U909

15 July 2002

Mr M. Andrews
Development and Infrastructure Assessment
PlanningNSW
Level 4, 20 Lee Street
Sydney NSW 2000

Dear Sir

Additional Information in Relation to Archaeology for the Ashton Coal Mine Project

I refer to the meeting held on 4 July 2002 involving yourself, officers from NPWS and White Mining representatives (Messrs I. Callow, A. Wells, D. Witter, N. McElhinney, G. Holt and P. Mitchell). It was agreed that the proponent would provide additional information in relation to the following (3) points, these being:

"1. Address the issue of areas that were not extensively surveyed by either extrapolating and predicting archaeological values or discussing why impacts would not be substantial to any sites in these areas;

2. Detailed assessment of subsidence impacts on known sites and any possible sites by considering nick point erosion, cracking and water ponding;

3. Discussion of the proposed long-term conservation outcomes of the project and justification based on the analysis of the archaeological value in the regional context".

Please find attached documentation which addresses each of the points raised by PlanningNSW. You should note that the information augments Aboriginal Archaeological report prepared by Dr D. Witter in June 2002.

Enclosed also for your information is correspondence from the Upper Hunter Wonnarua Council Inc supporting (subject to various recommendations) the development of the Ashton Coal Mine Project.

We note we provided copies of D. Witter recommendations to the four aboriginal community groups in the first week of June 2002. D. Witter contacted the Nation and the Land Council during the first week of July. To date we have not received any responses. This is some six weeks after the date was made available.

Please note that a copy of all the above documents has been forwarded to Ms M. Koettig of NPWS.

Yours faithfully
HLA-Envirosciences Pty Limited

Alan Wells
Regional Manager

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ADDENDUM 1

Ashton Coal Mining Project Environmental Impact Statement: Aboriginal Archaeology. Dan Witter, June 2002. A report to HLA-Envirosciences for White Mining Limited.

Below is an addition of this report in response to a requirement by Planning NSW to provide a "Address the issue of areas that were not extensively surveyed, by either extrapolating and predicting archaeological values, or discussing why impacts would not be substantial to any sites in those areas."

The following should be inserted in Section 15 Recommendations of the above report. It is provided here however in stand-alone form.

<u>15.9 Archaeological Potential of the Study Area</u>

As further context for the recommendations which have been presented the potential for further archaeology in the study area needs to be summarised from various parts of the report and assessed for possible NPWS sec 90 issues not identifiable from the known sites.

The various effects from European land use which would reduce the potential of the study area to produce archaeological sites have already been listed in Section 7.3, and has been assessed further by Mitchell (2002, 3-10). One effect is the deposition of sediments on the valley bottom during floods. This is a post-European process caused by grazing and other disturbances to ground cover in the upper catchment that resulted in erosion. These sediments cover the ground surface with a layer that prevents artefact detection even though there are exposed bare areas. The area covered by these post-European sediments is shown in the Figure 2 provided by Mitchell (2002), and appears to be about a third of the study area.

Other European land use effects are illustrated in the Figure 1 map by Mitchell (2002). Much of the ridge area is shown as having had gravel extracted or as eroded. Most of the terraces and some of the lower valley slopes are further shown as being cultivated. Although cultivation does little damage to artefacts, it destroys their original relationship to each other. Stream banks are places where artefacts are frequently found, and the map shows numerous sections where these have been disturbed and engineered for flood control. The map from Figure 1 added to Figure 2 indicates that over one third of the study area has been modified in various ways since European occupation, destroying, damaging or concealing the archaeology.

Another factor which affects the assessment the archaeological potential of the study area is ground cover, whether by pasture grasses or woodland leaf litter, as described in section 9.1 on foot coverage. The survey strategy was to use the areal photography to locate exposures and then to examine them. This meant walking dirt tracks, walking from one bare patch to another cross-country, or sometimes walking over an area to see if there were exposures not visible on the areal photography. The areas where exposures with artefacts were found in a cluster (large sites) were completely walked over as part of the site mapping process.

Table 15.1 has been prepared to show the relationships for the coverage, the conditions of site detection, the proposed impacts and the potential for more archaeology. This is in order to try to identify what locations may have undetected major archaeological sites.

zone	land	disturbance	impact	exposure	cov.	EWAs	archaeological potential
1	Ridge, valley side	20% from gravel extraction	Over burden emplacement, 100% destruction	Dirt vehicle tracks, dams	>10%	7	Small low density concentrations; limited microblade workshops.
2	Ridge, valley side	>10 % grazing degradation	Open cut & emplacement, 100% destruction	Bare patches stream banks, fire break, dams	30%	15	Medium sized medium density concentrations; limited microblade workshops
3	Ridge, valley side	20% grazing degradation	Open cut & infrastructure, 90% destruction	Bare patches	20%	12	Medium sized medium density concentrations; limited microblade workshops
4	Ter-race	10% previous mine, 50% cultivation 10% grazing degradation	Infrastructure 20% destruction	Dirt tracks, gully and creek banks	>10%	1	Large high density concentrations, complex microblade workshops
5	NA	100% Mine dump	Already 100% destroyed	NA	0%	NA	NA
6	Ter-races, valley side	>10% grazing degradation, 60% cultivated	Powerline, farm road >10% destruction	Dirt tracks, bare patches, dams	>10%	4	Medium sized medium density concentrations; systematic microblade workshops
7	Ridge, valley side	20% grazing degradation, 10% gravel extraction, >10% building construction, > 10% cultivation	Overburden emplacement, powerline, farm road & haul road. 20% destruction, 90% subsidence	Dirt tracks, bare patches, dams	20%	36	Large high density concentrations, limited microblade workshops
8	Ter-race	80% cultivation	Creek diversion >10% destruction, 60% subsidence	Dirt tracks, creek banks	>10%	4	Medium sized medium density concentrations; systematic microblade workshops
9	Ter-race, valley side	80% cultivation	60% subsidence	Creek banks	>10%	2	Medium sized medium density concentrations; systematic microblade workshops
10	Ter-race, valley side	10% land degradation	>10% subsidence	Dirt track bare patches	80%	12	Large high density concentrations, complex microblade workshops
11	Ter-race, valley side	80% cultivation, >10% building construction,	29% subsidence	Dirt track	>10%	4	Large high density concentrations, complex microblade workshops, hearths common

Table 15.1. Archaeological potential for the Ashton area.

The column "coverage is the percentage foot coverage for the zone indicated in **Map 9.1**".

The column "zones" in Table 15.1 refers to the coverage zones shown in **Map 9.2**. The type of landscape is listed under "land", and an assessment of the types of disturbance from European land use is estimated as a percentage. This was done using Mitchell 2002 Figure 1. The impact is the effects which would result from the proposed development. Percentage estimates were made from Map 4.1. Exposure is a summary of the exposure types (provided in detail in Appendix 2). The EWAs (exposures with artefacts) which were recorded are also listed as shown in Map 10 1a & b.

The "archaeological potential" collum was made by extrapolating the archaeology recorded during the survey, as well as considering what has been found on similar landscapes elsewhere in the Hunter. The reliability of estimating unlocated sites based on the foot coverage, as well as by extrapolation is discussed later. The terms for the archaeological potential column are defined as follows.

1. Concentrations. Artefact concentrations consist of area where there are high numbers of artefacts evenly distributed within a boundary, or where there is clusters of artefacts are grouped. The types are:
   - Small: Under 25 sqm (i.e. under 5 x 5 m)
   - Medium: 25 to 400 sqm (i.e. 5 x 5 m to 20 x 20m)
   - Large: Over 400 sqm (does not include microblade workshops)

2. Density. Artefact density is based on artefacts found on a lag surface on the B horizon, or an estimated number from excavation,
   - Low: >1 artefact per sq m.
   - Medium: 1 to 10 artefacts per sq m.
   - High: < 10 artefacts per sq m

3. Microblade workshops. Microblade workshops are a concentration resulting from the reduction of a microblade core. These form a small sharply defined feature rather than a concentration which is bounded as a density gradient. The microblade workshop types are:
   - Limited workshop: This is relatively few (>50) flakes from a single core contained within a 0.5 x 0.5 m area
   - Systematic workshop: This is relatively many (50 to 200) flakes from a single core contained within a 1 x 1 m area.
   - Complex workshop. This is more than one core and large numbers (>200) flakes contained within a 3 x 3 m area

15.10 Probabilities for Undetected Sites

Table 15.1 indicates large complex sites having abundant artefacts within some of the coverage zones. It is possible that some of which were not detected by the survey considering the effectiveness of the foot coverage. The likelihood of undetected major sites in these zones needs to be further evaluated.

Zones 1, 2 and 3.

These zones are along the northern section of Ashton ridge, and the southern slopes of Bettys Creek valley. Various small sites and scattered exposures with artefacts were recorded, but there is no indication of a major site likely to be in these zones. All of the ground in these zones is to be entirely destroyed and the coverage is discussed in section 9.2 Coverage Zones.

Zone 4

In coverage Zone 4 Bettys Creek enters Bowmans Creek. The juncture of two creeks in the Hunter is a common location for large scale Aboriginal occupation. The main exposure in this zone was the Bowmans Creek east cut bank. This bank showed the soil profile on top of the terrace and the Post-European alluvium covering it. No flakes were seen eroding as talus down the creek bank. It would be expected that if there was a major concentration of artefacts in the area, that a few would be detectible in this exposure. A substantial amount of flood plain engineering has taken place, and other sections of Bowmans Creek and Bettys Creek have also been bull dozed and modified. The chance of a major site in this area seems remote, and if it is present it is likely to be heavily disturbed. Perhaps such a site is located to the north, across the railway tracks and on a higher terrace or the valley slopes. A major camp site also may be on the eastern terraces of Bowmans Creek above the Bettys Creek junction. If so, it would not be impacted since it would be out of the developmental area

In a brief telephone conversation with Jan Wilson, currently doing an archaeological survey for the proposed Glendell Mine, her impression seemed to be that there was not much archaeology detectible on the lower Bettys Creek bottoms, unlike the higher parts of the catchment. Concentrations of artefacts were recorded by Nightingale (1991) where Swamp Creek enters Bowmans Creek (see section 6.7) in an analogous context to the junction of Bettys Creek. The Swamp Creek sites are to be destroyed by the Ravensworth East Mine.

Zones 5 and 8.

The coverage for these zones is discussed in section 9.2 Coverage Zones. These zones are the terraces and flood plain of Bowmans Creek where heavy grass cover made foot coverage ineffective. The survey showed that major sites occurred on valley slopes adjacent to a channel. It is possible that other large sites are on the terraces, but there was no indication from the 10 back hoe pits on Lines 1 and 2 from the subsurface testing by Peter Mitchell. These zones are in the subsidence area.

Zone 8. This zone also was described in section 9.2 Coverage Zones. Exposures with artefacts were found, including Glennies Flats Sites 1 and 2. The zone is outside of the mine area, and the only impact would be from a powerline and a new farm access road.

Zone 7

Zone 7 had two major sites were recorded on Bowmans Creek. Both of these were where the channel came in close to the valley slope. The eastern valley slopes south of these two sites were flatter and less erodable. Exposure was limited to dirt vehicle tracks. However, a track cutting across this area formed a transect, and some other partly overgrown dirt tracks were available to walk. If there had been a site of comparable size and density as the Waterhole and Oxbow Sites up stream, it is likely that it would have been indicated by the track exposures. The isolated finds in Map 10.1b appear to be part of the background scatter. It is suggested that this part of Zone 7 was too far away from the creek channel for large scale Aboriginal occupation, and the tributary channels were not adequate to support such an occupation. If there are big sites in the vicinity, they probably would be out on the terraces of Zone 9.

Zone 9.

Zone 9 consisted of ploughed paddocks on terraces. None of the area was freshly ploughed at the time of survey and field walking was not feasible. Even if there had been fresh ploughing, the lower terraces with the thick cover of Post-European sediment are unlikely to have been productive. However, this area is where Bowmans Creek flats open out onto the Hunter River. As is discussed in the regional evaluation in section 14.7, this area has the potential to have a major occupation. It should be noted however that most of Bowmans Creek channel and associated terraces in this zone, particularly towards where there is some high ground, is outside of the subsidence area. Thus even if it is present, it is unlikely to be impacted by the proposed development, and therefore was not investigated by the foot survey. The opening of Bayswater Creek where it joins the Hunter River terraces is likely to be an analogous situation. Considerable archaeology was found in this context, (Rich 1993), and this may apply here also.

Zone 10.

This zone is mostly occupied by the Glennies Creek Site which is largely outside of the subsidence area.

Zone 11

Zone 11 is the valley slopes and terraces on the Hunter River between Bowmans and Glennies Creek. The terraces here were also all cultivated, but not freshly ploughed. Most of this area was not covered on foot because little of it was in the impact zone. However the Hunter River Slope Site was recorded on a valley slope over looking the terraces. Artefacts were abundant and there was considerable hearth stone material. The presence of hearths is similar to the Narama sites on Bayswater Creek (Rich 1993), and the artefact assemblage also seems to be within the range of the Narama Sites (sections 6.4 and 12.22). Large and extensive sites can be expected in this area, but relatively little of it would be affected by subsidence. The main source of impacts would be farming activities by the owner or lessees.

15.11 Impact Minimisation

There was considerable consultation with the Aboriginal community and White Mining to investigate means to minimise developmental impact. This was mostly discussed relatively to the four management Areas in **Map 15.1**. Impacts from subsidence have also been considered in detail in the Appendix 6 Subsidence Study.

Management Area A

Although major sites were not expected in this area, it was clear that artefacts were present, of which the Ridge Top Site was an example. The entire area would be covered by an emplacement dump by the proposed mine. Such archaeology would be inevitably and unavoidable destroyed if the mine were to go ahead. Monitoring methods for soil and gravel reclamation seemed to be the only mitigative option.

Management Area B.

This is the open cut mine area with some of the emplacement that continues into Area A, as well as various infrastructure and facilities. Almost all of this area would be destroyed and disturbed by mining. There were discussions with White Mining on the possibility of protecting to protect the Tributary Site as an *in situ* artefact deposit with limited microblade workshops. I was suggested that the toe of the emplacement might be modified to not encroach on this site. However it is understood that even though this site in near the northern end of the dump that the area is necessarily required to hold overburden. The difficulties in this proposition are outlined in detail in a response by White Mining dated 31 May 2002 to Planning NSW about a proposal to preserve a woodland remnant which is also in the at that location.

Protection of the Railway Site was discussed, since it would be mainly destroyed by a haul road. It is not possible for the haul road to be altered with out reducing space for the emplacement. The TSR Site was on the edge of the proposed open cut, and there was no feasible means to protect it. The Bridge site was probably an extension of the Waterhole Site, but it is located in a very tightly planned area of development. Attempts to find preservational options were discussed at length in the field but it was found not possible to move any component of the development to preserve any part of it.

Thus all of the sites in Management Area B were considered for preservation or impact minimisation, and all possible options were explored. In no case however was there the flexibility to provide any protection. The lack of flexibility for this area is reflected in correspondence from the proponent dated 31 May 2002 explaining how leaving a woodland remnant as a wildlife corridor was not compatible with the mine plan.

Management Area C.

The main impact in this area is the diversion channel for Bowmans Creek. Most of the route of this channel was through a heavily grassed area, and the presence of sites was difficult to determine except for the Brunkers Lane Site. This was on a partly regrown track across the terraces which served as a transect. Protection for this site can be provided by moving the channel to the east. This measure has been agreed to by White Mining in response to additional issues raised by Peter Mitchell concerning the possible (but unlikely) presence of early buried sites.

Of particular concern was any accidental damage to the Waterhole Site and its grinding grooves by the construction of the channel diversion. It was shown in the field where the diversion cut was planned, and how it used the sand stone wall of the waterhole to direct flows down the diversion. It was shown that the diversion cut would not encroach on the waterhole or the sandstone outcrop with the grinding grooves. It was agreed that prior to any construction work a protective fence would need to be erected around the waterhole with its grinding grooves as well as some undisturbed archaeological deposit on the east bank. This would be with sufficient buffer to ensure that there would be no inadvertent damage.

Management Area D

This area consists of an emplacement dump and the subsidence area for the proposed underground mine. It also was where three major sites were found as well as three smaller ones. It was understood that the location of the long wall panels could not be altered. However, there was some room for flexibility for the emplacement. This has been altered to avoid impact to the eastern fringe of the Oxbow Site. however, EWA87 of the Oxbow site probably will be impacted by the emplacement or a sediment pond, the High Ridge Workshop Site would be unavoidably covered by the emplacement.

The Waterhole Site is not in a subsidence area, but the haul road under the bridge must pass through it. There was considerable discussion in the field about how the haul road could be best directed through the most disturbed part of the Waterhole site. It may be unavoidable however for the haul road to damage the edge of an intact deposit belonging to the site. There also was concern about a bund wall on part of the Waterhole Site, but it seemed feasible to obtain permission from the RTA to not make the bund wall extend on the site area. The Waterhole Site also had a fibre optic cable line through it and it was expected that there would be changes in powerlines that would put the Waterhole Site in a corridor for telecommunication and transmission lines. This could be done without impacting on the site.

The development surrounding the Waterhole Site and through it would alter its appearance greatly as an archaeological precinct, but it should be noted that it has already has had massive direct and visual impact from the New England Highway and the erosion from the gravel plant. In spite of this, there are some conservation outcomes. This consists of the main exposure on the slope being available for educational purposes to show what artefact concentrations look like, the protection of the fabric of the grinding grooves, and the protection of most, if not all of the intact deposit.

The Oxbow Site is in the middle of the subsidence area. From discussions it was agreed that the main concentration area could be fenced off for protection from cattle and allow ground cover to regenerate. This also would prevent damage from water tucks removing rain water from ponding due to subsidence. The western fringes can be avoided by an agreed to adjustment of the emplacement dump and sediment ponds. (See Appendix 6 Subsidence Study). *

The Ridge Peak Site is out of the emplacement area and marginally within the subsidence zone. It is potentially affected by a new farm road. It was discussed how this road can be altered to pass around the site and not through it. This site also would be within the suggested Glennies Creek Site conservation area and should be fenced off. // VCA

The Glennies Creek Site is the most outstanding of the sites recorded. It was discussed that the present dirt track through it needs to be fenced off, as well as the rest of it to prevent further impact by cattle. This area can be further conserved by a variety of methods, such as an Aboriginal Place or Voluntary Conservation agreement under the NPWS legislation. This is discussed further in section 14.8 Conservation Goals for the Hunter Valley. In correspondence from the proponent dated 12 July 2002 arrangements have been made to fence the, site and for power poles on the site to be made on foot by Energy Australia.

