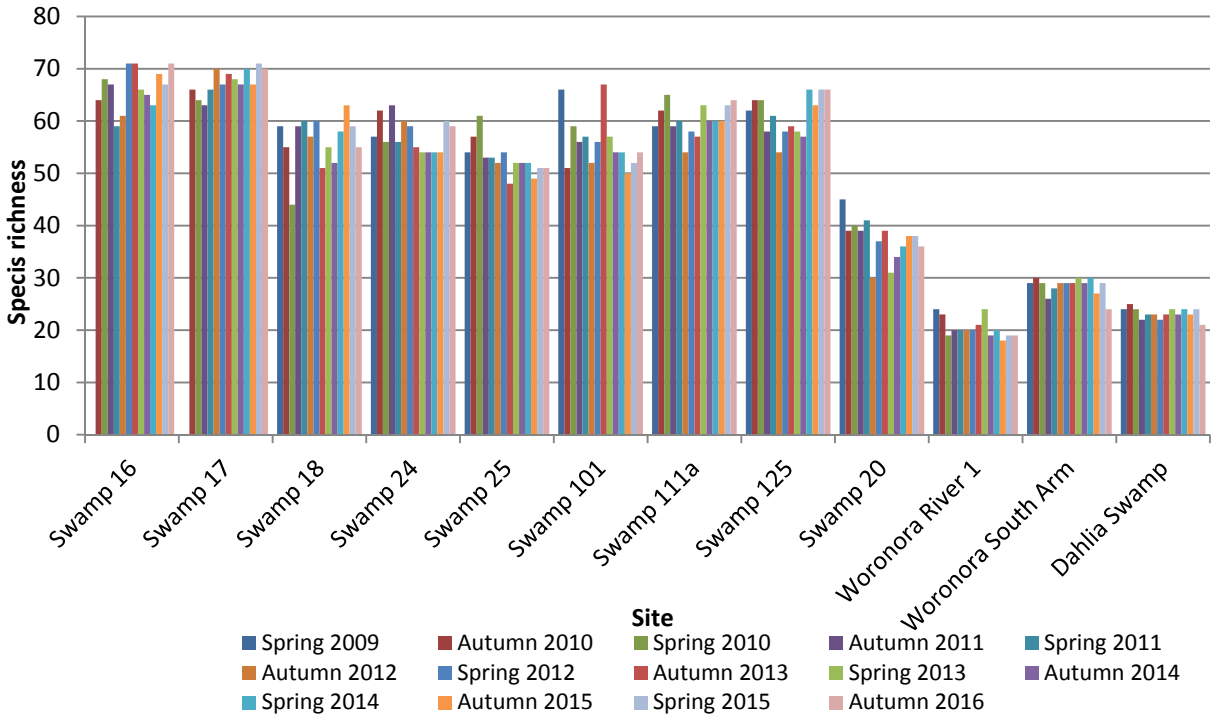



**Chart 78 Native Species Richness in Longwalls 20-22 Upland Swamp Sites, Spring 2009 – Autumn 2016**

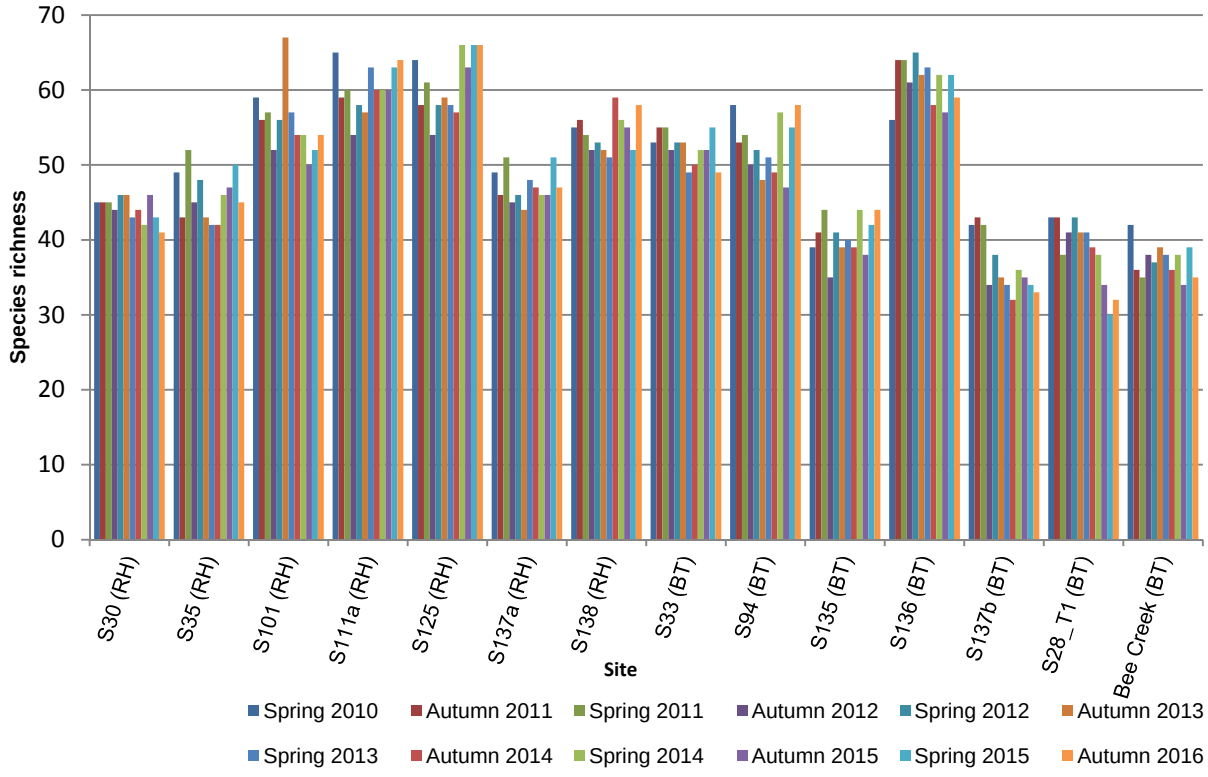



**Chart 79 Native Species Richness within Longwalls 23-27 Upland Swamp Sites Supporting Restioid Heath and Banksia Thicket, Spring 2010 – Autumn 2016**

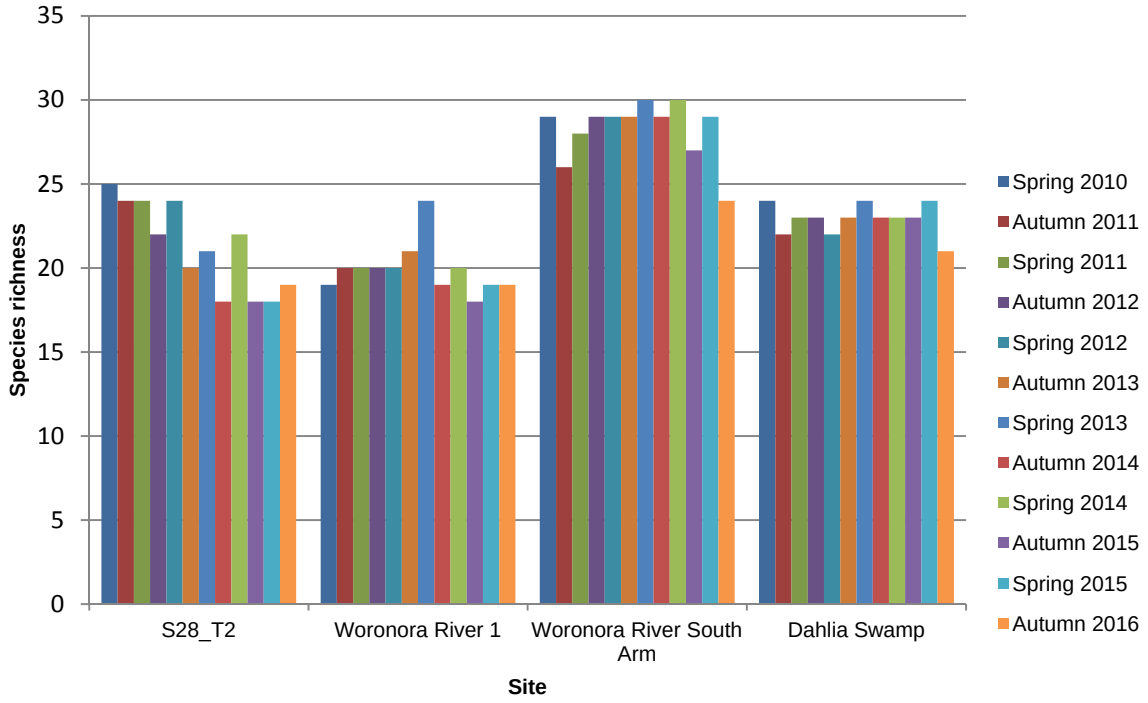



**Chart 80 Native Species Richness within Longwalls 23-27 Upland Swamp Sites Supporting Tea Tree Thicket, Spring 2010 – Autumn 2016**

***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 15).

The results of the Longwalls 20-22 and Longwalls 23-27 riparian vegetation monitoring programs (up to and including the autumn 2016 survey) can be summarised as follows:

- Water levels along the Eastern Tributary at the time of the autumn 2016 survey were lower than in any previous season. At the time of the survey (April 2016), no water was observed at sites MRIP05, MRIP06 and MRIP09, or along stretches between these monitoring sites. Inspections of these sites (MRIP05, MRIP06 and MRIP09) in early May 2016 observed standing water within pools adjacent to these sites, although the water levels were low compared to all previous seasons. At the time of survey, waters levels had only recently dropped at these sites and no vegetation dieback, additional to that observed in previous seasons, was observed.
- In autumn 2016 species richness within all riparian monitoring sites was variable, however no sites recorded species richness outside the range of all previous seasons (Charts 81 and 82). Analysis of this data (ANOVA) identified that throughout the monitoring period control sites had significantly lower species richness compared to the longwall sites, including in autumn 2016.
- Vegetation condition at riparian monitoring sites MRIP01, MRIP03, MRIP04, MRIP06, MRIP07, MRIP08, MRIP10 and MRIP12 was generally observed in good condition. Exceptions to the generally good condition of vegetation within these riparian sites was limited to isolated and scattered individuals observed with dieback and flood impacts including prone vegetation and burial by flood debris.

- At site MRIP11 some dieback of groundcover and shrub layer vegetation was recorded at isolated locations immediately adjacent to the water's edge (less than 50 cm from the water's edge). The extent of dieback on the western bank was confined primarily to the understorey due to the height of the bank, with very few shrubs occurring close to the waterline. Water levels were greatly reduced with areas of dry creek bed observed.
- As reported previously, increased ponding at site MRIP02 on the Waratah Rivulet and between sites MRIP05 and MRIP09 on the Eastern Tributary from subsidence has resulted in prolonged inundation of streamside vegetation causing vegetation dieback. Vegetation dieback was first observed at site MRIP02 in spring 2012 and between sites MRIP09 and MRIP05 in autumn 2014. Areas of riparian vegetation at site MRIP02 previously observed to be inundated by water remained inundated in autumn 2016. The level and areas of inundation at MRIP02 was generally similar to that observed in spring 2015. Small areas within sites MRIP05 and MRIP09, on the Eastern Tributary, which were previously inundated by water, were no longer inundated with water levels having decreased along the Eastern Tributary between sites MRIP06 and MRIP09 at the time of survey.
- In autumn 2016, the extent and level of dieback within site MRIP02 and between sites MRIP09 and MRIP05 was considered to be generally similar to that observed in spring 2015, however, some improvement was observed in *Gleichenia microphylla* sites MRIP02 and MRIP05, and some regeneration of shrubs at site MRIP09. Notwithstanding, dieback remains evident and many areas remain bare.
- In autumn 2016 increased mortality of the indicator species, *Lomatia myricoides* and *Schoenus melanostachys* was driven by the mortality of these species at site MRIP02 (accounting for 64% and 76% of the dead individuals of *Lomatia myricoides* and *Schoenus melanostachys,* respectively).
- The riparian vegetation performance indicator, *Impacts to riparian vegetation are expected to be localised and limited in extent, similar to the impacts previously experienced at Metropolitan Coal*, continued to be exceeded at site MRIP02 on Waratah Rivulet and between sites MRIP09 and MRIP05 on the Eastern Tributary, with vegetation dieback observed greater than 50 cm from the Waratah Rivulet/Eastern Tributary.
- Continued exceedance of the performance indicator for site MRIP02 on Waratah Rivulet and between sites MRIP09 and MRIP05 on the Eastern Tributary triggered ongoing assessment against the performance measure, *Negligible impact on threatened species and populations*. Assessments conducted by Dr. Colin Bower (FloraSearch, 2016) and Dr. David Goldney (Cenwest Environmental Services, 2016) for threatened flora or threatened fauna, respectively, concluded that the impact performance measure had not been exceeded. The 2016 threatened flora and fauna assessments are provided in Appendix H.

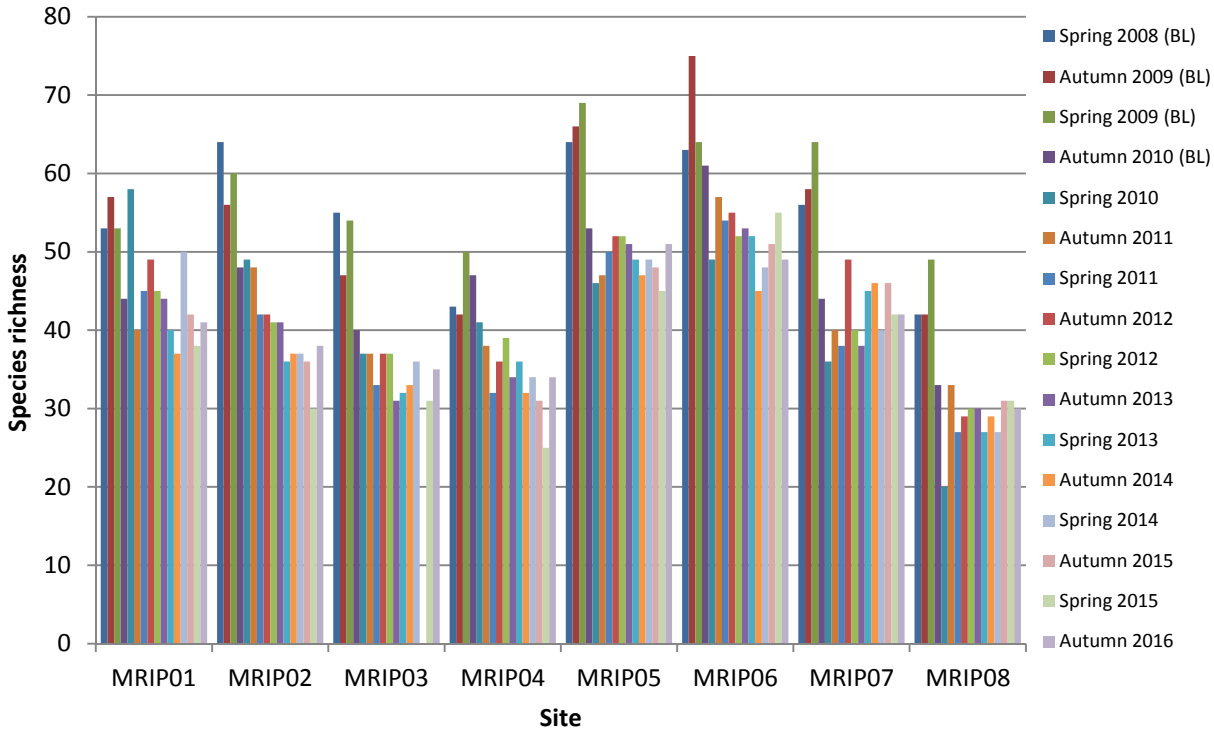



**Chart 81 Species Richness within Riparian Monitoring Sites Across All Seasons - Longwalls 20-22 Monitoring Program**

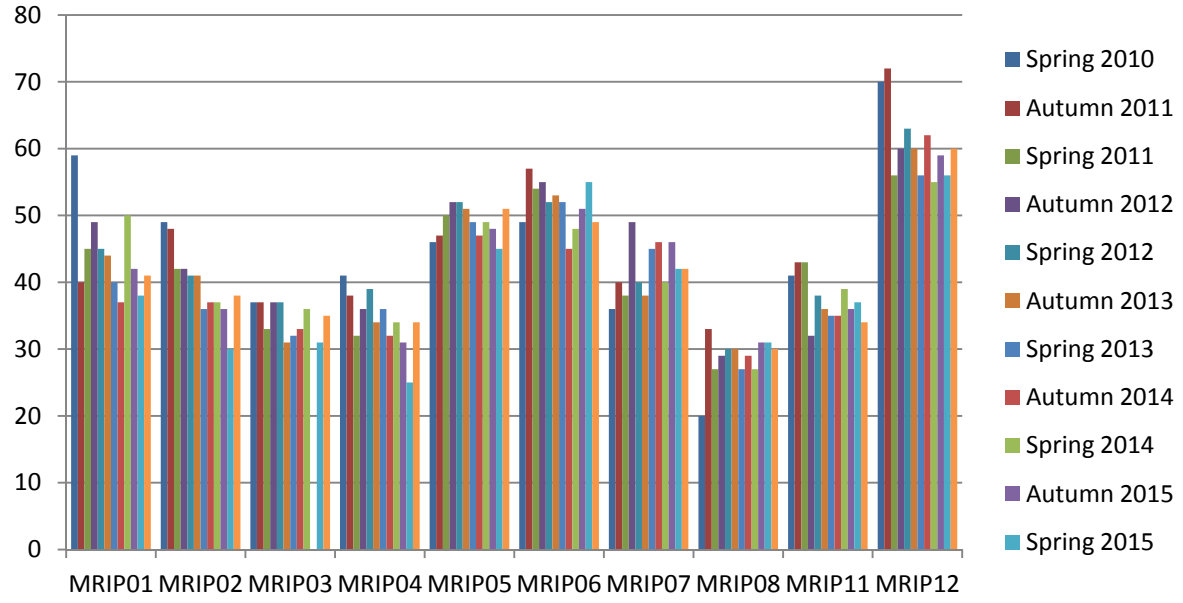



**Chart 82 Species Richness within Riparian Monitoring Sites Across All Seasons- Longwalls 23-27 Monitoring Program**

### *Aquatic Biota and their Habitats*

The aquatic ecology monitoring programs for Longwalls 20-22 and Longwalls 23-27 have been 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 16.

Multivariate and univariate statistical procedures (Permutational Multivariate Analyses of Variance [PERMANOVA] and Plymouth Routines in Multivariate Ecological research [PRIMER] software packages) were used to examine temporal and spatial patterns in macroinvertebrates and macrophytes sampled within the study area. Specifically, PERMANOVA's were 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 autumn 2016 monitoring results are summarised below.

Stream Monitoring Program

*Eastern Tributary*

In autumn 2016, mining impacts continued to be observed on the Eastern Tributary. At the time of the autumn 2016 survey, a reduction in pool water levels and surface flow had occurred (since the spring 2015 survey) and some sections of the stream were observed to be dry.

Multivariate analyses of the monitoring data before versus after commencement of mining indicates that any effect of longwall mining on assemblages of aquatic macroinvertebrates and macrophytes at Locations C1, C2, C3 and C4 are within the range of natural variability in these assemblages as measured by the control locations. Macroinvertebrate taxa that contributed most to the structure of assemblages at the locations sampled along Tributary C/Eastern Tributary were mayflies (Leptophlebiidae) and freshwater shrimp (Atyidae).

Univariate analyses for Longwalls 23-27 detected a significant before (spring 2009 to spring 2013) to after (autumn 2014 to autumn 2016) mining change in mean numbers of Atyidae at Location C2 in relation to the control locations in autumn 2016. It is likely that this result is mostly due to a small decrease in abundance of Atyidae at Location C2 in relation to the control locations. Analyses of macroinvertebrate data collected since spring 2008 for Longwalls 20-22 at Location C2 detected a significant before (spring 2008 to autumn 2010) to after (spring 2010 to autumn 2016) mining change in mean numbers of Atyidae in relation to the control locations in spring 2015, however, no detectable difference was found by the autumn 2016 survey.

Similar to the findings at Location C2, univariate analyses also detected a significant before to after mining change in mean number of Atyidae at Location C4 compared to the control locations in autumn 2016.

*Waratah Rivulet*

To date, 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 the commencement of mining.

*Tributary B*

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 2016 due to insufficient habitat available for sampling. Multivariate analyses indicate that assemblages of macroinvertebrates at Location B1 differed significantly from before to after spring 2012, in relation to the control locations. A significant decrease in mean diversity and numbers of Atyidae has also been detected at Location B1 from before to after spring 2012 in relation to the control locations. There has been no evidence of any significant impact to mean total abundance of macroinvertebrates or mean numbers of Leptophlebiidae. Considerable dieback of the fern, *Gleichenia dicarpa*, has occurred at Location B1 since spring 2012 indicating aquatic macrophyte assemblages at the Tributary B location have experienced a degree of environmental stress since spring 2012 as a result of Longwalls 20-22.

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). Flow diversion and reductions in pool water level were apparent at both sites in autumn 2016. Multivariate analyses have found a significant difference, before to after mining, in the structure of the assemblage of aquatic macroinvertebrates at Location B2 compared to the control locations since autumn 2014, including autumn 2016. 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 detected by the autumn 2016 survey. Leptophlebiidae have increased at Location B2 since spring 2015. No significant changes in mean diversity, abundance or numbers of Atyidae were detected before to after mining at Location B2 in relation to the control locations. Atyidae, however, do appear to have decreased at Location B2 within the after period. Analyses examining changes in aquatic macrophytes found no evidence of impacts at Location B2 that could be related to mining activities within the Longwalls 23-27 underground mining area.

Pool Monitoring Program

*Pools on Waratah Rivulet*

Multivariate analyses comparing temporal and spatial patterns of change in assemblages of aquatic macroinvertebrates and 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 in the structure of assemblages of macroinvertebrates or their main components (i.e. Leptophlebiidae and Atyidae) when comparing the before to after mining periods. Univariate analyses, however, indicate there has been a significant increase in mean diversity of macroinvertebrates in two of the large pools sampled (Pools J and M1) and the small pools (K, L and M) in relation to the control pools since the commencement of Longwalls 20-22 in autumn 2015, spring 2015 and autumn 2016.

Analyses comparing temporal and spatial patterns of change in assemblages of aquatic macrophytes in large pools (J, M1 and N) sampled on the Waratah Rivulet with the control pools have not detected significant differences in the structure of assemblages or mean diversity and cover when comparing the before to after mining periods.

To date, any effect of subsidence on aquatic macrophytes in Pools J, M1, K, L and M on the Waratah Rivulet appears to be within the range of natural variability as measured by the control locations.

*Pools on Eastern Tributary*

Analyses indicated significant differences in the structure of aquatic macroinvertebrate assemblages in large Pool ETAH before to after mining compared to control locations in autumn 2015 and autumn 2016, largely due to changes in the contribution that the families Atyidae and Leptophlebiidae made to the structure of the assemblage at Pool ETAH relative to the controls. However, there was no significant difference in the structure of the aquatic macroinvertebrate assemblage in Pool ETAH compared to control pools in spring 2015. 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, that could be associated with mining.

Analyses examining changes in aquatic macroinvertebrates and macrophytes in small pools (Pools ETAG, ETAI and ETAK) on Eastern Tributary found no evidence of impacts that could be related to mining activities within the Longwalls 23-27 underground mining area.

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

The spring 2015 Longwalls 20-22 and Longwalls 23-27 Aquatic Ecology Monitoring Reports prepared by Bio-Analysis Pty Ltd are provided in Appendix L. The autumn 2016 Longwalls 20-22 and Longwalls 23-27 Aquatic Ecology Monitoring Reports prepared by Bio-Analysis Pty Ltd are provided in Appendix M.

The key potential subsidence impacts and environmental consequences for streams described in the Project EA, Preferred Project Report and Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Biodiversity Management Plans are described in Section 6.1.2. 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 Longwalls 20-22 and Longwalls 23-27 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 (e.g. aquatic macrophytes, pools) and connectivity among sections of the stream channel, impeding fish passage.

The results of aquatic ecology monitoring for Longwalls 20-22 and Longwalls 23-27 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 Longwalls 20-22 and Longwalls 23-27 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. The aquatic ecology subsidence impact performance indicator: *The aquatic macroinvertebrate and macrophyte assemblages in streams and pools are not expected to experience long-term impacts as a result of mine subsidence* has been assessed as being exceeded for Location B1 on Tributary B. This will trigger an assessment against the biodiversity subsidence impact performance measure. The assessment against the biodiversity performance measure will be conducted in relation to threatened terrestrial flora and fauna; there are no threatened aquatic fauna or flora known, or considered likely to occur).

Assessment of Aquatic Ecology Data in response to Eastern Tributary Iron Staining Performance Measure Exceedance

In response to the exceedance of the Eastern Tributary iron staining performance measure (discussed in Section 12.1), Bio-Analysis Pty Ltd (2016) analysed the recent spring 2016 aquatic ecology data collected at monitoring sites on the Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26. Monitoring by Metropolitan Coal has indicated a progressive increase in the extent of iron staining on the Eastern Tributary between the maingate of Longwall 26 and the full supply level of the Woronora Reservoir. Iron staining was first observed at Location C2 and Pools ETAG, ETAH, ETAI and ETAK sampled by the aquatic ecology surveys during the spring 2016 survey. These aquatic ecology monitoring locations are situated between the full supply level of the Woronora Reservoir and the maingate of Longwall 26 and are shown on Figure 16.

The key findings from examination of the aquatic ecology data sampled at Location C2 and Pools ETAG, ETAH, ETAI and ETAK on the Eastern Tributary up until spring 2016, are summarised below:

- The aquatic ecology results to date (spring 2016) indicate aquatic macroinvertebrate assemblages on the Eastern Tributary have experienced a degree of environmental stress since spring 2015 as a result of mining. In autumn 2016 and spring 2016 there were significant differences in the numbers of Atyidae at Location C2 compared to the control sites. However, multivariate analysis of the aquatic macroinvertebrate data found no significant difference between the structure of assemblages at Location C2 and the control locations that would indicate an impact from mining. Similarly, univariate analyses found no significant difference to total diversity or abundance of macroinvertebrates or numbers of Leptophlebiidae at Location C2 compared to the control sites.

- Significant differences in the structure of the macroinvertebrate assemblage at Pool ETAH compared to the controls were identified in autumn 2015 and autumn 2016 (largely due to changes in the contribution that particular families made to the structure of the assemblage at Pool ETAH relative to the controls), however were not significantly different in spring 2015 or spring 2016. 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, that could be associated with mining. Analyses examining changes in aquatic macroinvertebrates and macrophytes in Pools ETAG, ETAI and ETAK on Eastern Tributary found no evidence of mining-related impacts.
- The significant differences that have been identified in the macroinvertebrate assemblage (described above), occurred prior to the appearance of iron staining/iron floc at the sampling locations in spring 2016.

Bio-Analysis' analysis of the aquatic ecology data indicates that the aquatic ecology performance indicator, *Aquatic macroinvertebrate and macrophyte assemblages in streams and pools are not expected to experience long-term impacts as a result of mine subsidence*, has not been exceeded.

***Amphibian Surveys***

Monitoring programs have been developed for Longwalls 20-22 and Longwalls 23-27 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 17.

The Spring-Summer 2015 Longwalls 20-22 and Longwalls 23-27 Amphibian Monitoring Reports prepared by Cenwest Environmental Services are provided in Appendix N.

A Poisson regression analysis has been used to analyse the amphibian survey results obtained to date (i.e. to spring/summer 2015). No adverse impact from mining has been detected for any frog species including the Giant Burrowing Frog and Red-crowned Toadlet, at the 95% confidence level.

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

### 6.1.4 Land Management

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

***Steep Slopes and Land in General***

Opportunistic 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 reporting period, surface cracking and minor rock fall was opportunistically observed at a rock ledge located over Longwall 23B (Figure 18). The fallen rock, approximately 50 cm wide and 3 m in length, came from the underside of the sandstone boulder overhang. Most of the fallen rock landed on the sandstone platform underneath, with some smaller pieces falling on the vegetated area below the platform. 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 observed surface cracking and rock fall are consistent with the predictions described in the Project EA, Preferred Project Report, and Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Land Management Plans, specifically, that the maximum predicted systematic strains are 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. The size and extent of surface cracking at the steep slopes and land in general was expected to be similar to that observed during the extraction of previous longwalls at Metropolitan Coal (i.e. where surface cracking up to approximately 25 m long and 0.1 m wide has been observed).

***Cliffs and Overhangs***

Visual inspections are conducted monthly for the period of time Longwalls 23-27 extraction is within 400 m of sites COH2, COH3, COH4, COH5, COH6, COH6a, COH7, COH8, COH9, COH10, COH14, COH15 and COH16 (Figure 18) and following the completion of each longwall to record evidence of subsidence impacts.

Previously, a small rock fall was recorded in December 2013 at site COH2 (Figure 18). No additional rock falls at the cliff or overhang sites were recorded during the reporting period.

The Project EA, Preferred Project Report and Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 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.

### 6.1.5 Heritage Management

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

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 19). The Aboriginal heritage sites monitoring program is carried out by an archaeologist (with experience in rock art recording and management) and Aboriginal stakeholder representatives.

Six heritage sites (FRC 15, FRC 176, 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 Aboriginal heritage surveys to have changes due to mining induced subsidence from Longwalls 20-22 and Longwalls 23-27 (as reported in the Metropolitan Coal 2015 Annual Review).

The second round of monitoring for Longwalls 23-27 (Round 2) was conducted in February and March 2016 following the completion of Longwall 24, by Niche Environment and Heritage. The Round 2 monitoring report is provided in Appendix O. No new changes due to mining induced subsidence were observed by the Round 2 survey.

The third round of monitoring for Longwalls 23-27 (Round 3) was conducted in September 2016 following the completion of Longwall 25 by Niche Environment and Heritage. The Round 3 monitoring report is also provided in Appendix O and the results are summarised below.

Aboriginal heritage site FRC 176 (a sandstone overhang with charcoal infill art on the ceiling) was observed to have changes attributable to mine subsidence (i.e. vertical cracking along the northern and southern ends of the shelter) during the Longwalls 23-27 Round 1 survey. No further changes were recorded at site FRC 176 during the Round 2 survey. During the Longwalls 23-27 Round 3 survey, the crack at the northern end of the shelter was observed to have opened 5 mm wider. The art panel was not affected by the cracking at the time of the Longwalls 23-27 Round 1, Round 2 and Round 3 surveys.

Changes due to mining were also recorded by the Longwalls 23-27 Round 3 survey to site FRC 275 (a sandstone overhang with charcoal infill art on the ceiling). The horizontal bedding plane of the shelters joins was observed to have opened, causing vertical hairline cracks along the back wall of the shelter. This cracking has not affected the art panel which is located on the ceiling of the shelter. Site FRC 275 will be observed in future monitoring rounds to assess whether or not there are changes to water flow and seepage at the site.

In accordance with the Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Heritage Management Plans, 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 2 of this report (labelled Project Underground Mining Area Longwalls 20-27 and 301-317). Of the sites at which changes due to mining induced subsidence have occurred, site FRC 281 has been affected by subsidence impacts as a result of cracking of sandstone that coincides with Aboriginal art. This means that less than 1% of sites within the mining area have been affected, which is within the approved performance measure.

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 and Longwalls 23-27 Heritage Management Plans including the potential for open sites and overhang sites to be impacted by the cracking of sandstone resulting from mine subsidence. Where cracking is coincident with an overhang, there is potential for an isolated rock fall as the result of mining, or in extreme cases, collapse. 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. The Project EA, Preferred Project Report, and Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Heritage Management Plans predicted that the majority of identified Aboriginal heritage sites would experience no significant change, particularly when compared to natural deteriorating processes unrelated to mining.

### 6.1.6 Built Features Management

The Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Built Features Management Plans were developed to manage the potential environmental consequences of the Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Extraction Plans on built features in accordance with Condition 6, Schedule 3 of the Project Approval. As indicated in the Metropolitan Coal 2015 Annual Review, the Metropolitan Coal Longwalls 20-22 Built Features Management Plan has effectively been discontinued as the appropriate monitoring for built features has been incorporated into the Metropolitan Coal Longwalls 23-27 Built Features Management Plan.

