Subsidence Management Plan

ANNEX E

Slope Stability Assessment

Ashton Coal
Longwall Panels 1 - 4

Subsidence Management Plan
Written Report

Slope Stability Assessment for Ashton Coal SMP

July, 2006

Ashton Coal

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2118645A, PR_6572

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Distribution: Ashton (x2 hard copies; x1 PDF); PB (x1 bound, x1 loose).........

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1. Introduction

This report details the results of stability assessments for natural slopes adjacent to Glennies (Falbrook) Creek and the Hunter River. The natural slopes overlie, or are located in the vicinity of, proposed longwall mining.

Longwall panels are proposed south of the New England Highway with the eastern most panel (Longwall 1) running adjacent to and within about 150m (at the closest point) of Glennies Creek. The southern end of the longwall panels 2, 3 and 4 will come within about 200m of the Hunter River.

The purpose of this report is to provide comment on the likely impact on stability of natural slopes adjacent the Hunter River and Glennies Creek due to subsidence movements associated with longwall mining. In particular, the likelihood of subsidence movements triggering slope instability that leads to a blockage or partial blockage of the adjacent Glennies Creek and Hunter Rivers.

The assessment was based on reference to geological maps, a walkover inspection by a senior engineering geologist and subsidence predictions by Strata Control Technology (SCT) provided in a report (‘Subsidence Assessment for Ashton Coal Mine Longwalls 1-4’, ASH3084A dated 30 June 2006).

2. Site Description

2.1 Topography

The ground across the proposed mining area generally slopes down to the west at around 2° to 3° (refer attached drawing). Adjacent to Glennies Creek the ground slopes steeply down to the east at a maximum slope of about 32°. The slope height from crest to toe is about 40m.

Ground adjacent the Hunter River slopes down to the south at about 10°-12°. The southern end of Longwall panels 2, 3 and 4 will underlie these slopes.

The location of the proposed longwall mining with respect to the natural slopes is shown in the attached Sections 1 and 2.

2.2 Geology

Reference to the Camberwell 1:100,000 geological series sheet indicated the area is underlain by coal seams, siltstone, lithic sandstone, shale and conglomerate of the Vane Subgroup.

The mine area is located to the west of the Camberwell anticline, a fold trending north-northwest causing the strata to dip with a shallow inclination down to the west.

3. Site Observations

The sites were inspected by an experienced engineering geologist on 6 July 2006 with observations summarised below. Slope profiles are shown on the attached Sections 1 and 2. The depth to the Pikes Gully Seam shown on the sections was based on depth of cover contours provided by Ashton.

Site 1 – Glennies Creek

- The slopes down to Glennies Creek were uniform and grass covered. The maximum measured slope angle was about 32 degrees below horizontal.
- The slope has a maximum of height of about 40m
- The slope contained no outcropping bedrock. Some scouring was observed on the slope possibly due to the existence of springs. Material exposed in the scoured areas comprised sandy clay with boulders to about 0.5m diameter. The material was assessed to be colluvium. There was no indication as to the depth of colluvium mantling the slope.
- There was no evidence of past or existing instability on the slope.
- The coal seam to be mined (Pikes Gully Seam) crops out near the toe of the slope. The coal seam was not observed during our inspection.

Photo 3-1 Natural Slopes adjacent Glennies Creek, looking south

Site 2 – Hunter River

- Slopes down to the Hunter River were uniform and measured to be about 10°-12°.
- The slopes were grassed covered. One portion of the slope was also well wooded.
- The maximum slope height (from hill crest to the Hunter River) was about 30m-40m.
- Outcropping conglomerate bedrock was observed on the slope near the crest and approximately half way down. Partial undermining of the slope has occurred adjacent the Hunter River due to scouring. Material exposed in this area comprised silty sands (presumably slopewash material). Based on surface observations, the slopes are expected to be underlain by a thin veneer (say maximum 2m depth) of silty sand slopewash then bedrock.
- Shallow drainage lines ran down the slope. At the time of the inspection the drainage lines were dry.

