



Centennial Coal



Subsidence Management Status Report

Four Monthly Update

1st July 2016 to 31st October 2016

Clarence Colliery

29th November 2016

Approved:

Date:


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..29/11/2016.....



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ATTACHMENTS

Plan CL556 – Subsidence Monitoring and Current Workings at 31/10/2016.

Plan CL618 – Combined Surface Monitoring Points as at 31/10/2016.

1. Introduction

The following Subsidence Management Status Report (SMSR) complies with the provisions of:

- Condition 17 of the SMP Approval for 900 Area dated 21st January 2014 (due to expire on 31st January 2019);
- Condition 17 of the SMP Approval for 800 Area dated 1st November 2013 (due to expire on 31st October 2018); and
- Condition 17 of the SMP Approval for 700 West (700W) dated 18th June 2012 (due to expire on 1st June 2017).

Reports continue to be sent every 4 months with data updated as results become available. The following SMP approvals have now expired:

- The Eastern Area SMP expired on 1st June 2013;
- The Outbye Area SMP expired on 1st May 2014;
- The 700 Area SMP expired on 1st May 2014; and
- The 314 and 316 Area SMP Expired on 1st February 2015.

This report covers the period from 1st July to 31st October 2016.

2. Face Position of Active Panels

Clarence Colliery worked within the 900 area and the 800 area during the reporting period with the following mining activities taking place:

- Development of the 808 panel continued throughout the reporting period;
- Extraction of the 812 Panel continued throughout the reporting period; ending on 17th August;
- Extraction of the 814 Panel continued throughout the reporting period, ending on 5th October;
- Development of the 911 panel continued throughout the reporting period;
- Development of the 912 panel continued throughout the reporting period;
- Development of the 806 panel commenced on 16th September and continued throughout the reporting period; and
- Development of the 816 panel was undertaken throughout the reporting period.

All panels as at 31st October 2016 are shown on Plan CL556 provided in **Attachment 1**.

3. Summary of Management Action Taken

Subsidence management actions taken during the reporting period included:

- Community Consultative Committee (CCC) meeting was held on 10th October 2016.

Dam Safety Committee

- Quarter 2 of the DSC report was completed and submitted. There were no mining activities within the Lithgow No.2 Dam Notification Area throughout the reporting period.
- Approval was granted by the DSC on 27th September 2016 to cease all monitoring and quarterly reporting as required under the conditions of Clarence 1, 2, and 3. It is noted that Clarence-1 expired 30th December 2014, and Clarence-2 and Clarence-3 both expired on 30th June 2016 and are no longer current.
- Resurvey of the rock marks around Lithgow No.2 Dam were due during July, however given the extended wet winter, approval from DSC was procured on 29th July to not complete this monitoring.
- Resurvey of the Lithgow No.2 Dam wall was completed on 27th July 2016. There were no significant changes observed in the condition of the dam wall.
- The 700A, 700B and 707 lines were resurveyed in June in line with the DSC requirements.

Environmental and Subsidence Monitoring

- Two-monthly downloads of multi-level groundwater piezometers continued (CLRP1, CLRP2, CLRP3, CLRP6, CC114, CC115, CLRP11, CLRP12, CLRP13, CLRP14, CLRP15 and CLRP16, CLRP17, CLRP18, CLRP19, CLRP22) and open hole piezometers (CLRP4, CLRP5, CLRP7, CLRP8, CLRP10 and CC113) during July and September 2016;
- Ongoing flora and fauna monitoring (fieldwork for Spring 2016 is currently underway at the time of writing this report);
- Surface subsidence management inspections;
- Ongoing underground mining system audits (in-panel and end of panel where access permits);

There were no other requests to modify subsidence or environmental monitoring programs during the reporting period. It is noted that the 800 Area Subsidence Monitoring Program (submitted during the previous reporting period) is still with the DRE being assessed.

A variation to the 900 Subsidence Monitoring Program was submitted to the Department on 28th October 2016 to update the proposed monitoring installations in light of a recent SMP variation (see below).

SMP Approvals Varied or Expired

The 900 SMP Approval was varied to modify the orientation of panels in the west of the SMP Area. Panels were reoriented from an east-west orientation to a north-south orientation (specifically, panels 911, 913, 915 and 917). The Approval was received on 7th June 2016.

A variation to the 900 Subsidence Monitoring Program was submitted to the Department to ensure that the subsidence monitoring is appropriate for the north-south oriented 915 and 917 panels.

Other

The mid panel report for the 812 panel was completed and submitted on the 16th June 2016.

The mid panel report for the 814 panel was completed and submitted on the 1st September 2016.

At least two post extraction audits were undertaken for the 812 and 814 panels.

4. Consultation with Stakeholders

4.1 CCC Meeting

Clarence Colliery held its quarterly CCC meeting on 10th October 2016. Items discussed at the meeting relating to subsidence management included:

- Overview of current operations and performance;
- Mining activities;
- Rehabilitation and River Clean Up Monitoring; and
- Environmental performance.

The next CCC meeting is scheduled for January 2017.

5. Observed or Reported Subsidence Impacts

5.1 Incidents

There were no observed or reported incidents relating to subsidence impacts in the reporting period.

5.2 Service difficulties

There were no observed or reported service difficulties relating to subsidence impacts in the reporting period.

5.3 Community complaints

There were no reported community complaints relating to subsidence impacts in the reporting period.

5.4 Impacts Detected During Monitoring/Inspections

No adverse impacts were detected during monitoring or inspections.

6. Subsidence Monitoring

6.1 Monitoring Results and Trends

6.1.1 U Line

The resurvey of the U subsidence monitoring line was undertaken on 28th July 2016. Results from this survey are presented in **Figure 1**

The U Line overlies the 400 Area and lies over and adjacent to the gateroads associated with the older longwall panels (and panel 408).

Maximum subsidence recorded during this survey was 27mm. The surveyed levels that were measured were all in line with the previous survey, indicating that there has been little to no movement.

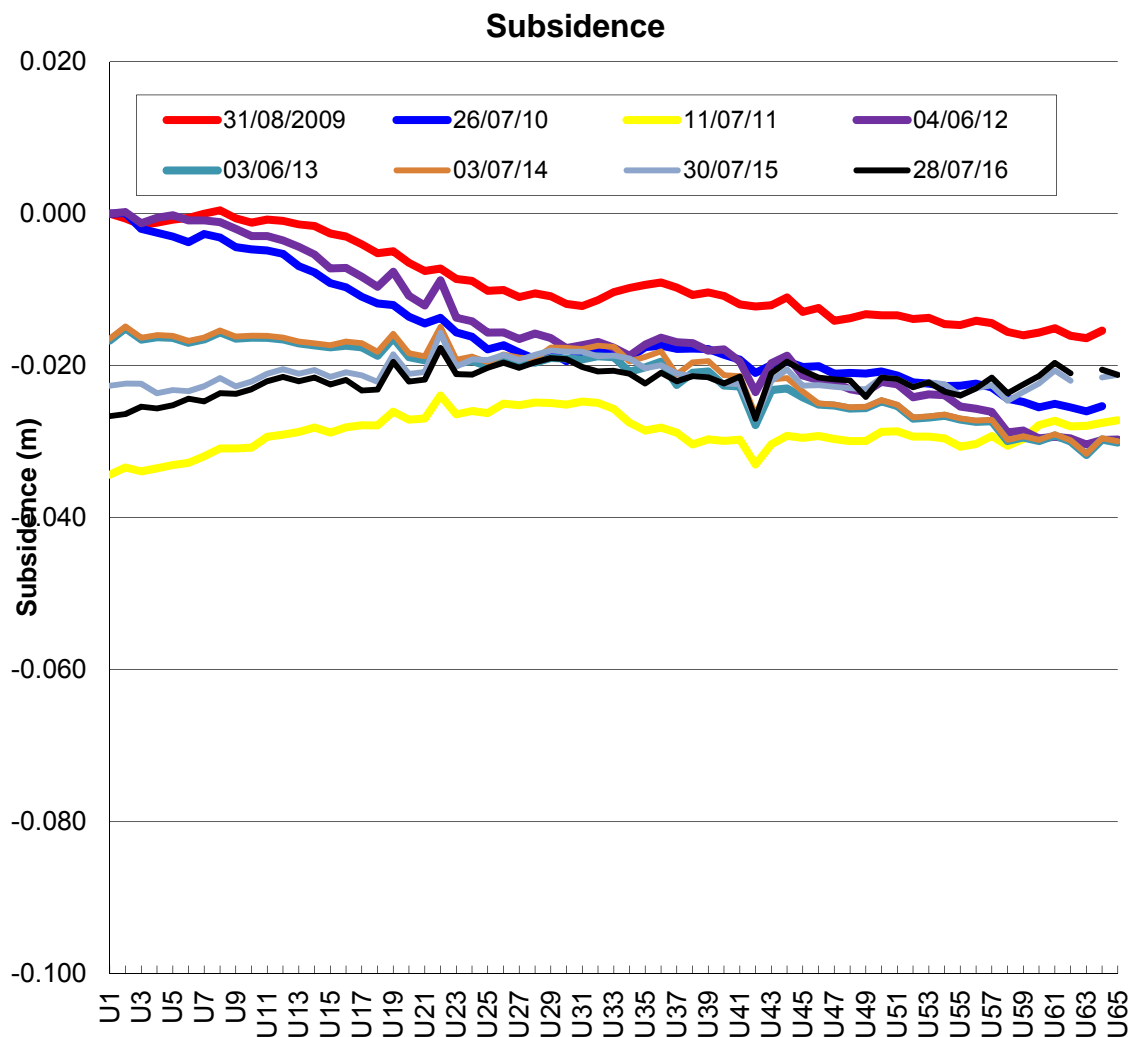


Figure 1. U Line Subsidence.

6.1.2 900A Line

The 900A Line was resurveyed on 15th August 2016. This survey was the annual survey of the 902 and 904 panels. Results from the survey of the 900A line are presented in **Figure 2**.

Results from the survey are very similar to the previous survey with a maximum subsidence of 33mm recorded.

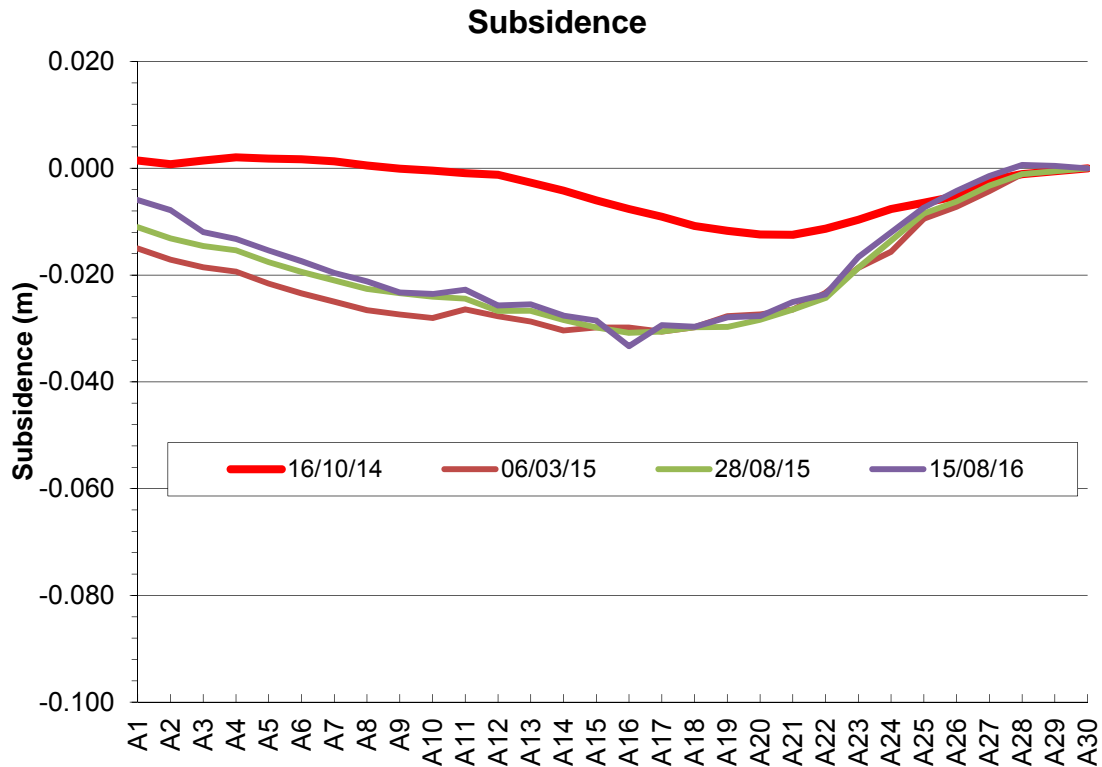


Figure 2. 900A Line Subsidence.

6.1.3 W and Z Lines

The W and Z lines are situated over the 400 Area and the 302 Panel. These lines are to the south of the U Line (**Section 6.1.2**). The survey of the W and Z Lines was undertaken on the 26th September 2016. Results from the W Line survey are presented in **Figure 3**. Results from the Z Line survey are presented in **Figure 4**. The Z Line crosses the W Line at Peg 9 (along the W Line).

Maximum subsidence recorded along the W Line was 37mm in line with the previous survey. It is worth noting that the behaviour of the subsidence line (or its trending) is very similar to previous survey results.

The Z Line recorded a maximum subsidence of 22mm. The movement recorded along the Z Line has fluctuated over the years and this may be a result of survey technique (GPS) used to measure the lines and the very small numbers that are being measured.

Irrespective, all results recorded along the W and Z Lines are well within Condition Green of the subsidence TARP and most certainly less than the maximum limit of 100mm.