The High Spur Site is within the edge of the subsidence area. It is on a steep slope, and is an example where there may be adverse effects from the subsidence by slumping. If so, the mine plan is not alterable to reduce this possibility (See Appendix 6 Subsidence Study).

The Hunter River Slope Site is partly within the subsidence area and also may be affected by erosion due to changes in slope. Alterations of the mine plan however are not feasible to minimise the chance of damage from this cause. (See Appendix 6 Subsidence Study).

Avoidance and Conservation

The options for avoidance and conservation were considered for all of the sites recorded. In this the Aboriginal community representatives were active on site with the White Mining management to try to achieve the best possible results. Alterations to the mine plan were made where ever possible. Those sites and isolated finds which are to be inevitably impacted will need to be mitigated in other ways, such as by monitoring or salvage.

References

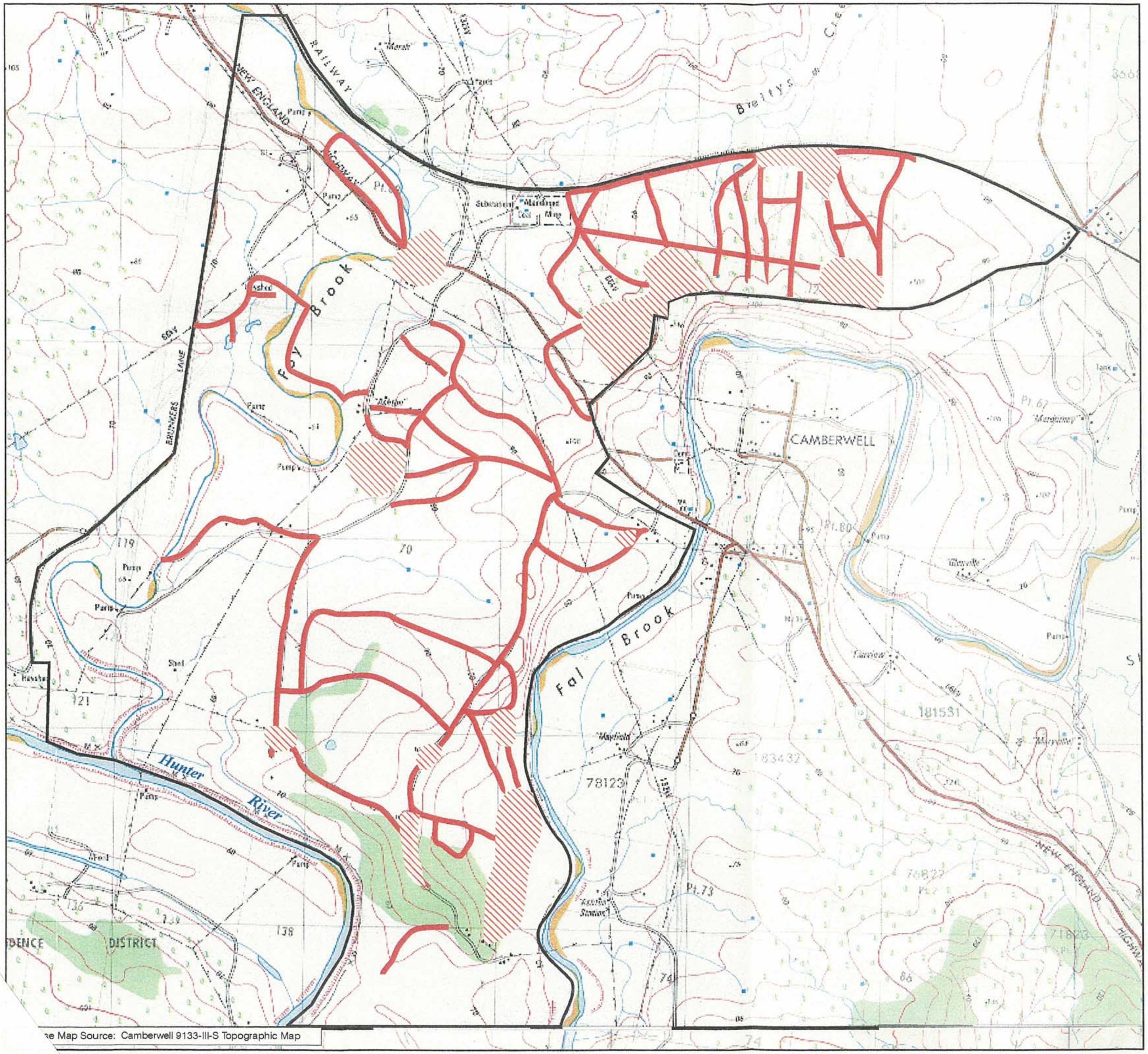
Mitchell, P. June 2002. Geomorphology of the Ashton Coal project site in relation to archaeology. Camberwell, Hunter Valley, NSW. Report by Groundtruth Consulting.

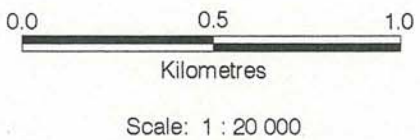
Nightingale , A. February 1999. Ravensworth East Mine archaeology report. For Peabody Resources Limited by ERM Mitchell McCotter.

Rich, B. 1993. Narama Salvage Project ,Lower Bayswater Creek, Hunter Valley, NSW. Report for Envirosciences Pty Ltd and Narama Joint Venture by Brayshaw McDonald Pty. Ltd.

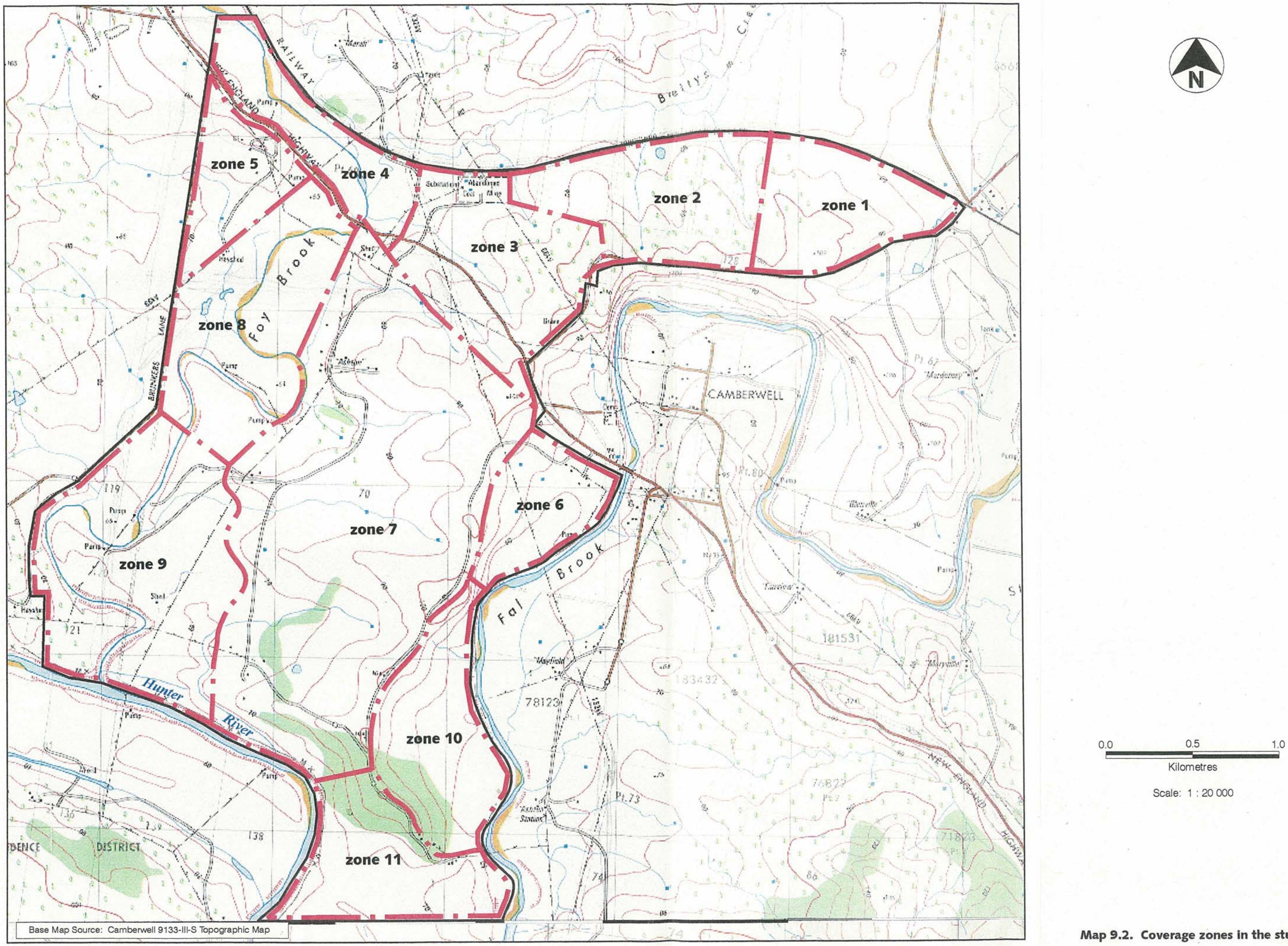
Witter, D. June 2002. Ashton Coal Mining Project Environmental Impact Statement: Aboriginal Archaeology. Report to HLA-Resources for White Mining Ltd.

Figures

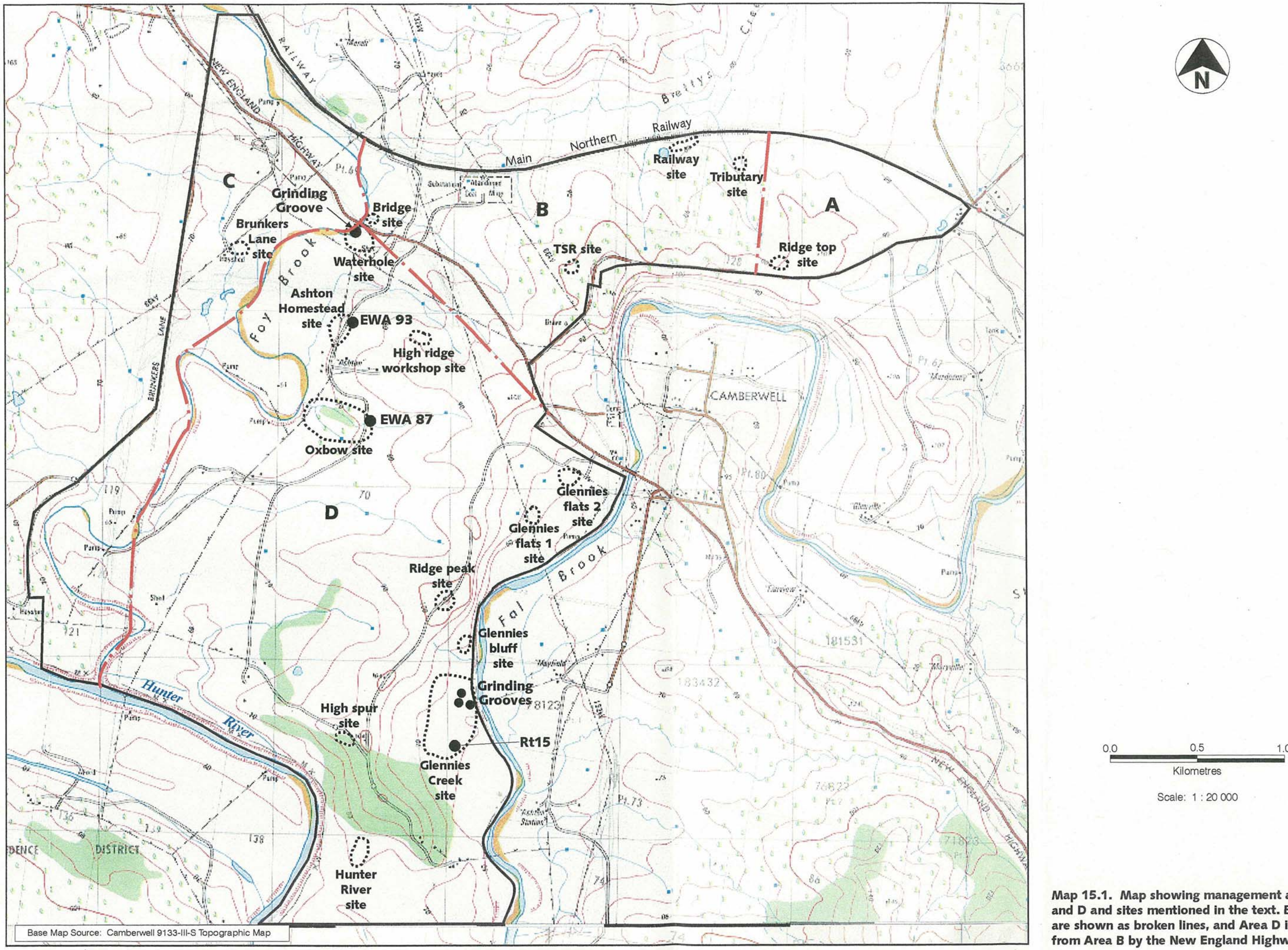




Map 9.1. Foot coverage of the study area. Hashed areas indicate main coverage by foot to examine exposures as indicated by aerial photography.



Map 9.2. Coverage zones in the study area



Map 15.1. Map showing management areas A,B,C and D and sites mentioned in the text. Boundaries are shown as broken lines, and Area D is separated from Area B by the New England Highway.

ADDENDUM 2

Below is an addition in response to a requirement by PlanningNSW to provide detailed assessment of subsidence impacts on known sites and any possible sites by considering nick point erosion, cracking and water ponding.

SUBSIDENCE STUDY

Subsidence Impacts

Subsidence is primarily a process of lowering the land surface. The potential impact from subsidence by the Aston underground mine has been examined in detail. This effect can be shown for the proposed Ashton mine by the following cross sections in **Figures 1, 1(a), 1(b) and 1(c)**.

The relationship of the area of subsidence to the rest of the proposed Ashton Mining Project can be seen in **Figure 2.** Within this area, the cumulative effects of subsidence have been modelled in the form of contours as shown in **Figure 3.** The archaeology recorded for the project area is shown in **Figure 4.**

From these maps **Table 1** has been prepared as a means of assessing the impact on the archaeology from subsidence. The method of evaluating the subsidence effects on archaeological sites was based on a system developed by HLA-Envirosciences and the National Parks and Wildlife Service. This process is documented by a record by Colin Phillips of HLA-Envirosciences of a field visit by Margrit Koettig and representatives of the mining industry to the Dartbook and Cumnock Mines on 8 February 2001. The method of interpreting the effects of subsidence in Table 1 to archaeological sites is explained as follows:

> The table has been produced as a means of assessing the potential impact on archaeological sites, as a result of subsidence. The table is derived from work conducted in the Dartbrook (U/G) extended project. The approach was developed during a meeting held on the 8th of February 2001, attended by Colin Phillips of HLA-Envirosciences, Victor Perry of the Wonnarua Tribal Council, Rick Cairns of Cumnock Colliery, Andrew Kerr of Anglo-Cola and Margrit Koettig of NPWS. It was agreed that the table would be a useful tool which may be used to clearly illustrate the likely impact on known archaeological sites. The figure of <10% was suggested as a reasonable method to describe a site, which with all available knowledge and data, would not be disturbed by the proposal. Any site which was considered to be disturbed, or possibly to be disturbed, was rated a >90%. Sites which were assigned this rating, were to be the subject of an application to NPWS for Section 90 Consent to Destroy. The history of these figures stems back to conditions of consent granted to Ulan Colliery previously.
>
> The following table, predicts the impact of subsidence, on each site which is assessed based on the map, produced in the assessment report. The first four columns identify each site, giving the site numbers and the location in AMG Coordinates. The next column describes the nature of the site. The column which describes the land form unit or zone is used to relate the site to its corresponding unit as determined in the archaeology report. The next two columns relate to the events of predicted subsidence. The subsidence unit refers to where the archaeological site is in relation to the subsidence along the longwall panel, therefore whether it will be on the side or slope, or at the bottom or trough of the subsided long wall. The incidence of subsidence reports on how many times the area will be subsided, correlates to the number of coal seams to be extracted from the area.
>
> There were three categories of surface disturbance identified, being either the open cut operation and associated infrastructure (e.g. buildings, roads etc) and the underground operation. Predicted impact provides a figure that relates to the predicted level of cumulative vertical subsidence. The

depth to Pikes Gully Seam was included as an important variable, due to the relationship between the depth of cover and surface cracking. Experience in the Hunter Valley has shown that the deeper the seam extraction, the less likely surface cracking will occur.

The predicted impact to each site is assigned a likely percentage based on information in the preceding columns. The sites, which are located at the base of the trough, on gate roads or outside any area of subsidence impact are assigned a percentage of <10% of impact. The rationale behind this has been based on previous meetings with NPWS associated with other underground mines in the Hunter Valley. The assumption in the impact prediction is that a site is more likely to be affected by horizontal displacement and cracking then vertical displacement, Therefore all sites which are located on the slope or side of a subsided longwall panel has been assessed as having >90% chance of disturbance. Sites which are located within infrastructure areas, emplacements and the open cut have also been assessed as having >90% chance of disturbance. The final column provides areas for general comments, which typically relates to the general locality of the site within the lease area.

The archaeological data come from two reports by Hardy (2001 and 2002) as well as one by Witter (2002) as shown in the "survey" column. The recorded archaeology is listed in the "site name" column. This is shown as numbers 1 to 24 for Hardy and for Witter EWA1 to EWA102 (exposures with artefacts),as well as GG1 to GG6 (grinding grooves). The site types for Hardy were artefact scatter and isolated find, whereas for Witter they were exposures with artefacts and grinding grooves. Some of the EWA and GG numbers are grouped together as a "site". In other cases a single EWA may indicate an artefact concentration as a "site". The sites within the subsidence area are provided as sets of 4 grid coordinates to form a polygon to contain one or more EWA.

