BAAL BONE COLLIERY
OPERATED BY THE WALLERAWANG COLLIERIES LIMITED

BAAL BONE COLLIERY
LW29-31 SMP Area

Subsidence Management Status Report No.16

for the period

7th December 2012 – 7th December 2013

December 2013

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1 INTRODUCTION

This Subsidence Management Status Report fulfils the requirements of Condition 19 of the Baal Bone Subsidence Management Plan (SMP) Longwalls 29 to 31 Approval Conditions. This is the sixteenth status report and covers the period 7 December 2012 to 7 December 2013.

Extraction of Longwall 31 (LW31) was completed on 3 September 2011.

Summaries of monitoring results post completion of LW 31 are presented in this report. Subsidence surveys, photographic monitoring and visual inspections were conducted in accordance with the approved Subsidence Monitoring Programs with environmental monitoring conducted in accordance with the approved Environmental Monitoring Programs.

2 PURPOSE AND SCOPE

The purpose of this document is to provide a summary of environmental and subsidence monitoring results, impacts, trends, analysis, the implemented management processes and consultation with relevant stakeholders following completion of mining in the LW 29-31 area. It also provides the opportunity for relevant stakeholders to provide feedback as required under the relevant approval Condition 19.

3 SUMMARY OF SUBSIDENCE MANAGEMENT ACTIONS

Subsidence management actions undertaken throughout this reporting period are outlined below.

1. Continuation of regular surface inspections.
2. Remediation of identified areas of surface cracking.
3. Continuation of ongoing groundwater quality monitoring programs.
4. Routine monitoring of groundwater piezometer levels.

4 CONSULTATION WITH STAKEHOLDERS

Consultation has been conducted with the following stakeholders during this reporting period:

- On 10 April 2013, Baal Bone colliery sought approval from the DTI Chief Inspector to fill and seal the South East up cast ventilation shaft located on ML1607 (ventilation shaft for longwalls 29-31). Approval was granted via a letter dated 30 April 2013.
- On 14 May 2013, Baal Bone colliery submitted a request to the Subsidence Executive Officer, requesting to discontinue visual inspections of surface watercourses and drainage lines, groundwater quality monitoring, and flora and fauna surveys of the SMP area.
- Notification of repairs to subsidence cracking areas across the SMP area was given to Forests NSW (landholders) on 4 June 2013. Work to remediate cracking areas was carried out during the period 11 – 20 June 2013.
- On 17 June 2013, notification regarding elevated levels of zinc at BBPB3 (groundwater monitoring bores in Cox's River Swamp) was provided to the Principal Subsidence Engineer and interagency Committee.
- On 5 December 2013, notification regarding elevated levels of zinc at BBPB3 and dissolved copper at BBPB4 was provided to the Principal Subsidence Engineer and interagency Committee.

5 SUMMARY OF SUBSIDENCE IMPACTS

Mining operations for LW 31 were completed in September 2011. Mining height was nominally 2.5m while seam thickness varies between 2.1m to 2.3m. Overburden ranges in thickness generally from 190m to 220m. The full extraction void is 220m wide (which includes the 5m width of development drivage both sides of the longwall block).

The only visible impacts associated with LW 31 observed was some tension cracking, as predicted, parallel to the gate roads and across the centre of the panel. Notification was provided, as required.

An Inspection Plan was developed, approved and implemented to identify, confirm and classify all cracking over the LW 29-31 area. Inspections were conducted and all cracking identified. A Risk Assessment was then conducted, including all relevant parties.

Following this, a Review of Environmental (REF) was prepared, including flora and fauna studies and remediation program. The REF was accepted by DTIRE and Forests NSW on 8 November 2012.

Subsidence crack remediation work was carried out as per the approved REF during June 2013.

Inspections were undertaken after the remediation work was completed on 20 June 2013 and again six months later on 2 December 2013 with generally good results across all sites. Additional non-mechanical works have been and will be carried out where remediation has not been satisfactory (soil slumping).

Monitoring of groundwater bores for both levels and quality has continued. During the reporting period zinc and copper levels were elevated above TARP triggers levels. This is further detailed in **Section 7.9**.

All required pre-mining, during-mining and post-mining subsidence surveys were completed in accordance with the Subsidence Monitoring Program. Survey results for subsidence, tilt and strain were generally below predicted levels. Some minor exceedances were noted and are detailed in **Section 6**.

No subsidence impacts were observed outside the nominated angle of draw on LW31.

Visual inspections and photographic monitoring of various surface features, including cliffs, roads, tracks and swamp vegetation were also completed, with no adverse or unpredicted impacts observed.

No subsidence impacts were noted generally in relation to flora and fauna.

6 SUBSIDENCE SURVEY SUMMARY, MONITORING AND ANALYSIS

All subsidence surveys and data monitoring as required by Baal Bone Colliery LW 29-31 SMP - Subsidence Monitoring Program (May 2009) have now been completed.

A record of all completed subsidence surveys during and post LW31 extraction period is shown in **Table 1**. Subsidence, tilt and strain results for the LW31 area were generally within the predicted range. A summary of subsidence, strain and tilt results are also detailed with comparison to the SMP predictions.

The minor exceedance on E Line over LW30 has previously been reported. The survey conducted on 23 September 2011 noted that this exceedance had increased to 126mm. The post mining survey conducted on 8 May 2012 noted a further increase of 14mm to a total of 142mm. The distance where this occurred is limited to a length of less than 50 metres.

Table 1 – Summary of Subsidence Survey Results

Line	Survey Date	SMP Prediction Subsidence (mm)	Measured Subsidence (mm)	SMP Prediction Strain (mm/m)	Measured Strain (mm/m)	SMP Prediction Tilt (mm/m)	Measured Tilt (mm/m)	SMP Prediction Horizontal Movement (mm)	Measured Horizontal Movement (mm)
E Line	10-03-2011	1400 – 1600	1638 (LW30)	9 – 21	14.2	32 – 52	27.1	400	216
E Line (LW 31)	12-07-2011		34		9.6		1.0		67
	14-07-2011		32		9.6		1.0		68
	21-07-2011		36		9.6		1.1		68
	26-07-2011		40		9.5		1.0		66
	28-07-2011		44		9.6		1.1		69
	02-08-2011		54		9.8		1.0		66
	05-08-2011		74		9.7		1.0		65
	08-08-2011		84		10.1		1.0		66
	10-08-2011		232		10.4		4.3		123
	12-08-2011		514		9.8		11.2		170
	17-08-2011		1245		9.5		37.5		
	19-08-2011		1340		11.9		42.4		234
	23-08-2011		1397		12.3		43.7		229
	25-08-2011		1415		12.3		43.7		244
	29-08-2011		1436		12.3		43.7		222
	23-09-2011		1726 (LW30)		13.8		43.2		242
	08-05-2012		1742 (LW30)		13.3		43.2		280

Line	Survey Date	SMP Prediction Subsidence (mm)	Measured Subsidence (mm)	SMP Prediction Strain (mm/m)	Measured Strain (mm/m)	SMP Prediction Tilt (mm/m)	Measured Tilt (mm/m)	SMP Prediction Horizontal Movement (mm)	Measured Horizontal Movement (mm)
F Line	21-01-2011	1400 – 1600	1418	9 – 21	12.0	32 – 52	26.1	400	333
	26-09-2011		1434		13.8		26.3		538 (LW29)
G Line	09-03-2011	1400 – 1600	50	9 - 21	2.3	32 – 52	0.9	400	61
	23-09-2011		58		2.5		0.9		44
H Line	21-01-2011	1300 – 1400	5	8 - 14	1.1	27 - 34	0.4	400	24
	06-04-2011		162		1.4		1.8		49
	08-04-2011		199		1.9		2.0		58
	12-04-2011		207		2.5		2.1		64
	15-04-2011		217		3.0		2.1		102
	29-04-2011		234		3.6		2.3		116
	12-05-2011		207		3.7		2.1		94
	26-05-2011		244		3.8		2.4		162
	23-09-2011		251		3.7		2.5		136

Line	Survey Date	SMP Prediction Subsidence (mm)	Measured Subsidence (mm)	SMP Prediction Strain (mm/m)	Measured Strain (mm/m)	SMP Prediction Tilt (mm/m)	Measured Tilt (mm/m)	SMP Prediction Horizontal Movement (mm)	Measured Horizontal Movement (mm)
I Line	21-01-2011	1300 - 1400	5	8 - 14	0.7	27 - 34	0.2		16
	06-04-2011		7		0.9		0.4		13
	08-04-2011		1		0.9		0.3		23
	12-04-2011		4		1.0		0.3		8
	15-04-2011		3		1.0		0.3		16
	29-04-2011		5		1.1		0,2		10
	12-05-2011		4		1.1		0.3		15
	26-05-2011		6		1.1		0.4		30
	23-09-2011		9		0.9		0.2		11

Line	Survey Date	SMP Prediction Subsidence (mm)	Measured Subsidence (mm)	SMP Prediction Strain (mm/m)	Measured Strain (mm/m)	SMP Prediction Tilt (mm/m)	Measured Tilt (mm/m)	SMP Prediction Horizontal Movement (mm)	Measured Horizontal Movement (mm)
J Line	12-07-2011	1300 - 1400	7		0.8		0.5		18
	14-07-2011		4		0.9		0.5		16
	21-07-2011		5		0.9		0.2		27
	26-07-2011		5		0.9		0.3		23
	28-07-2011		8		0.9		0.5		20
	02-08-2011		8		0.9		0.3		38
	05-08-2011		7		0.8		0.3		16
	08-08-2011		7		0.7		0.5		25
	10-08-2011		7		0.8		0.3		120
	12-08-2011		8		0.8		0.3		23
	17-8-2011		12		0.8		0.3		
	19-08-2011		9		0.7		0.4		32
	23-08-2011		8		0.7		0.2		40
	25-08-2011		12		0.9		0.3		17
	29-08-2011		13		0.7		0.3		34
	23-09-2011		15		0.7		0.3		23

Line Northern Pinch Point Reflectors	**Survey Date**	**SMP Prediction Subsidence (mm)**	**Measured Subsidence (mm)**	**SMP Prediction Strain (mm/m)**	**Measured Strain (mm/m)**	**SMP Prediction Tilt (mm/m)**	**Measured Tilt (mm/m)**	**SMP Prediction Horizontal Movement (mm)**	**Measured Horizontal Movement (mm)**
	04-04-2011		+6						12
	12-07-2011		+15						21
	14-07-2011		+14						16
	21-07-2011		+17						17
	26-07-2011		+14						25
	28-07-2011		+19						33
	02-08-2011		+14						43
	05-08-2011		+14						34
	08-08-2011		+17						38
	10-08-2011		+13						34
	12-08-2011		+12						36
	19-08-2011		+14						41
	23-08-2011		+13						39
	25-80-2011		+15						35
	29-08-2011		+14						35
	22-09-2011		+4						45
	08-05-2012		+9						33

Line Northern Pinch Point Prisms	**Survey Date**	**SMP Prediction Subsidence (mm)**	**Measured Subsidence (mm)**	**SMP Prediction Strain (mm/m)**	**Measured Strain (mm/m)**	**SMP Prediction Tilt (mm/m)**	**Measured Tilt (mm/m)**	**SMP Prediction Horizontal Movement (mm)**	**Measured Horizontal Movement (mm)**
	14-07-2011		1						6
	21-07-2011		8						8
	26-07-2011		5						21
	28-07-2011		2						25
	02-08-2011		6						34
	05-08-2011		7						27
	08-08-2011		6						26
	10-08-2011		9						29
	12-08-2011		9						24
	19-08-2011		6						29
	23-08-2011		9						27
	25-08-2011		2						22
	29-08-2011		6						21
	22-09-2011		10						33
	08-05-2012		13						24