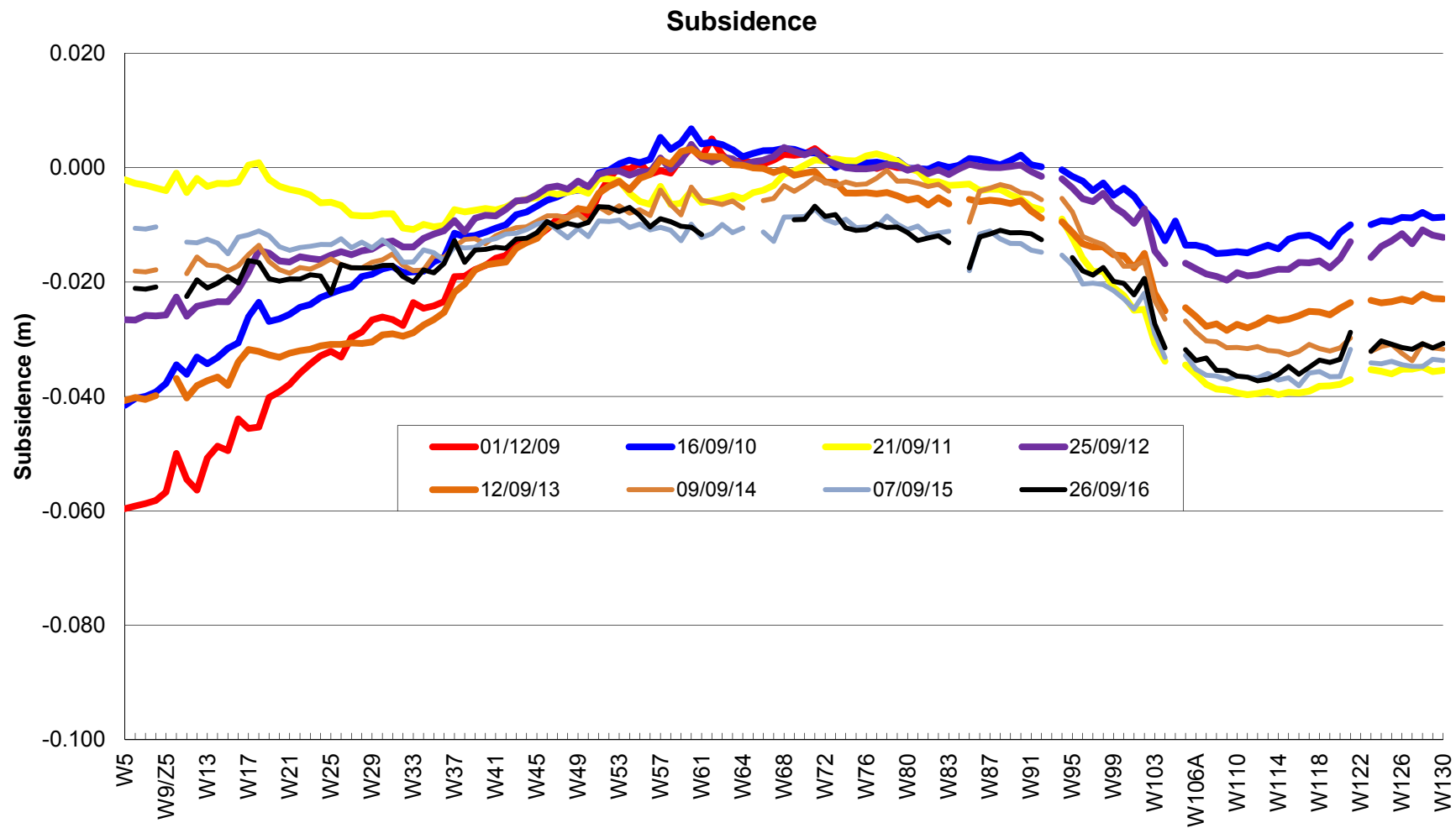


Figure 3. W Line Subsidence.

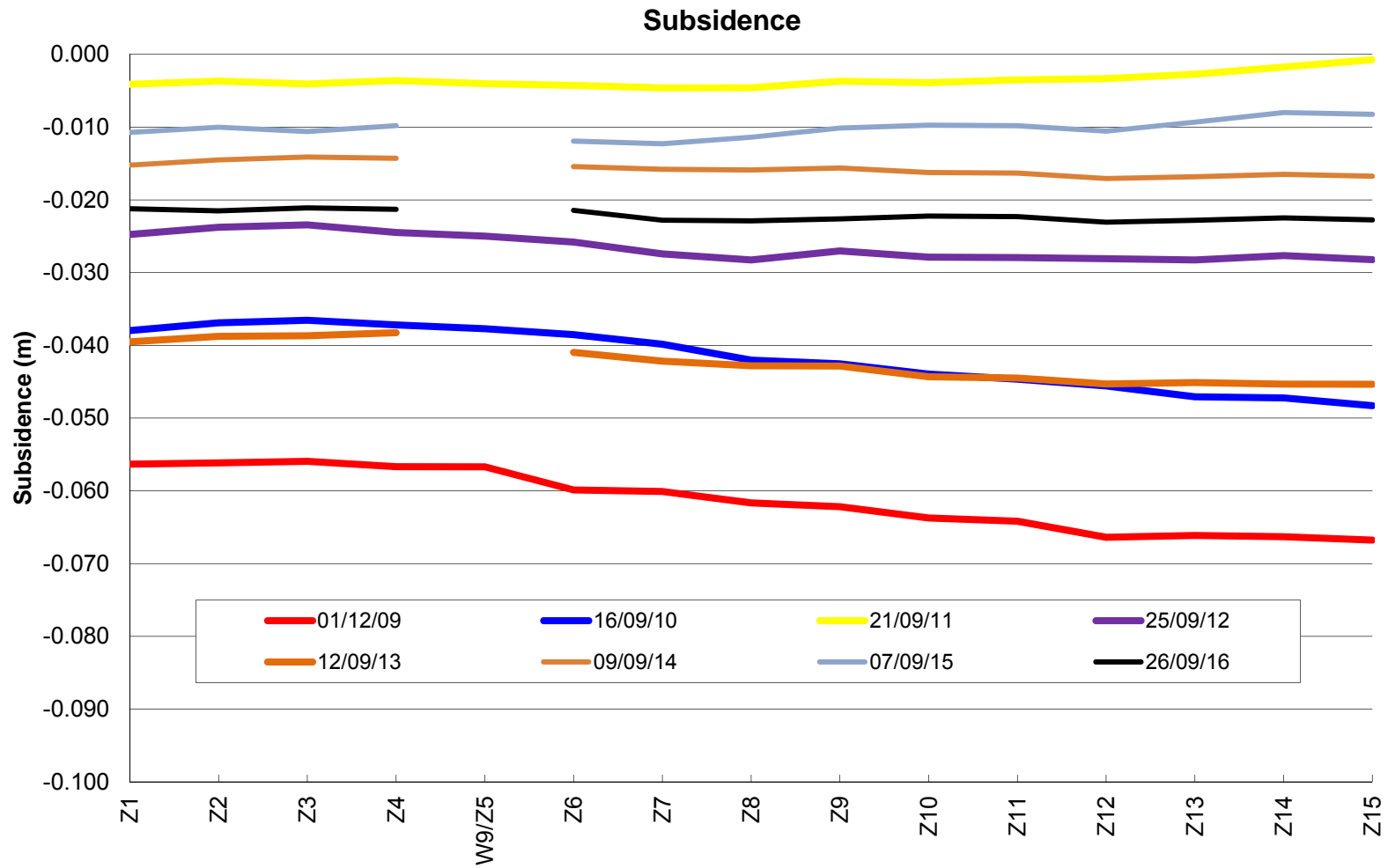


Figure 4. Z Line Subsidence.

6.1.4 700F Line

The 700F line was resurveyed on the 1st September 2016. The 700F line overlies the 716 panel and its barriers. One peg overlies the left hand side of the 714 panel.

As reported previously, a number of feno markers were severely damaged and/or lost during the 2013 bushfires. Losses were sustained from the creation of a firebreak/access track and/or direct fire. Regardless, a number of the pegs along this line can still be measured. The results from the 700F line are presented in **Figure 5**.

Maximum subsidence recorded from the survey was 10mm. This was recorded from Peg 9 and Peg 2 which are located over extracted pillars associated with the 716 Panel.

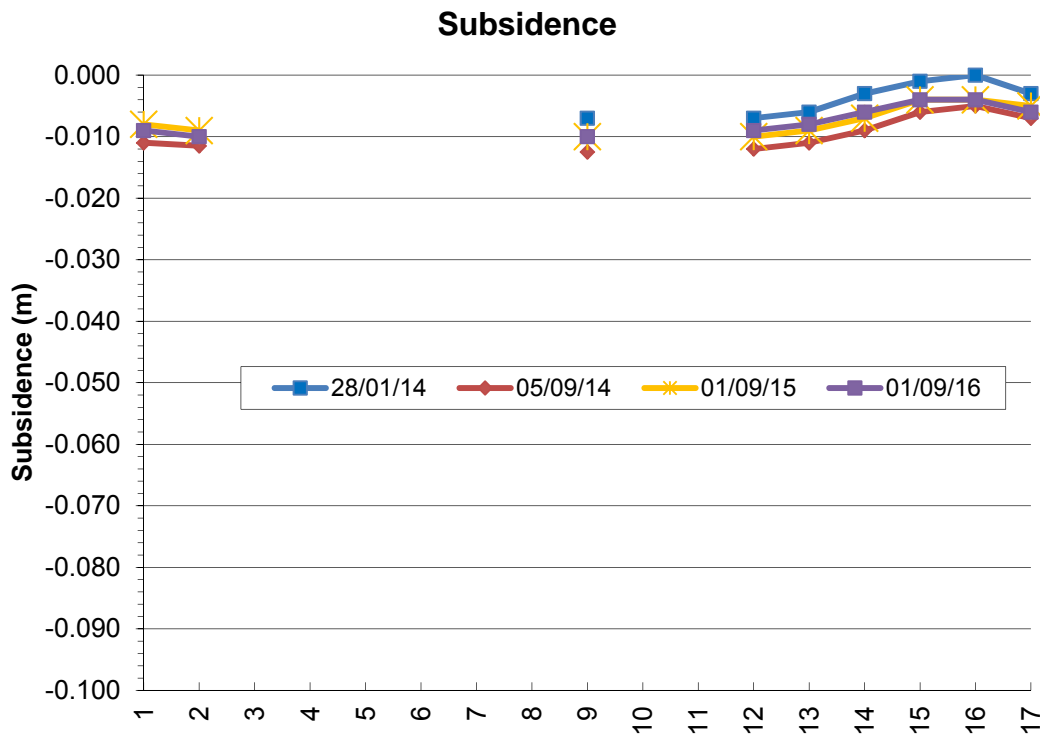


Figure 5. 700F Line Subsidence

6.1.5 903 Line

The 903 line was first surveyed in December 2015, and the most recent resurvey was conducted on 6th September 2016. Peg 8 recorded a maximum subsidence of 23 mm, with the remainder of the results in line with the previous surveys. Results from the survey are presented in **Figure 6**.

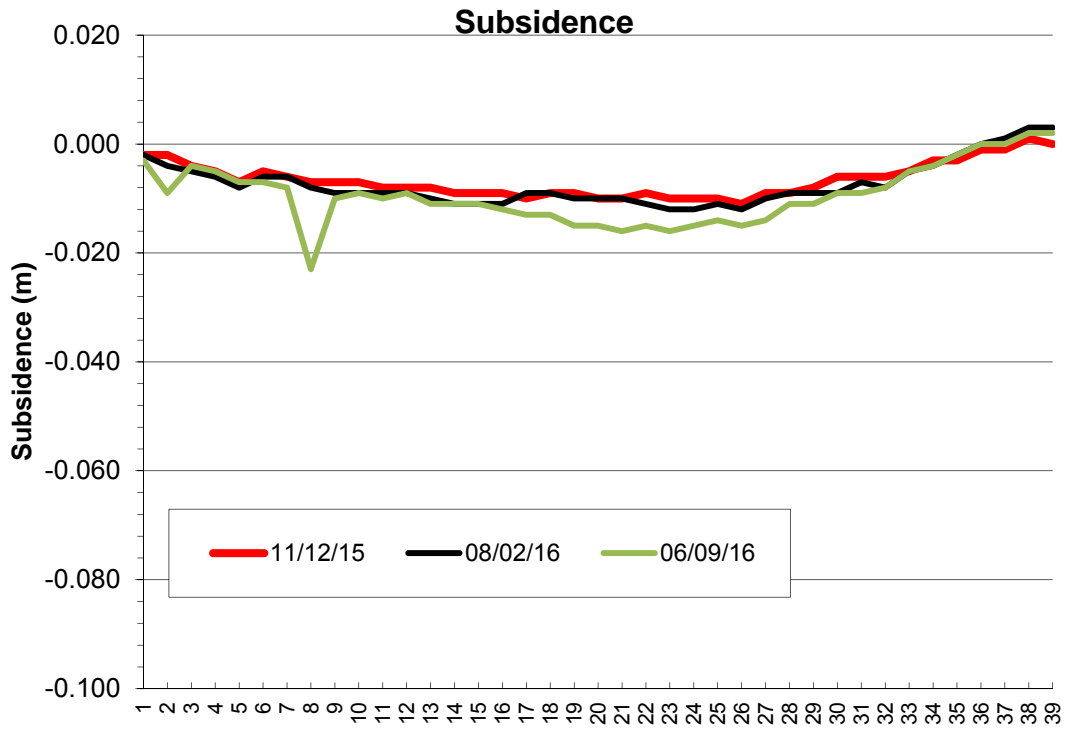


Figure 6. 903 Line Subsidence.

6.1.6 800C Line

The 800C line was resurveyed on 12th August 2016. Maximum subsidence was recorded to be 12mm. The 800C line is situated between the far inbye end of the 812 panel and the Blue Mountains National Park Boundary. This survey represents six months since the 812 Panel commenced extraction. Pegs 21 – 28 overlie the extracted panel and Peg 1 is the closest peg to the National Park (but still within the Newnes Plateau). The results from the 800C line survey are presented in **Figure 7**.