Photo 3-2 Natural Slopes adjacent Hunter River, looking west

4. Mine Subsidence Predictions

4.1 Glennies Creek

It is understood the mine subsidence calculations carried out by SCT show that the anticipated subsidence induced movements for the slopes adjacent Glennies Creek will be:

- less than 100mm of slope translation to the east, and
- 100mm slope crest rotation to the west.

4.2 Hunter River

The southern end of longwall panels 2 to 4 will underlie the slopes down to the Hunter River. SCT state that ‘there is likely to be significant surface cracking evident on the slopes associated with the proposed mining due to a relative down-slope movement of the upper section of the slope of several hundred millimetres’ and ‘a lateral translation of the entire slope of up to about 10mm for each longwall panel is expected in a down-slope direction’.

5. Slope Stability Assessment

Potential slope movement mechanisms considered for both sites include:

1. Slumping of the colluvium (Glennies Creek) or slopewash material (Hunter River)
2. Circular slip through a disturbed rock mass, and
3. Planar slip along a low strength sliding plane along or near the Pikes Gully seam.

The failure mechanisms are illustrated on the attached Section 1.

Mechanism 1 generally involves the reduction of the colluvium/slopewash strength due to increased pore water pressures leading to a slump. The likelihood of slump failure increases with slope angle. Debris from the slump may move down slope and with sufficient moisture content may form a debris flow.

Mechanism 2 comprises a circular type failure through the rock mass similar in shape to a slump in soil. The failures result from a large number of fractures in the rock mass with some shearing through intact rock 'bridges'. Such failures are generally only possible where there are steep high slopes as relatively high stresses are required to shear through the intact rock.

Mechanism 3 involves a passive block of rock on a low strength near horizontal slip plane with a lateral driving force provided by a large wedge of rock behind the slope and/or high groundwater pressures.

5.1 Effects of Mine Subsidence on Slope Stability

The main effects of the anticipated subsidence movements is fracturing and reducing the rock mass strength behind or beneath the subject slopes, as well as reducing the shear strength of potential sliding planes due to lateral movements caused by subsidence.

5.1.1 Mechanism 1 - slump in colluvium/slopewash material

It is anticipated that the subsidence movements will have negligible to no impact of the stability of the colluvium mantling the slopes adjacent Glennies Creek as the cracking associated with subsidence will be formed about 20m to 40m back from the slope crest. The slopes adjacent the Hunter River are expected to experience some cracking as a result of subsidence therefore increasing the permeability of the surficial slopewash material.