The landscape classification used by Witter was different from that by Hardy. This was because Witter was concerned to distinguish ridge from valley artefact distributions. The "landscape type" column is taken from the classification by Witter, and includes the site numbers from the Hardy survey.

Impacts on Archaeology

In Table 1 above the various factors which were used to estimate impact on the recorded archaeology were presented as subsidence unit, incidence of subsidence, potential impact from subsidence and depth of cover to the Pikes Gully coal seam. The result was a column labelled "NPWS likelihood of subsidence". The likelihood of subsidence is listed as either under 10% or greater than 90% as described above. The likely effects of subsidence on exposures with artefacts as sites, or as isolated finds, is shown in Table 2.

The list of sites in Table 2 does not include the Waterhole Site and its grinding grooves. Even though this is south of the New England Highway and on the edge of the underground mine it is out of the area of potential impact from subsidence. The sites which have a 90% or greater probability of effect from subsidence are the Homestead, Oxbow, Ridge Peak, High Ridge Workshop, and High Spur Sites. The nature of the potential effects from the ">90% likelihood of subsidence" is discussed in detail below

The estimate of >90% likelihood of subsidence also applies to 23 isolated finds. The Hunter River Slope site is on the edge of the subsidence area, with one point that has an under 10% likelihood of impact and three other points which are within the over

90% zone. The Glennies Creek Site covers a very large area, some of which is on the edge of the subsidence zone. Of the three exposures with artefacts within this zone, all have a less than 10% chance of impact since they are on gate roads. There are also 8 isolated finds with under 10% probability of impact.

Effects of Subsidence on Archaeological Site Integrity

Archaeological site integrity is concerned with the degree of disturbance or loss of material, among other factors. For example, the loss of some of the artefacts means that any analysis would be incomplete, or possibly distorted. The effects of disturbance or loss also mean that the spatial relationships are disrupted. For example, ploughing leaves the artefacts in the ground, but breaks up their pattern and grouping.

The effects of subsidence have been described as:

1. Cracking. These are cracks which may open in the ground. They are described as usually only a few millimetres wide, but sometimes may be several centimetres wide and have to be filled in for safety reasons. The exact location of a crack is unpredictable, and its formation is unstoppable. Such cracks could cause shifts in parts of an archaeological site, and some artefacts may drop down the cracks. On steep slopes cracks also could cause slumping.
2. Knick points and rilling. Changes in slope may cause knick points to progress up slope, or rills to form. This erosion could affect the integrity of a site, but can be controlled where it occurs.
3. Ponding. Ponds may occur when depressions are formed. The deposition of sediments in such ponds prevents further examination or investigation of a site.

The scale of impact to isolated finds or small artefact concentrations is potentially considerable. A rill from knick point advancement could remove a substantial part of a 50 x 50 metre artefact concentration. Except for an isolated find falling down a subsidence crack however, cracking would have relatively little effect on even small sites in most situations.

Small limited microblade workshop sites, such as the High Ridge Workshop Site are probably repeated over the landscape, and there are likely to be more which were not found by the survey. The High Ridge Workshop site however is in the Western Emplacement area and would be destroyed by the overburden dump, making subsidence impact irrelevant. The Ridge Peak site consists of a low density concentration of artefacts. This is another kind of site which can be expected to have other examples over Ashton ridge. However, as a look-out point above the large Glennies Creek Site it may have some unique characteristics. The occasional flake tools among the isolated finds also are probably widely distributed. Thus some loss to the above small sites and isolated finds is mitigated by there being a wide representation.

The High Spur Site however is a small site of a type which may not be widely represented elsewhere in the study area. This site includes a partly *in situ* workshop of burnt silcrete, as well as some quartz and tuff workshop material. None of the material in this complex workshop belongs to the microblade technology. The contents may be similar to EWA35 in the Oxbow Site, but it is on a high spur crest rather than by a tributary on a valley slope. This site is on a the brow of steep slope overlooking the Hunter River. It is understood that the effects of subsidence could result in slumping down the slope towards the river (although this is unlikely).

The location of the site over a long wall raises the issue that some adjustment to the location of the long wall or a gate road might make it more stable. In a document explaining the flexibility of options to Planning NSW (Wells 2002:p8) it is considered that "The nominated mine plan is considered to be the only option …". Therefore it is the position of the proponent that an alteration to the mine plan for this purpose is not feasible.

In the case of major sites which are 100 x 100 metres or more in size and have hundreds of artefacts the overall loss of integrity from subsidence is likely to be relatively little. The effects of cracking would not affect a sufficient percentage of a site to have an appreciable effect. Although rilling could remove some of the artefacts belonging to an activity area, a reasonable assemblage probably would remain. Ponding is perhaps the main concern since there may be reason to re-examine a major site. While it might require the removal of freshly deposited sediments, or timing when conditions are dry, it would remain accessible with accurate locational information.

The numerous points for the Oxbow site in Table 2 reflect its large size. All of the points as recorded by Witter and Hardy in this table are shown in the "greater than 90% likelihood of subsidence" column in Table 1. Figure 4 however shows that the main parts of this site with the major concentration of artefacts is in the middle of the trough. These are the points EWA 29, 30, 31, 32, and 36. This is the part of the subsidence which is the least likely change slopes on the surface or produce wide cracks. Any impacts from these would be negligible to the integrity of the site. The main effect would be ponding. It is a practice to pump water out of such ponds after rains ("de-watering"). This could result in considerable disturbance to the site by truck traffic, especially if the ground was wet. If however, the Oxbow Site is fenced to prevent cattle trampling the artefacts and causing erosion (as is recommended), it also would prevent water trucks from entering the site. It also might be thought that because of the formation of troughs over the low lying landscape, the appearance of this would be altered to some degree in the form of depressions. However, with the troughs being 200 metres wide, their visual effect would be subtle, and as an archaeological precinct in farm land, this site is not visually outstanding.

Another major site which would be affected by subsidence is the Hunter River Slope Site. The artefact assemblages of this site differ from the Waterhole, Oxbow and Glennies Creek Site group. It also has hearths and considerable hearth stone material. This site is on the west side of the south end of the second long wall. It is on sloping ground, and changes in slope from subsidence may have an adverse effect. At present however, this site is being impacted by erosion from a disused farm track which goes through it. This is a case where minor changes in the underground mine might ensure stability to this site. However, as has already been mentioned, alterations in the mine plan are not feasible e (Wells 2002:8)

The Glennies Creek Site is a very large and very rich site with grinding grooves in a relatively undisturbed setting. It is located at the base of the ridge and is on the outer edge of a long wall panel. Adverse effects from subsidence to part of it are estimated to be less than 10%. It is possible that the effects of subsidence may lower the ridge somewhat, but the basic site setting would remain the same. The direct effects of subsidence for both the known and the unknown archaeology at this site appears to be at a small scale, even though there would be a lowering of the landscape to the west. The indirect effects on the visual values of the curtilage would be unnoticeable.
In conclusion, the subsidence issue mainly seems to concern three sites: the Oxbow, High Spur and Hunter River Slope Sites.

1. The large Oxbow Site is likely to be extensively affected by ponding, reducing its accessibility, but with little damage to its integrity. A protective fence would prevent damage from pumping out ponded water after a rain. The artefact assemblages belonging to this site are similar to those of the Waterhole and Glennies Creek Sites.

mitigation??

2. The High Spur Site is an unusual small complex workshop site which may undergo slumping. It is not feasible however to make changes in the mine plan to minimise this possibility.

3. The Hunter Valley Slope Site is unlike the other major sites in the area, and the effects of slope change may cause relatively extensive damage (beyond that already taking place from the old farm track). It is not possible however to change the mine plan to reduce this possibility.

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Phillips, C. 8 February 2001. Field visit of Margrit Koettig to Dartbrook and Cumnock Mines to inspect surface effects of subsidence. HLA-envirosciences.

Wells, A. 28 March 2002. Ashton Coal Mine Project – Camberwell. 4. Project justification and alternatives. Letter to Executive Director, Planning NSW.

Witter, D. June 2002. Ashton Coal Mining Project Environmental Impact Statement, Aboriginal Archaeology. Report to HLA Envirosciences for White Mining Ltd, by Witter Archaeology.

FIGURES

Figure 1. Cross sections across the proposed Ashton underground mine area showing subsidence.

Figure 2. Ashton Coal Project mine layout. [map showing mine layout].

Figure 3. Map showing contours for the cumulative subsidence for the proposed Ashton underground mine.

Figure 4. Map showing the distribution of archaeological sites over the proposed Ashton development area. [map of "Figure 5, revised"].

TABLES

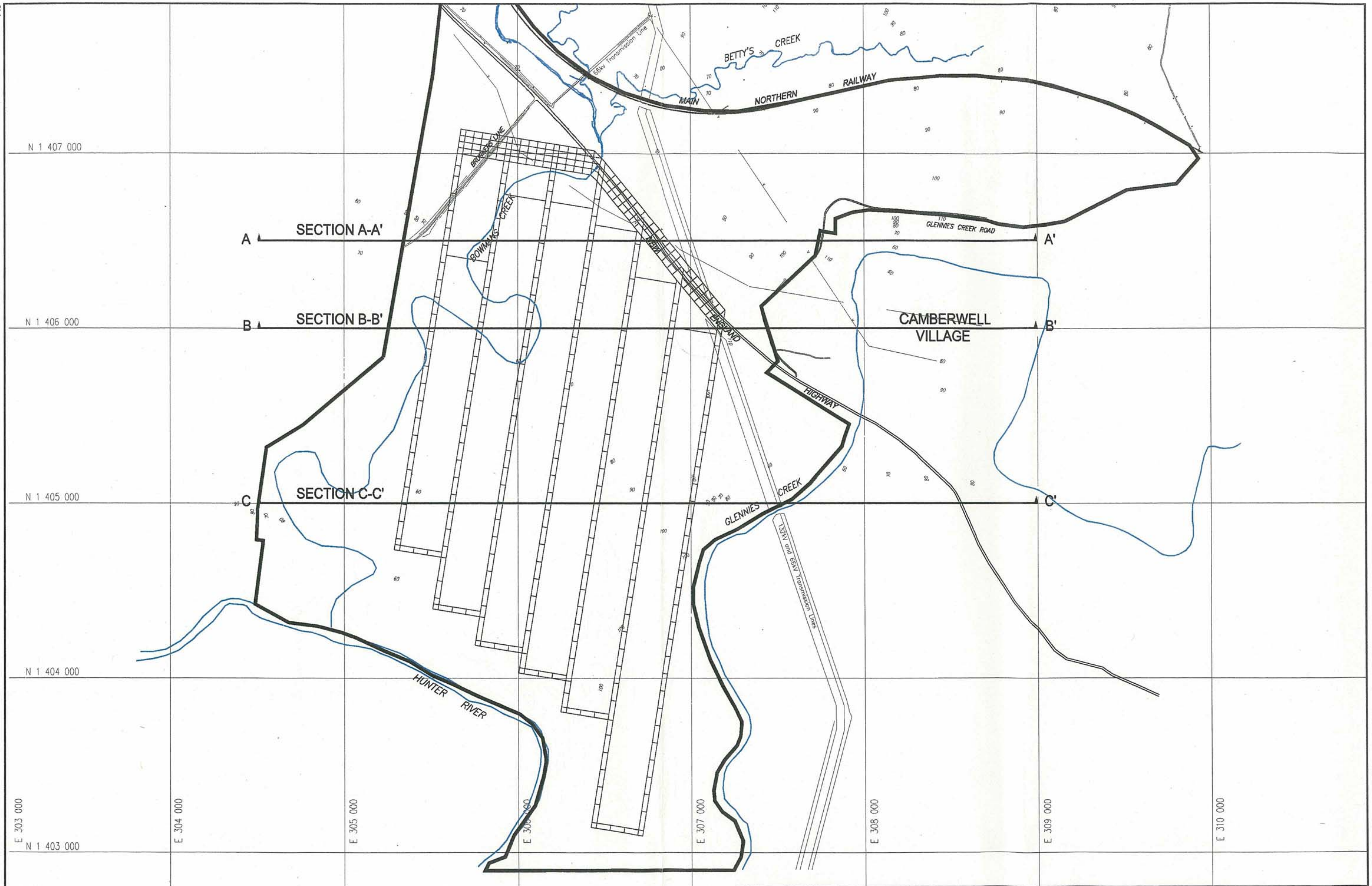
Table 1. Archaeological Sites and impacts from the proposed Ashton Mine, including variables from subsidence.

Where is it??

See over

Table 2. Effects of subsidence on archaeology where there is underground mining. Numbers with "W" are records by Witter and those with "H" are by Hardy.

Sites	< 10% likelihood	> 90% likelihood
Homestead		W79, W91, W93, H16, H17, H18, H21
Oxbow		W29, W30, W31, W32, W34, W35, W36, W87, W90 H5, H6, H7, H15,
High Ridge W/S		W84
Ridge Peak		W42
Glennies Creek	W61, W62, W63,	
High Spur		W46
Hunter River Slope	W95	W94, W101, W102
Isolated Finds	W48, W66, W67, W69, W70, W77, W78, H19	W40, W41, W43, W44, W45, W47, W49, W50, W51, W52, W56, W57, W58, W59, W60, W76, W83, W85, W86, W96, W97, H20, H22



LEGEND

DEVELOPMENT APPLICATION BOUNDARY

0 200 400 600 800 1000
metres

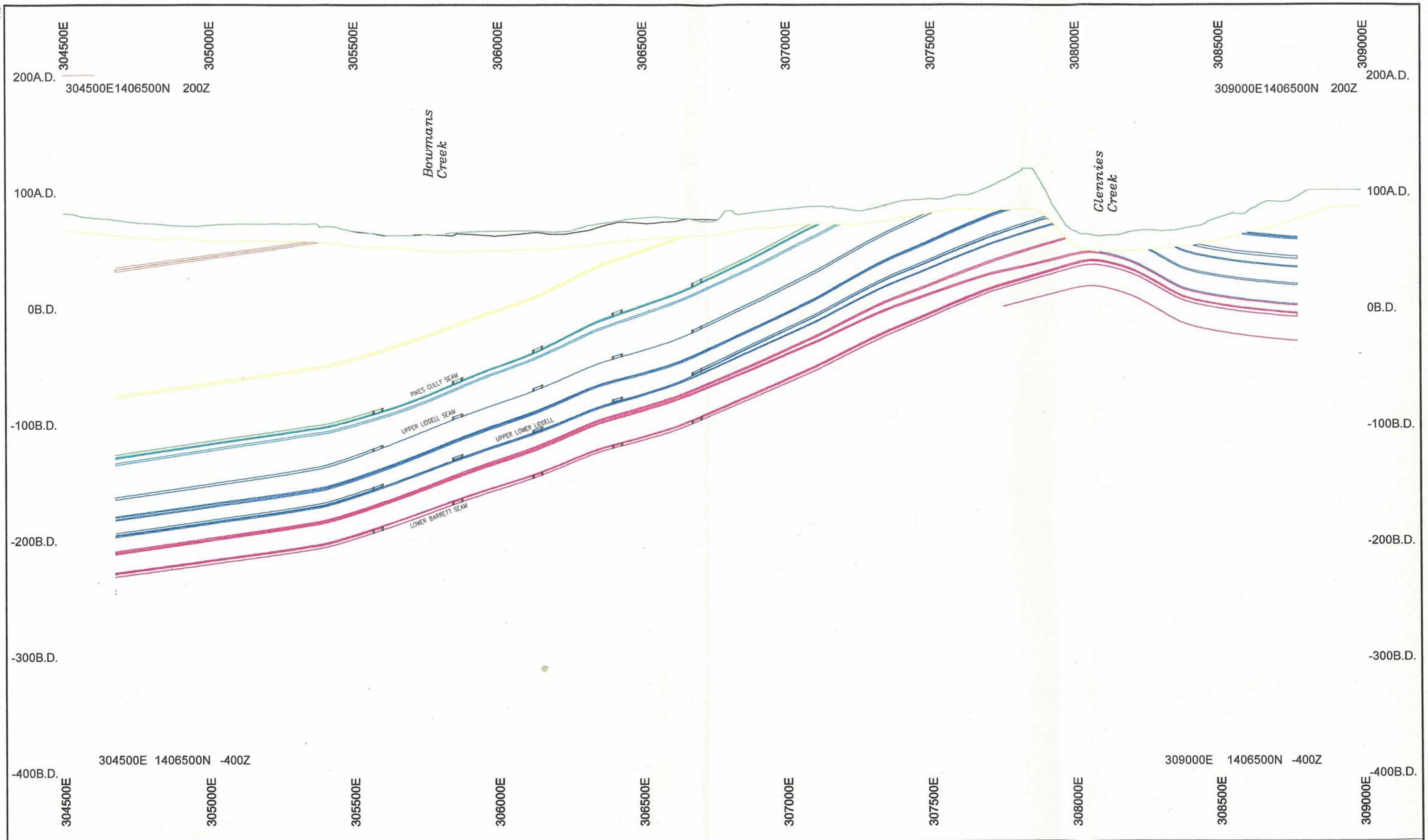
REFERENCE: Base Plan Supplied by Co-Resources Pty Ltd. - U909-Fig 1.DWG

HLA-Envirosciences Pty Limited
55-65 Grandview Street
Pymble, NSW
61 2 9988 4422

SECTION LOACATION PLAN
White Mining Limited
Ashton Coal Project - Archaeological Assessment
Camberwell, New South Wales

FIGURE **1**

DRAWN	PROJECT-FILE NUMBER	APPROVED	DATE	REVISED DATE
LJE/JF	U842-061/U909		February 2002	15th July 2002



Natural Surface
Cumulative Subsidence Surface

Seam BAYS1	Seam ULLD
Seam BAYS2	Seam LLLD
Seam LEM	Seam UB
Seam PG	Seam UBS
Seam UART	Seam LBS
Seam ART	Seam LB
Seam ULD	Seam HEB1
Seam MLD1	Seam HEB2
Seam MLD2	