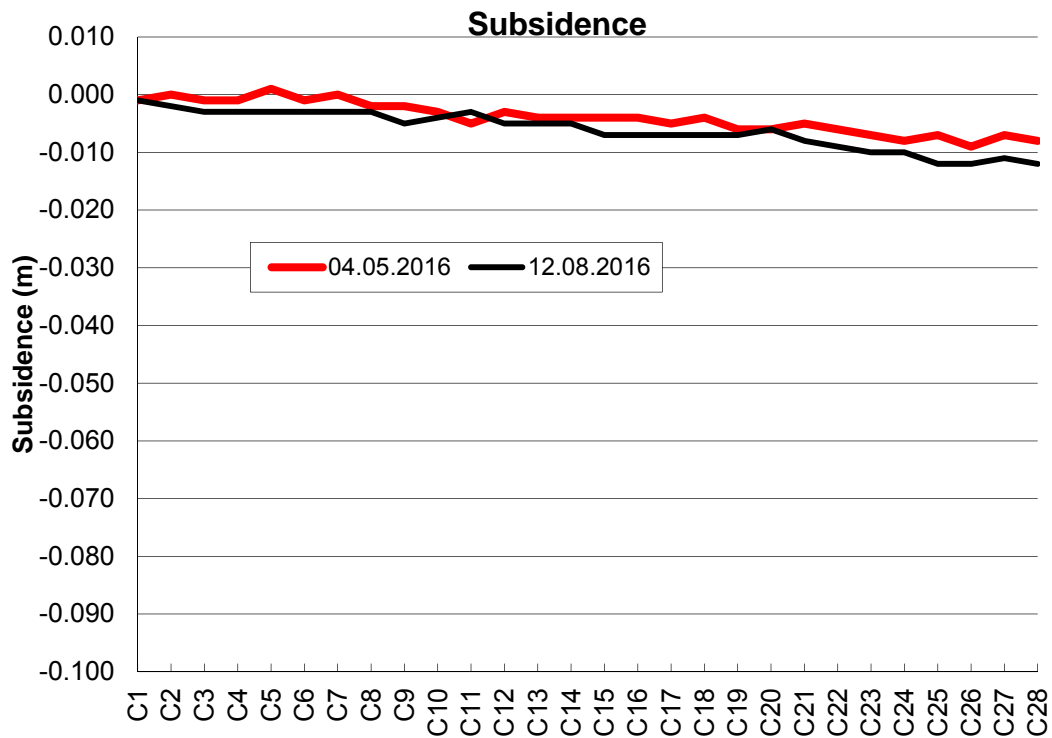


Figure 7. 800C Line Subsidence

The results show that there has been no movement near the National Park Boundary.

6.1.7 800D Line

The 800D line was resurveyed on 30th August 2016. Maximum subsidence was recorded to be 5mm, with two pegs recording anomalous movement. The 800D line is situated between the far inbye end of the 814 panel and the Blue Mountains National Park Boundary. This survey represents 3 months since the 814 Panel commenced extraction. Pegs 21 – 23 overlie the extracted panel and Peg 1 is the closest peg to the National Park (but still within the Newnes Plateau), the remainder of the pegs (17-1) lie away from any workings. The results from the 800D line survey are presented in **Figure 8**.

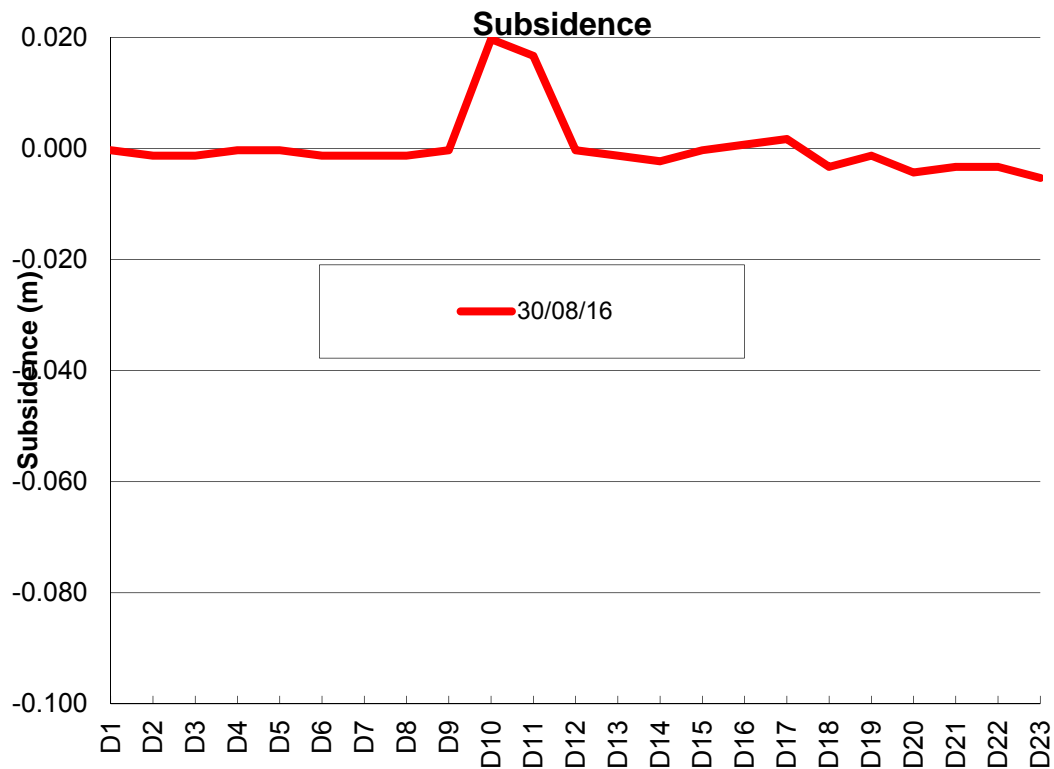


Figure 8. 800D Line Subsidence.

The results show that there has been no movement near the National Park Boundary.

6.1.8 800A Line

The 800A line was resurveyed on 20th September 2016. Maximum subsidence was recorded to be 16mm, recorded over the extracted 812 panel. The 800A line is extended mid panel between 808 panel, across 810, 812, 814, and into 816 panel. This survey represents 3 months since the 812 Panel commenced extraction. The results from the 800A line survey are presented in **Figure 9**.

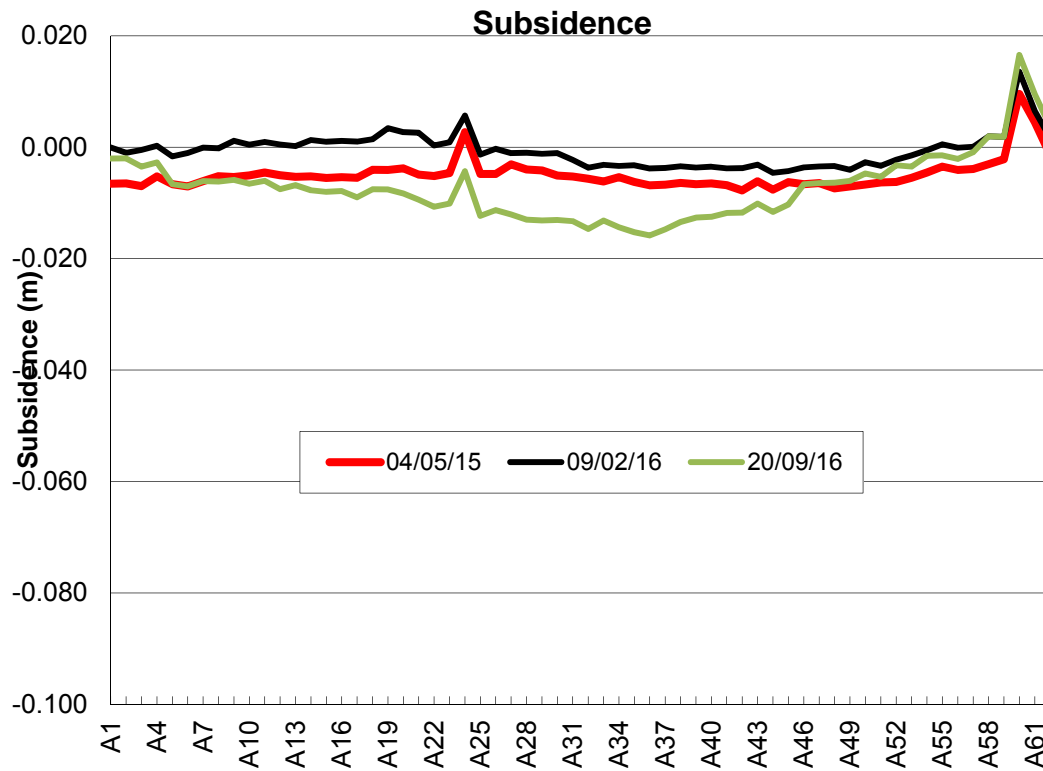


Figure 9. 800A Line Subsidence.

6.2 Cliffline and Pagoda Photographic Monitoring

Detailed inspections and photographic monitoring of the area above the far inbye end of the 810 - 814 panels and the area adjacent to the National Park was undertaken on 8th September 2016.

In summary, no surface expression of subsidence was noted during the inspection. If anything, the inspection continues to show substantial vegetation growth and recovery in and around the swamp since the pre-mining inspections undertaken in 2014.

ALL GPS co-ordinates were successfully relocated.

The vegetation recovery was consistent across the whole inspection area which included the Mining Lease boundary and the immediate environs of the Blue Mountains National Park.

7. Environmental Monitoring

Environmental monitoring locations are shown on Plan CL618 (Combined Surface Monitoring Points) provided in **Attachment 1**.

7.1 Photographic Monitoring of Newnes Plateau Shrub Swamps

Photographic monitoring was undertaken on 8th September 2016. No evidence of impacts to the Newnes Plateau Shrub Swamp adjacent to the Mining Lease boundary was identified.

7.2 Groundwater Monitoring

Groundwater monitoring sites and the relevant areas are outlined in **Table 1**. The location of all sites is shown on Plan CL618 (Combined Surface Monitoring Points) provided in **Attachment 1**. Some sites are for background monitoring purposes only at this stage and are not reported here.

It is noted that CLRP15 and CLRP16 are located either side of the Lithgow No.2 Dam (Plan CL618) and have been used to monitor potential impact on the dam from mining within the Dam Notification Area.

The most recent download was undertaken on 28th September 2016. Analysis of data from the most recent download period is summarised in the sub-sections herein.

Table 1. Groundwater Piezometers at Clarence

Piezometer	Installed	Area
CLRP1	2004	Eastern Area SMP, within 330 Area
CLRP2	2004	Eastern Area SMP, above 611E panel
CLRP3	2006	Eastern Area SMP, above 612 panel
CLRP4	2008	South of mining areas
CLRP5	2008	700 Area SMP, north of 700 area panels
CLRP6	2008	700 Area SMP, above 702/704 panels
CLRP7	2008	700 Area SMP, south of 700 area panels
CLRP10	2008	700 Area SMP, above 706 panel
CC113	2008	700 Area SMP, south of 700 area panels
CLRP8	Existing bore	Clarence Township. Piezo installed 2009
CC114	2009	800 Area SMP Application Area
CC115	2009	800 Area SMP Application Area
CLRP11	2010	700 West SMP Application Area
CLRP12	2010	700 West SMP Application Area
CLRP13	2010	800 Area SMP Application Area
CLRP14	2011	800 Area SMP Application Area
CLRP15	2011	Lithgow No.2 Dam
CLRP16	2011	Lithgow No.2 Dam
CLRP17	2013	800 Area SMP Application Area
CLRP18	2014	900 Area SMP Application Area
CLRP19	2013	800 Area SMP Application Area
CLRP22	2014	900 Area SMP Application Area

7.2.1 Open Hole Piezometers

CLRP4, CLRP5, CLRP7, CLRP8 and CLRP10

All groundwater levels (except CLRP4) in the open hole piezometers are installed in the Clarence Aquifer. The piezometers continued the broadly level trends they have showed over time.

Groundwater levels in all of these holes have declined slightly from historically high levels in the data record extending back to 2008, which were related to the generally wetter conditions between late 2010 and early 2013.

Minor noisy data and distinct small negative spikes in the record for CLRP8, in Clarence village, appear to be related to localised pumping of groundwater for domestic use. CLRP7 shows sporadic spikes related to groundwater sampling, including during the current period.

Mining impacts:

CLRP10 was directly undermined by panel 706 (1st workings only) in September 2011. Pillar extraction occurred in panel 708, around 250 m west of CLRP10, in April 2011. Panel 704, around 150 m east of CLRP10, was developed in April 2009, with partial pillar extraction in March 2010. In January and February 2014, pillar extraction occurred in Panel 700, approximately 700 – 900 m west-southwest of CLRP10.

First workings in panel 902 undermined CLRP5 during December 2013 – January 2014. During the current period, first workings occurred in the 900 area, around 1.5 km northwest and north.

There is no evidence of any mining-related impacts on any of these piezometers, based on the continuing uniform responses of the piezometers. The results from the open hole piezometers are presented in **Figure 10**.

