BAAL BONE COLLIERY
OPERATED BY THE WALLERAWANG COLLIERIES LIMITED

BAAL BONE COLLIERY
Subsidence Management Status Report
LW 29 - 31

Four Monthly Update

REPORT No. 6

For the period:
8th August 2009 to 7th December 2009

Approved by John Hayward
Manager, Mining Engineering
Baal Bone Colliery

TABLE OF CONTENTS

FIGURES

1 INTRODUCTION

This Subsidence Status Management Report fulfils the requirements of Condition 19 of the Baal Bone Subsidence Management Plan (SMP) Longwalls 29 to 31 Approval Conditions. This is the sixth report and covers the period 8th August 2009 to 7th December 2009.

2 PURPOSE AND SCOPE

The purpose of this document is to report the progress of mining, provide a summary of subsidence impacts, the implemented management processes and consultation with relevant stakeholders. It also provides the opportunity for relevant stakeholders to provide feedback as required under Condition 19.

3 FACE POSITION OF THE LONGWALL

Longwall production in the first panel (LW29) of the new SMP area commenced on 6 July 2009. In total, the faceline has retreated 1025m, to chainage 438m, as of 7 December 2009. The first goaf fall was recorded on 13 July 2009 at which time the face had retreated 18m.

4 SUMMARY OF SUBSIDENCE MANAGEMENT ACTIONS

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

1. Continuation of weekly surface inspections.
2. Continuation of ongoing flora, fauna and groundwater quality monitoring programs.
3. Fortnightly monitoring of groundwater piezometer levels.
4. Additional “snapshot” flora monitoring around BBP1, BBP2 and BBP6.
5. Seasonal photographic monitoring of swamp vegetation at BBP5 and BBP6.
6. Post-mining re-survey of the F-F subsidence survey line; **Figure 1**.
7. Establishment and pre-mining survey of the G-G subsidence survey line; **Figure 1**.
8. Approval received from Principal Subsidence Engineer for escarpment survey monitoring locations as contained with the Subsidence Monitoring Program for LW29-31.
9. Establishment of H-H, I-I and J-J subsidence survey lines around northern and southern pinch points; **Figures 1C & 1D**.
10. Confirmation of location and preliminary installation of scattered arrays at both northern and southern pinch points; **Figures 1C & 1D**.
11. Erection of additional warning signs around the perimeter of the mining area and at strategic points along the various forest tracks that traverse the SMP area; due to loss of signs by theft.

12. Publication of a public notice in the Lithgow Mercury regarding safety aspects of traversing the SMP area.

13. Notification in accordance with Condition 18(b) of Baal Bone's SMP Approval with regards to anomalous groundwater behaviour.

14. Submission to Principal Subsidence Engineer of hydrogeologist's report regarding Investigation of Anomalous Groundwater Behaviour.

15. Approval received from Director-General (DII) for minor variation (reduction) to width of LW31.

16. Uploaded copies of approved SMP Management Plans and Monitoring Programs to Xstrata's external website; www.xstrata.com/operations/baalbone/publications/.

5 CONSULTATION WITH STAKEHOLDERS

Consultation with stakeholders during this reporting period has centred around a notification made under Condition 18(b) of Baal Bone's SMP Approval, regarding anomalous groundwater behaviour identified subsequent to the commencement of extraction of LW29. Refer **Section 6.1.9** below for details.

Stakeholders notified included:

- Department of Industry and Investment – Environmental Sustainability Branch
- Department of Industry and Investment – Principal Subsidence Engineer
- Department of Environment, Climate Change and Water
- NSW Office of Water
- Sydney Catchment Authority
- Forests NSW (as landholder).

Due to a relatively large number of people accessing the Ben Bullen State Forest for recreational purposes, a public notice was placed in the Lithgow Mercury on 22 August 2009 to highlight the potential risks associated with traversing the SMP area.

6 SUBSIDENCE DEVELOPMENT, OBSERVED SUBSIDENCE IMPACTS & MONITORING RESULTS

6.1 Surface Subsidence Impacts

At the end of the reporting period the LW29 face had retreated a total of 1025m. Some tension cracking (<100mm) as predicted has appeared parallel to the gateroads and across the centre of the panel. There has been no subsidence impacts observed outside the nominated angle of draw. Subsidence survey monitoring of the F-F line at the start of LW29 has been completed, with the results summarised and discussed at **Section 6.2** below.

6.1.1 Wolgan Escarpment

In compliance with Condition 15 of the SMP approval, Dr Ken Mills of SCT Operations Pty Ltd was commissioned by Baal Bone to prepare a thorough technical review of the mine layout, as contained within the SMP and to establish scientific confidence in the finish position of the panels and the width of LW31 in the vicinity of the two known pinch points. The results of this review and assessment (SCT Report BBO3432, dated 9 December 2008) indicated that a 30 metre reduction in the width of Longwall 31, down to 220 metres overall width, will ensure a higher level of confidence in the ability of the mine layout to protect the Wolgan Escarpment.