A monitoring program has been implemented to monitor subsidence impacts on infrastructure owned by Endeavour Energy, Nextgen, TransGrid, Optus, Telstra, Roads and Maritime Services, Sydney Water and Wollongong City Council. The analysis of subsidence monitoring results is discussed in Section 6.1.1. No subsidence impact to any built feature was evident over the reporting 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 reporting 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 Garrawarra Complex is located more than 2.5 km from Longwalls 23-27. The heritage/historical significance subsidence impact performance measure was not exceeded during the reporting period.

During the reporting period, detailed discussions and risk assessments were held with the owners of transmission lines (TransGrid and Endeavour Energy) and the DRE in relation to Longwall 26 and Longwall 27 extraction in the vicinity of electrical assets. The risk assessments reviewed the potential for impacts on public safety in the event of a fault in electricity supply. The Longwalls 23-27 Subsidence Monitoring Program, Longwalls 23-27 Built Features Management Plan – Endeavour Energy and Longwalls 23-27 Built Features Management Plan – TransGrid were updated during the reporting period to include additional subsidence monitoring at transmission towers located at the end of Longwall 26 and Longwall 27. Metropolitan Coal also commenced a trial of real time 3D monitoring on two 330kV transmission towers located near Longwall 26 and Longwall 27 to inform the suitability and accuracy of the 3D monitoring technology for deployment to other built features.

In the previous reporting period, an extensive structural investigation was completed for Bridge 2 in consultation with the Roads and Maritime Services (RMS) to determine the safe and serviceable criteria for the bridge. Real time monitoring provisions and future mining stand-off requirements were also established. During the current reporting period, a real time high precision fibre optic monitoring system (Fibre Bragg Grating (FBG) Monitoring System) was installed on both bridge structures (RMS reference BN616-southbound and BN617-northbound) at the Old Princes Highway Underpass during 2016 to gather pre-mining data (i.e. prior to the commencement of Longwall 301). The pre-mining data will be used to filter out the effects of vehicles on the bridges, diurnal effects of expansion and contraction, and seasonal effects of earth swelling in summer/winter periods. This monitoring system communicates directly by mobile phone network to inform RMS bridge engineers and Metropolitan Colliery of detected movements.

Structural analysis of the Cawleys Road Bridge, as well as buildings within the Garrawarra Centre Complex, was also completed during the reporting period for the preparation of the Longwalls 301-303 Extraction Plan. In consultation with NSW Health, Longwalls 301-303 shortened the commencing ends of Longwalls 302 and 303 to reduce subsidence impacts to the Garrawarra Centre Complex.

For the preparation of the Longwalls 301-303 Built Features Management Plans (for the Longwalls 301-303 Extraction Plan submitted to the DP&E in November 2016; refer Section 4.1.2), individual risk assessments were completed with each of the 12 infrastructure owners in the vicinity of Longwalls 301-303. Each Longwalls 301-303 Built Features Management Plan was prepared in consultation with the infrastructure owner.

Reporting of built features monitoring and management for Longwalls 301-303 will be included in future Annual Reviews.

### 6.1.7 Public Safety Management

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

Monitoring of cliffs and overhangs, steep slopes and land in general has been conducted for subsidence impacts in accordance with the Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Land Management Plans, and of infrastructure items in accordance with the Metropolitan Coal Longwalls 23-27 Built Features Management Plan. No subsidence impacts were identified during the reporting period that were considered to pose a risk to public safety.

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

### 6.1.8 Assessment of Environmental Performance

The subsidence impact performance indicators and performance measures in Table 14 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 and Longwalls 23-27 Extraction Plan. Assessment against the subsidence impact performance indicators and performance measures have been conducted for the reporting period (1 January to 31 December 2016) in Table 14.

## Table 14
## Assessment of Environmental Performance – Underground Mining Area and Surrounds

| 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 | Continue monitoring | *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 | Assessments against the performance measure conducted for Waratah Rivulet and Eastern Tributary by Hydro Engineering & Consulting (2017) (Appendix B).<br>Continue monitoring | *Negligible reduction to the quality of water resources reaching the Woronora Reservoir* | No. Assessments for the period July to December 2016 to be subject to peer review. |
| Connective Cracking | *Visual inspection does not identify abnormal water flow from the goaf, geological structure, or the strata generally* | ✓ | ✓ | No | Continue monitoring | *No connective cracking between the surface and the mine* | No |
| | *The 20-day average mine water make does not exceed 2 ML/day* | ✓ | ✓ | No | Continue monitoring | | No |
| | *Significant departures from the predicted envelope of vertical potentiometric head profiles at Bores 9GGW2B and 9FGW1A do not occur* | ✓ | × | No | Continue monitoring | | No |
| | *Significant departure from the predicted envelope of the vertical potentiometric head profile at Bore 9GGW2B does not occur* | × | ✓ | No | Continue monitoring | | 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 | Continue monitoring | | No |

**Table 14 (Continued)**
**Assessment of Environmental Performance – Underground Mining Area and Surrounds**

| 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)** | | | | | | | |
| 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 | Continue monitoring | *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* | ✓ | ✓ | Yes | Assessment against the performance measure conducted by Hydro Engineering & Consulting (2017) (Appendix B).<br>Continue monitoring | *Negligible reduction in the water quality of Woronora Reservoir* | No. Assessment to be subject to peer review. |
| 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 | Continue monitoring | *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 | Continue monitoring | | No |

**Table 14 (Continued)**
**Assessment of Environmental Performance – Underground Mining Area and Surrounds**

| 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) | *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)* | ✓ | × | Yes (the water level in Pool P fell below historically recorded water levels during the reporting period) | Analysis of recession rates and the shape of the water level hydrograph indicate pool water levels were consistent with natural behaviour. There has been a change in the datum levels associated with a change in water level logger housing.<br>Continue monitoring | *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 |
| | *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)* | × | ✓ | Yes (Pool P, as above) | As above | | 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 | Continue monitoring | | 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 | Continue monitoring | | No |

**Table 14 (Continued)**
**Assessment of Environmental Performance – Underground Mining Area and Surrounds**

| 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) | *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 | Continue monitoring | *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 gas releases observed at Pools Q to W on the Waratah Rivulet* | ✗ | ✓ | Yes (at Pool U and Pool W) | Assessments against the performance measure conducted by Associate Professor Barry Noller (Appendix E)<br>Continue monitoring | | No. Assessments subject to peer review (Appendix F). |

**Table 14 (Continued)**
**Assessment of Environmental Performance – Underground Mining Area and Surrounds**

| 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)** | | | | | | | |
| 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* | × | ✓ | No | Continue monitoring | *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* | No. Note, however that the diversion of flows/change in natural drainage behaviour exceeded in January 2017. Contingency Plan process already initiated by the exceedance of the iron staining component of the performance indicator (see further below) |
| | *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) | Assessment against the performance measure | | As above. |
| | *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 | Assessment against the performance measure | | Yes. Contingency Plan and Incident Notification initiated |
| | *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 | Continue monitoring | | No |

**Table 14 (Continued)**
**Assessment of Environmental Performance – Underground Mining Area and Surrounds**

| 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? |
|---|---|---|---|---|---|---|---|
| **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 | Continue monitoring | *Negligible impact on threatened species and populations* | 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 – performance indicator exceeded for Swamp 20 (Longwalls 20-22 upland swamps) (Appendix C)<br>Yes – performance indicator exceeded for Swamp 28 (Longwalls 23-27 upland swamps) (Appendix C) | Assessments against the performance measure conducted by FloraSearch (threatened flora) and Cenwest Environmental Services (threatened fauna) (Appendices H and I)<br>Continue monitoring | *Negligible impact on threatened species and populations* | 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*[1] | ✓ | ✓ | Yes – performance indicator exceeded at site MRIP02 on the Waratah Rivulet and between sites MRIP09 and MRIP05 on the Eastern Tributary (Appendices J and K) | Assessment against the performance measure conducted by FloraSearch (threatened flora) and Cenwest Environmental Services (threatened fauna) (Appendix H)<br>Continue monitoring | | No |

**Table 14 (Continued)**
**Assessment of Environmental Performance – Underground Mining Area and Surrounds**

| 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? |
|---|---|---|---|---|---|---|---|
| **BIODIVERSITY MANAGEMENT (Continued)** | | | | | | | |
| 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 | Continue monitoring | *Negligible impact on threatened species and populations* | 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 | Continue monitoring | | 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 Location B1 on Tributary B | Assessment against the performance measure to be conducted | | Assessments to be conducted |
| Amphibian Monitoring | *The amphibian assemblage is not expected to experience changes significantly different to the amphibian assemblage at control sites* | ✓ | ✓ | No | Continue monitoring | | No |
| **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 | Continue monitoring | - | - |
| 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 |

**Table 14 (Continued)**
**Assessment of Environmental Performance – Underground Mining Area and Surrounds**

| 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? |
|---|---|---|---|---|---|---|---|
| **HERITAGE MANAGEMENT** | | | | | | | |
| Aboriginal Heritage Sites | - | ✓ | ✓ | - | - | *Less than 10% of Aboriginal heritage sites within the mining area are affected by subsidence impacts* | No |
| **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 | Continue monitoring | *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.

1 This indicator is exceeded if visual inspections identify vegetation dieback greater than 50 cm from the stream.

## 6.2 SURFACE FACILITIES AREA

Section 6.2 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 reporting period.

The environmental performance of surface facilities water management is described in Section 7.

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).

### 6.2.1 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 20). 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 210 times during the reporting 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 in close proximity to the noise monitor was detected in June 2016, but could not be sourced to any on-site activities. It was concluded that a particularly noisy vehicle may have been on Oxley Place or Hume Drive, proximal to the real-time monitoring location.

***Attended Noise Monitoring***

A comprehensive review of noise monitoring results for the reporting period has been conducted and is provided below.

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 20]) 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 6.2.5 and Appendix P).

The attended quarterly noise monitoring and compliance results for the reporting period are available in the quarterly monitoring reports prepared by SLR Consulting Pty Ltd (Appendix P).

In summary, during 2016, attended monitoring indicated exceedances of the noise criteria detailed in Conditions 1, 2 and 3, Schedule 4 of the Project Approval as follows:

- Daytime ($L_{Aeq}$):
  - Monitoring at 16 Oxley Place (in Quarters 1, 2 and 4) measured noise levels of 53 dBA, 55 dBA and 54 dBA, respectively, which were non-compliant with the daytime Noise Impact Assessment Criteria (50 dBA).
  - In Quarters 2 and 4, the measured noise levels of 55 dBA and 54 dBA were also non-compliant with the daytime Noise Mitigation Criteria (53 dBA) at this residence.
  - No exceedances of the daytime Noise Acquisition Criteria (55 dBA) were recorded.
- Evening ($L_{Aeq}$):
  - Monitoring at 16 Oxley Place (in Quarters 2 and 4) measured noise levels of 48 dBA and 49 dBA which were non-compliant with the evening Noise Impact Assessment Criteria (45 dBA).
  - In Quarter 4, the measured noise level of 49 dBA at 16 Oxley Place was also non-compliant with the evening Noise Mitigation Criteria (48 dBA) at this residence.
  - Monitoring at 16 Oxley Place (in Quarters 1 and 3) also measured noise levels of 48 dBA which were conditionally[9] non-compliant with the evening Noise Impact Assessment Criteria (45 dBA).
  - No exceedances of the evening Noise Acquisition Criteria (50 dBA) were recorded.
- Night-time ($L_{Aeq}$):
  - Monitoring at 16 Oxley Place (in Quarters 1, 2 and 4) measured noise levels of 48 dBA which were conditionally non-compliant with the night-time Noise Impact Assessment Criteria (45 dBA).
  - Monitoring at 50 Parkes Street (in Quarter 1) measured a noise level of 48 dBA which was conditionally non-compliant with the Noise Impact Assessment Criteria (45 dBA).

[9] 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/100m to 4.0°C/100m. 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/100m for this period.

  - No exceedances of the night-time Noise Mitigation Criteria (48 dBA) or the night-time Noise Acquisition Criteria (50 dBA) were recorded.

- Night-time ($L_{A1}$):
  - Monitoring at 16 Oxley Place (in Quarters 1, 2, and 3) measured noise levels of 58 dBA, 57 dBA and 54 dBA, respectively, which were non-compliant with the night-time $L_{A1}$ Noise Impact Assessment Criteria (50 dBA).
  - Monitoring at 53 Parkes Street (in Quarter 3) measured a noise level of 56 dBA which was non-compliant with the night-time $L_{A1}$ Noise Impact Assessment Criteria (50 dBA).
  - Monitoring at 36 Old Station Road (in Quarters 1, 3 and 4) measured noise levels of 57 dBA, 56 dBA and 53 dBA, respectively, which were non-compliant with the night-time $L_{A1}$ Noise Impact Assessment Criteria (50 dBA).

***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.

Sustained non-compliances with respect to the daytime, 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 2016 at 16 Oxley Place. The sustained non-compliances at 16 Oxley Place were identified in Quarter 2 (daytime), Quarters 1, 2, 3 and 4 (evening) and Quarters 1 and 2 (night-time) (Appendix P).

Sustained non-compliances with respect to the night-time maximum ($L_{A1}$) Noise Impact Assessment Criteria (Table 2, Condition 1, Schedule 4 of the Project Approval) were also identified during 2016 at 16 Oxley Place and 36 Old Station Road. The sustained non-compliances at 16 Oxley Place were identified in Quarters 1, 2 and 3 and the sustained non-compliances at 36 Old Station Road were identified in Quarter 4 (Appendix P).

No sustained non-compliances with respect to the Noise Mitigation Criteria (Table 4, Condition 3, Schedule 4 of the Project Approval) or Noise Acquisition Criteria (Table 3, Condition 2, Schedule 4 of the Project Approval) were recorded during 2016 at any of the representative attended noise monitoring locations (Appendix P).

Further details are provided in Table 15.

***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 2016.

This has included updated noise modelling of predicted noise levels for nearby residences based on extrapolation of the quarterly noise monitoring results, weather conditions and additional noise controls. This noise modelling was undertaken following receipt of the Quarter 2, Quarter 3 and Quarter 4, 2016, attended noise monitoring results (Appendix Q).

The Quarter 2, 2016 noise modelling (calibrated to the Quarter 2, 2016 attended noise monitoring results and weather conditions) predicted exceedances of the Noise Impact Assessment Criteria at 17 private residences, exceedances of the Noise Mitigation Criteria at eight private residences and exceedances of the Noise Acquisition Criteria at two private residences (Appendix Q). It should be noted that the modelled exceedances of the Noise Acquisition Criteria were modelled to be less than 1 dBA above the relevant criteria (50 dBA) (i.e. these predicted exceedances were of a magnitude that is considered to be negligible and not discernible; the maximum predicted exceedance was 50.6 dBA if the modelled result was expressed to one decimal point). Given the marginal nature of the predicted exceedances and ongoing implementation of further on-site noise management measures, the predicted exceedances were not considered to be systemic.

Following implementation of further noise mitigation measures as described below, the Quarter 3, 2016 noise modelling (calibrated to the Quarter 3, 2016 attended noise monitoring results and weather conditions) predicted exceedances of the Noise Impact Assessment Criteria at 17 private residences, exceedances of the Noise Mitigation Criteria at eight private residences and no exceedances of the Noise Acquisition Criteria (Appendix Q).

The Quarter 4, 2016 noise modelling (calibrated to the Quarter 4, 2016 attended noise monitoring results and weather conditions) predicted exceedances of the Noise Impact Assessment Criteria at 17 private residences, exceedances of the Noise Mitigation Criteria at eight private residences and no exceedances of the Noise Acquisition Criteria (Appendix Q).

As a result of the noise modelling, sustained non-compliances with the Noise Impact Assessment Criteria were predicted at 17 residences in Quarter 3, 2016 and at the same 17 residences in Quarter 4, 2016. Sustained non-compliances with the Noise Mitigation Criteria were predicted at eight residences in Quarter 3, 2016 and at the same eight residences in Quarter 4, 2016. No sustained non-compliances with the Noise Acquisition Criteria were predicted by the noise modelling.

Further details are provided in Table 15.

It should be noted that all of the residences predicted to be experiencing sustained non-compliances with 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 eight residences, only two did not accept the previous offer by Metropolitan Coal (Appendix Q).

***Reporting and Notification of Noise Exceedances***

Following conclusive identification of sustained 2015 noise non-compliances in Quarter 1 of 2016, Metropolitan Coal notified the DP&E and requested a meeting to discuss the nature of the observed noise exceedances and to investigate options to address these exceedances. On 17 May 2016, a meeting was convened with the DP&E Assessment Branch.

In December 2016 (i.e. following the receipt of the Quarter 3, 2016 monitoring report from SLR Consulting and associated noise modelling extrapolating these results to nearby residences), Metropolitan Coal notified 17 nearby residents that noise modelling predicted that they were experiencing noise levels exceeding the noise impact assessment criteria contained in the Project Approval.

In January 2017, Metropolitan Coal initiated a meeting with the DP&E to provide an update on the latest noise monitoring and modelling results.

In February 2017 (i.e. following the receipt of the Quarter 4, 2016 monitoring report from SLR Consulting and associated noise modelling extrapolating these results to nearby residences), Metropolitan Coal notified the DP&E, DRE and EPA of noise exceedances identified during the 2016 reporting period. Metropolitan Coal also notified the same 17 nearby residents that noise modelling predicted continued noise levels above the noise impact assessment criteria contained in the Project Approval.

***Trends in Noise Monitoring Data***

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

The operator attended quarterly noise monitoring results for 16 Oxley Place, 53 Parkes Street, 50 Parkes Street and 36 Old Station Road (Figure 20), from September 2010 to December 2016 (inclusive), are presented on Figures 21a to 21d, respectively. Figures 21a to 21d display a trend of gradually reducing noise levels since commencement of the Metropolitan Coal Project. This trend reflects the noise management and mitigation measures implemented since this time (as described below).

***Noise Management***

As indicated above, 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 2015 Annual Reviews describe the noise mitigation measures implemented prior to 2016.

A number of contingency mitigation measures were identified by Metropolitan Coal and were implemented progressively throughout the reporting period, including:

- Cladding and sealing of the new compressor shed and upgraded backfill plant pump room in Kingspan noise suppressive cladding.
- Additional sound power level testing to update the noise model.
- Recalibration of modelled truck noise emissions on the haul road to correspond to the measured noise level at 16 Oxley Place.
- Continued limiting of the number of trucks using the mine haul road in any 15 minute period.
- Full closure of the interface between the circular conveyor and ROM bin upper level, western facade.
- Closure of the four roof vents in the MD1 drive building.
- Closure of the gap between the southern facade and roof of the MD1 building.
- Closure of the louvre on the western facade of the MD1 building.

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. At a meeting held with the DP&E on 7 February 2017 (to discuss the 2016 noise monitoring results and associated modelling), it was agreed that Metropolitan Coal would:

- prepare a technical review of remaining available feasible noise mitigation measures and an associated evaluation of the reasonableness of these options (i.e. including additional on-site sound power level testing and evaluation of alternative engineering solutions); and
- provide written advice to DP&E as to whether the current noise impact assessment criteria could reasonably be achieved without wholesale replacement of large elements of the existing surface facilities, or alternative methods of coal handling/processing at the site.

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 the Project Approval in either 2015 or 2016. Prior to 2015, Metropolitan Coal voluntarily offered double glazing noise mitigation to a number of the nearest private residences.

***Operational Noise Complaints***

No operational noise related complaints were received by Metropolitan Coal during the reporting period.

### 6.2.2 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 reporting period. The report prepared in support of this Metropolitan Coal 2016 Annual Review is provided in Appendix R.

***Dust Deposition***

Metropolitan Coal monitors monthly dust deposition rates at ten dust gauges (DG1 to DG10, Figure 22), consistent with EPL No. 767 and the Metropolitan Coal Air Quality and Greenhouse Gas Management Plan.

As described in Table 2, sampling during the reporting period was not able to be conducted at all monitoring points at the frequencies described in Conditions M2.1 and M2.2 of EPL No. 767. Specifically, the dust deposition gauges include a bottle which captures the dust between collection periods. When inspected, samples from dust gauges DG5 (in July 2016) and DG7 (in January and March 2016) were unable to be collected as the bottle was broken and no sample was recoverable.

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 6.2.5 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 reporting period (Chart 83).

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 83). The annual average dust deposition rate over the whole network was 1.1 g/m$^2$/month for the reporting period.

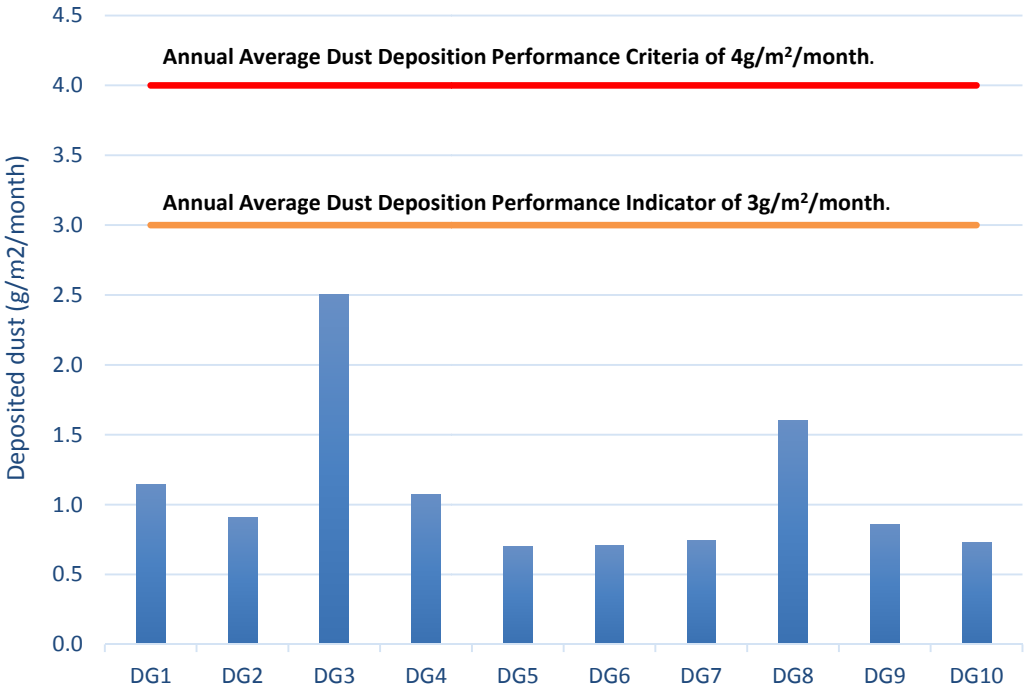



**Chart 83 Annual Average Dust Deposition Rates Measured at Dust Gauges (DG1 to DG10)**

Annual average dust deposition rates at each gauge from 2003 to 2016 are shown in Chart 84a and Chart 84b. From 2003 to 2016, 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 2016 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.

Additional temporary dust deposition gauges previously installed to the north of the stockpile area at 42 and 48 Parkes Street to understand the mine's potential impact on neighbouring properties to the north of the product stockpile, continued to be monitored from January to April 2016. Dust deposition levels recorded at the temporary dust deposition gauges were consistently low during the reporting period, with a maximum dust deposition rate of 3.3 g/m$^2$/month at 48 Parkes Street in January 2016.

Microscopic analysis of samples from 42 Parkes Street was conducted from January to April 2016 to determine the constituent components of the deposited dust. Dust constituents were grouped as coal and coke; inorganic, soil minerals (quartz, iron oxides, clays, etc.); and insect and plant remains. The proportion of coal matter was highly variable in each month, ranging from a trace (<5%) in January and February 2016, to minor (5-30%) in March 2016 and major (>30%) in April 2016.

The highest proportion of coal matter was recorded in April 2016 and comprised approximately 0.75 g/m$^2$/month of the 2.5 g/m$^2$/month sample. The proportion of plant matter was major (i.e. > 30%) in each sample, especially between January and March when levels were greater than 70%. This proportion of plant matter is consistent with expectations considering the site is surrounded by temperate rainforest on the Illawarra Escarpment and the Royal National Park.

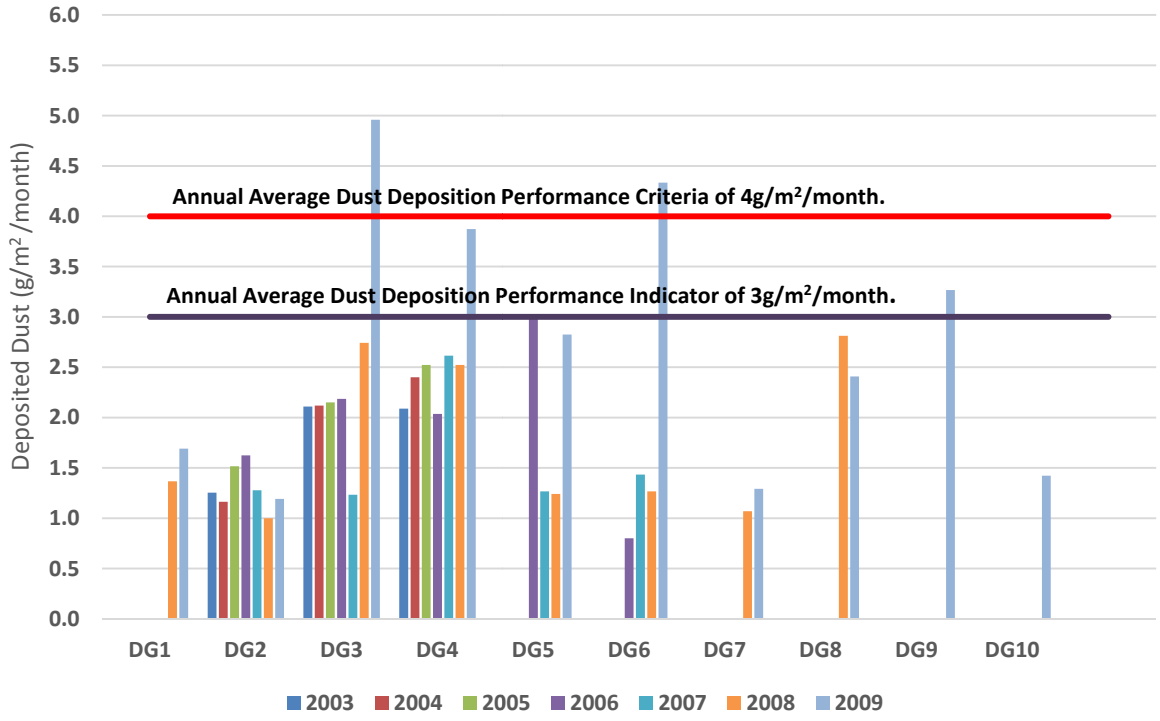



**Chart 84a Annual Average Dust Deposition Rates at DG1 to DG10 from 2003 to 2009**

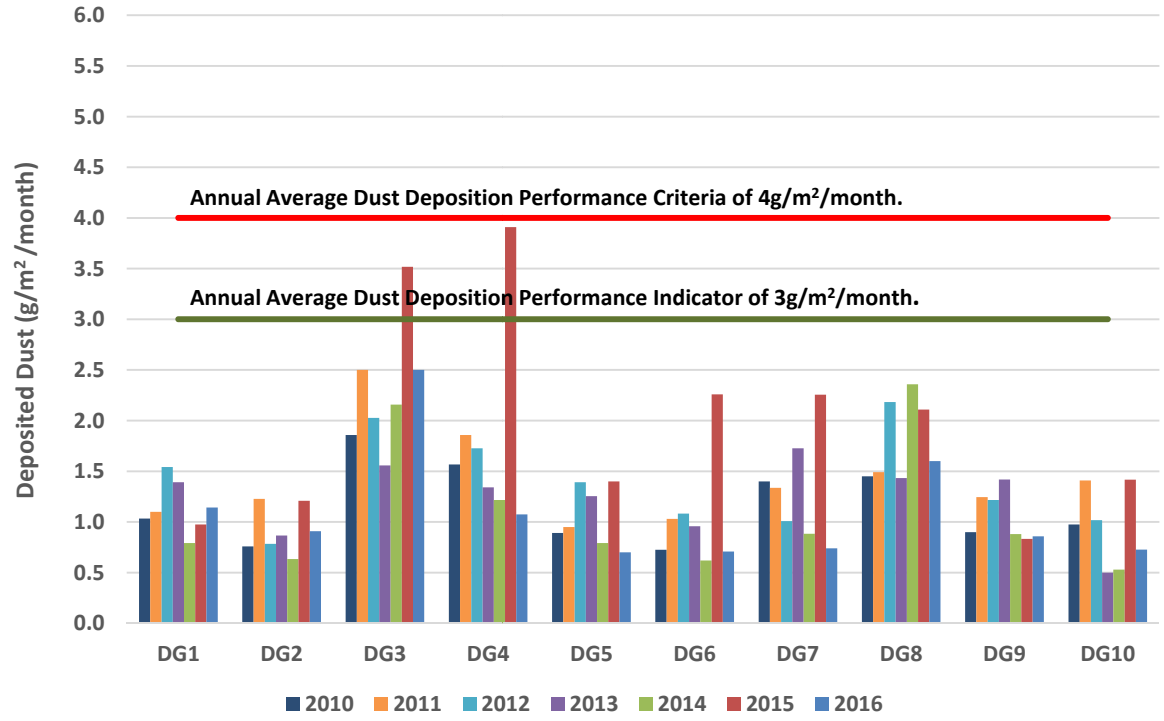



**Chart 84b Annual Average Dust Deposition Rates at DG1 to DG10 from 2010 to 2016**

***Particulate Matter***

One Tapered Element Oscillating Microbalance (TEOM) and one High Volume Air Sampler (HVAS) are located near the surface facilities area (Figure 22). 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 reporting 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 6.2.5 and key aspects are summarised below.

The annual average $PM_{10}$ concentrations (measured by the HVAS) from 2007 to 2016 are shown on Chart 85. The annual average $PM_{10}$ concentration measured at the HVAS for the reporting period was 13.4 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 85). Whilst all similar in magnitude, this annual average concentration was lower than 2012, 2013 and 2015, and marginally higher than 2014.

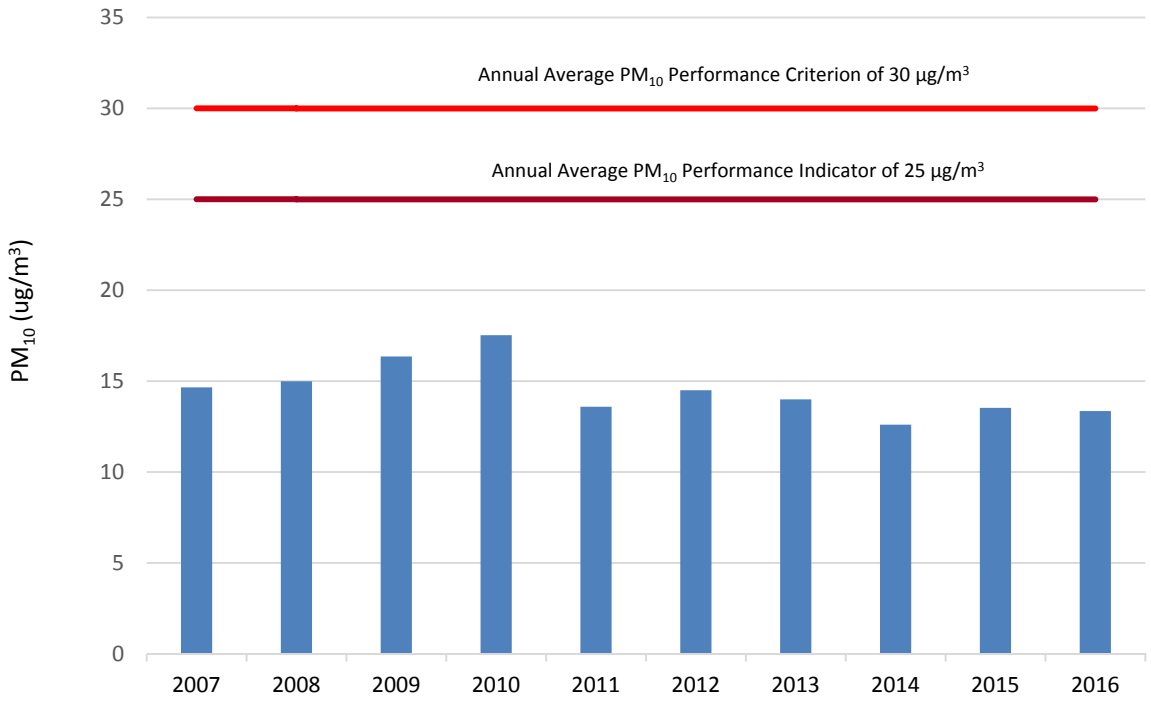



**Chart 85 Annual Average $PM_{10}$ Concentrations from 2007 to 2016 (measured by the HVAS)**

The performance indicator for 24-hour average $PM_{10}$ concentration is 37.5 µg/m$^3$. A 24-hour average $PM_{10}$ concentration of 40.6 µg/m$^3$ was recorded at the TEOM on 22 May 2016 (Chart 86) and concentrations of 52.1 µg/m$^3$ and 49.1 µg/m$^3$ were recorded at the HVAS on 23 May 2016 and 7 November 2016 (Chart 87), respectively. The 52.1 µg/m$^3$ $PM_{10}$ concentration recorded at the HVAS on 23 May 2016 also exceeded the 24-hour average $PM_{10}$ short-term impact assessment criterion of 50 µg/m$^3$.