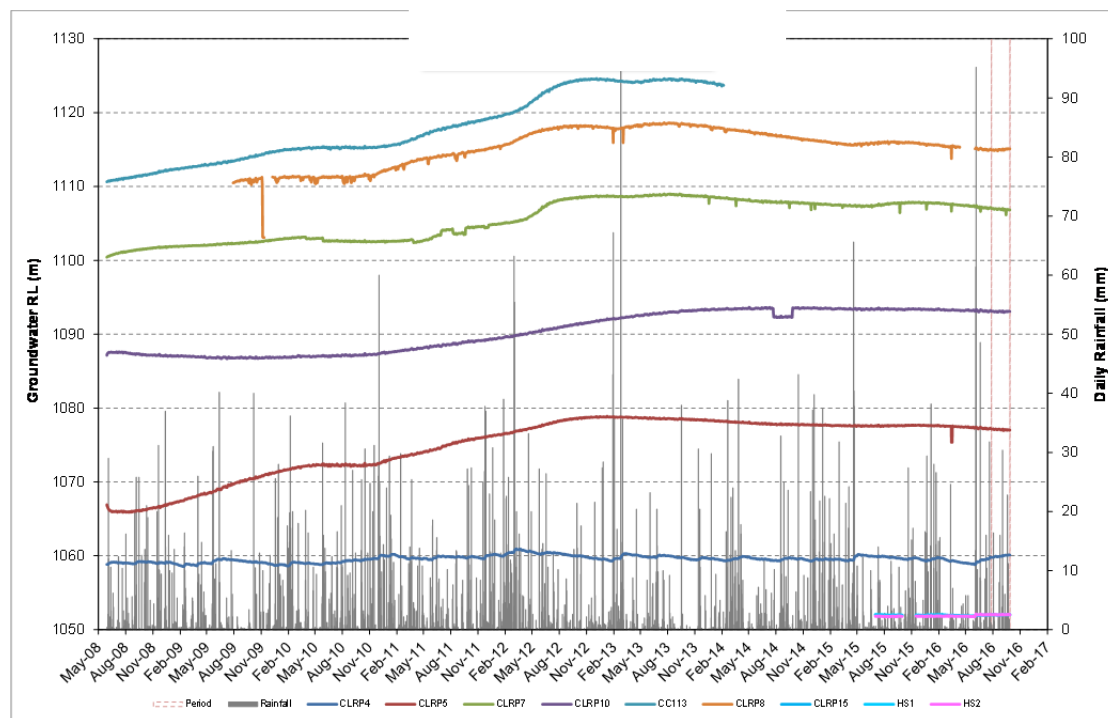


Figure 10. Open Hole Piezometer Results

7.2.2 Multi-level Piezometers

CLRP1

All piezometers within CLRP1 continue to record data. The data is presented in **Figure 11**.

There are no indications of any abnormal trends in the available data.

Mining impacts:

Pillar removal was carried out in Panel 330 immediately to the north of this bore in late 2004. This resulted in a significant depressurisation of the Katoomba seam, as measured by piezometer number 1. In December 2013, first workings in panel 803 were developed over 1km to the east. There was no evidence of any permanent mining-related impacts in the three piezometers higher up in the bore (including the two in the Banks Wall Sandstone), although piezometer number 2 just above the roof of the seam did show minor partial depressurisation followed by near-complete recovery. Since that time there have been no further indications from the data recorded to the present of any mining-related impacts. Pillar extraction occurred in Panel 803 during July 2014, with no apparent impact. Pressures recorded in the two Banks Wall Sandstone piezometers remained above pre-mining levels. During the current period, mining occurred in the 800 area, 2 – 3 km east of the hole, with no discernible impact on groundwater pressures.

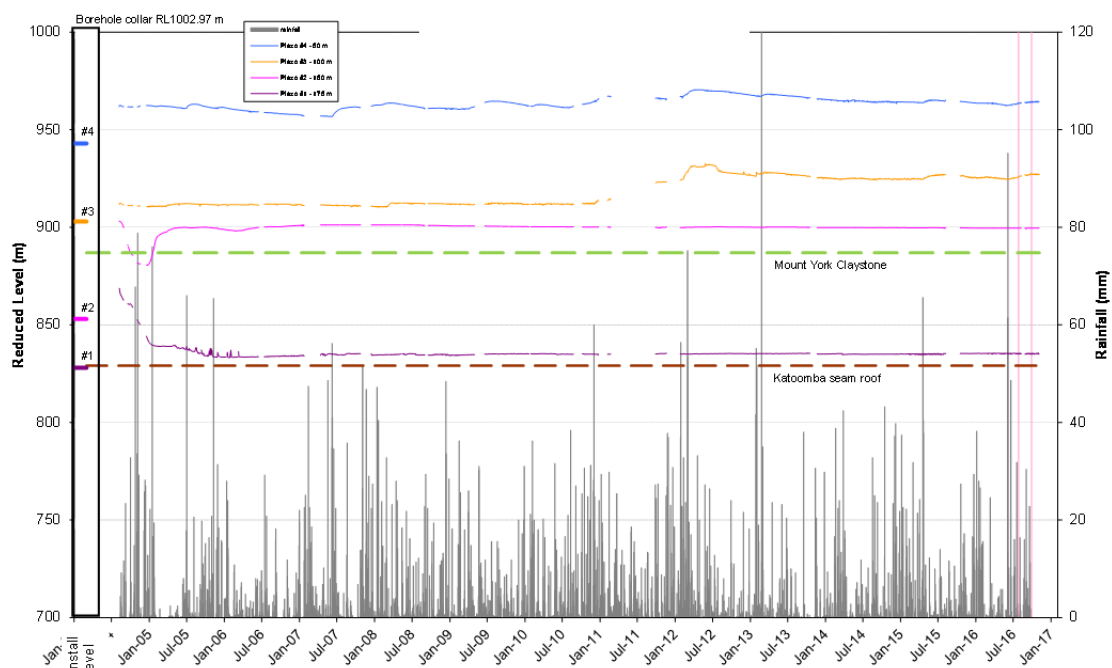


Figure 11. CLRP1 Results

CLRP2

The previous level trend, established over many years, has continued in CLRP 2's piezometers number 2 and number 3. These two instruments show very similar trends, suggesting that they are in close hydrogeological continuity. Piezometer 4

continued the slowly rising trend observed since March 2015. All pressures in the operating piezometers remain above pre-mining levels.

Mining impacts:

Total depressurisation occurred in piezometer number 1 in the coal seam in August 2007 after mining below the borehole, as would be expected. The other three piezometers showed no negative impact from mining at the time, and continue to show no impact from the mining. Results from CLRP 2 are presented in **Figure 12**.

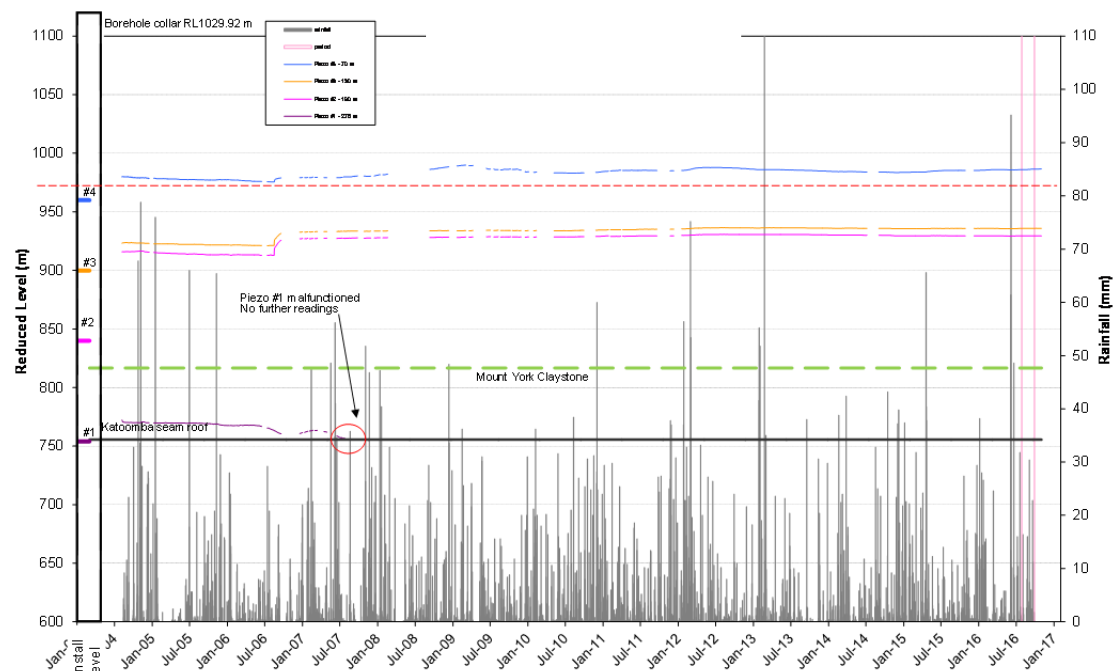


Figure 12. CLRP 2 Results

CLRP3

The data from CLRP 3 show a continuation of the level, steady trends recorded previously. Observations from this hole have shown very little pore pressure movement since their installation in early 2006. The data indicate that the groundwater level in piezometer number 2 dropped below the installation level in August 2007, and since then there have been no positive pore pressure readings. This borehole is located on an exposed steep-sided ridge and it is likely that groundwater drains quickly from the strata following rainfall. This explains the lack of any significant response to rainfall events.

Mining impacts:

This borehole was undermined shortly after it was installed in 2006, with no mining-related impacts evident in the data up to the present. Results from CLRP3 are presented in **Figure 13**.

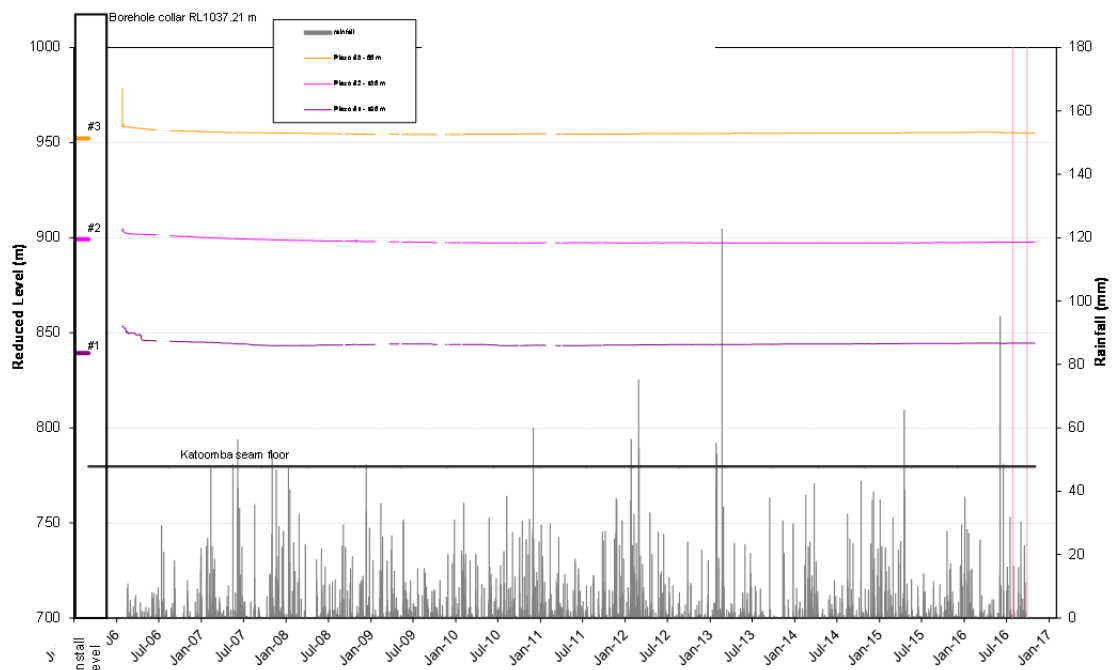


Figure 13. CLRP 3 Results

CLRP6

Previous data from CLRP 6 showed that piezometer number 1, the lowest in CLRP6, failed due to an instrumental problem in late October 2010. Data from the upper two piezometers generally continue the trends seen previously. Erratic behaviour in piezometer number 2 was observed previously. The erratic behaviour is likely to be an instrumental effect and the data are most likely unreliable, especially given that the pressure is higher than in the overlying piezometer number 3. Ongoing data collection has been problematic since the 2013 bushfire.

Mining impacts:

Partial extraction occurred in Panel 702 in September 2009 directly beneath this borehole, and the adjacent Panel 704 was partially extracted in December 2009. First workings in Panel 706, 250 m to the west, were driven during February 2012. During the current period mining occurred approximately 2 – 3 km to the north. There is no evidence from the available data of any adverse mining-related impacts on the strata containing the two functional piezometers during any of the mining within the early

panels of the 700 Area. CLRP 6 continues to be problematic since the 2013 bushfires.

CLRP15

Available data from CLRP 15 indicate that pore pressure in the Burra-Moko Head Sandstone (piezometer number 1), though declining slowly, has remained above the Lithgow No 2 Dam FSL, so that groundwater flow in this unit was towards the dam storage. Piezometer number 1 is located lower in the section than piezometer number 2, thus closer to the mining horizon. The lack of any response in piezometer number 1 indicates that the variability in piezometer number 2 that was observed is highly unlikely to be due to mining.

Available data from piezometer number 2 showed a generally slowly-rising pressure trend, although with irregular variations, followed by an irregularly falling trend, albeit with sporadic data, since late 2014. Over the current period, the trend was slowly rising.

Piezometer number 3 and number 4, installed in the Banks Wall sandstone, have shown no significant changes in their broadly level trends.

In addition to the multilevel piezometer array, a conventional aquifer piezometer was installed in an open hole at the same site. Data from this piezometer are downloaded every two months. The data showed a constant groundwater level, just above the FSL of Lithgow No 2 Dam, until mid-June 2014. At that time the data suddenly showed a rise in water level of some 20 m, followed by continued flat trends at the new level. The reason for this is unclear. A bench test of the instrument showed it was recording pressures reliably. An additional instrument was deployed, and showed similar results, indicating that the observed trend is unlikely to be an instrumental error. As well, temperature data are consistent across the pressure change, suggesting no significant change in hydrogeological conditions. The reason for the change in pressure remains unclear, although caving into the hole is suspected. However, the level trends, both before and after the baseline reset, are consistent, and suggest that the water level in this hole is controlled by the water in the reservoir, with flow towards the reservoir.

Since CLRP15 is located between the reservoir and the mine workings, the presence of a flow direction towards the dam is significant. This situation represents the normal pre-mining hydrogeological regime, and indicates that mining has had no impact on the groundwater regime between the dam and the mine workings.

Mining impacts:

First workings in 707 panel were about 250 m east of the borehole at the end of July 2012, and partial extraction was completed in August 2012. Pillar extraction in panel 716 approached to within approximately 750 m during August – September 2013. During the current period, mining occurred at around 3.5 – 4.5 km distance to the north, in the 900 area. The level trends and evidence of flow towards the reservoir indicate that there is no recognisable impact from mining

Results presented in **Figure 14** also include the data from the open hole piezometer situated next to the multi-level piezometer.