0 500 1000
metres

REFERENCE: Base Plan Supplied by Co-Resources Pty Ltd. - U909-Fig 1A.DWG

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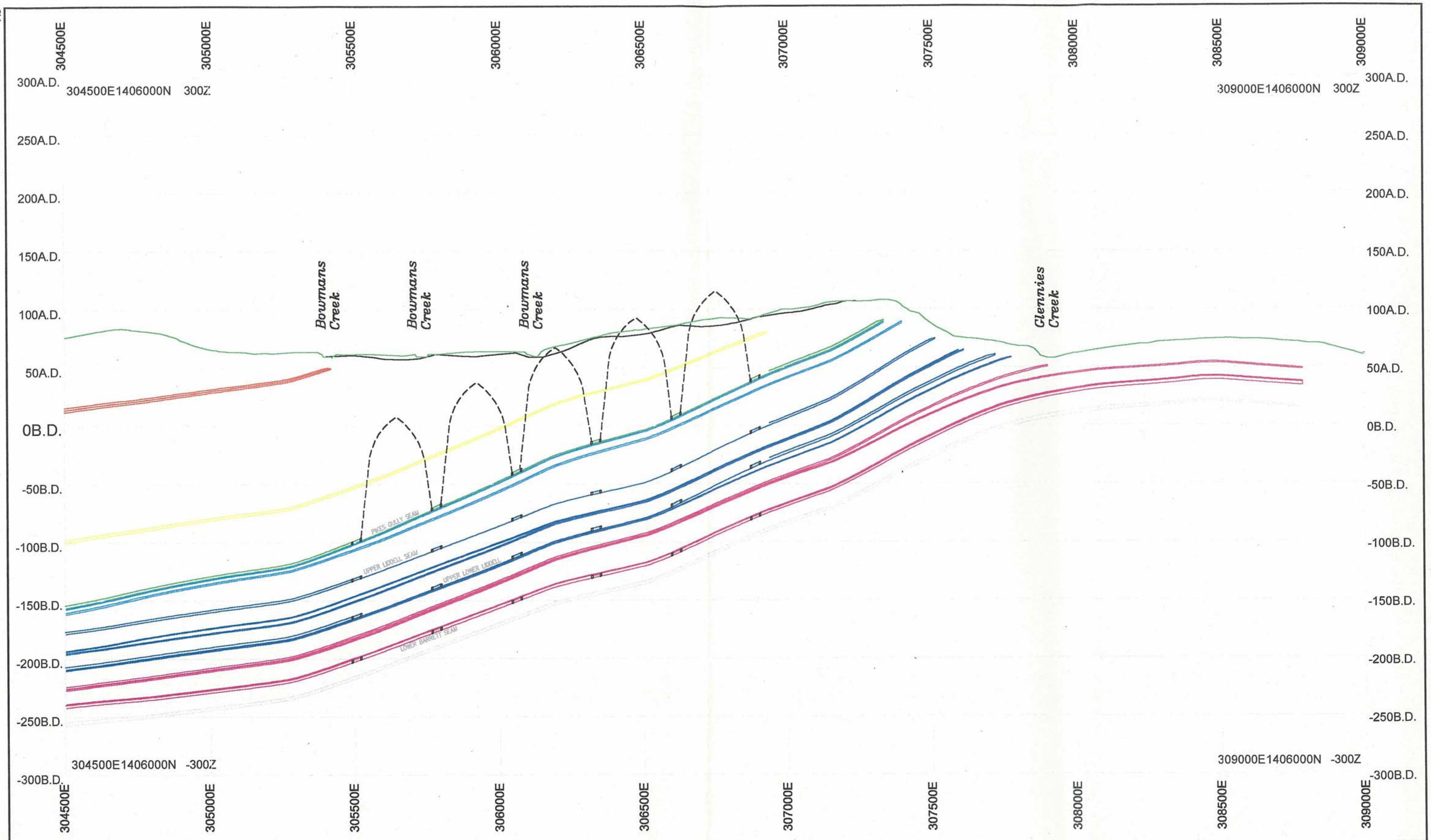
GEOLOGICAL CROSS SECTION A-A'
White Mining Limited
Ashton Coal Project - Archaeological Assessment
Camberwell, New South Wales

FIGURE **1A**

DRAWN	PROJECT-FILE NUMBER	APPROVED	DATE	REVISED DATE
LJE	U842-065/U909		February 2002	15th July 2002



Natural Surface

Cumulative Subsidence Surface

Seam BAYS1	Seam ULLD
Seam BAYS2	Seam LLLD
Seam LEM	Seam UB
Seam PG	Seam UBS
Seam UART	Seam LBS
Seam ART	Seam LB
Seam ULD	Seam HEB1
Seam MLD1	Seam HEB2
Seam MLD2	

Theoretical height of fracturing or bed separation above PGS Longwall Panel

0 500 1000
metres

REFERENCE: Base Plan Supplied by Co-Resources Pty Ltd. - U909-Fig 1B.DWG

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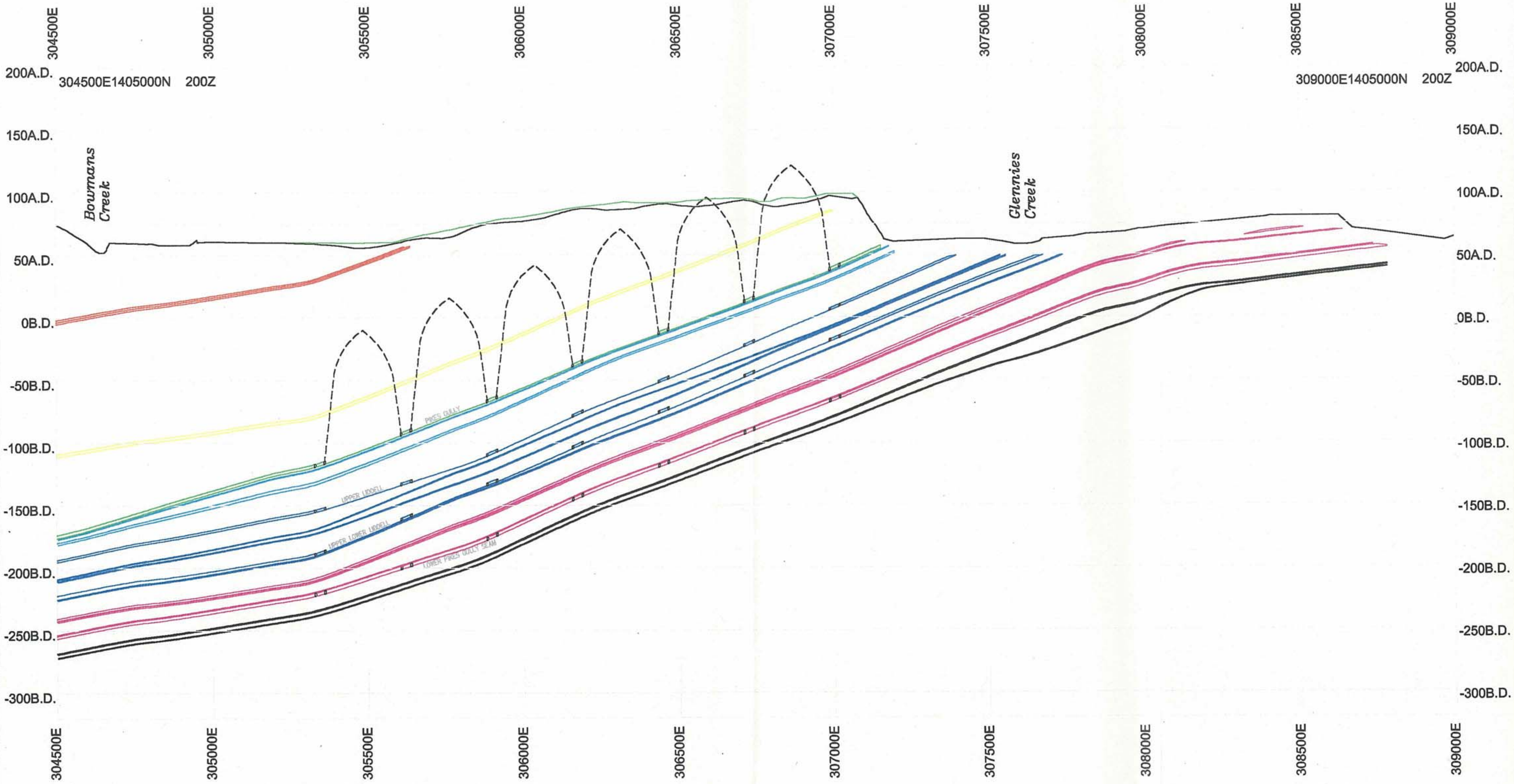
GEOLOGICAL CROSS SECTION B-B'
White Mining Limited
Ashton Coal Project - Archaeological Assessment
Camberwell, New South Wales

FIGURE
1B

DRAWN	PROJECT-FILE NUMBER	APPROVED	DATE	REVISED DATE
LJE	U842-065/U909		February 2002	15th July 2002



Natural Surface
Cumulative Subsidence Surface

Seam BAYS1
Seam BAYS2
Seam LEM
Seam PG
Seam UART
Seam ART
Seam ULD
Seam MLD1
Seam MLD2

Seam ULLD
Seam LLLD
Seam UB
Seam UBS
Seam LBS
Seam LB
Seam HEB1
Seam HEB2

Theoretical height of fracturing or bed separation above PGS Longwall Panel

0 500 1000
metres

REFERENCE: Base Plan Supplied by Co-Resources Pty Ltd.- U909-Fig 1C.DWG

HLA-Envirosciences Pty Limited
55-65 Grandview Street
Pymble, NSW
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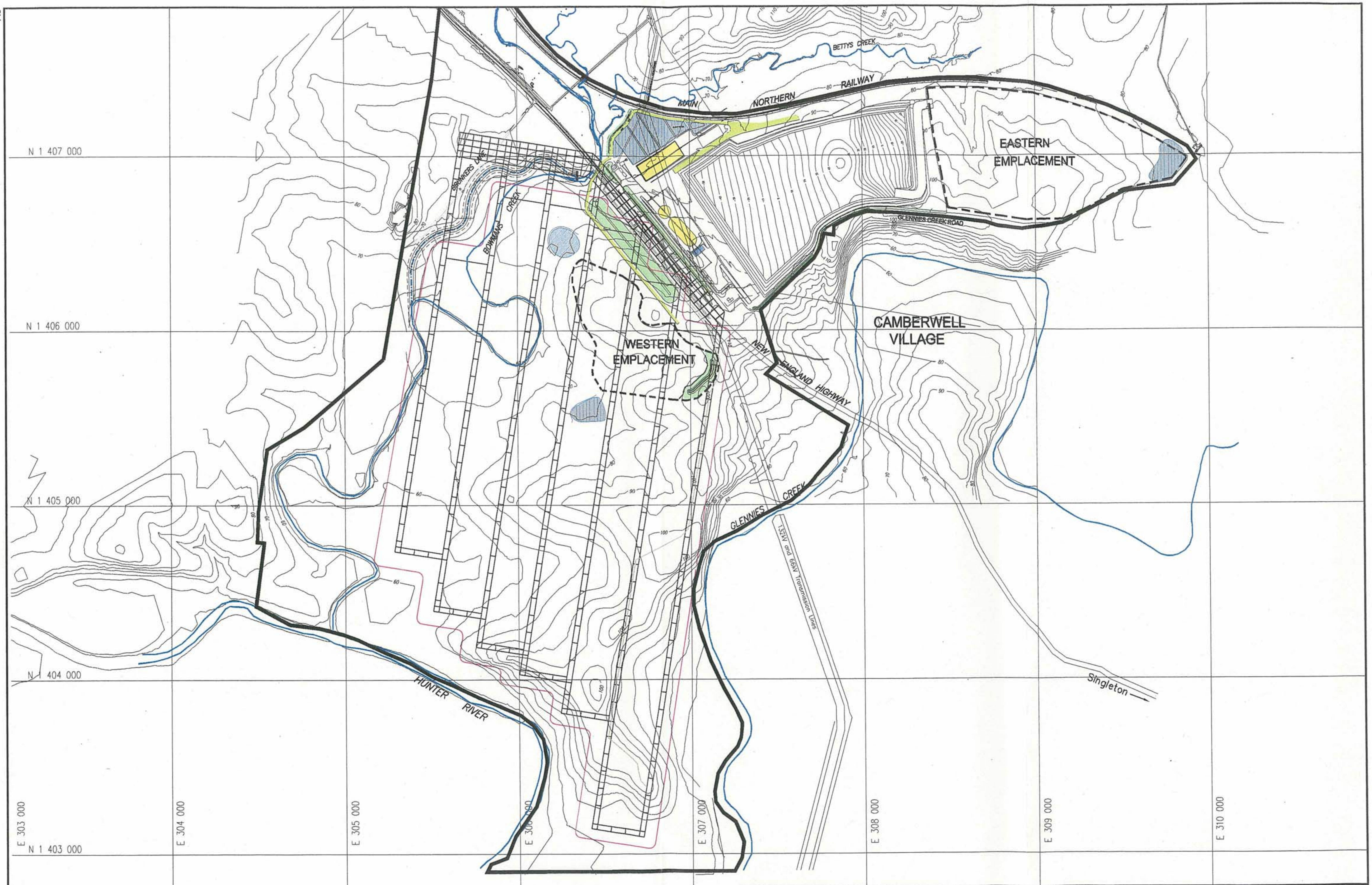
GEOLOGICAL CROSS SECTION C-C'
White Mining Limited
Ashton Coal Project - Archaeological Assessment
Camberwell, New South Wales

FIGURE
1C

DRAWN	PROJECT-FILE NUMBER	APPROVED	DATE	REVISED DATE
LJE	U842-065/U909		February 2002	15th July 2002



LEGEND

DEVELOPMENT APPLICATION BOUNDARY

LIMIT OF SUBSIDENCE

REFERENCE: Base Plan Supplied by Co-Resources Pty Ltd. - U909-Fig 2.DWG

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PROJECT LAYOUT
White Mining Limited
Ashton Coal Project - Archaeological Assessment
Camberwell, New South Wales

FIGURE **2**

DRAWN	PROJECT-FILE NUMBER	APPROVED	DATE	REVISED DATE
LJE/JF	U842-061/U909		February 2002	15th July 2002

LEGEND

DEVELOPMENT APPLICATION BOUNDARY

LIMIT OF SUBSIDENCE

CUMULATIVE SUBSIDENCE CONTOUR

REFERENCE: Base Plan Supplied by Co-Resources Pty Ltd. - U909-Fig 3.DWG

HLA-Envirosciences Pty Limited
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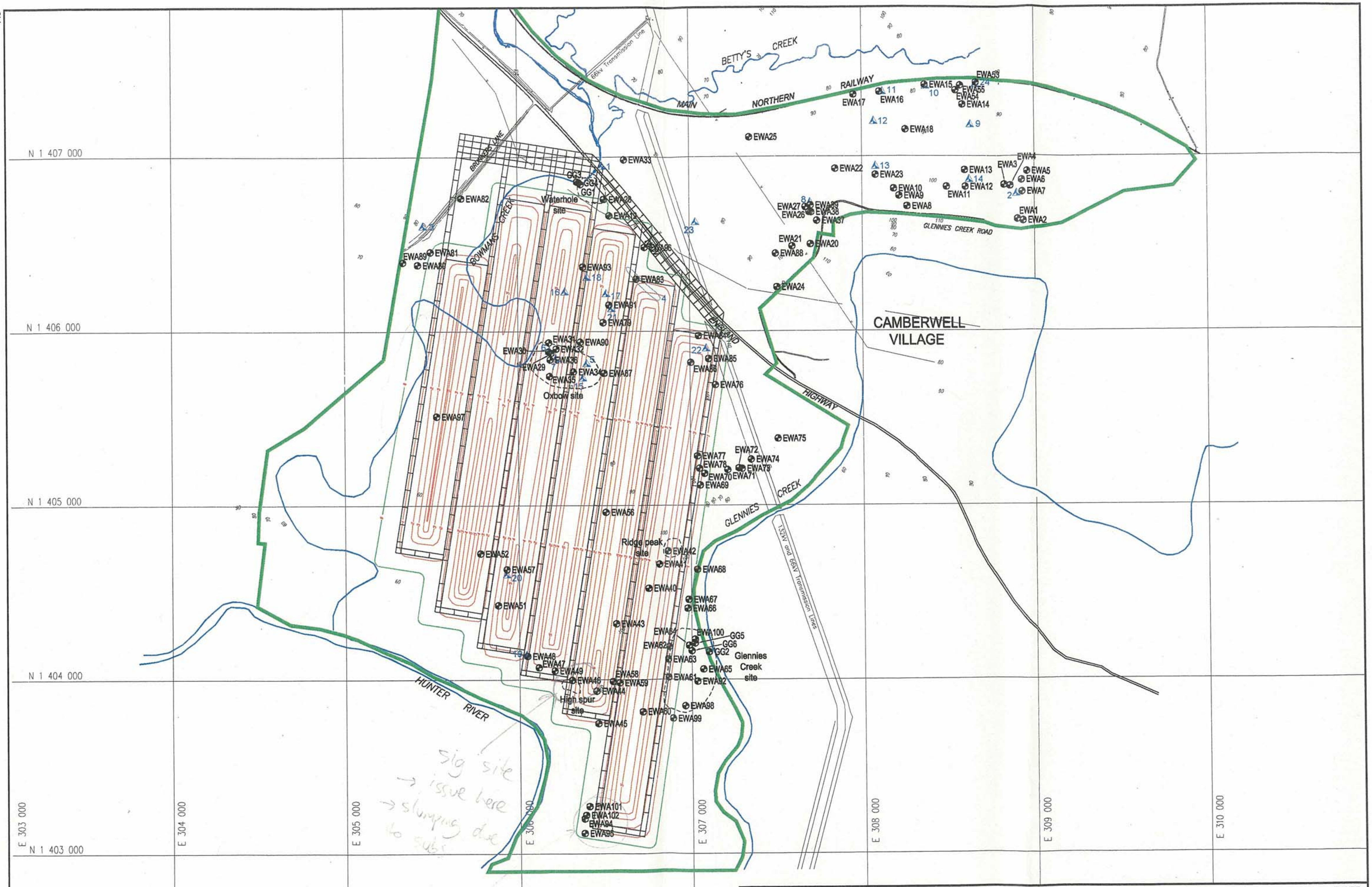
CUMULATIVE SUBSIDENCE CONTOURS
White Mining Limited
Ashton Coal Project - Archaeological Assessment
Camberwell, New South Wales