5.1.2 Mechanism 2 – slip through rock mass

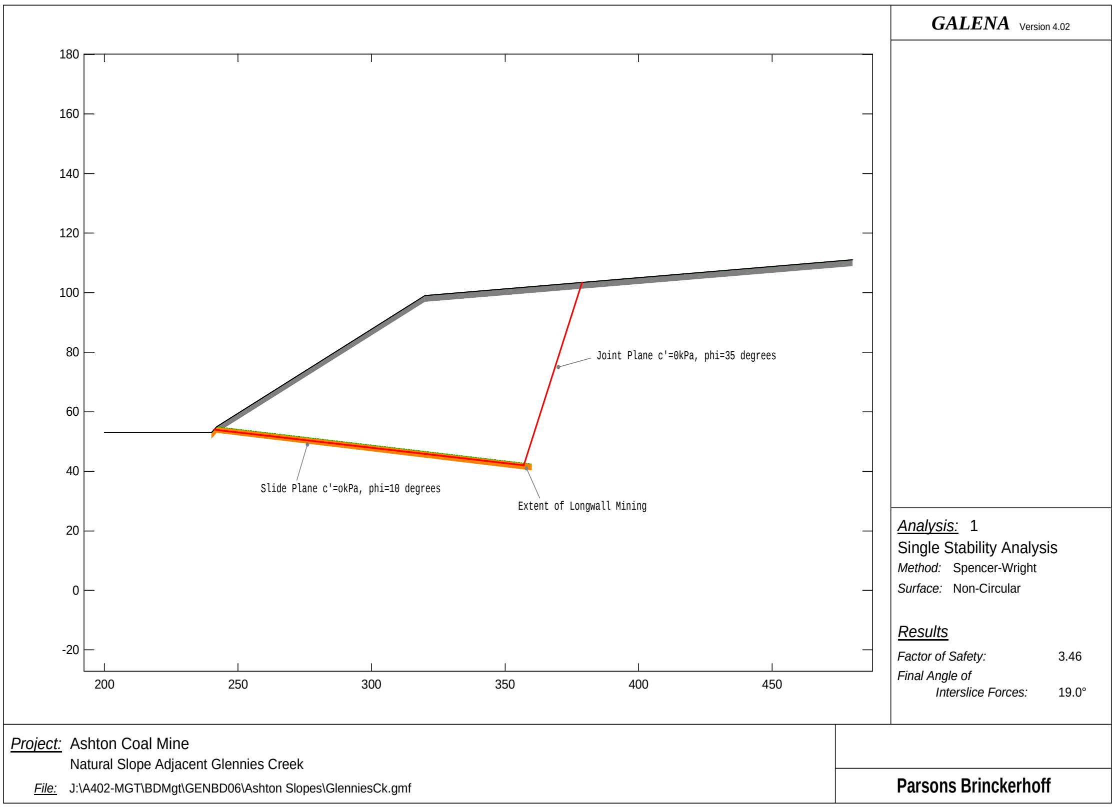
The strength and fracturing of the rock mass behind the slope controls the stability of the slope with respect to circular slip type failures. Increasing the fracturing in the rock mass reduces the strength of the rock mass and provides increased rock mass permeability and the potential for higher water pressures.

To initiate circular failure the disturbance due to subsidence would need to be large enough to shear most of the intact rock bridges combined with very steep ground slopes. Given the relatively small subsidence movements calculated, there does not appear to be sufficient disturbance to the rock mass to cause failure. In addition, given the slope angles and heights of the subject slopes, it is considered unlikely that sufficient stresses will develop in the rock mass to allow shearing through intact rock bridges.

5.1.3 Mechanism 3 – planar slip

It is likely that the peak strength along potential slip planes has been reduced by either the folding associated with the Camberwell anticline or stress relief related to the formation of the Glennies Creek valley. While the calculated lateral movements associated with subsidence may reduce shear strengths, in practice the reduction in overall strength along the potential slip plane will be small. As the existing slope does not show any evidence of planar slip, it is not anticipated that the subsidence movements will result in a planar slip failure.

A stability analysis was carried out using Galena slope stability software assessing planar slip for the Glennies Creek site. Absolute lower bound shear strength parameters were adopted as shown below. The analysed Factor of Safety was 3.46.



5.2 Probability assessment

The likelihood of the following occurring for each potential slope failure mechanism has been assessed:

1. Subsidence movements triggering slope instability, and

2. the resultant slope instability causing sufficient material to travel to and block the Hunter River or Glennies Creek at the subject locations.

Table 5-1 Likelihood Descriptors (1)

Descriptor	Description	Indicative Annual Probability
Almost Certain	The event is expected to occur	> 10-1
Likely	The event will probably occur under adverse conditions	10-2
Possible	The event could occur under adverse conditions	10-3
Unlikely	The event might occur under very adverse conditions	10-4
Rare	The event is conceivable but only under exceptional circumstances	10-5
Not Credible	The event is inconceivable or fanciful	<10-6

(1) Based on Table A1 'Landslide Risk Management Concepts and Guidelines', Australian Geomechanics Vol. 35, No. 1, 2000.