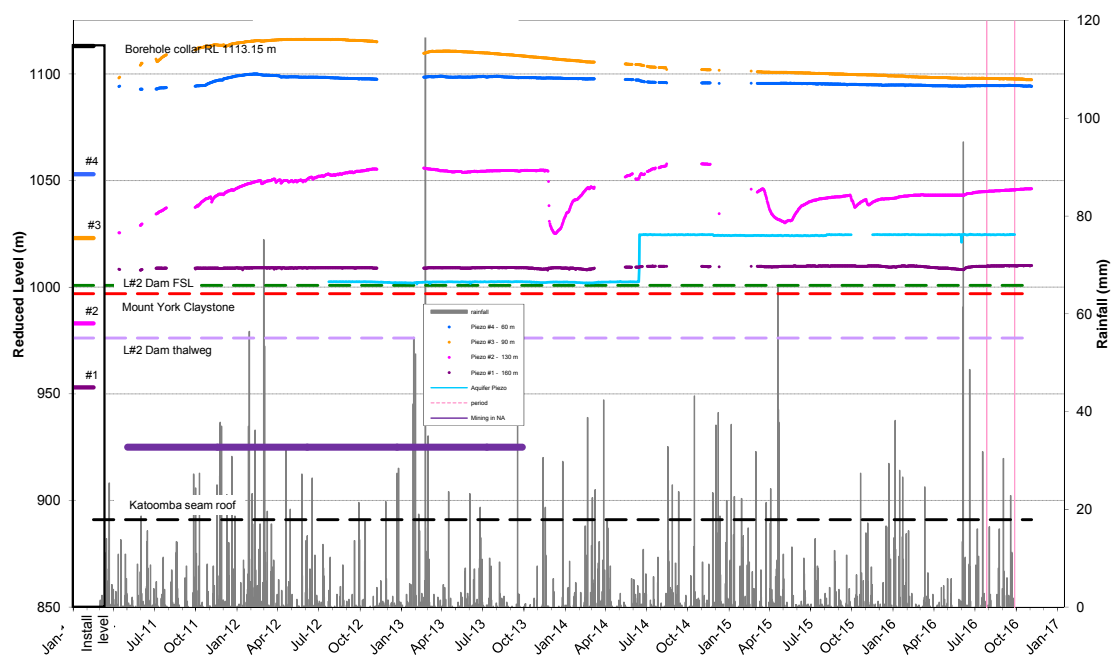


Figure 14. CLRP 15 Results

CLRP16

Piezometer number 2 within CLRP 16, located just above the level of the reservoir thalweg at the dam, shows a broadly level pressure trend over time, and lies above the dam full supply level.

Piezometer number 1, located in the cover sequence approximately 35 m above the level of the mine workings, also shows a level pressure trend in recent periods, following a more complex trend. The head measured by piezometer number 1 remains well above the values seen in the overlying piezometer. The overall pressure trend does not appear to be natural. It is possible that there are instrumental effects in these data or that the instrument has failed. As borehole CLRP15 is closer to the

workings, and has not shown this effect, it is highly unlikely to be due to mining impacts.

Mining impacts:

Pillar extraction in 716 panel was more than 1 km northeast of the borehole in August – September 2013. Pillar extraction in 700 Panel occurred over 1.8 km m the east during March 2014. Mining in the 900 area during the period was 4 – 5 km to the north. There is no evidence of mining impact in the groundwater record. Results from the piezometer are presented in **Figure 15**. The solid purple line indicates when mining within the Lithgow No.2 Dam Notification Area took place.

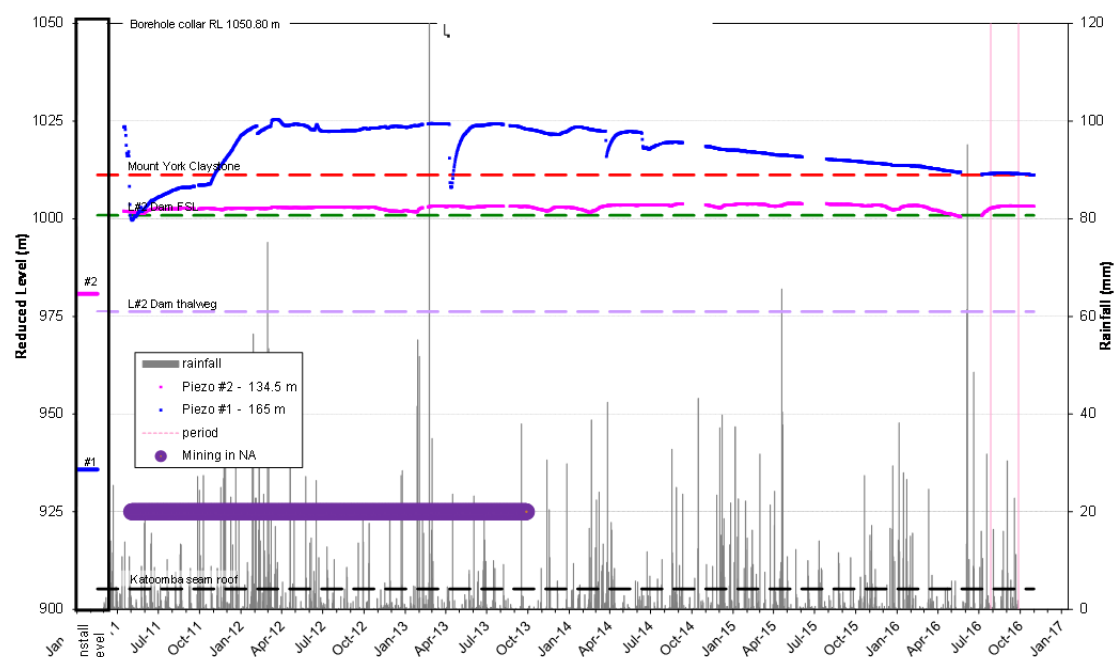


Figure 15. CLRP 16 Results

CC114

Previously observed trends recorded from CC114 continued, with piezometers number 1 and number 2 showing a generally flat trend.

Piezometer number 4 has drifted between slightly positive and negative pore pressures throughout most of the data record, and currently shows negative values. Negative pressures indicate that the piezometer is dry. The dry condition has previously been ascribed to lower-than-average rainfall. However, it may also be in part due to the topographic location of this installation, analogous to CLRP3, situated

on the edge of the deeply-incised Wollangambe Creek gorge. The elevated, exposed nature of the upper part of the section may allow fairly easy drainage of groundwater. Piezometer number 3 reversed the previous very slowly declining trend, but the variable “noisy” nature of the data suggests that this may not be a reliable instrument, especially given that the pressure is higher than in the overlying piezometer number 4. The reversal of trend to the current slowly rising trend coincides with heavy rains at the beginning of June, suggesting direct recharge through adjacent exposures of the aquifer.

There are no indications of any abnormal trends in the available data.

Mining impacts:

During the period, first workings and pillar extraction occurred in the 800 area, 2 – 3 km to the east. There is no indication of mining impact in the data. Results from CC114 are presented in **Figure 16**.

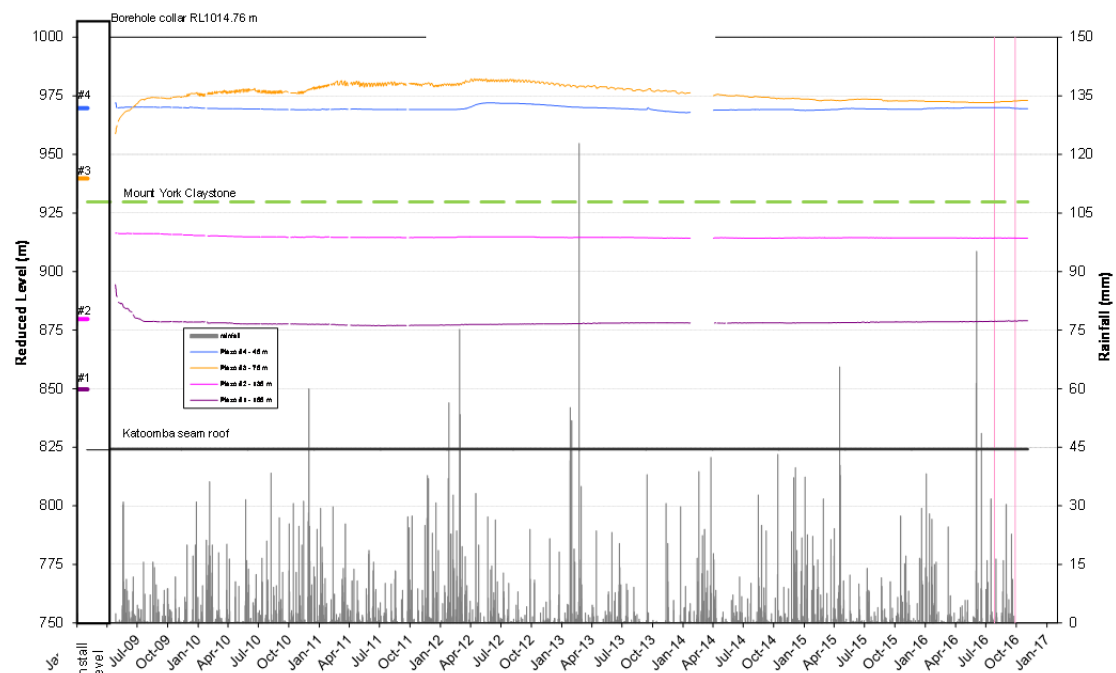


Figure 16. CC114 Results

CC115

Trends in the CC115 dataset after repair are broadly consistent with those seen previously, although at lower absolute levels than before. The difference in pressure heads are 30 – 50 m, which is highly unlikely to be a real groundwater phenomenon. The most likely reason is a calibration difference between the old and new data

loggers. It is noted that the loggers were replaced following the 2013 bushfire. This should be reviewed by the data logger installers.

All piezometers showed trends consistent with previous behaviour.

Piezometer number 1 is located approximately 13 m above the Katoomba seam working horizon. It showed steady pressure trends throughout almost the entire data record, but suddenly declined asymptotically by 11 m after reconnection. The steep decline seen in previous data slowed to an asymptotic curve, which levelled off, before commencing a slowly rising trend which has continued during the current period.

Piezometers number 2, number 3, and number 4 showed broadly level trends. Piezometers number 2 and number 3 continue to show very similar pressures, suggesting that the piezometers may be hydrogeologically connected.

All piezometers show very minor perturbations in trend in late May 2016. These consist of drops in pressure head of a few meters over this time, with partial recovery. The perturbations coincide with mining directly under the borehole (see below).

There are no indications of any abnormal effects in the available data, indicated by the consistent trends in these records, and subject to the comments above about calibration. The bushfire does not appear to have had any observable impact on the groundwater record at this location.

Mining impacts:

In late May 2016, the borehole was directly undermined by pillar extraction in Panel 812. The very small but distinct drop and recovery in the piezometers are mining impacts. It is notable that pressure has totally or partially recovered in each piezometer. No instruments showed a drop to negative values, and the upper strata have not been affected by development of a permeability connection to the workings. The movements are mining-induced, and according to expectations. They have not had a significant or permanent impact on the groundwater system. Piezometer number 1, which lies closest to the mining horizon, has shown slowly rising pressure trends for the past year, indicating that there has been no permeability connection created between the mining horizon and this installation level. During the current period, mining in the 800 area consisted of partial pillar extraction up to 1.5 km west of the borehole.

Results are presented in **Figure 17**.

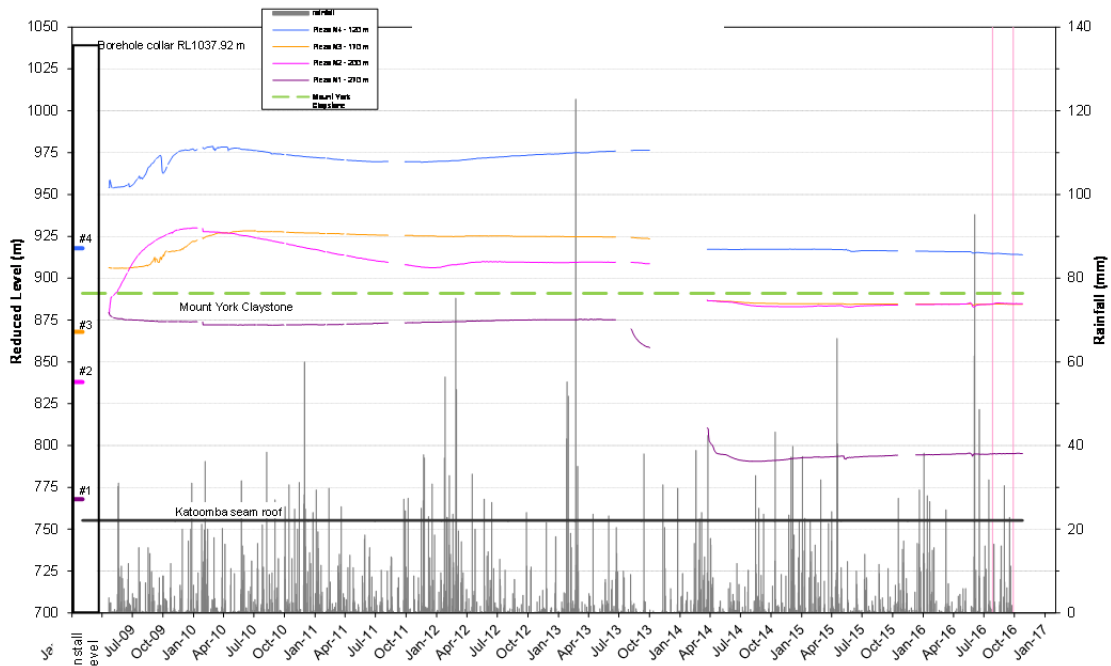


Figure 17. CC115 Results

CLRP17

The available data from CLRP 17 show steady trends with positive groundwater pressures, and continue trends seen previously.