FIGURE **3**

DRAWN	PROJECT-FILE NUMBER	APPROVED	DATE	REVISED DATE
LJE/JF	U842-061/U909		February 2002	15th July 2002

A3



LEGEND

▲1	ARCHAEOLOGICAL SITES (VANESSA HARDY 2001)
●	ARCHAEOLOGICAL SITES (DAN WITTER 2002)
( )	
—	CUMULATIVE SUBSIDENCE CONTOUR

REFERENCE: Base Plan Supplied by Co-Resources Pty Ltd. - U909-Fig 4.DWG

0 200 400 600 800 1000 metres

HLA

HLA-Envirosciences Pty Limited
55-65 Grandview Street
Pymble, NSW
61 2 9988 4422

CUMULATIVE SUBSIDENCE IMPACTS-REVISED
White Mining Limited
Ashton Coal Project - Archaeological Assessment
Camberwell, New South Wales

FIGURE **4**

DRAWN	PROJECT-FILE NUMBER	APPROVED	DATE	REVISED DATE
LJE/JF	U842-061/U909		February 2002	15th July 2002

TABLE 1 - ARCHAEOLOGICAL SITES AND IMPACTS FROM THE PROPOSED ASHTON MINE, INCLUDING VARIABLES FROM SUBSIDENCE

				AMG											
Site No.	Site Name		Survey	Easting	Northing	Site Type	Landscape Type	Subsidence Unit	Incidence of Subsidence	Surface Disturbance	Potential Impact	Depth of Cover to Pikes Gulley	NPWS % Likelihood of Disturbance	Comments	
1		1	Vanessa Hardy 2001	318521	6406528	artefact scatter	valley bottom		0	Infrastructure	0	70	>90%		
2		2	Vanessa Hardy 2001	320924	6406412	artefact scatter	ridge slope		0	open cut	0		>90%		
3		3	Vanessa Hardy 2001	317490	6406165	isolated find	valley bottom		0	nil	0	165	0		
4		4	Vanessa Hardy 2001	318534	6406338	artefact scatter	valley slope	THIS GRID REFERENCE HAS BEEN CORRECTED AND IS NOT UNDERGROUND							
5		5	Vanessa Hardy 2001	318451	6405395	artefact scatter	valley tributary	trough	4	ug	5	80	>90%		
6		6	Vanessa Hardy 2001	318231	6405464	artefact scatter	valley tributary	trough	4	ug	5	92	>90%		
7		7	Vanessa Hardy 2001	318271	6405421	artefact scatter	valley tributary	trough	4	ug	5	90	>90%		
8		8	Vanessa Hardy 2001	319732	6406339	artefact scatter	valley tributary		0	open cut	0		>90%		
9		9	Vanessa Hardy 2001	320651	6406802	artefact scatter	valley tributary		0	open cut	0		>90%		
10		10	Vanessa Hardy 2001	320391	6407019	artefact scatter	valley slope		0	open cut	0		>90%		
11		11	Vanessa Hardy 2001	320143	6406983	artefact scatter	valley tributary		0	Infrastructure	0		>90%		
12		12	Vanessa Hardy 2001	320094	6406812	artefact scatter	valley tributary		0	open cut	0		>90%		
13		13	Vanessa Hardy 2001	320109	6406555	artefact scatter	ridge slope		0	open cut	0		>90%		
14		14	Vanessa Hardy 2001	320648	6406487	artefact scatter	spur crest		0	open cut	0		>90%		
15		15	Vanessa Hardy 2001	318430	6405312	artefact scatter	valley tributary	trough	4	ug	5	82	>90%		
16		16	Vanessa Hardy 2001	318318	6405805	artefact scatter	valley slope	slope	4	ug	4	85	>90%		
17		17	Vanessa Hardy 2001	318555	6405798	artefact scatter	ridge crest	trough	4	ug	5	76	>90%		
18		18	Vanessa Hardy 2001	318445	6405889	artefact scatter	valley slope	slope	4	ug	1.5	77	>90%		
19		19	Vanessa Hardy 2001	318121	6403714	isolated find	spur crest	gate road	4	ug	1	132	<10%		
20		20	Vanessa Hardy 2001	318002	6404176	artefact scatter	valley tributary	slope	4	ug	3.6	128	>90%		
21		21	Vanessa Hardy 2001	318587	6405712	isolated find	valley slope	slope	4	ug	4	78	>90%		
22		22	Vanessa Hardy 2001	319142	6405495	artefact scatter	valley slope	slope	4	ug	3.1	30	>90%		
23		23	Vanessa Hardy 2001	319069	6406218	isolated find	ridge slope		0	open cut	0	12	>90%		
24		24	Vanessa Hardy 2001	320677	6407034	artefact scatter	spur slope		0	Infrastructure	0		>90%		
25	EWA1		Dan Witter 2002	320932	6406264	Exposures with artefacts	ridge crest		0	open cut	0		>90%	ridge crest	
26	EWA2		Dan Witter 2002	320966	6406254	Exposures with artefacts	ridge crest		0	open cut	0		>90%	ridge crest	
27	EWA3		Dan Witter 2002	320852	6406460	Exposures with artefacts	ridge slope		0	open cut	0		>90%	ridge slope, upper	
28	EWA4		Dan Witter 2002	320886	6406455	Exposures with artefacts	ridge slope		0	open cut	0		>90%	ridge slope, upper	
29	EWA5		Dan Witter 2002	320984	6406537	Exposures with artefacts	spur crest		0	open cut	0		>90%	ridge crest	
30	EWA6		Dan Witter 2002	320953	6406488	Exposures with artefacts	spur crest		0	open cut	0		>90%	ridge crest	
31	EWA7		Dan Witter 2002	320957	6406420	Exposures with artefacts	spur crest		0	open cut	0		>90%	ridge crest	
32	EWA8		Dan Witter 2002	320294	6406327	Exposures with artefacts	spur crest		0	open cut	0		>90%	ridge crest, slope	
33	EWA9		Dan Witter 2002	320247	6406386	Exposures with artefacts	spur crest		0	open cut	0		>90%	ridge slope	
34	EWA10		Dan Witter 2002	320216	6406427	Exposures with artefacts	spur crest		0	open cut	0		>90%	spur crest	
35	EWA11		Dan Witter 2002	320518	6406443	Exposures with artefacts	spur crest		0	open cut	0		>90%	spur crest	
36	EWA12		Dan Witter 2002	320627	6406444	Exposures with artefacts	spur crest		0	open cut	0		>90%	spur crest	
37	EWA13		Dan Witter 2002	320622	6406540	Exposures with artefacts	ridge slope		0	open cut	0		>90%	spur slope	
38	EWA14		Dan Witter 2002	320603	6406916	Exposures with artefacts	valley tributary		0	open cut	0		>90%	tributary margin	
39	EWA15		Dan Witter 2002	320384	6407026	Exposures with artefacts	valley slope		0	open cut	0		>90%	flat spur top	
40	EWA16		Dan Witter 2002	320124	6406981	Exposures with artefacts	valley tributary		0	Infrastructure	0		>90%	tributary bottom	
41	EWA17		Dan Witter 2002	319974	6406963	Exposures with artefacts	valley tributary		0	Infrastructure	0		>90%	flat spur slopes	
42	EWA18		Dan Witter 2002	320278	6406766	Exposures with artefacts	valley slope		0	open cut	0		>90%	tributary slopes	
43	EWA19		Dan Witter 2002	318566	6406245	Exposures with artefacts	valley slope		0	Infrastructure	0	63	>90%	flat spur top	
44	EWA20		Dan Witter 2002	319737	6406100	Exposures with artefacts	ridge slope		0	open cut	0		>90%	ridge slope	
45	EWA21		Dan Witter 2002	319631	6406086	Exposures with artefacts	ridge slope		0	open cut	0		>90%	slope tributary	
46	EWA22		Dan Witter 2002	319874	6406535	Exposures with artefacts	spur crest		0	open cut	0		>90%	spur crest	
47	EWA23		Dan Witter 2002	320108	6406504	Exposures with artefacts	spur crest		0	open cut	0		>90%	spur crest	
48	EWA24		Dan Witter 2002	319546	6405851	Exposures with artefacts	ridge crest		0	open cut	0		>90%	spur crest	
49	EWA25		Dan Witter 2002	319374	6406709	Exposures with artefacts	valley tributary		0	Infrastructure	0		>90%	tributary bottom	
50	EWA26		Dan Witter 2002	319727	6406284	Exposures with artefacts	ridge slope		0	open cut	0		>90%	spur crest	
51	EWA27		Dan Witter 2002	319704	6406313	Exposures with artefacts	ridge slope		0	open cut	0		>90%	spur crest, trib marg	
52	EWA28		Dan Witter 2002	318534	6406338	Exposures with artefacts	valley slope		0	Infrastructure	0	67	>90%	flat spur top	
53	EWA29		Dan Witter 2002	318241	6405450	Exposures with artefacts	valley tributary	trough	4	ug	4.5	92	>90%	tributary margin	
54	EWA30		Dan Witter 2002	318227	6405458	Exposures with artefacts	valley tributary	trough	4	ug	4.5	92	>90%	tributary margin	
55	EWA31		Dan Witter 2002	318227	6405510	Exposures with artefacts	valley tributary	trough	4	ug	4.5	92	>90%	tributary margin	
56	EWA32		Dan Witter 2002	318271	6405475	Exposures with artefacts	valley tributary	slope	4	ug	4	88	>90%	tributary margin	
57	EWA33		Dan Witter 2002	318646	6406566	Exposures with artefacts	valley tributary		0	Infrastructure	0	57	>90%	terrace	
58	EWA34		Dan Witter 2002	318375	6405345	Exposures with artefacts	valley tributary	slope	4	ug	1.5	85	>90%	tributary margin	
59	EWA35		Dan Witter 2002	318234	6405317	Exposures with artefacts	valley tributary	trough	4	ug	4.2	95	>90%	tributary margin	
60	EWA36		Dan Witter 2002	318236	6405412	Exposures with artefacts	valley tributary	trough	4	ug	4.4	92	>90%	tributary margin	
61	EWA37		Dan Witter 2002	319772	6406235	Exposures with artefacts	ridge slope		0	open cut	0		>90%	ridge crest, shoulder	
62	EWA38		Dan Witter 2002	319738	6406284	Exposures with artefacts	ridge slope		0	open cut	0		>90%	ridge crest, shoulder	
63	EWA39		Dan Witter 2002	319734	6406323	Exposures with artefacts	ridge slope		0	open cut	0		>90%	slope	
64	EWA40		Dan Witter 2002	318823	6404110	Exposures with artefacts	ridge crest	slope	4	ug	4.5	77	>90%	ridge saddle	
65	EWA41		Dan Witter 2002	318883	6404249	Exposures with artefacts	ridge crest	trough	4	ug	5	77	>90%	ridge crest	
66	EWA42		Dan Witter 2002	318933	6404325	Exposures with artefacts	ridge crest	slope	4	ug	4.8	75	>90%	ridge peak	
67	EWA43		Dan Witter 2002	318638	6403904	Exposures with artefacts	ridge crest	slope	4	ug	2.9	100	>90%	ridge peak	
68	EWA44		Dan Witter 2002	318531	6403514	Exposures with artefacts	ridge crest	slope	4	ug	5.2	110	>90%	ridge peak	
69	EWA45		Dan Witter 2002	318544	6403328	Exposures with artefacts	ridge crest	slope	4	ug	1	102	>90%	ridge saddle	
70	EWA46		Dan Witter 2002	318390	6403574	Exposures with artefacts	spur crest	slope	4	ug	1.3	118	>90%	high spur crest	
71	EWA47		Dan Witter 2002	318193	6403644	Exposures with artefacts	spur crest	slope	4	ug	1.8	126	>90%	spur crest	
72	EWA48		Dan Witter 2002	318127	6403708	Exposures with artefacts	spur crest	gate road	4	ug	1	132	<10%	spur crest	
73	EWA49		Dan Witter 2002	318287	6403627	Exposures with artefacts	spur crest	slope	4	ug	1.7	123	>90%	spur crest	
74	EWA50		Dan Witter 2002	317813	6404021	Exposures with artefacts	valley bottom						>90%	tributary flat	CORRECTED
75	EWA51		Dan Witter 2002	317954	6403998	Exposures with artefacts	valley slope	slope	4	ug	2.9	138	>90%	tributary flat	
76	EWA52		Dan Witter 2002	317847	6404293	Exposures with artefacts	valley bottom	slope	4	ug	2.9	141	>90%	tributary flat	
77	EWA53		Dan Witter 2002	320680	6407045	Exposures with artefacts	valley slope		0	Infrastructure	0		>90%	flat spur crest	
78	EWA54		Dan Witter 2002	320562	6406998	Exposures with artefacts	valley tributary		0	open cut	0		>90%	spur slope	
79	EWA55		Dan Witter 2002	320588	6407026	Exposures with artefacts	valley tributary		0	Infrastructure	0		>90%	spur slope	
80	EWA56		Dan Witter 2002	318571	6404543	Exposures with artefacts	spur crest	slope	4	ug	3	97	>90%	spur crest	
81	EWA57		Dan Witter 2002	318001	6404205	Exposures with artefacts	valley tributary	slope	4	ug	3.4	128	>90%	tributary bottom	
82	EWA58		Dan Witter 2002	318623	6403571	Exposures with artefacts	ridge slope	slope	4	ug	1.8	192	>90%	ridge slope	
83	EWA59		Dan Witter 2002	318662	6403564	Exposures with artefacts	ridge slope	slope	4	ug	1.2	85	>90%	ridge slope	
84	EWA60		Dan Witter 2002	318798	6403400	Exposures with artefacts	valley slope	slope	4	ug	4.8	80	>90%	tributary bottom	
85	EWA61		Dan Witter 2002	318947	6403600	Exposures with artefacts	valley slope	gate road	4	ug	1.3	68	<10%	flat spur crest	
86	EWA62		Dan Witter 2002	318948	6403776	Exposures with artefacts	valley slope	gate road	4	ug	1.9	72	<10%	flat spur crest	
87	EWA63		Dan Witter 2002	318943	6403704	Exposures with artefacts	valley slope	gate road	4	ug	1.7	70	<10%	spur crest	
88	EWA64		Dan Witter 2002	319065	6403786	Exposures with artefacts	valley slope		0	nil	0	65	0	spur crest	
89	EWA65		Dan Witter 2002	319148	6403650	Exposures with artefacts	valley slope		0	nil	0	55	0	terrace	
90	EWA66		Dan Witter 2002	319054	6403999	Exposures with artefacts	valley slope	gate road	4	ug	0.2	65	<10%	ridge slope	

Site No.	Site Name	Survey	AMG Easting	AMG Northing	Site Type	Landscape Type	Subsidence Unit	Incidence of Subsidence	Surface Disturbance	Potential Impact	Depth of Cover to Pikes Gulley	NPWS % Likelihood of Disturbance	Comments
91	EWA67	Dan Witter 2002	319059	6404050	Exposures with artefacts	valley slope	gate road	4	ug	0.2	65	<10%	ridge slope
92	EWA68	Dan Witter 2002	319107	6404223	Exposures with artefacts	ridge slope		0	nil	0	63	0	ridge slope
93	EWA69	Dan Witter 2002	319117	6404707	Exposures with artefacts	ridge crest	gate road	4	ug	1	45	<10%	ridge crest
94	EWA70	Dan Witter 2002	319141	6404775	Exposures with artefacts	ridge crest	gate road	4	ug	0.7	37	<10%	ridge crest
95	EWA71	Dan Witter 2002	319274	6404798	Exposures with artefacts	ridge crest		0	nil	0		0	ridge slope
96	EWA72	Dan Witter 2002	319339	6404810	Exposures with artefacts	valley slope		0	nil	0		0	ridge slope
97	EWA73	Dan Witter 2002	319392	6404800	Exposures with artefacts	valley slope		0	nil	0		0	ridge slope
98	EWA74	Dan Witter 2002	319410	6404860	Exposures with artefacts	valley slope		0	nil	0		0	ridge slope
99	EWA75	Dan Witter 2002	319563	6404982	Exposures with artefacts	valley bottom		0	nil	0		0	tributary bottom
100	EWA76	Dan Witter 2002	319197	6405285	Exposures with artefacts	ridge crest	gate road	4	ug	1	14	>90%	ridge crest
101	EWA77	Dan Witter 2002	319099	6404875	Exposures with artefacts	ridge crest	gate road	4	ug	2	44	<10%	ridge crest
102	EWA78	Dan Witter 2002	319111	6404804	Exposures with artefacts	ridge crest	gate road	4	ug	1.5	46	<10%	ridge crest
103	EWA79	Dan Witter 2002	318541	6405631	Exposures with artefacts	spur crest	trough	4	ug	4.8	82	>90%	spur crest
104	EWA80	Dan Witter 2002	317463	6405942	Exposures with artefacts	valley bottom		0	nil	0	168	>90%	flat spur
105	EWA81	Dan Witter 2002	317534	6406017	Exposures with artefacts	valley bottom		0	nil	0	165	>90%	terrace
106	EWA82	Dan Witter 2002	317707	6406329	Exposures with artefacts	valley bottom		0	nil	0	138	>90%	terrace
107	EWA83	Dan Witter 2002	318727	6405883	Exposures with artefacts	spur crest	slope	4	ug	1.2	65	>90%	spur crest
108	EWA84	Dan Witter 2002	319096	6405565	Exposures with artefacts	spur crest	slope	4	ug	1.6	36	>90%	spur shoulder
109	EWA85	Dan Witter 2002	319156	6405434	Exposures with artefacts	spur crest	slope	4	ug	2.9	27	>90%	high spur crest
110	EWA86	Dan Witter 2002	319054	6405411	Exposures with artefacts	ridge slope	slope	4	ug	4.9	34	>90%	tributary bottom
111	EWA87	Dan Witter 2002	318550	6405341	Exposures with artefacts	valley tributary	slope	4	ug	3.3	74	>90%	tributary bottom
112	EWA88	Dan Witter 2002	319535	6406043	Exposures with artefacts	ridge slope		0	open cut	0		>90%	spur crest
113	EWA89	Dan Witter 2002	317378	6405955	Exposures with artefacts	valley bottom		0	nil	0	173	0	terrace
114	EWA90	Dan Witter 2002	318412	6405517	Exposures with artefacts	valley slope	slope	4	ug	2	85	>90%	low flat spur
115	EWA91	Dan Witter 2002	318572	6405733	Exposures with artefacts	spur crest	slope	4	ug	4.7	78	>90%	spur crest
116	EWA92	Dan Witter 2002	319115	6403580	Exposures with artefacts	valley slope		0	nil	0	57	0	flat low spur crest
117	EWA93	Dan Witter 2002	318420	6405948	Exposures with artefacts	valley slope	slope	4	ug	1.3	77	>90%	tributary bottom
118	EWA94	Dan Witter 2002	318471	6402780	Exposures with artefacts	valley slope	slope	4	ug	0.5	77	>90%	slope
119	EWA95	Dan Witter 2002	318472	6402696	Exposures with artefacts	valley slope	gate road	4	ug	0.2	75	<10%	slope
120	EWA96	Dan Witter 2002	318772	6406066	Exposures with artefacts	valley tributary	gate road	4	ug	0.3	49	<10%	tributary bottom
121	EWA97	Dan Witter 2002	317583	6405075	Exposures with artefacts	valley bottom	slope	4	ug	3.4	165	>90%	terrace edge
122	EWA98	Dan Witter 2002	319047	6403438	Exposures with artefacts	valley slope		0	nil	0	68	0	slope
123	EWA99	Dan Witter 2002	318976	6403364	Exposures with artefacts	valley slope		0	nil	0	72	0	slope
124	EWA100	Dan Witter 2002	319098	6403821	Exposures with artefacts	valley slope		0	nil	0	68	0	slope
125	EWA101	Dan Witter 2002	318498	6402851	Exposures with artefacts	valley slope	slope	4	ug	0.6	80	>90%	slope
126	EWA102	Dan Witter 2002	318479	6402800	Exposures with artefacts	valley slope	slope	4	ug	0.4	78	>90%	slope
127	GG1	Dan Witter 2002	318400	6406421	Grinding Grooves			0	nil	0	79	0	waterhole outcrop
128	GG2	Dan Witter 2002	319179	6403750	Grinding Grooves			0	nil	0	68	0	creek bank
129	GG3	Dan Witter 2002	318379	6406435	Grinding Grooves			0	nil	0	81	0	rock shelf
130	GG4	Dan Witter 2002	318390	6406431	Grinding Grooves			0	nil	0	80	0	rock shelf
131	GG5	Dan Witter 2002	319098	6403799	Grinding Grooves			0	nil	0	68	0	slope
132	GG6	Dan Witter 2002	319080	6403755	Grinding Grooves			0	nil	0	68	0	slope