The Principal Subsidence Engineer has been consulted throughout the preparation of this report, as required by Condition 15(a), and has concurred with the recommendations contained therein. Baal Bone subsequently lodged a Subsidence Management Plan Variation Application to the Department of Industry and Investment to reduce the extraction width of LW31 from 240 metres to 210 metres, which reduces the extracted void width from 250 metres to 220 metres. This application was approval by the Director-General on 24 August 2009.

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

Results received to date confirm that neither instrument has registered any significant stress change associated with the mining of LW29; although this is not surprising as the distance between LW29 and the escarpment is large enough for there not to be any change.

Both instruments have registered some drift however, which is most probably associated with the depth of fresh bore hole above rock onto which the strain gauges are bonded (ie. inherent stresses introduced following initial drilling). Strains recorded are less than 200uS, which is well below the changes observed previously in LW26 where changes of significance were in the 1200-1400uS range.

Advice received indicates that the minor stress changes introduced as part of the instrument installation process should stabilise/normalise within a relative short time period.

6.1.2 Rock Features

To date there has been no subsidence impacts on rock features in the SMP area. Weekly inspections of the rock features were conducted around the LW29 start area and were continued until the longwall face had retreated at least 250m. Notification of this milestone was made to both DII and Forests NSW as required by the SMP Land Management Plan.

6.1.3 Surface Watercourses / Drainage structures

To date there has been no subsidence impacts observed on surface watercourses or drainage structures in the SMP area. Weekly inspections of the surface area will continue during longwall mining.

6.1.4 Fire Trails and Tracks

To date there has been no subsidence impacts on any fire trails or tracks in the SMP area; ongoing weekly inspections are continuing.

6.1.5 Swamp

Baseline seasonal photographic monitoring of the Coxs River Swamp was undertaken on 14 August 2009 and again on 7 October 2009. The next round of seasonal photographic monitoring is scheduled for January 2010.

6.1.6 Fauna

Biodiversity Monitoring Services (formerly known as Mount King Ecological Surveys) completed a seasonal survey in late November 2009.

Measurements of habitat characteristics derived from trap site descriptions have been used to provide an index of habitat complexity that can be helpful in determining changes over time of the habitats surveyed in the SMP Area. One index system used is that developed by Catling and Burt (1995), called the Habitat Complexity Score. This system scores the following parameters: Tree cover, tall and short shrub cover, ground cover, logs/rocks and litter cover. The scores range from 0 to 3, hence the maximum score is 18. The Habitat Complexity Scores for each site are given in the table below, together with the mean woodland results from 2005 to 2009.

Habitat Complexity Scores for Longwall 29-31 SMP Area

	Spring 2005	Summer 2006	Spring 2007	Spring 2008	Spring 2009
Woodland1	13	16	15	15	17
Woodland2	14	14	16	17	16
Mean Woodland	13.5	15	15.5	16	16.5
Creek	16	16	16	16	16
Swamp	-	-	-	13	17
Overall	14.3	15.3	15.6	15.2	16.5

These scores indicate moderate to high habitat complexity. These scores also show that all sites provide good habitat for ground-dwelling mammals and woodland birds.

Nine native mammal (plus two introduced), 51 bird, seven reptile and four amphibian species were recorded from the SMP area. Statistical analysis (ANOVA) of these results shows no significant differences for the biodiversity indices over the years. The evenness in both groups fell this year, possibly due to relatively large numbers of individual species (e.g. Eastern Grey Kangaroo, Crimson Rosella, and Pied Currawong).

The report concluded by noting that due to the monitoring data set that has been accumulated over the past six seasons (2005 to 2009), it is now possible to assess any differences in the biodiversity and habitat condition of those sites that are subject to underground mining in the future. This comparison showed that there are no significant differences in the biodiversity and habitat complexity over the years. It is concluded that, at present, there are no discernable impacts from underground mining of LW29-31 at Baal Bone Colliery upon the fauna on the surface. A full analysis of the year's data will be undertaken after the summer survey.

6.1.7 Flora

Gingra Ecological Surveys submitted their Spring 2009 seasonal monitoring report which summarises baseline monitoring completed during November 2009. Additional monitoring of the Coxs River swamp in the vicinity of the swamp piezometers (BBP5 and BBP6) was also conducted on 26 August.

The results show that levels of species diversity were within the previously recorded range at each site. The total number of species records in summer 2007 was 113 and in autumn 2008 it was 161 records. For the spring samplings there were 119 records in 2007, 141 records in 2008 and 147 records in 2009.