Table 5-2 Likelihood Assessment Site 1 - Glennies Creek

Mode of Failure	Assessed Likelihood
Slump in Colluvium	Rare (1)
Circular slip through rock mass	Not credible
Large Block Slide	Rare

(1) The likelihood of slumping in the colluvium at this location occurring with slump debris travelling to Glennies Creek, would be higher if the assessment was based on the trigger for instability being due to natural events such as high rainfall. The likelihood is increased due to reasonably steep slope angles, possible presence of groundwater springs on the slope and unknown thickness of colluvium.

Table 5-3 Likelihood Assessment Site 2 - Hunter River

Mode of Failure	Likelihood
Slump in Slopewash soils	Not credible
Circular slip through rock mass	Not credible
Large Block Slide	Not credible

6. Conclusion

Based on our assessment we conclude that the likelihood of slope instability at the subject sites occurring (or being triggered by) the predicted subsidence movements varies between rare and not credible for the Glennies Creek site and not credible for the Hunter River site.

The probability of slope instability being triggered by natural causes eg high rainfall events was assessed to be higher, particularly at the Glennies Creek site where slope gradients are reasonably steep.

It should be noted that this stability assessment was based primarily on surface observations and depth of cover contours provided by Ashton. A more thorough assessment would require detailed knowledge of geological conditions below the subject slopes, which for the purposes of this report and based on our initial assessment is not warranted at this stage. Any signs of slope instability at the subject sites should be reported to this office immediately for assessment. Sealing of subsidence cracks is also recommended.

Figures

Site Plan
Section 1
Section 2

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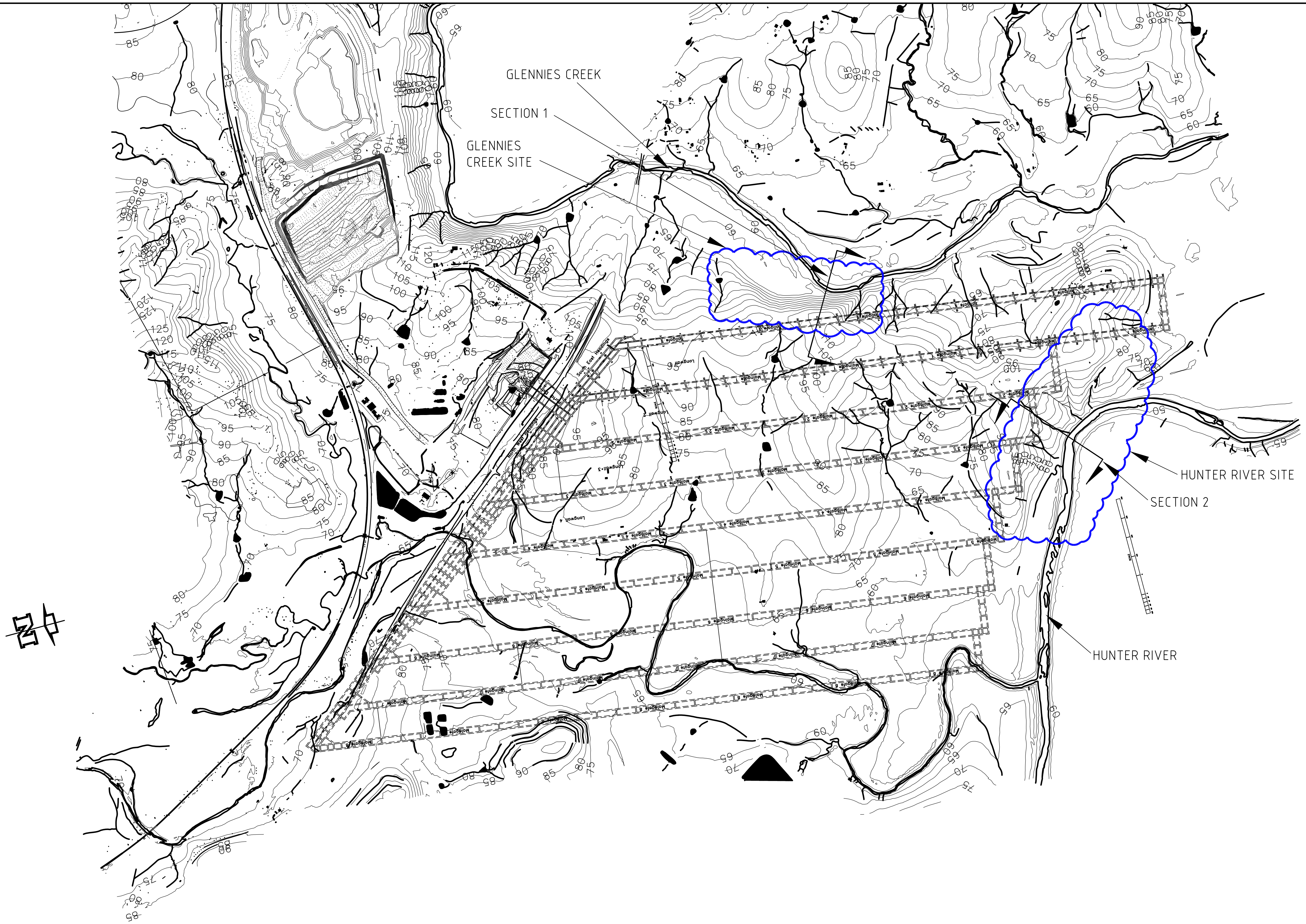