Line Southern Pinch Point	**Survey Date**	**SMP Prediction Subsidence (mm)**	**Measured Subsidence (mm)**	**SMP Prediction Strain (mm/m)**	**Measured Strain (mm/m)**	**SMP Prediction Tilt (mm/m)**	**Measured Tilt (mm/m)**	**SMP Prediction Horizontal Movement (mm)**	**Measured Horizontal Movement (mm)**
Reflectors	06-04-2011		14						10
	08-04-2011		14						9
	12-04-2011		14						8
	15-04-2011		17						9
	29-04-2011		14						7
	12-05-2011		12						10
	26-05-2011		15						10
	22-09-2011		14						10
	08-05-2012		14						9
Prisms	06-04-2011		1						8
	08-04-2011		1						7
	12-04-2011		1						6
	15-04-2011		2						7
	29-04-2011		1						4
	12-05-2011		2						5
	26-05-2011		3						9
	22-09-2011		2						9
	08-05-2012		2						8

7 ENVIRONMENTAL MONITORING SUMMARY AND ANALYSIS

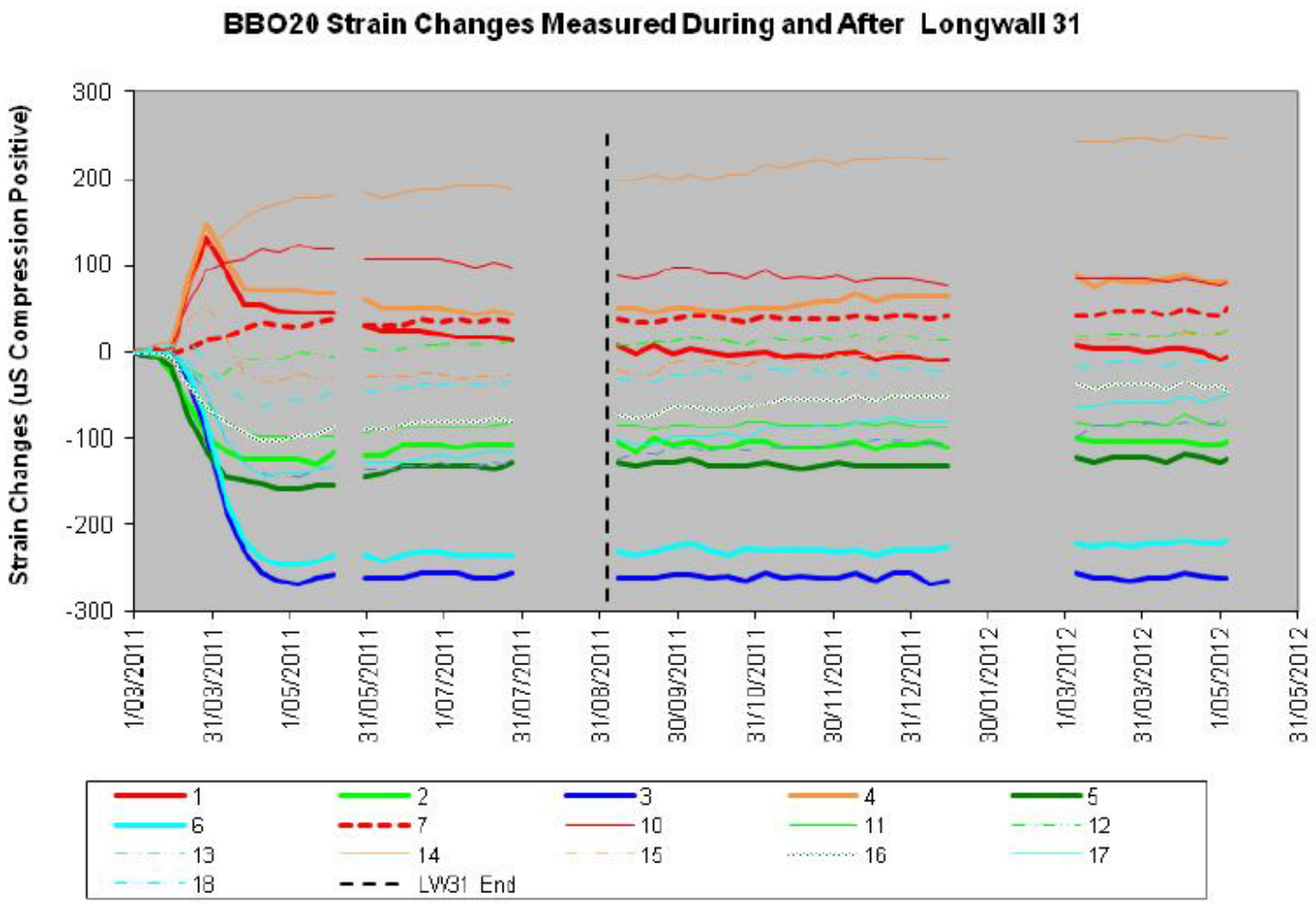
7.1 Wolgan Escarpment – Stress Cell Monitoring

Stress cell monitoring as required by Baal Bone Colliery LW 29-31 SMP - Subsidence Monitoring Program (May 2009) has now been completed.

Stress change monitoring instruments were been installed and commissioned in the vicinity of the two pinch points on LW31. Stress changes in the rock strata were monitored using a remote logger as Longwalls 29, 30 and 31 were progressively extracted. Stress cells were logged on a twice daily cycle and the information was downloaded periodically.

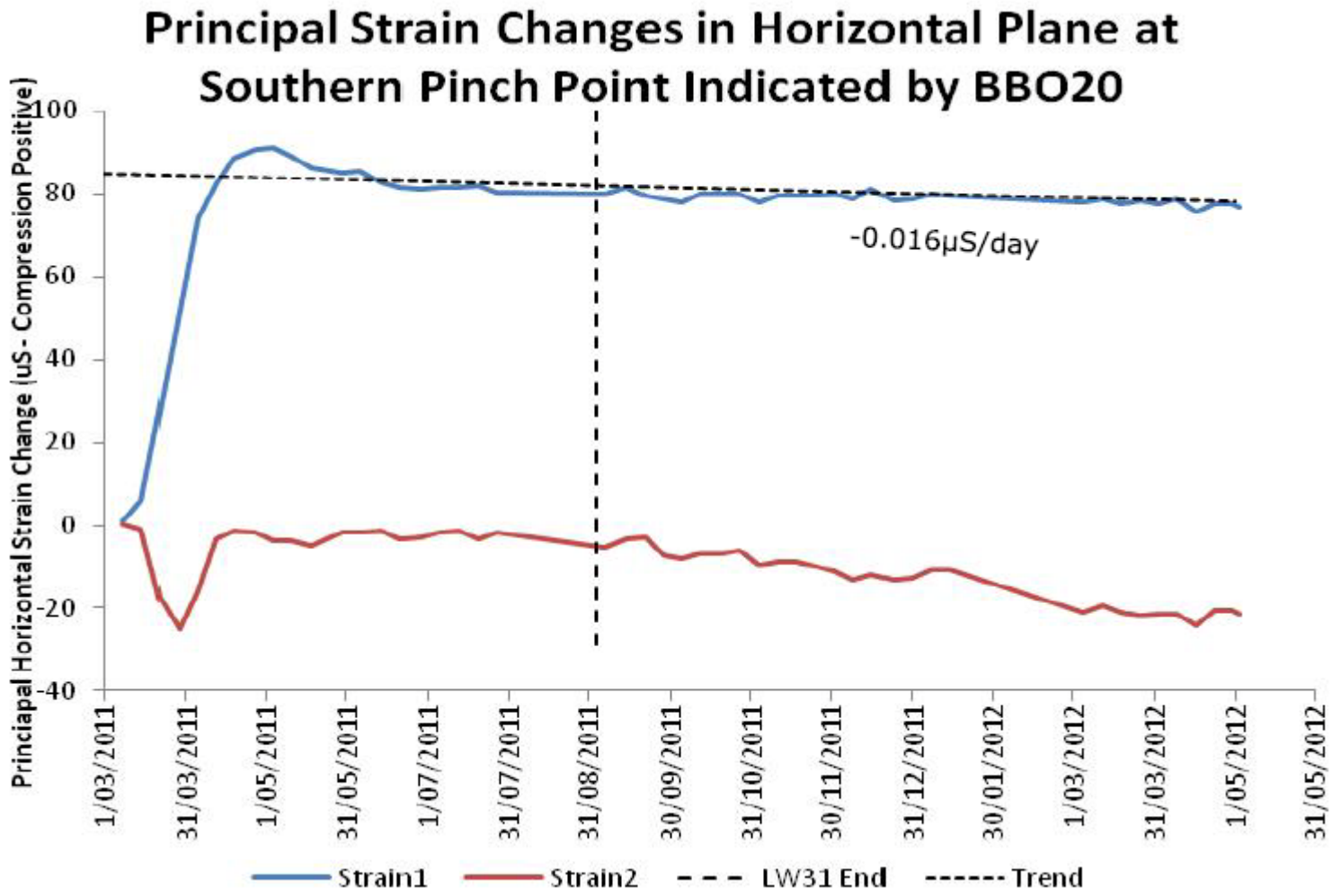
A summary of observations from completed stress cell monitoring can be found in **Figure 1** through to **Figure 8**.

Figure 1 - BBO20 Strain Changes Measured During and After Longwall 31



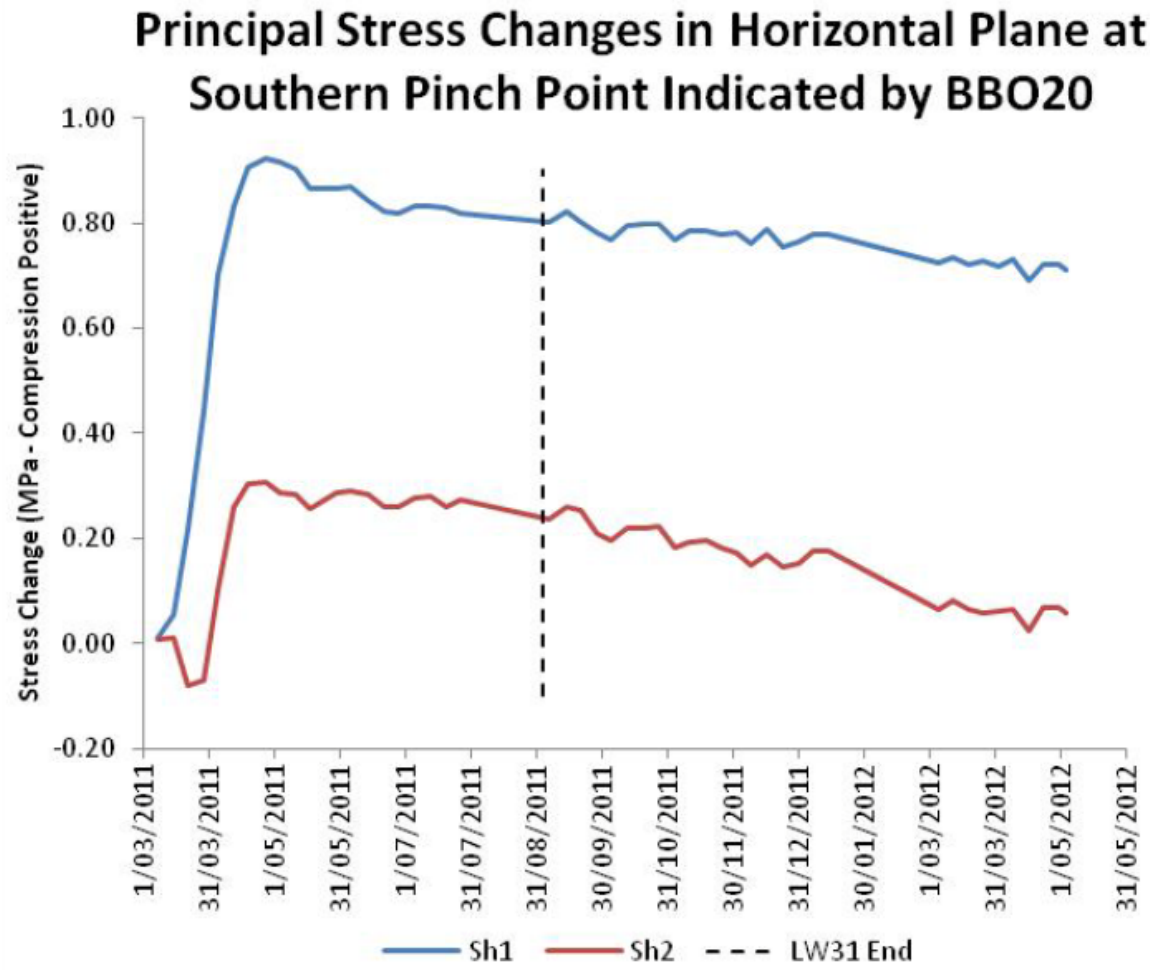
Source: Update to 3 May 2012 of Stress Cell Monitoring – LW31 at Baal Bone Colliery – Ken Mills (SCT Operations)