Plant Species Diversity for Longwall 29-31 SMP Area

Site	Species Count						
	Summer 2007	Spring 2007	Autumn 2008	Spring 2008	Autumn 2009	August 2009*	Spring 2009
BB05	28	26	33	33	41	NS	35
BB06	22	24	29	26	31	NS	28
BB07	18	19	29	23	26	NS	24
BB08	22	24	33	27	29	NS	25
BB09	14	14	23	20	19	16	22
BB10	9	12	14	12	10	10	13

*Additional requested survey

Comparison of results within the Baal Bone SMP area for spring samplings from 2007 to 2009 show no significant change in plant species diversity at any of the survey sites. This holds for the mesic (moisture associated) sites within the area of mining impact and the two swamp sites which are downstream from the subsidence management area.

There has been an increase in the detection of weed species, with additional species detected within one swamp site in spring 2009. The species detected, Fleabane (*Conyza* sp.) and Spear Thistle (*Cirsium vulgare*) are wind-blown opportunistic species which are able to occupy bare patches during favourable seasons. These species are present within cleared agricultural land downstream from the swamp sites. There is no evidence that their presence in spring 2009 is related to an impact of subsidence.

A decline in ground water piezometer levels near LW29 was detected during late July 2009 (refer Section 6.1.9) and an additional review of the health of the swamp vegetation was immediately undertaken. The results from sampling of vegetation at the swamp survey sites in August and again in November 2009 do not indicate any effect of subsidence on species diversity, plant species composition or weed invasion.

6.1.8 Underground Water Make

Data continues to be collected from the mines dewatering bores, flow meters and data loggers regarding mines water discharges and underground water storage levels. This data continues to be used to calibrate a mine water make model. Using flow meter data and the estimated goaf storage capacities determined so far, it has been calculated that the average level of groundwater seepage into the mine is in the order of 3.9 ML/day.

An addition flow meter has been installed underground to confirm the volume of water pumped out of the LW29-31 SMP area. As yet there is insufficient data available to confirm exact quantities, although it has been estimated that less than 5% of the mine's dewatering volume originates from this area.

6.1.9 Ground Water

Ian Forster from Aurecon (previously known as Connell Wagner) 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 (**Figure 2**). 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.

Previously it was identified that there was a notable gap in the data for Bore BBP6 for the period 4 June to 16 July. It has been determined that the contractor responsible for collecting water quality samples failed to reinstall the instrument when samples were collected on 4 June; the instrument was subsequently replaced by the contractor when the July water samples were collected on the 16th. A normal data stream recommenced after this date.

Coincidentally, data downloaded in late July showed an anomalous groundwater behaviour at BBP1 that had also commenced on or about 16 July. Water levels in BBP1 were noted to have declined independent of the response normally attributed to the effect of climatic conditions. Some potential irregularities were noted in the data and an error was suspected due to temporary removal of the monitoring equipment by the water sampling contractor.

Contact was made with the Principal Subsidence Engineer in early August to provide verbal notification of the anomalous result and to discuss the possibility of irregularities in the data and/or instrument readings. Following this discussion, the decision was taken to continue monitoring and to review the results and report back with an update.

Subsequently, the calibration of the monitoring equipment was checked and the integrity of the monitoring dataset reviewed. Monitoring frequency was also increased from bi-monthly to fortnightly. This monitoring confirmed that the water level in BBP1 appeared to have stabilised, however a decline had subsequently appeared at BBP2 (which is further away from the longwall panel). The remainder of the monitoring bores had not registered any decline in water level that cannot be attributed to the ongoing dry conditions.

Whilst a water level decline in a piezometer adjacent to a longwall panel was not unexpected, it is notable that levels begun to fluctuate only three days following the first goaf fall for LW29 and at a point in time when the face had retreated only 47m and the extraction was still subcritical. At that time, the longwall face was approximately 320m distant from BBP1. The rate of change in water level also exceeded initial predictions.

Following a second conversation with the Principal Subsidence Engineer on 21 August it was agreed that this situation constitutes an “irregular result” as defined in the Trigger Action Response Plan (TARP) for both the Environmental Monitoring Program (Condition 13) and the Surface and Groundwater Response Strategy (Condition 16), and that written notification should be made in accordance with Condition 18 of Baal Bone’s SMP Approval.

In line with the response required by the TARP, an internal meeting has been held with Baal Bone’s groundwater and subsidence consultants to review monitoring results, to consider additional monitoring options and to discuss a range of actions going forward. A preliminary Action Plan was formulated and discussed with the Principal Subsidence Engineer.

This included increasing the frequency of downloading and data review from the piezometers to a fortnightly cycle to enable more detailed monitoring of any future changes, completion of a snapshot flora assessment adjacent to the swamp piezometers, increasing the frequency of in-pit monitoring for additional seepage and inflows; together with a full review of the potential impact that Coxs River Lineament and/or other known geological structures in the immediate vicinity may have had on water levels in the aquifers.