100mm AT FULL SIZE

PRELIMINARY ISSUE
NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DRAWN	CHECK	DESIGN	VERIFY
A	12.07.06	ORIGINAL ISSUE	AWC	PAL	PAL	

DRAWING CHECK PRINT
DATE RAISED 13 / 07 / 06 BY DATE
DRAFTING CHECK
ENGINEERING CHECK
BACK-DRAFTING CHECK
NEXT ACTION

SCALES
0 100 200 400 600
Full Size 1:10000 ; Half Reduction 1:20000
SCALE (m)

A1 ORIGINAL
DO NOT SCALE THIS DRAWING - USE FIGURED DIMENSIONS ONLY
VERIFY ALL DIMENSIONS ON SITE

APPROVED FOR AND ON BEHALF OF PARSONS BRINCKERHOFF AUSTRALIA PTY LIMITED, MANAGING PARTNER OF PARSONS BRINCKERHOFF

SIGNED

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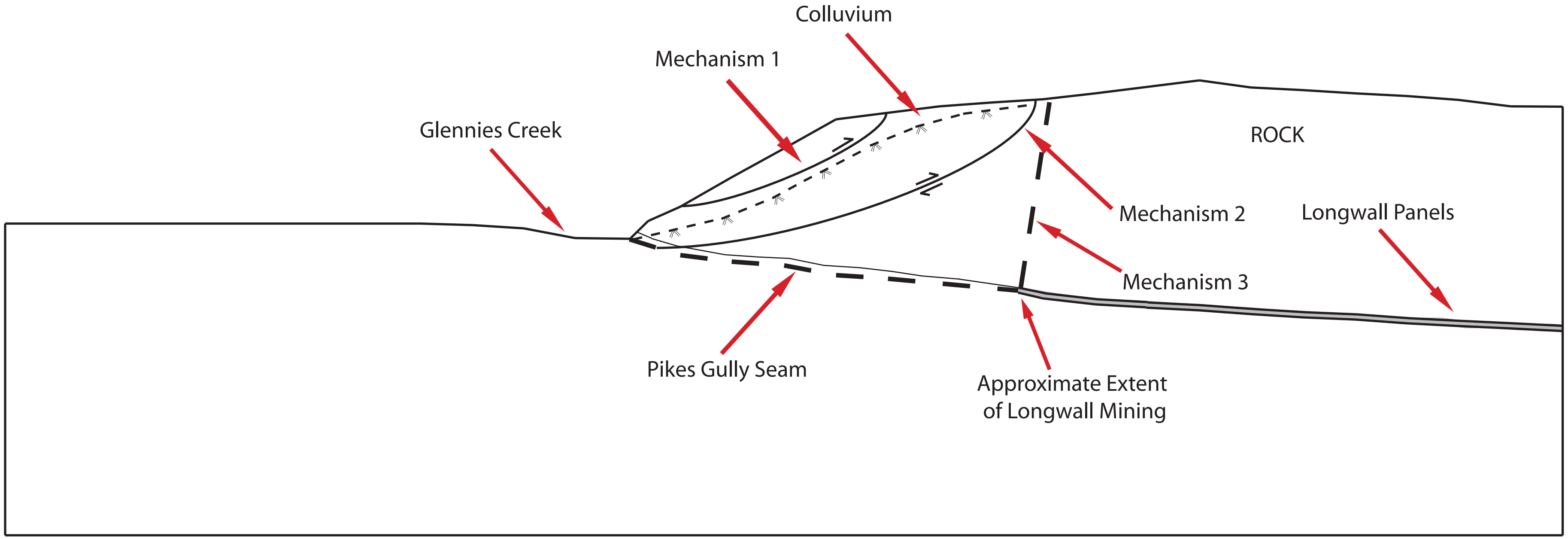
PROJECT
ASHTON MINE
STABILITY ASSESSMENT OF NATURAL SLOPES ADJACENT GLENNIES CREEK AND HUNTER RIVER