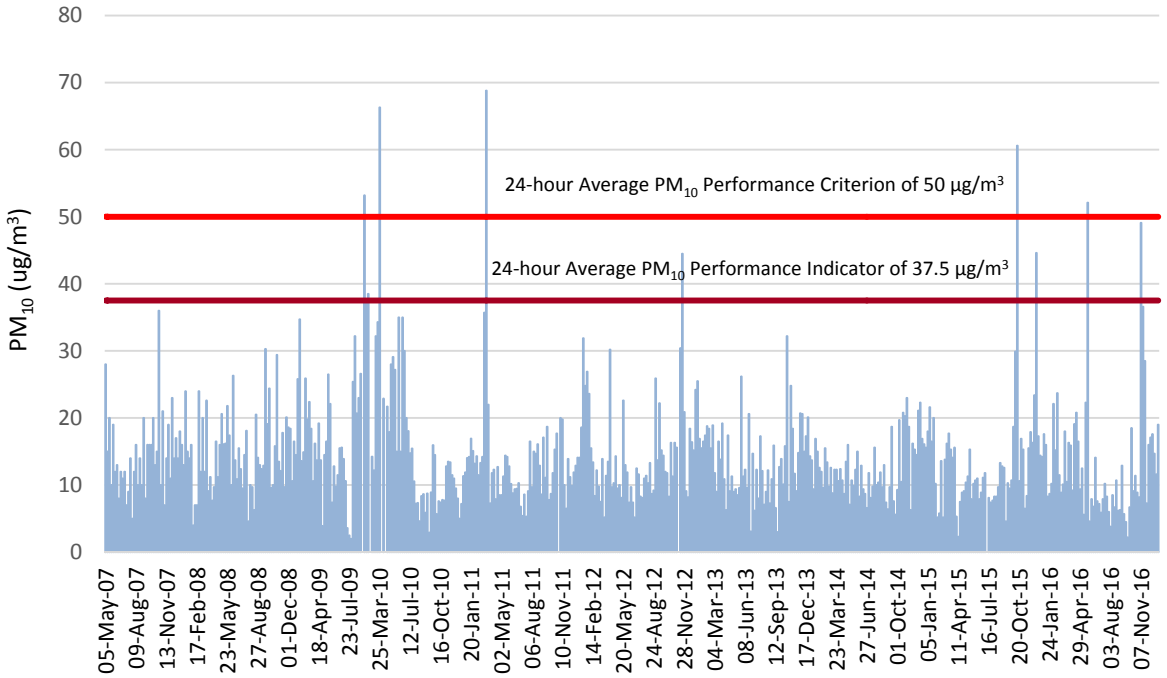



**Chart 86 24-hour Average $PM_{10}$ Concentrations (measured by the TEOM)**

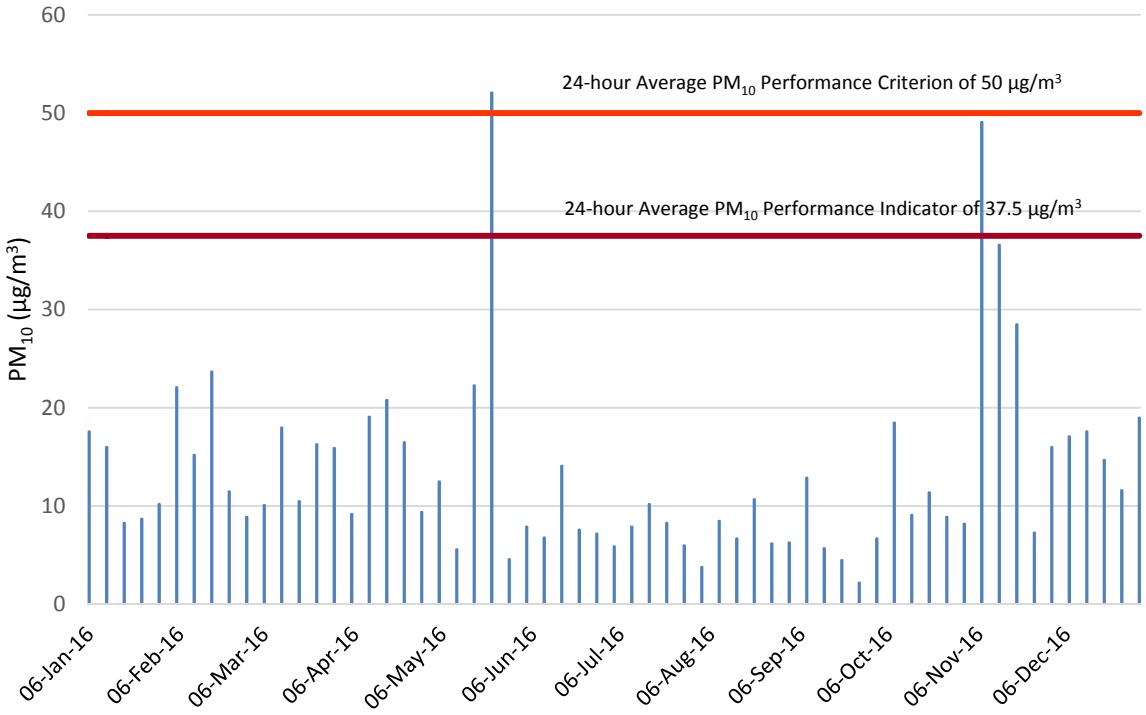



**Chart 87 24-hour Average $PM_{10}$ Concentrations (measured by the HVAS)**

The exceedances of the performance indicator and performance criterion on 22 and 23 May 2016, are considered to be the result of a widespread smoke haze caused by hazard reduction burning in the region at this time. The exceedance of the performance indicator on 7 November 2016 is considered to be a result of a demolition site located on Robertson Street in close proximity to the HVAS. Consequently, the exceedances of the 24-hour $PM_{10}$ performance indicator of 37.5 µg/m$^3$ and the exceedance of the 24-hour $PM_{10}$ short-term impact assessment criterion of 50 µg/m$^3$ are not considered to be a result of the Project.

The highest 10 minute average $PM_{10}$ concentration measured at the TEOM for the reporting period was 172.5.8 µg/m$^3$ in August 2016, which is higher than the air quality performance indicator for the 10 minute average $PM_{10}$ concentration of 150 µg/m$^3$. However, this peak is considered to be a result of woodsmoke detected during the day, 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.

***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 2017, Metropolitan Coal will assess the feasibility of installing a camera to allow for remote monitoring of coal stockpiles.

### 6.2.3 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.

The Metropolitan Coal Traffic Management Plan was revised during the reporting period to include the transport of coal reject to the Lend Lease Calderwood Urban Development Project.

Metropolitan Coal monitors the amount of product coal transported from site by road and by rail. A total of 1,784,187 t of product coal was transported from site by rail during the reporting 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 380,404 t of coal reject was transported from the site by road in 2016. Of this, 125,149 t of coal reject was transported to the Lend Lease Calderwood Urban Development Project to be beneficially re-used as fill material and 255,255 t was transported to the Glenlee Washery for disposal.

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.

As indicated in the Metropolitan Coal 2014 Annual Review and AEMR/Rehabilitation Report, following the provision of detailed upgrade design plans to the Wollongong City Council's Traffic Safety Committee and the Traffic Safety Committee's approval of the final intersection plans, Metropolitan Coal anticipated that the implementation of the upgrade works could occur. However, the intersection upgrade works required the Wollongong City Council to acquire the road easement from Crown Lands, which the Wollongong City Council advised it was not in a position to do.

Following further investigations for possible alternative arrangements to allow the intersection upgrade to progress, Metropolitan Coal requested the DP&E indicate whether the Director-General (now Secretary) was satisfied that the requirements of Condition 17 had been met. In May 2016, the DP&E (Compliance Southern Region) noted that Metropolitan Coal had made considerable effort to address the findings of the road safety audit, however, had been unable to address all recommendations due to the inability to obtain a mutually acceptable outcome with the Wollongong City Council. The DP&E (Compliance Southern Region) recommended Metropolitan Coal engage a road safety expert to review the works that have been undertaken to either confirm that the works that have been completed are sufficient to address the original risk identified, or whether alternative/additional actions can be undertaken to address the risk.

During the reporting period Metropolitan Coal engaged a road safety expert in accordance with the DP&E's recommendation. Metropolitan Coal will review the road safety report in the next reporting period and consider its recommendations.

In the previous reporting period, Metropolitan Coal marked designated footpaths in the carpark to improve pedestrian safety. The footpaths were extended into the yard area during the reporting period for pedestrian safety around forklifts/other heavy vehicles. A digital sign, which displays an entering vehicles speed, was installed at the bottom of the mine access road to manage the speed of vehicles entering the site.

### 6.2.4 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.

The Metropolitan Coal Waste Management Plan was revised during the reporting period to include the transport of coal reject to the Lend Lease Calderwood Urban Development Project.

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, aluminium cans and printer cartridges), 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 23(a) shows the amount of general waste disposed of in 2016 compared with previous calendar years. Approximately 280,847 kilograms (kg) of general waste was disposed of at a licensed landfill facility in 2016. Approximately 78 kg of oily rags/absorbents were also disposed of at a licensed landfill facility during the reporting period.

Waste recycled by Metropolitan Coal during the reporting period included waste oil, scrap wood, scrap metal, office waste (e.g. paper, cardboard and plastic), aerosol cans, empty drums and oil filters. Figure 23(b-e) shows the amount of waste oil, scrap wood, scrap metal and office waste (e.g. paper, cardboard and plastic) recycled in 2016, compared with previous calendar years.

During the reporting period new bins were added to the surface facilities area to assist with the segregation of waste. Metropolitan Coal also investigated the potential to recycle diesel particulate filters from underground mine equipment, however, was found to be economically not viable.

Figure 23(f) and Figure 23(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 2016 calendar years. In 2016, approximately 6,000 t of coal reject were emplaced underground and approximately 255,255 t of coal reject were disposed of at the Glenlee Washery. Metropolitan Coal also transported approximately 125,149 t of coal reject to the Lend Lease Calderwood Urban Development Project for the beneficial re-use of the coal reject as fill material during the reporting period. Some 133,593 t of coal reject was also used for upgrades to the Turkeys Nest Dam.

During the reporting 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. This upgrade included a new pump house, new pipeline (running from the surface to the longwall cut throughs) and new emplacement seals in the longwall cut throughs. The coal reject backfill emplacement project, including further testing of the coal reject emplacement material (e.g. slump testing, beach angle testing and spontaneous combustion assessment), will continue in 2017.

Metropolitan Coal has continued to consult with the Wollongong City Council regarding the potential for coal rejects to be beneficially re-used at the Helensburgh Landfill. Ongoing testwork of the coal reject material to demonstrate suitability for use as a landfill capping material was conducted in this regard.

The education program continued to be implemented during the reporting 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.

### 6.2.5 Assessment of Environmental Performance

The performance indicators, impact assessment criteria and Project Approval conditions in Table 15 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 reporting 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 15
## 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 2016, a distinct noise event was identified that warranted further investigation to determine whether it was the result of mine activities. A loud vehicle in close proximity to the noise monitor was detected in June 2016, but could not be sourced to any on-site activities. It was concluded that a particularly noisy vehicle may have been on Oxley Place or Hume Drive, proximal to the real-time monitoring location (Appendix P). |
| Noise Impact Assessment Criteria (Project Approval Table 2, Condition 1, Schedule 4) | Day $L_{Aeq(15\ minute)}$ – 50 dBA | No | Sustained non-compliance with respect to the daytime Noise Impact Assessment Criteria were identified by noise monitoring at 16 Oxley Place as a result of consecutive exceedances in Quarters 1 and 2 (2016) (measured noise levels of 53 dBA and 55 dBA, respectively) (Appendix P).<br>Sustained non-compliance with respect to the daytime Noise Impact Assessment Criteria was identified by noise modelling at nine private residences (Appendix Q). |
| | Evening $L_{Aeq(15\ minute)}$ – 45 dBA | No | Sustained non-compliances with respect to the evening Noise Impact Assessment Criteria were identified by noise monitoring at 16 Oxley Place as a result of consecutive exceedances in Quarter 4 (2015) and Quarters 1, 2, 3 and 4 (2016) (measured noise levels of 48 dBA, 48 dBA, 48 dBA, 48 dBA and 49 dBA, respectively) (Appendix P).<br>Sustained non-compliance with respect to the evening Noise Impact Assessment Criteria was identified by noise modelling at twelve private residences (Appendix Q). |
| | Night $L_{Aeq(15\ minute)}$ – 45 dBA | No | Sustained non-compliance with respect to the night-time Noise Impact Assessment Criteria were identified by noise monitoring at 16 Oxley Place as a result of consecutive exceedances in Quarter 4 (2015) and Quarters 1 and 2 (2016) (measured noise levels of 48 dBA, 48 dBA and 48 dBA, respectively) (Appendix P).<br>Sustained non-compliance with respect to the night-time Noise Impact Assessment Criteria was identified by noise modelling at sixteen private residences (Appendix Q). |
| | Night $L_{A1(1\ minute)}$ – 50 dBA | No | Sustained non-compliances with respect to the night-time maximum Noise Impact Assessment Criteria were identified by noise monitoring at (Appendix P):<br>• 16 Oxley Place as a result of consecutive exceedances in Quarter 4 (2015) and Quarters 1, 2 and 3 (2016) (measured noise levels of 58 dBA, 58 dBA, 57 dBA and 54 dBA, respectively).<br>• 36 Old Station Road as a result of consecutive exceedances in Quarters 3 and 4 (2016) (measured noise levels of 53 dBA and 56 dBA, respectively).<br>Sustained non-compliance with respect to the night-time maximum Noise Impact Assessment Criteria was identified by noise modelling at seventeen private residences (Appendix Q). |

## Table 15 (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 | Sustained non-compliance with respect to the daytime Noise Mitigation Criteria was identified by noise modelling at four private residences (Appendix Q). |
| | Evening $L_{Aeq(15\ minute)}$ – 48 dBA | No | Sustained non-compliance with respect to the evening Noise Mitigation Criteria was identified by noise modelling at eight private residences (Appendix Q). |
| | Night $L_{Aeq(15\ minute)}$ – 48 dBA | No | Sustained non-compliance with respect to the night-time Noise Mitigation Criteria was identified by noise modelling at eight private residences (Appendix Q). |
| Noise Acquisition Criteria (Project Approval Table 3, Condition 2, Schedule 4) | Day $L_{Aeq(15\ minute)}$ – 55 dBA | Yes | No sustained non-compliances with respect to the Noise Acquisition Criteria were identified by monitoring or modelling during the reporting period (Appendix P and Appendix Q). |
| | Evening $L_{Aeq(15\ minute)}$ – 50 dBA | Yes | |
| | Night $L_{Aeq(15\ minute)}$ – 50 dBA | Yes | |
| 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 reporting period. |

## Table 15 (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 | Following conclusive identification of sustained 2015 noise non-compliances in Quarter 1 of 2016, Metropolitan Coal notified the DP&E and requested a meeting to discuss the nature of the observed noise exceedances and to investigate options to address these exceedances.<br>Nearby residences were not notified of the exceedances of the Noise Impact Assessment Criteria until after Metropolitan Coal had met with DP&E to discuss the exceedances and modelling of predicted noise levels for nearby residences.<br>As operator-attended noise monitoring is conducted at a limited number of representative locations, noise modelling (based on extrapolation of the quarterly noise monitoring results, weather conditions and additional noise controls) was necessary to determine the specific residences that were experiencing noise levels exceeding the noise criteria and therefore required notification.<br>As a result, nearby residences were notified that they were potentially experiencing noise levels in excess of the Noise Impact Assessment Criteria in December 2016 (i.e. following the receipt of the Quarter 3, 2016 monitoring report from SLR Consulting and associated noise modelling extrapolating these results to nearby residences). |
| **AIR QUALITY** | | | |
| Air Quality Performance Indicators [1,2] | $PM_{10}$ indicator = 150 µg/m$^3$<br>(10 minute averaging period assessed using TEOM data) | Yes | The maximum 10 minute average $PM_{10}$ concentration recorded by the TEOM was 172.5 µg/m$^3$ on 21 August 2016. However, this peak is considered to be a result of woodsmoke detected during the day. The exceedance of the performance indicator is not considered to be a result of the Project (Appendix R). |
| | $PM_{10}$ indicator = 37.5 µg/m$^3$<br>(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 22 May 2016 by the TEOM of 40.6 µg/m$^3$, observations at the time noted widespread smoke haze throughout Sydney as a result of hazard reduction burns. The exceedance of the performance indicator concentration is not considered to be a result of the Project (Appendix R). |
| | $PM_{10}$ indicator = 37.5 µg/m$^3$<br>(24-hour averaging period assessed using HVAS data) | Yes | While exceedances of the 24-hour average $PM_{10}$ performance indicator concentration of 37.5 µg/m$^3$ were recorded by the HVAS on 23 May (52.1 µg/m$^3$) and 7 November (49.1 µg/m$^3$); these were related to hazard reduction burning activities and the nearby demolition site on Robertson Street, respectively. The exceedance of the performance indicator concentration is not considered to be a result of the Project (Appendix R). |
| | $PM_{10}$ indicator = 25 µg/m$^3$<br>(Annual averaging period assessed using HVAS data) | Yes | An annual average $PM_{10}$ concentration of 13.4 µg/m$^3$ was recorded by the HVAS (Appendix R). |
| | Maximum total deposited dust level = 3 g/m$^2$/month (Annual averaging period)[3] | Yes | The performance indicator concentration for annual average deposited dust of 3 g/m$^2$/month was met at all dust deposition monitoring sites during the reporting period (Appendix R). |

## Table 15 (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 is estimated to be less than 26.7 µg/m$^3$ (Appendix R). |
| | $PM_{10}$ Criteria[4] = 30 µg/m$^3$ (Annual averaging period) | Yes | An annual average $PM_{10}$ concentration of 13.4 µg/m$^3$ was recorded by the HVAS (Appendix R). |
| | $PM_{10}$ Criteria[4] = 50 µg/m$^3$ (24 hour averaging period) | Yes | While one exceedance of the 24-hour average $PM_{10}$ criterion of 50 µg/m$^3$ was recorded by the HVAS on 23 May 2016 of 52.1 µg/m$^3$, observations at the time noted hazard reduction burning was being conducted in the region. The exceedance of the $PM_{10}$ criterion is not considered to be a result of the Project (Appendix R). |
| | 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 reporting period at all dust gauges (Appendix R). |
| **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 2016 reporting period. |
| **GREENHOUSE GASES** | | | |
| Greenhouse Gas Emissions (Project Approval Condition 10, Schedule 4) | *10. The Proponent shall implement all reasonable and feasible measures to minimise:*<br>*(a) energy use on site; and*<br>*(b) the scope 1, 2 and 3 greenhouse gas emissions produced on site,*<br>*to the satisfaction of the Director-General.* | 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 reporting period. |
| | *Annual road maintenance contributions to relevant councils are made by 30 November.* | Yes | Metropolitan Coal made contributions to the Wollongong City Council, Campbelltown City Council and Wollondilly Shire Council by 30 November 2016. |

## Table 15 (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 | *Coal transported off-site by road in a calendar year does not reach 150,000 tonnes prior to 31 October.* | Yes | Metropolitan Coal has currently ceased the transport of product coal to Corrimal Cokeworks and Coalcliff Cokeworks. No product coal was transported by road during the reporting period. |
| | *Product coal truck movements to the Corrimal Cokeworks and Coalcliff Cokeworks do not exceed 22 and 27 movements respectively in any one day.* | Yes | |
| Limits on Approval (Project Approval Condition 6[b], Schedule 2) | • *The Proponent shall not:*<br>*(a) ...*<br>*(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 1,784,187 t of product coal from site by rail in the 2016 calendar year. |
| Transport (Project Approval Conditions 17, 18, 19, 20 and 21, Schedule 4) | *17. By the end of 2010, the Proponent shall:*<br>*(a) undertake a road safety audit of the Parkes Street and Colliery Road intersection, in consultation with the RTA and WCC; and*<br>*(b) implement any recommendations of this audit,*<br>*to the satisfaction of the Director-General.* | Yes, the road safety audit has been undertaken.<br>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.<br>In accordance with the DP&E's (Compliance Southern Region) recommendation, Metropolitan Coal engaged a road safety expert to review the works that have been undertaken to either confirm that the works that have been completed are sufficient to address the original risk identified, or whether alternative/additional actions can be undertaken to address the risk. Metropolitan Coal will review the road safety report in the next reporting period and consider its 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 for resolution.* | Yes | Metropolitan Coal has made a suitable annual contribution to the Wollongong City Council, Campbelltown City Council and Wollondilly Shire Council. |

## Table 15 (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) (Cont.) | *19. The Proponent shall not:*<br>*(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;*<br>*(b) transport more than 170,000 tonnes of coal off site by road in a calendar year;*<br>*(c) transport any coal off site to the Port Kembla Coal Terminal by road;*<br>*(d) permit the departure of more than 25 trucks containing product coal for delivery to the Corrimal Cokeworks on any given day; or*<br>*(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.* | Yes | No emergencies requiring amendments to Condition 19 occurred during the reporting 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:*<br>• *an increase in the amount or type of waste recycled;*<br>• *a decrease in the amount of waste generated that is disposed of to licensed landfill facilities; and/or*<br>*no practicable opportunities for additional waste minimisation have been identified to those currently being implemented.* | Yes | Metropolitan Coal has minimised waste generation during the reporting period. The underground emplacement project had reduced the off-site disposal of coal reject by approximately 112,837 t at the end of the reporting period.<br>During the reporting period, Metropolitan Coal also commenced the transport of coal reject to the Lend Lease Calderwood Urban Development Project for the beneficial re-use of the coal reject as fill material. Metropolitan Coal transported 125,148 t coal reject to the Lend Lease Calderwood Urban Development Project during the reporting period.<br>No further practicable opportunities for waste minimisation were identified. |

## Table 15 (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 and 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 DECCW waste tracking requirements.*<br>*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:*<br>*(a) minimise the waste (including coal reject) generated by the project; and*<br>*(b) ensure that the waste generated by the project is appropriately stored, handled, and disposed of,*<br>*to the satisfaction of the Director-General.* | Yes | Metropolitan Coal has minimised waste (including coal reject) generated during the reporting period. The underground emplacement project had reduced the off-site disposal of coal reject by approximately 112,837 t at the end of the reporting period).<br>Waste on-site is adequately sorted and stored according to waste type prior to collection. Weekly site inspections are conducted by the site Environment and Community Superintendent to ensure waste is separated and stored in accordance with the Metropolitan Coal Waste Management Plan.<br>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.

# 7 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 reporting period. The environmental performance of water management in the underground mining area and surrounds is described in Section 6.1.2.

The surface facilities area is located in a steep-sided valley adjacent to the town of Helensburgh and next to Camp Gully (Figure 3). 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 24). 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 16 describes the volume of water sourced from Camp Gully during the reporting period, a total of 70 ML. In comparison, Metropolitan Coal sourced 47 ML of water from Camp Gully in the 2015 calendar year, 77 ML of water from Camp Gully in the 2014 calendar year, 99 ML in the 2013 calendar year and 94 ML from Camp Gully in the 2012 calendar year.

**Table 16**
**Camp Gully Water Take, 1 January to 31 December 2016**

| 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 | 70 | 70 |

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 386 ML of potable town water (as recorded by the Sydney Water meter) during 2016 (a monthly average of approximately 32.2 ML), in comparison to 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 88). Ongoing site auditing during the reporting period has not identified incidences of potable water being used where there is a viable alternative. The high value for potable water used per ROM tonne for September 2016 in Chart 88 is a result of the low ROM output at the time of the longwall changeover.

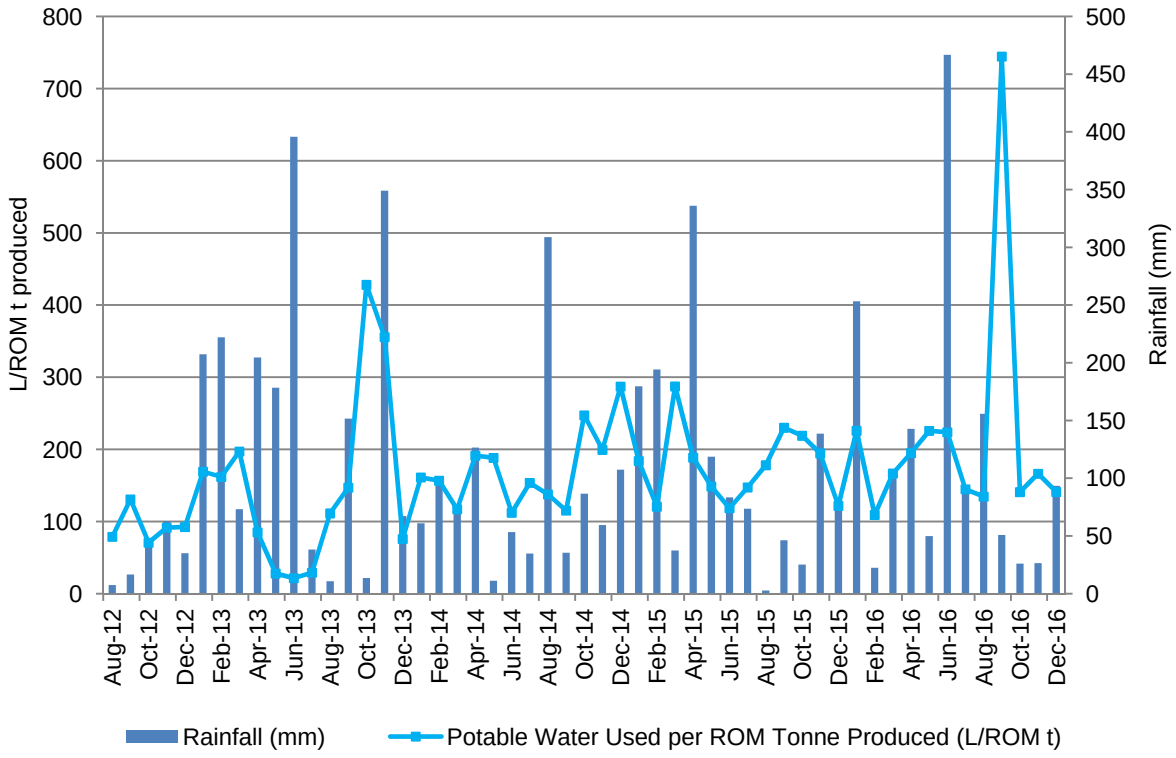



**Chart 88 Potable Water Used per ROM Tonne Produced vs Rainfall**

***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 reporting period was approximately 166 ML, in comparison to 96 ML in 2015, 109 ML in 2014, 151 ML in 2013 and 98 ML in 2012.

On 28 July 2016, Metropolitan Coal personnel observed the water in Camp Gully to have a green discolouration. Immediate investigation indicated that the water in the Water Treatment Plant (from which water is discharged to Camp Gully) had a similar discolouration. The Water Treatment Plant discharge line was immediately isolated so that no further discharge to Camp Gully could occur. Water quality samples were taken from the Water Treatment Plant, and upstream and downstream of the discharge point for laboratory analysis. Field parameters measured at the time were all within historical levels and the relevant EPL No. 767 limits. Within one hour of ceasing discharge from the Water Treatment Plant, the green discolouration in Camp Gully was observed to have dissipated.

The investigation also indicated that water from the underground workings containing a spill of hydraulic fluid (Quintolubric 818-02, a water-based biodegradable fluid) was pumped to the surface for treatment. The Quintolubric includes a green dye which is designed to be visible at very low concentrations so that it can be detected under a black light in the event of a high pressure injection injury to underground personnel. The ecological information in the Quintolubric Material Safety Data Sheet indicates: Toxicity (not expected to be harmful to aquatic life); Persistence and Degradability (not expected to persist in the environment if spilled or released), Bio-accumulative Potential (not expected to bio-accumulate in the environment based on its physical properties); Mobility in Soil (expected to have low mobility in soil and sediments with adsorption being the predominant physical process); and Other adverse effects (none anticipated).

On 2 August 2016, the EPA issued Metropolitan Coal with a formal warning letter in relation to the incident, considered to be a breach of EPL No.767 Condition L1.1 on the basis that Quintolubric 818-02 is not defined in Table L2.4 of EPL No.767.

To ensure that a similar incident does not occur in the future, underground personnel have been asked to report any spills that occur underground to the Environment and Community Superintendent. In addition, safety valves (with an automatic shut off) have been fitted to prevent supply from the Quintolubric 818-02 storage tank to the underground in the event of a spill.

***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 8.2 to 8.5 pH), oil and grease (ranging from less than 5 mg/L to 6 mg/L) and total suspended solids (ranging from 8 mg/L to 16 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 reporting period. Similarly, no exceedances of the EPL No. 767 concentration limits were recorded by Metropolitan Coal in the 2011 to 2015 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 reporting period, Metropolitan Coal completed the upgrade of the Turkey's Nest Dam and installed a new sediment catch pit to improve the efficiency of the water management system. Coal reject material was beneficially re-used for the Turkey's Nest Dam upgrade. Erosion and sediment controls have been implemented during the Turkey's Nest Dam upgrade, including sediment fences. In the next reporting period, Metropolitan Coal will revegetate/rehabilitate the now completed outer batters of the Turkey's Nest Dam.

Road maintenance activities during the reporting period included the resurfacing of the unsealed access road to the top Metropolitan Coal site office also assisted with site erosion and sediment control (and dust control).

### *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 17.

**Table 17**
**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.*<br>*Potable water has not been used in circumstances where there is a viable alternative.* | Yes | Ongoing site auditing during the reporting 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 reporting 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.* | No | On 28 July 2016, water discharged from the Water Treatment Plant contained hydraulic fluid from the underground workings which is not defined in the EPL. This resulted in a breach of EPL No. 767 Condition L1.1. |
| 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 reporting period. |

# 8 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.

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.

During the reporting period Metropolitan Coal installed a transect of groundwater piezometers (T1 to T5) overlying the 300 series longwalls, following the approval of the applicable Construction Management Plan Surface Works Assessment Form.

Metropolitan Coal also submitted a Construction Management Plan Surface Works Assessment Form to the DP&E and WaterNSW for the proposed installation of piezometers in Longwalls 301-303 upland swamps in accordance with the NSW Government's *Draft Policy Framework for Biodiversity Offsets for Upland Swamps and Associated Threatened Species (May 2015)* (Draft Upland Swamp Offsets Policy). In response, WaterNSW raised concerns regarding the amount of disturbance associated with the installation of the monitoring bores. Following further consultation with WaterNSW and the DP&E, paired piezometers were proposed and approved to be installed in a reduced number of swamps (specifically, Swamps 40, 41, 46, 50, 51, 52, 53 and 71a) on the basis of vegetation characteristics, landform features, swamp sediment profile and predicted subsidence. The upland swamp piezometers were installed during the reporting period.

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

In the next reporting period, Metropolitan Coal will install a number of additional groundwater piezometers over, or in the vicinity of, the 300 series longwalls.

# 9 REHABILITATION

## 9.1 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 9.2.

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 9.3.

A summary of the rehabilitation status at Metropolitan Coal for the previous, current and forecast reporting periods is provided in Table 18.

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 reporting period are described in Section 9.4.

An assessment of rehabilitation environmental performance is provided in Section 9.5.

**Table 18**
**Rehabilitation Status**

| Mine Area Type | As at December 2015 | As at December 2016 | As at December 2017 (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 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 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 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 that the area has successfully met the rehabilitation land use objectives and completion criteria.*

## 9.2 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 25 shows the designated rehabilitation zones (1 to 7) that are currently available for rehabilitation at the surface facilities area. Rehabilitation activities undertaken during the reporting period included active planting of native vegetation (some 300 Blady grass, *Imperata cylindrica*), and control of introduced and environmental weeds across the designated rehabilitation zones (in particular Crofton Weed, *Ageratina adenophora*, Ginger Lilly, *Hedychium gardnerianum*, exotic grasses and annual weed species).