Figure 2 – Principal Strain Changes in Horizontal Plane at Southern Pinch Point Indicated by BBO20



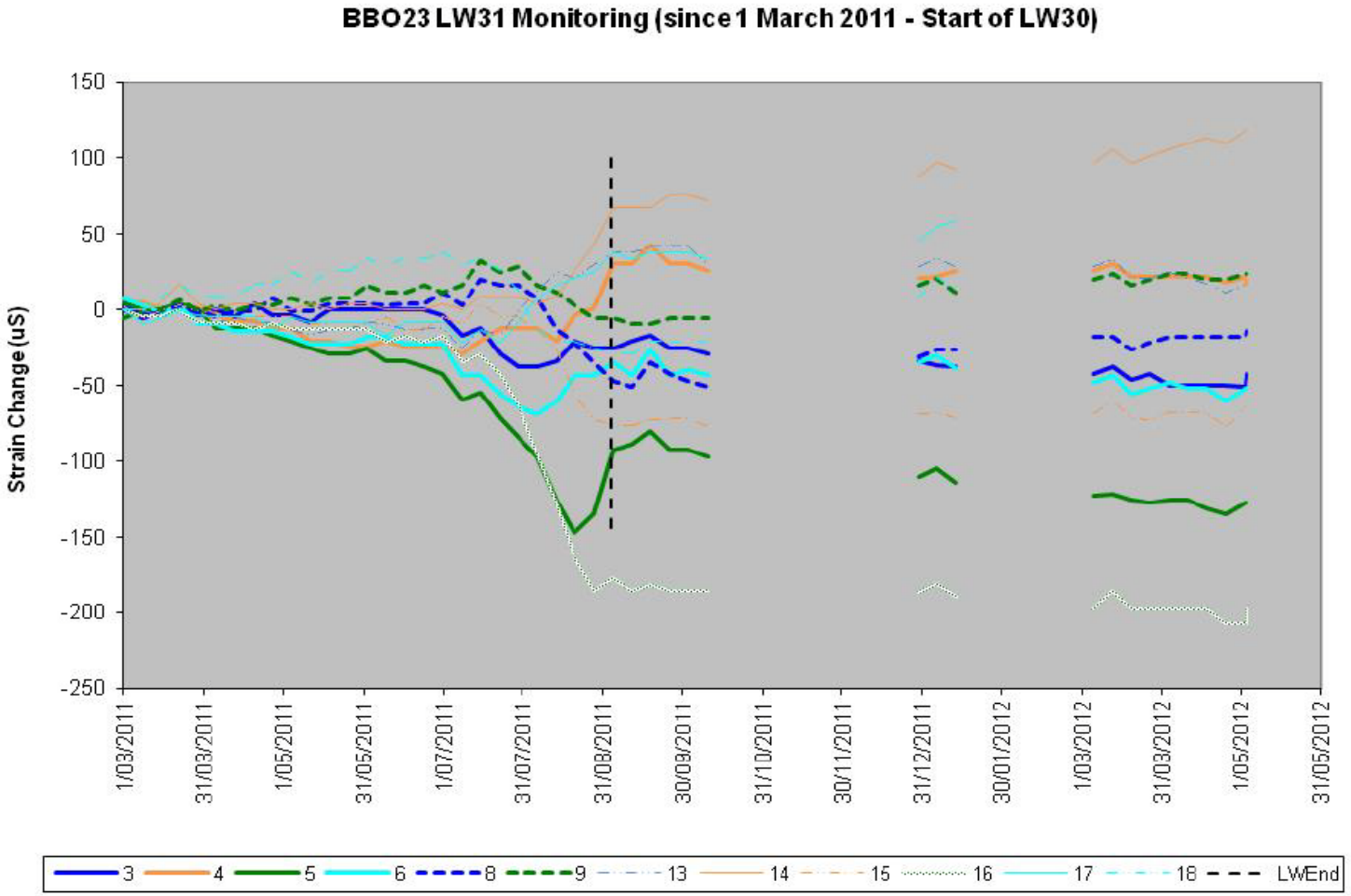
Source: Update to 3 May 2012 of Stress Cell Monitoring – LW31 at Baal Bone Colliery – Ken Mills (SCT Operations)

Figure 3 – Principal Stress Changes in Horizontal Plane at Southern Pinch Point Indicated by BBO20



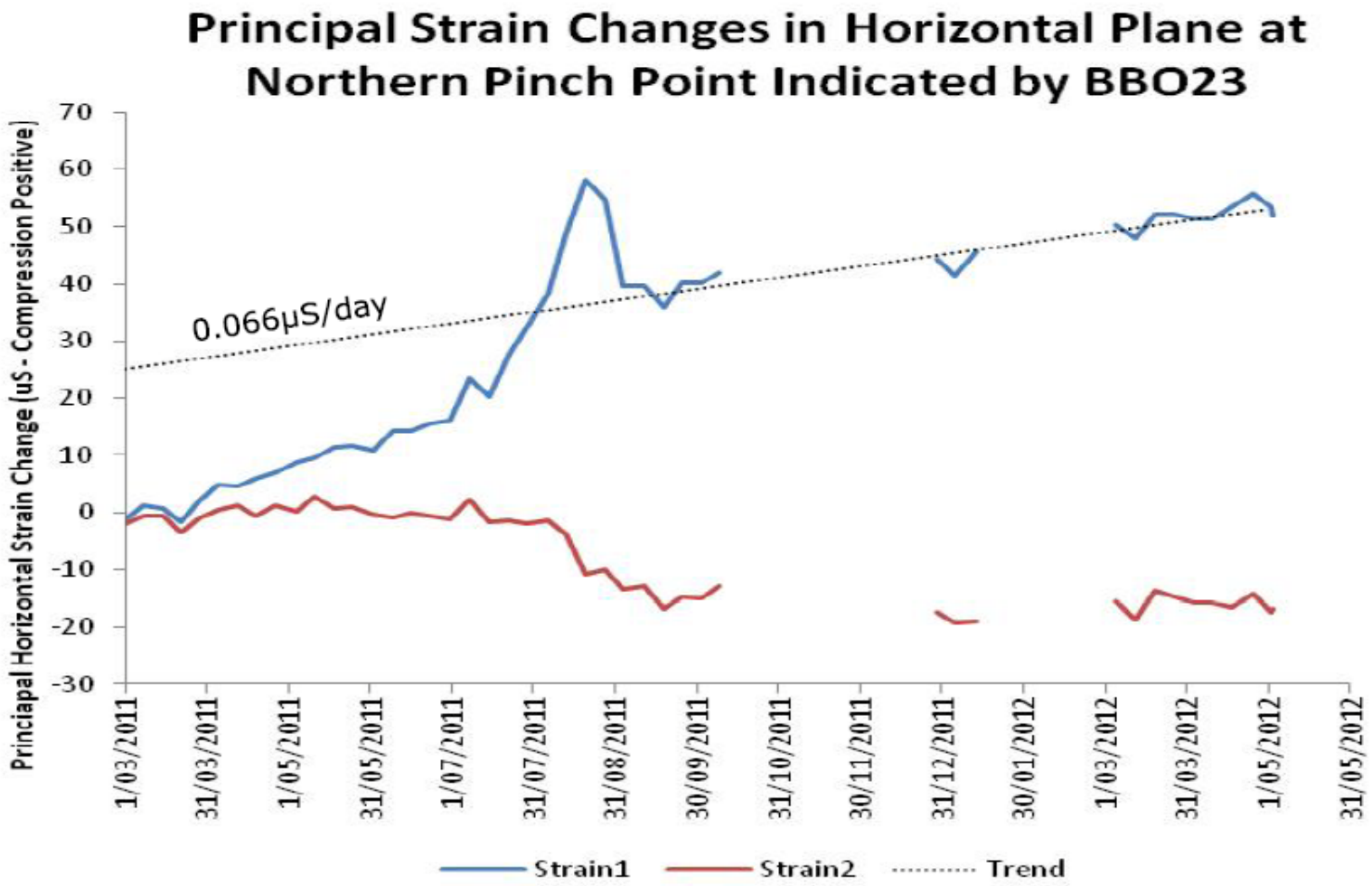
Source: Update to 3 May 2012 of Stress Cell Monitoring – LW31 at Baal Bone Colliery – Ken Mills (SCT Operations)

Figure 4 – BBO23 LW31 Monitoring Since 1 March 2011



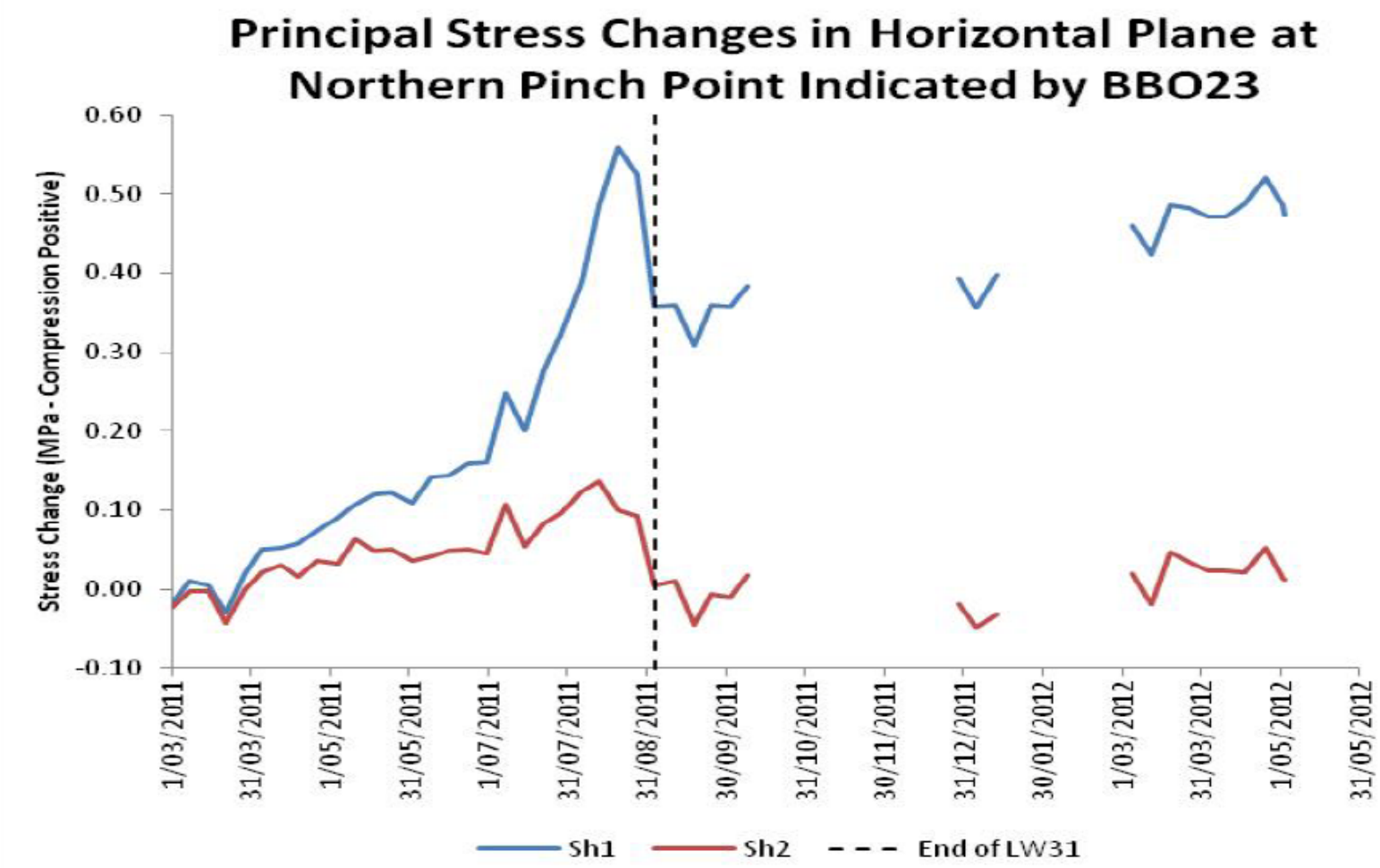
Source: Update to 3 May 2012 of Stress Cell Monitoring – LW31 at Baal Bone Colliery – Ken Mills (SCT Operations)