The two available piezometers show very steady, level positive pressure trends.

Mining impacts:

Mining in the 800 area was 0.2 – 1 km north, east and west of the piezometer. Pillar extraction proceeded past the site in September 2016, with no apparent affect. The very slow decline in the lower piezometers probably reflects stabilisation of the piezometers after installation. The steady, level trends in the uppermost piezometer indicate that there has been no dewatering in the near-surface aquifer. There is no evidence of mining impact in the groundwater record. Monitoring results for piezometric height at CLRP17 is presented in **Figure 18**.

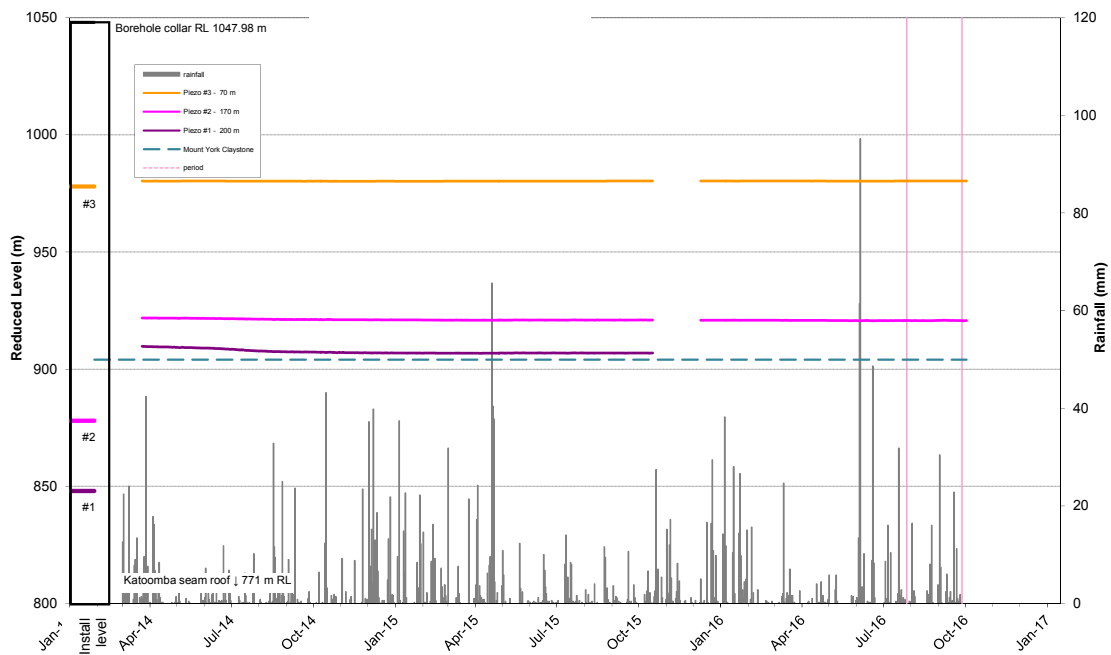


Figure 18. CLR17 Piezometric Height

CLR19

The CLR19 data previously showed a very slow decline in pressure in piezometer number 1, and similarly slow increases in pressure in piezometers number 2 and number 3, which then levelled off to stable trends before very slowly declining. Previous pressure trends continue in the available data.

In Piezometer number 1, installed approximately 100 m above the working horizon but below the Mount York Claystone, the pressure trend was initially level, with a head that lay near the top of the Mount York Claystone (the regional aquiclude). The coincidence suggests that this is a confined aquifer with no significant leakiness or formation damage in the cap rock, which is controlling pressure in the underlying aquifer. As this piezometer is installed in a low permeability unit, pressures can take some time to dissipate, possibly explaining that the slow decline may have been due to gradual stabilisation of the borehole after installation.

Mining impacts:

Pillar extraction took place immediately below the piezometer site during March 2016. Current mining is partial pillar extraction 1 – 2.5 km from the borehole, to the east, south, and west. The data show no impact from mining. The slow decline in piezometer number 1 is most likely due to slow stabilisation after installation, and does not appear to be an impact caused by mining.

Monitoring results for piezometric height at CLRP19 is presented in **Figure 19**.

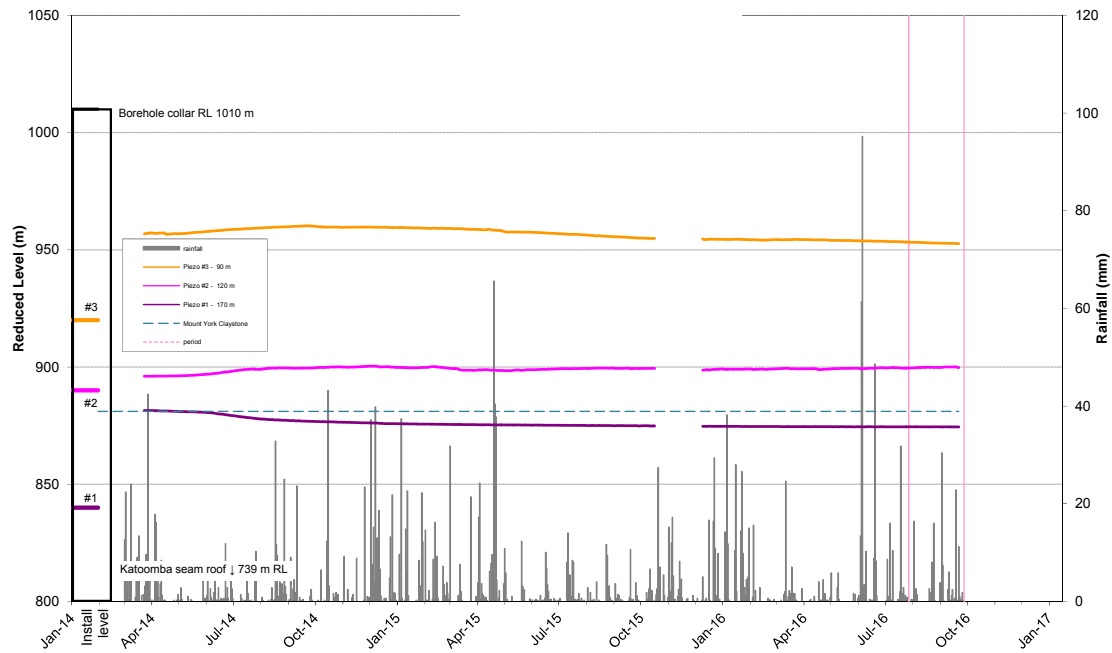


Figure 19. CLRP19 Piezometric Height

CLRP14

Piezometers 1, 2, and 4 from CLRP 14 continue the level trends displayed previously.

The lowest piezometers show similar stable pressure trends. The similarity of pressure previously observed in piezometers number 1 and number 2 suggested that the instruments were in hydrogeological continuity. Since early 2014 these pressures started to diverge. Data from recent periods show the trends converging again.

The uppermost piezometer number 4 shows a nearly level trend. Piezometer number 4 commenced producing more stable data, although, for a few days after 19 August 2014, the pressure head varied by up to 1 m daily. The cause of this anomalous behaviour is unclear, but it is transient, unprecedented, and likely to be non-significant.

Mining impacts:

Pillar extraction in the 800 area has occurred previously under the piezometers; first workings were 1 – 2 km east. The available data record shows no mining impact. The data record shows no mining impact. Results are presented in **Figure 20**.

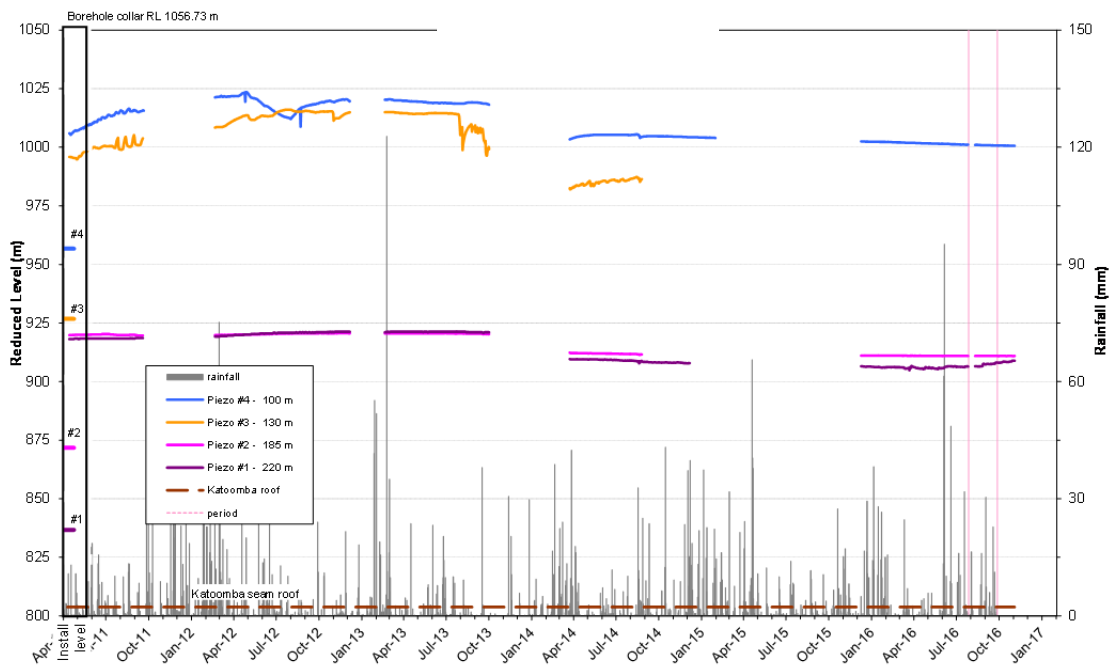


Figure 20. CLRP14 Piezometric Height

CLRP22

Trends observed previously from CLRP 22 continue in the available data. Piezometer number 1, installed approximately 100 m above the working horizon but below the Mount York Claystone, has stabilised after a very slowly rising pressure trend, with pressure that lies near the top of the Mount York Claystone (the regional aquiclude). The coincidence suggests that this is a confined aquifer with no significant leakiness or formation damage in the cap rock, which is controlling pressure in the underlying aquifer.

Piezometer number 1, installed approximately 100 m above the Mount York Claystone, showed a level trend.

Mining impacts:

The nearest mining during the period was 1.5 – 3 km southwest of the installation. Old workings lie more than 400 m to the east. There is no indication in the current data of any mining impact. The data record shows no mining impact. Results are presented in **Figure 21**.

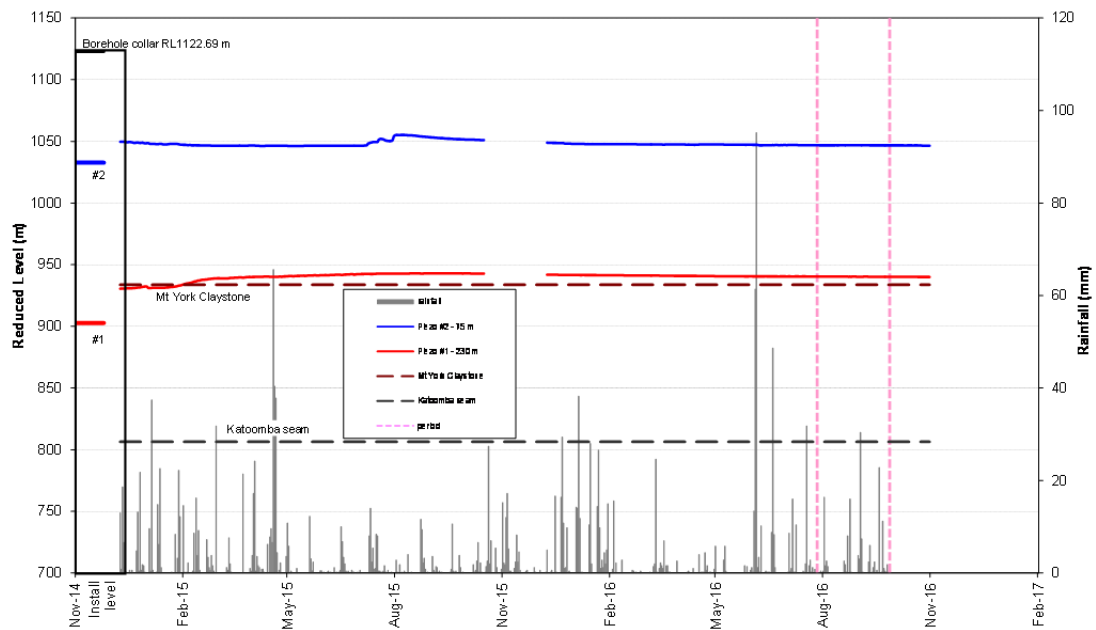


Figure 21. CLRP22 Piezometric Height

7.3 Surface Water Monitoring

Results from the surface water monitoring at Farmers Creek indicate no adverse impact from mining on surface water quality.

7.4 Flora Monitoring

Flora monitoring fieldwork for Clarence Colliery is undertaken by Gingra Ecological Surveys. Fieldwork is undertaken three times per year – autumn, spring and summer. The spring flora monitoring is currently being completed, and thus no report has been provided at this point in time. Verbal advice has been provided that there was no evidence of death or dieback which could be attributed to an effect of subsidence across the sites that have been surveyed. Further information will be provided in the next reporting period.

7.5 Fauna Monitoring

Fauna monitoring at Clarence Colliery is undertaken by Biodiversity Monitoring Services. Fieldwork commenced in 2004 and is undertaken 3 times per year – autumn, spring and summer.

7.5.1 800 Area

The 800 Area is within ML 1583. An initial fauna survey was undertaken in March 2009 and three sites were established. The sites are:

- 800 Swamp 1 Site samples Newnes Plateau Shrub Swamp in the central part of the 800 Area.
- 800 Heath Site samples Montane heath vegetation south of Dumbano fire trail.
- 800 Swamp 2 Site samples the woodland and gully vegetation in the eastern part of the 800 Area.