Fortnightly monitoring was continued during late August and September, and an investigation report into the anomalous groundwater behaviour was prepared by Ian Forster of Aurecon Australia Pty Ltd (dated 01.10.09) and lodged with the Principal Subsidence Engineer on 1 October 2009.

The following discussion has been sourced directly from this report:

There are at least four possible scenarios that have been put forward for the decline in groundwater levels.

Scenario 1: The zone of interconnected fracturing in the strata above the longwall may have reached up into the Burra-Moko Head Sandstone aquifer and resulted in the drainage of groundwater from the aquifer into the mine workings. This would produce a drop in level in the piezometers nearest to the panel.

Scenario 2: The subsidence caused by the extraction of the longwall panel may have resulted in a change in the groundwater gradient, which has diverted groundwater towards the subsidence trough and away from the piezometers.

*Scenario 3: The extraction of the panel may have caused a degree of stress relief, resulting in some movement on the fault zone that runs parallel to the swamp (ie. Coxs River Lineament). A known structural fault zone also runs between BBP1 and BBP2, and any movement on these faults could result in rapid drainage of water from the aquifer into the fault zone (**Figure 2**).*

Scenario 4: The extraction of the panel may have resulted in some movement on the structural/stress zones located in/above the workings, with possible impacts on the groundwater in the aquifer.

The first possible scenario is considered unlikely for several reasons, but primarily because the initial decline in the groundwater level in BBP1 occurred when the longwall panel had retreated less than 50 metres. It is therefore considered highly unlikely that the zone of interconnected fracturing above the goaf would have reached the Burra-Moko Head Sandstone so soon, when the extraction was still sub-critical. The depth of cover to the Burra-Moko Head Sandstone at the start of the panel is about 120 metres, so that this represents a W/H ratio of 0.43, which is extremely low. Data published by Li (2005) indicates that the lowest W/H ratio for the cases examined, where hydraulic connection has been confirmed, is 1.29.

In addition, the depth of cover to the Burra-Moko Head Sandstone is about 47t, where t is the extraction thickness. Work by Forster & Enever (1992) in the Newcastle Coalfield indicated that the fractured zone extended from 20t to 33t above the seam, and there is no reason to assume that the situation is significantly different in the western coalfield. Again, this suggests that a hydraulic connection to the goaf is unlikely to be the cause of the anomalous conditions.

Another factor which indicates that drainage to the goaf is not the reason for the loss of water is the presence of the faults. The fault between BBP1 and BBP2 has a throw of up to 5 metres, so that the water-bearing zone in the sandstone, which is 2 to 3 metres thick, has been truncated by the faulting. As a result, it is unlikely that drainage would occur from the western side of the fault into the fractured zone above the goaf. Because of this, the groundwater level in BBP2 would not have shown any response to the mining, if this mechanism was the cause of the anomalous behaviour.

Given the above factors, it seems reasonable to assume that hydraulic connection between the aquifer in the Burra-Moko Head Sandstone and the mine workings is not the reason for the decline in groundwater level in the bores.

The second scenario has also been discounted for similar reasons to the first theory. Again, this is because the changes in gradient when the impacts were first observed would have been minimal, and unlikely to result in any significant drainage from the aquifer.

A more likely explanation for the observed changes is that there has been some movement on the major fault zone or on the structural/stress zones that have been located in the workings (Scenario 3). The major fault passes close to all affected boreholes and so any movement could potentially affect all of them. Even a small movement could open a cavity on the fault, and since the longwall panel converges with the fault as it retreats further, it is possible that further movements may continue to occur as the mining progresses.

The potential for any impact from the structural/stress zones detected in the mine is uncertain (Scenario 4), although both zones follow creek valleys, and both pass very close to the three boreholes, so they cannot be discounted as a causal factor. If there are high stresses in these zones, then even a small movement may trigger stress relaxation and the formation of fractures. This stress relaxation could produce anomalous movements in the groundwater levels.

Although the impact of major structures appears to be the most likely explanation for the anomalous groundwater movements (Scenarios 3 and 4), this is not certain at this stage, but may become clearer as the monitoring proceeds. It will also become evident whether the observed changes are temporary or permanent. At the end of August, the longwall had retreated 374 metres, which is just supercritical in terms of distance. This suggests that the strata disturbance is at its maximum, and that any additional movement may be limited.

Currently, there does not appear to be any impact on the swamp, but this needs to be monitored closely over the coming months. It worth noting that the groundwater supply to the swamp includes groundwater flow from the western side, in addition to any contribution from the eastern side. This is in addition to the contribution from rainfall and runoff. As a result, it is not certain that there will be any changes in the conditions in the swamp.

Ongoing monitoring of groundwater levels in the piezometers continued throughout October and November. While all sites have shown a slight decline in levels consistent with the ongoing dry conditions, the levels in the two piezometers affected by mining appear to have stabilised; BBP1 has begun to recover slightly and the decline at BBP2 has flattened out.