Figure 5 – Principal Strain Changes in Horizontal Plane at Northern Pinch Point Indicated by BBO23



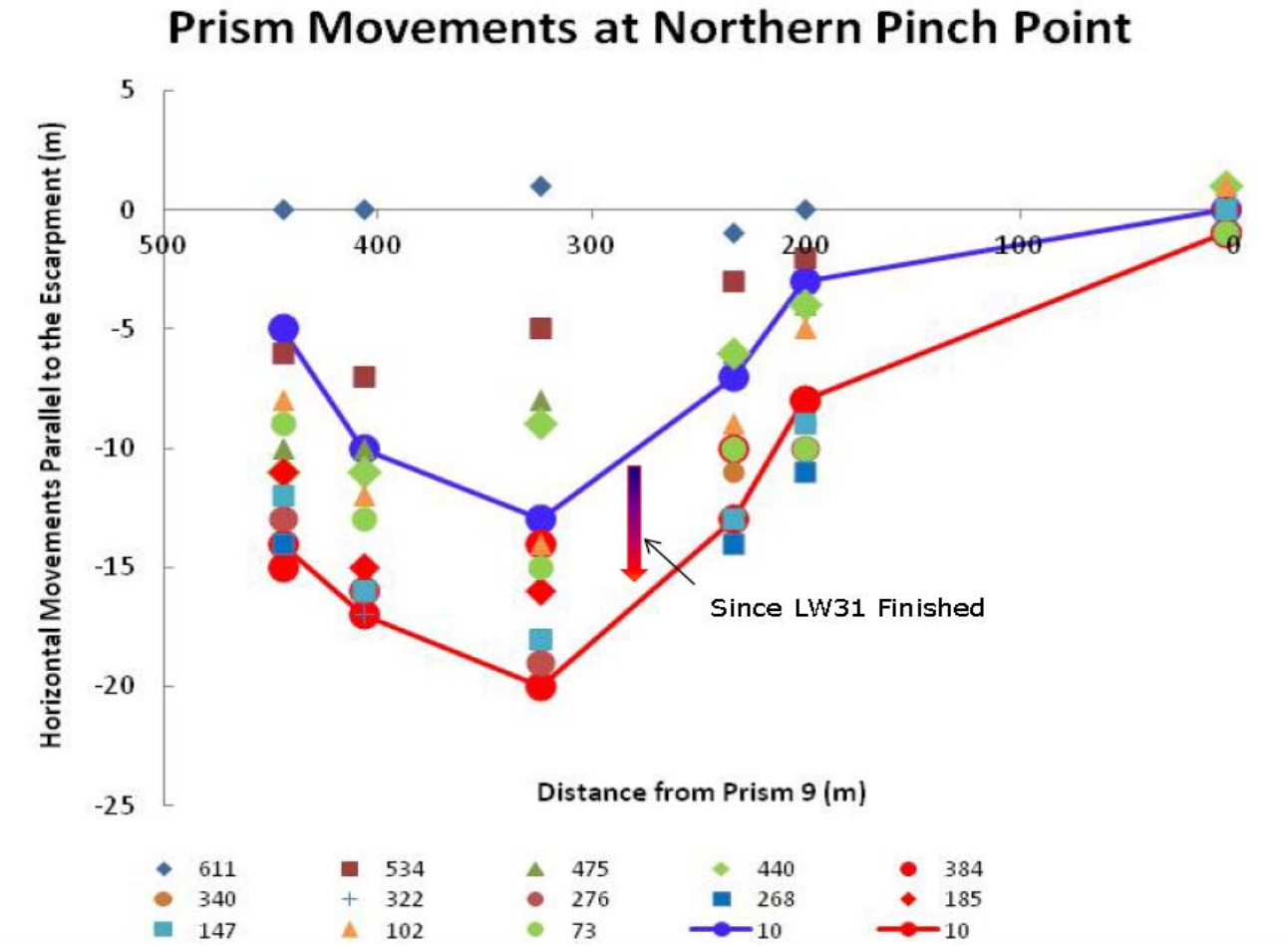
Source: Update to 3 May 2012 of Stress Cell Monitoring – LW31 at Baal Bone Colliery – Ken Mills (SCT Operations)

Figure 6 – Principal Stress Changes in Horizontal Plane at Northern Pinch Point Indicated by BBO23



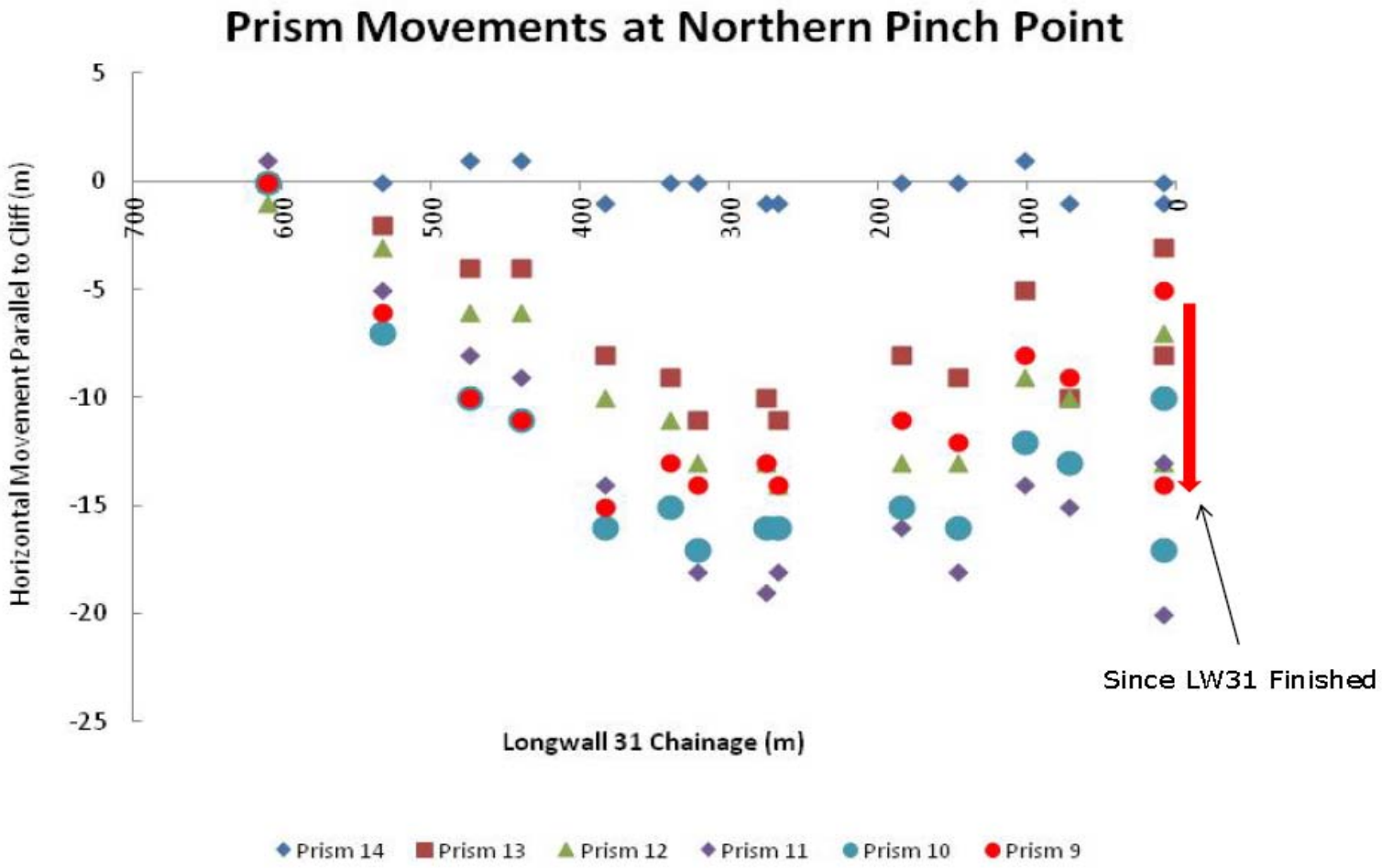
Source: Update to 3 May 2012 of Stress Cell Monitoring – LW31 at Baal Bone Colliery – Ken Mills (SCT Operations)

Figure 7 – Prism Movements at Northern Pinch Point



Source: Update to 3 May 2012 of Stress Cell Monitoring – LW31 at Baal Bone Colliery – Ken Mills (SCT Operations)

Figure 8 – Prism Movements at Northern Pinch Point



Source: Update to 3 May 2012 of Stress Cell Monitoring – LW31 at Baal Bone Colliery – Ken Mills (SCT Operations)

7.2 Rock Features

All rock feature and subsidence surveys as required by Baal Bone Colliery LW 29-31 SMP -Subsidence Monitoring Program (May 2009) and Land Management Plan (June 2009) have now been completed.

To date there have been no adverse or unpredicted subsidence impacts on identified rock features in the vicinity of the SMP area.

7.3 Surface Drainage Depressions

All surface drainage depression inspections as required by Bone Colliery LW 29-31 SMP - Environmental Monitoring Program (May 2009) have now been completed.

To date there has been one unpredicted subsidence impact observed on surface drainage depressions within the SMP area, in LW 30, details of which were included in previous Status and End of Panel Report**.** Apart from this incident some minor fractures, within predicted ranges and below TARP trigger values, as identified in the SMP Environmental Monitoring Program, have been identified.

Inspections of the area during or immediately following runoff producing rainfall events (i.e. 25mm / 24 hour period) continued during longwall mining; there has been no observable change to pre-mining flow characteristics and/or stream morphology during this reporting period.

7.4 Fire Trails and Tracks

All fire trails and track surveys as required by Baal Bone Colliery LW 29-31 SMP - Land Management Plan (June 2009) have now been completed.

To date there have been no subsidence impacts on any fire trails or tracks in the SMP area.

7.5 Swamp

As scheduled in the Baal Bone Colliery LW 29-31 SMP - Environmental Monitoring Program (May 2009), seasonal photographic monitoring of the Coxs River Swamp has been discontinued since the cessation of mining.

Monitoring completed to date indicate that seasonal variations in swamp appearance are consistent with those observed during pre-mining assessments, particularly when antecedent ground moisture levels are taken into consideration. These observations are confirmed by the results of the seasonal flora and fauna monitoring programs.

7.6 Fauna

All fauna studies as required by Bone Colliery LW 29-31 SMP - Environmental Monitoring Program (May 2009 have now been completed

Four sites within and near the Baal Bone Colliery Longwall 29-31 SMP Area were surveyed for fauna by Biodiversity Monitoring Services during September 2011. Three of these sites have been surveyed since 2005.

No survey was conducted during the reporting period. Listed below is a summary of the 2011 fauna monitoring.

A total of 20 native mammal (plus three introduced), 58 bird, five reptile and three amphibian species have been located within or near Longwall 29-31 SMP Area at Baal Bone Colliery during 2011. The list of fauna species located during the 2011 surveys in the SMP Area provides a total assemblage of species located within Baal Bone Colliery and LW29-31 SMP Area over the years. At present, 30 native mammal, 95 bird, 14 reptile and six amphibian species are known to occur within the LW29-31 SMP Area.

The number of birds, native mammals, reptile and amphibian species located in 2011 was similar to that located in earlier years. As expected with continued surveys, the number of species located within the SMP area has increased over the years. It is expected that the number of new species located each year will continue to increase and finally level out. Then the final overall species richness can be calculated from the final slope of the asymptote.