No buildings were renovated or removed during the reporting period.

## 9.3 REHABILITATION MANAGEMENT – UNDERGROUND MINING AREA

### 9.3.1 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 reporting 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.

### 9.3.2 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 as described in the Metropolitan Coal Rehabilitation Management Plan (i.e. the pool water level has fallen below the 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 previously been undertaken at Pools A, F and G on the Waratah Rivulet. 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 reporting period are described in Section 6.1.2. 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 reporting period, except Pool A (pool water levels fell to or below the pool’s cease to flow level during the period 24 November to 31 December 2016).

Since stream remediation activities have been conducted at Pools A and F, all pools between Pools A and F have continued to overflow their rock bars, including throughout the 2015 and 2016 calendar years[10]. Since June 2012, Pool A stopped overflowing its downstream rock bar between 7 December 2012 and 25 January 2013 (reference pools WRP2, WRP3 and WRP4 on Woronora River also ceased overflowing during the same December 2012 to January 2013 period). More recently, Pool A water levels fell to or below the pool's cease to flow level for the period 24 November to 31 December 2016. Water levels in some Woronora Pools also fell below their cease to flow levels in this period. Pool F has continued to overflow its rock bar since February 2013. Stream remediation activities at Pool G were conducted in 2015 and 2016. Since the completion of the stream remediation activities during the reporting period the water levels in Pool G have continued to overflow its rock bar.

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

Pool N, which fell below its cease to flow level in early September 2012, has overflowed its rock bar since December 2014.

During the reporting period, Metropolitan Coal conducted supplementary brush matting (using locally collected vegetative material) and erosion controls at Pools A and F, to encourage the regeneration of native vegetation and for erosion control.

***Eastern Tributary***

As described in Section 6.1.2, the pools on the Eastern Tributary downstream of the Longwall 26 maingate have been visually inspected by Metropolitan Coal and photographed 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.

From January to June 2016, there were no observed changes in the natural drainage behaviour of pools on the Eastern Tributary downstream of the Longwall 26 maingate. 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 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 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 (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.

[10] Pool B stopped overflowing from the 28 December 2012 to the 25 January 2013. The reference pools WRP2, WRP3 and WRP4 on Woronora River also ceased overflowing over the same period. The water levels in Pool B have remained above their cease to flow levels since that time.

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 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.

In accordance with the Metropolitan Coal Rehabilitation Management Plan, Metropolitan Coal will assess the progress of the stream remediation measures in achieving the rehabilitation objective for the Eastern Tributary against the following 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.*

In the next reporting period Metropolitan Coal will prepare detailed stream remediation plans for the Eastern Tributary, starting with Pools ETAH and ETAK. The detailed stream remediation plans will be developed in consultation with the DRE, WaterNSW and DP&E.

## 9.4 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 reporting period included supplementary brush matting in areas of low regeneration potential, direct seeding with locate native plant species including *Pultenaea stipularis,* Large-leaf Bush Pea (*Pultenaea daphnoides*), Variable Bossiaea (*Bossiaea heterophylla*) and Large-leaf Hop-bush (*Dodonaea triquetra*). Weed control activities targeted Crofton Weed (*Ageratina adenophora*), introduced grasses and annual weed species.

Rehabilitation activities along the disused access track to the Darkes Forest Mine during the reporting period included supplementary brush matting, partial track closure, and weed control measures targeting Pampas Grass (*Cortaderia* species), Crofton Weed (*Ageratina adenophora*), Blackberry (*Rubus fruticosus*), introduced grasses and annual weed species.

Additional catchment improvement works conducted by Metropolitan Coal during the reporting period included the implementation of weed control measures on Fire Road 9J (targeting Crofton Weed, *Ageratina adenophora*, introduced grasses and annual weed species) and brush matting, partial track closure and erosion and sediment control (installation of 12 coir logs) on Fire Road 9C.

## 9.5 ASSESSMENT OF ENVIRONMENTAL PERFORMANCE

An assessment of the environmental performance of rehabilitation management during the reporting period is provided in Table 19.

## Table 19
## 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.*<br>*The site is neat and tidy (i.e. it does not contain any rubbish).*<br>*No weed management measures are required.*<br>*No erosion or sediment control measures are required.*<br>*Where appropriate, native vegetation is naturally regenerating or active revegetation is establishing.*<br>*No further active revegetation measures are required.* | Not currently applicable | Not currently applicable during the reporting period as no rehabilitation of surface distribution areas in the underground mining area has been conducted.<br>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, an assessment against the rehabilitation performance indicator won't be made until a significant period of drier climatic conditions has 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 | The requirement for stream remediation on the Eastern Tributary was identified in early 2017. Stream remediation plans for individual rock bars will be developed in 2017 for the proposed stream remediation activities. |
| | *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 reporting period. |
| | *Other land affected by the Project* | *Restore ecosystem function, including maintaining or establishing self sustaining native ecosystems:*<br>• *comprised of local native plant species; with*<br>• *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 19 (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 reporting 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:*<br>*(a) be prepared by a team of suitably qualified and experienced experts whose appointment has been endorsed by the Director-General;*<br>*(b) be prepared in consultation with relevant stakeholders, including the WCC and the CCC;*<br>*(c) investigate options for the future use of the area upon the completion of mining;*<br>*(d) describe and justify the proposed rehabilitation strategy for the area; and*<br>*(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 19 (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<br>(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.*<br>*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<br>(Project Approval Condition 5, Schedule 6) | *5. The Proponent shall:*<br>*(a) pay SCA $100,000 by the end of 2011 to carry out catchment improvement works within the Woronora catchment area; or*<br>*(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 9.4). |
| Offsets<br>(Project Approval Condition 6, Schedule 6) | *6. If the Proponent exceeds the performance measures in Table 1 of this approval, and either*<br>*(a) The contingency measures implemented by the Proponent have failed to remediate the impact; or*<br>*(b) The Director-General determines that it is not reasonable or feasible to remediate the impact,*<br>*then the Proponent shall provide a suitable offset to compensate for the impact to the satisfaction of the Director-General.*<br>*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 6.1.2, 9.3 and 12.1). Metropolitan Coal has proposed to conduct stream remediation measures on the Eastern Tributary in accordance with the Longwalls 23-27 Water Management Plan Contingency Plan. |

# 10 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 reporting 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.

## 10.1 COMMUNITY ENGAGEMENT ACTIVITES AND INITIATIVES

***Community Consultative Committee***

Three CCC meetings were held during the reporting period (6 April, 10 August and 14 December 2016). 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 reporting period included noise management and mitigation, air quality monitoring and management, trucking through Helensburgh, underground coal reject emplacement, vegetation management at the surface facilities area, stream remediation, the Longwalls 301-303 Extraction Plan, and the proposed sale of Metropolitan Coal to South32 Limited.

A report on the progress of the CCC in 2016 was provided to the Secretary of the DP&E on 24 February 2017 and a copy of the letter is provided as Appendix S.

***Community Consultative Centre***

Metropolitan Coal closed its Community Consultative Centre in the Helensburgh central business district in early 2016 due to low community visitation. The Centre has been a valuable initiative for the mine and the community.

***Community and Environment Newsletters***

Metropolitan Coal distributed a Community Newsletter in October 2016 (via letterbox drop) to provide an update on Metropolitan Coal's operations and mine activities. The newsletter included an operations update, information on underground coal reject emplacement plant, dust suppression activities and the rehabilitation of surface areas. The newsletter also described the reduction in truck movements through Helensburgh and the success of the Metropolitan Mine Rescue team at the 57$^{th}$ Southern Mines Rescue Competition.

The newsletter included relevant contact details such that further communication could be facilitated with the community.

## 10.2 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 2016. All donation requests were assessed on their individual merit and funding was distributed accordingly.

In total, community donations and sponsorship during 2016 amounted to over $80,000 and included the following:

- Ongoing sponsorship of the Helensburgh Tigers Rugby League Football Club and Helensburgh Tigers Junior Rugby League Football Club.
- Sponsorship of the Thirroul Butchers Old Boys Rugby League Team.
- Donation to the Holy Cross Primary School to support their annual fete and Environment Program.
- Donation to Helensburgh Public School's Environment Program.
- Ongoing sponsorship of the Helensburgh-Stanwell Park Surf Life Saving Club.
- Donation to Woonona Lions Club.
- Donation to the Rotary Club of Fairy Meadow.
- Donation to the Bulli Police Citizens Youth Club.
- Donation to the Sydney Special Children's Christmas Party.
- Donation to 'Carols in the Burgh' for community Christmas Carols in Helensburgh.
- Donation to the Helensburgh Historical Society Helensburgh Railway Station Book.
- Sponsorship of local BMX athletes.

## 10.3 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 reporting period, one complaint was received in March 2016 from a Helensburgh resident concerned with dust levels on Parkes Street due to trucking. Metropolitan Coal advised the resident that all dust controls were operational including the truck wash, road washing and stockpile dust suppression sprays. Metropolitan Coal also indicated to the resident that the current dry weather conditions were exacerbating the level of dust. Metropolitan Coal also discussed with the EPA the potential to use the watercart to reduce the dust load on Parkes Street during extended dry periods.

A summary of community complaints received since January 2006 is provided in Figure 26. 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.

A number of concerns or queries were also raised with Metropolitan Coal personnel during the reporting period.

# 11 INDEPENDENT ENVIRONMENTAL AUDIT

In accordance with Condition 8, Schedule 7 of the Project Approval, an Independent Environmental Audit of the Project was commissioned by the end of December 2014 and conducted from May to December 2015 by a team of experienced and independent experts endorsed by the Secretary of Planning. Metropolitan Coal received the final Independent Environmental Audit report in January 2016. The Independent Environmental Audit included a detailed review and verification of water monitoring results.

The Research Program, *Significance of Chain Pillars on Simulated Groundwater Pressures*, funded by Metropolitan Coal, has been implemented and progressed by Dr. Noel Merrick during the reporting period and has informed the preparation of the Longwalls 301-303 Extraction Plan. There are no activities resulting from the audit that are outstanding.

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

# 12 INCIDENTS AND NON-COMPLIANCES DURING THE REPORTING PERIOD

## 12.1 EASTERN TRIBUTARY PERFORMANCE MEASURE

***Incident Notification and Reporting***

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.

Monitoring conducted in accordance with the Metropolitan Coal Longwalls 23-27 Water Management Plan identified that the following subsidence impact performance measure for the Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26 had been exceeded in relation to iron staining (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 the subsidence impact performance measure 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.

Since Incident Notification on 14 October 2016, Metropolitan Coal provided the DP&E and relevant agencies with:

- a detailed report on the incident within seven days of incident notification (21 October 2016);
- a schedule of key tasks to obtain information and develop contingency measures (28 October 2016); and
- regular status updates on the implementation of the key tasks (dated 25 November 2016, 21 December 2016 and 3 February 2017).

The 3 February 2017 status update reported that the ***no diversion of flows, no change in the natural drainage behaviour of pools*** component of the Eastern Tributary subsidence impact performance measure had also been exceeded.

Metropolitan Coal provided the DP&E (21 February 2017) with a proposed course of action in relation to the exceedance of the Eastern Tributary subsidence impact performance measure, focussed on the implementation of stream remediation measures. As described in Section 9.3.2, Metropolitan Coal will prepare detailed stream remediation plans for the Eastern Tributary, starting with Pools ETAH and ETAK. The detailed stream remediation plans will be developed in consultation with the DRE, WaterNSW and DP&E.

***Minimal Iron Staining Exceedance***

The extent of iron staining on the Eastern Tributary was observed to increase after the completion of Longwall 25 in April 2016. Longwall 25 is located approximately 250 m upstream of the maingate of Longwall 26.

An Eastern Tributary Performance Indicator Iron Staining Register was developed to record the results of the visual inspections and to assist in the assessment of the Longwalls 23-27 Water Management Plan iron staining performance indicator:

> *Visual inspection of the Eastern Tributary between the full supply level of the Woronora Reservoir and Pool ETAF does not show significant changes in the extent or nature of iron staining to more than 30% of the Eastern Tributary that isn't also occurring in the Woronora River (control site).*

The regular visual inspections conducted by Metropolitan Coal during the reporting period identified a progressive increase in iron staining on the Eastern Tributary between the maingate of Longwall 26 and the full supply level of the Woronora Reservoir. In June 2016 iron staining was observed at Boulderfield ETAF, Rock bar ETAF(2), Pool ETAH, Rock bar ETAH and Rock bar ETAK downstream of the Longwall 26 maingate (Appendix D). As at December 2016, as a result of Longwalls 23-27 extraction, iron staining extends along the majority of the relevant reach of the Eastern Tributary.

Iron staining/flocculent material is associated with the flushing of iron from sandstone fractures created by upsidence and valley closure. Experience at Metropolitan Coal prior to the Project Approval indicated that areas of the substratum in the Waratah Rivulet and other watercourses had been observed to be affected by orange-red iron staining for several hundred metres downstream of mine subsidence fractures.

'*Negligible environmental consequences'* for a watercourse are considered in the Project Approval conditions to mean … *minimal iron staining*, and was assumed incorrectly by the Metropolitan Coal Project Planning Assessment Commission to be achieved in circumstances where predicted valley closure is less than 200 millimetres (mm). This presented an inconsistency with previous observations at Metropolitan Coal of iron staining occurring several hundred metres downstream of mine subsidence fractures (i.e. for several hundred metres downstream of sections of stream where the predicted closure exceeded 200 mm) and where impacts occurred.

Following the exceedance of the iron staining component of the Eastern Tributary subsidence impact performance measure in October 2016 Metropolitan Coal implemented a number of tasks from October 2016 to January 2017 to inform the development of contingency measures. The tasks included:

- Increasing the frequency of water quality sampling at sites ETWQF, ETWQN, ETWQAF, ETWQAG, ETWQAH, ETWQAI, ETWQAK, ETWQAQ and ETWQAU on the Eastern Tributary and at site WOWQ2 on the Woronora Reservoir from monthly to weekly.

- Specialist assessment of the available Eastern Tributary water quality data.
- Continued monitoring of iron staining and other stream attributes (such as gas releases, the natural drainage behaviour of pools and stream flows) on the Eastern Tributary in accordance with the Metropolitan Coal Longwalls 23-27 Water Management Plan.
- Field inspections of the upper reaches of the Woronora Reservoir (i.e. downstream of the full supply level) to identify the presence/absence of iron staining.
- Specialist assessment against the subsidence impact performance measure for biodiversity of *Negligible impact on threatened species, populations, or ecological communities* in accordance with the Metropolitan Coal Longwalls 23-27 Biodiversity Management Plan.
- Analysis of the spring 2016 aquatic ecology monitoring data for the Eastern Tributary and relevant reference pools.
- Consideration of the subsidence effects associated with Longwall 26 compared to Longwall 27.

The available water quality data was regularly reviewed by Associate Professor Barry Noller (The University of Queensland) and Hydro Engineering & Consulting. The source of the iron and manganese is from carbonate minerals in the Hawkesbury sandstone. Reducing conditions in the groundwater has solubilised iron and manganese. The soluble iron and manganese, which is able to enter the Eastern Tributary via cracking from longwall mining has resulted in the increase in iron staining and dissolved manganese concentrations. While dissolved manganese concentrations have increased in the Eastern Tributary since July 2016, analysis of water quality data indicates the watercourse subsidence impact performance measure, *Negligible reduction to the quality of water resources reaching the Woronora Reservoir*, had not been exceeded.

Inspection of the upper reaches of the Woronora Reservoir (i.e. downstream of the full supply level) for iron staining indicated that some iron staining/flocculent was observed in the upper-most reaches of the Woronora Reservoir full supply level within the boulderfield, however, the water in the inundated area were observed to be clear.

In accordance with the Longwalls 20-22 and 23-27 Biodiversity Management Plans, an exceedance of a watercourse subsidence impact performance measure triggers an assessment against the biodiversity subsidence impact performance measure, *Negligible impact on threatened species, populations or ecological communities*. On the basis that the environmental consequences of the incident relate to in-stream habitats, and that there are no threatened aquatic fauna or flora known, or considered likely to occur, an assessment against the biodiversity performance measure was conducted in relation to threatened terrestrial fauna (namely, the Red-crowned Toadlet, *Pseudophryne australis,* and the Giant Burrowing Frog, *Heleiporus australiacus*) by Cenwest Environmental Services. The assessment indicated the biodiversity subsidence impact performance measure, *Negligible impact on threatened species, populations or ecological communities,* had not been exceeded as a result of the identified impacts to the Eastern Tributary.

The results of analysis of the aquatic ecology monitoring data are summarised in Section 6.1.3. Analysis of the aquatic ecology data indicates that the aquatic ecology performance indicator, *Aquatic macroinvertebrate and macrophyte assemblages in streams and pools are not expected to experience long-term impacts as a result of mine subsidence*, has not been exceeded at sites on the Eastern Tributary. The aquatic ecology monitoring programs for Longwalls 20-22 and Longwalls 23-27 have been designed to monitor subsidence-induced impacts on aquatic ecology (referred to as stream monitoring) and the response of aquatic ecosystems to the implementation of stream remediation works (referred to as pool monitoring). These monitoring programs will continue to be conducted bi-annually in autumn and spring.

Subsidence assessments completed by MSEC for the Metropolitan Coal Project Environmental Assessment (Project EA) and Metropolitan Coal Longwalls 23-27 Extraction Plan indicated that predicted conventional strains resulting from the extraction of Longwalls 23 to 27 would be of sufficient magnitude to result in fracturing of the uppermost bedrock. Fracturing and dilation of the uppermost bedrock could also occur along the alignments of streams due to valley related movements. MSEC's assessment of subsidence effects in November 2016 indicated that the observed subsidence movements and observed impacts to date were consistent with the predictions and impact assessments for the Eastern Tributary outlined in the Project EA and Longwalls 23-27 Extraction Plan.

As indicated above, Metropolitan Coal will prepare detailed stream remediation plans for the Eastern Tributary. In the development of the stream remediation plans, Metropolitan Coal will consider, with advice from a geotechnical engineer, whether strategic additional polyurethane injection (i.e. additional to the remediation of specific rock bars) may assist in reducing the extent of iron staining.

***No Diversion of Flows/Change in the Natural Drainage Behaviour of Pools Exceedance***

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.

'*Negligible environmental consequences'* for a watercourse was assumed by the Metropolitan Coal Project Planning Assessment Commission to be achieved in circumstances where predicted valley closure is less than 200 millimetres (mm). 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) (to January 2017) 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 will prepare detailed stream remediation plans for the Eastern Tributary, starting with Pools ETAH and ETAK. The detailed stream remediation plans will be developed in consultation with the DRE, WaterNSW and DP&E in accordance with the Metropolitan Coal Rehabilitation Management Plan.

## 12.2 NOISE

***Sustained Non-compliances – Attended Noise Monitoring and Modelling***

Conclusive identification of the sustained noise non-compliances in 2015 was not determined until Quarter 1 of 2016. Sustained non-compliances with respect to the Noise Impact Assessment Criteria were identified at two representative noise monitoring locations (16 Oxley Place and 50 Parkes Street). Notwithstanding, the sustained non-compliances were reported in the Metropolitan Coal 2015 Annual Review (Metropolitan Coal, 2015), which also noted, "*It is anticipated that sustained non-compliances with respect to the Noise Impact Assessment Criteria could also be expected at proximal residences over the next reporting period*".

As described in Section 6.2.1, during 2016 Metropolitan Coal identified sustained non-compliances at two representative noise monitoring locations (16 Oxley Place and 36 Old Station Road) with respect to the Noise Impact Assessment Criteria (Condition 1, Schedule 4 of the Project Approval).

As a result of the continuation of the monitored non-compliances, modelling of predicted noise levels for nearby residences (based on extrapolation of the quarterly noise monitoring results, weather conditions and additional noise controls) was conducted and identified sustained non-compliances with respect to the Noise Impact Assessment Criteria at 17 private residences. The modelling also indicated that eight of the 17 private residences also experienced sustained non-compliances with respect to the Noise Mitigation Criteria (Condition 3, Schedule 4 of the Project Approval).

It is noted that these locations 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 reporting period, and a range of operational noise control measures has been implemented since Project Approval (Section 6.2.1).

During the reporting period, no complaints related to operational noise were received by Metropolitan Coal.

It should also be noted that all of the residences predicted to be experiencing sustained non-compliances with 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 eight residences, only two did not accept the previous offer by Metropolitan Coal (Appendix Q). Metropolitan Coal has also previously extended the same offer to six of the residences experiencing sustained non-compliances with the Noise Impact Assessment Criteria. Of these residences, three have accepted the noise mitigation works.

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.

Metropolitan Coal anticipates that sustained non-compliances with respect to the Noise Impact Assessment Criteria and, to a lesser extent, the Noise Mitigation Criteria will continue to be observed over the next reporting period. Metropolitan Coal will continue to consult with the DP&E, DRE, EPA and the local community.

***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). Notifications of the exceedances of the Noise Impact Assessment Criteria were not made within the timeframe specified in Condition 1, Schedule 5.

Following conclusive identification of sustained 2015 noise non-compliances in Quarter 1 of 2016, Metropolitan Coal notified the DP&E and requested a meeting to discuss the nature of the observed noise exceedances and to investigate options to address these exceedances. On 17 May 2016, a meeting was convened with the DP&E Assessment Branch.

Nearby residences were not notified of the exceedances of the Noise Impact Assessment Criteria until after Metropolitan Coal had met with DP&E to discuss the exceedances and modelling of predicted noise levels for nearby residences. As operator-attended noise monitoring is conducted at a limited number of representative locations, noise modelling (based on extrapolation of the quarterly noise monitoring results, weather conditions and additional noise controls) was necessary to determine the specific residences that were experiencing noise levels exceeding the noise criteria and therefore required notification. As a result, nearby residences were notified that they were potentially experiencing noise levels in excess of the Noise Impact Assessment Criteria in December 2016 (i.e. following the receipt of the Quarter 3, 2016 monitoring report from SLR Consulting and associated noise modelling extrapolating these results to nearby residences).
During the next reporting period, Metropolitan Coal will continue to consult with the DP&E, DRE and EPA and will continue to notify relevant residences following the receipt of the quarterly attended noise monitoring reports (and associated modelling extrapolating these results to nearby residences).

## 12.3 AIR QUALITY

Metropolitan Coal has identified an administrative non-compliance with respect to Condition M2 *Requirement to monitor concentrations of pollutants discharged*, of EPL No. 767. As described in Table 2 and Section 6.2.2, sampling was not able to be conducted at all monitoring points at the frequencies described in Conditions M2.1 and M2.2 of EPL No. 767.

Specifically, the dust deposition gauges include a bottle which captures the dust between collection periods. When inspected, samples from dust gauges DG5 (in July 2016) and DG7 (in January and March 2016) were unable to be collected as the bottle was broken and no sample was recoverable.

In relation to the administrative non-compliances recorded against EPL No. 767, Metropolitan Coal has determined that, in the event that the broken dust deposition gauge bottles are determined to be caused by vandalism, Metropolitan Coal may undertake an investigation to move or more effectively secure the monitoring points.

## 12.4 LICENSED DISCHARGE

As described in Section 7, on 28 July 2016, Metropolitan Coal personnel observed the water in Camp Gully to have a green discolouration. Immediate investigation indicated that the water in the Water Treatment Plant (from which water is discharged to Camp Gully) had a similar discolouration. The Water Treatment Plant discharge line was immediately isolated so that no further discharge to Camp Gully could occur. The investigation also indicated that water from the underground workings containing a spill of hydraulic fluid (Quintolubric 818-02, a water-based biodegradable fluid) was pumped to the surface for treatment. On 2 August 2016, the EPA issued Metropolitan Coal with a formal warning letter in relation to the incident, considered to be a breach of EPL No.767 Condition L1.1 on the basis that Quintolubric 818-02 is not defined in Table L2.4 of EPL No.767.

To ensure that a similar incident does not occur in the future, underground personnel have been asked to report any spills that occur underground to the Environment and Community Superintendent. In addition, safety valves (with an automatic shut off) have been fitted to prevent supply from the Quintolubric 818-02 storage tank to the underground in the event of a spill.

# 13 ACTIVITIES PROPOSED IN THE NEXT REPORTING PERIOD

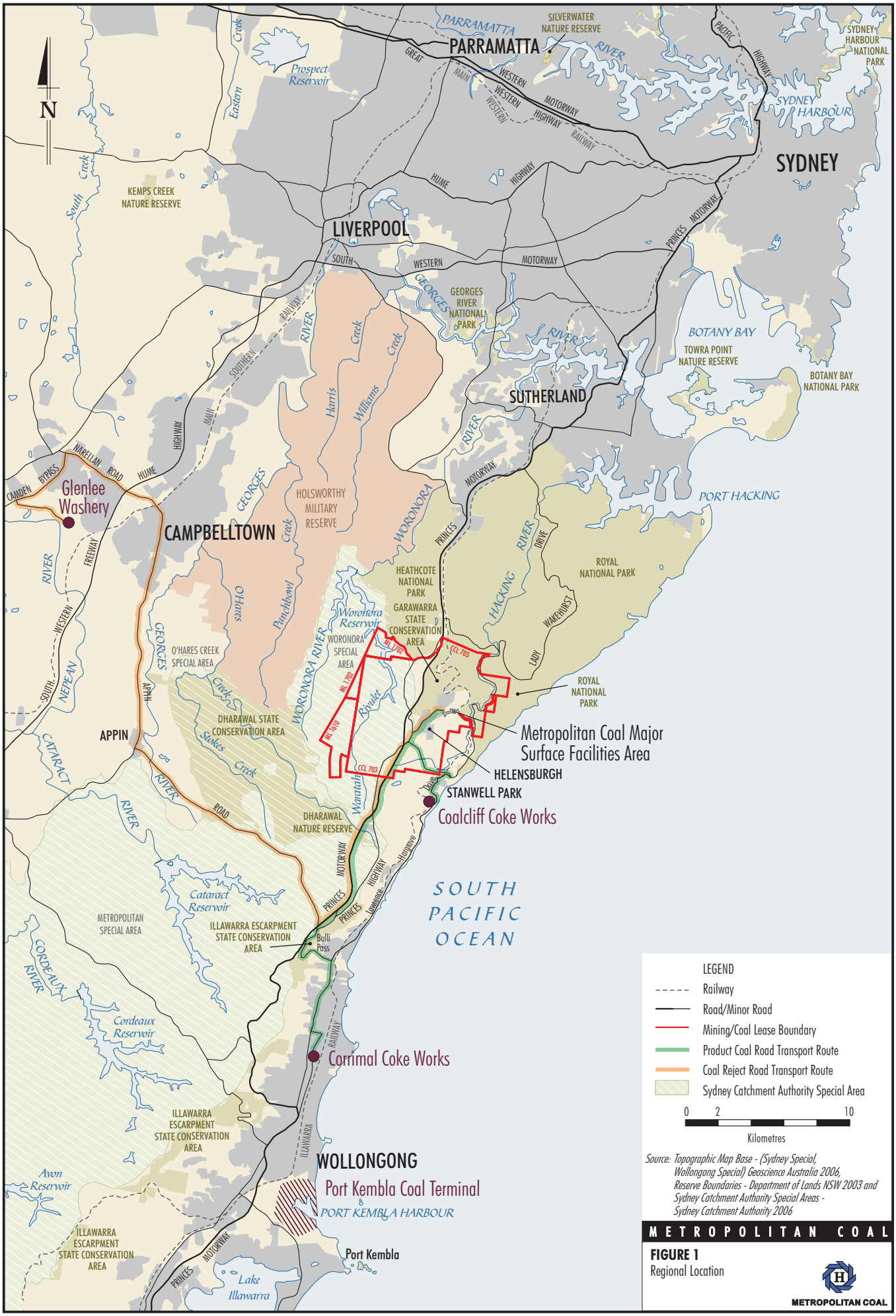
In the next reporting period, Longwall 27 will be completed in March 2017 and Longwall 301 will commence in May 2017 (subject to Extraction Plan approval) (Figure 6).

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

- Metropolitan Coal will prepare a technical review of remaining available feasible noise mitigation measures and an associated evaluation of the reasonableness of these options by the end of June 2017. Metropolitan Coal will then provide written advice to DP&E as to whether the current noise impact assessment criteria could reasonably be achieved without wholesale replacement of large elements of the existing surface facilities, or alternative methods of coal handling/ processing at the site. Metropolitan Coal will continue to implement noise monitoring, management and modelling in accordance with the Metropolitan Coal Noise Management Plan.
- Metropolitan Coal will continue to consult with the DP&E, DRE and EPA and to notify relevant residences following the receipt of the quarterly attended noise monitoring reports (and associated modelling extrapolating these results to nearby residences).
- Metropolitan Coal will assess the feasibility of installing a camera to allow for remote monitoring of dust emissions from coal stockpiles by July 2017.
- Metropolitan Coal will continue the transport of coal reject to the Lend Lease Calderwood Urban Development Project for the beneficial re-use of coal reject as fill material.
- 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.
- Trialling and commissioning of the backfill plant and associated coal reject injection into the goaf will continue.
- Metropolitan Coal will review the road safety report completed for the Mine Access Road and Parkes Street intersection and consider its recommendations. The review is anticipated to be completed by June 2017.
- Metropolitan Coal will revegetate/rehabilitate the completed outer batters of the Turkey's Nest Dam.
- The Metropolitan Coal Longwalls 20-22 and Longwalls 23-27 Extraction Plans will be superseded by the Longwalls 301-303 Extraction Plan following the completion of Longwall 27 and once the Longwalls 301-303 Extraction Plan is approved (anticipated by May 2017).
- Metropolitan Coal will update the Longwalls 301-303 Water Management Plan to include additional monitoring and management commitments made by Metropolitan Coal post the submission of the Longwalls 301-303 Extraction Plan in response to regulator comments. It is anticipated that the Longwalls 301-303 Water Management Plan will be revised by August 2017.
- In accordance with the Longwalls 301-303 Extraction Plan, Metropolitan Coal will review and revise where necessary the Metropolitan Coal Environmental Management Strategy, Metropolitan Coal Catchment Monitoring Program, Metropolitan Coal Construction Management Plan and Metropolitan Coal Rehabilitation Management Plan to be consistent with the Longwalls 301-303 Extraction Plan. It is anticipated that the plans will be reviewed and where necessary revised by September 2017.
- Metropolitan Coal will install a new multi-level piezometer over Longwall 302 and anticipates that installation will be completed by the end of August 2017. Following consultation with WaterNSW, Metropolitan Coal will also investigate the potential to install two new screened piezometers between bore 9EGW2A and the Woronora Reservoir, and install the piezometers if bore installation in this location is practicable.

- Metropolitan Coal will also investigate the siting of an additional Vibrating Wire Piezometer bore to the north-east of Longwall 301 (in consideration of access constraints within the Garrawarra State Conservation Area administered by the NSW National Parks and Wildlife Service) to assess the effect of depressurisation by the century-old workings. This investigation has commenced.
- Metropolitan Coal will install ridge top monitoring stations that will be surveyed during the extraction of Longwalls 301-303 to provide additional subsidence and valley closure monitoring data in May 2017. Metropolitan Coal will also conduct a LiDAR survey of Longwalls 301-303 prior to the commencement of Longwall 301 and trial its effectiveness compared to traditional subsidence survey techniques following the extraction of Longwall 301.
- Metropolitan Coal will establish additional cross lines on the Eastern Tributary to monitor subsidence movements in May 2017.
- Metropolitan Coal will prepare detailed stream remediation plans for the Eastern Tributary, starting with Pools ETAH and ETAK. The detailed stream remediation plans will be developed in consultation with the DRE, WaterNSW and DP&E.
- 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 2017.