Site Name	Survey	Easting	Northing
Waterhole Site	Dan Witter 2002	318250	6406450
	Dan Witter 2002	318500	6406500
	Dan Witter 2002	318550	6406150
	Dan Witter 2002	318700	6406300
Oxbow Site	Dan Witter 2002	318200	6405550
	Dan Witter 2002	318500	6405550
	Dan Witter 2002	318200	6405250
	Dan Witter 2002	818600	6405250
Ridge Peak Site	Dan Witter 2002	318900	6404350
	Dan Witter 2002	318960	6404350
	Dan Witter 2002	318900	6404290
	Dan Witter 2002	318960	6404290
High Spur Site	Dan Witter 2002	318360	6403600
	Dan Witter 2002	318420	6403600
	Dan Witter 2002	318360	6403540
	Dan Witter 2002	318420	6403540
Glennies Creek	Dan Witter 2002	318900	6403850
	Dan Witter 2002	319200	6403850
	Dan Witter 2002	318900	6403300
	Dan Witter 2002	319200	6403300
High Ridge Workshop Site	Dan Witter 2002	319070	6405590
	Dan Witter 2002	319130	6405590
	Dan Witter 2002	319070	6405530
	Dan Witter 2002	310130	6405530
Ashton Homestead Site	Dan Witter 2002	318250	6405800
	Dan Witter 2002	318460	6406000
	Dan Witter 2002	318550	6405600
	Dan Witter 2002	318600	6405760
Hunter River Slope Site	Dan Witter 2002	318490	6402900
	Dan Witter 2002	318550	6402900
	Dan Witter 2002	318390	6402650
	Dan Witter 2002	318450	6402650

Table 2. Effects of subsidence on archaeology where there is underground mining. Numbers with "W" are records by Witter and those with "H" are by Hardy.

Sites	< 10% likelihood	> 90% likelihood
Homestead		W79, W91, W93, H16, H17, H18, H21
Oxbow		W29, W30, W31, W32, W34, W35, W36, W87, W90 H5, H6, H7, H15,
High Ridge W/S		W84
Ridge Peak		W42
Glennies Creek	W61, W62, W63,	
High Spur		W46
Hunter River Slope	W95	W94, W101, W102
Isolated Finds	W48, W66, W67, W69, W70, W77, W78, H19	W40, W41, W43, W44, W45, W47, W49, W50, W51, W52, W56, W57, W58, W59, W60, W76, W83, W85, W86, W96, W97, H20, H22

ADDENDUM 3

Ashton Coal Mining Project Environmental Impact Statement: Aboriginal Archaeology. Dan Witter, June 2002. A report to HLA-Envirosciences for White Mining Limited.

Below is an additional part of this report in response to a requirement by Planning NSW to provide a "Discussion of the proposed long-term conservation outcomes of the project and justification based on analysis of the archaeological value in a regional context."

The following should be inserted in Section 14 Significance of the above report. It is provided here however in stand-alone form.

14.4 A Summary of the Archaeology of the Hunter Valley Region

As part of the context for the significance assessment, the overall issues for the archaeology of the Hunter need to be reviewed.

The Hunter Valley is a gap in the Dividing Ranges almost entirely surrounded by mountain sides. It is a well defined physiographic region with a distinctive combination of habitats. It is a region where Aboriginal culture could be expected to evolve cultural adaptations that belong specifically to a naturally bounded area.

There is relatively little known about the archaeological time depth for the Hunter Valley. The identification of sites earlier than about 5,000 years ago has been extremely difficult. The result is that directly dated deposits, superficially at least, make it look as though the Hunter Valley was little occupied during the Pleistocene or Early Holocene.

Part of the difficulty has been that rock shelters do not occur on the rolling plains and hills within the valley. Rock shelters are a common target for archaeologists since they often accumulate sediments. Since rock shelters are regularly inhabited, they frequently contain a record of human activities over a period of time. The only rock shelters in the Hunter are a few located on the southern fringe of the valley. Excavations by the Australian Museum of two of these shelters were carried out at Sandy Hollow near Denman and at Milbrodale near Bulga. Sandy Hollow provided two dates: 530 ± 80 BP and 1300 ± 100 BP (Moore 1970:37), as did Milbrodale: 630 ± 60 BP and 1410 ± 90 (Moore 1970:45).

Another potential source for old archaeological deposits is in alluvium, such as valley fill. Although there has been frequent archaeological testing of valley fills and terrace deposits in the Hunter Valley, relatively little has been revealed except for artefacts in Glennies Creek alluvium dating to about 20,000 BP (Koettig1986). The scarcity of artefacts found may be due to several factors. For example, areas where sediments are being deposited by water may have been too wet for people to camp. Perhaps cold air flow during the Pleistocene meant people mainly occupied the warmer slopes and ridge tops. The hydrolology of the valley bottoms may have resulted in the periodic scouring and erosion of sediments that contained artefacts. The early occupation may not have left dense concentrations of artefacts, and the sample provided by gully banks and back hoe trenches has a low probability of recovering them.

Another type of deposit consists of sand sheets and sand dunes. It is possible that these may have been active at various times in the past, and blowing sand would have buried early sites. Excavations into these have not been productive for recovering unambiguous early archaeological evidence.

Some land surfaces are stable, and are neither eroding or being covered. On these surfaces, such as gentle hill slopes, flat ridge tops or early terraces, Pleistocene artefacts could be present, but have an accumulation of later artefacts mixed with them. An inferred early age for such surfaces therefore does not date the artefacts present. The numerous dates for archaeological sites from hearths on these surfaces have been consistently under about 5,000 years old. Some of the valley bottom surfaces however can be dated as being deposited over the last 6,000 years. In the case of these, the possibility of Pleistocene age artefacts can be eliminated.

The archaeological record of the Hunter region is almost entirely in the form of flaked stone artefacts. Rock art sites and burials, for example, are extremely rare, and other kinds of sites such as grinding grooves are uncommon. Stone artefacts in the Hunter are however extremely abundant. Artefact types also can be for dating. As particular kinds of stone tools appear or disappear in the archaeological record they can serve as chronological markers for Australian prehistory.

For example, backed blades as an artefact type emerge Australia-wide after 5,000 years ago and are of exceptional abundance in the Hunter Valley. The practice of hafting flakes on handles as "chisel adzes" also occurs after this time. Artefacts of this type are uncommon in the Hunter. However, the hafted flake tool referred to as an elouera is occasionally recorded in the Hunter and dates to this late time period. Although backed blades are common in the Hunter, their absence on sites does not necessarily mean a site is older than 5,000 years, since this artefact type does not invariably occur on all later sites. .

There are no tool types which belong exclusively to the time earlier than 5,000 BP, although it has also been noted in Australian prehistory that on average earlier artefacts tend to be larger. However, the size range has not changed through time, and large artefacts were frequently made later. The presence of large artefacts, or even a concentration of large artefacts is not a reliable indicator of an early time period.

As a region, the Hunter has a remarkable abundance of backed blades, and these commonly occur in sites on valley bottom surfaces younger than 6,000 years. The evidence therefore is that early sites are very difficult to identify, and late ones are extremely common. On the face of it therefore, even considering the ambiguities and problems in dating sites mentioned above, it looks as though there was a population explosion in the Hunter at the time when backed blades appear in Aboriginal culture.

It is often argued that the development of new technologies in Australian prehistory, such backed blades, went with a population increase (e.g. Lourandos 1997). If so, the implication for the Hunter is a population boom out of proportion for other parts of Australia. The current evidence for this is far from conclusive, but considering the vast amount of impact surveys in the region, and the persistent attempts to locate early deposits, the issue of a dramatic population boom in the Hunter Valley seems unavoidable.

Apart from the population question, backed blades are a major area of debate in Australian prehistory. This includes how they were made, what they were used for, and their regional distribution. Backed blades are generally more frequent in the Dividing Range Country and southeastern Coast than further west in Southeast Australia. Their abundance in the Hunter Valley and sophistication in production is extraordinary even for the Dividing Range country. Perhaps the only other place in Australia with similar abundance in backed blades and technological complexity is Gippsland in Victoria.

Part of the debate about backed blades is what they should be called and how they should be defined. For the purpose here, backed blades are considered a product of the microblade technology. The microblade technology is a method for making flakes with a highly controlled cross sections from prepared cores. These flakes are thin, with parallel or evenly tapering sides and usually elongated. Flakes of this type are not easy to make. Flakes made in this way could be used and modified in a variety of ways, but the focus of their production was to be shaped into geometric and pointed forms. This shaping was done by trimming (backing) a lateral edge of the flake, or the ends, leaving one lateral edge sharp and untouched. The trimming was most often conducted by a crushing technique using a hammerstone and anvil which made the edge an abrupt or backed surface. Shaping by pressure retouch was also used.

In this definition, backed blades are flakes made on a microblade core that were then shaped into distinctive forms. Other, thicker flakes, not made on a microblade core, but worked by the same backing technique on an anvil (i.e. eloueras) are not backed blades by this definition and do not belong to the microblade technology. The microblade technology often resulted in thin elongated flakes, but those flakes that were backed were not necessarily twice as long as wide. This twice as long as wide rule is the classic definition of "blade". In this case the term "microblade technology" is appropriate because elongated flakes are prominent if not invariable. The term "backed flakes", as used by some archaeologists, is not preferable, since this can apply to non-microblade core products.

The microblade technology consists of the wide range of methods for flake production using (for the most part) specialised cores. The actual backing technique is much less complex. The methods and techniques of microblade core reduction used by Aboriginal people often required a deep understanding of the physics of stone fracturing as well as great manual skill.

This technology is developed to an outstanding peak in the Hunter Valley. There are a variety of core reduction methods which are distinctive to the Hunter (e.g. the "Redbank A" process, Hiscock, 1993). In addition, the Hunter features larger and more complex microblade workshops than are normally found elsewhere. This includes workshops where more than one microblade core was used, and where there was massive flake production.

The way in which Australian backed blades were used is a subject of archaeological debate. There has never been a clear ethnographic description of backed blades and their use, and there are no hafted backed blades in museums. In most parts of Australia it appears that backed blades went out of use by about 1,000 years ago.

However, the dates from the Hunter Valley indicate they were in use up to European contact.

Backed blades occur extensively in world archaeology. In most cases they have been identified as inserts into a compound spear head or other weapon. World ethnography also indicates that spear or arrow heads can be used as knife-like implements. The implication for Australia is that these backed blades were primarily for used as spear heads and secondarily as cutting implements. Backed blades occasionally show various kinds of light usewear on the sharp edge. Usually this is absent. Part of the reason for infrequent use wear is probably that they were rejects on the workshop floor.

Some excavations have produced backed blades which show resin on the backed surface, supporting the interpretation that they were hafted, and it was the sharp flake edge which was needed as an implement. Other residues found on backed blades include starch grains. These however seem to have been inadvertently stuck on from using grass tree resin as an adhesive.

The inference remains that backed blades were most likely required for Aboriginal hunting spears. Hafting them as barbs has been suggested, but this is not supported by the breakage pattern. If one end of the backed blade was inserted into a spear head, it would be prone to break in half. Such breaks are rare. It is more likely that they provided a continuous compound cutting edge.

It is thought that the pre-European vegetation was mostly woodland or open woodland throughout most of the Hunter. This would have been an excellent habitat for grey kangaroos. Backed blades for a highly efficient spear to hunt medium sized game animals is therefore is a warranted proposition.

It has been suggested that the complexity of the microblade technology throughout Australia is best explained as part of an instant supply strategy (Witter 1988). It made it possible to repair and maintain hunting equipment at any time, using almost any kind of flakable stone, and high quality stone material was extensively transported as well. Sites with extensive microblade reduction could be interpreted as "gearing-up" base camps where hunting equipment was produced. Sites with more limited microblade reduction could be interpreted as maintenance of hunting equipment at satellite camps. This model should not be confused with the hunting of migratory big game animals. It represents an option to harvest a high biomass resource (abundant kangaroos).

The adoption of such hunting equipment after 5,000 BP in the Hunter could have been the key to the "population boom". If so, the Hunter Valley was indeed a "valley of hunters". This idea is in contrast to what is known ethnographically from central and tropical Australia where plant foods make up an overwhelming part of the diet. It is risky however to impose patterns from such very different environments to southeastern Australia.

This line of argument leads to the Hunter Valley as being potentially of outstanding significance in Australia, representing one of the most extraordinary developments in Australian prehistory. The elaboration and sophistication of the microblade technology can be thought of as a cultural achievement equal to the finest examples of rock art in northern Australia.

The present crisis in the Hunter is a process of cumulative developmental impact. It is possible that so much will be lost that it will never be possible to assess the validity of the above. The opportunity for reserves to provide evidence of this legacy for the future may well disappear while archaeologists are still trying to come to terms with the subject.

Many vital questions remain for the Hunter in addition to the microblade technology. For example, throughout most of the Dividing range country stone tools seem to be mostly made on a "nuclear" body, or a piece of stone of suitable size which had an edge made on it and was resharpened as it was used. Further to the west in NSW the tools were more often large flakes which were made and then resharpened. In the Hunter flake tools tend to be more common and larger than most of the Dividing Range country. This is probably because of the exceptional quantity of large cobbles for raw material in the Hunter. This supply of silcrete and siliceous tuff tends to have superb flaking properties, and may also have been a factor in the evolution of microblade technology in the Hunter.

The microscopic details of use-wear on these flake tools, and the landscape features in which they occur has a great potential to help understand Aboriginal land use and settlement strategies in the Hunter. While the microblade technology dominates some sites, it is less prominent on others, and a much better understanding of the full took kit is needed. Even if hunting kangaroos was of great importance, as suggested, there is a wide range of other foods including aquatic plants with starchy tubers such (e.g. ribbon lily), and migratory fish (e.g. eels and mullet) may have been important. This is not to mention a wealth of other plants and animals available.

Another set of problems in prehistory is the relationship of the inhabitants of the Hunter Valley with each other and to neighbouring regions. The Wonnarua tribe is identifiable at European contact, although its antiquity as a social entity is unknown. However there are questions such as whether there were particular clan core areas, or places where clans met, or places where there were multi-tribal gatherings hosted by the Wonnarua. There seems to be little clear oral history on such places in the Hunter, but when compared to other parts of southeastern Australia, they should have been present. These also are places where ceremonies of many different types can be expected to take place. The locations for these, by analogy elsewhere in southestern Australia, would have been connected to Dreaming tracks and would have been at places with Dreamtime creation stories. The Milbrodale area is identifiable as a ceremonial location because of its dramatic rock and nearby bora initiation rings (the later now destroyed). Normally however direct reference by oral tradition is needed to identify such highly significant places. Recently, a methodology to recognise such places has been developed for Mt Drysdale near Cobar (Witter 2000) which perhaps may be adapted for the Hunter..

In summary, the archaeology of the Hunter Valley is complex. The archaeological methods to understand it are still in the developmental stage. It must be realised that attempts to infer a living society from small pieces of flaked stone on a landscape are difficult in the extreme. The piece-meal process of investigation by EIS has had limited success, partly because it is difficult to make it research oriented. Although evidence remains difficult to interpret, it seems inescapable that the archaeology of this region is exceptional in Australia and it is of outstanding National significance. Unfortunately, long term conservation of archaeological reserves or protected areas is in conflict with other interests where an entire region is underlain by coal.