There have been no additional mining related impacts observed at these sites. At no time has there been any indication of mining related impacts in either of the two piezometers in the Coxs River swamp.

6.2 Subsidence Development (Summary of Survey Results)

Baseline (pre-mining) survey monitoring of the E-E and F-F lines were conducted on 10 July 2009 and 27 May 2009 respectively. Refer **Figure 1** for locations.

Following commencement of extraction of LW29, three dimensional subsidence movement surveys on the F-F line were undertaken on 3 August, 11 August and 18 August 2009. Results from these surveys confirm that subsidence movements remain within the acceptable range as defined in the SMP Application and as noted in the Subsidence Monitoring Program.

A slightly elevated level of horizontal movement (ie. 50mm) was however noted at Station 20 on the F-F line, which is inside the goaf area. Following a discussion with Dr Ken Mills of SCT Operations Pty Ltd, it was concluded that the steep nature of the terrain at this point would have exacerbated the level of horizontal movement (ie. creep) in a downslope (northward) direction; and that the systematic horizontal movement would nevertheless remain within the predicted range.

A summary of the survey monitoring results are included in the table below:

Parameter	Predicted Results	Maximum measured result
Vertical subsidence (mm)	1400 - 1600	1341
Horizontal movement (mm)	400	450
Tensile strain (mm/m) K=1.5	9 - 16	11.7
Tilt (mm/m) K=5.0	32 - 52	25.6

7 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. The identification and management of the anomalous groundwater behaviour confirms that the monitoring, review and Trigger Action Response Plan (TARP) process' are effective.

8 PROPOSED ADDITIONAL / OUTSTANDING MANAGEMENT ACTIONS

As discussed above in Section 6.1.9, additional management actions and response procedures have been implemented in accordance with the Groundwater Management TARP. While ongoing monitoring and review of the groundwater situation is continuing, there is no proposal at this stage to implement any additional management actions.

9 CONCLUSIONS

During the reporting period production in LW29 continued, with the faceline retreating a total of 823m, to chainage 438m. Routine scientific and survey monitoring of impacts on rock features, escarpments, and surface and groundwater regimes continued, as did seasonal monitoring of flora and fauna.

Anomalous groundwater behaviour in several monitoring bores was identified shortly after starting extraction of LW29. Following consultation with the Principal Subsidence Engineer and specialist consultants, it was agreed that this situation constituted an "irregular result" as defined in the Trigger Action Response Plan (TARP) for both the Environmental Monitoring Program (Condition 13) and the Surface and Groundwater Response Strategy (Condition 16).

Management of the situation, including written notification to stakeholders was undertaken in accordance with Condition 18 of Baal Bone's SMP Approval.

With the exception of the groundwater data, all other monitoring results are within expected / predicted parameters. Routine and scheduled seasonal monitoring will continue.

During the reporting period, Baal Bone lodged a Subsidence Management Plan Variation Application to the Department of Industry and Investment for a reduction in the extraction width of LW31 from 240 metres to 210 metres. This will reduce the extracted void width from 250 metres

to 220 metres and will ensure a higher level of confidence in the ability of the mine layout to further protect the Wolgan Escarpment.

This application was approval by the Director-General on 24 August 2009.

FIGURE 1: Proposed Subsidence Survey and Data Monitoring Locations
(Source: *Baal Bone Colliery LW29-31 SMP Subsidence Monitoring Program*)