New species located during 2011 are the Eastern Pygmy-possum, House Mouse, Large Forest Bat, White-necked Heron, Buff-banded Rail, Golden-headed Cisticola, Beautiful Firetail, White's Rock-skink, Bibron's Toadlet and the Giant Dragonfly.

Overall there have been 11 threatened species located within the LW29-31 SMP Application Area at Baal Bone Colliery as a result of surveys since 2005. In 2011, the following threatened species were located: Gang-gang Cockatoo, Scarlet Robin, Varied Sittella, Eastern Pygmy-possum, Little Pied Bat, Eastern False Pipistrelle, Eastern Bent-wing Bat, Greater Broad-nosed Bat. The first three species are part of a suite of threatened species that are listed partly because of their declining population status within the western slopes of NSW. This area (called the sheep-wheat belt) has undergone extensive clearing and much of the woodland habitat preferred by these species has been lost. However, in the Newnes Plateau region woodland habitat has been retained (albeit logged), and such bird species are still to be located. None of these threatened bird species would be directly affected by subsidence-induced changes to their preferred habitat.

Two new threatened species were located during the 2011 surveys, the Eastern Pygmy-possum and the Giant Dragonfly. Both were associated with Long Swamp, with the Eastern Pygmy-possum pit-trapped in a stand of banksia close to the swamp and at least five Giant Dragonflies were observed flying over Long Swamp close to piezometer BBP5.

The Giant Dragonfly is listed as Endangered under the NSW TSC Act.

Table 2: Result from Analysis of Data from 2006 to 2011

BIODIVERSITY INDICES	SIGNIFICANT DIFFERENCES BETWEEN PRE AND POST MINING
Species richness of faunal groups	NO
Diversity indices of faunal groups	NO
Capture rates of individual species	NO
Contribution to the faunal assemblages by species dependant upon woodland	NO
Contribution to the faunal assemblages by species declining in the Central West	NO
Habitat complexity scores	NO

Conclusions

The configuration of survey sites established in previous years adequately samples the three major environments within Baal Bone SMP Application Area i.e. woodland, swamp and creekline. These sites will provide the best possible data for the long-term monitoring of terrestrial vertebrates. The survey

techniques used have been successful in locating a wide range of species, including new records for the Newnes Plateau region.

The accumulation of data from the on-going surveys makes it possible to track changes to the terrestrial vertebrate fauna within the Baal Bone Colliery SMP Application Area during and after mining activities. At present, there appears to be no evidence of any significant effects from subsidence upon the fauna diversity at Baal Bone Colliery.

It should be noted that a number of Giant Dragonflies were located at Long Swamp during the 2011 surveys. The combination of wet weather and warm conditions during this year's summer would have encouraged the breeding of this endangered species. Long Swamp and the adjoining littoral vegetation can be considered to be of importance in terms of the number of threatened species located there (six in 2011).

7.7 Flora

All flora studies as required by Bone Colliery LW 29-31 SMP - Environmental Monitoring Program (May 2009 have now been completed

Systematic vegetation monitoring quadrats were established within the SMP area in January 2007.

Prior to the establishment of monitoring sites the SMP area was the subject of a flora survey conducted over a 3 day period in October 2005.

No survey was conducted during this reporting period. A summary of the 2011 results is included.

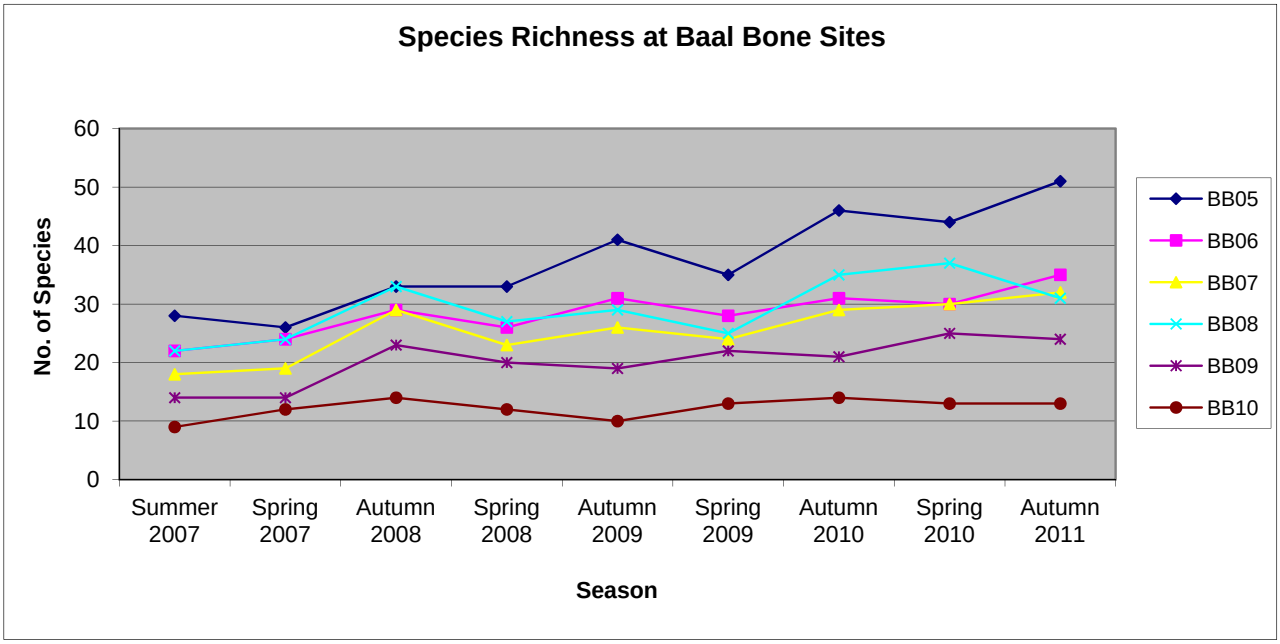
Each seasonal survey involves recording of vegetation structure, dominant species, estimated cover and height for each stratum, full floristics, an estimated cover abundance for each species using the modified Braun-Blanquet scale and condition of common species using the condition scale. Observations of general condition of the surface environment, stream water flow and quality are also made where relevant.

Results

Plant Species Diversity

Species diversity results show that levels of species diversity recorded in 2011 were at the higher end or above the previously recorded range at each site. **Figure 9** shows species richness recorded across all sites during spring and autumn since the baseline data was obtained.

Figure 9 - Species Richness at Baal Bone Vegetation Monitoring Sites



Discussion

The vegetation monitoring being undertaken is conducted in a manner which allows assessment against a number of indicators which may provide evidence of an effect of subsidence. These indicators are:

- a decline in diversity and abundance of plant species which typically are associated with wet, sheltered areas
- an increase in diversity and abundance of plant species which typically occur in forests or woodlands in locations initially supporting species characteristic of more sheltered communities
- an increase in diversity and abundance of exotic species or native species favoured by disturbance
- unusual variation in species diversity
- decline in condition of plant species known to be sensitive to changes in water availability.

Changes in these indicators may also result from prevailing climatic conditions and other disturbances independent of mining such as bushfires, logging operations, recreational activities and feral animals.

Gross species diversity records do not necessarily provide a clear indication of an effect of mining. Experience from other mines in the Lithgow area indicates that there is a seasonal response, with grasses, orchids and other ground layer plants being detected in spring, summer and autumn, but not winter.

The levels of species richness and weed growth are all consistent with a response to rainfall. There has been no evidence which would indicate an effect of subsidence on vegetation distribution and abundance at the monitoring sites.

7.8 Groundwater - Levels

Aurecon monitors data loggers in the six piezometers on a regular basis to gather baseline data regarding groundwater level fluctuations in the vicinity of the Coxs River Swamp. Baseline data obtained prior to commencement of mining confirms a strong correlation between groundwater levels and prevailing climatic conditions, most particularly the relationship to rainfall.

Long term groundwater level trends are shown in **Figure 10**. Groundwater levels have remained reasonably level over the current reporting period however declining groundwater trends continued since February 2013, due to below average rainfall across 2013.

Piezometers BBPB5 and BBPB6 (located within Coxs Creek Swamp) generally remained stable up until August – September 2013, and then maintained a declining trend as the weather became drier.

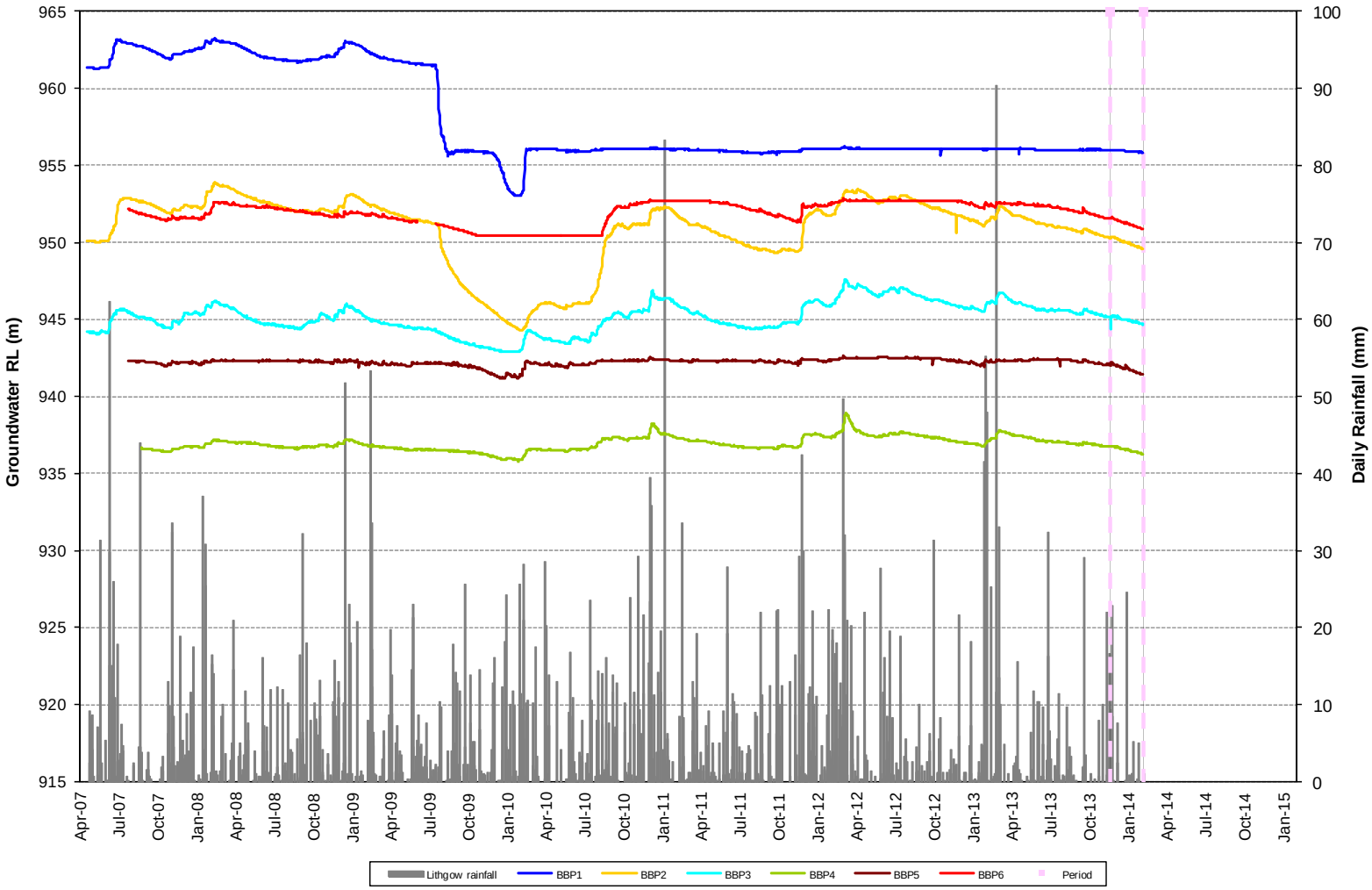
The piezometers located outside of the swamp, BBPB2, BBPB3, and BBPB4 normally display the greatest variation, as they are more predominately influenced by rainfall. However there is not a marked difference between these instruments and those located in the swamps during the reporting period. This is interpreted to be due to the very dry conditions.