14.5 Landscape Context of the Ashton Area

Human populations can be expected to be concentrated where resources are the most abundant and accessible. In the case of nomadic societies these are likely to be the places where the most people camp the most frequently for the longest time. Such places are expected to be few within a particular territory, although there may be a great many small camps of different types scattered throughout. Places of population concentration are usually a cultural focus with unique archaeological characteristics and are crucial for the reconstruction of prehistory. Normally these cultural centres can be understood by the landscape features which provided the resources for the population base.

Hunting and gathering people tend to concentrate at various times of the year where resources are the most productive or diverse. The best watered areas are usually the most ecologically productive, and likely to provide abundant plant food, or support large populations of animals. High diversity is likely to supply the most different kinds of food over a longer period of time. Ecologically productive environments are usually highly diverse and it is also possible for diversity to be increased by patchiness in which a wide variety of resources would be available from nearby different habitats. Ecotones, or the boundary between environments, have a similar effect.

Other circumstances which provide maximal resources are migratory animals or specific stands of rich food plants. Examples of migratory resources which allowed large gatherings of Aborigines in Australia include the Bogong moth in NE Victoria, and the Brewarrina fish Traps on the Darling River in western NSW. The Bunya nut groves in the Dividing Range of northern NSW and southern Queensland also periodically attracted large numbers of Aboriginal people.

These factors can be considered for a model of the major prehistoric Aboriginal population centres for the Hunter Valley. Such population centres would have the highest priority for conservation. A model using stream rank and catchment has been prepared by Mitchell (2002). This analysis produced two nodes where major streams joined with their catchments in the Hunter Valley Central Lowlands. One of these is where Wattle Ponds, Glendon Brook and Black Creek join the Hunter River within 5 km. The second was where Bayswater, Bowmans and Glennies Creek as well as Wollombi Brook join the Hunter River. This second node includes the southern part of the Ashton study area. This analysis indicates that the Ashton confluence area would have been exceptionally productive and diverse ecologically.

The ecological potential for the Ashton confluence area can be examined in further detail by using the Hunter Valley land systems study (Story et al. 1963). The land systems on a 25 km section from Singleton to Jerrys Plains are shown in Fig. 14.1

This figure shows seven types of land systems:

1. Hu (Hunter). Terraced valley bottoms. This land system consists of terraced valley bottoms of the Hunter River and major streams.
2. K (Killarney). Undulating lowlands. This land system is mainly moderate to gentle valley slopes creek bottoms and low hills.
3. Bl (Blairgowrie). Undulating lowlands. This is similar to the Killarney Land System, except that it includes black earth soils and is more calcareous.
4. Gd (Glendower) Rounded hills. This land system is comprised of high hills and ridges with open tributary valleys.
5. Ap (Apis). Rocky hills. This land system is steep and rocky ridges.
6. Sh (Sandy Hollow). Gentle slopes. This land system consists of gentle sandy slopes deposited from nearby sandstone ranges.
7. Wa (Warkworth) Dunes. This land system which consists of sand dunes or sand sheets.

The land system map shows the Ashton section of the Hunter River to be a network of terraced streams, and a mosaic of undulating and hilly topography, as well as having a patch of sand dunes. This pattern enhances the impression of a well watered, productive and diverse environment which could have been a central area for Aboriginal people. Warkworth

In addition to the overall richness of the habitat, additional environmental potentials need to be considered. There appear to be no stands of plants in the area which would have which would have provided great quantities of food in a way similar to the Bunya nuts. The most important carbohydrate source was probably the ribbon lily tubers. These can be seen today in small ponds and stock dams in the Hunter. As a food this would have been more abundant in the upper catchments.

Trapping migratory eels is another possibility. Elsewhere in Australia, such as in south western Victoria, eel trapping was of great importance (Laurandos 1997). The small scale eel trapping methods used by the Aborigines was the most feasible for lakes, ponds and small channels in the upper catchments of streams. Thus is likely that any eel trapping in the Hunter was probably in the upper catchments.

A second migratory fish is the mullet. These are know to have seasonal runs in the Hunter River, and there is some ethnographic comment that they were important to the Wonnarua. There seem to be no descriptions of large scale Aboriginal fish traps for the Hunter similar to the Darling River at Brewarrina. Small scale traps or netting locations however remain a possibility. There seem to be few ethnographic details of inland fish trapping or netting by Aborigines. There is however a reference for the use of brush weirs and nets for mullet runs at Morton Island, Queensland (Hall 1982:85-86). If such small scale trapping took place in the Hunter, it is possible that places where stream channels enter the Hunter River may have been more suitable than a larger scale operation on the Hunter River itself. If so, the Ashton section of the Hunter River may have a suitable place for Aboriginal people to gather for mullet catches.

The combination of a rich environment which also afforded fish netting or trapping is a set of factors which may have made the Ashton section of the Hunter River periodically a population centre. This may explain the four large sites found in the Ashton study area (Waterhole, Oxbow, Glennies Creek and Hunter River Slope Sites), as well as the major sites (Rich 1993) near the mouth of Bayswater Creek on the Narama Mine.

14.6 Cumulative Impact on the Environmental Potential

While the methods of resource exploitation for the Ashton section of the Hunter river is not known, a case can be made that it was a zone of exceptional potential. If it was an area of high population density, then it also is likely to have archaeological sites which are not duplicated elsewhere in the Hunter Valley. If so, what is the prospect for the long term conservation and protection of such sites?

The Central Lowlands of the Hunter Valley is everywhere underlain by coal. There has been extensive mining, and more is planned. As each mine is established, it destroys large areas by open cuts, emplacement dumps, infrastructure, and there is further damage from subsidence. This impact becomes cumulative. The more land surface which is disturbed or destroyed, the more important the archaeology is which remains. This is especially the case if there are no known representative examples elsewhere.

A map showing the cumulative impact in the form of mining leases and exploration licences is shown in Fig. 14.3. This map reveals that nearly all of the Ashton section of the Hunter River is either already part of an active mine or is likely to be. The proposed Ashton mine is one of the few remaining areas on this map. Considering the scale of destruction which has occurred, and still is planned, the Ashton area is a high priority for conservation goals.

It must be understood that archaeological resources are finite and fragile. They are non-replicating and their loss is irreversible. Unlike vegetation which can recolonise rehabilitated land surfaces, and animal species which can become re-established, the archaeology is gone forever. As a combined social science and earth science archaeology is still struggling to develop its fundamental principles, even though much progress has been made. The loss of a resource which would allow a future understanding of a key area for a region which is arguably of National significance is of great concern.

It should not be forgotten that the Aboriginal people who belong to the Hunter have a special heritage interest. Future archaeological study may show that Mitchell's "node 1" was "Wonnarua City", and the core area and population centre for the Wonnarua tribe in prehistory. If so, then the preservation of as much as possible of this area would be of great concern to Aboriginal people.

14.7 The Ashton Confluence Zone

The Ashton confluence zone is the area on the Hunter River between Bowmans Creek and Glennies Creek. Bayswater Creek is nearby to the west, and Wollombi Brook is some distance to the south. This core area is likely to have been of critical strategic importance to the Hunter Valley Aboriginal population. Not only is it an area with apparent high human carrying capacity, but it is the focal point of access to catchments of four stream valleys. In addition, the land systems indicate an unusually fined-grained environment with relatively small patches of terraces, undulating lowlands, rounded hills and a patch of sand sheet.

A closer look at this focal area is provided by Fig. 14.4 which shows a 7 x 7 km area where Bayswater, Bowmans and Glennies Creeks open out on to the Hunter River. Bayswater Creek was in the Narama and Ravensworth South Mine area. A dense pattern of registered sites can be seen along Bayswater Creek indicating extensive Aboriginal encampments. All of these sites are now destroyed by mining. The salvage excavations prior to mining produced great quantities of artefacts, including large microblade workshops (Rich 1993).

The archaeology recorded for the lower section of Bowmans Creek where it merges with the terraces of the Hunter River has a different pattern. This part of Bowmans Creek is entirely cultivated and at the time of survey had heavy plant cover. Since it was outside of the subsidence impact area and not at threat from development, it was not surveyed. It is not known therefore if encampments of the same size as on Bayswater Creek and with the same kinds of artefacts are present. However, it should be noted on the Fig 14.1 by Mitchell that the Bayswater catchment is much smaller, nor does it head up in the Mount Royal Ranges where there is a higher rain fall. The hydrology of this valley therefore is similar to Bettys, Swamp, Yorks or Station Creeks. The mouth of Bowmans Creek is similar to Glennies Creek as a permanent stream with well-cut channels. Wollombi Creek is probably similar as well.

Given the environmental and regional cultural context certain archaeological points need to be made concerning the Ashton study area as follows.

1. The Glennies Creek Site is in a highly strategic position in the Ashton confluence zone. Large encampments with similar contents extend up to the Oxbow and Waterhole Sites on Bowmans Creek. Analysis of the contents from these sites indicates artefact assemblages unlike those described elsewhere in the Hunter. The production of backed blades on these sites was infrequent and mostly unplanned. The tool kit includes small flake tools which had a drill-like projection shaped on them which appears to be unusual elsewhere in the Hunter. A major part of the tool kit was large heavy-duty tools which were probably mostly stored around the margins of the site. The Glennies Creek Site is the largest and best preserved of these sites. It is not directly threatened by mining.
2. The Hunter River Slope Site as a major archaeological site also is in a strategic position, with different contents to the Glennies Creek Site, but appears to have similarities with the lower Bayswater Creek sites. The full extent of this site is not known, and it has been disturbed by a farm track. It is partly threatened by mining.
3. The archaeology of the lower terraces of Bowmans Creek and Glennies Creek are unknown, but a soil pit in a Glennies Creek terrace produced an early artefact, probably of Pleistocene age. The Ashton confluence zone may have been one of the most reliable sources of water during the maximum aridity period of the Late Pleistocene.
4. The Hunter Valley Central Lowlands may have had a population boom after 5,000 years ago because of a new technology (as indicated by the microblade

technology) that allowed an efficient use of a high kangaroo biomass. The Ashton confluence zone is in the centre of the Hunter Valley Central Lowlands, and could be expected to have had a vital role in any cultural changes.

In summary, even though the archaeology of the Ashton confluence zone has only been partly archaeologically explored, there is reason to suggest it was a focus for Aboriginal culture and population, and as indicated by Mitchell, a nodal point. These nodal points, whether in a high resource zone, or at intersecting travel routes, were consistently of special importance in the Aboriginal Dreamtime, and as creation places on Dreaming tracks. It can be expected that there were major Dreamtime creation events associated with this area, and that the large encampments there supported important ceremonies. Methods to use archaeological evidence to identify a camp site complex belonging to a ceremonial centre have been used for Mount Drysdale near Cobar in Western NSW (Witter 2000). It is possible that variations (suitable for the hunter) of those methods could be used to understand the Ashton confluence zone better.

14.8 Conservation Goals for the Hunter Valley

It has been proposed above that the Ashton confluence zone is likely to have been an Aboriginal population focus in the Hunter, and possibly a Dreamtime creation and ceremonial area. It also has been suggested that archaeological methods will be available which will indicate this type of locality. This introduces the issue of long term conservation goals for the area for places of significance. Two goals are proposed here:

1. The long-term conservation of the Glennies Creek Site, which is the most outstanding site recorded on the Ashton Mine study area, is feasible within the mine plan. Options for this include An Aboriginal Place or a Voluntary Conservation Agreement under the NPWS legislation. The area based on the evidence available would start at the bluff of the Ashton ridge overlooking Glennies creek, and on the west follow the ridge line, including the Ridge Peak site (which is probably closely related to activities on the Glennies Creek Site), and continue to the property boundary. On the east it would follow the Glennies Creek Bank, also to the property boundary. This boundary fence would form the southern end of the area.

2. Larger or additional areas for conservation should be considered, given the size of the area identifiable as the Ashton confluence zone. This would need to be supported by further field work, such as survey and subsurface testing. At present there is no special reason to indicate that the type of Narama Bayswater Creek site pattern is likely to be at the mouth Bowmans or Glennies Creeks. Further survey work would be needed to explore the issue of other conservation areas. This should include the Glennies Creek confluence with the Hunter river and the sand covered point of land on the opposite side of the Hunter at "Archerfield".

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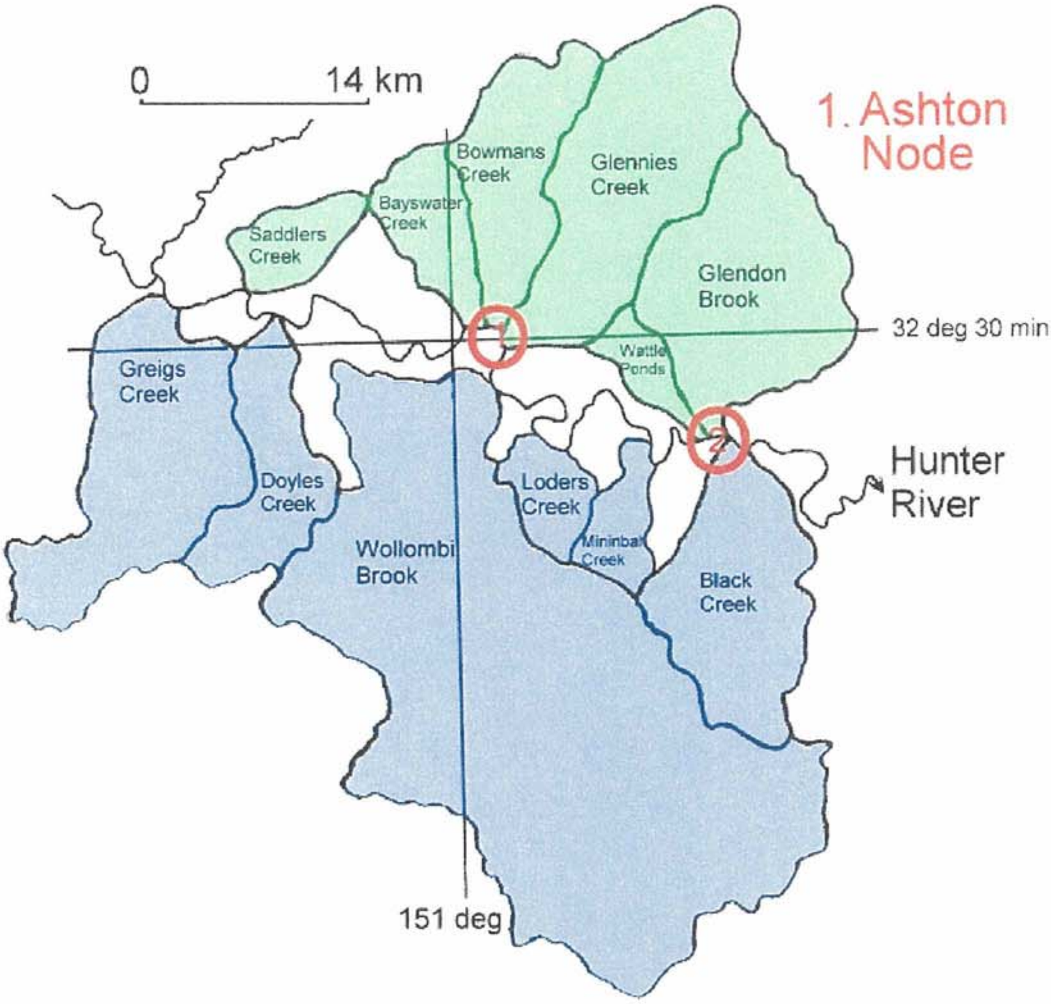
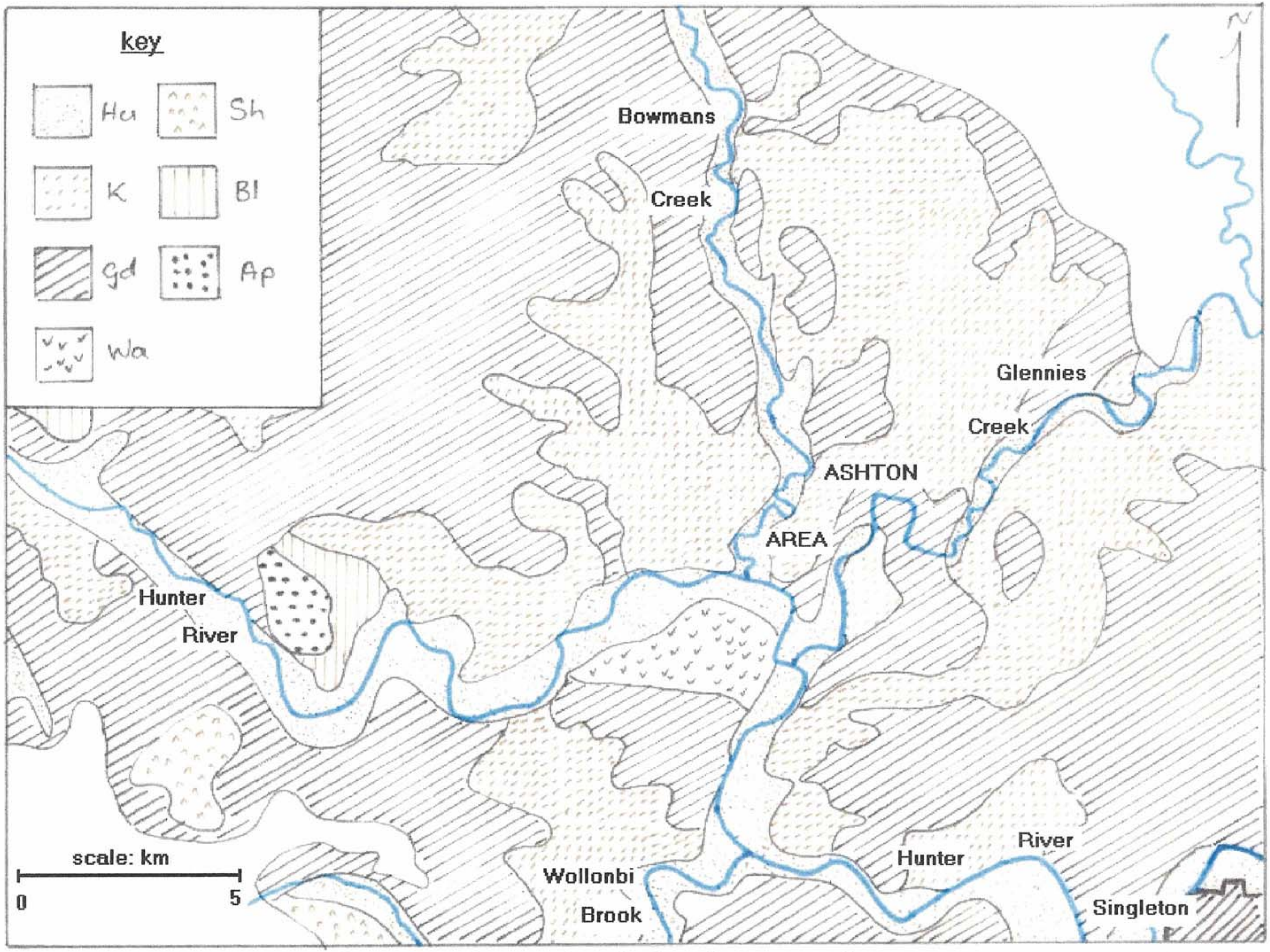
FIGURES