Selection of these areas complement flora and fauna survey sites elsewhere across the Clarence Colliery area. Existing control sites would be suitable as control sites for these new sites. These three sites are mapped in **Figure 22**, together with other fauna survey sites currently monitored within Clarence Colliery.

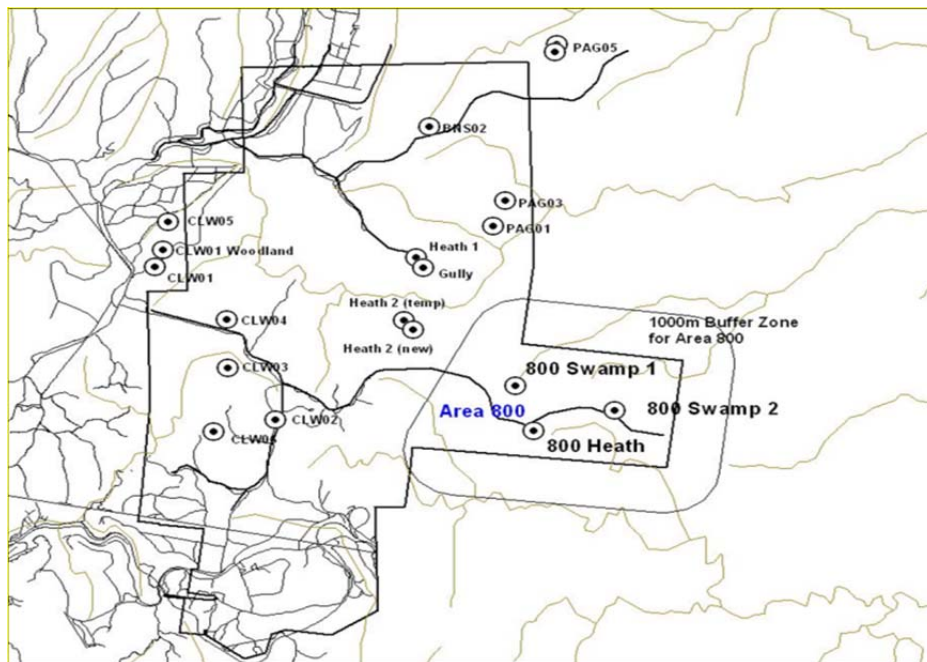


Figure 22. Location of Fauna Monitoring Sites in 800 SMP Area

A total of 31 bird, 10 native mammal, three introduced mammal, six reptile and three amphibian species were located during the surveys. There are no significant differences between the biodiversity indices for spring 2009 through to 2016 (non-parametric Kruskal-Wallis One Way Analysis of Variance on Ranks). However, the numbers of animals located fell from 2012 onwards, with the exception of reptiles. Reptiles appeared to be able to avoid the hot burn, probably by going underground.

Despite falls in diversity indices since 2013, overall, species richness and Simpsons Diversity have either risen slightly or have remained stable over the years. The fall in numbers and species richness in 2013 (due to State Mine fire) has not recovered in spring 2016 and monitoring in the future will provide important data on recovery times for these three groups of fauna.

Given the low levels of subsidence from previous mining at Clarence Colliery, and the predicted low levels (30–100mm) of subsidence for Area 800, the risk of adverse impacts on fauna within this area is considered to be low. Mining (first workings only) commenced in Area 800 in July 2012. Since this time, partial extraction has occurred beneath “800 Swamp 2” and first workings has occurred beneath the other two sites. The monitoring of recovery from fire within those sites mined and un-mined will be an important tool in the on-going assessment of mining activities.

7.5.2 900 Area

Two fauna monitoring sites are situated within the 900 Area as shown in **Figure 23**.

Site A North (CLW07) is located along Paddys Creek, a tributary to Bungleboori Creek. The site covers the creekline and surrounding woodland and low heathy shrub. Along the western edge of the site is a cliffline about 50 m high. The site was burnt in the 2013 State Mine fire and the vegetation is still recovering. Consequently, little of the original shrub cover exists at present. The burnt remains of a pipeline run beside the creek, possibly connected with the nearby quarry. The creek was flowing strongly during the survey. Site A North sampled land above Panel 911.

Site B South (CLW08) is also located along Paddys Creek, but further towards the headwaters. The site covers the creekline and associated riparian area, as well as the surrounding woodland. At the time of the survey water in the creek was slowly flowing and there were a series of small water holes in the area. A deep trench had been dug beside the creek, presumably to drain the area. The site was burnt in the 2013 State Mine fire and the vegetation is still recovering. Consequently, little of the original shrub cover exists at present. The burnt remains of a pipeline run beside the creek, possibly connected with the nearby quarry. Site B South sampled land above the yet to be developed Panel 915.

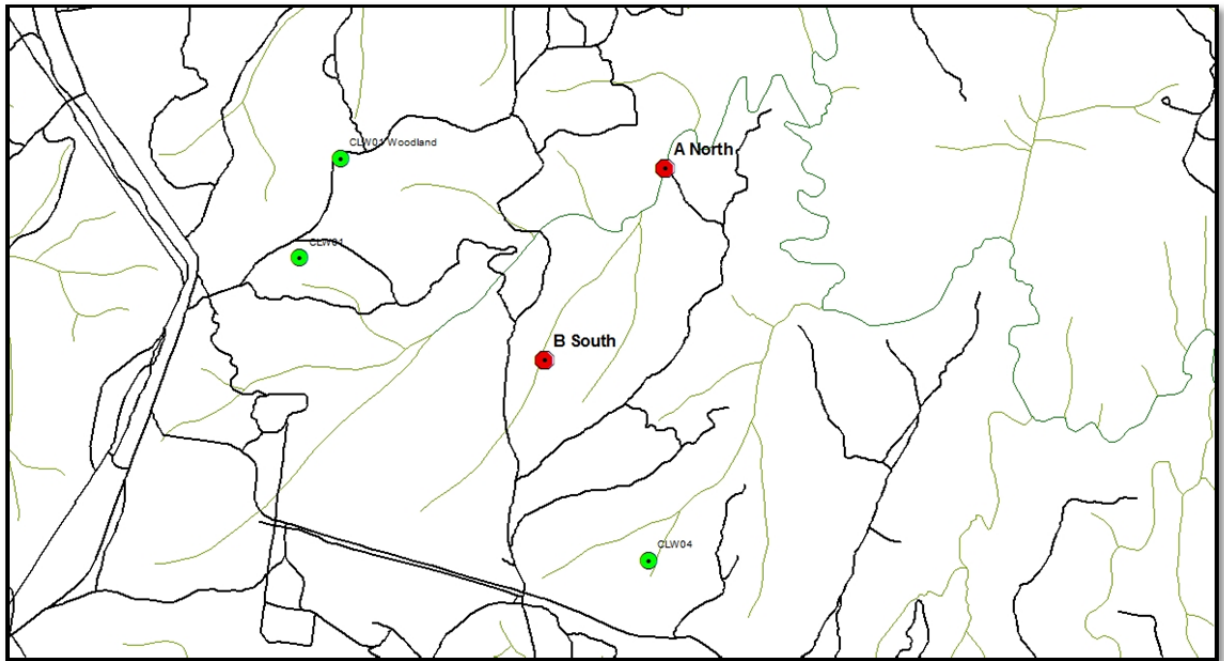


Figure 23. Location of Fauna Monitoring Sites in 900 SMP Area

A total of 43 bird, eleven native mammal, one introduced mammal, two reptile and two amphibian species were located during the surveys.

The fauna monitoring survey of the 900 Area has shown that the choice of survey sites was successful, in terms of the number of individuals and diversity of species within the main fauna groups surveyed. Also, there were sufficient numbers and diversities of these fauna groups to be able to calculate a set of diversity indices that form part of the baseline monitoring database. As with that found in other sites within Clarence Colliery that have been affected by the 2013 State Mine fire, fauna numbers and diversity were low, particularly concerning mammals. However, this year has seen an increase in the number of native mammals trapped which could indicate some recovery. It is anticipated that populations will build up over time. Four threatened species were located during the surveys, (Flame Robin, Varied Sittella, Eastern False Pipistrelle and Eastern Bent-wing Bat).

The values of the habitat characteristics and the Habitat Complexity Scores reflect the effects from the State Mine fire. Most values are low for each site and this is particularly seen in the tree and tall shrub cover which are very low for shrub swamps and woodland habitats. It is anticipated that these values will increase over time.

Given the low levels of subsidence from previous mining at Clarence Colliery, and the predicted low levels (30mm) of subsidence for the 900 Area, the risk of adverse impacts on fauna within this area is considered to be low. However, further monitoring is recommended to provide accurate baseline and comparison data. This

should be undertaken during three seasons of the year (autumn, spring and summer) to ensure natural variability of fauna populations are taken into consideration.

7.5.3 Outbye Area

Three sites surveyed in Spring 2016 have been established within the Outbye SMP Area including (**Figure 24**):

- *Heath North (Site 1)* – Sandstone Plateaux Tea Tree – Dwarf Sheoak – Banksia Rock Heath Sandstone Plateau and Ridge Scribbly Gum Silvertop Ash Shrubby Woodland;
- *Gully (Site 2)* – Pagoda Rock Sparse Shrubland and Newnes Sheltered Peppermint – Brown Barrel Shrubby Forest; and
- *Heath South (Site 3)* - Exposed Blue Mountains Sydney Peppermint – Silvertop Ash Shrubby Woodland.

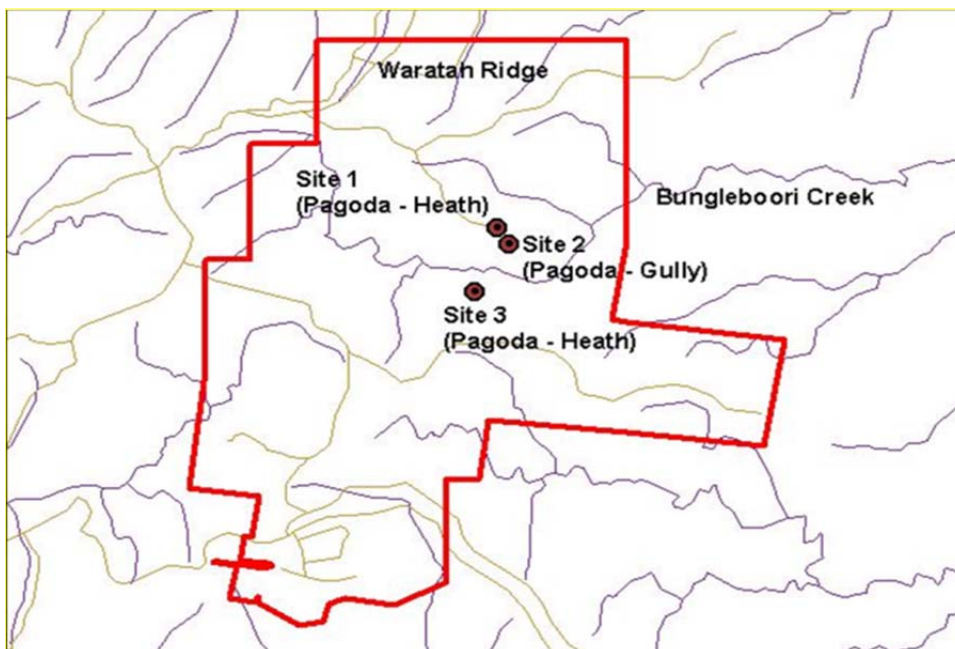


Figure 24. Location of Fauna Monitoring Sites in Outbye SMP Area

Eleven native mammal (plus four introduced), 33 bird, eight reptile and two amphibian species were recorded from the SMP area.

The survey for the 2016 spring period was conducted three years after the State Mine Fire burnt within the Outbye SMP Area. At this stage, not all the data obtained can be used to monitor any effects from underground mining, but it does provide an important baseline for monitoring the recovery from fire by fauna in the future. It also provides important data to compare the rates of recovery within areas that have been previously mined and those still to be mined or used as controls.

The results from this year's survey show that there has been some recovery from the impacts of the State Mine Fire. Habitat characteristic values are beginning to increase and small mammal fauna is returning. The impacts from the State Mine Fire have definitely been felt by the small mammal fauna, but reptile fauna appears to be able to survive its effects. Bird numbers and diversity are similar to that recorded each spring indicating that this fauna group is able to colonise previously burnt areas successfully.

Given the low levels of subsidence from previous mining at Clarence Colliery, and the predicted low levels (30-100mm) of subsidence for the Outbye SMP Area, the risk of adverse impacts on fauna within this area is considered to be low. There has been no evidence of any mining related impacts on fauna within the Outbye SMP areas to date.

7.5.4 700 Area

Three fauna monitoring sites established within Clarence Colliery Eastern SMP Area were sampled during the Spring 2016 monitoring surveys, see **Figure 25**. These sites are described as:

- BNS02 (Bungleboori North 1) – a swamp located within the (now freshly cleared) pine forest east of Waratah Ridge Road. The swamp supports a mix of Newnes Shrub Swamp and Blue Mountains Sandstone Plateau Forest.
- PAG01/02 – a pagoda and steep hill overlooking Bungleboori Creek. This site samples Pagoda Complex and Blue Mountains Sandstone Plateau Forest vegetation, as well as habitats unique to the cliffline environment.
- PAG03/04 – a pagoda and steep hill overlooking Bungleboori Creek, similar to PAG01/02.