# FIGURES

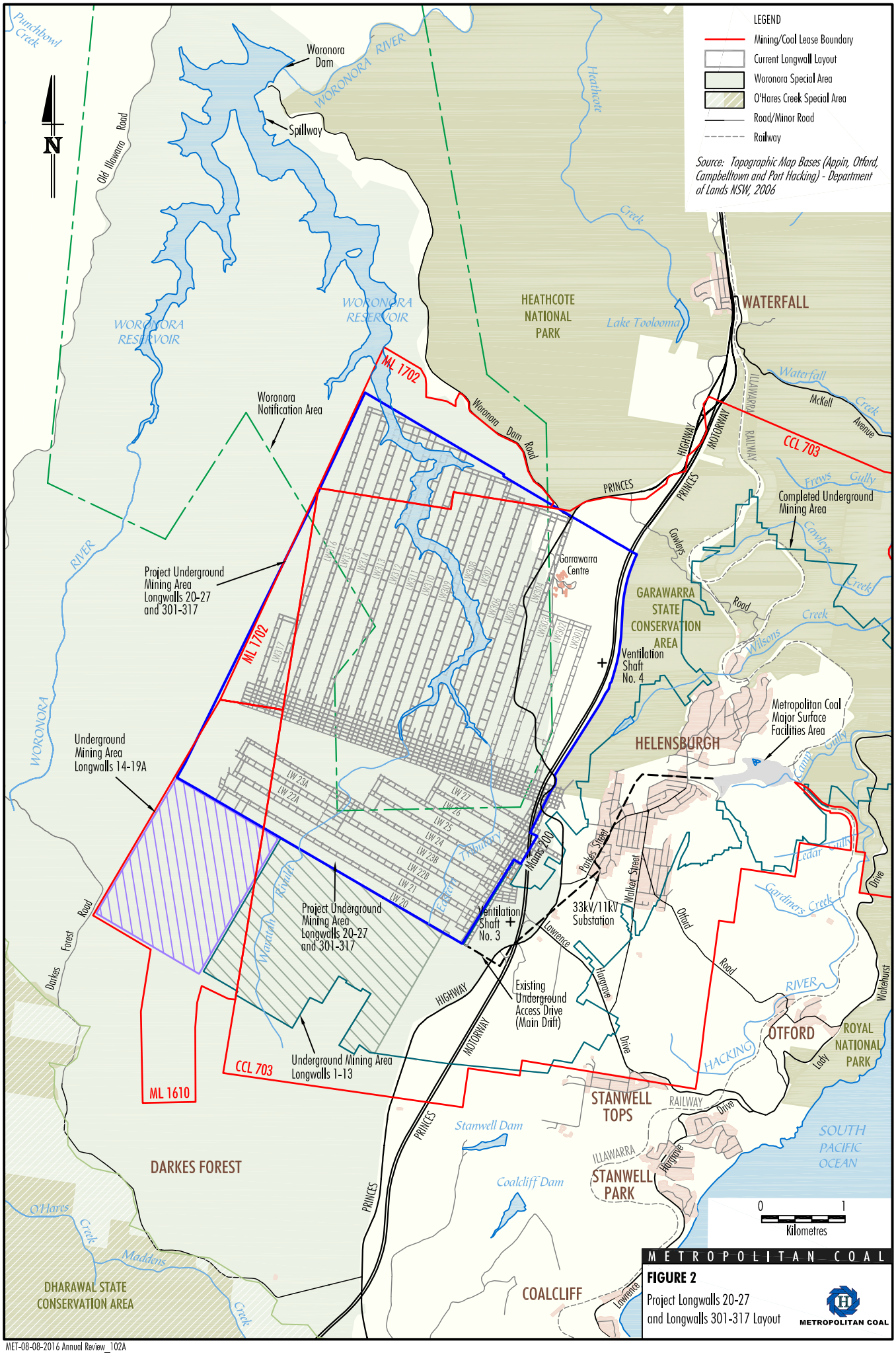



*Source: Topographic Map Base - (Sydney Special, Wollongong Special) Geoscience Australia 2006, Reserve Boundaries - Department of Lands NSW 2003 and Sydney Catchment Authority Special Areas - Sydney Catchment Authority 2006*

METROPOLITAN COAL

**FIGURE 1**
Regional Location

METROPOLITAN COAL


LEGEND
Mining/Coal Lease Boundary
Current Longwall Layout
Woronora Special Area
O'Hares Creek Special Area
Road/Minor Road
Railway
Source: Topographic Map Bases (Appin, Otford, Campbelltown and Port Hacking) - Department of Lands NSW, 2006
N
Punchbowl Creek
Woronora Dam
Spillway
WORONORA RIVER
Old Illawarra Road
Heathcote Creek
HEATHCOTE NATIONAL PARK
WATERFALL
Lake Toolooma
WORONORA RESERVOIR
WORONORA RESERVOIR
ML 1702
Woronora Notification Area
Woronora Dam Road
HIGHWAY
MOTORWAY
PRINCES
ILLAWARRA RAILWAY
Waterfall
McKell Avenue
Creek
CCL 703
Frews Gully
Completed Underground Mining Area
Cowleys Creek
Project Underground Mining Area Longwalls 20-27 and 301-317
Garrawarra Centre
GARAWARRA STATE CONSERVATION AREA
Road
Wilsons Creek
Ventilation Shaft No. 4
Metropolitan Coal Major Surface Facilities Area
HELENSBURGH
Camp Gully
Underground Mining Area Longwalls 14-19A
Mains 200
Parkes Street
Walker Street
Cedar Gully
Gardiners Creek
Drive
33kV/11kV Substation
Ventilation Shaft No. 3
Lawrence
Oxford Road
Darkes Forest Road
Project Underground Mining Area Longwalls 20-27 and 301-317
Existing Underground Access Drive (Main Drift)
Hargrave Drive
RIVER
Wakehurst
OTFORD
ROYAL NATIONAL PARK
HACKING
Lady
Underground Mining Area Longwalls 1-13
CCL 703
ML 1610
STANWELL TOPS
RAILWAY
Stanwell Dam
SOUTH PACIFIC OCEAN
ILLAWARRA
STANWELL PARK
DARKES FOREST
Coaldcliff Dam
O'Hares Creek
Maddens Creek
DHARAWAL STATE CONSERVATION AREA
COALCLIFF
0
1
Kilometres
METROPOLITAN COAL
FIGURE 2
Project Longwalls 20-27 and Longwalls 301-317 Layout
METROPOLITAN COAL

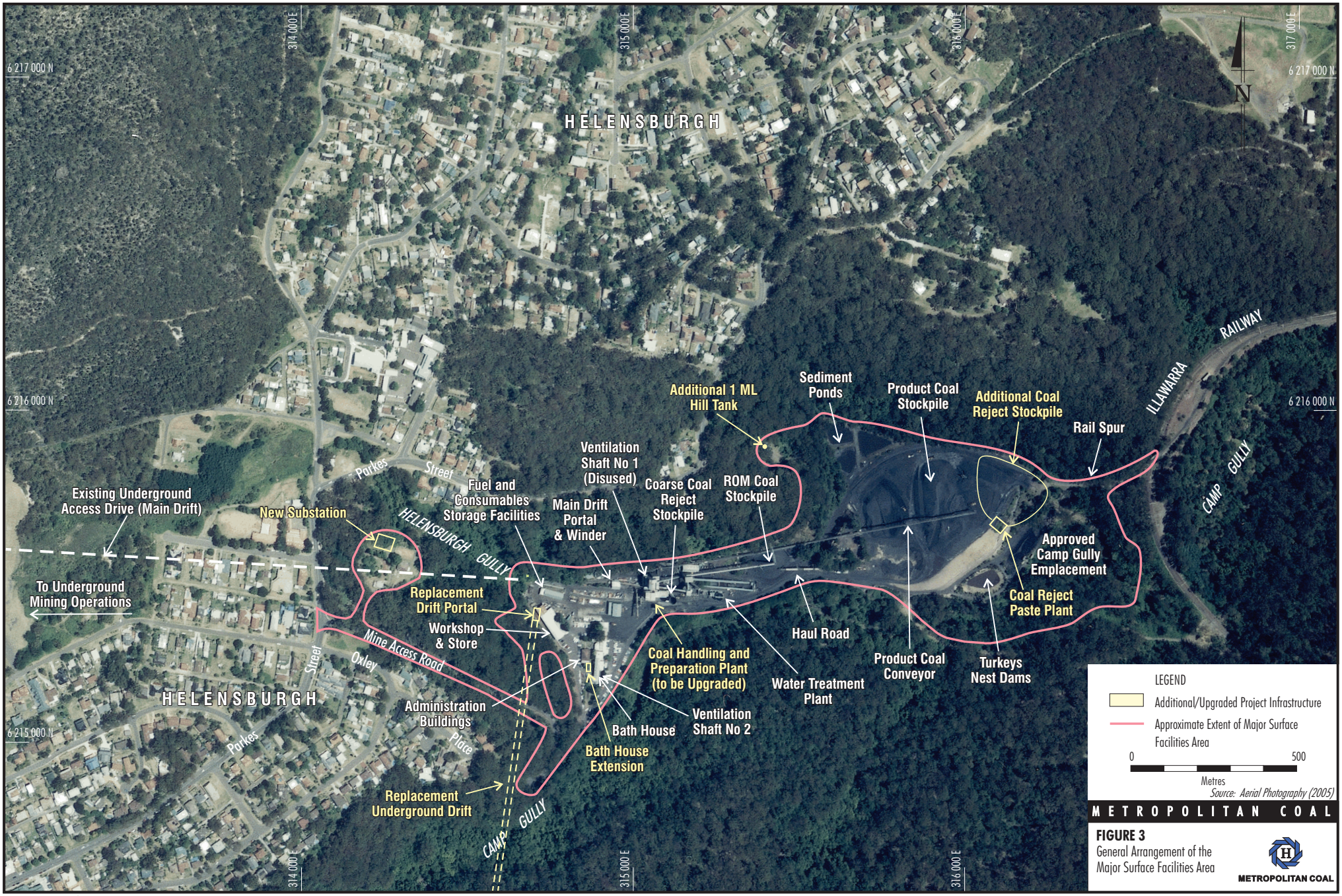



**FIGURE 3**
General Arrangement of the Major Surface Facilities Area

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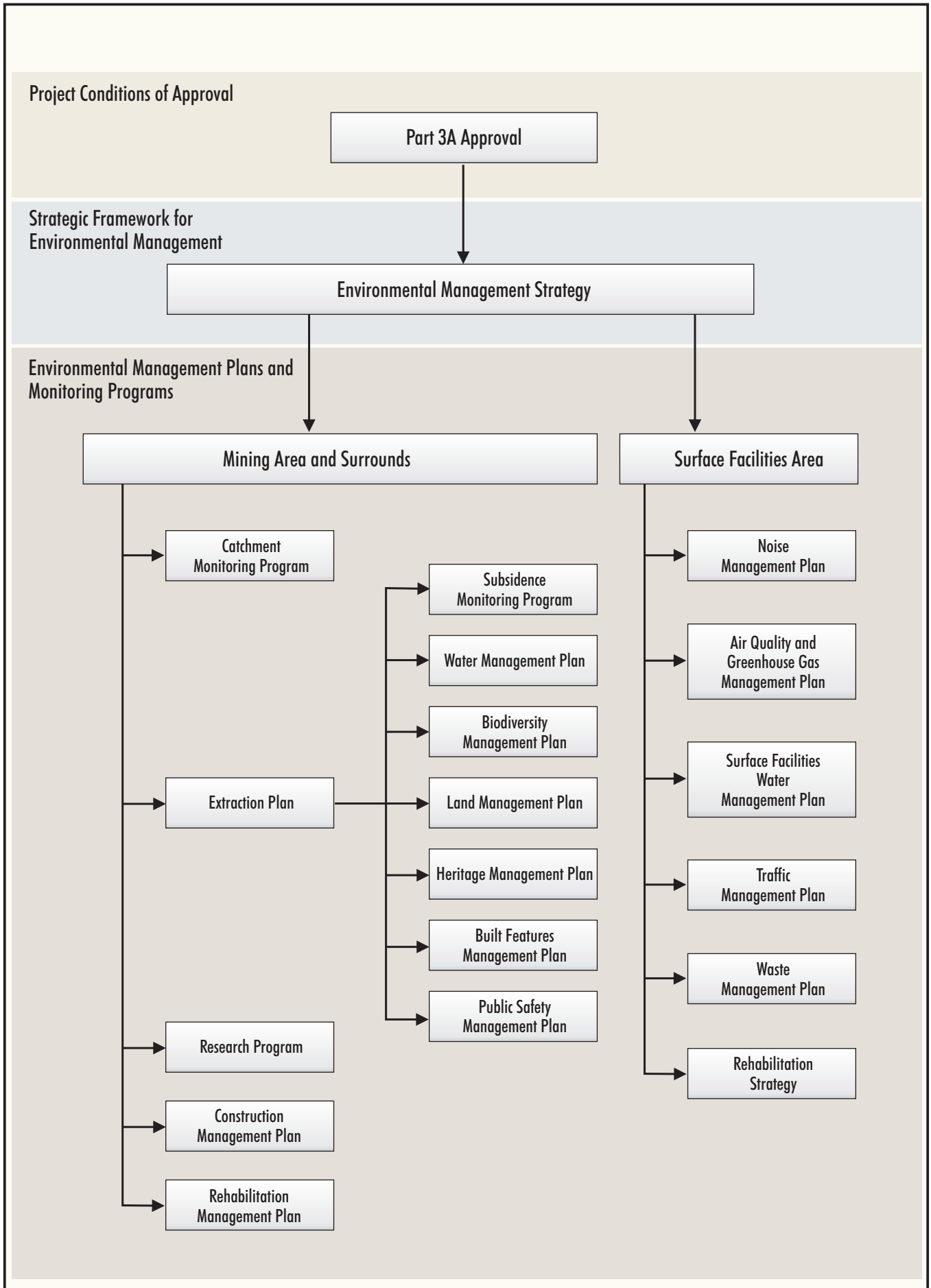


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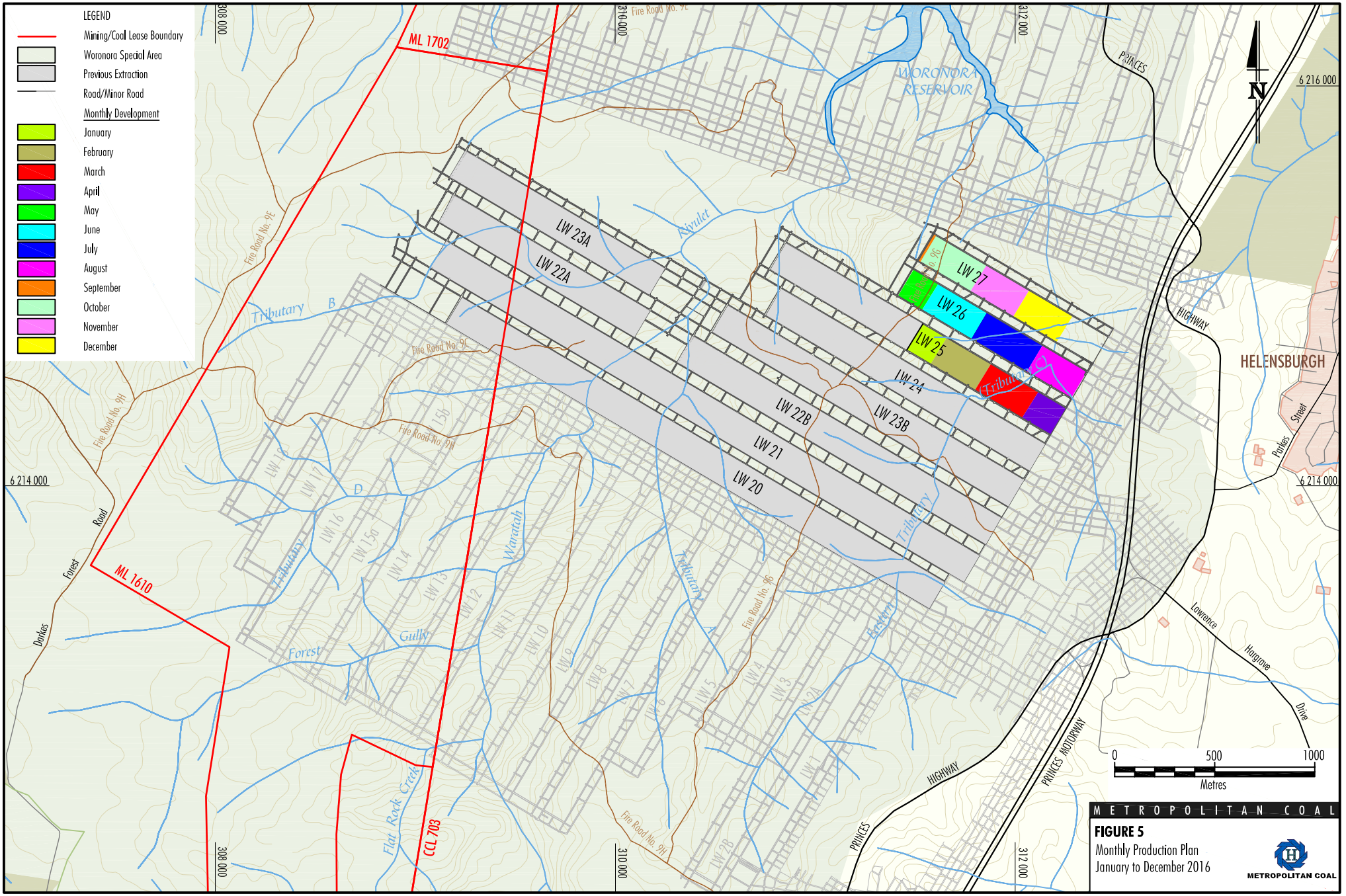
**FIGURE 4**
Environmental Management Structure

METROPOLITAN COAL

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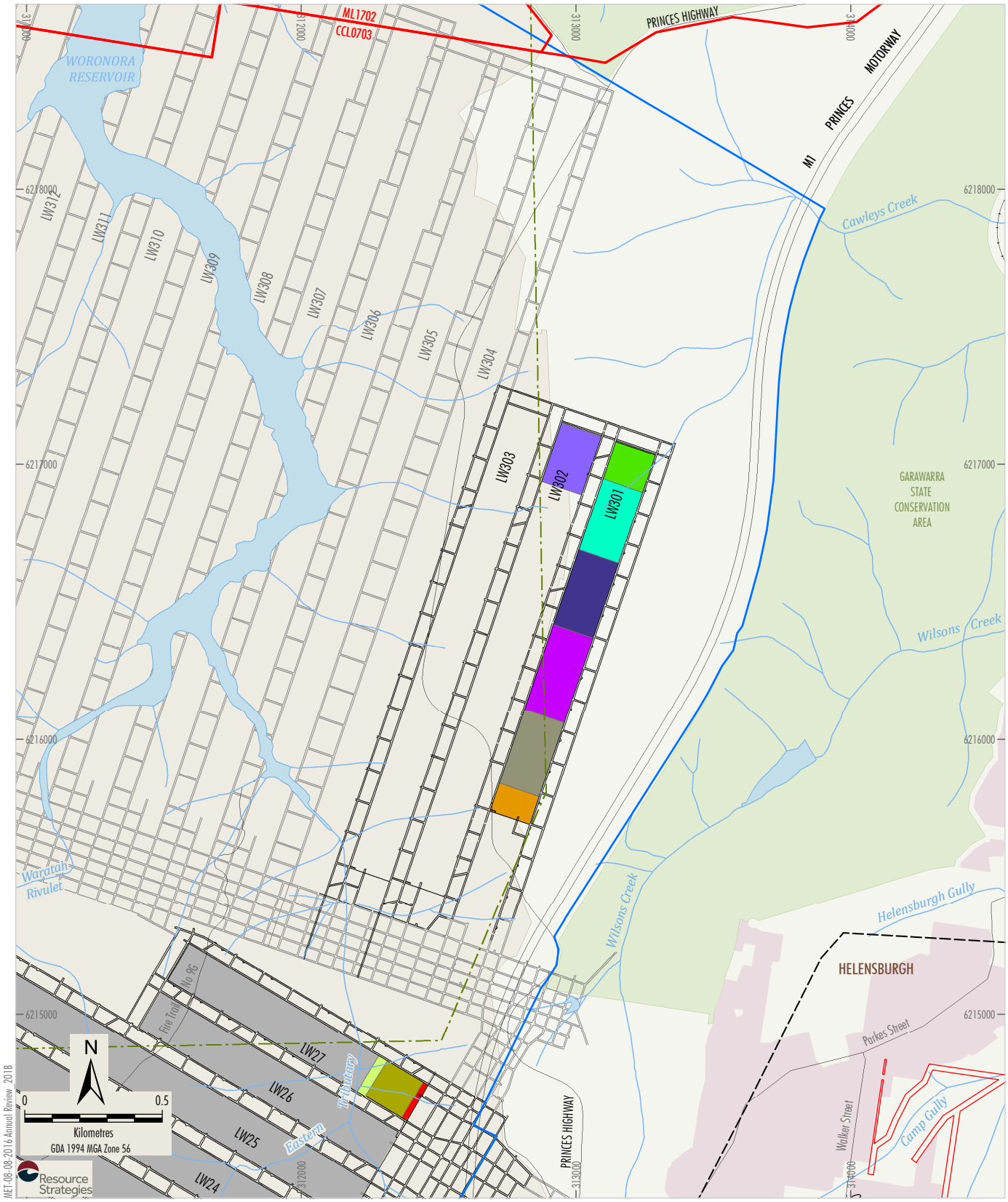



LEGEND

- 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)

Development

- January 2017
- February 2017
- March 2017
- May 2017
- June 2017
- July 2017
- August 2017
- September 2017
- October 2017
- December 2017

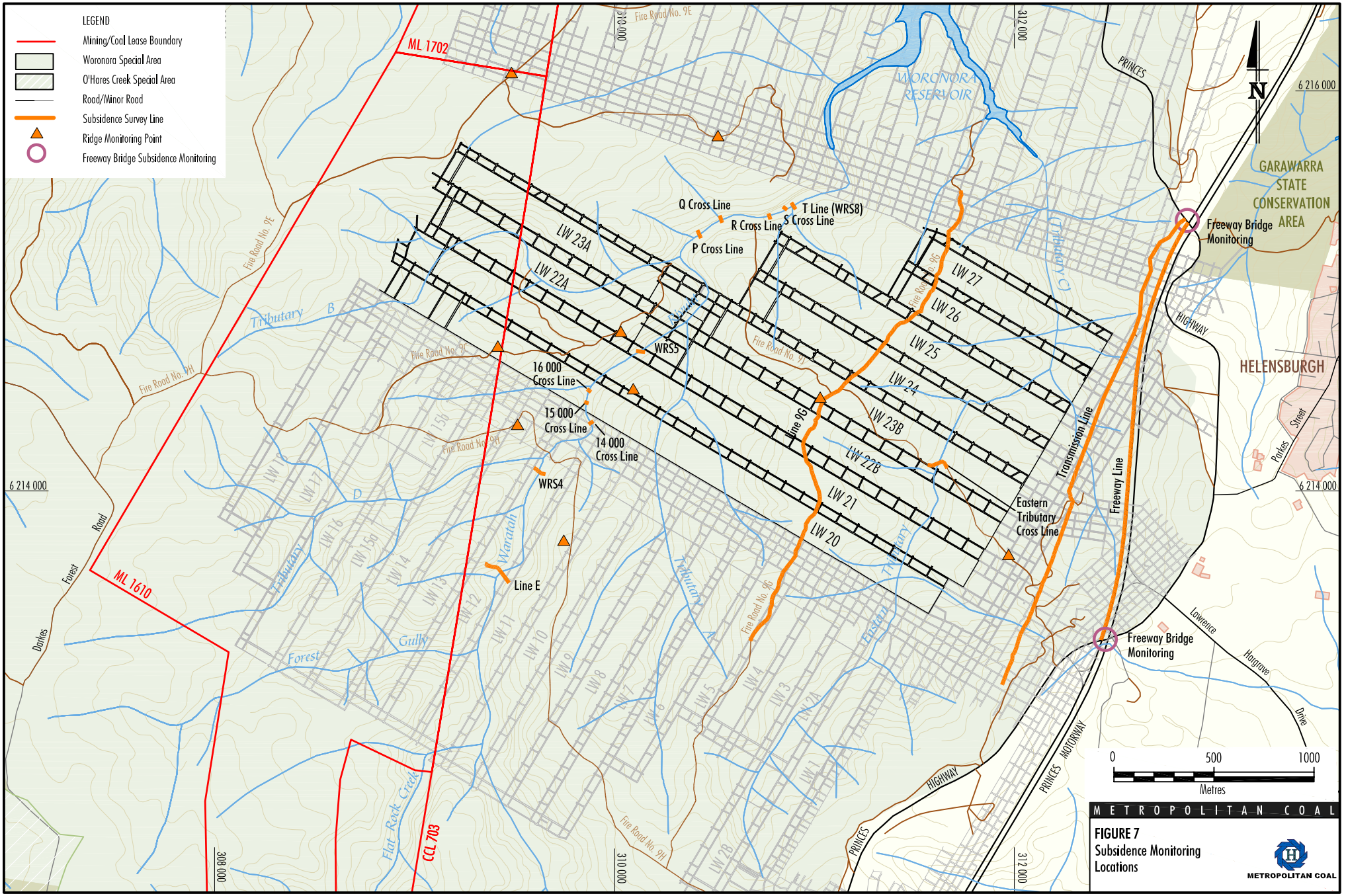
*Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2016); MSEC (2016)*