The north to south downstream groundwater gradient has been maintained over the current period (highest level observed in BBPB1 and lowest level observed in BBPB4), indicating that an overall flow has been maintained down through the swamp. The gradient between piezometers BBPB6 and BBPB2 is towards the north, indicating that there may be a temporary disconnect (or pooling) occurring in this area, due to the prevailing dry conditions in 2013.

All groundwater levels appear to be approximately at (or above) pre-mining levels, with the only exception being at piezometer BBPB1, where a groundwater level has re-stabilised at RL 956 m (approximately 5 m below pre-mining level).

There is no observable impact on groundwater due to mining for the reporting period.

Figure 10 – Coxs River Swamp Groundwater Levels



7.9 Groundwater – Quality

ALS Environmental collects groundwater samples for quality analysis from the six bores on a monthly basis (**Figures 11 through 15**).

During the reporting period (December 2012 to December 2013) all analytes remained within Trigger Action Response Plan (TARP) levels with the exception of elevated levels of zinc at BBPB3 (**Figure 15**) and copper at BBPB4 (**Figure 11**).

The zinc exceedance at BBPB3 is classified as a major impact (i.e. Zn > 0.175 mg/L for > 2 consecutive months). BBPB4 has seen an exceedance in copper levels, classified as a major impact (i.e. Cu > 0.043 mg/L for > 2 consecutive months).

Figure 11 shows that copper levels at BBPB4 exceeded the major impact trigger level (0.043mg/L) from September through to December 2013 - therefore a major impact TARP event. It should be noted that BBPB4 is a background bore and its purpose is to provide a benchmark for comparison with the other potentially affected monitoring bores. BBPB4 is an aquifer groundwater bore and is not located within the Cox's River Swamp. BBPB4 is located approximately 70 metres to the west of the wetland in an area where no subsidence was expected to occur.

The 2013 copper increases coincided with similar events during the 2012 monitoring period where copper levels increased from July - October 2012.

In February 2012 Baal Bone Colliery commissioned a report by Aurecon which investigated groundwater quality and the TARP trigger levels:

> *Groundwater Level and Water Quality Changes compared to TARP Trigger Values in and around the Coxs River Swamp from 2009 to 2011 for SMP Area LW29-31 (Aurecon, March 2012).*

A copy of the Aurecon report was provided to the Principal Subsidence Engineer, Subsidence Executive Officer and NSW Office of Water in March 2012.

The Aurecon report found that copper levels increased during spring each year, suggesting a biological process. Aurecon stated that:

> "The release of trace metals from wetland soils to the local groundwater is known to occur as a result of biological degradation of organic matter. The decaying organic matter releases carbon dioxide, which forms carbonic acid in the groundwater. The acid conditions reduce the alkalinity such that the water is poorly buffered and the trace metals are released (Schaller et.al. 2011 and Maltby 2009)."

In response to the major impact TARP event of copper at BBPB4 between September to December 2013, Baal Bone Colliery submitted a formal notification to the Principal Subsidence Engineer and Department of Planning and Infrastructure on 5 December 2013.

Figure 15 shows that zinc levels at BBPB3 exceeded the major impact TARP trigger levels during all months during the reporting period. This major impact TARP event has continued since August 2012.
The Aurecon (March 2012) report investigated the minor impact increases in zinc at BBPB3 which occurred during the previous reporting period however was unable to find obvious reasons for these increases. The Aurecon investigation suggested that variable rainfall and corresponding changes in groundwater levels could be contributing to changes in zinc levels.

In response to the major impact TARP event at BBPB3, Baal Bone Colliery submitted an initial formal notification to the Principal Subsidence Engineer and Interagency Committee on 5 December 2012. With the continuation of the TARP major impact levels, further formal notifications were issued to the Principal Subsidence Engineer and interagency committee on 17 June and again on 5 December 2013.

All other piezometers were well below the TARP trigger levels for Zinc.

Figure 11 – Cox's Swamp Piezometer Reading - Copper (filterable)

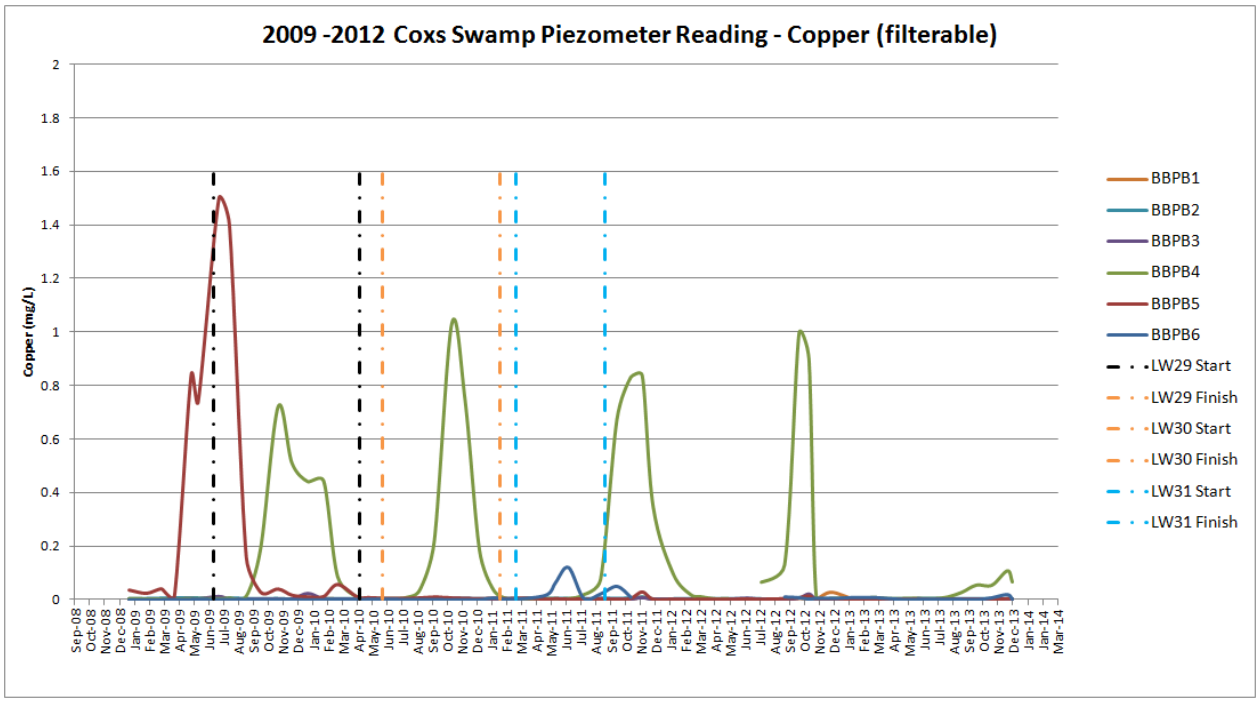


Figure 12 – Cox's Swamp Piezometer Reading – Electrical Conductivity

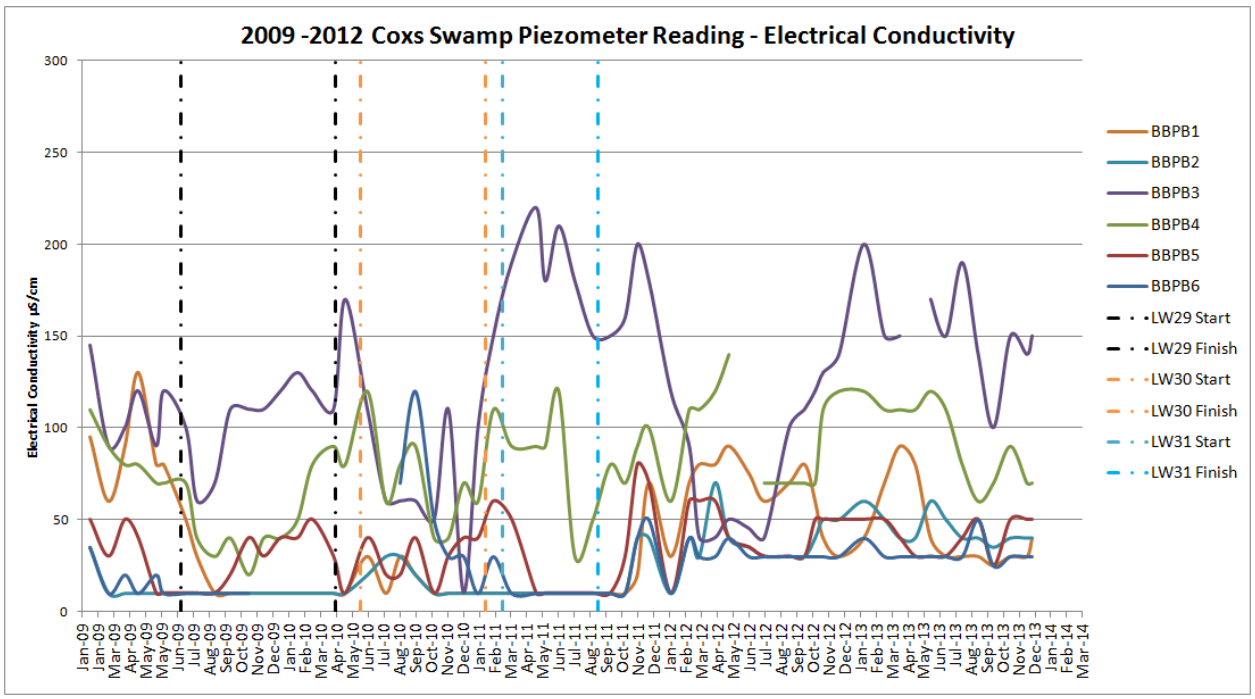


Figure 13 – Cox's Swamp Piezometer Reading – pH

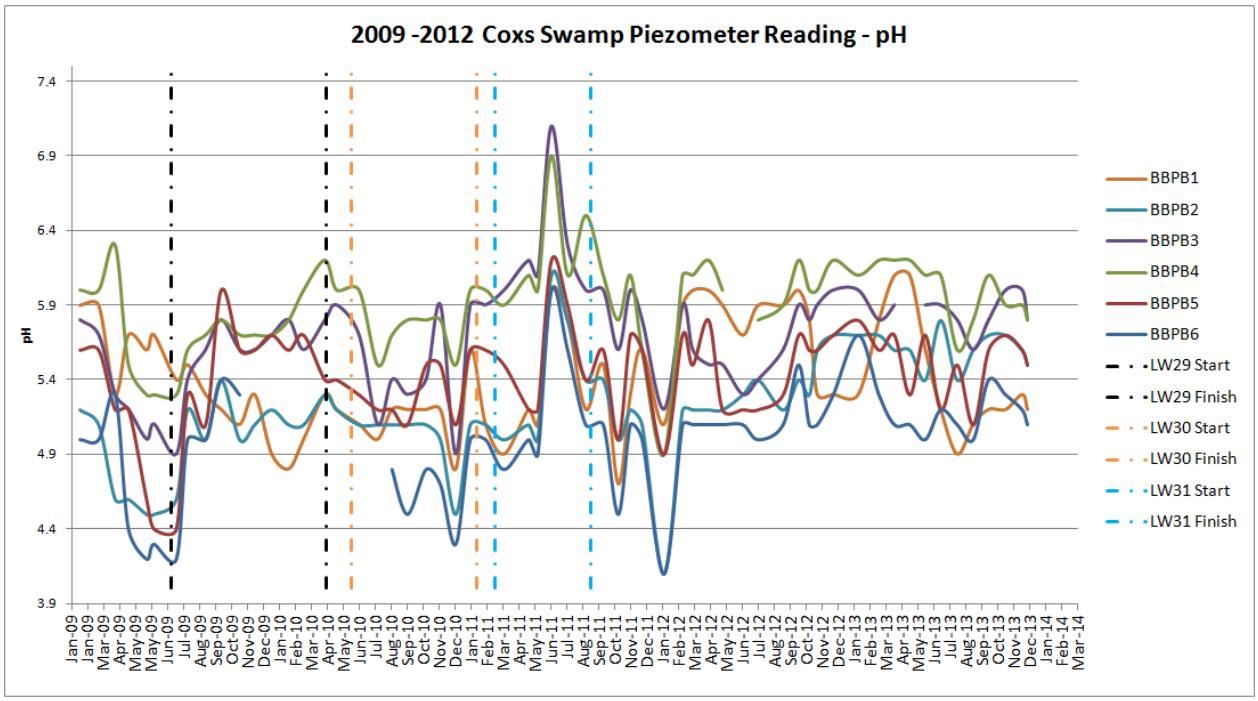


Figure 14 – Cox's Swamp Piezometer Reading - Iron (filterable)