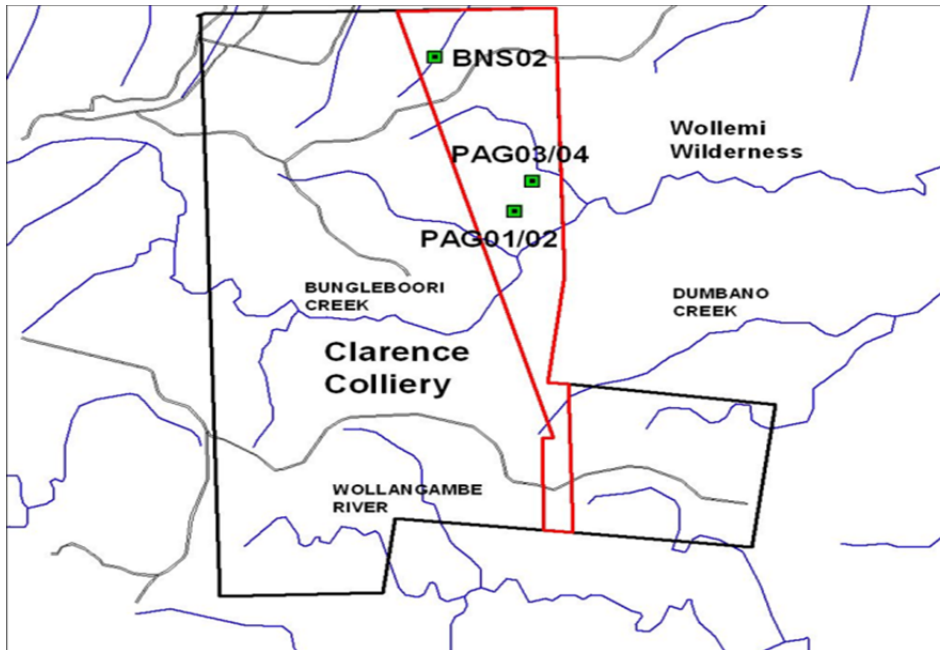


Figure 25. Location of Fauna Monitoring Sites in 700 Eastern SMP Area

Ten native mammal (plus four introduced), 46 bird, five reptile and three amphibian species were recorded from the SMP area.

An analysis of the indices obtained from the spring survey shows that the faunal assemblages remained constant, in terms of the biodiversity indices. This comparison showed that there are no significant differences in the biodiversity and habitat complexity scores over the years since the surveys commenced. At this stage, there are no apparent subsidence effects upon the fauna within the Clarence Colliery Eastern SMP Area.

Four threatened species were located within the SMP Area; the Eastern False Pipistrelle, Eastern Bent-wing Bat, Gang-gang Cockatoo and Flame Robin.

7.5.5 700 Area

All six monitoring sites were sampled during the Spring survey within the 700 Area. These sites sample pagoda complexes and swamps within the western SMP area (which incorporates the approved 700 Area) of Clarence Colliery. Two of the sites sample land where no underground mining has occurred (control sites) and four sites sample land where underground mining has or will occur (treatment sites). **Figure 26** depicts the spatial location of the sites. A description of the sites is provided below:

- *CLW01* – Control site, not undermined, pagoda landscape;
- *CLW02* – Undermined November 2009, swamp landscape;
- *CLW03* – Undermined October 2010, swamp landscape;

- *CLW04* – Control site, not undermined, swamp landscape;
- *CLW05* – Control site, not undermined, swamp landscape; and
- *CLW06* – Undermined November 2011, pagoda landscape.

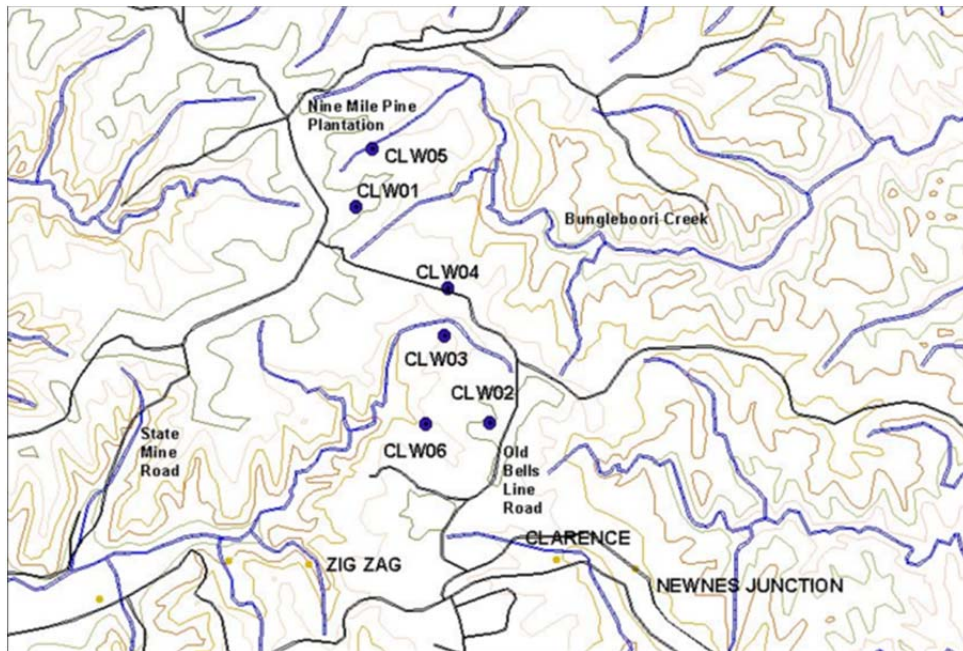


Figure 26. Location of Fauna Monitoring Sites in 700 Western SMP Area

Nineteen native mammal, three introduced mammal, 58 bird, seven reptile and seven amphibian species were recorded from the SMP area.

The survey for the 2016 spring period was conducted three years after the State Mine fire burnt much of Newnes Plateau. The 2016 spring surveys within Clarence Colliery 700 Area SMP Area produced six threatened species. These were the Gang-gang Cockatoo, Flame Robin, Scarlet Robin, Varied Sittella, Eastern False Pipistrelle and Eastern Bent-wing Bat.

Analysis of the data shows that there are little differences between the habitat characteristics and biodiversities of the control and treatment sites and it is concluded that, at present, underground mining has not caused any noticeable changes to the native fauna populations and their associated habitats. The monitoring of recovery from fire within those sites mined and un-mined will be an important tool in the on-going assessment of mining activities.

7.6 Cliff Line and Pagoda Photographic Monitoring

There was no indication of any surface subsidence during the period. All GPS coordinates were successfully relocated. In respect of the 800 Area inspection, there was again, substantial vegetation growth making direct replication of photo sites challenging.

8. Adequacy, Quality and Effectiveness

The partial extraction system at Clarence Colliery has been monitored during the design, development, and extraction phases to ensure the necessary dimensions of the system are maintained and regularly independently audited by Golders.

All subsidence monitoring results are generally below the 100mm maximum predicted.

Surface inspections found no evidence of any cracking or subsidence related surface impacts.

Subsidence and environmental monitoring has been adequate in measuring the impacts of the partial extraction system. Subsidence monitoring has demonstrated trends in ground movement associated with pillar compression due to the partial extraction.

Subsidence management within each SMP Area has been effective in protecting surface features (including clifflines and pagodas), surface infrastructure, surface water, upper aquifers, Newnes Plateau Shrub Swamps/Newnes Plateau Hanging Swamps, flora and fauna.

There has been no adverse impact on the upper aquifers, swamps or baseflows to swamps detected as a result of mining activities.

9. Proposed Management Actions

During the next reporting period the following subsidence management activities are proposed:

- Resurvey of the 707 Line (Annual);
- Surface inspection of the 800 Area (Quarterly)
- Resurvey of the 800B Line (Annual)
- Resurvey of the 800A Line (3 months post extraction 814 Panel);
- Resurvey of 700A Line
- Resurvey of 700B Line
- Resurvey of the 800C Line (12 months post extraction 812 panel);
- Resurvey of the H and I Lines
- Resurvey of the 800A Line (Annual)
- Continue with flora, fauna, groundwater and monitoring;
- Surface inspection of the far inbye end of 810, 812 and 814 panels including areas within the National Park;
- Awaiting approval (or otherwise) of the 900 Subsidence Monitoring Program (in line with the recent changes to the panel orientations);
- Awaiting approval (or otherwise) of the 800 Subsidence Monitoring Program for 808 and 816 panels (updating the 810, 812 and 814 subsidence monitoring programs)
- Continue surface water monitoring for Farmers Creek upstream and downstream;
- Continue with underground mining system audits (in-panel and end of panel);

10. Conclusion

Subsidence and environmental monitoring has been carried out generally in accordance with the relevant Subsidence, Infrastructure, Public Safety and Environmental Monitoring Programs required under the various SMP and Clause 88 approvals. Mining systems have been implemented as planned.

No subsidence impacts have been observed by the management of Clarence Colliery in the reporting period. No surface cracking has been detected and there has been no adverse impacts detected on surface water, upper aquifers, swamps, flora or fauna.

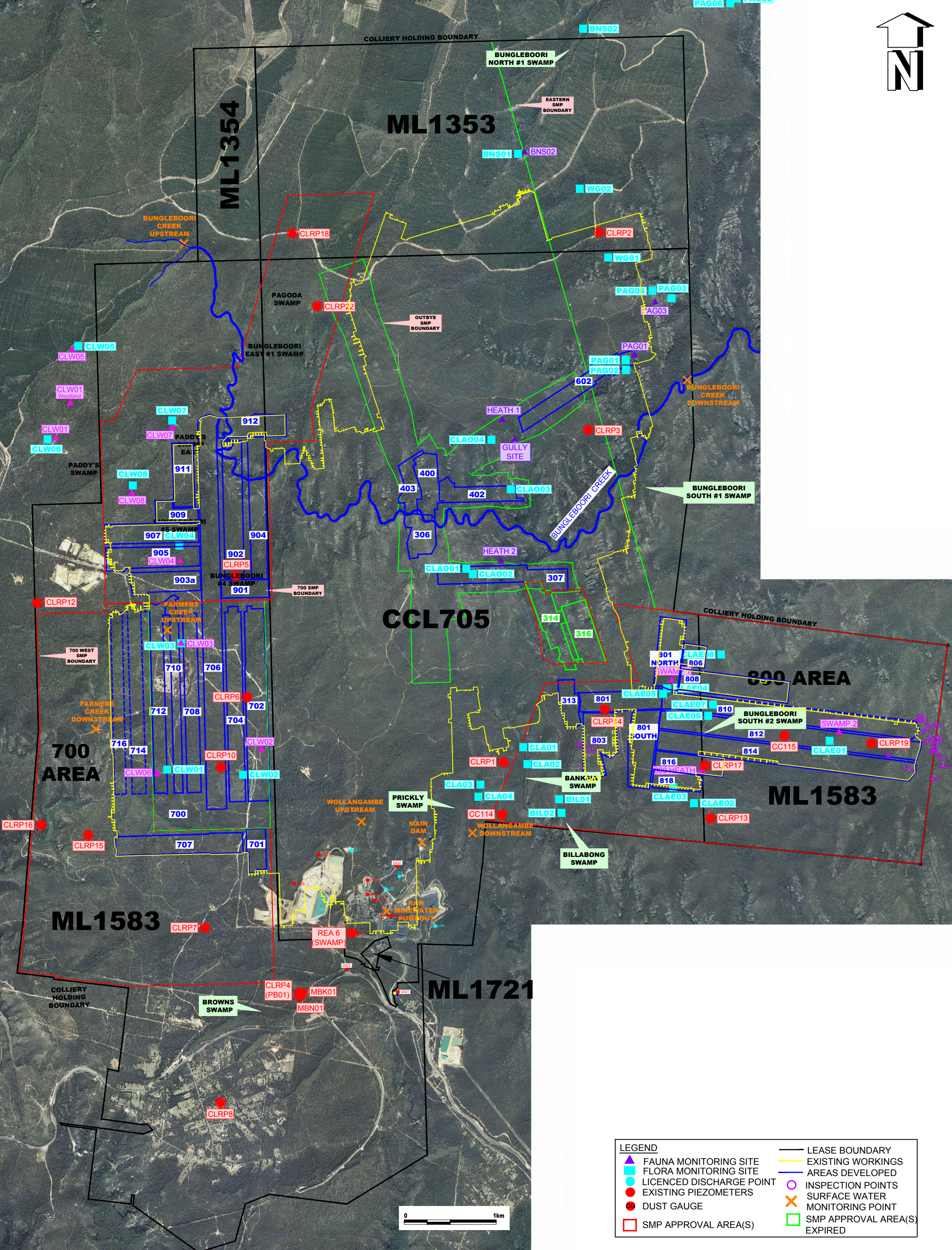
From the last reporting period there has been no need for early response or emergency procedures to ensure adequate management of potential subsidence impacts.

Attachment 1: Plans

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SUBSIDENCE LINES		WORKINGS		DATE	
—	609 PANELS	+	WORKINGS	02.11.2016	
—	611A,B,C PANELS	+	EXTRACTION	REFERENCE	
—	612 & 614 PANELS	+	COLLIERY HOLDING	N:\SHARED\PLANS\SUBSIDENCE\SMP_REPORT\ALL_SUBSIDENCES	
—	330 PANELS	+		SCALE AS SHOWN (1:12,000)	
—	611D,E PANELS	+			
—	605 PANEL	+			
—	302 PANEL	+			
—	402 PANEL	+			
—	307 PANEL	+			
—	707 PANEL	+			
—	PANEL 700 'A' LINE	+			
—	700 PANEL 'B' LINE	+			
—	700 PANEL 'C' LINE	+			
—	POWER POLES	+			
—	700 PANEL 'D' LINE	+			
—	700 PANEL 'E' LINE	+			
—	PANEL 716 'F' LINE	+			
—	900 AREA 'A' LINE	+			
—	800 AREA 'A' LINE	+			
—	810 PANEL 'B' LINE	+			
—	812 PANEL 'C' LINE	+			
—	900 AREA '903' LINE	+			
—	PANEL 814 'D' LINE	+			



LEGEND	
	FAUNA MONITORING SITE
	FLORA MONITORING SITE
	LICENCED DISCHARGE POINT
	EXISTING PIEZOMETERS
	DUST GAUGE
	SMP APPROVAL AREA(S)
	LEASE BOUNDARY
	EXISTING WORKINGS
	AREAS DEVELOPED
	INSPECTION POINTS
	SURFACE WATER MONITORING POINT
	SMP APPROVAL AREA(S) EXPIRED

DATE	24.11.2016
REFERENCE	N:\Shared\Plans\Environmental Panel_extraction_monitoring_CL618.dwg
SCALE	AS SHOWN

COMBINED SURFACE MONITORING POINTS



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