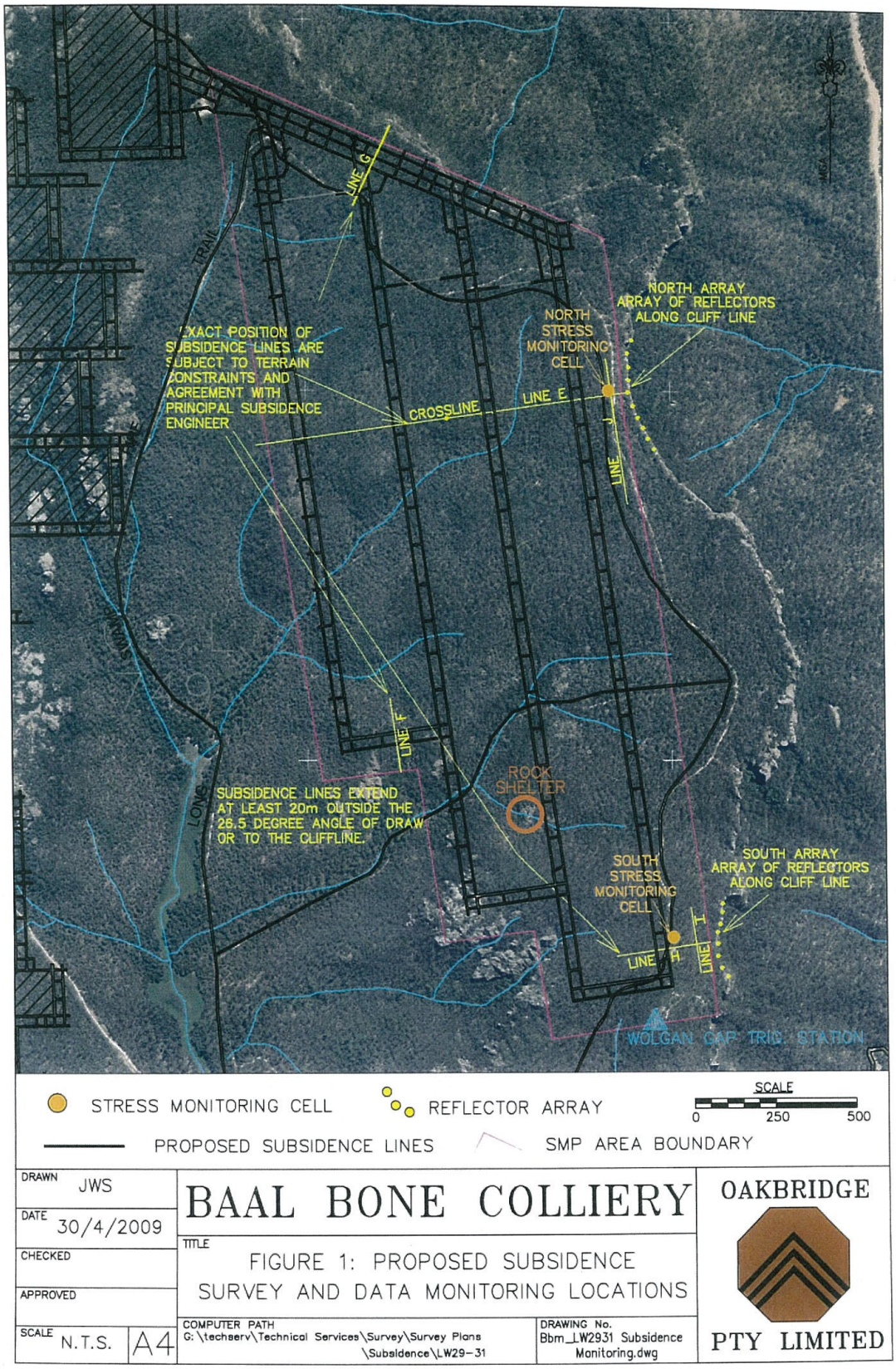


FIGURE 1C: Survey Monitoring of North Pinch Point Area

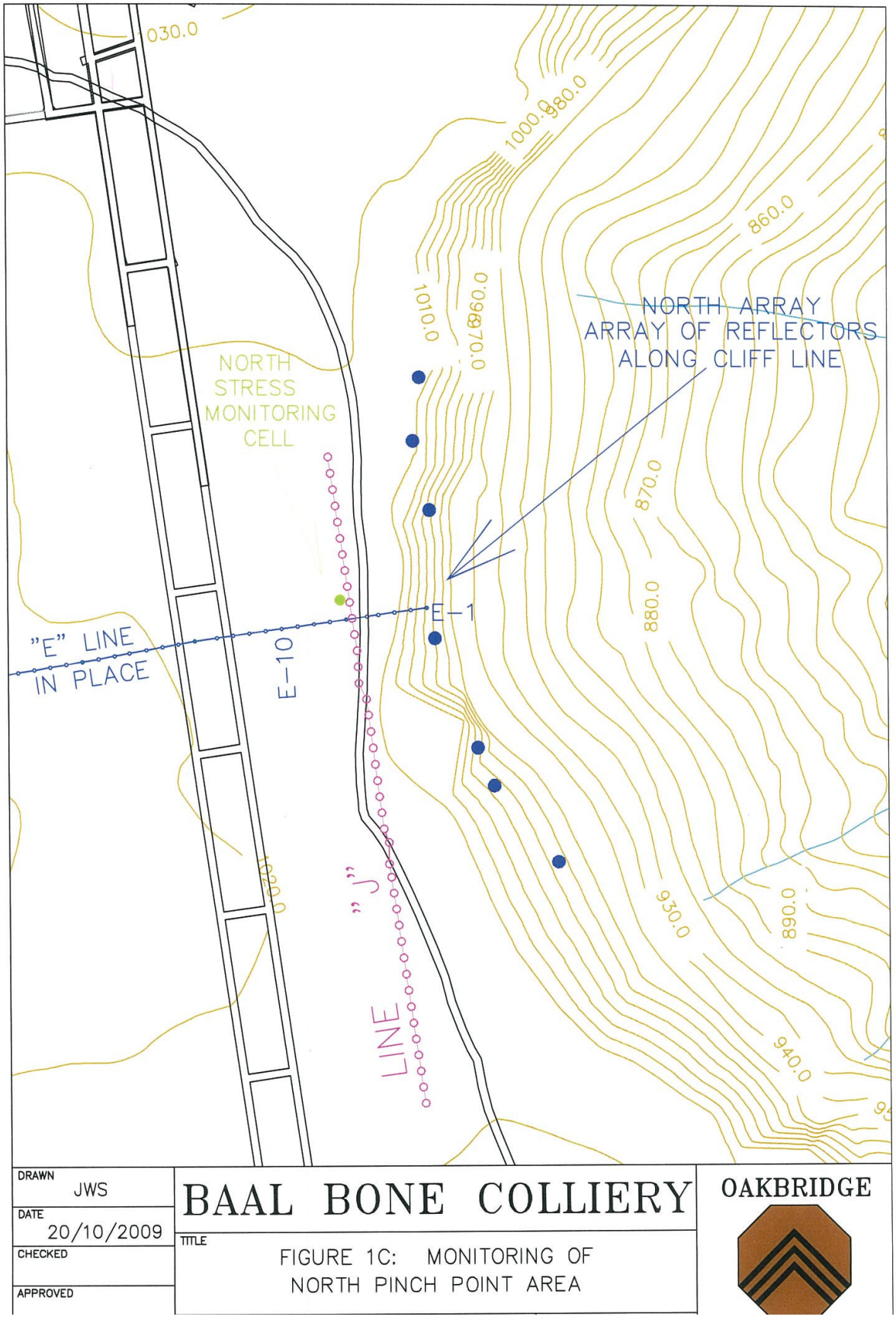