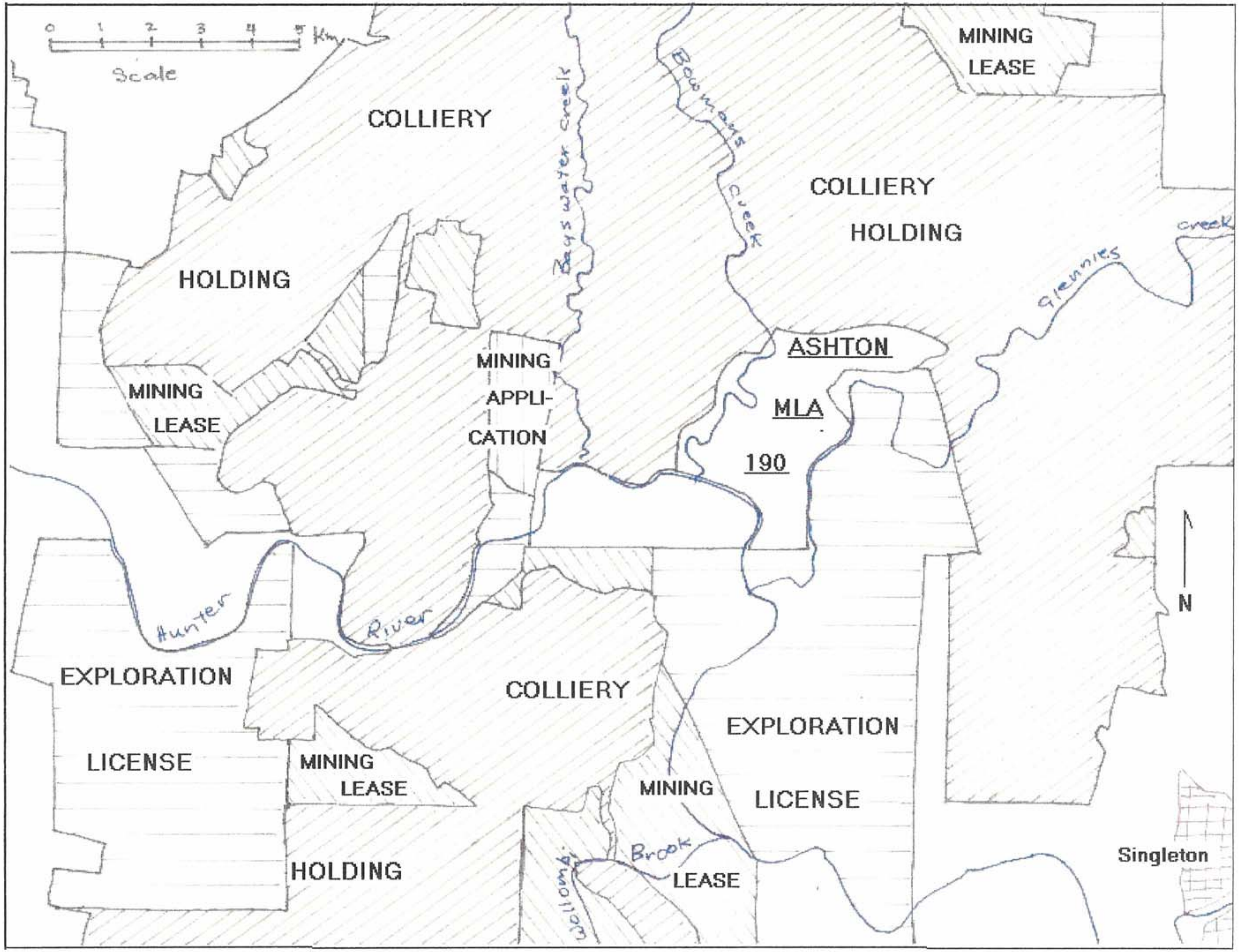


Catchments of 4th order streams or greater in the central lowlands of the Hunter Valley. Green = left bank tributaries, blue = right bank tributaries. Stream order defined at 1:250,000 scale.

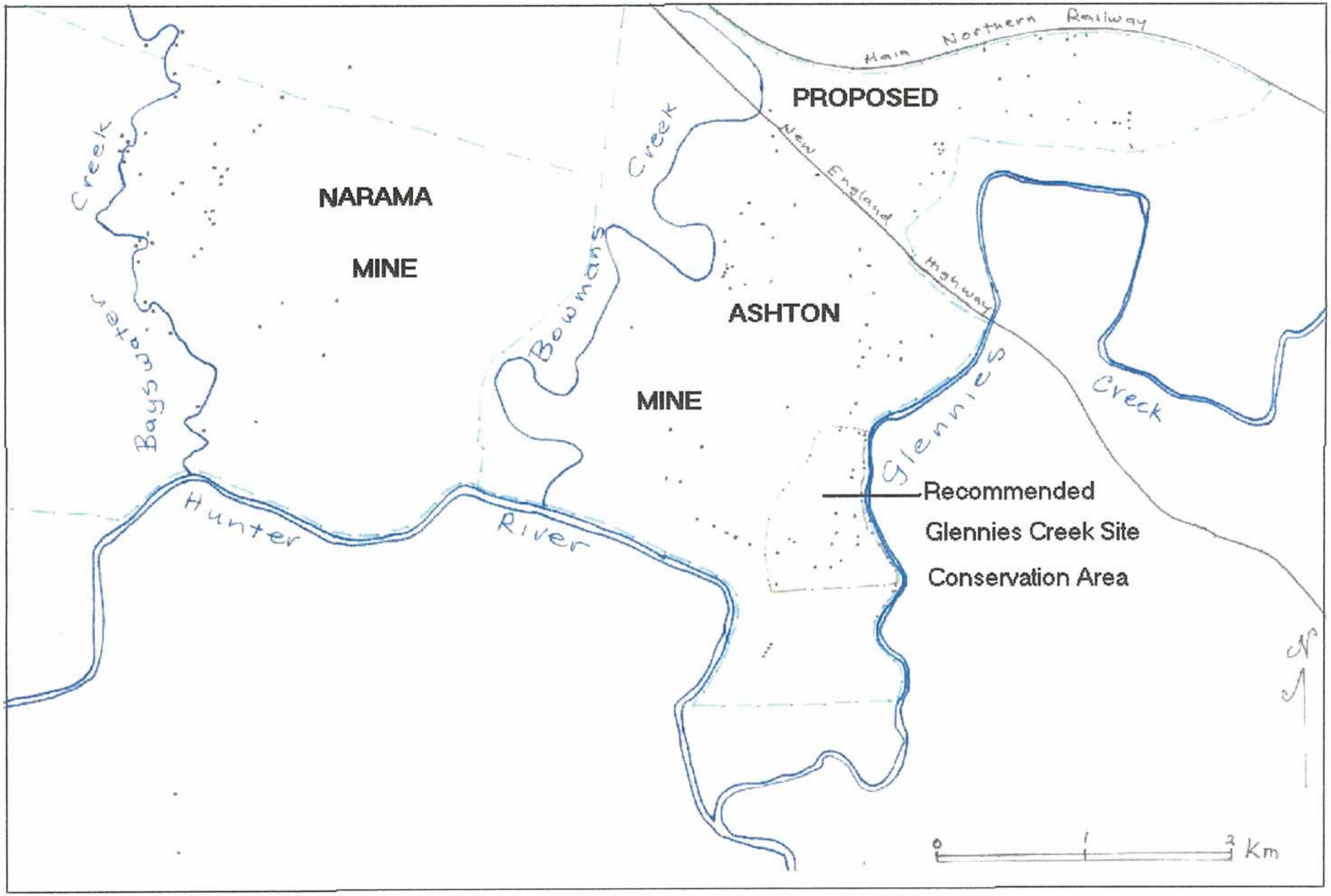
Stream and catchment analysis taken from Mitchell 2002 **Figure 14.1**



Land systems in the Central Lowlands of the Hunter Valley. From Story et al. 1963. **Figure 14.2**



Cumulative mining impact in the Central Lowlands of the Hunter Valley. Map from Mineral Resources NSW. Figure 14.3



Ashton confluence zone showing the recommended Glennies Creek conservation area.
Recorded EWAs (exposures with artefacts) and registered sites are shown as dots. Figure 14.4

APPENDIX

Relative landscape diversity of the Ashton Lease

This document was prepared in response to a request from NPWS expressed at the Planning NSW meeting on 4 July for further context information on the geomorphology and archaeology of the Ashton lease.

Assumptions.
In the context of attempting to rank the relative significance of Aboriginal archaeology on the Ashton lease in relation to other parts of the Central lowlands of the Hunter Valley the following assumptions were accepted:

- That landscape diversity, that is geodiversity and biodiversity, will be positively correlated with past Aboriginal occupation and land uses because more diverse landscapes can be expected to provide more resources.
- That landscape diversity will be positively correlated with catchment size.
- That landscape diversity can be assessed using simple measures of catchment size, stream order, numbers of identified soil landscapes and numbers of identified land systems.

Methodology and limitations.
To analyse catchment characteristics a DLWC GIS layer was used to calculate stream order (Strahler method) and catchment area.

As a crude measure of geodiversity and biodiversity the number of land systems (Story et al., 1963) and the number of soil landscapes (Kovac and Lawrie 1991) mapped within each of the larger catchments was tallied.

All of the work was done at 1:250,000 scale with limited time. Only published sources were used and it must be emphasised that the two critical maps of land systems and soil landscapes are related in that data from the earlier mapping (land systems) would have been used in the preparation of the later map. Limitations of the GIS rivers layer include the scale of the map and a number of obvious digitising errors. At the scale used, 1^{st} and 2^{nd} order streams are generally not recognised and catchment area calculations have been rounded to the nearest 10 km^2. Therefore streams designated in this report as 4^{th} order systems would probably be 6^{th} order if the calculations had been done on a 1:25,000 map. The differences are not important in the context of this analysis.

Results.
The central lowlands of the Hunter Valley are broadly defined as the region between the Goulburn River junction below Denman to the Black Creek junction below Branxton. It includes all of the tributary streams but does not extend into the more rugged Triassic sandstone landscapes except in the upper reaches of Greigs Creek and Wollombi Brook.

Within this 106 km reach of the Hunter River there are six left bank tributaries equal to or greater than 4^{th} order and six right bank tributaries. Third order tributaries have catchments of less than about 50 km^2 and have not been included in this analysis as areas of that size are not likely to be reliably mapped for either land systems or soil landscapes at the map scale. Figure 1 shows the 12 catchments and Table 1 summarises their characteristics with the data presented in rank order of catchment size.

In Figure 1 and Table 1 it can be seen that there is a reasonable link between landscape diversity as defined above and catchment size. The data is too crude to justify this statement statistically but there does seem to be sufficient weight of evidence to support the hypothesis that larger catchments are likely to provide a greater range of resources that would be valued by Aboriginal people.

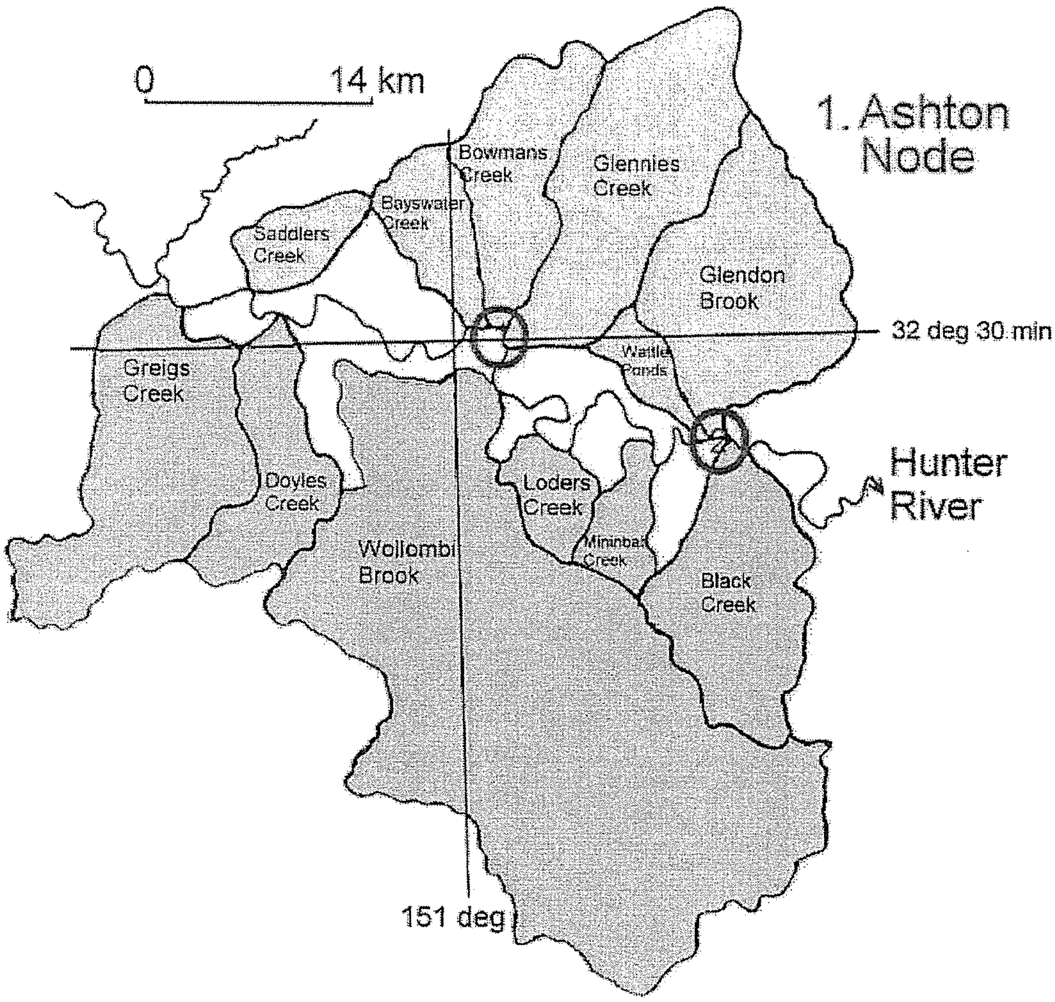


Figure 1. Catchments of 4th order streams or greater in the central lowlands of the Hunter Valley. Green = left bank tributaries, blue = right bank tributaries. Stream order defined at 1:250,000 scale.

Rank	Catchment	Area km^2	Stream order	No of Land systems	No of Soil Landscapes
1	Wollombi Brook	1870	6	11	18
2	Glendon Brook	480	5	9	12
3	Greigs Creek	430	5	7	8
4	Black Creek	380	5	9	8
5	Glennies Creek	280	5	9	10
6	Bowmans Creek	250	4	6	8
7	Doyles Creek	200	4	6	7
8	Bayswater Creek	140	4	4	5
9	Mininbah Creek	100	4	4	5
10	Saddlers Creek	90	4	8	6
11	Loders Creek	80	4	3	4
12	Wattle Ponds Creek	60	4	4	4

Table 1. Summary characteristics of the larger Hunter River tributary in the central lowlands.

It is also reasonable to expect that there will a relationship between catchment size and permanency of stream flow. This will not be a simple linear relationship however as stream flow is also affected by topography, soil and vegetation as well as climatic conditions in each catchment. Within a small area like the central lowlands annual average rainfall is known to decline by about 200 mm from Black Creek to Greigs Creek. Both Greigs Creek and Wollombi Brook have very different geology and topography within their Triassic sandstone landscape that will also affect flow conditions. Never the less, the larger catchments (ranked in Table 1) can be expected to have provided longer term water supplies than smaller catchments. It is therefore then to extend the diversity hypothesis to suggest that these streams will be likely to have provided refuge areas for people during periods of drought.

Resources are not uniformly distributed across any one catchment and this is particularly true of water supplies. Water availability will generally, but not invariably, increase downstream and it can be argued that stream junctions may be favoured locations for camp sites. Although at a different scale, such a pattern has been identified on the Cumberland Plain of the Sydney Basin (McDonald and Mitchell 1994) which is an environment generally similar to the central lowlands. Other commonly acknowledged correlations with site location are positions with higher ground adjacent to water supplies. The predictive strength of these relationships has not been demonstrated but accepting them for the basis of argument does provide another means of ranking the likely significance of different locations.

From the arguments presented above it follows that larger stream junctions may form nodes of occupation within a catchment. This same logic can be extended to suggest that where several nodes are in close proximity the archaeological significance of that location may be greater.

Applying these arguments to the central lowlands all large tributary junctions on the Hunter are likely to be important nodes and potentially those of greatest importance would be those in close proximity to one another and which have adjacent high ground. In the study reach considered, two locations fit this pattern and these have been identified in Figure 1.

1. Ashton node. The Ashton node is formed by the close junctions of Bayswater, Bowmans and Glennies Creek with the Huinter River. All three streams join the Hunter within 4 km and within 5 km of Wollombi Brook. More than half of this area is within the Ashton lease.

2. A second node occurs downstream at the Wattle Ponds, Glendon Brook and Black Creek complex where all three streams join the Hunter within 5 km.

Dan, Need to say something about likely significance of these two nodes and whether or not the second node still exists, or have the coal getters got it! I don't know.

Some conclusion...

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