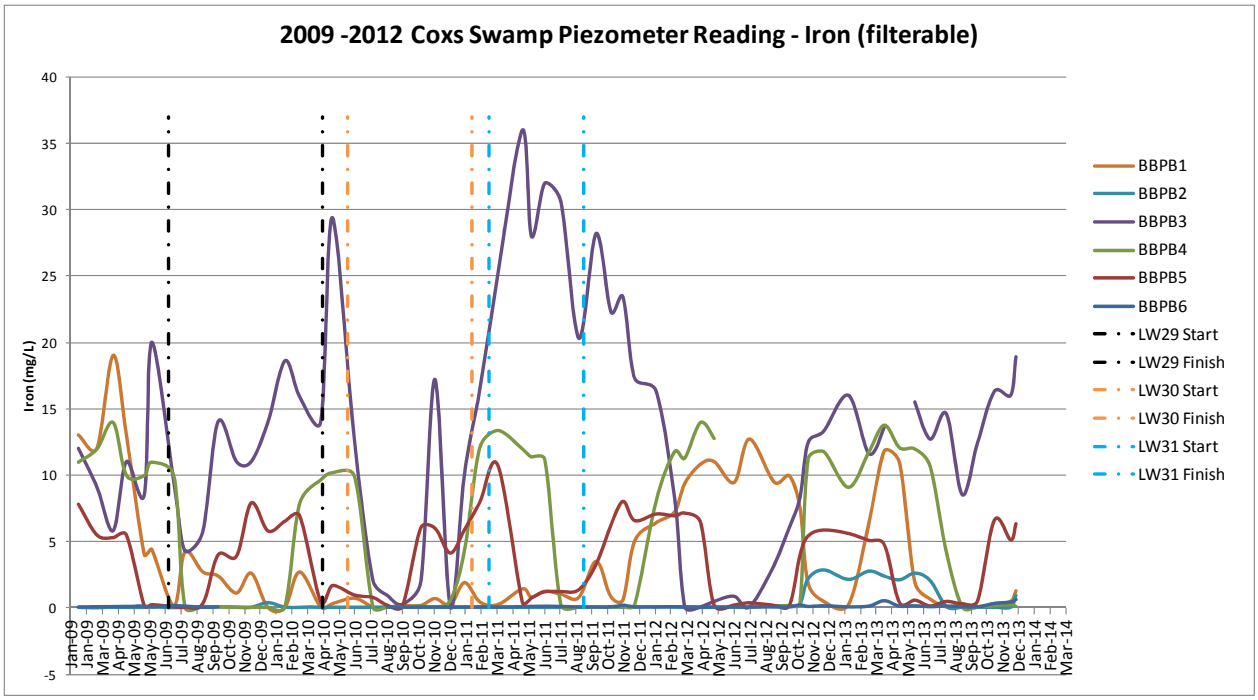
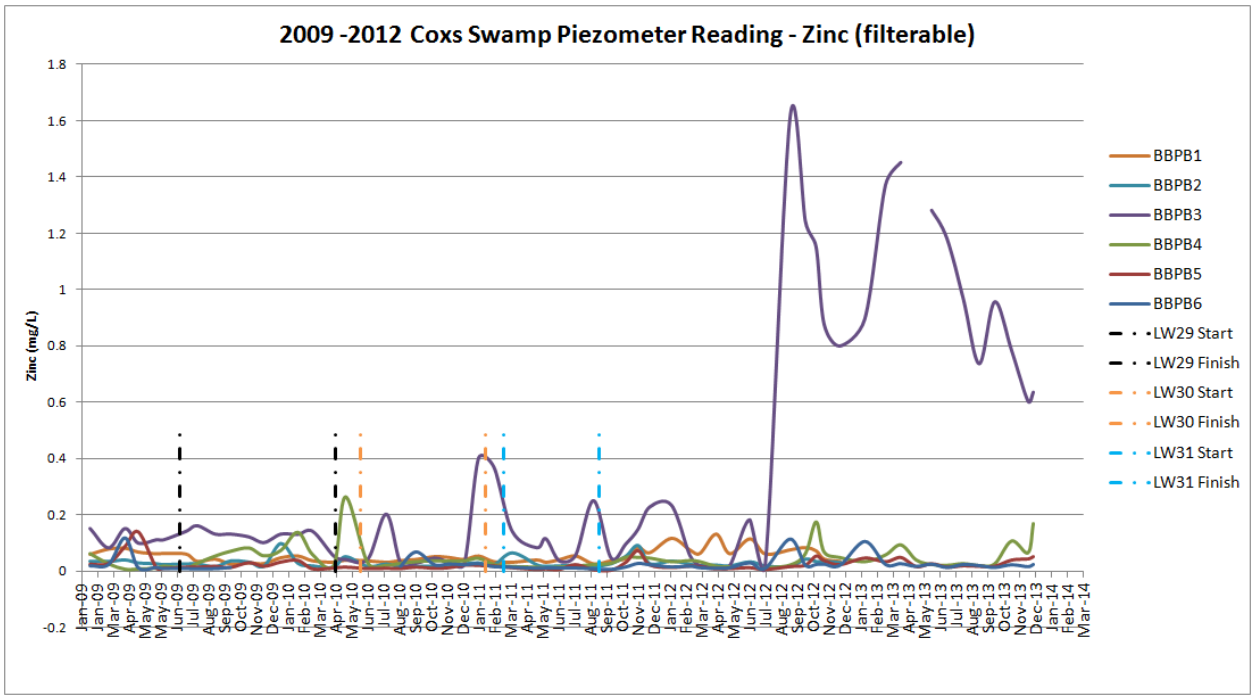


Figure 15 – Cox's Swamp Piezometer Reading - Zinc (filterable)



8 TRENDS IN MONITORING RESULTS

Pre, during and post Longwall 31 extraction, routine scientific and survey monitoring of impacts on rock features and escarpments have been completed. Monitoring of surface and groundwater regimes continued. Though there have been two minor exceedances relating to subsidence and horizontal movement, these have been located over LWs 29 and 30. Monitoring results over LW31 were within expected / predicted parameters and displayed no discernable trends.

9 ADEQUACY, QUALITY AND EFFECTIVENESS

The adequacy, quality and effectiveness of the implemented management response processes, based on compliance with approval conditions, are considered to be satisfactory to date. Notification, consultation and development of an inspection program and remediation program with regard to the surface cracking are also considered to be appropriate and effective.

10 PROPOSED ADDITIONAL / OUTSTANDING MANAGEMENT ACTIONS

Repairs to surface cracking above LW 29-31 was carried out in June 2013. Remediation works will be monitored throughout 2014 to determine the success of the remediation and carry out additional work where required.

11 CONCLUSIONS

During the reporting period (December 2012 to December 2013):

Monitoring of groundwater bores for both levels and quality has continued with no observable major impact on groundwater levels due to mining. Exceedances in zinc at BBPB3 and copper at BBPB4 were registered during 2012 and 2013 and reported. Formal notifications were issued to the Principal Subsidence Engineer and interagency committee on 17 June 2013 and 5 December 2013.

As determined by investigations carried out by Aurecon, it is believed that fluctuations of trace metals in the monitoring piezometers are attributed to natural and biological processes and not with impacts of mining.

A LW 29-31 Inspection Plan was developed, approved and implemented to identify, confirm and classify all cracking over the LW 29-31 area. Inspections were conducted and all cracking identified. A Risk Assessment was then conducted, including all relevant parties.

Following this, a Review of Environmental (REF) was prepared, including flora and fauna studies and remediation program. The REF was accepted by DTIRE and Forests NSW on 8 November 2012.

Subsidence crack remediation work was carried out as per the approved REF during June 2013.

Inspections were undertaken after the remediation work was completed on 20 June and again six months later on 2 December 2013 with generally good results across all sites. Additional non-mechanical works have been and will be carried out where remediation has not been satisfactory (soil slumping).

All other monitoring results are within expected / predicted parameters and displayed no discernable trends.

Figure 16 - Subsidence Survey and Data Monitoring Locations (Source: *Baal Bone Colliery LW29-31 SMP Subsidence Monitoring Program*)