Peabody ENERGY

METROPOLITAN COAL

**Production Plan Forecast**
**January to December 2017**

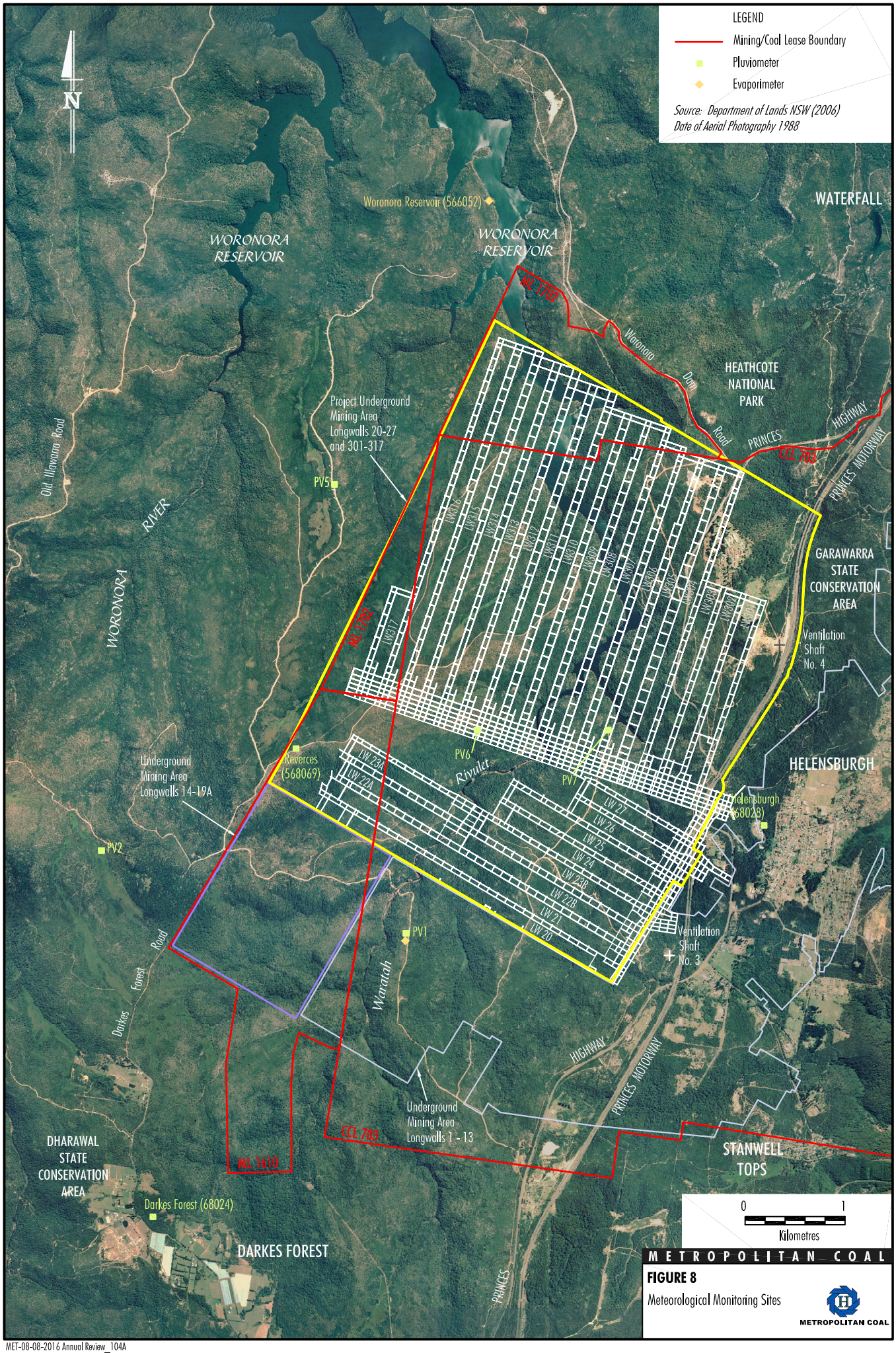
**Figure 6**

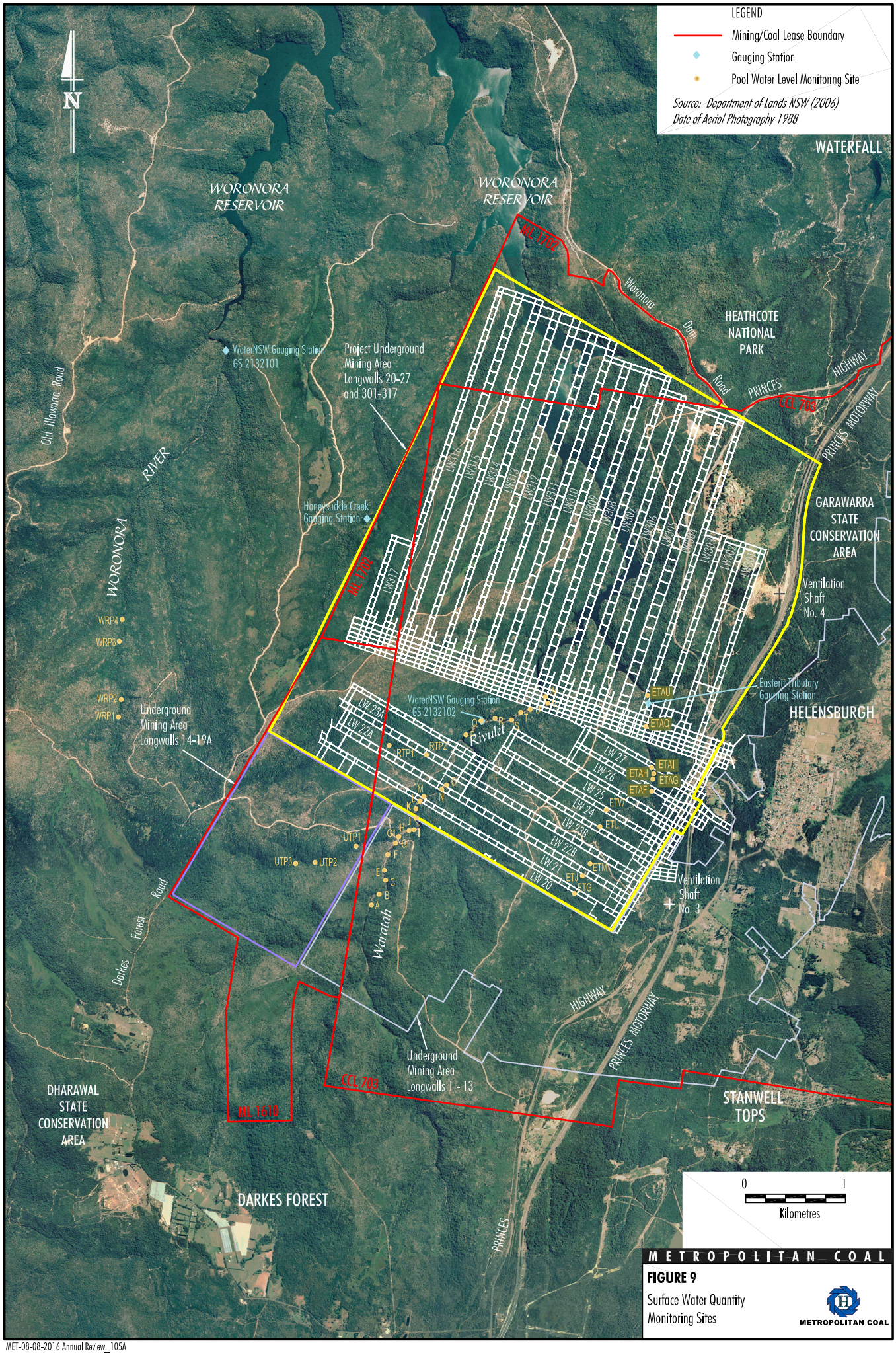


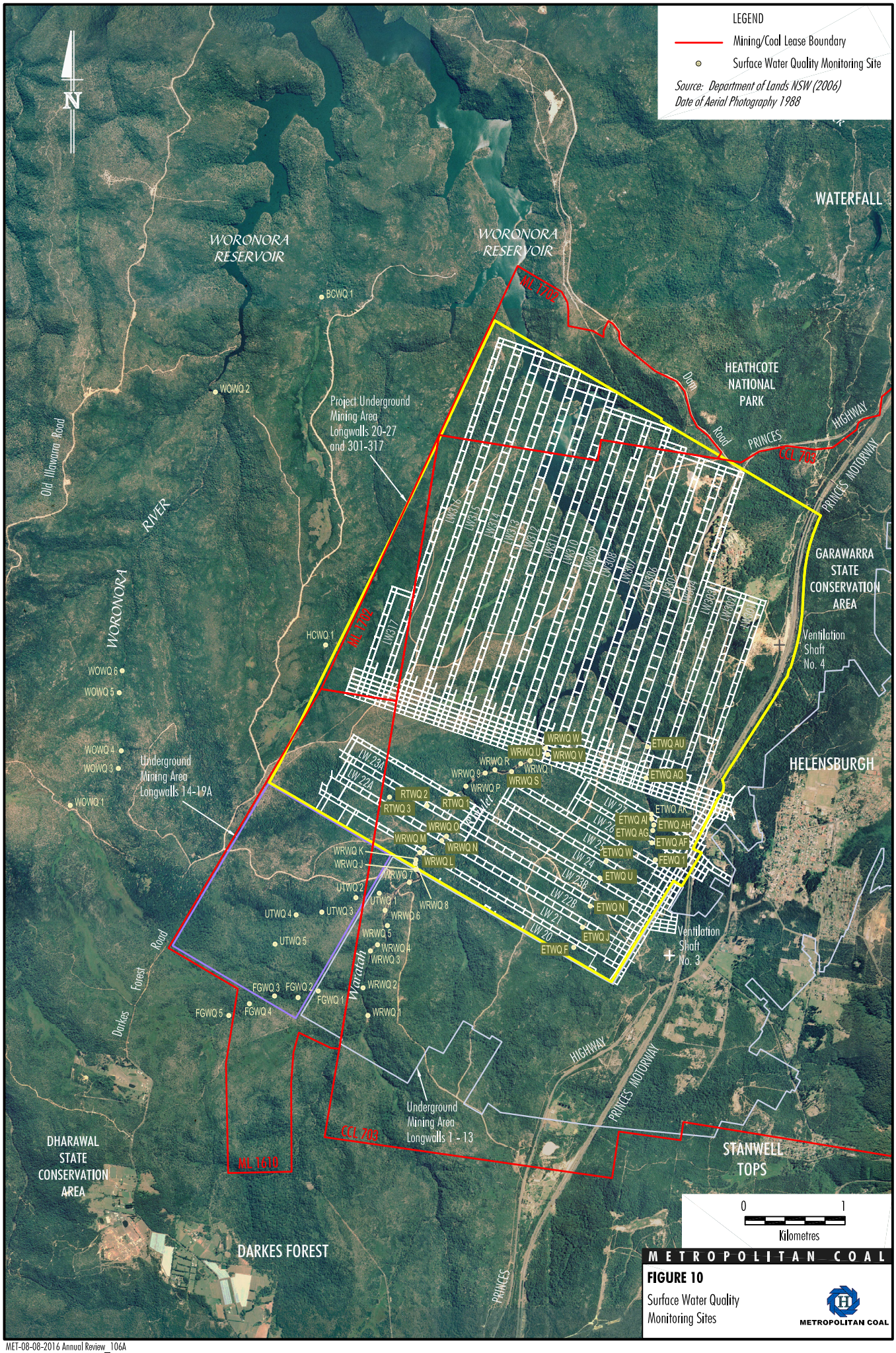

METROPOLITAN COAL

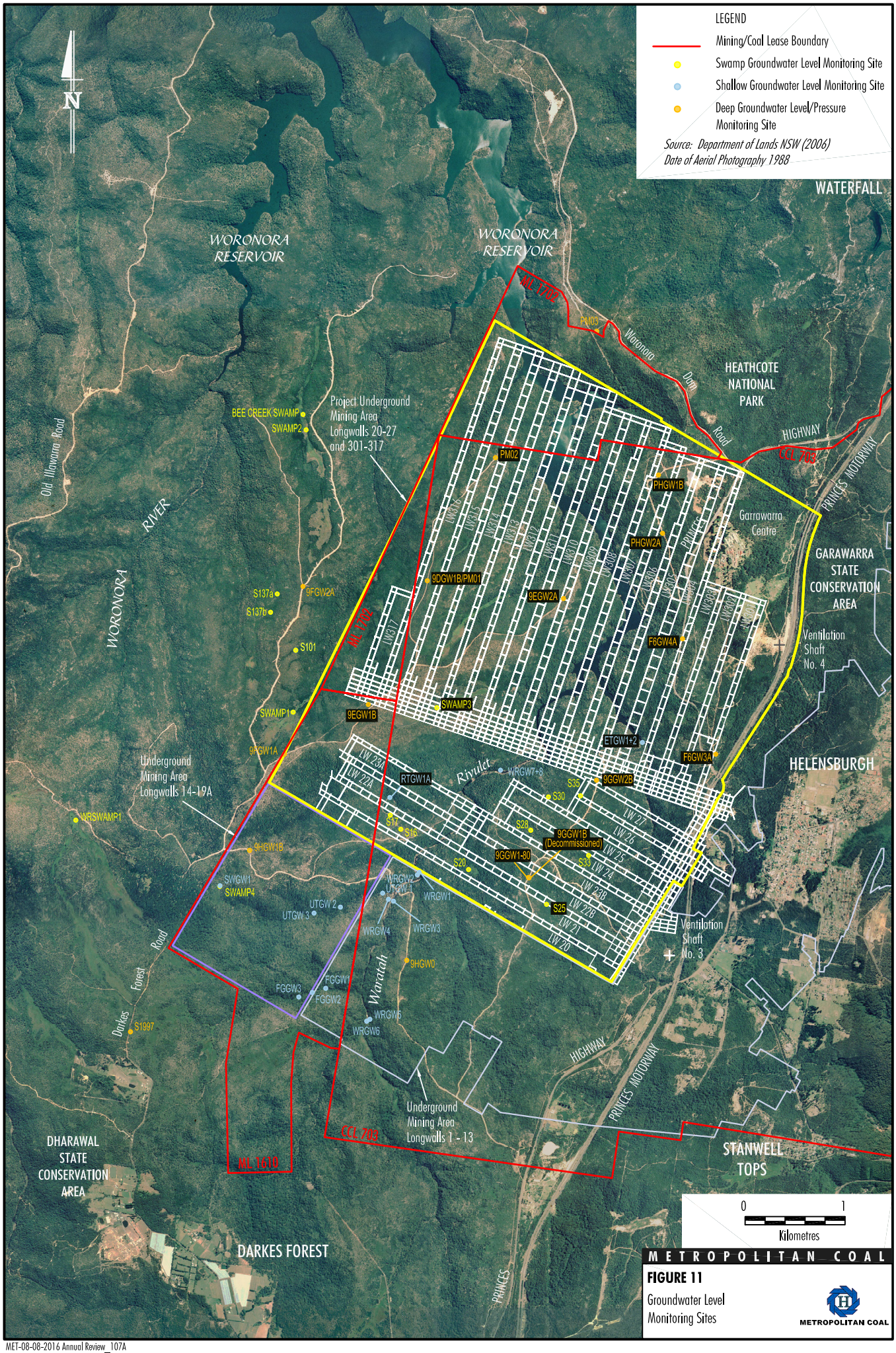
**FIGURE 7**
Subsidence Monitoring Locations

METROPOLITAN COAL


LEGEND
Mining/Coal Lease Boundary
Pluviometer
Evaporimeter
Source: Department of Lands NSW (2006)
Date of Aerial Photography 1988
N
WATERFALL
Woronora Reservoir (566052)
WORONORA RESERVOIR
WORONORA RESERVOIR
ML 1610
Woronora Dam
HEATHCOTE NATIONAL PARK
Road
PRINCES HIGHWAY
CCL 705
PRINCES MOTORWAY
Project Underground Mining Area Longwalls 20-27 and 301-317
PV5
Old Illawarra Road
RIVER
WORONORA
ML 1577
LW316
LW315
LW314
LW313
LW312
LW311
LW310
LW309
LW308
LW307
LW306
LW305
LW304
LW303
LW302
LW301
LW317
GARAWARRA STATE CONSERVATION AREA
Ventilation Shaft No. 4
Underground Mining Area Longwalls 14-19A
Reverces (568069)
PV6
Rivulet
PV7
LW23A
LW22A
HELENSBURGH
Helensburgh (68028)
PV2
LW27
LW26
LW25
LW24
LW23B
LW22B
LW21
LW20
Ventilation Shaft No. 3
PV1
Waratah
Forest Road
Darkes
HIGHWAY
PRINCES MOTORWAY
Underground Mining Area Longwalls 1 - 13
CCL 705
ML 1610
DHARAWAL STATE CONSERVATION AREA
STANWELL TOPS
Darkes Forest (68024)
DARKES FOREST
PRINCES
0
1
Kilometres
METROPOLITAN COAL
FIGURE 8
Meteorological Monitoring Sites
METROPOLITAN COAL


LEGEND
Mining/Coal Lease Boundary
Gauging Station
Pool Water Level Monitoring Site
Source: Department of Lands NSW (2006)
Date of Aerial Photography 1988
N
WATERFALL
WORONORA RESERVOIR
WORONORA RESERVOIR
ML 1609
Woronora Dam Road
HEATHCOTE NATIONAL PARK
PRINCES HIGHWAY
PRINCES MOTORWAY
CCL 702
WaterNSW Gauging Station GS 2132101
Project Underground Mining Area Longwalls 20-27 and 301-317
Old Illawarra Road
RIVER
WORONORA
Honeysuckle Creek Gauging Station
ML 1609
GARAWARRA STATE CONSERVATION AREA
Ventilation Shaft No. 4
WRP4
WRP3
WRP2
WRP1
Underground Mining Area Longwalls 14-19A
WaterNSW Gauging Station GS 2132102
Eastern Tributary Gauging Station
HELENSBURGH
Rivulet
RTP1
RTP2
UTP1
UTP2
UTP3
Waratah
Darkes Forest Road
Ventilation Shaft No. 3
HIGHWAY
PRINCES MOTORWAY
Underground Mining Area Longwalls 1 - 13
CCL 702
ML 1610
DHARAWAL STATE CONSERVATION AREA
DARKES FOREST
STANWELL TOPS
PRINCES
0
1
Kilometres
METROPOLITAN COAL
FIGURE 9
Surface Water Quantity Monitoring Sites
METROPOLITAN COAL


LEGEND
Mining/Coal Lease Boundary
Surface Water Quality Monitoring Site
Source: Department of Lands NSW (2006)
Date of Aerial Photography 1988
N
WORONORA RESERVOIR
WORONORA RESERVOIR
WATERFALL
BCWQ 1
WOWQ 2
Project Underground Mining Area Longwalls 20-27 and 301-317
ML 1702
Dam
HEATHCOTE NATIONAL PARK
Old Illawarra Road
PRINCES HIGHWAY
CCL 703
PRINCES MOTORWAY
RIVER
WORONORA
GARAWARRA STATE CONSERVATION AREA
HCWQ 1
ML 1577
Ventilation Shaft No. 4
WOWQ 6
WOWQ 5
WOWQ 4
WOWQ 3
WOWQ 1
Underground Mining Area Longwalls 14-19A
HELENSBURGH
RTWQ 2
RTWQ 3
RTWQ 1
UTWQ 2
UTWQ 1
UTWQ 4
UTWQ 3
UTWQ 5
FGWQ 3
FGWQ 2
FGWQ 1
FGWQ 5
FGWQ 4
WRWQ 1
WRWQ 2
WRWQ 3
WRWQ 4
WRWQ 5
WRWQ 6
WRWQ 7
WRWQ 8
WRWQ 9
WRWQ J
WRWQ K
WRWQ L
WRWQ M
WRWQ N
WRWQ O
WRWQ P
WRWQ R
WRWQ S
WRWQ T
WRWQ U
WRWQ V
WRWQ W
ETWQ AU
ETWQ AQ
ETWQ AR
ETWQ AI
ETWQ AH
ETWQ AG
ETWQ AF
ETWQ W
FEWQ 1
ETWQ U
ETWQ N
ETWQ J
ETWQ F
Ventilation Shaft No. 3
Forest Road
Darkes
Warragan
HIGHWAY
PRINCES MOTORWAY
Underground Mining Area Longwalls 1 - 13
CCL 703
ML 1610
DHARAWAL STATE CONSERVATION AREA
DARKES FOREST
STANWELL TOPS
PRINCES
0
1
Kilometres
METROPOLITAN COAL
FIGURE 10
Surface Water Quality Monitoring Sites
METROPOLITAN COAL

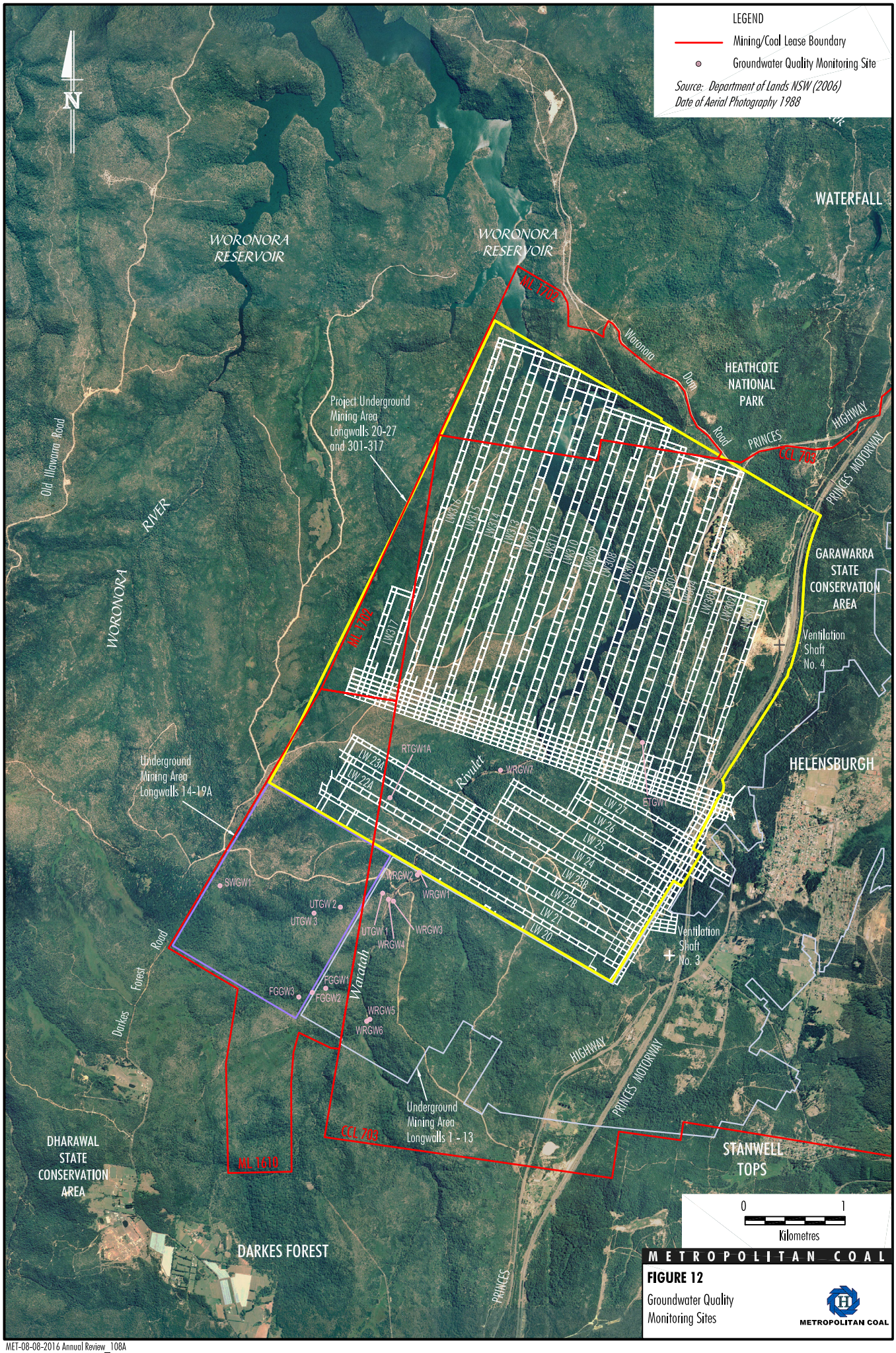



METROPOLITAN COAL

**FIGURE 11**

Groundwater Level Monitoring Sites

METROPOLITAN COAL

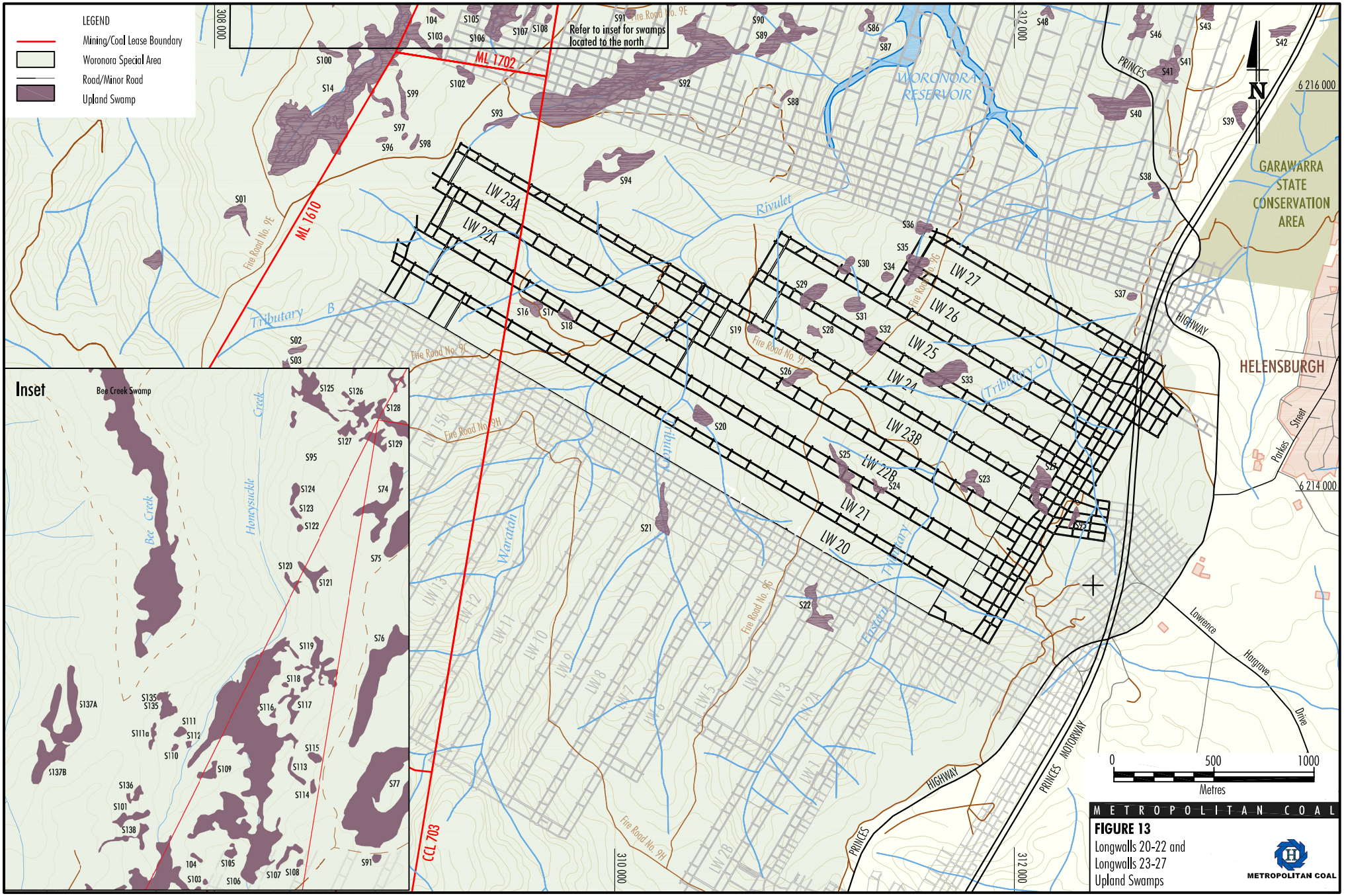


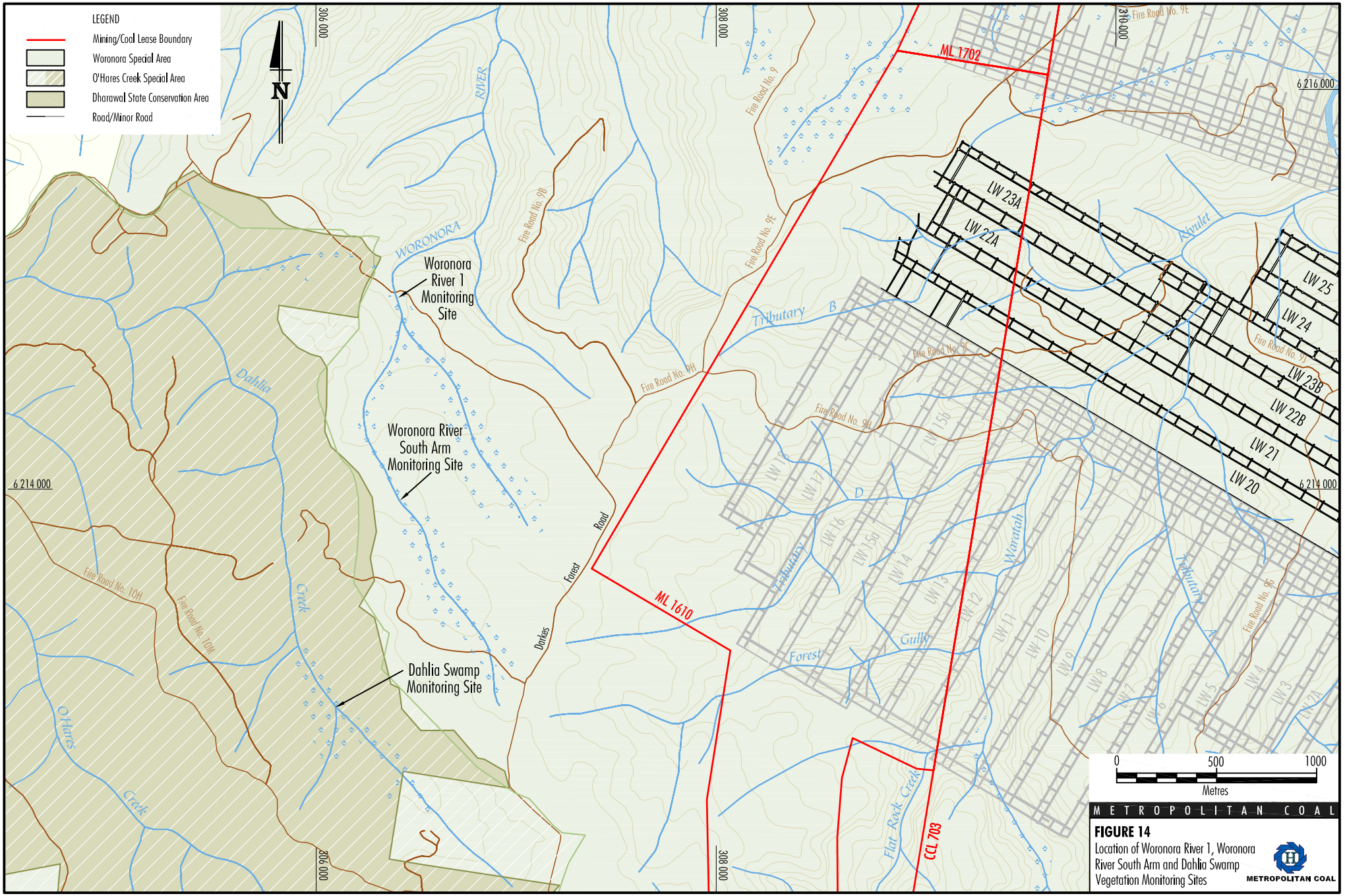

METROPOLITAN COAL

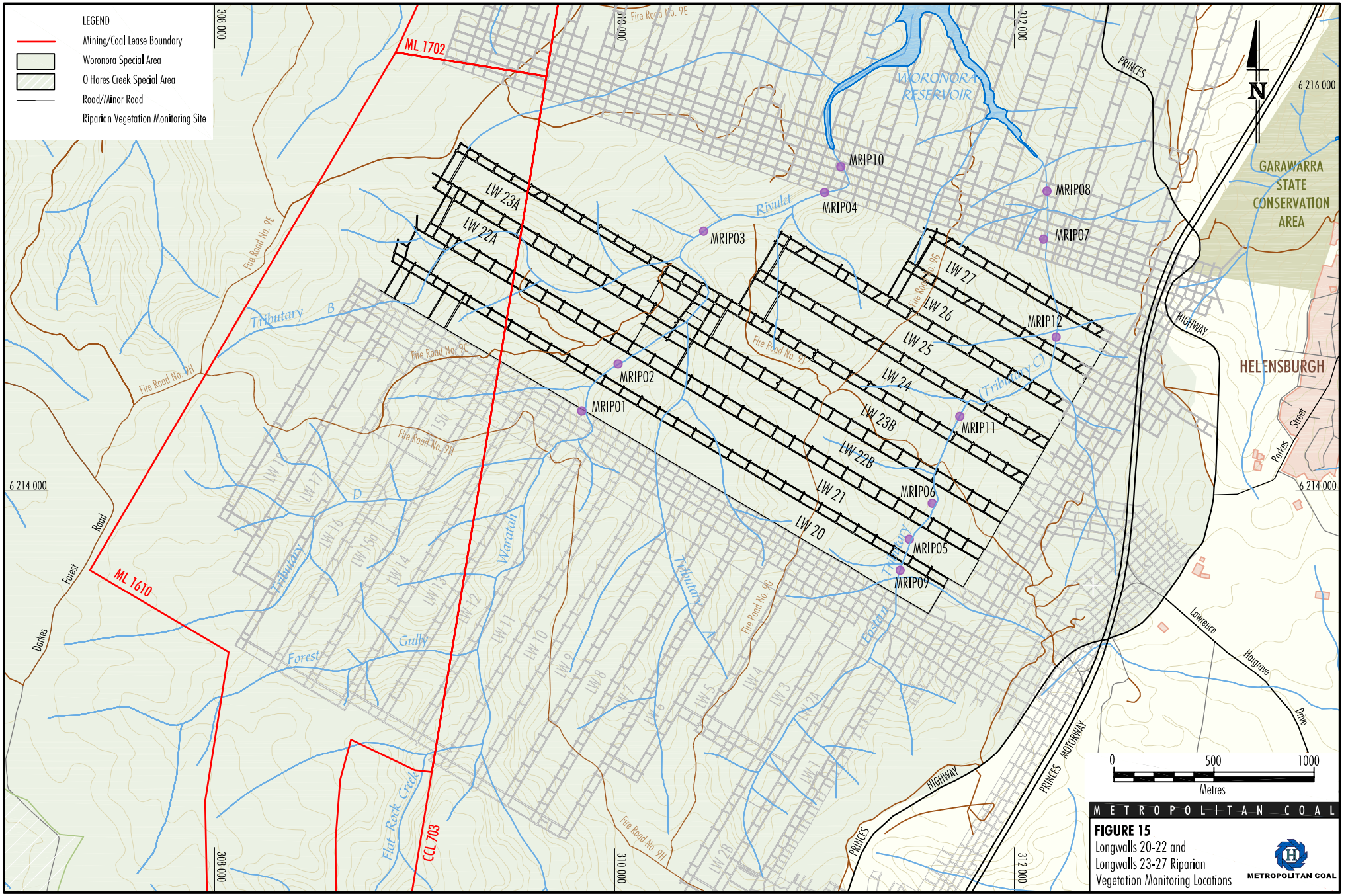
**FIGURE 12**

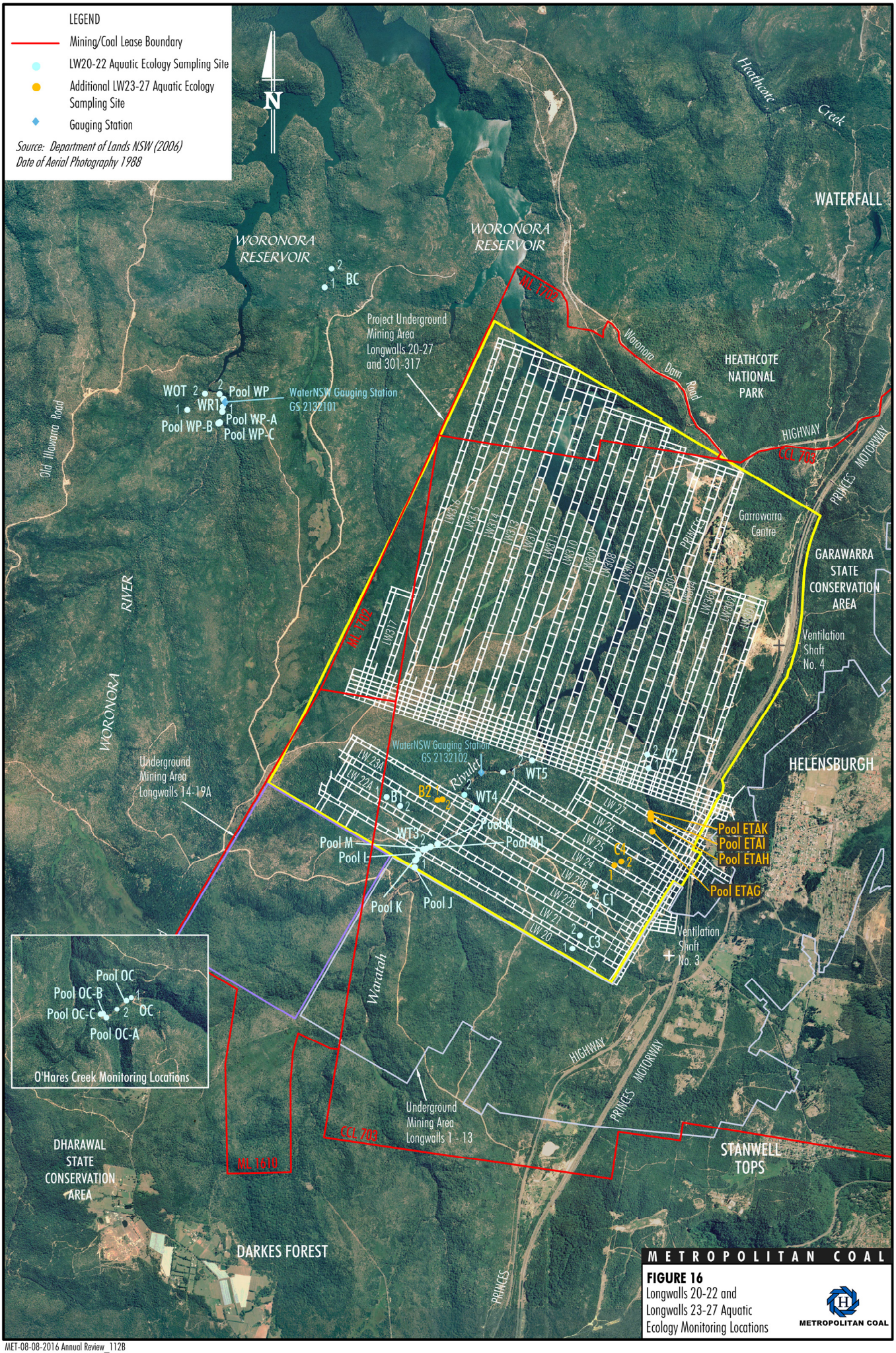
Groundwater Quality Monitoring Sites

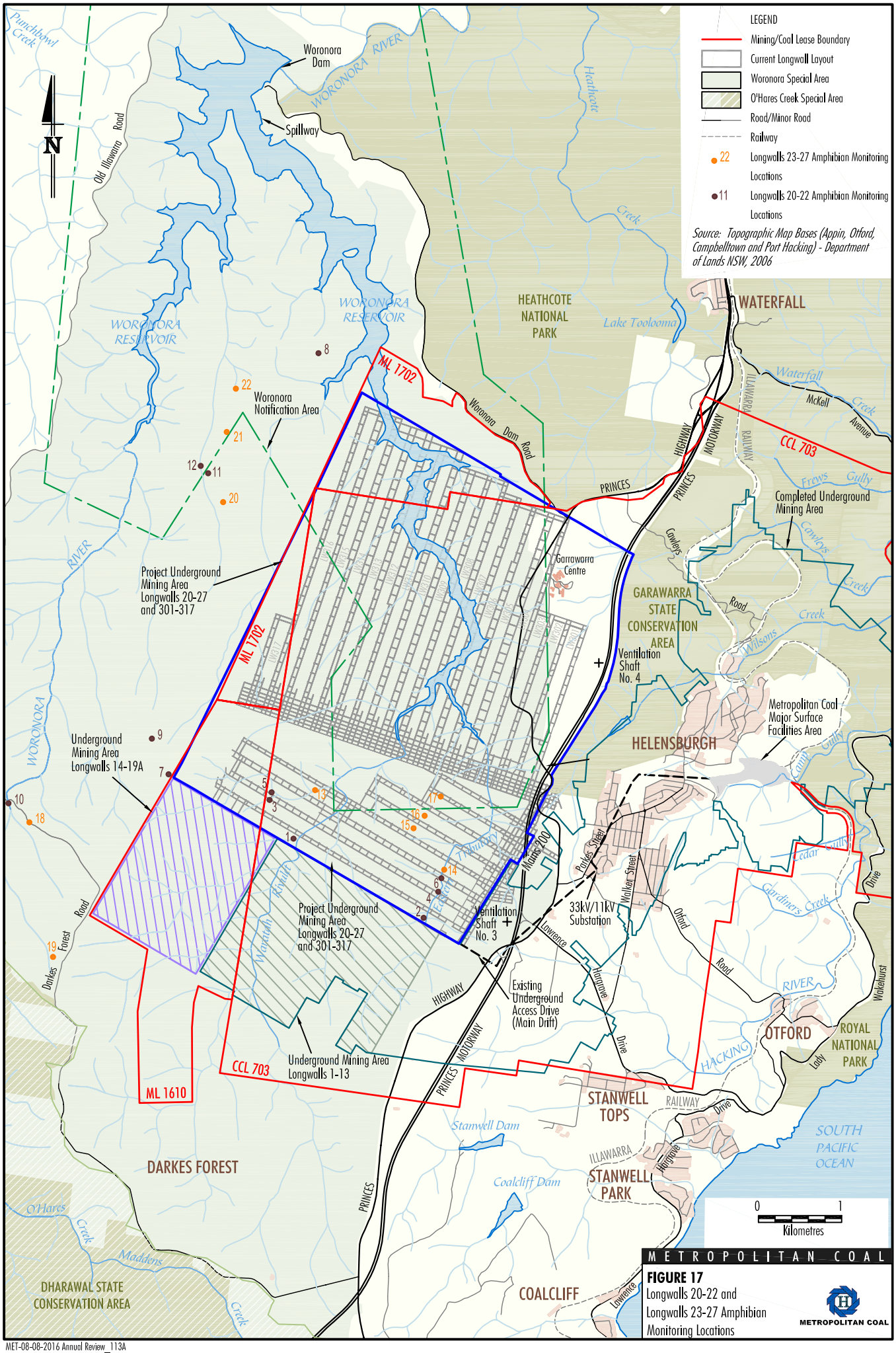
METROPOLITAN COAL


LEGEND
Mining/Coal Lease Boundary
Woronora Special Area
Road/Minor Road
Upland Swamp
Inset
Bee Creek Swamp
Refer to inset for swamps located to the north
ML 1702
ML 1610
CCL 703
LW 23A
LW 22A
LW 27
LW 26
LW 25
LW 24
LW 23B
LW 22B
LW 21
LW 20
Rivulet
Tributary B
Tributary C
Waratah Tributary
Eastern Tributary
Bee Creek
Honeysuckle Creek
WORONORA RESERVOIR
GARAWARRA STATE CONSERVATION AREA
HELENSBURGH
PRINCES HIGHWAY
PRINCES MOTORWAY
Parkes Street
Lawrence Hargrove Drive
Fire Road No. 9E
Fire Road No. 9C
Fire Road No. 9H
Fire Road No. 9J
Fire Road No. 9G
Fire Road No. 9B
308 000
312 000
310 000
6 216 000
6 214 000
N
0
500
1000
Metres
METROPOLITAN COAL
FIGURE 13
Longwalls 20-22 and
Longwalls 23-27
Upland Swamps
METROPOLITAN COAL