PROJECT No.	DISCIPLINE	NUMBER	REV.
2118645A	- GEO -	0001	A

Plotted By: crowa Plot Date: 13/07/06 - 11:00 Cad File: J:\A402-MGT\BDMgt\GENBD06\Ashton Slopes\2118645A-GEO-0001.dwg

SECTION 1



Ashton Coal Mine
Slope Stability Assessment

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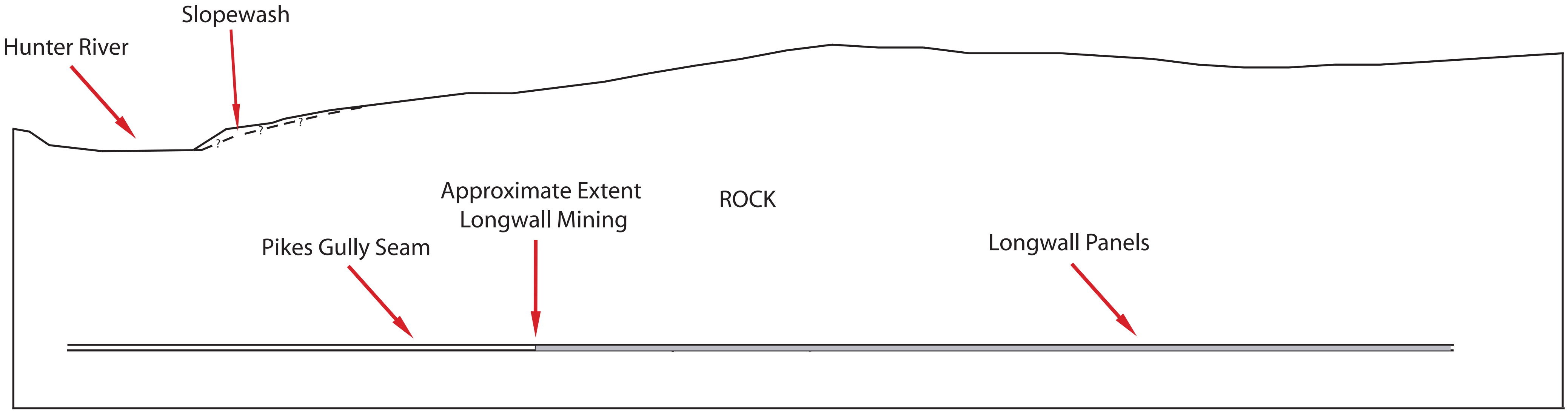
SCALE 1:2500

2118645A *Date: 12/07/2006, Drawn: CSB*

0 100m

SECTION 2



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