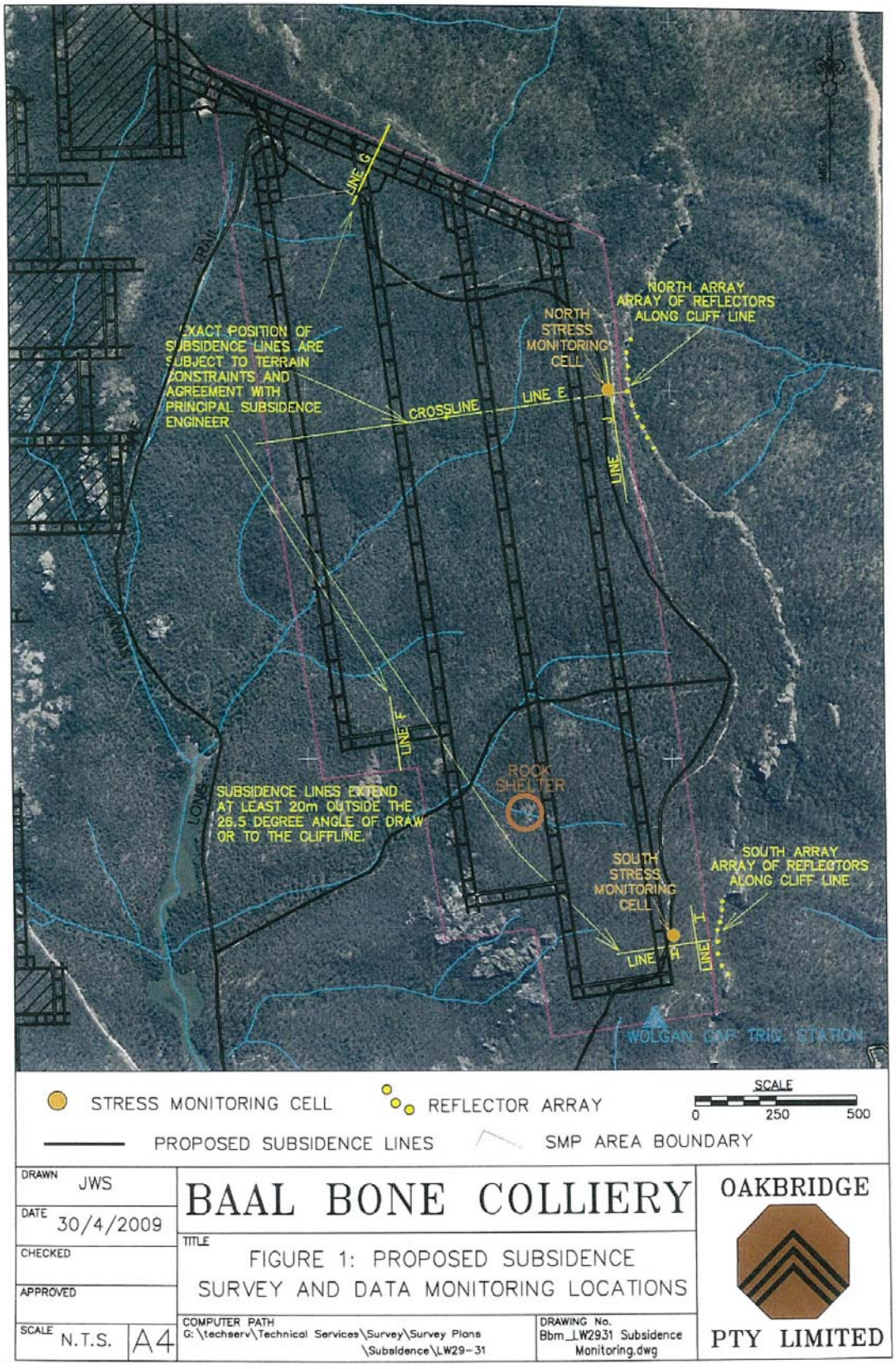


Figure 17 - Location of Groundwater Observation Bores and Geological Structures

aurecon

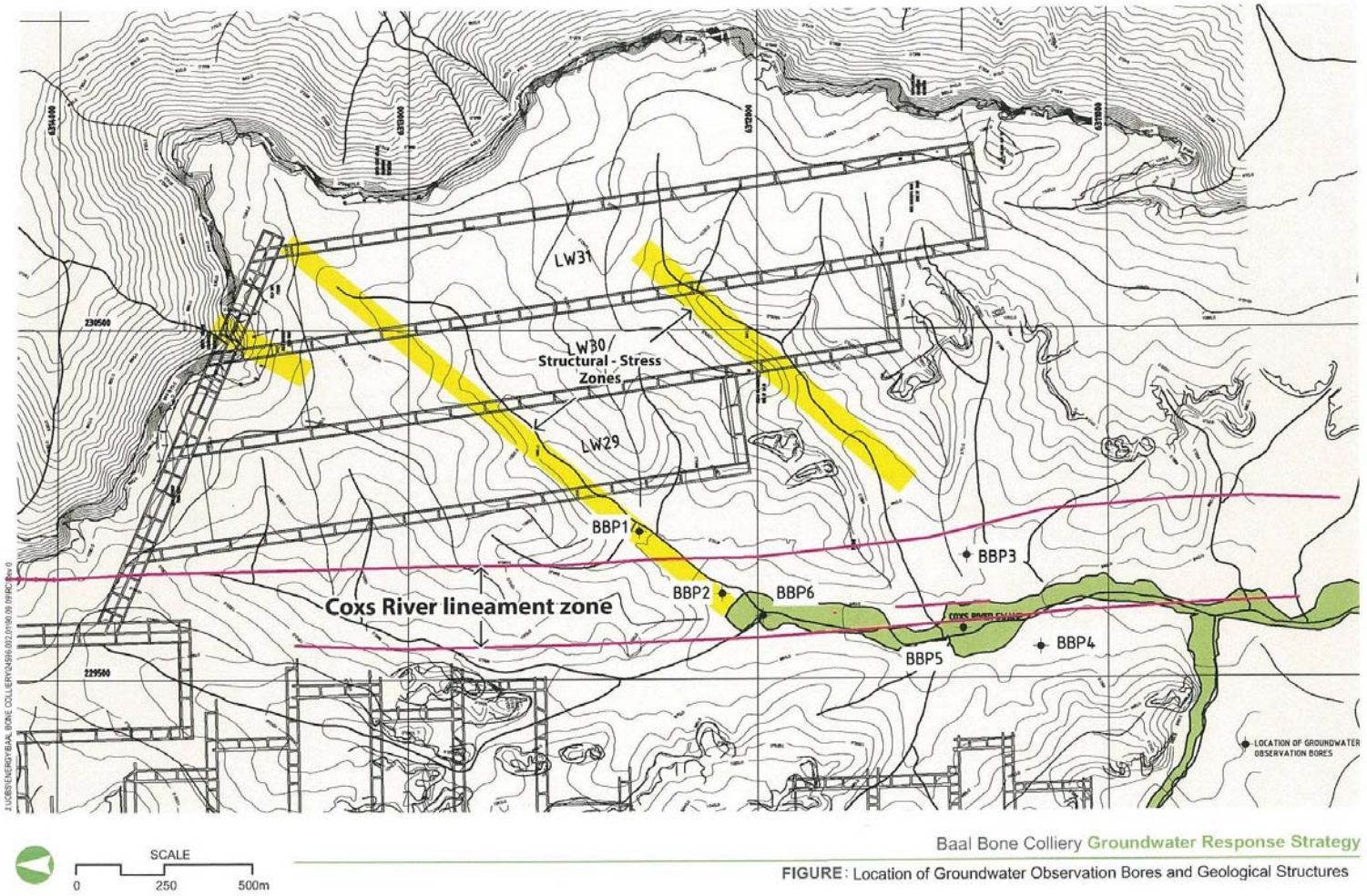


Figure 18 - Survey Monitoring and Stress Cell Location North Pinch Point Area

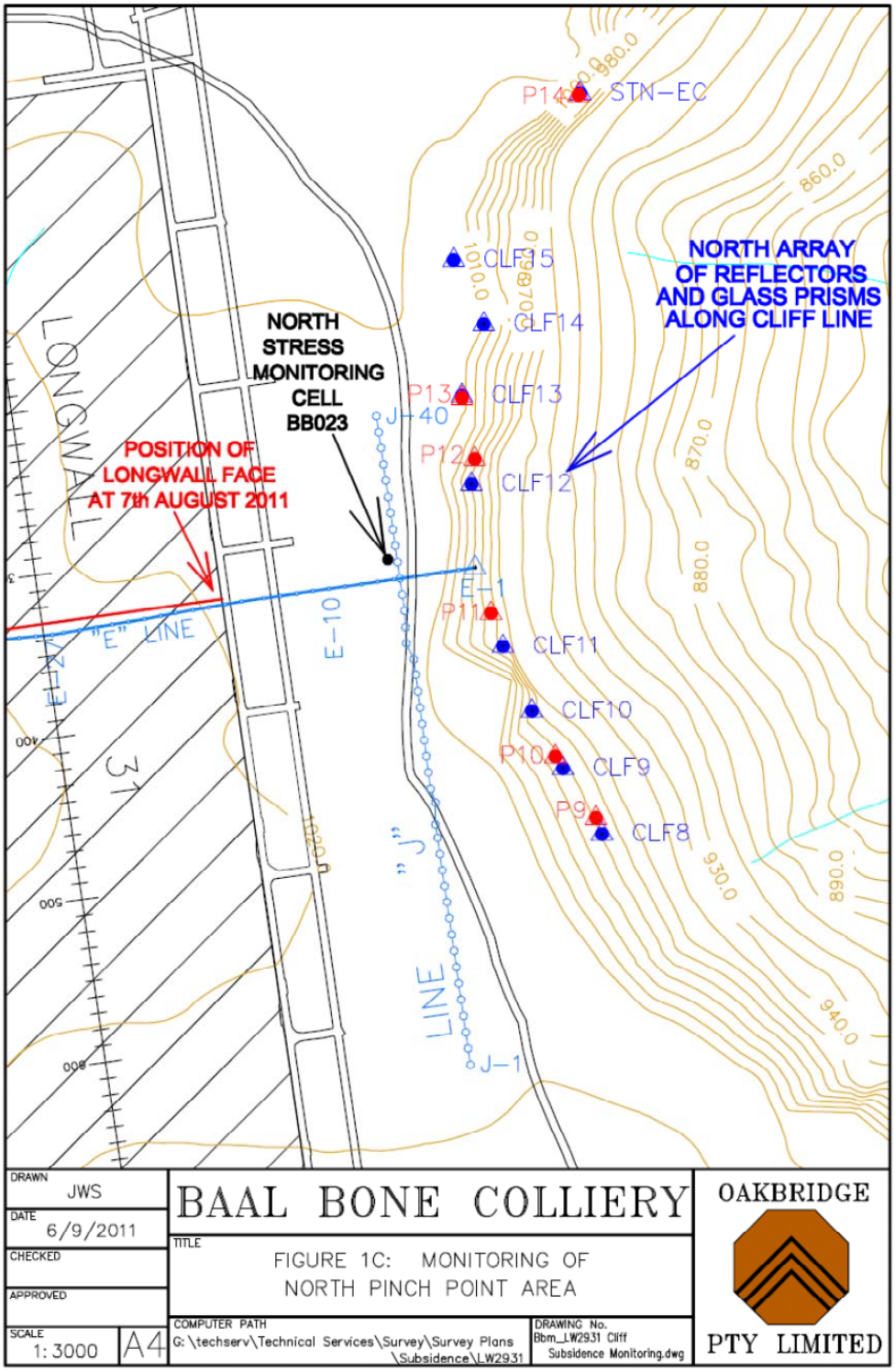


Figure 19 - Survey Monitoring and Stress Cell Location South Pinch Point Area

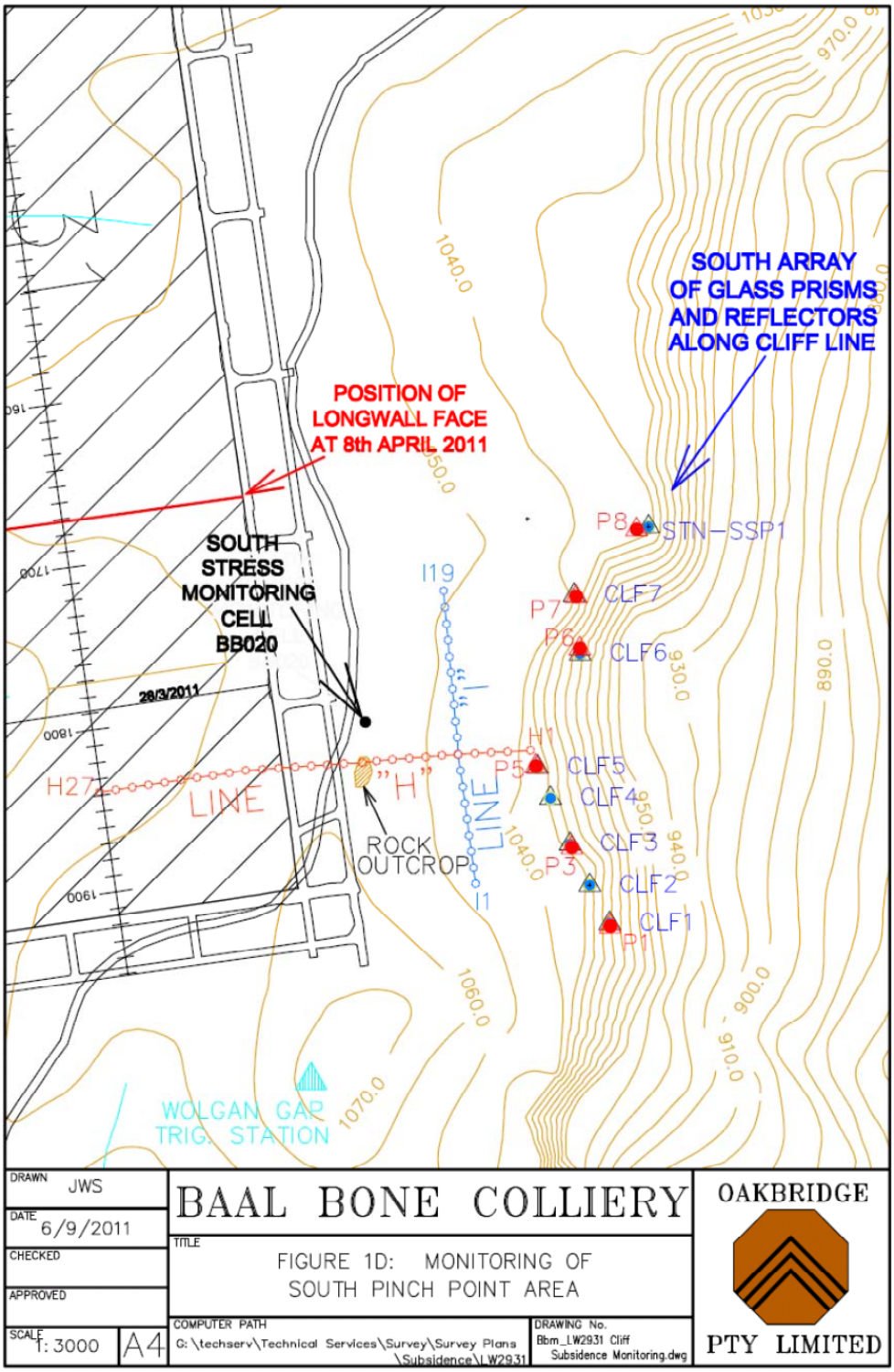


Figure 20 – Longwall Extraction Timing