LEGEND
Mining/Coal Lease Boundary
Woronora Special Area
O'Hares Creek Special Area
Dharawal State Conservation Area
Road/Minor Road
N
306 000
308 000
310 000
6 216 000
6 214 000
806 000
ML 1702
ML 1610
CCL 703
WORONORA RIVER
Woronora River 1 Monitoring Site
Woronora River South Arm Monitoring Site
Dahlia Swamp Monitoring Site
Fire Road No. 9
Fire Road No. 9B
Fire Road No. 9E
Fire Road No. 9H
Fire Road No. 9K
Fire Road No. 9L
Fire Road No. 9J
Fire Road No. 9G
Fire Road No. 10H
Fire Road No. 10M
Tributary B
Tributary D
Tributary A
Dahlia Creek
O'Hares Creek
Forest Road
Darkes Forest
Waratah Gully
Flat Rock Creek
Aqueduct
LW 23A
LW 22A
LW 25
LW 24
LW 23B
LW 22B
LW 21
LW 20
LW 15b
LW 17
LW 16
LW 15a
LW 14
LW 13
LW 12
LW 11
LW 10
LW 9
LW 8
LW 7
LW 6
LW 5
LW 4
LW 3
LW 2A
0
500
1000
Metres
METROPOLITAN COAL
FIGURE 14
Location of Woronora River 1, Woronora River South Arm and Dahlia Swamp Vegetation Monitoring Sites
METROPOLITAN COAL


LEGEND
Mining/Coal Lease Boundary
Woronora Special Area
O'Hares Creek Special Area
Road/Minor Road
Riparian Vegetation Monitoring Site
ML 1702
ML 1610
CCL 703
308 000
310 000
312 000
6 214 000
6 216 000
N
WORONORA RESERVOIR
GARAWARRA STATE CONSERVATION AREA
HELENSBURGH
PRINCES HIGHWAY
PRINCES MOTORWAY
Parkes Street
Lawrence Hargrave Drive
Darkes Forest Road
Rivulet
Tributary B
Tributary C
Tributary D
Tributary A
Eastern Tributary
Waratah Gully
Flat Rock Creek
Forest
Fire Road No. 9E
Fire Road No. 9H
Fire Road No. 9K
Fire Road No. 9J
Fire Road No. 9L
Fire Road No. 9G
MRIP01
MRIP02
MRIP03
MRIP04
MRIP05
MRIP06
MRIP07
MRIP08
MRIP09
MRIP10
MRIP11
MRIP12
LW 20
LW 21
LW 22A
LW 22B
LW 23A
LW 23B
LW 24
LW 25
LW 26
LW 27
0
500
1000
Metres
METROPOLITAN COAL
FIGURE 15
Longwalls 20-22 and
Longwalls 23-27 Riparian
Vegetation Monitoring Locations
METROPOLITAN COAL

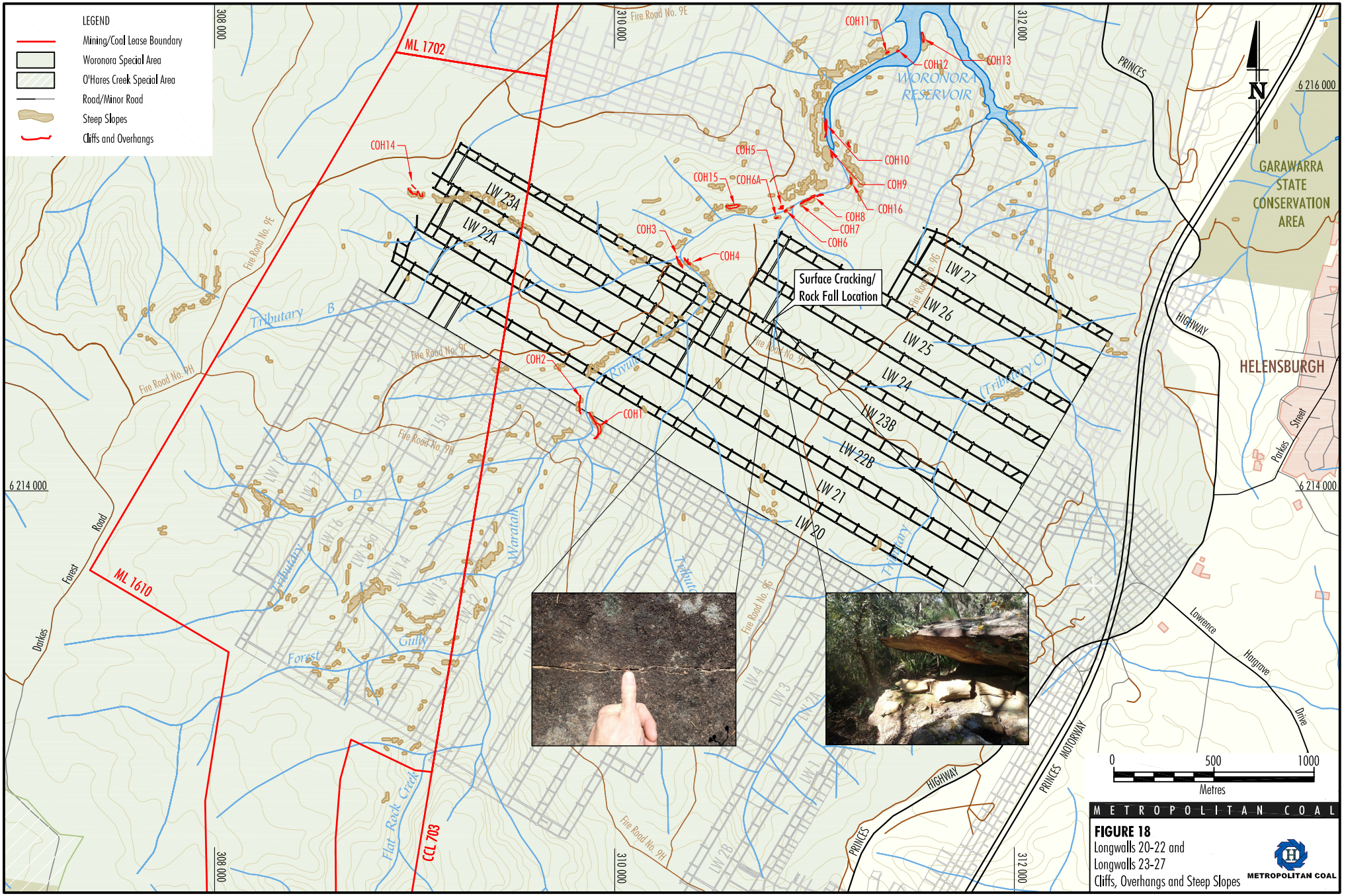

LEGEND
Mining/Coal Lease Boundary
LW20-22 Aquatic Ecology Sampling Site
Additional LW23-27 Aquatic Ecology Sampling Site
Gauging Station
Source: Department of Lands NSW (2006)
Date of Aerial Photography 1988
N
WORONORA RESERVOIR
WORONORA RESERVOIR
Heathcote Creek
WATERFALL
BC
ML 1610
Project Underground Mining Area Longwalls 20-27 and 301-317
Woronora Dam Road
HEATHCOTE NATIONAL PARK
HIGHWAY
SCC 709
PRINCES MOTORWAY
WOT
WR1
Pool WP
WaterNSW Gauging Station GS 2132101
Pool WP-B
Pool WP-A
Pool WP-C
Old Illawarra Road
Garrawarra Centre
GARAWARRA STATE CONSERVATION AREA
Ventilation Shaft No. 4
WORONORA RIVER
Underground Mining Area Longwalls 14-19A
WaterNSW Gauging Station GS 2132102
Rivulet
WT5
WT4
WT3
B1
B2
HELENSBURGH
Pool M
Pool L
Pool M1
Pool K
Pool J
Pool ETAK
Pool ETAI
Pool ETAH
Pool ETAG
C1
C2
C3
C4
Ventilation Shaft No. 3
Waratah
Pool OC
Pool OC-B
Pool OC-C
Pool OC-A
OC
O'Hares Creek Monitoring Locations
Underground Mining Area Longwalls 1 - 13
DHARAWAL STATE CONSERVATION AREA
ML 1610
STANWELL TOPS
DARKES FOREST
METROPOLITAN COAL
FIGURE 16
Longwalls 20-22 and Longwalls 23-27 Aquatic Ecology Monitoring Locations
METROPOLITAN COAL




METROPOLITAN COAL

**FIGURE 17**
Longwalls 20-22 and Longwalls 23-27 Amphibian Monitoring Locations

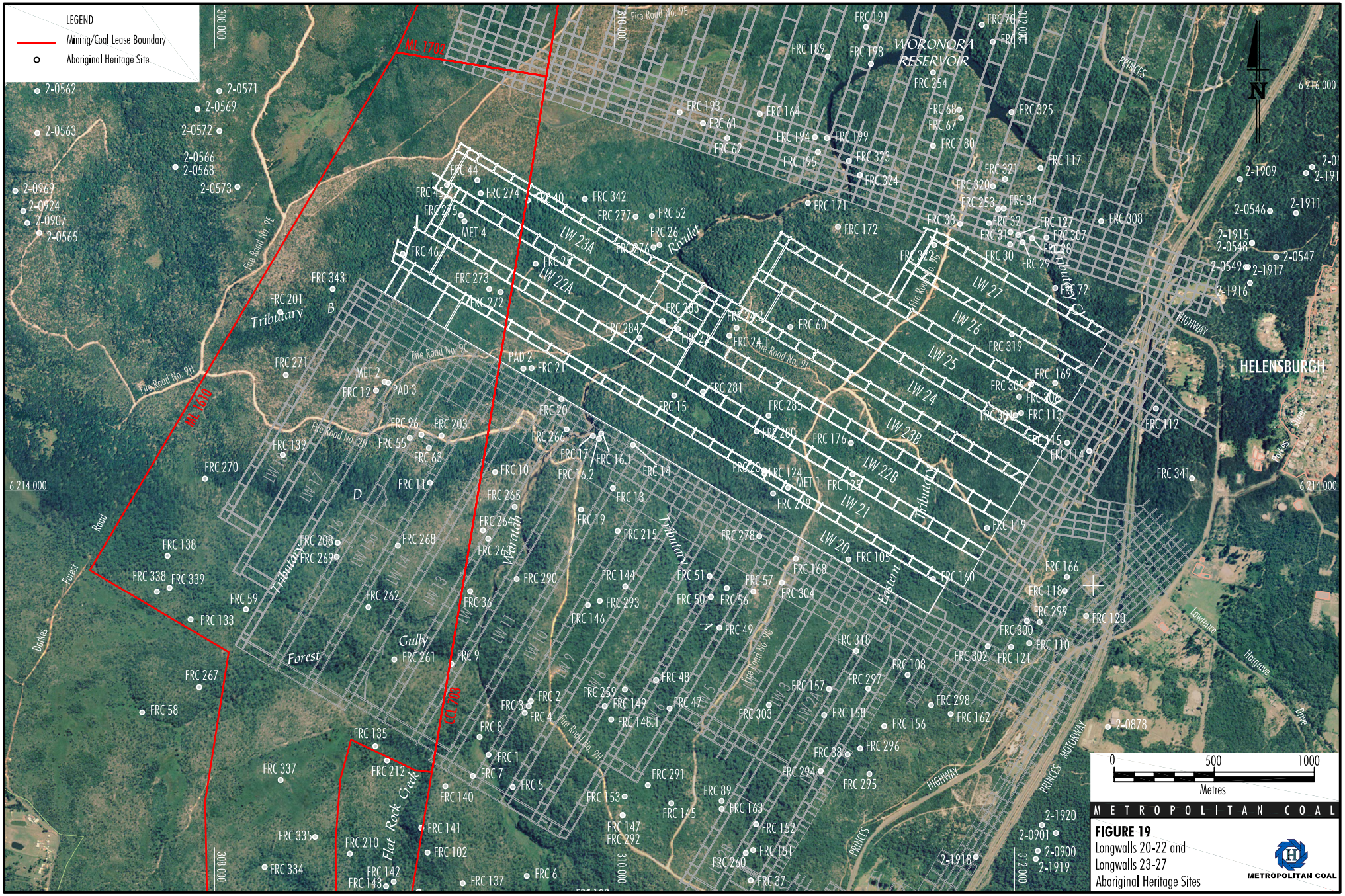
METROPOLITAN COAL




METROPOLITAN COAL

**FIGURE 18**
Longwalls 20-22 and
Longwalls 23-27
Cliffs, Overhangs and Steep Slopes

METROPOLITAN COAL


LEGEND
Mining/Coal Lease Boundary
Aboriginal Heritage Site
ML 1709
ML 1610
WORONORA RESERVOIR
HELENSBURGH
Rivulet
Tributary
Gully
Forest
Flat Rock Creek
Fire Road No. 9E
Fire Road No. 9C
Fire Road No. 9H
Fire Road No. 9I
Fire Road No. 9A
LW 23A
LW 22A
LW 27
LW 26
LW 25
LW 24
LW 23B
LW 22B
LW 21
LW 20
LW 17
LW 16
LW 15
LW 14
LW 13
LW 12
LW 11
LW 10
LW 9
LW 8
LW 7
LW 6
LW 5
LW 3
LW 2A
Western
Darkes Forest Road
Princes Motorway
Princes Highway
Lawrence Hargrave Drive
6 216 000
6 214 000
308 000
310 000
312 000
N
0
500
1000
Metres
METROPOLITAN COAL
FIGURE 19
Longwalls 20-22 and Longwalls 23-27
Aboriginal Heritage Sites
METROPOLITAN COAL

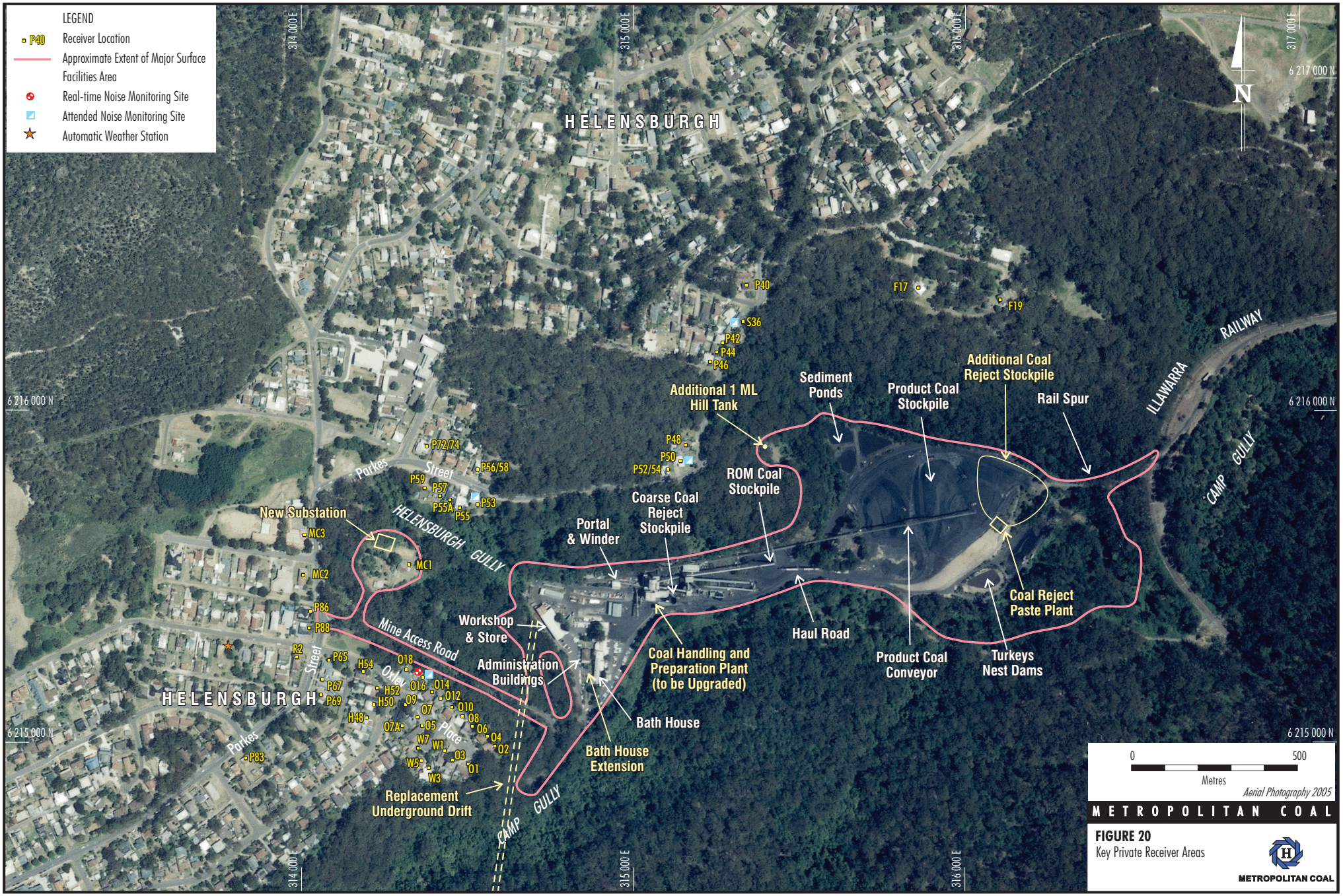
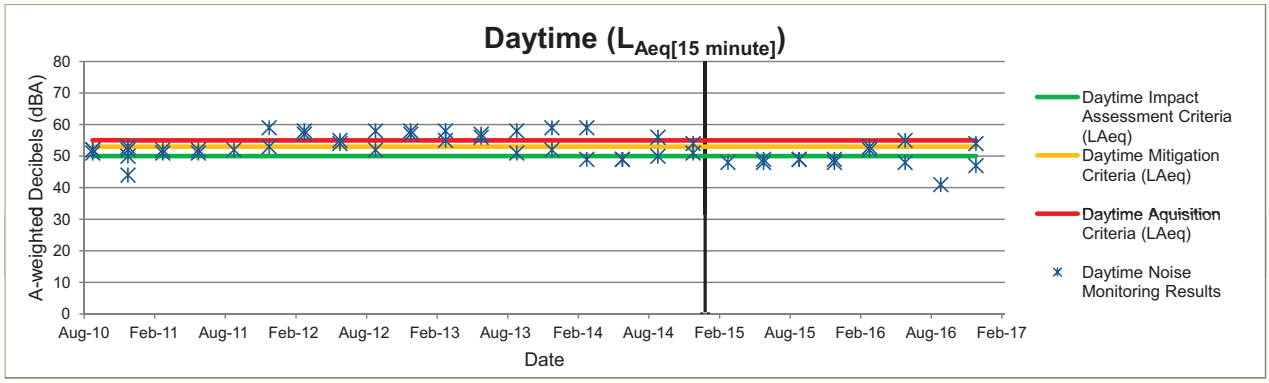
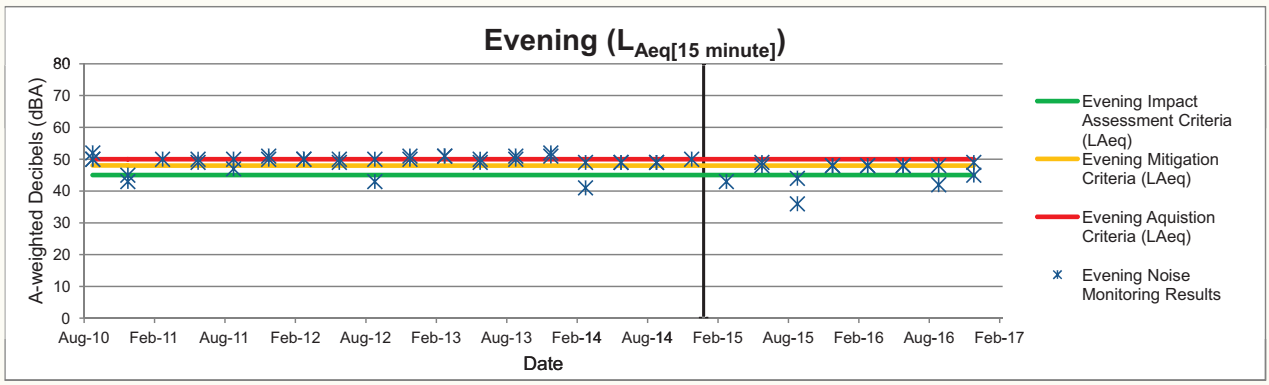


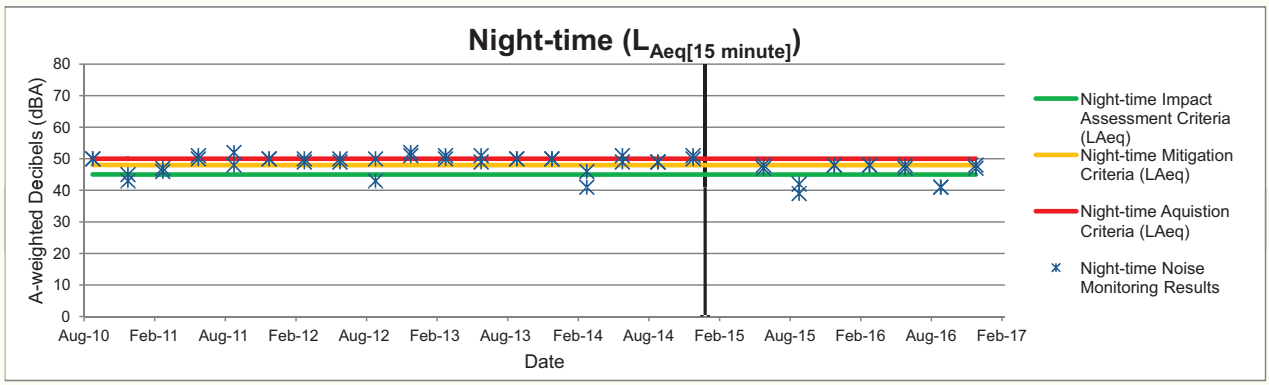

**FIGURE 20**
Key Private Receiver Areas

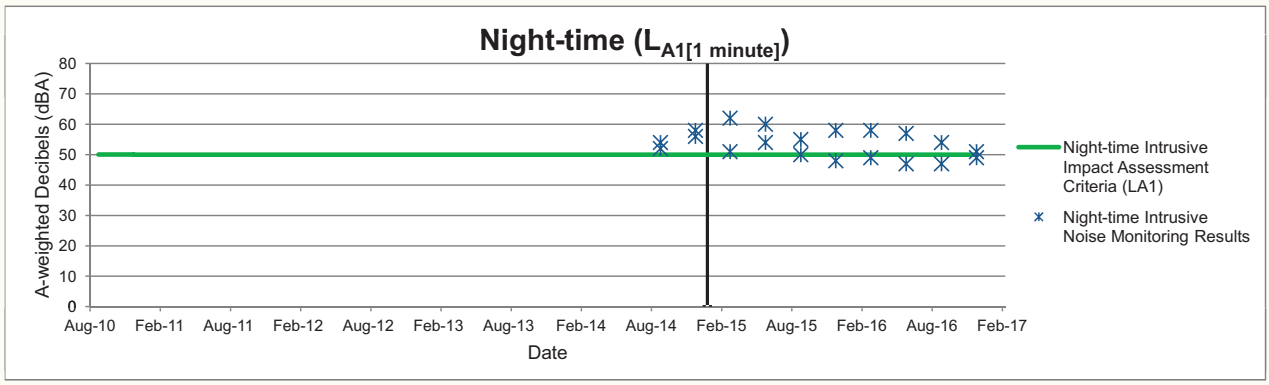
METROPOLITAN COAL

MET-08-08-2016 Annual Review_004A



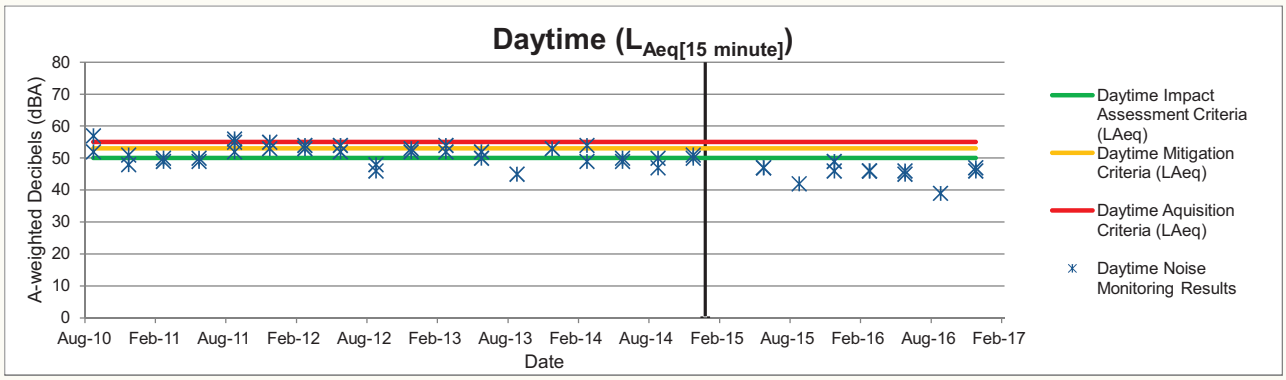



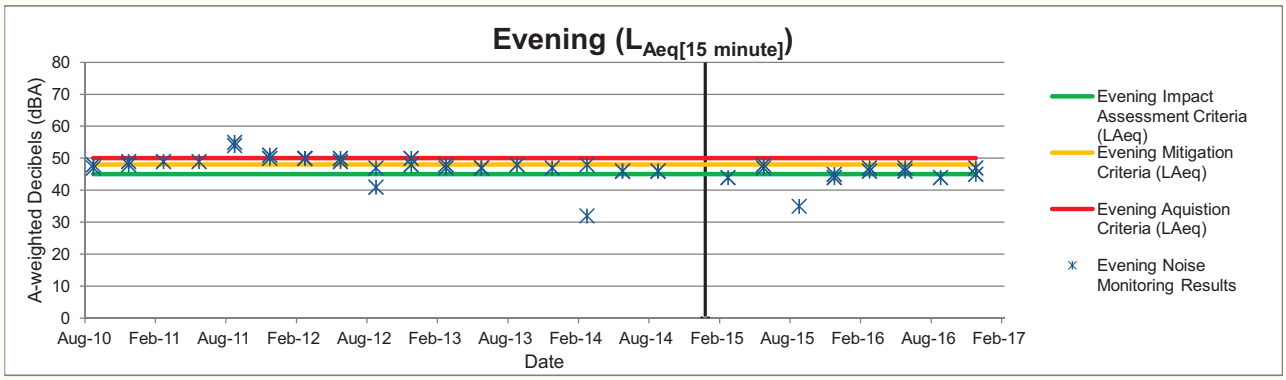

*Note 1: In accordance with Conditions 1, 2 and 3, Schedule 4 of the Project Approval, the assessment, acquisition and mitigation criteria are only applicable from the end of 2014.*