FIGURE 1D: Survey Monitoring of South Pinch Point Area

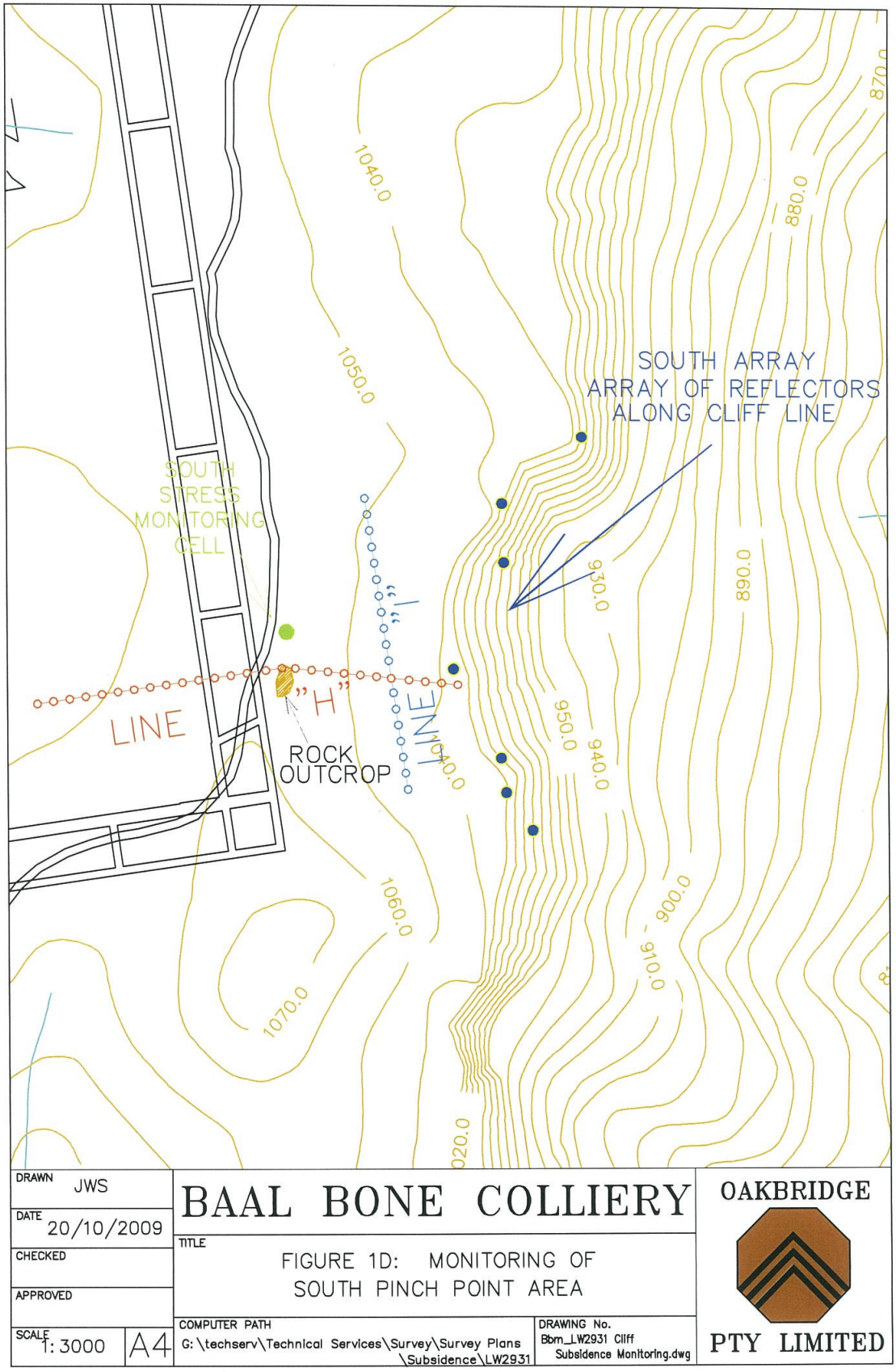
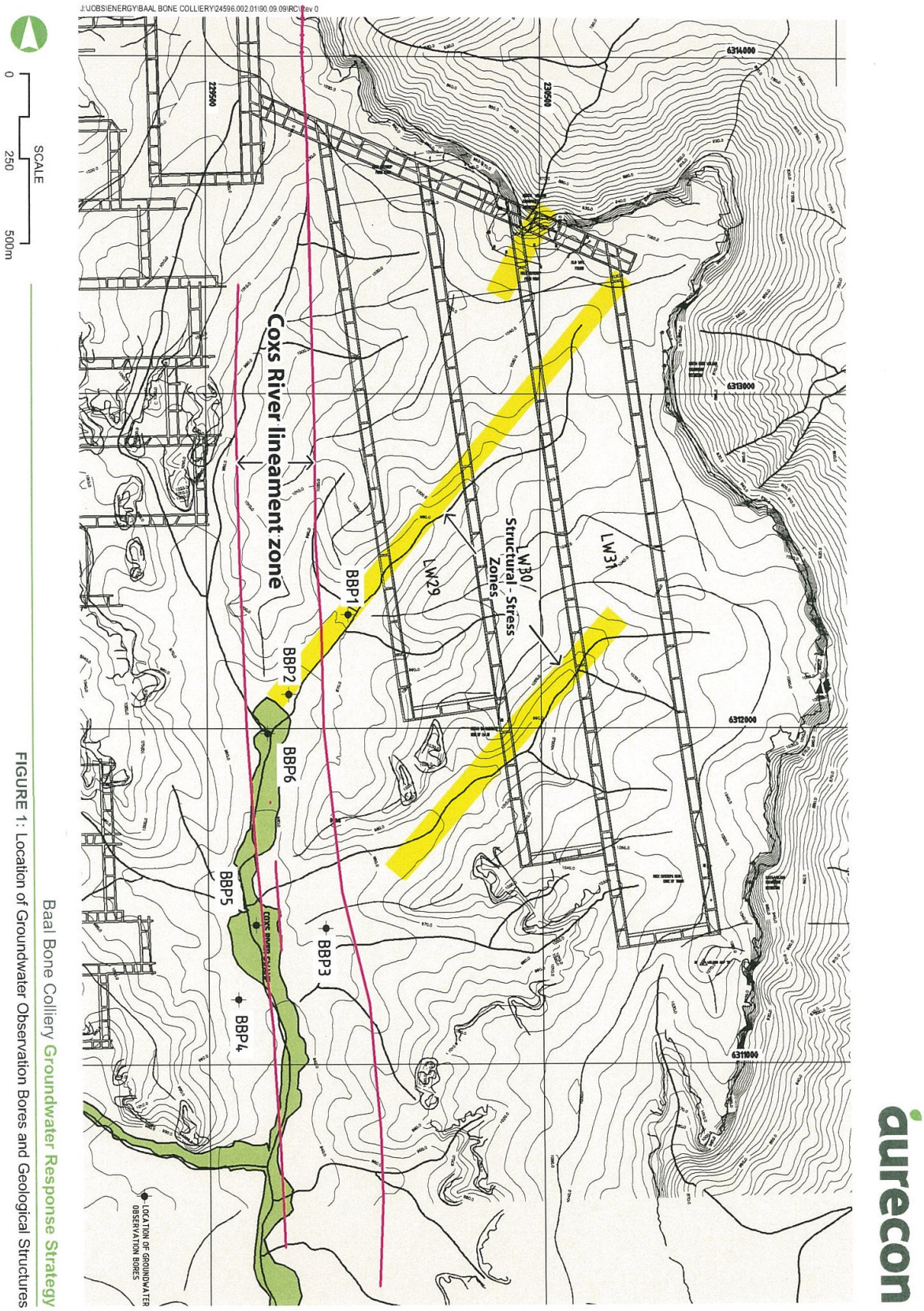


FIGURE 2: Location of Groundwater Observation Bores and Geological Structures



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