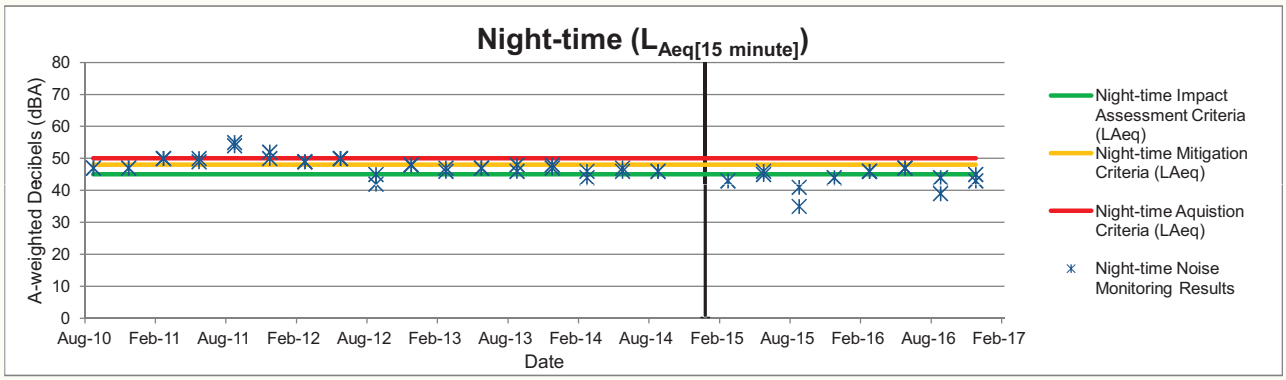
METROPOLITAN COAL

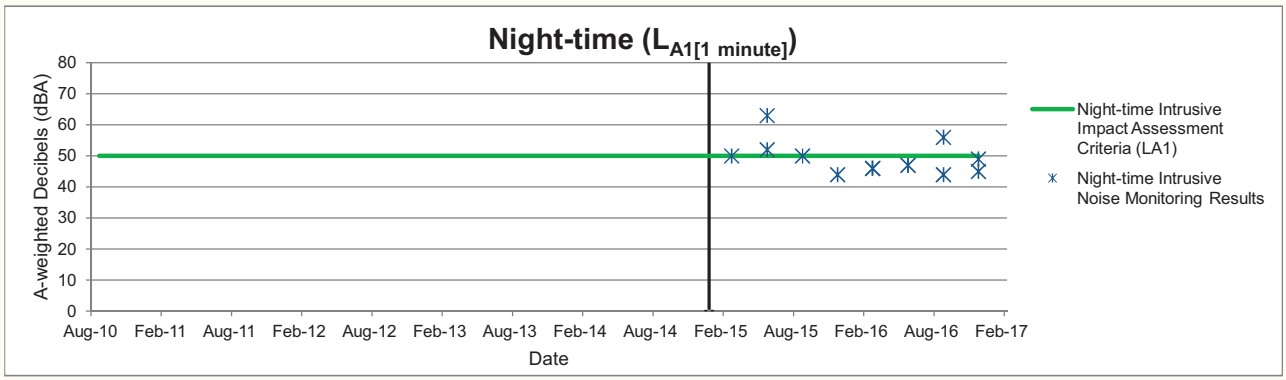
**FIGURE 21a**
Quaterly Opertor Attended Noise Monitoring at 16 Oxley Place (September 2010 to December 2016)

METROPOLITAN COAL



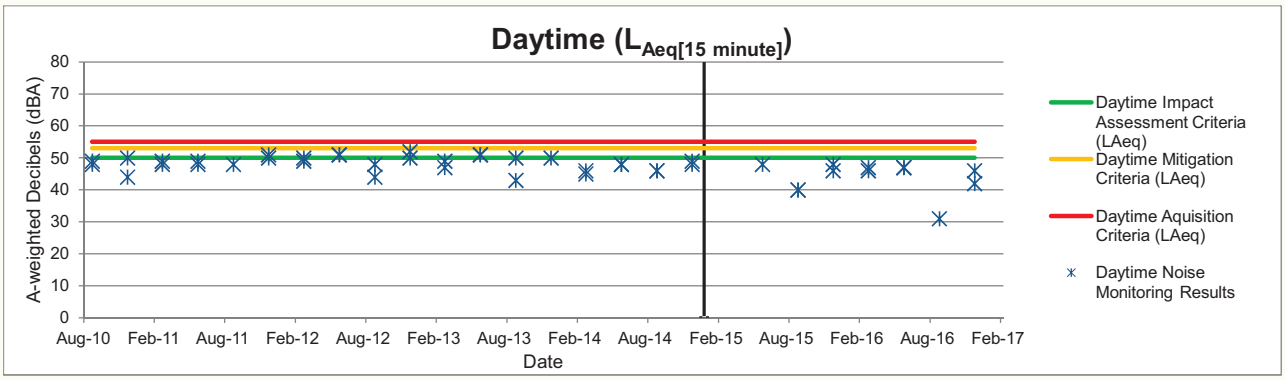



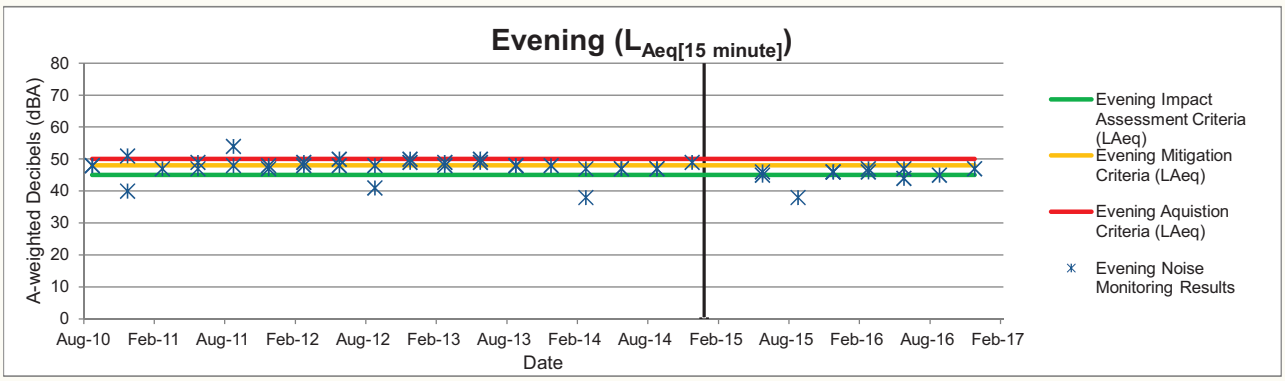

*Note 1: In accordance with Conditions 1, 2 and 3, Schedule 4 of the Project Approval, the assessment, acquisition and mitigation criteria are only applicable from the end of 2014.*

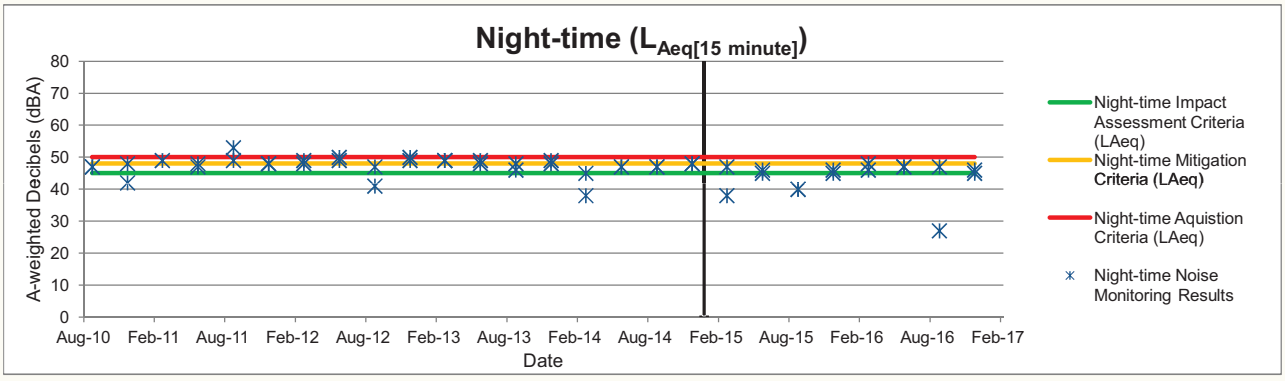
METROPOLITAN COAL

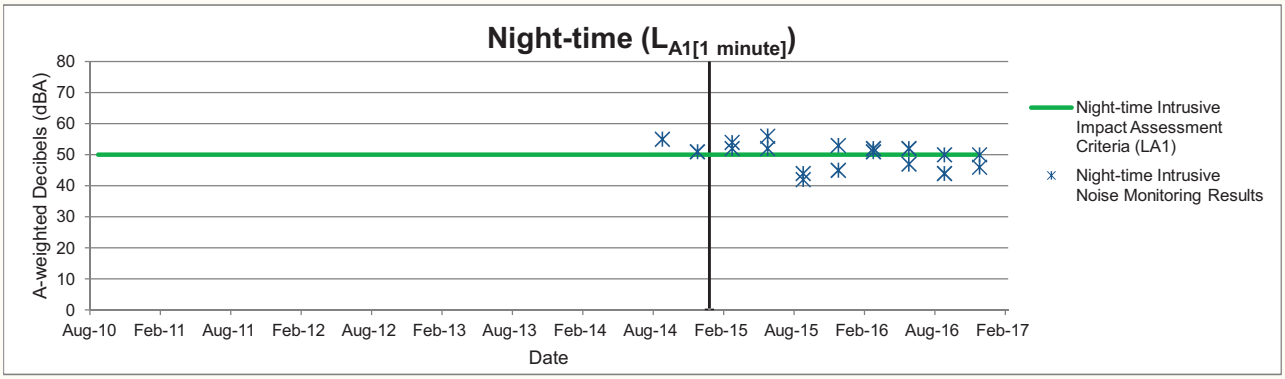
**FIGURE 21b**
Quaterly Opertor Attended Noise Monitoring at 53 Parkes Street (September 2010 to December 2016)

METROPOLITAN COAL



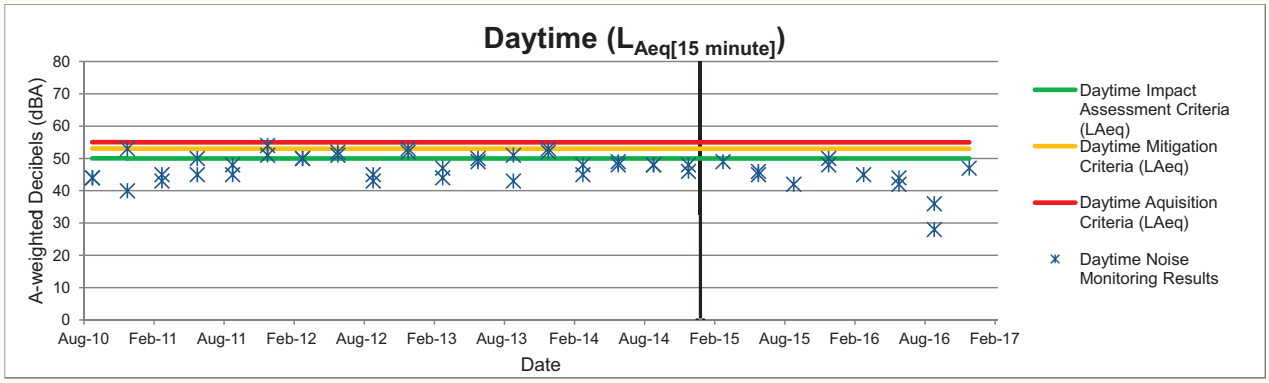



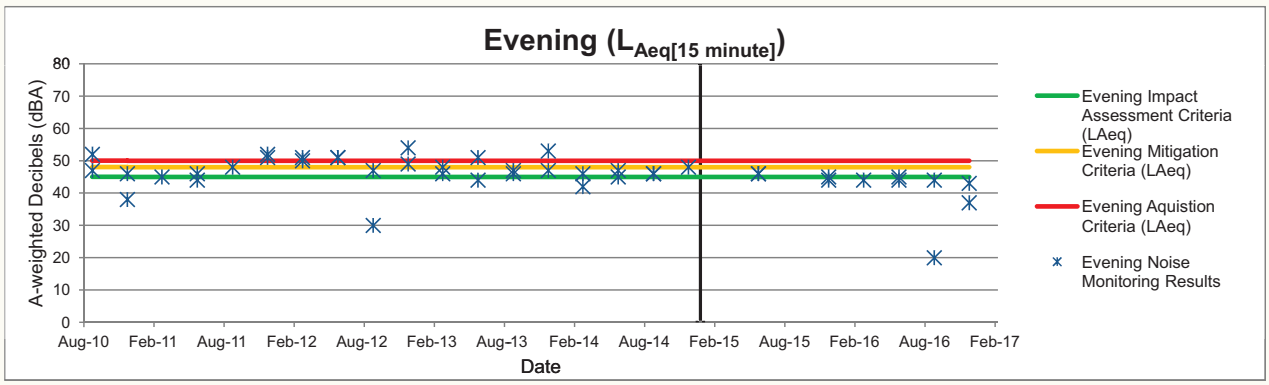

*Note 1: In accordance with Conditions 1, 2 and 3, Schedule 4 of the Project Approval, the assessment, acquisition and mitigation criteria are only applicable from the end of 2014.*

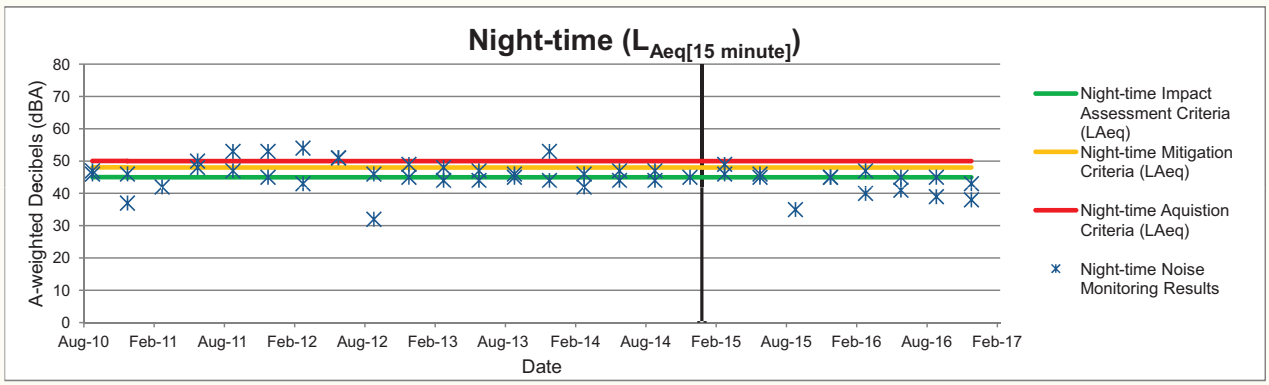
METROPOLITAN COAL

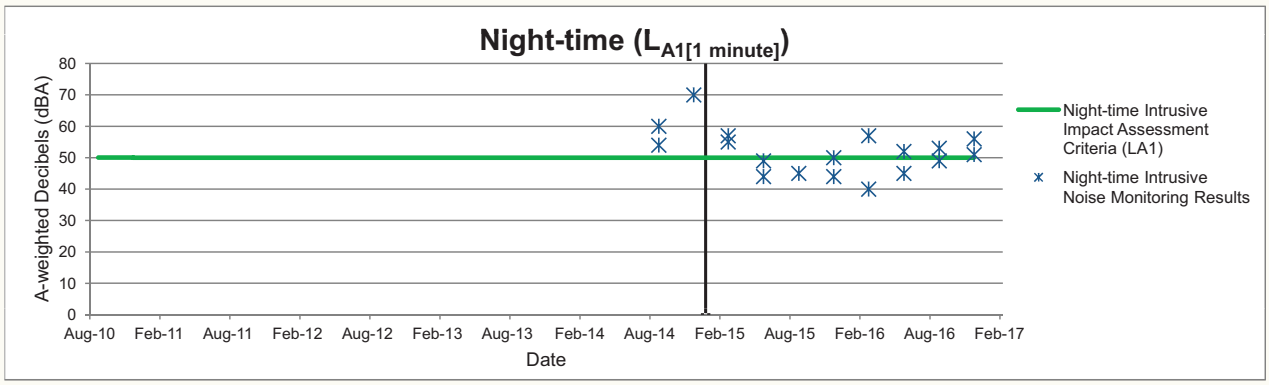
**FIGURE 21c**
Quaterly Opertor Attended Noise Monitoring at 50 Parkes Street (September 2010 to December 2016)

METROPOLITAN COAL




*Note 1: 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.*

METROPOLITAN COAL

**FIGURE 21d**
Quaterly Opertor Attended Noise Monitoring at 36 Old Station Road (September 2010 to December 2016)

METROPOLITAN COAL

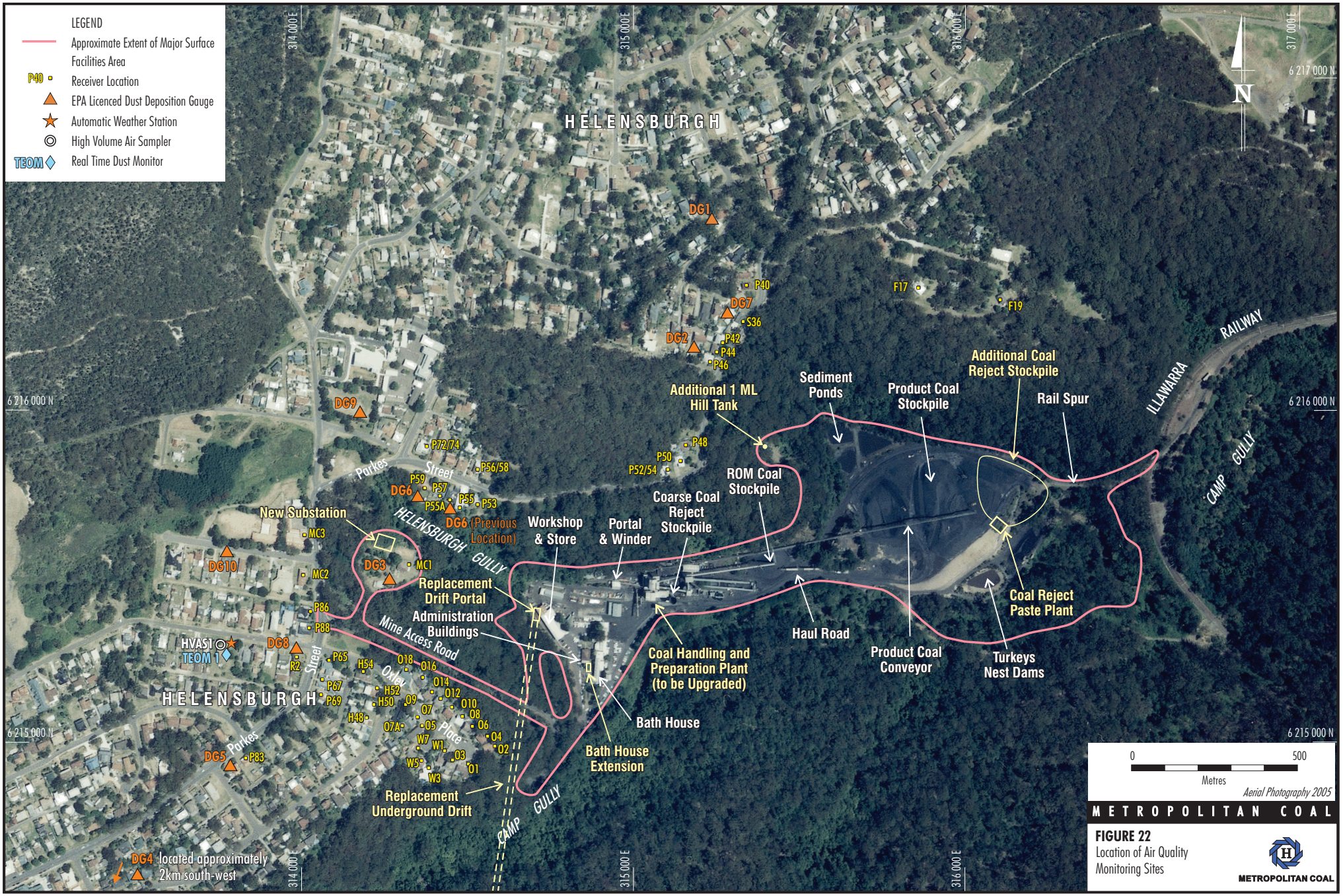



**FIGURE 22**
Location of Air Quality Monitoring Sites

METROPOLITAN COAL

MET-08-08-2016 Annual Review_005A

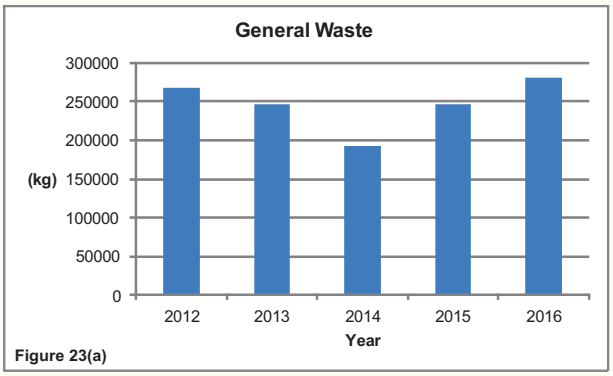


Figure 23(a)

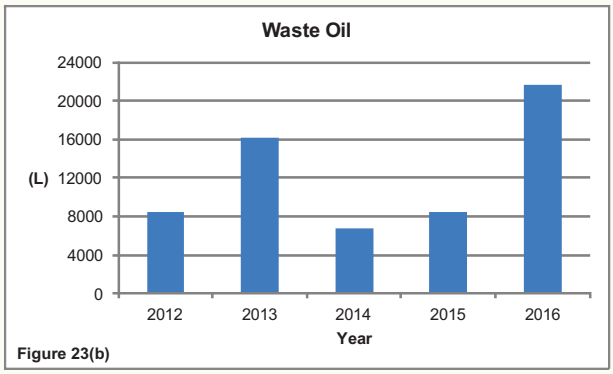


Figure 23(b)

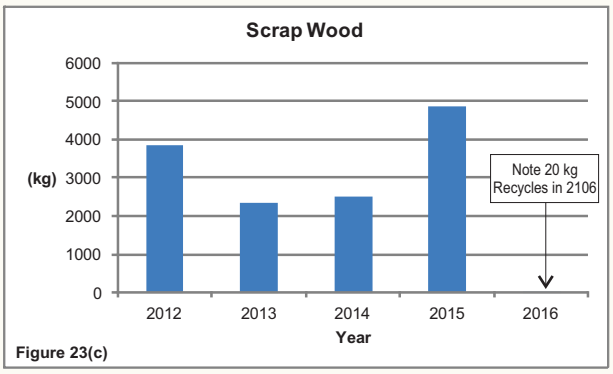


Figure 23(c)

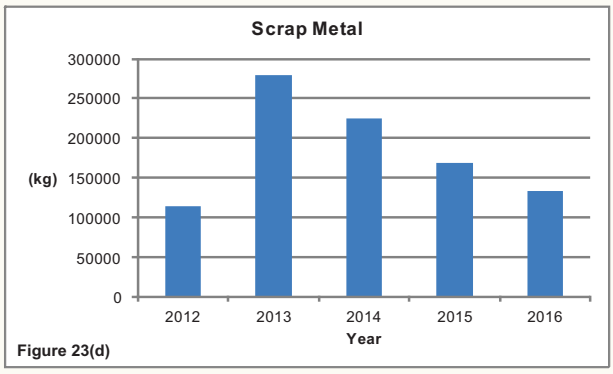


Figure 23(d)

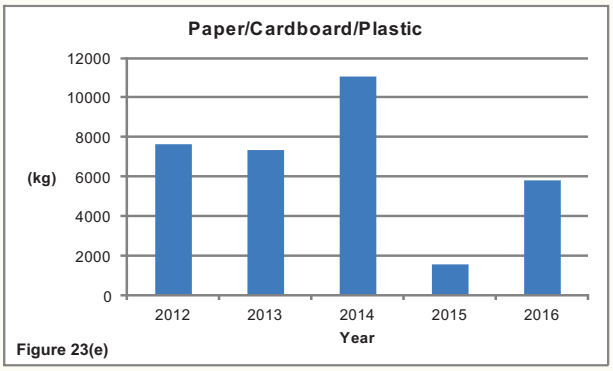


Figure 23(e)

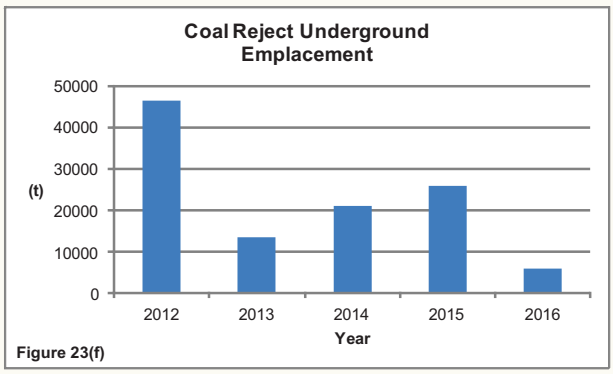


Figure 23(f)

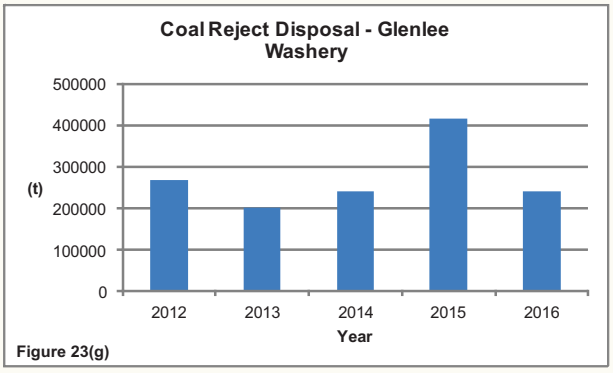


Figure 23(g)

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**FIGURE 23**

Comparison of Waste Generated and Recycled in 2016 with Previous Years

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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

0 50 100 150 200 250
Metres

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

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**FIGURE 24**
Metropolitan Coal's Water Sources and Key Infrastructure

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**FIGURE 25**
Rehabilitation Zones Currently Available at the Surface Facilities Area

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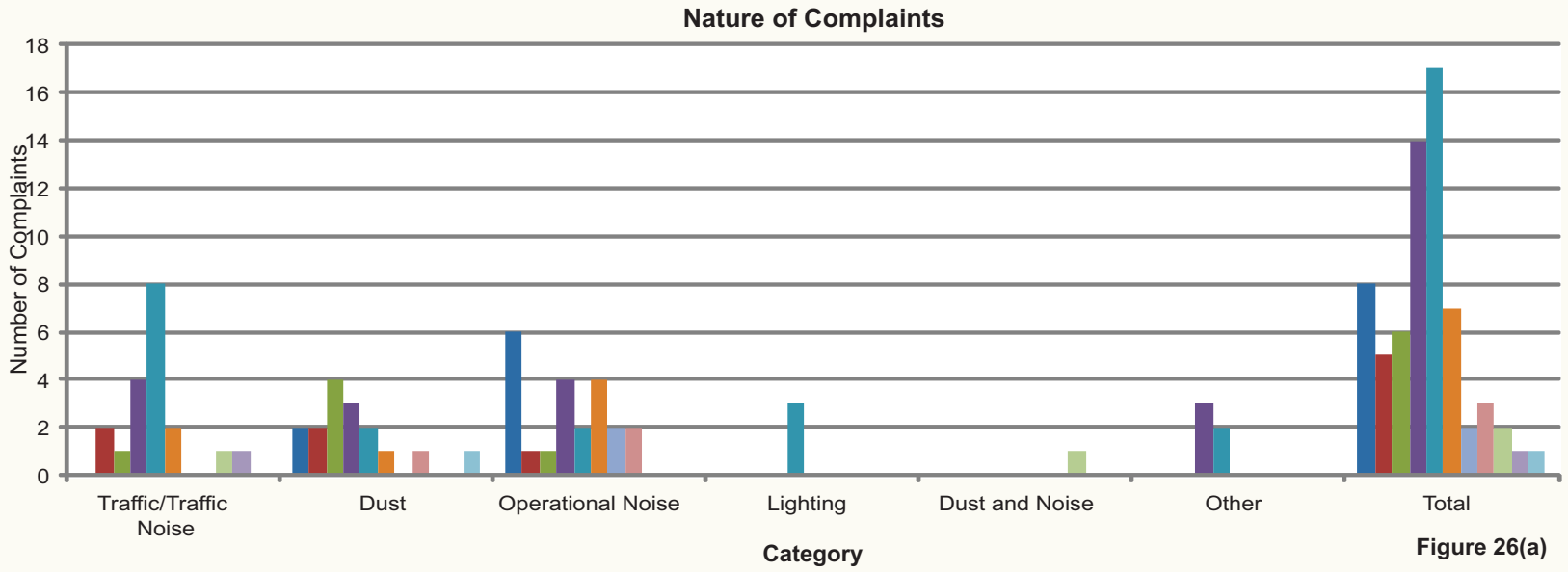


Figure 26(a)

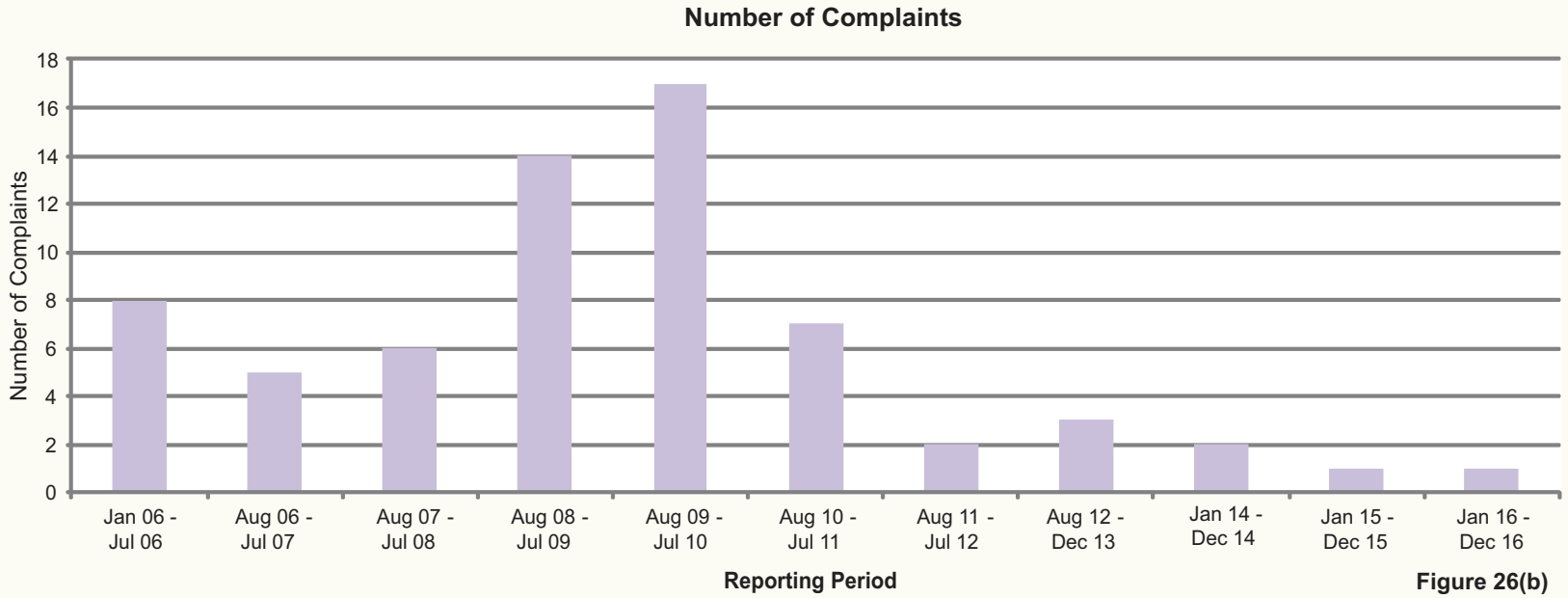


Figure 26(b)

METROPOLITAN COAL

**FIGURE 26**
Summary of Complaints Recorded, January 2006 to December 2016

METROPOLITAN COAL

# APPENDICES

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

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| APPENDIX C | METROPOLITAN COAL 2016 ANNUAL REVIEW GROUNDWATER MONITORING AND ENVIRONMENTAL PERFORMANCE ASSESSMENT |
| APPENDIX D | MAPPED POOL LOCATIONS ON THE WARATAH RIVULET, EASTERN TRIBUTARY, TRIBUTARY A AND TRIBUTARY B |
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| APPENDIX E2 | POOLS U AND W GAS RELEASES ASSESSMENT AGAINST SUBSIDENCE IMPACT PERFORMANCE MEASURE |
| APPENDIX F1 | PEER REVIEW OF POOL W GAS RELEASES ASSESSMENT |
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| APPENDIX G1 | INDEPENDENT PEER REVIEW OF ASSESSMENT AGAINST THE WATER QUALITY PERFORMANCE MEASURE (METROPOLITAN COAL 2015 ANNUAL REVIEW) |
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| | |
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